AUTOMATED SURFACE OBSERVING SYSTEM
Site Technical Manual
S100

AAI Systems Management Incorporated

ASOS Program Office
Silver Spring, Maryland
July 1998

U.S. DEPARTMENT OF COMMERCE
William M. Daley, Secretary

National Oceanic and Atmospheric Administration
D. James Baker, Administrator

National Weather Service
John J. Kelly, Jr. Director

This manual supersedes S100 dated May 92, which shall be destroyed in accordance with applicable security regulations.

REGISTERED TRADEMARKS

CHANGE 1 INFORMATION

Change 1 consists of changes necessitated by the following task orders and ECPs:

TO 265 - RS 422 Pinout (ECP066)
TO 306 - DCP Power Expansion
TO 309 - ASOS Thunderstorm Sensor
TO 336 - ASOS Software Version 2.6
E93SM05F093- UPS Bypass
E94SM05F118- Wind Firmware Version 4.0
E94SM05F130- Wind Tower Watershield
E95SM05F139- High Speed Modems
E95SM05F150- Yagi Antenna
E95SM05F151- Temp Probe for DCP and SCA
E96SM05F158- RF Attenuators
E96SM05F161- Backup Sensors at Combined Sensor Group
E96SM05F163- Remote Wind Installation
E96SM05F166- Line Driver Replacement
E96SM05F167- Local OID and printer power by the UPS
E96SM05F168- Redesign Fiber Optic Cables
E96SM05F169- Press Vent Relocat on Alaska Shelters
E96SM05F174- Aluminum Pole for Freez Rain Snsr
E96SM05F176- DCP Pressure Sensor
E96SM05F181- Thunderstorm Sensor
E96SM05F185- SCA Solar Shield
E96SM05F186- Pressure Ports
E96SM05F187- Class I Delay Relay
E96SM05F189- Power Expansion at the ASOS DCP
E96SM05F190- Wind Sensor Direction Filter
E97SM05F195- SCA Thermostat Location
E97SM05F196- Temperature Probe Relocation
E97SM05F200- Visibility Firmware Version 039
E97SM05F202- Implementation of Software Version 2.4B

Change 1 also addresses and closes TPDRs
97-01 through 97-28
98-01 through 98-04

CHANGE 2 INFORMATION

Change 2 consists of changes necessitated by the following task orders and ECPs:

TO 347 - Uninterruptible Power Supply Replacement
E97SM05F203 - RF Modem Replacement
E97SM05F204 - Software Version 2.49
E98SM05F209 - SCA Combined Installation Alternative GTA Radio Antenna
E98SM05F215 - Voice Software 4.0

Change 1 addresses and closes TPDRs
98-05 through 98-09
99-01 through 99-07

S100-ASOS Technical Manual Deficiency Report

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Dates of issue for original and changed pages are:

Original . . . 0 . . . March 97

Change . . . 1 . . . January 98

Change . . . 2 . . . December 98

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SAFETY SUMMARY

The following general safety precautions must be observed during all phases of operation, service, and repair of this equipment. Failure to comply with these precautions or with specific warnings elsewhere in this manual violates safety standards of design, manufacture, and intended use of the equipment. AAI assumes no liability for the customer's failure to comply with these requirements.

KEEP AWAY FROM LIVE CIRCUITS

Operating and maintenance personnel must at all times observe all safety regulations. Do not replace components while the equipment is energized. Under certain conditions, dangerous potentials may exist when the power has been turned off, due to charges retained by capacitors. To avoid injury, always remove power and discharge and ground a circuit before touching it.

RESUSCITATION

Personnel working with or near this system should be familiar with modern methods of resuscitation. Such information may be obtained from the Bureau of Medicine and Surgery.

NEVER LOOK INTO THE CEILOMETER'S LASER TRANSMITTER WITH MAGNIFYING OPTICS

The ceilometer is intended for operation in an area restricted from public access, and pointing vertically up. Whenever this is not the case, care must be observed so as to prevent exposure to the laser beam through focusing optics. Work area access by unauthorized persons during service operations must be prevented.

DO NOT SUBSTITUTE PARTS OR MODIFY INSTRUMENT

Because of the danger of introducing additional hazards, do not install substitute parts or perform any unauthorized modification to the instrument. Return the instrument to the depot/AOMC for service and repair to ensure that safety features are maintained.

TEST EQUIPMENT

Ensure that all test equipment is calibrated within required dates and is in good operating condition. Ensure that all test equipment is properly grounded before use.

ACCESSING EQUIPMENT

Before attempting to service any ASOS equipment, notify airport security and gain access to the system by following local procedures and adhere to all airport traffic regulations.

CROSSING RUNWAYS

Before crossing any runway, radio the tower and request clearance. Proceed only with clearance, and only after illuminating the caution light mounted on top of your vehicle.

DANGEROUS PROCEDURE WARNINGS

Warnings, such as the example below, precede potentially dangerous procedures throughout this manual. Instructions contained in the warnings must be followed.

WARNING

Death or severe injury may result if power is not removed from the equipment prior to maintenance activities. Ensure that output power switch is set to 0 (off) position and facility power is removed from ACU.

EQUIPMENT CAUTIONS

Cautions, such as the example below, precede procedures where failure to follow the specific instructions may result in damage to the equipment. Instructions contained in the cautions must be followed.

CAUTION

Do not bend fiberoptic cables. Bending could break the optical fibers.

This equipment contains parts sensitive to damage by electrostatic discharge (ESD). Use ESD precautionary procedures when touching, removing, or installing assemblies.

LIST OF ABBREVIATIONS AND ACRONYMS

ACU	-	Acquisition Control Unit
AOMC	-	ASOS Operations Monitoring Center
ASOS	-	Automated Surface Observing System
ATC	-	Air Traffic Controller
AWIPS	-	Advanced Weather Information Processing System
A/D	-	Analog to digital
cps	-	Characters per second
CPU	-	Central Processing Unit
CRT	-	Cathode Ray Tube
CST	-	Continuous Self-Test
CVD	-	Controller Video Display
db	-	Decibel
DCP	-	Data Collection Package
DIO	-	Digital I/O
DMM	-	Digital multimeter
DRAM	-	Dynamic Random Access Memory
DTE	-	Data Terminal Equipment
EMI	-	Electromagnetic interference
EPROM	-	Erasable programmable read-only memory
ESD	-	Electrostatic discharge
FAA	-	Federal Aviation Administration
FRU	-	Field replaceable unit
GFI	-	Ground fault interrupt
GTA	-	Ground To Air
inHg	-	Inches of mercury
I/O	-	Input/output
LCD	-	Liquid crystal display
LDD	-	Lightning Detection Data
LED	-	Light emitting diode
LEDWI	-	Light emitting diode weather indication
NLQ	-	Near letter quality
NWS	-	National Weather Service
OID	-	Operator interface device
OND	-	Observer notification device
PM	-	Preventive maintenance
PSD	-	Port Sharing Device
P/N	-	Part number
RAM	-	Random access memory
rf	-	Radio frequency
RVR	-	Runway Visual Range
S/A	-	Stand-alone
SAL	-	System analog loopback
SAO	-	Surface aviation observation
SCA	-	Single Cabinet ASOS
SCC	-	Serial communication controller
SIO	-	Serial I/O
SRAM	-	Static random access memory
TCCC	-	Tower computer control complex
T/D	-	Temperature/dewpoint
TS	-	Temperature spread
UPS	-	Uninterruptible power supply
VDU	-	Video display unit
VF	-	Voice frequency

CHAPTER 1

SYSTEM OVERVIEW

SECTION I. DESCRIPTION AND LEADING PARTICULARS

1.1.1 INTRODUCTION

The Automated Surface Observing System (ASOS) automatically collects weather data and provides accurate, 24-hour accumulated weather reports to local weather observers; weather forecasters; airport personnel, including pilots and air traffic controllers (ATC's); and Federal Aviation Administration (FAA) and National Weather Service (NWS) personnel. ASOS functions include: measurement of weather elements, data processing and display, communication, and data storage (archiving). The ASOS is a flexible system with a modular construction that allows deployment in a variety of configurations for operation with or without the attendance of an observer. Unattended, the ASOS automatically collects, processes, and error checks data and formats, displays, archives, and reports the weather elements included in a surface weather observation. The ASOS also accepts inputs from observers (when present), who may also override or add information to the automatically generated observation. Because of the flexibility of the ASOS, it can provide useful weather information in text, video, and audio format to a variety of users. table 1.1.1 lists the users with which the ASOS can interface.

Table 1.1.1. ASOS Users

User Name	Description
Automation of Field Operations and Services (AFOS)	National Weather Service (NWS) forecasters use the AFOS outputs from the acquisition control unit (ACU) to perform their duties. ASOS provides hourly surface meteorological reports (METAR's), Aerodrome Forecasts (TAF's), and special weather reports (SPECI's) to any AFOS user. Local AFOS users receive data via direct connection (hardwire). Remote AFOS users receive data through telephone lines. These terminals are not the ASOS technician's responsibility.
Airline displays	One-minute weather observations, in the International Civil Aviation Organization (ICAO) METAR format are available from the ACU for distribution to up to 50 airline displays located throughout the airport complex. The airline displays receive reports and forecasts through coaxial cables connected to a single jack on the ACU. These terminals are not the ASOS technician's responsibility.
Controller Video Displays (CVD's)	Federal Aviation Administration (FAA) CVD's serve air traffic controllers (ATC's) in the tower. Up to nine displays may receive data from a single ASOS. The CVD's receive METAR's, 1-minute altimeter data, 5-second wind data, and density altitude data (when greater than 1000 ft).
FAA radio	ASOS produces a computer-generated voice message from the last METAR (hourly surface observation report), or from the current 1-minute observation. The voice message is generated continuously, with five seconds delay between the completion of one message and the beginning of the next. The voice message is output to a radio communications link for transmission to aircraft in the VHF frequency range. The operator interface device (OID) provides FAA ATC's with the ability to select the broadcast product (i.e., last METAR hourly report or current 1-minute observation).
Dial-In reports	The ASOS computer-generated voice message (see FAA radio above) is also output for up to eight telephone lines to provide audio reports for dial-in callers.

Table 1.1.1. ASOS Users -CONT

User Name	Description
Operator Interface Device (OID)	The OID is used to receive minute-by-minute data (including hourly, local, and special observations) and all data requested from the OID. Up to three OID's are provided with the ASOS. The primary OID has priority over the secondary OID's. When an observer is signed on at the primary OID, changes to system data cannot be made via the secondary OID's. One of the two secondary OID's can be equipped with an FAA handset. The handset is used to generate voice messages which can be added to the continuous FAA radio transmission. The FAA handset interfaces to the ACU via direct connection (hardwire).
Remote users	Up to five dial-in ports provided with the ACU can be used to allow remote users to perform all OID functions and to send/receive information such as minute-by-minute weather data, archive information, maintenance data, and diagnostics results. Users interface with the ACU via telephone lines and a remote computer terminal. When accessing the ASOS remotely via a modem hookup, the user cannot perform observer or ATC level input functions. The five remote user ports are identified as follows: a. User phone 1 (OID #4) b. User phone 2 (OID #5) c. User phone 1 spare (OID #6) d. User phone 2 spare (OID #7) e. OID spare (OID #8)
Video display units (VDU's)	Up to four local VDU's provide 1-minute observations for various airport personnel. VDU's are capable of operating up to 200 feet from the ACU.
Tower computer control complex (TCCC)	For future use.
Advanced weather information processing system (AWIPS)	AWIPS uses the AWIPS output from the acquisition control unit (ACU). ASOS provides routine, hourly surface meteorological reports (METAR's), SPECI weather reports, and SHEF reports to AWIPS. ASOS also provides the latest one-minute observation (OMO) when requested by AWIPS. Local AWIPS users receive data via direct connection (hardwire). Remote AWIPS users receive data through telephone lines.
FAA ADAS	The FAA ADAS Data Acquisition System (ADAS) both transmits and receives messages with the ASOS via the FAA ADAS port at the acquisition control unit (ACU). Messages to the FAA ADAS are translated into the ADAS format before transmission. ASOS provides METAR hourly reports and unscheduled SPECI reports to the FAA ADAS via phone line. In addition, the FAA ADAS receives and disseminates Lightning Detection Data (LDD) to the ASOS.
RVR	At selected sites, the acquisition control unit (ACU) provides a port to interface a Runway Visual Range (RVR) computer. The RVR computer sends RVR data to ASOS at a minimum rate of once per minute via a dedicated hardwire link or phone line.

1.1.2 **PURPOSE OF THIS MANUAL**

This manual provides site maintenance personnel with the primary source of technical information required for the maintenance of the ASOS. The ASOS theory of operation and troubleshooting data are presented to enable maintenance personnel to quickly remedy any problem and return the system to an operational condition. This manual is divided into 16 chapters, parts list, and maintenance drawings which are described in the following paragraphs.

1.1.2.1 **Chapter 1, System Overview**. Chapter 1 provides system level maintenance data for the ASOS. The Chapter is divided into five sections: description, installation, operation, theory, and maintenance. Chapter 1 contains all system level maintenance procedures and, therefore, should be referenced first when fault isolating the ASOS.

1.1.2.2 **<u>Chapter 2, Acquisition Control Unit (ACU)</u>**. Chapter 2 provides the physical description, theory of operation, installation, and maintenance procedures for the ACU subsystem of the ASOS, including all peripherals. Notice that the standard ASOS ACU includes a built-in local Data Collection Package (DCP) function which can support up to three locally sited sensors, where sensor data and control are interfaced via fiberoptic modules.

1.1.2.3 **<u>Chapter 3, Data Collection Package (DCP)</u>**. Chapter 3 describes the data collection package (DCP) processing system. Theory of operation and installation, operating, and maintenance procedures are provided for the rf link, uninterruptible power supply (UPS), modem, sensor processors, power supplies, and environmental enclosure cooling system. Each DCP cabinet supports up to 16 sensors and is designed for unsheltered installation remote from the ACU. At airports, DCP cabinets will generally be sited near the approach end of runways. The standard ASOS ACU also can serve as a local DCP for up to three sensors that are situated close to the shelter in which the ACU is installed.

1.1.2.4 **<u>Chapters 4 through 13 and 16, Sensors and Subsystems</u>**. Chapters 4 through 13 and 16 provide maintenance information on the ASOS sensors and subsystems, including: introduction, physical description, specifications, installation, theory of operation, and maintenance. Chapter assignments are as follows:

a. Chapter 4, Wind Sensors
b. Chapter 5, Temperature/Dewpoint (Model H083/1088) Sensors
c. Chapter 6, Visibility Sensor
d. Chapter 7, Present Weather Sensor
e. Chapter 8, Ambient Pressure Sensor
f. Chapter 9, Cloud Height Sensor (Ceilometer)
g. Chapter 10, Liquid Precipitation Accumulation Sensor (Rain Gauge)
h. Chapter 11, Freezing Rain Sensor
i. Chapter 12, Ground-to-Air Radio
j. Chapter 13, Codex 3600 Series Modem
k. Chapter 16, Thunderstorm Sensor

1.1.2.5 **<u>Chapter 14, Single Cabinet ASOS (SCA)</u>**. Chapter 14 describes the Single Cabinet ASOS (SCA) system. Theory of operation and installation, operating, and maintenance procedures are provided for the rf link, uninterruptible power supply (UPS), modem, sensor processors, power supplies, and environmental enclosure cooling system. The SCA cabinet contains both the ACU and DCP combined into one cabinet and is designed for unsheltered installation. The SCA uses the same sensors and peripherals as the standard ASOS.

1.1.2.6 **<u>Chapter 15, Port-Sharing Device (PSD)</u>**. Chapter 15 describes the Port Sharing Device software task that runs in the ACU. The PSD enables the single port on the remote terminal to AFOS to communicate with both ASOS and the auxiliary backup terminal (ABT).

1.1.2.7 **<u>Parts List</u>**. The parts list (located after the last chapter) provides a listing of all repair parts, including assemblies, subassemblies, and parts common and peculiar to the ASOS. The listing includes: item name, Federal Stock Number (FSN), Federal manufacturer's code, manufacturer's part number, and recommended initial stock quantities. A cross-reference from the FSN to manufacturer's stock numbers is also included, which provides alternate sources for procurement where applicable.

1.1.2.8 **<u>Maintenance Drawings</u>**. The maintenance drawings section (located after the parts list in volume II) describes the formats used on oversize maintenance drawings contained in this manual. These drawings include detailed block diagrams, power distribution drawings, and cabling diagrams.

1.1.3 **SCOPE OF THIS MANUAL**

This manual provides all information necessary for on-site maintenance support of the ASOS, which includes preventive maintenance, operation, fault isolation, and removal/installation of field replaceable units (FRU's). To enable site maintenance personnel to quickly locate the maintenance procedures for the various subsystems of the ASOS, each subsystem is described in a separate Chapter as described in paragraph 1.1.2. To further aid maintenance personnel, each Chapter follows the same format. Chapters consist of five major sections whose order and basic content are as follows:

1.1.3.1 **Section I, Description and Leading Particulars**. Section I provides an introduction to the system/subsystem and should be referenced to gain a general understanding of the system or to obtain physical descriptions and locational information.

1.1.3.2 **Section II, Installation**. Section II provides information on the method of replacing the individual subsystem. This information is provided on the assumption that the subsystem was previously installed by the factory installation team, and that all mounting hardware and electrical wiring are in place.

1.1.3.3 **Section III, Operation**. Section III provides the procedures to power on/off, initialize, determine operational status, and operate a system/subsystem. This information enables maintenance personnel to effectively utilize the ASOS. Standard operating procedures are provided in the ASOS Software User's Manual.

1.1.3.4 **Section IV, Theory of Operation**. Section IV provides detailed theory of operation for a system/subsystem and includes basic and detailed block diagrams.

1.1.3.5 **Section V, Maintenance**. Section V provides corrective and preventive maintenance procedures for a system/subsystem. Procedures are provided for cleaning and inspection, adjustment/calibration, troubleshooting through the use of diagnostics, and removal/replacement of failed FRU's. Section V should be referenced when troubleshooting or performing scheduled maintenance on the ASOS.

1.1.4 **ASOS SYSTEM DESCRIPTION**

Figure 1.1.1 illustrates a typical ASOS installation. The system consists of an acquisition control unit (ACU), up to three data collection packages (DCP's), sensors that gather weather information, and user terminals. The ACU receives sensor data from the DCP(s); analyzes, compiles, and logs the data; and provides the data to the various ASOS users. All interfacing with the ASOS is accomplished via the ACU. The DCP controls the data collection process. It receives data from the individual sensors, formats the data, and transmits the data to the ACU. The DCP also provides and controls all primary electrical power to the sensors. The sensors gather the weather information. The sensor complement can consist of up to 16 sensors per remote DCP. These sensors perform specialized functions to gather raw data regarding weather and atmospheric conditions. These data typically include temperature, wind, and precipitation. The sensors are then either polled by the DCP or automatically transfer their data to the DCP where the data are incorporated into the ASOS data processing scheme. In addition to the sensors connected to the remote DCP, up to six sensors can be connected directly to the ACU. These sensors are referred to individually as local sensors, or collectively as the local DCP. The first three local sensor slots are reserved for pressure sensors contained inside the ACU. Any of the other types of ASOS sensors can be connected to local sensor ports 4, 5, and 6 of the ACU.

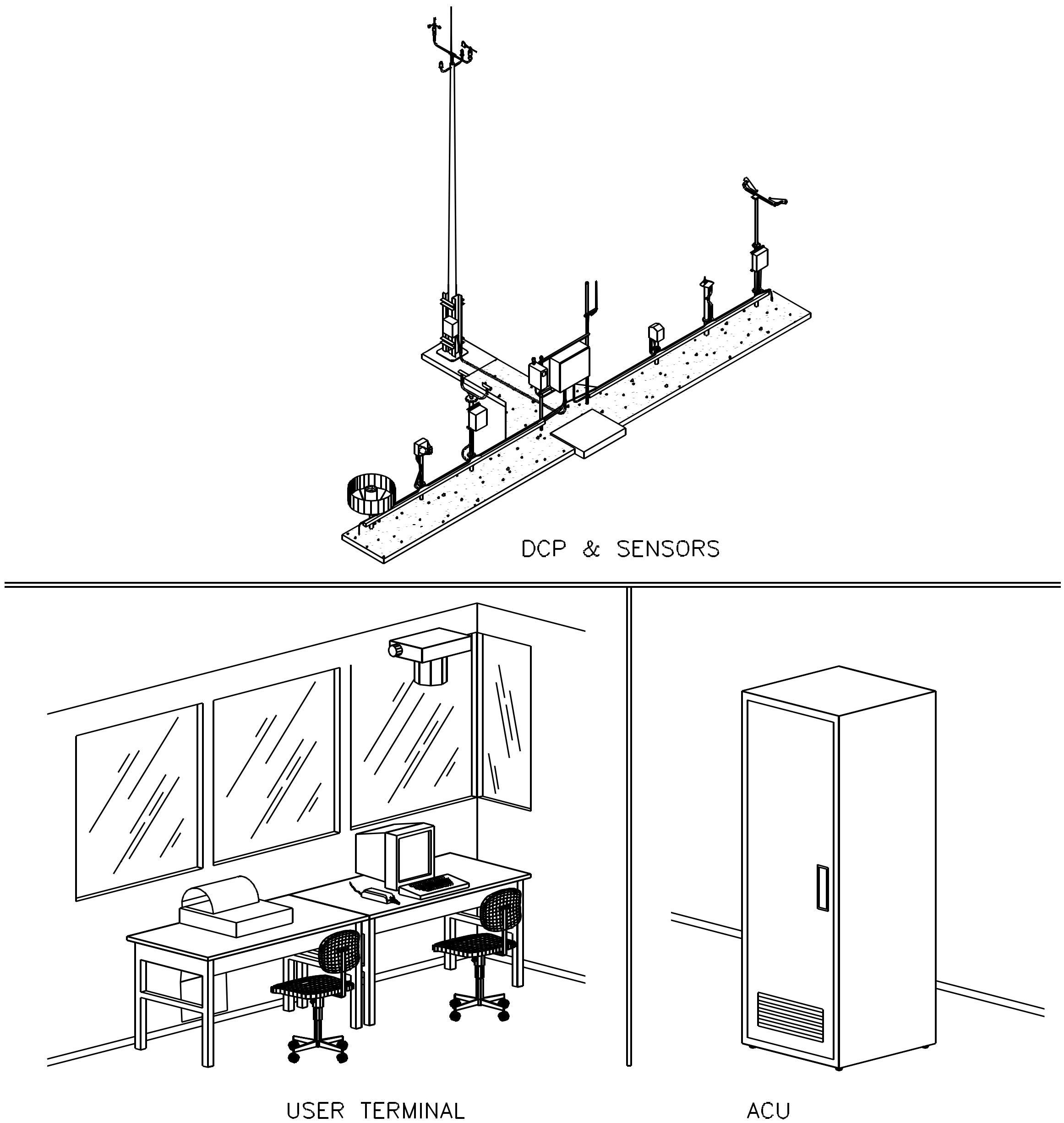

Figure 1.1.1. Typical ASOS

1.1.5 **SYSTEM CONFIGURATIONS**

Each ASOS is configured to meet the specific requirements at each individual site. The present configuration of a site can be reviewed by accessing the site configuration screens via the OID or a remote terminal. The site maintenance manual provides maintenance documentation for all possible assemblies and subassemblies in the ASOS but does not relate to any specific configuration. The technician should consult the configuration screens and site specific documentation to make determinations such as sensor configuration, number of OID and user terminals, sensor pad configuration, and facility power and signal cable routing.

1.1.6 **RELATED PUBLICATIONS**

In addition to this manual, the ASOS is supported by the following manuals:

a. ASOS Software User's Manual - Provides detailed information on ASOS operation and all ASOS OID screens.

b. ASOS Ready Reference Guide - Provides operator reference information for system operation.

c. Link MC70 User's Guide - Provides vendor support information for the OID.

d. Panasonic dot matrix printer model KX-P1180i, KX-P2180, or KX-P3123 Operating Instructions Manual - Provides vendor support information for the dot matrix printer.

e. UDS 2440 Installation and Operation - Provides vendor support documentation for the model 2440 stand-alone telephone modems.

f. UDS V.3225 Installation and Operation - Provides vendor support documentation for the model V.3225 stand-alone telephone modems.

g. UDS V.3400 Installation and Operation - Provides vendor support documentation for the model V.3400 stand-alone telephone modems.

h. Motorola DDS/MR64 Installation and Operation - Provides vendor support documentation for the model DDS/MR64 line driver.

1.1.7 **SYSTEM SPECIFICATIONS**

ASOS system specifications are provided in table 1.1.2.

Table 1.1.2. System Specifications

Sensor	Limits	Accuracy	Resolution
Wind Speed	0 to 125 knots	±2 knots or 5%, whichever is greater	1 knot
Wind Direction	Winds ≥5 knots Winds 2 to 5 knots	±5° - Winds must be displaced more than 5°	1 degree
Temperature	-80°F to +130°F	±1.8° for readings between -58°F and 122°F. ±3.6° for readings between -80°F and -58°F. ±3.6° for readings between 122°F and 130°F.	0.1°F
Dewpoint	.0°F ≤ TS < 10.8°F** 10.8°F ≤ TS <14.4°F** 14.4°F ≤ TS <16.2°F** 16.2°F ≤ TS < 18.0°F**	±2° for dewpoint readings: Td > 32°F. ±3.4° for dewpoint readings: 32°F ≥ Td > -0.4°F. ±4.5° for dewpoint readings: -0.4°F ≥ Td ≥ -31°F. ±2.2° for dewpoint readings: Td > 32°F. ±3.4° for dewpoint readings: 32°F ≥ Td >-0.4°F. ±4.5° for dewpoint readings: -0.4°F ≥ Td ≥ -31°F. ±2.3° for dewpoint readings: Td > 32°F. ±3.6° for dewpoint readings: 32°F ≥ Td >-0.4°F. ±4.5° for dewpoint readings: -0.4°F ≥ Td ≥ -31°F. ±2.5° for dewpoint readings: Td > 32°F. ±3.8° for dewpoint readings: 32°F ≥ Td >-0.4°F. ±4.5° for dewpoint readings: -0.4°F ≥ Td ≥ -31°F.	0.1°F

*,** See notes at the end of table

Table 1.1.2. System Specifications -CONT

Sensor	Limits	Accuracy	Resolution
Dewpoint (cont)	18.0°F ≤ TS < 19.8°F**	±2.7° for dewpoint readings: Td > 32°F. ±4.1° for dewpoint readings: 32°F ≥ Td > -0.4°F. ±4.5° for dewpoint readings: -0.4°F ≥ Td ≥ -31°F.	
	19.8°F ≤ TS < 21.6°F**	±2.9° for dewpoint readings: Td > 32°F. ±4.5° for dewpoint readings: 32°F ≥ Td > -31°F.	
	21.6°F ≤ TS < 23.4°F**	±3.1° for dewpoint readings: Td > 32°F. ±5.0° for dewpoint readings: 32°F ≥ Td ≥ -31°F.	
	23.4°F ≤ TS < 25.2°F**	±3.2° for dewpoint readings: Td > 32°F. ±5.4° for dewpoint readings: 32°F ≥ Td ≥ -31°F.	
	25.2°F ≤ TS < 27.0°F**	±3.4° for dewpoint readings: Td > 32°F. ±5.8° for dewpoint readings: 32°F ≥ Td ≥ -31°F.	
	27.0°F ≤ TS < 28.8°F**	±3.6° for dewpoint readings: Td > 32°F. ±6.3° for dewpoint readings: 32°F ≥ Td ≥ -31°F.	
	28.8°F ≤ TS <30.6°F**	±3.8° for dewpoint readings: Td > 32°F. ±6.7° for dewpoint readings: 32°F ≥ Td ≥ -31°F.	
	30.6°F ≤ TS < 36.0°F**	±4.5° for dewpoint readings: Td > 32°F. ±7.9° for dewpoint readings: 32°F ≥ Td ≥ -31°F.	
	36.0°F ≤ TS < 45.0°F**	±5.6° for dewpoint readings: Td > 32°F. ±7.9° for dewpoint readings: 32°F ≥ Td ≥ -0.4°F. ±9.9° for dewpoint readings: -0.4° ≥ Td ≥ -31°F.	
	45.0°F ≤ TS < 54.0°F**	±6.8° for dewpoint readings: Td > 32°F. ±11.9° for dewpoint readings: 32°F ≥ Td ≥ -31°F.	
	54.0°F ≤ TS < 63.0°F**	±7.9° for dewpoint readings: Td > 32°F. ±13.9° for dewpoint readings: 32°F ≥ Td ≥ -31°F.	
Pressure	16.9" to 31.5" of mercury	±0.02" of mercury	0.0003"
Visibility*	 Up to 1¼ miles 1½ to 1-3/4 miles 2 to 2½ miles 3 to 3½ miles 4 to 10 miles Up to 1¼ miles 1½ to 1¾ miles 2 to 2½ miles 3 to 3½ miles 4 to 10 miles	For 80% of measurements ±¼ mile ±¼, -½ mile ±½ mile ±½, -1 mile ±1 report increment For 98% of measurements ±½ mile ±½, -¾ mile ±1 mile +2 reporTable increments, -1 mile +2 reporTable increments	--
Rain Accum	0 to 10.0"/hr	±0.02" or 4% of hourly total, whichever is greater	0.01"
Snow Depth	0 to 99"	0 - 5": ±½" >5 - 99": ±1"	½" 1"

*,** See notes at the end of table

Table 1.1.2. System Specifications -CONT

Sensor	Limits	Accuracy	Resolution
Frozen Precip Water Equiv	0 to 40"	±0.04" or 1% of the total accumulation	0.01"
Freezing Rain Occurrence	--	Detection is reported whenever freezing rain accumulates to 0.01".	--
Ceilometer	0 to 12,650 ft	±100 ft or 5%, whichever is greater	50 ft
Thunderstorm	0-5, 5-10, 10-30 miles	100% for thunderstorms within 10 miles with 3 or more cloud-to-ground discharges	--
Present Weather	Occurrence 99% of time Identification: Rain 90% of time Snow 97% of time Precip 99% of time	0.01"/hr or 10%, whichever is greater	

* Accuracy requirements for 80% of the measurements. For the remaining 20% of the measurements, double the requirements.

** Temperature spread (TS) equals temperature minus dewpoint temperature.

SECTION II. SYSTEM INSTALLATION

System installation is not the site technician's responsibility. Information concerning installation of individual sensors and removal/replacement of various FRU's in the ACU, DCP, and sensors is provided in the appropriate ACU, DCP, or sensor Chapter of this manual.

SECTION III. OPERATION

1.3.1 INTRODUCTION

System maintenance operations are performed from the operator interface device (OID) terminal or from the remote maintenance monitoring terminal (described in paragraph 1.3.14). From either of these terminals, users can access the diagnostic program screens that are an integral part of the system; change the system configuration; change output port assignments, parameters, and message formats; change communications port characteristics; enable and disable communications ports; change the dialing mode between pulse and tone; request 2-hour archive of 5-minute observations for 15 days; turn sensors on or off; turn sensor report processing on or off; change selected site constants such as date, time, latitude, longitude, and elevation; make log entries; and reset the system. By using the handset in conjunction with its designated OID terminal, the technician can also record, play back, and control automated voice messages. The functions that a user can perform on the ASOS depend on how the user signs on the system. There are four levels of users that sign on to the system: observers, air traffic controllers (ATC's), system managers, and technicians. In addition, an unsigned user has certain capabilities on the system. Some functions can be performed by more than one type of user. For example, the technician and system manager have the same maintenance capabilities under the MAINT (maintenance) function. The ASOS Software User's Manual identifies the functions assigned to each type of user. This section provides control and indicator information for the OID and printer, descriptions of all maintenance screens, and detailed system maintenance operating procedures. Additional information on the other ASOS screens and operating procedures are provided in the ASOS Software User's Manual.

1.3.2 OPERATOR INTERFACE DEVICE (OID) CONTROLS AND INDICATORS

The OID is a standard cathode ray tube (CRT) terminal. The keyboard (Figure 1.3.1) is divided into four functional areas: the main keypad, editing keypad, auxiliary keypad, and function keypad. The editing keypad contains the arrow, REMOVE, and edit keys. The arrow keys are used to move the cursor to the different fields on the screen. The REMOVE key is used to delete the character under the cursor. The edit keys are used to move the cursor to a specific point on the screen when editing log entries. The auxiliary keypad is used to access the maintenance/operator screens. The keypad on the OID screen overlays the auxiliary keypad area such that the function in the upper left corner of the OID keypad is represented by key 7 and the function in the lower right corner of the OID keypad is represented by key 3. The function keypad contains the HELP key, which is used to access the system help feature. Help can also be accessed by pressing the 0 key on the auxiliary keypad. Function keys F12 and F20 control the system's audio alarm. Pressing F12/F20 permanently disables the alarms. Pressing F12/F20 again enables the alarms. The audio alarm can be disabled for the current alarm by pressing the F11 or F19 key. Additional information on the OID and its use is provided in the ASOS Software User's Manual and the associated computer terminal manual at your site.

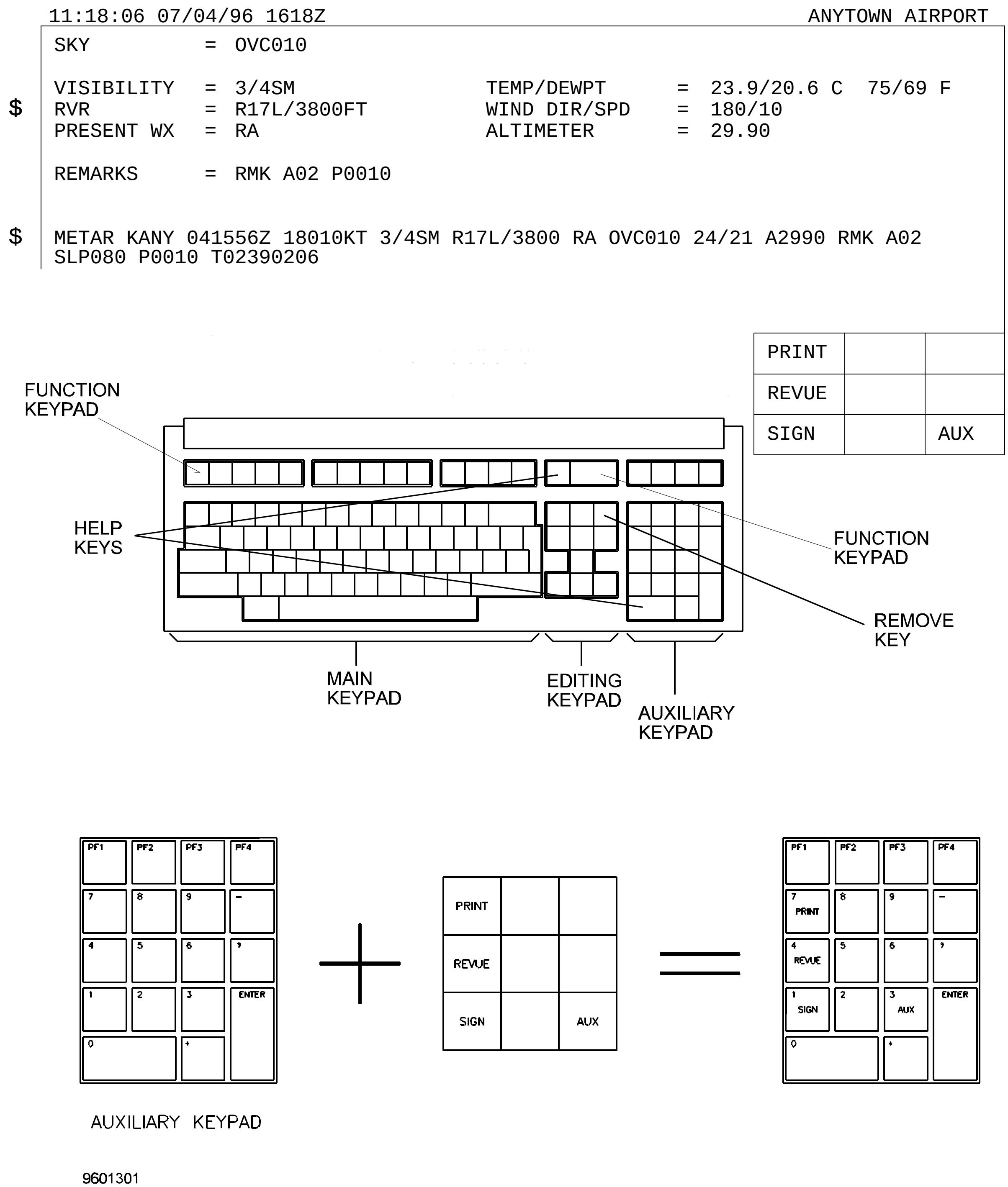

Figure 1.3.1. OID Keyboard Controls and Indicators

1.3.3 PRINTER CONTROLS AND INDICATORS

The printer controls and indicators are described in the Panasonic dot matrix printer manual.

1.3.4 MAINTENANCE SCREEN DESCRIPTIONS

1.3.4.1 **Introduction**. The ASOS technician uses the maintenance screens to interface with the ASOS continuous self-test (CST) program, which runs continuously during normal system operation. The program monitors the operational status of all ASOS hardware by reading and writing diagnostic data between the central processing unit (CPU) and the system hardware components. The self-test is repeated every 7 minutes and the results are entered into the system log. The technician interface screens provide a TEST key that is used to specify testing for sensors and/or field replaceable units (FRU's).

Certain items, specifically the wind sensor, the model 1088 temperature/dewpoint sensor, and telephone modems in the ACU, provide internal detailed diagnostics. These detailed diagnostics are not run as part of the normal CST cycle but are run on demand. If, during normal system data processing, a sensor failure is detected by the sensor processing program, the sensor processing program issues a command to the sensor to run its detailed diagnostic program. This command forces the sensor into an immediate detailed test. If the sensor fails its detailed diagnostic, an FRU failure message is entered into the maintenance log. The technician may also manually initiate the detailed diagnostics by pressing the TEST key on the wind sensor or the 1088 screens.

The telephone modems in the ACU may be configured for either dial-up operation (operating on the public switched telephone network) or leased line operation. As mentioned above, the modems provide an internal detailed diagnostic program, known as a system analog loopback (SAL) test. ASOS diagnostics test dial-up modems by initiating the internal SAL. However, running the SAL test disrupts normal data transmission (disconnects the telephone user). For this reason, the modems are tested every 7 minutes only when they are not in use (on-line). If a modem is on-line when it is scheduled for testing, the test is skipped until the next 7-minute cycle. The technician can perform an on-demand test of a selected dial-up modem at any time by pressing the TEST key on the modem maintenance screen, which immediately initiates the internal SAL. Therefore, the technician must be aware that if the modem is on-line, pressing TEST will disrupt current data transmission. Leased line modems are always on-line and therefore are not tested at all by the ASOS software; neither can a technician test them on demand.

The self-test/diagnostic program uses a series of easily accessible screens to display test results and to enable the technician to run specific portions of the diagnostic program. The screens are arranged in a hierarchical manner such that the key element of the system is displayed on the first maintenance screen. The units under each element of the system are accessed by placing the cursor on the element (i.e., ACU or DCP) and pressing the SEL key. The elements in that area are displayed on the OID. The process of moving the cursor and pressing the SEL key is repeated until the specific unit (i.e., sensor, board, or power supply screen) is displayed on the OID. Figure 1.3.2 illustrates the hierarchy of the maintenance screens.

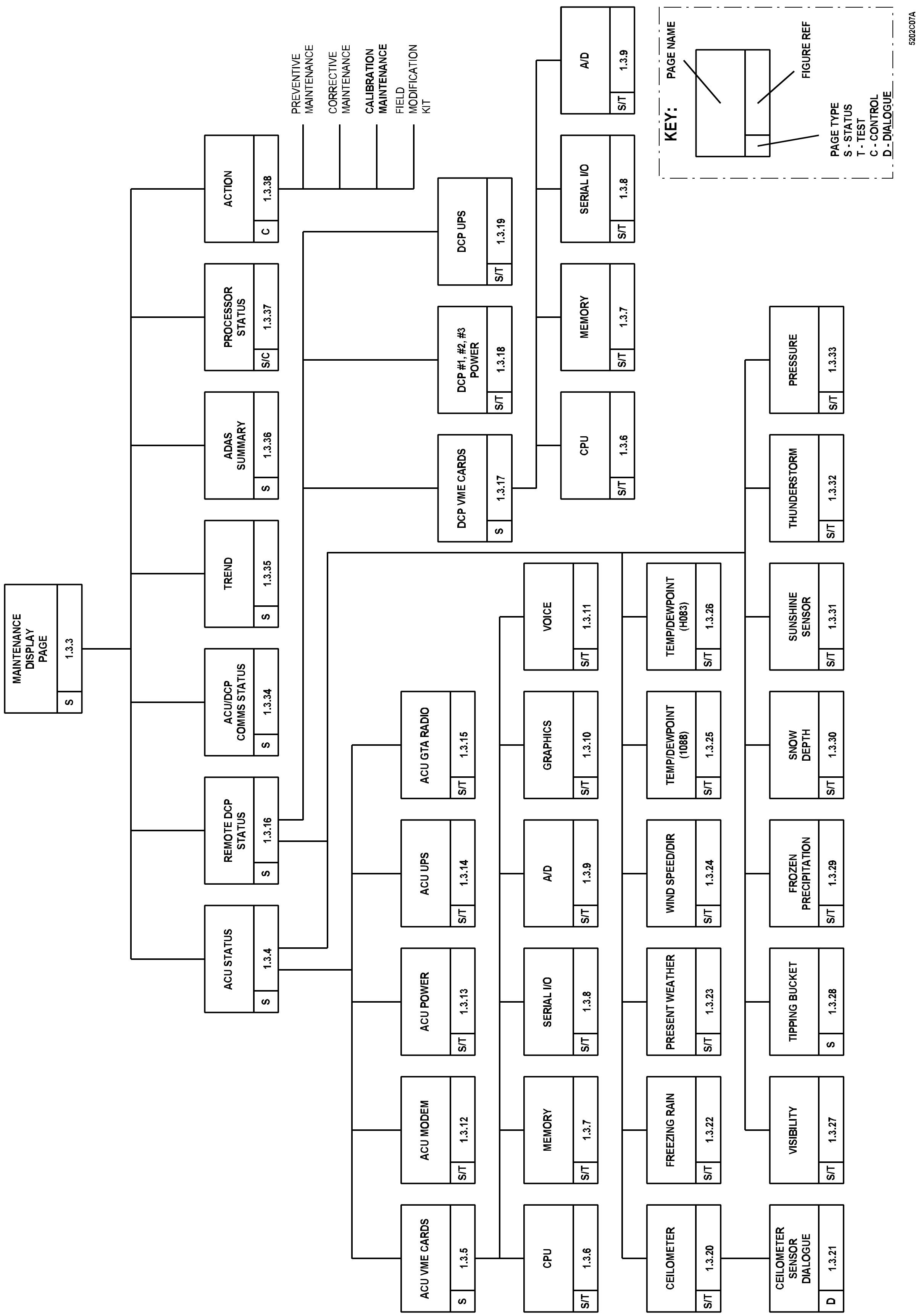

Figure 1.3.2. Maintenance Screens Hierarchy

1.3.4.2 **Maintenance Screen Keypad**. The maintenance screen keypad, which is located in the lower right corner of each screen, enables the technician to access the different maintenance screens, print individual screens, and perform on-demand diagnostic tests on an individual element of the ASOS hardware. The keypad provides up to eight active key functions. The purpose of each of these keys is as follows:

a. PRINT - Enables the currently displayed screen to be printed on the printer. PRINT function is not available to remote (dial-in) users (paragraph 1.3.14.1).

b. PREV/NEXT - Enables the cursor to be moved to the different fields on the currently displayed screen.

c. SEL - Enables the selection of a specific maintenance screen indicated by the position of the cursor.

d. TEST - For items with internal detailed diagnostic capability (1088, wind sensor, and ACU telephone modems), initiates detailed testing. For all other hardware, selects items on displayed screen for testing. T's are displayed on screen until items are tested during next CST cycle. CST results (pass or fail) are then displayed.

e. EXIT - Returns the user to the 1-minute screen on the OID.

f. CLEAR - Clears all counters for the fail count fields on the screen displayed and all screens summarized by this field.

g. BACK - Returns the user to the previous screen/keypad.

h. POWER - Appears on DCP Sensor Screens to enable the technician to control power to the individual sensors.

1.3.4.3 **Maintenance Screen Status Indicator Fields**. The maintenance screen status indicator fields are located to the right of each screen field. The status indicator field indicates the present operational status of the respective hardware components displayed on a screen. These fields display either a P (pass), T (testing), C (conditional), F (fail), or D (degraded) character depending on the present status of the unit or the result of the last continuous diagnostic or on-demand diagnostic test. An * (asterisk) is placed in the field if the item has not yet been tested.

A numeric fail count may be displayed to the right of the status indicator field. The fail count increments each time the status field transitions from P to F. It also increments each time the status field transitions from T (when the TEST key is pressed) to F. The fail count does not increment if F status is continually displayed by successive CST cycles. In most cases, the presence of a fail count generates the maintenance flag ($) in the next METAR. Sensor report processing OFF also produces a $. The CLEAR key, when pressed, clears all fail counts on the displayed screen and all screens beneath it on the maintenance hierarchy.

The C (conditional) indication is displayed on a summary-type screen to indicate that a hardware item is currently passing its CST but that failures have been generated (fail count(s) present on a lower screen in the maintenance hierarchy). For example, on the DCP screen, a C status would appear for the visibility sensor if the subordinate visibility screen showed the sensor passing CST but a fail count was still displayed. Using the CLEAR key to erase the fail count would change the visibility status on the DCP screen from C to P.

The system operates somewhat differently for tests associated with the serial input/output (SIO) boards and telephone modems. Before describing this in detail, it is important to make the following distinction between fail counts and accumulated failures.

a. Fail Count - Numeric value displayed on modem or SIO screen. Indicates transitions from P to F or T to F as described above (does not generate a $ in observation).

b. Accumulated Failures - Internal count kept by the CST indicating the actual number of failed test responses received (since the internal counter was last cleared). Accumulated failures generate a $ as described below.

When there are fewer than five accumulated failures (and the test is currently passing), a $ is not placed in the observation and a status of C (conditional) is reflected on the next higher screen. When the accumulated failures reach five or more (and the test is currently passing), a status of D is displayed (and is reflected on the next higher screen) and a $ is placed in the observation.

At 0600 LST each day, the number of accumulated failures is summarized in the system (maintenance) log as a code 9999 message. If the number of accumulated failures is less than five at this time, the system automatically clears the accumulated failure counter, the displayed fail count, and the associated C status. If the number of accumulated failures is five or more, the displayed fail count is cleared, but the accumulated failure counter is not cleared and the D (degraded) status is still reported.

The technician can use the CLEAR key for these tests. When pressed, the CLEAR key erases the number of accumulated failures and the displayed fail count. As a result, the C or D status is canceled (P is displayed) and any associated $ is removed from the observation.

1.3.4.4 **Sensor Data Quality, Report Process, and Sensor Response Fields**. Each sensor screen contains three additional test fields: data quality, report process, and sensor response. These fields identify operational data transmission status to the technician. The data quality field is controlled by the sensor processing program; specifically, by the processing algorithm for the sensor. If the algorithm determines that the data being received from the sensor are logically incorrect, the sensor processing program displays an F (fail) status in the data quality field. Table 1.3.1 lists the failure conditions for each sensor. The report processing field indicates whether or not a sensor algorithm is using the data being reported by the sensor. When report processing is on (status = Y), the algorithm is using the sensor data to update the 1-minute screen. When report processing is off (status = N), the algorithm ignores the sensor data, and the corresponding 1-minute field reports missing (unless a value is manually entered by an observer). During sensor configuration, report processing is off. The report processing status is conditioned from the review sensor status screen. The sensor response field displays a failed status (F) whenever the sensor does not respond to a data request from the sensor processing program or the self-test program and a pass status (P) when the sensor is responding when polled. Sensor response is also called sensor status.

Table 1.3.1. Sensor Data Quality Algorithm Checks

Sensor	Check
Wind direction	a. Must vary more than 1 degree during 5-minute period in which the 2-minute average wind speed exceeds 5 knots. b. Must have at least 18 (of 24 total) samples present in current 2-minute period.
Temperature/dewpoint	a. TA must vary by more than 0.1°F over a 60-minute period. b. TA must not change more than 6°F over a 1-minute period. c. TD cannot be more than 2 degrees greater than TA. d. TD must vary by more than 0.1°F over a 60-minute period. e. TD must not change more than 6°F over a 1-minute period. f. Must have at least 4 (of 5 total) samples present in current 5-minute period. g. In the event that the temperature/dewpoint sensor stops reporting, the system reports the last values for 15 minutes. If a new temperature or dewpoint value is not provided within 15 minutes, respective parameter is marked missing. At least four readings in the last 5 minutes must be available before a new value can be calculated. If new value for temperature or dewpoint is not computed in last 15 minutes, respective sensor is marked missing. Sensor must provide at least four valid readings within 5 minutes for system to compute new value.
Visibility	a. Extinction coefficient must be between 65.6 and 0.00 /km. b. Must not drop from a reading of 7 miles or more to a reading of less than 2 miles in 1 minute with a wind speed of less than 7 knots. c. Must be greater than 2 miles if TA-TD is greater than 5°F. d. Must have at least 8 (of 10 total) samples present in current 10-minute period.
Day/night	a. Sensor must report N (night) at midnight. b. Sensor must report D (day) at noon.
Present weather	a. If sensor indicates snow, TA must indicate a temperature of less than 38°F. b. If sensor indicates liquid precipitation, TA must be greater than 28°F. c. Must have at least 8 (of 10 total) samples present in 10-minute period.
Liquid precipitation	a. Rain gauge sends optical pulse to DCP with each tip of its tipping bucket. Pulses must be greater than 50 milliseconds long. b. Must indicate precipitation accumulation if the present weather sensor has indicated 10 or more moderate or heavy occurrences of precipitation since the previous hourly observation.
Sky	Must not be missing more than 2 consecutive ceilometer samples or more than 4 total samples (of 60 total) in current 30-minute period.
Pressure	a. Sensor must report within ±0.04 inHg of other 1 or 2 pressure sensors. b. Must not be missing more than 1 sample (of 10 total) in current 1-minute period or more than 2 samples in current 12-hour period.
Freezing rain	Must have at least 12 samples (of 15 total) samples present in current 15-minute period.
Snow depth	a. Must indicate between 0 and 99 inches. b. Must not exceed a rate of change of 2 inches per minute. c. Must vary by more than 0.5 inch when the present weather sensor report indicates snow (S) or heavy snow (S+) over a 30-minute period and the 5-minute average TA is less than 32°F.
Thunderstorm	a. Number of lightning strikes for each range must be less than 4000. b. Must not be missing more than 3 consecutive thunderstorm samples in current 15-minute period.

1.3.4.5 **Maintenance Screen Description**. The maintenance screen (Figure 1.3.3) provides overall test status information to the technician. It also enables the technician to access the next level status and test screens. The function of each field is described in table 1.3.2.

```
   11:21:56 11/21/97 1612Z                                  ANYTOWN AIRPORT

   ACU   P        DCP #1   P      ACU/DCP COMMS   *   TREND                PROC
$                 DCP #2   P                          ADAS SUMMARY
                  DCP #3   P

                                                             MAINTENANCE
                                                    | PRINT | CLEAR | PREV |
                                                    | SEL   | ACT   |      |
                                                    | EXIT  |       | NEXT |
```

Figure 1.3.3. Maintenance Screen

1.3.4.6 **Maintenance Action Selection**. An important function of the maintenance screen is the ACT key on the MAINTENANCE keypad. This key permits the technician to access the maintenance action screens from which maintenance tasks are started and documented in the system maintenance log. The technician enters unit/assembly stock numbers and unit serial numbers to screens that specify preventive, corrective, or calibration maintenance tasks. Field modification kit numbers are entered on a field modification kit screen.

Table 1.3.2. Maintenance Screen Field Descriptions

Field	Description
ACU	Displays the summary status of all hardware items in the ACU cabinet and any associated local sensors. The SEL key enables the technician to select the ACU status screen, where the individual status of ACU hardware and local sensors can be found.
DCP #1 DCP #2 DCP #3	Displays the summary status of all hardware items in the respective data collection package (DCP) along with its associated sensors. The SEL key enables the technician to access the DCP status screen of interest, where the individual status of DCP hardware and corresponding sensors can be found.
ACU/DCP COMMS	Displays the status of the intercommunications devices in the ASOS configuration (DCP to ACU communications). The SEL key enables the technician to select the ACU/DCP communications status screen.
TREND	Displays the communication status of the ACU and DCP radios (RF modems). The SEL key enables the technician to select the trend screen, from which the technician can check the communication link between the ACU and DCP(s).
ADAS SUMMARY	Displays ADAS communication log entries per hour. The SEL key enables the technician to select the ADAS summary screen.
PROC	Displays the operational status of the ACU and DCP processors. The SEL key enables the technician to select the processor status screen, from which the technician may reset the ACU or DCP.

1.3.4.7 **ACU Status Screen**. The ACU status screen (Figure 1.3.4) displays the status of each ACU local sensor and hardware area and provides menu commands to access sensor diagnostic and hardware status functions. This screen pertains to the ACU only (the DCP has a separate, similar screen). The function of each field on the ACU status screen is described in table 1.3.3. Each sensor screen under the ACU status screen is similar to the same type sensor screen under the DCP status screen because the sensor tests (and sensors) are identical. Since most sensors are typically configured as part of the DCP at the majority of ASOS installation sites, the sensor screens are described in this section under the DCP status screen. These screens will not be covered again under the ACU status screen. However, the sensor screens that appear under the ACU status screen do not have the three sensor power-related items that appear on the DCP sensor screens. The sensor power-related items consist of the POWER key that enables the technician to turn DCP sensor power on and off, a POWER CONTROL status field that indicates whether sensor power is on or off, and a POWER STATUS field that indicates the status of sensor power as a pass or fail condition.

```
11:21:56 11/21/97 1612Z                                         ANYTOWN AIRPORT

     LOCAL   SENSORS:                  HARDWARE:
  PRESSURE   SENSOR #1   P
  PRESSURE   SENSOR #2   P           VME CARDS RACK     P
  PRESSURE   SENSOR #3   P
                                     MODEM RACK         P

                                     ACU POWER          P

                                     ACU UPS            P

                                     GTA RADIO          P

                                                           ACU STATUS
                                                      PRINT  CLEAR  PREV
                                                      SEL
                                                      EXIT   BACK   NEXT
```

Figure 1.3.4. ACU Status Screen

Table 1.3.3. ACU Status Screen Field Descriptions

Field	Description
LOCAL SENSORS	Displays the status of each of the sensors configured as a local sensor in the ACU, and enables the technician to select a specific sensor screen.
VME CARDS RACK	Displays the summary status of all boards located in the ACU VME card rack, and enables the technician to select the ACU VME cards screen.
MODEM RACK	Displays the summary status of all modems located in the ACU modem rack, and enables the technician to select the ACU modem screen.
ACU POWER	Displays the status of all power-related functions in the ACU. Enables the technician to display individual status screens.
ACU UPS	Displays the summary status of the UPS in the ACU, and enables the technician to select individual status screens.
GTA RADIO	Displays the summary status of the GTA radio in the ACU, and enables the technician to select the ACU GTA radio screen.

1.3.4.8 **ACU VME Cards Screen**. The ACU VME cards screen (Figure 1.3.5) pertains only to the ACU. This screen displays the test status of each board in the VME card rack. The ACU VME cards screen also enables the technician to select a specific board's diagnostic screen.

```
   11:21:56 11/21/97 1621Z                                 ANYTOWN AIRPORT

       BOARD NAME
$      #1 CPU A          P                #13 A/D                  P
$      #2 CPU B          P                #14 A/D RESISTOR
       #3 MEMORY         P                #15 DIGITAL I/O
$      #4                                 #16 VIDEO CONTROLLER     P
       #5 SIO #1         P                #17
       #6 SIO #2         P                #18
       #7 SIO #3         P                #19
       #8 SIO #4         P                #20 VOICE PROC #1        P
       #9 SIO #5         P                #21 VOICE PROC #2        P
       #10 SIO #6        P
       #11 SIO #7        P
$      #12 SIO #8        P                             VME CARDS
                                                 PRINT   CLEAR   PREV
                                                 SEL
                                                 EXIT    BACK    NEXT
```

Figure 1.3.5. ACU VME Cards Screen

1.3.4.9 **CPU Screen**. The CPU screen (Figure 1.3.6) pertains to both the ACU and the DCP. The ACU always contains two CPU's. The primary CPU operates the system while the other is the backup, or redundant, CPU. Because this screen summarizes the status of both CPU's, the identical screen is displayed regardless of whether the technician selects CPU A screen or the CPU B screen (from the VME cards screen). The top half of the CPU screen displays the CST status for the primary CPU, while the bottom part of the screen identifies the current redundant CPU and displays the pass/fail status of its internal built-in test. The function of each field on the CPU screen is described in table 1.3.4.

The DCP contains either one or two CPU's, depending on site configuration. When the DCP contains two CPU's, this screen operates the same as described above for the ACU. When the DCP contains only one CPU, there is no redundant CPU and only the top part of the screen is applicable.

```
11:21:56 11/21/97 1621Z                                          ANYTOWN AIRPORT
                          ACU
                       PRIMARY CPU

DRAM                       P
EPROM                      P
BUS ERRORS                 P

SERIAL PORT #1
 LOOPBACK                  P
 XMIT ERRORS               P

SERIAL PORT #2
 LOOPBACK                  P
 XMIT ERRORS               P                                  CPU
-----------------------------------------------------------| PRINT | CLEAR |     |  $
                                                           |-------|-------|-----|
REDUNDANT CPU              B                               | TEST  |       |     |
 STATUS                    P                               |-------|-------|-----|
                                                           | EXIT  | BACK  |     |
```

Figure 1.3.6. CPU Screen

Table 1.3.4. CPU Screen Field Descriptions

Field	Description
DRAM	Displays the results of the dynamic random access memory (DRAM) test. This test is based on an alternating pattern of 1's and 0's. The output status (P = pass or F = fail) is displayed upon completion of a data comparison.
EPROM	Displays the results of the erasable programmable read only memory (EPROM) test. This test is based on a checksum. The checksum must be equal to the last byte stored in the EPROM. The output status (P = pass or F = fail) is displayed upon completion of the checksum comparison.
BUS ERRORS	Displays the results of the bus errors test. The bus errors test is based on a memory write to a specific address. The contents of the memory addressed are then evaluated and the output status (P = pass or F = fail) is displayed.
SERIAL PORT	This test ensures that the CPU can communicate with its internal UART (two ports). For each port, the CPU reads the UART interrupt sector register and tests for bus errors. The status field indicates a P (pass) if no bus errors occurred and indicates an F (fail) if bus errors were encountered.
LOOPBACK	Displays the results of the loopback test. This test ensures that the CPU can communicate with its internal UART (two ports). For each port, the CPU reads the UART interrupt sector register and tests for bus errors. The status field indicates a P (pass) if no bus errors occurred and indicates an F (fail) if bus errors were encountered.
XMIT ERRORS	Displays the results of the XMIT errors test. This test checks for errors encountered during data transmission (or incoming data) and is based on the UART status register contents. The register contents are evaluated for parity errors, framing errors, and overrun errors on incoming data. If such errors occur for two out of three consecutive CST cycles, an F (fail) is displayed in the status field; otherwise, the status field indicates P (pass).
REDUNDANT CPU	Indicates which CPU is being used as the redundant CPU.
STATUS	Indicates the status of the redundant CPU: P (pass) indicates functioning and F (fail) indicates not operating correctly.

1.3.4.10 **Memory Screen**. The memory screen (Figure 1.3.7) pertains to both the ACU and DCP (although DCP screen shows no EPROM line). This screen displays the results of the diagnostic test performed on the major functional circuits on each memory board in the system. The function of each field on the memory screen is described in table 1.3.5.

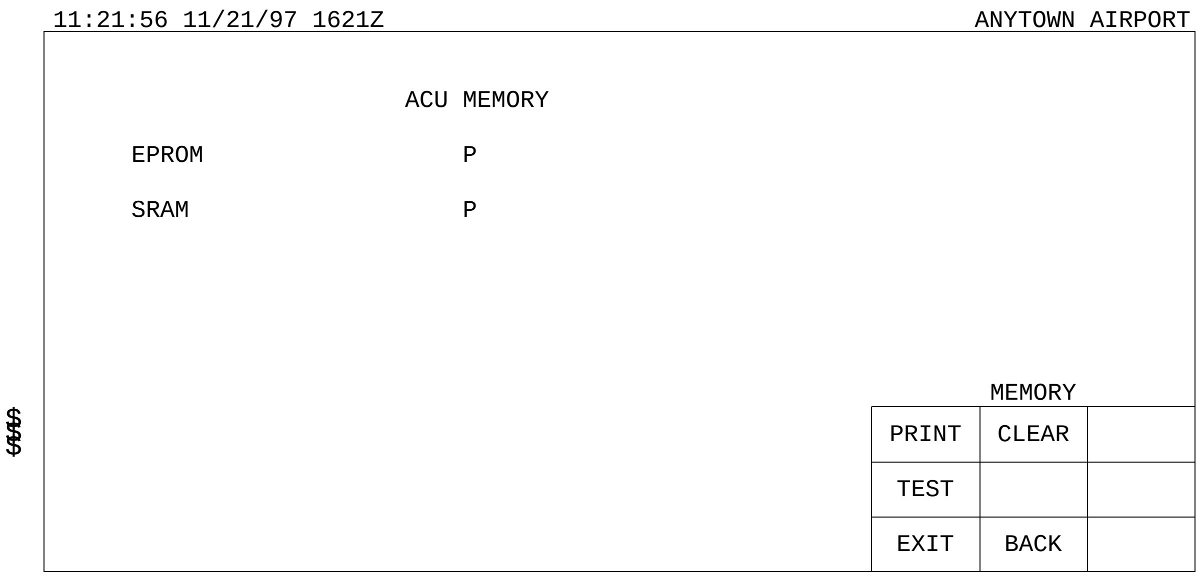

Figure 1.3.7. Memory Screen

Table 1.3.5. Memory Screen Field Descriptions

Field	Description
EPROM	From the ACU memory board, displays the results of the EPROM test. This test is based on checksum. The checksum must be equal to the last byte stored in the EPROM. The output status (P = pass or F = fail) is displayed upon completion of the checksum comparison. For the DCP memory board, this field is not displayed because the board contains no EPROM.
SRAM	Displays the results of the SRAM test. This test indicates whether or not the CPU can access the SRAM without encountering bus errors. The CPU reads from an SRAM location and tests for bus errors. The status field indicates a P (pass) if no bus errors occurred or an F (fail) if bus errors did occur.

1.3.4.11 **Serial I/O Screen**. The serial I/O screen (Figure 1.3.8) pertains to both the ACU and DCP. This screen displays the results of the diagnostic test performed on the major functional circuits on a serial I/O (SIO) board. The function of each field on the serial I/O screen is described in table 1.3.6. When fewer than five LOOPBACK failures have been detected and the port is currently passing the LOOPBACK test, a $ is not added to the observation and a status of C (conditional) is reflected on the next higher screen. When five or more LOOPBACK failures have occurred and the port is currently passing this test, a status of D (degraded) is displayed for the port (and is also reflected on the next higher screen) and a $ is added to the observation. At 0600 LST each day, the number of accumulated failures is summarized in the system (maintenance) log. The system operates identically for XMIT ERROR failures. The technician can use the CLEAR key to reset the fail counts and clear the C or D status indication. Paragraph 1.3.4.3 provides additional information on SIO test reporting.

```
11:21:56 11/21/97 1621Z                                         ANYTOWN AIRPORT

                          LOOPBACK     XMIT ERR
     SIO #1
       PORT #1              P            P
       PORT #2              P            P
       PORT #3              P            P
       PORT #4              P            P

                                                                      ACU SIO
                                                            PRINT   CLEAR          $
                                                            TEST
                                                            EXIT    BACK
```

Figure 1.3.8. Serial I/O Screen

Table 1.3.6. Serial I/O Screen Field Descriptions

Field	Description
LOOPBACK	Displays the results of the loopback test. This test ensures that the CPU can communicate with the two UART's (four ports total) on the SIO board. For each port, reads the UART vector interrupt register and tests for bus errors. The status field indicates a P (pass) if no bus errors occurred, an F (fail) if bus errors were encountered, or a D if more than five errors have been detected and the test is currently passing.
XMIT ERRORS	Displays the results of the XMIT errors test. This test checks for errors encountered during data transmission (on incoming data) and is based on the UART status register contents. The register contents are evaluated for parity errors, framing errors, and overrun errors on incoming data. The status field indicates a P (pass) if no errors occurred, an F if errors were detected, or a D if more than five errors occurred and the test is currently passing.

1.3.4.12 **<u>A/D Screen Description</u>**. The A/D screen (Figure 1.3.9) pertains to both the ACU and DCP, and is essentially the same for both. The ACU contains one analog-to-digital (A/D) card which is used for self-tests of power supply voltages within the ACU cabinet. The DCP contains either one or two A/D boards. The first DCP A/D board is used to self-test cabinet voltages and to sense whether the first eight sensors are on or off. The second A/D board is installed in DCP's that contain more than eight sensors.

The diagnostic test performs two functional tests on each A/D board: register readback and reference voltage tests. The register readback test sends control words to the control register on the board and reads the data back via a status register also located on the A/D board. Failure of the register readback test indicates a failure of the A/D board to properly store command data or a possible I/O failure. The reference voltage test checks the operation of the A/D conversion circuits by checking the value of a +2.5 vdc precision reference voltage in the ACU or DCP cabinet.

```
11:21:56 11/21/97 1621Z                                        ANYTOWN AIRPORT

                         ACU
REGISTER
 READBACK                 P

REFERENCE
 VOLTAGE                  P



                                                                   A/D
                                                        | PRINT | CLEAR |      |
                                                        | TEST  |       |      |
                                                        | EXIT  | BACK  |      |
```

Figure 1.3.9. A/D Screen

1.3.4.13 **<u>Graphics Screen</u>**. The graphics screen (Figure 1.3.10) pertains to the ACU only. This screen displays the results of the diagnostic test performed on the major functional circuits on the video controller board. The function of each field on the graphics screen is described in table 1.3.7.

```
11:21:56 11/21/97 1621Z                                        ANYTOWN AIRPORT

CRT CONTROLLER READBACK            P

PARALLEL I/F TIMER READBACK        P

LOOPBACK #1                        P

LOOPBACK #2                        P

RT CLOCK READBACK                  P

                                                                 GRAPHICS
                                                        | PRINT | CLEAR |      |
                                                        | TEST  |       |      |
                                                        | EXIT  | BACK  |      |
```

Figure 1.3.10. Graphics Screen

Table 1.3.7. Graphics Screen Field Descriptions

Field	Description
CRT CONTROLLER READBACK	Displays the results of the CRT controller readback test. This test is based on cursor position, which is stored in a register on the video controller board. This register is read twice to ensure that the cursor remains stationary. The cursor positions are compared and the output status (P = pass or F = fail) is displayed.
PARALLEL I/F TIMER READBACK	Displays the results of the parallel I/F timer readback test. This test checks hardware that is only used for diagnostic purposes. The parallel I/F timer readback test is based upon a write/read routine. The data are evaluated and the output status (P = pass or F = fail) is displayed. Failure of this test does not necessitate the replacement of the video controller board. Failure of the CRT controller readback test and/or the RT clock readback test in conjunction with failure of this test indicates a real-time failure.
LOOPBACK	Displays the results of the loopback tests. This test checks hardware that is only used for diagnostic purposes. The loopback test is based upon a write/read routine. The data are evaluated and the output status (P = pass or F = fail) is displayed. Failure of this test does not necessitate the replacement of the video controller board. Failure of the CRT controller readback test and/or the RT clock readback test in conjunction with failure of this test indicates a real-time failure.
RT CLOCK READBACK	Displays the results of the RT clock readback test. The RT clock readback test tests clock calendar timing. Numbers from an RT clock chip are read and evaluated, and the output status (P = pass or F = fail) is displayed. ASOS does not use the RT clock on the video board.

1.3.4.14 **Voice Screen**. The voice screen (Figure 1.3.11) pertains only to the ACU. This screen displays the results of the diagnostic test performed on the major functional circuits on the voice CPU/memory and voice recorder/playback boards in the system. The function of each field on the voice screen is described in table 1.3.8.

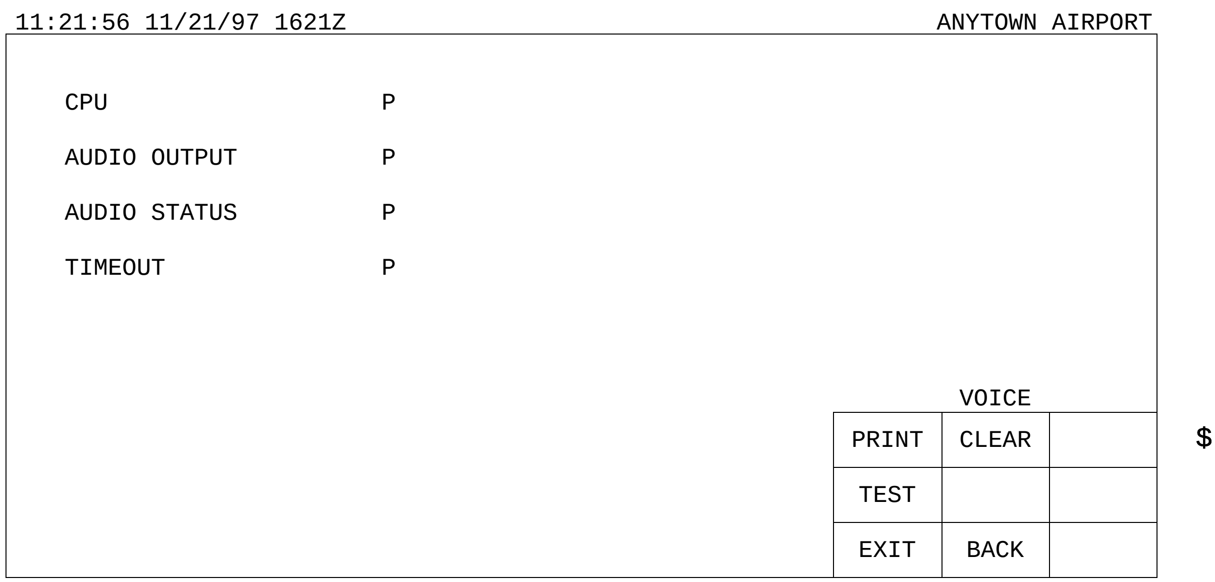

Figure 1.3.11. Voice Screen

Table 1.3.8. Voice Screen Field Descriptions

Field	Description
CPU	Displays the results of the CPU test. The CPU test specifically tests the operational status of the voice CPU/memory board. Inputs to the status field are based on a digital input received from the A/D converter. The CPU status is evaluated and the output status (P = pass or F = fail) is displayed.
AUDIO OUTPUT	Displays the results of the audio output test. The audio output test tests the operation of the voice recorder/playback board and indirectly tests the voice CPU/memory board. The audio output test is based on an internal audio test that checks the audio circuitry and the output status (P = pass or F = fail) is displayed.
AUDIO STATUS	Displays the results of the audio status test. The audio status test tests the operation of the voice recorder/playback board and indirectly tests the voice CPU/memory board. The audio status test is based upon a monitored audio line. Inputs to the status field are based on a digital input received from the A/D converter. The status is evaluated and the output status (P = pass or F = fail) is displayed.
TIMEOUT	Displays the results of the timeout test. The timeout test specifically tests the operational status of the voice CPU/memory board watchdog timer. The status is determined by the watchdog timer response, which is evaluated and the output status (P = pass or F = fail) is displayed.

1.3.4.15 **ACU Modem Screen**. The ACU modem screen (Figure 1.3.12) pertains only to the ACU. This screen displays the port assignments for each modem and the status of the last internal system analog loopback (SAL) test performed on the individual modems. The telephone modems in the ACU may be configured for either dial-up operation (on the public switched telephone network) or leased line operation. This screen displays only dial-up modems. The dial-up modems are tested (SAL is run) automatically every 7 minutes as long as they are not in use (on-line). If a modem is on-line when it is scheduled for testing, the test is skipped until the next 7-minute cycle. The technician can perform an on-demand test of a selected dial-up modem at any time by pressing the TEST key, which immediately initiates the internal SAL. Therefore, the technician must be aware that if the modem is on-line, pressing TEST will disrupt current data transmission. Leased line modems are not displayed on this screen because modems are always on-line and therefore are not tested at all by the ASOS software; neither can a technician test them on-demand. The STATUS field associated with each modem shows the current CST status for each modem. A status of P or F indicates that the modem is currently passing or failing its internal SAL test. An associated fail count is incremented each time that the status changes from P to F (or T to F). When fewer than five failures have been detected and the modem is currently passing, a $ is not added to the observation and a status of C (conditional) is reflected on the next higher screen. When five or more failures have occurred and the modem is currently passing, a status of D (degraded) is displayed for the modem (and is also reflected on the next higher screen) and a $ is added to the observation. At 0600 LST each day, the number of accumulated failures is summarized in the system (maintenance) log. The technician can use the CLEAR key to reset the fail counts and clear the C or D status indication. If a test has not been performed for a particular modem, an * is displayed in the status field. Paragraph 1.3.4.3 provides additional information on modem failure reporting.

```
11:21:56 07/04/96 1621Z                                        ANYTOWN AIRPORT
     MODEM         PORT         MODEM NAME          STATUS    FAILCOUNT

     #1            2-3          OID-4 USER #1         P
     #2            3-3          OID-5 USER #2         P
     #3            4-4          AFOS PHONE            P
     #4            7-4          OID-6 USR SPR #1      P
     #5            8-1          OID-7 USR SPR #2      P
     #6            8-2          OID-8 SPARE           P
     #7
     #8
     #9
     #10
     #11
     #12                                                   ACU MODEM
     #13                                              PRINT   CLEAR   PREV
     #14
     #15                                              TEST
     #16
                                                      EXIT    BACK    NEXT
```

Figure 1.3.12. ACU Modem Screen

1.3.4.16 **ACU Power Screen**. The ACU power screen (Figure 1.3.13) pertains only to the ACU. This screen displays the status of all power-related functions within the ACU. The test result fields indicate the status of the various power supplies as a P (pass) or F (fail) condition.

```
11:21:56 11/21/97 1621Z                                        ANYTOWN AIRPORT
                                 POWER SUPPLIES:

    +2.5 REFERENCE          P                     POWER SUPPLY A         P
    +5 SUPPLY VOLTS         P                     POWER SUPPLY B         P

   +12 SUPPLY VOLTS         P

   -12 SUPPLY VOLTS         P

    +5 VME RACK             P
   +12 VME RACK             P
   -12 VME RACK             P
    +5 RADIO A              P
    +5 RADIO B              P                            ACU PWR
   +12 RADIO A              P                     PRINT   CLEAR
   +12 RADIO B              P
   -12 RADIO A              P                     TEST
   -12 RADIO B              P
                                                  EXIT    BACK
```

$

Figure 1.3.13. ACU Power Screen

1.3.4.17 **ACU UPS Screen**. There are two types of power supply assemblies that may be installed in the ACU: SOLA UPS, which is installed in ACU serial numbers 437 and below (40044-10), and Deltec UPS, which is installed in serial numbers 438 and above (40044-30, -40, and -70). Figure 1.3.14 contains the two types of OID screens available, and table 1.3.9 describes the function of each field on the ACU UPS screen.

```
11:21:56 11/21/97 1621Z                                    ANYTOWN AIRPORT

   BATTERY VOLTAGE:             53

   INPUT VOLTAGE:              116

   OUTPUT VOLTAGE:             116              UPS INLINE:
                                                CMD UPS INLINE:
   OUTPUT ENABLED:              P
   ON AC LINE:                  P
   BATTERY STATUS:              P
   TRIAC STATUS:                P
   TEMPERATURE:                 P                          ACU UPS
   R3232 STATUS:                P                    | PRINT | CLEAR |       |
   TIMEOUT:                     P                    | TEST  |       | BYPAS |
                                                     | EXIT  | BACK  |       |
                                For SOLA UPS
```

```
11:21:56 11/21/97 1621Z                                    ANYTOWN AIRPORT

   BATTERY VOLTAGE:                            BATTERY MANAGEMENT:  FLOATING

   INPUT VOLTAGE:                              LINE REGULATION:     NORMAL

   OUTPUT VOLTAGE:                             UPS INLINE:          P
                                               CMD UPS INLINE:      OFF
   UPS OPERATION:               P
   ON AC LINE:                  P
   BATTERY STATUS:              P
   INVERTER:                    P
   GROUND STATUS:               P                          ACU UPS
   UTILITY                      P                    | PRINT | CLEAR |       |
   TIMEOUT:                     P                    | TEST  |       | BYPAS |
                                                     | EXIT  | BACK  |       |
                               For Deltec UPS
```

Figure 1.3.14. ACU UPS Screen

Table 1.3.9. ACU UPS Screen Field Descriptions

Field	Description
SOLA UPS	$
BATTERY VOLTAGE	Displays a numeric value indicating the present backup battery voltage.
INPUT VOLTAGE	Displays a numeric value indicating the present input line voltage to the UPS.
OUTPUT VOLTAGE	Displays a numeric value indicating the present ac output voltage from the UPS to the rest of the ACU.
OUTPUT ENABLED	Indicates that UPS output is on (pass) or off (fail).
ON AC LINE	Indicates whether the UPS is using facility (line) voltage (P) or generating ac voltage from battery (in inverter mode) (F).
BATTERY STATUS	Indicates the present battery status in the ACU as a P (pass) or F (fail).
TRIAC STATUS	Indicates the present status of tap-changing TRIAC’s on the UPS 1.5 Kva inverter board as a P (pass) or F (fail).
TEMPERATURE	Indicates present temperature status in the ACU as a P (pass) or F (fail). If fail, inverter board is in overheat alarm and shuts off UPS.
RS232 STATUS	Indicates the present status of the UPS RS232 communications as a P (pass) or F (fail).
TIMEOUT	Indicates the present status of the UPS watchdog timer as a P (pass) or F (fail).
UPS INLINE	Displays P when UPS is inline or F when UPS is bypassed.
CMD UPS INLINE	Bypasses UPS when set to OFF or places UPS inline when set to ON.
Deltec UPS	$
BATTERY VOLTAGE	Displays a numeric value indicating the present backup battery voltage.
INPUT VOLTAGE	Displays a numeric value indicating the present input line voltage to the UPS.
OUTPUT VOLTAGE	Displays a numeric value indicating the present ac output voltage from the UPS to the rest of the DCP.
UPS OPERATION	Indicates that UPS is functioning in a normal (P) or abnormal (F) manner.
ON AC LINE	Indicates whether the UPS is using facility (line) voltage (P) or generating ac voltage from the battery (in inverter mode) (F).
BATTERY STATUS	Indicates present battery status in the DCP as a P (pass) or F (fail).
INVERTER	Indicates whether the internal inverter is operating in overvoltage or undervoltage status.
GROUND STATUS	F indicates a ground failure in facility wiring.
UTILITY	Checks for an overvoltage or unsynchronized signal from facility power.
TIMEOUT	Indicates the present status of the UPS watchdog timer as a P (pass) or F (fail).
BATTERY MANAGEMENT	Indicates if the current from the batteries is FLOATING, RESTING, CHARGING, or DISCHARGING.
LINE REGULATION	Indicates if the UPS is maintaining a STEP-UP, STEP DOWN, or NORMAL status.
UPS INLINE	Displays P when UPS is inline or F when UPS is bypassed.
CMD UPS INLINE	Bypasses UPS when set to OFF or places UPS inline when set to ON.

1.3.4.18 **GTA Radio Screen**. The GTA radio screen (Figure 1.3.15) pertains only to the ACU and applies to application software version 2.1 or higher. This screen displays the status of all GTA radio-related functions in the ACU. Table 1.3.10 describes the function of each field on the ACU GTA radio screen.

```
11:21:56 11/21/97 1621Z                                        ANYTOWN AIRPORT

   RADIO ID NUMBER:            123456            RADIO RESPONSE:         P

   TRANSMIT FREQUENCY:         125.375

   POWER LEVEL SETTING:        50

   MAX POWER SETTING:          189

   POWER SUPPLY STATUS:
   +5V                          P
   +12V                         P
   -12V                         P                              GTA RADIO
   -80V                         P
   VFWD STATUS       050        P                         |       | CLEAR |       |
   VRFD STATUS       002        P                         | TEST  |       |       |
                                                          | EXIT  | BACK  |       |
```

Figure 1.3.15. ACU GTA Radio Screen

Table 1.3.10. ACU GTA Radio Screen Field Descriptions

Field	Description
RADIO ID NUMBER	Displays a numeric value indicating the designator specific to each radio.
TRANSMIT FREQUENCY	Displays a numeric value indicating the current command value. This value will equal the command frequency (117.975 to 136.975 in increments of 0.025).
POWER LEVEL SETTING	Displays a numeric digital value indicating the command power level. This value is equal to commanded power level (0 to 255).
MAX POWER SETTING	Displays a numeric digital value indicating the maximum power level. Each GTA radio has a unique maximum power level (0 to 255).
POWER SUPPLY STATUS	Consists of four individual tests: +5V, +12V, -12V, and -80V.
+5V	Indicates that the internal measured operating voltage is within the tolerances of 3V to 7V.
+12V	Indicates that the internal measured operating voltage is within the tolerances of 9.6V to 14.4V.
-12V	Indicates that the internal measured operating voltage is within the tolerances of -9.6V to -14.4V.
-80V	Indicates that the internal measured operating voltage is within the tolerances of -96V to -64V.
VFWD STATUS	Displays the digital value of the VFWD between 000 and 255.
VRFD STATUS	Displays the digital value of the VRFD between 000 and 255.
RADIO RESPONSE	Indicates if the ACU is capable of communicating with the radio.

1.3.4.19 **Remote DCP Status Screen Description**. The remote DCP status screen (Figure 1.3.16) displays the operational status of each sensor connected to the DCP as well as the status of all hardware in the DCP pertaining only to the DCP. This screen pertains to the DCP only (the ACU has a separate, similar screen). If the ASOS is equipped with optional uninterruptible power supplies (UPS's), each DCP may contain either one or two UPS's. UPS #2 is provided only if the number of sensors connected to the DCP provides a load too large for a single UPS. This second UPS would be mounted in a separate cabinet, referred to as an auxiliary DCP, behind the basic DCP cabinet. The remote DCP status screen also enables the technician to select the associated screen for each of the status fields on the screen. The function of each field is described in table 1.3.11.

```
11:21:56 11/21/97 1621Z                                        ANYTOWN AIRPORT
     SENSOR GROUP:                            HARDWARE:

 PRESENT WEATHER     P               VME             P
 WIND SPEED/DIR      P
 TEMP/DEWPOINT       P               DCP POWER       P
 VISIBILITY #1       P
 VISIBILITY #2       P               DCP UPS#1       P
 VISIBILITY #3       P
 CEILOMETER #1       P               DCP UPS#2       P
 CEILOMETER #2       P
 CEILOMETER #3       P
 TIPPING BUCKET      P
 SNOW DEPTH          P
 FREEZING RAIN       P                                           REMOTE DCP#1
 FROZEN PRECIP       P                                      | PRINT | CLEAR | PREV |
 SUNSHINE            P
 THUNDERSTORM        P                                      | SEL   |       |      |

                                                            | EXIT  | BACK  | NEXT |
```

Figure 1.3.16. Remote DCP Status Screen

Table 1.3.11. Remote DCP Status Screen Field Descriptions

Field	Description
SENSOR GROUP	Displays the status of each of the sensors connected to the DCP, and enables the technician to select a specific sensor screen.
VME	Displays the summary status of all boards located in the DCP VME card rack, and enables the technician to select the DCP VME cards screen.
DCP POWER	Displays the summary status of the DC power supplies in the DCP, and enables the technician to select individual status screens.
DCP UPS #1	Displays the status of all power-related functions in the DCP. Enables the technician to display individual status screens.

1.3.4.20 **DCP VME Cards Screen Description.** The DCP VME cards screen (Figure 1.3.17) pertains only to the DCP. This screen displays the test status of each board in the VME card rack. The DCP VME cards screen also enables the technician to select the diagnostic screen of a specific board.

```
  11:21:56 11/21/97 1621Z                                      ANYTOWN AIRPORT
       BOARD NAME

     #1   CPU A                  P
     #2   CPU B                  P
     #3   MEMORY                 P
     #4   SIO #1                 P
     #5   SIO #2                 P
$    #6   SIO #3                 P
$    #7   SIO #4                 P
     #8
     #9   A/D #1                 P
     #10  A/D RESISTOR           P
$    #11  A/D #2                 P
     #12  DIGITAL I/O                                           VME CARDS
$$$                                                   | PRINT | CLEAR | PREV |
                                                      | SEL   |       |      |
                                                      | EXIT  | BACK  | NEXT |
```

Figure 1.3.17. DCP VME Cards Screen

1.3.4.21 **DCP #1, #2, #3 Power Screen**. The DCP #1, #2, #3 power screen (Figure 1.3.18) pertains to the DCP only. This screen indicates the status of all power-related functions within the DCP's. The test result fields indicate the status of the various power supplies as a P (pass) or F (fail) condition.

```
  11:21:56 11/21/97 1621Z                                      ANYTOWN AIRPORT
                                  POWER SUPPLIES:
     +2.5 REFERENCE          P
     +5 SUPPLY #1 VOLTS      P
     +5 SUPPLY #2 VOLTS      P
    +12 SUPPLY #1 VOLTS      P
    +12 SUPPLY #2 VOLTS      P
    -12 SUPPLY #1 VOLTS      P
    -12 SUPPLY #2 VOLTS      P

                                                                DCP#1 PWR
$$$                                                   | PRINT | CLEAR |      |
                                                      | TEST  |       |      |
                                                      | EXIT  | BACK  |      |
```

Figure 1.3.18. DCP #1, #2, #3 Power Screen

1.3.4.22 **DCP UPS Screen**. There are two types of uninterruptible power supplies that may be installed in the DCP: A SOLA UPS, which is installed in DCP serial numbers 438 and below, or a Deltec UPS, which $ is installed in serial numbers 439 and above. Figure 1.3.19 contains the two types of OID screens available, and table 1.3.12 describes the function of each field on the DCP UPS screen.

```
11:21:56 11/21/97 1621Z                                         ANYTOWN AIRPORT

 BATTERY VOLTAGE:              72

 INPUT VOLTAGE:               116

 OUTPUT VOLTAGE:              118           UPS INLINE:               P
                                            CMD UPS INLINE:           OFF
 OUTPUT ENABLED:               P
 ON AC LINE:                   P
 BATTERY STATUS:               P
 TRIAC STATUS:                 P
 TEMPERATURE:                  P
 RS232 STATUS:                 P                      DCP#1 UPS#1

 TIMEOUT:                      P                  PRINT   CLEAR
                                                  TEST            BYPAS
                                                  EXIT    BACK
```

For SOLA UPS $

```
11:21:56 11/21/97 1621Z                                         ANYTOWN AIRPORT

 BATTERY VOLTAGE:              56           BATTERY MANAGEMENT:   FLOATING

 INPUT VOLTAGE:               120           LINE REGULATION:      NORMAL

 OUTPUT VOLTAGE:              119           UPS INLINE:           P
                                            CMD UPS INLINE:       OFF
 UPS OPERATION                 P
 ON AC LINE:                   P
 BATTERY STATUS:               P
 INVERTER:                     P
 GROUND STATUS:                P
 UTILITY:                      P                      DCP#1 UPS#1

 TIMEOUT:                      P                  PRINT   CLEAR
                                                  TEST
                                                  EXIT    BACK
```

For Deltec UPS $

Figure 1.3.19. DCP UPS Screen

Table 1.3.12. DCP UPS Screen Field Descriptions

Field	Description
$ **SOLA UPS**	
BATTERY VOLTAGE	Displays a numeric value indicating the present backup battery voltage.
INPUT VOLTAGE	Displays a numeric value indicating the present input line voltage to the UPS.
OUTPUT VOLTAGE	Displays a numeric value indicating the present ac output voltage from the UPS to the rest of the DCP.
OUTPUT ENABLED	Indicates that UPS output is on (P) or off (F).
ON AC LINE	Indicates whether the UPS is using facility (line) voltage (P) or generating ac voltage from battery (in inverter mode) (F).
BATTERY STATUS	Indicates present battery status in the DCP as a P (pass) or F (fail).
TRIAC STATUS	Indicates the present status of tap-changing TRIAC's on the UPS 1.5 Kva Inverter Board as a P (pass) or F (fail).
TEMPERATURE	Indicates the present temperature status of the UPS 1.5 Kva Inverter Board as a P (pass) or F (fail). If fail, inverter board is in overheat alarm and shuts off UPS.
RS232 STATUS	Indicates the present status of the UPS RS232 communications as a P (pass) or F (fail).
TIMEOUT	Indicates the present status of the UPS watchdog timer as a P (pass) or F (fail).
UPS INLINE	Displays P when UPS is inline or F when UPS is bypassed.
CMD UPS INLINE	Bypasses UPS when set to OFF or places UPS inline when set to ON.
$ **Deltec UPS**	
BATTERY VOLTAGE	Displays a numeric value indicating the present backup battery voltage.
INPUT VOLTAGE	Displays a numeric value indicating the present input line voltage to the UPS.
OUTPUT VOLTAGE	Displays a numeric value indicating the present ac output voltage from the UPS to the rest of the DCP.
UPS OPERATION	Indicates that UPS is functioning in a normal (P) or abnormal (F) manner. Normal indicates that utility is OK, battery is OK, and UPS is operating from facility ac power. Abnormal indicates failure of any of the above conditions.
ON AC LINE	Indicates whether the UPS is using facility (line) voltage (P) or generating ac voltage from the battery (in inverter mode) (F).
BATTERY STATUS	Indicates present battery status in the DCP as a P (pass) or F (fail).
INVERTER	Indicates whether the internal inverter is operating in overvoltage or undervoltage status. P indicates voltage within range, and F indicates voltage outside range.
GROUND STATUS	F indicates a ground failure in facility wiring.
UTILITY	Checks for an overvoltage or unsynchronized signal from facility power.
TIMEOUT	Indicates the present status of the UPS watchdog timer as a P (pass) or F (fail).
BATTERY MANAGEMENT	Indicates if the current from the batteries is FLOATING, RESTING, CHARGING, or DISCHARGING. FLOATING indicates trickle charge, RESTING indicates no charge to or discharge from battery, CHARGING indicates that UPS is charging battery, and DISCHARGING indicates that battery is discharging.
LINE REGULATION	Indicates if the UPS is maintaining a STEP-UP, STEP DOWN, or NORMAL status.
UPS INLINE	Displays P when UPS is inline or F when UPS is bypassed.
CMD UPS INLINE	Bypasses UPS when set to OFF or places UPS inline when set to ON.

1.3.4.23 **Ceilometer and Ceilometer Sensor Dialogue Screens**. The ceilometer screen (Figure 1.3.20) and the ceilometer sensor dialogue screen (Figure 1.3.21) pertain to the DCP when a ceilometer is configured to the DCP and to the ACU when a ceilometer is configured as a local sensor. The ceilometer screen displays the current operating status of the selected ceilometer (cloud height sensor) and provides the means for direct communication (direct dialogue mode) with the sensor. The ASOS polls the ceilometer for status reports every 30 seconds. The reports comprise cloud height, sensor diagnostics, and operating mode indicators. The diagnostic and operating mode indicators are displayed along the left side of the screen. Table 1.3.13 describes the function of each field. Direct dialogue mode allows the technician to monitor and change ceilometer parameters and obtain in-depth status and operating information regarding the sensor. The direct mode also allows the technician to perform sensor troubleshooting procedures and specify sensor operating parameters. Pressing the DIALG key displays the ceilometer sensor dialogue screen. In direct dialogue mode keyboard entries (ceilometer commands) are displayed in the ENTER COMMAND: field of the screen. When the technician presses the enter key, the ceilometer CPU receives the ceilometer commands. Power to the ceilometer can be toggled on or off by pressing the POWER key. The POWER CONTROL field indicates the state of sensor power (ON/OFF) and POWER STATUS indicates the status of the power as a P (pass) or F (fail) condition. Chapter 9, Section III provides detailed information on available ceilometer commands and ceilometer output message interpretation.

```
11:21:56 11/21/97 1621Z                                       ANYTOWN AIRPORT

  HDW                       P                 DATA QUALITY            P
  SUP. VOL.                 P                 REPORT PROCESS          Y
  LASER PWR                 P                 SENSOR RESPONSE         P
  TEMP                      P
  SLR SHTTR            0                      POWER STATUS            P
  BLOWER               1                      POWER CONTROL          ON
  HTR                  1
  PUL FREQ             6
  GAIN                 2

                                                           CEILOMETER #1
                                                    | PRINT | CLEAR | DIALG |   $
                                                    | TEST  |       | POWER |
                                                    | EXIT  | BACK  |       |
```

Figure 1.3.20. Ceilometer Screen

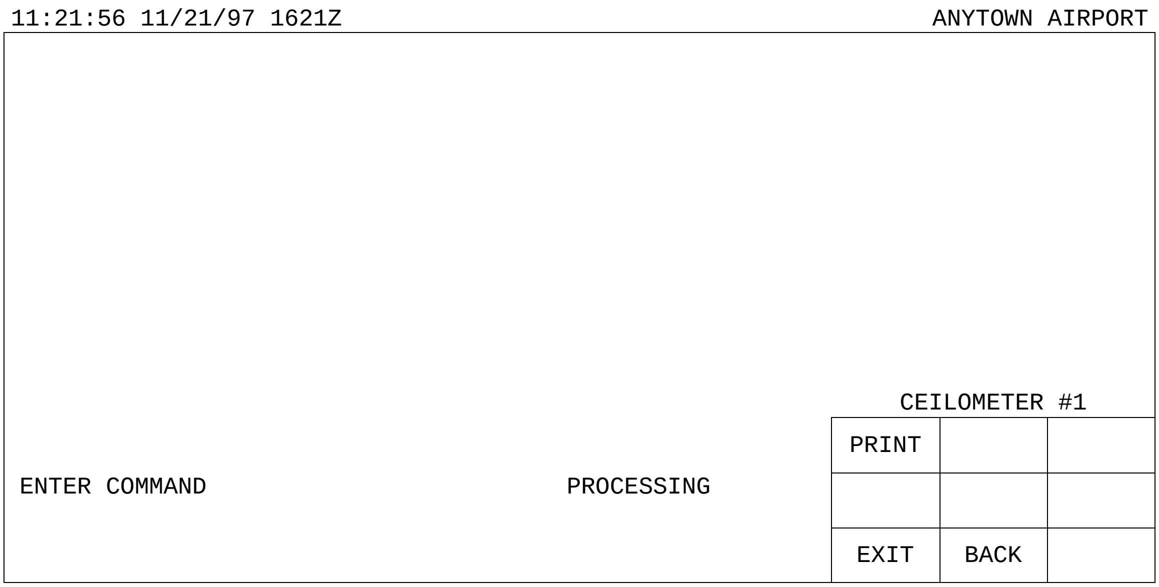

Figure 1.3.21. Ceilometer Sensor Dialogue Screen

Table 1.3.13. Ceilometer Screen Field Descriptions

Field	Description
HARDWARE	Indicates status of general hardware alarm bit sent by ceilometer. If ceilometer detects a malfunction in its operation, this field is set to F to indicate that maintenance of the sensor is required.
SUP. VOL.	Indicates status of the supply voltage alarm bit sent by ceilometer. This field is set to F when ceilometer diagnostic detects a failure of any power supply reference in the sensor.
LASER PWR	Indicates status of laser power low alarm bit sent by ceilometer. This field is set to F when ceilometer diagnostic detects that transmitted laser power level is below its normal level.
TEMP	Indicates status of temperature alarm bit sent by ceilometer. This field is set to F when ceilometer detects a failure in heating system of the sensor.
SLR SHTTR	Indicates the present status of the ceilometer's optional solar shutter (0 = off, 1 = on).
BLOWER	Indicates present status of ceilometer's window conditioner blower (0 = off, 1 = on).
HTR	Indicates present status of ceilometer's window conditioner heater (0 = off, 1 = on).
PUL FREQ	Indicates the present transmitter pulse repetition frequency as follows: 0 = 620 Hz 4 = 830 Hz 1 = 660 Hz 5 = 910 Hz 2 = 710 Hz 6 = 1000 Hz 3 = 770 Hz 7 = 1120 Hz
GAIN	Indicates the present gain of the receiver amplifier as follows: 0 = 250 (low) 2 = 930 (high)

1.3.4.24 **Freezing Rain Screen**. The freezing rain screen (Figure 1.3.22) pertains to the DCP when a freezing rain sensor is configured to the DCP and to the ACU when such a sensor is configured as a local sensor. The freezing rain screen displays the current operational status of the freezing rain sensor. The screen displays the present status of the data quality checks, report process, and sensor status functions. In addition, power to the sensor can be turned on and off using the POWER key. The POWER CONTROL field on the screen indicates the state of sensor power (ON/OFF) and the POWER STATUS field indicates the status of sensor power as a P (pass) or F (fail) condition.

```
11:21:56 11/21/97 1621Z                                   ANYTOWN AIRPORT

PROBE STATUS         P                  DATA QUALITY      P          $
HEATER STATUS        P                  REPORT PROCESS    Y
ELECTRONICS STATUS   P                  SENSOR RESPONSE   P          $

                                        POWER STATUS      P          $
                                        POWER CONTROL    ON          $

                                                   FREEZING RAIN
                                              | PRINT | CLEAR |       |  $
                                              | TEST  |       | POWER |  $
                                              | EXIT  | BACK  |       |
```

Figure 1.3.22. Freezing Rain Screen

1.3.4.25 **Present Weather Sensor Screen**. The present weather sensor screen (Figure 1.3.23) pertains to the DCP when a present weather sensor is configured to the DCP and to the ACU when such a sensor is configured as a local sensor. This screen displays the current operational and self-test data being received from the sensor. The field of most importance to the technician is the ERROR STATUS CODE field, which indicates, via a four-digit code, the status of FRU's in the sensor. A status code of 0000 indicates that all FRU's are currently passing the present weather internal self-test. A value other than 0000 indicates a failure of one or more FRU's. Definitions for all possible codes are provided in table 1.3.14 along with definitions of all the other fields on the screen. The POWER key enables the technician to turn sensor power on/off. POWER CONTROL indicates the state of sensor power as ON or OFF. POWER STATUS indicates the status of sensor power as a P (pass) or F (fail).

```
11:21:56 11/21/97 1621Z                                   ANYTOWN AIRPORT

 ERROR STATUS CODE          0000 P          DATA QUALITY       P
 SIMULATED EVENT              NP P          REPORT PROCESS     Y
 SIMULATED AMOUNT           1234 P          SENSOR RESPONSE    P
 SIMULATED DATA CKSUM         90 P
 CARRIER AVERAGE RAW DATA    450            POWER STATUS       P      $
 CHANNEL LOCK ON/OFF         111            POWER CONTROL     ON
 LOW AVERAGE RAW DATA        -40                                      $
 LOW CHANNEL BASELINE        -10                                      $
 PEAK AVERAGE RAW DATA       076
 PARTICLE BASELINE           084                                      $
 HIGH AVERAGE RAW DATA       091                                      $
 HIGH CHANNEL BASELINE       090                                      $
 DIAG DATA CKSUM              BA P                  PRESENT WEATHER
                                              | PRINT | CLEAR |       |  $
                                              | TEST  |       | POWER |
                                              | EXIT  | BACK  |       |
```

Figure 1.3.23. Present Weather Sensor Screen

Table 1.3.14. Present Weather Sensor Screen Field Descriptions

Field	Description
ERROR STATUS CODE	Displays the current status of the FRU's in the sensor. The definition of each code is provided below: **NOTE** The present weather sensor will attempt to reset itself whenever it detects a failure. During this reset process, the ERROR STATUS CODE field displays the code 80 along with the detected error. For example, the code 0280 identifies the failure as heater power supply (ASOS Designator A1PS1) and indicates that the sensor is attempting to reset itself. Code — Definition 0000 All FRU's are functioning properly. 0080 Present weather sensor system reset is in process. This is only a status field that informs the technician when the sensor is performing an automatic reset. Upon completion of this process, the 8 changes back to a 0. 0100 Frame Assembly malfunction 0200 Heater Power Supply (24V) malfunction 0300 Heater Power Supply (24V) and Frame Assembly 0400 Signal Processor #2 Card (SP2) 0500 Signal Processor #2 Card (SP2) and Frame Assembly 0600 Signal Processor #2 Card (SP2) and Heater Power Supply (24V) 0700 Heater Power Supply (24V), Frame Assembly, and Signal Processor #2 Card (SP2) 0800 Signal Processor #1 Card (SP1) 0900 Frame Assembly and Signal Processor #1 Card (SP1) 0A00 Signal Processor #1 Card (SP1) and Heater Power Supply (24V) 0B00 Signal Processor #1 Card (SP1), Heater Power Supply (24V), and Frame Assembly 0C00 Signal Processor #1 Card (SP1) and Signal Processor #2 Card (SP2) 0D00 Signal Processor #1 Card (SP1), Signal Processor #2 Card (SP2), and Frame 0E00 Signal Processor #1 Card (SP1), Signal Processor #2 Card (SP2), and Heater Power Supply (24V) 0F00 Signal Processor #1 Card (SP1), Signal Processor #2 Card (SP2), Frame, and Heater Power Supply (24V) 1000 Receiver AGC Card (AGC) 2000 Transmitter Card (TX) 3000 Receiver AGC Card (AGC) Transmitter Card (TX) 4000 Analog Power Supply (15V) 5000 Receiver AGC Card (AGC) Analog Power Supply (15V) 6000 Transmitter Card (TX) Analog Power Supply (15V) 7000 Receiver AGC Card (AGC) Transmitter Card (TX) Analog Power Supply (15V) 8000 Transmitter/Digital Power Supply (5V) and Microprocessor Card (MPU) 9000 Receiver AGC Card (AGC) Transmitter/Digital Power Supply (5V) and Microprocessor Card (MPU) A000 Transmitter Card (TX) Transmitter/Digital Power Supply (5V) and Microprocessor Card (MPU)

Table 1.3.14. Present Weather Sensor Screen Field Descriptions -CONT

Field	Description
ERROR STATUS CODE (CONT)	Code — Definition B000 Receiver AGC Card (AGC) Transmitter Card (TX) Transmitter/Digital Power Supply (5V) and Microprocessor Card (MPU) C000 Analog Power Supply (15V) Transmitter/Digital Power Supply (5V) and Microprocessor Card (MPU) D000 Receiver AGC Card (AGC) Analog Power Supply (15V) Transmitter/Digital Power Supply (5V) and Microprocessor Card (MPU) E000 Transmitter Card (TX) Analog Power Supply (15V) Transmitter/Digital Power Supply (5V) and Microprocessor Card (MPU) F000 Receiver AGC Card (AGC) Transmitter Card (TX) Analog Power Supply (15V) Transmitter/Digital Power Supply (5V) and Microprocessor Card (MPU)
SIMULATED EVENT	Displays the results of simulated events test. The simulated events test consists of the sensor sending a preset event back during diagnostic testing. This event is checked against the correct value stored in the diagnostic test program.
SIMULATED AMOUNT	Displays the results of the simulated amounts test. The simulated amounts test consists of the sensor sending a preset event back to the ACU during diagnostic testing. This event is checked against the correct value stored in the diagnostic test program.
SIMULATED DATA CKSUM	Displays the results of the checksum error test. This test sums the ASCII bytes of data being received from the sensor and compares this value to a checksum value received directly from the sensor. If the two values do not match, the system assumes that a communications error has occurred and indicates a fail status in the CKSUM field.
CARRIER AVERAGE RAW DATA	Displays the corresponding 1-minute averaged raw data in tens of millivolts being received from signal processor #1. These data are used to monitor signal strength and accidental blockage or source failure.
DIAG DATA CKSUM	Displays the results of the checksum error test. This test sums the ASCII bytes of data being received from the sensor and compares this value to a checksum value received directly from the sensor. If the two values do not match, the system assumes that a communications error has occurred and indicates a fail status in the DIAG DATA CKSUM field.

1.3.4.26 **Wind Speed and Direction Sensor Screen**. The wind speed and direction sensor screen (Figure 1.3.24) pertains to the DCP when a wind sensor is configured to the DCP and to the ACU when a wind sensor is configured as a local sensor. This screen displays the current self-test data received from the wind sensor. The diagnostic program performs two levels of testing on the wind sensor. The first level is used during the normal on-line diagnostic and provides the diagnostic program with the overall status of the sensor, simulated wind direction and speed, and a data transmission checksum value. The data are evaluated by the diagnostic program to determine if a fault exists in the wind sensor. If so, the diagnostic program automatically executes the second level test, which provides detailed self-test data on all circuitry in the wind sensor. A technician performing an on-demand diagnostic can also execute the second level test by pressing the TEST key with the wind speed and direction sensor screen displayed on the OID. The data from both the first and second level tests are displayed on the screen. The specific data received during these tests and a description of each of the fields on the wind speed and direction sensor screen are provided in table 1.3.15. When the on-demand test is exercised, the sensor cannot be brought back on line immediately.

```
11:21:56 11/21/97 1621Z                                         ANYTOWN AIRPORT

  SENSOR STATUS                  P          POWER SUPPLY GROUND   +0.0
  SIM WIND DIRECTION         123 P          POWER SUPPLY +5.0 V   +5.0
  SIM WIND SPEED             045 P          ENCLOSURE TEMP        +003C
  SIM DATA CKSUM              1C P          EXTERNAL TEMP         +000C
  WIND SPEED UNITS             K            DIAG DATA CHECK     P
  SPEED ERROR                    P
  DIRECTION ERROR                P          DATA QUALITY        P
  VOLTAGE ERROR                  P          REPORT PROCESS      Y
  SPEED SENSOR MISSING           P          SENSOR RESPONSE     P
  DIR SENSOR MISSING             P
  TEMPERATURE ERROR              P          POWER STATUS        P
  FATAL ERROR                    P          POWER CONTROL      ON
  RAM CHECK                      P                      WIND LIGHT WEIGHT
  ROM CHECK                      P                      | PRINT | CLEAR |       |
                                                        | TEST  |       | POWER |
                                                        | EXIT  | BACK  |       |
```

Figure 1.3.24. Wind Speed and Direction Sensor Screen

Table 1.3.15. Wind Speed and Direction Sensor Screen Field Descriptions

Field	Description
SENSOR STATUS	Indicates the overall operational status of the wind sensor. Received during both first and second levels of testing.
SIM WIND DIRECTION	Displays the results of the simulated wind direction test. This test is performed by having the wind sensor control processor send the value 123 instead of the actual wind direction data. Received during both first and second levels of testing.
SIM WIND SPEED	Displays the results of the simulated wind speed test. This test is performed by having the wind sensor control processor send the value 045 instead of the actual wind speed data. Received during both first and second levels of testing.
SIM DATA CKSUM	Displays the results of the checksum test. This test sums the values received for sensor ID, sensor status, and wind direction and speed and compares the value to a checksum value received from the wind sensor. Failure of this test indicates a transmission error between the sensor and the DCP. Received during second level testing.
WIND SPEED UNITS	The units field displays current units for wind speed as follows: K = Knots M = MPH m = Meters/second R = Revs/minute P = Pulses/second
SPEED ERROR	This field contains the speed error flag. If this parameter checks good, a P (pass) is indicated in the status field. If this parameter checks bad, an F (fail) is indicated in the field.
DIRECTION ERROR	This field contains the direction error flag. If this parameter checks good, a P (pass) is indicated in the status field. If this parameter checks bad, an F (fail) is indicated in the field.
VOLTAGE ERROR	Displays the operational status of the wind sensor's power supply. Indicates a pass or fail status.
SPEED SENSOR MISSING	This field contains the speed head missing flag. If this parameter checks good, a P (pass) is indicated in the status field. If this parameter checks bad, an F (fail) and the associated fail count are indicated in the status field.

Table 1.3.15. Wind Speed and Direction Sensor Screen Field Descriptions -CONT

Field	Description
SPEED SENSOR MISSING	This field contains the speed head missing flag. If this parameter checks good, a P (pass) is indicated in the status field. If this parameter checks bad, an F (fail) and the associated fail count are indicated in the status field.
DIR SENSOR MISSING	This field contains the direction head missing flag. If this parameter checks good, a P (pass) is indicated in the status field. If this parameter checks bad, an F (fail) and the associated fail count are indicated in the status field.
TEMPERATURE ERROR	This field contains the internal temperature (too hot, too cold) failure flag.
FATAL ERROR	Displays the results of an internal test performed on the wind sensor's processor. A fail status in this field indicates the failure of the wind sensor's processor. Received during second level testing.
RAM CHECK	Displays the results of the wind sensor's internal RAM test. During this test, the wind sensor's internal processor checks its internal RAM by writing data to it and then reading the data back. Received during second level testing.
ROM CHECK	Displays the results of the wind sensor's internal ROM test. During this test, the wind sensor's internal processor performs a checksum type test on its internal ROM. Received during second level testing.
POWER SUPPLY GROUND	Displays the results of the power supply ground test. This test measures the potential difference between the ground terminal at the +5V power supply and the ground terminal at the processor circuit board located in the wind direction assembly. The test detects poor ground within the sensor. This condition may be the result of loose wires or corrosion. Received during second level testing.
POWER SUPPLY +5.0 V	Displays the results of wind sensor's +5V power supply test. Total failure of the +5V power supply results in a loss of all wind sensor data. Received during second level testing.
ENCLOSURE TEMP	This field displays the enclosure temperature in degrees Fahrenheit. The allowable range is 32 to 122 degrees F.
EXTERNAL TEMP	For ASOS, always displays "000C" (not used).
DIAG DATA CHECK	Displays the results of the level 1 checksum test. This test sums the values received for sensor ID, sensor status, and wind direction and speed and compares the value to a checksum value received from the wind sensor. Failure of this test indicates a transmission error between the sensor and the DCP.

1.3.4.27 **Temperature/Dewpoint (Model 1088) Screen**. The temperature/dewpoint (model 1088) screen (Figure 1.3.25) pertains to the DCP when a model 1088 sensor is configured to the DCP and to the ACU when a model 1088 sensor is configured as a local sensor. This screen displays the current status of each of the model 1088 diagnostic tests. The screen also displays the present status of the data quality checks, operating status, and sensor status functions. The screen allows the technician to perform on-demand diagnostic testing of the model 1088 temperature/dewpoint sensor. Pressing the TEST key causes the sensor's internal extended diagnostics to be executed within the sensor. The internal extended diagnostic issues a T2 command that is received by the sensor's calibrator assembly. In response, the calibrator assembly substitutes known precision resistors in paths normally occupied by the temperature sensing elements. This simulates ambient temperatures of 32 and 122 degrees Fahrenheit, and these calibration values are displayed with decimal accuracy on the screen in respective SIMULATED TEMP DATA and SIMULATED DEWPOINT DATA fields. As shown on figure 1.3.25, these values correlate to the P (pass) condition, which is displayed in the adjacent field. When this diagnostic capability is exercised, the sensor cannot be brought back on line immediately. Pressing the POWER key turns sensor power on and off. The status of POWER CONTROL indicates if sensor power is turned on (ON/OFF). POWER STATUS indicates the status of the sensor power as a P (pass) or F (fail) condition. table 1.3.16 describes each field on the temperature/dewpoint (model 1088) screen.

```
11:21:56 11/21/97 1621Z                                              ANYTOWN AIRPORT

  SIMULATED TEMP DATA   0 DEG C        32.00 P      TEMP QUALITY          P
  SIMULATED TEMP DATA  50 DEG C       122.00 P      DEW QUALITY           P
  SIMULATED DEWPOINT DATA   0 DEG C    32.00 P      REPORT PROCESS        Y
  SIMULATED DEWPOINT DATA  50 DEG C   122.00 P      SENSOR RESPONSE       P
  ASPIRATOR FAN                              P
   0 DEGREE C CALIBRATION                    P      POWER STATUS         P
  50 DEGREE C CALIBRATION                    P      POWER CONTROL       ON
  REALTIME DIAGNOSTICS                       P

  MIRROR SERVO                               P
  CRITICAL VOLTAGE                           P
  DIRTY MIRROR                               P
  SIMULATED DATA ERROR                       P                 1088
                                                        PRINT   CLEAR
                                                        TEST             POWER
                                                        EXIT    BACK
```

Figure 1.3.25. Temperature/Dewpoint (Model 1088) Screen

Table 1.3.16. Temperature/Dewpoint (Model 1088) Screen Field Descriptions

Field	Description
SIMULATED TEMPERATURE DATA - 0 DEG C	Displays results of the simulated 0 degrees C temperature test. This test is performed by switching a precision 100-ohm resistor into the measurement path of the model 1088 in place of the temperature sensor. The value of the resistor is such that the model 1088 should return a reading of 0 degrees C if measurement circuitry is functioning properly.
SIMULATED TEMPERATURE DATA - 50 DEG C	Displays results of the simulated 50 degrees C temperature test. This test is performed by switching a precision 120-ohm resistor into the measurement path of the model 1088 in place of the temperature sensor. The value of the resistor is such that the model 1088 should return a reading of 50 degrees C if measurement circuitry is functioning properly.
SIMULATED DEWPOINT DATA - 0 DEG C	Displays results of the simulated 0 degrees C dewpoint test. This test is performed by switching a precision 100-ohm resistor into the measurement path of the model 1088 in place of the dewpoint sensor. The value of the resistor is such that the model 1088 should return a reading of 0 degrees C if measurement circuitry is functioning properly.
SIMULATED DEWPOINT DATA - 50 DEG C	Displays results of the simulated 50 degrees C dewpoint test. This test is performed by switching a precision 120-ohm resistor into the measurement path of the model 1088 in place of the dewpoint sensor. The value of the resistor is such that the model 1088 should return a reading of 50 degrees C if measurement circuitry is functioning properly.
ASPIRATOR FAN	Displays results of the aspirator fan motion test. The test ensures that the aspirator fan is running by checking for airflow through the aspirator. The test monitors the value of two thermal resistors; one in the airflow path and the other out of the airflow path. The cooling effects of the moving air lowers the resistance of the thermal resistor located in the airflow path. If the two resistive values become equal, the system detects this condition as a loss of airflow, indicating a fan failure.
0 DEG C CALIBRATION	Indicates results of the model 1088 internal 0 degrees C calibration check. The simulated temperature and temperature dewpoint resistors are used as the calibration references for this test.

Table 1.3.16. Temperature/Dewpoint (Model 1088) Screen Field Descriptions -CONT

Field	Description
50 DEG C CALIBRATION	Indicates the results of the model 1088 internal 50 degrees C calibration check. The simulated temperature and temperature dewpoint resistors are used as the calibration references for this test.
REALTIME DIAGNOSTICS	Indicates by the presence of a T in the status field when the system is performing a real-time diagnostic (system diagnostic) or the model 1088 is performing an autobalance cycle.
MIRROR SERVO	Indicates the status of the mirror servo control circuitry and the current position of the test/operate mode switch in the model 1088. If the mode switch is in the test position, the MIRROR SERVO field indicates a fail status.
CRITICAL VOLTAGE	Indicates that one of the power supplies in the model 1088 is out of tolerance.
DIRTY MIRROR	Indicates the status of the dewpoint mirror in the aspirator. The test monitors the position of the autobalance dial. If the dial indicates a reading between 450 and 500, the DIRTY MIRROR field indicates a fail status.
SIMULATED DATA ERROR	Indicates a summary status of the simulated 0 and 50 degrees C temperature and dewpoint status tests.

1.3.4.28 **Temperature/Dewpoint (Model H083) Screen**. The temperature/dewpoint (model H083) screen (Figure 1.3.26) pertains to the DCP when a model H083 sensor is configured to the DCP and to the ACU when a model H083 sensor is configured as a local sensor. This screen displays the current operational status of the model H083 temperature/dewpoint sensor. The model H083 sensor has limited self-test capability and supplies only one maintenance related field: THERMAL RUNAWAY. The THERMAL RUNAWAY field indicates the status of the dewpoint mirror control servo loop. If a fault occurs within this loop that allows the mirror temperature to rise above 65 degrees C, the sensor automatically issues a cooling command to the mirror assembly and reports this condition to the diagnostic program by setting the THERMAL RUNAWAY status bit to F. Pressing the POWER key turns sensor power on and off. The status of POWER CONTROL indicates if sensor power is turned on (ON/OFF). POWER STATUS indicates the status of the sensor power as a P (pass) or F (fail) condition.

```
11:21:56 11/21/97 1621Z                                        ANYTOWN AIRPORT

                                              TEMP QUALITY            P
                                              DEW QUALITY             P
 THERMAL RUNAWAY     P                        REPORT PROCESS          Y
                                              SENSOR RESPONSE         P

                                              POWER STATUS            P
                                              POWER CONTROL          ON

                                                               H083
                                                       | PRINT | CLEAR |       |
                                                       | TEST  |       | POWER |
                                                       | EXIT  | BACK  |       |
```

Figure 1.3.26. Temperature/Dewpoint (Model H083) Screen

1.3.4.29 **Visibility Sensor Screen**. The visibility sensor screen (Figure 1.3.27) pertains to the DCP when a visibility sensor is configured to the DCP and to the ACU when such a sensor is configured as a local sensor. This screen displays the current self-test data received from the visibility sensor. From these data, the diagnostic program determines the operational status of the sensor. If the diagnostic program detects a malfunction in the sensor, it invokes the detailed diagnostic on the sensor. The system initiates this diagnostic by issuing a command to the visibility sensor, which responds by displaying the data on the visibility sensor screen. These data provide the detailed test results of the key sensor circuits. As a result, the functional components of the system as well as the diagnostic circuitry are tested. The functions of each field on the visibility sensor screen are provided in table 1.3.17.

```
  11:21:56 11/21/97 1621Z                                         ANYTOWN AIRPORT
    SENSOR STATUS                  P         DAY/NIGHT ELEC HEATER        P
    SIMULATED EXT COEFF      12.34 P         ENCLOSURE ELEC HEATER        P
    SIMULATED PHOTO STATUS       D P         INSIDE AMBIENT TEMP     28.1 P
    SIMULATED DATA CKSUM        E2 P         CHECKSUM                  F9 P
    ADD CHECK                      P
    RAM CHECK                      P         VIS QUALITY                  P
    ROM CHECK                      P         PHOTO QUALITY                P
    EEPROM CHECK                   P         REPORT PROCESS               Y
    RECEIVER OP STATUS             P         SENSOR RESPONSE              P
    TRANSMITTER OP STATUS          P
    DAY/NIGHT OP STATUS            P         POWER STATUS                 P
$   HEATER THERMOSTAT       ON/OFF P         POWER CONTROL                ON
    RCVR HOOD HEATER               P
$   XMTR HOOD HEATER               P                          VISIBILITY #1
$   RCVR WINDOW HEATER             P                   | PRINT | CLEAR |       |
$   XMTR WINDOW HEATER             P
    DAY/NIGHT WINDOW HEATER        P                   | TEST  |       | POWER |
    RCVR ELEC HEATER               P
    XMTR ELEC HEATER               P                   | EXIT  | BACK  |       |
```

Figure 1.3.27. Visibility Sensor Screen

Table 1.3.17. Visibility and Day/Night Sensor Screen Field Descriptions

Field	Description
SENSOR STATUS	The status field contains a symbol indicating visibility sensor status. A P is displayed for pass and an F is displayed for fail.
SIMULATED EXT COEFF	The simulated extinction coefficient value is 12.34/km. If value on screen matches this value, a P (pass) is indicated in the status field. If value does not match this value, an F (fail) and the associated fail count are indicated in the status field.
SIMULATED PHOTO STATUS	The simulated photometer status is D indicating day. If the value on the screen matches this value, a P (pass) is indicated in the status field. If the value does not match this value, an F (fail) and the associated fail count are indicated in the status field.
SIMULATED DATA CKSUM	If the simulated checksum of this test matches the correct value, a P (pass) is indicated in the status field. If the value does not match this value, an F (fail) and the associated fail count are indicated in the status field.
ADD CHECK	In this test, the processor writes data values to RAM locations. To each location, the value that is written is equal to that location's address. After all locations are written to, the processor reads back data and compares the stored data to the address. A P (pass) in the status field indicates a match between the values written to and read from each address. An F (fail) and associated fail count in the status field indicate that the values read from one or more addresses did not match the values written to those addresses.
RAM CHECK	In the RAM test, the processor writes known values to selected addresses in RAM and then reads them back. An F (fail) and the associated fail count are reported in the status field if any of the values written to a given location in RAM are not the same when they are read back. A P (pass) is reported in the status field if all the values written to a given location in RAM are the same when they are read back.

Table 1.3.17. Visibility and Day/Night Sensor Screen Field Descriptions -CONT

Field	Description
ROM CHECK	In the ROM test, the processor reads each address in ROM and calculates the checksum. The last address in ROM contains the twos complement of the checksum of all other ROM locations. When this value is added into the checksum of the rest of the ROM, a result of zero should be obtained. A P (pass) in the status field indicates a healthy ROM. An F (fail) and the associated fail count in the status field indicate a failed ROM.
EEPROM CHECK	In the EEPROM test, the processor reads each address in EEPROM and calculates the checksum. The last address in EEPROM contains the twos complement of the checksum of all other EEPROM locations. When this value is added into the checksum of the rest of the EEPROM, a result of zero should be obtained. When a recalibration occurs, the values of the EEPROM are changed. The visibility sensor automatically writes the proper twos complement value into the last location of EEPROM. A P (pass) in the status field indicates that the EEPROM checksum is zero. An F (fail) and associated fail count in the status field indicate that the EEPROM checksum value is other than zero.
RECEIVER OP STATUS	The general operation of the receiver is continuously monitored as a part of taking visibility measurements. This field indicates the receiver status (P = pass, F = fail).
TRANSMITTER OP STATUS	The number of flashes is continuously monitored as a part of taking visibility measurements, and there should be two flashes per second. This field indicates the status of the transmitter (P = pass, F = fail).
DAY/NIGHT OP STATUS	This field indicates the status of the day/night sensor (P = pass, F = fail).
HEATER THERMOSTAT	This field indicates the status of the heater circuit (P = pass, F = fail).
RCVR HOOD HEATER	This field indicates the status of the receiver hood heater (P = pass, F = fail).
XMTR HOOD HEATER	This field indicates the status of the transmitter hood heater (P = pass, F = fail).
RCVR WINDOW HEATER	This field indicates the status of the receiver window heater (P = pass, F = fail).
XMTR WINDOW HEATER	This field indicates the status of the transmitter window heater (P = pass, F = fail).
DAY/NIGHT WINDOW HEATER	This field indicates the status of the day/night window heater (P = pass, F = fail).
RCVR ELEC HEATER	This field indicates the status of the receiver electronics heater (P = pass, F = fail).
XMTR ELEC HEATER	This field indicates the status of the transmitter electronics heater (P = pass, F = fail).
DAY/NIGHT ELEC HEATER	This field indicates the status of the day/night electronics heater (P = pass, F = fail).
ENCLOSURE ELEC HEATER	This field indicates the status of the electronics enclosure heater (P = pass, F = fail).
INSIDE AMBIENT TEMP	This test monitors the temperature, in degrees C, inside the controller enclosure. The allowable range is 20 to 70 degrees C. If the value on the screen is within this range, a P (pass) is indicated in the status field. If the value is not within range, an F (fail) and the associated fail count are indicated in the status field.
VIS QUALITY	This field indicates whether or not visibility data received from sensor is valid (logically correct) when compared to the standard specified in the data quality monitoring algorithm. A P (pass) (data quality meets the standard required by monitoring test algorithm) and an F (fail) and the associated fail count (data quality does not meet the standard required by monitoring test algorithm or sensor failed diagnostics) indicate pass/fail conditions.
PHOTO QUALITY	This field indicates whether or not photometer data received from the sensor is valid (logically correct) when compared to the standard specified in the data quality monitoring algorithm. A P (pass) (data quality meets the standard required by monitoring test algorithm) and an F (fail) and the associated fail count (data quality does not meet the standard required by monitoring test algorithm or sensor failed diagnostics) indicate pass/fail conditions.

1.3.4.30 **Tipping Bucket Sensor Screen**. The tipping bucket sensor screen (Figure 1.3.28) pertains to the DCP or ACU. The screen contains one sensor field that displays DATA QUALITY status as a P (pass) or F (fail). Data quality is reckoned during moderate or heavy rain in a 10-minute period. During this time, if at least one tip of the bucket occurs, a P status is indicated on the screen. If no tips occur during 10 minutes, an F status is displayed. An F status can be cleared only if a tip occurs or if a deconfiguration is followed by a reconfiguration. Deconfiguring the tipping bucket, however, may have an adverse effect on daily and monthly summary data. While the sensor is deconfigured, estimated values are placed in the summaries for a period of time. Eventually, missing will be reported on the summary screens.

```
11:21:56 11/21/97 1621Z                                 ANYTOWN AIRPORT

                                         DATA QUALITY           P

                                                TIPPING BUCKET
                                             | PRINT | CLEAR |       |
                                             |       |       |       |
                                             | EXIT  | BACK  |       |
```

Figure 1.3.28. Tipping Bucket Sensor Screen

1.3.4.31 **Frozen Precipitation Screen**. The frozen precipitation screen (Figure 1.3.29) pertains to the DCP when a frozen precipitation sensor is configured to the DCP and to the ACU when such a sensor is configured as a local sensor. Currently, there is no frozen precipitation sensor in the operational baseline (this screen is for future expansion). The frozen precipitation screen displays the current operational status of the frozen precipitation sensor. The screen displays the present status of the data quality checks, report process, and sensor status functions. In addition, power to the sensor can be turned on and off using the POWER key. The POWER CONTROL field on the screen indicates the state of sensor power (ON/OFF) and the POWER STATUS field indicates the status of sensor power as a P (pass) or F (fail) condition.

```
11:21:56 11/21/97 1621Z                                 ANYTOWN AIRPORT

                                       DEW QUALITY             P
                                       REPORT PROCESS          Y
                                       SENSOR RESPONSE         P

                                       POWER STATUS            P
                                       POWER CONTROL          ON

                                               FROZ PREC WATER
$                                            |       | CLEAR |       |
                                             | TEST  |       | POWER |
                                             | EXIT  | BACK  |       |
                  NOTE:  THIS SCREEN RESERVED FOR FUTURE EXPANSION.
```

Figure 1.3.29. Frozen Precipitation Screen

1.3.4.32 **Snow Depth Screen**. The snow depth screen (Figure 1.3.30) pertains to the DCP when a snow depth sensor is configured to the DCP and to the ACU when such a sensor is configured as a local sensor. Currently, there is no snow depth sensor in the operational baseline (this screen is for future expansion). The snow depth screen displays the current operational status of the snow depth sensor. The screen displays the present status of the data quality checks, report process, and sensor status functions. In addition, power to the sensor can be turned on and off using the POWER key. The POWER CONTROL field on the screen indicates the state of sensor power (ON/OFF) and the POWER STATUS field indicates the status of sensor power as a P (pass) or F (fail) condition.

```
11:21:56 11/21/97 1621Z                                  ANYTOWN AIRPORT

                                          DEW QUALITY            P
                                          REPORT PROCESS         Y
                                          SENSOR RESPONSE        P

                                          POWER STATUS           P
                                          POWER CONTROL         ON

                                                      SNOW DEPTH
                                                     | CLEAR |         $
                                               TEST  |       | POWER
                                               EXIT  | BACK  |
          NOTE:  THIS SCREEN RESERVED FOR FUTURE EXPANSION.
```

Figure 1.3.30. Snow Depth Screen

1.3.4.33 **Sunshine Screen**. The sunshine screen (Figure 1.3.31) pertains to the DCP when a sunshine sensor is configured to the DCP and to the ACU when such a sensor is configured as a local sensor. Currently, there is no sunshine sensor in the operational baseline (this screen is for future expansion). The sunshine screen displays the current operational status of the sunshine sensor. The screen displays the present status of the data quality checks, report process, and sensor status functions. In addition, power to the sensor can be turned on and off using the POWER key. The POWER CONTROL field on the screen indicates the state of sensor power (ON/OFF) and the POWER STATUS field indicates the status of sensor power as a P (pass) or F (fail) condition.

```
11:21:56 11/21/97 1621Z                                  ANYTOWN AIRPORT

                                          DEW QUALITY            P
                                          REPORT PROCESS         Y
                                          SENSOR RESPONSE        P

                                          POWER STATUS           P
                                          POWER CONTROL         ON

                                                       SUNSHINE
                                                     | CLEAR |         $
                                               TEST  |       | POWER
                                               EXIT  | BACK  |
          NOTE:  THIS SCREEN RESERVED FOR FUTURE EXPANSION.
```

Figure 1.3.31. Sunshine Screen

1.3.4.34 **<u>Thunderstorm Screen</u>**. The thunderstorm screen (Figure 1.3.32) pertains to the DCP when a thunderstorm sensor is configured to the DCP and to the ACU or SCA when such a sensor is configured as a local sensor. The thunderstorm screen displays the current operational status and self-test data being received from the sensor. Pressing the TEST key causes the sensor's internal diagnostics to be executed within the sensor. The screen displays the present status of the data quality checks, report process, and sensor status functions. In addition, power to the sensor can be turned on and off using the POWER key. The POWER CONTROL field on the screen indicates the state of sensor power (ON/OFF) and the POWER STATUS field indicates the status of sensor power as a P (pass) or F (fail) condition.

```
11:21:56 11/21/97 1621Z                                  ANYTOWN AIRPORT

SELFTEST                    C6    P             DATA QUALITY          P
INPUT VOLTAGE > 11 VOLT           P             REPORT PROCESS        Y
INPUT VOLTAGE < 13 VOLT           P             SENSOR RESPONSE       P
5 VOLT SUPPLY                     P
10 VOLT SUPPLY                    P             POWER STATUS          P
                                                POWER CONTROL        ON

                                                         THUNDERSTORM
                                                  PRINT   CLEAR
                                                  TEST            POWER
                                                  EXIT    BACK
```

Figure 1.3.32. Thunderstorm Screen

1.3.4.35 **<u>Pressure Sensor Screen</u>**. The pressure sensor screen (Figure 1.3.33) pertains to the DCP when pressure sensors are configured to the DCP and to the ACU or SCA when pressure sensors are configured as local sensors. This screen displays the current operational status of the pressure sensor. Either sensor #1, #2, or #3 can be called up by the technician. Data quality, report process, and sensor status functions are displayed on this screen.

```
11:21:56 11/21/97 1621Z                                  ANYTOWN AIRPORT

                                             DEW QUALITY             P
                                             REPORT PROCESS          Y
                                             SENSOR RESPONSE         P

                                                         PRESSURE #1
                                                  PRINT   CLEAR
                                                  TEST
                                                  EXIT    BACK
```

Figure 1.3.33. Pressure Sensor Screen

1.3.4.36 **<u>ACU/DCP Communications Status Screen</u>**. The ACU/DCP communications status screen (Figure 1.3.34) shows the test status of the communications link between the ACU and the DCP. The communications link can be either a radio link, using rf modems (radios) in the ACU and DCP, or may be hardwired, using line drivers. Depending on site configuration, either one or two radios/line drivers may be installed in both the ACU and the DCP. The first radio/line driver is referred to as radio/line driver A, and the optional second radio/line driver is referred to as radio/line driver B. Where radio links are used, omnidirectional antennas are usually used at the ACU and at each DCP. At certain sites where co-channel interference has been experienced, yagi antenna arrays replace the omnidirectional antennas. The yagi antenna is a seven-element array, PN 62828-90413-2, with 10 dB gain and 14 dB front:back ratio. The yagis are usually oriented for vertical polarization, but may be oriented horizontally to further isolate ACU-DCP links. Additionally, five watt attenuators of 3 dB, 6 dB, 10 dB, 20 dB, or 30dB (PN 62828-90424-2, -3, -4, -5 and -6 respectively) may be installed to reduce transmit power into the yagi antennas. Combinations of these attenuators reduce interference to an accepTable level.

```
11:21:56 07/04/96 1621Z                                 ANYTOWN AIRPORT
                  ACU       DCP #1      DCP #2      DCP #3
 RADIO A
  OR L/D A         P         P           P           P

 RADIO B
  OR L/D B         P         P           P           P


 PRIMARY LINK      A         A           A           A

 DEGRADED COMMS    P

 HARDFAIL COMMS    P
                                                   ACU/DCP COMM
                                           | PRINT | CLEAR |       |
                                           |       |       |       |
                                           | EXIT  | BACK  |       |
```

Figure 1.3.34. ACU/DCP Communications Status Screen

The ACU/DCP communications status screen shows the current test status for all radios/line drivers in the ACU and in DCP's 1, 2, and 3. The PRIMARY LINK field at the bottom of the screen identifies which radio/line driver in each cabinet is currently being used for data communication. The primary assignment does not change unless there is a failure in the primary device, in which case, the backup radio/line driver (if available) becomes the new primary device.

The system updates the status on the ACU/DCP communications status screen as the various links are tested during CST. One ACU/DCP link is tested each minute. As there is no TEST key associated with this screen, the technician cannot manually select to test the ACU/DCP communications links.

RF noise, maintenance actions, and line-of-sight obstructions can cause temporary interruptions, or glitches, in ACU/DCP communications. For this reason, the system software allows a certain amount of degradation in ACU/DCP communication before appending a $ to the observation as described in the following paragraphs.

When an ACU/DCP communications failure is detected, an F status indication is displayed in the appropriate field in the upper half of the screen and the associated fail count is incremented. This fail count does not cause a $ in the observation.

At 6 a.m. (local standard time) each day, the system evaluates the ACU/DCP communications failures that occurred over the last 24 hours. These failures are summarized on the trend screen and the fail counts on the ACU/DCP communications status screen are cleared. If the number of communications failures exceeds 20 percent, the status of the DEGRADED COMMS field on the ACU/DCP communications status screen is changed to C and a $ is added to the observation to indicate the need for maintenance action. The maintenance technician can clear the C status by pressing the CLEAR key.

The HARDFAIL COMMS field is used to indicate a complete failure in ACU/DCP communications. An F is placed in the appropriate field in the event that communications failures are detected continuously for a period of 1 minute. When this occurs, the corresponding fail count is incremented and a $ is added to the observation. The technician can clear these fail counts (and the $) by pressing the CLEAR key.

1.3.4.37 **<u>Trend Screen</u>**. The trend screen (Figure 1.3.35) supplies performance information on the ACU and DCP radios. At 6 a.m. local standard time each day, the fail counts from the ACU/DCP communications status screen (Figure 1.3.34) are transferred to the trend screen. This screen lists the number of all radio or line driver communications fail counts by date for the previous 31 days. Data are grouped into four clusters: two for each radio/line driver. Each cluster consists of three columns. The first column in each cluster provides the date of occurrence using the mm/dd format. The second column displays fail counts as indicated on the ACU/DCP communications status screen (Figure 1.3.34), and the third column displays a percentage value indicating the number of failed communication attempts compared to the number of tries.

```
 11:21:56 11/21/97 1621Z                                            ANYTOWN AIRPORT
  RADIO/LINE DRIVER A     ACU FAILCOUNTS / PERCENTAGES     RADIO/LINE DRIVER B
 00/00 00000 00000% 06/30 00000 100.0%    00/00 00000 00000%
 00/00 00000 00000% 07/01 00000 97.63%    00/00 00000 00000% 07/01 00000 44.22%
 00/00 00000 00000% 07/02 00001 85.28%    00/00 00000 00000% 07/02 00000 13.07%
 00/00 00000 00000% 07/03 00000 16.23%    00/00 00000 00000% 07/03 00000 0.000%
 00/00 00000 00000% 07/04 00000 21.01%    00/00 00000 00000% 07/04 00000 0.000%
 00/00 00000 00000% 07/05 00000 20.31%    00/00 00000 00000% 07/05 00000 0.000%
 00/00 00000 00000% 07/06 00000 20.70%    00/00 00000 00000% 07/06 00000 0.000%
 00/00 00000 00000% 07/07 00000 3.267%    00/00 00000 00000% 07/07 00000 0.013%
 00/00 00000 00000% 07/08 00000 3.102%    00/00 00000 00000% 07/08 00000 0.000%
 00/00 00000 00000% 07/09 00000 3.069%    00/00 00000 00000% 07/09 00000 0.000%
 00/00 00000 00000% 07/10 00000 2.953%    00/00 00000 00000% 07/10 00000 0.000%
 00/00 00000 00000% 07/11 00000 3.325%    00/00 00000 00000% 07/11 00000 0.000%
 00/00 00000 00000%                       00/00 00000 00000%        TREND
 00/00 00000 00000%                       00/00 00000 00000%  | PRINT | CLEAR |      |
 00/00 00000 00000%                       00/00 00000 00000%  |       |       |      |
                                                              | EXIT  | BACK  |      |
```

Figure 1.3.35. Trend Screen

1.3.4.38 **ADAS Summary Screen**. The ADAS summary screen (Figure 1.3.36) provides a record of communication status between ADAS and ASOS. This screen displays continuous hourly counts over a 24-hour period to indicate any of four status conditions that occur during each hour. These status conditions include the following : SP (ADAS has started polling ASOS), LP (ASOS has lost poll from ADAS), LNK (ADAS-ASOS link established), and DIS (ADAS has disconnected from ASOS).

```
11:21:57 11/21/97 1621Z                                         ANYTOWN AIRPORT
    HRBEG     SP    LP    LNK   DIS         HRBEG     SP    LP    LNK   DIS
    12:00     000   000   000   000         00:00     000   000   000   000
    13:00     000   000   000   000         01:00     000   000   000   000
    14:00     000   000   000   000         02:00     000   000   000   000
    15:00     000   000   000   000         03:00     001   000   001   000
    16:00     000   000   000   000         04:00     000   001   000   001
    17:00     000   000   000   000         05:00     000   000   000   000
    18:00     000   000   000   000         06:00     000   000   000   000
    19:00     000   000   000   000         07:00     000   000   000   000
    20:00     000   000   000   000         08:00     000   000   000   000
    21:00     000   000   000   000         09:00     000   000   000   000
    22:00     000   000   000   000         10:00     000   000   000   000
    23:00     000   000   000   000         11:00     000   000   000   000
                                                            ADAS SUMMARY
                                                          | PRINT |      |      |
                                                          |       |      |      |
                                                          | EXIT  | BACK |      |
```

Figure 1.3.36. ADAS Summary Screen

1.3.4.39 **Processor Status Screen**. The processor status screen (Figure 1.3.37) pertains to both the ACU and DCP. This screen enables the technician to observe the operational status of the ACU and DCP processors, reinitialize the ACU and DCP's processors, and generate selective error message reports. The technician has the option on the DCP's to perform either a hard or soft initialization. A hard initialization resets the DCP's CPU's, clears memory and downloads the system software to the DCP. A soft initialization resets the CPU's but does not clear memory.

NOTE

Exercising the RESET function in the ACU field initializes a system reset which forces the system into the power-up initialization sequence.

The START PRINT and END PRINT functions enable specific portions of the Maintenance Error Log to be printed. To print specific portions of the log, the cursor is placed at the START PRINT field. The desired error code number is entered to begin the report. The cursor is then placed at the END PRINT field and the desired error code number is entered to end the report. The designated portion of the log is then automatically printed on the printer. If a user error is detected when the START PRINT or END PRINT error code number is entered, the system generates an audio alarm (beep), displays an error message, and then exits the mode. The user must then reenter the START PRINT and END PRINT values. Possible errors include non-numeric characters and a start number greater than the end number.

```
11:21:56 11/21/97 1621Z                                      ANYTOWN AIRPORT

           ACU       RUNNING

            DCP #1    INITIALIZING
              HARD
              SOFT
$
           DCP #2    INITIALIZING
              HARD
              SOFT

           DCP #3    RUNNING                              PROCESSOR STATS
              HARD
              SOFT

     START PRINT       END PRINT
     ____              ____
```

PROCESSOR STATS

PRINT		PREV
RESET	CHANG	
EXIT	BACK	NEXT

Figure 1.3.37. Processor Status Screen

1.3.4.40 **Maintenance Action Screen**. The maintenance action screen (Figure 1.3.38) enables the technician to start the system maintenance log (START key) and to select four maintenance data entry screens from which he enters unit stock numbers, serial numbers, and field modification kit numbers. These entries are recorded in the system maintenance log (SYSLG) to correlate equipment identification with servicing tasks. Preventive maintenance (PREVT key), corrective maintenance (CORR key), calibration (CAL key), and field maintenance kit (FMK key) screens are selected from the maintenance ACTION keypad. An ABORT key returns the technician to the 1-minute screen and does not save entries on the screen.

```
11:21:56 11/21/97 1621Z                                      ANYTOWN AIRPORT
```

ACTION

PRINT	PREVT	CORR
CAL	FMK	ABORT
EXIT	BACK	START

$$$

Figure 1.3.38. Maintenance Action Screen

1.3.4.41 **<u>Preventive Maintenance Action Screen</u>**. The preventive maintenance action screen (Figure 1.3.39) is used by the technician to enter agency stock numbers (ASN's) and unit serial numbers into the system maintenance log when preventive maintenance is being applied to units within ASOS. ASN's for ASOS cabinets and FRU's are based on the assembly reference designator listed in the Parts List reference designator column (located after the last chapter). The reference designator is used in conjunction with the ASOS designator (S100) to determine the ASN as follows: S100-(reference designator). Examples of how this screen is used are illustrated by air filter cleaning in the ACU (paragraph 2.5.2.1) and check memory board LOW BATT indicator (paragraph 2.5.2.4). For the cleaning task, the Parts List (located after the last chapter) shows the reference designator of the ACU blower filter to be 1FL1. Therefore, the agency stock number for this part is S100-1FL1. This number is typed in the AGENCY STOCK NUMBER field. Similarly, agency stock number S100-1A2A3 is typed to specify the LOW BATT indicator on the ACU memory board. For the UNITS SERIAL NUMBERS field, numbers are acquired from visual inspection of the assemblies and typed in the field. The preventive maintenance action screen prompts the technician to verify if all entered data are correct. A Y entry stores these numbers in the system maintenance log and clears the screen for entry of numbers pertaining to the next unit used in preventive maintenance. Any additional data relevant to the task may be entered directly on the SYSLG screen (paragraph 1.3.13). The preventive maintenance action screen keypad is identical to the maintenance action screen keypad.

```
11:21:56 11/21/97 1621Z                                   ANYTOWN AIRPORT
                         PREVENTATIVE MAINTENANCE DATA

 AGENCY STOCK NUMBER:   S100-1

 UNIT SERIAL NUMBER:    1

 ALL ENTERED DATA CORRECT (Y/N)?:    N




                                                            ACTION
                                                   | PRINT | PREVT | CORR  |
                                                   | CAL   | FMK   | ABORT |
                                                   | EXIT  | BACK  | START |
```

Figure 1.3.39. Preventive Maintenance Action Screen

1.3.4.42 **<u>Corrective Maintenance Action Screen</u>**. The corrective maintenance action screen is identical in layout to the preventive maintenance action screen (Figure 1.3.39). This screen is used by the technician to enter agency stock numbers and unit serial numbers into the system maintenance log when ASOS assemblies and units are repaired or removed and replaced. Pertinent agency stock numbers are acquired by referencing the Parts List (located after the last chapter). Unit serial numbers are acquired from engraved or stenciled identification data. Using the OID keyboard, the technician enters number data in the same manner as described for the preventive maintenance action screen. If additional related data are to be entered, the technician may enter the data directly on the SYSLG screen (paragraph 1.3.13).

1.3.4.43 **Calibration Maintenance Action Screen**. The calibration maintenance action screen is identical in layout to the preventive maintenance action screen (Figure 1.3.39). This screen is used by the technician to enter agency stock numbers and unit serial numbers into the system maintenance log when ASOS assemblies and units are calibrated. Pertinent agency stock numbers are acquired by referencing the Parts $
List (located after the last chapter). Unit serial numbers are acquired from engraved or stenciled identification $
data. Using the OID keyboard, the technician enters number data in the same manner as described for the preventive maintenance action screen. If additional related data are to be entered, the technician may enter the data directly on the SYSLG screen (paragraph 1.3.13).

1.3.4.44 **Field Modification Kit Action Screen**. The field modification kit action screen (Figure 1.3.40) enables the technician to enter field modification kit numbers. When a field modification kit is installed in ASOS, its number is entered on this screen and stored in the system maintenance log. A Y entered in the ALL ENTERED DATA CORRECT (Y/N)? field stores the kit number and clears the screen. Any additional data related to the field modification kit number may be entered directly on the SYSLG screen (paragraph 1.3.13). The field modification kit action screen keypad is identical to the maintenance action screen keypad.

```
11:21:56 11/21/97 1621Z                               ANYTOWN AIRPORT
                    FIELD MODIFICATION KIT MAINTENANCE DATA

  FIELD MODIFICATION KIT NUMBER:









                                                   ACTION
                                          | PRINT | PREVT | CORR  |   $
                                          | CAL   | FMK   | ABORT |
                                          | EXIT  | BACK  | START |
```

Figure 1.3.40. Field Modification Kit Action Screen

1.3.5 **SYSTEM POWER ON PROCEDURES**

Chapters 2 and 3 provide procedures to power up the ACU peripherals and the DCP, respectively. When powering up an entire system, these procedures are used to power up the ACU and its associated DCP's. It does not matter which order the cabinets are powered up. After the ACU and DCP's are powered up, the system performs whatever initialization is necessary and automatically begins normal operation.

1.3.6 **SYSTEM SIGN-ON**

To sign on to the system as a maintenance technician, the procedure provided in table 1.3.18 is performed.

Table 1.3.18. System Sign-On Procedures

Step	Procedure
1	At OID, ensure that 1-minute screen is displayed; if not, press EXIT key.
2	Press SIGN key. The OID displays the message ENTER YOUR INITIALS.
3	Enter two or three alphabetic characters and press RETURN. The OID displays the message ENTER PASSWORD.
4	Enter your maintenance password and press RETURN. If the sign-on is successful, the system displays all other users currently on the system; otherwise, the system displays an error message and sounds an alarm. **NOTE** If an observer or ATC is presently signed on at any OID, neither the system manager nor the technician can make any changes to system configuration, site physical characteristics data, or passwords.
5	The listing of users signed on to the system is only displayed for a brief period of time and then removed by the system. Use the AUX-USERS subfunction to review the list again if desired.
6	If signed on as a technician, the MAINT key is displayed in the keypad area of the screen and can be used to access the technician interface screens.

1.3.7 **SYSTEM SIGNOFF**

To sign off the system, the procedure provided in table 1.3.19 is performed.

Table 1.3.19. System Signoff Procedures

Step	Procedure
1	At OID, ensure that 1-minute screen is displayed. If not, press EXIT key until the 1-minute screen is displayed.
2	Press SIGN key. The OID displays the message ENTER YOUR INITIALS.
3	Enter the two or three alphabetic characters used to sign on the system and press RETURN. The OID displays the message ENTER PASSWORD (or press RETURN to sign off).
4	Press RETURN. If signed on as a technician or supervisor, the MAINT field is removed from the OID keypad screen.

1.3.8 **RUNNING ASOS DIAGNOSTICS**

The ASOS diagnostics run continuously and repeat approximately every 7 minutes. Upon completion of a diagnostic test, the system automatically logs the results in the maintenance log. In addition to the continuously running diagnostic, the technician can run direct dialogue tests on certain sensors. Procedures for running the direct dialogue tests are provided in the respective sensor chapter. To run specific parts of the ASOS diagnostics, the procedures provided in table 1.3.20 are performed.

1.3.9 **MONITORING/CONTROLLING SENSOR POWER FROM THE OID**

Electrical power to each sensor can be remotely monitored and controlled from the individual sensor screens at the OID. Turning sensor power off suspends all communications between the sensor and the ACU. The system also logs a power off message in the maintenance log and displays an M in the sensor status field on the 1-minute screen. Sensor power should only be removed from the sensor at the DCP or at the actual sensor for maintenance or emergency situations. When power is removed from a sensor in either manner, a sensor power failure error is generated. To monitor sensor power status or to turn power on or off for a specific
$ sensor, the procedures provided in table 1.3.21 are performed. Power supplied to the local sensors cannot
$ be controlled via the sensor screens.

Table 1.3.20. Running ASOS Diagnostics

Step	Procedure
	NOTE If an observer or ATC is presently signed on at any OID, neither the system manager nor the technician can make any changes to system configuration, site physical characteristics data, or passwords.
1	Sign on the system as a technician using the procedure in table 1.3.18.
2	At OID, press MAINT key. The maintenance screen is displayed on the OID and indicates the present status of the system.
3	To run a specific portion of the diagnostic test, use the PREV/NEXT keys to move the cursor to the subassembly to be tested and press SEL key. The OID displays the appropriate status screen.
4	Using the PREV/NEXT keys, move the cursor to the item to be tested and press SEL key. The OID displays the item's status screen.
5	For units with built-in extended diagnostics (i.e., wind sensor, 1088 sensor, and ACU modems), the extended diagnostics are initiated immediately and the results are reported when the diagnostics are complete. For all other units, the T's remain on the screen until the unit is next tested during the CST, and the results of that test are then reported. Typically, this requires less than 1 minute but should take no longer than a full CST cycle (7 minutes). If the T's remain displayed longer, the unit is probably not responding to the CST checks. The technician should ensure that the unit is properly installed in the system and turned on. If any unit fails, or if the T's remain displayed even though the unit is installed and turned on, the technician should refer to the applicable Chapter for specific troubleshooting and removal and replacement procedures.
6	Upon repair of the fault, repeat steps 1 through 5.
7	To return to the next higher status screen, press BACK key.

Table 1.3.21. Monitoring/Controlling Sensor Power

Step	Procedure
	NOTE If an observer or ATC is presently signed on at any OID, neither the system manager nor the technician can make any changes to system configuration, site physical characteristics data, or passwords.
1	Sign on the system as a technician.
2	At OID, press MAINT key. The maintenance screen is displayed on the OID and indicates the present status of the system.
3	Using the PREV/NEXT keys, position the cursor on the selected DCP field and press SEL key. The OID displays the remote DCP screen.
4	Using the PREV/NEXT keys, position the cursor at the selected sensor field and press SEL key. The OID displays the desired sensor screen.
5	Press the POWER key on the keypad to toggle the sensor power on/off. The POWER CONTROL field on the screen indicates the status of sensor power as on or off.
6	To return to the remote DCP screen, press BACK key.

1.3.10 **RECONFIGURING THE SYSTEM**

Reconfiguration of the system requires both a hardware and software change. The technician can reconFigure the hardware system at any time. Usually, hardware reconfiguration may be required as a result of a system malfunction or a modification to the system. The hardware change consists of connecting the cables from the input/output (I/O) boards in the DCP('s) to the fiberoptic boards that communicate with the sensors. The hardware change must then be identified to the software system via the site configuration screen. The site configuration (SITE CONFG) screens are used to perform the software change portion of reconfiguration. The site configuration screens and their functions are described in paragraph 1.3.16. The system should be reconfigured when adding new sensors. In addition to reconfiguring sensor input/output channels, the technician may also identify the number of CPU's, UPS's, A/D's, I/O boards, modems, and video boards presently in the system and at which OID the handset is located. In the DCP, the only hardware items that cannot be reconfigured are the UPS's. For a system so equipped, UPS #1 is always connected to SIO #1 CHANNEL 1 and UPS #2 is always connected to SIO #3 CHANNEL 2.

1.3.10.1 **Configuring the OID**. The OID's must be properly configured to interface with the ASOS. The ASOS requires terminals which communicate using a VT220 style format. The OID is configured using the procedures provided in table 1.3.22. These procedures are provided specifically for the Link MC70 terminal. Additional information is contained in the terminal vendor manual located on-site.

Table 1.3.22. Configuring the OID Terminal

Step	Procedure
1	Apply power to the LINK MC$_{70}$ OID. **NOTE** Press the HELP key 2 times in succession to repaint the screen.
2	At the OID keyboard, press the F3 (SET-UP) key. The OID displays the terminal setup directory. **NOTE** The ENTER key referenced in this procedure is located in the auxiliary keypad area of the keyboard. DO NOT use the ENTER key located in main keypad area.
3	Using the cursor keys, move right to the SCREEN submenu.
4	Verify that the functions below are displayed: WIDTH CHANGE CLEAR ON SCREEN COLUMNS 80 SCREEN DATA LINES 24 PAGE COLUMNS 132 PAGE LINES 24/25 PAGE LINE MULTIPLIER 1 NUMBER OF PAGES 1 NUMBER OF SESSIONS 1 SESSION DISPLAY, SPLIT 1, FULL POWER-ON TAB STOPS OFF TAB STOPS
5	Using the cursor keys and ENTER key, select and toggle each field that does not contain the correct information.
6	Using the cursor keys, move right to the MODES submenu.

Table 1.3.22. Configuring the OID Terminal -CONT

Step	Description
7	Verify that the functions below are displayed. FEATURE LOCK OFF CONTROLS MODE INTEPRT RECEIVED CR CR RECEIVED LF LF TRANSMIT MODE 8-BIT TRANSFER/PRINT/SEND ANSWERBACK MESSAGE BELL SETTINGS PERSONALITY
8	Using the cursor keys and ENTER key, select and toggle each field that does not contain the correct information.
9	Using the cursor keys and ENTER key, select BELL SETTINGS.
10	BELL TONE AND BELL VOLUME are user preference and may be set accordingly. Press SHIFT UP-ARROW to return to the MODES submenu.
11	Using the cursor keys and ENTER key, select PERSONALITY.
12	Using the cursor keys and ENTER key, select VT320/VT220. If the entry is changed, an ARE YOU SURE? (Y/N)Y verification message is displayed. Press ENTER. The system returns to the MODES submenu.
13	Using the cursor keys, move right to the DISPLAY submenu.
14	Verify that the functions below are displayed: SCREEN SAVER OFF SCREEN SAVER MODE BLANK REVERSE SCREEN OFF SCROLL SPEED JUMP TOP STATUS LINE BLANK HOST MESSAGE OFF SCREEN RESOLUTION 16x16 DISPLAY FUNCTIONS CURSOR DISPLAY
15	Using the cursor keys and ENTER key, select and toggle each field that does not contain the correct information.
16	Using the cursor keys and ENTER key, select CURSOR DISPLAY.
17	BLINK and CURSOR COLOR are user preference and may be set accordingly. Press SHIFT UP-ARROW to return to the DISPLAY submenu.
18	Using the cursor keys, move right to the ATTRIBUTES submenu.
19	Verify that the functions below are displayed: SETUP MENU COLOR BLUE FOREGROUND COLOR WHITE BACKGROUND COLOR NORMAL COLORS BOLD COLORS DIM COLORS BORDER COLOR NORMAL ATTRIBUTES BOLD ATTRIBUTES DIM ATTRIBUTES

Table 1.3.22. Configuring the OID Terminal -CONT

Step	Description
20	Using the cursor keys and ENTER key, select and toggle each field that does not contain the correct information.
21	Using the cursor keys, move right to the PORT submenu.
22	Verify that the functions below are displayed: COMMUNICATIONS MODE FULL DPX ON-LINE/LOCAL ON-LINE TRACE BOTH PORT A SETTINGS PORT B SETTINGS COMMUNICATIONS CARTRIDGE SESSION RESOURCES
23	Using the cursor keys and ENTER key, select and toggle each field that does not contain the correct information.
24	Using the cursor keys and ENTER key, select PORT A SETTING.
25	Verify that the functions below are displayed: TRANSMIT BAUD RATE 9600 RECEIVE BAUD RATE RCV=XMIT DATA/STOP/PARITY BITS 8/1/NONE RECEIVE HANDSHAKE NONE TRANSMIT HANDSHAKE NONE TRANSMIT LIMIT NONE BREAK 250 MS INTERFACE RS-232C MODEM CONTROL ASCII DISCONNECT DELAY OFF
26	Press SHIFT UP-ARROW to return to the PORT submenu.
27	Using the cursor keys and ENTER key, select SESSION RESOURCES.
28	Verify that the functions below are displayed: PRTA PRTB BUF1 BUF2 SESSION 1 HOST AxPr ACTV SESSION 2 ACTV (BUF2)
29	Press SHIFT UP-ARROW to return to the PORT submenu.
30	Using the cursor keys, move right to the KEYBOARD submenu.
31	Verify that the functions below are displayed: KEY AUTOREPEAT OFF KEYCLICK MEDIUM KEYBOARD LANGUAGE US NATIONAL MODE OFF CHARACTER SET MULTNATL CORNER KEY OFF KEY DEFINITIONS LOCK OFF KEY FUNCTIONS KEY MODES USER-DEFINED KEYS
32	Using the cursor keys and ENTER key, select and toggle each field that does not contain the correct information.
33	Using the cursor keys, move right to the EXIT submenu.

Table 1.3.22. Configuring the OID Terminal -CONT

Step	Description
34	Verify that the functions below are displayed: EXIT SETUP EXIT SETUP AND CANCEL CHANGES EXIT SETUP AND SAVE RESTORE LAST SAVED DEFAULT ALL DEFAULT USER-DEFINED KEYS
35	Using cursor keys and ENTER key, select EXIT SETUP AND SAVE. An ARE YOU SURE? (Y/N)Y verification message is displayed. Select ENTER. The OID exits the setup procedure.

1.3.10.2 **Configuring the Remote Terminals**. The remote terminals provide qualified ASOS users with the capability to access the ASOS from off-site locations (described in paragraph 1.3.14). When configuring the remote terminal, the following parameter values are recommended:

a. 2400 baud (300 to 28.8k baud also available dependent upon modem installed) $

b. No parity

c. 8 data bits

d. 1 stop bit

e. Full duplex

1.3.10.3 **Deconfiguring and Reconfiguring Sensors to a Remote DCP**. Configuring a sensor to a remote DCP consists of assigning the sensor to an available SIO port on the DCP using the sensor configuration screen. Similarly, deconfiguring a sensor consists of removing an assigned port from the same screen. When a visibility sensor or ceilometer configuration is changed, the system requires the operator to access the sensor algorithm configuration screen (paragraph 1.3.16.3) and ensure that algorithm parameters (sensor location, priority, etc) are correct for the configured sensors. Whenever a sensor is configured to the system, the technician must ensure that is properly installed and that it is physically connected to the specified port. Table 1.3.23 provides a procedure for deconfiguring and reconfiguring a sensor to a remote DCP. Deconfiguring a sensor results in the loss of archive data and accumulated daily/monthly summary data. For this reason, the technician should not deconFigure any sensor unless permanently removing that sensor type or unless instructed by specific maintenance procedures. Sensor report processing is turned off while $
configuring the sensor. $

Table 1.3.23. Sensor DeconFigure and ReconFigure Procedure

Step	Procedure
SENSOR DECONFIGURATION	
CAUTION Deconfiguring sensor will result in loss of accumulated daily and monthly summary data. Do not deconFigure sensor unless that type of sensor is being removed from system permanently (unless instructed by other maintenance procedures).	
1	At OID, sign on to system as a technician.
2	Access sensor configuration screen (paragraph 1.3.16.2) by pressing REVUE-SITE-CONFIG-SENSOR keys.
3	On sensor configuration screen, press CHANG key. A cursor is displayed over the first SIO port. Message SYSTEM MODIFICATIONS flashes at top of screen.

Table 1.3.23. Sensor DeconFigure and ReconFigure Procedure -CONT

Step	Description
4	Using PREV and NEXT keys, move cursor to highlight code for sensor to be deconfigured.
5	To deconFigure sensor, enter two asterisks (**) in place of highlighted sensor code.
6	Press BACK key to cause system to accept new configuration. Message SYSTEM MODIFICATIONS is removed when system has accepted change.
7	If deconfigured sensor was visibility or ceilometer, press ALGOR key to display sensor-algorithm configuration screen (paragraph 1.3.16.3). Review to ensure that sky/visibility algorithm, primary assignments, priorities, etc, are correct per system manager specification.
8	Press EXIT key to return to 1-minute screen.
SENSOR RECONFIGURATION	
1	At OID, sign on to system as a technician.
2	Access sensor configuration screen (paragraph 1.3.16.2) by pressing REVUE-SITE-CONFIG-SENSOR keys.
3	**NOTE** If no SIO ports are available, a new SIO board must be added to the system and must be configured on the hardware configuration screen (paragraph 1.3.16.1). Select an available SIO port on which to conFigure sensor (available slots denoted by double asterisks (**)).
4	Ensure that sensor being configured is physically connected to the selected SIO port as follows: **NOTE** If fiberoptic module corresponding to selected SIO slot is not installed in the system, technician must install it in the DCP and then connect sensor to this module. a. Referring to port assignments for DCP SIO boards (Table 3.4.1), determine which fiberoptic module in DCP corresponds to SIO port selected for sensor. b. Physically connect sensor being configured to this fiberoptic module.
5	On sensor configuration screen, press CHANG key. A cursor is displayed over the first DCP SIO port. Message SYSTEM MODIFICATIONS flashes at top of screen.
6	Using PREV and NEXT keys, move cursor to highlight asterisks at SIO port selected for sensor.
7	To conFigure sensor, enter two-character code for sensor being configured. A list of allowable codes is provided in paragraph 1.3.16.2.
8	Press BACK to cause system to accept new configuration. Message SYSTEM MODIFICATIONS is displayed at top of OID until system has accepted change.
9	If configured sensor is visibility or ceilometer, press ALGOR key to display sensor-algorithm configuration screen (paragraph 1.3.16.3). Review to ensure that sky/visibility algorithm, primary assignments, priorities, etc, are correct per system manager specification.
10	Message SYSTEM MODIFICATIONS is removed when system has accepted change.
11	Press EXIT key to return to 1-minute screen.

1.3.11 DCP DOWNLOAD

DCP initialization or download can be initiated by the technician via the PROC screen. The technician may have to reinitialize the DCP after performing preventive or corrective maintenance or as an attempt to correct a data communication problem within the system (e.g., such as the loss of data from a sensor or DCP). System initialization is performed automatically when power is applied to the system. The DCP's are initialized by performing the procedures provided in table 1.3.24. For systems with multiple remote DCP's, performing a download to a system interrupts ACU communication with all others (until the download is complete).

Table 1.3.24. DCP Download Procedures

Step	Procedure
1	At OID 1-minute screen, sign on as a technician. The MAINT key is displayed in the keypad area of the OID.
2	Press MAINT key. The OID displays the maintenance screen.
3	Using PREV/NEXT keys, position the cursor over the PROC field and press SEL key. The OID displays the processor status screen.
4	Using PREV/NEXT keys, position the cursor over the selected DCP HARD field and press RESET key. The respective status field displays INITIALIZING while the unit is initializing. The progress of the download can be monitored by the PERCENT COMPLETE message displayed at the top of the screen. When the download is complete, the DCP status field changes to RUNNING.
5	Using EXIT key, return to 1-minute screen.

1.3.12 **REVIEWING/PRINTING THE SYSTEM MAINTENANCE LOG**

The system maintenance log contains maintenance data for the previous 31 days and the current day. A four-digit error code is associated with each message that appears in the system log. The ASOS Software Users Manual contains a complete listing by error code number of all system log error messages. Any ASOS operator can review and print the system maintenance log one screen at a time without being signed on the system. The entire log or portions of the log can be printed using the processor status (PROC) screen. Only operators signed on as technicians or managers can change or add entries to the maintenance log. To review/print the system maintenance log data from the system log screen, the procedure provided in table 1.3.25 is performed. To print the complete system maintenance log or selected portions of the log, the procedures provided in table 1.3.26 are performed using the processor status screen.

Table 1.3.25. Reviewing/Printing the System Maintenance Log From the System Log Screen

Step	Procedure
	NOTE A listing of the system log maintenance error codes is provided in the ASOS Software User's Manual, Section 4.
1	At 1-minute screen, press REVUE key. The OID displays the REVIEW keypad on the OID.
2	Press SYSLG key. The OID displays the system log screen.
3	Using PREV/NEXT keys, page through the maintenance data.
4	To view the maintenance data for a specific date, press DATE key. The system displays the ENTER DATE: MM/DD/YY prompt. Enter the desired date and press RETURN. The OID displays the maintenance log data starting at the date specified.
5	To search for maintenance codes, specific dates, or recent days, press FILTR key. The Review-SYSLOG-FILTR function prompts the user to enter a maintenance code, specific date, or recent day. After entering the desired filter values, press BACK key and if a match is found, that portion of the maintenance log is displayed. When selecting specific date(s) on the filter screen, month and year must be included (e.g., 03/01/91 and 03/05/91).
6	To print the maintenance log data displayed on the OID, press PRINT key. The maintenance log data displayed on the OID is printed on the printer.
	NOTE Maintenance log data can only be printed one OID screen at a time. Refer to table 1.3.26 to print larger portions.
7	Press EXIT key to return to 1-minute screen.

Table 1.3.26. Printing the System Maintenance Log

Step	Procedure
	NOTE A listing of the system log maintenance error codes is provided in the ASOS Software User's Manual, Section 4.
1	At OID 1-minute screen, sign on as a technician. The MAINT key is displayed in the keypad area of the OID.
2	Press MAINT key. The OID displays the maintenance screen.
3	Using PREV/NEXT keys, position the cursor over the PROC field and press SEL key. The OID displays the processor status screen.
4	Using PREV/NEXT keys, position the cursor over the START PRINT field and press CHANG key.
5	Enter the error number where the system maintenance log printout is to begin and press RETURN. The cursor moves to the END PRINT field. Enter the error number where the printout is to end and press RETURN. The requested system maintenance log data are printed on the printer.
6	Press EXIT key to return to 1-minute screen.

1.3.13 ENTERING DATA INTO THE SYSTEM MAINTENANCE LOG

Data entry to the system maintenance log can only be made by operators who are signed on to the system as technicians or system managers. The entry can be multiple lines and can be time tagged by using the DATE function before entering the maintenance comment. The technician should make entries into the system maintenance log whenever preventive or corrective actions are performed on the system; however, upon successful repair of an FRU, the diagnostic automatically logs that the FRU has been repaired. Log entries should clearly define the maintenance action performed. Data are entered into the system maintenance log using the procedures provided in table 1.3.27.

Table 1.3.27. Making System Maintenance Log Entries

Step	Procedure
1	At 1-minute screen, sign on as a technician or system manager.
2	At 1-minute screen, press REVUE key. The OID displays the REVIEW keypad on the OID.
3	Press SYSLG key. The OID displays the system log screen. **NOTE** If the log entry is being made at the current time, omit step 4.
4	Press DATE key. The OID displays a prompt for month/day/ year. Enter the selected month (1 to 12), the selected day of the month (1 to 31), and year and press RETURN. The system displays the log entry for the date specified on the first line of the log screen.
5	Press WRITE key, enter message using the OID keyboard, and then press EXIT or BACK. The message can be a maximum of 200 characters. The entry is recorded in the system log (at the bottom of the log).

1.3.14 REMOTE MAINTENANCE MONITORING

The ASOS provides a remote maintenance monitor (RMM) capability that allows an off-site user, using a terminal (or personal computer) and a telephone modem, to dial into the ASOS on one of its user ports. When a call is made to the ASOS, the system requests the user to enter an access code. Depending on how the user enters the access code, one of four modes may be selected: remote OID mode, direct command mode, monochrome monitor mode, and ASCII terminal mode. Except for the last mode, a VT-220 (monochrome) terminal or a VT-320 (color) terminal must be used. A personal computer may also be used, as long as a VT-220/320 emulation program is employed. Paragraph 1.3.10.2 provides information on setting up serial communications for an RMM terminal. The following paragraphs provide information on each of the four available modes.

1.3.14.1 **Remote OID Mode**. This mode is accessed by dialing into the ASOS using a telephone modem and a VT-320/220 terminal. After the telephone connection is made, the system prompts the user to enter a remote access code. This code must be properly entered, using all uppercase letters, within 30 seconds. Up to three attempts may be made. When the access code is properly entered, the 1-minute screen is displayed and the remote terminal functions as an OID. The user may then operate the system as an unsigned user or sign on to the system as a technician or system manager (observers and ATC's are not allowed from a remote monitor). The user then has all of the same capabilities as provided by the local OID's, with the exception that there is no print capability. When the user operates as an unsigned user, the ASOS disconnects the user if there is no activity for a period of 5 minutes.

1.3.14.2 **Direct Command Mode**. The direct command mode allows a remote user to directly access the data in the various ASOS logs (communications, edit, system, OBS, daily summary log, etc). This mode is accessed in the same manner as the remote OID mode, except that the pound sign (#) is typed at the beginning of the remote access code (#CODE). When the access code is properly entered, a CMD> prompt is displayed. The user then enters commands as described in table 1.3.28 and the following paragraphs.

a. All arguments are optional. If no arguments are entered, all entries for the selected command are displayed. Any arguments entered indicate a range of data to be displayed. The default arguments are as follows:

start date	01/01/0000
start time	00:00
end date	12/31/9999
end time	23:59

b. For any of the commands where the user can enter dates and times (e.g., OBS, 5MIN, SHEF, SYSLOG, LEDWI, THUNDER, COMLOG, ADAS, ALDARS, and EDITLOG commands), the following logic applies. If the start date only is entered with the command, the default start time is used and the end date and time are assumed to be the current system date and time. If the start date and start time only are entered with the command, the end date and time are assumed to be the current system date and time. If the start date, start time, and end date only are entered with the command, the default end time is used.

c. For the SYSLOG and COMLOG commands, in addition to the date and time arguments, the user can also enter a single code or two codes. Any code entry must be directly followed by a C (i.e., 9999C). Entering a single code value indicates that all log entries with the designated code are to be displayed. Entering two code values indicates a range of codes to be displayed. The user must enter the code value(s) as the last argument(s); however, the code argument(s) can be entered with any combination of the remainder of the SYSLOG/COMLOG valid arguments.

d. For the ARC5MIN command, the user must enter a valid archive index (i.e., 1, 2, or 3). Archive data are then displayed if available.

e. For the TREND command, the user must enter a valid device number (i.e., 0 = ACU, 1 = DCP #1, 2 = DCP #2, and 3 = DCP #3). If device is enabled, data are displayed.

f. For any of the commands where the user can only enter dates (i.e., the DAILY and DSM commands), the following logic applies. If the start date only is entered with the command, the end date is assumed to be the current system date.

Table 1.3.28. Direct Command Mode Commands

	Command	Results
	NOTE The following commands can be entered for the direct command mode, where MM indicates a month, DD indicates a day, HHMM indicates a time, I indicates an archive index, and CODE 1 and CODE2 indicate SYSLOG code:	
	12HR1 HHMM HHMM	Outputs 12-hour screen one data.
	12HR2 HHMM HHMM	Outputs 12-hour screen two data.
	12HRP HHMM HHMM	Outputs 12-hour 15-minute precipitation data.
	12HRC1 HHMM HHMM	Outputs 12-hour ceilometer #1 data, if ceilometer #1 is configured.
	12HRC2 HHMM HHMM	Outputs 12-hour ceilometer #2 data, if ceilometer #2 is configured.
	12HRC3 HHMM HHMM	Outputs 12-hour ceilometer #3 data, if ceilometer #3 is configured.
	12HR HHMM HHMM	Outputs all 12-hour data.
	5MIN MMDD HHMM MMDD HHMM	Outputs 5-minute observation data.
$	ADAS MMDD HHMM MMDD HHMM	Outputs ADAS summary data.
$	ALDARS MMDD HHMM MMDD HHMM	Outputs ALDARS lightning data.
	ARC5MIN I	Outputs archived 5-minute observation data.
	BYE	Exits direct command mode.
$	CLOUD HHMM HHMM	Outputs cloud layer cover factor data.
$ $	COMLOG MMDD HHMM MMDD HHMM CODE1 CODE2	Outputs communications log data.
	DAILY MMDD MMDD	Outputs daily data.
$	DSM MMDD MMDD	Outputs Daily Summary Message data.
$ $	EDITLOG MMDD HHMM MMDD HHMM	Outputs edit log data.
	HELP	Outputs help information for the direct command mode.
	LEDWI MMDD HHMM MMDD HHMM	ASOS maintains a 12-hour archive of present weather sensor (LEDWI) reports (C command responses). This archive is not available on normal OID screens, but is available remotely using this LEDWI command. Refer to Chapter 7 for format of LEDWI C data.
	MONTH	Outputs monthly data.
$	MSM	Outputs Monthly Summary Message data.
$	OBS MMDD HHMM MMDD HHMM	Outputs observation data.
	SHEF MMDD HHMM MMDD HHMM	Outputs SHEF observation data.
	SYSLOG MMDD HHMM MMDD HHMM CODE1 CODE2	Outputs system log data.
$ $	THUNDER MMDD HHMM MMDD HHMM	Outputs thunderstorm sensor data.
$	TREND D	Outputs rf communication trend data.
$	XMODEM	Toggles from/to Xmodem mode.

g. For any of the commands where the user can only enter times (i.e., the 12-hour and cloud screens), the following logic applies. If no arguments are entered with the command, the end date and time are assumed to be the time of the most recent 12-hour archive and the start date and time are assumed to be the date and time of 13 hours prior to end time. If the start time only is entered with the command, the end time is assumed to be the time of the most recent 12-hour archive.

h. All times entered are assumed to be local standard time. The user must append a Z to the time entry to access Zulu time. All times, LST or UTC, are converted to the correct type automatically before data are accessed (i.e., all 12-hour data are displayed with UTC times and the remainder of the data are displayed with LST times).

i. The direct command mode also allows the user to enter any keystroke to exit a command while data are being output and to use <CTRL Q> and <CTRL S> to stop and start scrolling.

j. For the XMODEM command, the user is prompted to direct DCM data to a file or a screen output. $ $

1.3.14.3 **Monochrome Monitor Mode**. The monochrome monitor mode is accessed in the same manner as the remote OID mode, except that a dollar sign ($) is typed at the beginning of the remote access code ($CODE). The monitor then functions as an OID in the same manner as the remote OID mode but without the color capabilities.

1.3.14.4 **ASCII Terminal Mode**. The ASCII terminal mode is accessed in the same manner as the remote OID mode, except that an asterisk (*) is typed at the beginning of the remote access code (*CODE). This mode is for use with all "dumb" terminals. The user has limited available options, which are displayed at the bottom of the screen. Number keys are used instead of keypad keys. The information scrolls across the screen in typical ASOS format excluding borders and colors, and is only available for review (not editing or changing). When prompted, the user may enter dates and times in MMDD and HHMM format.

1.3.15 **SYSTEM POWER OFF PROCEDURES**

Chapters 2 and 3 provide power-off procedures for the ACU/peripherals and the DCP, respectively. Should it become necessary to power down the entire system, the ACU/peripherals and the DCP's are powered off according to these procedures. It does not matter in what order the ACU and DCP's are powered down.

1.3.16 **SITE CONFIGURATION SCREENS**

Site configuration screen (Figure 1.3.41) provides the technician and system manager access to the configuration data specific to his site. This screen and its subfunctions can be used by the technician and system manager as both a source of information and a tool in reconfiguration. The configuration screens provide five standard key functions. The purpose of each is as follows:

a. PRINT - Enables the currently displayed screen to be printed on the printer.

b. PREV/NEXT - Enables the cursor to be moved to the different fields on the currently displayed screen.

c. BACK - Causes the previous screen to be displayed.

d. CHANG - Causes the screen function to go into an edit mode. After making change, BACK or EXIT key must be pressed for system to incorporate change.

e. EXIT - Causes the current screen to be exited and the 1-minute screen to be displayed on the OID.

Of special interest to the technician is the sensor (SENSR) and hardware (HDWE) configuration screens. The sensor screen is used to conFigure the sensor-to-serial I/O port scheme. The hardware screen is used to identify the number of CPU's, UPS's, A/D's, I/O boards, modems, and video boards in the system.

```
11:21:56 07/04/96 1621Z                          ANYTOWN AIRPORT

                                                      CONFIG
                                             | HDWE  | EXTRN |       |
                                             | DEFIN | SENSR | COMMS |
                                             | EXIT  | BACK  |       |
```

Figure 1.3.41. Site Configuration Screen

1.3.16.1 **Hardware Configuration Screen**. The hardware configuration screen (Figure 1.3.42) enables the user to review and change the recorded quantities of CPU's, SIO's, UPS's, video cards, and A/D cards presently in the ACU and DCP's. The VOICE PORT field permits the location of the FAA handset to be specified as either OID-1 PRIMARY or OID-2 SECONDARY. This field must be set correctly to permit entry of voice messages from the respective OID. The CHANG key is used to enter the change mode. The user can change the hardware quantities using the arrow keys and keyboard. The DCP STATUS and VOICE PORT fields are changed using the arrow keys and the sequence (SEQN) key.

```
  11:21:56 11/21/97 1621Z                              ANYTOWN AIRPORT

                        DCP #1         DCP #2            DCP #3
         ACU            ENABLED        DISABLED          DISABLED

       QUANTITIES       QUANTITIES

     CPU         2     CPU         2
$    SIO         8     SIO         4
$    UPS         1     UPS         2
$    VIDEO CARD  1     A TO D      2
                                                      CONFIG
$    VOICE PORT OID-2  SECONDARY             | PRINT |       |       |
                                             |       | CHANG |       |
                                             | EXIT  | BACK  |       |
```

Figure 1.3.42. Hardware Configuration Screen

1.3.16.2 **Sensor Configuration Screen**. The sensor configuration screen (Figure 1.3.43) enables the user to review and change the recorded sensor-to-serial I/O port scheme at the DCP's. By pressing the CHANG key, the user can change the configuration using the arrow keys and the keyboard. The two-character field presented under each I/O port can have one sensor assigned. A sensor-I/O port assignment is changed by typing over the existing sensor code. A list of sensor codes is provided in table 1.3.29. Fields are provided to record local sensors and pressure sensors. These fields can be changed in the same manner as sensor code assignments on the screen. By pressing the ALGOR key on the keypad, the algorithm configuration screen is displayed.

```
11:21:56 11/21/97 1621Z                                    ANYTOWN AIRPORT

         SIO #1      SIO #2        SIO #3      SIO #4        SIO #5
   PORTS 2  3  4     1  2  3  4    1  3  4     1  2  3  4    1  2

 DCP #1  C1 V1 PW    TB WS TD FR   C2 TS **                                 $

 DCP #2

 DCP #3

 LOCAL SENSORS

 ** ** **                                               CONFIGURATION

 PRESSURE SENSORS                                   | PRINT |       |       |   $

 P1 P2 **                                           | ALGOR | CHANG |       |

                                                    | EXIT  | BACK  |       |
```

Figure 1.3.43. Sensor Configuration Screen

Table 1.3.29. Sensor Codes

Sensor Code	Definition	
TD	Temperature/dewpoint sensor	
WS	Wind speed/direction sensor	
V1-V3	Visibility sensors	
SD	Snow depth sensor	
FR	Freezing rain sensor	
FP	Frozen precipitation sensor	
SS	Sunshine sensor	
C1-C3	Ceilometer sensors	
TB	Tipping bucket sensors	
PW	Present weather sensors	
TS	Thunderstorm sensor	$
P1-P3	Pressure sensors	$

1.3.16.3 **Sensor-Algorithm Configuration Screen**. The sensor-algorithm configuration screen (Figure 1.3.44) enables the user to review and change the recorded sky and visibility sensor algorithm configurations. These configurations are single-sensor, backup, and meteorological discontinuity. In addition, the user can review and assign sensor specific information such as primary and secondary sensors, sensor elevation, location, representative sensor, and priority. Because setup of algorithms for a particular site is the responsibility of the system manager, the technician should make no change to this screen except under direction of the system manager. Additional information on sensor algorithms can be obtained from the ASOS User's Guide (an NWS publication) or by contacting the system manager.

```
 3:18:40 11/21/97 1818Z                                         ANYTOWN AIRPORT
$  SKY ALGORITHM:
   PRIM SENSOR #: 1          MET DISC SENSOR #: 2          BACKUP SENSOR #: 3
     ELEVATION: 277             ELEVATION: 277                ELEVATION: 277
                                LOCATION: N                   LOCATION: E

$  VISIBILITY ALGORITHM:
   PRIM SENSOR #: 1          MET DISC SENSOR #: 2          BACKUP SENSOR #: 3
                                LOCATION: N                   LOCATION: E

                                                              ALGORITHM
                                                        PRINT
                                                                CHANG
                                                        EXIT    BACK
```

Figure 1.3.44. Sensor-Algorithm Configuration Screen

1.3.16.4 **Define Configuration Screen**. The define configuration screen (Figure 1.3.45) enables the user to review and change the recorded sensor and hardware configurations and types. New definitions should be made only in conjunction with an actual change of hardware or other sensors. For the sensors and hardware items, the configuration type, model number, or vendor is listed. By pressing the CHANG key, the user is presented with a change keypad. The PREV/NEXT keys are used to select the field to be changed. When the field to be changed is highlighted, a SEQN key on the change keypad is used to sequence through all of the allowable entries for that field. When the new entry is displayed, the screen can be exited and the new entry remains in the field.

```
13:14:23 11/21/97 1814Z                                         ANYTOWN AIRPORT
                              DEFINE CONFIGURATION

      SENSORS                                 HARDWARE
    CEILOMETER        PHASE I               ACU MEMORY        1 MEGABYTE
    VISIBILITY        BELFORT ASOS          DCP MEMORY        1 MEGABYTE
    TEMP/DEW POINT    1088                  RS 232 MODEM      UDS
    PRESENT WX        LEDWI                 SYNCH MODEM       UDS
    WIND              BELFORT ASOS          ACU/DCP COMM      PHASE I RADIO
    PRESSURE          SETRA MODEL 470       RT CLOCK          VIDEO CARD
    FREEZING RAIN     PHASE II              ACU POWER SUP     ASTEC
    SNOW DEPTH        PHASE II              DCP POWER SUP     R.O. ASSOC.
    HAIL              PHASE II              ACU UPS           CPI
    SUNSHINE          PHASE II              DCP UPS           CPI
    LIQUID PRECIP     BELFORT ASOS          GTA RADIO         MOTOROLA VT-200
$   THUNDERSTORM      LLP TSS 924                            DEFINE CONFIG
                                                        PRINT
                                                                CHANG
                                                        EXIT    BACK
```

Figure 1.3.45. Define Configuration Screen

1.3.16.5 **ACU Serial Communications Screen**. The ACU serial communications screen (Figure 1.3.46) provides access to the configuration and parameter data for each of the serial I/O communication ports. This screen provides the recorded equipment-to-I/O port scheme currently in use in the system. The SIO key is used to move the cursor to the next I/O port. By pressing the CHANG key, the user can change data on the display using the keyboard. The equipment-to-I/O port scheme recorded for software use and the hardware configuration must match for proper communication operations. In addition, the ACU serial communications screen provides fields for communication status, baud rate, parity select, bits/character, and stop bits for the configuration of any desired communication scheme. When configuring a GTA radio to the ACU, there are two fields that must be completed: FREQUENCY and POWER LEVEL. These two fields are mandatory and must be completed before exiting the COMMS screen. These fields may also be changed at the front panel of the radio; when this is done, the ACU copies and reads the current setting and stores it as a final setting and displays it on the ACU serial communications screen. The figure applies only to systems operating application software version 2.1 or higher. For earlier versions, radio adjustments must be made manually at the radio.

```
13:19:45 07/04/96 1819Z                                        ANYTOWN AIRPORT
PORT MOD FUNCTION          PORT MOD FUNCTION          PORT MOD FUNCTION
 1-1                        4-1     UPS                 7-1     GTA RADIO
   2                          2     PRESSURE #3           2     VDU-1
   3                          3     OID-2 SECONDARY       3     VDU-2
   4                          4     PRINTER               4
 2-1     ACU-DCP A          5-1     LOCAL SENSOR #1     8-1
   2     PRESSURE #1          2     LOCAL SENSOR #2       2
   3 1   OID-4 USER #1        3     LOCAL SENSOR #3       3
   4     VOICE                4     LOCAL SENSOR #4       4
 3-1     ACU-DCP B          6-1     LOCAL SENSOR #5
   2     PRESSURE #2          2     LOCAL SENSOR #6
   3 2   OID-3 SECONDARY      3     LOCAL SENSOR #7
   4     OID-1 LOCAL          4     LOCAL SENSOR #8
              FUNCTION ACU-DCP A
 STATUS        ENABLED    HANDSHAKE   RTS/CTS              ACU SERIAL COMMS
 BAUD RATE     2400       CONNECTION  RADIO            | PRINT |       | PREV |
 PARITY SELECT NONE
 BITS/CHAR     8                                       | SIO   | CHANG |      |
 STOP BITS     1
                                                       | EXIT  | BACK  | NEXT |
```

Figure 1.3.46. ACU Serial Communications Screen

1.3.16.6 **External Communications Screen**. The external communications screen (Figure 1.3.47) enables the user to review and change external communication information. This information is used by the system software in communication with the various ASOS customers. The communication consists of user address and codes, product type, message formats, and transmission parameters. By pressing the CHANG key and using the keyboard, the user can change the external communications data fields. The PRODUCT ID is automatically set depending on site commissioning status (site physical screen).

```
    08:28:48 11/21/97 1528Z                                         ANYTOWN AIRPORT
      STATION ID (XXX):         ANY          WMO IDENTIFIER:        KANY
      FORECASTOFFICE (CCC):     ITB          PRODUCT ID (NNN):      MTR
    AFOS:                                    15-MIN SHEF ID (NNN):  RR6
      ADDRESS:                  RDC          1-HOUR SHEF ID (NNN):  RR7
$     15-MIN SHEF ADDRESS:                   DSM/MSM PRODUCT ID:    DSM / MSM
      1-HOUR SHEF ADDRESS:                 ADAS:
      STATION IDS/PHONE NUMBERS              ASOS ADDRESS:          100
$        STATION 1:                          ADAS TIMEOUT (SEC):    360
                              12015551212  TCCC:
         STATION 2:                          TCCC ADDRESS:          100
                              12015551213  AOMC:
         STATION 3:                          PRIMARY PHONE NO:      9,5551215
                              12015551214    SECONDARY PHONE NO:
      MESSAGE FORMAT TYPE:    I              AOMC 1200 BAUD:        NO
      PARITY SELECTION:       NONE                                   EXTERNAL
      REPLY REQUEST:          NO                            PRINT
      BUSY ATTEMPT TIME:      1
$     SEND REPLY TIME(SECS):  120                                   CHANG
$     RECV REPLY TIME(MINS):  2
      BACKUP FOR ADAS:        NO                            EXIT    BACK
```

Figure 1.3.47. External Communications Screen

1.3.17 SITE SCREENS

In addition to the site configuration screens, the technician can access the five other types of site screens. The technician has the capability to review the site specific information on the physicals (PHYS), version (VERSN), normals (NORML), pressure (PRESS), and criteria (CRIT) screens. These site specific screens are described in the following paragraphs.

1.3.17.1 **Site Physical Screen**. The site physical screen (Figure 1.3.48) provides access to the site specific physical characteristics. In addition, the report time, edit time, transmit time, and SHEF transmit times are provided. Only the system manager and technician can make changes to this screen. Only the system manager can make changes to the "COMMISSIONED:" field.

```
  08:28:48 11/21/97 1528Z                                              ANYTOWN
                                     AIRPORT
    STATION
       NAME:                    ANYTOWN AIRPORT
       IDENTIFIER:              LHX         DATE:                    12/19/91
       COMMISSIONED:            NON         TIME:                    15:27:56 UTC
       ATTENDED:                NO          UTC TO LST OFFSET:       -7
       OPEN 24 HOURS:           YES         METAR SWITCH DATE:       06/01/96 UTC
       OPENING TIME:                        METAR SWITCH TIME:       00:00:00 UTC
$      CLOSING TIME:                        DSM GENERATED:           YES
$      ELEVATION:               4215  FEET  PRIMARY DSM XMIT TIME:            UTC
$                                           INTERMED DSM XMIT TIMES:          UTC
$   FIELD ELEVATION:            4226  FEET                                    UTC
$   PRESSURE SENSOR ELEVATION:  4193  FEET                                    UTC
$                                           MSM GENERATED:           YES
$   OBS HOURLY REPORT TIME:     55          MSM XMIT TIME:                    UTC
    OBS EDIT TIME:               5:00                                PHYSICAL
$   OBS HOURLY TRANSMIT TIME:   55:00                      PRINT
$   SHEF HOURLY TRANSMIT TIME:  22
$   LATITUDE:                   38:57N                             CHANG
$   LONGITUDE:                  77:27W
$   MAG DECLINATION:            9W                         EXIT    BACK
```

Figure 1.3.48. Site Physical Screen

1.3.17.2 **Site Version Screen**. The site version screen (Figure 1.3.49) provides access to software version (SW),
sensor firmware version (SENSR), and AOMC communications (AOMC) information. The SW screen $
(Figure 1.3.50) provides the current versions of software being used in the ASOS at the site. These fields are
automatically updated by the system. The sensor firmware version screen (Figure 1.3.51) provides an indication of $
the version of sensor firmware being used in the ASOS. An identifier consisting of up to seven characters is provided $
for each sensor. This identifier can be changed by pressing the CHANG key. The AOMC screen (Figure 1.3.52) $
provides access to AOMC communications information, consisting of upload/download statuses and dates. During system operation, all changes made to the site specific screens are put in files to be routed to the AOMC for recording purposes. When a file is pending, an upload request is displayed in the STATUS field. The technician or system manager can manually upload or download this information if desired. Records of system changes can be obtained from the AOMC. By using the PREV/NEXT keys, the user can select a desired field. Then, using the UP-LD key, the user can cause an upload of status data (transmit to the AOMC). Using the DN-LD key, the user can cause a download of status data (to the ASOS ACU). The CNCL key allows the user to cancel events that are not in progress on the current cursor line. Automatic events cannot be canceled. If an observer or air traffic controller is signed on to the system, downloads cannot be performed.

```
08:28:48 11/21/97 1528Z                                ANYTOWN AIRPORT

                                                      VERSION
                                                 SW     AOMC    SENSR      $


                                                 EXIT   BACK
```

Figure 1.3.49. Site Version Screen

```
08:28:48 11/21/97 1528Z                                ANYTOWN AIRPORT
UNIT   BOARD   NAME              DEVICE VERSION   DATE

ACU    CPU A   PSOS OS           EPROM   1.81   03/07/95
       CPU B   PSOS OS           EPROM   1.81   03/07/95
       MEMORY  ACU APPLICATION   EPROM   2.52   11/24/97                   $
       MEMORY  DCP APPLICATION   EPROM   2.52   11/24/97                   $

DCP-1  CPU A   BOOT              EPROM   1.90   11/03/97                   $
       CPU B   BOOT              EPROM   1.90   11/03/97                   $
       MEMORY  DCP APPLICATION   RAM     2.52   11/24/97                   $

DCP-2  CPU A   BOOT              EPROM   1.90   11/03/97                   $
       CPU B   BOOT              EPROM   1.90   11/03/97                   $
       MEMORY  DCP APPLICATION   RAM     2.52   11/24/97                   $
                                                       SOFTWARE VERSIONS
DCP-3  CPU A   BOOT              EPROM   1.90   11/03/97   PRINT           $
       CPU B   BOOT              EPROM   1.90   11/03/97                   $
       MEMORY  DCP APPLICATION   RAM     2.52   11/24/97                   $

                                                           EXIT   BACK
```

Figure 1.3.50. SW Screen

$

8:28:48 11/21/97 1528Z ANYTOWN AIRPORT

SENSOR FIRMWARE VERSION

CEILOMETER	XXXXXXX
VISIBILITY	XXX
TEMP/DEW POINT	XXXXX
PRESENT WX	XXXXX
WIND	XXXXXX
PRESSURE	XXXXXXX
FREEZING RAIN	XXXXXXX
LIQUID PRECIP	XXXXX
THUNDERSTORM	XXXXXX

FIRMWARE VERSION

PRINT		
	CHANG	
EXIT	BACK	

Figure 1.3.51. Sensor Firmware Version Screen

08:28:48 11/21/97 1528Z ANYTOWN AIRPORT

DATA FILE		STATUS	LAST UPLOAD	LAST DOWNLOAD
SITE	NORMAL	COMPLETE		11/20/91 11:37:58
	PHYSICAL	COMPLETE		11/20/91 09:38:01
	PRESSURE	COMPLETE		11/20/91 09:38:11
	CRITERION	COMPLETE	07/04/96 13:05:25	11/20/91 09:38:11
CONFIG	DEFINES	COMPLETE		11/20/91 11:37:22
	RS-232 COMM	COMPLETE	12/14/91 15:02:21	11/20/91 09:40:17
	SENSORS	AUTO UPLOAD REQ	07/04/96 13:05:38	
	HARDWARE	AUTO UPLOAD REQ	07/04/96 13:04:11	
	EXTERNAL COMM	COMPLETE	07/04/96 13:05:51	
CMD	VOICE/PASSW	AUTO UPLOAD REQ		
VOICE	AIRPORT NAME	COMPLETE		
VERSN	SENSOR	COMPLETE		

AOMC COMMS STATUS

PRINT	UP-LD	PREV
CNCL	DN-LD	
EXIT	BACK	NEXT

Figure 1.3.52. AOMC Screen

1.3.17.3 **Site Normals Screen**. The site normals screen (Figure 1.3.53) provides access to the site specific normals for various weather parameters. Site normal data for 12 months are stored. Only the system manager can make changes to this screen.

```
08:28:48 11/21/97 1528Z                                             ANYTOWN AIRPORT
                          NORMALS FOR OCTOBER
DAY TMIN TMAX TAVG SUN    DAY TMIN TMAX TAVG SUN    DAY TMIN TMAX TAVG SUN
 1  49   74   61   708    11  44   70   57   683    21  40   66   53   659
 2  48   74   61   705    12  44   70   57   681    22  40   66   53   656
 3  48   73   61   703    13  43   69   56   678    23  40   65   53   654
 4  47   73   60   700    14  43   69   56   676    24  40   65   52   652
 5  47   72   60   698    15  43   68   55   673    25  39   64   52   649
 6  46   72   59   695    16  42   68   55   671    26  39   64   51   647
 7  46   72   59   693    17  42   68   55   668    27  39   64   51   645
 8  46   71   58   690    18  42   67   54   666    28  38   63   51   642
 9  45   71   58   688    19  41   67   54   663    29  38   63   51   640
10  45   70   57   685    20  41   66   54   661    30  38   62   50   638
                                                                                    $
MONTHLY NORMAL HEATING DEG DAYS:  307          AVG/SUM: 42   68   55   20802         $
MONTHLY NORMAL COOLING DEG DAYS:  7                             NORMALS
MONTHLY NORMAL PRECIP:      3.01                        | PRINT |       | PREV  |
SEASON HEATING DEGREE DAYS: 2915                        |       |       |       |
SEASON COOLING DEGREE DAYS: 455                         | EXIT  | BACK  | NEXT  |
```

Figure 1.3.53. Site Normals Screen

1.3.17.4 **Site Pressure Screen**. The site pressure screen (Figure 1.3.54) provides access to the site specific pressure data. Only the system manager can make changes to this screen.

```
13:10:48 11/21/97 1810Z                                             ANYTOWN AIRPORT
                         PRESSURE REDUCTION RATIO (R)

        TEMP     R        TEMP     R        TEMP     R        TEMP     R

        -70    1.0111     -65    1.0111     -60    1.0111     -55    1.0111

        -69    1.0111     -63    1.0111     -59    1.0111     -54    1.0111

        -68    1.0111     -63    1.0111     -58    1.0111     -53    1.0111

        -67    1.0111     -62    1.0111     -57    1.0111     -52    1.0111

        -66    1.0111     -61    1.0111     -56    1.0111     -51    1.0111

PRESSURE REDUCTION CONSTANT: 0.0000                             PRESSURE
                                                        | PRINT | PAGE  |       |   $
                                                        |       |       |       |
                                                        | EXIT  | BACK  |       |
```

Figure 1.3.54. Site Pressure Screen

1.3.17.5 **Site Criteria Screen**. The site criteria screen (Figure 1.3.55) consists of three screens that define the conditions that cause automatic special alerts, local alerts, and SHEF alerts to be generated by the system. By using the PAGE key, the user can move between three screens in a circular fashion. Only the system manager can make changes to this screen.

```
08:28:48 11/21/97 1528Z                                      ANYTOWN AIRPORT

CRITERIA FOR SPECIAL ALERTS

   SKY CONDITION:

      CEILING AT OR BELOW         3000   1500   1000   500  FEET
      USER'S CEILING AT OR BELOW  600    800    0      0    0     0

      LAYERS BELOW                1000   FEET
      USER'S LAYERS BELOW         800    0      0      0

$  VISIBILITY:                    3      2      1      MILES
$     USER'S VISIBILITY           1/2    3/4    1 1/4

   RVR:                           2400   FEET                 CRITERIA
$$$                                                  PRINT  PAGE

                                                     EXIT   BACK
```

Figure 1.3.55. Site Criteria Screen (Sheet 1 of 3)

```
13:10:48 11/21/97 1810Z                                      ANYTOWN AIRPORT

CRITERIA FOR LOCAL ALERTS

   SKY CONDITION:

      CEILING AT OR BELOW   0    0    0    0    0    0    FEET

$  VISIBILITY:  1/2                                       MILES

                                                              CRITERIA
$$$                                                  PRINT  PAGE

                                                     EXIT   BACK
```

Figure 1.3.55 Site Criteria Screen (Sheet 2)

```
13:10:48 01/07/92 1810Z                                      ANYTOWN AIRPORT

CRITERIA FOR SHEF ALERTS

   15-MINUTE ONSET THRESHOLD:                0.40 INCHES

   15-MINUTE TERMINATION THRESHOLD:          0.02 INCHES

                                                              CRITERIA
$$$                                                  PRINT  PAGE

                                                     EXIT   BACK
```

Figure 1.3.55. Site Criteria Screen (Sheet 3)

SECTION IV. SYSTEM THEORY OF OPERATION

1.4.1 INTRODUCTION

This section describes the ASOS at the system level. Detailed information on the various subassemblies is provided in the specific Chapter for that subassembly. Each ASOS is configured to meet the specific requirements of a given site. Configuring a system entails identifying the specific sensors required and the number and types of users that are to have access to the system. Regardless of the type of configuration, the ASOS always contains four major units: acquisition control unit (ACU), data collection package (DCP), sensors, and peripherals. Figure 1.4.1 illustrates a typical ASOS configuration. ASOS configurations differ in the number of each component contained in the configuration. The major differences are in the number of DCP's, sensors, and peripherals at the site. Regardless of the configuration, each site is provided with only one ACU. There are two major types of ASOS systems: Class I and Class II. Class I systems are designed for small airports. Class II systems are designed for larger, towered airports. Class II systems are provided with uninterruptible power supplies (UPS's) and $
UPS bypass circuits for the ACU and DCP(s) and redundant components in the ACU. $

1.4.2 ACQUISITION CONTROL UNIT (ACU)

The ACU is the central controlling element of the ASOS. It receives weather information from the sensors via the DCP. The ACU processes the weather data via weather reporting algorithms and makes these data available to the various users via the peripheral devices attached to the system. In Class II systems, the ACU is equipped with the auxiliary UPS backup power supply. In addition, the Class II ACU contains redundant rf modems or line drivers for increased system availability.

1.4.3 PERIPHERALS

The peripheral devices consist of one to three operator interface devices (OID's), one to four video display units (VDU's), one to nine controller video displays (CVD's), an FAA handset, and a printer. In addition to these ASOS peripherals, the ACU may be equipped with a video driver option that allows it to provide a video signal for distribution to up to 50 non-ASOS airline displays. All other output from the system is via direct connection (hardwire) or modems, which are connected to the ACU via telephone lines. The modem interface also services the AFOS. The OID is the primary operator input/output device for the system. The observer uses the OID to monitor the weather data being reported by the system. Observers also use the OID to enter weather observations into the system and to request weather summaries from the system. The technician uses the OID to check system status, to reconFigure the system, and to run the on-demand diagnostic test on specific elements of the system. The VDU and CVD are display devices that provide weather data to other users of the system such as the air traffic controllers (ATC's). The CVD's serve ATC's in the tower and the VDU's can be located throughout the airport to be used by the various personnel. A digitized voice output is routed to a local transmitter, which provides local weather and pressure data to pilots using the airport. The FAA handset enables ATC's to augment messages onto the automatically generated digitized voice output of weather data. The printer is the hard copy device for the system. It provides a hard copy output of data such as weather summaries, observations, and log messages. The log messages identify the system status and changes $
made to the METAR observation by the observer. The system maintenance log provides the technician $
with the maintenance history of the system and provides the results of each self-test performed on the system. If a unit in the ASOS fails its self-test, the log indicates the cause of the failure.

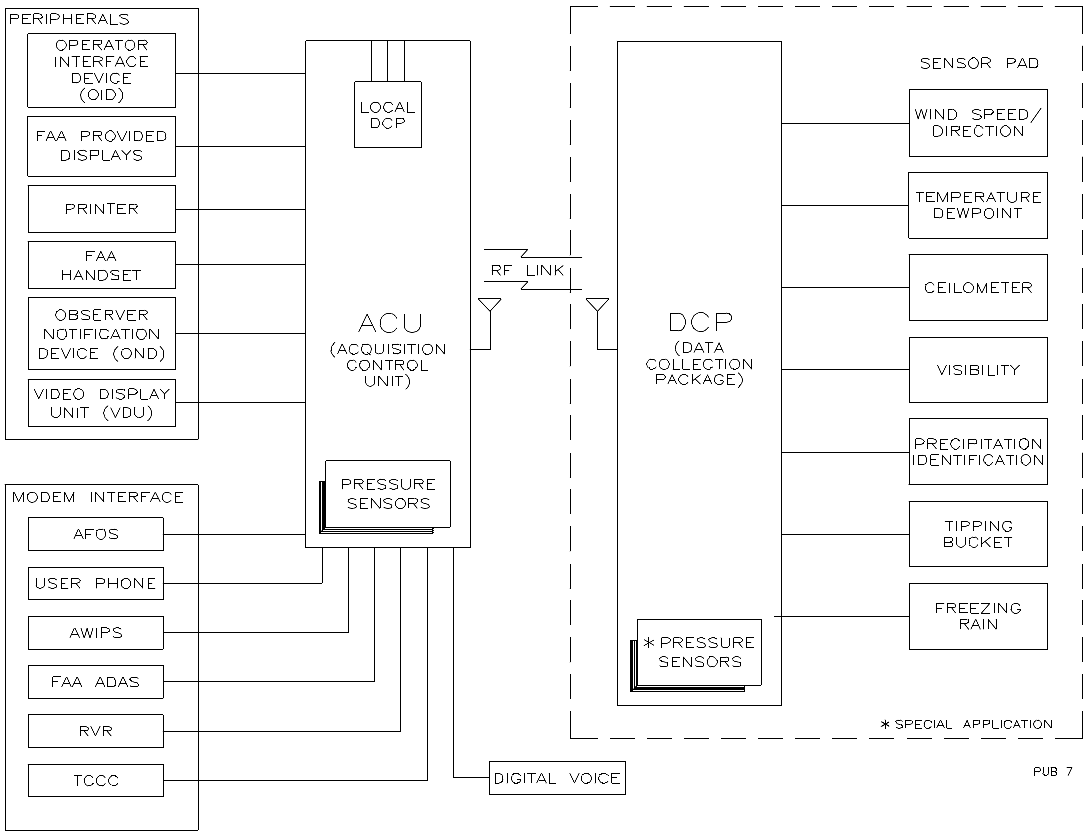

Figure 1.4.1. Typical ASOS Configuration - Basic Block Diagram

1.4.4 DATA COLLECTION PACKAGE (DCP)

The DCP processes the weather data being received from the sensors and transfers the data to the ACU. The DCP also controls both primary and heater sensor power. The system can utilize two types of DCP's: a local and a remote. The remote DCP's are located on the sensor pads. Each remote DCP has the data handling capability to support up to 16 sensors. However, the remote DCP optional UPS can only
$ provide power to nine sensors. Therefore, when using more than nine sensors on a sensor pad, an auxiliary box (62828-40370) is required. The optional auxiliary box, which is considered part of the remote DCP, contains the additional UPS. Many sites are equipped with more than one remote DCP. When more than one remote DCP is used, they are usually placed at different locations at the airport with some installed near the runways and one installed in the center of the airport. The units installed near the runway are called touchdown zone DCP's. The units in the center of the airport are called the "combined zone sensor group". At some sites, redundant ceilometer and visibility sensors are added to the combined group to function as a backup sensor group.

DCP's and sensors installed in areas of meteorological discontinuity are called METDISCON Sensor Groups (MDSG). Communications between the different DCP's are controlled by the ACU. Communications between the ACU and DCP's are accomplished primarily via rf modems. The system also has the capability of a direct wire hookup between the DCP's and the ACU. The local DCP is a function contained within the ACU cabinet. The local DCP gives the ACU the capability of directly
$ controlling sensors. The pressure sensors in all of the systems are normally located in the ACU cabinet
$ (due to site specific requirements, pressure sensors may be located in the DCP). In addition to the pressure sensors, the ACU can also handle up to three additional sensors via the local DCP. These sensors are connected to the rear of the ACU via fiberoptic modems.

1.4.5 **SENSORS**

The sensor complement, like most other system components, reflects the requirements of the individual sites. Some sites may be provided with more than one of the same type of sensor to function as METDISCON or BACKUP sensors. The cloud height and visibility sensors are often duplicated at a site, with a maximum of three each possible; PRIMARY (designated as C1 and V1), METDISCON (designated as C2 and V2), and BACKUP (designated as C3 and V3). Usually, each touchdown zone is provided with its own cloud height and visibility sensor. This ensures that the cloud and visibility conditions at that specific runway are being reported accurately.

Some airport sites will experience meteorological phenomena which are peculiar to one runway approach only. At such locations, a meteorological discontinuity (METDISCON, or MDSG) sensor group will be located, consisting of a DCP and three sensor pedestals. The MDSG is similar to the standard touchdown zone installation (62828-40107), but the sensor complement will consist of a visibility sensor, a ceilometer, or possibly, both. The MDSG DCP communicates with the ACU via UHF modems.

1.4.6 **ASOS OPERATION AND MONITORING CENTER (AOMC)**

1.4.6.1 **ASOS/AOMC Interface**. The ASOS Operation and Monitoring Center (AOMC) is the central monitoring and maintenance computer for all NWS ASOS sites. The AOMC performs three functions for every NWS ASOS: the monitoring of ASOS hardware trouble, the maintenance of site specific data, and ASOS time synchronization.

1.4.6.2 **ASOS Trouble Monitoring.** The AOMC monitors all ASOS METAR's through an NWS computer system known as the gateway. If a particular ASOS outputs a maintenance flag ($) in METAR or if the AOMC fails to receive a METAR during the proper time period, the AOMC notes a hardware problem with that ASOS site. The AOMC operator then uses a remote maintenance monitor to further investigate the problem and then notifies the appropriate maintenance personnel.

1.4.6.3 **ASOS Site Specific Data**. For each NWS ASOS site, the AOMC maintains the latest configuration of site specific data. The site specific data are contained in four site files, six configuration $
files, a command file, and a voice file as follows:

a. Site - Normals
b. Site - Physicals
c. Site - Pressure
d. Site - Criterion
e. Configuration - Definitions
f. Configuration - RS-232 communications
g. Configuration - Sensors
h. Configuration - Hardware
i. Configuration - Externals
j. Configuration - Sensor Firmware Version $
k. Command - Voice/password
l. Voice - Airport name

1.4.6.3.1 **File Upload and Download.** Site specific files can be either uploaded from the ASOS to the AOMC or downloaded from the AOMC to the ASOS. Uploading and downloading is always initiated by the ASOS (it places a phone call to the AOMC and requests a download or an upload). The ACU may initiate an upload or download sequence automatically. For example, the ASOS initiates an upload after a technician changes system configuration via the OID, or initiates a download request if it detects a loss of site data. An upload or download may also be initiated manually via the site version - AOMC screen at the OID (paragraph 1.3.17.2).

1.4.6.3.2 **Upload/Download Sequence.** The ACU has between two and five telephone modems dedicated to remote OID's (user ports 1 and 2, user spare ports 1 and 2, and the spare OID port). The ACU uses these telephone modems to place calls to the AOMC. When an upload or download sequence has been initiated (either automatically or manually), each available (not in use) OID modem places a call every 2 minutes until a connection to the AOMC is made. After the connection is made, the ACU either uploads files to the ACU or requests a file download from the AOMC.

1.4.6.4 **ASOS Time Synchronization**. Each ASOS has an internal software clock. All ASOS software clocks are synchronized to a time standard provided by the automated computer time service (ACTS). The time synchronization of the ASOS clocks is accomplished with the aid of the AOMC.

1.4.6.4.1 **AOMC Interface to ACTS.** The AOMC communicates with the ACTS to keep its own internal software clock in synchronization with the time standard. Individual ASOS sites call the AOMC as required to synchronize their internal software clocks.

1.4.6.4.2 **ASOS Synchronization Sequence.** The ASOS time synchronization sequence begins when the ACU is powered up or when an observer presses the RESET key on the edit screen. At first, the ACU uses a hardware real-time clock (contained on the ACU memory board) as a default clock. As soon as possible after the power up or reset, the ACU calls the AOMC to obtain the current standard time. The ACU then initializes its software clock with the AOMC time and stops using its default hardware clock. Ten hours later, the ACU again calls the AOMC to check its software clock against the standard time. Based on the difference between the software clock and AOMC time, the ACU introduces a correction factor into its software clock to adjust its accuracy. One week later, the ACU again calls the AOMC for a time check and further adjusts its software clock. From this point, the ACU calls the AOMC once every 2 months to check and adjust its software clock.

SECTION V. SYSTEM MAINTENANCE

WARNING

Before attempting to service any ASOS equipment, the technician must perform the following:

Upon arrival at an airport, notify airport security and gain access to the system by following local procedures.

Adhere to all airport traffic regulations.

Before crossing any runway, radio the tower and request clearance.

Proceed only with clearance, and only after illuminating the caution light mounted on top of your vehicle.

1.5.1 **INTRODUCTION**

This section contains corrective and preventive maintenance procedures for the ASOS. Preventive maintenance identifies the quarterly and semiannual tasks required to keep the ASOS in peak operational condition. Corrective maintenance provides detailed procedures for performing the system diagnostic test, performing fault isolation, and removing and installing FRU's. The system diagnostic test is continuously running and automatically prints system status that identifies the operational status of the system after each cycle of the self-test. If the self-test detects a failure, the suspected FRU is identified in the system maintenance log and printed on the printer. The technician's first step in system repair is to replace the indicated FRU. If the system does not identify an FRU, the corrective maintenance table in this section is then used to isolate to a faulty FRU. Table 1.5.1 lists the tools and test equipment required to perform maintenance on the system. These are the preferred items that the technician should have available to perform maintenance on the system. If the specific item listed in the table is not available, an equivalent item may be substituted. The specific tools required for removal and installation of each FRU are specified within each procedure. Table 1.5.2 lists the required consumables needed to maintain the ASOS. Although the Source column in table 1.5.2 provides a recommended source for some of the items, the technician can substitute an equivalent product.

1.5.2 **MAINTENANCE ACTION RECORDING AND DOCUMENTATION**

Whenever the technician performs maintenance tasks, all actions must be documented in the system maintenance log. For the purpose of entering unit/assembly or modification kit identification numbers, the process is initiated by the ACT key of the maintenance screen keypad. Next, the technician continues entry process to the system maintenance log by activating the START key of the maintenance action screen (paragraph 1.3.4.40), then performs the specified maintenance action under preventive maintenance, corrective $
maintenance, calibration, or field modification kit installation. When all actions are completed, the technician accesses the corresponding PM, CM, CAL, or FMK screens (paragraphs 1.3.4.41 through 1.3.4.44) and enters $
appropriate identification numbers, which, in turn, are written to the system maintenance log. The technician can write corresponding maintenance messages to the log at any time during the process by accessing the SYSLG screen (paragraph 1.3.13). Table 1.5.3 provides a sequence to be followed when specified maintenance tasks are to be performed by technicians at ASOS sites. In addition, the sensor firmware version $
screen allows the current version of sensor firmware to be documented (changed) if required by the specified $
maintenance action. $

Table 1.5.1. Tools and Test Equipment

	Item	Description	Part No./Model No.
	1	Common handtools (i.e., wrenches, screwdrivers, nut drivers)	
	2	Digital multimeter (DMM)	Fluke 77
	3	Laptop computer	ZEOS 286 (minimum)
	4	PROCOMM software	PROCOMM Plus, Datastorm Tech.
	5	Precision torque gauge	PN SO-3, SEEKONK Mfg.
	6	STI LEDWI calibration kit	Model STI200, Scientific Technology, Inc.
	7	PorTable pressure standard	Model 760-16B, Paroscientific, Inc
	8	Ceilometer calibration reflector	Model CT-16, Vaisala, Inc.
	9	RF UHF to BNC adapter (MIL-SPEC)	MIL-SPEC 9183 UG-20/A/U
	10	Visibility sensor calibration kit	32041, Belfort Equipment Company
	11	Black Box (Mini Sam)RS-232 Test Tool	Model TS153B
	12	Magnetic compass	S&Y 183, Stocker and Yale
	13	Laptop Interface cable	62828-90314-2
	14	Laptop Null cable	62828-90314-1
	15	Adapter - DB9 (male) to DB25 (female)	Black Box TR-FA601
	16	Adapter - DB9 (female) to DB25 (male)	Black Box TR-FA600
	17	In-line rf power meter	Bird model 43 (with BNC connectors)
	18	RF meter plug-in module	Bird model 5d
	19	Sun program disk (wind alignment)	
	20	Wind alignment tool	CIMTECH 2767
	21	Psychrometer	Belfort 556-8
	22	Laboratory beaker	Fischer Scientific Model 2-540 (NSN 6640-00-264-8323)
	23	Cable, RF (N to N)	62828-42016-30
	24	Cable, RF (BNC to N)	62828-42024-30
$	25	Davis Pelorus Instrument	Davis Instrument Corp. Model 031
$	26	Spotting Scope (Monocular)	Bushnell Corp. Model 78-1545 (or equiv.)
	27	Alignment protractor	
$	28	Tripod	Bogen Photo Corp. Model G120 w/G1171 Head
	29	Dual speed F420 wind speed calibrator	ASN F850A-1
	30	Ribbon Cable, Audio Adj	62828-42037
	31	50 Ohm Load	Bird 8362NM
	32	Meter Element	Bird 25-C (6625-00-980-8255)
	33	Oscilloscope	Tektronix TAS485 (6625-00-548-8181)
	34	RF Frequency Counter	HP5384A/34110/A
	35	RF Load Sampler	Bird 4274-025 (6625-01-080-5452)
	36	Meter Element	Bird 110-1 (6625-00-502-7502)
$	37	Extender Board, VME	Dawn VME Products 20800-188
	38	Test Cable, BNC to BNC	62828-42046
	39	Scanner w/AC Adapter	Radio Shack PRO 36/273-1455 or equivalent
	40	Wire brush	(Commercial)
	41	Scraper, w/razor blade	(Commercial)
	42	Gloves, rubber	(Commercial)

Table 1.5.2. Consumable Materials List

Item	Quantity	Source	
Alcohol, anhydrous isopropyl, 91%	1 quart	ASN-052-C-12	
Applicator, cotton-tip	100 pieces		
Bottle, squeeze			
Brush, soft (1-inch paint)	1 each		
Cloth, lint-free	10 pieces		
Coating Compound, metal pretreatment	1 quart	MIL-C-8514, or (DOD-P-15328)	
Detergent, liquid	22 oz	Joy dish washing liquid	
DC-4, Dow Corning, anti-corrosion dielectric compound	1 tube		
Filter-Coat	1 can		
INSECTA paint	1 pint	INSECTA Incorporated	
Lacquer thinner, odorless	1 quart	Parks 2215	
Optical Gel Code 0608	4 oz	R.P.Cargille 24231 (AMP 501555-1)	$
Paint, Cabinet	1 quart	Sherwin-Williams, Polane, No. 521-1719 F663W56, Hi-Gloss White, Non-Textured Finish	
Paint, Enamel, gloss-white	1 quart	Rust-Oleum, or equal	
Paint, Primer, for clean metal	1 quart	Rust-Oleum, or equal	
Paint, Primer, for rusty metal	1 quart	Rust-Oleum, or equal	
Paint, Primer, zinc-rich	1 quart	Rust-Oleum, or equal	
Paint, Wind Tower	1 quart	FED-STD-595 Color 12197 (Orange) 17875 (White)	$
Primer	1 quart	Zinc Chromate, TT-P-1757, Type I, Color Y	
RTV 732 Silicon Sealer	1 tube		
Rust Stripper (for lightly rusted surfaces)	1 quart	Rust-Oleum, or equal	
Rust Reformer (for heavily rusted surfaces)	1 quart	Rust-Oleum, or equal	
Restorer, contact	1 can	Radio Shack 64-2315	
Tape, adhesive, electrical	2 rolls		
Tissue, lens	50 pieces		
Window cleaner	12 oz	Windex glass cleaner with ammonia	

Table 1.5.3. Maintenance Action Sequence

Step	Procedure
1	Sign on system as a technician.
2	Select MAINT function and observe maintenance screen. Observe that MAINTENANCE keypad is displayed in lower right corner.
3	Press ACT key and observe that maintenance action screen is displayed.
4	Press START key. This stores a maintenance action message in the system maintenance log, indicating the start of a maintenance action to follow.
5	Perform specified preventive maintenance, corrective maintenance, calibration, or field kit modification tasks. Verify that all maintenance steps are complete and that appropriate units/assemblies or field modification kits are identified.
6	Reaccess maintenance action screen. Use PREVT, CORR, CAL, and FMK keys to document all maintenance tasks performed. If necessary, enter any additional relevant maintenance data or messages into SYSLG screen (paragraph 1.3.13).
7	Verify that system maintenance log has recorded complete and relevant maintenance notations regarding each task performed.
8	Sign off ASOS.

1.5.3 PREVENTIVE MAINTENANCE (PM)

1.5.3.1 **Introduction**. ASOS preventive maintenance is performed at two intervals: 90 days and semiannually. Table 1.5.4 provides the preventive maintenance schedule for each system major assembly.

Table 1.5.4. System Preventive Maintenance Schedule

Interval/Unit	What To Do	How To Do It
	90 Days	
ACU	Clean air filters. Clean CRT screens. Clean cabinets. Check memory board LOW BATT indicator.	Table 2.5.2 Table 1.5.7 Table 2.5.3 Paragraph 2.5.2.4
Ceilometer	Routine inspection and cleaning Clean windows. Check window conditioner.	Paragraph 9.5.2.2 Table 9.5.2 Table 9.5.2
CODEX modem	Clean and inspect.	Paragraph 13.5.2.1
DCP	Clean cabinets.	Table 3.5.2
Freezing rain sensor	Clean and inspect.	Table 11.5.1
GTA radio	RF power output Modulation level check VSWR at transmitter output check Frequency stability check	Table 12.5.2 Table 12.5.3 Table 12.5.4 Table 12.5.5
Present weather sensor	Clean lenses. Calibrate sensor.	Paragraph 7.5.2.2 Table 7.5.2
Pressure sensor	Clean and inspect. Verify accuracy of pressure sensor data.	Paragraph 8.5.2.2 Table 8.5.2
SCA	Perform visual inspection. Clean CRT screens.	Table 14.5.2 Table 14.5.4
$ System	Perform visual inspection. Clean peripherals.	Table 1.5.5 Table 1.5.7
Temperature/dewpoint sensor	Clean/inspect aspirator air passages. Clean/inspect aspirator mirror. Perform optical loop adjustments. Verify temperature and dewpoint readings.	Table 5.5.2 Table 5.5.2 Table 5.5.3 or 5.5.4 Table 5.5.5
Thunderstorm sensor	Clean and inspect.	Table 16.5.1
Tipping bucket	Clean and inspect.	Table 10.5.1
Visibility sensor	Clean lens assemblies. Calibrate sensor.	Table 6.5.2 Table 6.5.3
Wind sensor	Perform routine inspection. Check obstruction lights.	Paragraph 4.5.2.1 Paragraph 4.5.2.2
	Semiannually	
ACU	Check/clean batteries.	Paragraph 2.5.2.5
Ceilometer	Check sensor calibration.	Table 9.5.3
DCP	Check/clean batteries, inspect desiccant (at special sites).	Paragraph 3.5.2.2
SCA	Check/clean batteries, inspect desiccant.	Table 14.5.2
System	Visual inspection and cleaning (as reqd).	Table 1.5.5
Temperature/dewpoint sensor	Check DC power supplies. Calibrate sensor.	Table 5.5.8 Table 5.5.9 or 5.5.11
Wind sensor	Mechanical operation inspection (bearings, cup balance, vane balance). Perform starting torque bearing test. Check wind direction and speed data. Check wind direction alignment.	Table 4.5.2 Table 4.5.17 Table 4.5.5 Paragraph 4.5.2.5
	Annually	
GTA radio	Antenna cable conductance and insulation	Table 12.5.6
Present weather sensor	Treat with insect paint.	Paragraph 7.5.2.4
System	Visual inspection (as reqd) Paint Refurbishment	Table 1.5.5 Paragraph 1.5.3.5
Thunderstorm sensor	Replace desiccant.	Table 16.5.1
Tipping bucket	Inspect cable connector.	Table 10.5.1
Wind sensor	Inspect crossarm assembly cable connector.	Table 4.5.2

1.5.3.2 **Visual Inspection**. Visual inspection is performed in two parts. The first part requires that power be applied to the system; the second part requires that power be removed from the system. The visual inspection procedure is provided in table 1.5.5. The DCP and sensor facilities must be inspected periodically. Table 1.5.6 specifies a checklist of items and the period for performing these tasks.

1.5.3.3 **Cleaning**. Cleaning is required for the ACU, DCP, and sensor cabinets; the CRT and display screens on the OID's, VDU, and CVD; and the printer and OID keyboard. The cleaning procedure is provided in table 1.5.7.

1.5.3.4 **Corrosion Removal and Prevention, Steel Surfaces**. If corrosion (rust) is detected on steel parts such as instrument subsystem pedestals, towers, wind tower base, or masts, proceed as follows: $

a. Wire brush affected areas thoroughly; then, wipe away all residue powder with a dry, clean cloth.

b. Inspect rusted areas to determine whether remaining rust lies on surface, or whether it has corroded deeply into the metal. If rust has penetrated below the surface, proceed with step d; if not, proceed with step c.

CAUTION

Do not allow any chemicals used in this procedure to contact the skin or eyes. Wear rubber gloves and safety glasses. If any fluid splashes on exposed skin or eyes, flush with water immediately.

c. If rust is on or near the surface, proceed as follows:

1. Wearing rubber gloves, apply Rust Stripper with an applicator pad or a cloth. Apply evenly over rusty surfaces; scrub vigorously.
2. Allow 30 minutes for Rust Stripper to work; then, wipe dry with a clean cloth.
3. Allow treated surfaces to air-dry for 30 minutes.
4. Using a clean, 2-inch paint brush, coat all treated and bare areas with zinc-rich primer.
5. Allow 1 hour drying time for primer.
6. Coat the entire surface with gloss white enamel.
7. Allow painted surfaces to dry for 8 hours; do not contact painted surfaces during drying period.

d. If rust has penetrated below the surface, proceed as follows:

1. Wearing rubber gloves, apply Rust Reformer with an applicator pad or cloth. Apply evenly over rusty surfaces, and scrub thoroughly.
2. When treated surfaces appear to be dry, wipe with a clean cloth.
3. Using clean, 2-inch paint brush, coat all treated and bare areas with rusty metal primer.

4. Allow 2 hours drying time.

5. Coat all treated surfaces with gloss-white enamel.

6. Allow 8 hours drying time; then, coat the entire surface with gloss-white enamel.

1.5.3.5 **Refurbishment of Painted Aluminum Surfaces**. Wherever paint has been damaged, or is peeled or blistered, proceed as follows:

a. Scrape away all loose paint with a razor blade scraper.

b. Using a 2-inch paint brush, coat the bare aluminum areas, and areas where yellow primer is showing, with zinc-chromate primer.

c. Allow primer to dry for 4 hours.

$ d. Apply a coat of paint (refer to table 1.5.2 for proper paint) to primed areas.

$ e. If repainting of the entire surface is required, allow 8 hours drying time, then paint entire
$ surface.

Table 1.5.5. Visual Inspection Procedures

Step	Procedure
1	With power applied, ensure that blower at the bottom of the ACU equipment cabinet, the fans on the rear of the UPS's, and the muffin fans on the bottom of the DCP VME card rack are operating properly.
2	With power applied, at the wind sensor tower, cover the light sensor on the tower light control box and ensure that the clearance lights at the top of the tower illuminate.
3	Remove power from the system and inspect the inner ACU, DCP, and sensor cabinets for signs of pinched or chafed wiring, loose hardware, and proper connector mating.
4	With power removed from the system, check the outside of all enclosures for signs of corrosion.
5	With power removed from the system, at the sensor pad, ensure that all hardware securing the sensors to the pad is tight. Check each mounting column for visual signs of wear or corrosion. Ensure that there are no cracks in the columns. **NOTE** After performing the visual inspection procedure, reapply power to the system and wait until the system initializes and successfully completes its diagnostic check before leaving the area.

Table 1.5.6. Facilities Maintenance Checklist

Item/Task	Period
EXTERNAL SURFACES	
Corrosion, Removal & Treatment	Semiannually (para 1.5.3.4)
Fasteners, tighten	Semiannually
Paint	Yearly
FOUNDATIONS	
Condition	Yearly
FENCING	
Condition	Yearly
Paint	Yearly
SIGNAGE	
Condition	Yearly
Paint	Yearly
LIGHTNING PROTECTION SYSTEM	
Condition (visual inspection)	Semiannually
ROADS AND WALKWAYS	
Condition	Yearly
Snow removal	Quarterly (in season)
LAND	
Ground cover	Yearly
Grass height	Quarterly (in season)
Snow removal	Quarterly (in season)
ELECTRICAL EQUIPMENT AND CABLES	
Condition (visual inspection)	Semiannually
Operation	Quarterly

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Table 1.5.7. Cleaning Procedure

Step	Procedure
	WARNING Ensure that power has been removed from a peripheral device before cleaning the device. Tools and Material Required: Hand-held vacuum cleaner Mild detergent and water Lint-free cloths
1	**NOTE** Wring out the cloth before washing the screens. Using soft cloth dampened with a mixture of mild detergent and water, clean CRT and display screens and external cases of the peripheral devices. Using lint-free cloth, dry screens and cases.
2	Using small hand-held vacuum cleaner, remove dust from the OID keyboard and the printer.

Table 1.5.8. Corrective Maintenance Symptom Analysis

Symptom	What To Do	How To Do It
SYSTEM/ACU		
System is completely dead.	Check ac and dc power.	Reference ACU ac/dc power distribution diagram (Figure 2.4.12) and verify presence of ac and dc voltages.
Problem with ACU uninterruptible power supply (UPS) in Class II system.	Check UPS.	Paragraph 2.5.3.2
ACU computer does not initialize.	Check VME card rack.	Paragraph 2.5.3.3
Loss of ACU/DCP communications.	Check ACU/DCP communication link.	Paragraph 2.5.3.4
Failure of an SIO board or loss of communication with a peripheral or user.	Check SIO boards.	Paragraph 2.5.3.5
Printer malfunction	Check printer.	Refer to printer vendor manual.
DCP		
DCP is completely dead.	Check ac and dc power.	Reference DCP ac/dc power distribution diagram (Figure 3.4.8) and verify presence of ac and dc voltages. Check fuses on DC Power Distribu-tion Assembly A4A1.
Problem with DCP UPS in Class II system.	Check UPS.	Paragraph 3.5.3.2
DCP computer will not initialize.	Check VME cards.	Paragraph 3.5.3.3
DCP cabinet overheats or becomes too cold.	Check DCP heater circuit.	Paragraph 3.5.3.4
CEILOMETER		
Sensor will not respond.	Check fiberoptic modules. Troubleshoot sensor.	Paragraph 1.5.3.3 Paragraph 9.5.3.2
PRESENT WEATHER SENSOR		
Sensor will not respond.	Check fiberoptic modules. Troubleshoot sensor.	Paragraph 1.5.3.3 Paragraph 7.5.3
PRESSURE SENSORS		
All three pressure sensors read incorrectly.	Clean pressure port.	Paragraph 8.5.2.2
One or two pressure sensors read incorrectly.	Replace faulty sensor(s).	Paragraph 8.5.5
Sensor will not respond.	Troubleshoot sensor.	Paragraph 8.5.3.2
TEMPERATURE/DEWPOINT SENSOR		
Sensor will not respond.	Check fiberoptic modules. Troubleshoot sensor.	Paragraph 1.5.3.3 Paragraph 5.5.3.2
$ **THUNDERSTORM SENSOR**		
$ $ Sensor will not respond.	Check fiberoptic modules. Troubleshoot sensor.	Paragraph 1.5.3.3 Paragraph 16.5.3.2
TIPPING BUCKET		
Sensor fails to report rain accumulation.	Test rain gauge.	Paragraph 10.5.3.2
VISIBILITY SENSOR		
Sensor will not respond.	Check fiberoptic modules. Troubleshoot sensor.	Paragraph 1.5.3.3 Paragraph 6.5.4
WIND SENSOR		
Sensor will not respond.	Check fiberoptic modules. Troubleshoot sensor.	Paragraph 1.5.3.3 Paragraph 4.5.3.2

1.5.4 CORRECTIVE MAINTENANCE

1.5.4.1 **Introduction**. Corrective maintenance involves the isolation, removal, and replacement of faulty FRU's. The ASOS is equipped with a powerful automatic self-test program designed to isolate most faults to a single FRU. However, due to system hardware configuration, there will be instances when the diagnostics can only isolate to a group of FRU's, such as a sensor or an I/O channel. Obviously, the troubleshooting approach for these two types of conditions is very different. When the FRU is specifically called out, the technician need only replace the faulty unit. When a group of FRU's is called out, the technician must isolate the failed FRU by referencing the theory of operation and associated drawings and following two basic procedures.

The first procedure involves connector checks that ensure that all boards, cables, and connectors are present and properly connected. The second procedure involves ac and dc power supply tests. Although the system monitors all critical power supply voltages in the ACU, DCP, and sensors, failure of a power supply may result in a loss of communications between the circuit powered by that supply and the rest of the system. Power supplies are tested by both visual and mechanical inspection. Before measuring any voltages, the technician should visually inspect the suspected area for obvious signs of power supply failure. During this inspection, the technician should pay particular attention to circuit breakers, panel lights, and light emitting diode (LED) indicators on the units to ensure that they are functioning normally. The physical checks involve checking fuses and the power supply voltages using a digital multimeter (DMM). In most cases, these tests isolate the fault.

To ensure proper operation of the system, the technician must allow the ASOS to automatically initialize upon the application of primary power to the ACU and verify that the continuous self-test diagnostics run without failure. Table 1.5.8 provides corrective maintenance symptom analysis information.

1.5.4.2 **System Diagnostics**. The system diagnostics run continuously in the background of the ASOS operating software. The diagnostics complete a check of the entire system every 7 minutes. The test data received via the diagnostic program are displayed on the technician interface screens. These screens are described in Section III of this chapter. Error messages are also entered into the system log and printed on the printer.

1.5.4.3 **Fiberoptic Module Test**. The DCP communicates with its sensors via fiberoptic data links. The ACU can also support up to three local sensors via fiberoptic links. Each fiberoptic link is made up of a fiberoptic module in the DCP (or ACU), a corresponding module in the sensor, and two fiberoptic cables connecting the two fiberoptic modules. The fiberoptic modules in the DCP (or ACU) and the sensors convert electrical RS-232 serial data to optical data and vice versa. The fiberoptic links are not tested automatically by the CST and must therefore be tested manually using an RS-232 test tool to check the electrical data paths. Data communication for all sensors except the model HO83 temperature/dewpoint sensor and the rain gauge is half-duplex. That is, the DCP first polls the sensor and the sensor then returns the requested data. Table 1.5.9 provides a procedure to manually test a fiberoptic link for the half-duplex communications links. The HO83 data link is simplex (one-way only) communication. This sensor outputs data to the DCP (or ACU) on a regular basis. The DCP (or ACU) then simply receives and processes the data. The procedure to test an HO83 data link is provided in table 1.5.10. The rain gauge is not digital communications at all. Rather, the rain gauge simply outputs an optical pulse to the DCP for each tip of its tipping bucket. The rain gauge fiberoptic link is tested as part of the overall sensor test (described in paragraph 10.5.3).

1.5.4.4 **Fiberoptic Cable Replacement**. During initial installation, fiberoptic cable lengths were custom cut to lengths required to run between the sensor and the ACU/DCP or Single Cabinet ASOS (Figure 1.5.1). Replacement fiberoptic cables are available in standardized lengths (Table 1.5.11). When fault isolation identifies the fiberoptic cable as the failure, the technician refers to table 1.5.12 to remove the defective fiberoptic cable, measures the fiberoptic cable length, and round the length up to the nearest standard cable length as identified in table 1.5.11. At most sites, a maximum of two standard cables can be joined using the fiberoptic joiner (62828-90432) to achieve the required length. At sites with a remote wind sensor group, up to three cables can be joined.
The replacement fiberoptic cable part numbers are identified as 62828-42100-XX where XX is the length of the cable (-10, -15, -20, -30, -40, -50, -100 for 10', 15’, 20', 30', 40', 50’ and 100' respectively). As an example, the fiber optic cable length for a rain gauge mounted on pedestal number 6 is 27.5'. After rounding up to the nearest standard length, the 62828-42100-30 (30 foot) fiberoptic cable is selected as the replacement cable.

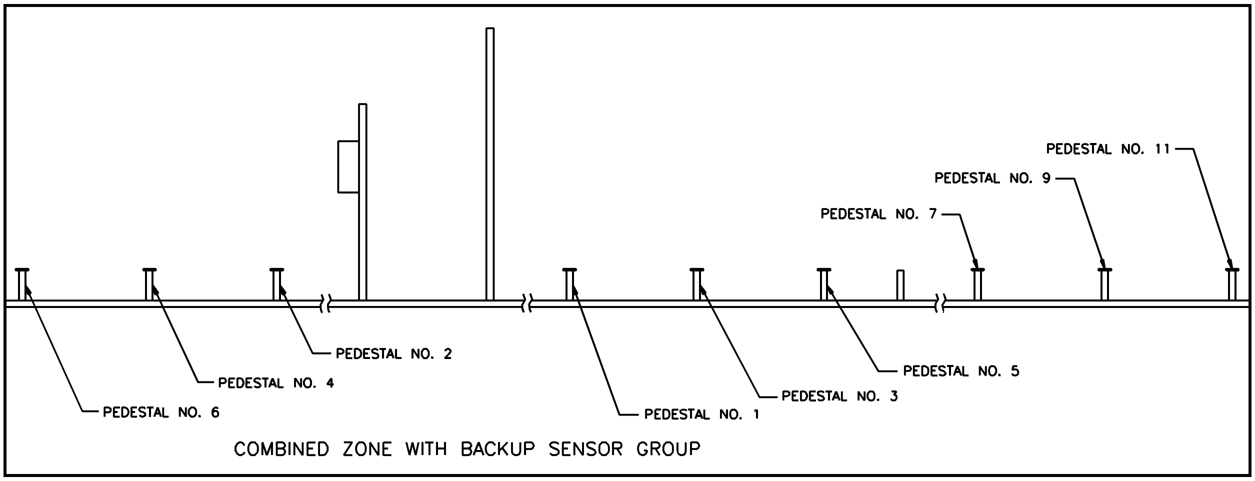

Figure 1.5.1. Combined Zone Pedestal Locational

Table 1.5.9. Fiberoptic Link Testing - Half-Duplex Link

Step	Procedure
1	At the OID, access sensor configuration screen. If the failing sensor is associated with a remote DCP, determine the serial I/O (SIO) port to which the sensor is assigned. Refer to the list of Port Assignments for DCP SIO Boards (Chapter 3, Section IV) to identify the corresponding fiberoptic module. If the failing sensor is associated with the ACU, use this screen to identify the corresponding ACU fiberoptic module.
2	At DCP (or ACU), connect RS-232 test tool (Figure 1.5.2) in line with fiberoptic module (DTE to modem) for failing sensor (between fiberoptic module and corresponding DB-9 connector from cabinet harness).
3	On RS-232 test tool, verify periodic RxD signal activity from SIO board. If no activity, problem is in SIO board in DCP (or ACU). If activity is present, proceed to step 4.
4	On RS-232 test tool, verify TxD signal activity from fiberoptic module. If TxD signal is active, problem is in SIO board. If no activity is present, proceed to step 5.
5	Remove RS-232 test tool from fiberoptic module and reconnect DB-9 connector to module.
6	At failing sensor, connect RS-232 test tool in line with the sensor fiberoptic module (DTE to modem) between fiberoptic module and corresponding DB-9 connector from cabinet harness.
7	On RS-232 test tool, verify periodic activity on TxD signal from fiberoptic module in DCP (or ACU). If signal is active, continue with step 8. If signal is not active, proceed to step 9.
8	On RS-232 test tool, verify periodic activity on RxD signal from sensor. If no activity, problem is in sensor serial data interface circuits. If both TxD and RxD signals are active, proceed to step 9.
9	Remove RS-232 test tool from sensor fiberoptic module and reconnect DB-9 connector to module. One at a time, remove and replace the following units and retest system until the problem is corrected: a. Fiberoptic module in DCP (or ACU) b. Fiberoptic module in sensor c. Fiberoptic cable

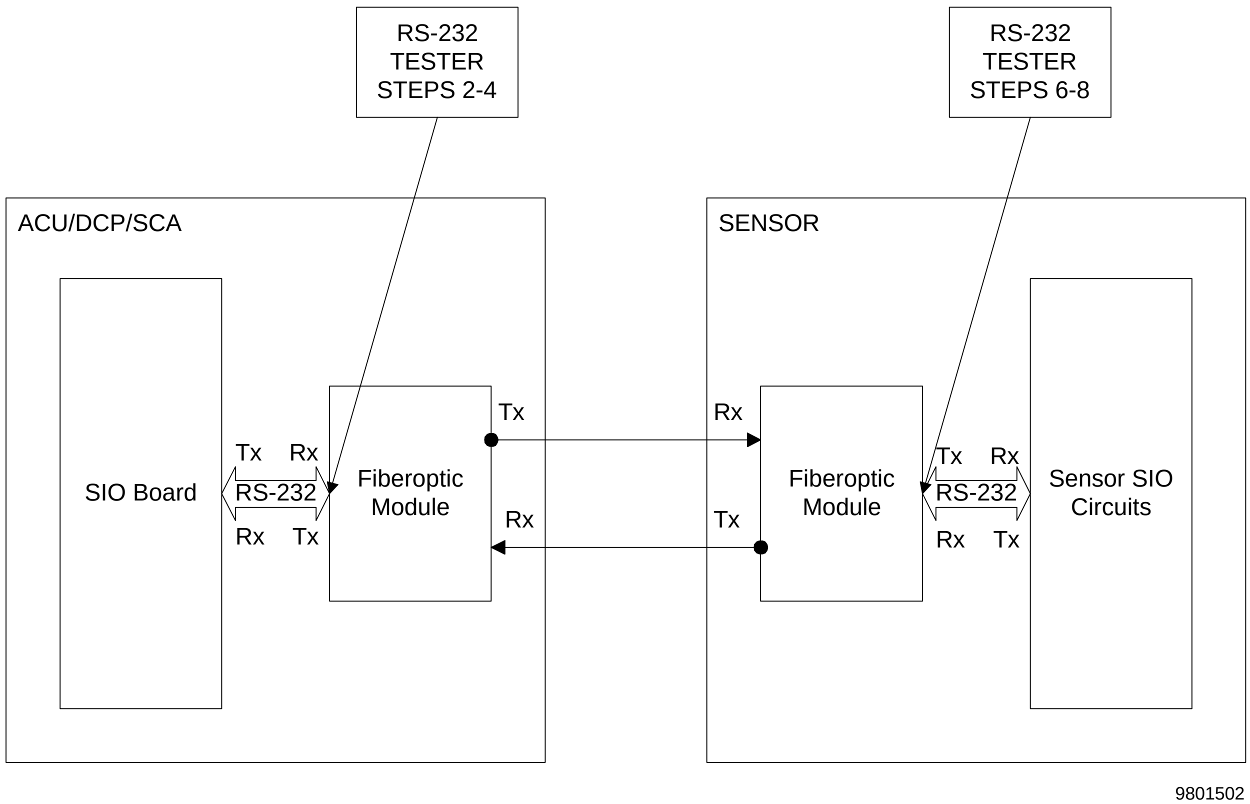

Figure 1.5.2. Fiberoptic Link Testing - Half-Duplex Link

Table 1.5.10. Fiberoptic Link Testing - HO83 Link

Step	Procedure
1	In the HO83 sensor, connect RS-232 test tool in line with sensor fiberoptic module (between fiberoptic module and corresponding DB-9 connector from cabinet harness).
2	Verify periodic activity of RxD signal on RS-232 test tool. If signal is active, proceed to step 3. If not, problem is in serial data interface in HO83 sensor.
3	Remove RS-232 test tool from HO83 fiberoptic module and reconnect DB-9 connector to module.
4	At OID, access sensor configuration screen. If HO83 sensor is associated with a remote DCP, determine SIO port to which the sensor is assigned. Refer to the list of Port Assignments for DCP SIO Boards (Chapter 3, Section IV) to identify the corresponding fiberoptic module. If HO83 sensor is associated with the ACU, use this screen to identify the corresponding ACU fiberoptic module.
5	In DCP (or ACU), connect RS-232 test tool in line with fiberoptic module for HO83 sensor (between fiberoptic module and corresponding DB-9 connector from cabinet harness).
6	Verify periodic activity of TxD signal on RS-232 test tool. If signal is active, problem is in DCP (or ACU) SIO board. If signal is not active, proceed with step 7.
7	Remove RS-232 test tool from fiberoptic module and reconnect DB-9 connector to module. One at a time, remove and replace the following units and retest system until the problem is corrected: a. Fiberoptic module in DCP (or ACU) b. Fiberoptic module in sensor c. Receive fiberoptic cable between DCP (or ACU) and sensor.

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Table 1.5.11. ASOS Fiberoptic Cables

Pedestal	Typical Sensor	Req. Length	New Length	New Part Number (Ref Des)	Old Part Number (Ref Des)
6	Rain Gauge	27.5'	30'	62828-42100-30 (W120)	62828-42040-60 (W23)
4	Temp/Dew	25.5'	30'	62828-42100-30 (W118)	62828-42040-40 (W21)
2	LEDWI	18'	20'	62828-42100-20 (W116)	62828-42040-20 (W19)
N/A	Thunderstorm	8'	10'	62828-42100-10 (W124)	N/A
1	Ceilometer	19.5'	20'	62828-42100-20 (W115)	62828-42040-10 (W18)
3	Freezing Rain	25.5'	30'	62828-42100-30 (W117)	62828-42040-30 (W20)
5	Visibility	28'	40'	62828-42100-40 (W119)	62828-42040-50 (W22)
N/A	Wind	26'	TBD	62828-42100-xx (W121)	62828-42040-80 (N/A)
7	Ceilometer	36.5'	50'	62828-42100-50 (W122)	N/A
9	Reserved	42.5'	50'	62828-42100-50	N/A
11	Visibility	48'	50'	62828-42100-50 (W123)	N/A

Table 1.5.12. Fiberoptic Cable Replacement

Step	Procedure
	Fiberoptic Cable Removal
	Tools required: Small flat-tipped screwdriver No. 1 Phillips screwdriver **WARNING** Death or severe injury may result if power is not removed from cabinet prior to maintenance activities. Ensure that UPS POWER switch is set to 0 (off) position and facility power is removed from cabinet.
1	If applicable, set UPS POWER switch to off (0) position.
2	Set primary Circuit Breaker Module to OFF position.
3	At ac junction box, remove facility power from equipment cabinet by setting cabinet circuit breaker to off.
4	Using Phillips screwdriver, remove 22 screws and flat washers securing shielded cover assembly to Faraday box. Lower Faraday box cover.
5	Accessing underside of fiberoptic module through Faraday box, disconnect fiberoptic transmit (TX) and receive (RX) cables.
6	Remove fiberoptic cable from cabinet.
7	At the sensor associated with the faulty fiberoptic cable, access underside of fiberoptic module and disconnect fiberoptic transmit (TX) and receive (RX) cables.
8	Remove fiberoptic cable from sensor.
9	Remove fiberoptic cable from raceway.
10	Measure length of faulty fiberoptic cable, round the length up to the nearest standard cable length as identified in the parts list and order replacement cable.

Table 1.5.12. Fiberoptic Cable Replacement -CONT

Step	Procedure
	FIBEROPTIC CABLE INSTALLATION
	Tools required: Small flat-tipped screwdriver No. 1 Phillips screwdriver **WARNING** Death or severe injury may result if power is not removed from cabinet prior to maintenance activities. Ensure that UPS POWER switch is set to 0 (off) position and facility power is removed from cabinet. **NOTE** Replacement fiberoptic cables must be properly marked prior to installation.
1	At equipment cabinet end of the replacement fiberoptic cable, apply the appropriate information to the wrap around tags using the following definitions: a. On marker FOM#: line, write three letter code for ACU, DCP, or SCA followed by the fiberoptic modem number (1-3 for ACU, 1-16 for DCP, 1-13 for SCA). b. On marker SENSOR: line, write two character software code for sensor as follows: C1, C2, C3 for Ceilometer 1 thru 3 V1, V2, V3 for Visibility 1 thru 3 PW for Present Weather FR for Freezing Rain WS for Wind Sensor TD for Temperature/Dewpoint TB for Tipping Bucket TS for Thunderstorm c. On marker COUPLED? Y N line, circle Y if replacement cable uses two cables connected by a fiberoptic joiner or circle N if one cable is used.
2	Repeat step 1 for sensor end of replacement fiberoptic cable.
3	If applicable, at UPS, ensure that UPS POWER switch is set to off (0) position.
4	Ensure that power is removed from equipment cabinet.
	CAUTION Bending the fiberoptic cable during installation beyond the minimum bend radius of 1.8 inches could damage the cable. The minimum bend radius for long term storage is 1.2 inches. Ensure that the minimum bend radius is not exceeded. **NOTE** If two standard fiberoptic cables are joined to form the replacement cable, connect TX to RX at each fiberoptic joiner (62828-90432). Couplers, if used, must be installed in an area that will not contact standing water.
5	Route replacement fiberoptic cable between sensor and equipment cabinet. Ensure that sufficient length of cable remains at each end to connect to the fiberoptic modems. Store excess cable in Faraday box, raceway, or sensor as applicable.
6	At sensor, using tags as a guide, connect fiberoptic TX and RX cables to module connector.
7	At equipment cabinet, using tags as a guide, connect fiberoptic TX and RX cables to appropriate module connector though opened Faraday box.
8	Using Phillips screwdriver, install screws and flat washers securing shielded cover assembly to Faraday box.
9	Apply facility power to equipment cabinet by setting circuit breaker in ac junction box to on position.
10	Set primary Circuit Breaker Module to ON position.
11	If applicable, set UPS POWER switch to 1 (on) position.

CHAPTER 2

ACQUISITION CONTROL UNIT (ACU) AND PERIPHERALS

SECTION I. DESCRIPTION AND LEADING PARTICULARS

2.1.1 INTRODUCTION

The acquisition control unit (ACU) and associated peripherals (Figure 2.1.1) provide central control and user interface for the Automated Surface Observing System (ASOS). The ACU is used for data acquisition, processing, quality checks, storage, formatting, and output. The ACU is also used to control system self-test and diagnostics and to interface with all operator displays and external communications with the system. This Chapter provides the physical description, installation procedures, operation procedures, theory of operation, and maintenance procedures for the ACU and associated peripherals.

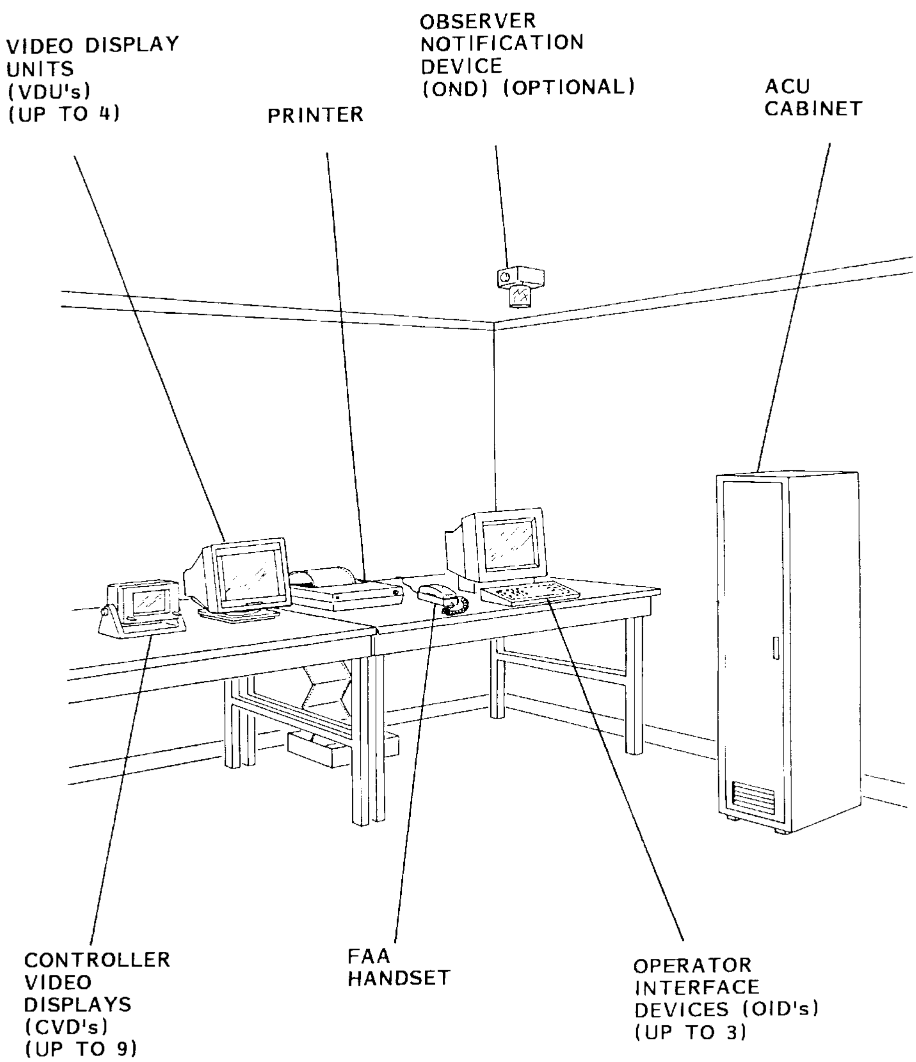


Figure 2.1.1. ACU and Peripherals

2.1.2 **PHYSICAL DESCRIPTION**

As shown in figure 2.1.1, a typical ACU/peripheral installation contains the following major units:

a. ACU Cabinet, Unit 1

b. Up to 17 Controller Video Displays (CVD's), Units 81 through 89 (first CVD location) and 91 through 98 (second CVD location)

c. Printer, Unit 12

d. FAA Handset, Unit 5

e. Up to three Operator Interface Devices (OID's), Units 11, 21, and 31

f. Optional Observer Notification Device (OND), Unit 6

g. Up to ten Video Display Units (VDU's), Units 41 through 44 (first VDU location), Units 51 through 53 (second VDU location), Units 61 and 62 (third VDU location), and Unit 71 (fourth VDU location)

The ACU communicates with the data collection package (DCP) via either a radio frequency (rf) modem link or via a direct line link. When an rf modem link is used, an RF Antenna (1E1) is also connected to the ACU. Most sites use omnidirectional antennas. Yagi antennas and attenuators are installed at sites where co-channel interference is experienced. In addition to the above listed equipment, the ACU may be equipped with a video driver option that allows it to drive external airline displays which are not part of the actual ASOS.

2.1.2.1 **Class I and Class II Systems**. Throughout this Chapter and Chapter 3, a distinction is made between Class I systems and Class II systems. The Class I system is the basic model ASOS. This model will be installed at most Class I (non-towered) airports and other observation sites. The Class II ASOS is almost identical to the Class I system, except that all Class II systems have the following additional features to increase system availability and performance:

a. Uninterruptible power supplies (UPS's) and UPS bypass circuits in the ACU and DCP that allow the ASOS to operate in the event of a loss of facility ac power.

b. A third (redundant) pressure sensor in the ACU (Class I system has two). This third sensor allows the ASOS to continue to report altimeter settings and pressure data even if one of its three pressure sensors fails.

c. Redundant communications equipment for ACU/DCP data communications. This includes a second rf modem (or line driver) in both the ACU and DCP, and a second CPU in the DCP.

d. Electromagnetic interference (EMI) shielded ACU and DCP cabinets

These features are available as options for Class I systems.

2.1.2.2 **__ACU Cabinet__**. The ACU cabinet (Figure 2.1.2) measures 70 inches high, 25 inches wide, and 32 inches deep. For Class II systems, honeycombed rf filters in the front and rear doors of the cabinet and rf gaskets on the doors provide EMI shielding for up to 100 decibels (db). The cabinet contains five equipment racks, a battery box, a blower, and a connector panel. Brief descriptions of these components are provided in table 2.1.1.

2.1.2.2.1 **ACU Tie-Down**. In earthquake prone areas, the ACU is anchored down (at sites not using equipment shelters) with two sections of construction "U" channel and attaching hardware (including associated materials). The ACU tie-down installation method is determined by the material that the ACU is being attached to (wood or concrete). The ACU tie-down installation procedure (including all parts and tools needed) is contained in table 2.5.32. ACU's installed in equipment shelters that are in earthquake prone areas will use a different anchoring scheme, which is as yet undetermined.

2.1.2.3 **__Controller Video Displays (CVD's)__**. The ACU can drive up to nine CVD's located in the airport control tower for use by air traffic controllers. Each CVD is a liquid crystal display (LCD) that may be either a free standing unit or panel mounted. The CVD displays the following information:

a. Wind direction and speed

b. Altimeter setting

c. Most recent hourly meteorological report (METAR) data

2.1.2.4 **__Printer__**. The printer is a dot matrix type printer that features several fonts and print quality modes. The features, operation, and maintenance of this printer are explained in the corresponding printer operation manual. Refer to paragraph 2.5.7 for printer setup procedures. The following types of information are automatically printed:

a. Initials of persons signed on and off system

b. 1-minute observations before and after editing

c. Equipment and communications failures $

d. Reason for alarms

e. Daily and monthly summaries

f. Hourly meteorological reports (METAR's) and SPECI's at end of day (15 minutes past midnight)

g. Edits to meteorological reports (METAR's) by the observer $

The printer also produces hard copies of OID displays in response to user requests.

2.1.2.5 **__FAA Handset__**. The FAA handset allows operators to monitor audio weather reports generated by the ASOS and to append verbal comments to the audio reports.

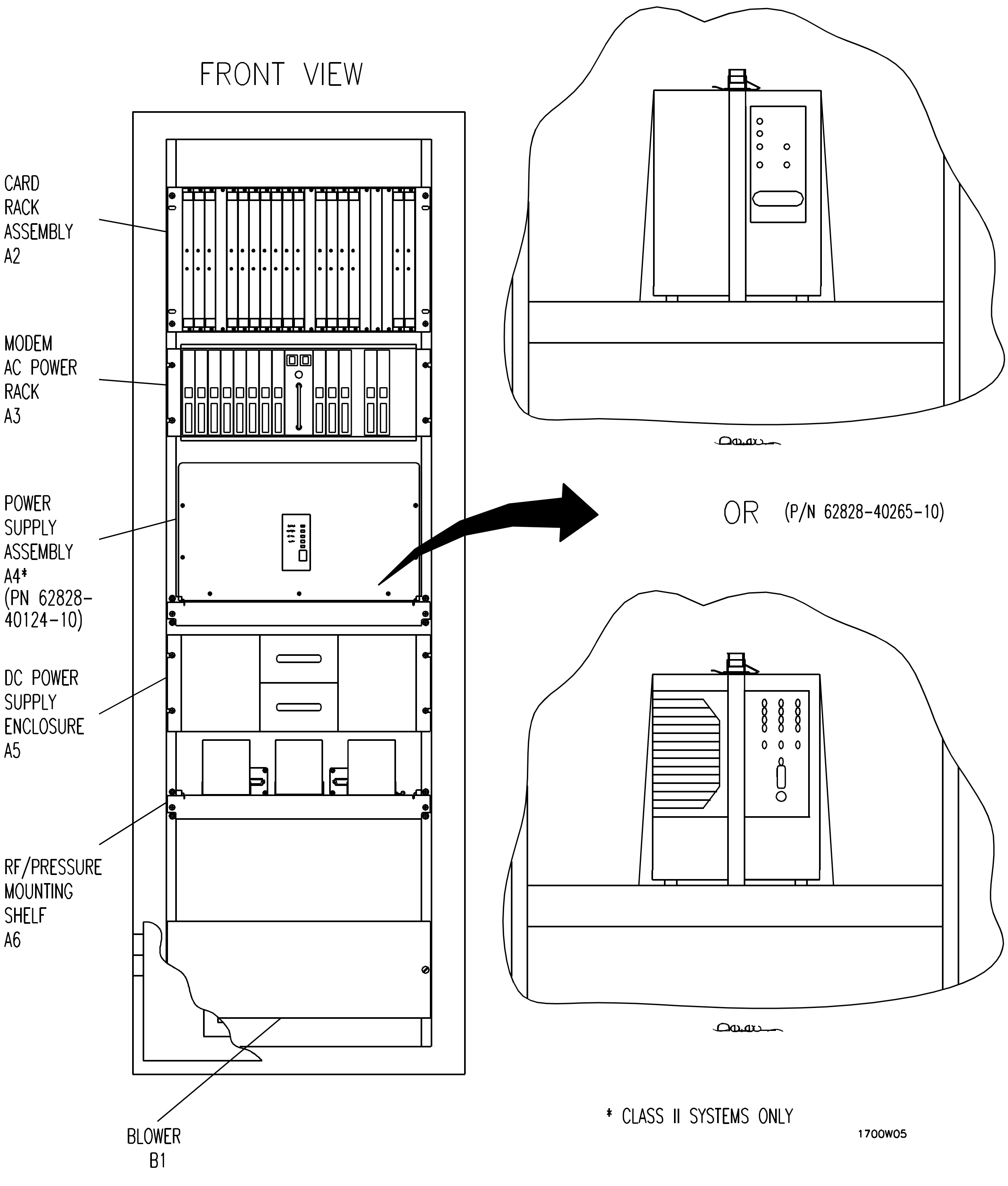


Figure 2.1.2. ACU Cabinet Unit 1 Locational View (Sheet 1 of 2)

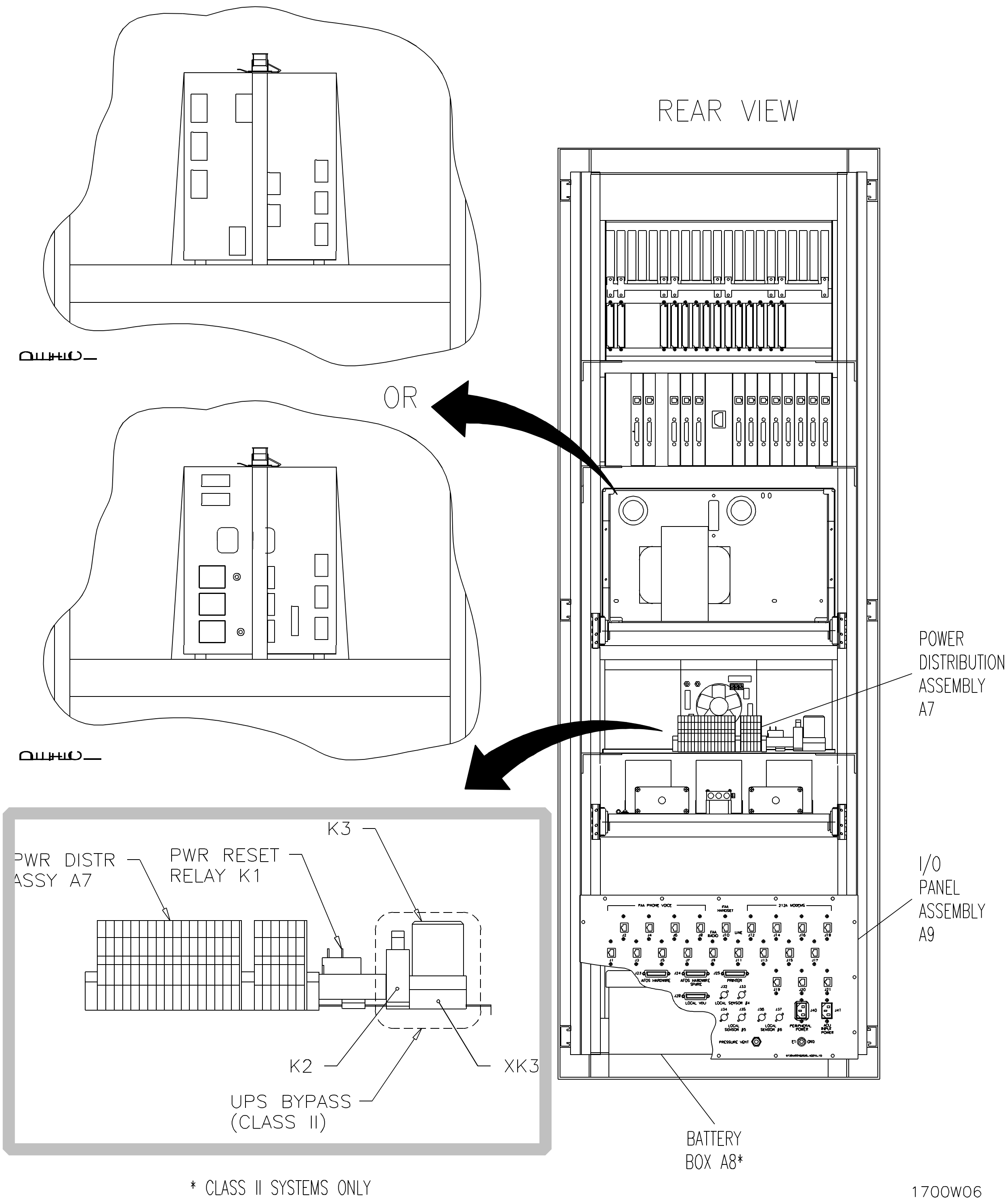


Figure 2.1.2. ACU Cabinet Unit 1 Locational View (Sheet 2)

Table 2.1.1. ACU Cabinet Major Assemblies

Unit	Name	Figure	Purpose
1A1	Codex Modem	-	ADAS modem, refer to Chapter 13.
1A2	Card Rack Assembly	2.1.3	Contains up to 16 circuit boards that perform all of the data processing and input/output (I/O) functions associated with the ACU.
1A3	Modem AC Power Rack	2.1.4	Contains up to 10 modems, which are used for all telephone communications with the ACU. May also contain up to two line drivers for ACU/DCP communication (when rf modems are not used).
1A4	Power Supply Assembly	2.1.5	Provides an uninterruptible power supply (UPS) that supplies power to the ACU in the event of main facility power loss. The UPS supplies ac power for the ACU cabinet, printer, and primary OID for a minimum of 10 minutes. Power Supply Assembly 1A4 is installed in Class II systems and in Class I systems where it has been installed as an option. Power Supply Assembly 1A4 may be one of two different assemblies. Power supply assembly, part number 62828-40124-10 (Figure 2.1.5, sheet 1), is installed in systems having serial numbers 437 and below and contains UPS part number 62828-90057. Systems having serial numbers 438 and above contain power supply assembly 62828-40265-10 (sheet 2). This assembly contains either UPS part number 62828-90338-10 or 62828-90338-20.
1A5	DC Power Supply Enclosure	2.1.6	Rack containing two dc power supplies. Each power supply provides +5V, +12V, and -12V for the ACU cabinet.
1A6	RF/Pressure Mounting Shelf	2.1.7	Slide-mounted shelf containing rf modems and pressure sensors. For Class I systems, the shelf contains one rf modem (unless communication is by line driver) and two pressure sensors. For Class II systems, the shelf contains a second rf modem, an rf modem switch, and a third pressure sensor. For Class II systems using line driver communication, rf modems are not installed and an LD1/LD2 switching board replaces the rf modem switch.
1A7	Power Distribution Assembly	-	Terminal strip that distributes ac and dc power within the ACU. Contains Power Reset Relay K1 and in Class II systems contains UPS Bypass Relays K2 and K3.
1A8	Battery Box	2.1.8	Contains either four or five 12-volt batteries for the UPS. Battery Box 1A8 may be one of three different assemblies. Battery box part number 62828-40063-10 contains five batteries, which are used with power supply assembly part number 62828-40124-10. Battery box part number 62828-40063-30, referred to as the interim battery box, contains four batteries and packing material and is used with power supply assembly part number 62828-40265-10. Battery box part number 62828-40262-20, referred to as the production model battery box, is similar to part number 62828-40063-30 but is physically smaller. It contains four batteries and is also used with power supply assembly part number 62828-40265-10.
1A9	I/O Panel Assembly	2.1.9	The main interface panel for all external connections to the ACU. Main facility power is applied to the system via AC INPUT POWER connector J41 on this panel. PERIPHERAL POWER connector J40 is controlled by the UPS (in Class II systems) and supplies UPS ac power to the primary OID and printer.
B1	Blower	-	Cools the ACU cabinet.

2.1.2.6 **Operator Interface Devices (OID's)**. The OID consists of a display and a keyboard and provides full control over all aspects of the ASOS. The ACU may have multiple OID's. One local OID, also known as the primary OID, is located within 100 feet of the ACU. Two secondary OID's (not shown) may be located up to 3 miles from the ACU. Communication using remote OID's is accomplished over telephone lines using modems. There are four types of OID users: observers, air traffic controllers, system managers, and technicians. Different log-on sequences and passwords for each type of user allow tailored control of the appropriate systems. Only those displays pertinent to the particular user are available to that user.

2.1.2.7 **RF Antenna**. The rf antenna enables ACU/DCP communications and operates within the ASOS operating frequency (410.075 or 410.950 MHZ). Because the rf antenna is an omnidirectional antenna, its use reduces the placement restrictions of the DCP's. Most sites use the omnidirectional antennas. Yagi antennas and attenuators are installed at sites where co-channel interference is experienced.

2.1.2.8 **Observer Notification Device (OND)**. One of the ASOS configurations includes an OND, which is an alarm light, similar to the on-the-air indicators used in radio stations. The OND light blinks on and off to alert the observer or air traffic controller that a report (METAR or SPECI) is soon to be transmitted and that it may be edited during the pretransmission period. The OND light blinks until the edit time ends and the report is transmitted.

2.1.2.9 **Video Display Unit (VDU)**. Up to four VDU's can be placed at various locations in the airport. The VDU is a 12-inch diagonal monochrome cathode ray tube (CRT) display. The VDU displays the current ASOS 1-minute weather observations and the most recently transmitted METAR.

2.1.2.10 **Airline Displays**. The ACU can have a number of airline displays distributed throughout the airport complex. These displays are industrial terminals without keyboards that are not a part ASOS. Each airline display presents ASOS 1-minute weather observations and other OID displays.

2.1.3 ACU CONFIGURATIONS

The ACU (P/N 62828-40044) has six possible configurations as shown below:

-10 Class II system as described in paragraphs 2.1.2 and 2.1.2.1. The -10 system uninterruptible power supply is built by SOLA. The SOLA battery box contains five 12V lead-acid batteries.

-20 Standard Class I system as described in paragraphs 2.1.2 and 2.1.2.1.

-30 Class II system as described in paragraphs 2.1.2 and 2.1.2.1. The -30 system’s uninterruptible power supply is built by DELTEC. The DELTEC battery box contains four 12V lead-acid batteries.

-40 Class I system as described in paragraphs 2.1.2 and 2.1.2.1. The -40 system includes an uninterruptible power supply built by DELTEC.

-50 Class I system as described in paragraphs 2.1.2 and 2.1.2.1. The -50 system includes a third pressure sensor installed for improved reliability.

-60 Class I system as described in paragraphs 2.1.2 and 2.1.2.1. The -60 system includes an uninterruptible power supply built by DELTEC and a third pressure sensor installed for improved reliability.

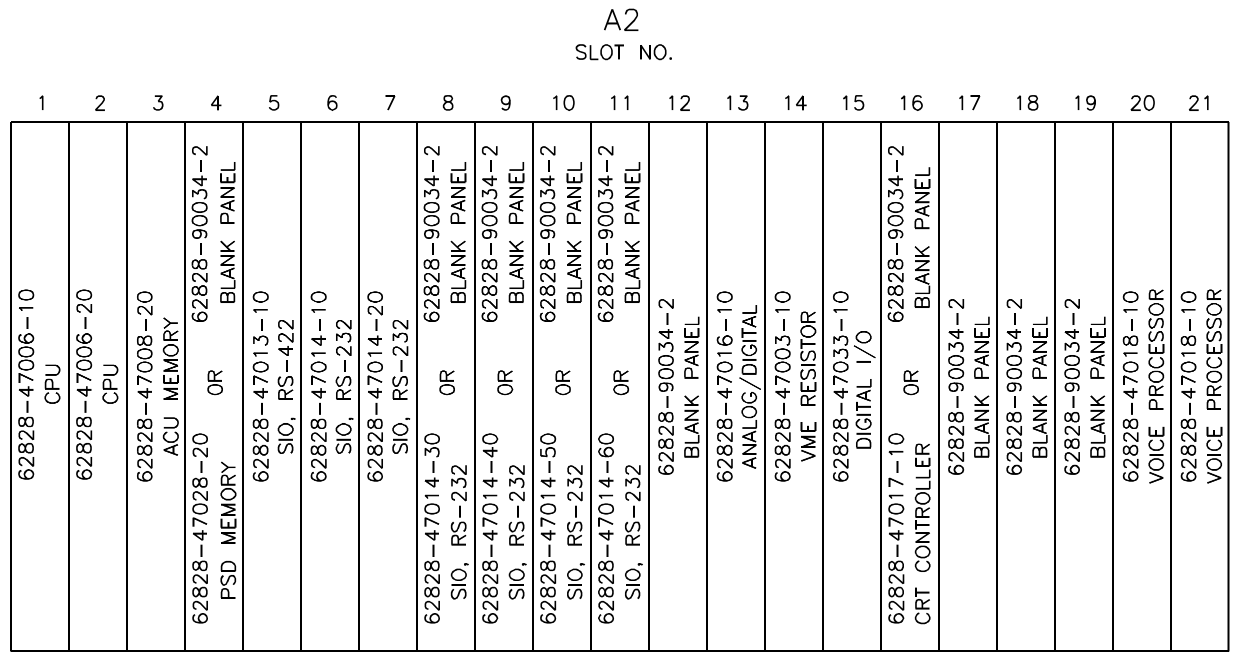


Figure 2.1.3. Card Rack Assembly 1A2

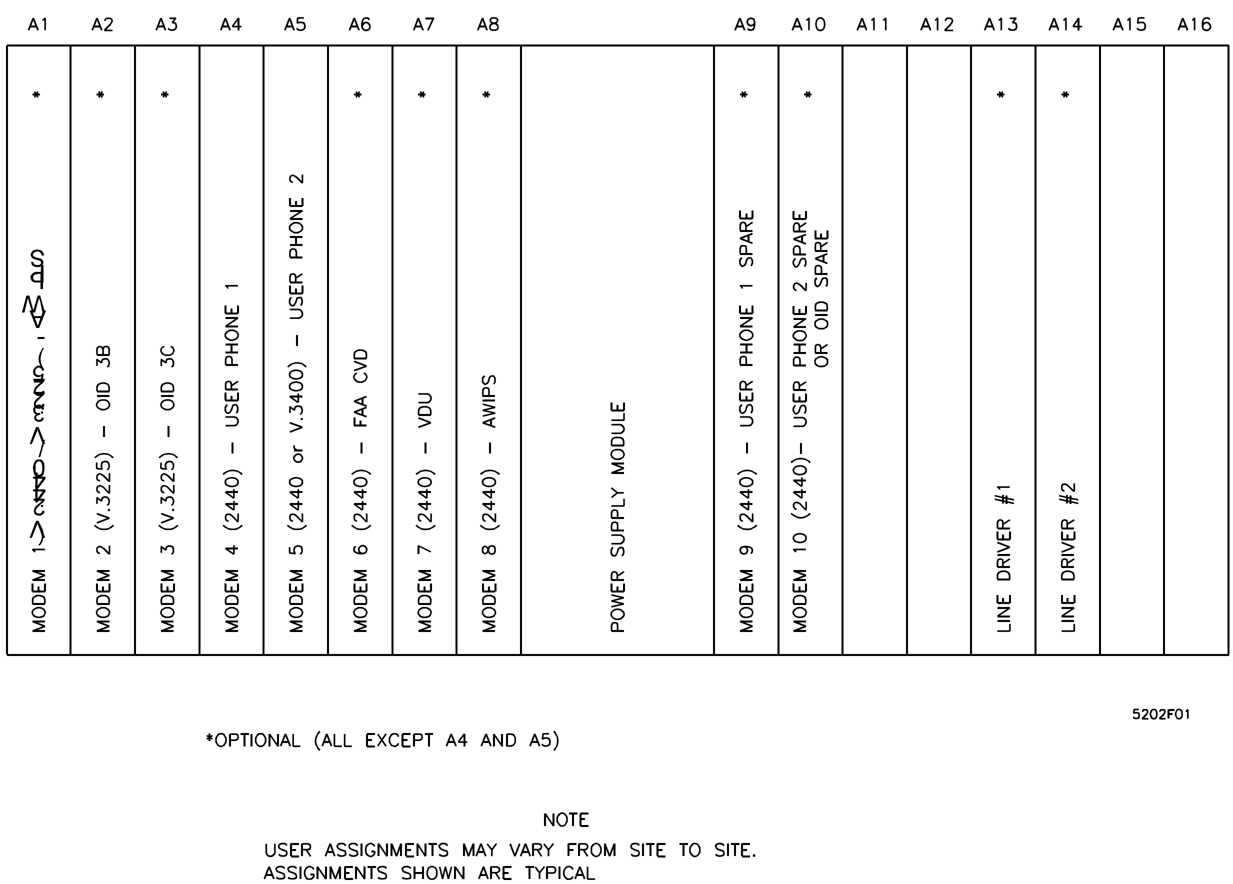


Figure 2.1.4. Modem AC Power Rack 1A3

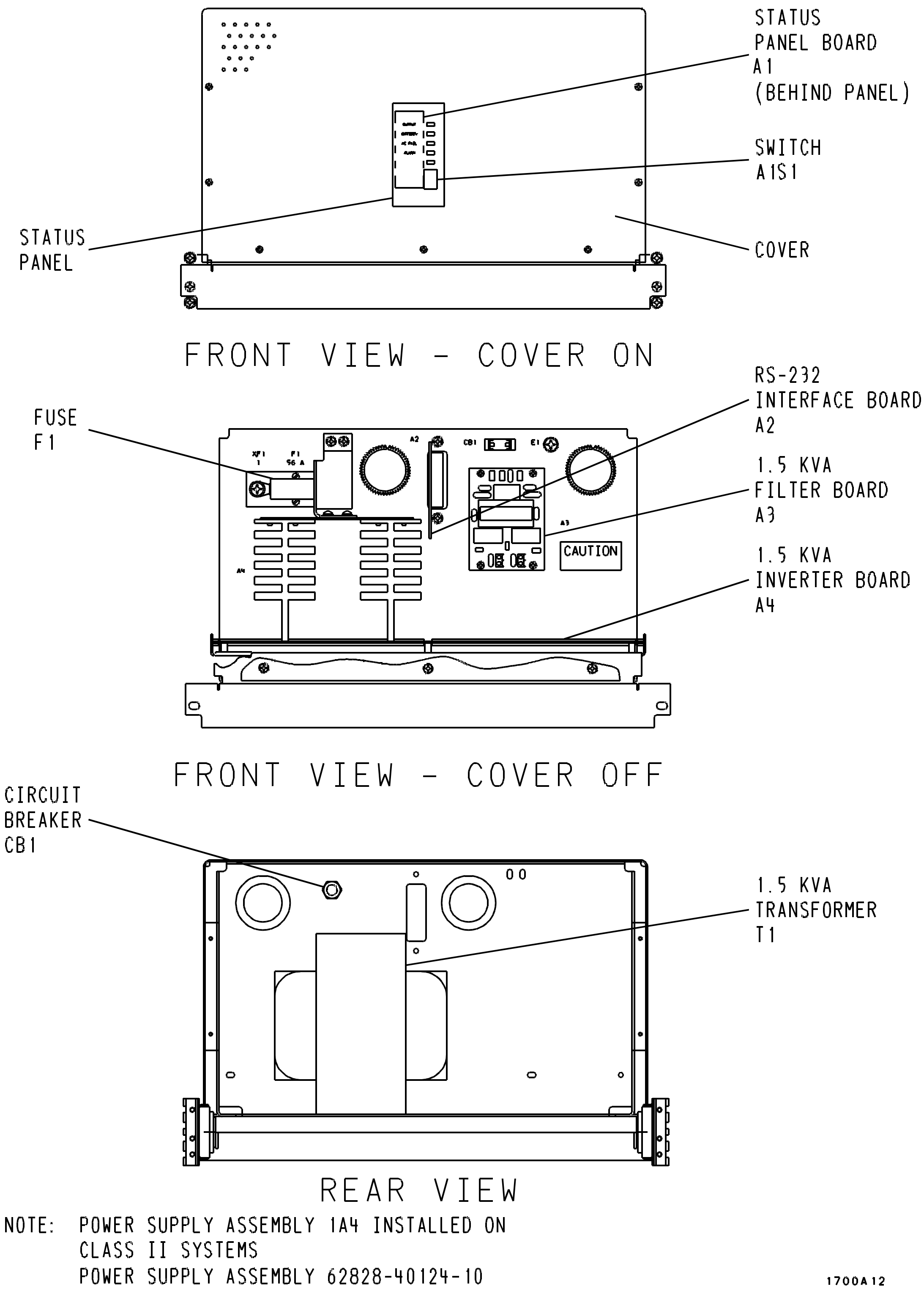
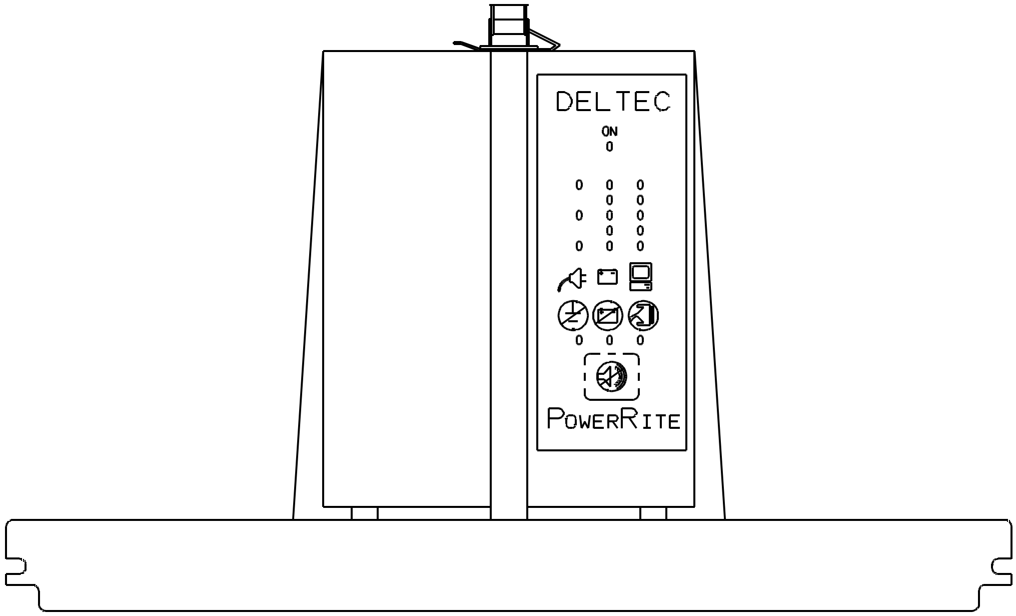
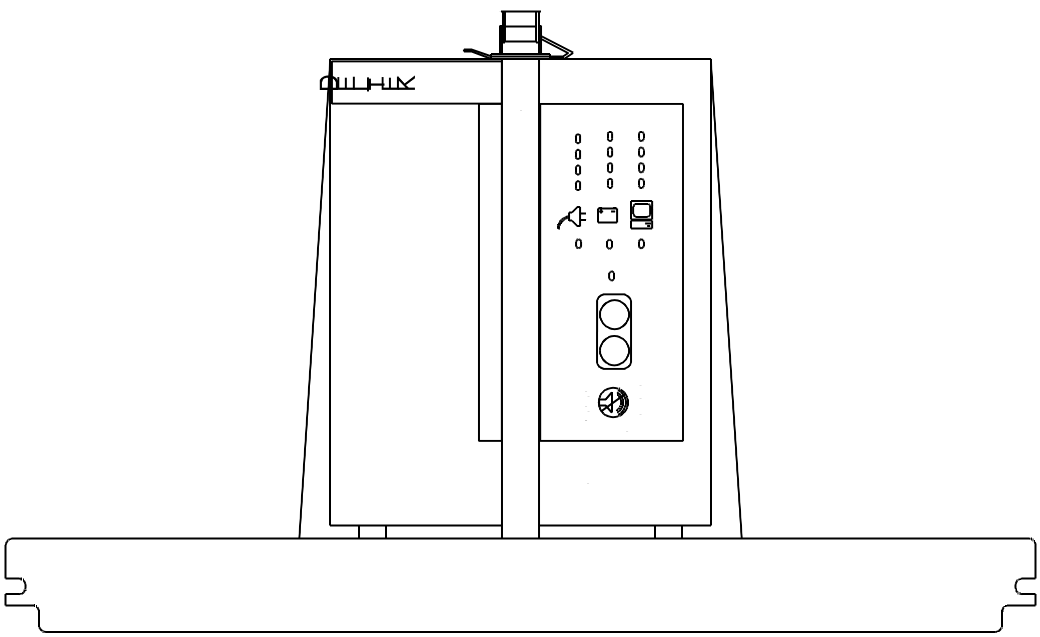


Figure 2.1.5. Power Supply Assembly 1A4 (Sheet 1 of 2)



FRONT VIEW



FRONT VIEW

Figure 2.1.5. Power Supply Assembly 1A4 (Sheet 2)

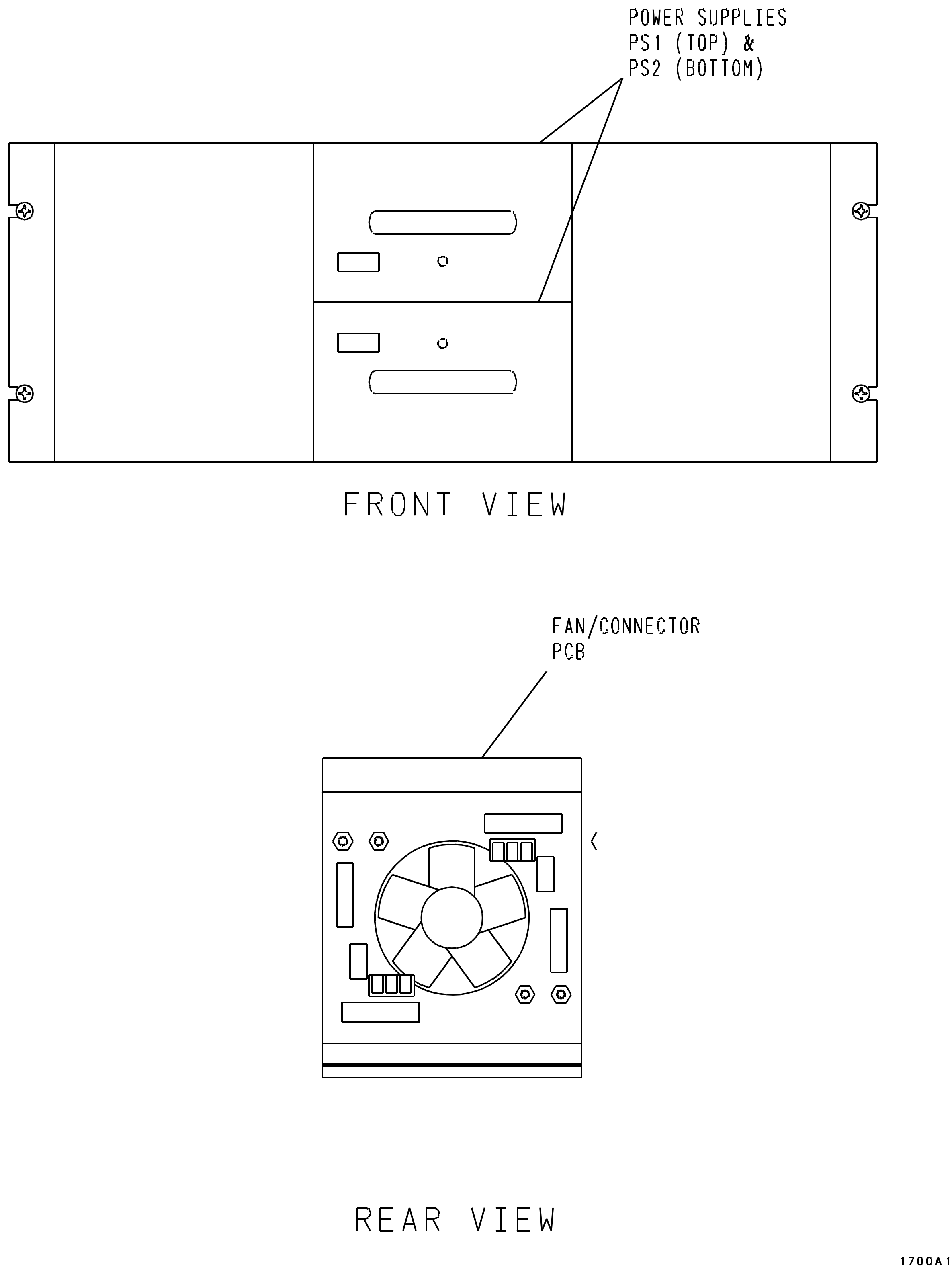


Figure 2.1.6. DC Power Supply Enclosure 1A5

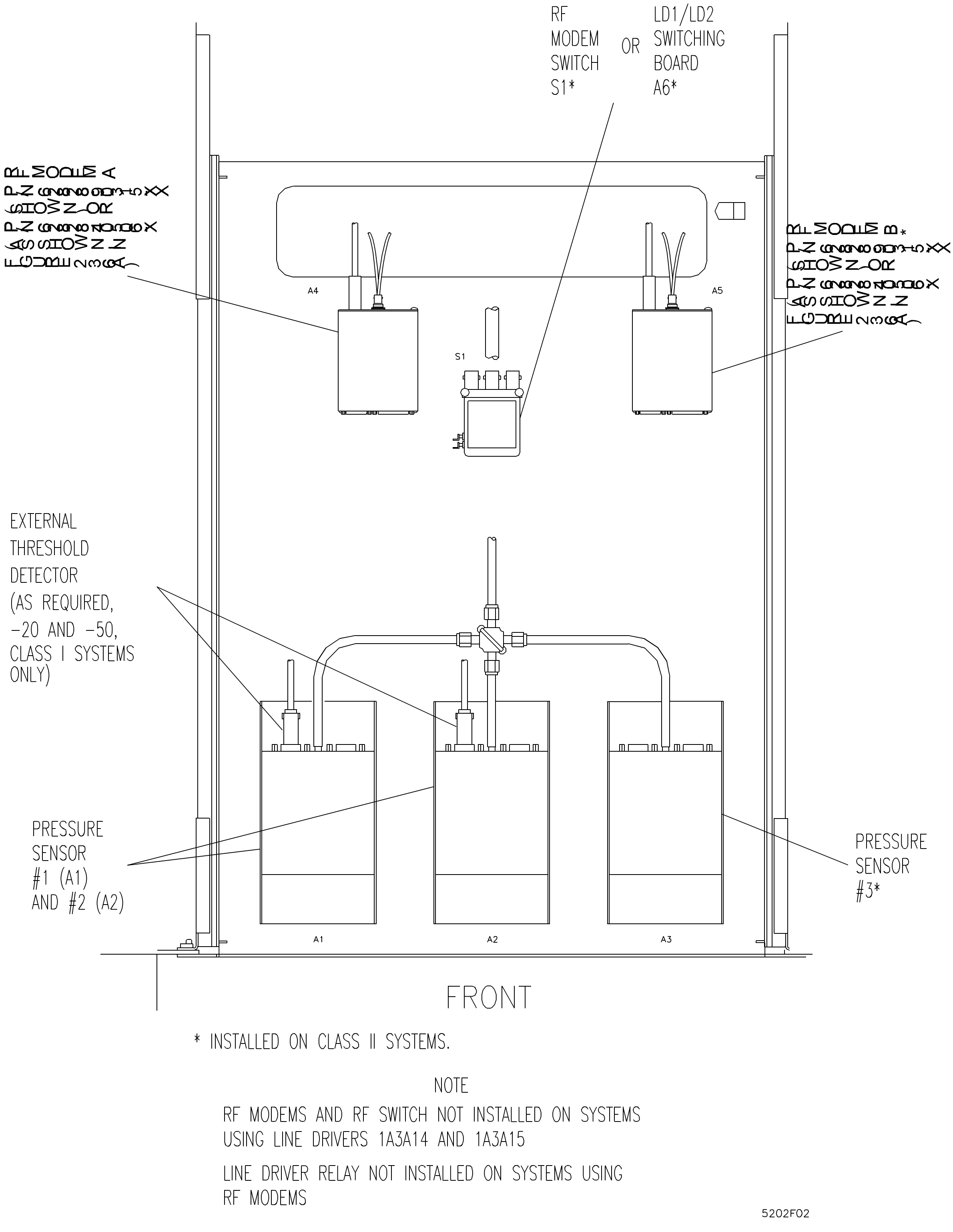


Figure 2.1.7. RF/Pressure Mounting Shelf 1A6 (Sheet 1 of 2)

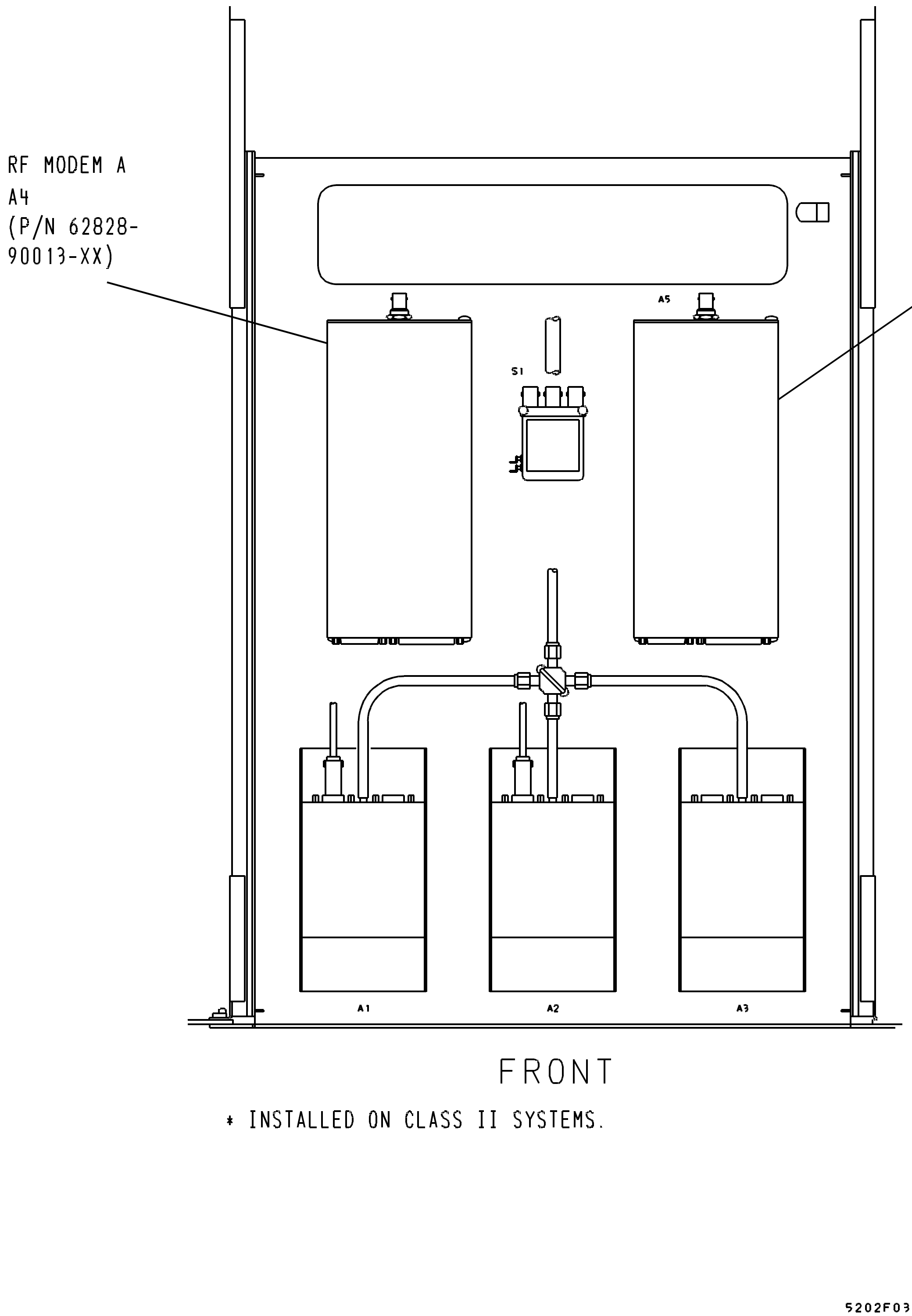
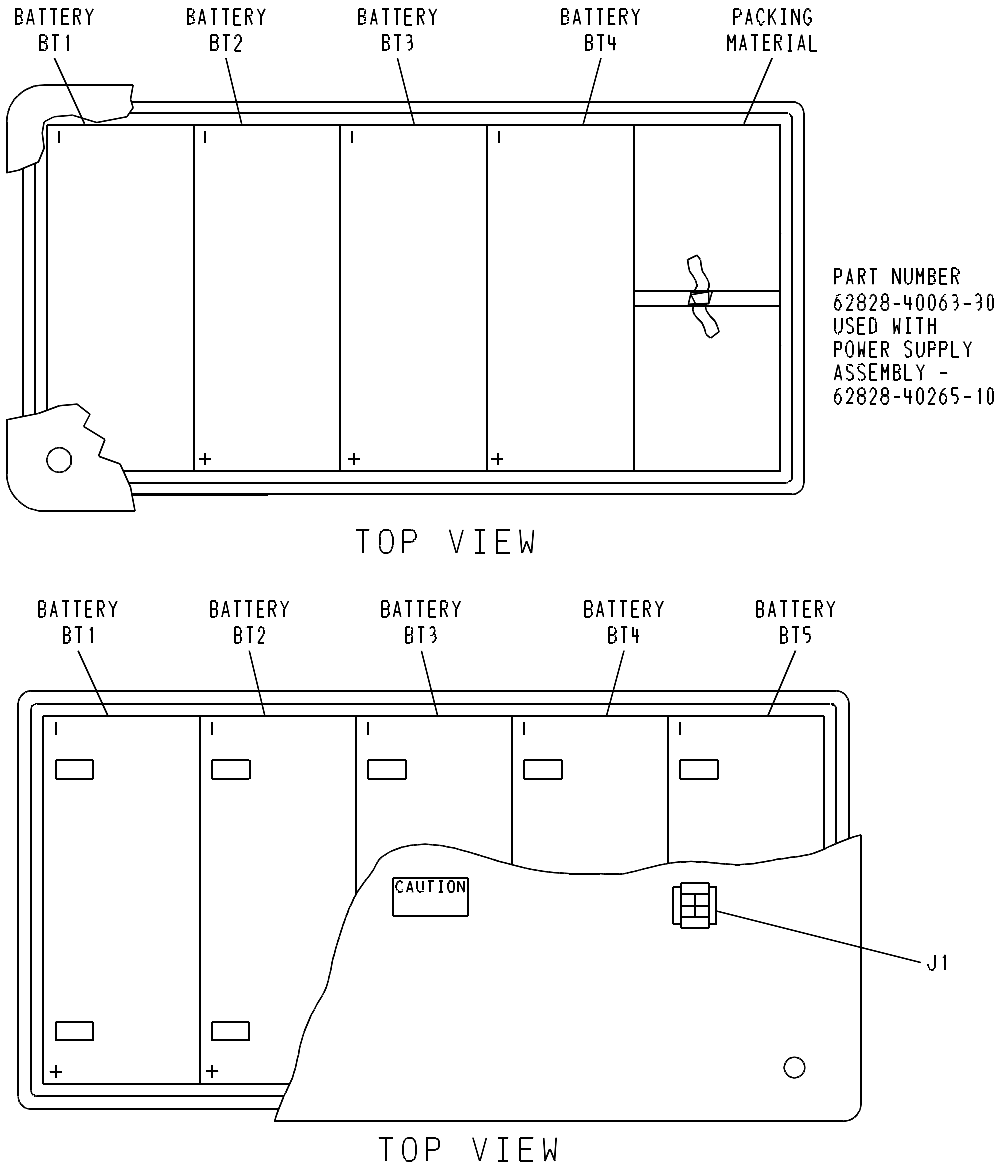


Figure 2.1.7. RF/Pressure Mounting Shelf 1A6 (Sheet 2)



PART NUMBER 62828-40063-10 USED WITH
POWER SUPPLY ASSEMBLY - 62828-40124-10

NOTES:

1. PORTION OF TOP COVER SHOWN.
2. BATTERY BOX 1A8 INSTALLED ON ALL CLASS II SYSTEMS AND ON THOSE CLASS I SYSTEMS WHERE IT HAS BEEN INSTALLED AS AN OPTION.

1700W03

Figure 2.1.8. Battery Box 1A8

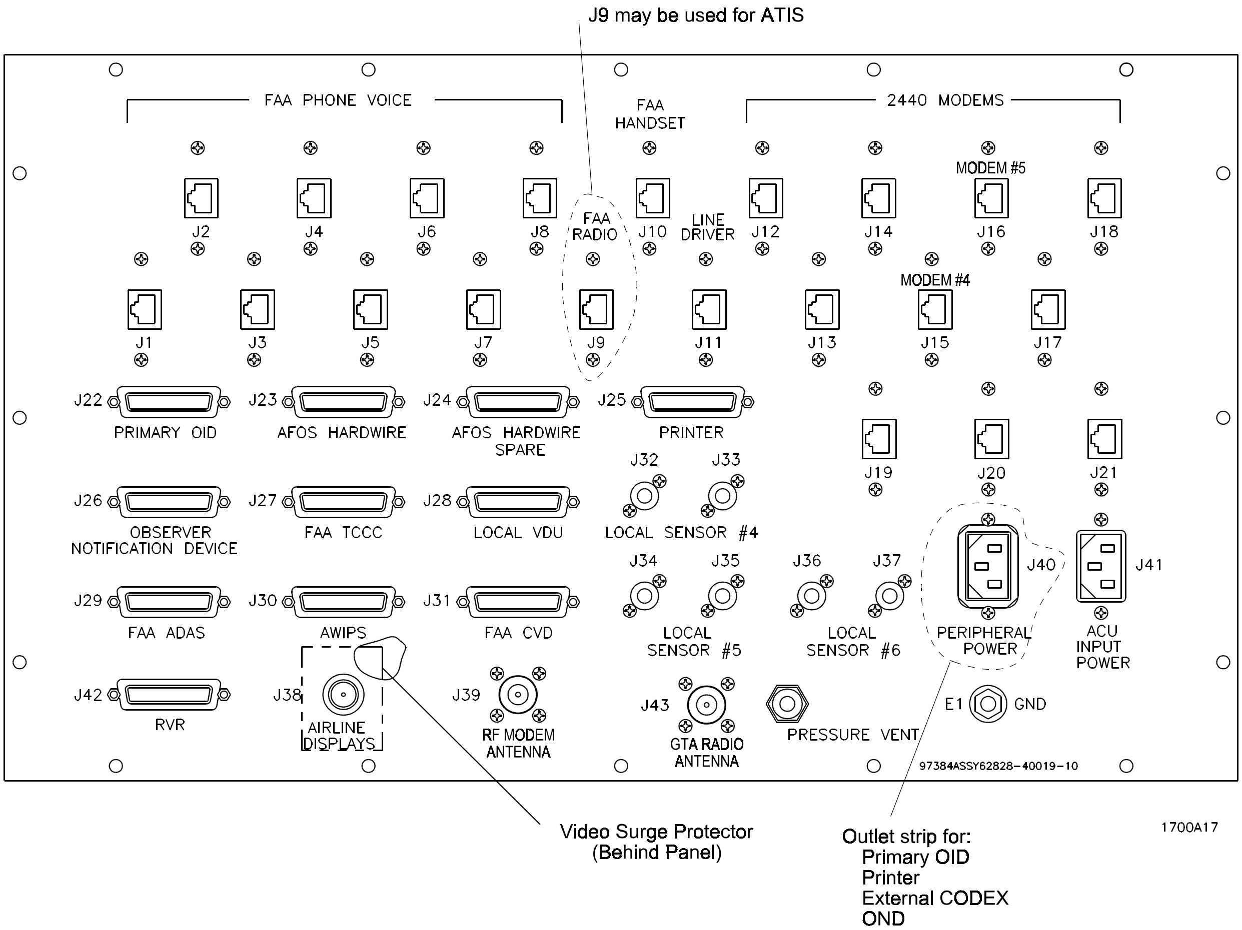


Figure 2.1.9. I/O Panel Assembly 1A9

SECTION II. INSTALLATION

Installation of a complete acquisition control unit (ACU) is not the responsibility of the site technician. The procedures for removing and replacing individual field replaceable units (FRU's) are contained in Section V.

SECTION III. OPERATION

2.3.1 INTRODUCTION

System maintenance control is performed from the operator interface device (OID), where the user can monitor self-test results, initiate diagnostic tests, review and update the maintenance logs, conFigure the system, and control power to sensors at remote data collection packages (DCP's). In addition to the OID displays, various units within the acquisition control unit (ACU) contain controls and indicators that can be used during system maintenance. This section describes these ACU controls/indicators. Refer to Chapter 1 for system related operating procedures and a complete description of all maintenance display pages.

2.3.2 CONTROLS AND INDICATORS

2.3.2.1 **Operator Interface Device (OID)**. The OID is a standard cathode ray tube (CRT) terminal. The keyboard (Figure 2.3.1) is divided into four functional areas: the main keypad, editing keypad, auxiliary keypad, and function keypad. The editing keypad contains the arrow, REMOVE, and edit keys. The arrow keys are used to move the cursor to the different fields on the display. The REMOVE key is used to delete the character under the cursor. The edit keys are used to move the cursor to a specific point on the page when editing log entries. The auxiliary keypad is used to access the maintenance/observer displays. The keypad on the OID display overlays the auxiliary keypad area such that key 7 represents the function in the upper left corner of the OID keypad and key 3 represents the function in the lower right corner of the OID keypad. The function keypad contains the HELP key, which is used to access the system help feature. Help can also be accessed by pressing the 0 key on the auxiliary keypad. Function keys F12 and F20 control the system's audio alarm. Pressing F12/F20 disables the alarms until the user signs off the system. Pressing F12/ F20 again enables the alarm. The audio alarm can be disabled for the current alarm by pressing the F11 or F19 key. Additional information on the OID and its use is provided in the ASOS Software User's Manual.

2.3.2.2 **Printer**. The model KX-P1180, KX-P2180, or KX-P3123 printer controls and indicators are described in the corresponding Printer Operation Manual. Paragraph 2.5.7 provides the procedures for setting up the model KX-P1180, KX-P2180, and KX-P3123 printers.

2.3.2.3 **Controller Video Display (CVD)**. The CVD (Figure 2.3.2) contains a brightness control and a contrast/reset control. The brightness control is used to adjust the overall intensity of the video display. Turning the contrast/reset control adjusts the contrast between the light and dark areas on the screen. Pressing the contrast/reset control resets the CVD.

2.3.2.4 **Observer Notification Device (OND)**. The OND is an alarm light. When the ASOS generates an observer alert message, the light blinks on and off for a maximum of 5 minutes.

2.3.2.5 **Card Rack Assembly**. Of the nine types of boards (maximum) in the card rack assembly, five contain controls/indicators. These boards are illustrated on figure 2.3.3 and each control/indicator is described in table 2.3.1.

2.3.2.6 **Modem AC Power Rack**. The modem ac power rack contains up to 10 telephone modems (models 2440, V.3225, V.3400) and up to two DDS/MR64 or D19.2 line drivers. The modem rack also contains an ac power supply module that provides power to all modems and line drivers installed in the rack. The modems, the line drivers, and the power supply module are illustrated on figure 2.3.4 and controls and indicators are described in table 2.3.2.

```
11:18:06 07/04/96 1618Z                                      ANYTOWN AIRPORT

   SKY        = OVC100

   VISIBILITY = 1 3/4SM               TEMP/DEWPT   = 12.2 /7.8   C  54 /46  F
   RVR        = R17L/3800FT           WIND DIR/SPD = 180/10
   PRESENT WX = RA                    ALTIMETER    = 29.90

   REMARKS    = RMK  P0019


   METAR KANY 041558Z AUTO 18010KT 1 3/4SM R17L/3800 RA OVC100 12/08 A2990
```

PRINT		
REVUE		
SIGN		AUX

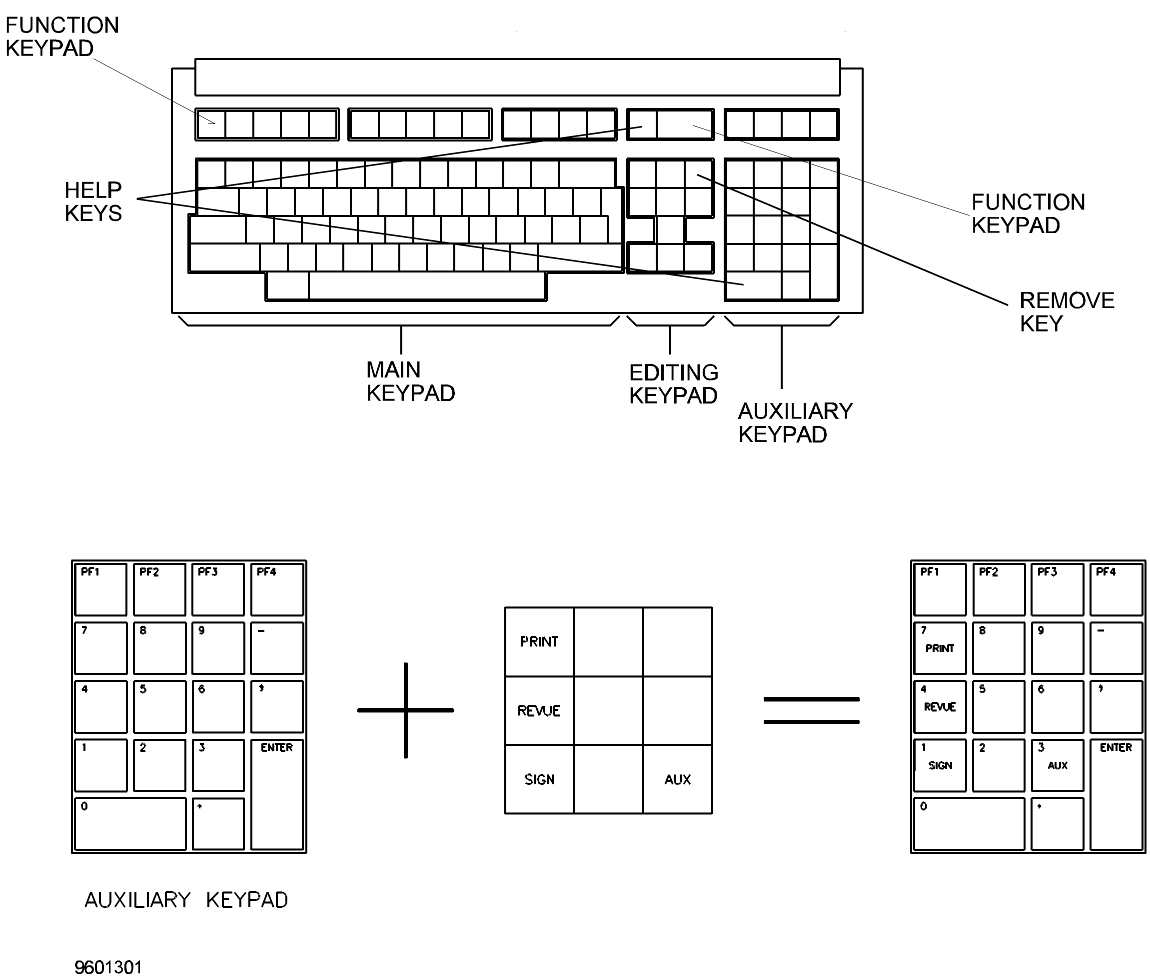


Figure 2.3.1. Keyboard

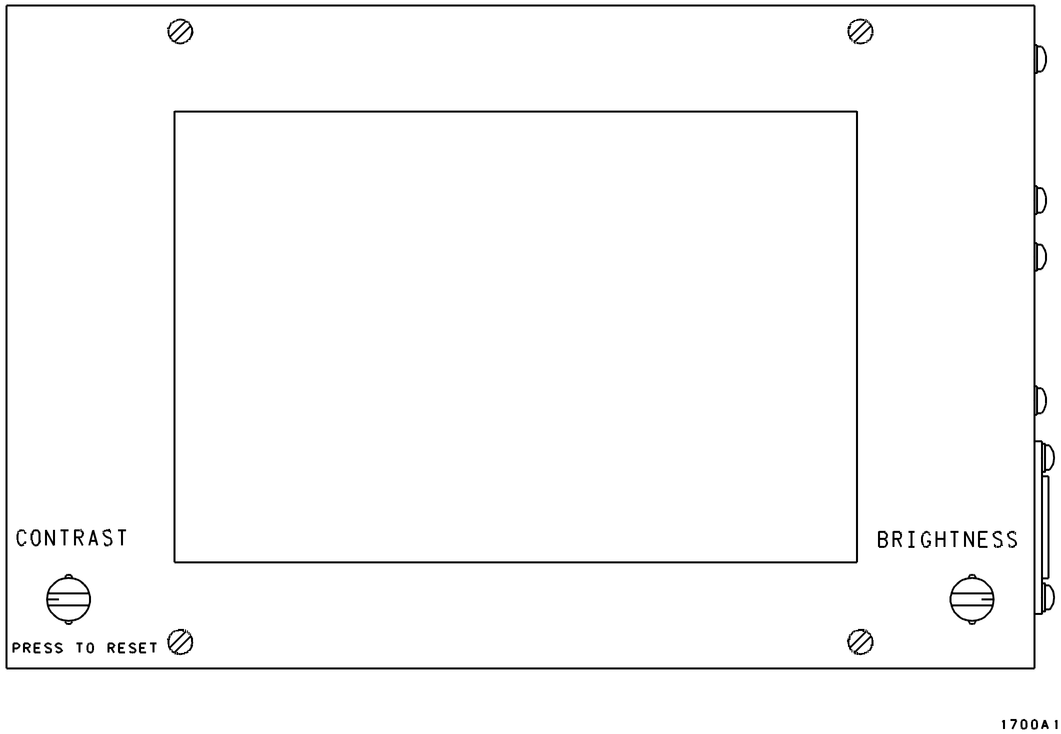


Figure 2.3.2. Controller Video Display (CVD)

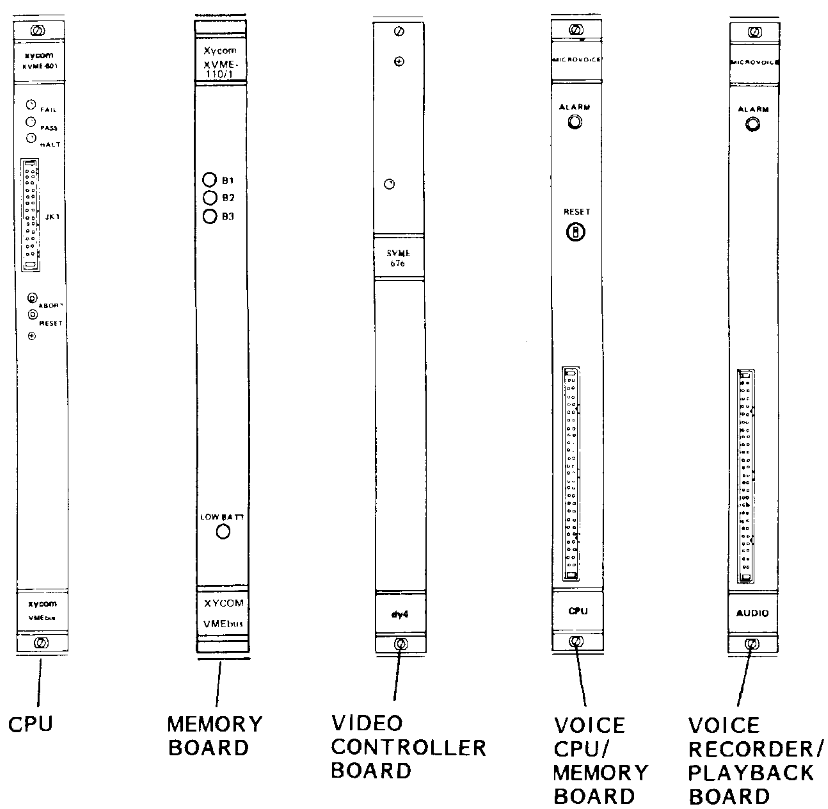


Figure 2.3.3. Card Rack Assembly Controls and Indicators

Table 2.3.1. Card Rack Assembly Controls and Indicators

Control/ Indicator	Type	Description
NOTE The controls and indicators contained on the VME cards are not the primary troubleshooting indicators. The technician should refer to the maintenance pages first and use the VME card indicators only for secondary reference.		
CPU		
FAIL	Light emitting diode (LED)	When illuminated, indicates that the CPU has failed its internal self-test. When the CPU self-test is in process, the FAIL and PASS indicators flash.
PASS	LED	When illuminated, indicates that the CPU has passed its internal self-test. When the CPU self-test is in process, the FAIL and PASS indicators illuminate.
HALT	LED	When illuminated, indicates that the CPU has entered the halt state (nonprocessing state).
ABORT	Pushbutton switch	When pressed, halts program execution without resetting the CPU. This switch is for developmental use only. It should not be used in the field. If it is pressed, press the RESET switch.
RESET	Pushbutton switch	When pressed, resets the CPU and the VMEbus. Resetting the CPU does not affect the contents of the dynamic random access memory (DRAM).
Memory Board		
B1	LED	When illuminated, indicates that the bank 1 memory module is being addressed.
B2	LED	When illuminated, indicates that the bank 2 memory module is being addressed.
B3	LED	When illuminated, indicates that the bank 3 memory module is being addressed.
LOW BATT	LED	When illuminated, indicates that backup battery on board is low and memory board must be replaced (may also illuminate if J22 jumper is not installed).
Video Controller Board		
SVME 676	LED	Software programmable. Not used during normal operation. The initialization routine turns this indicator off to conserve energy.
Voice CPU/Memory Board		
ALARM	LED	When illuminated, indicates that the watchdog timer on the voice CPU/memory board detected a CPU hardware or software failure.
RESET	Pushbutton switch	When pressed, resets the CPU and does not reset the VME system. No messages are broadcast until a play message string command is successfully received.
Voice Recorder/Playback Board		
ALARM	LED	When illuminated, indicates that no audio output has occurred for 30 to 60 seconds.

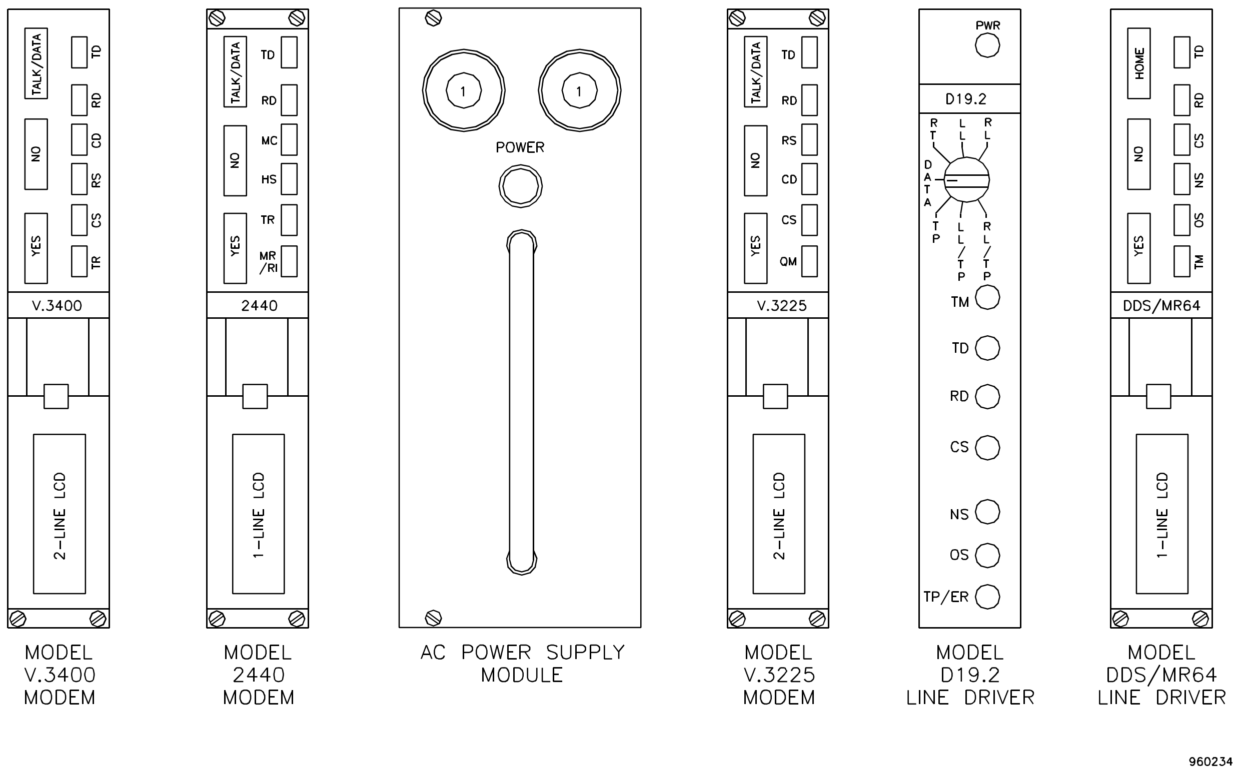


Figure 2.3.4. Modem AC Power Rack Controls and Indicators

Table 2.3.2. Modem AC Power Rack Controls and Indicators

Control/ Indicator	Type	Description
NOTE The controls and indicators contained on the modems and line drivers are not the primary troubleshooting indicators. The technician should refer to the maintenance pages first and use the modem indicators only for secondary reference.		
2440 Modem		
TD	LED	Transmit data. When illuminated, indicates that data are being transmitted from ACU computer to the respective voice frequency (VF) line.
RD	LED	Receive data. When illuminated, indicates that data are being received on-line and are being transferred to ACU computer.
MC	LED	Modem check. When illuminated, indicates that modem is off-line, in talk mode, errors detected during diagnostics, or data are being retransmitted.
HS	LED	High-speed. When illuminated, indicates that modem is operating at maximum configured speed, which is 2400 bps. When extinguished, indicates that modem is operating at medium speed (1200 bps). When flashing, indicates that modem is operating in low speed (0 to 300 bps).
TR	LED	Terminal ready. When illuminated, indicates that ACU computer is on-line and ready for data transfers.
MR/RI	LED	Modem ready. When illuminated, indicates that modem is operational and is connected to the telephone line. When flashing, indicates that modem is receiving a ring signal.

Table 2.3.2. Modem AC Power Rack Controls and Indicators -CONT

Control/ Indicator	Type	Description
TALK/DATA	Pushbutton switch	Talk/data mode select. Used in conjunction with 1-LINE LCD to allow manual phone calls for either data or voice communication. Not used for ASOS.
YES	Pushbutton switch	Used in conjunction with 1-LINE LCD to answer modem configuration questions. Not used for ACU rack-mounted modems.
NO	Pushbutton switch	Used in conjunction with 1-LINE LCD to answer modem configuration questions. Not used for ACU rack-mounted modems.
1-LINE LCD	Liquid crystal display	Displays menu of options available for manual modem configuration and test. Because ACU rack-mounted modems are configured and tested automatically by ACU computer, LCD is not used.
AC Power Supply Module		
Circuit breakers	Pushbuttons or rocker switches	Left and right circuit breakers provide overcurrent protection for left and right sides of modem rack, respectively.
POWER	Indicator	When illuminated, indicates that ac power supply module is on.
V.3325 Modem		
TD	LED	Transmit data. When illuminated, indicates that data are being transmitted from ACU computer to the respective VF line.
RD	LED	Receive data. When illuminated, indicates that data are being received on-line and are being transferred to ACU computer.
RS	LED	Request to send. When illuminated, indicates that ACU computer (via a serial I/O board) has issued a request to send signal to the modem on pin 4 of the RS-232 interface. This occurs when the serial I/O board is ready to send data to the modem.
CD	LED	Carrier detect. When illuminated, indicates that modem has connected with another modem on-line.
CS	LED	Clear to send. When illuminated, indicates that modem has given a clear to send signal on pin 5 of the RS-232 interface. This indicates that modem is ready to receive data from ACU computer (via a serial I/O board).
QM	LED	Quality monitor. When illuminated, indicates low quality of modem communications signals.
TALK/DATA	Pushbutton switch	Talk/data mode select. Used in conjunction with 2-LINE LCD to allow manual phone calls for either data or voice communication. Not used for ASOS.
YES	Pushbutton switch	Used in conjunction with 2-LINE LCD to answer modem configuration questions. Not used for ASOS.
NO	Pushbutton switch	Used in conjunction with 2-LINE LCD to answer modem configuration questions. Not used for ASOS.
2-LINE LCD	Liquid crystal display	Displays menu of options available for manual modem configuration and test. Because modems are configured and tested automatically by ACU computer, LCD is not used for ASOS.
V.3400 Modem		
TD	LED	Transmit data. When illuminated, indicates that data are being transmitted from ACU computer to the respective VF line.
RD	LED	Receive data. When illuminated, indicates that data are being received on-line and are being transferred to ACU computer.
RS	LED	Request to send. When illuminated, indicates that ACU computer (via a serial I/O board) has issued a request to send signal to the modem on pin 4 of the RS-232 interface. This occurs when the serial I/O board is ready to send data to the modem.

Table 2.3.2. Modem AC Power Rack Controls and Indicators -CONT

Control/ Indicator	Type	Description
CD	LED	Carrier detect. When illuminated, indicates that modem has connected with another modem on-line.
CS	LED	Clear to send. When illuminated, indicates that modem has given a clear to send signal on pin 5 of the RS-232 interface. This indicates that modem is ready to receive data from ACU computer (via a serial I/O board).
TR	LED	Terminal Ready indicator. Illuminates when DTE asserts Data Terminal Ready.
TALK/DATA	Pushbutton switch	Talk/Data mode select. Used in conjunction with 2-LINE LCD to allow manual phone calls for either data or voice communication. Not used for ASOS.
YES	Pushbutton switch	Used in conjunction with 2-LINE LCD to answer modem configuration questions. Not used for ASOS.
NO	Pushbutton switch	Used in conjunction with 2-LINE LCD to answer modem configuration questions. Not used for ASOS.
2-LINE LCD	Liquid crystal display	Displays menu of options available for manual modem configuration and test. Because modems are configured and tested automatically by ACU computer, LCD is not used for ASOS.
D19.2 Line Driver		
PWR	LED	Power indicator. When illuminated, indicates that power is applied to line driver.
Mode switch	Seven-position rotary switch	Selects line driver mode of operation. In the ASOS, this switch is kept in the DATA position. The LL/TP and RL/TP are used for manually testing the line drivers. The line driver modes are listed below for reference purposes. DATA- Normal operation RT- Remote terminal loopback LL- Local line loopback RL- Remote terminal loopback TP- Test pattern LL/TP- Local line with test pattern RL/TP- Remote loopback with test pattern
TM	LED	Test mode. Illuminates or blinks when line driver is placed in the test mode by the ACU computer.
TD	LED	Transmit data. When illuminated, indicates that data are being transmitted from ACU computer to DCP over dedicated lines.
RD	LED	Receive data. When illuminated, indicates that data are being received from DCP over dedicated lines and are being transferred to ACU computer.
CS	LED	Clear to send. When illuminated, indicates that line driver has given a clear to send signal on pin 5 of the RS-232 interface. This indicates that line driver is ready to receive data from ACU computer (via a serial I/O board).
NS	LED	No signal. When illuminated, indicates that no signal is present on ACU/DCP dedicated line.
OS	LED	Out of service. When illuminated, indicates that line driver has received an out of service code from the corresponding line driver in the DCP.
TP/ER	LED	Test pattern/error. When line driver is placed in test mode, indicator illuminates to indicate that an error has been received.
DDS/MR64 Line Driver		
TD	LED	Transmit data. When illuminated, indicates that data are being transmitted from ACU computer to DCP over dedicated lines.
RD	LED	Receive data. When illuminated, indicates that data are being received from DCP over dedicated lines and are being transferred to ACU computer.

Table 2.3.2. Modem AC Power Rack Controls and Indicators -CONT

Control/ Indicator	Type	Description
CS	LED	Clear to send. When illuminated, indicates that line driver has given a clear to send signal on pin 5 of the RS-232 interface. This indicates that line driver is ready to receive data from ACU computer (via a serial I/O board)
NS	LED	No signal. When illuminated, indicates that no signal is present on ACU/DCP dedicated line.
OS	LED	Out of service. When illuminated, indicates that line driver has received an out of service code from the corresponding line driver in the DCP.
TM	LED	Test Mode. When illuminated, indicates that the DDS/MR64 is in Test mode.
HOME	Pushbutton switch	Data mode or Set mode select. Used in conjunction with 1-LINE LCD when in Set mode for manual modem configuration.
YES	Pushbutton switch	Used in conjunction with 1-LINE LCD to answer modem configuration questions.
NO	Pushbutton switch	Used in conjunction with 1-LINE LCD to answer modem configuration questions.
1-LINE LCD	Liquid crystal display	Displays menu of options available for manual modem configuration and test.

2.3.2.7 **Power Supply Assembly**. The power supply assembly (Figure 2.3.5) monitors ac input power to the ACU and supplies normal/emergency output power to all equipment in the ACU cabinet including peripherals within 100 feet of the ACU. The controls and indicators for the SOLA uninterruptible power supply (UPS) contained in power supply 62828-40124-10 are illustrated on figure 2.3.5 and described in table 2.3.3. Power supply 62828-40265-10 can contain either Deltek UPS 62828-90338-10 (figure 2.3.6 and table 2.3.4) or Deltek UPS 62828-90338-20 (figure 2.3.7 and table 2.3.5).

2.3.2.8 **DC Power Supply Enclosure**. Each of the two +5V and ±12V power supplies has a power (I/O) switch and a power on indicator lamp. The on/off switches are normally kept in the on position, and the power supplies are turned on and off via the UPS.

2.3.2.9 **Codex Modem**. The Codex 3600 Series modem is Government-furnished equipment (GFE) that interfaces with the Federal Aviation Administration (FAA) ADAS via the Data Multiplexer Network. Refer to Chapter 13.

2.3.2.10 **RF Modems**. RF data modems provide communications between the ACU and DCP cabinets. Only the Johnson Data rf modem (62828-40506-X) has controls and indicators as shown on figure 2.3.8 and described in table 2.3.6.

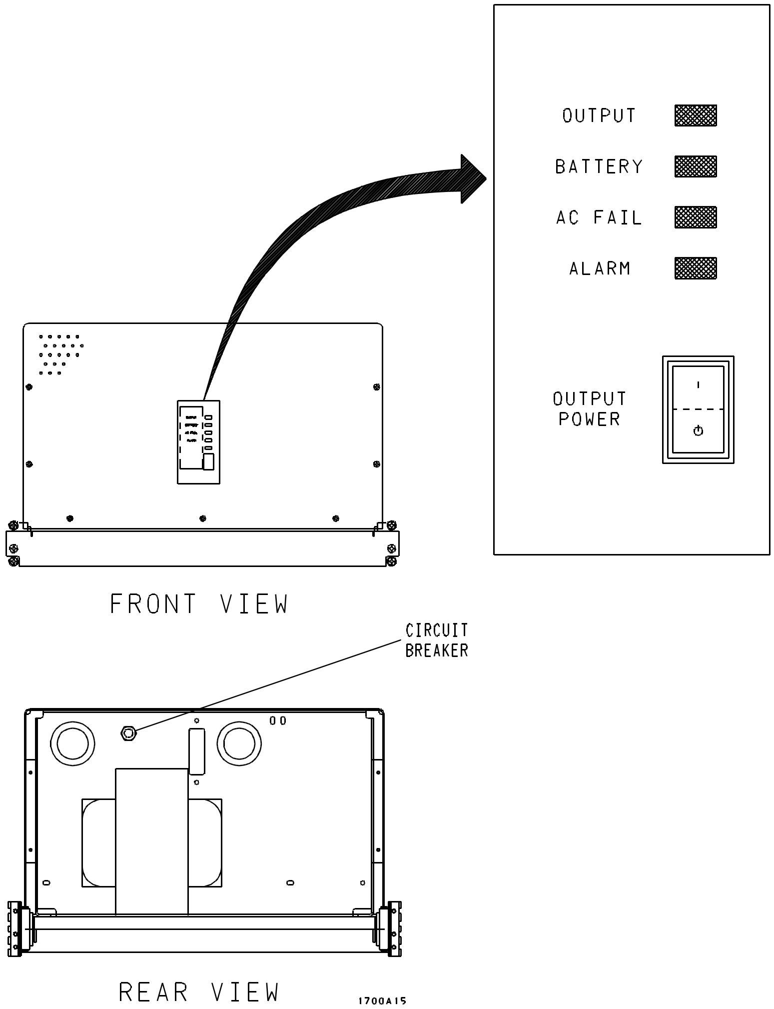


Figure 2.3.5. Power Supply Assembly 62828-40124-10 Controls and Indicators

Table 2.3.3. Power Supply Assembly 62828-40124-10 Controls and Indicators

Control/ Indicator	Type	Description
OUTPUT POWER	Rocker switch	When set to on (1), turns UPS on and applies ac power to ACU cabinet and peripherals.
OUTPUT	LED	When illuminated, indicates that UPS is on and that ac power is being supplied to ACU loads.
BATTERY	LED	When illuminated, indicates that ACU backup batteries in Battery Box 1A8 are fully charged. When blinking, indicates that batteries are low and UPS is recharging them.
AC FAIL	LED	When illuminated, indicates that ACU primary power source has failed and that UPS is supplying backup ac power to ACU loads. The UPS beeps every 10 seconds while backup power is being used.
ALARM	LED	When illuminated, indicates that UPS has overheated, backup battery is dead (less than 40 vdc), backup battery is overvoltage (greater than 78 vdc), or there is some other problem with UPS components.
Circuit breaker	Pushbutton switch	Provides overload protection for the UPS and its loads. Pushbutton switch pops out when circuit breaker trips; press in to reset the breaker.

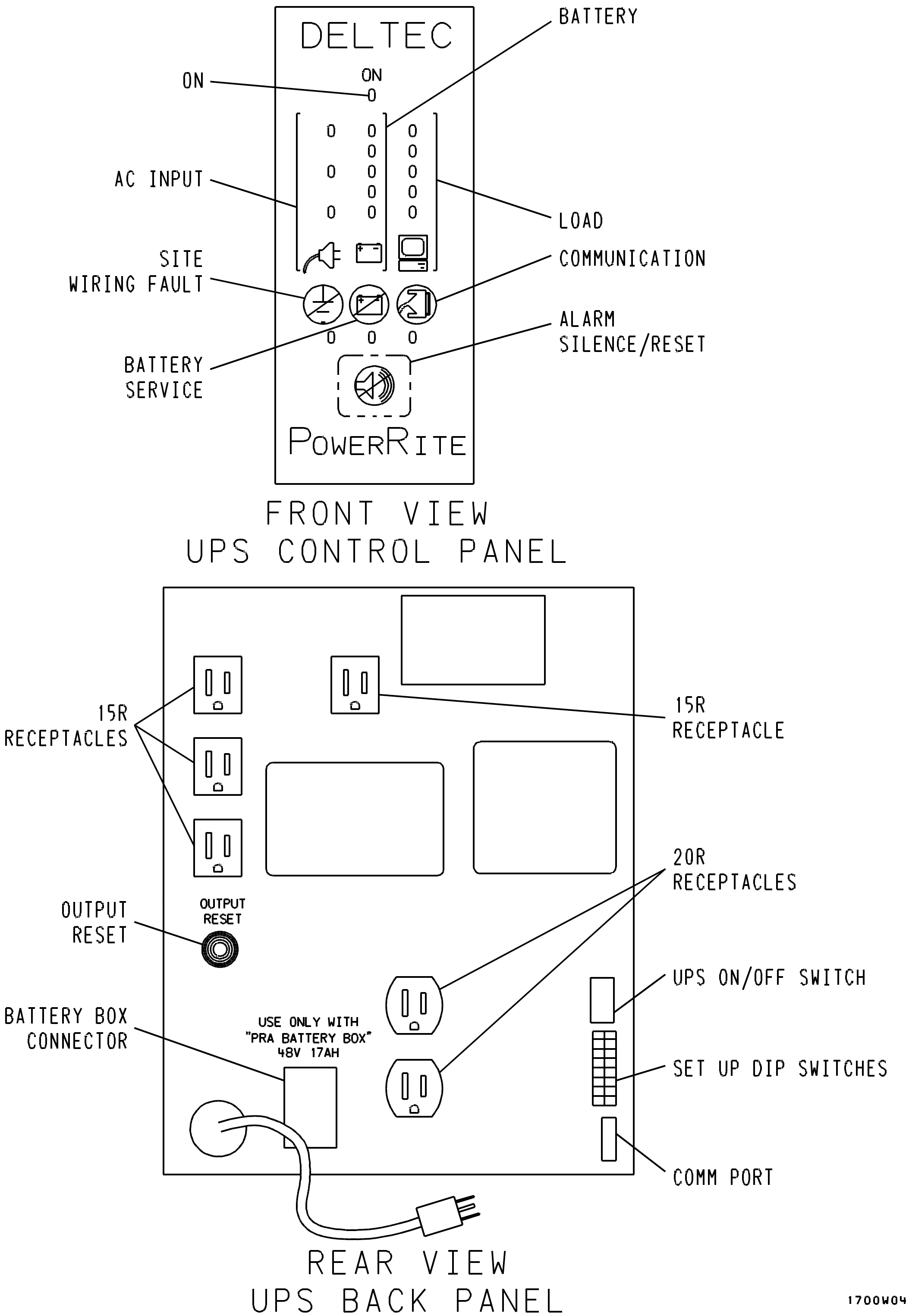
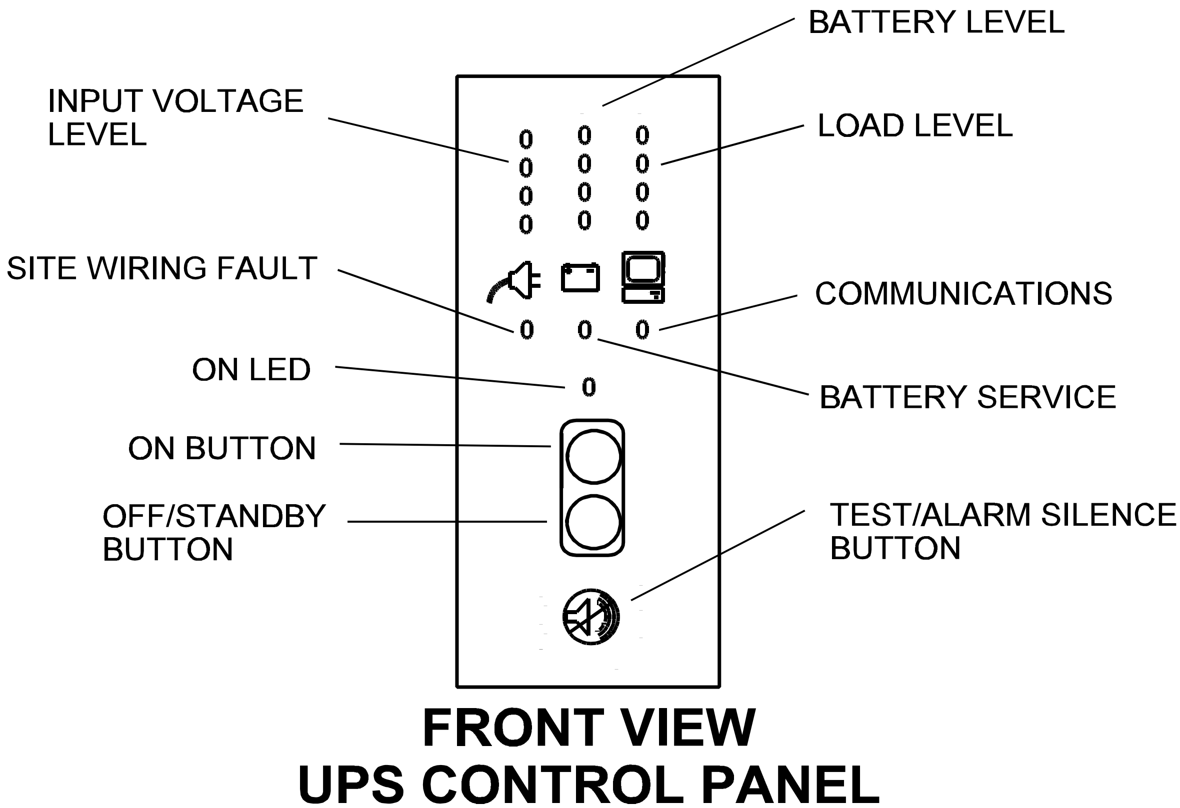


Figure 2.3.6. Power Supply Assembly 62828-40265-10 with Deltek UPS 62828-90338-10 Controls and Indicators

Table 2.3.4. Power Supply Assembly 62828-40265-10 with Deltek UPS 62828-90338-10 Controls and Indicators

<table>
<tr><th>Control/ Indicator</th><th>Type</th><th colspan="3">Description</th></tr>
<tr><td>ON</td><td>LED</td><td colspan="3">When illuminated, indicates that output voltage is available.</td></tr>
<tr><td>AC INPUT</td><td>LEDs (three)</td><td colspan="3">When top LED is illuminated, indicates that line is too high (overvoltage condition) and that UPS is in battery operation. When middle LED is illuminated, indicates that the line is OK. When bottom LED is illuminated, indicates that line is too low (undervoltage condition) and that the UPS is in battery operation.</td></tr>
<tr><td>SITE WIRING FAULT</td><td>LED</td><td colspan="3">When illuminated, indicates that there is either no existing ground wire connection or that the line and neutral wires are reversed in the line receptacle.</td></tr>
<tr><td>BATTERY</td><td>LED's (four green, one red)</td><td colspan="3">When illuminated, indicate the condition of the battery charge.</td></tr>
<tr><td>BATTERY SERVICE</td><td>LED</td><td colspan="3">When illuminated, indicates when a potential battery failure is detected. If reset is pushed, continues to flash until service is performed.</td></tr>
<tr><td>ALARM SILENCE/ RESET</td><td>Pushbutton</td><td colspan="3">The alarm sounds at any new alarm condition. If the problem is resolved or if ALARM SILENCE/RESET is pushed, the buzzer sounds.</td></tr>
<tr><td>LOAD</td><td>LED's (five)</td><td colspan="3">When the top LED is illuminated, indicates when the load current or wattage exceeds full load. The bottom four (green) LED's show either the load current or load wattage (whichever is higher) in increments of approximately one-fourth of full rating.</td></tr>
<tr><td>COMMUNICATION</td><td>LED</td><td colspan="3">Turns on after the UPS receives a command code from a computer to establish communication. Flashes during data transfer via the COMM PORT.</td></tr>
<tr><td>UPS ON/OFF SWITCH</td><td>Rocker switch</td><td colspan="3">When set to on (1), turns on UPS and applies ac power to ACU cabinet and peripherals.</td></tr>
<tr><td rowspan="10">SETUP DIP SWITCHES</td><td rowspan="10">DIP switches</td><td colspan="3">Switches 1, 2, 3, 4, 5, 7, and 8 are user-defined switches. OFF is default position.</td></tr>
<tr><td>Switch</td><td>Function</td><td>Default Position</td></tr>
<tr><td>1</td><td>Line Voltage Select</td><td>OFF</td></tr>
<tr><td>2</td><td>Line Voltage Select</td><td>OFF</td></tr>
<tr><td>3</td><td>Site Warning Alarm</td><td>OFF</td></tr>
<tr><td>4</td><td>Back Alarm</td><td>OFF</td></tr>
<tr><td>5</td><td>Low/Auto Shutdown</td><td>OFF</td></tr>
<tr><td>6</td><td>Not Used</td><td>OFF</td></tr>
<tr><td>7</td><td>ASOS Protocol</td><td>OFF - Firmware vsn 2.1 & up
ON - Firmware below vsn 2.1</td></tr>
<tr><td>8</td><td>Frequency Select</td><td>OFF</td></tr>
<tr><td>COMM PORT</td><td>Connector</td><td colspan="3">Allows the UPS to report status to the ACU.</td></tr>
<tr><td>BATTERY BOX CONNECTOR</td><td>Connector</td><td colspan="3">Allows external batteries to be connected to the UPS.</td></tr>
<tr><td>OUTPUT RESET</td><td>Pushbutton</td><td colspan="3">Provides overload protection for the UPS and its loads. Pops out when circuit breaker trips; pressed in to reset the breaker.</td></tr>
<tr><td>5-15R</td><td>Receptacles (four)</td><td colspan="3">Used to provide power to additional equipment.</td></tr>
<tr><td>5-20R</td><td>Receptacles (two)</td><td colspan="3">Used to provide power to additional equipment.</td></tr>
</table>



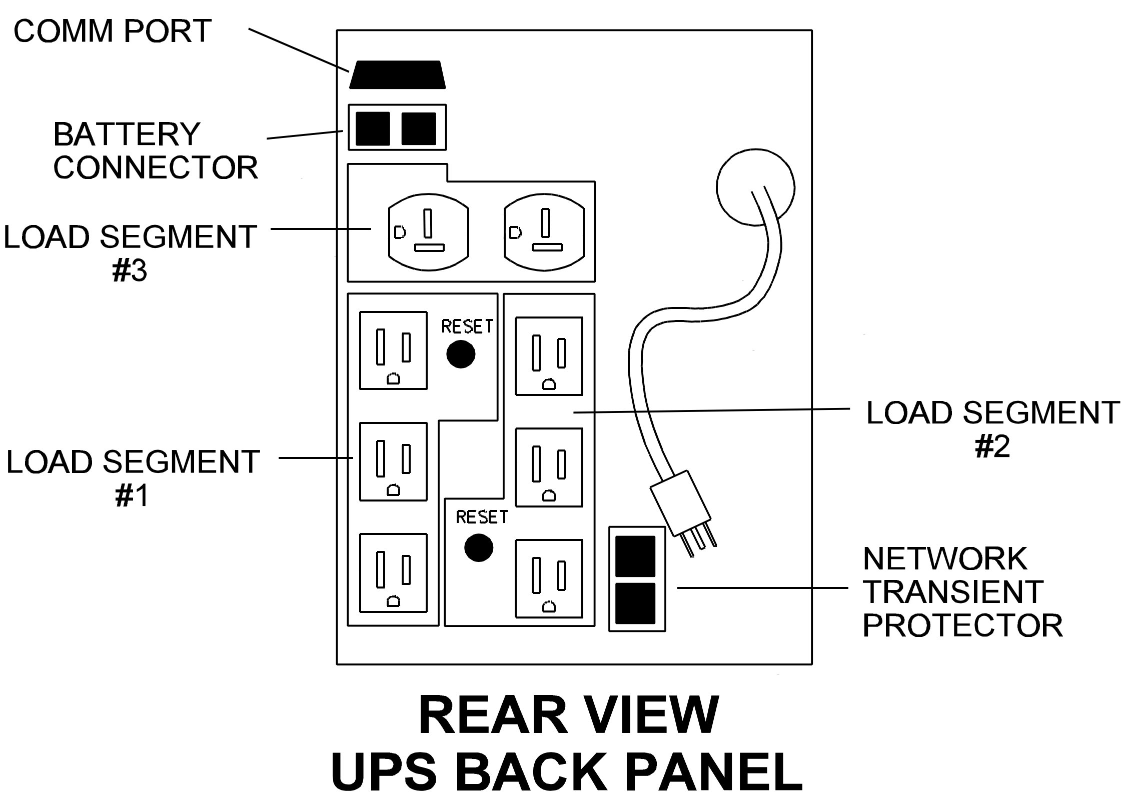


Figure 2.3.7. Power Supply Assembly 62828-40265-10 with Deltek UPS 62828-90338-20
Controls and Indicators

Table 2.3.5. Power Supply Assembly 62828-40265-10 with Deltek UPS 62828-90338-20 Controls and Indicators

Control/ Indicator	Type	Description
ON LED	LED	When illuminated, indicates that output voltage is available.
INPUT VOLTAGE LEVEL	LEDs Red Green Green Red	Reading LEDs from top to bottom: 1 (top) - Line voltage is too high: UPS battery providing power. 2 - Line voltage is normal: AC input providing power. 3 - Line voltage is lower than normal: AC input providing power. 4 (bot) - Line voltage is too low: UPS battery providing power.
SITE WIRING FAULT	LED	When illuminated, indicates that there is either no existing ground wire connection or that the line and neutral wires are reversed in the line receptacle.
BATTERY LEVEL	LEDs Green Green Green Red	Reading LEDs from top to bottom: 1 (top) - Batteries are fully charged. 2 - Battery charge is approximately 2/3 of full charge. 3 - Battery charge is approximately 1/3 of full charge. 4 (bot) - Low battery (3 - 5 minutes of battery backup remaining).
BATTERY SERVICE	LED	When illuminated, indicates when a potential battery failure is detected. An audio alarm will be also be sounding.
TEST/ALARM SILENCE BUTTON	Pushbutton	The alarm sounds at any new alarm condition. If the problem is resolved or if ALARM SILENCE/RESET is pushed, the buzzer sounds.
LOAD LEVEL	LED's Red Green Green Green	Reading LEDs from top to bottom: 1 (top) - Load current exceeds full load. 2 - Load current is at maximum. 3 - Load current is at 2/3 of maximum. 4 (bot) - Load current is at 1/3 of maximum.
COMMUNICATION	LED	Turns on after the UPS receives a command code from a computer to establish communication. Flashes during data transfer via the COMM PORT.
ON BUTTON	Pushbutton	When pressed, applies ac power to UPS receptacles.
OFF/STANDBY BUTTON	Pushbutton	When pressed, removes power from UPS receptacles, but the batteries will continue to charge. To completly remove power, the UPS must be unplugged.
COMM PORT	Connector	Allows the UPS to report status to the ACU.
BATTERY CONNECTOR	Connector	Allows external batteries to be connected to the UPS.
NETWORK TRANSIENT PROTECTOR	Connector	Not used in ASOS.
LOAD SEGMENTS #1 AND #2	Receptacles	Six 5-15R receptacles used to provide power to equipment. Each segment is protected by a RESET button that pops out when an overload condition exists.
LOAD SEGMENT #3	Receptacles	Two 5-20R receptacles used to provide power to equipment.

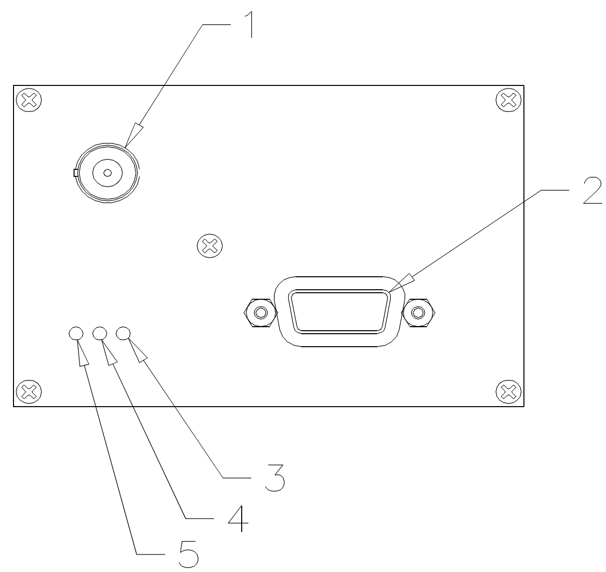


Figure 2.3.8. Johnson Data RF Modem Controls and Indicators

Table 2.3.6. Johnson Data RF Modem Controls and Indicators

Index	Control/ Indicator	Description
1	SMA Connector	RF output (requires SMAM-to-BNCF adapter)
2	HDB-15 Connector	High density 15 pin female power/communications connector (requires adapter cable 62828-42110-10)
3	RX LED (Yellow)	Illuminates when receiving data
4	TX LED (Red)	Illuminates when transmitting data
5	PWR LED (Green) (Flashing)	Illuminates when power is applied Illuminates when setup mode is active

2.3.3 OPERATIONAL PROCEDURES

The primary operational procedures associated with the ACU and peripherals are the application and removal of power. Also, the technician may occasionally have to enter the site ID and AOMC phone number, and refresh the OID screen. The following paragraphs describe each of these procedures.

2.3.3.1 **ACU Power Up and Power Down Procedures**. Tables 2.3.7 and 2.3.8 provide the procedures to apply and remove power from the ACU and its peripherals.

Table 2.3.7. ACU and Peripherals Power Up Procedures $

Step	Procedure
1	At OID, set power switch located on monitor base to ON position. The power-on indicator located in the left front of the CRT illuminates.
2	If ACU has a UPS, ensure that UPS POWER switch is set to off (0) position.
3	At ACU DC Power Supply Enclosure 1A5, ensure that ON/OFF switches on power supplies PS1 and PS2 are set to ON (1) position.
4	Set facility power circuit breaker for ACU to on position. If Class I ACU, power is applied to ACU cabinet components when facility power is applied.
5	If ACU has a UPS, set UPS POWER switch to on (1) position. Power is applied to components in Class II ACU cabinet.
6	With power applied to OID and ACU and after a brief warmup delay, OID displays the 1-minute display. If the display is not being updated, press the HELP key twice to refresh the screen. The data fields may contain the letter M, indicating that the sensor(s) are not reporting measurement data. If the message NEED SID AND AOMC PHONE message is displayed at the top of the screen, the system has lost its memory and requires a download of site specific data from the AOMC. In this case, perform the following procedures: a. Sign on system as a technician. b. Call up the REVUE SITE CONFIG EXTERN display on the OID and enter the phone number of the AOMC in the AOMC PHONE NUMBER field. c. Call up the REVUE SITE PHYS display on the OID and enter the three to five-character SID code for the ASOS site in the STATION IDENTIFIER field. The system then calls the AOMC and receives a download of site specific data. After the download is complete, the system automatically initializes to the proper configuration and begins normal operation.
7	Ensure that any other peripheral devices (VDU's, CVD's, printer, etc) associated with the ACU are turned on.

Table 2.3.8. ACU and Peripherals Power Down Procedures $

Step	Procedure
1	Turn printer off by setting power switch, located on right side of printer, to off position.
2	Turn off OID by setting power switch on monitor base to OFF position.
3	If ACU has a UPS, set UPS POWER switch to OFF position.
4	Set facility power circuit breaker for ACU to OFF position.
5	Turn off any other peripheral devices (VDU's, CVD's, etc) associated with the ACU.

2.3.3.2 **<u>Providing Site ID and AOMC Phone Number</u>**. If the ACU loses its site specific data, it requests a download of site specific data from the AOMC. If the ACU has also lost its site ID (SID) code and the AOMC phone number, it displays the prompt NEED SID AND AOMC PHONE on the top line of the OID. In this case, the technician must enter the site ID and the AOMC phone number at the OID so that the ACU can call the AOMC and request the download. Table 2.3.9 provides procedures to enter the SID code and $ the AOMC phone number. After the download is complete, the system automatically initializes to the proper configuration and begins normal operation.

2.3.3.3 **<u>Refresh OID</u>**. In the event that power is removed from the ACU cabinet, the OID retains the last display on its screen. If, after power returns to the ACU, the OID screen is not updated, the screen must be refreshed by pressing the HELP key twice. This reestablishes ACU/OID communication and allows the system to function normally.

2.3.4 USING LAPTOP COMPUTER AS PRIMARY OID

Some sites may not have a primary OID connected directly to the PRIMARY OID connector (J22) of ACU I/O Panel Assembly 1A9. This may be because another local OID serves as primary (e.g., tower OID) or because a particular site has no local OID at all. In either case, the technician may connect the laptop $ computer to the PRIMARY OID connector (as described in table 2.3.10) to perform all technician-related tasks. SIO port 3-4 must be properly configured for a primary OID on the ACU serial communications page before the system will be able to communicate with the laptop computer. If not, the technician must access the ACU serial communications page from another OID (a remote OID as described in paragraph 1.3.14 if no other is available) and set up port 3-4 as follows:

FUNCTION: OID (any available, 1-8)
STATUS: ENABLED
BAUD RATE: 9600
PARITY SELECT: NONE
BITS/CHAR: 8
STOP BITS: 1
HANDSHAKE: NONE
CONNECTION: HARDWIRED

$ **Table 2.3.9. SID and AOMC Phone Number Entry**

Step	Procedure
1	To determine if system requires download of site specific data from AOMC, verify that message NEED SID AND AOMC PHONE is displayed at top of OID screen.
2	Sign on system as a technician.
3	Call up the REVUE SITE CONFIG EXTERN display on the OID and enter the phone number of the AOMC in the AOMC PHONE NUMBER field.
4	Call up the REVUE SITE PHYS display on the OID and enter the three to five-character SID code for the ASOS site in the STATION IDENTIFIER field. The system then calls the AOMC and receives a download of site specific data. After the download is complete, the system automatically initializes to the proper configuration and begins normal operation.

$ **Table 2.3.10. Connecting Laptop Computer as Primary OID**

Step	Procedure
	NOTE SIO port 3-4 (corresponds to PRIMARY OID connector J22 on I/O Panel Assembly 1A9) must be configured as a hardwired OID port on ACU serial communications page before laptop computer can be recognized as an OID. Paragraph 2.3.4 provides setup parameters.
	INITIALIZATION
	Tools required: Laptop computer with PROCOMM Plus installed Laptop interface (Y-shaped) cable DB-9 to DB-25 adapter

Table 2.3.10. Connecting Laptop Computer as Primary OID -CONT $

Step	Procedure
1	Connect RS-232 (COM1) port of laptop computer to PRIMARY OID connector J22 on I/O Panel Assembly 1A9 using the following support items: (1) Laptop interface (Y-shaped) cable (2) One DB-9 to DB-25 adapter
2	Turn on laptop computer and initialize to PROCOMM Plus program. When program initializes, press any key to enter terminal mode (blank) screen.
3	On laptop computer, set CAPS LOCK to ON.
4	Using ALT-S command (setup facility), set up the following TERMINAL OPTIONS: (1) Terminal emulation: VT220 (2) Duplex: FULL (3) Soft flow control (XON/XOFF): OFF (4) Hard flow control (CTS/RTS): OFF (5) Line wrap: OFF (6) Screen scroll: OFF (7) CR translation: CR (8) BS translation: NON-DESTRUCTIVE (9) Break length (milliseconds): 350 (10) Enquiry: OFF (11) EGA/VGA true underline: OFF (12) Terminal width: 80 (13) ANSI 7 or 8 bit commands: 8 BIT
5	Return (exit) to terminal mode (blank) screen.
6	Using ALT-P command (line/port option), set CURRENT SETTINGS as follows: (1) Baud rate: 9600 (2) Parity: NONE (3) Data bits: 8 (4) Stop bits: 1 (5) Port: COM1
7	Return (exit) to terminal mode (blank) screen.
8	ACU begins communication and 1-minute display is displayed on laptop screen. Laptop computer now functions as an OID. If display is not correct, set NUM LOCK key to ON and press 0 (help) twice to refresh screen.
9	Sign on and operate OID in usual manner. Ensure that NUM LOCK is set to ON when using number keys with function keypad on screen and that NUM LOCK is set to OFF when entering alphanumeric characters (e.g., initials and password during sign-on).
SIGNOFF	
1	From 1-minute display, sign off in usual manner. Ensure that NUM LOCK is set to ON when using SIGN key on display and that NUM LOCK is set to OFF when entering initials for signoff.
DISCONNECTING LAPTOP PRIMARY OID	
1	Sign off OID as described above.
2	Using ALT-X (exit) command, exit Procomm Plus.
3	Turn off laptop computer.
4	Disconnect cables and adapter between laptop computer and I/O Panel Assembly 1A9.

SECTION IV. THEORY OF OPERATION

2.4.1 ACU AND PERIPHERALS OVERVIEW

The task of central control and dissemination of all data is performed by the acquisition control unit (ACU), which is the central receiving point of all sensor data. The ACU receives sensor data from the data collection packages (DCP's), processes the data according to preprogrammed instructions (algorithms), and outputs the appropriate information to the various peripheral devices and users. In addition, the ACU controls a speech processor that communicates using digitized human speech. Another important feature of the ACU is the conduct of all diagnostic routines and the meaningful interpretation of results to maintenance personnel. This section describes ACU theory of operation at the simplified block diagram and detailed block diagram levels. The Codex modem, when furnished, is described in Chapter 13.

2.4.2 SIMPLIFIED BLOCK DIAGRAM DESCRIPTION

A simplified block diagram of the ACU is depicted on figure 2.4.1. The major subassemblies of the ACU are the card rack assembly, the modem ac power rack, the power supply assembly, the dc power supply enclosure, the rf/pressure mounting shelf, the I/O panel assembly, and the battery box. The ACU's major functions are grouped into three functional areas: data processing, data input/output, and power distribution and control. These functional areas are discussed in the following paragraphs.

2.4.2.1 **Data Processing**. The data processing functional area is responsible for system timing and control, data processing, data formatting and storage, and data quality checks. All hardware required for data processing is contained in the card rack assembly and includes two central processing units (CPU's) and a memory board.

2.4.2.1.1 **Central Processing Units (CPU's)**. The CPU boards provide central processing and control for the entire ASOS. Both CPU boards are identical. The CPU boards are programmed to perform self-tests once per second during real-time operation and constantly monitor each other. If a self-test error is detected, the faulty CPU is flagged off-line and the other CPU assumes the processing duties.

2.4.2.1.2 **Memory Board**. The memory board contains the ASOS operational software used by the CPU's. The memory board also stores archive data, the maintenance log, and site specific constants. The board contains up to 6 megabytes of memory with a battery backup for random access memory (RAM) in the event of a power failure.

2.4.2.2 **Data Input/Output**. The data input/output (I/O) functional area is responsible for data acquisition and communications between the data processing functional area and the ASOS users (Chapter 1). Due to the large number and variety of ASOS communications, the I/O functional area is the largest and most complex of the ACU system. Communications between ASOS users and the data processing functional area are established through telephone lines, modems, and I/O boards. Communications between the ACU and DCP are established through I/O boards and rf modems (or optional line drivers). Communications between the pressure sensors and the data processing functional area are established through I/O boards. Five different types of I/O boards exist: serial I/O, analog to digital (A/D), digital I/O, digital voice processing, and video controller. The type of I/O board used is dependent on the requirements of the user. The modems (up to 10) contained in the modem ac power rack are used for remote communications via telephone lines. The rf/pressure mounting shelf contains up to two rf modems (primary and secondary). The rf modems are used to establish an rf communications link between the ACU and the DCP's when no direct lines are available. When direct lines are available at the DCP, communications are accomplished through line drivers (short haul modems) located in the modem ac power rack. ACU I/O hardware is described in the following paragraphs.

2.4.2.2.1 **Serial I/O Boards**. From three to eight serial I/O (SIO) boards are used to interface the ACU CPU boards with other communications equipment. SIO board 1 is a model XVME 401 interface, which provides four RS-422 serial I/O ports. SIO board 1 is dedicated to the FAA tower computer control complex (TCCC), the FAA ADAS, and RVR. All other SIO boards are model XVME 490/1, each of which provides four RS-232 ports. SIO boards 2 and 3 are dedicated to the two (in Class II) rf modems or line drivers, the first two pressure sensors, modems 4 and 5 in the modem ac power rack (these correspond to user phone 1 and 2 ports), the digital voice system, and the primary operator interface device (OID). SIO boards 4 through 8 are optional. Unlike the first three SIO boards, their individual I/O ports are not dedicated to specific pieces of equipment. Rather, their ports are assigned to various equipments by the ACU serial communications page on the OID. They may interface any piece of equipment requiring RS-232 communications, such as the printer, a local video display unit (VDU), a controller video display (CVD), AFOS hardwire and spare, or the other modems in the modem ac power rack, etc.

2.4.2.2.2 **Analog to Digital (A/D) and VME Resistor Boards**. The A/D board converts analog signals to digital data so that the data can be read by the CPU. These boards convert analog dc power monitor signals from the dc power supplies and the rf modems into digital data. The CPU then reads the data to determine the power status of the dc power supplies and the rf modems. The VME resistor board scales the dc voltages before they are applied to the A/D board.

2.4.2.2.3 **Digital I/O Board**. The digital I/O board contains four digital I/O ports that allow the CPU to read and write control signals from and to the ACU. In particular, the digital I/O board inputs status signals from the dc power supplies and the voice processor board (via the VME resistor board). In Class II systems, the digital I/O board outputs a control signal to control an rf modem switch (or line driver relay) that switches between the primary and secondary rf modems (or line driver). The digital I/O board in the Class II system also monitors and controls the UPS bypass circuit.

2.4.2.2.4 **Digital Voice Processing**. Digital voice processing consists of three operations: producing a verbal report from a stored vocabulary based on current ASOS data, recording an operator-generated addendum up to 90 seconds long, and producing an output consisting of the automatically generated data and the operator input. Outputs are available for the FAA handset, dial-up reports, and FAA radio communications for aircraft. Voice processing is accomplished with two dedicated boards: a voice processor board and a voice recorder/playback board. The voice processor board contains the CPU for the digital voice system. It receives digital voice files from the ASOS CPU, creates voice reports consistent with the data reported by the sensors, and receives operator-generated digitized audio from the voice recorder/playback board. The voice recorder/playback board receives digitized voice from the voice processor board and converts the data into audio. Audio is output for dial-in weather requests, for the FAA handset at OID port 5C, and to the GTA radio for pilot use. In addition, the voice recorder/playback board receives input voice audio from the FAA handset, digitizes the input audio, and transfers the digitized audio to the voice processor board for storage in RAM.

2.4.2.2.5 **Video Controller Board**. The video controller board is an option that can be installed in the ACU to allow it to drive external airline displays that are not part of the ASOS. The video controller board outputs a composite RS-170 video signal required to drive the airline video displays.

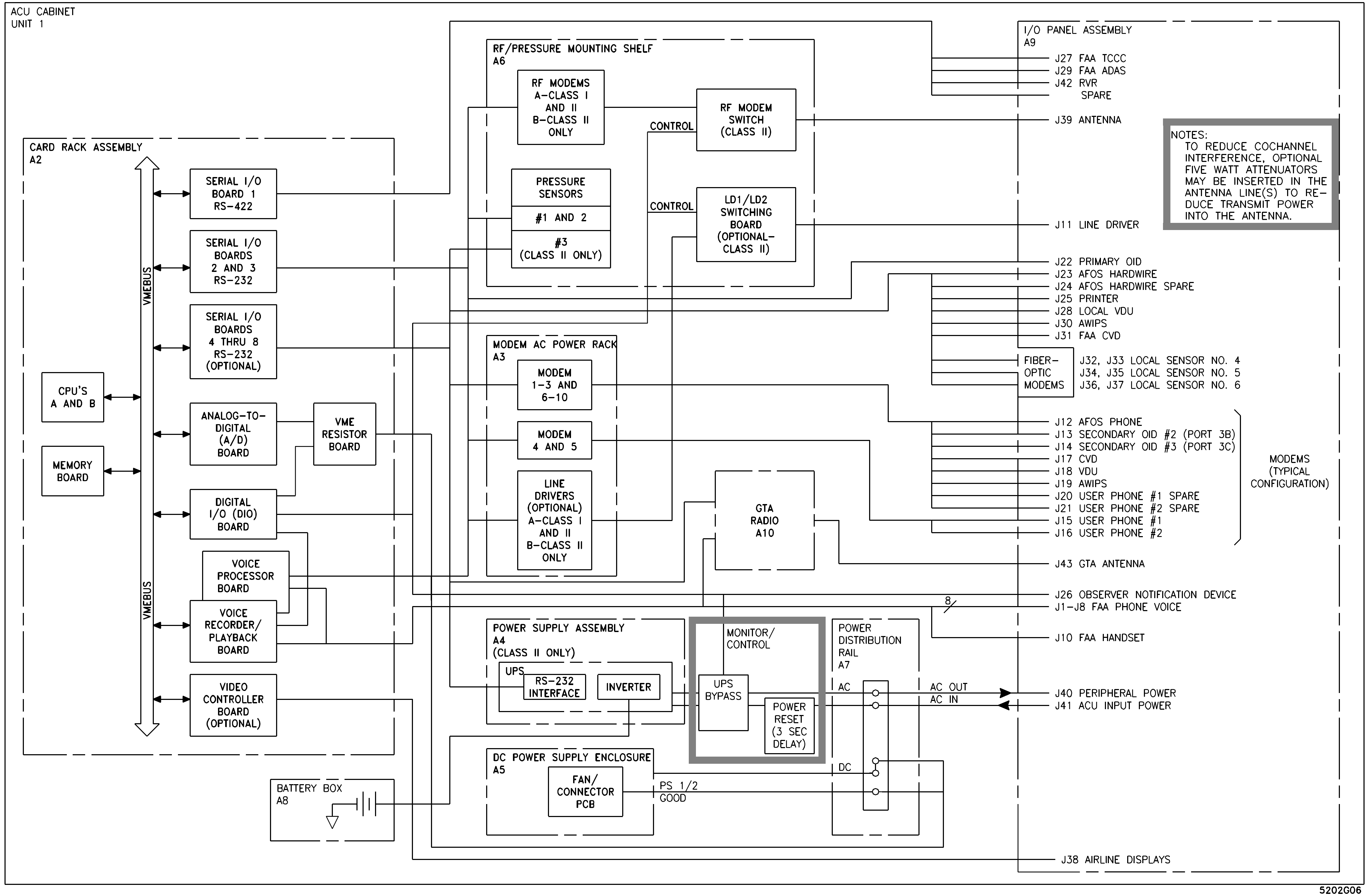


Figure 2.4.1. ACU Simplified Block Diagram

2.4.2.2.6 **ACU/DCP Communication**. Communications between the ACU and DCP are established via an rf modem or line driver link. For Class II systems using an rf modem link, the communication system consists of two rf modems, an rf modem switch, and an rf antenna. The CPU communicates with one of the modems via an SIO board RS-232 data link. The modem, in turn, communicates with the DCP via the rf antenna. The two rf modems are identical, with one serving as the primary communications link and the other as a backup. The rf switch selects which modem uses the antenna. In the event that the primary rf modem fails (transmitter or receiver), all communications are automatically switched to the secondary rf modem. For Class I systems, a single rf modem provides the data link (rf switch is not required). The line driver communication link is similar, except that communication with the DCP is over a direct line rather than the airwaves. For Class II systems, two line drivers are installed in the modem ac power rack, and an LD1/LD2 switching board (installed in the rf/pressure mounting shelf) switches between primary and secondary line drivers. For Class I systems, a single line driver handles all ACU/DCP communication.

2.4.2.2.7 **Telephone Modems**. Telephone modems are used to provide communication between the ACU and remote users or other devices (refer to Chapter 1, Section I for a list of the ASOS users who can receive/transmit data over modems). The modem ac power rack can contain up to 10 modems. Three different models may be installed in the modem rack: model 2440 (2400 baud), model V.3225 (9600 baud), and model V.3400 (28800 baud). The model 2440 modem is used for USER PHONE #1 (modem 4, refer to figure 2.1.4), USER PHONE #2 (at some sites), and most other applications. The model V.3225 is used with optional OID #2 (port 3B) and optional OID #3 (port 3C). The model V.3400 is used for USER PHONE #2 instead of the model 2440 at selected sites.

Modems 4 and 5 are included in every installation and are dedicated to the USER PHONE #1 and #2 communication ports. These two modems communicate with the CPU via specific ports on SIO boards 2 and 3, respectively. All of the other modems are provided as needed for communications options. These modems may be connected to any port on SIO boards 4 through 8, depending upon how the ACU communications are configured on the ACU serial communications page of the OID.

2.4.2.3 **Power Distribution and Control**. The power distribution and control functional area consists of Power Distribution Rail A7, DC Power Supply Enclosure A5, and Power Supply Assembly A4 (Class II systems only). The power distribution rail consists of a terminal strip that distributes ac and dc power and a power reset relay that delays power application to the ACU for three seconds after site power is interrupted. The dc power supply enclosure contains two identical power supplies that generate +5 volts, -12 volts, and +12 volts. These two power supplies are wired in parallel to provide a guaranteed output in the event that either supply fails. Special circuits built into the power supplies prevent a failed power supply from dragging down the operational power supply. Class II systems contain an uninterruptible power supply (UPS) bypass circuit mounted on Power Distribution Rail A7. The UPS bypass circuit provides additional power source control and monitoring. In the event of a power failure, the UPS is capable of supplying backup ac power to the ACU under full load for a minimum of 10 minutes. Special line loss circuitry in the UPS constantly monitors the input voltage for a power loss. When a power loss is detected, the circuitry allows Battery Box A8 to drive an inverter (dc to ac conversion), which supplies ac power to the ACU. ACU components requiring ac power are the dc power supplies and the modem ac power rack. The primary OID, the printer, and the FAA modems also receive UPS backup power via PERIPHERAL POWER connector J40 on the I/O panel assembly. Any additional peripherals connected to the UPS place an extra load on the UPS and reduce its capability to supply power. The UPS and Battery Box A8 are not included in Class I systems. For these systems, ac power for internal ACU equipment and the PERIPHERAL POWER connection is supplied directly from the input power applied to ACU INPUT POWER connector J41.

2.4.3 DETAILED BLOCK DIAGRAM DESCRIPTION

2.4.3.1 **General**. This section contains descriptions and detailed block diagrams of the ASOS ACU. The card rack assembly is described using a detailed block diagram. The circuit cards dedicated to processing ASOS sensor data are also described. Descriptions of the rf and telephone modems, digital pressure sensors, and local sensor fiber optic modems include theory of operation and associated diagrams.

Peripherals associated with the ACU, and connected through the connector panel, are the printer, CVD's, VDU's, OID's, airline displays, OND, and FAA handset. Repair of a faulty ACU peripheral consists of replacing the failed peripheral. Accordingly, the theory of operation of peripherals is presented on a general level. The drawings associated with peripherals are intended to provide the technician with the information necessary to conduct continuity checks when a connector is suspected of being faulty or needs replacement. Power distribution and control is described using detailed block diagrams of the distribution of dc and ac voltages to the ACU, including the UPS in the power supply assembly.

2.4.3.2 **Card Rack Assembly**. The card rack assembly contains up to 17 circuit boards that perform all of the data processing and input/output functions. The following circuit boards are used specifically to process data: CPU's A and B, and the memory board provide the computational system for the ACU. The following circuit boards perform the ACU input/output functions: serial I/O (SIO) boards (up to eight), the A/D board (in conjunction with the VME resistor board), the digital I/O board, the voice processor and voice recorder/playback boards, and the video controller board. All of the circuit boards are designed to accommodate the VMEbus backplane construction. Figure 2.4.2 illustrates the VMEbus chassis, backplane configuration, and connector pin assignments as required by the VMEbus specification. One or two 96-pin bus connectors are located on the rear edge of the board and are labeled P1 and P2. The 96-pin connectors consist of 3 rows of pins (32 pins per row) labeled rows A, B, and C. The pin connections for P1 contain the standard address, data, and control signals necessary for system bus communication. The P1 pin assignments are listed by pin number order. The pin connections for P2 vary according to the function provided by the circuit board. The following paragraphs provide detailed information on the circuit boards and their dedicated functions, and reference figure 2.4.3 (ACU Card Rack Assembly Detailed Block Diagram).

2.4.3.2.1 **Central Processing Unit (CPU)**. The CPU executes the ASOS operational software. All operational software resides in the erasable programmable read-only memory (EPROM) on the memory board. Execution of the operational software involves data processing, data formatting, data quality checks, and data storage. The card rack assembly contains two CPU circuit boards, both of which are identical and contain a 68010 series microprocessor running at 10 MHZ, memory (EPROM and dynamic random access memory (DRAM)), two RS-232 ports, and a 16-bit timer. During system operation, one of the CPU's functions as the primary CPU, which performs all processing and I/O functions. The other (secondary) CPU provides a redundant processor. If, at any time, the primary CPU fails, it is taken off-line and the secondary CPU becomes the primary CPU. Initially, CPU A is the primary CPU. Two pushbutton switches labeled RESET and ABORT are provided on the front of the circuit board. ABORT halts program execution without resetting the CPU. This switch is used for development purposes and should not be used in the field. In the event that ABORT is pressed, RESET should be pressed to reset the CPU and activate SYSRESET, thereby resetting the entire backplane via the VMEbus. Resetting the CPU does not affect the contents of the DRAM. The following paragraphs provide a detailed block diagram description of the CPU and its various modes of operation.

The CPU consists of nine functional areas (Figure 2.4.3): the system resource function, dual UART and timer, RS-232 driver and receiver logic, CPU clock, CPU, interrupt logic, VME interface logic, address buffer and decode, and memory. The system resource function on CPU A provides the system clock, system reset, bus arbitration, and bus timer functions for the entire VMEbus. Because CPU A is the bus controller, the system resource function on CPU B is not used.

The dual UART and timer provides two RS-232 serial communication channels (channels A and B), a timer, and two I/O and control ports. The RS-232 driver and receiver logic interfaces UART channels A and B to external devices via connector JK1 on the CPU by providing standard transmit and receive lines. On both CPU A and CPU B, the two channels are not used. On CPU A, however, a loopback jumper is

P1 (VME BUS) PIN ASSIGNMENTS

Pin Number	Row A Signal Mnemonic	Row B Signal Mnemonic	Row C Signal Mnemonic
1	D00	BBSY	D08
2	D01	BCLR	D09
3	D02	ACFAIL	D10
4	D03	BG0IN	D11
5	D04	BG0OUT	D12
6	D05	BG1IN	D13
7	D06	BG1OUT	D14
8	D07	BG2IN	D15
9	GND	BG2OUT	GND
10	SYSCLK	BG3IN	SYSFAIL
11	GND	BG3OUT	BERR
12	DS1	BR0	SYSRESET
13	DS0	BR1	LWORD
14	WRITE	BR2	AM5
15	GND	BR3	A23
16	DTACK	AM0	A22
17	GND	AM1	A21
18	AS	AM2	A20
19	GND	AM3	A19
20	IACK	GND	A18
21	IACKIN	SERCLK(1)	A17
22	IACKOUT	SERDAT(1)	A16
23	AM4	GND	A15
24	A07	IRQ7	A14
25	A06	IRQ6	A13
26	A05	IRQ5	A12
27	A04	IRQ4	A11
28	A03	IRQ3	A10
29	A02	IRQ2	A09
30	A01	IRQ1	A08
31	-12V	+5V STDBY	+12V
32	+5V	+5V	+5V

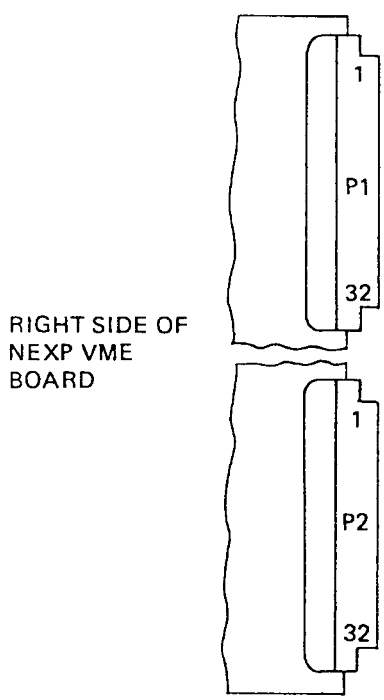


Figure 2.4.2. ACU VMEbus Chassis and Connector Pin Assignments (Sheet 1 of 3)

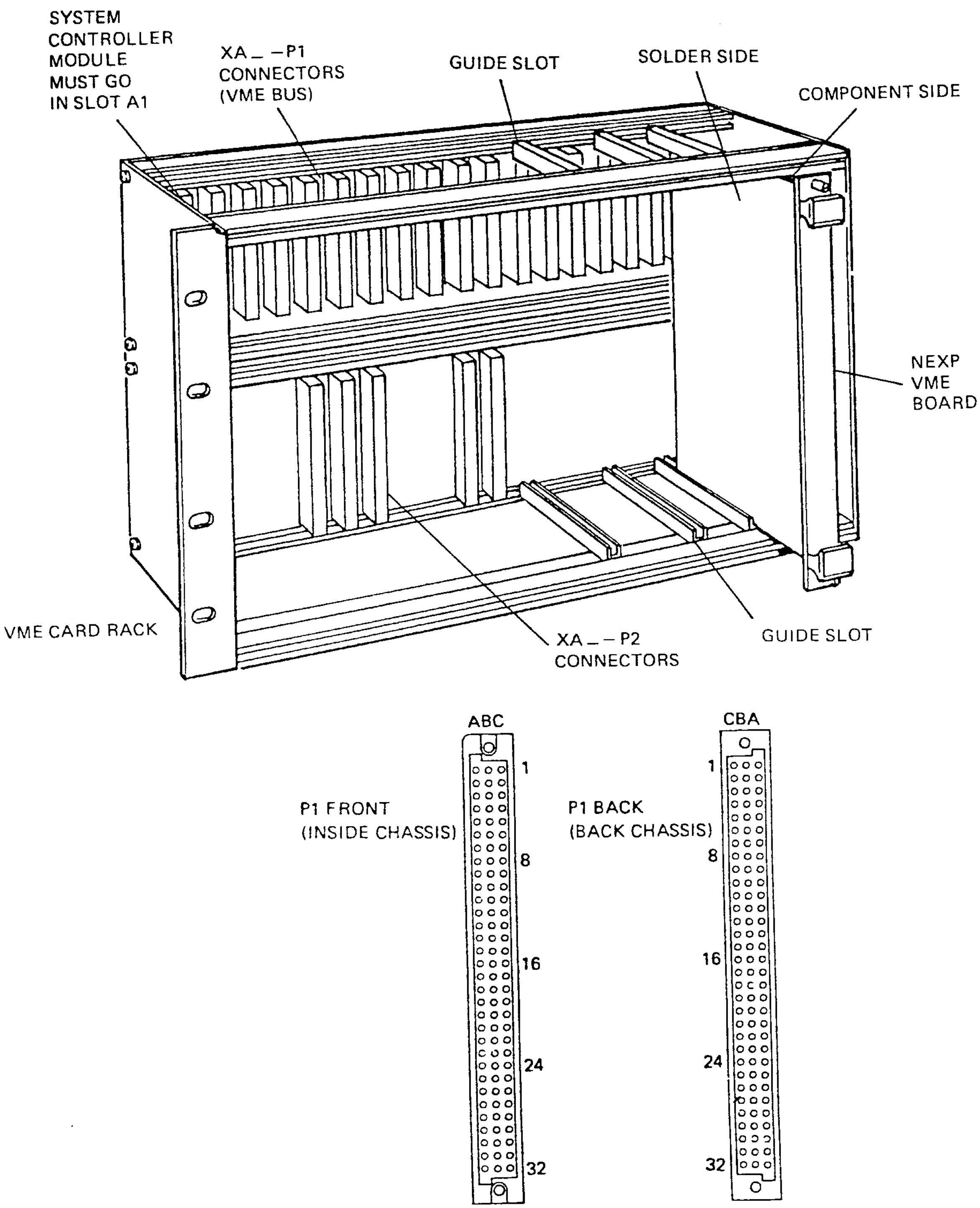


Figure 2.4.2. ACU VMEbus Chassis and Connector Pin Assignments (Sheet 2)

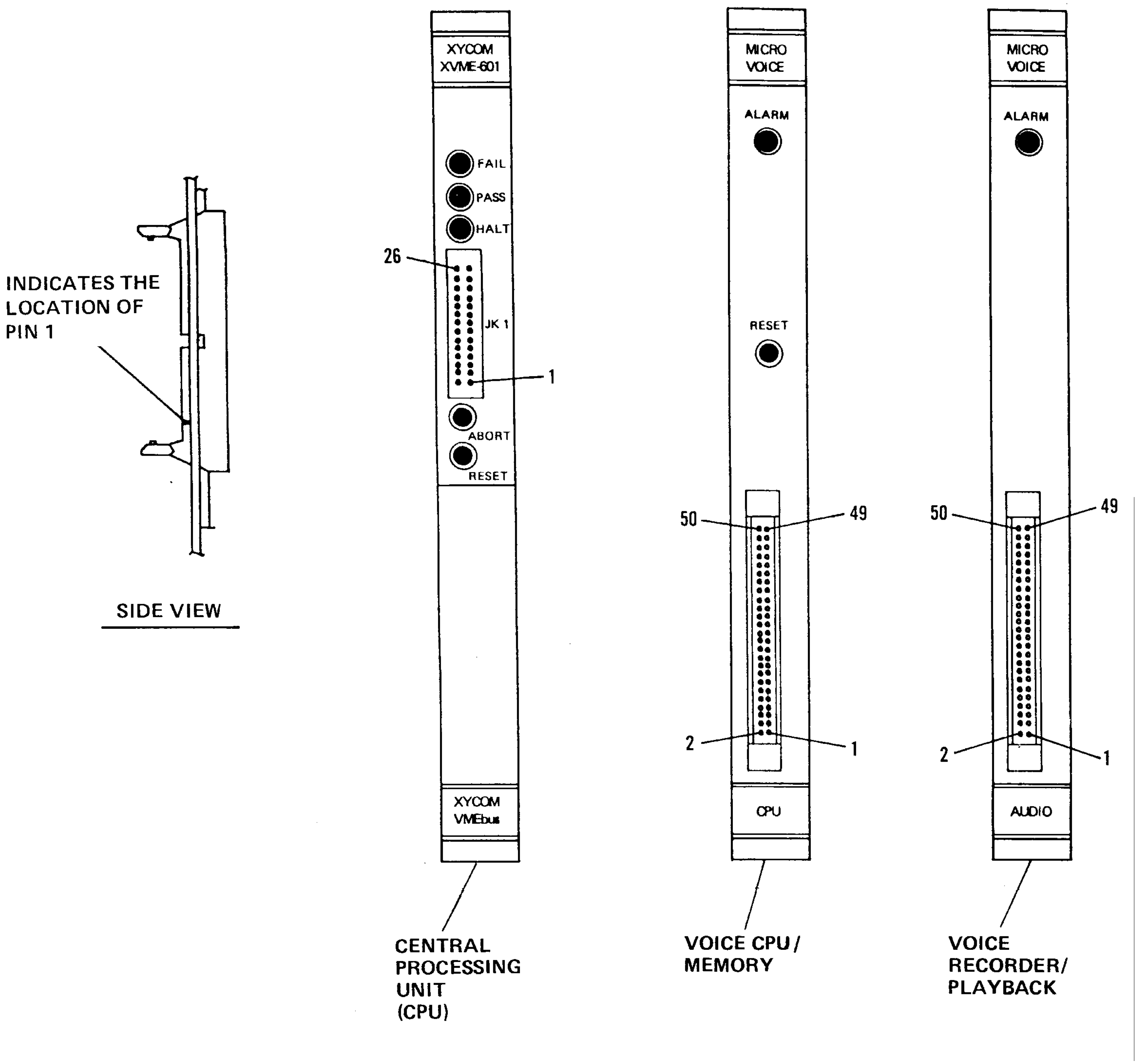


Figure 2.4.2. ACU VMEbus Chassis and Connector Pin Assignments (Sheet 3)

installed between the channel B transmit and receive lines (pins 14 and 16 of connector JK1). This jumper identifies CPU A as the initial primary CPU. When power is first applied to the ACU, both CPU's issue a message from their respective UART channel B. CPU A then receives the message back via the installed loopback jumper. Both CPU's then examine their receive lines. When CPU A detects that it has received the signal via the loopback jumper, it assumes the role of the primary CPU. When CPU B detects that it has not received its transmitted signal, it assumes the role of the secondary CPU. The secondary CPU continuously monitors the primary CPU status by examining a memory location in the memory board used to store a free running count. The primary CPU updates this count on a periodic basis. Failure to update the count indicates a CPU failure. The secondary CPU then becomes the primary CPU.

The CPU clock provides the 10 MHZ clock signal required by the CPU. The CPU executes the ASOS operational software. The interrupt logic monitors the dedicated interrupt lines and informs the CPU when an interrupt line is active. The interrupts are prioritized and processed on a first come, first serve basis. The VME interface logic provides the standard address, data, and control signals necessary for system bus communication. The address buffer and decode provides the address. The onboard memory consists of 128K bytes of EPROM and 512K bytes of DRAM. The operating system software for the CPU is contained in the EPROM. The refresh circuitry for the DRAM is not disabled during a RESET; therefore, the CPU may be reset without affecting the memory contents.

The ACU continuous self-test (CST) checks the status of the CPU's once per minute. CST results are displayed on the CPU page of the OID. The CST checks the following areas of both the primary and secondary CPU: DRAM, EPROM, BUS ERRORS, SERIAL PORT #1 and #2 LOOPBACK, and SERIAL PORT #1 and #2 XMIT ERRORS. For the primary CPU, test pass/fail status is displayed for each of these areas. For the secondary (redundant) CPU, test status is displayed for the overall board only. The technician can manually run the CPU test from the CPU page at any time. A T status is displayed for each test category until the test is run again during the next CST cycle. After the cycle, the latest test status is displayed and the fail count (if applicable) is incremented.

The DRAM test is based on an alternating pattern. Data are output to the DRAM and read back, the returned data are evaluated, and the test status is displayed. The EPROM test is based on a checksum. The checksum is compared to the last byte in the EPROM, the result is evaluated, and the test status is displayed. The BUS ERRORS test is based on a memory write to a specific address, with the contents of the addressed memory evaluated and the test status displayed.

The SERIAL PORT #1 and #2 LOOPBACK tests ensure that the CPU can communicate with its internal UART. The CPU reads the UART interrupt vector register and checks for bus errors. Test status is displayed as P (pass) if no bus errors occurred.

For the SERIAL PORT #1 and #2 XMIT ERRORS test, the CPU reads the contents of the status register for the corresponding port. This register contains information on transmission errors detected by the UART during RS-232 communications. Specifically, the CPU checks the status register for parity errors, framing errors, and overrun errors that may have occurred. If such errors occur for three consecutive CST cycles, an F (fail) is displayed for the test status; otherwise, test status is P (pass).

2.4.3.2.2 **Memory Board**. The XVME-110 memory board contains three memory banks. Each bank is independently configured via jumpers to specify VME address/memory chip size, device speed, device pinout, and backup power. The following paragraphs provide a detailed block diagram description of the memory board.

The memory board consists of nine functional areas (Figure 2.4.3): banks 1, 2, and 3 memory devices; VME/bank address decode and control; battery backup; data buffer; bus cycle control; address buffer and decode logic; and the system real-time clock. The first bank contains up to 4 Mbytes of EPROM. The EPROM contains the operational software program run by the CPU. It also contains the DCP software load that is transferred to a DCP in the event that a DCP loses its program load and requires reinitialization. Banks

2 and 3 contain up to 2 Mbytes of static random access memory (SRAM). The SRAM provides storage for ASOS weather archives. The address and control signals used to address memory locations are generated by the VME/bank address decode and control. The memory boards are configured with a battery backup to provide an alternate power source in the event of a power loss. The data buffer, bus cycle control, and address buffer and decode logic provide the standard address, data, and control signals necessary for system bus communication. The real-time clock maintains clock calendar timing, which is accessed by the CPU upon initialization. When initialized, the CPU maintains a clock via software.

The ACU continuous self-test (CST) checks the status of the memory board once per minute. CST results are displayed on the memory page of the OID. The CST performs an EPROM test and an SRAM test. The technician can manually run the memory test from the memory page at any time. A T status is displayed for each test category until the test is run again during the next CST cycle. After the cycle, the latest test status is displayed and the fail count (if applicable) is incremented.

The EPROM test is based on a checksum, which is compared to the last byte in the EPROM. The result is evaluated and the test status is displayed. The SRAM test ensures that the CPU can read data from the SRAM on the memory board without encountering bus errors.

2.4.3.2.3 **Serial I/O (SIO) Board**. The card rack assembly contains one XVME-491 SIO board and up to seven XVME-490/1 SIO boards. The XVME-491/1 SIO board (SIO board 1) provides four RS-422 serial ports, while each of the XVME-490/1 SIO boards (SIO boards 2 through 8) provides four RS-232 ports. The SIO boards communicate with the CPU on a character-by-character basis. The CPU must process interrupts on each and every transmitted and received character. The following paragraphs provide a detailed block diagram description of the SIO board.

The SIO board consists of six functional areas (Figure 2.4.4): two serial communication controllers (SCC's), interrupt logic, data buffer, bus cycle control, and address buffer and decode logic. The SCC's provide a variety of communication modes. Upon power up, the CPU initializes the SCC's to the proper communication modes. Interrupts are generated via the interrupt logic. An interrupt can signify that a received character is available, that the transmit buffer is empty, or an external/ status change. The data buffer, bus cycle control, and address buffer and decode logic provide the standard address, data, and control signals necessary for system bus communication.

The four ports of each of SIO boards 1 through 3 are factory assigned to specific devices. Their ports are dedicated to these devices via corresponding connectors on the ACU main wiring harness. Although these ports can be reassigned via the ACU serial communications page of the OID, the technician should not reassign them; assigning these ports to other FRU's would invalidate their corresponding harness markers. Table 2.4.1 identifies each of the ports of these SIO boards and lists the corresponding harness connector and the device to which it is connected.

Unlike SIO boards 1 through 3, SIO boards 4 through 8 are optional. Most systems will not have all of these SIO boards installed. As such, the ports of these SIO boards are not factory assigned to specific devices. Rather, these ports are assigned to various devices during the initial configuration of the system. This assignment is made via the ACU serial communications page of the OID. Figure 2.4.4 identifies all of the ports of SIO boards 4 through 8 and identifies the W014 (or W016) connector that corresponds to each. The devices to which these connectors mate depend upon the device assigned to that port by the ACU serial communications page. Figure 2.4.4 also identifies the pin-to-pin wiring between each of the SIO boards and their respective connectors.

Table 2.4.1. Port Assignments for SIO's 1 Through 3

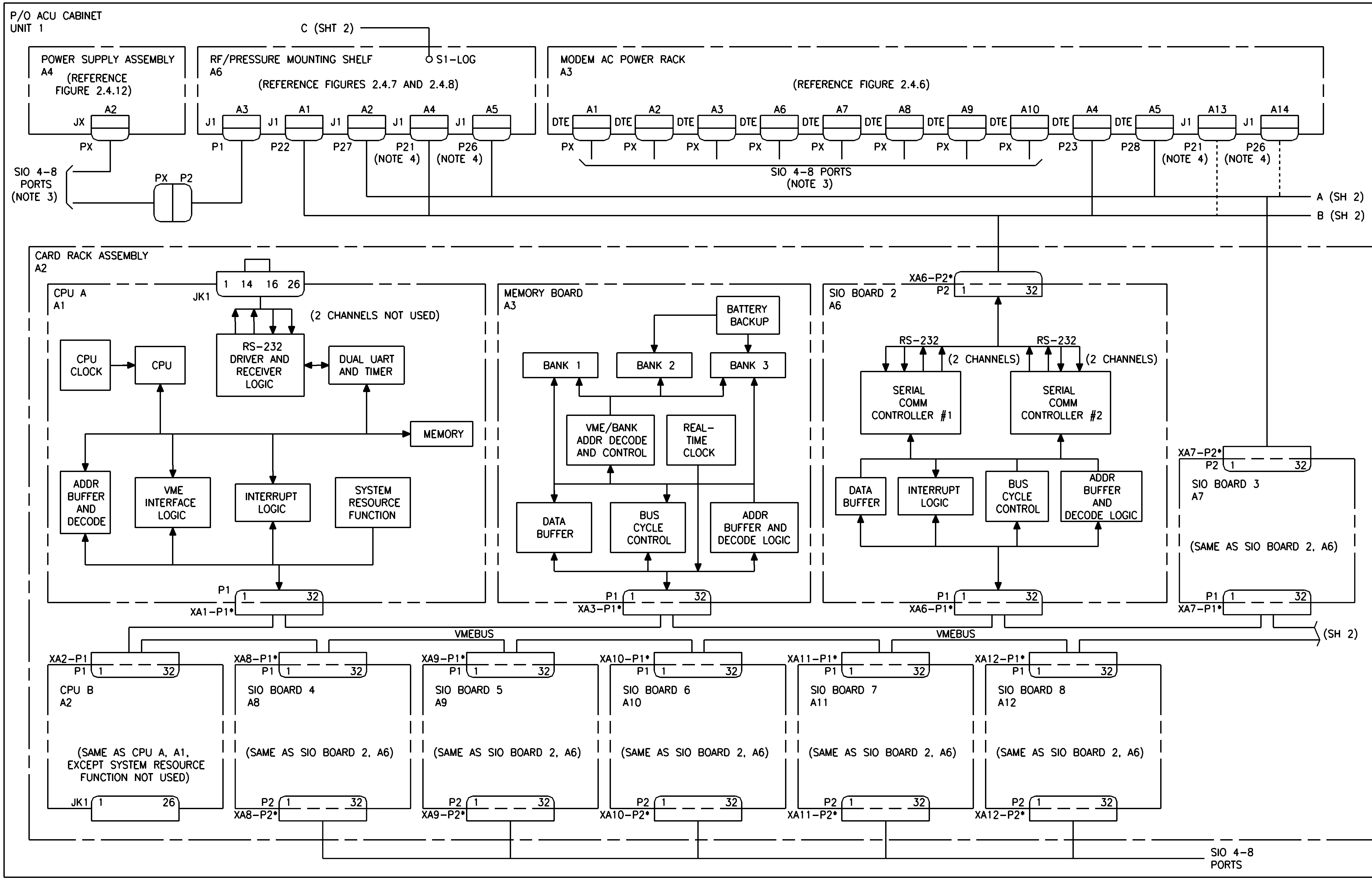
SIO Board	Port	W014/16 Connector	Device	Function
1 (RS-422) Note 1	1	P16	1A9J29	FAA ADAS
	2	P17	1A9J27	FAA TCCC
	3	P18	1A9J42	RVR
	4	P19	N/A	Spare
2 (RS-232)	1	P21	1A6A4 or 1A3A13	RF Modem A Line Driver A
	2	P22	A6A1	Pressure Sensor #1
	3	P23	1A3A4	Modem #4 (User Phone #1)
	4	XA20-P2	1A2A20	Voice Processor Board
3 (RS-232)	1	P26	1A6A5 or 1A3A14	RF Modem B (Class II only) Line Driver B (Class II only
	2	P27	1A6A2	Pressure Sensor #2
	3	P28	1A3A5	Modem #5 (User Phone #2)
	4	P29	1A9J22	Primary OID

Note 1- ACU S/N 288 and below use crossover connector cables (W77) between W014/16 and the device connectors to conFigure the RS-422 ports for DTE I/O. ACU S/N 289 and above are factory wired for DTE I/O.

The ACU CST checks the status of the SIO boards once per minute. CST results are displayed on the ACU SIO display pages of the OID (there is one page for each of the eight SIO boards). The CST performs a LOOPBACK test and an XMIT ERRORS test on each of the four ports of an SIO board. The technician can manually run the SIO test from an SIO page at any time. A T status is displayed for both test categories until the test is run again during the next CTS cycle. After the cycle, the latest test status is displayed and the fail count (if applicable) is incremented.

For the LOOPBACK test, the CPU reads an interrupt vector register on the SIO board to ensure that it can communicate with the SIO port. For the XMIT ERRORS test, the CPU reads the contents of the SCC status register for the corresponding port. This register contains information on transmission errors detected by the SCC during RS-232 communications. Specifically, the CPU checks the status register for parity errors, framing errors, and overrun errors that may have occurred. For both LOOPBACK and XMIT ERRORS tests, CST status is displayed as either P (pass), F (fail), or D (degraded). A status of D is displayed if five or more errors have been detected and the port is currently passing the test. At 0600 LST each day, the number of accumulated failures is summarized in the system (maintenance) log. Paragraph 1.3.4.3.3 provides additional information on SIO test reporting.

2.4.3.2.4 **Voice Processor and Voice Recorder/Playback Boards**. The voice processor board and the voice recorder/playback board make up the digital voice processing system of the ACU. Both of these boards are connected to the VMEbus for power and system reset purposes. Communication between the CPU and the digital voice system is accomplished via the RS-232 link between SIO board 2 and the voice processor board (rather than over the VMEbus). The voice processor board communicates with the voice recorder/playback board via a 50-pin ribbon cable connected between the front panels of both boards. Voice outputs from the digital voice system are passed to the I/O panel where they are made available for dial-up reports, the FAA handset, and FAA radio communications for aircraft. Additional information on these boards is provided in the digital voice processor detailed block diagram description (paragraph 2.4.3.3).



NOTES

1. UNLESS OTHERWISE NOTED, ALL ACU CABINET WIRING IS PART OF HARNESS W014 (CLASS II) OR W016 (CLASS I).
*2. REFERENCE FIGURE 2.4.2 FOR ACU VMEBUS CHASSIS AND PIN ASSIGNMENTS.
3. W014/W016 CONNECTOR (PX) ATTACHED TO FRU DEPENDS UPON WHICH SIO PORT THE FRU IS ASSIGNED (VIA ACU SERIAL COMMS DISPLAY ON OID). REFER TO FIGURE 2.4.4 FOR SIO PORT-TO-PX RELATIONSHIP.
4. W014/W016 CONNECTORS P21 AND P26 GO TO EITHER RF MODEMS OR LINE DRIVERS, DEPENDING ON SITE CONFIGURATION.

Figure 2.4.3. ACU Card Rack Assembly Detailed Block Diagram (Sheet 1 of 2)

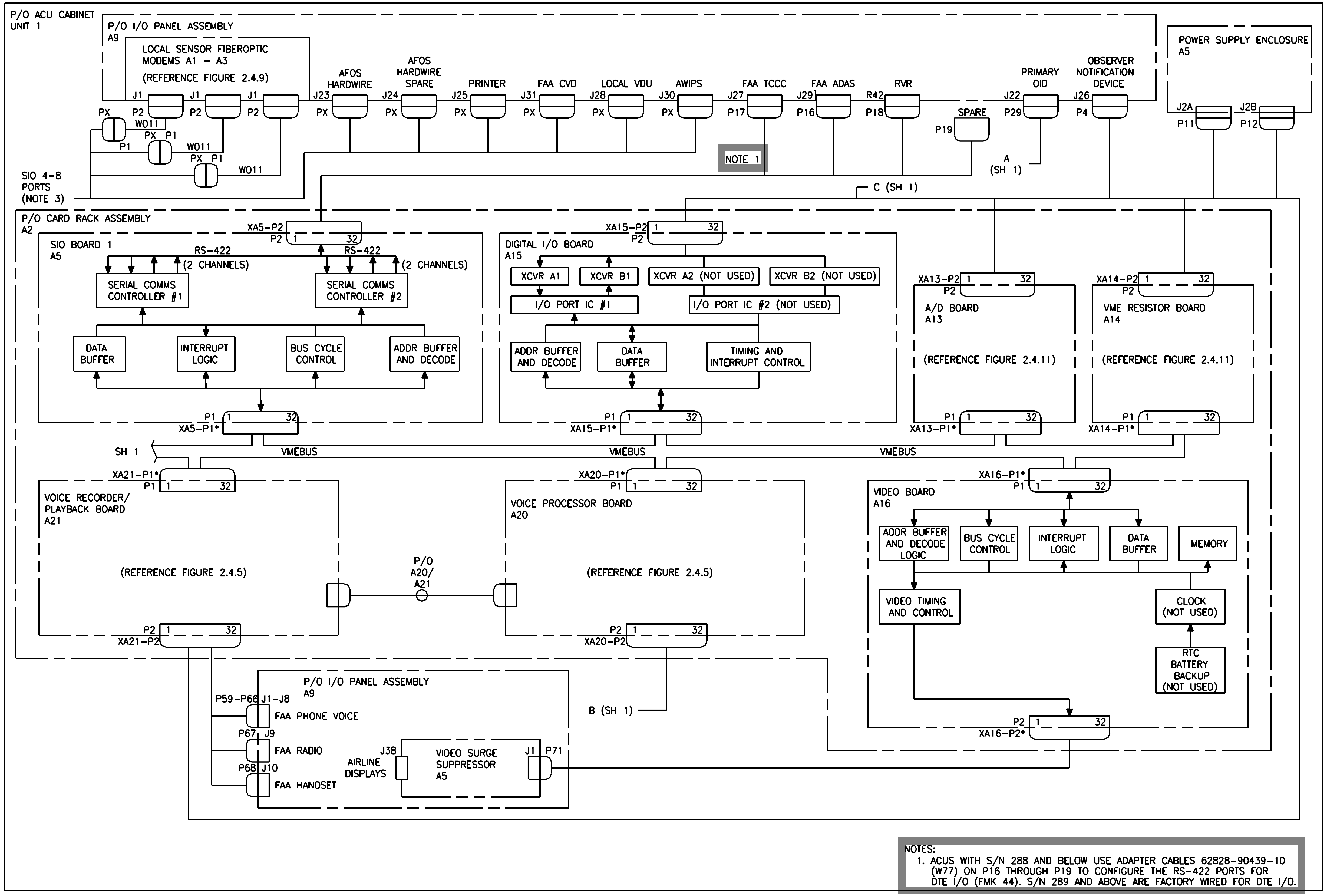


Figure 2.4.3. ACU Card Rack Assembly Detailed Block Diagram (Sheet 2)

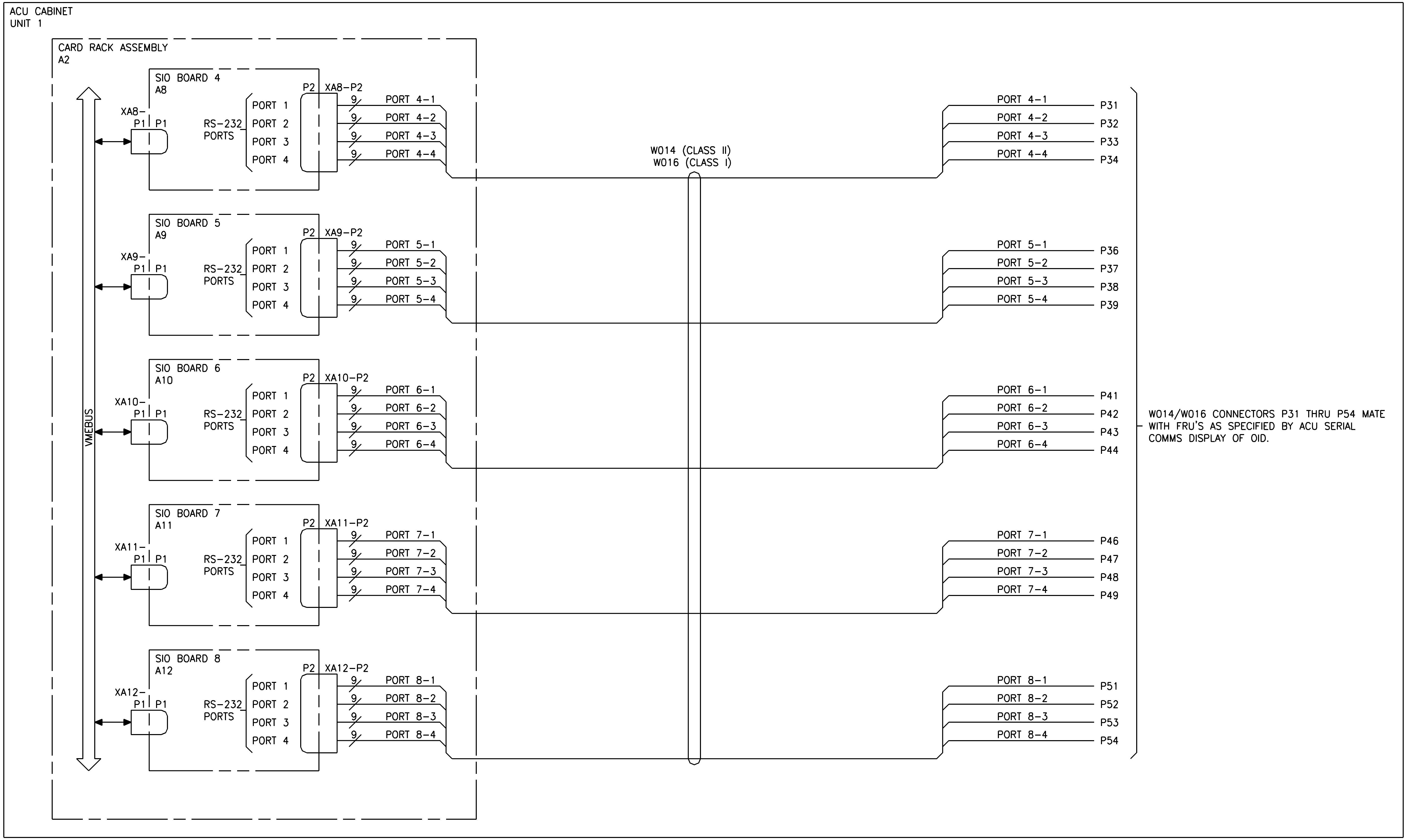


Figure 2.4.4. SIO Boards 4 Through 8 Ports and Pin Assignments (Sheet 1 of 2)

SIO BOARDS 4-8 TO W014/W016 CONNECTOR (PX) PIN ASSIGNMENTS

	SIO BOARD 4 (1A2A8)			SIO BOARD 5 (1A2A9)			SIO BOARD 6 (1A2A10)			SIO BOARD 7 (1A2A11)			SIO BOARD 8 (1A2A12)		
	FROM	TO	SIGNAL	FROM	TO	SIGNAL	FROM	TO	SIGNAL	FROM	TO	SIGNAL	FROM	TO	SIGNAL
PORT 1	A2XA8P2-A4	P31-17	RXC0	A2XA9P2-A4	P36-17	RXC0	A2XA10P2-A4	P41-17	RXC0	A2XA11P2-A4	P46-17	RXC0	A2XA12P2-A4	P51-17	RXC0
	A2XA8P2-A1	P31-2	TXD0	A2XA9P2-A1	P36-2	TXD0	A2XA10P2-A1	P41-2	TXD0	A2XA11P2-A1	P46-2	TXD0	A2XA12P2-A1	P51-2	TXD0
	A2XA8P2-A6	P31-20	DTR0	A2XA9P2-A6	P36-20	DTR0	A2XA10P2-A6	P41-20	DTR0	A2XA11P2-A6	P46-20	DTR0	A2XA12P2-A6	P51-20	DTR0
	A2XA8P2-A8	P31-24	TXC0	A2XA9P2-A8	P36-24	TXC0	A2XA10P2-A8	P41-24	TXC0	A2XA11P2-A8	P46-24	TXC0	A2XA12P2-A8	P51-24	TXC0
	A2XA8P2-A2	P31-3	RXD0	A2XA9P2-A2	P36-3	RXD0	A2XA10P2-A2	P41-3	RXD0	A2XA11P2-A2	P46-3	RXD0	A2XA12P2-A2	P51-3	RXD0
	A2XA8P2-A3	P31-4	RTS0	A2XA9P2-A3	P36-4	RTS0	A2XA10P2-A3	P41-4	RTS0	A2XA11P2-A3	P46-4	RTS0	A2XA12P2-A3	P51-4	RTS0
	A2XA8P2-A5	P31-5	CTS0	A2XA9P2-A5	P36-5	CTS0	A2XA10P2-A5	P41-5	CTS0	A2XA11P2-A5	P46-5	CTS0	A2XA12P2-A5	P51-5	CTS0
	A2XA8P2-C1	P31-7	GND0	A2XA9P2-C1	P36-7	GND0	A2XA10P2-C1	P41-7	GND0	A2XA11P2-C1	P46-7	GND0	A2XA12P2-C1	P51-7	GND0
	A2XA8P2-A7	P31-8	DCD0	A2XA9P2-A7	P36-8	DCD0	A2XA10P2-A7	P41-8	DCD0	A2XA11P2-A7	P46-8	DCD0	A2XA12P2-A7	P51-8	DCD0
PORT 2	A2XA8P2-A12	P32-17	RXC1	A2XA9P2-A12	P37-17	RXC1	A2XA10P2-A12	P42-17	RXC1	A2XA11P2-A12	P47-17	RXC1	A2XA12P2-A12	P52-17	RXC1
	A2XA8P2-A9	P32-2	TXD1	A2XA9P2-A9	P37-2	TXD1	A2XA10P2-A9	P42-2	TXD1	A2XA11P2-A9	P47-2	TXD1	A2XA12P2-A9	P52-2	TXD1
	A2XA8P2-A14	P32-20	DTR1	A2XA9P2-A14	P37-20	DTR1	A2XA10P2-A14	P42-20	DTR1	A2XA11P2-A14	P47-20	DTR1	A2XA12P2-A14	P52-20	DTR1
	A2XA8P2-A16	P32-24	TXC1	A2XA9P2-A16	P37-24	TXC1	A2XA10P2-A16	P42-24	TXC1	A2XA11P2-A16	P47-24	TXC1	A2XA12P2-A16	P52-24	TXC1
	A2XA8P2-A10	P32-3	RXD1	A2XA9P2-A10	P37-3	RXD1	A2XA10P2-A10	P42-3	RXD1	A2XA11P2-A10	P47-3	RXD1	A2XA12P2-A10	P52-3	RXD1
	A2XA8P2-A11	P32-4	RTS	A2XA9P2-A11	P37-4	RTS	A2XA10P2-A11	P42-4	RTS	A2XA11P2-A11	P47-4	RTS	A2XA12P2-A11	P52-4	RTS
	A2XA8P2-A13	P32-5	CTS1	A2XA9P2-A13	P37-5	CTS1	A2XA10P2-A13	P42-5	CTS1	A2XA11P2-A13	P47-5	CTS1	A2XA12P2-A13	P52-5	CTS1
	A2XA8P2-C9	P32-7	GND1	A2XA9P2-C9	P37-7	GND1	A2XA10P2-C9	P42-7	GND1	A2XA11P2-C9	P47-7	GND1	A2XA12P2-C9	P52-7	GND1
	A2XA8P2-A15	P32-8	DCD1	A2XA9P2-A15	P37-8	DCD1	A2XA10P2-A15	P42-8	DCD1	A2XA11P2-A15	P47-8	DCD1	A2XA12P2-A15	P52-8	DCD1
PORT 3	A2XA8P2-A20	P33-17	RXC2	A2XA9P2-A20	P38-17	RXC2	A2XA10P2-A20	P43-17	RXC2	A2XA11P2-A20	P48-17	RXC2	A2XA12P2-A20	P53-17	RXC2
	A2XA8P2-A17	P33-2	TXD2	A2XA9P2-A17	P38-2	TXD2	A2XA10P2-A17	P43-2	TXD2	A2XA11P2-A17	P48-2	TXD2	A2XA12P2-A17	P53-2	TXD2
	A2XA8P2-A22	P33-20	DTR2	A2XA9P2-A22	P38-20	DTR2	A2XA10P2-A22	P43-20	DTR2	A2XA11P2-A22	P48-20	DTR2	A2XA12P2-A22	P53-20	DTR2
	A2XA8P2-A24	P33-24	TXC2	A2XA9P2-A24	P38-24	TXC2	A2XA10P2-A24	P43-24	TXC2	A2XA11P2-A24	P48-24	TXC2	A2XA12P2-A24	P53-24	TXC2
	A2XA8P2-A18	P33-3	RXD2	A2XA9P2-A18	P38-3	RXD2	A2XA10P2-A18	P43-3	RXD2	A2XA11P2-A18	P48-3	RXD2	A2XA12P2-A18	P53-3	RXD2
	A2XA8P2-A19	P33-4	RTS2	A2XA9P2-A19	P38-4	RTS2	A2XA10P2-A19	P43-4	RTS2	A2XA11P2-A19	P48-4	RTS2	A2XA12P2-A19	P53-4	RTS2
	A2XA8P2-A21	P33-5	CTS2	A2XA9P2-A21	P38-5	CTS2	A2XA10P2-A21	P43-5	CTS2	A2XA11P2-A21	P48-5	CTS2	A2XA12P2-A21	P53-5	CTS2
	A2XA8P2-C17	P33-7	GND2	A2XA9P2-C17	P38-7	GND2	A2XA10P2-C17	P43-7	GND2	A2XA11P2-C17	P48-7	GND2	A2XA12P2-C17	P53-7	GND2
	A2XA8P2-A23	P33-8	DCD2	A2XA9P2-A23	P38-8	DCD2	A2XA10P2-A23	P43-8	DCD2	A2XA11P2-A23	P48-8	DCD2	A2XA12P2-A23	P53-8	DCD2
PORT 4	A2XA8P2-A28	P34-17	RXC3	A2XA9P2-A28	P39-17	RXC3	A2XA10P2-A28	P44-17	RXC3	A2XA11P2-A28	P49-17	RXC3	A2XA12P2-A28	P54-17	RXC3
	A2XA8P2-A25	P34-2	TXD3	A2XA9P2-A25	P39-2	TXD3	A2XA10P2-A25	P44-2	TXD3	A2XA11P2-A25	P49-2	TXD3	A2XA12P2-A25	P54-2	TXD3
	A2XA8P2-A30	P34-20	DTR3	A2XA9P2-A30	P39-20	DTR3	A2XA10P2-A30	P44-20	DTR3	A2XA11P2-A30	P49-20	DTR3	A2XA12P2-A30	P54-20	DTR3
	A2XA8P2-A32	P34-24	TXC3	A2XA9P2-A32	P39-24	TXC3	A2XA10P2-A32	P44-24	TXC3	A2XA11P2-A32	P49-24	TXC3	A2XA12P2-A32	P54-24	TXC3
	A2XA8P2-A26	P34-3	RXD3	A2XA9P2-A26	P39-3	RXD3	A2XA10P2-A26	P44-3	RXD3	A2XA11P2-A26	P49-3	RXD3	A2XA12P2-A26	P54-3	RXD3
	A2XA8P2-A27	P34-4	RTS3	A2XA9P2-A27	P39-4	RTS3	A2XA10P2-A27	P44-4	RTS3	A2XA11P2-A27	P49-4	RTS3	A2XA12P2-A27	P54-4	RTS3
	A2XA8P2-A29	P34-5	CTS3	A2XA9P2-A29	P39-5	CTS3	A2XA10P2-A29	P44-5	CTS3	A2XA11P2-A29	P49-5	CTS3	A2XA12P2-A29	P54-5	CTS3
	A2XA8P2-C25	P34-7	GND3	A2XA9P2-C25	P39-7	GND3	A2XA10P2-C25	P44-7	GND3	A2XA11P2-C25	P49-7	GND3	A2XA12P2-C25	P54-7	GND3
	A2XA8P2-A31	P34-8	DCD3	A2XA9P2-A31	P39-8	DCD3	A2XA10P2-A31	P44-8	DCD3	A2XA11P2-A31	P49-8	DCD3	A2XA12P2-A31	P54-8	DCD3

5202C24

SIGNAL DEFINITION

RXC – RECEIVING CLOCK
TXD – TRANSMIT DATA
DTR – DATA TRANSMISSION READY
TXC – TRANSMITTING CLOCK
RXD – RECEIVE DATA
RTS – REQUEST TO SEND
CTS – CLEAR TO SEND
GND – GROUND
DCD – DATA CARRIER DETECT

Figure 2.4.4. SIO Boards 4 Through 8 Ports and Pin Assignments (Sheet 2)

2.4.3.2.5 **Video Board**. The video board is an option that is installed on systems connected to airline video displays. The video board functions as the interface between the VMEbus and the airline video displays. The airline video displays are updated once per minute. The video display is memory mapped.

The video board consists of eight functional areas: data buffer, bus cycle control, address buffer and decode logic, memory, video timing and control, clock, RTC battery backup, and interrupt logic. The data buffer, bus cycle control, and address buffer and decode logic provide the standard address, data, and control signals necessary for system bus communication. The memory provides the storage for the display information. Each character location has a specific memory location. The data stored in memory are used to select a specific character and how it is displayed. The video timing and control provides the sync signals (horizontal and vertical) and display timing signals as well as memory address refresh. These discrete video signals are combined and output as a composite video signal. The clock and battery backup are not used.

The ACU CST checks the status of the video board once per minute. CST results are displayed on the video (graphics) page of the OID. The CST performs five tests: CRT CONTROLLER READBACK, PARALLEL I/F TIMER READBACK, LOOPBACK #1 and #2, and RT CLOCK READBACK. The technician can manually run the video memory test from the video page at any time. A T status is displayed for each test category until the test is run again during the next CST cycle. After the cycle, the latest test status is displayed and the fail count (if applicable) is incremented.

The CRT CONTROLLER READBACK test reads the contents of a register in a CRT controller in the video timing and control area of the board. The status word is evaluated and the test status is displayed. The PARALLEL I/F TIMER READBACK test checks the operation of a parallel interface on the board. This parallel interface is not used. The LOOPBACK #1 and #2 tests check the status of two RS-422 SCC's provided by the board. These SCC's are not used by the system. The RT CLOCK READBACK tests clock timing. This clock is not used by the system.

2.4.3.2.6 **Digital I/O Board**. The digital I/O board provides address buffer and control, a data buffer, timing and interrupt control, two dual I/O port IC's (#1 and #2), and four transceivers. The CPU communicates with the digital I/O board over the VMEbus via the address buffer and decode, the data buffer, and the timing and interrupt control. The two dual I/O port IC's provide a total of four ports (ports A1, B1, A2, and B2), each of which communicates with external devices via a dedicated transceiver. Port A1 is configured as an input only port. This port is used by the CPU to input a watchdog timer signal from the voice processor board and to input status bits for the dc power supplies (via the VME resistor board) and the UPS bypass circuit. Port B1 is configured as an output only port. This port is used by the CPU to output control signals to the voice recorder/playback board, the rf modem switch (or line driver relay), and the UPS bypass circuit. Ports A2 and B2 on the DIO board are not used in the ACU. The ACU CST does not check the status of the digital I/O board.

2.4.3.2.7 **A/D Board and VME Resistor Board**. The A/D board and the VME resistor board make up the ACU power and signal monitoring function. The A/D board, in conjunction with the VME resistor board, receives dc power monitor signals and converts them to digital values that may be read by the CPU via the VMEbus. A detailed description of these boards is provided in the ACU power and signal monitoring description (paragraph 2.4.3.8).

2.4.3.3 **Digital Voice Processor System**. The digital voice processor (Figure 2.4.5) is made up of Voice Processor Board A20 and Voice Recorder/Playback Board A21. These two boards operate together as a system and are tested together. They are both connected to the VMEbus for power and system reset purposes, but they do not communicate with the CPU via the VMEbus. CPU/voice system communication is accomplished via the RS-232 link between SIO board 2 and the voice processor board.

2.4.3.3.1 **Voice Processor Board**. The voice processor board contains a Z80XXX series (Z80 thousand series) microprocessor and the necessary memory to execute onboard instructions. These instructions are used to reconstruct digitized human voice, create voice reports, and receive operator-generated digitized audio from the voice recorder/playback board. The voice processor board communicates with the VMEbus directly for power and system reset and indirectly via SIO board 2 for system communication. The following paragraph provides a detailed block diagram description of the voice processor board.

The voice processor board consists of nine functional areas (Figure 2.4.5): system reset/power interface, DRAM, EPROM vocabulary, CPU, audio board interface, timing and control logic, serial communications controller, RS-232 driver and receiver logic, and watchdog timer and alarm. The system reset/power interface generates an internal reset when the system reset signal from the VMEbus is received or the RESET pushbutton switch on the front of the board is pressed and power is applied. The internal reset disables message broadcast until a play message string is received from the CPU via SIO board 2. The VMEbus interface for power and ground requirements is also provided by the system reset/power interface. The DRAM provides 1 Mbyte of memory for message/file storage. This is the area where digitized messages from the FAA handset are stored. These messages are appended to the automatically generated observation messages. The EPROM vocabulary consists of 512 Kbytes of EPROM for voice files. The onboard CPU executes the operational software to execute new message strings and to monitor the eight telephone lines. The audio board interface provides the communication path to the voice recorder/playback board via the 50-pin connector on the front of the board. The necessary timing and interface signals required by the CPU and peripherals are provided by the timing and control logic. The serial communications controller provides the RS-232 serial communication channel, and the RS-232 driver and receiver logic provides the standard RS-232 receive and transmit lines. The watchdog timer and alarm provides an alarm signal to the primary CPU (via Digital I/O Board 1A2A15) when a CPU software or hardware failure occurs.

2.4.3.3.2 **Voice Recorder/Playback Board**. The voice recorder/playback board receives digitized voice from the voice processor board and converts it into audio. Audio is output as a weather data message for dial-in weather requests and to a VHF transmitter for airline use. In addition, the voice recorder/playback board receives audio signals from the FAA handset and transmits the digitized audio to the voice processor board for processing. The following paragraph provides a detailed block diagram description of the voice recorder/playback board.

The voice recorder/playback board consists of six functional areas (Figure 2.4.5): CPU board interface, power interface logic, radio transmitter output logic, record and playback logic, telephone line output logic, and audio alarm output logic. Pinouts for the output of the voice recorder/processor board (XA21-P2) are provided on the table on figure 2.4.5. The signal mnemonics and pins associated with row A and row C of XA21-P2 are listed with the associated plug connector. For example, the RING signal of the FAA handset line can be monitored at pin 20 of XA21-P2 or pin 2 of plug 68 (P68). The CPU board interface provides the communication path to the voice processor board via the 50-pin connector on the front of the board. The VMEbus interface for power and ground requirements is provided by the power interface logic. The radio transmitter output logic and the record and playback logic digitize audio input and synthesize digitized voice to audio. The interface circuits to the telephone outputs and line output peripherals are provided by the telephone line output logic. The audio alarm output logic provides an audio alarm indicator. One of the audio line outputs is continually monitored by the alarm circuit. A loss of audio for a predetermined period causes the indicator on the voice recorder/playback board to illuminate. Chapter 12 provides information on GTA radio pin-to-pin connections.

XA21–P2 TO P59–68 PIN ASSIGNMENTS

XA21–P2 PIN NUMBER	ROW A SIGNAL MNEMONIC	ROW A P1 THROUGH P10 PIN NUMBERS	ROW C SIGNAL MNEMONIC	ROW C P1 THROUGH P10 PIN NUMBERS
20	RING, FAA HANDSET	P68–2	FAA HANDSET	P68–3
24	RING, FAA RADIO	P67–2	FAA RADIO	P67–3
25	RING, LINE #8	P66–2	LINE #8	P66–3
26	RING, LINE #7	P65–2	LINE #7	P65–3
27	RING, LINE #6	P64–2	LINE #6	P64–3
28	RING, LINE #5	P63–2	LINE #5	P63–3
29	RING, LINE #4	P62–2	LINE #4	P62–3
30	RING, LINE #3	P61–2	LINE #3	P61–3
31	RING, LINE #2	P60–2	LINE #2	P60–3
32	RING, LINE #1	P59–2	LINE #1	P59–3

NOTE:
1. REFER TO CHAPTER 12, FIGURE 12.4.2, FOR CONNECTION POINTS.

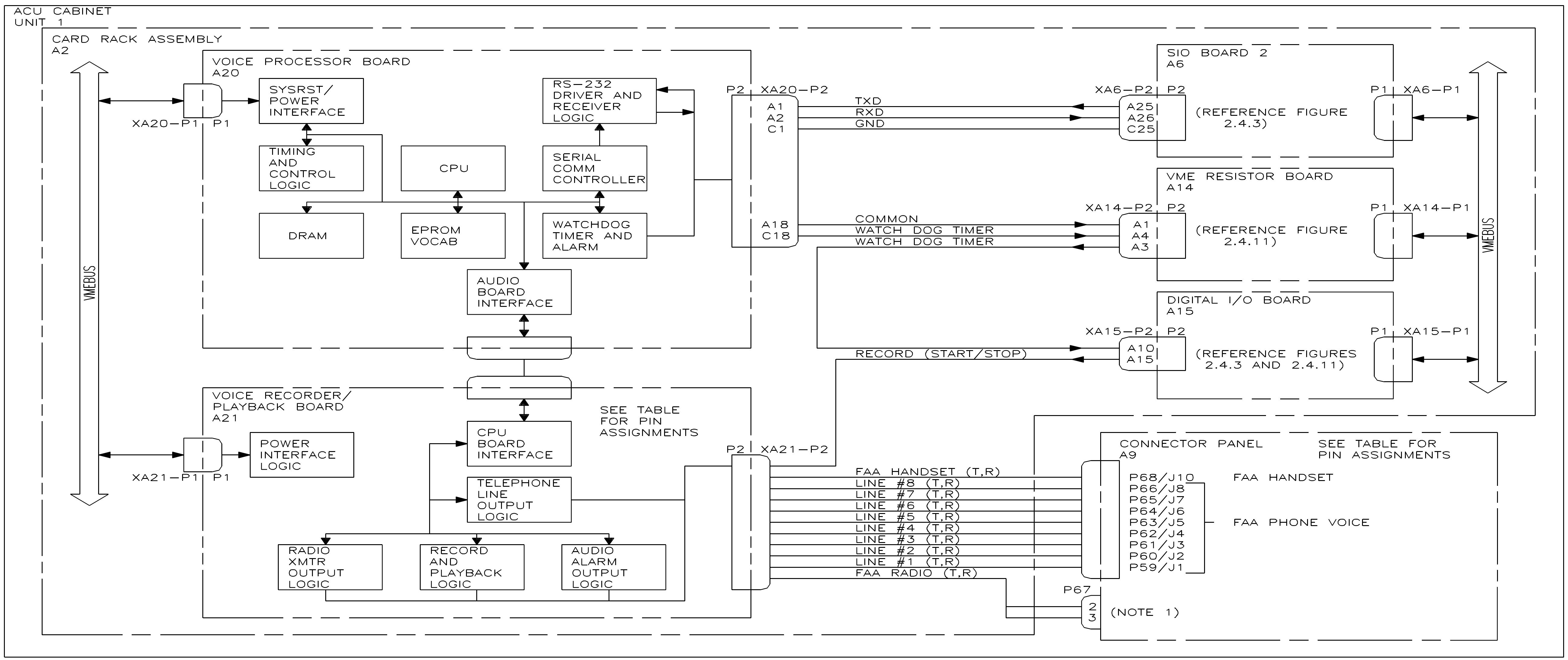


Figure 2.4.5. Digital Voice Processor Detailed Block Diagram

2.4.3.3.3 **Testing the Digital Voice Processing System**. The ACU CST checks the status of the digital voice processing system once per minute. CST results are displayed on the voice page of the OID. The CST performs four tests on the voice processing system: CPU, AUDIO OUTPUT, AUDIO STATUS, and TIMEOUT. The technician can manually run the voice processing test from the VOICE page at any time. A T status is displayed for the four test categories until the test is run again during the next CST cycle. After the cycle, the latest test status is displayed and the fail count (if applicable) is incremented.

The CPU test checks the operational status of the voice processor board. The TIMEOUT test checks the operational status of the watchdog timer. The AUDIO OUTPUT and AUDIO STATUS tests check the operation of the voice recorder/playback board and indirectly test the voice processor board. The AUDIO OUTPUT test is based on an internal audio test that checks the audio circuitry. The AUDIO STATUS test is based upon a monitored audio line. The status of each test is evaluated and the test status is displayed.

2.4.3.4 **Modem Communications**. Three different types of modem communications are provided in the ACU cabinet: modems for telephone communications, rf communications, and dedicated line communications. The system is configured with rf modems or line drivers (commonly referred to as short haul modems); it does not contain both. The following paragraphs provide a detailed block diagram description of the modems and their modes of operation.

2.4.3.4.1 **Telephone Modems**. Modem AC Power Rack 1A3 can contain up to 10 telephone modems (Figure 2.4.6) which operate in a 2-wire full duplex mode over both leased lines and the public switched network. The modems provide communications to external devices over leased line or public switched telephone network at data rates of 2400, 9600, or 28800 baud (models 2440, V.3225, and V.3400 respectively). All data transfers are under the control of the SIO boards, which communicate with the data terminal equipment (DTE) ports of the modems using RS-232 protocol.

In most cases, the modems used are model 2440 devices, which operate at data rates of up to 2400 baud. Modems 1A3A4 and A5 are provided in all systems, and are dedicated as USER PHONE #1 (model 2440) and #2 (model 2440 or V.3400). These modems are controlled by port 3 of SIO boards 2 (A6) and 3 (A7). The outputs of these modems are connected to J15 and J16 of I/O Panel Assembly 1A9. Sheet 1 of figure 2.4.6 illustrates the installation of the model 2440 and V.3400 modems.

All of the other modems are optional and are installed in the system as required to provide the following ports:

a. AFOS phone

b. OID spare

c. ADAS

d. VDU's

e. AWIPS

f. User Phone #1 spare

g. User Phone #2 spare

h. Printer

These modems are controlled by SIO boards 4 through 8. Their outputs are connected to connectors J12 through J14 and J17 through J21 of I/O Panel Assembly 1A9.

As stated above, model 2440 modems are used for most ASOS telephone communication applications. The exceptions are USER PHONE #2 at selected sites which uses the 28800 baud modem (model V.3400) and optional secondary OID's (OID #2, port 3B, and OID #3, port 3C) which use the 9600 baud modem (V.3225). When secondary OID ports are active, model V.3225 modems are installed in modem rack slots A2 and A3. Leased line connections are made at connectors J13 and J14 of I/O Connector Panel 1A9. Sheet 2 of figure 2.4.6 illustrates the configuration of an ACU that has been modified to accept V.3225 modems (9600 baud) in slots A2 and A3. This modification is performed for ACU's (Class I and Class II) having serial numbers 364 and below. Sheet 3 of figure 2.4.6 shows the configuration of an ACU for which the V.3225 modems were built in as original equipment. This configuration applies to Class I and Class II ACU's with serial numbers 365 and above.

The ACU CST checks the status of the telephone modems configured for dial-up operation (leased line modems are always on-line and cannot be tested). CST results for the dial-up modems are displayed on the MODEM RACK page of the OID. Each modem is tested once every 7 minutes, as long as the modem is not busy (no user is logged onto the system). If the modem is busy during a CST cycle, the CST is not performed. This is because running the CST on an active modem disrupts the communications and valuable information may be lost.

The test that is performed during CST is an analog self-test loopback test. The CPU initiates the test, but the entire test is performed inside the modem. The transmitter in the modem is internally linked to the receiver. The modem then generates a test pattern, transmits it over the loopback, receives the data, and checks for errors. The modem completes the test by reporting its pass/fail status back to the CPU. The CPU then displays the status on the MODEM RACK page. A status of D (degraded) is displayed for a modem if five or more failures have been detected and the modem is currently passing its loopback test. At 0600 LST each day, the number of accumulated failures is summarized in the system (maintenance) log. Chapter 1, Section III provides additional information on SIO test reporting.

In addition to the regular CST testing, the technician may manually initiate a test of a dial-up modem from the MODEM RACK page. When a test is ordered, the modem immediately tests itself as described above. As mentioned before, if the modem is busy when the test is ordered, current communications are disrupted as the test is performed. For this reason, the technician should ensure that the modem is not in use before manually issuing a test command. The LCD indicator on the front of the modem which should indicate OFF-LINE can be used to verify that the modem is not in use.

2.4.3.4.2 **RF Modems**. Three different rf modems are used in two ACU configurations. The modems are 62828-90013-XX (AAI Corporation), 62828-90315-XX (Motorola, Inc), or 62828-40506-X (Johnson Data). ACU -10 cabinets (62828-40044-10) serial number 185 and below and ACU -20 cabinets (62828-40044-20) serial number 245 and below were originally manufactured with AAI rf modems. The -10 cabinets with serial numbers 186 and above and the -20 cabinets with serial numbers 246 and above were manufactured with Motorola modems.

Normally, a system built with AAI modems continues to operate with the modems until sufficient spares can no longer be obtained. When this occurs, the entire site (ACU and DCP) must be modified to operate with Motorola modems. This modification is accomplished by the installation of FMK 18886. This FMK an be ordered through NLSC using ASN S100-FMK18886. Each kit contains adapter cables W050 (to route signals and power from the existing harness to the new modems) and two modems (the quantity required to complete a Class I system). Two FMK's must be ordered to upgrade a Class II system. All AAI modems removed from a system must be returned to the National Reconditioning Center.

NOTE

> When an AAI modem (62828-90013-XX) fails, ASN S100-FMK18886 must be ordered to replace the modem with the Motorola modem (62828-90315-XX). AAI modems cannot be replaced with the Johnson Data modems (62828-40506-X).
>
> **When a Motorola modem (62828-90315-XX) fails and spare Motorola modems are not available, a Johnson Data modem (62828-40506-X), a**n adapter cable (62828-42110-10), and a SMAM-to-BNCF adapter must be ordered to replace the failing rf modem.

When spare Motorola rf modems can no longer be obtained, Johnson Data modems are used. When the failure occurs in the ACU, a modem (62828-40506-X), an adapter cable (62828-42110-10), and a SMAM-to-BNCF adapter must be ordered. The Johnson Data modems are compatible with the Motorola modems (Motorola and Johnson Data modems can coexist within the ACU). When the Motorola rf modem fails in a Class II DCP, two modems, adapter cables and adapters must be ordered.

Figure 2.4.7 illustrates the ACU and rf modem configurations as follows:

- Sheet 1- original equipment AAI rf modem (-10 ACU s/n $\leq$185 and -20 ACU s/n $\leq$245)
- Sheet 2- as sheet 1 but shown modified for Motorola rf modems
- Sheet 3- as sheet 2 but shown with Johnson Data modems
- Sheet 4- original equipment Motorola rf modem (-10 ACU s/n $\geq$186 and -20 ACU s/n $\geq$246)
- Sheet 5- as sheet 4 but shown with Johnson Data modems

For a Class II system, the ACU rf communications equipment consists of two rf modems (A and B), an rf modem switch, and an omnidirectional antenna (Figure 2.4.7, sheets 1 through 6). Omnidirectional antennas are usually used in the ACU-DCP rf link.

Sheet 3 of figure 2.4.7 illustrates the configuration of systems with Motorola modems built in as original equipment. Effectivity for this configuration is -10 cabinets with serial number 186 and above and -20 cabinets with serial number 246 and above.

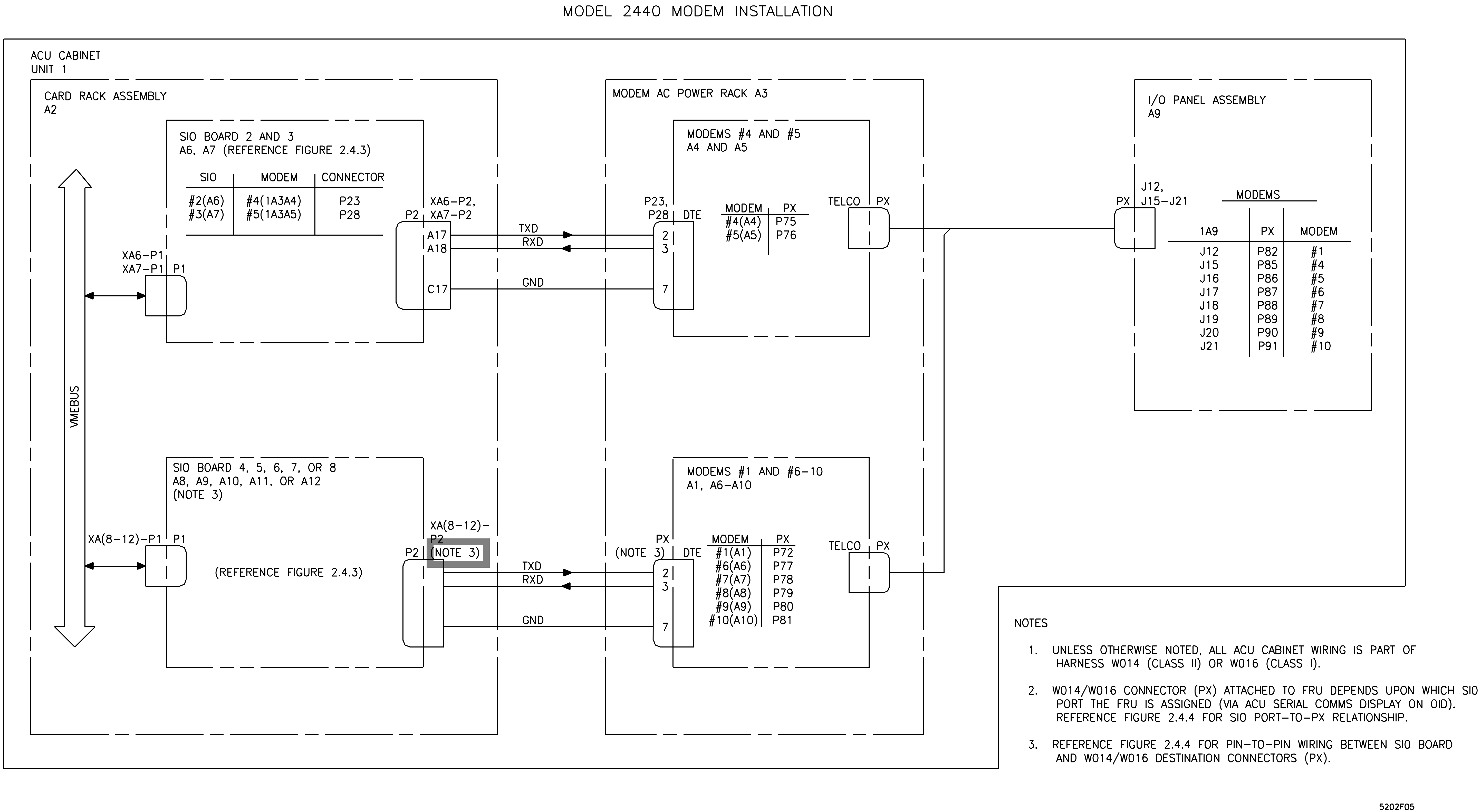


Figure 2.4.6. Leased Line and Public Switched Telephone ModemCommunications Detailed Block Diagram (Sheet 1 of 3)

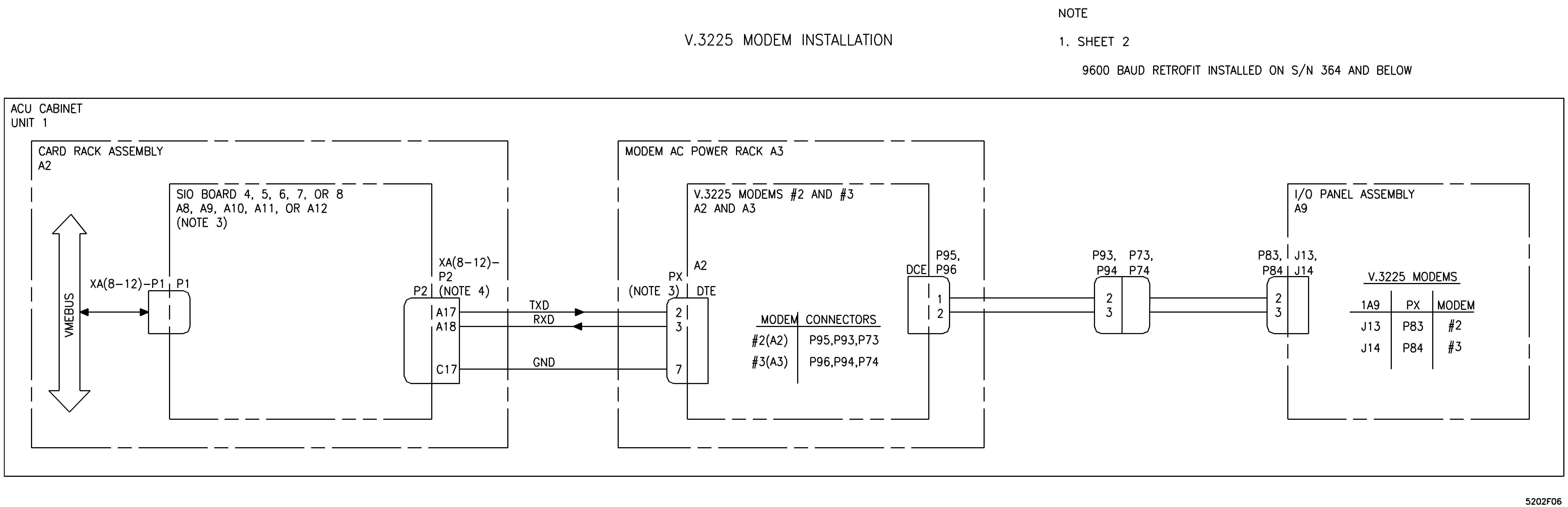


Figure 2.4.6. Leased Line and Public Switched Telephone Modem Communications Detailed Block Diagram (Sheet 2)

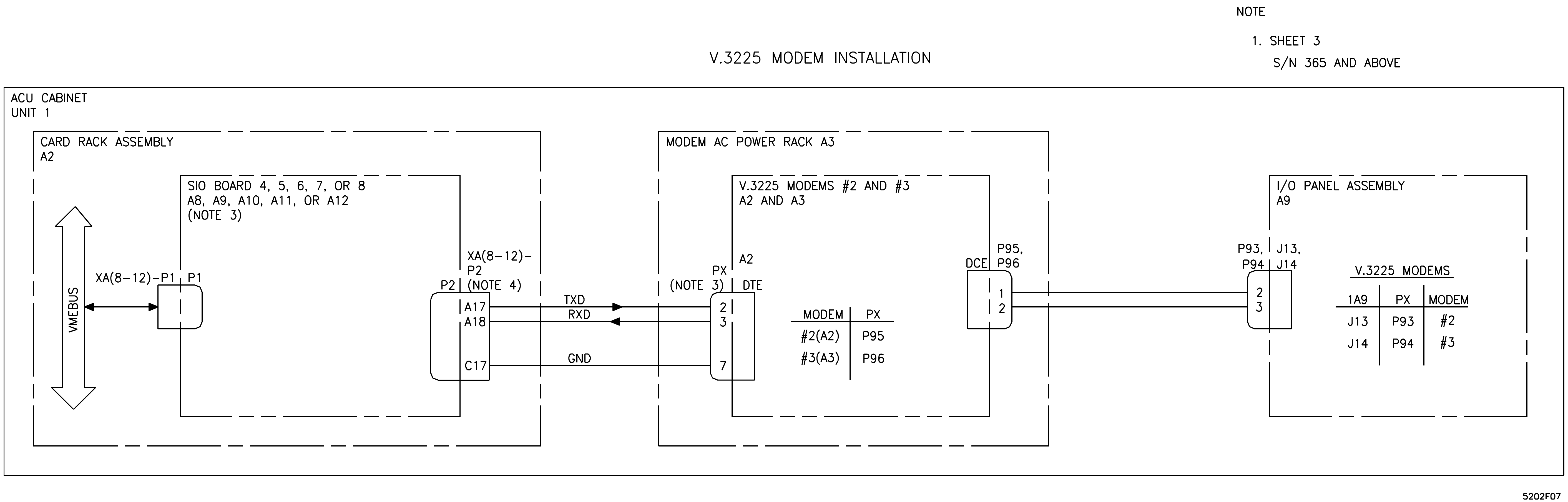
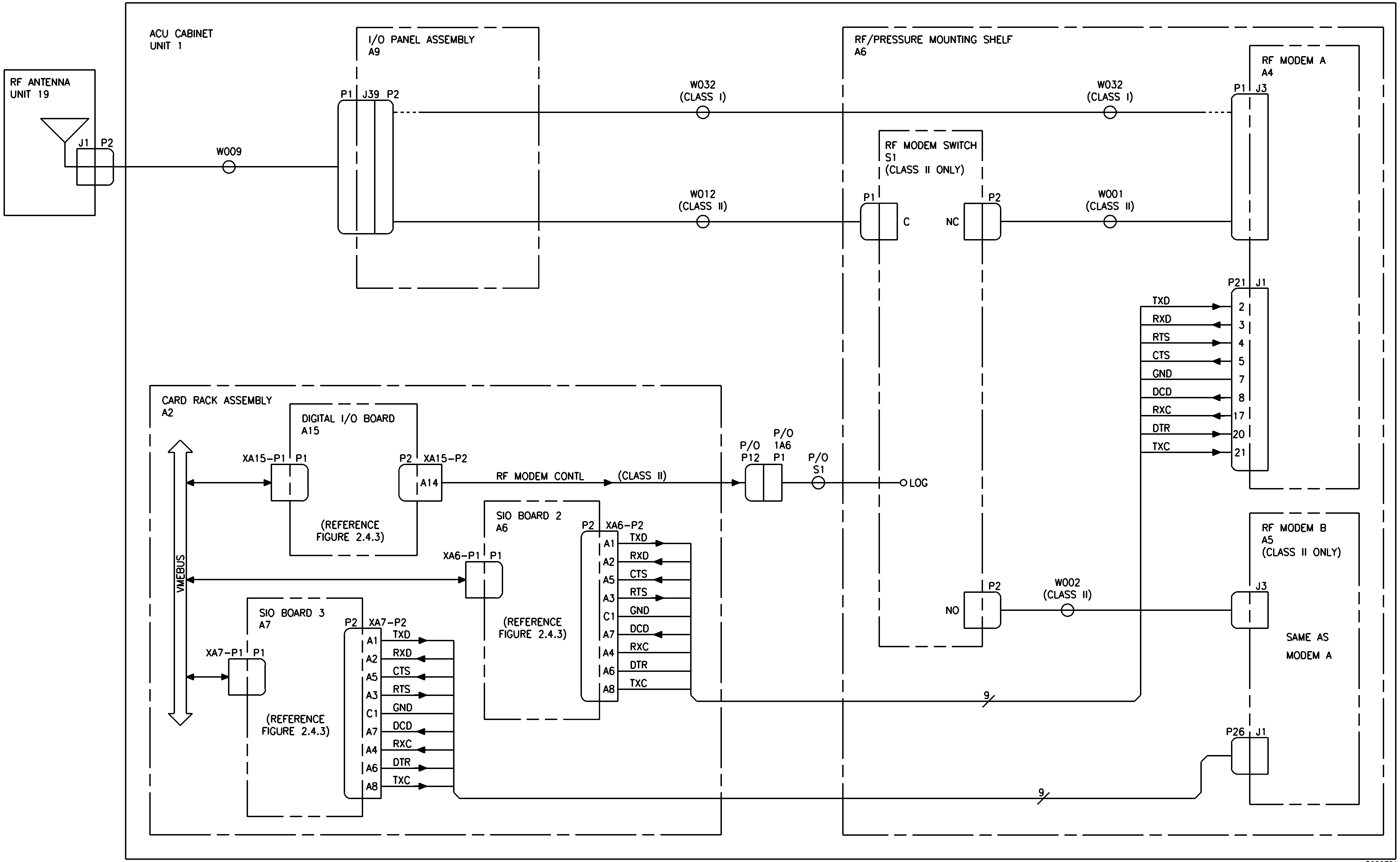


Figure 2.4.6. Leased Line and Public Switched Telephone Modem Communications Detailed Block Diagram (Sheet 3)

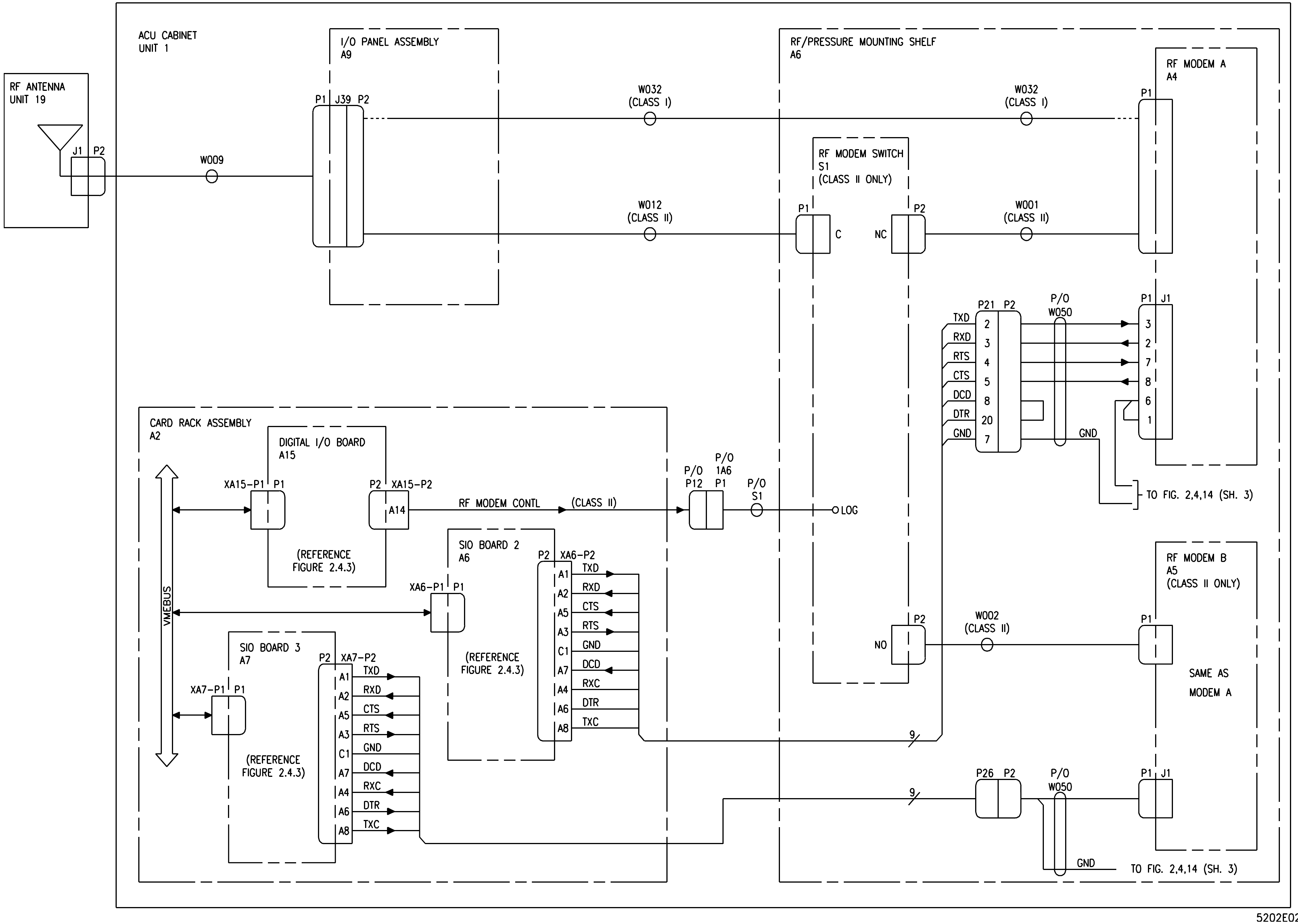


NOTES

1. UNLESS OTHERWISE NOTED, ALL ACU CABINET WIRING IS PART OF HARNESS W014 (CLASS II) OR W016 (CLASS I).
2. SIGNAL DESCRIPTION
   - TXD – TRANSMIT DATA
   - RXD – RECEIVE DATA
   - CTS – CLEAR TO SEND
   - RTS – REQUEST TO SEND
   - GND – GROUND
   - DCD – DATA CARRIER DETECT
   - RXC – RECEIVING CLOCK
   - DTR – DATA TERMINAL READY
   - TXC – TRANSMIT CLOCK
3. SHEET 1
   ACU 62828-40044-10: S/N 185 AND BELOW
   ACU 62828-40044-20: S/N 245 AND BELOW
4. TO REDUCE COCHANNEL INTERFERENCE, OPTIONAL FIVE WATT ATTENUATORS MAY BE INSERTED IN THE ANTENNA LINE(S) TO REDUCE TRANSMIT POWER INTO THE ANTENNAS.

AAI MODEMS

Figure 2.4.7. ACU RF Modem/Line Driver Communications Link Detailed Block Diagram (Sheet 1 of 6)



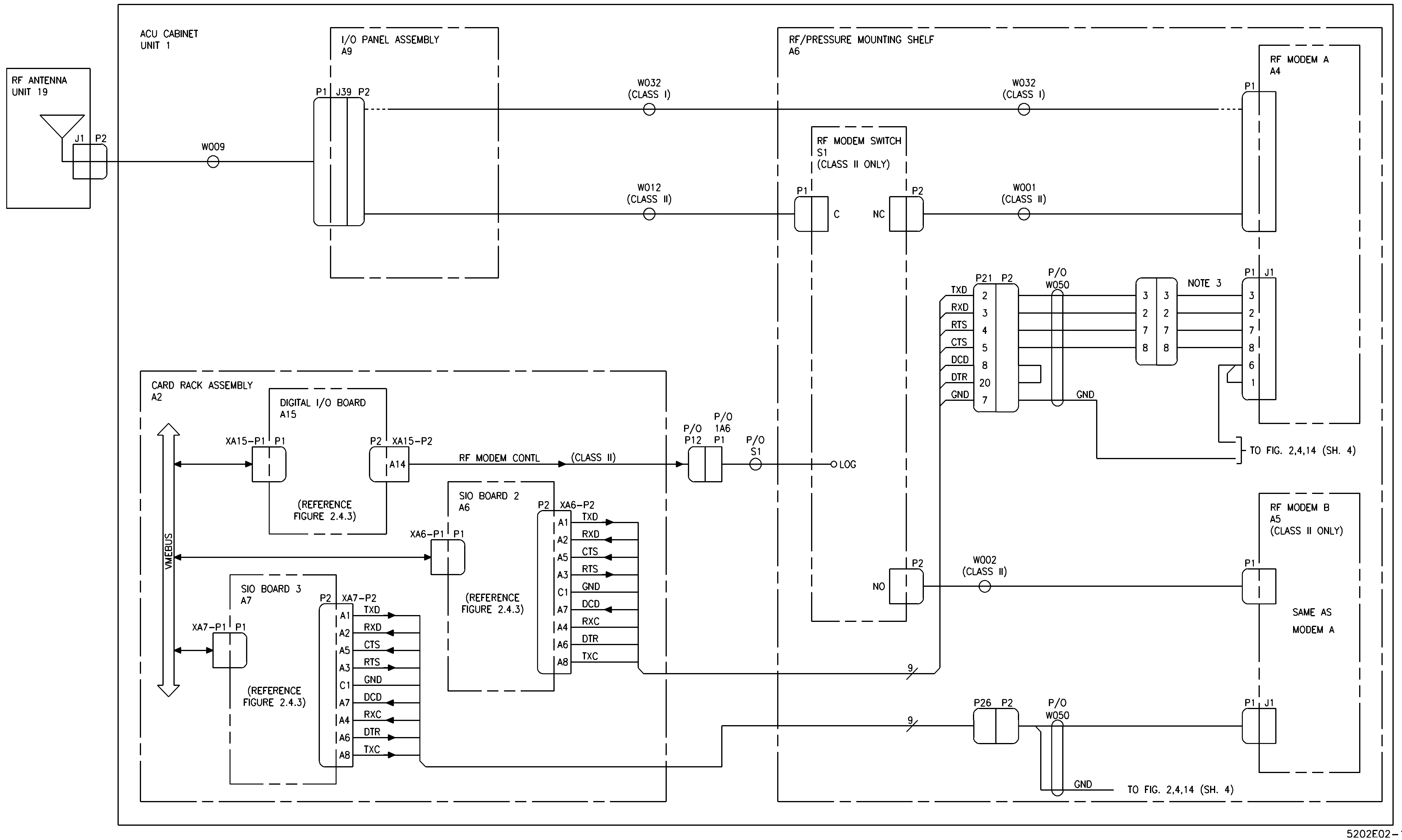
NOTE

1. SHEET 2
   FMK 18886 INSTALLED ON
   ACU 62828-40044-10:
   S/N 185 AND BELOW
   ACU 62828-40044-20:
   S/N 245 AND BELOW

2. TO REDUCE COCHANNEL INTERFERENCE, OPTIONAL FIVE WATT ATTENUATORS MAY BE INSERTED IN THE ANTENNA LINE(S) TO REDUCE TRANSMIT POWER INTO THE ANTENNAS

SYSTEM CONVERTED FROM AAI MOTOROLA MODEMS

Figure 2.4.7. ACU RF Modem/Line Driver Communications Link Detailed Block Diagram (Sheet 2 of 6)



NOTE

1. FMK 18886 INSTALLED ON ACU 62828-40044-10: S/N 185 AND ABOVE ACU 62828-40044-20: S/N 245 AND ABOVE

2. TO REDUCE COCHANNEL INTERFERENCE, OPTIONAL FIVE WATT ATTENUATORS MAY BE INSERTED IN THE ANTENNA LINE(S) TO REDUCE TRANSMIT POWER INTO THE ANTENNAS

3. ADAPTER CABLE 62828-42110-10 INSTALLED BETWEEN W50P1 AND RF MODEM.

SYSTEM CONVERTED FROM AAI TO MOTOROLA MODEMS EQUIPED WITH JOHNSON DATA MODEMS

Figure 2.4.7. ACU RF Modem/Line Driver Communications Link Detailed Block Diagram (Sheet 3 of 6)

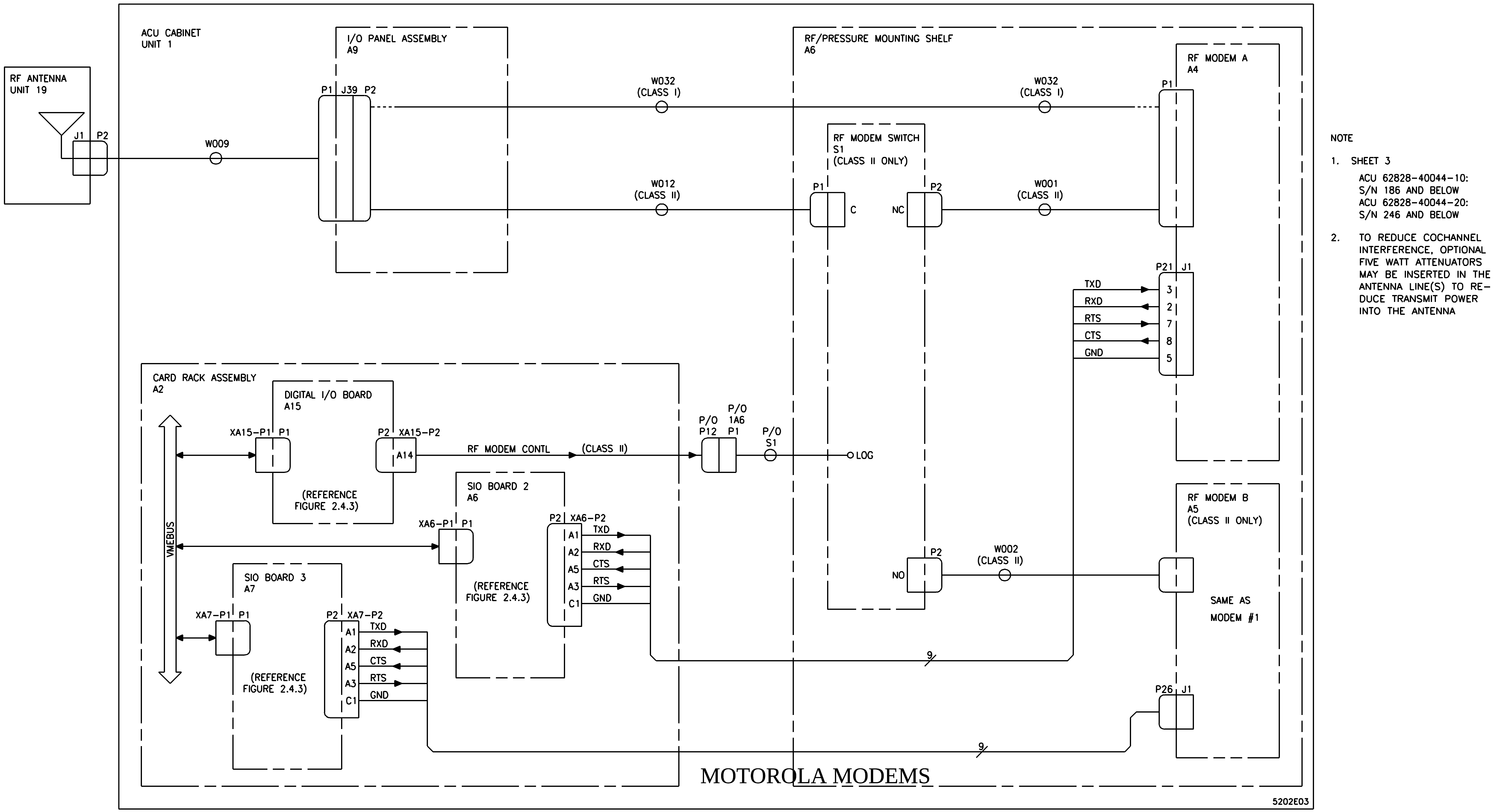
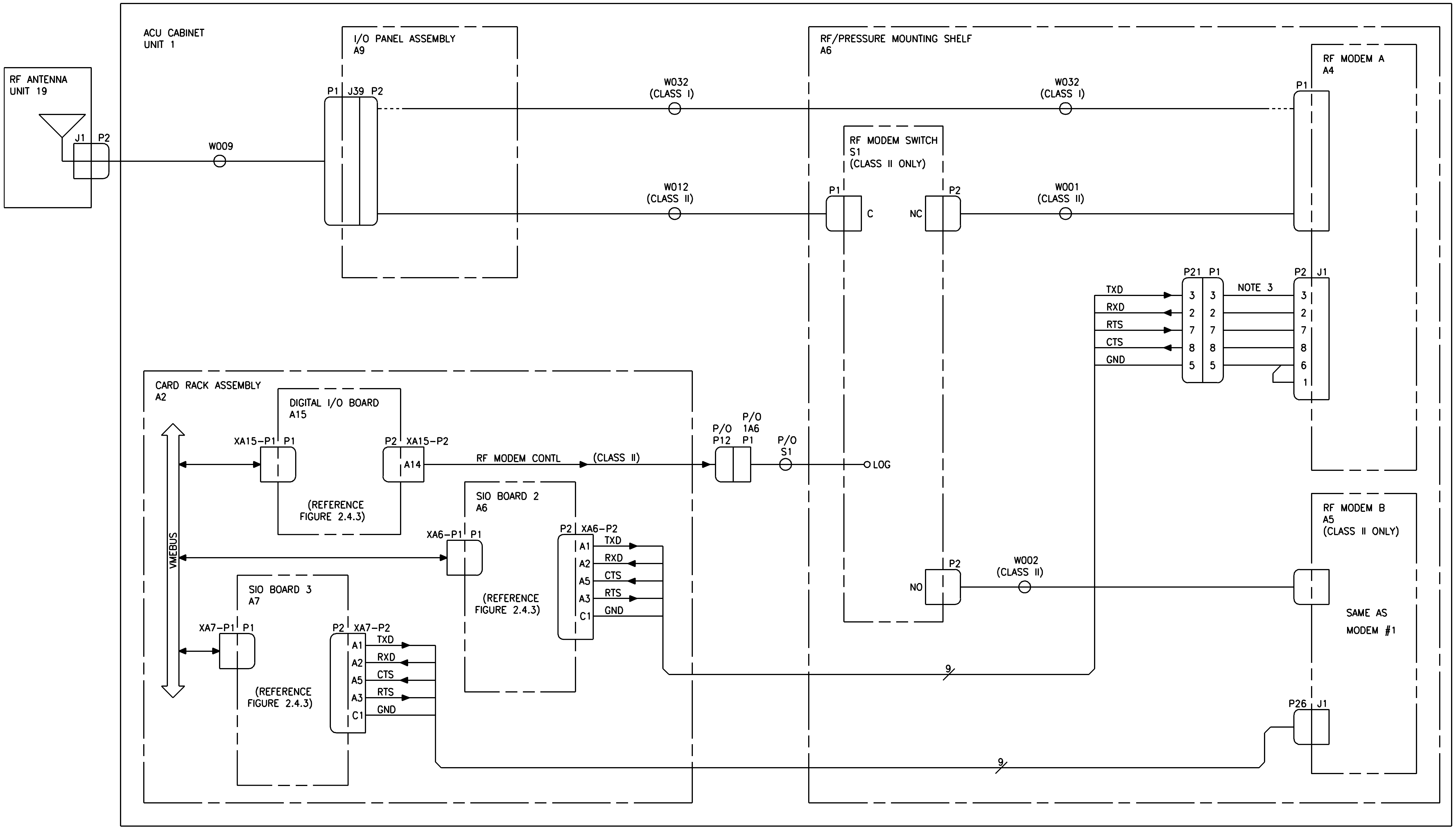


Figure 2.4.7. ACU RF Modem/Line Driver Communications Link Detailed Block Diagram. (Sheet 4 of 6)



NOTE

1. SHEET 3
   ACU 62828-40044-10:
   S/N 186 AND ABOVE
   ACU 62828-40044-20:
   S/N 246 AND ABOVE
2. TO REDUCE COCHANNEL INTERFERENCE, OPTIONAL FIVE WATT ATTENUATORS MAY BE INSERTED IN THE ANTENNA LINE(S) TO REDUCE TRANSMIT POWER INTO THE ANTENNA
3. ADAPTER CABLE 62828-42110-10 INSTALLED BETWEEN P2 AND RF MODEM.

CONVERTED FROM MOTOROLA MODEMS TO JOHNSON DATA MODEMS

Figure 2.4.7. ACU RF Modem/Line Driver Communications Link Detailed Block Diagram (Sheet 5 of 6)

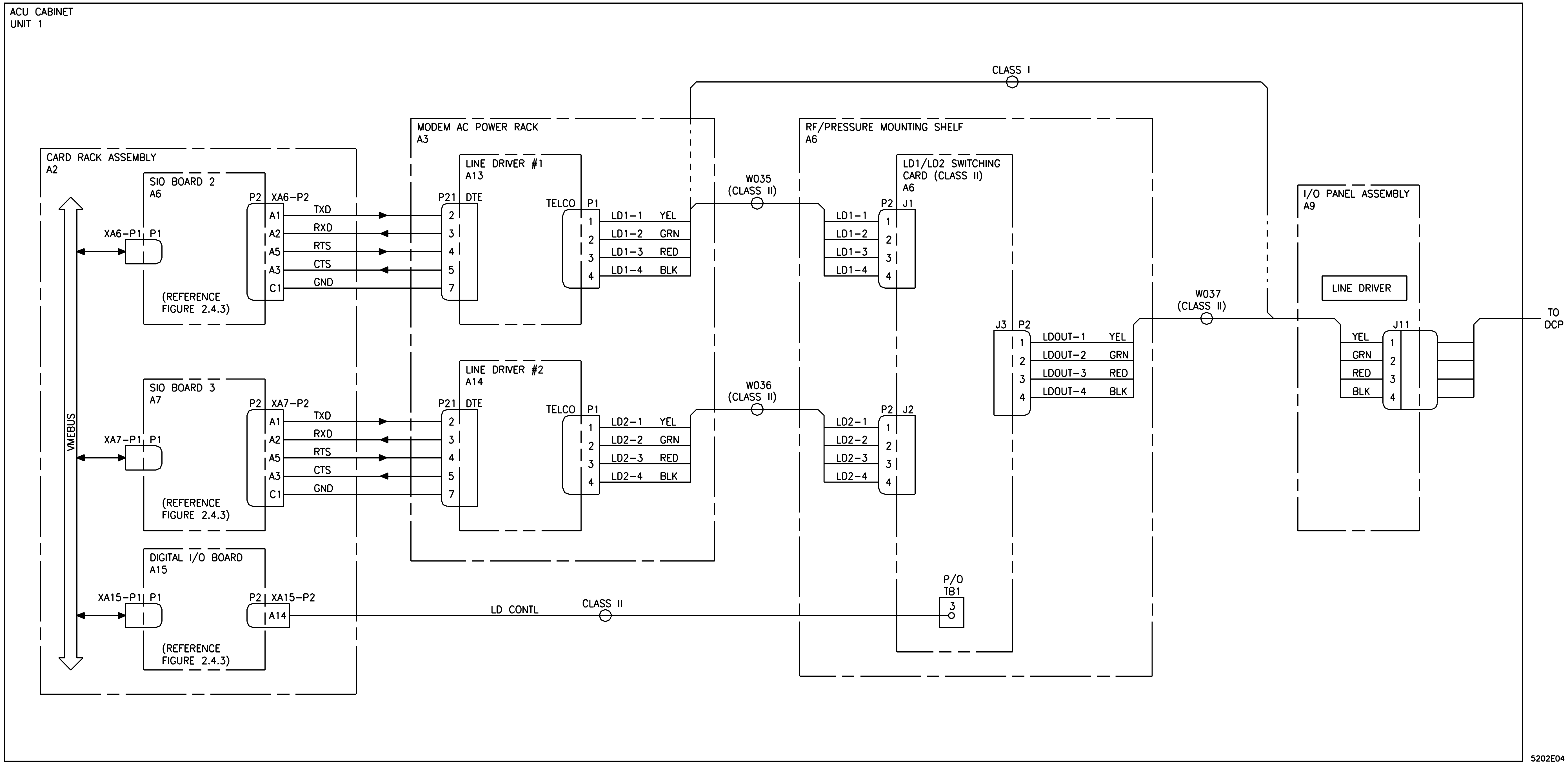


Figure 2.4.7. ACU RF Modem/Line Driver Communications Link Detailed Block Diagram (Sheet 6 of 6)

For a Class II system, the ACU rf communications equipment consists of two rf modems (A and B), an rf modem switch, and an omnidirectional antenna (Figure 2.4.7, sheets 1 through 6. Omnidirectional antennas are usually used in the ACU-DCP rf link. However, at certain sites where RFI was experienced, yagi antennas are used at one or both ends of the link. A yagi can only be used at the ACU if all DCP's are illuminated within the yagi's 10-degree beamwidth. A seven-element yagi, PN 62828-90413-2, provides 10 dB gain over the 406 - 420 MHz band and has a front:back ratio of 14 dB. Additionally, at sites where cochannel interference is particularly troublesome, five watt attenuators of 3 dB, 6 dB, 10 dB, 20 dB, or 30 dB (PN 62828-90424 -2, -3, -4, -5, and -6, respectively) may be inserted in the antenna line(s) to reduce transmit power into the antennas. The rf modems are identical, with one modem serving as the primary communications link and the other as a backup. The test is based on a loop test. The ACU transmits a predefined pattern across the communications link, and the DCP verifies modems operate in the UHF frequency range in half duplex mode. The primary CPU communicates with rf modem A via SIO board 2 and with modem B via SIO board 3. The rf switch selects which modem uses the antenna. The switch is controlled by the CPU via DIO board A15. In the event that the primary CPU senses a failure in its primary rf link (no data received for a period of 2-1/2 minutes), it writes a selection word to the DIO board to toggle the rf switch. The other modem then becomes the primary modem and controls all rf communications between the DCP and ACU. For a Class I system, the rf communications circuitry is similar, except there is no redundant rf system (there is only one rf modem and no rf switch).

The ACU CST checks the status of the ACU/DCP communications link once per minute. CST results are displayed on the ACU/DCP COMM page of the OID. This test performs two checks: RADIO A OR L/D A and RADIO B OR L/D B. The RADIO A OR L/D A test checks the A link between the ACU and up to three DCP's. The RADIO B OR L/D B test does the same for link B (Class II systems only). The CST also identifies which link (modem or line driver) (A or B) is currently serving as the primary link in the ACU and all DCP's.

The rf communications the reception of the pattern by responding with an OK or ERROR acknowledgment. An incorrect reception signifies an error and a failed indication. A failed indication is also displayed if the DCP fails to respond at all to the ACU transmission.

2.4.3.4.3 **Line Drivers**. If dictated by the configuration, two line drivers and an LD1/LD2 switching board (Figure 2.4.7, sheet 6) are used in place of rf modems and the rf modem switch. The line drivers in the ACU are connected by a direct line to corresponding line drivers in the DCP. The line drivers are commonly referred to as short haul modems and perform a function similar to that of the rf modems. Diagnostically, the line driver is tested in lieu of the rf modem and the status is displayed on the ACU/ DCP COMM page. The diagnostic test is the same as that used for the rf modems.

Normally, a system built with UDS D19.2 line drivers continues to operate with the line drivers until sufficient spares can no longer be obtained. When this occurs, the entire site (ACU and DCP) must be modified to operate with Motorola DDS/MR64 line drivers as detailed in Field Modification Kit FMK 086. This FMK can be ordered through NLSC. Each kit contains two line drivers required to update a Class I system. Order two kits to upgrade a Class II system. All UDS line drivers removed from a system must be returned to the National Reconditioning Center.

2.4.3.5 **Pressure Sensors**. The rf/pressure mounting shelf is a slide-mounted rack containing up to three barometric pressure sensors (Figure 2.4.8). Three pressure sensors are installed in Class II systems, while Class I systems have pressure sensors 1 and 2 only. The pressure sensors provide barometric pressure in inches of mercury (inHg). The primary CPU communicates with pressure sensors 1 and 2 via RS-232 ports of SIO boards 2 and 3. Pressure sensor 3, when installed, communicates with the CPU via one of the optional SIO boards (4 through 8). An adapter cable (W026) is used for pressure sensor 3 data. This cable adapts the 25-pin RS-232 connector for the optional SIO port to the 9-pin RS-232 connector on the pressure sensor. The pressure connection is provided at the connector panel and is labeled PRESSURE PORT.

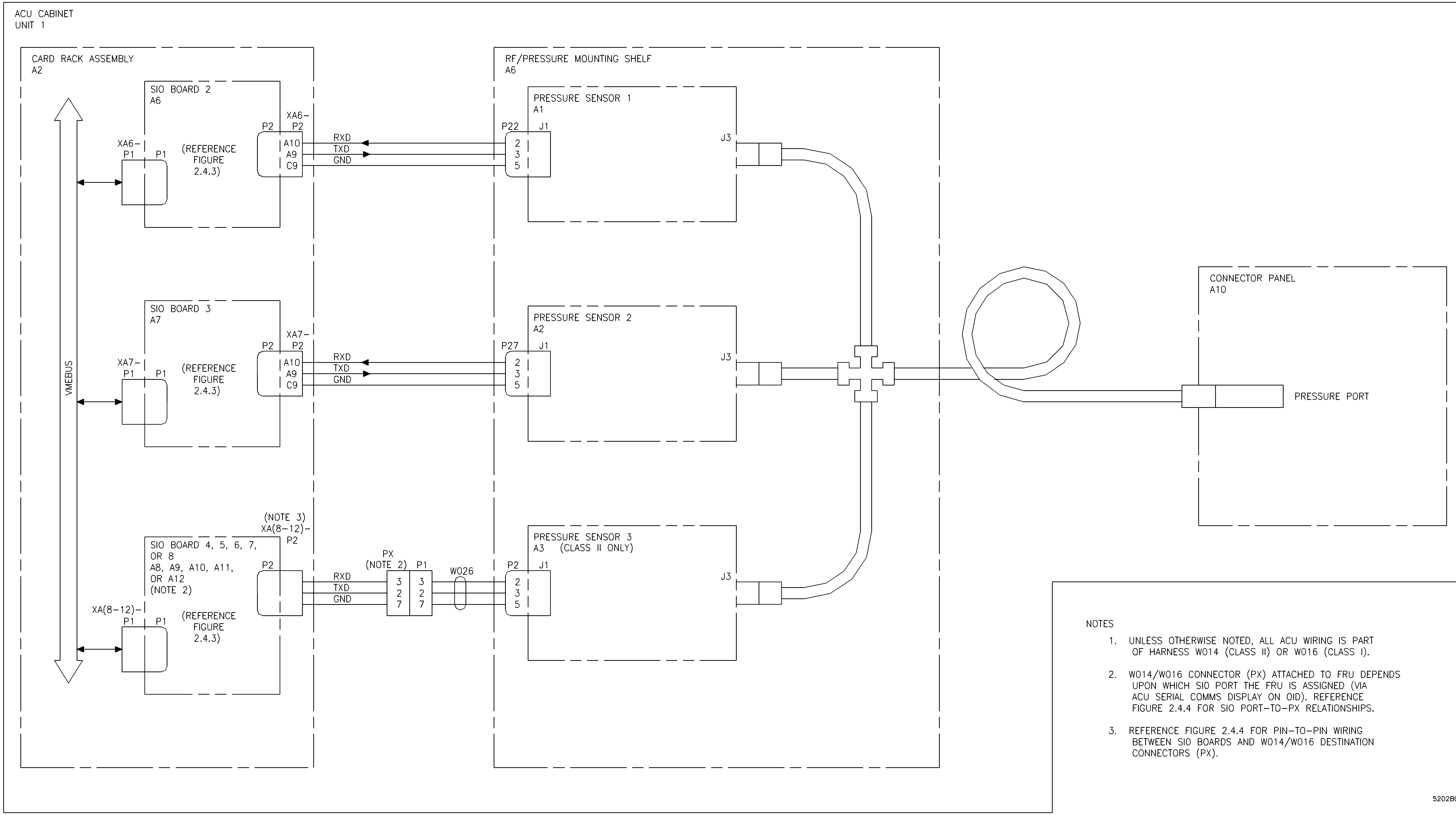
Pressure sensors that are installed in Class I ACU cabinets (without optional UPS) must be equipped with threshold detectors, which may be either internal (built into the sensor) or external. A threshold detector ensures that the pressure sensor resets completely in the event of a dc power undervoltage fluctuation (when its power drops below 4.55 vdc). Threshold detectors are not required on Class II systems because the ACU's uninterruptible power supply prevents such fluctuations. Internal threshold detectors were built into pressure sensors with serial numbers 358495, 358509, and 363914 and above. Internal detectors are being added to all other sensors when they are returned to the depot for repair. In these cases, a label is applied to the repaired sensor, indicating that an internal detector has been added. External threshold detectors are installed on Class I systems via FMK #027. The external detector is a small module that is mounted to the sensor's DB-9 power connector (J2). The external detector then becomes part of the pressure sensor and should not be removed (it is not an FRU). As part of the FMK, a label is placed on the pressure sensor stating "EXTERNAL THRESHOLD DETECTOR REQUIRED". FMK 27 can be ordered through NLSC. Order S100-FMK27 for threshold detector and labels. Special authorization is required when ordering this kit.

The ACU CST displays the current status of the pressure sensors on the OID PRESSURE #1, #2, and #3 pages. Status is provided for three parameters: DATA QUALITY, REPORT PROCESSING, and SENSOR RESPONSE. The DATA QUALITY field displays the current status (pass/fail) of data quality checks performed by pressure sensor algorithm software. The REPORT PROCESSING field indicates Y if report processing is currently turned on (system reports sensor data) or indicates N if report processing has been manually turned off (system reports manually entered pressure data or "missing" if no manual data). The SENSOR RESPONSE field indicates an F if the CPU does not receive pressure sensor data responses.

2.4.3.6 **Local Sensor Fiberoptic Modems**. The local sensor fiberoptic modems provide fiberoptic ports for three additional local sensors (Figure 2.4.9). These fiberoptic modems are connected to RS-232 ports on the optional SIO boards (4 through 8). Adapter cables (W011) are used to adapt the 25-pin RS-232 connectors for the SIO ports to the 9-pin RS-232 connectors on the fiberoptic modems. Electrical data transmitted from an SIO board are converted to optical data and are then transferred to the connected device. Optical data received from the connected device are converted to electrical data and transmitted to the SIO board as received data.

2.4.3.7 **Observer Notification Device and Peripheral Power**. Figure 2.4.10 illustrates detailed wiring for the observer notification device (OND) and peripheral power strip W006. The OND is controlled by the CPU via a digital output signal from DIO Board A15. When the OND is to flash, the CPU repeatedly toggles this signal on and off. The printer, primary OID, and FAA modems (not part of the ASOS) may receive their power from power strip W006, which is connected to PERIPHERAL POWER connector J40 on I/O Panel Assembly 1A9. In Class II systems, connector J40 receives power from the UPS in Power Supply Assembly 1A4. As such, backup power is supplied to these peripherals in the event of a loss of primary ac power. The OND operates on 12 vdc, and therefore has a 12 vdc converter built into its power cord that plugs directly into any available ac wall outlet.

2.4.3.8 **ACU Power and Signal Monitoring**. The circuitry shown on the ACU power and signal monitoring detailed block diagram (Figure 2.4.11) interfaces with both analog voltage signals and digital data points to allow monitoring by system software. The hardware is used by the diagnostic software to read the status of dc power supply output voltages, the power applied to the rf modems, as well as UPS bypass circuit in Class II systems. Sheets 1 through 3 of figure 2.4.11 show three different configurations of power monitoring circuitry, depending on the rf modem installation (paragraph 2.4.3.4.2). Sheet 1 shows the configuration for original equipment AAI rf modems, sheet 2 illustrates a system that has been modified for Motorola modems, and sheet 3 shows the configuration for original equipment Motorola modems. The following paragraphs describe the operation of the ACU power and signal monitoring circuitry.



NOTES

1. UNLESS OTHERWISE NOTED, ALL ACU WIRING IS PART OF HARNESS W014 (CLASS II) OR W016 (CLASS I).
2. W014/W016 CONNECTOR (PX) ATTACHED TO FRU DEPENDS UPON WHICH SIO PORT THE FRU IS ASSIGNED (VIA ACU SERIAL COMMS DISPLAY ON OID). REFERENCE FIGURE 2.4.4 FOR SIO PORT-TO-PX RELATIONSHIPS.
3. REFERENCE FIGURE 2.4.4 FOR PIN-TO-PIN WIRING BETWEEN SIO BOARDS AND W014/W016 DESTINATION CONNECTORS (PX).

Figure 2.4.8. Pressure Sensor Detailed Block Diagram

NOTES

1. UNLESS OTHERWISE NOTED, ALL ACU WIRING IS PART OF HARNESS W014 (CLASS II) OR W016 (CLASS I).

2. W014/W016 CONNECTOR (PX) ATTACHED TO FRU DEPENDS UPON WHICH SIO PORT THE FRU IS ASSIGNED (VIA ACU SERIAL COMMS DISPLAY ON OID). REFERENCE FIGURE 2.4.4 FOR SIO PORT-TO-PX RELATIONSHIP.

3. REFERENCE FIGURE 2.4.4 FOR PIN-TO-PIN WIRING BETWEEN SIO BOARDS W014/W016 DESTINATION CONNECTORS (PX).

4. SIGNAL DESCRIPTION

TXD – TRANSMIT DATA
RXD – RECEIVE DATA
GND – GROUND

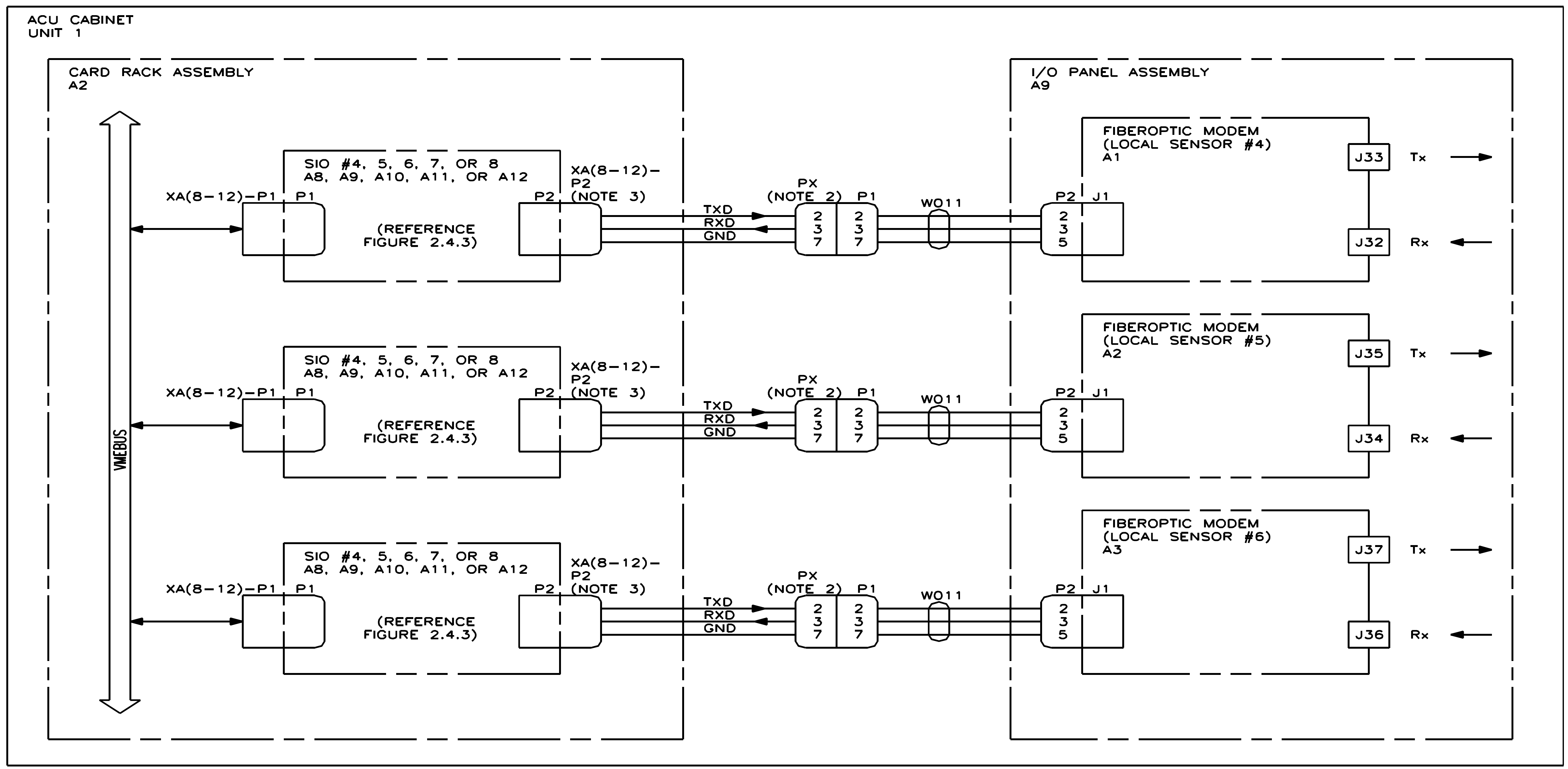


Figure 2.4.9. Local Sensor Fiberoptic Modem Detailed Block Diagram

NOTES

1. UNLESS OTHERWISE NOTED, ALL ACU CABINET WIRING IS PART OF HARNESS W0I4 (CLASS II) OR W0I6 (CLASS I).

2. W014/W016 CONNECTOR (PX) ATTACHED TO FRU DEPENDS UPON WHICH SIO PORT THE FRU IS ASSIGNED (VIA ACU SERIAL COMMS DISPLAY ON OID). REFERENCE FIGURE 2.4.4 FOR SIO PORT-TO-PX RELATIONSHIP.

3. REFERENCE FIGURE 2.4.4 FOR PIN-TO-PIN WIRING BETWEEN SIO BOARDS W014/W016 DESTINATION CONNECTORS (PX).

4. SIGNAL DESCRIPTION

   TXD - TRANSMIT DATA
   RXD - RECEIVE DATA
   GND - GROUND

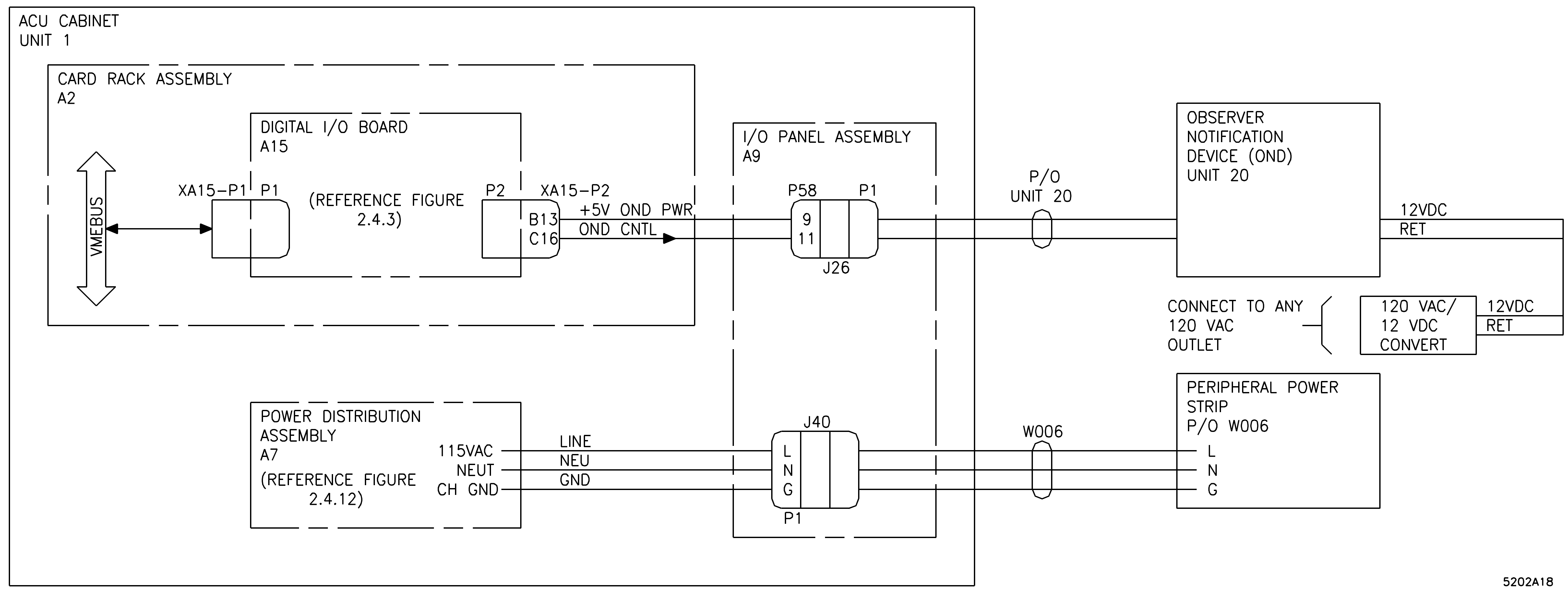


Figure 2.4.10. Observer Notification Device and Peripheral Power

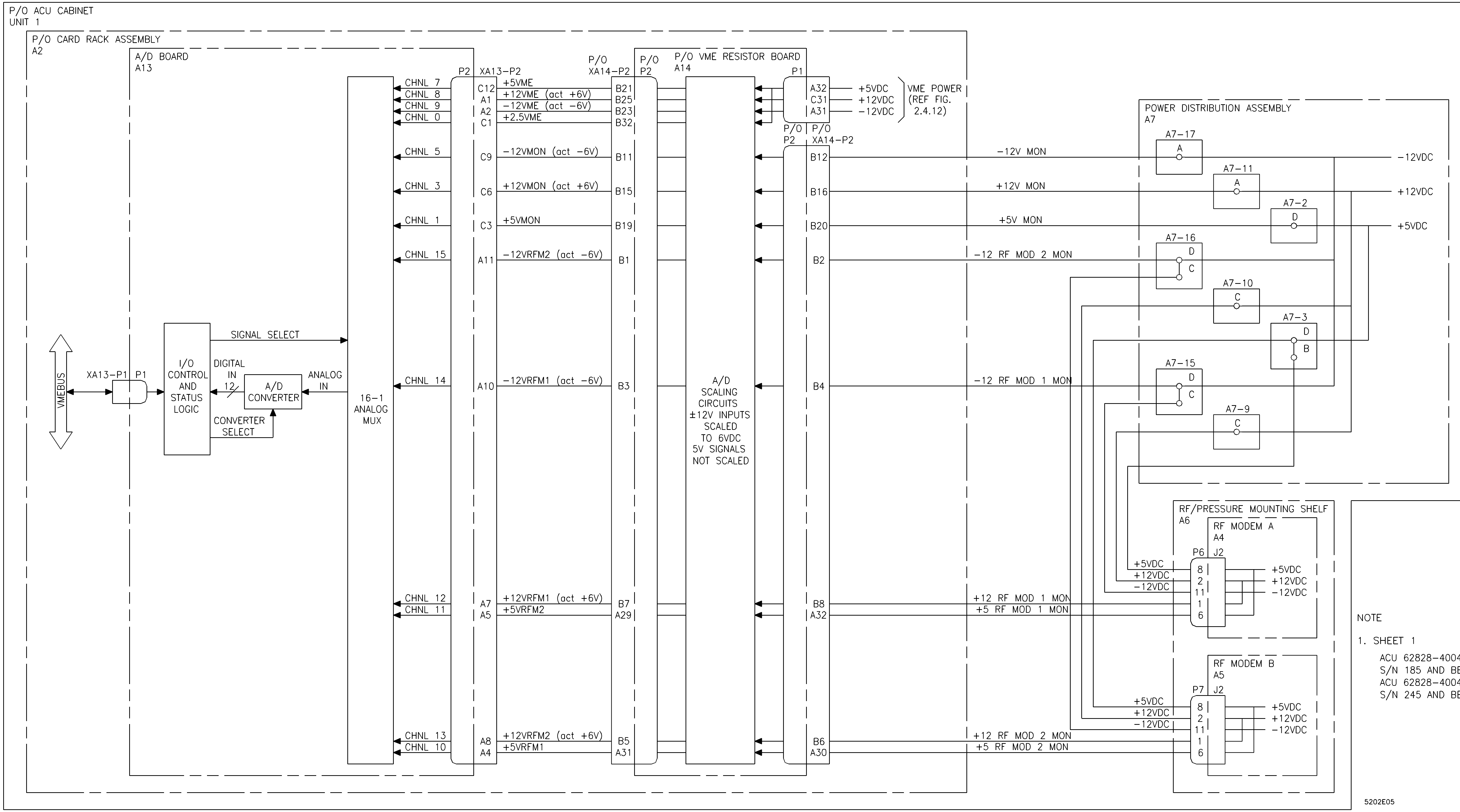


Figure 2.4.11. ACU Power and Signal Monitoring Detailed Block Diagram (Sheet 1 of 4)

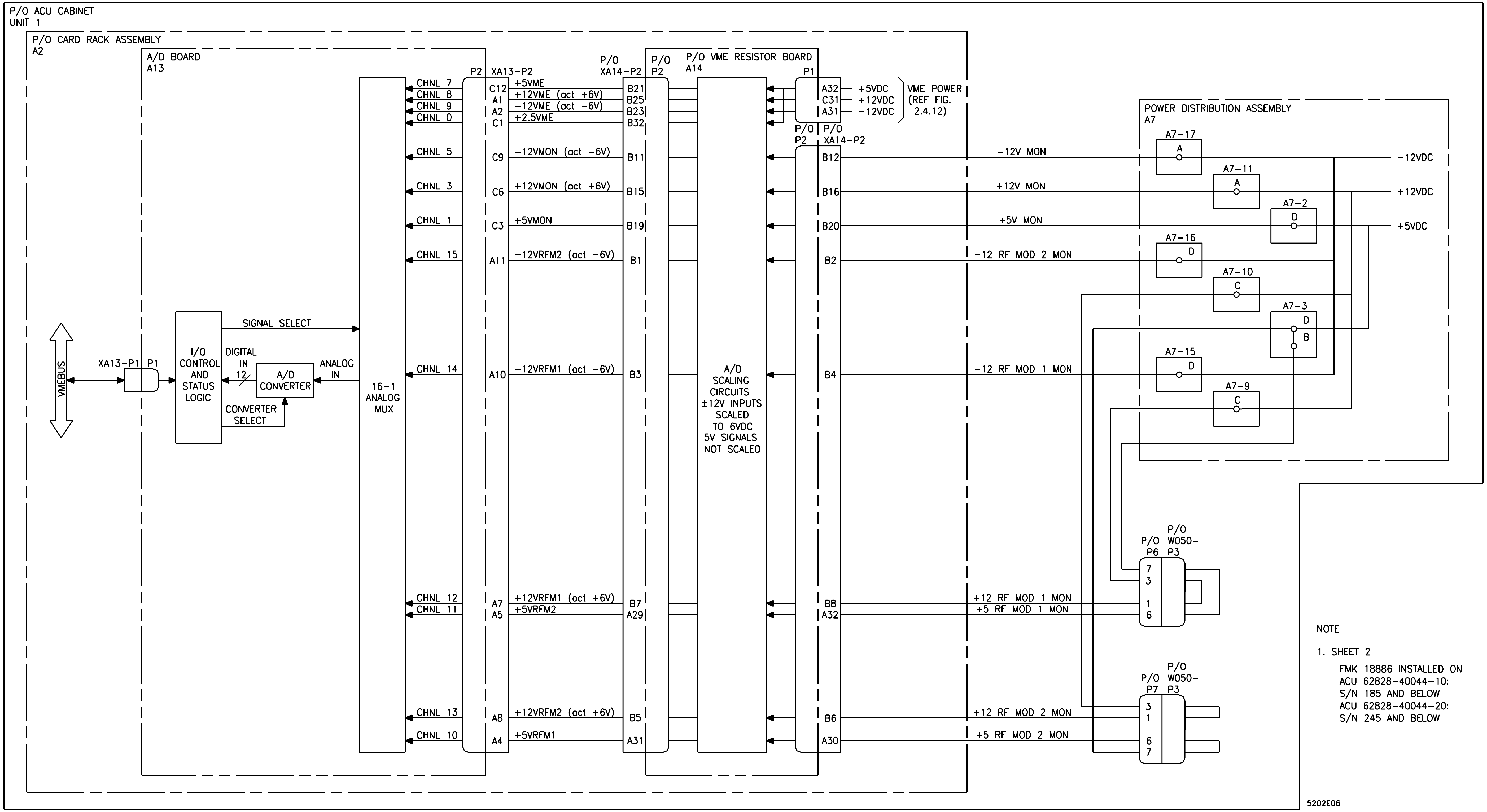


Figure 2.4.11. ACU Power and Signal Monitoring Detailed Block Diagram (Sheet 2)

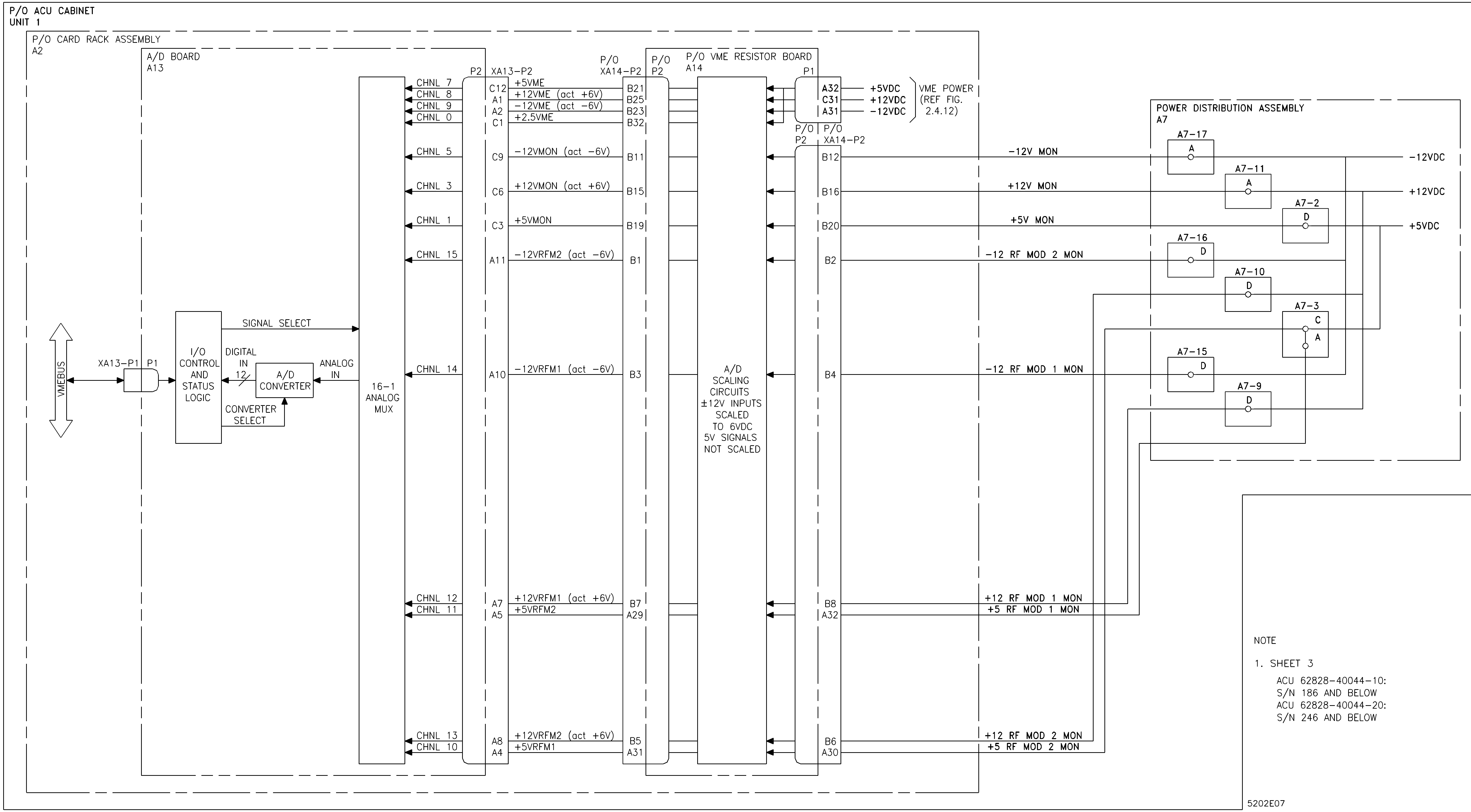
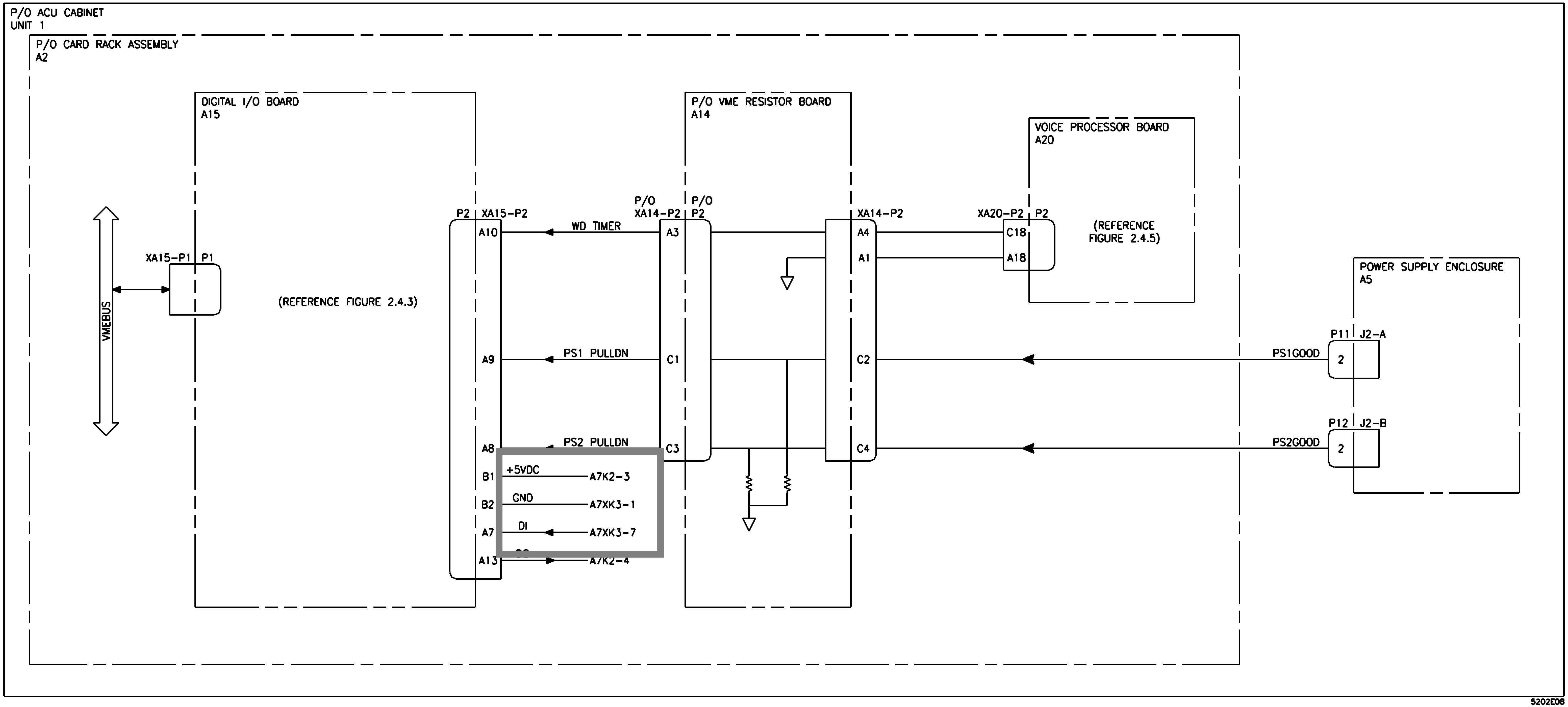


Figure 2.4.11. ACU Power and Signal Monitoring Detailed Block Diagram (Sheet 3)



NOTE

1. UNLESS OTHERWISE NOTED, ALL ACU CABINET WIRING IS PART OF HARNESS W014 (CLASS II) OR W016 (CLASS I).

Figure 2.4.11. ACU Power and Signal Monitoring Detailed Block Diagram (Sheet 4)

The ACU power and signal monitoring circuitry consists of an A/D board, VME resistor board, and digital I/O board. The A/D board and DIO board each provide an interface to the VMEbus for access by the CPU (P1). These VMEbus interfaces contain control and status logic that identifies and conducts all VMEbus data transfers with the boards. The A/D board and DIO board also provide second interfaces for analog and digital user-defined devices (P2).

The A/D board contains 16 input analog channels numbered from 0 to 15 on the user interface port (P2). An analog multiplexer, under software control, selects 1 of the 16 possible analog signals for application to the A/D converter. The selected analog signal is converted to a 12-bit digital data value by the A/D converter that is then read by the computer over the VMEbus via the I/O control and status logic.

The analog input channels of the A/D board receive monitor signals corresponding to dc power supply outputs, rf modem power, and VMEbus (card rack assembly) power. All of these analog power signals are input via the VME resistor board. The VME resistor board scales ±12 vdc power signals down to ±6 vdc levels for the A/D converter. The 5 vdc power signals are passed through the VME resistor board unscaled. The voltages monitored at the actual power supply outputs are typically more than +5V and ±12V due to adjustments for losses between the power supplies and the loads.

The VME resistor board contains a precision voltage source that outputs a 2.5 ±0.1 vdc reference voltage. This reference voltage is input on channel 0 of the A/D board. The CPU selects this signal for conversion during the ACU CST to test the operation of the A/D converter on the A/D board.

The digital I/O board allows the CPU to monitor the status of four digital status bits. These bits are the watchdog timer from the voice processor board, two status bits from the two dc power supplies, and UPS bypass status (Class II only). All signals except the UPS bypass status are routed through the VME resistor board before being applied to the digital I/O board. The power supply status bits (PS1/2GOOD) are normally at a logic 1 level. When a failure occurs in one of the power supplies, the corresponding status bit goes to logic 0. On the VME resistor board, a pulldown resistor is connected to each of the power supply status bits. The pulldown resistor ensures that the status bit goes to logic 0 to indicate a failure when the corresponding power supply is removed from the system.

The ACU CST checks the status of the A/D board once per minute. The overall status of this board is displayed on the A/D page of the OID. The CST provides two tests for this board: REGISTER READBACK and REFERENCE VOLTAGE. The technician can manually run the A/D test from the A/D page at any time. A T status is displayed for all test categories until the test is run again during the next CST cycle. After the cycle, the latest test status is displayed and the fail count (if applicable) is incremented.

The REGISTER READBACK test checks the ability of the CPU to write and read data to and from the board. The REFERENCE VOLTAGE test is based on the A/D board properly converting the 2.5 vdc reference voltage from the VME resistor board.

In addition to testing the A/D board, the CST also checks the status of each of the monitored power supply lines. The results of these checks are displayed on the ACU PWR page of the OID. The pass/fail status of all monitored 5 vdc and ±12 vdc lines is displayed, along with the status of the 2.5 vdc reference voltage. Also given is the pass/fail indication for each of the two dc power supplies. The power supply checks are based on the status of the PSXGOOD bits input via the digital I/O board.

2.4.3.9 **Power Distribution and Control**. This paragraph contains detailed descriptions and detailed block diagrams of the ac/dc power distribution. The ACU is divided into two types of power distribution: ac and dc. The following paragraphs describe both the ac and dc power distribution.

2.4.3.9.1 **AC Distribution**. Class II ACU cabinets contain Power Supply Assembly 1A4, which provides UPS functions. Some Class I ACU's also contain a UPS as an option. Power Supply Assembly 1A4 can be one of two types, depending on the ACU serial number. The ACU's that have power supply assemblies installed are listed below with the effective serial numbers.

a. Power supply assembly 62828-40124-10 is installed in ACU serial numbers 437 and below.

b. Power supply assembly 62828-40265-10 is installed in ACU serial numbers 438 and above.

Power Distribution Assembly A7 provides the ACU with proper reset and UPS bypass capability. The assembly consists of a solid state Time Delay Relay A7K1, Digital I/O Module A7K2 (Class II only), and Power Relay A7K3 (Class II only). During initial turn-on, power is applied to solid state Time Delay Relay A7K1 which delays power application for approximately three seconds then distributes power throughout the ACU in Class I systems or applies power to Power Relay A7K3 normal closed contacts and Power Supply Assembly A4. Power to Power Relay A7K3 normally closed contacts is routed through Power Distribution Assembly A7 where it is distributed to the ACU assemblies.

After power is applied to Class II ACU assemblies, ASOS operational software monitors Power Relay A7K3 bypass status via Digital I/O Module A7K2 and Digital I/O Board A2XA15. When UPS status is good, Power Relay A7K3 is energized via Digital I/O Board A1A2XA15 and Digital I/O Module A7K2 to route power from the UPS output applied to Power Relay A7K3 normal open contacts to the ACU.

The following paragraphs describe ac power distribution for the two power supply assemblies.

2.4.3.9.2 **AC Distribution for Power Supply Assembly 62828-40124-10 (Figure 2.4.12)**. Facility power is provided to the ACU via ACU INPUT POWER connector J41 on the I/O panel assembly. Input power is applied to Power Distribution Assembly 1A7 Power Reset Relay K1 which provides a three second delay to allow the pressure sensors and rf modems to stabilize after power is interrupted and then distributed throughout the ACU. For both Class I and Class II ACU's, blower B1 receives its ac power directly from the power distribution assembly.

For Class II systems (serial number 437 and below), a UPS is provided by Power Supply Assembly A4 and Battery Box A8 (serial number 437 and below). The UPS is not a unit in itself, but is the collection of the following eight units:

a. Circuit breaker 1A4CB1

b. 1.5 KVA Filter Board 1A4A3

c. 1.5 KVA Inverter Board 1A4A4

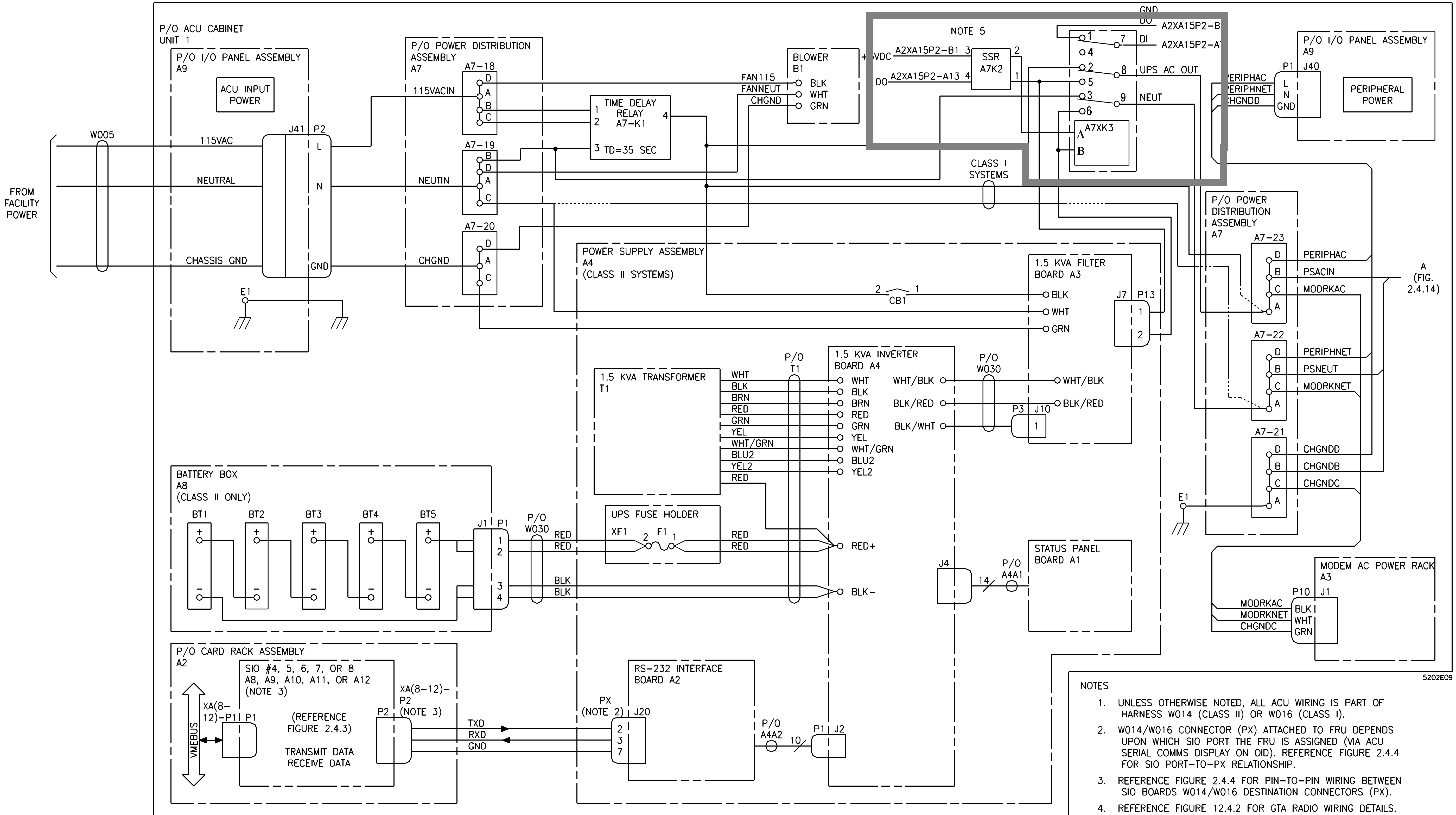
d. 1.5 KVA transformer 1A4T1

e. Battery Box 1A8

f. Fuse 1A4F1

g. RS-232 Interface Board 1A4A2

h. Status Panel Board 1A4A1



NOTES

1. UNLESS OTHERWISE NOTED, ALL ACU WIRING IS PART OF HARNESS W014 (CLASS II) OR W016 (CLASS I).
2. W014/W016 CONNECTOR (PX) ATTACHED TO FRU DEPENDS UPON WHICH SIO PORT THE FRU IS ASSIGNED (VIA ACU SERIAL COMMS DISPLAY ON OID). REFERENCE FIGURE 2.4.4 FOR SIO PORT-TO-PX RELATIONSHIP.
3. REFERENCE FIGURE 2.4.4 FOR PIN-TO-PIN WIRING BETWEEN SIO BOARDS W014/W016 DESTINATION CONNECTORS (PX).
4. REFERENCE FIGURE 12.4.2 FOR GTA RADIO WIRING DETAILS.
5. A7K2 PINS 1 AND 2 MAY BE JUMPERED TO INHIBIT SOFTWARE CONTROL.

Figure 2.4.12. ACU AC Power Distribution Detailed Block Diagram for 62828-40124-10

Input ac power is applied through circuit breaker CB1 to 1.5 KVA Filter Board A3. The filter board filters the input line voltage and routes it to 1.5 KVA Inverter Board A4 on the WHT/BLK (neut) and BLK/RED (line) wires of W030.

During normal (noninterrupted power) operation, the inverter board monitors the input voltage from the filter board and regulates it to provide a constant 120 vac output signal. The inverter board uses transformer T1 to perform this regulation. The secondary coil of T1 has multiple taps that are routed to tap-switching triacs on the inverter board. If the inverter board senses that the input line voltage is low, it causes one of the triacs to switch in a T1 secondary tap that steps up the voltage to the required level. The stepped-up voltage is then output from the BLK/WHT terminal of the inverter board to connector S10 of 1.5 KVA Filter Board A3. Similarly, if the inverter board senses that the input ac voltage is high, the T1 secondary tap is changed to step the voltage down to the required level, and the stepped-down voltage is output to the filter board. The filter board filters the ac voltage and outputs the regulated voltage from connector J7 as the UPS ac output signal.

When the inverter board senses a loss of its input ac signal, it uses transformer T1 to convert dc voltage from Battery Box A8 to a backup ac signal. Battery Box A8 contains five 12 vdc batteries wired in series to provide a total of 60 vdc. This dc voltage is applied through fuse F1 to the RED terminal of the inverter board, where it is then routed to the center tap of the primary coil of T1. When the inverter board senses a loss in the input ac signal from the inverter board, it alternatingly switches in the two other two primary leads of T1 (BLU2 and YEL2). This causes alternating current in the T1 primary, which is induced to the secondary coil of T1. The inverter board then uses its tap-switching triacs, as described above, to output a regulated ac voltage to the filter board.

The regulated, filtered UPS ac output signal from the filter board is routed to Power Distribution Assembly A7 for distribution to ACU assemblies. Units that receive the UPS output voltage from the power distribution assembly are the dc power supply enclosure, the card rack assembly, and the modem ac power rack. UPS ac voltage is also routed to PERIPHERAL POWER connector J40 on the I/O panel assembly to provide backed up ac power to the primary OID, the printer, and to FAA modems.

RS-232 Interface Board A2 allows the CPU to monitor the operational status of the UPS. The inverter board contains circuitry to monitor the status of the ac input and output voltages, battery voltages, tap-switching triac status, etc. During CST, the CPU communicates with the inverter board, via the RS-232 interface board, to obtain these status data. The CPU analyzes these UPS data and displays the results on the ACU UPS page of the OID.

The ACU CST checks the status of the UPS once per minute. CST results are displayed on the ACU UPS page of the OID. The CST performs 10 tests on the UPS. These tests are based on information determined by the 1.5 KVA inverter board and communicated to the CPU via the RS-232 interface board. The technician can manually run the UPS test from the UPS page at any time. A T is displayed for the 10 test categories until the test is run again during the next CST cycle. After the cycle, the latest test status is displayed and the fail count (if applicable) is incremented.

The BATTERY VOLTAGE test indicates the current voltage provided by the battery box. The INPUT VOLTAGE test indicates the current value (in vac) of the facility input voltage being received by the inverter board from the 1.5 KVA filter board. The OUTPUT VOLTAGE test indicates the current value (in vac) of the regulated ac voltage being output from the inverter board to the filter board. The OUTPUT ENABLED test indicates whether or not the UPS output is currently enabled or disabled via the OUTPUT POWER switch on the status panel. The ON AC LINE test indicates the power source on which the UPS is operating (P = facility input (ac line), F = UPS operating on battery backup). The BATTERY STATUS test indicates the condition of the battery box supply. The TRIAC STATUS test indicates the operating condition of the tap changing triacs on the inverter board. The TEMPERATURE test checks for an overheat condition as detected by a sensor on the inverter board. The RS-232 test checks for transmission errors encountered by the RS-232 interface board. Finally, the TIMEOUT test indicates a failure in the event that the CPU receives no response at all from the RS-232 interface board.

In a Class I ACU that does not contain a UPS (UPS is an option in a Class I ACU), jumpers are installed between the UPS input and UPS output terminals on Power Distribution Assembly 1A7. That is, wires are installed between terminals A7-18C and -23A (115 vac), and between terminals -19C and -22C (neutral) to bypass the Class II UPS described above.

2.4.3.9.3 **AC Distribution for Power Supply Assembly 62828-40265-10 (Figure 2.4.13)**. Facility power is provided to the ACU via ACU INPUT POWER connector J41 on the I/O panel assembly. Input power is applied to Power Distribution Assembly 1A7 for distribution throughout the ACU. For both Class I and Class II ACU's, blower B1 receives its ac power directly from the power distribution assembly. For Class II systems (serial number 438 and above), facility power is provided by Power Supply Assembly 1A4 and Battery Box 1A8.

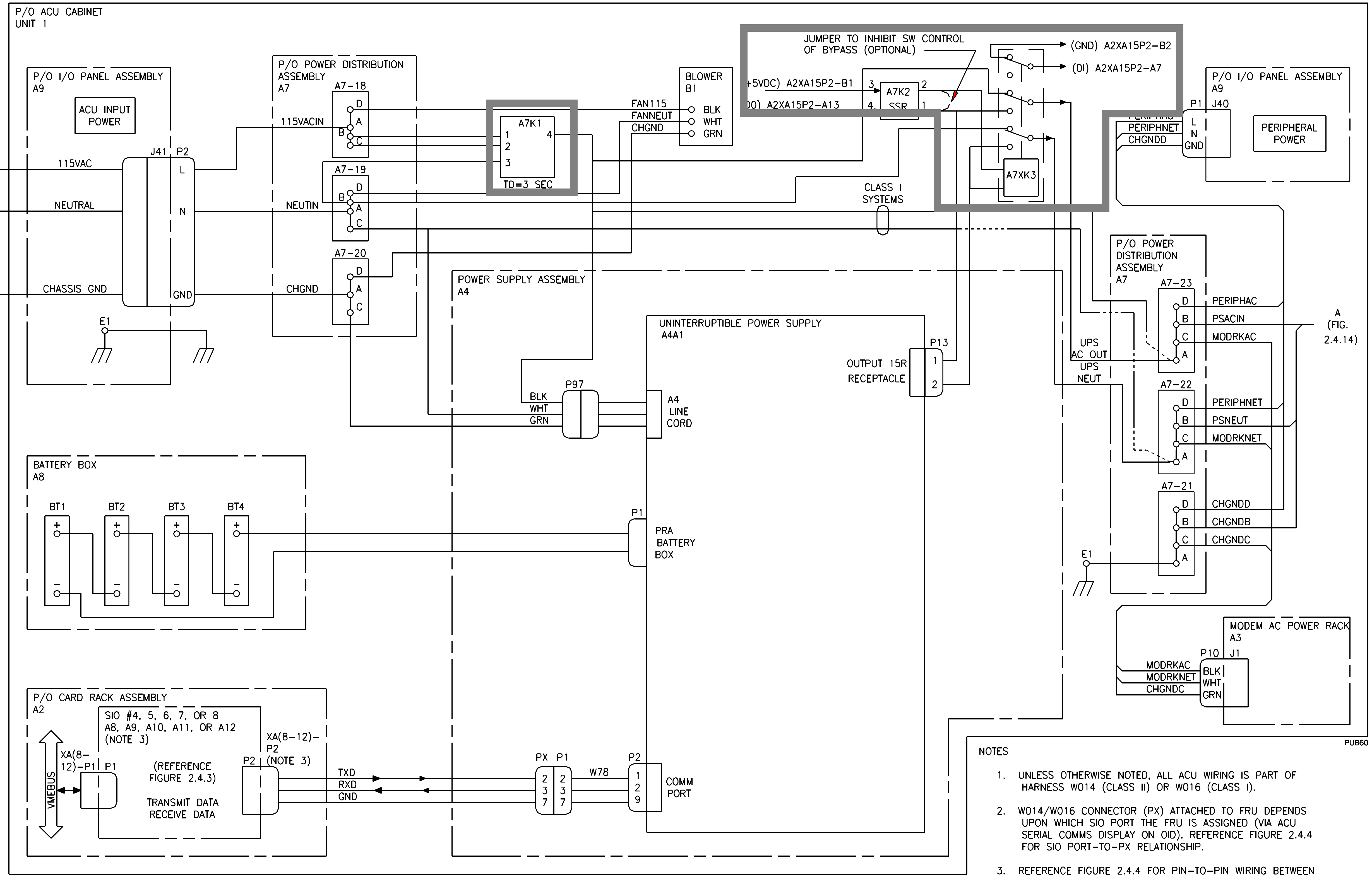
Input ac power is applied through connector P97. During normal (noninterrupted power) operation, the UPS assembly monitors the input signal internally and maintains a steady output voltage.

When the UPS detects a loss in its input ac voltage, it inverts dc voltage from Battery Box 1A8 to a backup ac voltage. Battery Box 1A8 contains four 12-vdc batteries wired in series to provide a total of 48 vdc.

The regulated, filtered UPS ac output signal from the UPS is routed to Power Distribution Assembly 1A7 for distribution to ACU assemblies. The dc power supply enclosure and the modem ac power rack receive the UPS output voltage from the power distribution assembly. UPS ac voltage is also routed to PERIPHERAL POWER connector J40 on the I/O panel assembly to provide backed-up ac power to the primary OID, the printer, and FAA modems. An UPS bypass circuit has been added to Class II ACU's, which allows the ACU to operate from unconditioned ac power input in the event that the UPS fails or is undergoing maintenance. The bypass circuit includes three relays. A 1-second time-delay relay, A7K1, ensures that whenever primary power is interrupted briefly, it cannot be reapplied for 1 second, so that power-up reset circuits in ACU FRU's will correctly reset those FRU's. Solid-state relay A7K2 allows software control of the UPS bypass function; software control can be disabled by jumpering terminals 1 and 2. A7K2 normally connects the coil of ac power relay A7K3, a triple-pole, double-throw relay, to UPS output, so that it will be energized whenever UPS is providing an output. When the software command is active, A7K2 contacts open to release A7K3, bypassing the UPS and connecting the unconditioned primary ac power input to ac power distribution. The third set of A7K3 contacts, when the relay is released, sends a ground signal to the DIO board to indicate that unconditioned primary input power is selected.

The RS-232 COMM PORT on the UPS allows the CPU to monitor the operational status of the UPS. The UPS contains circuitry to monitor the status of the ac input and output voltages, battery voltages, etc. During CST, the CPU communicates with the UPS to obtain these status data. The CPU analyzes these UPS data and displays the results on the ACU UPS page of the OID.

The ACU polls the UPS approximately every 2 minutes with a dump status command to obtain a current status of the UPS. BATTERY VOLTAGE status (provided as a numerical value) indicates the current voltages provided by the battery box. INPUT VOLTAGE status (provided as a numerical value) indicates the current value (in vac) of the facility input voltage being received by the UPS. OUTPUT VOLTAGE status (provided as a numerical value) indicates the current value (in vac) of the regulated ac voltage being output from the UPS. UPS OPERATION status indicates whether or not the UPS is functioning in a normal (indicated by a P (utility is OK, battery is OK, and UPS is in its normal state)) or abnormal operation (indicated by an F). The ON AC LINE status indicates the power source on which the UPS is operating



NOTES

1. UNLESS OTHERWISE NOTED, ALL ACU WIRING IS PART OF HARNESS W014 (CLASS II) OR W016 (CLASS I).
2. W014/W016 CONNECTOR (PX) ATTACHED TO FRU DEPENDS UPON WHICH SIO PORT THE FRU IS ASSIGNED (VIA ACU SERIAL COMMS DISPLAY ON OID). REFERENCE FIGURE 2.4.4 FOR SIO PORT-TO-PX RELATIONSHIP.
3. REFERENCE FIGURE 2.4.4 FOR PIN-TO-PIN WIRING BETWEEN SIO BOARDS W014/W016 DESTINATION CONNECTORS (PX).

Figure 2.4.13. ACU AC Power Distribution Detailed Block Diagram for 62828-40265-10

(P = facility input (ac line), F = UPS operating on battery backup). BATTERY STATUS (P for pass or F for fail) indicates whether battery power is low from the battery box supply. INVERTER status indicates whether the internal inverter is operating in overvoltage or undervoltage status. GROUND STATUS (P for pass or F for fail) checks for a ground failure. UTILITY status (P for pass or F for fail) indicates an overvoltage or unsynchronized signal from facility power. TIMEOUT status (P for pass or F for fail) indicates a failure in the event that the CPU receives no response at all from the UPS. BATTERY MANAGEMENT status (provided as a word description) indicates if the current from the batteries is FLOATING (trickle charge), RESTING (not charging or discharging), CHARGING, or DISCHARGING. Finally, LINE REGULATION status (provided as a word description) indicates if the UPS is maintaining a STEP-UP, STEP DOWN, or NORMAL voltage from facility power.

In a Class I ACU without a UPS (UPS is an option in a Class I ACU), jumpers are installed between the UPS input and output terminals on Power Distribution Assembly 1A7; that is, wires are installed between terminals -18C and -23A (115 vac) and between terminals -19C and -22C (neutral) to bypass the Class II UPS described above.

2.4.3.9.4 **DC Power Distribution.** Figure 2.4.14, sheets 1 through 6, illustrate dc power distribution. Sheet 1 shows the common dc circuitry for all rf modem installations. Sheets 2 through 6 show five different configurations of dc power distribution wiring, depending on the rf modem installation (paragraph 2.4.3.4.2) as follows:

Sheet 2- original equipment AAI rf modem configuration
Sheet 3- as sheet 2 but shown modified for Motorola rf modems
Sheet 4- as sheet 3 but shown with Johnson Data modems
Sheet 5- original equipment Motorola rf modem configuration
Sheet 6- as sheet 5 but shown with Johnson Data modems

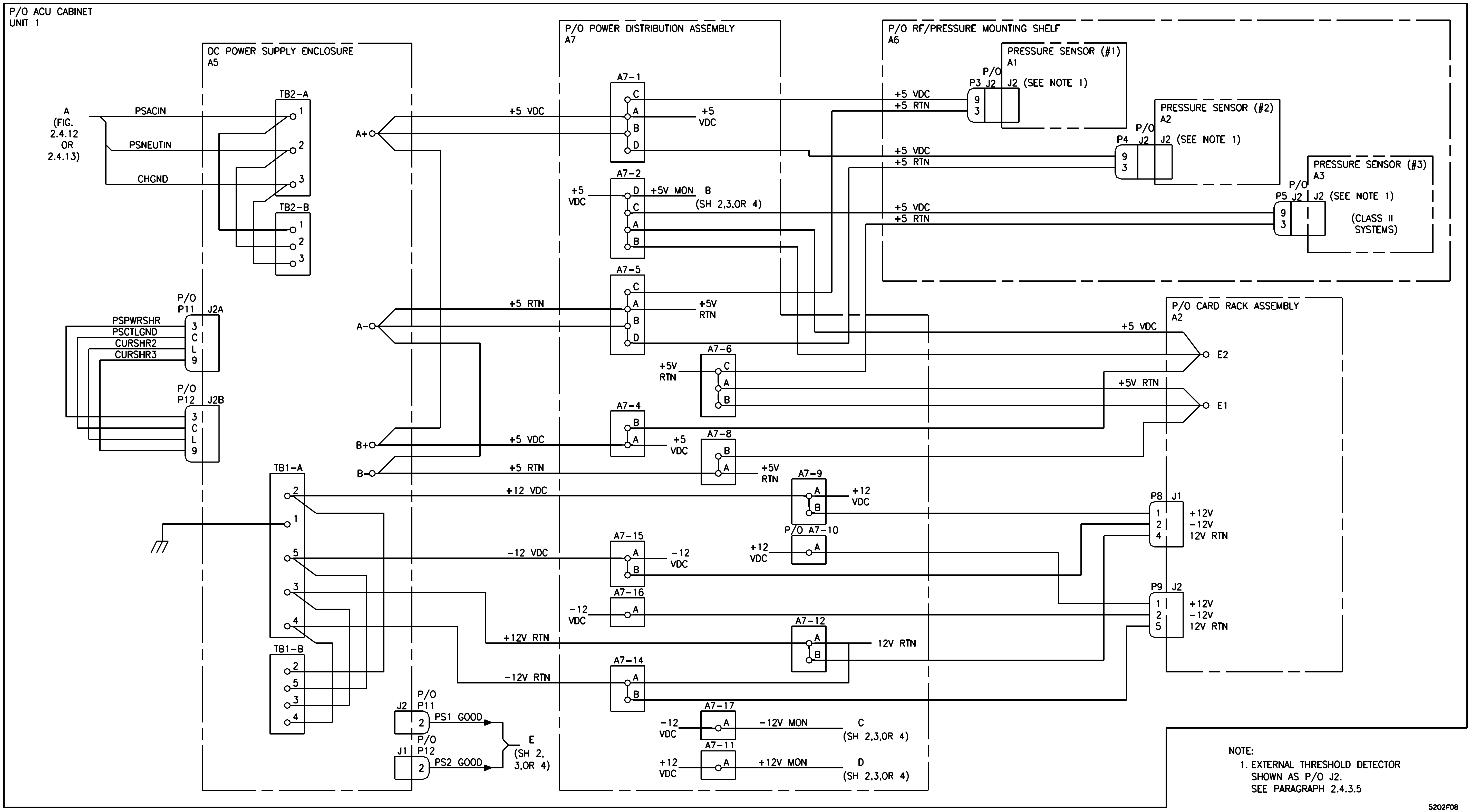
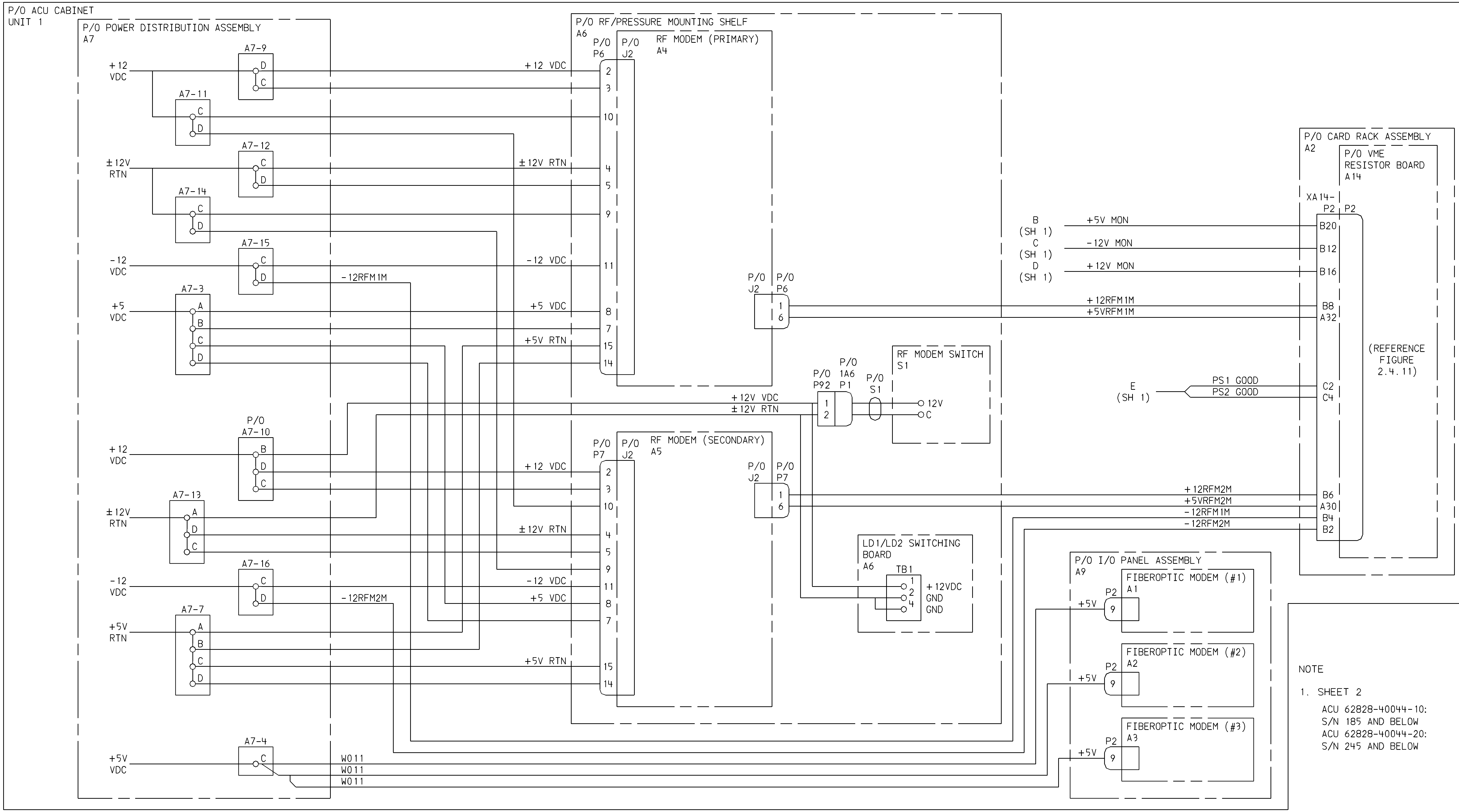
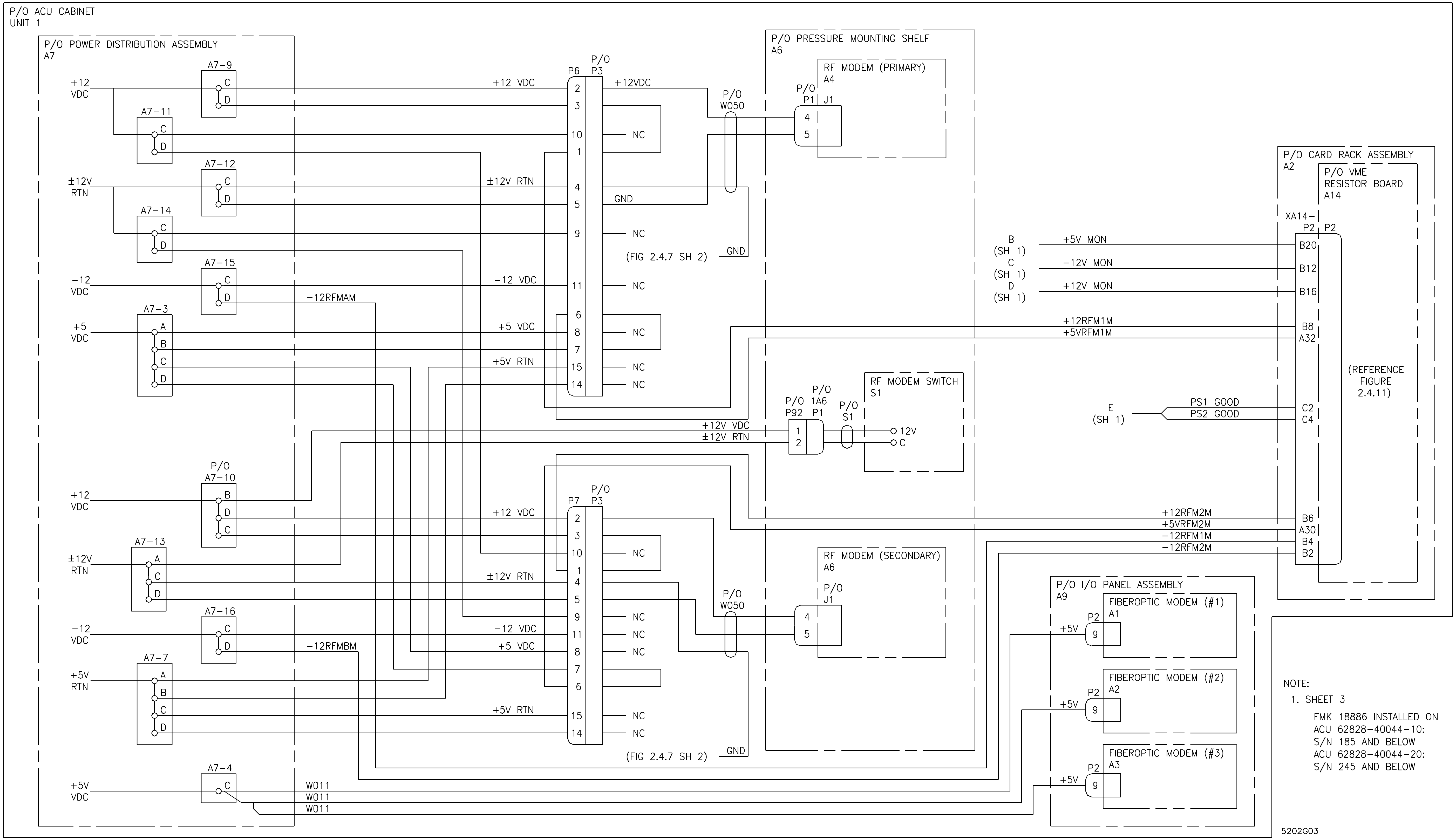


Figure 2.4.14. ACU DC Power Distribution Detailed Block Diagram (Sheet 1 of 6)



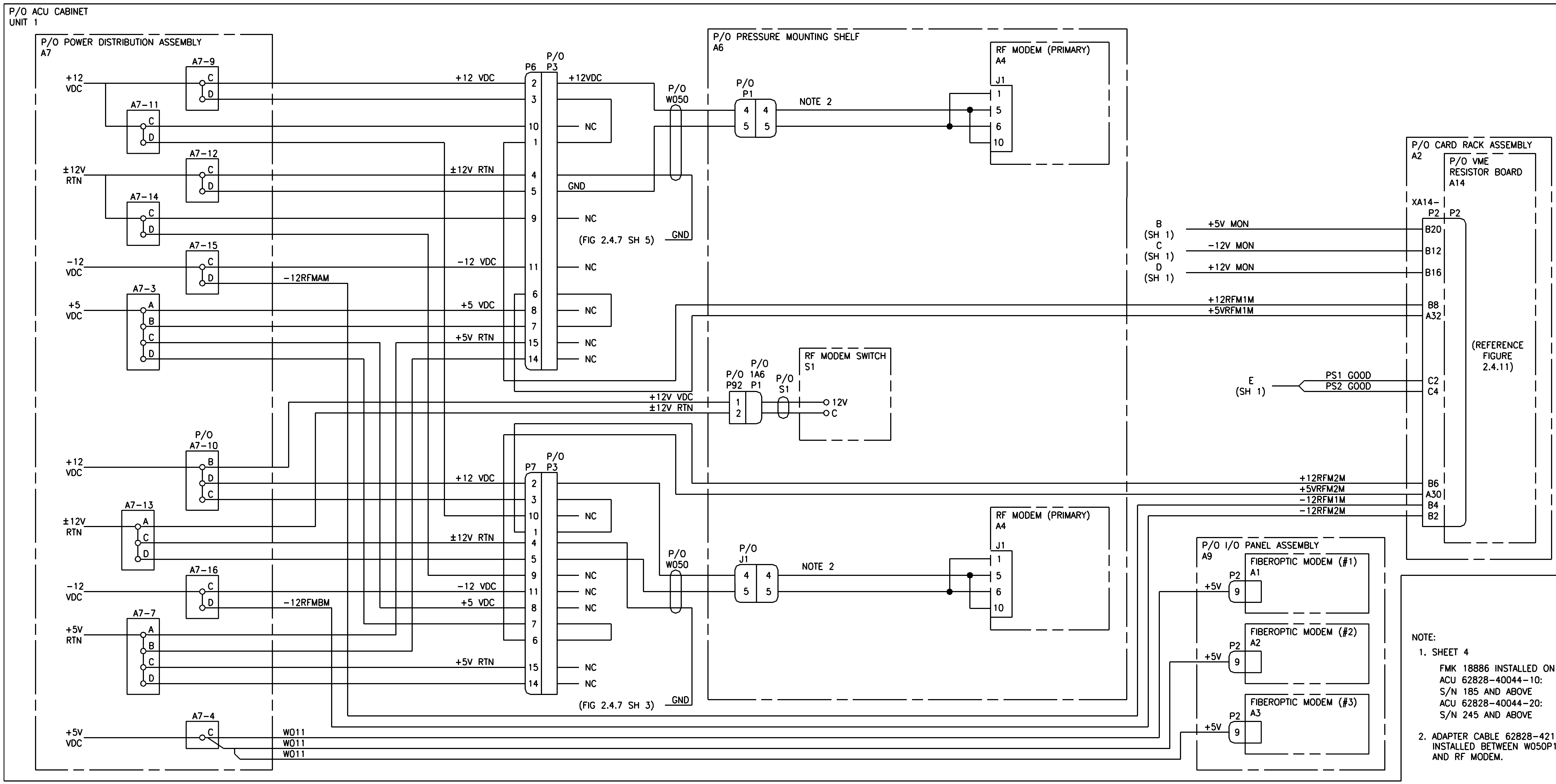
AAI MODEMS

Figure 2.4.14. ACU DC Power Distribution Detailed Block Diagram (Sheet 2 of 6) $



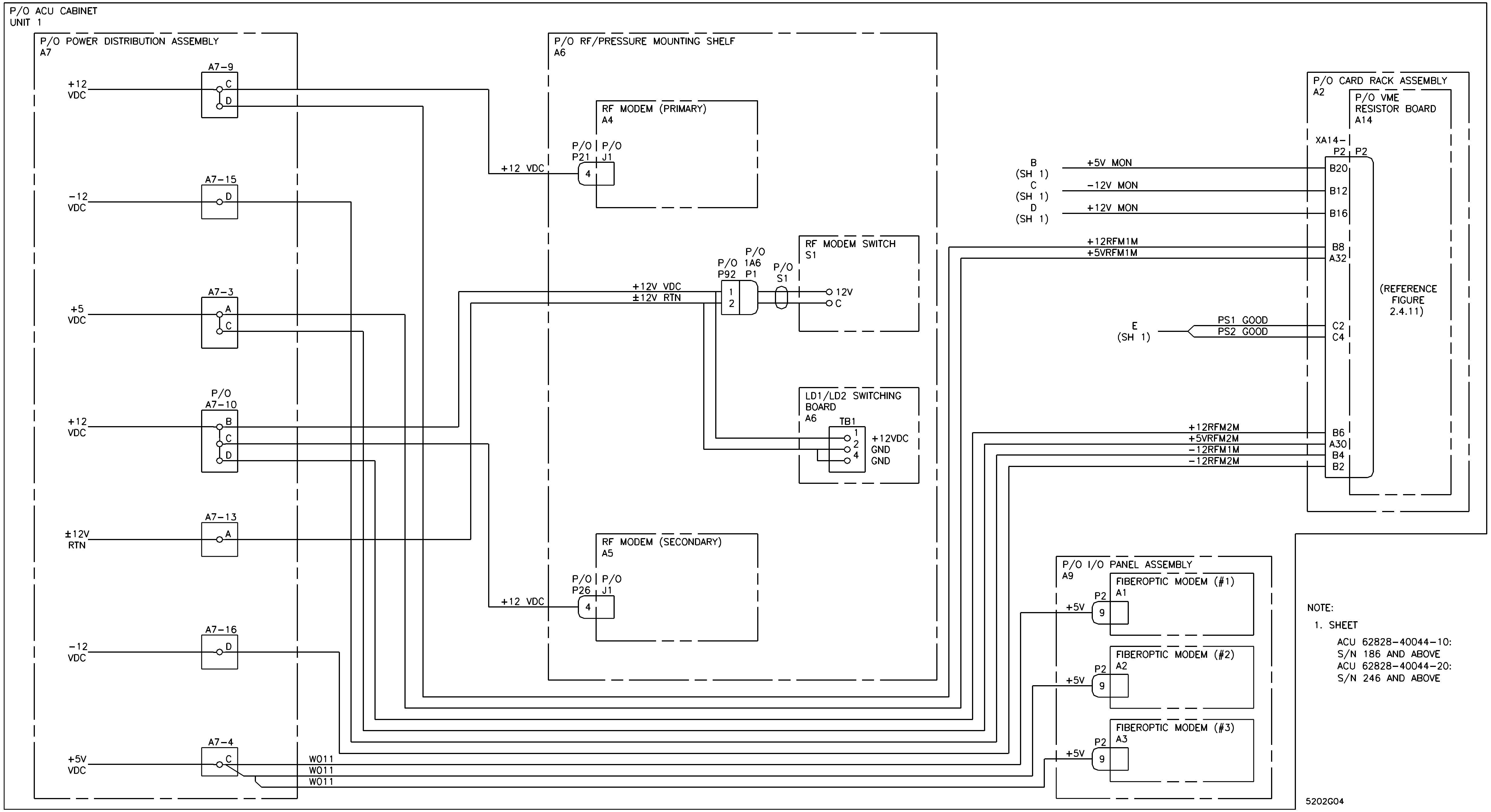
SYSTEM CONVERTED FROM AAI MODEMS TO MOTOROLA MODEMS

Figure 2.4.14. ACU DC Power Distribution Detailed Block Diagram (Sheet 3 of 6)



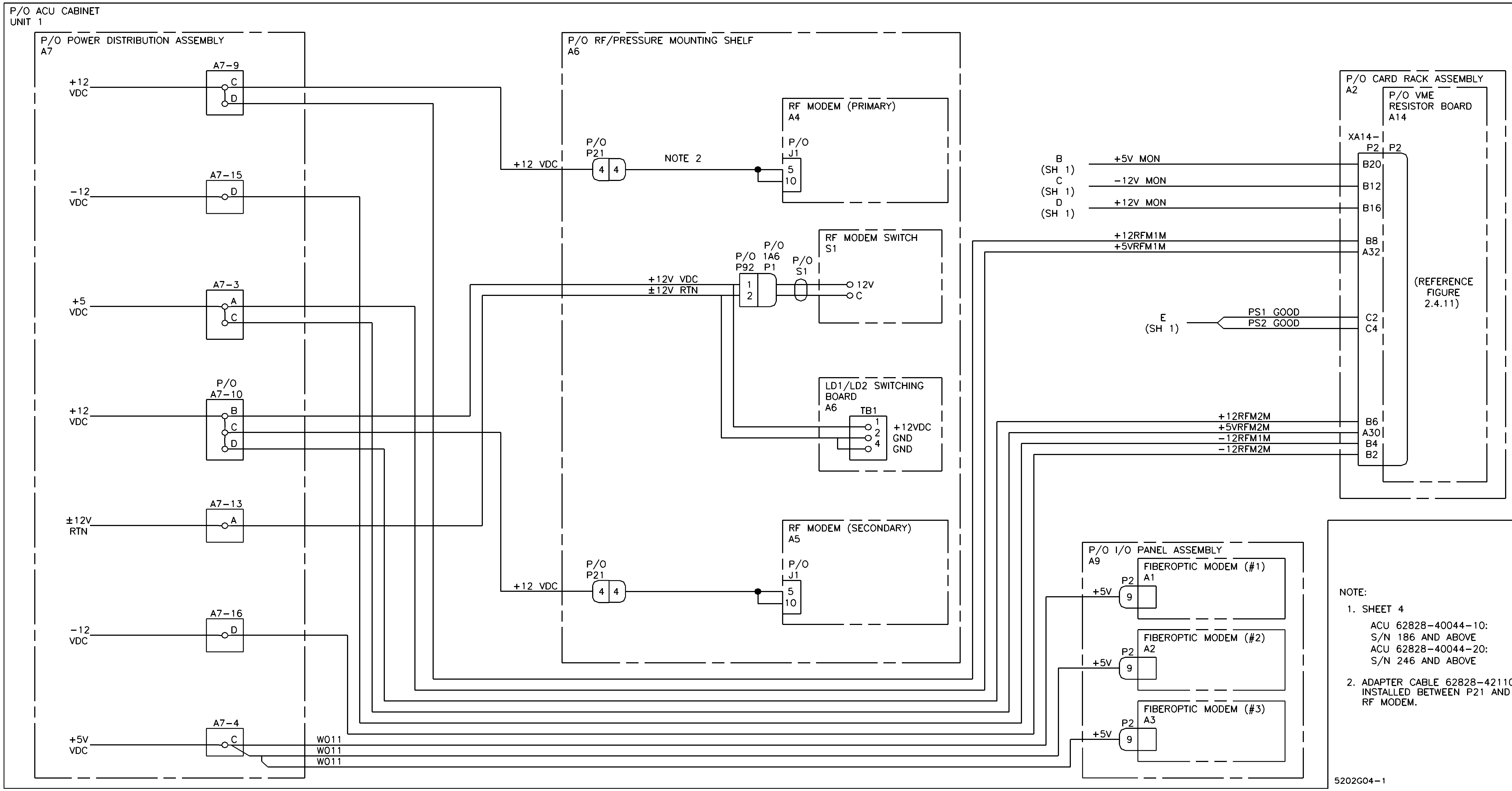
SYSTEM CONVERTED FROM AAI MODEMS TO MODEMS EQUIPPED WITH JOHNSON DATA MODEMS

Figure 2.4.14. ACU DC Power Distribution Detailed Block Diagram (Sheet 4 of 6)



MOTOROLA MODEMS

Figure 2.4.14. ACU DC Power Distribution Detailed Block Diagram (Sheet 5 of 6)



SYSTEM CONVERTED FROM MOTOROLA MODEMS TO JOHNSON DATA MODEMS

Figure 2.4.14. ACU DC Power Distribution Detailed Block Diagram (Sheet 6 of 6)

SECTION V. MAINTENANCE

2.5.1 INTRODUCTION

This section contains the preventive and corrective maintenance procedures for the acquisition control unit (ACU) cabinet. Preventive maintenance ensures that the ACU cabinet remains operational. Corrective maintenance allows fault isolation to a faulty field replaceable unit (FRU). The procedures for removal and replacement of a faulty FRU are also provided in this section. Malfunctions within the ACU cabinet are identified by the ASOS continuous self-test (CST). Maintenance information for the pressure sensor is located in Chapter 8. Maintenance information for the Codex modem is located in Chapter 13.

2.5.2 PREVENTIVE MAINTENANCE

Preventive maintenance consists of those procedures that are performed on a scheduled basis to maintain the ACU cabinet in an operational state. All preventive maintenance tasks for the ACU cabinet are provided in table 2.5.1.

Table 2.5.1. ACU Preventive Maintenance Schedule

Interval	What To Do	How To Do It
90 days	Clean air filters	Paragraph 2.5.2.1
	Clean cathode ray tube (CRT)/display screens on the OID's, VDU's and CVD's	Paragraph 2.5.2.2
	Clean ACU cabinet	Paragraph 2.5.2.3
	Check memory board LOW BATT indicator	Paragraph 2.5.2.4
Semiannually	Check/clean batteries	Paragraph 2.5.2.5

2.5.2.1 **Air Filter Cleaning**. Due to continuous air flow through the ACU cabinet, the air filters can become clogged with dust and foreign matter resulting in an unsTable thermal condition. Periodic air filter cleaning prevents this condition from occurring. Refer to table 2.5.2 for the air filter cleaning procedure.

2.5.2.2 **Display Screen Cleaning**. Cleaning the display screens is required to remove dust and dirt that accumulate on the screens. The display screen cleaning procedure is provided in Chapter 1, Section V.

2.5.2.3 **ACU Cabinet Cleaning**. Cleaning the ACU cabinet is required to remove dust and dirt that accumulate on the external surface and to remove any internal debris. The ACU cabinet cleaning procedure is provided in table 2.5.3.

2.5.2.4 **Check Memory Board LOW BATT Indicator**. The LOW BATT indicator on ACU Memory Board 1A2A3 should be checked every 90 days or whenever the technician visits the site. If the LOW BATT indicator is illuminated, the backup battery on the board has failed and ACU Memory Board 1A2A3 must be replaced.

2.5.2.5 **Check/Clean Batteries**. For Class II systems, there are two types of battery packs depending on which power supply assembly is installed. The power supply assembly 62828-40124-10 configuration has five batteries in Battery Box 1A8; the power supply assembly 62828-40265-10 configuration has only four batteries. The batteries should be checked and cleaned semiannually or whenever the CST indicates that the batteries have failed or are low. The individual batteries should be removed from the battery box in accordance with the battery removal procedure of table 2.5.30. The batteries should be checked for leakage or corrosion on the terminals and replaced in accordance with the installation procedure of table 2.5.30. If a battery is found to be leaking, it should be replaced. If battery terminals are corroded, they should be cleaned with a terminal brush or other wire brush before the battery is reinstalled.

Table 2.5.2. Air Filter Cleaning

Step	Procedure
	Tools and material required: Vacuum cleaner Mild detergent and water Lint-free cloths Phillips screwdriver **WARNING** ACU cabinet power is left on when cleaning the air filter. Death or severe injury may result if hands and tools are not kept clear of moving blower parts and cabinet power wiring when cleaning filter.
	NOTE There are two types of cabinets for the ACU. One type has a partial length front door with the fan/blower assembly mounted behind an air intake grill. The other type of cabinet has a full length door with the fan/blower assembly immediately accessible with the door open.
1	If the ACU cabinet has a partial length front door, remove six Phillips screws and lockwashers securing air intake grill to lower front of cabinet. Remove air intake grill. Proceed to step 3.
2	If cabinet has a full length front door, open front door. Loosen knurled knobs on either side of shield in front of fan/blower B1 and remove shield.
3	Remove filter.
4	Clean filter using detergent solution.
5	Dry filter.
6	Vacuum air intake grill (both types of cabinets) and blower shield (full length door cabinet).
7	Reinstall filter.
8	If full length door cabinet, install blower shield in front of blower and hand tighten two knobs on shield.
9	If partial length front door cabinet, position air intake grill in front of fan/blower assembly. Install Phillips screws and lockwashers securing grill to cabinet.

Table 2.5.3. ACU Cabinet Cleaning

Step	Procedure
	Tools and material required: Hand-held vacuum cleaner Mild detergent and water Lint-free cloths **WARNING** Death or severe injury may result if power is not removed from ACU prior to performing maintenance activities inside the cabinet. Ensure that UPS POWER switch is set to 0 (off) position and facility power is removed from ACU. **NOTE** Wring out cloth before washing surfaces.
1	Set UPS POWER switch to 0 (off) position.
2	Remove facility power from ACU cabinet.
3	Clean external surfaces using lint-free cloth dampened with a mixture of mild detergent and water.
4	Dry surfaces using lint-free cloth.
5	Using hand-held vacuum cleaner, remove any loose debris inside ACU cabinet.
6	Apply facility power to ACU cabinet.
7	Set UPS POWER switch to 1 (on) position.

2.5.3 CORRECTIVE MAINTENANCE

2.5.3.1 **Introduction**. Corrective maintenance involves the isolation, removal, and replacement of faulty FRU's. The ASOS is equipped with a powerful automatic self-test program that is designed to isolate most faults to a single FRU. However, because of the system hardware configuration, there will be instances when the diagnostics can only isolate to a group of FRU's, such as a sensor or an I/O channel. The troubleshooting approach for single FRU and group FRU types of conditions is different.

When the FRU is specifically called out, the technician need only replace the faulty unit. When a group of FRU's is called out, the technician must isolate the failed FRU by referencing the theory of operation and associated drawings and following two basic procedures. The first procedure involves connector checks, which ensure that all boards, cables, and connectors are present and properly connected. The second procedure involves ac and dc power supply tests. Although the system monitors all critical power supply voltages in the ACU, data collection package (DCP), and sensors, failure of a power supply may result in a loss of communications between the system and its FRU's.

Power supplies are tested through both visual and mechanical inspection. Before measuring any voltages, the technician should visually inspect the suspected area for obvious signs of power supply failure. During this inspection, the technician should pay particular attention to circuit breakers, panel lights, and light emitting diode (LED) indicators on the units to ensure that they are functioning normally. The physical checks involve checking fuses and the power supply voltages using a DMM. In most cases, these tests will isolate the fault.

After an FRU has been replaced, the technician must allow the ASOS to automatically initialize upon the application of primary power to the ACU and verify that the continuous self-test diagnostics run without failure. The technician should also display the corresponding maintenance page on the OID and ensure that the FRU passes its CST checks. Table 2.5.4 provides corrective maintenance symptom analysis information for the ACU.

Table 2.5.4. Corrective Maintenance Symptom Analysis

Symptom	What To Do	How To Do It
System is completely dead.	Check ac and dc power.	Reference ACU AC/DC power distribution diagram figure 2.4.12 and verify ac and dc voltages.
Problem with ACU uninterruptible power supply (UPS) if installed.	Check UPS.	Paragraph 2.5.3.2
ACU computer does not initialize.	Check VME card rack.	Paragraph 2.5.3.3
Loss of ACU/DCP	Check ACU/DCP communications link.	Paragraph 2.5.3.4
Failure of an SIO board or loss of communication with a peripheral or user	Check SIO boards. Check modems.	Paragraph 2.5.3.5 Paragraph 2.5.5
Printer malfunction	Check printer	Paragraph 2.5.7 and printer vendor manual

2.5.3.2 **UPS Checks**. In a Class II system with serial number 437 and below, and in certain Class I systems which have been retrofitted per FMK # 088, for all components except the fan/blower assembly. If power is not applied to the ACU when the UPS POWER switch is set to ON (1), but the blower still operates, there could be a failure in the UPS. During operation, there are a number of tools available to fault isolate the UPS. The CST continually checks the status of the UPS and provides status information on the ACU UPS page of the OID. Error messages are printed on the printer and entered into the maintenance log. Also, the status

LED's on the UPS status panel provide valuable information for analyzing UPS problems. Table 2.5.5 provides procedures for troubleshooting the SOLA UPS. Table 2.5.6 provides procedures to prepare this SOLA UPS for maintenance and to return the UPS to operation following service.

In a Class II system with serial number 438 and above, a Deltek UPS (either UPS 62828-90338-10 or 62828-90338-20) provides the same functions except that the troubleshooting procedures are conducted primarily from the OID page. Table 2.5.7 provides the procedures for troubleshooting the Deltek UPS based on observed symptoms.

Table 2.5.5. UPS Fault Isolation (62828-40124-10)

Step	Symptom	Checks/Corrective Actions
1	UPS will not turn on. Indicators on Status Panel Board 1A4A1 are all extinguished.	Ensure that facility power is being applied to ACU. On back of Power Supply Assembly 1A4, check circuit breaker CB1. If tripped, reset CB1 and cycle OUTPUT POWER switch on status panel off and back on. Remove power from UPS and remove UPS cover per table 2.5.6. Visually inspect 1.5 KVA Filter Board 1A4A3 for damage. Replace filter board if damaged. Apply facility power to ACU cabinet. Using digital multimeter (DMM), verify 120 ±10% vac between terminal 1 of circuit breaker CB1 and WHT terminal of 1.5 KVA Filter Board 1A4A3. If voltage is not present, replace CB1. Verify 120 ±10% vac between WHT/BLK and BLK/RED terminals of 1.5 KVA Filter Board 1A4A3. If voltage is not present, replace A3. Replace 1.5 KVA Inverter Board 1A4A4. If problem persists, replace transformer 1A4T1.
2	UPS will not turn on. BATTERY indicator on status panel is on or blinking, but OUTPUT indicator is off.	This is normal situation with OUTPUT POWER switch set to off (0); therefore, ensure that OUTPUT POWER switch on Status Panel Board 1A4A1 is in the on (1) position. Remove power from UPS and remove UPS cover per table 2.5.6. Inspect ribbon cable on Status Panel Board 1A4A1 for damage or loose connections. Set OUTPUT POWER switch to on (1) position. Using DMM, ensure continuity across terminals of switch. Replace switch if no continuity. Set OUTPUT POWER switch to off (0) position. Reinstall UPS cover per table 2.5.6. To ensure that problem was not due to cable connectors, set OUTPUT POWER switch to on (1) position and attempt to operate UPS again. If problem is not corrected, replace Status Panel Board 1A4A1. If problem persists, replace 1.5 KVA Inverter Board 1A4A4.

Table 2.5.5. UPS Fault Isolation (62828-40124-10) - CONT

Step	Symptom	Checks/Corrective Actions
3	UPS operates, but CPU cannot communicate with RS-232 Interface Board 1A4A2. Failure indicated for TIMEOUT test or RS-232 test on ACU UPS page at OID.	From ACU serial communications page on OID, determine which SIO board and port the UPS is assigned. Select ACU SIO page corresponding to board to which UPS is assigned. From ACU SIO page, press TEST key to run CST on this SIO board. If port assigned to UPS fails LOOPBACK or XMIT ERRORS test, replace SIO board. If both tests pass, continue. At rear of UPS (Power Supply Assembly 1A4), disconnect W014/W016 connector from UPS RS-232 connector (1A4A2-J20). Insert RS-232 test box between UPS RS-232 connector and corresponding W014/W016 connector. Select ACU UPS page at OID. From ACU UPS page, press TEST key to run CST on UPS. On RS-232 tester, ensure that transmit (TxD) and receive (RxD) signals are being passed between the UPS and the SIO board (at least once per minute). If both signals are active, replace the following (in order) and retry UPS: a. SIO board to which UPS is connected b. RS-232 Interface Board 1A4A2 If transmit signal is missing, replace SIO board. If receive signal is missing, check/replace W078. If W078 P1-3 to P2-2 check measures continuity, continue. Remove power from UPS and remove UPS cover per table 2.5.6. Inspect ribbon cable between RS-232 interface board and 1.5 KVA Inverter Board 1A4A4. Ensure that ribbon cable is not twisted or damaged. Reseat connectors to ensure proper connection. After checking ribbon cable, replace cover per table 2.5.6 and operate system again. If problem is not corrected, replace RS-232 Interface Board 1A4A2. If problem persists, replace 1.5 KVA Inverter Board 1A4A4.
4	ALARM indicator on status panel is illuminated.	Overheat condition likely. On UPS status panel, set OUTPUT POWER switch to off (0) position. Inspect inside of ACU cabinet to ensure proper ventilation around UPS and that ACU blower is operating. Replace if necessary. Allow UPS to cool. Set UPS OUTPUT POWER switch to on (1) position. If UPS fails to turn on and ALARM indicator remains illuminated, set UPS OUTPUT power switch to off (0) position and proceed to step 5.

Table 2.5.5. UPS Fault Isolation (62828-40124-10) - CONT

Step	Symptom	Checks/Corrective Actions
5	With UPS cool, ALARM indicator on UPS status panel is illuminated when facility power is applied to ACU. UPS does not output power.	Ensure that connector W030-P1 is securely attached to connector J1 on Battery Box 1A8. Attempt to operate UPS again by setting OUTPUT POWER switch to on (1) position. Remove power from UPS and remove UPS cover per table 2.5.6. **WARNING** Ensure that W030-P1 connector is disconnected from Battery Box 1A8 before attempting to test fuse 1A4F1 for continuity. Failure to disconnect the battery box may result in injury to personnel or damage to equipment. Ensure that connector W030-P1 is disconnected from Battery Box 1A8. Inspect UPS fuse 1A4F1 and test for continuity using DMM. If fuse is good, proceed to next step. If fuse is open, replace fuse. If, after replacing fuse, problem persists and fuse again opens, replace 1.5 KVA Inverter Board 1A4A4. **WARNING** Exercise extreme caution in connecting UPS battery and taking measurement with UPS cover off. Death or severe injury may occur if contact is made with battery terminal or wires. Connect battery cable W030-P1 to connector J1 on Battery Box 1A8. Using DMM, measure dc voltage at battery terminals (RED+ and BLK-) of Inverter Board 1A5. Disconnect battery cable W030-P1 from connector J1 on Battery Box 1A8. If indication was less than 40 ±4 vdc, replace batteries BT1 through BT5 in Battery Box 1A8. If problem persists, replace 1.5 KVA Inverter Board 1A4A4. If battery voltage was above 40 ±4 vdc, replace 1.5 KVA Inverter Board 1A4A4.
6	After 24 hours of continuous charging (UPS has operated continually on facility power), BATTERY indicator on UPS status panel blinks, indicating low battery.	Remove power from ACU and remove UPS cover per table 2.5.6. **WARNING** Ensure that W030-P1 connector is disconnected from Battery Box 1A8 before attempting to test fuse 1A4F1 for continuity. Failure to disconnect battery box may result in injury to personnel or damage to equipment. Inspect UPS fuse 1A4F1 and test for continuity using DMM. If fuse is good, proceed to next step. If fuse is open, replace fuse. If, after replacing fuse, problem persists and fuse again opens, replace 1.5 KVA Inverter Board 1A4A4. Replace batteries BT1 through BT5 in Battery Box 1A8. If problem persists, replace 1.5 KVA Inverter Board 1A4A4. If problem persists, replace transformer 1A4T1.

Table 2.5.5. UPS Fault Isolation (62828-40124-10) - CONT

Step	Symptom	Checks/Corrective Actions
7	One or more indicators on Status Panel Board 1A4A1 do not illuminate.	Remove power from UPS and remove UPS cover per table 2.5.6. Inspect ribbon cable on Status Panel Board 1A4A1 for damage or loose connections. After checking ribbon cable, reinstall UPS cover per table 2.5.6 and operate system again. If problem persists, replace KVA Status Panel Board 1A4A1. If problem persists, replace 1.5 KVA Inverter Board 1A4A4.
8	UPS beeps when OUTPUT POWER switch is set to off (0) position.	Replace 1.5 KVA Inverter Board 1A4A4. **NOTE** Failure (step 9) may be result of circuit breaker CB1 tripping below its rated value. If problem persists after performing the following corrective actions, CB1 may be faulty.
9	UPS circuit breaker 1A4CB1 continually trips when facility power is applied to ACU cabinet.	Remove power from ACU and remove UPS cover per table 2.5.6. Inspect 1.5 KVA Filter Board 1A4A3 and 1.5 KVA Inverter Board 1A4A4 for signs of damage. Replace if necessary. On 1.5 KVA Filter Board 1A4A3, disconnect CB1 output wire from BLK terminal. Reset CB1. Apply facility power to ACU cabinet. If CB1 trips, replace CB1. Remove facility power from ACU cabinet. Reconnect CB1 wire to BLK terminal of 1.5 KVA Filter Board 1A4A3. On 1.5 KVA Inverter Board 1A4A4, disconnect input wires from WHT/BLK and BLK/RED terminals. Apply facility power to ACU cabinet. If CB1 trips, replace 1.5 KVA Filter Board 1A4A3. Remove facility power from ACU cabinet. Reconnect wires to WHT/BLK and BLK/RED terminals of 1.5 KVA Inverter Board 1A4A4. On 1.5 KVA Filter Board 1A4A3, disconnect connector from J10. **WARNING** Ensure that W030-P1 connector is disconnected from Battery Box 1A8 before attempting to disconnect transformer T1. Failure to disconnect battery box may result in injury to personnel or damage to equipment.

Table 2.5.5. UPS Fault Isolation (62828-40124-10) - CONT

Step	Symptom	Checks/Corrective Actions
		On 1.5 KVA Inverter Board 1A4A4, tag and disconnect 10 transformer 1A4T1 wires from their terminals. Apply facility power to ACU cabinet. If CB1 trips, replace 1.5 KVA Inverter Board 1A4A4. Remove facility power from ACU cabinet. Reconnect 10 transformer wires to respective connectors on 1.5 KVA Inverter Board 1A4A4. Apply facility power to ACU cabinet. If CB1 trips, replace transformer 1A4T1. Remove facility power from ACU cabinet. Reconnect connector to J10 on 1.5 KVA Filter Board 1A4A3. Disconnect W014/W016 connector P13 from connector J7 on 1.5 KVA Filter Board 1A4A3. Apply facility power to ACU cabinet. If CB1 trips, replace 1.5 KVA Filter Board 1A4A3. If not, problem is not in UPS components, but a short circuit probably exists in ACU cabinet wiring or in one of the loads connected to the UPS output.
10	Failure indicated for TRIAC test on ACU UPS page at the OID.	Replace 1.5 KVA Inverter Board 1A4A4. If problem persists, replace transformer 1A4T1.

Table 2.5.6. UPS (62828-40124-10) Pre-Service and Post-Service Procedures

Step	Procedure
PRE-SERVICE: REMOVING UPS POWER AND REMOVING COVER	
	Tools required: Small flat-tipped screwdriver No. 2 Phillips screwdriver **WARNING** Ensure that power is completely removed from the UPS by performing the following steps. Death or severe injury may result if power is not completely removed from the UPS prior to removing the cover on Power Supply Assembly 1A4 and performing maintenance on UPS subassemblies.
1	Set OUTPUT POWER switch S1 on UPS status panel to off (0) position. OUTPUT indicator on status panel extinguishes.
2	Remove facility power from the ACU cabinet.
3	On Battery Box 1A8, disconnect cable connector W030-P1 from battery box connector J1. To remove cable connector, squeeze tabs on side of connector inward while rocking the connector free.
4	Wait at least 30 seconds while UPS capacitors discharge through bleeders and other drains.
5	Remove screws, lockwashers, and flat washers that hold Power Supply Assembly 1A4 drawer to ACU cabinet. Pull power supply assembly drawer out of cabinet to its fully extended and locked position.
6	Remove three screws and washers at lower front of Power Supply Assembly 1A4 cover.
7	Remove three screws and washers at top rear of Power Supply Assembly 1A4 cover.

Table 2.5.6. UPS (62828-40124-10) Pre-Service and Post-Service Procedures -CONT

Step	Procedure
8	**CAUTION** Status panel ribbon cable is delicate. Use caution when lifting cover and disconnecting cable to prevent damage to status panel cable. Carefully raise cover approximately 6 inches and disconnect status panel ribbon cable from J4 on 1.5 KVA Inverter Board 1A4A4.
9	Lift cover from off Power Supply Assembly 1A4.
POST-SERVICE: INSTALLING UPS COVER AND APPLYING POWER TO UPS	
	Tools required: Small flat-tipped screwdriver No. 2 Phillips screwdriver **WARNING** Ensure that facility power is removed from ACU and that cable W030-P1 is disconnected from Battery Box 1A8 before performing maintenance on UPS. Death or severe injury may result if power is not completely removed from UPS prior to maintenance activities. **CAUTION** Status panel ribbon cable is delicate. Use caution when connecting cable and lowering cover to prevent damage to status panel cable. Ribbon connector is not keyed. Ensure that pin 1 on cable mates with pin 1 on board.
1	While holding cover approximately 6 inches above its normal position, carefully connect status panel ribbon cable to connector J4 on 1.5 KVA Inverter Board 1A4A4. Pin 1 on ribbon connector is marked with ink dot or other marking. Ensure that this mates with pin 1 of inverter board.
2	Lower cover into position on Power Supply Assembly 1A4, taking care not to disturb or pinch status panel ribbon cable.
3	Secure cover to Power Supply Assembly 1A4 by installing six screws and washers in bottom front and top rear of cover.
4	Release locks on power supply assembly slide rails and slide assembly back into ACU cabinet.
5	Using screws, lockwashers, and flat washers, secure power supply assembly drawer to ACU cabinet.
6	On UPS Status Panel Assembly 1A4A1, ensure that OUTPUT POWER switch is set to OFF (0) position.
7	Connect battery cable W030-P1 to connector J1 on Battery Box 1A8.
8	Apply facility power to ACU cabinet.

Table 2.5.7. UPS Fault Isolation (62828-90338-10 or 62828-90338-20)

Step	Symptom	Checks/Corrective Actions
1	UPS will not start.	Line cord is not connected. Connect line cord. UPS power switch is OFF. Turn switch ON. Wall socket is dead. Test wall socket. Nominal input voltage is too high or too low for voltage setting. DIP Switch Settings (UPS 62828-90338-10 only) Voltage / S1 / S2 127 / ON / OFF 120 / OFF / OFF (Default) 110 / OFF / ON Using multimeter, check input voltage and set DIP switches (UPS 62828-90338-10 only) properly in accordance with the above table. Battery fuse or circuit is open. Turn UPS power switch to OFF. Replace battery fuse or set circuit breaker to ON. Turn UPS power switch to ON.
2	Alarm continues after ALARM SILENCE button is pushed.	Overheat condition likely. On UPS, set power switch to off position. Inspect inside of ACU cabinet to ensure proper ventilation around UPS and that ACU blower is operating. Replace if necessary. Allow UPS to cool. Set power switch to on position. If UPS fails to turn on and alarm continues, set UPS power switch to off position and proceed to step 3.
3	With UPS cool, ALARM continues when facility power is applied to ACU. UPS does not output power.	Ensure that connector P1 is securely attached to UPS. Attempt to operate UPS again by setting UPS power switch to on position.
4	Battery service LED is red.	Replace batteries BT1 through BT4. If problem persists, replace UPS.
5	Top LED above load symbol is solid red.	Determine if load(s) is defective or too many loads are connected to the UPS. Overload condition because of excessive current.
6	All LED's above load symbol are on.	High dc charging voltage. Turn UPS off and disconnect all loads connected to UPS (modem power supply, ACU DC#1, ACU DC #2, GTA Radio, and Codex modem). Connect loads one at a time back into UPS and turn power back on after each one is plugged in until problem returns. If problem persists, remove and replace UPS.
7	Red LED (top or bottom) above ac input voltage symbol is lit.	Line voltage is either too high or too low. UPS in battery operation. Correct input voltage if possible or be prepared to lose power to load in approximately 2 to 5 minutes after impending low battery LED turns on.

Table 2.5.7. UPS Fault Isolation (62828-90338-10 or 62828-90338-20) - CONT $

Step	Symptom	Checks/Corrective Actions	
8	Red LED (top or bottom) above ac input symbol is flashing.	Line voltage has returned to normal, but RESET was not pushed. Wait until power returns to normal, then press RESET.	$ $ $

2.5.3.3 **VME Card Rack Check**. The ACU VME cards page displays overall status of the ACU card rack boards. The ASOS is configured with redundant hardware for increased system availability. The technician must examine the maintenance log periodically to replace redundant faulty units to reduce the possibility of redundant malfunctions. When a single board is identified as a faulty FRU, it must be replaced. Failure of all or multiple boards indicates that a failure on any board tied to VMEbus could exist. This is a catastrophic failure and requires the technician to isolate the malfunctioning board through board removal and replacement. Table 2.5.8 provides procedures to isolate the faulty FRU in the event of such a failure.

Table 2.5.8. Card Rack Assembly Fault Isolation Procedures

Step	Procedure
1	Remove power from system by setting UPS POWER switch to OFF (0) position and remove facility power from ACU cabinet. Visually inspect both front and rear of Card Rack Assembly 1A2 for damage, loose power connections, etc.
2	**NOTE** Reference paragraph 2.5.4 for the proper removal and installation procedures for the card rack circuit boards. Refer to paragraph 2.5.8 for proper jumper settings. Remove CPU B (1A2A2) from card rack. At the rear of card rack, install jumpers across A2-IACK (slot 2, row A, pins 21 and 22).
3	Apply facility power to ACU cabinet and set UPS POWER switch to ON (1) position. If system initializes properly, CPU B is suspect. Verify jumpers on board and reinstall to confirm board is bad. If system does not initialize properly, proceed to step 4.
4	Replace CPU A (1A2A1). Apply facility power to ACU cabinet and set UPS POWER switch to ON (1) position. If system initializes properly, CPU A is suspect.Verify jumpers on board and reinstall to confirm board is bad. If system does not initialize properly, proceed to step 5.
5	Replace Memory Board 1A2A3. Apply facility power to ACU cabinet and set UPS POWER switch to ON (1) position. If system initializes properly, Memory Board 1A2A3 is suspect. Remove J22 on suspect board for 30 seconds and reinstall jumper. Verify jumpers on board and reinstall to confirm board is bad. If system does not initialize properly, proceed to step 6.
6	One at a time, replace each SIO board in slots A4 through A21 and apply power to system. If system initializes, board most recently replaced is suspect. Verify jumpers are set correctly on suspect SIO and reinstall to confirm board is bad. If system fails to initialize, card rack itself is bad or multiple failures exist.

2.5.3.4 **ACU/DCP Communication System Checks**. The communication link between the ACU and the DCP can be either via rf modems or line drivers. For Class II systems, redundant hardware is used to increase system availability. The ACU CST continually monitors the status of the communication link between the ACU and the DCP. When the ACU is requesting sensor weather data from the DCP, it makes up to three attempts to communicate before logging a failure. For example, if the DCP does not respond to the first request, the ACU requests a second time. If the DCP still does not respond, the ACU requests a third time. If the DCP still fails to respond, a communications failure is noted and the requested data are lost. When the ACU is requesting other types of data (DCP CST results, sensor CST results, etc), only one request is made. If the DCP fails to respond, a failure is logged and no retry is made. The status of the link is reported on the ACU/DCP COMMS page at the OID. Also, when malfunctions are detected, error messages are printed on the printer and entered into the maintenance log. The following paragraphs describe checks of the ACU/DCP communications link.

2.5.3.4.1 **RF Communications**. In the Class II system, the primary (A or B) rf modem in the ACU maintains communication with the primary CPU/rf modem set (A or B) in the DCP. Every minute, the ACU checks its secondary modem to ensure that it can communicate with the DCP. If the ACU primary or secondary rf modem cannot communicate with the DCP, then an error message is printed and entered into the maintenance log, and an F is indicated for the modem on the ACU/DCP COMMS page. Because these are not sensor weather data, no retries are made before logging the failure (as described above).

The ACU can determine the status of the current primary CPU/rf modem link in the DCP and display this status on the ACU/DCP COMMS page on the OID. However, because the DCP's secondary link is not in use, the ACU cannot determine its status. As such, it is normal for the ACU/DCP COMMS status page to indicate P (pass) for the primary DCP link and * (not yet tested) for the secondary link. If the current DCP primary link fails, the DCP will automatically reset and the other link becomes the new primary link (see below). In this case, an ACU/DCP COMMS FAILURE message is entered in the maintenance log and the failure of the first link is noted on the ACU/DCP COMMS page. The status for the new primary link will be shown as P on the ACU/DCP COMMS page (assuming that the new link is operational).

ACU/DCP communications are half-duplex (one way at a time). The ACU polls the DCP for data, and the DCP responds. The DCP never initiates a communication. In the event that the DCP does not receive any ACU communications for a period of 2 minutes and 40 seconds, the DCP resets itself. When this occurs, the former secondary CPU initializes itself as the new primary CPU. When this CPU receives a synchronization message from the ACU (transmitted once per minute at second #59), it sends a message to the ACU that it has switched systems and reset. A message DCP # ___ HAS RESET TO THE BOOT PROMS is printed on the printer and is entered into the maintenance log. When the DCP receives the next synchronization message from the ACU, the DCP completes its initialization and begins normal operation with the new primary CPU/rf modem set.

In a configuration with more than one DCP, the ACU examines the status of all ACU/DCP links in identifying the source of the failure. That is, a loss of communications with all DCP's indicates that the problem is in the ACU. A loss of communications with a single DCP in the multiple configuration indicates that the fault lies in the failing DCP.

When a complete communication breakdown occurs in a single DCP system, the technician must determine whether the failure is in the ACU or the DCP. This is most easily accomplished using an in-line rf power meter to determine if the ACU and the DCP are transmitting from their respective rf modems. Because the DCP will not transmit anything unless it first receives an inquiry from the ACU, the ACU transmissions should be checked first.

Table 2.5.9 provides a list of ACU/DCP communication symptoms and references the technician to additional procedures that may be used to isolate rf system faults. Procedures are provided for both Class I and Class II ACU's and DCP's.

2.5.3.4.2 **Line Driver Communications**. For a line driver communications link, the system performs the same checks and issues the same error messages. The operation of the ACU/DCP COMMS page is the same. Because there are no rf antennas in a line driver system, the technician should carefully check all connections for the ACU-DCP cable before replacing equipment in either cabinet.

NOTE

Normally, a system built with UDS D19.2 line drivers continues to operate with the line drivers until sufficient spares can no longer be obtained. When this occurs, the entire site (ACU and DCP) must be modified to operate with Motorola DDS/MR64 line drivers. Two line drivers are required to update a Class I system. Four line drivers are required to upgrade a Class II system. All UDS line drivers removed from a system must be returned to the National Reconditioning Center.

When a problem is suspected with ACU or DCP line drivers, the technician should make the following checks of the line drivers.

a. Ensure that power is applied to the line driver. If not, determine reason for power interruption to line driver.

b. Check for proper connection of RS-232 and telephone cables to line driver.

c. For the D19.2 line drivers perform the following:

  (1) Ensure that front panel switch on each line driver is in DATA position.

  (2) Ensure that TM indicator on front panel of line driver is not illuminated or blinking. If TM indicator is on or blinking perform the following:

    (a) Ensure that all ACU and DCP line driver rotary switches are in DATA position.

    (b) Disconnect RS-232 cable and telephone cable from line driver.

    (c) Temporarily remove power from line driver and reapply power (in ACU, remove it from modem rack and then insert it).

    (d) If indicator does not extinguish, replace line driver. If problem is not corrected, replace associated line driver in other cabinet.

d. For the DDS/MR64 line drivers perform the following:

  (1) Ensure that “ERROR” is not displayed on each line driver LCD. If LCD displays “ERROR” perform the following:

    (a) Disconnect RS-232 cable and telephone cable from line driver.

(b) Temporarily remove power from line driver and reapply power (in ACU, remove it from modem rack and then insert it).

(c) If indicator does not extinguish, refer to paragraph 2.5.3.4 and verify line driver configuration.

(d) If "ERROR" is still displayed on LCD, replace line driver. If problem is not corrected, replace associated line driver in other cabinet.

Table 2.5.9. RF Failure Symptoms

Symptom	Corrective Action
ACU loses communication with all DCP's in multiple-DCP system.	a. Check ACU rf system: Table 2.5.10 (Class II) Table 2.5.11 (Class I) b. Replace ACU antenna.
ACU loses communication with one DCP in a multiple-DCP system.	a. Check DCP rf system: Table 2.5.12 (Class II) Table 2.5.13 (Class I) b. Replace DCP antenna.
ACU loses communication with DCP in single-DCP system.	a. Check ACU rf system: Table 2.5.10 (Class II) Table 2.5.11 (Class I) b. Check DCP rf system: Table 2.5.12 (Class II) Table 2.5.13 (Class I) c. Replace DCP antenna. d. Replace ACU antenna.

Table 2.5.10. ACU RF Communication Checkout Class II

Step	Test	Corrective Action
NOTE This procedure disables one ACU rf modem (A or B) while testing the other. This procedure must be performed twice (once with only rf modem A enabled and once with rf modem B enabled) to fully test the ACU communication systems. Throughout the procedure, inspect all applicable rf cables and connections as possible source of failure.		
1	Using an rf scanner, select site transmit frequency. Adjust squelch and volume and verify that polling tone is generated by the ACU radio.	If ACU is transmitting, check DCP communications. Refer to table 2.5.12.
2	At OID (from the 1-minute display), press REVUE-SITE-CONFIG-COMMS keys to select communications configuration (ACU serial communication) page (Figure 1.3.41).	

Table 2.5.10. ACU RF Communication Checkout Class II -CONT

Step	Test	Corrective Action
3	Using CHANGE function, disable one of the two ACU-DCP links (A or B).	
4	At ACU I/O Panel Assembly 1A9, install an in-line rf power meter between the ACU antenna cable and ANTENNA output connector J39.	
5	Watch the rf power meter to ensure that the ACU transmits at least once per minute (synchronization messages are sent out during second 59 each minute).	If ACU is not transmitting, proceed with step 6. If ACU is transmitting at least once per minute, reconnect cable to ANTENNA connector. Then insert power meter in line at connector at base of ACU antenna. If transmissions are not detecTable at the antenna, then problem is in cabling from ACU to antenna. If transmissions are still detected at the antenna, then problem is in ACU antenna or in DCP.
6	Remove rf power meter and reconnect antenna cable to ANTENNA connector J39.	
7	At ACU RF/Pressure Mounting Shelf 1A6, install rf power meter between output of rf modem switch 1A6S1 and output cable W012.	
NOTE Output coaxial cable is an FRU and connections should be checked before replacing other FRU's.		
8	Watch the rf power meter to ensure that the ACU transmits at least once per minute.	If ACU is transmitting at least once per minute, check output coaxial cable and replace rf surge protector 1A9J39 on I/O Panel Assembly 1A9. If ACU is not transmitting, proceed with step 9.
9	Remove rf power meter and reconnect cable to rf modem switch S1.	
10	Install rf power meter in line at the output BNC connector of currently enabled rf modem. Ensure that modem transmits at least once per minute.	If modem is not transmitting, continue with step 11. If modem is transmitting, proceed to step 12.
11	Insert RS-232 tester in line at connector J1 of enabled rf modem. Verify activity on TxD, RTS, and CTS signals at input to rf modem.	If RTS signal is not active at least once per minute, replace SIO board corresponding to enabled modem (SIO #2 for modem A, SIO #3 for modem B). If RTS is active and CTS is not, replace failing rf modem. If RTS and CTS are active, but TxD signal is not active at least once per minute, replace SIO board corresponding to failing modem. If RTS, CTS, and TxD signals are all active, replace failing modem.

Table 2.5.10. ACU RF Communication Checkout Class II -CONT

Step	Test	Corrective Action
12	Using DMM, ensure correct logic level between rf modem switch terminals 1A6S1-TTL and S1-COM as follows: Enabled Modem — S1-TTL A — Logic 0 (0.0 to 1.0 vdc) B — Logic 1 (3.0 to 5.0 vdc)	If voltage is not correct for enabled radio, replace DIO board 1A2A15. **NOTE** Coaxial cable at output of rf modem is an FRU and connection should be checked. Check coaxial cable between rf modem and rf modem switch. If voltage is correct and cable looks good, replace rf modem switch 1A6S1.
13	Remove all test equipment and reconnect all cables.	
14	At ACU serial communications page of OID, use CHANGE function to enable the ACU-DCP link (A or B) previously disabled.	

Table 2.5.11. ACU RF Communication Checkout Class I

Step	Test	Corrective Action
NOTE Throughout the procedure, inspect all applicable rf cables and connections as possible source of failure.		
1	Using an rf scanner, select site transmit frequency. Adjust squelch and volume and verify that polling tone is generated by the ACU radio.	If ACU is transmitting, check DCP communica-tions. Refer to table 2.5.13.
2	At ACU I/O Panel Assembly 1A9, install an in-line rf power meter between the ACU antenna cable and ANTENNA output connector J39.	
3	Watch the rf power meter to ensure that the ACU transmits messages at least once per minute (synchronization messages are sent out during second 59 each minute).	If ACU is not transmitting, proceed with step 4. If ACU is transmitting at least once per minute, reconnect cable to ANTENNA connector. Then insert power meter in line at connector at base of ACU antenna. If transmissions are not detecTable at the antenna, then problem is in cabling from ACU to antenna. If transmissions are still detected at the antenna, then problem is in ACU antenna or in DCP.
4	Remove rf power meter and reconnect antenna cable to ANTENNA connector J39.	
5	At ACU RF/Pressure Mounting Shelf 1A6, install rf power meter between output BNC connector of RF Modem 1A6A4 and output cable W032.	
NOTE Output coaxial cable is an FRU and connections should be checked before replacing other FRU's.		

Table 2.5.11. ACU RF Communication Checkout Class I -CONT

Step	Test	Corrective Action
6	Watch the rf power meter to ensure that the rf modem transmits at least once per minute.	If the rf modem is transmitting at least once per minute, check coaxial cable, then replace rf surge protector 1A9J39 on I/O Panel Assembly 1A9. If rf modem is not transmitting, proceed with step 7.
7	Insert RS-232 tester in line at connector J1 of RF Modem 1A6A4. Verify activity on TxD, RTS, and CTS signals at input to rf modem.	If RTS signal is not active at least once per minute, replace SIO board 2. If RTS is active and CTS is not, replace failing rf modem. If RTS and CTS are active, but TxD signal is not active at least once per minute, replace SIO board 2. If RTS, CTS, and TxD signals are all active, replace RF Modem 1A6A4.

Table 2.5.12. DCP RF Communication Checkout Class II

Step	Test	Corrective Action
	NOTE This procedure tests one rf link (A or B) at a time. This procedure must be performed twice (once for link A and once for link B) to fully test the DCP communications system. Examine PASS indicators on CPU's A and B to determine which CPU/rf modem link is currently primary (PASS indicator is illuminated steadily on primary). Throughout this procedure, the technician may have to manually reset the DCP to maintain primary assignment on link being tested. The DCP is manually reset by pressing the RESET switch on the CURRENT primary CPU. For example, the technician can test rf modem B when the A CPU/modem is currently primary by resetting the A CPU, which causes the B CPU to take over primary assignment. RF modem B may then be tested. Throughout the procedure, inspect all applicable rf cables and connections as possible source of failure.	
1	Select link (A or B) to be tested first. If necessary, reset DCP to toggle primary assignment to selected link under test.	
2	Examine PASS indicator on opposite (secondary) CPU. This indicator should flash after DCP receives synchronization message from ACU (may have to wait up to 1 minute for this to occur).	If PASS LED on secondary CPU flashes, link under test is receiving sync message. Proceed to step 8. If PASS LED does not flash (and DCP resets after 2 minutes and 40 seconds), continue with step 3.
3	On selected rf modem under test, insert RS-232 tester in line with cable from CPU and modem connector J1.	
4	Ensure that selected link under test is still primary (press CPU RESET if necessary).	
	NOTE Cable between CPU and rf modem is an FRU and should be checked before replacing other FRU's.	

Table 2.5.12. DCP RF Communication Checkout Class II -CONT

Step	Test	Corrective Action
5	5 Verify activity of RxD signal on RS-232 tester at least once per minute (ACU sends synchronization messages during second 59 each minute).	If RxD signal is active, check cable between CPU and rf modem under test, then replace CPU. If RxD signal is not active, continue with step 6.
6	Using DMM, ensure correct logic level between rf modem switch terminals A1A5S1-TTL (white wire) and S1-COM (black wire) as follows: Link Under Test — S1-TTL A — Logic 0 (0.0 to1.0 vdc) B — Logic 1 (3.0 to5.0 vdc)	If voltage is not correct for current primary link, replace DIO Board A1A2A12. If voltage is correct, proceed to step 7.
7	Press RESET to toggle primary assignment to opposite CPU/rf modem. Wait to see if ACU/DCP communications resume on opposite link.	If communications resume, fault is due to one of the following: a. Cable between first rf modem and rf modem switch (check connections). b. First rf modem c. RF modem switch If communications do not resume, fault is due to one of the following: a. RF modem switch b. Cabling from DCP antenna to rf modem switch c. RF surge protector A1A3J8 d. Both radios failed (or cables between radios and rf modem switch) e. DCP antenna f. ACU antenna
8	On selected rf modem under test, insert RS-232 tester in line with cable from CPU and modem connector J1.	

NOTE

Cable between CPU and rf modem is an FRU and should be checked before replacing other FRU's.

Table 2.5.12. DCP RF Communication Checkout Class II -CONT

Step	Test	Corrective Action
9	Ensure that selected link is still primary, and verify activity on RTS, CTS, and TxD signals on RS-232 tester (at least once per minute).	If RTS signal is not active, replace corresponding CPU board. If RTS is active but CTS is not, replace rf modem. If RTS and CTS are active but TxD is not, replace corresponding CPU.
10	At output of same rf modem, connect an in-line rf power meter between output BNC connector and output cable.	
11	Ensure that selected link under test is still primary (press CPU RESET if necessary).	
12	Watch the rf power meter to ensure that the rf modem transmits messages at least once per minute.	If rf modem is transmitting, continue with step 13. If rf modem is not transmitting, replace rf modem.
13	Remove rf power meter and reconnect modem output cable.	
14	Install rf power meter between output of rf modem switch A1AS1 and output cable W013.	
15	Ensure that selected link under test is still primary (press CPU RESET if necessary).	
	NOTE Coaxial cable between rf modem and switch is an FRU and should be checked before replacing other FRU's.	
16	Watch the rf power meter and ensure that system transmits from rf modem switch at least once per minute.	If transmissions are indicated, continue with step 17. If transmissions are not indicated, check coaxial cable, then replace rf modem switch.
17	Remove rf power meter and reconnect rf switch output cable.	
18	At Faraday Box A1A3, install rf power meter between output of rf surge suppressor A3J8 and output cable W010.	
19	Ensure that selected link under test is still primary (press CPU RESET if necessary).	
	NOTE Coaxial cable between rf modem switch and surge suppressor is an FRU and should be checked before replacing other FRU's.	
20	Watch the rf power meter and ensure that system transmits from the rf surge suppressor at least once per minute.	If transmissions are indicated, continue with step 21. If transmissions are not indicated, replace rf surge suppressor.
21	Remove rf power meter and reconnect cable to surge suppressor.	
22	Insert power meter in line at connector at base of DCP antenna.	

Table 2.5.12. DCP RF Communication Checkout Class II -CONT

Step	Test	Corrective Action
23	Ensure that selected link under test is still primary (press CPU RESET if necessary).	
NOTE Cables between DCP rf surge suppressor and DCP antenna are FRU's and should be checked before replacing other FRU's.		
24	Watch the rf power meter and ensure that system transmits to the antenna at least once per minute.	If transmissions are not indicated at the base of the antenna, then problem is in cabling from surge suppressor to antenna. If transmissions are indicated, then problem is in the DCP antenna or the ACU antenna.

Table 2.5.13. DCP RF Communication Checkout Class I

Step	Test	Corrective Action
NOTE Throughout the procedure, inspect all applicable rf cables and connections as possible source of failure.		
1	Examine PASS indicator on CPU A1A2A1 to ensure that it is steadily illuminated.	If PASS indicator is not illuminated steadily, press RESET switch on the CPU. If CPU does not initialize, replace CPU.
2	On rf modem A1A5A1, insert RS-232 tester in line with cable from CPU and modem connector J2.	
3	Verify activity of RxD signal on RS-232 tester at least twice per minute.	If RxD signal is active, proceed to step 4. If RxD signal is not active, fault is due to one of the following: a. Cabling/connections from DCP antenna to rf modem b. RF surge protector A3J8 c. RF Modem A1A5A1 d. DCP antenna e. ACU antenna
NOTE Cable between CPU and rf modem is an FRU and should be checked before replacing other FRU's.		
4	Verify activity on RTS, CTS, and TxD signals on RS-232 tester (at least twice per minute).	If RTS signal is not active, replace CPU A1A2A1. If RTS is active, but CTS is not, replace rf modem. If RTS and CTS are active, but TxD is not, replace CPU.
5	At output of rf modem, connect an in-line rf power meter between output BNC connector and output cable.	

Table 2.5.13. DCP RF Communication Checkout Class I -CONT

Step	Test	Corrective Action
6	Watch the rf power meter to ensure that the rf modem transmits messages at least once per minute.	If rf modem is transmitting, continue with step 7. If rf modem is not transmitting, replace rf modem.
7	Remove rf power meter and reconnect modem output cable.	
8	At Faraday Box A1A3, install rf power meter between output of rf surge suppressor A3J8 and output cable W010.	
NOTE Coaxial cable between rf modem and surge suppressor is an FRU and should be checked before replacing other FRU's.		
9	Watch the rf power meter and ensure that system transmits from the rf surge suppressor at least twice per minute.	If transmissions are indicated, continue with step 11. If transmissions are not indicated, replace rf surge suppressor.
10	Remove rf power meter and reconnect cable to surge suppressor.	
11	Insert power meter in line at connector at base of DCP antenna.	
NOTE Cables between DCP rf surge suppressor and DCP antenna are FRU's and should be checked before replacing other FRU's.		
12	Watch the rf power meter and ensure that system transmits to the antenna at least twice per minute.	If transmissions are not indicated at the base of the antenna, then problem is in cabling from surge suppressor to antenna. If transmissions are indicated, then problem is in the DCP antenna or the ACU antenna.

2.5.3.5 **Serial I/O Board Checks**. The ACU continuous self-test (CST) checks the operation of the SIO boards once per minute. A LOOPBACK test and a TRANSMIT ERROR test is performed on each of the four ports of each SIO board. When a failure is discovered, an error message is printed on the printer and entered into the maintenance log. The error message identifies the SIO board and port, the type of test failed, and gives instructions to replace the board. Also, an F indication is displayed on the appropriate ACU SIO page at the OID. For this type of SIO board failure, the technician need only replace the identified board to repair the system.

In addition to the definitive SIO board failures described above, general communications failures may occur between the CPU and some device (peripheral, local sensor, or user). These failures may be the fault of an SIO board, but they may also be the fault of the device, or equipment in between the SIO and the device (e.g., telephone modems, cable connections, etc). Often the CPU itself may detect such communication failures. In such case, a general error message, such as PRIMARY OID COMMUNICATION FAILURE or AFOS PHONE PORT DOWN is printed on the printer and entered into the maintenance log.

When such general loss of communication occurs, the technician should first access the ACU serial communications page on the OID and determine to which SIO port the failing device is assigned. The ACU functional diagrams and the descriptions of Section IV of this Chapter should be referenced to determine all of the equipment cables between the corresponding SIO board and the device which lost communications. The technician should then inspect all cable connections associated with the failing port.
If all cable connections appear to be good and the port is still not operating, an RS-232 test box can be used

to check communication between the SIO port and the next device in line with it (e.g. modem, printer, OID, etc). The RS-232 test box is inserted between the connector for the failing SIO Port and the device which lost communications.

When using the RS-232 test box, the technician must verify the activity of the applicable RS-232 signals. In all cases, the transmit data (TxD) and receive data (RxD) signals must be active to indicate correct communication. Depending on the device being investigated, two handshaking signals may also be required: request to send (RTS) and clear to send (CTS). In order to determine whether the RTS and CTS signals should be present for a given application, the technician must access the ACU serial communications page at the OID, select the port that is being investigated, and look at the HANDSHAKING field. This field will indicate either NONE or CTS/RTS. If CTS/RTS is indicated, the technician must ensure that these signals are present on the RS-232 tester. If NONE is indicated, the technician need only verify the TxD and RxD signals.

2.5.3.6 **Diagnostics**. The ACU CST runs continuously in the background of the ASOS operating software as described in Chapter 1. The CST completes a check of the system every minute with the exception of the modem rack. The CST checks each of the individual telephone modems in the modem rack once every 7 minutes, as long as the modems are not busy (testing a busy modem would disrupt communication). The test data received via the diagnostic program are displayed on the technician interface display pages, which are described in Chapter 1, Section III. If the CST detects a failure, the unit is tagged as faulty and a message is entered into the maintenance log. Where redundant hardware is present (i.e., CPU's, rf modems, pressure sensors, or line drivers), the faulty FRU is bypassed via software and the failure is entered into the maintenance log and a maintenance flag ($) is added to the next METAR.

2.5.4 REMOVAL AND INSTALLATION PROCEDURES

2.5.4.1 **General**. The following chart is provided to facilitate safe and efficient removal of assemblies found to be defective through performance of the preventive maintenance and troubleshooting procedures. Procedures provided for replacement of duplicate assemblies, such as the VME cards and dc power supplies, are sufficient for maintenance of all units and are described for one assembly only. Only those assemblies and subassemblies whose replacement procedures are not obvious have been provided in this chapter. The removal/installation sequence of attaching hardware (screws, washers, nuts, etc) is reflected by the relative order of their presentation in the applicable step.

Unit to Be Replaced	Removal/Installation/ Table reference
Modem/line driver rack power supply	2.5.14
RF modem	2.5.15
RF switch	2.5.16
VME card rack circuit board	2.5.17
Modem/line driver rack circuit board	2.5.18
Power supply assembly filter board	2.5.19
Power supply assembly transformer	2.5.20
Power supply assembly fuse	2.5.21
Power supply assembly RS-232 board	2.5.22
Power supply assembly inverter board	2.5.23
Power supply assembly status panel	2.5.24
Power supply assembly OUTPUT POWER switch	2.5.25
Power supply assembly circuit breaker	2.5.26

Unit to Be Replaced	Removal/Installation/ Table reference
DC power supply	2.5.27
DC power supply fan connector board	2.5.28
Blower	2.5.29
Battery box and battery	2.5.30
Uninterruptible power supply	2.5.31
ACU tie-downs	2.5.32
Pressure sensor	See Chapter 8
GTA Radio	See Chapter 12
Codex modem	See Chapter 13

2.5.4.2 **Orienting DB-25 Adapters**. On I/O Panel 1A9, DB-25 adapters J22 through J31 and J42 (p/n 62828-90148-1) are combination EMI filter/surge suppressor devices. The manufacturer of these adapters places its part number label on the surge suppressor end of the device. When installing a new DB-25 adapter, the maintenance technician must orient the new adapter so that its surge suppressor (label) end faces the outside of the ACU cabinet (EMI end is inside cabinet).

Table 2.5.14. Modem/Line Driver Rack Power Supply Removal and Installation

Step	Procedure
	REMOVAL
	Tools required: Small flat-tipped screwdriver **WARNING** Death or severe injury may result if power is not removed from ACU prior to maintenance activities. Ensure that UPS POWER switch is set to 0 (off) position and facility power is removed from ACU.
1	Set UPS POWER switch to 0 (off) position.
2	Remove facility power from ACU cabinet.
3	Disconnect ac power cord from rear of modem/line driver rack.
4	Using small flat-tipped screwdriver, loosen power supply holding screw on rear of modem/line driver rack.
5	Lower modem/line driver rack hinged front panel.
6	**CAUTION** Power supply module is heavy. Grasp handle with one hand while supporting bottom of power supply module with other hand. Grasp power supply handle and slide out of modem/line driver rack.
	INSTALLATION
	Tools required: Small flat-tipped screwdriver **WARNING** Death or severe injury may result if power is not removed from ACU prior to maintenance activities. Ensure that UPS POWER switch is set to 0 (off) position and facility power is removed from ACU.
1	Verify that UPS POWER switch is set to 0 (off) position.

Table 2.5.14. Modem/Line Driver Rack Power Supply Removal and Installation - CONT

Step	Procedure
2	Verify that facility power is removed from ACU cabinet.
3	Position power supply in guide strips and slide into modem/line driver rack.
4	Close hinged front panel.
5	Using small flat-tipped screwdriver, tighten power supply holding screw on rear of modem/line driver rack.
6	Connect ac power cord to modem/line driver rack.
7	Apply facility power to ACU cabinet.
8	Set UPS POWER switch to 1 (on) position.

Table 2.5.15. RF Modem Removal and Installation

Step	Procedure
REMOVAL	
	Tools required: No. 1 Phillips screwdriver No. 2 Phillips screwdriver Small flat-tipped screwdriver **<u>CAUTION</u>** Damage to rf modems may result if power is not removed from ACU prior to removal or installation. Ensure that UPS POWER switch is set to 0 (off) position and facility power is removed from ACU. **NOTE** Refer to paragraph 2.4.3.4.2 for replacement rf modem information.
1	Set UPS POWER switch to 0 (off) position.
2	Remove facility power from ACU cabinet.
3	**WARNING** Pressure sensors in RF/Pressure Mounting Shelf 1A6 are safety-critical devices. Pressure sensors may output erroneous readings if damaged or if plastic vent tubing is damaged or obstructed. Throughout this procedure, exercise caution to avoid damage to pressure sensors and vent tubing. Using No. 2 Phillips screwdriver, remove two screws, lockwashers, and flat washers securing rf/pressure mounting shelf slide mount to frame. Slide mounting shelf out until slides lock in fully extended position.
4	Using figure 2.1.7, locate rf modem to be removed.
5	At rf modem to be removed, use small flat-tipped screwdriver to remove D connectors (two for AAI model, one for Motorola and Johnson Data models) from rf modem.
6	Remove BNC connector from modem rf output connector. If modem being removed is Johnson Data model then remove SMAM-to-BNCF adapter.

Table 2.5.15. RF Modem Removal and Installation - CONT

Step	Procedure
7	Using No. 1 Phillips screwdriver, remove two screws, lockwashers, and flat washers from the bottom of mounting shelf that secure rf modem to shelf. Remove rf modem from mounting shelf. **NOTE** When an AAI modem (62828-90013-XX) fails, and a replacement AAI modem is not available, ASN S100-FMK18886 must be ordered to replace the modem with the Motorola modem (62828-90315-XX). AAI modems cannot be replaced with the Johnson Data modems (62828-40506-X). When a Motorola modem (62828-90315-XX) fails and spare Motorola modems are not available, a Johnson Data modem (62828-40506-X), an adapter cable (62828-42110-10), and a SMAM-to-BNCF adapter must be ordered to replace the failing rf modem.
INSTALLATION	
	Tools required: No. 1 Phillips screwdriver No. 2 Phillips screwdriver Small flat-tipped screwdriver **CAUTION** Damage to rf modems may result if power is not removed from ACU prior to removal or installation. Ensure that UPS POWER switch is set to 0 (off) position and facility power is removed from ACU.
1	Verify that UPS POWER switch is set to 0 (off) position.
2	Verify that facility power is removed from ACU cabinet.
2.1	If rf modem to be installed is a Johnson Data model, ensure that bottom mounting plate is removed from the modem. If necessary, remove bottom mounting plate using a No. 2 Phillips screwdriver and discard.
3	**WARNING** Pressure sensors in RF/Pressure Mounting Shelf 1A6 are safety-critical devices. Pressure sensors may output erroneous readings if damaged or if plastic vent tubing is damaged or obstructed. Throughout this procedure, exercise caution to avoid damage to pressure sensors and vent tubing. Using No. 2 Phillips screwdriver, remove two screws, lockwashers, and flat washers securing rf/pressure mounting shelf slide mount to frame. Slide mounting shelf out until slides lock in fully extended position.
4	Position replacement rf modem on mounting shelf and use No. 1 Phillips screwdriver to install two screws, lockwashers, and flat washers securing rf modem to mounting shelf. Screws are installed from bottom side of mounting shelf.
4.1	If replacement modem is a Johnson Data modem (62828-40506-X), install adapter cable (62828-42110-10) and a SMAM-to-BNCF adapter to rf modem.
5	Install BNC connector to modem rf output connector (or to SMAM-to-BNCF adapter).
6	Using small flat-tipped screwdriver, install and secure power/signal D connectors to rf modem.

Table 2.5.15. RF Modem Removal and Installation - CONT

Step	Procedure
7	**WARNING** Pressure sensors in RF/Pressure Mounting Shelf 1A6 may output erroneous values if plastic vent tubing binds or crimps when shelf is closed. Exercise caution when closing shelf to prevent damage to pressure sensor vent tubing. While taking care not to damage or crimp pressure sensor vent tubing, release mounting shelf slide locks and push mounting shelf back into cabinet. After closing shelf, ensure that pressure sensor tubing is properly connected to sensor and to PRESSURE VENT on I/O Panel Assembly 1A9 and is not damaged or crimped.
8	Using No. 2 Phillips screwdriver, install two screws, lockwashers, and flat washers securing mounting shelf to frame.
9	Apply facility power to ACU cabinet.
10	Set UPS POWER switch to 1 (on) position.

Table 2.5.16. RF Switch Removal and Installation

Step	Procedure
REMOVAL	
	Tools required: No. 1 Phillips screwdriver No. 2 Phillips screwdriver **CAUTION** Equipment damage may occur if power is not removed from ACU prior to removal or installation. Ensure that UPS POWER switch is set to 0 (off) position and facility power is removed.
1	Set UPS POWER switch to 0 (off) position.
2	Remove facility power from ACU cabinet.
3	**WARNING** Pressure sensors in RF/Pressure Mounting Shelf 1A6 are safety-critical devices. Pressure sensors may output erroneous readings if damaged or if plastic vent tubing is damaged or obstructed. Throughout this procedure, exercise caution to avoid damage to pressure sensors and vent tubing. Using No. 2 Phillips screwdriver, remove two screws, lockwashers, and flat washers securing rf/pressure mounting shelf slide mount to frame.
4	At rf switch, tag and remove three BNC connectors.
5	Disconnect rf switch in-line connector (A6-P1) from ACU harness connector P92.
6	Using No. 1 Phillips screwdriver, remove two screws, flat washers, and lockwashers securing rf switch to standoffs. Remove rf switch.

Table 2.5.16. RF Switch Removal and Installation - CONT

Step	Procedure
	INSTALLATION
	Tools required: No. 1 Phillips screwdriver No. 2 Phillips screwdriver Large flat-tipped screwdriver **CAUTION** Equipment damage may occur if power is not removed from ACU prior to removal or installation. Ensure that UPS POWER switch is set to 0 (off) position and facility power is removed.
1	Verify that UPS POWER switch is set to 0 (off) position.
2	Verify that facility power is removed from ACU cabinet.
3	**WARNING** Pressure sensors in RF/Pressure Mounting Shelf 1A6 are safety-critical devices. Pressure sensors may output erroneous readings if damaged or if plastic vent tubing is damaged or obstructed. Throughout this procedure, exercise caution to avoid damage to pressure sensors and vent tubing. Using No. 2 Phillips screwdriver, remove two screws, lockwashers, and flat washers securing rf/pressure mounting shelf slide mount to frame.
4	Position rf switch near standoffs at rear of rf/pressure mounting shelf.
5	Using No. 1 Phillips screwdriver, install two screws, flat washers, and lockwashers securing rf switch to standoffs.
6	Connect rf switch in-line connector (A6-P1) to ACU harness connector P92.
7	Using markers as a guide, install three BNC connectors on rf switch.
8	**WARNING** Pressure sensors in RF/Pressure Mounting Shelf 1A6 may output erroneous values if plastic vent tubing binds or crimps when shelf is closed. Exercise caution when closing shelf to prevent damage to pressure sensor vent tubing. While taking care not to damage or crimp pressure sensor vent tubing, release mounting shelf slide locks and push mounting shelf back into cabinet. After closing shelf, ensure that pressure sensor tubing is properly connected to sensor and to PRESSURE VENT on I/O Panel Assembly 1A9 and is not damaged or crimped.
9	Using No. 2 Phillips screwdriver, install two screws, lockwashers, and flat washers securing mounting shelf to frame.
10	Apply facility power to ACU cabinet.
11	Set UPS POWER switch to 1 (on) position.

Table 2.5.17. VME Card Rack Circuit Board Removal and Installation

Step	Procedure
REMOVAL	
	Tools required: Small flat-tipped screwdriver **CAUTION** Damage to equipment may result if power is not removed prior to removal or installation. Ensure that UPS POWER switch is set to 0 (off) position and facility power is removed. To avoid damage to circuit boards, use proper electrostatic discharge (ESD) handling procedures to include the use of a grounding strap when performing the following procedures.
1	Set UPS POWER switch to 0 (off) position.
2	Remove facility power from ACU cabinet.
3	Using figure 2.1.3, locate circuit board to be removed.
4	If removing Voice Processor Board 1A2A20 or Voice Recorder/Playback Board 1A2A21, disconnect cable from the front of the boards by exerting an outward force on the cable release tabs located at the top and bottom of the connector.
5	Using small flat-tipped screwdriver, loosen captive screws located at the top and bottom of the board.
6	**CAUTION** When removing a CPU board from the rack, support the board via the handles. Failure to support the board properly when it releases from the rear connector may result in the board hitting the bottom of the card rack. If the board is equipped with extractor handles, press handles in opposite directions to release the board. If the board does not have extractor handles, gently rock the board while exerting an outward pressure and remove board from the rack.
7	**CAUTION** Jumper J22 on ACU memory board must be disconnected before shipping or storing board. Failure to comply may result in discharge of battery. If board removed is ACU Memory Board A1A2A3, remove jumper J22 from board. Install jumper on one pin only of J22 for shipping or storage.
INSTALLATION	
	Tools required: Small flat-tipped screwdriver **CAUTION** Damage to equipment may result if power is not removed prior to removal or installation. Ensure that UPS POWER switch is set to 0 (off) position and facility power is removed. To avoid damage to circuit boards, use proper ESD handling procedures to include the use of a ground strap when performing the following procedures.
1	Verify that UPS POWER switch is set to 0 (off) position.
2	Verify that facility power is removed from ACU cabinet.

Table 2.5.17. VME Card Rack Circuit Board Removal and Installation -CONT

Step	Procedure
3	If board being installed is CPU A or B (1A2A1 or 1A2A2) or RS-232 SIO board #2 through #7 (1A2A6 through 1A2A12), conFigure board jumpers for slot into which it is being installed (paragraph 2.5.6).
4	**NOTE** Jumper J22 on ACU memory board must be properly installed to enable battery backup circuit. If board installed is ACU Memory Board 1A2A3, remove jumper clip from storage position (one pin) of J22 and install across both pins of J22.
5	Holding the board by the handles, position board with the component side to the right and carefully slide board into the card rack on its guides. Align board with the rear connector and press into place.
6	Using small flat-tipped screwdriver, tighten captive screws located at the top and the bottom of the board.
7	If installing Voice Processor Board 1A2A20 or Voice Recorder/Playback Board 1A2A21, connect cable attached to the front of the boards as follows: a. Position connector extraction tabs to their fully extended position. b. Locate cable keys and position keys to the right; install cable in the connector.
8	Apply facility power to ACU cabinet.
9	Set UPS POWER switch to 1 (on) position.

Table 2.5.18. Modem/Line Driver Rack Circuit Board Removal and Installation

Step	Procedure
REMOVAL	
	NOTE ACU power need not be turned off for a modem/ line driver circuit board interchange. This allows normal operation of ACU during removal and replacement.
1	Using figure 2.1.4, locate circuit board to be removed.
2	Lower modem/line driver rack hinged front panel.
3	Using the handle located at the middle of the board, gently rock board until free from the rear connector. Remove board.
INSTALLATION	
	NOTE ACU power need not be turned off for a modem/ line driver circuit board interchange. This allows normal operation of ACU during removal and replacement.
1	On circuit board being installed, verify that switch settings and jumper installations match those of previously removed board.
2	Position component side of the board to the right and align on the guides, then slide board into slot.
3	Ensure that edge connector of board is aligned with the rack connector, then apply enough pressure to set the board into the rack connector.
4	Close modem/line driver rack hinged front panel.

Table 2.5.19. Power Supply Assembly Filter Board Removal and Installation

Step	Procedure
REMOVAL	
	Tools required: No. 2 Phillips screwdriver **WARNING** Ensure that power is completely removed from UPS by performing the procedure in table 2.5.6. Death or severe injury may result if power is not completely removed from UPS prior to removing the cover in front of UPS components and performing maintenance on UPS subassemblies.
1	Remove power supply assembly cover in accordance with table 2.5.6.
2	At 1.5 KVA Filter Board 1A4A3, remove harness connectors from board connectors J7 and J10.
3	Tag and remove five single wires from 1.5 KVA Filter Board 1A4A3.
4	Using Phillips screwdriver, remove four screws, flat washers, and lockwashers securing 1.5 KVA Filter Board 1A4A3 to standoffs.
5	Remove filter board from power supply assembly.
INSTALLATION	
	Tools required: No. 2 Phillips screwdriver Ensure that power is completely removed from UPS by performing the procedure in table 2.5.6. Death or severe injury may result if power is not completely removed from UPS prior to removing the cover in front of UPS components and performing maintenance on UPS subassemblies.
1	Verify that power supply assembly cover is removed in accordance with table 2.5.6.
2	Position 1.5 KVA Filter Board 1A4A3 on standoffs with connectors J7 and J10 on bottom.
3	Using Phillips screwdriver, install four screws, flat washers, and lockwashers securing 1.5 KVA Filter Board 1A4A3 to standoffs.
4	Using tags as a guide, install five wires on 1.5 KVA Filter Board 1A4A3.
5	Install harness connectors on board connectors J7 and J10.
6	Install power supply assembly cover in accordance with table 2.5.6.

Table 2.5.20. Power Supply Assembly Transformer Removal and Installation

Step	Procedure
REMOVAL	
	Tools required: No. 2 Phillips screwdriver 3/8-inch nut driver **WARNING** Ensure that power is completely removed from UPS by performing the procedure in table 2.5.6. Death or severe injury may result if power is not completely removed from UPS prior to removing the cover in front of UPS components and performing maintenance on UPS subassemblies.
1	Remove power supply assembly cover in accordance with table 2.5.6.

Table 2.5.20. Power Supply Assembly Transformer Removal and Installation -CONT

Step	Procedure
2	At 1.5 KVA Inverter Board 1A4A4, tag and remove seven transformer wires with solderless (spade) connectors from spade connectors on inverter board.
3	Using 3/8-inch nut driver, tag and remove three transformer wires from standoffs on 1.5 KVA Inverter Board 1A4A4.
4	Using Phillips screwdriver, remove four screws and flat washers securing transformer to power supply assembly.
5	**WARNING** Transformer is heavy equipment (weighs approximately 45 pounds) and requires two-man or mechanical lift. Failure to comply may result in injury to personnel or damage to equipment. Carefully remove transformer from power supply assembly drawer.
INSTALLATION	
	Tools required: No. 2 Phillips screwdriver 3/8-inch nut driver **WARNING** Ensure that power is completely removed from UPS by performing the procedure in table 2.5.6. Death or severe injury may result if power is not completely removed from UPS prior to removing the cover in front of UPS components and performing maintenance on UPS subassemblies.
1	Verify that power supply assembly cover is removed in accordance with table 2.5.6.
2	**WARNING** Transformer is heavy equipment (weighs approximately 45 pounds) and requires two-man or mechanical lift. Failure to comply may result in injury to personnel or damage to equipment. Position transformer on power supply assembly with three heavy gauge wires on the right.
3	Using Phillips screwdriver, install four screws and flat washers securing transformer to power supply assembly.
4	Using 3/8-inch nut driver and tags as a guide, install three transformer wires to standoffs on 1.5 KVA Inverter Board 1A4A4.
5	On 1.5 KVA Inverter Board 1A4A4, using tags as a guide, install seven transformer wires to spade connectors on 1.5 KVA Inverter Board 1A4A4.
6	Install power supply assembly cover in accordance with table 2.5.6.

Table 2.5.21. Power Supply Assembly Fuse Removal and Installation

Step	Procedure
	REMOVAL
	Tools required: Fuse puller **WARNING** Ensure that power is completely removed from UPS by performing the procedure in table 2.5.6. Death or severe injury may result if power is not completely removed from UPS prior to removing the cover in front of UPS components and performing maintenance on UPS subassemblies.
1	Remove power supply assembly cover in accordance with table 2.5.6.
2	Using fuse puller, remove fuse F1 from fuse holder A4XF1.
	INSTALLATION
	WARNING Ensure that power is completely removed from UPS by performing the procedure in table 2.5.6. Death or severe injury may result if power is not completely removed from UPS prior to removing the cover in front of UPS components and performing maintenance on UPS subassemblies.
1	Verify that power supply assembly cover is removed in accordance with table 2.5.6.
2	Install replacement fuse F1 in fuse holder A4XF1.
3	Install power supply assembly cover in accordance with table 2.5.6.

Table 2.5.22. Power Supply Assembly RS-232 Board Removal and Installation

Step	Procedure
	REMOVAL
	Tools required: Small flat-tipped screwdriver 3/16-inch nut driver **WARNING** Ensure that power is completely removed from UPS by performing the procedure in table 2.5.6. Death or severe injury may result if power is not completely removed from UPS prior to removing the cover in front of UPS components and performing maintenance on UPS subassemblies.
1	Remove power supply assembly cover in accordance with table 2.5.6.
2	Disconnect RS-232 board ribbon connector A4A2-P1 from connector J2 on 1.5 KVA Inverter Board 1A4A4 by grasping connector with thumb and index finger and exerting an upward force on connector.
3	Using small flat-tipped screwdriver, loosen retaining screws on serial port (DB-25) connector (at rear of RS-232 board) and remove connector from RS-232 board.
4	Using 3/16-inch nut driver, remove two lugs (standoffs) securing RS-232 board to power supply assembly chassis.
5	Remove RS-232 board from power supply assembly.

Table 2.5.22. Power Supply Assembly RS-232 Board Removal and Installation -CONT

Step	Procedure
	INSTALLATION
	Tools required: Small flat-tipped screwdriver 3/16-inch nut driver **WARNING** Ensure that power is completely removed from UPS by performing the procedure in table 2.5.6. Death or severe injury may result if power is not completely removed from UPS prior to removing the cover in front of UPS components and performing maintenance on UPS subassemblies.
1	Verify that power supply assembly cover is removed in accordance with table 2.5.6.
2	Carefully position RS-232 board in power supply assembly with component side to the right.
3	Using 3/16-inch nut driver, install two lugs (standoffs) securing RS-232 board to power supply assembly chassis.
4	Install RS-232 ribbon board connector A4A2-P1 to connector J2 on 1.5 KVA Inverter Board 1A4A4. Ensure that pin 1 on ribbon connector (marked with ink dot or other marking) mates with pin 1 of Inverter Board 1A4A4.
5	Install connector harness serial port (DB-25) connector to RS-232 board. Using small flat-tipped screwdriver, tighten retaining screws.
6	Install power supply assembly cover in accordance with table 2.5.6.

Table 2.5.23. Power Supply Assembly Inverter Board Removal and Installation

Step	Procedure
	REMOVAL
	Tools required: No. 2 Phillips screwdriver 3/8-inch nut driver **WARNING** Ensure that power is completely removed from UPS by performing the procedure in table 2.5.6. Death or severe injury may result if power is not completely removed from UPS prior to removing the cover in front of UPS components and performing maintenance on UPS subassemblies.
1	Remove power supply assembly cover in accordance with table 2.5.6.
2	Remove RS-232 ribbon connector A2-P1 from inverter board connector A4J2.
3	Tag and remove 10 wires with solderless (spade) connectors from inverter board terminals.
4	Tag seven wires attached to the four inverter board standoffs.
5	Using 3/8-inch nut driver, remove four nuts, four flat washers, four lockwashers, and seven wires from four inverter board standoffs.
6	Remove four screws, flat washers, lockwashers, and nuts securing mounting bracket to insulator (insulator is located on top of two heat sinks).
7	Using Phillips screwdriver, remove three screws and flat washers securing inverter board to power supply assembly chassis.
8	Carefully slide inverter board forward and remove from power supply assembly.

Table 2.5.23. Power Supply Assembly Inverter Board Removal and Installation -CONT

Step	Procedure
INSTALLATION	
	Tools required: No. 2 Phillips screwdriver 3/8-inch nut driver **WARNING** Ensure that power is completely removed from UPS by performing the procedure in table 2.5.6. Death or severe injury may result if power is not completely removed from UPS prior to removing the cover in front of UPS components and performing maintenance on UPS subassemblies.
1	Verify that power supply assembly cover is removed in accordance with table 2.5.6.
2	Carefully position inverter board into card guides, with insulator under mounting bracket.
3	Using Phillips screwdriver, install three screws and flat washers securing inverter board to power supply assembly chassis.
4	Using Phillips screwdriver, install four screws, flat washers, lockwashers, and nuts securing mounting bracket to insulator. Insulator is located on top of two heat sinks.
5	Using 3/8-inch nut driver and tags as a guide, install four nuts, four flat washers, four lockwashers, and seven wires to four inverter board standoffs.
6	Using tags as a guide, install 10 wires with solderless (spade) connectors to inverter board terminals.
7	Install RS-232 connector A2-P1 on inverter board connector A4-J2. Ensure that pin 1 on ribbon connector (marked with ink dot or other marking) mates with pin 1 of inverter board.
8	Install power supply assembly cover in accordance with table 2.5.6.

Table 2.5.24. Power Supply Assembly Status Panel Removal and Installation

Step	Procedure
REMOVAL	
	Tools required: 5/16-inch nut driver **WARNING** Ensure that power is completely removed from UPS by performing the procedure in table 2.5.6. Death or severe injury may result if power is not completely removed from UPS prior to removing the cover in front of UPS components and performing maintenance on UPS subassemblies.
1	Remove power supply assembly cover in accordance with table 2.5.6.
2	Tag and remove two wires from OUTPUT POWER switch S1.
3	Using 5/16-inch nut driver, remove two nylon nuts and spaces securing status panel to power supply assembly cover.
4	Remove status panel from power supply assembly cover.
INSTALLATION	
	Tools required: 5/16-inch nut driver **WARNING** Ensure that power is completely removed from UPS by performing the procedure in table 2.5.6. Death or severe injury may result if power is not completely removed from UPS prior to removing the cover in front of UPS components and performing maintenance on UPS subassemblies.

$ **Table 2.5.24. Power Supply Assembly Status Panel Removal and Installation - CONT**

Step	Procedure
1	Verify that power supply assembly cover is removed in accordance with table 2.5.6.
2	Position status panel on mounting screws.
3	Using 5/16-inch nut driver, install two nylon nuts and spacers securing status panel to power supply assembly cover.
4	Using tags as a guide, install two wires to OUTPUT POWER switch S1.
5	Install power supply assembly cover in accordance with table 2.5.6.

Table 2.5.25. Power Supply Assembly OUTPUT POWER Switch Removal and Installation

Step	Procedure
REMOVAL	
	WARNING Ensure that power is completely removed from UPS by performing the procedure in table 2.5.6. Death or severe injury may result if power is not completely removed from UPS prior to removing the cover in front of UPS components and performing maintenance on UPS subassemblies.
1	Remove power supply assembly cover in accordance with table 2.5.6.
2	At rear of OUTPUT POWER switch, tag and remove two wires.
3	Press plastic tabs on both sides of switch while pushing switch out the front of power supply assembly cover.
INSTALLATION	
	WARNING Ensure that power is completely removed from UPS by performing the procedure in table 2.5.6. Death or severe injury may result if power is not completely removed from UPS prior to removing the cover in front of UPS components and performing maintenance on UPS subassemblies.
1	Verify that power supply assembly cover is removed in accordance with table 2.5.6.
2	Push switch through the front of power supply assembly cover until plastic tabs lock switch into place.
3	At rear of OUTPUT POWER switch using tags as a guide, install two wires.
4	Install power supply assembly cover in accordance with table 2.5.6.

Table 2.5.26. Power Supply Assembly Circuit Breaker Removal and Installation

Step	Procedure
REMOVAL	
	Tools required: Small flat-tipped screwdriver 9/16-inch nut driver
	WARNING Ensure that power is completely removed from UPS by performing the procedure in table 2.5.6. Death or severe injury may result if power is not completely removed from UPS prior to removing the cover in front of UPS components and performing maintenance on UPS subassemblies.

Table 2.5.26. Power Supply Assembly Circuit Breaker Removal and Installation -CONT

Step	Procedure
1	Remove power supply assembly cover in accordance with table 2.5.6.
2	Using small flat-tipped screwdriver, remove two wires from circuit breaker.
3	Using 9/16-inch nut driver, remove nut and washer securing circuit breaker to power supply assembly chassis.
4	Carefully remove circuit breaker from chassis.
INSTALLATION	
	Tools required: Small flat-tipped screwdriver 9/16-inch nut driver **WARNING** Ensure that power is completely removed from UPS by performing the procedure in table 2.5.6. Death or severe injury may result if power is not completely removed from UPS prior to removing the cover in front of UPS components and performing maintenance on UPS subassemblies.
1	Verify that power supply assembly cover is removed in accordance with table 2.5.6.
2	Install circuit breaker in power supply assembly chassis.
3	Using 9/16-inch nut driver, install nut and washer securing circuit breaker chassis.
4	Using small flat-tipped screwdriver, install two wires on circuit breaker.
5	Install power supply assembly cover in accordance with table 2.5.6.

Table 2.5.27. DC Power Supply Removal and Installation

Step	Procedure
REMOVAL	
	Tools required: Small flat-tipped screwdriver **NOTE** ACU power need not be turned off for dc power supply interchange. This allows normal operation of ACU during removal and replacement.
1	Using figure 2.1.6, locate dc power supply to be removed.
2	**NOTE** On/off switch has a built-in lock that prevents removing power supply while switch is in 1 (on) position. Switch must be set to 0 (off) before power supply can be removed. At dc power supply, set front panel on/off switch to 0 (off) position.
3	CAUTION Wait 1 minute before removing power supply from chassis to allow internal capacitors to discharge through drain circuits. Using small flat-tipped screwdriver, remove two panel screws securing dc power supply to Power Supply Enclosure 1A5.
4	Grasp dc power supply handle and slide out of enclosure.

Table 2.5.27. DC Power Supply Removal and Installation -CONT

Step	Procedure
INSTALLATION	
	Tools required: Small flat-tipped screwdriver NOTE ACU power need not be turned off for dc power supply interchange. This allows normal operation of ACU during removal and replacement.
1	Set replacement power supply front panel on/off switch to 0 (off) position.
2	Position dc power supply in Power Supply Enclosure 1A5 and slide into enclosure.
3	Using small flat-tipped screwdriver, install two panel screws securing dc power supply to enclosure.
4	Set power supply front panel on/off switch to 1 (on) position.

Table 2.5.28. DC Power Supply Fan Connector Board Removal and Installation

Step	Procedure
REMOVAL	
	Tools required: Small flat-tipped screwdriver No. 1 Phillips screwdriver No. 2 Phillips screwdriver 3/8-inch nut driver **WARNING** Death or severe injury may result if power is not removed from ACU prior to maintenance activities. Ensure that UPS POWER switch is set to 0 (off) position and facility power is removed from ACU.
1	Set UPS POWER switch to 0 (off) position.
2	Remove facility power from ACU cabinet.
3	NOTE On/off switch has a built-in lock that prevents removing power supply while switch is in 1 (on) position. Switch must be set to 0 (off) position before power supply can be removed. Set front panel on/off switch on dc power supplies to 0 (off) position.
4	**CAUTION** Wait 1 minute before removing power supplies from chassis to allow internal capacitors to discharge through drain circuits. Using small flat-tipped screwdriver, remove four panel screws securing dc power supplies to DC Power Supply Enclosure 1A5.
5	Remove dc power supplies from enclosure.
6	Using No. 1 Phillips screwdriver at rear of power supply enclosure, remove four screws securing connectors J2A and J2B to dc power supply fan connector board. Remove connectors J2A and J2B.
7	At dc power supply fan connector board, tag and remove wires from terminal boards TB1A and TB1B.
8	Using No. 2 Phillips screwdriver, remove wires from terminal boards TB2A and TB2B.
9	Using 3/8-inch nut driver, tag and remove wires from output studs A and B.
10	Using No. 1 Phillips screwdriver, remove 12 screws, flat washers, and lockwashers securing fan connector board to dc power supply enclosure.
11	Remove fan connector board from dc power supply enclosure.

Table 2.5.28. DC Power Supply Fan Connector Board Removal and Installation -CONT

Step	Procedure
	INSTALLATION
	Tools required: Small flat-tipped screwdriver No. 1 Phillips screwdriver No. 2 Phillips screwdriver 3/8-inch nut driver **WARNING** Death or severe injury may result if power is not removed from ACU prior to maintenance activities. Ensure that UPS POWER switch is set to 0 (off) position and facility power is removed from ACU.
1	Verify that UPS POWER switch is set to 0 (off) position.
2	Verify that facility power is removed from ACU cabinet.
3	Position fan connector board on rear of DC Power Supply Enclosure 1A5 with connector J2A in the top right corner.
4	Using No. 1 Phillips screwdriver, install 12 screws, flat washers, and lockwashers securing fan connector board to dc power supply enclosure. Ensure that two green chassis ground wires are connected.
5	Install connectors J2A and J2B on fan connector board.
6	Using No. 1 Phillips screwdriver, install four screws securing connectors J2A and J2B to fan connector board.
7	Using 3/8-inch nut driver and tags as a guide, install wires on output studs A and B.
8	Using No. 2 Phillips screwdriver, install wires on fan connector board terminal boards TB2A and TB2B.
9	Install wires on terminal boards TB1A and TB2A.
10	Set front panel on/off switch on dc power supplies to 0 (off) position.
11	Slide dc power supplies into Power Supply Enclosure 1A5.
12	Using small flat-tipped screwdriver, install four panel screws securing dc power supplies to enclosure.
13	Set dc power supplies front panel on/off switches to 1 (on) position.
14	Apply facility power to ACU cabinet.
15	Set UPS POWER switch to 1 (on) position.

Table 2.5.29. Blower Removal and Installation

Step	Procedure
	REMOVAL
	Tools required: No. 2 Phillips screwdriver Diagonal cutting pliers Small screwdriver **WARNING** Death or severe injury may result if power is not removed from ACU prior to maintenance activities. Ensure that UPS POWER switch is set to 0 (off) position and facility power is removed from ACU.
1	Set UPS POWER switch to 0 (off) position.
2	Remove facility power from ACU cabinet.

Table 2.5.29. Blower Removal and Installation -CONT

Step	Procedure
3	**NOTE** Blower may have either long power cord or short power cord. If blower has long power cord, it is connected directly to Power Distribution Assembly 1A7 at rear of ACU. If blower has short power cord, it is butt-spliced into extension that connects to 1A7. If blower has short power cord, at rear of cabinet, tag ac power wires at butt splice connection to blower power cord.
4	If blower has short power cord, using diagonal cutting pliers, cut cabinet harness ac power cord near butt splice connectors.
5	If blower has long power cord, using small screwdriver, disconnect three blower power wires from Power Distribution Assembly 1A7.
6	**NOTE** There are two types of cabinets for the ACU. One type has a partial length front door with the blower mounted behind an air intake grill. The other type of cabinet has a full length door with the blower accessible with the door open. If ACU cabinet has a partial length front door, using Phillips screwdriver, remove six Phillips screws and lockwashers securing air intake grill to lower front of cabinet. Remove air intake grill.
7	If ACU cabinet has a full length front door, open front door. Loosen knurled knobs on either side of shield in front of blower B1 and remove shield.
8	Remove air filter from blower.
9	Using Phillips screwdriver, remove four screws, lockwashers, and flat washers securing blower to ACU cabinet.
10	Remove blower from cabinet.
INSTALLATION	
	Tools required: No. 2 Phillips screwdriver Wire stripper Crimping tool Butt splice connectors M7928/5-3 Small screwdriver **WARNING** Death or severe injury may result if power is not removed from ACU prior to maintenance activities. Ensure that UPS POWER switch is set to 0 (off) position and facility power is removed from ACU.
1	Verify that UPS POWER switch on UPS status panel is set to 0 (off) position.
2	Verify that facility power is removed from ACU cabinet.
3	**NOTE** There are two types of cabinets for the ACU. One type has a partial length front door with the blower mounted behind an air intake grill. The other type of cabinet has a full length door with the blower accessible with the door open. Slide blower into ACU cabinet. Using Phillips screwdriver, install four screws, flat washers, and lockwashers securing blower to cabinet.

Table 2.5.29. Blower Removal and Installation -CONT

Step	Procedure
4	**NOTE** Blower may have either long power cord or short power cord. If blower has long power cord, it is connected directly to Power Distribution Assembly 1A7 at rear of ACU. If blower has short power cord, it is butt-spliced into extension that connects to 1A7. If blower has long power cord, using small screwdriver, connect three blower power wires to Power Distribution Assembly 1A7 as follows: BLK 1A7-18D WHT 1A7-19D GRN 1A7-20D
5	If blower has short power cord, using crimping tool and butt splice connectors (with tags as a guide), connect blower ac power wires to cabinet harness ac power extension wires.
6	Install air filter in blower.
7	If ACU cabinet has a partial length front door, position air intake grill in front of blower. Using Phillips screwdriver, install six Phillips screws and lockwashers securing air intake grill to lower front of cabinet.
8	If ACU cabinet has a full length front door, install blower shield in front of blower and hand tighten two knurled knobs on shield.
9	Apply facility power to ACU cabinet.
10	Set UPS POWER switch to 1 (on) position.

Table 2.5.30. Battery Box and Battery Removal and Installation

Step	Procedure
REMOVAL	
	Tools required: Two 5/16-inch box wrenches No. 2 Phillips screwdriver Small screwdriver **WARNING** Death or severe injury may result if power is not removed from ACU prior to performing maintenance activities. Ensure that UPS POWER switch is set to 0 (off) and facility power is removed from ACU. Severe injury may result if the negative and positive battery terminals are shorted together. Exercise caution while removing batteries.
1	Set UPS POWER switch to 0 (off) position.
2	Remove facility power from ACU cabinet.
3	Disconnect Battery Box 1A8. a. For battery box, part number 62828-40063-10, connector J1, squeeze tabs on side of connector inward while rocking connector free. b. For battery box, 62828-40062-30 or 62828-90360-10, pull battery box connector P1 out of UPS PRA BATTERY BOX connector.

Table 2.5.30. Battery Box and Battery Removal and Installation -CONT

Step	Procedure
4	Wait at least 30 seconds while UPS capacitors discharge through bleeders and other drains. **NOTE** ACU blower 1B1 must be removed to access Battery Box 1A8.
5	Using small screwdriver, tag and remove three blower ac power wires from AC Power Distribution Assembly 1A7 terminals 1A7-18D, -19D, and -20D.
6	**NOTE** There are two types of cabinets for the ACU. One type has a partial length front door with the blower mounted behind an air intake grill. The other type of cabinet has a full length door with the blower accessible with the door open. If ACU cabinet has a partial length front door, using Phillips screwdriver, remove six Phillips screws and lockwashers securing air intake grill to lower front of cabinet. Remove air intake grill.
7	If ACU cabinet has a full length front door, open front door. Loosen knurled knobs on either side of shield in front of blower B1 and remove shield.
8	Remove air filter from blower.
9	Using Phillips screwdriver, remove four screws, lockwashers, and flat washers securing blower to ACU cabinet.
10	Remove blower from ACU cabinet.
11	**WARNING** Pressure sensors in RF/Pressure Mounting Shelf 1A6 are safety-critical devices. Pressure sensors may output erroneous readings if plastic vent tubing to I/O panel assembly is damaged or crimped. Throughout this procedure, exercise caution to avoid damage to pressure vent tubing. Disconnect retaining strap securing Battery Box 1A8 to inside of ACU cabinet.
12	**WARNING** Battery box is heavy equipment (weighs from 60 to 70 pounds) and should be slid, not lifted. If lifted, two-man or mechanical lift is required. Failure to comply may result in injury to personnel or damage to equipment. Slide Battery Box 1A8 from ACU cabinet through blower opening.
13	**CAUTION** When lifting top of battery tray, do not pull the attached wires off the connector. Lift top of battery box and position so that battery terminals can be accessed.
14	**WARNING** Batteries contain corrosive fluid. Do not tip batteries during removal. Severe injury may result if the negative and positive battery terminals are shorted together. Exercise caution while removing batteries. Using two 5/16-inch box wrenches, remove bolt, flat washers, lockwasher, and nut from negative terminal of battery BT1 (connected to top of battery box via black wires). Remove black wires from negative terminal.

Table 2.5.30. Battery Box and Battery Removal and Installation -CONT

Step	Procedure
15	Using two 5/16-inch box wrenches, remove bolt, flat washers, lockwasher, and nut from positive terminal of battery BT5 (connected to top of battery box via red wires). Remove red wires from positive terminal.
16	Remove top of battery box.
17	Using two 5/16-inch box wrenches, remove bolt, lockwasher, flat washers, and nut from battery terminals and remove all jumper wires.
18	Using strap tied around battery BT5 or packing material, remove from battery box.
19	Remove and retain strap.
20	Remove additional batteries.
INSTALLATION	
	Tools required: Two 5/16-inch box wrenches **WARNING** Death or severe injury may result if power is not removed from ACU prior to performing maintenance activities. Ensure that UPS POWER switch is set to 0 (off) and facility power is removed from ACU.
1	Verify that UPS POWER switch is set to 0 (off) position.
2	Verify that facility power is removed from ACU.
3	Tie previously removed strap around battery BT5 or packing material to facilitate future removal. Leave approximately 2 inches of slack between top of battery or packing material and strap.
4	Using figure 2.1.8, install batteries in battery box.
5	**NOTE** Refer to figure 2.4.12 or 2.4.13 for wiring diagram of battery box. Using markers as a guide and two 5/16-inch box wrenches, install jumpers to battery terminals, securing with bolt, flat washer, lockwasher, and nut.
6	Position top of battery box so that red wires can be connected to positive terminal and black wires can be connected to negative terminal.
7	Using two 5/16-inch box wrenches, install bolt, flat washers, lockwasher, and nut securing wires to respective terminals.
8	Position top over battery box and press into place.
9	**WARNING** Battery box is heavy equipment (weighs approximately 75 pounds) and should be slid, not lifted. If lifted, two-man or mechanical lift is required. Failure to comply may result in injury to personnel or damage to equipment. Pressure sensors in RF/Pressure Mounting Shelf 1A6 are safety-critical devices. Pressure sensors may output erroneous readings if plastic vent tubing to I/O panel assembly is damaged or crimped. Throughout this procedure, exercise caution to avoid damage to pressure vent tubing. Slide battery box into ACU cabinet through blower opening. While taking care not to damage or crimp pressure sensor vent tubing, position box with connector J1 to right and two rear corners in contact with vertical plates.
10	Secure battery box in position by installing retaining strap to left and right vertical plates.

Table 2.5.30. Battery Box and Battery Removal and Installation -CONT

Step	Procedure
11	**NOTE** There are two types of cabinets for the ACU. One type has a partial length front door with the blower mounted behind an air intake grill. The other type of cabinet has a full length door with the blower accessible with the door open. Slide blower into ACU cabinet. Using Phillips screwdriver, install four screws, flat washers, and lockwashers securing blower to cabinet.
12	Install air filter in blower.
13	If ACU cabinet has a partial length front door, position air intake grill in front of blower. Using Phillips screwdriver, install six Phillips screws and lockwashers securing air intake grill to lower front of cabinet.
14	If ACU cabinet has a full length front door, install blower shield in front of blower and hand tighten two knurled knobs on shield.
15	Using small screwdriver and tags as a guide, install three blower ac power wires to AC Power Distribution Assembly 1A7 terminals 1A7-18D, -19D, and -20D.
16	Ensure that pressure sensor vent tubing is properly connected to pressure sensors and PRESSURE VENT on I/O Panel Assembly 1A9 and is not damaged or crimped.
17	**NOTE** Ensure that battery plug is fully seated and locked into place. Connect Battery Box 1A8. a. For battery box, part number 62828-40063-10, position W030 cable connector P1 on top of battery box connector J1 and press connector into place. b. For battery box, part number 62828-40062-30 or 62828-90360-10, insert battery box connector into UPS PRA BATTERY BOX connector.
18	Apply facility power to ACU cabinet.
19	Set UPS POWER switch to 1 (on) position.

Table 2.5.31. Uninterruptible Power Supply Removal and Installation

Step	Procedure
	REMOVAL
	Tools required: Phillips screwdriver **WARNING** Death or severe injury may result if power is not removed from the ACU prior to performing maintenance activities. Ensure that UPS POWER switch is set to 0 (off) and that facility power is removed from the ACU. Severe injury may result if the negative and positive battery terminals are shorted together. Exercise caution while removing batteries.
$ 1	Set UPS power switch to off position.
2	Remove facility power from ACU cabinet.
3	Disconnect UPS from wiring harness by removing connectors P97, P1, and P13.
4	Using screwdriver, disconnect cable W78 connector P2 from COMM PORT by removing two screws.

Table 2.5.31. Uninterruptible Power Supply Removal and Installation -CONT

Step	Procedure
5	Using screwdriver, remove four screws securing shelf, then slide UPS shelf out of ACU.
6	Unstrap UPS from shelf.
7	Lift and pull UPS off shelf.
INSTALLATION	
	Tools required: Phillips screwdriver **WARNING** Death or severe injury may result if power is not removed from the ACU prior to performing maintenance activities. Ensure that UPS power switch is set to off and that facility power is removed from the ACU. $ Severe injury may result if the negative and positive battery terminals are shorted together. Exercise caution while removing batteries.
1	Verify that UPS power switch is set to off position. $
2	Verify that facility power is removed from ACU.
3	Slide UPS shelf out of ACU.
4	Place UPS on shelf.
5	Secure UPS onto shelf with strap.
6	Slide shelf into ACU cabinet; using Phillips screwdriver, install four screws securing shelf in place.
7	Using Phillips screwdriver, connect cable W78 connector P2 to COMM PORT by securing two screws.
8	Connect UPS to wiring harness by connecting connectors P97, P1, and P13.
9	Apply facility power to ACU.
10	Set UPS power switch to on position. $

Table 2.5.32. ACU Tie-Down Removal and Installation

Step	Procedure
INSTALLATION	
	Tools and materials required: Small Flat-blade screwdriver 3/4-inch open end wrench No. 2 Phillips screwdriver 3/8 inch power drill (wood installation) ½-inch power (hammer type preferred) drill (concrete installation) Various wood, metal, and masonry bits Scotchbrite (or equivalent) pad Denatured alcohol Earthquake mounting kit (part number 62828-40306-100) **WARNING** Death or severe injury may result if power is not removed from ACU prior to performing FMK instructions. Ensure that OUTPUT POWER switch is set to 0 (off) and facility power is removed from ACU.

Table 2.5.32. ACU Tie-Down Removal and Installation -CONT

Step	Procedure
	NOTE If this installation is being performed for the first time it is necessary to use the materials and instructions found in FMK #078. If this installation is being performed to reinstall an ACU that already has earthquake mounts, it will be necessary to replace the lag bolts, washers, lag shields (used for concrete installation only), and conductive adhesive (see the following chart for information): ITEM / QTY / CAGE CODE / PART NUMBER / NOMENCLATURE 1 / 2 / 0J8A4 / 62828-40270-1 / Channel, Mounting 2 / 4 / 0J8A4 / 62828-90410-1 / Screw, Lag Bolt Hx-Hd 3 / 4 / 0J8A4 / 62828-90329-2 / Washer, Flat-metal, Rd 4 / 1 / 3796X / 72-00192 / Adhesive, Conductive, w/primer 5 / 4 / 88367 / 1155 / Lag Shield This procedure is based upon a UPS installation: where no UPS is installed, skip all steps which refer to the UPS or to the battery box.
1	Set OUTPUT POWER switch on UPS status panel to 0 (off) position. OUTPUT indicator on status panel extinguishes.
2	Remove facility power from ACU cabinet.
3	Disconnect Battery Box 1A8. a. For battery box, part number 62828-40063-10, connector J1, squeeze tabs on side of connector inward while rocking connector free. b. For battery box, part number 62828-40062-30, pull battery box connector P1 out of UPS PRA BATTERY BOX connector.
4	Wait at least 30 seconds while UPS capacitors discharge through bleeders and other drains.
	NOTE ACU blower 1B1 must be removed to access Battery Box 1A8.
5	Using small screwdriver, tag and remove three blower ac power wires from AC Power Distribution Assembly 1A7 terminals 1A7-18D, -19D, and -20D.
6	**NOTE** There are two types of cabinets for the ACU. One type has a partial length front door with the blower mounted behind an air intake grill. The other type of cabinet has a full length door with the blower accessible with the door open. If ACU cabinet has a partial length front door, using Phillips screwdriver, remove six Phillips screws and lockwashers securing air intake grill to lower front of cabinet. Remove air intake grill.
7	If ACU cabinet has a full length front door, open front door. Loosen knurled knobs on either side of shield in front of blower B1 and remove shield.
8	Remove air filter from blower.
9	Using Phillips screwdriver, remove four screws, lockwashers, and flat washers securing blower to ACU cabinet.
10	Remove blower from ACU cabinet.
11	Disconnect strap securing Battery Box 1A8 to inside of ACU cabinet.

Table 2.5.32. ACU Tie-Down Removal and Installation -CONT

Step	Procedure
	WARNING Battery box is heavy equipment (weighs from 60 to 70 pounds) and should be slid, not lifted. If lifted, two-man or mechanical lift is required. Failure to comply may result in injury to personnel or damage to equipment.
12	Slide Battery Box 1A8 from ACU cabinet through blower opening.
13	Verify all cables connected to the I/O panel assembly are properly marked. Disconnect all cables from the I/O panel assembly.
14	If 1A9 is ported through tubing, disconnect pressure tubing from 1A9.
15	Secure ACU to floor. Determine the type of material that the ACU is to be mounted to (concrete or wood). Follow the instructions for that material type. **CONCRETE** **NOTE** Perform the following steps if the material that the ACU is to be mounted is composed of concrete. a. Place "U" channel pieces in ACU as shown in figure 2.5.1, Section A-A and mark bottom of ACU (in four places, as shown) in preparation for drilling mounting holes. b. Use a center punch to define hole centers to be drilled. c. Using 2X4 boards as supports, lift the ACU above the floor. Drill four holes, 0.397 inch in diameter, through bottom of cabinet. d. Place ACU in its exact position. Using the four holes drilled through the bottom of the ACU as a guide, mark the floor in preparation for drilling. e. Move ACU out of position and drill four holes 0.625 inch in diameter into the concrete to a depth of 2.88 inches each. f. Blow each hole clean of dust and insert an anchor (lag shield) into each hole until it is flush with the surface. h. Using sandpaper, remove paint and primer from around holes drilled in the ACU; clear a 0.75-inch diameter circle surrounding each hole diameter on the interior and exterior surfaces of the cabinet. i. Move ACU back into position and prepare all surfaces to be bonded. These surfaces include the bottom edge of each lag bolt, both sides of each washer, the area around each "U" channel hole, and the paint-free areas around the holes drilled in the ACU cabinet. Prepare all surfaces to be bonded using the following instructions: (1) Scour all surfaces to be bonded with a Scotchbrite (or equivalent) pad. (2) Clean all surfaces to be bonded with denatured alcohol. (3) Apply primer to all surfaces to be bonded; allow to air dry for 2 hours. j. Place the two "U" channel pieces into position and secure the ACU to the floor with the lag bolts and flat washers. The bottom edge of each lag bolt, each washer, and the paint-free areas around the holes drilled in the ACU cabinet should be coated with conductive adhesive immediately prior to use.

Table 2.5.32. ACU Tie-Down Removal and Installation -CONT

Step	Procedure
	WOOD **NOTE** If the material that the ACU is to be mounted to is composed of wood, perform the following steps. a. Place "U" channel pieces in ACU as shown in figure 2.5.1, Section A-A and mark bottom of ACU (in four places, as shown) in preparation for drilling mounting holes. b. Use a center punch to define hole centers to be drilled. c. Using 2X4 boards as supports, lift the ACU above the floor. Drill four holes, 0.397 inch in diameter through bottom of cabinet. d. Determine the position of the ACU. The chosen position must allow the lag bolts to be screwed into the floor joists when the lag bolts are installed. e. Place ACU in its exact position. Using the four holes drilled through the bottom of the ACU as a guide, mark the floor in preparation for drilling. f. Move ACU out of position and drill four holes 0.312 inch in diameter through the wood floor and into the joists to a depth of 2.88 inches each. g. Blow each hole clean of sawdust. h. Using sandpaper, remove paint and primer from around holes drilled in the ACU; clear a 0.75-inch diameter circle surrounding each hole diameter, on the interior and exterior surfaces of the cabinet. i. Move ACU back into position and prepare all surfaces to be bonded. These surfaces include the bottom edge of each lag bolt, both sides of each washer, the area around each "U" channel hole, and the paint-free areas around the holes drilled in the ACU cabinet. Prepare all surfaces to be bonded using the following instructions: (1) Scour all surfaces to be bonded with a Scotchbrite (or equivalent) pad. (2) Clean all surfaces to be bonded with denatured alcohol. (3) Apply primer to all surfaces to be bonded and allow to air dry for 2 hours. j. Place the two "U" channel pieces into position and secure the ACU to the floor with the lag bolts and flat washers. The bottom edge of each lag bolt, each washer, and the paint free areas around the holes drilled in the ACU cabinet should be coated with conductive adhesive immediately prior to use.
16	Vacuum inside of ACU cabinet and remove all foreign matter.
17	Slide battery box into ACU cabinet through blower opening. While taking care not to damage or crimp pressure sensor vent tubing, position box with connector J1 to right and two rear corners in contact with restraining angles.
18	Secure battery box in position by hooking restraining strap to left and right angles.
19	Slide blower into ACU cabinet. Using Phillips screwdriver, install four screws, flat washers, and lockwashers securing blower to cabinet.
20	Install air filter in blower.

Table 2.5.32. ACU Tie-Down Removal and Installation -CONT

Step	Procedure
21	If ACU cabinet has a partial length front door, position air intake grill in front of blower. Using Phillips screwdriver, install six Phillips screws and lockwashers securing air intake grill to lower front of cabinet.
22	If ACU cabinet has a full length front door, install blower shield in front of blower and hand tighten two knurled knobs on shield.
23	Using small screwdriver and tags as a guide, install three blower ac power wires to AC Power Distribution Assembly 1A7 terminals 1A7-18D, -19D, and -20D.
24	If pressure tubing was disconnected from 1A9 (in step 14), reconnect it and ensure that it is not damaged or crimped.
25	NOTE Ensure that battery plug is fully seated and locked into place. Connect Battery Box 1A8. a. For battery box, part number 62828-40063-10, position W030 cable connector P1 on top of battery box connector J1 and press connector into place. b. For battery box, part number 62828-40062-30, insert battery box connector into UPS PRA BATTERY BOX connector.
26	Reconnect all cables to the I/O Panel Assembly.
27	Apply facility power to ACU cabinet.
28	(Class II Systems Only) Set UPS POWER switch to 1 (on) position.
CHECK OUT SYSTEM	
1	Sign on at OID as a technician.
2	Check 12 HR pages to ensure that data is being collected from sensors.
3	Ensure that all peripherals connected to the system are operational.
4	Clear all failures on MAINT pages for the ACU and DCP that were caused by powering system down.
5	Update maintenance log to reflect addition of ACU tie-downs.

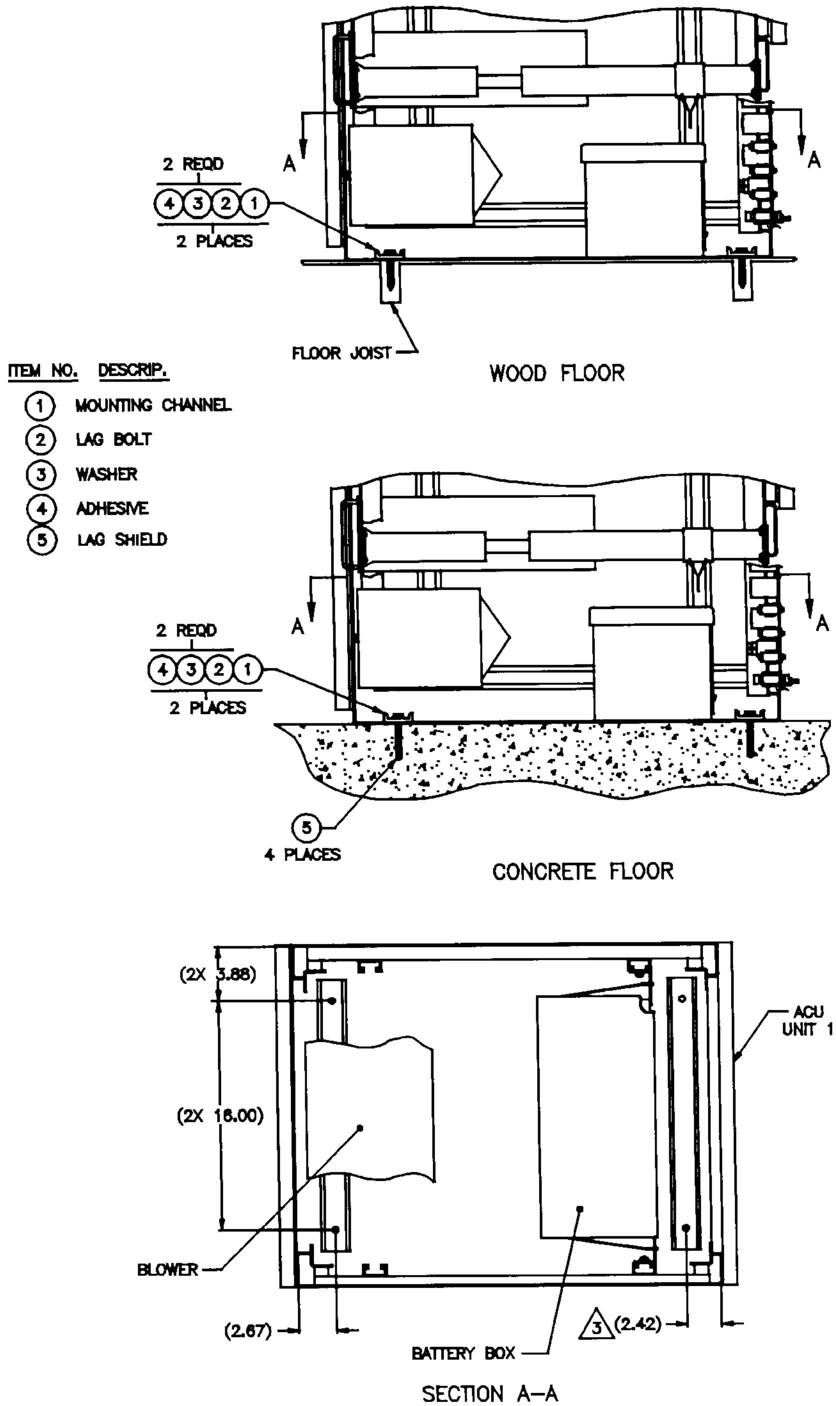


Figure 2.5.1 Earthquake Mounting Installation

2.5.5 SETTING UP LEASED LINE MODEMS

Leased lines are used to allow the ACU to communicate with peripherals (OID's, VDU's, CVD's, and printers) located at various positions throughout the ASOS site. For each leased line peripheral, two telephone modems are used: one at the ACU and one at the peripheral. At the ACU, a rack-mounted modem is installed in Modem AC Power Rack 1A3. At the peripheral, a stand-alone (S/A) modem is used.

2.5.5.1 **Setting Up ACU Rack-Mounted Modems**. After a rack-mounted modem is installed in the ACU, it is configured via the ACU serial communications page. From this page, the modem is assigned a function, assigned to an SIO port, assigned a baud rate, and specified for leased line operation. Baud rates for the model 2440 modem are 2400 for OID's, VDU's, and printers and 1200 for CVD's. The baud rate is 9600 for the model V.3225 modem and 28800 for the model V.3400 modem. After a rack-mounted modem is installed and configured on the ACU serial communications page, the ACU program automatically programs the modem for operation. No other action is required on the part of the technician.

2.5.5.2 **Setting Up Stand Alone Modems**. After a stand alone modem is installed at the peripheral end, it must be manually programmed to operate in leased line mode with the proper parameters. This is accomplished using the LCD display and the YES and NO pushbutton switches on the front panel of the modem (same as rack-mounted modems shown on figure 2.3.4). The LCD display presents main menus, submenus, and configuration options to the technician. The NO pushbutton is used to sequence through the main menus and the YES pushbutton is used to branch to submenus and to select appropriate options. The Installation and Operation Manual for the stand-alone modem provides detailed information on all menus, submenus, and options available with the modem and provides instructions on their use. Table 2.5.33 identifies the settings that must be manually made for models 2440 and V.3225 stand-alone modems. The model V.3400 does not require manual setup. This table addresses only the settings that must be checked or changed by the technician. They do not address options that are automatically set by the factory or are not required for ASOS operation. The actual menu and option titles that appear on the modem LCD display may vary, depending on the modem's internal firmware.

2.5.6 SETTING UP LINE DRIVER MODEMS

The model D19.2 line drivers are obsolete and are replaced by the model DDS/MR64. If a D19.2 line driver fails at a site and spare D19.2 line drivers are not available, then all the D19.2 line drivers must be replaced with the DDS/MR64 line drivers. After installation, the ACU and DCP DDS/MR64 line drivers must be manually programmed to operate with the ASOS parameters by using the LCD display and the YES and NO pushbutton switches on the front panel of the modem (same as rack-mounted modems shown on figure 2.3.4). The LCD display presents main menus, submenus, and configuration options to the technician. The YES/NO pushbuttons are used to sequence through the main menus and submenus and to select appropriate options. The Installation and Operation Manual for the stand-alone line driver provides detailed information on all menus, submenus, and options available with the modem and provides instructions on their use. Table 2.5.34 identifies the options and switch settings that must be manually made for the model DDS/MR64 line driver in the ACU (refer to paragraph 3.5.6 for the model DDS/MR64 line driver in the DCP). This table addresses only the settings that must be checked or changed by the technician. The table does not address options that are automatically set by the factory or are not required for ASOS operation. The actual menu and option titles that appear on the modem LCD display may vary, depending on the modem's internal firmware.

Table 2.5.33. Stand-Alone Modem Setup Parameters

<table>
<tr><th>Step</th><th>Procedure</th></tr>
<tr><td colspan="2">MODEL 2440 SETUP PARAMETERS</td></tr>
<tr><td colspan="2">NOTE
The factory settings (step 1) should be performed first and the SAVE operation (step 6) performed last. The order in which other settings are made may vary.

Actual menu, submenu, and option names appearing on LCD display may vary due to version of modem firmware. Titles shown in parentheses indicate possible alternates.</td></tr>
<tr><td>1</td><td>Using OPTIONS? main menu and FACTORY? submenu, select FACTORY 1 settings.</td></tr>
<tr><td>2</td><td>Using OPTIONS? main menu and SPKR OPTS? submenu, set speaker control always to OFF.</td></tr>
<tr><td>3</td><td>Using OPTIONS? main menu and TELE OPTS? submenu, set the following:

$ a. LINE TYPE? (or PRIV/PSTN?) to LEASED (or PRIVATE) for OID or VDU
$ to Dial (for AFOS Dial Line)

b. ANS/ORIG? to ANSWER mode</td></tr>
<tr><td>4</td><td>Using DATA OPTS? main menu and DTE OPTS? submenu, set DTE RATE? to one of the following baud rates:

a. 2400 for OID, VDU, or printer

b. 1200 for CVD

$ c. 300 for AFOS Dial Line</td></tr>
<tr><td>5</td><td>Using DATA OPTS? main menu and AT CMDS? submenu (or STAT OPTS? main menu and ACU OPTS? submenu), set AT CMDS (or ACU) to D (i.e., disabled).</td></tr>
<tr><td>6</td><td>Using SAVE? main menu, save above settings in modem for permanent use after power up.</td></tr>
<tr><td colspan="2">MODEL V.3225 DIAL UP SETUP PARAMETERS</td></tr>
<tr><td colspan="2">NOTE
The MODEM is configured by using the front panel push buttons. Use the NO push button to cycle through the menu options and the YES push button to select the submenus. Configuration options are selected by pressing YES or NO push buttons when prompted by LCD display with “CHANGE?”. Pressing YES activates the configuration option.

Factory option set #1 configures the modem for dial up.

Actual menu, submenu, and option names appearing on LCD display may vary due to version of modem firmware.</td></tr>
<tr><td>1</td><td>Using MODIFY CONFIGURATION? menu and LOAD/STORE OPTION SET? submenu, load factory option set #1 and answer YES to the ARE YOU SURE? prompt. Modem then prompts to STORE PRESENT OPTIONS? Answer YES.</td></tr>
<tr><td colspan="2">MODEL V.3225 LEASE LINE SETUP PARAMETERS</td></tr>
<tr><td colspan="2">NOTE
This setup procedure is typical. Modem firmware versions may differ which may cause additional LCD messages to be displayed between steps within this table.

The factory settings (step 1) should be performed first and the STORE PRESENT OPTIONS (step 4) performed last. The order in which other settings are made may vary.</td></tr>
<tr><td>1</td><td>Using MODIFY CONFIGURATION? menu and LOAD/STORE OPTION SET? submenu, load factory option set #1 and answer YES to the ARE YOU SURE? prompt. Modem then prompts to STORE PRESENT OPTIONS? Answer NO at this time (this is performed as last step).</td></tr>
</table>

Table 2.5.33. Stand-Alone Modem Setup Parameters -CONT

Step	Procedure
2	Using MODIFY CONFIGURATION? menu and CHANGE MODEM PARAMETERS? submenu, perform the following: a. Ensure that DCE RATE is set for 9600 TRELLIS. b. Set NORMAL ORIGINATE? FORCED ANSWER mode to FORCED ANSWER. c. Ensure that V.32 FAST TRAIN option is set to DISABLED. d. Ensure that AUTO RETRAIN option is set to ENABLED. e. Change LINE TYPE from DIAL to LEASE.
3	Using MODIFY CONFIGURATION? menu and CHANGE DTE PARAMETERS? submenu, perform the following: a. Ensure that DTE RATE is 9600. b. Set AT COMMAND SET to DISABLED (D). c. Set CTS STATE to CTS FOLLOWS DCD.
4	Using MODIFY CONFIGURATION? menu and LOAD/STORE OPTION SET?, perform STORE PRESENT OPTIONS and answer YES to the ARE YOU SURE? prompt. LCD temporarily displays OPTIONS PERMANENT prompt. Programming is then complete. LCD displays V.32 9600 IDLE or TRAINING until leased line connection is established, then changes to V.32 9600 ON LINE.

Table 2.5.34. Model DDS/MR64 ACU Rack Mount Line Driver Setup

Step	Procedure
	NOTE D19.2 line drivers and DDS/MR64 line drivers are not compatible. If a D19.2 line driver fails and the failed line driver must be replaced with a DDS/MR64 line driver, all D19.2 installed in the system must be replaced with DDS/MR64 line drivers. Ensure that the line driver LCD does not display “ERROR”, if “ERROR” cannot be cleared the line driver may be defective. The line driver is configured by using the front panel push buttons. Use the NO push button to cycle through the menu options and the YES push button to select the submenus. Configuration options are selected by pressing YES or NO push buttons when prompted by LCD display with “CHANGE?”. Pressing YES activates the configuration option.
1	Use front panel push buttons to conFigure the DDS/MR64 line driver as follows:

Display	Press	Configures Option
“NO SIGNAL ASYNC DTE RATE” or “ASYNC RA 1200 2.4K BPS LINE”	HOME	(start configuration process)
TEST	NO	N/A
“SYNC DTE CHANGE?”	YES	ASYNC DTE
“RATE ADAPTER DISABLED - CHANGE?”	NO	DISABLE
“CHANGE TIMING ?”	YES	**INT**
“CHG LINE RATE?”	YES	2400 BPS
“BITS PER WORD=09 CHANGE?”	YES	10

Table 2.5.34. Model DDS/MR64 ACU Rack Mount Line Driver Setup -CONT

Step	Display	Press	Configures Option
1 (cont)	"CHANGE CONTROL OPTIONS?"	YES	N/A
	"CHANGE RTS CONTROL?"	YES	NORMAL RTS
	"CHANGE SYNC BUFFER OPT?:"	YES	SYNC BUFFER DIS
	"CHANGE REMOTE LB OPT?"	YES	RMT LB ENABLED
	"CHANGE DSR OPTION?"	YES	DSR OPT ENABLED
	"CHANGE SYS STATUS OPT?"	YES	SS OPT DISABLED
	"CHANGE CA OTP?"	YES	CA OPT DISABLED
	"CHANGE RTS-CTS DELAY?"	YES	RTS-CTS NORMAL
	"CHANGE DTE RL OPT?"	YES	DTE RL DISABLED
	"CHANGE DTE LL OPT?"	YES	DTE LL DISABLED
	"CHANGE DTE TP OPT?"	YES	DTE TP DISABLED
	"CHANGE DTE RT OPT?"	YES	DTE RT DISABLED
	"CHANGE 64K SCRAM OPT?	YES	SCRAMBLER DIS
	"LOAD FACTORY OPTION SET?	NO	N/A
	"SAVE NEW CONFIGURATION?"	YES	N/A
2	Remove power from ACU.		
$ 3	Remove line driver from modem rack and set jumpers (Figure 2.5.1A) as follows: SW1- RS232 Enable JP1 EN JP2 CH GND SW2- V.35 Enable SW3-1 OFF SW3-2 ON SW3-3 OFF SW3-4 OFF SW3-5 OFF SW3-6 OFF SW3-7 OFF SW3-8 OFF SW4-1 OFF SW4-2 OFF SW4-3 ON SW4-4 ON		
4	Reinsert line driver into modem rack and restore power to ACU.		

2.5.7 SETTING UP A DOT MATRIX PRINTER

2.5.7.1 **ACU Serial Communications**. The dot matrix printer used with ASOS can be a Panasonic model KX-P1180, KX-P2180, or KX-P3123. For any of these printers, the technician must ensure that it is properly configured on the ACU serial communications page (Figure 1.3.44). As a minimum, the printer parameters on this page should be set as follows:

BAUD RATE:	2400 for remote printer (9600 for local printer)
PARITY SELECT:	NONE
BITS/CHAR:	8
STOP BITS:	1
HANDSHAKE:	XON/XOFF

After specifying the ACU serial communications parameters, the printer must be manually set up using its front panel controls and indicators. Table 2.5.35 provides the procedure to perform this setup for the KX-P2180. Table 2.5.36 provides the KX-P1180 setup procedure. Table 2.5.37 provides the KX-P3123 setup procedure.

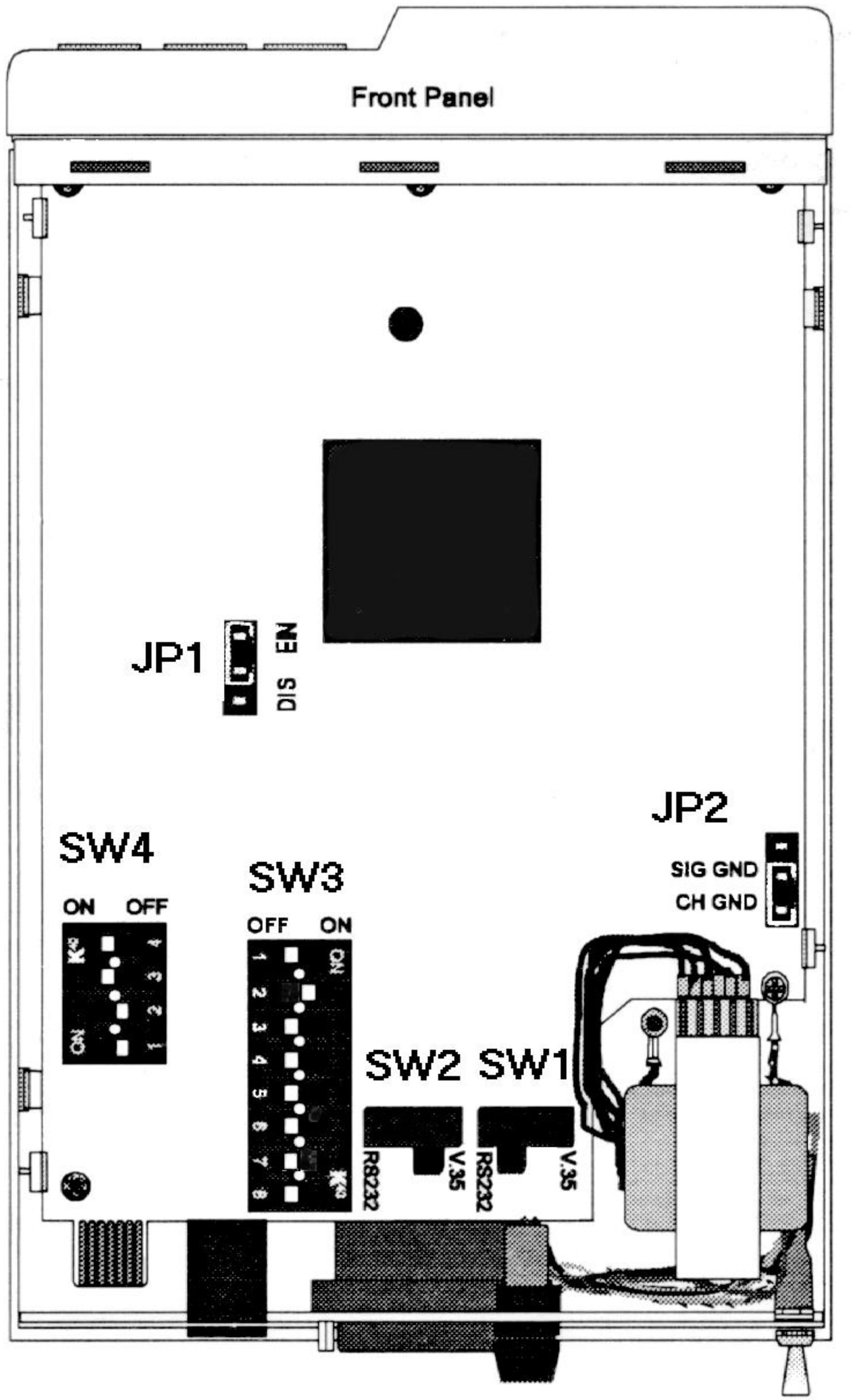


Figure 2.5.1A. DDS/MR64 Line Driver Switch and Jumper Location

Table 2.5.35. Model KX-P2180 Printer Setup

Step	Procedure
1	Turn POWER switch OFF.
2	While pressing and holding FUNCTION switch, turn POWER switch ON. The ON LINE/FUNCTION indicator blinks. Initial setup mode is active.
3	Press and release SUPER QUIET switch until ROW indicators are as follows: FONT OFF PITCH ON FORM LENGTH OFF FONT ON
4	Press TEAR OFF key to toggle interface from parallel to serial. The indicator over the first column illuminates.
5	Press and release SUPER QUIET switch until ROW indicators are as follows: FONT OFF PITCH ON FORM LENGTH ON FONT ON
6	Press TEAR OFF key to toggle protocol from DTR to XON/XOFF. The indicator over the first column illuminates.
7	Press FUNCTION switch to exit initial setup mode. The ON LINE/FUNCTION indicator stops blinking.
8	Press SUPER QUIET switch to enter quiet mode.
9	Press FUNCTION switch to enter function mode. The ON LINE/FUNCTION indicator blinks.
10	Press and release TEAR OFF key until column indicator is blinking over MACRO.
11	Press LOAD PARK switch to save the macro. A beep is heard and the column indicator stops blinking.
12	Press FUNCTION switch to exit function mode. The ON LINE/FUNCTION indicator stops blinking.

Table 2.5.36. Model KX-P1180 Printer Setup

Step	Procedure
	Tools Required: No. 2 Phillips screwdriver
1	Turn POWER switch OFF.
2	While pressing and holding FUNCTION switch, turn POWER switch ON. The ON LINE/FUNCTION indicator blinks. Initial setup mode is active.
3	Press and release SUPER QUIET switch until ROW indicators are as follows: FONT OFF PITCH ON FORM LENGTH OFF FONT ON
4	Press TEAR OFF key to toggle interface from parallel to serial. The indicator over the first column illuminates.
5	Ensure that printer POWER switch is set to OFF.
6	Ensure that RS-232 serial data cable is disconnected from back of printer and that printer power cable is disconnected from facility output.
7	Remove smoked plastic cover, top cover (with paper guide), and platen knob from printer.

Table 2.5.36. Model KX-P1180 Printer Setup -CONT

Step	Procedure
8	Remove upper cabinet from printer by performing the following steps (Figure 2.5.2): a. Raise rear of printer to gain access to underside. b. Insert No. 2 Phillips screwdriver into center of release openings. Push screwdriver in to release hooks. c. While hooks are released, separate upper cabinet from lower cabinet.
9	On serial interface board at rear of printer, set DIP switch SW1-8 to ON position. This selects XON/XOFF protocol.
10	Install upper cabinet, platen knob, smoked plastic cover, and top cover onto printer.
11	Connect RS-232 serial data cable to rear of printer.
12	Connect printer power cable to facility outlet.
13	Turn printer POWER switch to ON.

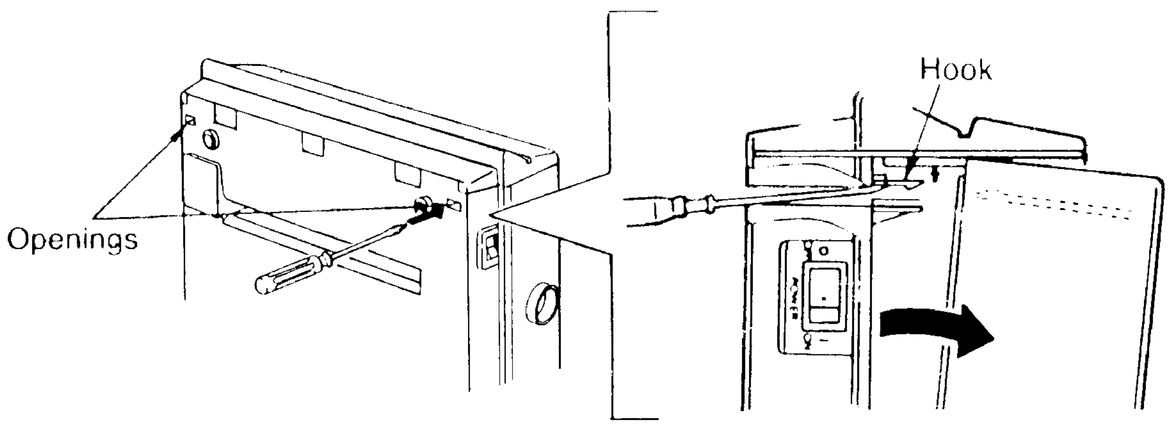


Figure 2.5.2 Upper Cabinet Removal

Table 2.5.37. Model KX-P3123 Printer Setup

Step	Procedure
DEFAULT CONFIGURATION	
NOTE It is not necessary to set up a NEW printer that you have just removed from the box if you intend to use it in the local mode (connected directly to the printer port, J25); the configuration for this mode should have been setup at the factory. The "local" mode is not the same as the factory settings mode mentioned below.	
FACTORY SETTINGS	
NOTE If you suspect that the printer settings have been accidently changed, you should reset the printer to the "factory settings" mode using the following procedure, prior to performing the printer setup procedure (otherwise continue to step 1under printer setup procedure):	

Table 2.5.37. Model KX-P3123 Printer Setup -CONT

Step	Procedure
1	Turn power switch OFF.
2	While pressing the FUNCTION key on the printer, turn the power switch on to enter the setup mode. The ON LINE/FUNCTION will start blinking. Row indicators R1 (FONT), R2 (PITCH), R3 (FORM LENGTH), & R4 (OTHERS) will be blinking.
3	Press LF. You will hear a beep.
4	Press FUNCTION to exit the function mode.
PRINTER SETUP	
1	Turn power switch off.
2	While pressing the FUNCTION key on the printer, turn the power switch on to enter the setup mode. The ON LINE/FUNCTION will start blinking. Row indicators R1 (FONT), R2 (PITCH), R3 (FORM LENGTH), & R4 (OTHERS) will be blinking.
3	**PRINTER (INTERFACE) SETUP** Press and release SUPER QUIET until row indicators are as follows: R1 FONT ON R2 PITCH ON R3 FORM LENGTH OFF R4 OTHERS ON
4	Press TEAR OFF to toggle interface from PARALLEL to SERIAL. The indicator over C1 will light (column indicator C3 is already lit).
	REMOTE PRINTER (ONLY) BAUD RATE SETUP **NOTE** If the printer you are setting up is a remote printer (a printer using a modem), you must perform the following steps (otherwise, go to step 5): a. Press and release SUPER QUIET until row indicators are as follows: R1 FONT OFF R2 PITCH OFF R3 FORM LENGTH ON R4 OTHERS ON b. Press LF to select 2400 baud. Column indicator C4 will be illuminated.
5	**PRINTER (PROTOCOL) SETUP** Press and release SUPER QUIET until row indicators are as follows: R1 FONT ON R2 PITCH ON R3 FORM LENGTH ON R4 OTHERS ON
6	Press TEAR OFF to toggle protocol from DTR to XON/XOFF. The indicators over columns C1,C2, and C3 will be illuminated.
7	Press FUNCTION to exit initial setup mode. The ON LINE/FUNCTION indicator will be illuminated.

Table 2.5.37. Model KX-P3123 Printer Setup -CONT

Step	Procedure
	PRINTER (HANDSHAKE) SETUP
8	Verify that HANDSHAKE on the OID COMMS page is set to XON/XOFF by the AOMC. **NOTE** If HANDSHAKE is not set correctly (to XON/XOFF) on the OID COMMS page by the AOMC, it is possible to overwrite the printer buffer. To verify and/or change the selection for HANDSHAKE, you must: a. Sign on to the OID as a technician. b. Press REVUE SITE CONFIG COMMS. If XON/XOFF appears as the HANDSHAKE selection, press EXIT to return to the 1-minute page; otherwise, you must continue to step c. c. Using the PREV and NEXT keys, move the cursor to the PRINTER port. d. Press CHANG and move cursor to HANDSHAKE. e. Press SEQN until XON/XOFF is selected. f. Press EXIT to exit COMMS page and return to the 1-minute page.
OPTIONAL PROCEDURES	
NOTE The following optional printer procedures are presented to enable the technician to optimize the KX-P3123 printer capabilities.	
	PRINT CURRENT SETTINGS (OPTIONAL) **NOTE** To print the current configuration of the printer, the following procedure is performed: a. Turn power switch off. b. While pressing the FUNCTION key on the printer, turn the power switch on to enter the setup mode. The ON LINE/FUNCTION will start blinking. Row indicators R1 (FONT), R2 (PITCH), R3 (FORM LENGTH), & R4 (OTHERS) will be blinking. c. Press TEAR OFF, LOAD/PARK ON LINE, or FF. The printer will print all current settings. d. Press FUNCTION to exit the function mode.
	SUPER QUIET MODE (OPTIONAL) **NOTE** To allow the printer to function with reduced printer noise (but also with reduced printer speed), the following procedure should be performed: a. Be sure power is on. Make sure that the ON LINE/FUNCTION indicator is not blinking. If it is blinking, press FUNCTION. b. To enter super quiet mode, press SUPERQUIET. You will hear a beep and the SUPERQUIET indicator will illuminate. c. Press FUNCTION. The ON LINE/FUNCTION indicator will start blinking.

Table 2.5.37. Model KX-P3123 Printer Setup -CONT

Step	Procedure
	d. Press and release TEAR OFF until only Row R4 (OTHERS) is illuminated and column C3 (MACRO #1) is blinking. e. Press LOAD PARK to set macro. You will hear a beep and the column indicator C3 will stop blinking and stay lit. f. Press TEAR OFF to save macro. You will hear two beeps and indicator C3 will start blinking. g. Press FUNCTION to exit the function mode. The ON LINE/FUNCTION indicator will stop blinking.
	ZERO SLASH SETUP (OPTIONAL) **NOTE** This procedure causes a slash to be placed across the number 0 (zero) when it is printed. a. Press and release SUPER QUIET until the row indicators are as follows: R1 FONT OFF R2 PITCH OFF R3 FORM LENGTH OFF R4 OTHERS ON b. Press LOAD PARK; C2 indicator will illuminate.

2.5.8 **ACU CPU AND SIO BOARD JUMPER CONFIGURATIONS**

When replacing a CPU board, the technician must conFigure jumpers on a basic XVME-601/6 CPU board (manufacturer's P/N 70601-006) for the slot it is to be installed. This changes the CPU part number to 62828-47006-XX, where XX is determined by the slot number. Similarly, when replacing a RS-232 SIO board , the technician must conFigure jumpers on a basic XVME-490/1 board (manufacturer's P/N 70490-001) to create the 62828-47014-XX part that corresponds to the slot it is installed. The following altered item drawings (located on the following pages) define the jumper configurations for the following ACU and DCP circuit boards:

Part Number	Title
62828-47006	CPU Circuit Card Assembly
-10 ASSY	ACU Primary CPU
-20 ASSY	ACU Secondary CPU
-30 ASSY	DCP Primary CPU
-40 ASSY	DCP Secondary CPU
62828-47008	Circuit Card Assembly, ACU Memory
62828-47013	Circuit Card Assembly, SIO RS-422
62828-47014	Circuit Card Assembly, SIO RS-232
62828-47016	Circuit Card Assembly, Analog/Digital
62828-47018	Circuit Card Assembly, Voice Processor
62828-47028	Circuit Card Assembly, Memory, DCP
62828-47033	Circuit Card Assembly, Digital I/O
62828-47003	Circuit Card Assembly, VME Resistor

2.5.9 **JOHNSON DATA RF MODEM SETUP**

Johnson Data rf modem frequencies are assigned and setup at the depot. Order rf modem part number 62828-40506-1 for 410.075 MHz or 62828-40506-2 for 410.950 Mhz.

DWG NO. 62828-47006 SH 1

REVISIONS				
ZONE	REV	DESCRIPTION	DATE	APPROVED
	A	INC ECNS 16917,16932 (A01-A02)	91-9-9	JLH/TN
	B	INC ECNS 18428,20525 (B01-B02)	93-3-8	TBN
	C	INC ECN 21138 (C01)	93-6-14	TBN
	D	INC ECN 25908 (D01)	95-6-05	CDR
	E	INC E01 (ECN 31214)	97-06-13	DD/CGF
	F	INC ECN AS00192	98-1-8	CGF

NOTES:

1. INTERPRET DRAWING IN ACCORDANCE WITH DOD-STD-100.
2. MATERIAL: MAKE FROM 62828-90092-1.
3. WORKMANSHIP SHALL BE IN ACCORDANCE WITH MIL-STD-454, REQUIREMENT 9.
4. IDENTIFY PER MIL-STD-130, METHOD OPTIONAL, WITHOUT DAMAGE TO PART. LOCATE IN ANY CONVENIENT AREA ON THE PRINTED CIRCUIT BOARD OR REAR OF MOUNTING PANEL. DO NOT OBLITERATE OR OBSCURE VENDOR IDENTIFICATION OR SERIALIZATION.

△5 JUMPERS SUPPLIED WITH FN 1.

JUMPER CONFIGURATION △5

-10 ASSY		-20 ASSY		-30 ASSY		-40 ASSY	
REF DES	DISPOSITION	REF DES	DISPOSITION	REF DES	DISPOSITION	REF DES	DISPOSITION
J1	IN	J1	IN	J1	IN	J1	IN
J2-A	IN	J2-A	IN	J2-A	IN	J2-A	IN
J2-B	OUT	J2-B	OUT	J2-B	OUT	J2-B	OUT
J3	IN	J3	OUT	J3	IN	J3	OUT
J4	IN	J4	IN	J4	IN	J4	IN
J5	IN	J5	OUT	J5	IN	J5	OUT
J6	IN	J6	IN	J6	IN	J6	IN
J7-A	IN	J7-A	IN	J7-A	IN	J7-A	IN
J7-B	OUT	J7-B	OUT	J7-B	OUT	J7-B	OUT
J8-A	IN	J8-A	IN	J8-A	IN	J8-A	IN
J8-B	OUT	J8-B	OUT	J8-B	OUT	J8-B	OUT
J9	OUT	J9	OUT	J9	OUT	J9	OUT
J10	IN	J10	IN	J10	OUT	J10	OUT
J11	OUT	J11	OUT	J11	IN	J11	IN
J12	OUT	J12	OUT	J12	OUT	J12	OUT
J13	OUT	J13	OUT	J13	OUT	J13	OUT
J14	OUT	J14	OUT	J14	OUT	J14	OUT
J15	OUT	J15	OUT	J15	OUT	J15	OUT
J16	IN	J16	IN	J16	IN	J16	IN
J17-A	OUT	J17-A	OUT	J17-A	OUT	J17-A	OUT
J17-B	OUT	J17-B	OUT	J17-B	OUT	J17-B	OUT
J17-C	OUT	J17-C	OUT	J17-C	OUT	J17-C	OUT
J17-D	IN	J17-D	IN	J17-D	IN	J17-D	IN
J18-A	OUT	J18-A	OUT	J18-A	OUT	J18-A	OUT
J18-B	OUT	J18-B	OUT	J18-B	OUT	J18-B	OUT
J18-C	OUT	J18-C	OUT	J18-C	OUT	J18-C	OUT
J18-D	IN	J18-D	IN	J18-D	IN	J18-D	IN
J19-A	OUT	J19-A	OUT	J19-A	OUT	J19-A	OUT
J19-B	OUT	J19-B	OUT	J19-B	OUT	J19-B	OUT
J19-C	OUT	J19-C	OUT	J19-C	OUT	J19-C	OUT
J19-D	IN	J19-D	IN	J19-D	IN	J19-D	IN
J20-A	OUT	J20-A	OUT	J20-A	OUT	J20-A	OUT
J20-B	OUT	J20-B	OUT	J20-B	OUT	J20-B	OUT
J20-C	OUT	J20-C	OUT	J20-C	OUT	J20-C	OUT
J20-D	IN	J20-D	IN	J20-D	IN	J20-D	IN

SH NO.	REV LTR
1	F
2	-

ALTERED ITEM DRAWING

SEE SEPARATE PARTS LIST PL62828-47006

DASH NO.	SERIAL NO.	NEXT ASSY	USED ON
10,20		62828-40300	ASOS
30,40		62828-40070	ASOS
10,20		62828-40044	ASOS

EFFECTIVITY — APPLICATION

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES. TOLERANCES ON FRACTIONS ± — DECIMALS .XX ± — .XXX ± — ANGLES ± —

CONTR 50-SANW-1-00050
DFTG L.KLEIN 91-4-22
CHECKING M.KRAUSE 91-4-30
ENGRG J.R.ROWE
PROJ A.H.LAYMAN
MFG D.A.FRANCKOWIAK
QA W.J.McCONNELL
ILS B.L.TURNBAUGH

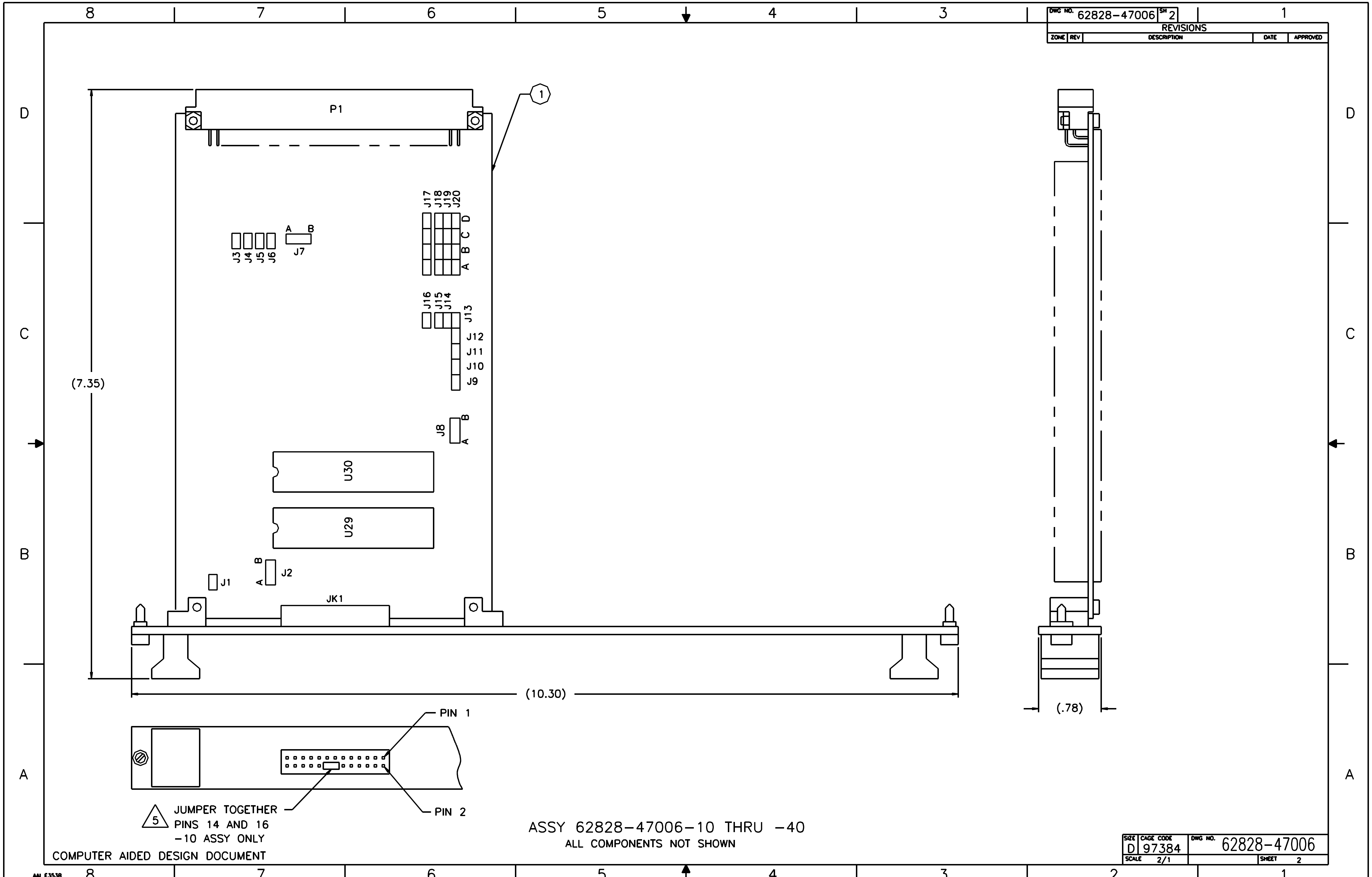
AAI CORPORATION
HUNT VALLEY,MD 21030-0126

CIRCUIT CARD ASSY, CPU

SIZE D CAGE CODE 97384 DWG NO. 62828-47006
SCALE 2/1 SHEET 1 OF 2

COMPUTER AIDED DESIGN DOCUMENT

AAI E3528


DWG NO. 62828-47006 SH 2
REVISIONS
ZONE REV DESCRIPTION DATE APPROVED
P1
1
J17 J18 J19 J20
A B C D
A B
J7
J3 J4 J5 J6
J16 J15 J14
J13
J12
J11
J10
J9
J8
A B
U30
U29
J1
J2
JK1
(7.35)
(10.30)
(.78)
PIN 1
PIN 2
5
JUMPER TOGETHER
PINS 14 AND 16
-10 ASSY ONLY
ASSY 62828-47006-10 THRU -40
ALL COMPONENTS NOT SHOWN
COMPUTER AIDED DESIGN DOCUMENT
SIZE D CAGE CODE 97384 DWG NO. 62828-47006
SCALE 2/1 SHEET 2

DWG NO. 62828-47008 SH 1

REVISIONS				
ZONE	REV	DESCRIPTION	DATE	APPROVED
	A	INC ECNS 16917,16932 (A01-A02)	91-9-9	JLH/TN
	B	INC ECN 17575 (B01).	92-2-14	JLH/TN
	C	INC ECN 20525 (C01).	93-03-24	TBN
	D	INC ECN 25908 (D01).	95-06-05	CDR
	E	INC E01 (ECN 27155)	96-04-30	CDR

NOTES:

1. INTERPRET DRAWING IN ACCORDANCE WITH DOD-STD-100.
2. MATERIAL: MAKE FROM 62828-90087-1.
3. WORKMANSHIP SHALL BE IN ACCORDANCE WITH MIL-STD-454, REQUIREMENT 9.
4. IDENTIFY PER MIL-STD-130, METHOD OPTIONAL, WITHOUT DAMAGE TO PART. LOCATE IN ANY CONVENIENT AREA ON THE PRINTED CIRCUIT BOARD OR REAR OF MOUNTING PANEL. DO NOT OBLITERATE OR OBSCURE VENDOR IDENTIFICATION OR SERIALIZATION.
5. (△5) JUMPERS SUPPLIED WITH FN 1.
6. SWITCH SW8 MAY BE LEFT IN EITHER OPEN OR CLOSED POSITIONS.
7. (△7) INSTALL ON ONE PIN ONLY. JUMPER WILL BE REPOSITIONED TO MOUNT ON BOTH PINS IN THE FIELD.
8. (△8) U52 CONSISTS OF TWO MICROCIRCUITS.

JUMPER CONFIGURATION △5	
REF DES	DISPOSITION
J1	OUT
J2	OUT
J3-A	OUT
J3-B	IN
J4	IN
J5	IN
J6	OUT
J7-A	IN
J7-B	OUT
J8-A	IN
J8-B	OUT
J9-A	IN
J9-B	OUT
J10-A	IN
J10-B	OUT
J11	OUT
J12-A	IN
J12-B	OUT
J13	IN
J14	OUT
J15	IN
J16-A	OUT
J16-B	IN
J17-A	OUT
J17-B	IN
J18-A	IN
J18-B	OUT
J19-A	IN
J19-B	OUT
J20-A	IN
J20-B	OUT
J21	IN
J22	△7
J23	OUT
J24	IN
J25-A	OUT
J25-B	IN
J26-A	OUT
J26-B	OUT
J27-A	IN
J27-B	OUT
J28-A	IN
J28-B	OUT
J29	IN

SH NO.	REV LTR
1	E
2	C
3	E

ALTERED ITEM DRAWING
SEE SEPARATE PARTS LIST PL62828-47008

DASH NO.	SERIAL NO.	NEXT ASSY	USED ON
10,20		62828-40044	ASOS

EFFECTIVITY / APPLICATION

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES. TOLERANCES ON FRACTIONS ± — DECIMALS .XX ± — .XXX ± — ANGLES ± —

CONTR	50-SANW-1-00050
DFTG	L.KLEIN 91-4-22
CHECKING	F.CUSTODERO 91-5-1
ENGRG	J.R.ROWE
PROJ	A.H.LAYMAN
MFG	D.A.FRANCKOWIAK
QA	W.J.McCONNELL
ILS	B.L.TURNBAUGH

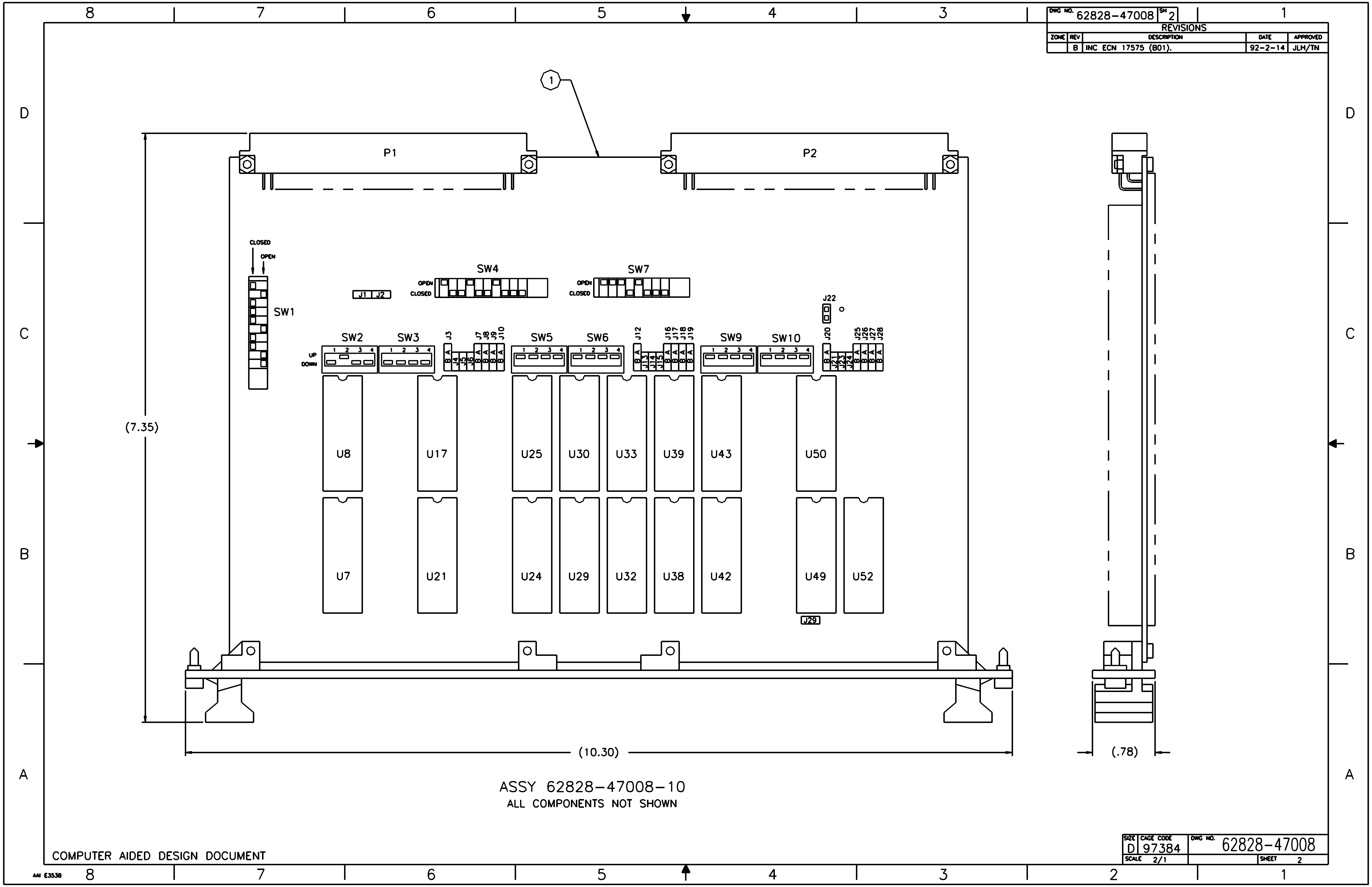
AAI CORPORATION
HUNT VALLEY, MD 21030-0126

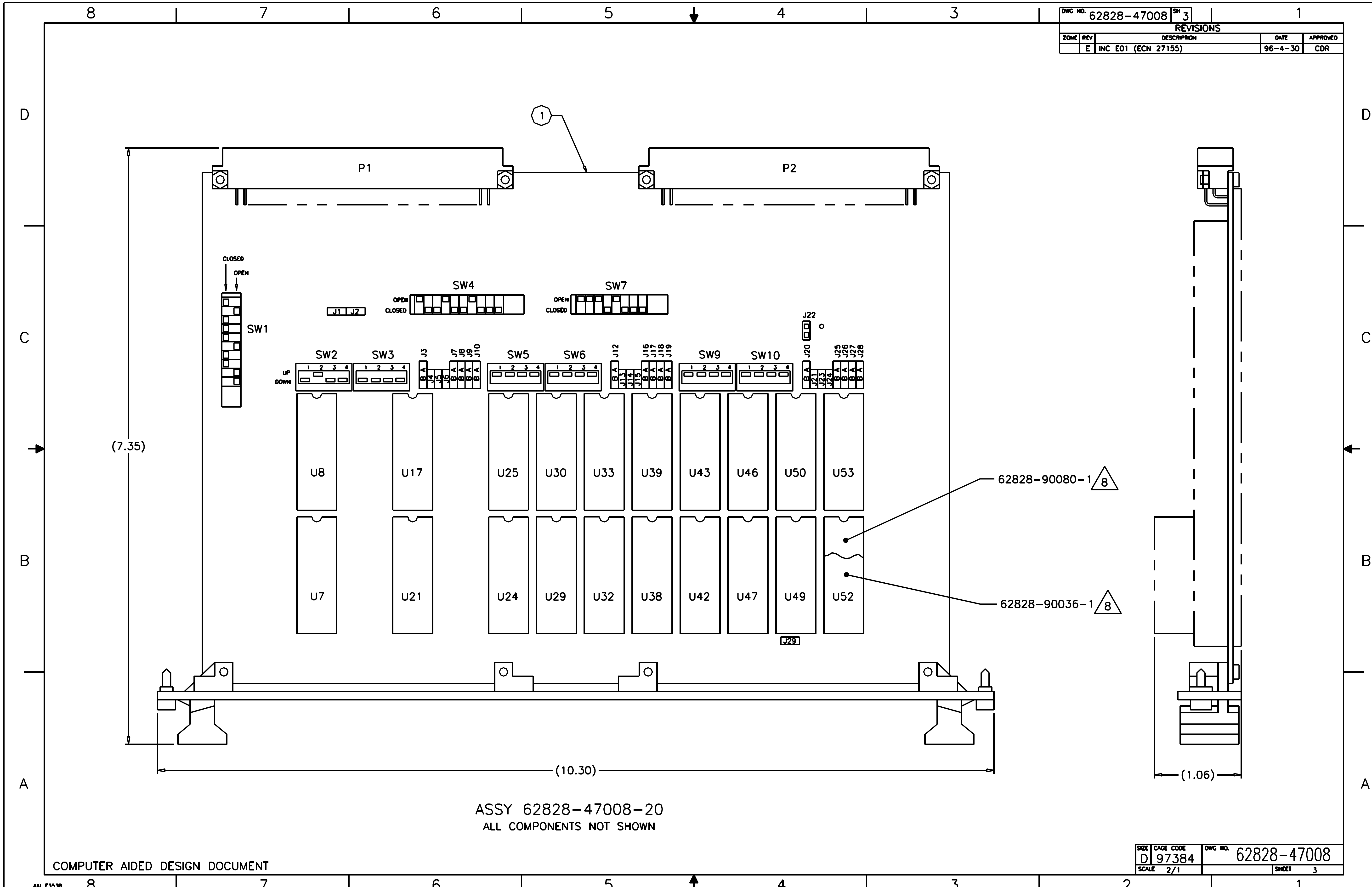
CIRCUIT CARD ASSEMBLY, ACU MEMORY

SIZE D CAGE CODE 97384 DWG NO. 62828-47008
SCALE 2/1 SHEET 1 OF 3

COMPUTER AIDED DESIGN DOCUMENT

AAI E3528


62828-47008
REVISIONS
ZONE REV DESCRIPTION DATE APPROVED
B INC ECN 17575 (B01). 92-2-14 JLH/TN
P1
P2
SW1
SW2
SW3
SW4
SW5
SW6
SW7
SW9
SW10
U8
U17
U25
U30
U33
U39
U43
U50
U7
U21
U24
U29
U32
U38
U42
U49
U52
J22
J29
(7.35)
(10.30)
(.78)
ASSY 62828-47008-10
ALL COMPONENTS NOT SHOWN
COMPUTER AIDED DESIGN DOCUMENT
SIZE D CAGE CODE 97384 DWG NO. 62828-47008
SCALE 2/1 SHEET 2



DWG NO. 62828-47008 SH 3
REVISIONS
ZONE REV DESCRIPTION DATE APPROVED
E INC E01 (ECN 27155) 96-4-30 CDR
P1
P2
SW1
SW2
SW3
SW4
SW5
SW6
SW7
SW9
SW10
U8
U17
U25
U30
U33
U39
U43
U46
U50
U53
U7
U21
U24
U29
U32
U38
U42
U47
U49
U52
J29
(7.35)
(10.30)
(1.06)
62828-90080-1
62828-90036-1
ASSY 62828-47008-20
ALL COMPONENTS NOT SHOWN
COMPUTER AIDED DESIGN DOCUMENT
SIZE D CAGE CODE 97384 DWG NO. 62828-47008
SCALE 2/1 SHEET 3

DWG NO. 62828-47013 SH 1

REVISIONS

ZONE	REV	DESCRIPTION	DATE	APPROVED
	A	INC ECNS 16917,16932 (A01-A02)	91-9-9	JLH/TN
	B	INC ECN 20525 (B01).	93-03-24	TBN
	C	INC ECN 25908 (C01).	95-06-05	CDR
	D	INC D01 (ECN 31214)	97-06-13	DD/CGF

NOTES:

1. INTERPRET DRAWING IN ACCORDANCE WITH DOD-STD-100.
2. MATERIAL: MAKE FROM 62828-90090-1.
3. WORKMANSHIP SHALL BE IN ACCORDANCE WITH MIL-STD-454, REQUIREMENT 9.
4. IDENTIFY PER MIL-STD-130, METHOD OPTIONAL, WITHOUT DAMAGE TO PART. LOCATE IN ANY CONVENIENT AREA ON THE PRINTED CIRCUIT BOARD OR REAR OF MOUNTING PANEL. DO NOT OBLITERATE OR OBSCURE VENDOR IDENTIFICATION OR SERIALIZATION.

△5 JUMPERS SUPPLIED WITH CIRCUIT CARD.

JUMPER CONFIGURATION △5	
REF DES	DISPOSITION
J3-A	OUT
J3-B	IN
J4-A	OUT
J4-B	IN
J5-A	OUT
J5-B	IN
J6-A	OUT
J6-B	IN
J7	OUT
JA1	IN
JA2	OUT
JA3	IN
JA10	IN
JA11	IN
JA12	IN
JA13	IN
JA14	IN
JA15	IN

SH NO.	REV LTR
1	D
2	-

ALTERED ITEM DRAWING

DASH NO.	SERIAL NO.	NEXT ASSY	USED ON
10		62828-40340	ASOS
10		62828-40044	ASOS

EFFECTIVITY / APPLICATION

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES. TOLERANCES ON FRACTIONS DECIMALS ANGLES ± — .XX ± — .XXX ± — ± —

CONTR 50-SANW-1-00050
DFTG T.SOLTAS 91-4-26
CHECKING F.CUSTODERO 91-5-4
ENGRG J.R.ROWE
PROJ A.H.LAYMAN
MFG D.A.FRANCKOWIAK
QA W.J.McCONNELL
ILS B.L.TURNBAUGH

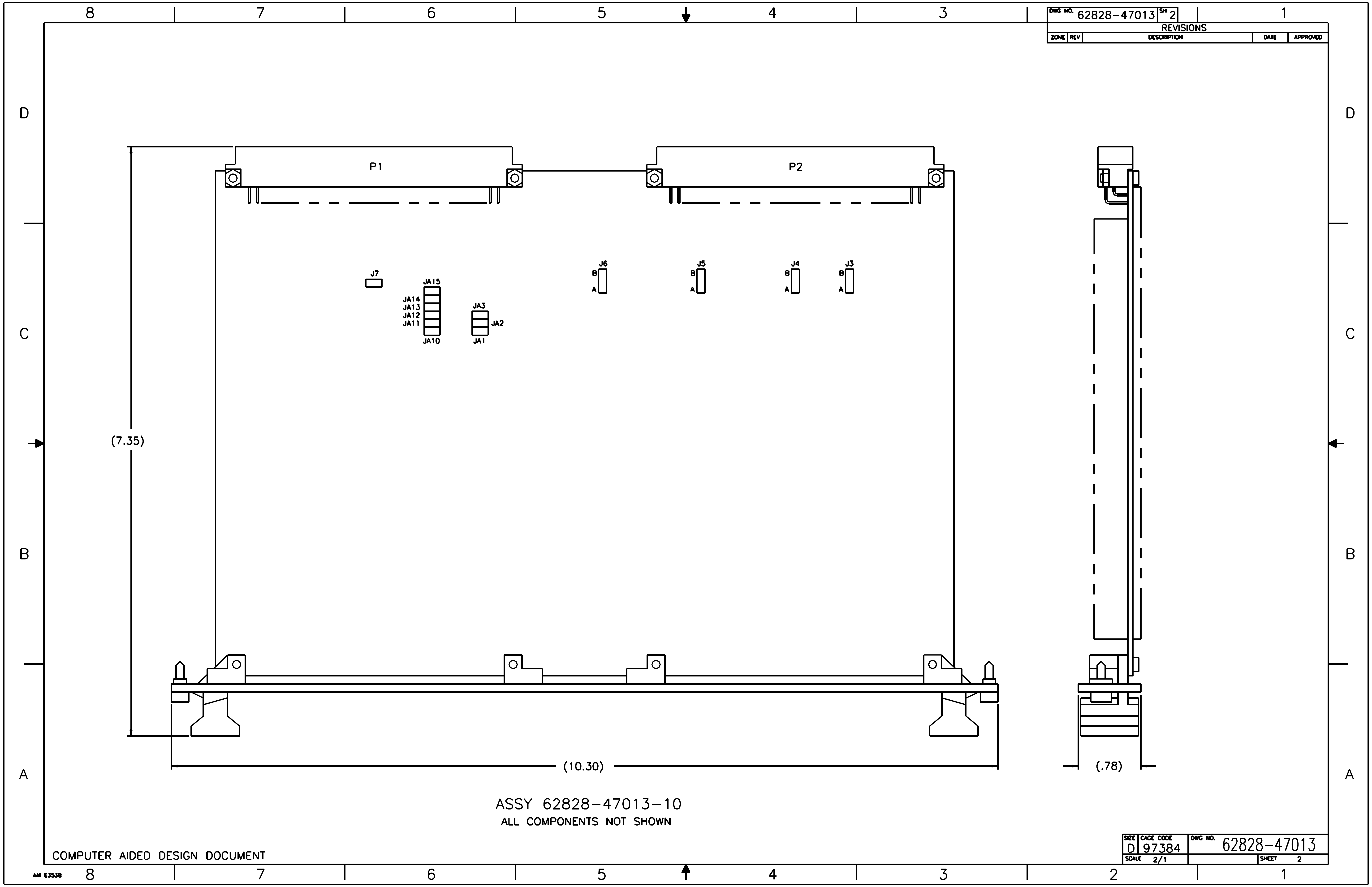
AAI CORPORATION
HUNT VALLEY,MD 21030-0126

CIRCUIT CARD ASSEMBLY, SIO, RS-422

SIZE D CAGE CODE 97384 DWG NO. 62828-47013
SCALE 2/1 SHEET 1 OF 2

COMPUTER AIDED DESIGN DOCUMENT

AAI E3528



62828-47013 SH 2
REVISIONS
ZONE REV DESCRIPTION DATE APPROVED
P1
P2
J7
JA15
JA14
JA13
JA12
JA11
JA10
JA3
JA2
JA1
J6
J5
J4
J3
B
A
(7.35)
(10.30)
(.78)
ASSY 62828-47013-10
ALL COMPONENTS NOT SHOWN
COMPUTER AIDED DESIGN DOCUMENT
SIZE D
CAGE CODE 97384
DWG NO. 62828-47013
SCALE 2/1
SHEET 2
AM E3538

DWG NO.	62828-47014	SH 1

REVISIONS

ZONE	REV	DESCRIPTION	DATE	APPROVED
	A	INC ECNS 16877,16917,16932 (A01-A03)	91-9-9	JLH/TN
	B	INC ECN 20525 (B01).	93-03-24	TBN
	C	INC ECNS 25041 & 25908 (C01-C02).	95-06-22	CDR
	D	INC D01 (ECN 31214)	97-06-13	DD/CGF

NOTES:

1. INTERPRET DRAWING IN ACCORDANCE WITH DOD-STD-100.
2. MATERIAL: MAKE FROM 62828-90089-1.
3. WORKMANSHIP SHALL BE IN ACCORDANCE WITH MIL-STD-454, REQUIREMENT 9.
4. IDENTIFY PER MIL-STD-130, METHOD OPTIONAL, WITHOUT DAMAGE TO PART. LOCATE IN ANY CONVENIENT AREA ON THE PRINTED CIRCUIT BOARD OR REAR OF MOUNTING PANEL. DO NOT OBLITERATE OR OBSCURE VENDOR IDENTIFICATION OR SERIALIZATION.
5. (5) JUMPERS SUPPLIED WITH CIRCUIT CARD.
6. -80 THRU -110 ASSEMBLIES APPEAR AS LINE CALLOUTS ON DRAWING 62828-40070.

   -30 THRU -60 ASSEMBLIES APPEAR AS LINE CALLOUTS ON DRAWING 62828-40044.

JUMPER CONFIGURATION (5)

ASSY -10		ASSY -20		ASSY -30		ASSY -40		ASSY -50		ASSY -60	
REF DES	DISPOSITION	REF DES	DISPOSITION	REF DES	DISPOSITION	REF DES	DISPOSITION	REF DES	DISPOSITION	REF DES	DISPOSITION
JA1	IN	JA1	IN	JA1	IN	JA1	IN	JA1	IN	JA1	IN
JA2	OUT	JA2	OUT	JA2	OUT	JA2	OUT	JA2	OUT	JA2	OUT
JA3	IN	JA3	IN	JA3	IN	JA3	IN	JA3	IN	JA3	IN
JA10	OUT	JA10	IN	JA10	OUT	JA10	IN	JA10	OUT	JA10	IN
JA11	IN	JA11	OUT	JA11	OUT	JA11	IN	JA11	IN	JA11	OUT
JA12	IN	JA12	IN	JA12	IN	JA12	OUT	JA12	OUT	JA12	OUT
JA13	IN	JA13	IN	JA13	IN	JA13	IN	JA13	IN	JA13	IN
JA14	IN	JA14	IN	JA14	IN	JA14	IN	JA14	IN	JA14	IN
JA15	IN	JA15	IN	JA15	IN	JA15	IN	JA15	IN	JA15	IN
J1	OUT	J1	OUT	J1	OUT	J1	OUT	J1	OUT	J1	OUT

JUMPER CONFIGURATION (5)

ASSY -70		ASSY -80		ASSY -90		ASSY -100		ASSY -110		ASSY -120	
REF DES	DISPOSITION	REF DES	DISPOSITION	REF DES	DISPOSITION	REF DES	DISPOSITION	REF DES	DISPOSITION	REF DES	DISPOSITION
JA1	OUT	JA1	OUT	JA1	OUT	JA1	OUT	JA1	OUT	JA1	IN
JA2	OUT	JA2	OUT	JA2	OUT	JA2	OUT	JA2	OUT	JA2	OUT
JA3	IN	JA3	IN	JA3	IN	JA3	IN	JA3	IN	JA3	IN
JA10	OUT	JA10	IN	JA10	OUT	JA10	IN	JA10	OUT	JA10	OUT
JA11	IN	JA11	OUT	JA11	OUT	JA11	IN	JA11	IN	JA11	OUT
JA12	IN	JA12	IN	JA12	IN	JA12	OUT	JA12	OUT	JA12	OUT
JA13	IN	JA13	IN	JA13	IN	JA13	IN	JA13	IN	JA13	IN
JA14	IN	JA14	IN	JA14	IN	JA14	IN	JA14	IN	JA14	IN
JA15	IN	JA15	IN	JA15	IN	JA15	IN	JA15	IN	JA15	IN
J1	OUT	J1	OUT	J1	OUT	J1	OUT	J1	OUT	J1	OUT

SH NO.	REV LTR
1	D
2	C

ALTERED ITEM DRAWING

DASH NO.	SERIAL NO.	NEXT ASSY	USED ON
10 THRU 60		62828-40340	ASOS
120		62828-40300	SINGLE CAB ASOS
80 THRU 110		62828-40000	ASOS
70		62828-40070	ASOS
30 THRU 60		62828-40000	ASOS
10,20		62828-40044	ASOS
EFFECTIVITY		APPLICATION	

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES. TOLERANCES ON FRACTIONS DECIMALS ANGLES ± — .XX ± — .XXX ± — ± —

CONTR	50-SANW-1-00050
DFTG	T.SOLTAS 91-4-26
CHECKING	F.CUSTODERO 91-5-2
ENGRG	J.R.ROWE
PROJ	A.H.LAYMAN
MFG	D.A.FRANCKOWIAK
QA	W.J.McCONNELL
ILS	B.L.TURNBAUGH

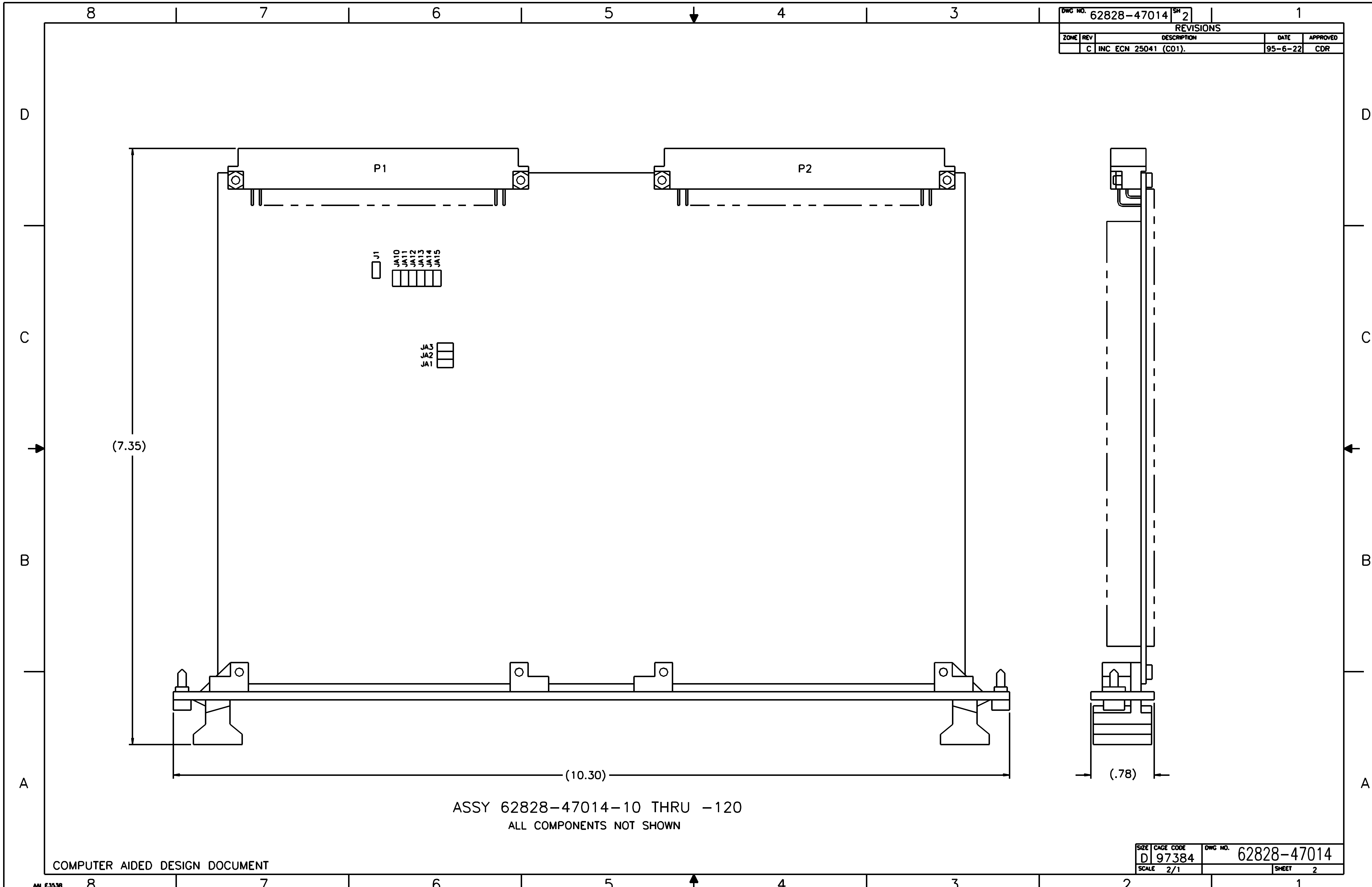
AAI CORPORATION
HUNT VALLEY,MD 21030-0126

CIRCUIT CARD ASSEMBLY, SIO, RS-232

SIZE D | CAGE CODE 97384 | DWG NO. 62828-47014
SCALE 2/1 | SHEET 1 OF 2

COMPUTER AIDED DESIGN DOCUMENT

AAI E3528


DWG NO. 62828-47014 SH 2
REVISIONS
ZONE REV DESCRIPTION DATE APPROVED
C INC ECN 25041 (C01). 95-6-22 CDR
P1
P2
J1
JA10 JA11 JA12 JA13 JA14 JA15
JA3
JA2
JA1
(7.35)
(10.30)
(.78)
ASSY 62828-47014-10 THRU -120
ALL COMPONENTS NOT SHOWN
COMPUTER AIDED DESIGN DOCUMENT
SIZE D CAGE CODE 97384 DWG NO. 62828-47014
SCALE 2/1 SHEET 2

DWG NO. 62828-47016 SH 1

REVISIONS				
ZONE	REV	DESCRIPTION	DATE	APPROVED
	A	INC ECNS 16917,16932 (A01-A02)	91-9-9	JLH/TN
	B	INC ECN 20525 (B01)	93-03-25	TBN
	C	INC ECN 25908 (C01)	95-06-05	CDR
	D	INC D01 (ECN 28665)	96-05-28	CDR
	E	INC E01 (ECN 31214)	97-06-13	DD/CGF

NOTES:

1. INTERPRET DRAWING IN ACCORDANCE WITH DOD-STD-100.
2. MATERIAL: MAKE FROM 62828-90091-1.
3. WORKMANSHIP SHALL BE IN ACCORDANCE WITH MIL-STD-454, REQUIREMENT 9.
4. IDENTIFY PER MIL-STD-130, METHOD OPTIONAL, WITHOUT DAMAGE TO PART. LOCATE IN ANY CONVENIENT AREA ON THE PRINTED CIRCUIT BOARD OR REAR OF MOUNTING PANEL. DO NOT OBLITERATE OR OBSCURE VENDOR IDENTIFICATION OR SERIALIZATION.

△5 JUMPERS SUPPLIED WITH CIRCUIT CARD.

JUMPER CONFIGURATION △5			
-10 ASSY		-20 ASSY	
REF DES	DISPOSITION	REF DES	DISPOSITION
J1-A	OUT	J1-A	OUT
J1-B	IN	J1-B	IN
J2-A	IN	J2-A	IN
J2-B	OUT	J2-B	OUT
J3-A	OUT	J3-A	OUT
J3-B	IN	J3-B	IN
J4-A	OUT	J4-A	OUT
J4-B	IN	J4-B	IN
J5-A	OUT	J5-A	OUT
J5-B	IN	J5-B	IN
J6 THRU J9	OUT	J6 THRU J9	OUT
J10	IN	J10	IN
J11	IN	J11	IN
J12	IN	J12	IN
J13 THRU J20	OUT	J13 THRU J20	OUT
J21-A	IN	J21-A	IN
J21-B	OUT	J21-B	OUT
J21-C	IN	J21-C	IN
J21-D	OUT	J21-D	OUT
J22-A	IN	J22-A	IN
J22-B	OUT	J22-B	OUT
J22-C	OUT	J22-C	OUT
J22-D	OUT	J22-D	OUT
J23	OUT	J23	OUT
J24	OUT	J24	OUT
J25	IN	J25	IN
J26	IN	J26	IN
J27	IN	J27	IN
J28	OUT	J28	OUT
J29	IN	J29	IN
J30	IN	J30	IN
J31	IN	J31	OUT
J32	OUT	J32	OUT

SH NO.	REV LTR
1	E
2	-

ALTERED ITEM DRAWING

DASH NO.	SERIAL NO.	NEXT ASSY	USED ON
10		62828-40340	ASOS
20		62828-40000	ASOS
10		62828-40070	ASOS
10		62828-40044	ASOS
EFFECTIVITY		APPLICATION	

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES. TOLERANCES ON FRACTIONS ± — DECIMALS .XX ± — .XXX ± — ANGLES ± —

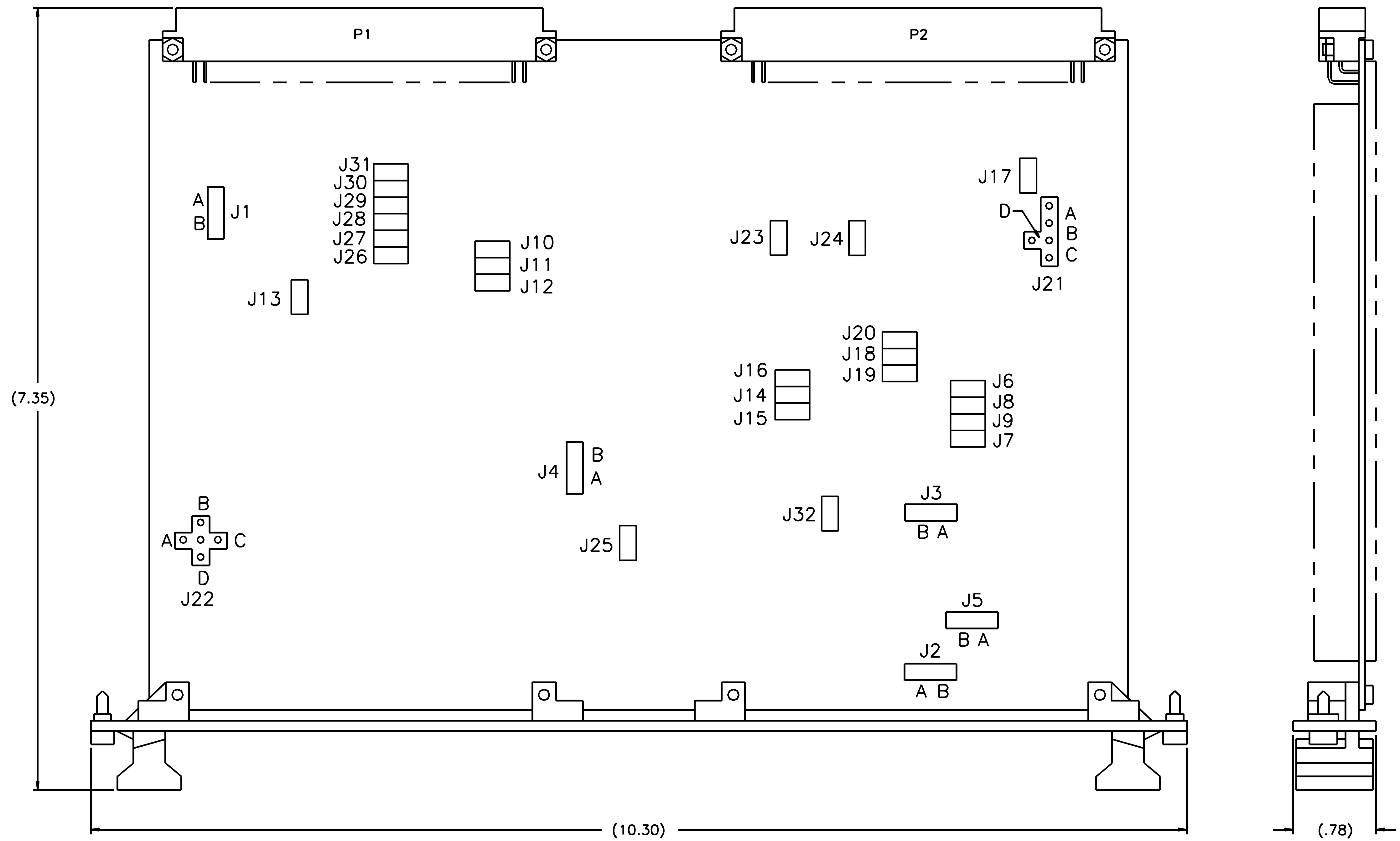
CONTR 50-SANW-1-00050
DFTG L.KLEIN 91-4-22
CHECKING F.CUSTODERO 91-5-2
ENGRG J.R.ROWE
PROJ A.H.LAYMAN
MFG D.A.FRANCKOWIAK
QA W.J.McCONNELL
ILS B.L.TURNBAUGH

AAI CORPORATION
HUNT VALLEY, MD 21030-0126

CIRCUIT CARD ASSEMBLY, ANALOG/DIGITAL

SIZE D CAGE CODE 97384 DWG NO. 62828-47016
SCALE 2/1 SHEET 1 OF 2

COMPUTER AIDED DESIGN DOCUMENT



ASSY 62828-47016-10 AND -20

ALL COMPONENTS NOT SHOWN

COMPUTER AIDED DESIGN DOCUMENT

DWG NO.	SH
62828-47016	2

REVISIONS

ZONE	REV	DESCRIPTION	DATE	APPROVED

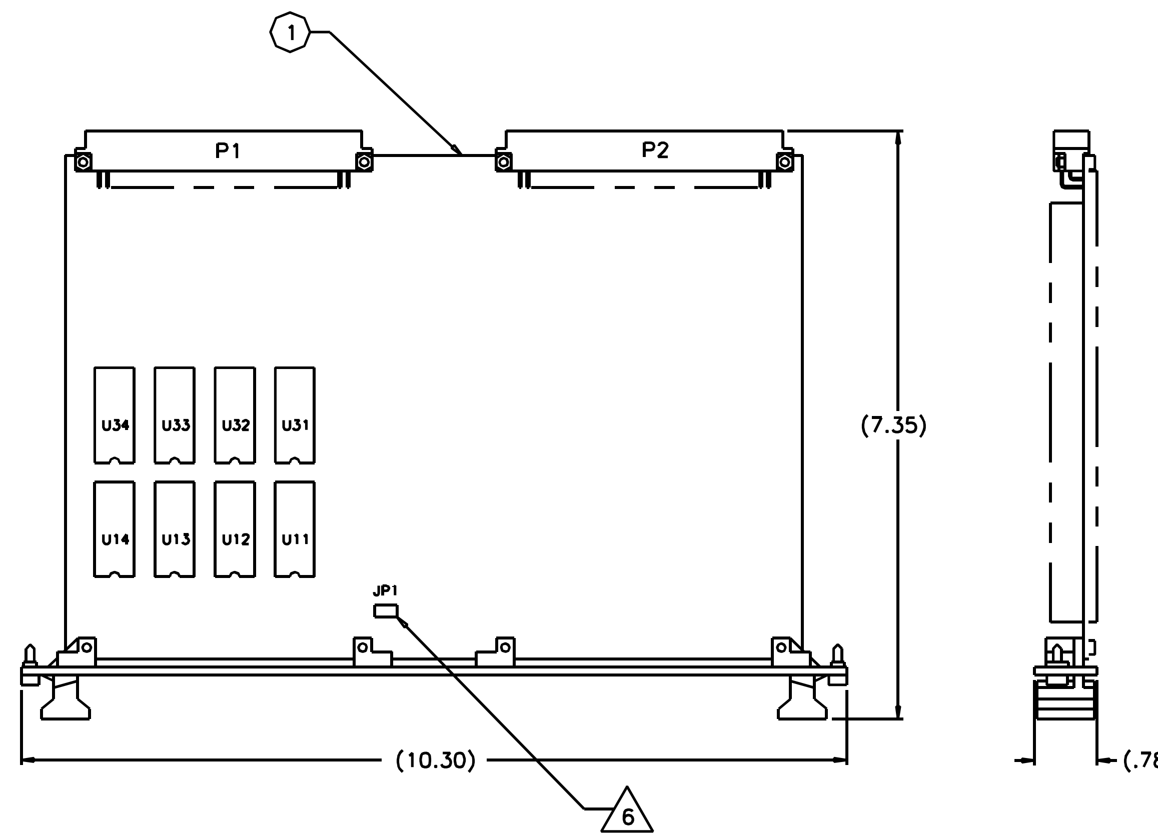
SIZE	CAGE CODE	DWG NO.
D	97384	62828-47016
SCALE 2/1		SHEET 2

DWG NO. 62828-47018 SH 1

REVISIONS				
ZONE	REV	DESCRIPTION	DATE	APPROVED
	A	INC ECNS 16917,16932 (A01-A02)	91-9-9	JLH/TN
	B	INC ECNS 20525, 20790 (B01-B02).	93-04-13	TBN
	C	INC ECN 25908 (C01).	95-06-06	CDR
	D	INC D01 (ECN 31214).	97-06-13	DD/CGF

NOTES:

1. INTERPRET DRAWING IN ACCORDANCE WITH DOD-STD-100.
2. MATERIAL: MAKE FROM 62828-90084-1.
3. WORKMANSHIP SHALL BE IN ACCORDANCE WITH MIL-STD-454, REQUIREMENT 9.
4. IDENTIFY PER MIL-STD-130, METHOD OPTIONAL, WITHOUT DAMAGE TO PART. LOCATE IN ANY CONVENIENT AREA ON THE PRINTED CIRCUIT BOARD OR REAR OF MOUNTING PANEL. DO NOT OBLITERATE OR OBSCURE VENDOR IDENTIFICATION OR SERIALIZATION.
5. (△) ASSY NUMBER 62828-47018-10 CONSISTS OF TWO CIRCUIT CARDS, AN AUDIO CARD AND A CPU CARD. THE ALTERATIONS SHOWN ARE FOR THE CPU CARD ONLY. THE AUDIO CARD WILL REMAIN AS PART OF THE ASSY BUT WILL NOT BE ALTERED.
6. (△) REMOVE JUMPER AT JP1 AND DISCARD.



ASSY 62828-47018-10 (5)

ALL COMPONENTS NOT SHOWN

ALTERED ITEM DRAWING

SEE SEPARATE PARTS LIST PL62828-47018

10		62828-40340	ASOS
10		62828-40044	ASOS
DASH NO.	SERIAL NO.	NEXT ASSY	USED ON
EFFECTIVITY		APPLICATION	

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES. TOLERANCES ON FRACTIONS ± — DECIMALS .XX ± — .XXX ± — ANGLES ± —

CONTR	50-SANW-1-00050
DFTG	L.KLEIN 91-4-22
CHECKING	F.CUSTODERO 91-5-4
ENGRG	J.R.ROWE
PROJ	A.H.LAYMAN
MFG	D.A.FRANCKOWIAK
QA	W.J.McCONNELL
ILS	B.L.TURNBAUGH

AAI CORPORATION
HUNT VALLEY,MD 21030-0126

CIRCUIT CARD ASSEMBLY, VOICE PROCESSOR

SIZE D CAGE CODE 97384 DWG NO. 62828-47018

SCALE 1/1 SHEET 1 OF 1

COMPUTER AIDED DESIGN DOCUMENT

DWG NO. 62828-47028 SH 1

ZONE	REV	DESCRIPTION	DATE	APPROVED
	A	INC ECNS 16917,16932 (A01-A02)	91-9-9	JLH/TN
	B	INC ECN 17575 (B01).	92-2-14	JLH/TN
	C	INC ECN 20525 (C01).	93-03-25	TBN
	D	INC ECN 21226 (D01).	93-06-14	TBN
	E	INC ECN 22702 (E01).	94-10-11	TBN
	F	INC ECN 25908 (F01).	95-06-05	CDR

NOTES:

1. INTERPRET DRAWING IN ACCORDANCE WITH DOD-STD-100.
2. MATERIAL: MAKE FROM 62828-90086-1.
3. WORKMANSHIP SHALL BE IN ACCORDANCE WITH MIL-STD-454, REQUIREMENT 9.
4. IDENTIFY PER MIL-STD-130, METHOD OPTIONAL, WITHOUT DAMAGE TO PART. LOCATE IN ANY CONVENIENT AREA ON THE PRINTED CIRCUIT BOARD OR REAR OF MOUNTING PANEL. DO NOT OBLITERATE OR OBSCURE VENDOR IDENTIFICATION OR SERIALIZATION.

△5 JUMPERS SUPPLIED WITH FN 1.

△6 JUMPER WILL BE REMOVED DURING FIELD INSTALLATION (DISPOSITION = OUT).

△7 INSERT JUMPER AT THIS LOCATION DURING FIELD INSTALLATION (DISPOSITION = IN).

8. -20 ASSEMBLY APPEARS AS LINE CALLOUT IN DRAWING 62828-40044.

JUMPER CONFIGURATION △5

REF DES	DISPOSITION	REF DES	DISPOSITION	REF DES	DISPOSITION
J1	IN	J21	IN	J39-A	OUT
J2-A	IN	J22	IN	J39-B	IN
J2-B	OUT	J23	IN	J40	IN
J3-A	OUT	J24	OUT	J41	IN
J3-B	IN	J25-A	IN	J42-A	IN
J4	OUT	J25-B	OUT	J42-B	OUT
J5	OUT	J26-A	OUT	J42-C	OUT
J6	OUT	J26-B	IN	J43-A	OUT
J7	OUT	J27-A	OUT	J43-B	IN
J8	OUT	J27-B	IN	J44-A	IN
J9	IN	J28-A	OUT	J44-B	OUT
J10	IN	J28-B	IN	J45-A	IN
J11	IN	J29-A	OUT	J45-B	OUT
J12	IN	J29-B	IN	J46-A	IN
J13	OUT	J30	IN	J46-B	OUT
J14	IN	J31	IN	J47	OUT
J15	OUT	J32	IN	J48	IN
J16	IN	J33	OUT	J49	IN
J17-A	IN	J34-A	IN △6	J50	OUT
J17-B	OUT	J34-B	OUT △7	J51	IN
J18-A	IN	J35	OUT	J52	IN
J18-B	OUT	J36	IN		
J19-A	IN	J37	IN		
J19-B	OUT	J38-A	IN		
J20-A	IN	J38-B	OUT		
J20-B	OUT	J38-C	OUT		

SH NO.	REV LTR
1	F
2	E
3	D

ALTERED ITEM DRAWING
SEE SEPARATE PARTS LIST PL62828-47028

DASH NO.	SERIAL NO.	NEXT ASSY	USED ON
20		62828-40044	ASOS
10		62828-40070	ASOS

EFFECTIVITY — APPLICATION

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES. TOLERANCES ON FRACTIONS ± — DECIMALS .XX ± — .XXX ± — ANGLE ± —

CONTR 50-SANW-1-00050
DFTG T.SOLTAS 91-4-30
CHECKING F.CUSTODERO 91-5-4
ENGRG J.R.ROWE
PROJ A.H.LAYMAN
MFG D.A.FRANCKOWIAK
QA W.J.McCONNELL
ILS B.L.TURNBAUGH

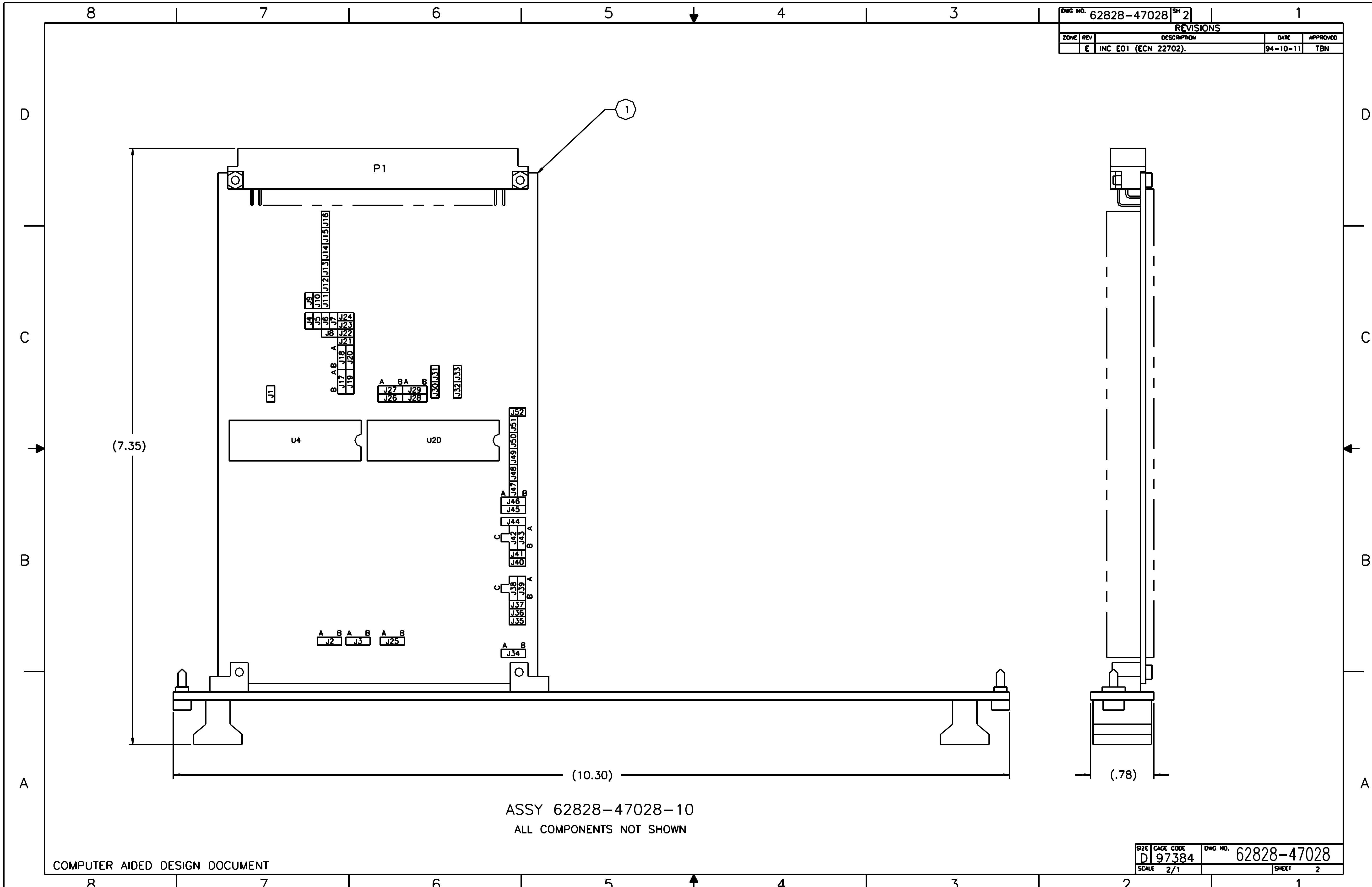
AAI CORPORATION
HUNT VALLEY,MD 21030-0126

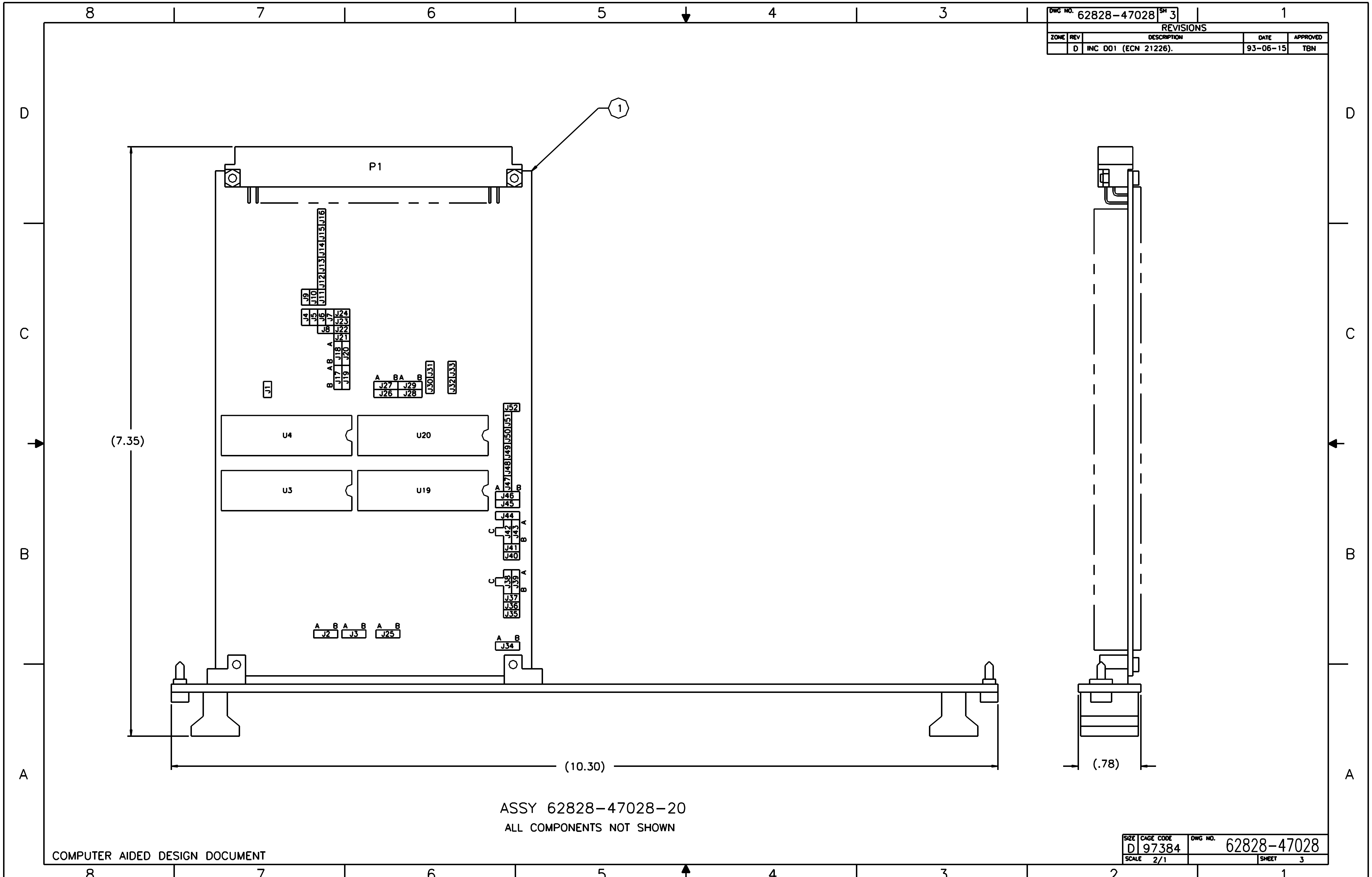
CIRCUIT CARD ASSEMBLY, MEMORY

SIZE D CAGE CODE 97384 DWG NO. 62828-47028
SCALE 2/1 SHEET 1 OF 3

COMPUTER AIDED DESIGN DOCUMENT

AAI E3528


DWG NO. 62828-47028 SH 2
REVISIONS
ZONE REV DESCRIPTION DATE APPROVED
E INC E01 (ECN 22702). 94-10-11 TBN
P1
U4
U20
(7.35)
(10.30)
(.78)
ASSY 62828-47028-10
ALL COMPONENTS NOT SHOWN
SIZE D CAGE CODE 97384 DWG NO. 62828-47028
SCALE 2/1 SHEET 2
COMPUTER AIDED DESIGN DOCUMENT



DWG NO. 62828-47028 SH 3
REVISIONS
ZONE | REV | DESCRIPTION | DATE | APPROVED
D | INC 001 (ECN 21226). | 93-06-15 | TBN
P1
U4
U20
U3
U19
(7.35)
(10.30)
(.78)
ASSY 62828-47028-20
ALL COMPONENTS NOT SHOWN
COMPUTER AIDED DESIGN DOCUMENT
SIZE D
CAGE CODE 97384
DWG NO. 62828-47028
SCALE 2/1
SHEET 3

DWG NO. 62828-47033 SH 1

REVISIONS

ZONE	REV	DESCRIPTION	DATE	APPROVED
	A	INC ECNS 16917,16932 (A01-A02)	91-9-9	JLH/TN
	B	INC ECN 20680 (B01).	93-6-28	TBN
	C	INC ECN 25908 (C01).	95-6-05	CDR
	D	INC D01 (ECN 31214)	97-06-13	DD/CGF

NOTES:

1. INTERPRET DRAWING IN ACCORDANCE WITH DOD-STD-100.
2. MATERIAL: MAKE FROM 62828-90088-1.
3. WORKMANSHIP SHALL BE IN ACCORDANCE WITH MIL-STD-454, REQUIREMENT 9.
4. IDENTIFY PER MIL-STD-130, METHOD OPTIONAL, WITHOUT DAMAGE TO PART. LOCATE IN ANY CONVENIENT AREA ON THE PRINTED CIRCUIT BOARD OR REAR OF MOUNTING PANEL. DO NOT OBLITERATE OR OBSCURE VENDOR IDENTIFICATION OR SERIALIZATION.

△5 JUMPERS SUPPLIED WITH CIRCUIT CARD.

JUMPER CONFIGURATION △5	
REF DES	DISPOSITION
J1	IN
J2	OUT
J3	IN
JA1	IN
JA2	IN
JA3	IN
JA10	IN
JA11	OUT
JA12	IN
JA13	OUT
JA14	IN
JA15	IN

SH NO.	REV LTR
1	D
2	–

ALTERED ITEM DRAWING

DASH NO.	SERIAL NO.	NEXT ASSY	USED ON
10		62828-40340	ASOS
10		62828-40070	ASOS
10		62828-40044	ASOS

EFFECTIVITY / APPLICATION

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES. TOLERANCES ON FRACTIONS ± — DECIMALS .XX ± — .XXX ± — ANGLES ± —

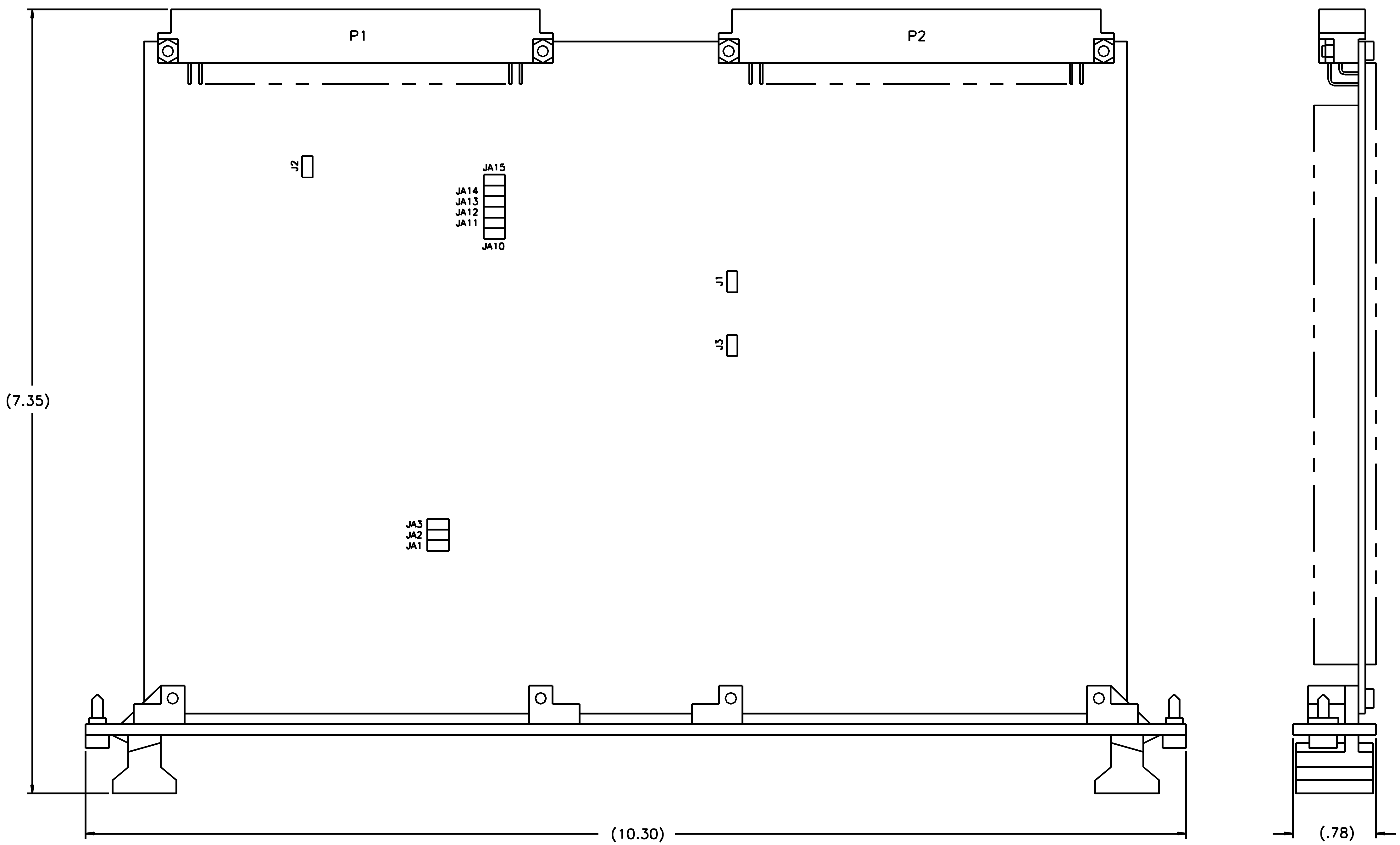
CONTR 50-SANW-1-00050
DFTG T.SOLTAS 91-4-29
CHECKING F.CUSTODERO 91-5-2
ENGRG J.R.ROWE
PROJ A.H.LAYMAN
MFG D.A.FRANCKOWIAK
QA W.J.McCONNELL
ILS B.L.TURNBAUGH

AAI CORPORATION
HUNT VALLEY,MD 21030-0126

CIRCUIT CARD ASSEMBLY, DIGITAL I/O

SIZE D CAGE CODE 97384 DWG NO. 62828-47033
SCALE 2/1 SHEET 1 OF 2

COMPUTER AIDED DESIGN DOCUMENT



ASSY 62828-47033-10

ALL COMPONENTS NOT SHOWN

DWG NO. 62828-47033	SH 2

REVISIONS

ZONE	REV	DESCRIPTION	DATE	APPROVED

COMPUTER AIDED DESIGN DOCUMENT

SIZE	CAGE CODE	DWG NO.
D	97384	62828-47033
SCALE 2/1		SHEET 2

DWG NO. 62828-47003 SH 1

REVISIONS				
ZONE	REV	DESCRIPTION	DATE	APPROVED
	A	INC ECN 15398,15933,15948,16431,16831 (A01-A05)	91-8-31	SL/TN
	B	INC ECN 20517 (B01).	93-3-12	TBN
	C	INC ECN 21701 (C01).	93-08-06	TBN
	D	INC ECN 25072 (D01).	94-10-21	TBN
	E	INC E01-E02 (ECN 25664 & 25908)	95-09-18	CDR
	F	INC F01-F02 (ECNS 27496 & 28323)	96-04-30	CDR

NOTES:

1. INTERPRET DRAWING IN ACCORDANCE WITH DOD-STD-100.
2. SOLDER PER MIL-STD-454, REQUIREMENT 5 USING FN 9.
3. WORKMANSHIP SHALL BE IN ACCORDANCE WITH MIL-STD-454, REQUIREMENT 9.
4. (△) SQUARE (▫) INDICATES PIN 1 LOCATION.
5. (△) ELECTROSTATIC DISCHARGE CONTROL PROGRAM FOR PROTECTION OF ELECTRICAL AND ELECTRONIC PARTS. ASSEMBLIES AND EQUIPMENT SHALL BE IN ACCORDANCE WITH DOD-STD-1686, CLASS 2 AND DOD-HDBK-263. PLACE LABEL IN A CLEAR VISIBLE AREA ON THE COMPONENT SIDE.
6. INSTALL ONLY THE PARTS INDICATED ON PARTS LIST. INSTALL JUMPER WIRE (FN 10) ON COMPONENT SIDE AT LOCATIONS SPECIFIED IN JUMPER CHART. INSTALL JUMPER WIRE (FN 18) ON -20 ASSEMBLY, U2-6 TO R141-2 LOCATION ONLY. USE INSULATION (FNS 11 AND 19) AS REQUIRED TO PREVENT SHORTING.
7. (△) MARK APPROPRIATE DASH NUMBER WITH .12 HIGH GOTHIC STYLE CHARACTERS USING BLACK LACQUER PER TT-L-58, TYPE II, CLASS 2. LOCATE APPROXIMATELY AS SHOWN.
8. E1 THRU E4 ARE PADS ONLY (NO COMPONENTS).
9. THIS IS A SERIALIZATION CONTROLLED ITEM.
10. FN 14 (S1) SWITCH SETTINGS, WHICH ARE SITE SPECIFIC, ARE DEFINED FOR INSTALLATION.

JUMPER CHART

-10		-20		-30	
FROM	TO	FROM	TO	FROM	TO
R1-1	R1-2	R75-1	R75-2	R1-1	R1-2
R6-1	R6-2	R78-1	R78-2	R6-1	R6-2
R45-1	R45-2	U2-6	R141-2	R7-1	R7-2
R48-1	R48-2			R75-1	R75-2
R78-1	R78-2			R78-1	R78-2
R80-1	R80-2			R80-1	R80-2
E1	E3			E1	E3
E2	E4			E2	E4
R96-1	R96-2				
R99-1	R99-2				

SHT NO.	REV LTR
1	F
2	E

CAUTION
SENSITIVE ELECTRONIC DEVICES

SEE SEPARATE PARTS LIST PL62828-47003

DASH NO.	SERIAL NO.	NEXT ASSY	USED ON
30		62828-40340	ASOS
20		62828-40070	ASOS
10		62828-40044	ASOS

EFFECTIVITY — APPLICATION

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES. TOLERANCES ON FRACTIONS ± — DECIMALS .XX ± — .XXX ± — ANGLES ± —

CONTR	50-SANW-1-00050
DFTG	W.BREHM 90-12-17
CHECKING	E.EVANS 91-01-02
ENGRG	N.SUTER
PROJ	J.ROWE
MFR	D.FRANCKOWIAK
QA	W.McCONNELL
ILS	B.TURNBAUGH

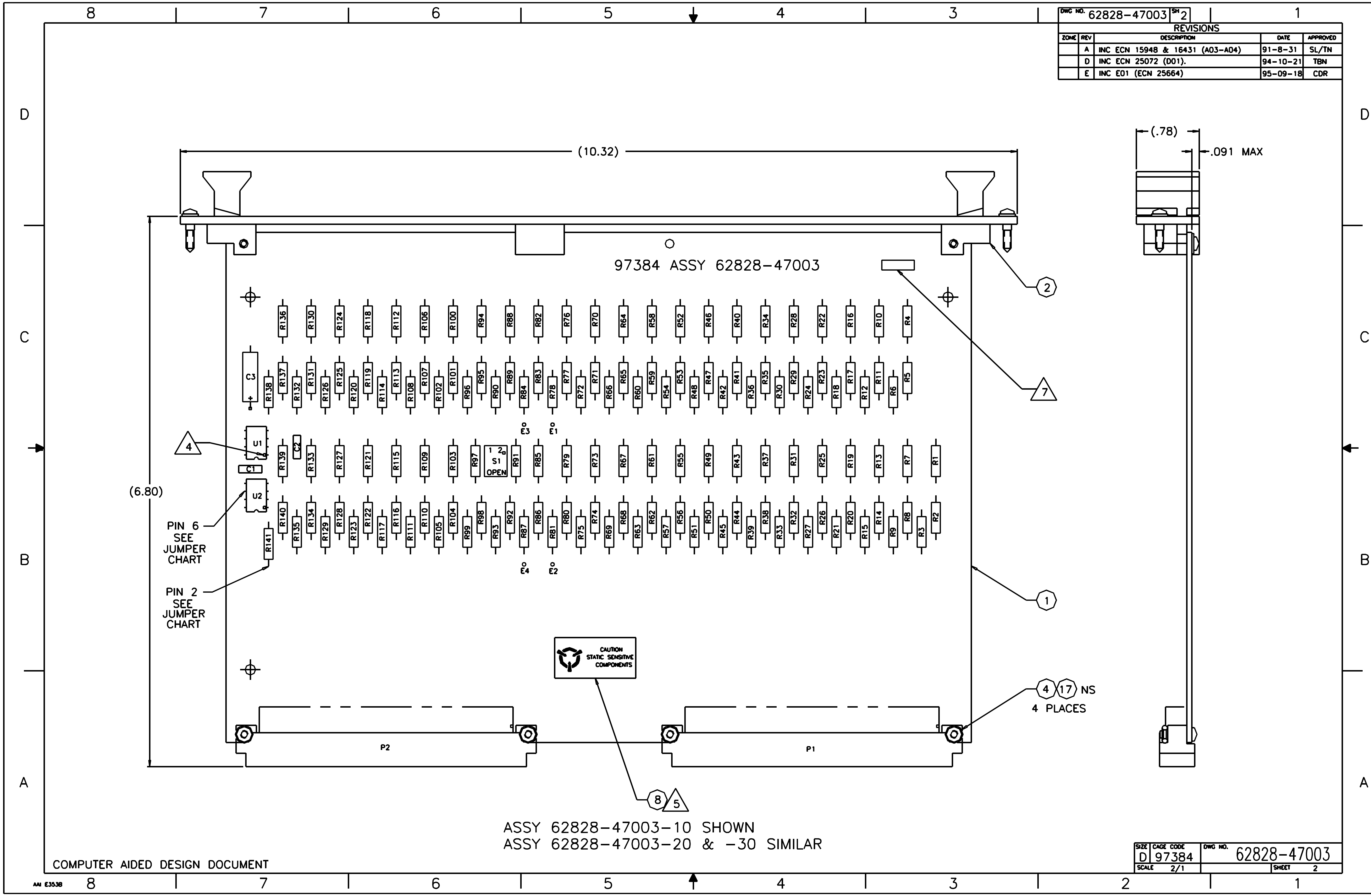
AAI CORPORATION
HUNT VALLEY, MD 21030-0126

VME RESISTOR BOARD ASSEMBLY

SIZE D | CAGE CODE 97384 | DWG NO. 62828-47003
SCALE 2/1 | SHEET 1 OF 2

COMPUTER AIDED DESIGN DOCUMENT

AAI E3528


DWG NO. 62828-47003 SH 2
REVISIONS
ZONE REV DESCRIPTION DATE APPROVED
A INC ECN 15948 & 16431 (A03-A04) 91-8-31 SL/TN
D INC ECN 25072 (D01). 94-10-21 TBN
E INC E01 (ECN 25664) 95-09-18 CDR
(10.32)
(.78)
.091 MAX
97384 ASSY 62828-47003
(6.80)
PIN 6 SEE JUMPER CHART
PIN 2 SEE JUMPER CHART
CAUTION STATIC SENSITIVE COMPONENTS
4 17 NS
4 PLACES
P2
P1
ASSY 62828-47003-10 SHOWN
ASSY 62828-47003-20 & -30 SIMILAR
COMPUTER AIDED DESIGN DOCUMENT
SIZE D CAGE CODE 97384 DWG NO. 62828-47003
SCALE 2/1 SHEET 2
AM E3538

CHAPTER 3

DATA COLLECTION PACKAGE

SECTION I. DESCRIPTION AND LEADING PARTICULARS

3.1.1 INTRODUCTION

Each ASOS may have up to three data collection packages (DCP's) and their sensor complements. The DCP's are designated Unit 2, Unit 3, and Unit 4. This section defines the purpose of the DCP and describes its physical configuration. Locational illustrations are provided to identify DCP assemblies and subassemblies applicable to maintenance personnel.

3.1.2 PURPOSE

An Automated Surface Observing System (ASOS) typically utilizes between one and three remotely located (i.e., outside) DCP's, which function as data links between ASOS sensors and the acquisition control unit (ACU). As illustrated on figure 3.1.1, data exchanges between the DCP and externally mounted sensors are accomplished via fiberoptic cabling, while data transfers between the DCP and ACU are accomplished via radio frequency (rf) communication. However, the system can be configured for hardwire communications between the ACU and DCP. A single DCP may handle data exchanges for up to 16 sensors.

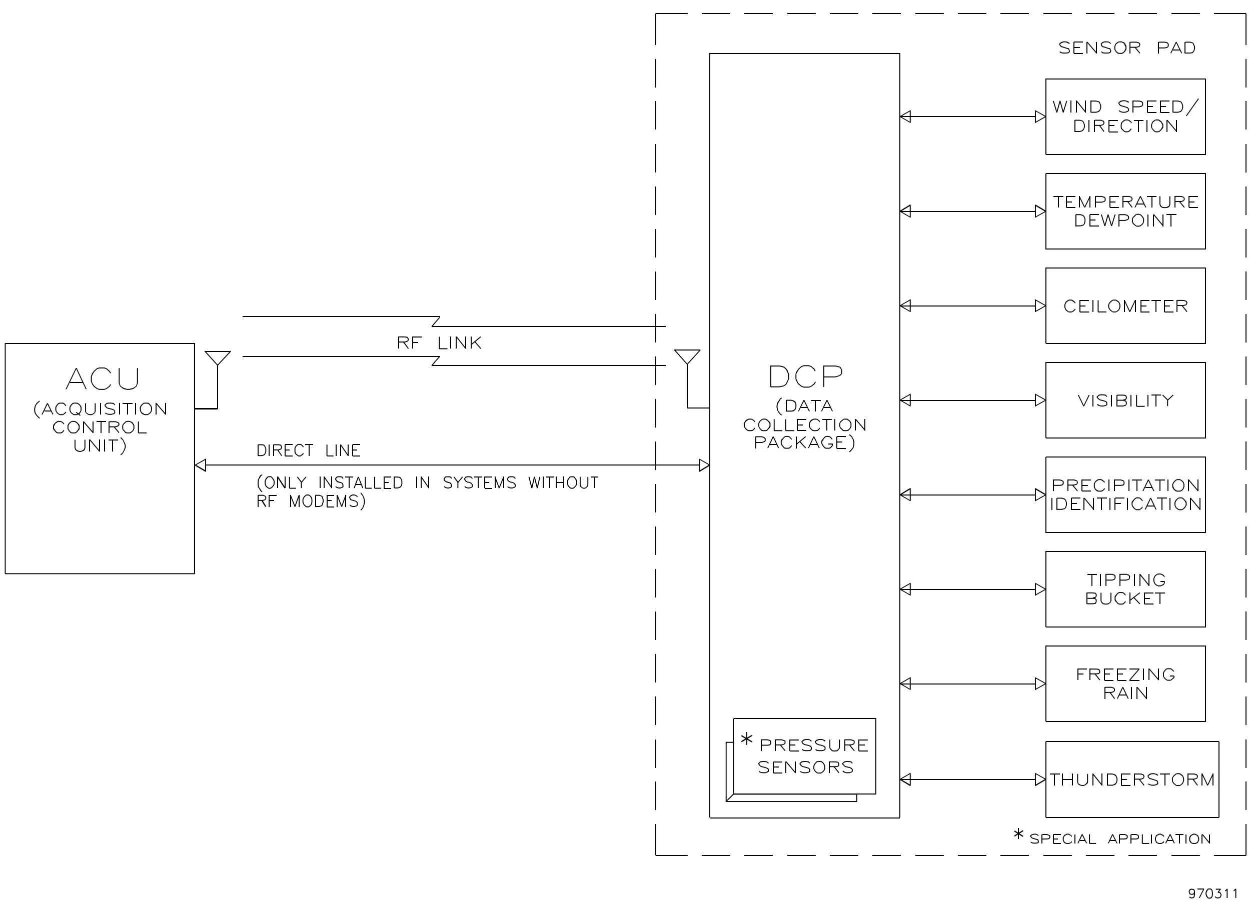


Figure 3.1.1. DCP Communications Link - Simplified

3.1.2.1 **Class I and Class II Systems**. Throughout this chapter and Chapter 2, a distinction is made between Class I systems and Class II systems. The Class I DCP is the basic model DCP. This model will be installed at most Class I (non-towered) airports and other observation sites. The Class II DCP is very similar to the Class I system, except that the Class II DCP has several additional features to increase system availability and performance. These additional features are identified as follows:

a. There are two types of uninterruptible power supplies that may be installed in the DCP: UPS 62828-90057, which is installed in serial number 438 and below, and UPS 62828-90338-10, which is installed in serial numbers 439 and above. The UPS allows the DCP to operate in the event of a loss of facility power.

b. Redundant communications equipment for ACU/DCP data communications. This includes a second CPU and a second rf modem (or line driver) in the DCP.

c. Electromagnetic interference (EMI) shielded DCP equipment cabinet.

d. UPS bypass circuit for additional power monitoring and control capability.

e. At designated sites that have pressure sensors mounted in the DCP, a third (redundant) pressure sensor is added. The third sensor allows ASOS to continue to report altimeter settings and pressure data when one of the three pressure sensors fails.

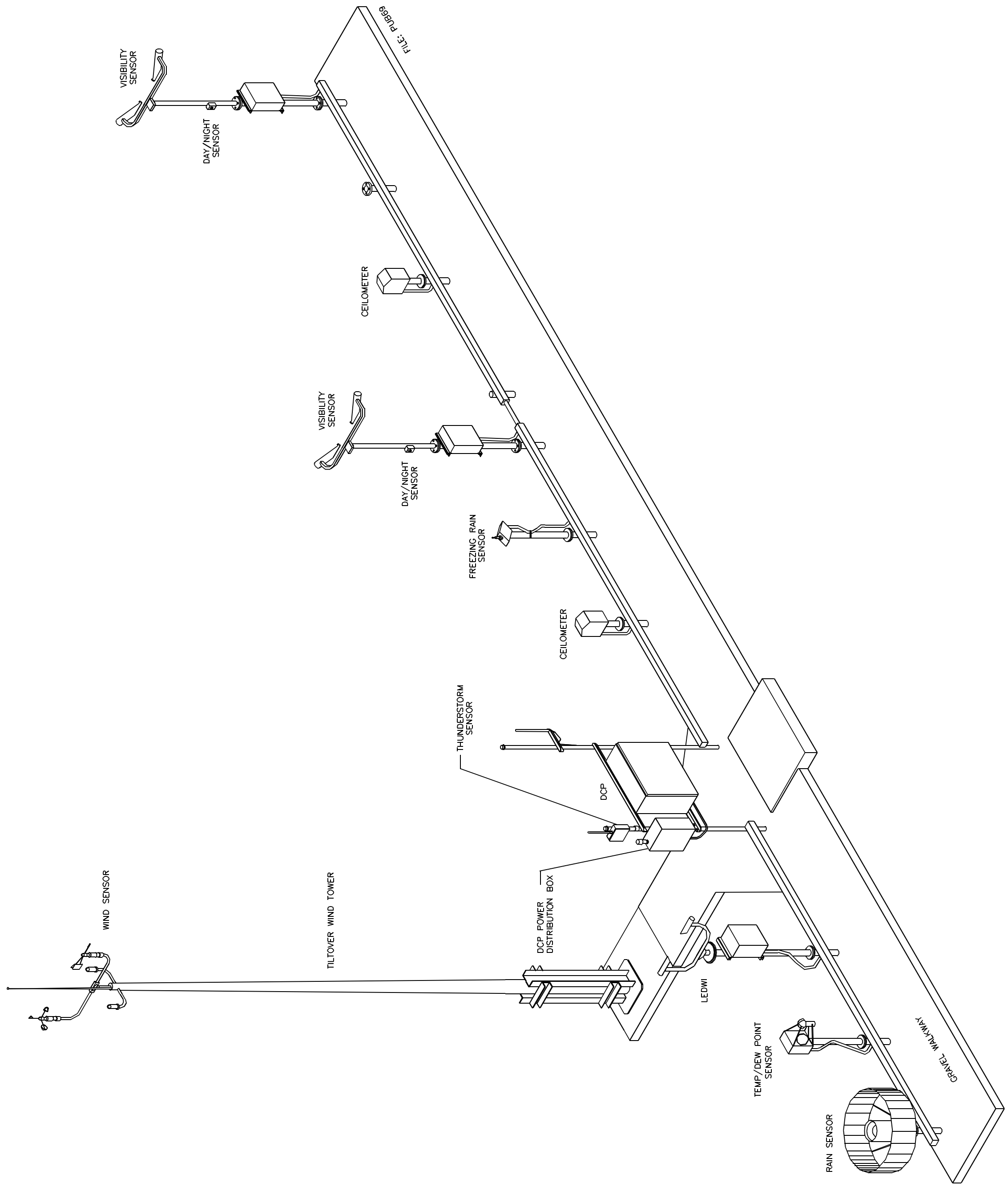
Although the above-mentioned features are standard for Class II DCP's, they are also available as options for Class I DCP's.

3.1.2.2 **Optional Auxiliary Box**. Because of lack of space within the 62928-40070-20 Class I DCP cabinet, an auxilliary box is used to house the optional UPS. The auxiliary box is mounted behind the main DCP cabinet. Also, if more than nine sensors are connected to a Class II DCP, a second UPS is required to provide the back-up ac power for sensors 10 through 17. This second UPS will be mounted in an auxiliary box. Refer to chapter 14 for descriptions and troubleshooting of the auxiliary box.

3.1.3 PHYSICAL DESCRIPTION

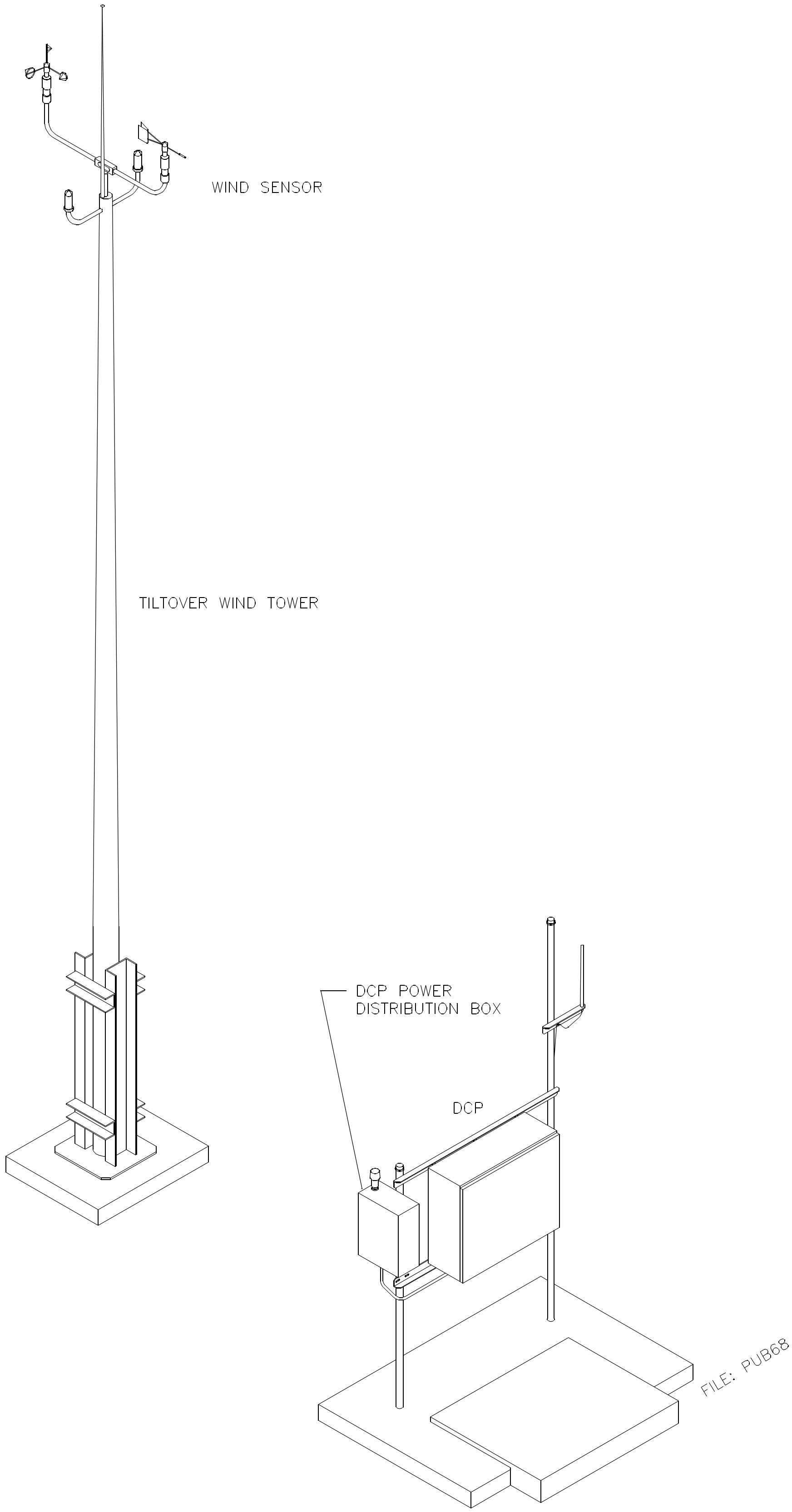
Figure 3.1.2 illustrates three types of DCP installations; combined sensor group (shown with backup sensors), touchdown zone pad, and remote wind sensor pad. Each type consists of the following major units: the DCP equipment cabinet, an externally mounted ac junction box, and an rf antenna. For a Class II installation having more than nine sensors, an auxiliary DCP equipment cabinet housing a second UPS can be added to meet sensor power requirements.

3.1.3.1 **DCP Equipment Cabinet, Unit 2, 3, or 4**. Figure 3.1.3 illustrates a typical Class II DCP equipment cabinet. The Class I DCP equipment cabinet is similar but does not contain the UPS components, UPS bypass circuit, or the backup battery box. The Class II DCP contains one of three types of UPS. A SOLA UPS 62828-90057 is installed in serial numbers 438 and below and has components that are behind a UPS cover (sheet 1). Either of two interchangeable Deltek UPS's, 62828-90338-10 or 62828-90338-20 is installed in serial numbers 439 and above; their components are installed inside the UPS box and cannot be removed (sheet 2). In addition to the UPS components and the battery box, the DCP equipment cabinet also contains a card rack assembly, a circuit breaker module rack, an rf modem mounting plate, four dc power supplies, power reset relay, and a Faraday box. At selected sites, the DCP also contains pressure sensors. Many of these assemblies are mounted on, and identified with, a large mounting plate assembly (A1). The Faraday box contains two distribution strips/buses, interconnecting electrical and fiberoptic cabling, and electromagnetic interference (EMI) filters. Brief descriptions of the DCP assemblies are provided in table 3.1.1. Additional information for selected DCP assemblies is provided in the following paragraphs.



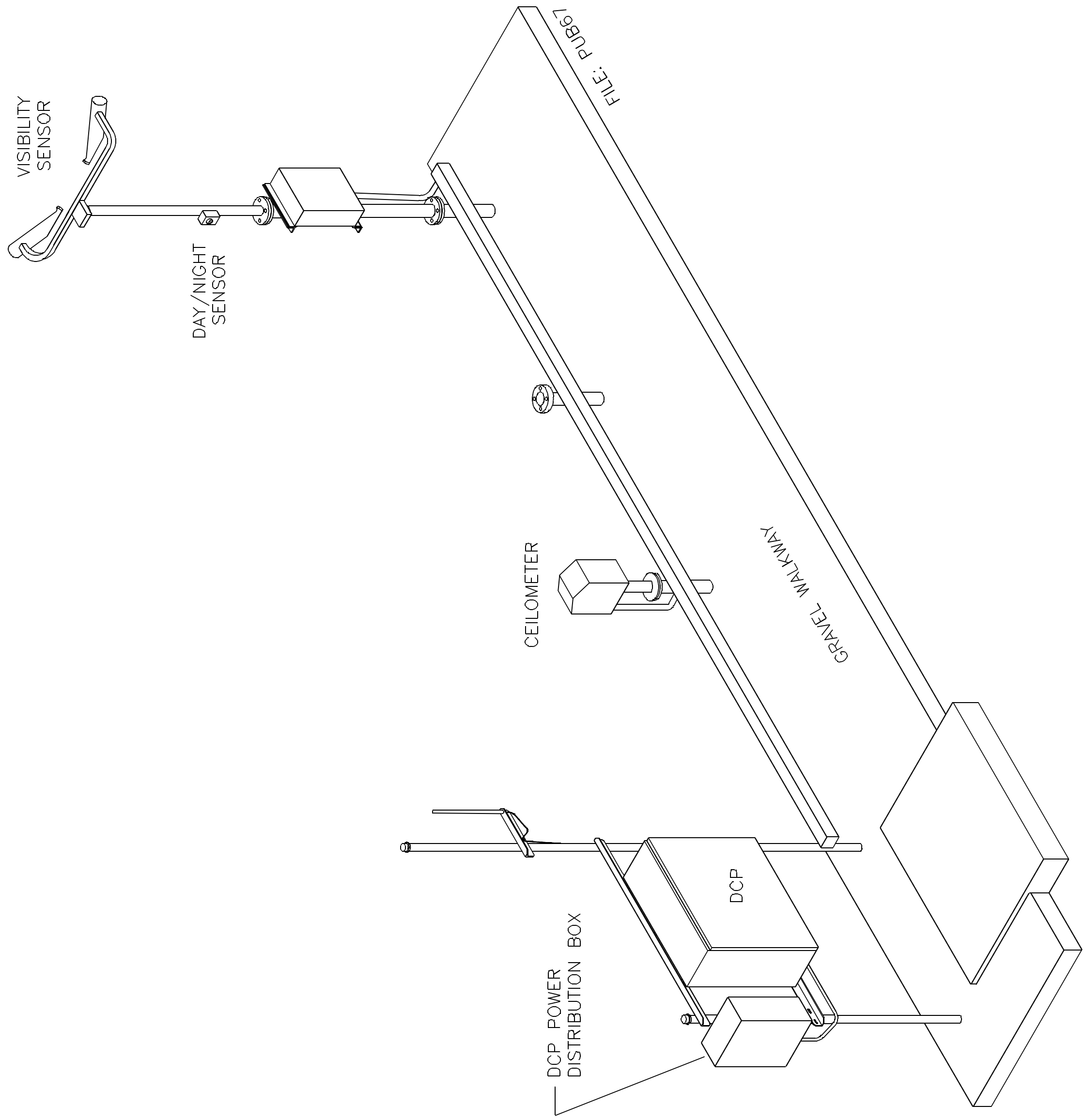
Combined Sensor Group (With Backup Sensors)

Figure 3.1.2. DCP Installation (Sheet 1 of 3)



Remote Wind Sensor Pad

Figure 3.1.2. DCP Installation (Sheet 2)



Touchdown Zone Pad

Figure 3.1.2. DCP Installation (Sheet 3)

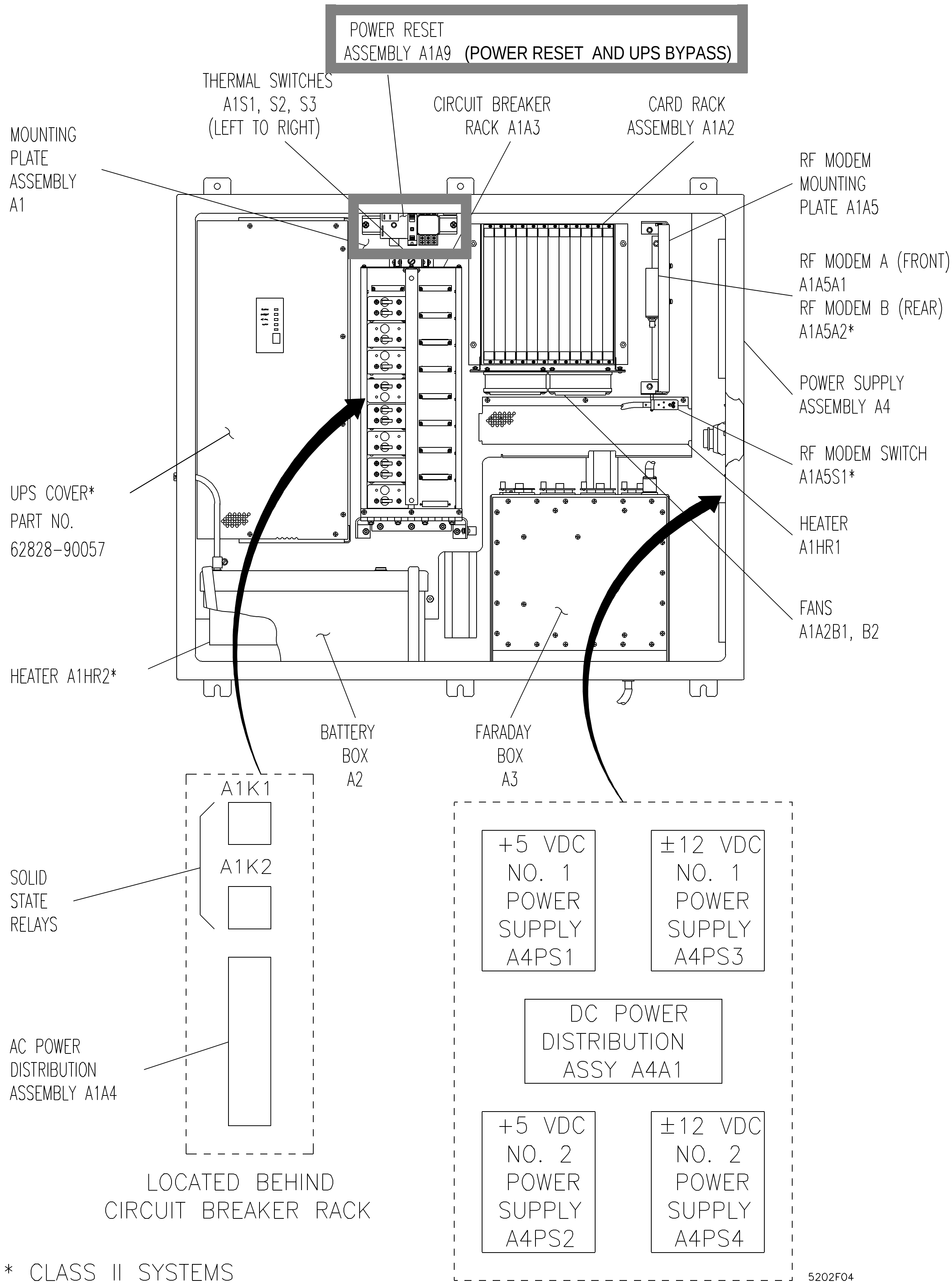


Figure 3.1.3. DCP Equipment Cabinet - Locational View (Sheet 1 of 2)

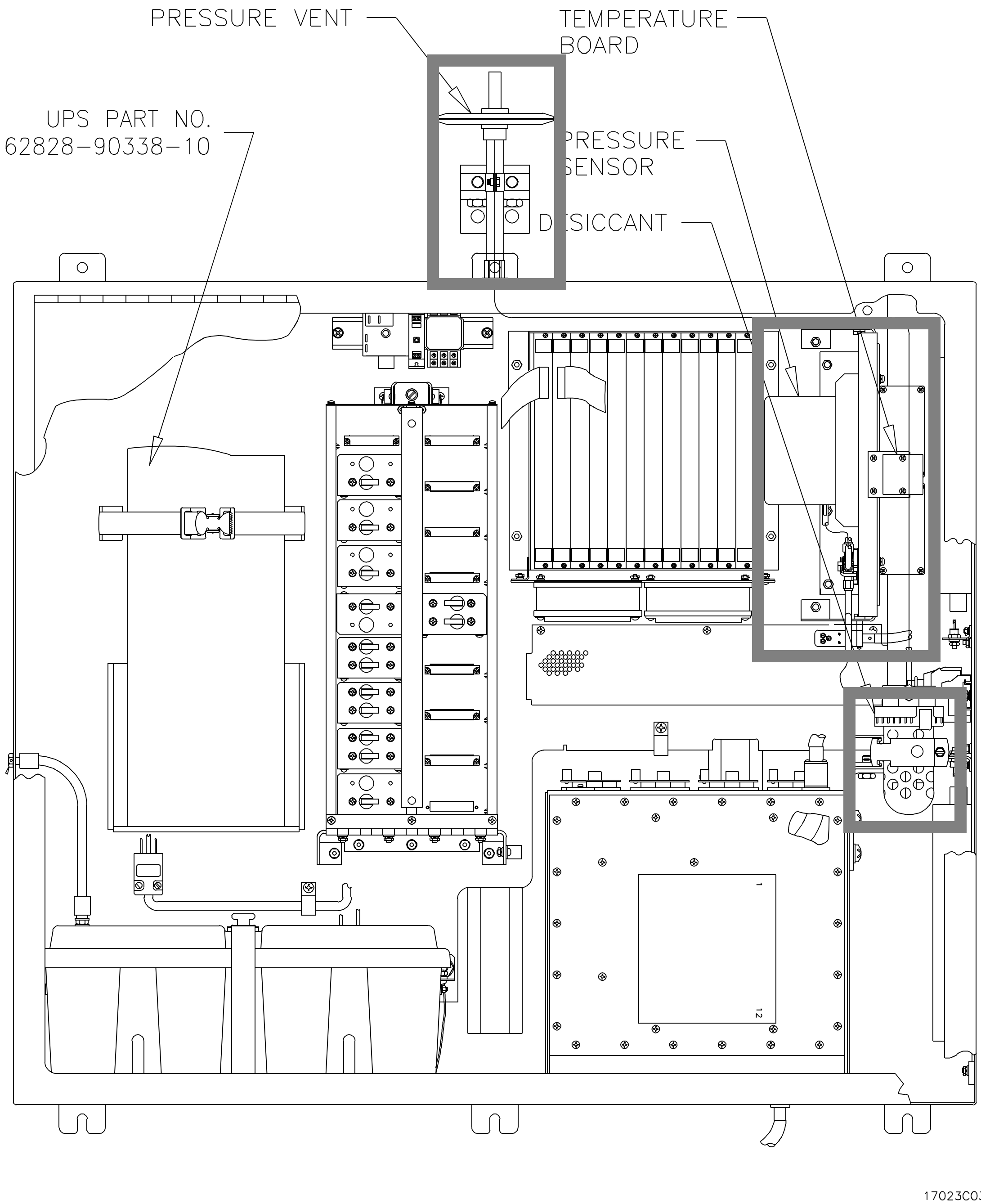


Figure 3.1.3. DCP Equipment Cabinet - Locational View (Sheet 2)

Table 3.1.1. DCP Equipment Cabinet Major Assemblies

Unit	Nomenclature	Purpose
A1	Mounting Plate Assembly	Main mounting plate in DCP equipment cabinet.
A1A2	Card Rack Assembly	Contains up to 12 circuit boards that perform all data processing and I/O functions associated with the DCP.
A1A3	Circuit Breaker Rack	Hinged rack assembly containing up to 18 circuit breaker modules. Left row modules (A1 through A9) are allocated for DCP and first eight sensors. Right row modules (A10 through A18) are allocated for optional auxiliary DCP (if Class II system) and sensors 9 through 16.
A1A4	AC Power Distribution Assembly	A terminal strip/bus that distributes ac power (facility or UPS) to DCP assemblies and associated sensors.
A1A5	RF Modem Mounting Plate	For Class II system with rf communication link to ACU, contains rf modem A (A1A5A1), rf modem B (A1A5A2), and an rf modem switch (A1A5S1). For Class I rf link system, contains only rf modem A. For Class II system with line driver link to ACU, contains line driver A (A1A5A1), line driver B (A1A5A2), and an LD1/LD2 switching board (A1A5A3). For Class I line driver system, contains only line driver A. Only on Class I Antarctica systems and selected sites, contains two pressure sensors (A1A5A3 and A1A5A4), third sensor added for Class II systems (A1A5A5).
	UPS cover	Contains UPS status panel and shields individual UPS assemblies (refer to figure 3.1.6 sheet 1). UPS 62828-90057 is installed in serial numbers 438 and below. DCP UPS is installed in Class II systems.
A1A6	UPS	Uninterruptible power supply part numbers 62828-90057, 62828-90338-10, or 62828-90338-20 provide backup ac power.
A1A9	Power Reset Assembly	Contains power delay relay K1 and Class II systems UPS Bypass relays K2 and K3.
A1HR1, HR2	Heater assemblies	Two heater assemblies provide heating for the DCP equipment cabinet. Heater HR1 is mounted below the card rack assembly and contains two 375-watt metal bar elements. HR2 is a 350-watt silicon strip heater element that is mounted behind the battery box in a Class II system. Heater HR2 is not installed in Class I systems.
A2	Battery Box	Contains either four or five 12-volt batteries for UPS. Battery Box A2 may be one of three different assemblies. Part number 62828- 40062-10 contains five batteries and is used with SOLA UPS 62828-90057 in DCP serial numbers 438 and below. Part number 62828-40062-30, referred to as the interim battery box, contains four batteries and packing material and is used with Deltek UPS 62828-90038-10 or 62828-90338-20 in DCP serial numbers 439 and above. Part number 62828-90360-10, referred to as the production model battery box, is similar to 62828-40063-30 but is physically smaller. It contains four batteries and is also used with Deltek UPS 62828-90038-10 or 62828-90338-20 in DCP serial numbers 439 and above.
A1S1-S3	Thermal switches	Control activation of DCP heater elements.
A1K1, K2	Solid state relays	Used in conjunction with thermostats to control cabinet heater operation.
A3	Faraday Box	Central signal/power distribution point for DCP associated circuitry. Power, rf signals, and sensor fiberoptics are routed through this box.
A4	Power Supply Assembly	Mounting plate that physically holds dc power supplies and dc power distribution assembly to DCP equipment cabinet.
A4PS1,PS2	5 vdc power supplies	Source of +5 vdc power for DCP cabinet.
A4PS3,PS4	±12 vdc power supplies	Source of ±12 vdc power for DCP cabinet.
A4A1	DC power	A terminal strip/bus that distributes dc power to circuitry within the DCP equipment cabinet.

3.1.3.1.1 **Card Rack Assembly A1A2**. The 12-slot card rack assembly provides system interconnection for up to 12 circuit board assemblies. These circuit board assemblies provide data processing and input/output (I/O) functions for the DCP. Figure 3.1.4 identifies the specific boards located in each position of the rack. CPU B is installed in Class II systems only to provide a redundant processor in the event that there is a failure in CPU A or its associated ACU communications link. All DCP's contain at least one serial I/O (SIO) board (SIO #1), but up to four additional SIO's may be installed, depending on the number of sensors supported by the DCP. Similarly, all DCP's contain at least one analog to digital converter board (A/D board #1), but A/D board #2 is added when the DCP supports more than eight sensors.

3.1.3.1.2 **Circuit Breaker Rack 1A1A3**. Circuit breaker rack 1A1A3 (Figure 3.1.5) contains up to 18 circuit breaker modules that control power application to the DCP, DCP sensors (16 maximum), and the optional auxiliary DCP. Circuit Breaker Module A1 is the primary module. It applies power to the UPS (Class II DCP) or DCP electronics (Class I) and to the first group of eight sensors associated with it. Circuit breaker A10 is optional. It applies power to an optional second UPS and to a second group of sensors that may be connected to the DCP. Primary Circuit Breaker Modules A1 and A10 are not field replaceable units (FRU's) themselves. Rather, the individual circuit breakers on these modules are the FRU's. Each module installed in slots A2 through A9 and A11 through A18 is dedicated to one of the installed sensors and applies power to that sensor. These sensor-dedicated modules are FRU's, and their piece parts (circuit breakers, module board) are not. These modules are equipped with relays that permit software control of power to the sensor electronics. The modules installed in slots A2 through A9 and A11 through A18 may contain any of the module models. The model installed in a given slot is determined by the type of sensor that the module is controlling. Each of the models is defined by a different dash number appended to its basic part number. All of the modules have at least one circuit breaker for the corresponding sensor electronics and heaters. Several of the modules provide a second breaker for the sensor's heater circuits. This heater breaker provides a separate run for sensors with high power heaters. The circuit breaker module models are identified as shown in table 3.1.2.

Table 3.1.2. DCP Circuit Breakers

Sensor Type	Dash Number	Heater Breaker
Ceilometer (CHI)	-10	Yes (obsolete, replaced with -80)
Temperature/dewpoint (T/D)	-20	No
Visibility	-30	No
Wind	-40	No
Light emitting diode weather indication (LEDWI) (present weather indicator)	-50	Yes
Tipping bucket (no power)	-60	Heater only
Freezing rain	-70	Yes (obsolete, replaced with -90)
Ceilometer (CHI)	-80	Yes
Freezing rain	-90	Yes
Thunderstorm	-100	Yes

3.1.3.1.3 **DCP Uninterruptible Power Supply (UPS)**. For Class II systems, there are three types of uninterruptible power supplies that may be installed. SOLA UPS 62828-90057 is installed in DCP's with serial numbers 438 and below. Either Deltek UPS 62828-90338-10 or 62828-90338-20 is installed in DCP's with serial numbers 439 and above. A UPS is included in the DCP to provide a backup ac power source for the DCP and up to nine sensors. If more than nine sensors are associated with a Class II DCP, a secondary UPS is installed in an optional auxiliary box. The UPS generates its ac backup power from the dc power provided by Battery Box A2. UPS 62828-90057 is not a unit in itself but is a collection of seven FRU's mounted on Mounting Plate Assembly A1 and the UPS cover. These FRU's are illustrated and identified on figure 3.1.6. UPS 62828-40338-10 is an FRU that is mounted on Mounting Plate Assembly A1.

3.1.3.1.3a **Power Reset Assembly**. Power Reset Assembly A1A9 (Class I and Class II systems) is located in the top center of the cabinet, above the circuit breaker rack. The power reset assembly consists of Time Delay Relay A1A9K1. The time delay relay ensures that the DCP resets properly after power is interrupted by delaying power application approximately three seconds.

3.1.3.1.3b **UPS Bypass Circuit**. The UPS bypass circuit (Class II systems) is co-located with the Power Reset Assembly A1A9 in the top center of the cabinet. The UPS bypass circuit consists of Digital I/O Module A1A9K2 and Power Relay A1A9K3. The ASOS application software monitors and controls the power relay which routes site power or UPS output power to the cabinet.

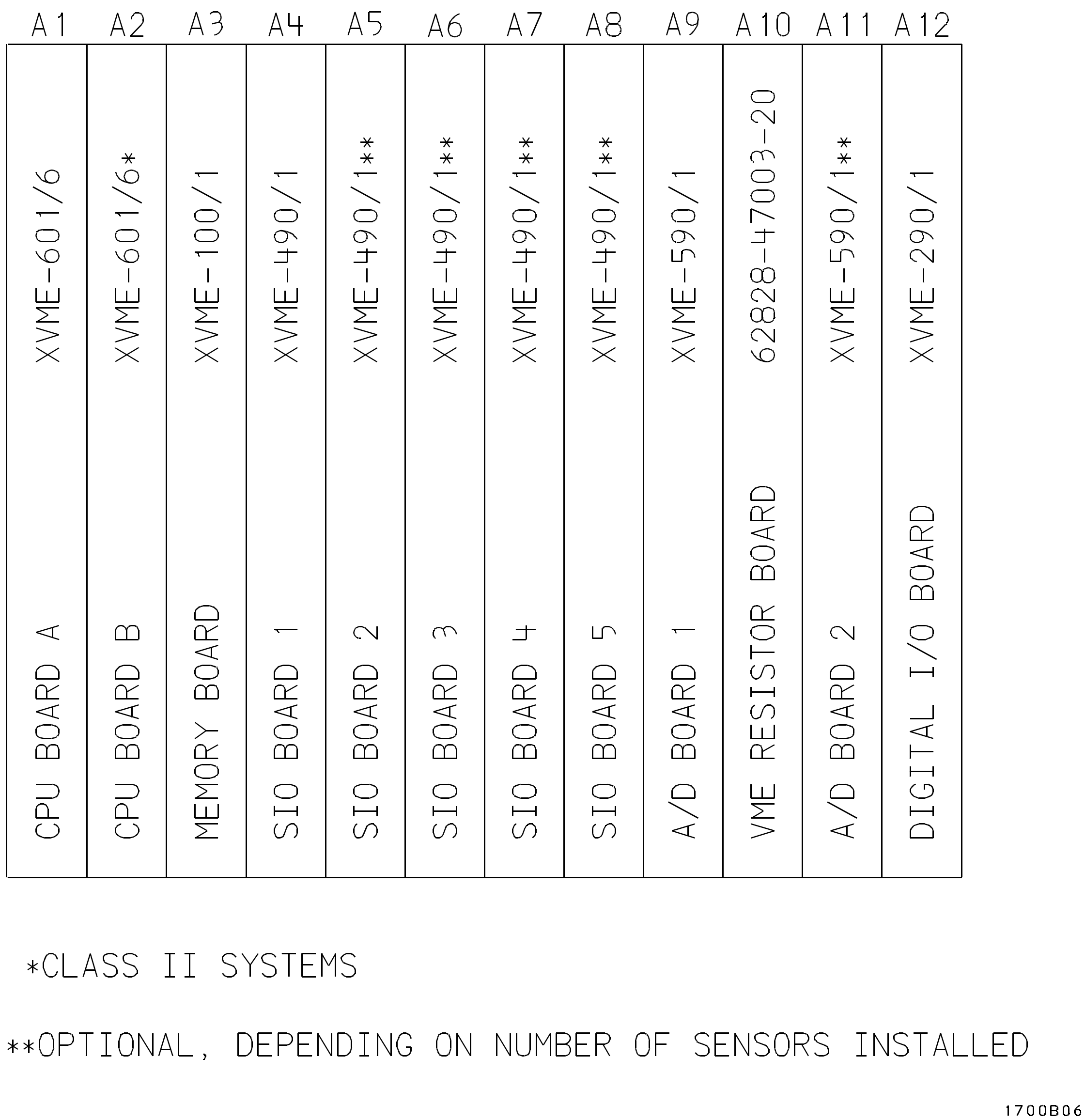


Figure 3.1.4. VME Card Rack - Stuffing Chart

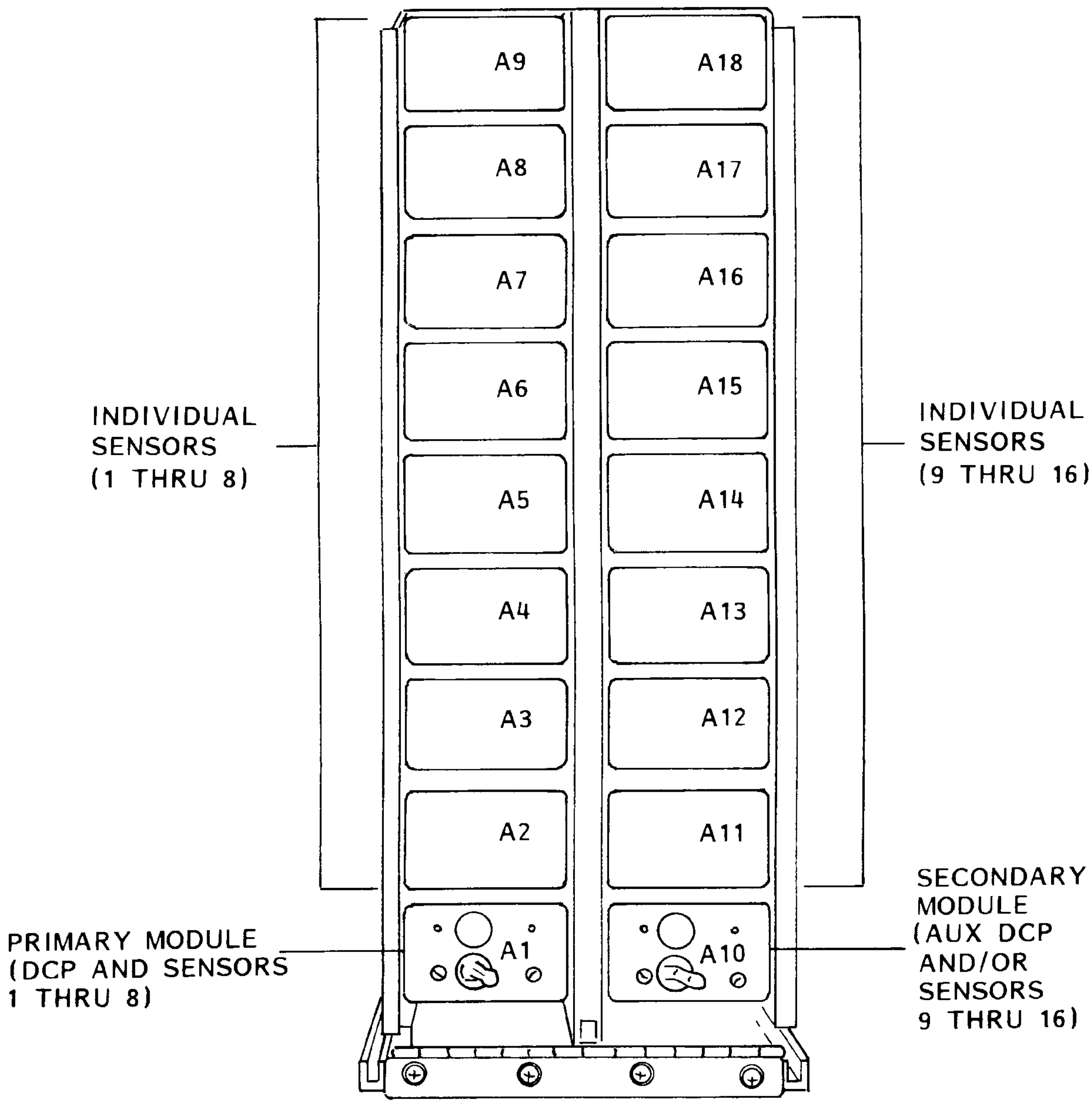
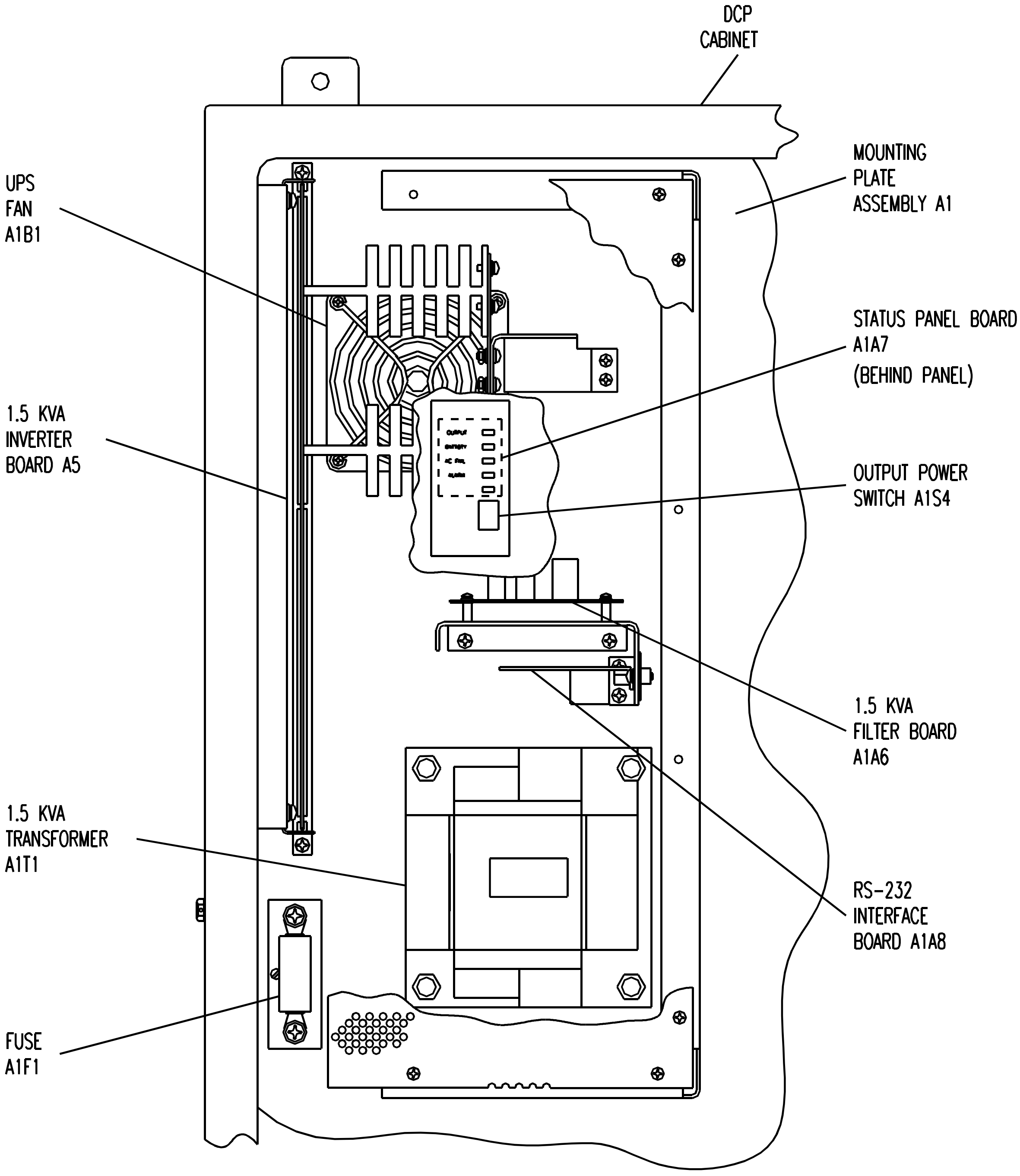


Figure 3.1.5. Circuit Breaker Module Rack - Stuffing Chart



NOTES:

1. COVER REMOVED FOR CLARITY.
2. DCP UPS COMPONENTS INSTALLED ON CLASS II SYSTEMS.

Figure 3.1.6. DCP Uninterruptible Power Supply - Locational View

3.1.3.1.4 **DCP Heaters**. Heater A1HR1 is installed in both Class I and Class II systems. It contains two 375-watt heater elements for a combined total of 750 watts. For a Class II system, HR2 is also installed to provide heating for the battery box and the UPS components. HR2 is a 350-watt element. Three thermal switches (A1S1 through S3) are used in conjunction with two solid state relays (A1K1 and K2) to control the heaters. Power is applied to one element of HR1 and to HR2 (if installed) as the internal DCP temperature drops below 50 degrees Fahrenheit. If the internal temperature continues to fall below 40 degrees Fahrenheit, the second element of HR1 is activated. Overheat protection prevents application of heater power when temperatures exceed 80 degrees Fahrenheit. Heater operation is disabled if facility ac input power loss necessitates operation of the UPS.

3.1.3.1.5 **Faraday Box A3**. Figure 3.1.7 illustrates the parts/assembly locations associated with the Faraday box, which provides the signal and power interfaces for DCP operations. Up to 16 fiberoptic modules (A3A1 through A16, one per sensor) may be located on top of the box. These modules provide digital/optical data conversions necessary for DCP communication with individual sensor assemblies. Each fiberoptic module possesses a distinct transmit and receive channel. The rf output connection to the externally mounted antenna assembly is located on top of the box. The left side of the shielded box assembly contains two DB-25 connectors (J5 and J6) which carry sensor power lines while the five remaining connectors (J1 through J4 and J9) are EMI filter equipped and route ac power throughout the DCP. Two ac distribution panels (A17 and A18), with surge suppression capability, are located inside the Faraday box and provide the necessary ac interconnections between the input facility power, the DCP, and its sensors.

3.1.3.2 **AC Junction Box**. The ac junction box (Figure 3.1.8), located external to the DCP equipment cabinets, provides the main control point for the facility ac site power. The box consists of a standard circuit breaker box which contains one dual (2-phase) 40-ampere main circuit breaker, two 30-ampere circuit breakers, two 15-ampere circuit breakers, and a 15-ampere ground fault interrupter (GFI) circuit breaker. The four secondary breakers provide power to the clearance lights, primary DCP, auxiliary DCP, and utility GFI outlet located on the side of the box. The GFI outlet provides additional safety for the technician when working on the equipment and should be used to supply power to any test equipment or support equipment used at the sensor pad. For the power expanded DCP (Figure 3.1.9), a dual 30-ampere circuit breaker replaces one 30-ampere circuit breaker and the 40-ampere main circuit breaker.

3.1.3.3 **RF Antenna**. The rf antenna enables ACU/DCP communications and operates on the ASOS rf frequencies (410.075 or 410.950 MHZ). The antenna itself is usually an omnidirectional antenna, but it is mounted onto its mast in such a manner as to provide some directional gain (in the direction of the ACU antenna). At certain sites where RFI was experienced, yagi antennas are used at one or both ends of the link. A yagi can only be used at the ACU if all DCP's are illuminated within the yagi’s 10-degree beamwidth. A seven-element yagi, PN 62828-90413-2, provides 10 dB gain over the 406 - 420 MHz band and has a front:back ratio of 14 dB. Additionally, at sites where cochannel interference is particularly troublesome, five watt attenuators of 3 dB, 6 dB, 10 dB, 20 dB, or 30 dB (PN 62828-90424-2, -3, -4, -5 and -6, respectively) may be inserted in the antenna line(s) to reduce transmit power into the antennas.

3.1.4 **DCP CONFIGURATIONS**

There are seven possible configurations for the DCP, which are described below. In addition, there is a special application version of the DCP, which contains three pressure sensors.

- -10 Class II DCP with an uninterruptible power supply (UPS) built by SOLA
- -20 Standard Class I DCP (small cabinet)
- -30 Class II DCP with an enclosure built by Electrorack, an extension on the Faraday box, and an UPS built by SOLA
- -40 Class I DCP with an enclosure built by Electrorack, an extension on the Faraday box, and the old style backplate
- -50 Class II DCP with the new backplate, an UPS by Deltec, and the new harness
- -60 Class I DCP with the new backplate, and the new harness
- -70 Class I DCP with an UPS built by Deltec

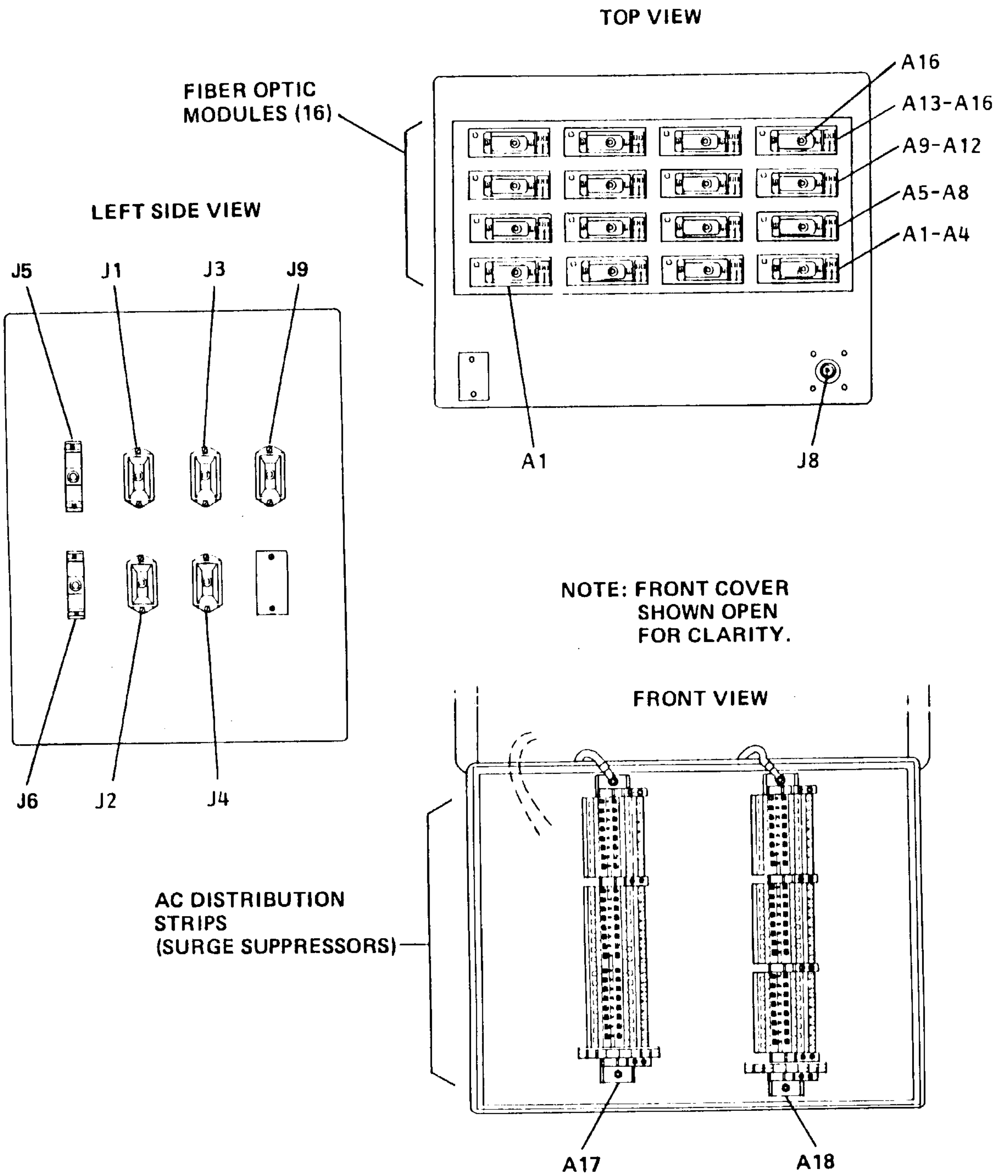


Figure 3.1.7. Faraday Box - Locational View

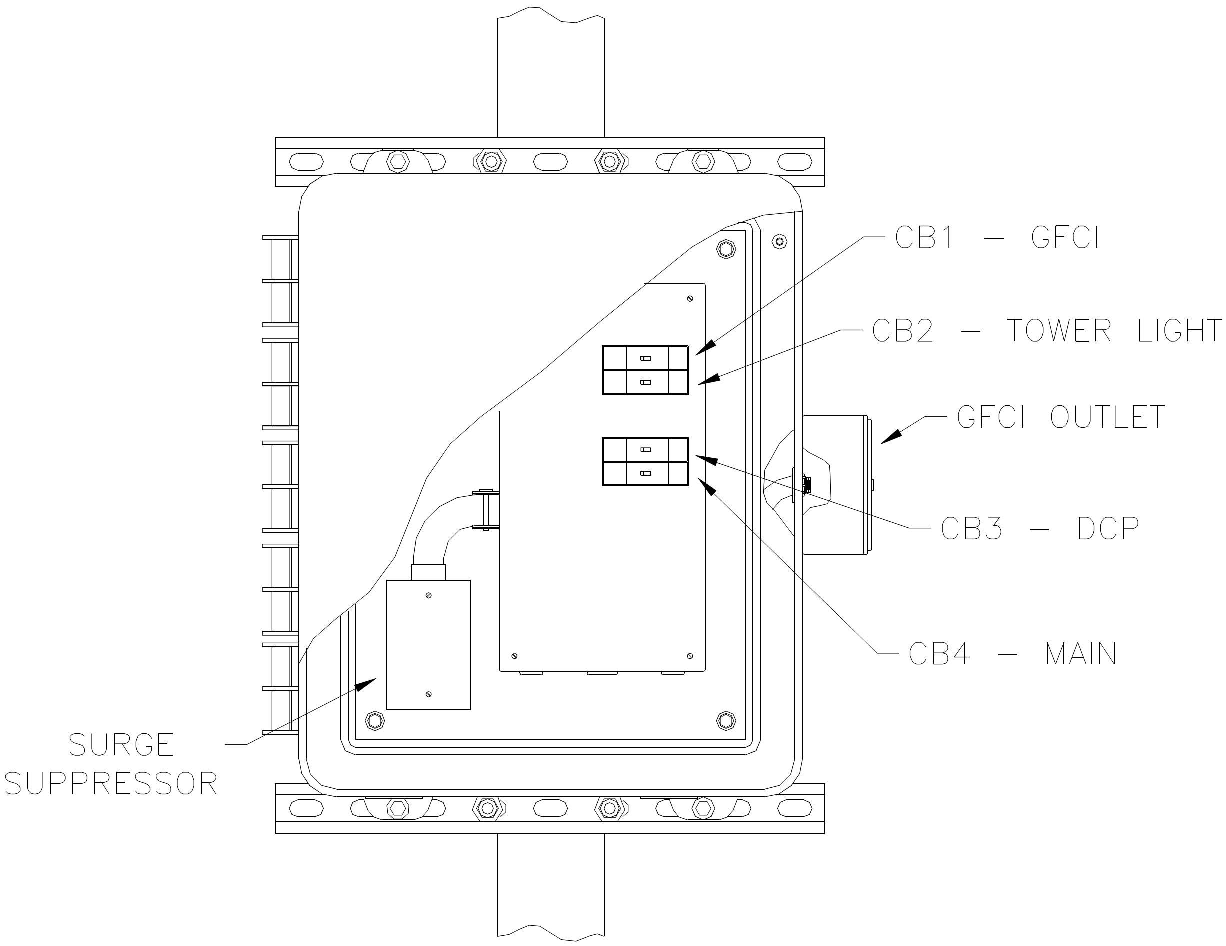


Figure 3.1.8. Typical AC Junction Box (Sheet 1 of 2)

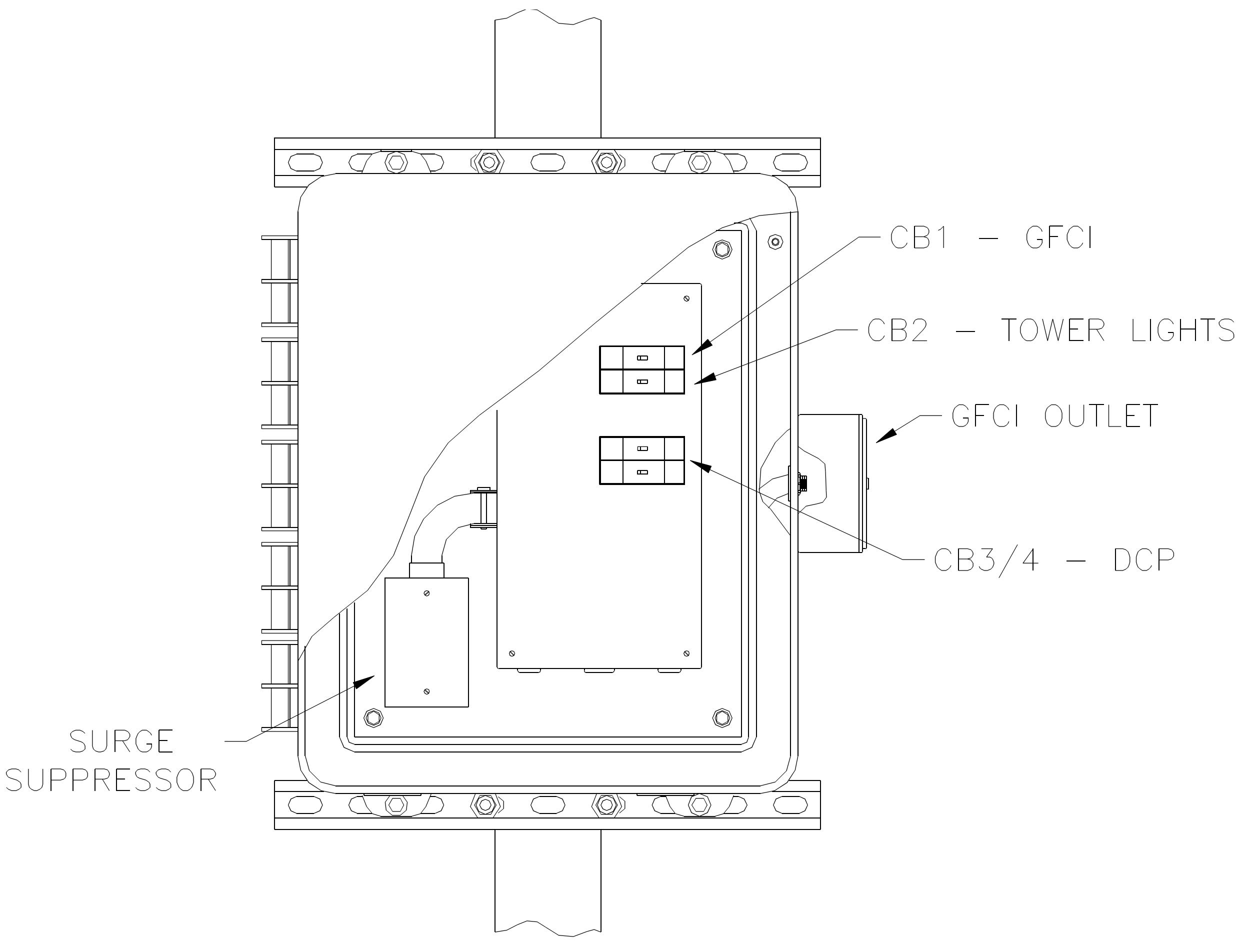


Figure 3.1.8. Typical AC Junction Box (Sheet 2)

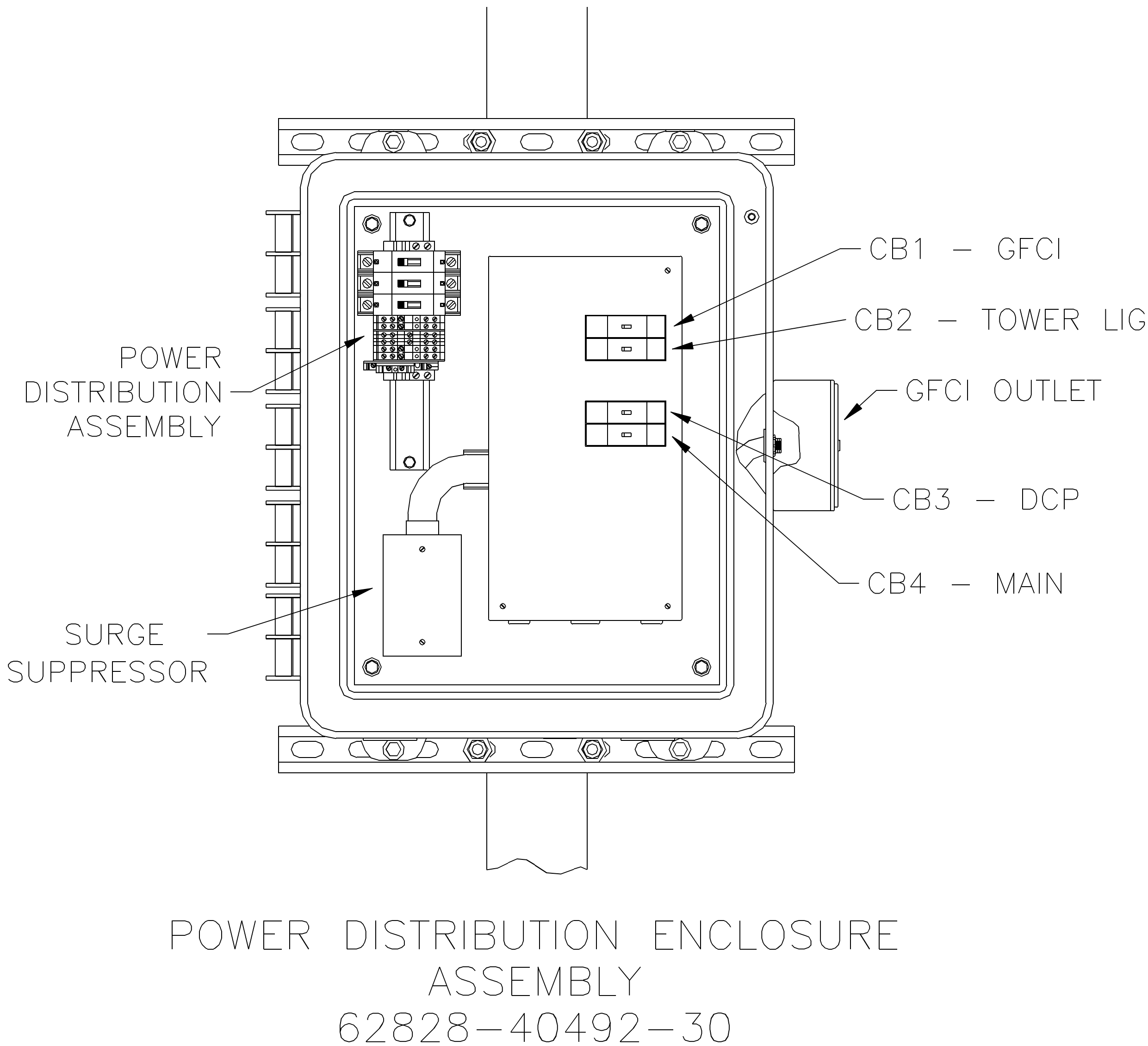


Figure 3.1.9. Power Expansion DCP AC Junction Box - Locational View

SECTION II. INSTALLATION

Installation of the DCP is not the responsibility of the site technician. The removal and installation procedures for the individual field replaceable units (FRU's) within the DCP are contained in Section V.

SECTION III. OPERATION

3.3.1 INTRODUCTION

This section provides the information necessary for maintenance personnel to correctly interpret and utilize the controls and indicators associated with data collection package (DCP) assemblies. The operational procedures for the application and removal of DCP input power are also provided.

3.3.2 CONTROLS AND INDICATORS

This paragraph describes the DCP maintenance controls and indicators. The assemblies within the DCP that contain maintenance-related controls and indicators are the status panel of the uninterruptible power supply (UPS), the card rack assembly, and the power control module rack.

3.3.2.1 **UPS Status Panel**. The status panel in UPS 62828-90057 (Class II systems with DCP serial numbers 438 and below) provides an OUTPUT POWER switch and several LED indicators. UPS's 62828-90338-10 and 62828-90338-20 (Class II systems only with serial number 439 and above) provide an on/off switch and several LED indicators. Descriptions of these controls and indicators are provided for their ACU counterpart in Chapter 2, Section III of this manual and are not repeated here. $ $ $

3.3.2.2 **Card Rack Assembly A1A2**. The card rack assembly contains three circuit board assemblies (two distinct types) with controls and indicators: CPU's A and B (slots A1 and A2, respectively) and the memory board (slot A3). Descriptions of the controls and indicators for the CPU boards are provided for their ACU counterparts in Chapter 2, Section III of this manual and are not repeated here. The memory board contains two LED indicators labeled BANK 1 and BANK 2. These indicators are illuminated when their respective memory banks are being accessed by the CPU.

3.3.2.3 **Circuit Breaker Rack A1A3**. The circuit breaker module located in slot A1 controls the application of power to the UPS (Class II DCP) or DCP electronics (Class I) and to the first group of eight sensors. Similarly, the module in slot A10 controls the application of power to the optional second UPS (Class II) and to the second group of eight sensors. The modules in slots A2 through A9 and A11 through A18 control the application of power to the electronics and heaters of the individual sensors. These modules are equipped with relays that allow system software to control power to the sensor electronics. Table 3.3.1 describes the control/indicator functions of a typical power control module as illustrated by figure 3.3.1. Slots A2 through A9 and A11 through A18 contain different models of circuit breaker modules. The types of modules installed in slots A2 through A9 and A11 through A18 depends on the type of sensor being controlled from that slot. Each of the models is defined by a dash number appended to its basic part number. All of the modules have at least one circuit breaker for the corresponding sensor electronics and heaters. Several models also provide a separate, second breaker for the sensor's heater circuits. This heater breaker provides a separate run for sensors with high-current heaters. The circuit breaker module models are identified as follows:

Sensor Type	Dash Number	Heater Breaker	Software Controlled
Ceilometers (CHI)	-10	Yes	Yes (obsolete, use -80)
Temperature/dewpoint (T/D)	-20	No	Yes
Visibility	-30	No	Yes
Wind speed/direction	-40	No	Yes
Present weather	-50	Yes	Yes
Tipping bucket (no electronics)	-60	Heater only	No
Freezing rain	-70	Yes	Yes (obsolete, use -90)
Ceilometer	-80	Yes	Yes
Freezing rain	-90	Yes	Yes
Thunderstorm	-100	Yes	Yes

Table 3.3.1. Power Control Module Controls and Indicators

Control/ Indicator	Type	Description
NOTE Modules that do not utilize both of the circuit breakers described below contain a void in the associated module position.		
POWER	Circuit breaker	When set to on (left) position, ac power is applied to the DCP or sensor associated with specific rack slot assignment. The circuit breaker modules in slots A1 and A10 (if installed) are not software-controllable via the operator interface device (OID). All remaining modules (except the -60, which is heater only) may be controlled from the OID when this breaker is in on position. When set to off (right) position, ac power is removed and the DCP and/or sensor is disabled. Software control cannot enable a module when this breaker is set to off position.
HEATER	Circuit breaker	When set to on (left) position, ac power is applied to the associated sensor's heater circuitry. When set to off (right) position, ac power is removed from sensor circuitry.

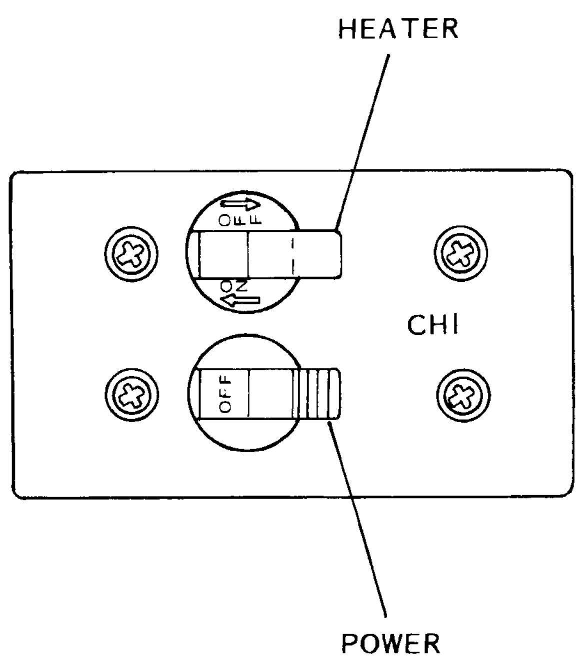


Figure 3.3.1. Power Control Module Controls and Indicators

3.3.2.4 **RF Modems**. RF data modems provide communications between the ACU and DCP cabinets. Only the Johnson Data rf modem (62828-40506-X) has controls and indicators as shown on figure 3.3.2 and described in table 3.3.1A.

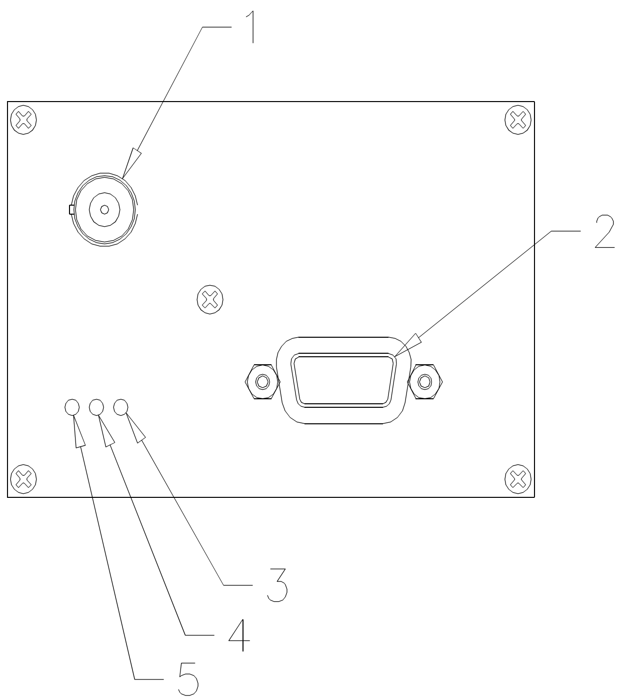


Figure 3.3.2. Johnson Data RF Modem Controls and Indicators

Table 3.3.1A. Johnson Data RF Modem Controls and Indicators

Index	Control/ Indicator	Description
1	SMA Connector	RF output (requires SMAM-to-BNCF adapter)
2	HDB-15 Connector	High density 15 pin female power/communications connector (requires adapter cable 62828-42110-10)
3	RX LED (Yellow)	Illuminates when receiving data
4	TX LED (Red)	Illuminates when transmitting data
5	PWR LED (Green) (Flashing)	Illuminates when power is applied Illuminates when setup mode is active

3.3.3 OPERATIONAL PROCEDURES

Operational procedures associated with the DCP equipment cabinet consist of the application and removal of power. Power up and power down procedures for the DCP equipment cabinet are provided in tables 3.3.2 and 3.3.3, respectively.

3.3.4 USING LAPTOP COMPUTER AS DCP OID

OID display pages are used for testing and other maintenance functions associated with the DCP and sensors. For this reason, the ASOS provides a DCP OID capability. This capability allows a laptop computer (or other VT220/320 terminal) to function as an OID. The laptop computer is connected to DCP SIO port 1-1, which is not used in a Class I DCP but is the UPS port in a Class II DCP. As such, when connecting the laptop computer to a Class II DCP, the technician must disconnect the SIO port connector from the UPS so that the laptop computer can be connected. After connecting and initializing the laptop computer, the system automatically signs the user on to OID #8, as a technician, with the initials DCP. When finished using the DCP OID, the technician signs off of the system from the 1-minute display in the normal manner. The technician must sign off of the DCP OID before removing power from the DCP for any maintenance actions. If the DCP is turned off before the technician signs off, the technician may not be able to initialize the DCP OID after restoring power. Table 3.3.4 provides a procedure to connect the laptop computer to the DCP and initialize the computer as the DCP OID.

Table 3.3.2. DCP Power Up Procedure

Step	Procedure
1	If DCP is a Class II DCP, ensure that UPS POWER switch is set to off (0) position.
2	Ensure that all circuit breaker module switches in Circuit Breaker Rack A1A3 (slots A1 through A18) are set to off (right) position.
3	Set DCP circuit breaker, located in ac junction box, to on position.
4	Set primary Circuit Breaker Module A1A3A1 to ON (left) position. If Class I DCP, power is applied to DCP when this breaker is turned on.
5	If Class II DCP, set UPS POWER switch to on (1) position.
6	To apply power to individual sensors, set corresponding circuit breaker module switches in Circuit Breaker Rack A1A3 (slots A2 through A9 and A11 through A18) to on (left) position.

Table 3.3.3. DCP Power Down Procedure

Step	Procedure
1	In Circuit Breaker Rack A1A3, set sensor circuit breakers in slots A2 through A9 and A11 through A18 to off (right) position.
2	If Class II DCP, set UPS POWER switch to off (0) position.
3	Set primary Circuit Breaker Module A1A3A1 to OFF (right) position.
4	Set DCP circuit breaker, located in ac junction box, to off position.

Table 3.3.4. Connecting Laptop Computer as DCP OID

Step	Procedure
	Tools required: Laptop computer with PROCOMM Plus installed Laptop interface (Y-shaped) cable $ Laptop null cable DB-9 to DB-25 adapter Large flat-tipped screwdriver Small flat-tipped screwdriver **WARNING** 120 vac is present in cabinet if DCP has not been powered down prior to connecting DCP OID. To avoid death or severe injury, exercise extreme caution when connecting DCP OID.
1	**INITIALIZATION** a. If Class I DCP, locate DB-25 connector for SIO port 1-1 (W017-P22). Proceed to step d. b. If Class II DCP, using large flat-tipped screwdriver, loosen knurled captive screw at top of Circuit Breaker Module Rack A1A3. Lower circuit breaker module rack to gain access to UPS SIO connector. c. Using small flat-tipped screwdriver, disconnect SIO port 1-1 connector (W015-P22) from UPS RS-232 Interface Board A1A8. d. Connect RS-232 (COM1) port of laptop computer to DCP SIO port 1-1 connector (W015/W017-P22) using the following support items: (1) Laptop interface (Y-shaped) cable (2) One DB-9 to DB-25 adapter $ (3) Laptop null cable e. Raise circuit breaker module rack and secure captive screw. f. Turn on laptop computer and initialize to PROCOMM Plus program. When program initializes, press any key to enter terminal mode (blank) screen. g. Using ALT-S command (setup facility), set up the following TERMINAL OPTIONS: (1) Terminal emulation: VT220 (2) Duplex: FULL (3) Soft flow control (XON/XOFF): OFF (4) Hard flow control (CTS/RTS): OFF (5) Line wrap: OFF (6) Screen scroll: OFF (7) CR translation: CR (8) BS translation: NON-DESTRUCTIVE (9) Break length (milliseconds): 350 (10) Enquiry: OFF (11) EGA/VGA true underline: OFF (12) Terminal width: 80 (13) ANSI 7 or 8 bit commands: 8 BIT h. Return (exit) to terminal mode (blank) screen.

Table 3.3.4. Connecting Laptop Computer as DCP OID - CONT

Step	Procedure
	I. Using ALT-P command (line/port option), set CURRENT SETTINGS as follows: (1) Baud rate: 9600 (2) Parity: NONE (3) Data bits: 8 (4) Stop bits: 1 (5) Port: COM1 j. Return (exit) to terminal mode (blank) screen. k. On laptop computer, set CAPS LOCK to ON and NUM LOCK to OFF. l. Press <CTRL>A (no carriage return). m. Type OID (no carriage return). The system responds with STANDBY while OID initializes. After a short delay, the 1-minute display is displayed on the laptop screen. If display is not correct, set NUM LOCK to ON and press 0 (help) twice to refresh screen. Technician is automatically signed on to OID #8, as a technician, with initials DCP (there is no need for manual sign-on). n. Laptop computer now functions as an OID. Set NUM LOCK to ON to use laptop number keys as OID function keypad in usual manner. Set NUM LOCK to OFF to type alphabetic characters.
2	**SIGNOFF** **NOTE** The technician must sign off of the DCP OID before removing power from the DCP for any maintenance actions. If the technician does not sign off before the DCP is turned off, the technician may not be able to initialize the DCP OID after restoring power. From 1-minute display, sign off in usual manner (select SIGN key, enter DCP as initials, and press return twice). Ensure that NUM LOCK is set to ON when using SIGN key on display and set to OFF when entering initials for signoff.
3	**DISCONNECTING DCP OID** Tools required: Large flat-tipped screwdriver Small flat-tipped screwdriver a. Sign off DCP OID as described above. b. Using ALT-X (exit) command, exit PROCOMM Plus. c. Turn off laptop computer.

Table 3.3.4. Connecting Laptop Computer as DCP OID - CONT

Step	Procedure
	WARNING 120 vac is present in cabinet if DCP has not been powered down prior to connecting DCP OID. To avoid death or severe injury, exercise extreme caution when connecting DCP OID.
	d. If Class I DCP, disconnect cables and adapter between laptop computer and DCP harness connector W017-P22. Place unused connector P22 in position that it will not be damaged or interfere with other equipment. Procedure is then complete for Class I DCP. For Class II DCP, perform steps e through h.
	e. If Class II DCP, using large flat-tipped screwdriver, loosen knurled captive screw at top of Circuit Breaker Module Rack A1A3. Lower circuit breaker rack to gain access to UPS SIO connector.
	f. Disconnect cables and adapter between laptop computer and DCP harness W015-P22.
	g. Using small flat-tipped screwdriver, install connector W015-P22 to UPS RS-232 Interface Board A1A8.
	h. Raise circuit breaker module rack and secure captive screw.

SECTION IV. THEORY OF OPERATION

3.4.1 DATA COLLECTION PACKAGE (DCP) OVERVIEW

The DCP collects information directly from the remote weather sensors and provides the collected data to the acquisition control unit (ACU) for processing. The DCP also provides ac power for each interfaced sensor.

3.4.2 DCP BASIC BLOCK DIAGRAM DESCRIPTION

3.4.2.1 **General**. Figure 3.4.1 provides an overall block diagram of the DCP. The major subassemblies of the DCP are the card rack assembly, the rf modem mounting plate, the Faraday box, the uninterruptible power supply, the power supply assembly, and the battery box. The DCP's major functions are grouped into three functional areas: data processing, input/output, and power distribution and control. The following paragraphs provide a basic block diagram description of these functional areas.

3.4.2.2 **DCP Data Processing**. The data processing functional area is responsible for system timing and control, data processing, data formatting and storage, and data quality checks. All hardware required for data processing is contained in the card rack assembly and includes one (Class I systems) or two (Class II) central processing unit (CPU) boards and a memory board. The following paragraphs provide brief descriptions of these data processing boards.

3.4.2.2.1 **CPU Boards**. The CPU board(s) provide central processing and control for the DCP and its corresponding sensors. For Class II systems, one CPU functions as the primary CPU, and the second serves as the secondary CPU. Both CPU boards perform self-tests once per second during real-time operation and constantly monitor each other. If a self-test error is detected, the faulty CPU is flagged off-line and the other CPU assumes the processing duties. For Class I systems, only one CPU board is provided.

3.4.2.2.2 **Memory Board**. The memory board stores the DCP execuTable code, which is downloaded from the ACU during DCP initialization. The memory board also saves data before a system shutdown. The board can contain up to 1 megabyte of memory with a battery backup for random access memory (RAM) in the event of facility ac input power loss.

3.4.2.3 **DCP Input/Output**. The DCP input/output (I/O) functional area is responsible for communication between the data processing functional area, the ACU, and the remote weather sensors. This area also monitors ac and dc power supplies and controls power to the sensors.

3.4.2.3.1 **DCP/ACU Communication**. Communications between the DCP and ACU are established via an rf modem or line driver link. For Class II systems using an rf modem link, the communication system consists of two rf modems, an rf modem switch, and an rf antenna. At certain sites where RFI was experienced, yagi antennas are used at one or both ends of the link. A yagi can only be used at the DCP if the ACU is illuminated within the yagi's 10-degree beamwidth. Additionally, five watt attenuators of 3 dB, 6 dB, 10 dB, 20 dB, or 30 dB (PN 62828-90424-2, -3, -4, -5 and -6, respectively) may be inserted in the antenna line(s) to reduce transmit power into the antennas. Each of the two Class II CPU's communicates with one of the modems via a direct RS-232 data link, and the modem, in turn, communicates with the ACU via the rf antenna. For Class I systems, a single rf modem connected to the single Class I CPU provides the data link, and an rf switch is not required. The line driver communication link is similar, except that communication with the ACU is over a direct line rather than the airwaves. For Class II systems, two line drivers are provided, and an LD1/LD2 switching board switches between primary and secondary line drivers. For Class I systems, a single line driver handles all DCP/ACU communication.

3.4.2.3.2 **Serial I/O (SIO) Boards**. Five XVME 490/1 type SIO boards provide communication between the CPU, optional pressure sensors, and the remote sensors (sensors mounted external to the DCP). The DCP has one SIO board as a minimum configuration. Up to four additional SIO boards may be added, depending on the number of sensors connected to the DCP. Each SIO board provides four RS-232 serial ports. For remote sensors, the SIO boards communicate with fiberoptic modems contained in the Faraday box, which in turn communicate with the individual sensors and the auxiliary DCP equipment cabinet. Optional pressure sensors use cables W73, W74, and W75 instead of fiberoptic modems to communicate with the SIO boards. In Class II systems, one SIO port is also used to communicate with the uninterruptible power supply (UPS) in the power distribution and control functional area.

3.4.2.3.3 **Analog to Digital (A/D) and VME Resistor Boards**. One or two A/D boards convert analog data to digital so that the data can be read by the CPU. One A/D board is used if the DCP supports eight or fewer sensors. The second A/D board is required for a DCP that has nine or more sensors. These boards convert analog dc and ac power monitor signals to dc data. The CPU's then read the data to determine the operational status of the dc power supplies and to monitor the ac power being used by the remote sensors. The VME resistor board scales the dc voltages before they are applied to the A/D boards.

3.4.2.3.4 **Digital I/O Board**. The digital I/O board contains four digital I/O ports that allow the CPU's to read and write control data from and to DCP assemblies. The primary use of the digital I/O ports is to allow the system software to control the application of ac power to the sensors via the power control modules. In Class II systems, the CPU's also use the digital I/O board to select between primary and secondary rf modems (or line drivers) by controlling the rf switch (or line driver relay) and to control and monitor the UPS bypass circuit.

3.4.2.4 **<u>DCP Power Distribution and Control</u>**. The power distribution and control functional area is shown in simplified form in figure 3.4.2. The power distribution area consists of several assemblies located throughout the DCP equipment cabinet. Facility ac input power is applied to the DCP via the Faraday box, which provides electromagnetic interference (EMI) shielding and surge protection. The ac power is then routed through a time delay relay, through an input circuit breaker module in the circuit breaker rack, to the ac distribution strip. For Class II systems, ac power is then routed to a UPS bypass circuit and to the DCP uninterruptible power supply (UPS). The UPS is not a unit in itself but is a group of several field replaceable units (FRU's) that are collectively referred to as the UPS. The UPS provides backup ac power to the DCP assemblies and up to nine sensors for a minimum of 10 minutes. Special line loss circuitry within the UPS monitors the applied ac power. If an ac input power loss is detected, the UPS uses the battery backup source (via a dc-to-ac conversion) to continue providing ac power to the DCP. The power outputs of the UPS are returned to the ac distribution strip. For both Class I and Class II systems, ac power is distributed from the ac distribution strip to DCP assemblies, including the sensor circuit breaker modules and the dc power supplies. The dc power supplies provide +5 vdc and ±12 vdc for the DCP assemblies via the dc distribution strip. Assemblies requiring dc power include the rf modems (or line drivers) and the card rack assembly. DC power is also applied to the control circuitry for the DCP heaters and to the sensor circuit breaker modules. While the actual configuration of the sensor circuit breaker modules varies according to the sensors interfaced, the function of these modules is to provide circuit breaker control for the external sensor electronics and heater (if applicable). In addition, special control and monitoring circuitry in each circuit breaker module allows system software to remove ac power from the associated sensor and to check the amount of electrical current being used by the sensor. The sensed current level and dc power supply outputs are monitored by the system software through the card rack assembly. The ac power outputs of the sensor circuit breaker modules are routed to the external weather sensors through the Faraday box.

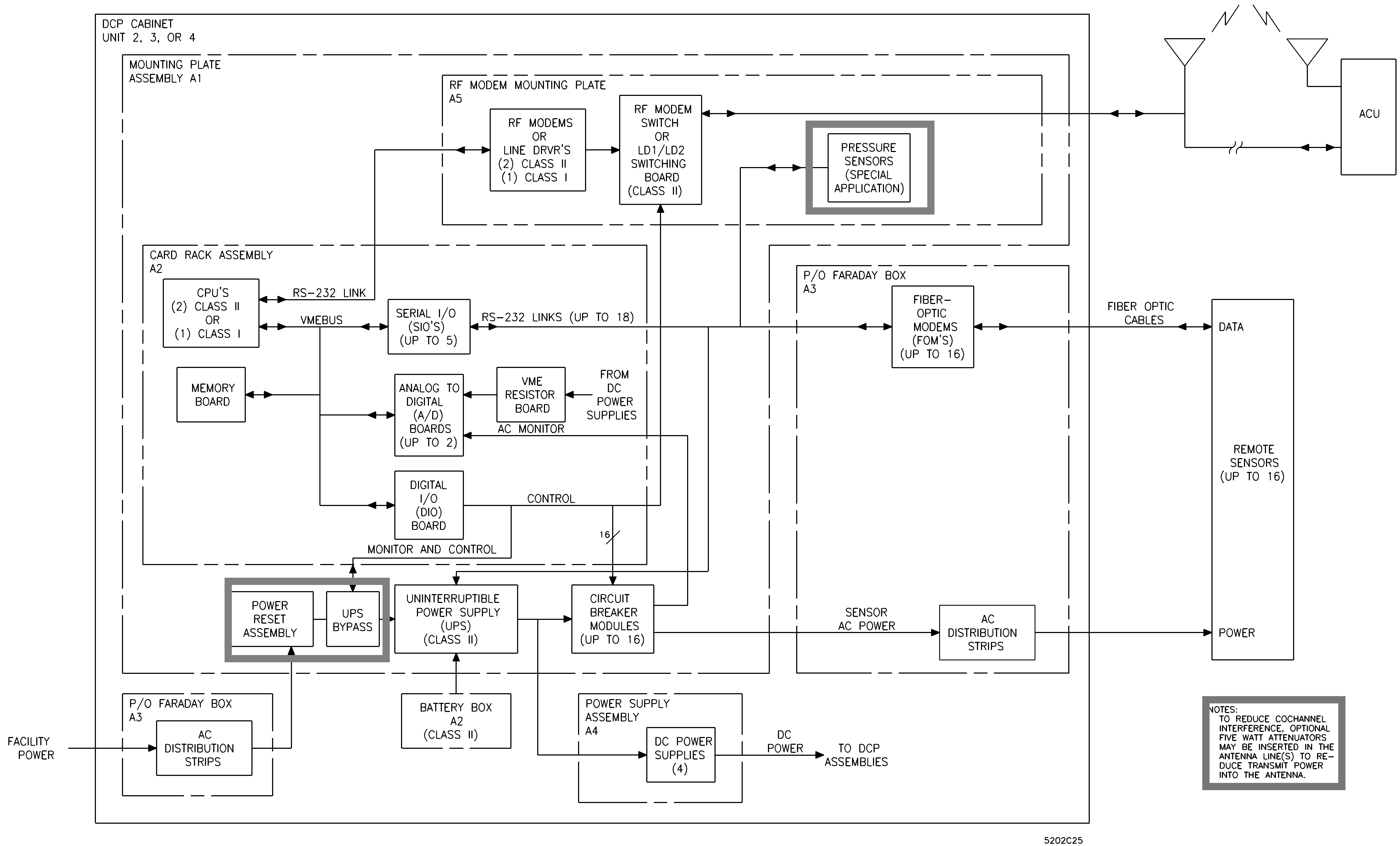


Figure 3.4.1. DCP Simplified Block Diagram

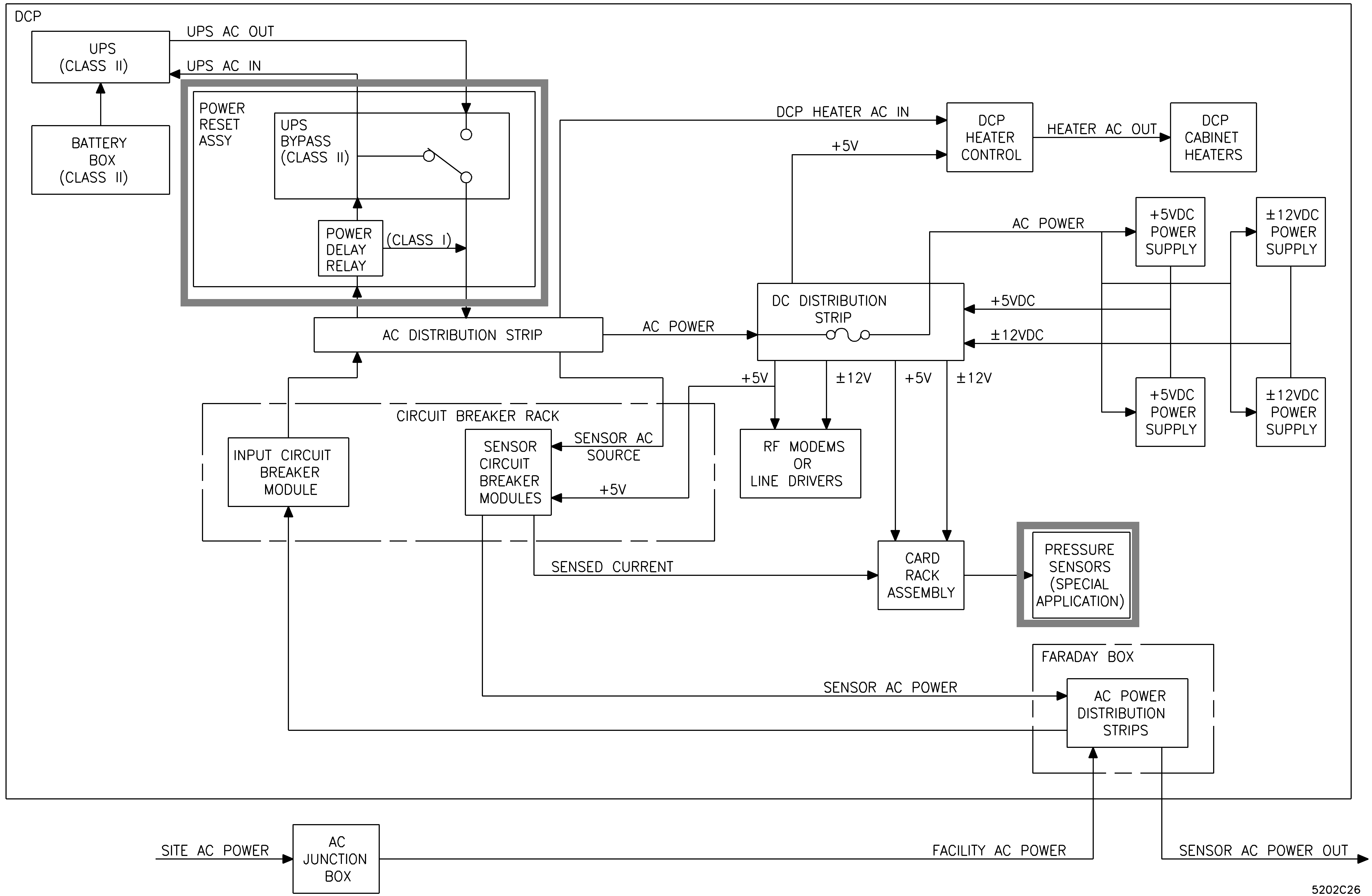


Figure 3.4.2. DCP Power Distribution and Control Simplified Block Diagram

3.4.3 DCP DETAILED BLOCK DIAGRAM DESCRIPTION

3.4.3.1 **General**. This paragraph contains detailed block diagrams and descriptions of the ASOS DCP. A description of the card rack assembly includes a detailed block diagram and a description of the circuit boards dedicated to the processing of ASOS sensor data. A description of the rf modems includes diagrams and theory of operation. The sensor fiberoptic modules are described including the theory of operation and associated diagrams. Repair of a faulty DCP peripheral consists of replacing the failed peripheral. Accordingly, the theory of operation of peripherals is presented at a general level. The drawings associated with peripherals are intended to provide the technician with the information necessary to conduct continuity checks when a connector is suspected of being faulty or needs replacement. Power distribution and control are described using detailed block diagrams for the distribution of dc and ac voltages to the DCP, including the UPS.

3.4.3.2 **DCP Card Rack Assembly**. The DCP card rack assembly contains up to 12 circuit boards that perform all of the data processing and I/O functions. The CPU's and memory board are used specifically to process data. The SIO boards, the A/D boards, the VME resistor board, and the digital I/O board perform the DCP I/O functions. All of the circuit boards are designed to accommodate the VMEbus backplane construction. Figure 3.4.3 illustrates the VMEbus chassis, backplane configuration, and connector pin assignments as specified by the VMEbus specification dictated by BICC-VERO Electronics, Inc. Two 96-pin bus connectors on the back edge of the board are labeled P1 and P2. The 96-pin bus connector consists of three rows of pins (32 pins per row) labeled rows A, B, and C. The pin connections for P1 contain the standard address, data, and control signals necessary for system bus communication. The P1 pin assignments are listed by pin number order. The pin connections for P2 vary according to the function provided by the circuit board. The following paragraphs provide detailed information on the circuit boards and their dedicated functions.

3.4.3.2.1 **Central Processing Units (CPU's)**. The CPU's execute the ASOS operational software upon initialization. All operational software resides in battery backed up RAM on Memory Board A1A2A3. Execution of the operational software involves data processing, data formatting, data quality checks, and data storage. For a Class II DCP, the VME card rack contains two CPU circuit boards, both of which are identical and contain a 68010 series (68 thousand series) microprocessor running at 10 MHZ, memory (EPROM and dynamic random access memory (DRAM)), two RS-232 ports, and a 16-bit timer. During system operation, one of the CPU's functions as the primary CPU, which performs all processing and I/O functions. The other (secondary) CPU provides a redundant processor. If at any time the primary CPU fails, it is taken off-line and the secondary CPU becomes the primary CPU. Initially, CPU A is the primary CPU. Two pushbutton switches labeled RESET and ABORT are provided on the front of the circuit board. ABORT halts program execution without resetting the CPU. This switch is used for development purposes and should not be used in the field. If ABORT is pressed, RESET should be pressed to reset the CPU and activate SYSRESET, thereby resetting the entire backplane via the VMEbus. Resetting the CPU does not affect the contents of the DRAM. The following paragraphs provide detailed block diagram descriptions of the CPU and the various modes of operation.

The CPU consists of nine functional areas (Figure 3.4.4): the system resource function, UART and timer, RS-232 driver and receiver logic, CPU, CPU clock, interrupt logic, VME interface logic, address buffer and decode, and memory. The system resource function of CPU A provides the system clock, system reset, bus arbitration, and bus timer functions for the entire VMEbus. Therefore, because CPU A is the bus controller, the system resource function of CPU B is not used.

The dual UART and timer provides two RS-232 serial communication channels, a timer, and two ports. The RS-232 driver and receiver logic provides the standard RS-232 receive and transmit lines. The RS-232 driver and receiver logic interfaces UART channel A of its CPU to one of the two rf modems (A5A1 and A2) via connector JK1 on the CPU's. UART channel B on both CPU's are not used. On CPU B, however, a loopback jumper is installed between the channel B transmit and receive lines (pins 14 and 16 of JK1). This jumper identifies CPU B as the initial secondary CPU. When the DCP is first initialized, both CPU's issue a message to their respective UART channel B. CPU B then receives the message back via the installed loopback jumper. Both CPU's then examine their receive lines. When CPU B detects that it has received the signal via the loopback jumper, it assumes the role of secondary CPU. When CPU A detects that it has not received its transmitted signal, it assumes the role of primary CPU.

The CPU clock provides the 10 MHZ clock signal required by the CPU, which executes the ASOS operational software. The interrupt logic monitors the dedicated interrupt lines and informs the CPU when an interrupt line is active. The interrupts are prioritized and processed on a first-come, first-serve basis. The VME interface logic provides the standard address, data, and control signals necessary for system bus communication. The address buffer and decode provides the memory address and system address. The onboard memory consists of 128K bytes of EPROM and 512K bytes of DRAM. The refresh circuitry for the DRAM is not disabled during a RESET; therefore, the CPU may be reset without affecting the memory contents.

The DCP continuous self-test (CST) checks the status of the CPU's once per minute. CST results are displayed on the CPU display page of the OID. The CST checks the following areas of both the primary and secondary CPU: DRAM, EPROM, BUS ERRORS, SERIAL PORT #1 and #2 LOOP-BACK, and SERIAL PORT #1 and #2 XMIT ERRORS. For the primary CPU, test pass/fail status is displayed for each of these areas. For the secondary (redundant) CPU, test status is displayed for the overall board only. The technician can manually select to run the CPU test from the CPU page at any time. When this is done, a T status is displayed for each test category until the test is run again during the next CTS cycle. After the cycle, the latest test status is displayed and the fail count (if applicable) is incremented.

The DRAM test is based on an alternating pattern. Data are output to the DRAM and read back and the returned data are evaluated and the test status is displayed. The EPROM test is based on a checksum. The checksum is compared to the last byte in the EPROM and the result is evaluated and the test status is displayed. The BUS ERRORS test is based on a memory write to a specific address, with the contents of the addressed memory evaluated and the test status displayed.

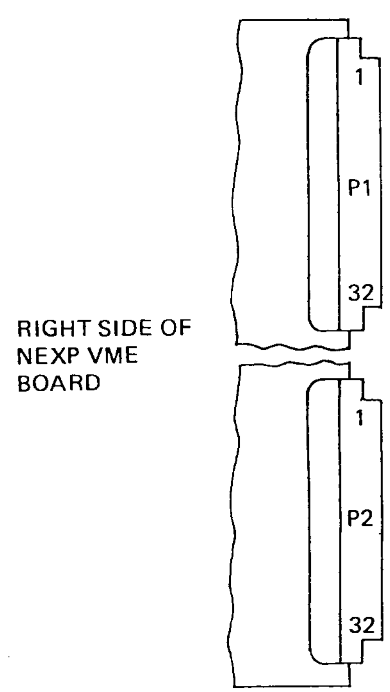
The SERIAL PORT #1 and #2 LOOPBACK tests ensure that the CPU can communicate with its internal UART. The CPU reads the UART interrupt vector register and checks for bus errors. Test status is displayed as P (pass) if no bus errors occurred.

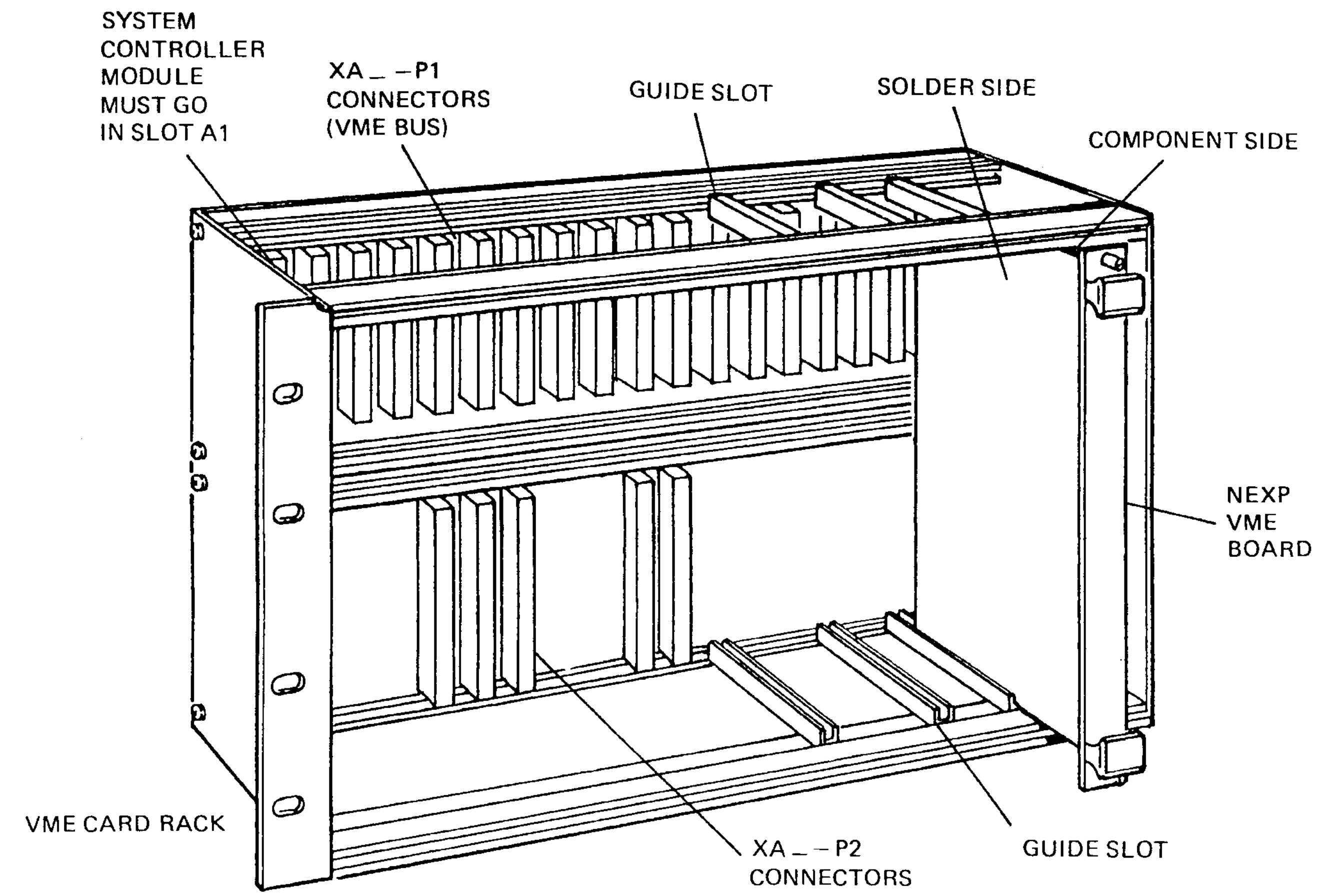
For the SERIAL PORT #1 and #2 XMIT ERRORS test, the CPU reads the contents of the status register for the corresponding port. This register contains information on transmission errors detected by the UART during RS-232 communications. Specifically, the CPU checks the status register for parity errors, framing errors, and overrun errors that may have occurred. If such errors occur for three consecutive CST cycles, an F (fail) is displayed for the test status; otherwise, test status is P (pass).

3.4.3.2.2 **Memory Board**. The XVME-100 memory board can contain up to 1M byte of static RAM (SRAM) memory arranged into two banks (up to 512K bytes of memory per bank). Each bank can contain up to four 128K x 8 bit memory devices. Each bank is independently configured via jumpers to specify VME address/memory chip size, device speed, device pinout, and backup power. The following paragraphs a provide detailed block diagram description of the memory board.

P1 (VME BUS) PIN ASSIGNMENTS

Pin Number	Row A Signal Mnemonic	Row B Signal Mnemonic	Row C Signal Mnemonic
1	D00	BBSY	D08
2	D01	BCLR	D09
3	D02	ACFAIL	D10
4	D03	BG0IN	D11
5	D04	BG0OUT	D12
6	D05	BG1IN	D13
7	D06	BG1OUT	D14
8	D07	BG2IN	D15
9	GND	BG2OUT	GND
10	SYSCLK	BG3IN	SYSFAIL
11	GND	BG3OUT	BERR
12	DS1	BR0	SYSRESET
13	DS0	BR1	LWORD
14	WRITE	BR2	AM5
15	GND	BR3	A23
16	DTACK	AM0	A22
17	GND	AM1	A21
18	AS	AM2	A20
19	GND	AM3	A19
20	IACK	GND	A18
21	IACKIN	SERCLK(1)	A17
22	IACKOUT	SERDAT(1)	A16
23	AM4	GND	A15
24	A07	IRQ7	A14
25	A06	IRQ6	A13
26	A05	IRQ5	A12
27	A04	IRQ4	A11
28	A03	IRQ3	A10
29	A02	IRQ2	A09
30	A01	IRQ1	A08
31	-12V	+5V STDBY	+12V
32	+5V	+5V	+5V





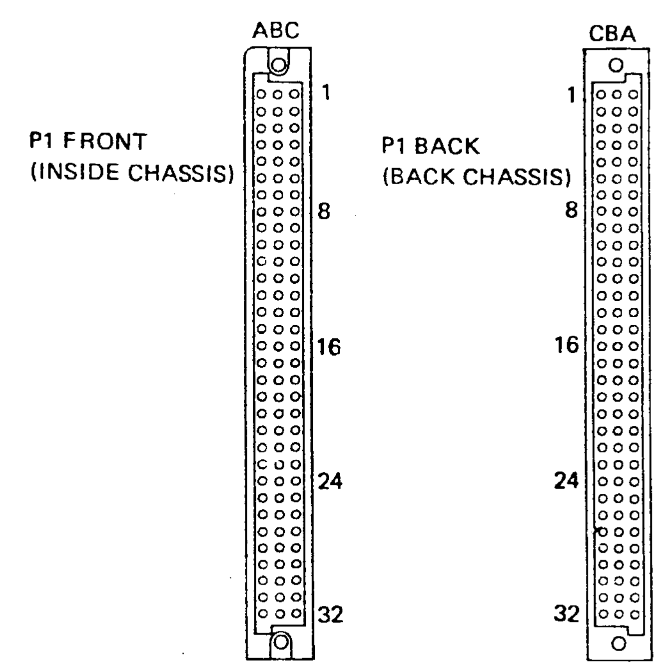


Figure 3.4.3. DCP VMEbus Chassis and Connector Pin Assignments (Sheet 1 of 2)

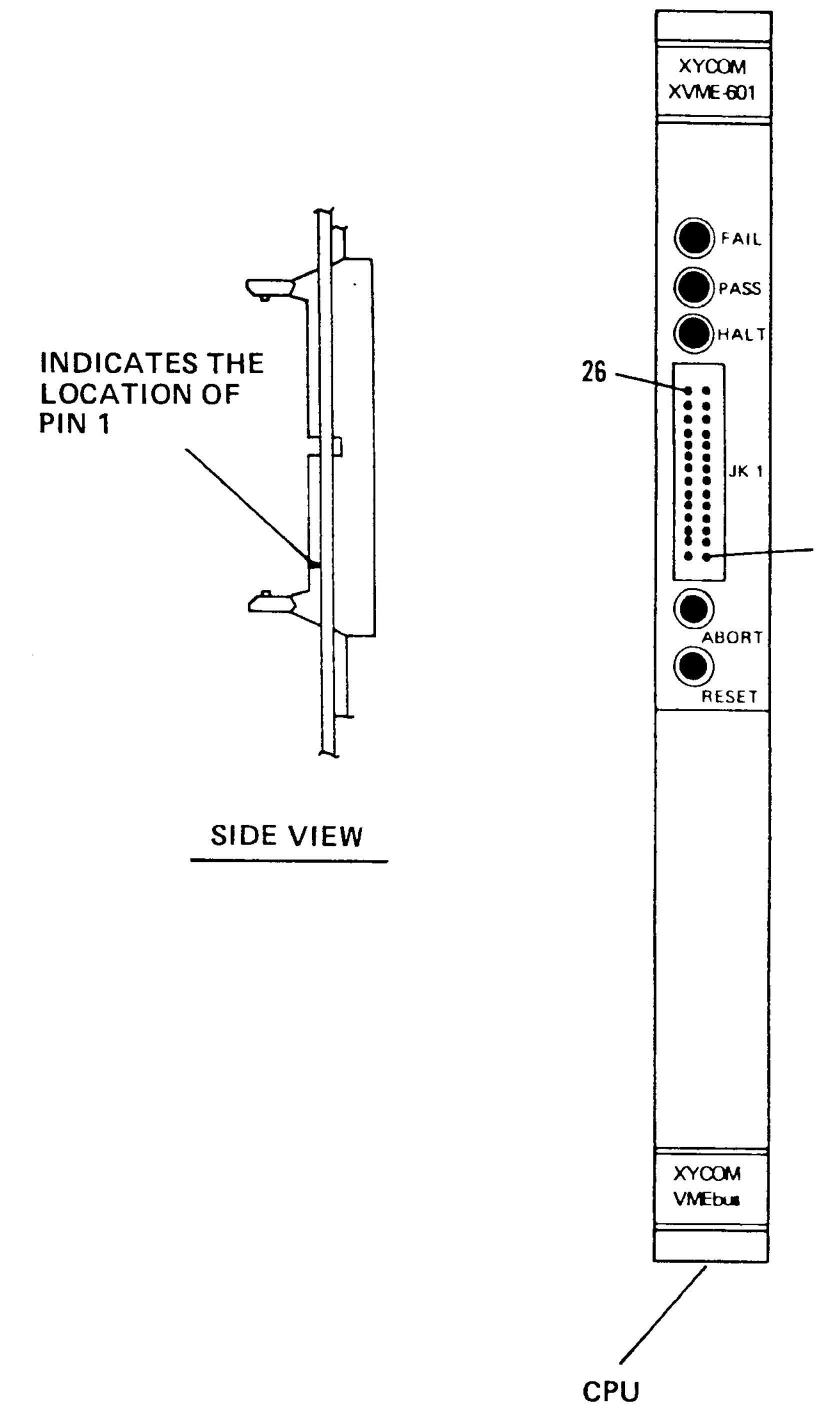
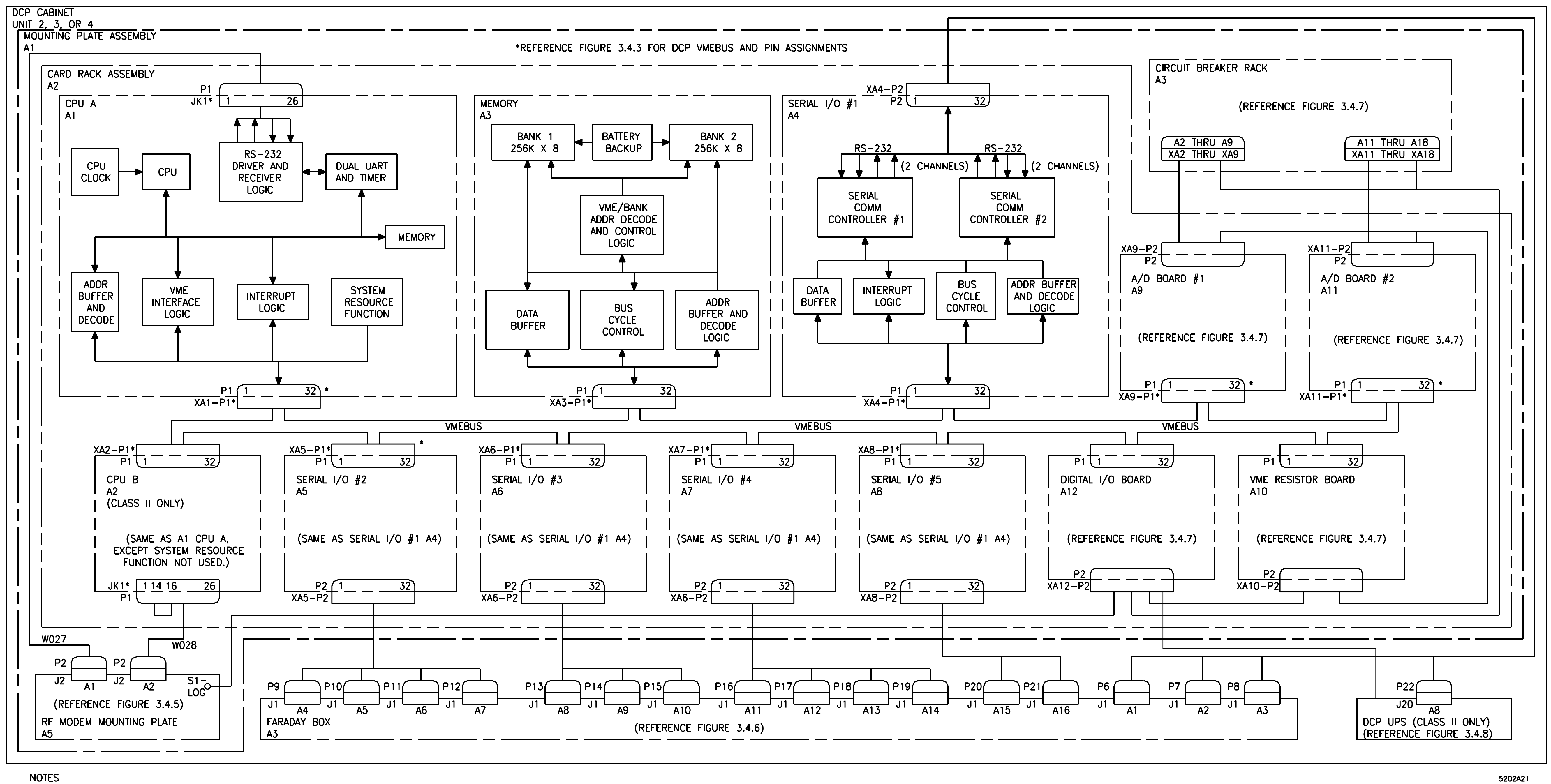


Figure 3.4.3. DCP VMEbus Chassis and Connector Pin Assignments (Sheet 2)



NOTES

*1. REFERENCE FIGURE 3.4.3 FOR DCP VMEBUS AND PIN ASSIGNMENTS.

2. UNLESS OTHERWISE NOTED ALL DCP CABINET WIRING IS PART OF HARNESS W015 (CLASS II) OR W017 (CLASS I).

3. DEPENDING UPON PORT AVAILABILITY AT SELECTED SITES WITH PRESSURE SENSORS LOCATED IN THE DCP, CONNECTORS AT FARADAY BOX A3 P6 – P21 COULD BE CONNECTED TO W73, W74 OR W75 FOR PRESSURE SENSORS P1, P2 AND P3 RESPECTIVELY.

Figure 3.4.4. DCP VME Card Rack Detailed Block Diagram

The memory board consists of seven functional areas (Figure 3.4.3): two banks (1 and 2), VME/bank address and decode logic, battery backup, data buffer, bus cycle control, and address buffer and decode logic. The address and control signals used to address memory locations are generated by the VME/bank address decode and control logic. The memory board is configured with a battery backup to provide an alternate power source in the event of facility ac input power loss. The data buffer, bus cycle control, and address buffer and decode logic provide the standard address, data, and control signals necessary for system bus communication.

The DCP CST checks the status of the memory board once per minute. CST results are displayed on the memory display page of the OID. The CST performs an SRAM test on the DCP memory board. The technician can manually select to run the memory test from the memory page at any time. When this is done, a T status is displayed for the SRAM test category until the test is run again during the next CTS cycle. After the cycle, the latest test status is displayed and the fail count (if applicable) is incremented.

The SRAM test ensures that the CPU can read data from the SRAM on the memory board without encountering bus errors. The results are evaluated and the test status is displayed.

3.4.3.2.3 **Serial I/O (SIO) Boards**. Each of the five (maximum) XVME 490/1 type SIO boards used in the DCP provide four RS-232 serial ports. The XVME 490/1 SIO boards communicate with the Faraday box and the DCP UPS. The SIO boards communicate with the CPU on a character-by-character basis. The CPU processes interrupts on each and every transmitted and received character. The following paragraphs provide a detailed block diagram description of the SIO board.

The SIO board consists of six functional areas (Figure 3.4.4): two serial communication controllers (SCC's), interrupt logic, data buffer, bus cycle control, and address buffer and decode logic. Each of the SCC's provides two communication ports. Upon power up, the SCC's are initialized to the proper communication modes. Interrupts are generated via the interrupt logic. An interrupt can signify that a received character is available, that the transmit buffer is empty, or an external/ status change. The data buffer, bus cycle control, and address buffer and decode logic provide the standard address, data, and control signals necessary for system bus communication.

The four ports of each of the DCP SIO boards are factory assigned to specific devices. The ports are connected to these devices via corresponding connectors on the DCP main harness. Table 3.4.1 identifies each of the ports of the DCP SIO boards and lists the corresponding harness connector and the device to which it is connected.

The DCP CST checks the status of the SIO boards once per minute. CST results are displayed on the DCP SIO display pages of the OID (there is one page for each of the five SIO's). The CST performs a LOOPBACK test and an XMIT ERRORS test on each of the four ports of an SIO board. The technician can manually select to run the SIO test from an SIO page at any time. When this is done, a T status is displayed for both test categories until the test is run again during the next CTS cycle. After the cycle, the latest test status is displayed and the fail count (if applicable) is incremented.

For the LOOPBACK test, the CPU reads an interrupt vector register on the SIO board to ensure that it can communicate with the SIO port. For the XMIT ERRORS test, the CPU reads the contents of the SCC status register for the corresponding port. This register contains information on transmission errors detected by the SCC during RS-232 communications. Specifically, the CPU checks the status register for parity errors, framing errors, and overrun errors that may have occurred. For both LOOPBACK and XMIT ERRORS tests, CST status is displayed as either P (pass), F (fail), or D (degraded). A status of D is displayed if five or more errors have been detected and the port is currently passing the test. At 0600 LST each day, the number of accumulated failures is summarized in the system (maintenance) log. Paragraph 1.3.4.3.3 provides additional information on SIO test reporting.

Table 3.4.1. Port Assignments for DCP SIO Boards

SIO Board	Port	W015/17 Connector	Device	Function[1]
1	1	P22	A1A8 or A1A6	UPS #1 RS-232 Interface Board (Class II)
	2	P6	A1A3A1	Fiberoptic Module #1
	3	P7	A1A3A2	Fiberoptic Module #2
	4	P8	A1A3A3	Fiberoptic Module #3
2	1	P9	A1A3A4	Fiberoptic Module #4
	2	P10	A1A3A5	Fiberoptic Module #5
	3	P11	A1A3A6	Fiberoptic Module #6
	4	P12	A1A3A7	Fiberoptic Module #7
3	1	P13	A1A3A8	Fiberoptic Module #8
	2	None	None	UPS #2 RS-232 Interface Board (future use)
	3	P14	A1A3A9	Fiberoptic Module #9
	4	P15	A1A3A10	Fiberoptic Module #10
4	1	P16	A1A3A11	Fiberoptic Module #11
	2	P17	A1A3A12	Fiberoptic Module #12
	3	P18	A1A3A13	Fiberoptic Module #13
	4	P19	A1A3A14	Fiberoptic Module #14
5	1	P20	A1A3A15	Fiberoptic Module #15
	2	P21	A1A3A16	Fiberoptic Module #16
	3	None	None	Not used
	4	None	None	Not used

[1] Depending upon port availability at selected sites with pressure sensors located in the DCP, connectors P6 - P21 could be connected to W73, W74, or W75 for pressure sensors P1, P2, and P3 respectively.

3.4.3.2.4 **A/D Boards, Digital I/O Board, and VME Resistor Board**. The two A/D boards, the digital I/O board, and the VME resistor board collectively make up the DCP power monitoring and digital I/O function. The A/D boards, in conjunction with the VME resistor board, receive dc power monitor signals and convert them to digital values that may be read by the CPU via the VME bus. The digital I/O board provides digital input and output ports for use by the CPU. The CPU uses the output ports to write control signals to various FRU's in Circuit Breaker Rack A1A3 and in the rf modem mounting plate. The CPU uses the input ports to read configuration data from the VME resistor board. A detailed description of these boards is provided in the DCP power monitoring and digital I/O description (paragraph 3.4.3.5).

3.4.3.3 **RF Modem Communications**. Two different types of ACU/DCP communications may be provided by the DCP equipment cabinet: rf communications or direct line communications. RF modems are installed in the DCP to facilitate rf communications. Line drivers are installed for direct line communications. The following paragraphs provide a detailed block diagram of the rf communications equipment and its operation.

3.4.3.3.1 **RF Modem Rack**.As described for ACU rf modems (paragraph 2.4.3.4.2), three different types of modems are used in the DCP cabinets. The modems are 62828-90013-XX (AAI Corporation), 62828-90315-XX (Motorola, Inc), or 62828-40506-X (Johnson Data). Sheets 1 through 5 of figure 3.4.5 document the possible installations of these three types of modems as follows:

$ Sheet 1- original equipment AAI rf modem (-10 DCP s/n ≤189 and -20 DCP s/n ≤251)
$ Sheet 2- as sheet 1 but shown modified for Motorola rf modems
$ Sheet 3- as sheet 2 but shown with Johnson Data modems
$ Sheet 4- original equipment Motorola rf modem (-10 DCP s/n >190 and -20 DCP s/n >251)
$ Sheet 5- as sheet 4 but shown with Johnson Data modems
$

NOTE $

When an AAI modem (62828-90013-XX) fails, ASN S100-FMK18886 must be ordered to replace the modem with the Motorola modem (62828-90315-XX). AAI modems cannot be replaced with the Johnson Data modems (62828-40506-X). $ $ $

When a Motorola modem (62828-90315-XX) fails and spare Motorola modems are not available, a Johnson Data modem (62828-40506-X), an adapter cable (62828-42110-10), and a SMAM-to-BNCF adapter must be ordered to replace the failing rf modem. $ $ $

For a Class II system, the DCP rf communications equipment consists of two rf modems (A and B), an rf switch assembly, and a shared omnidirectional antenna (Figure 3.4.5, sheets 1 through 5). The rf modems are identical, with one serving as the primary communications link and the other as the secondary. The modems operate in the UHF frequency range in half-duplex mode. CPU A (A1) communicates with rf modem A via the CPU's built-in RS-232 port (connector JK1). CPU B (A2) communicates with rf modem B. The rf switch selects which modem is to use the antenna. This switch is controlled by the CPU's via Digital I/O Board A12. In the event that the primary CPU senses a failure in its rf link (no data received for a period of 2 minutes and 40 seconds), primary control is handed over to the other CPU. The new primary CPU then writes a selection word to the digital I/O board to toggle the rf switch. The new primary CPU and its modem then control all rf communications between the DCP and the ACU. For a Class I system, the rf communications circuitry is similar, except that there is no redundant rf system (there is only one CPU, one rf modem, and no rf switch).

The DCP CST checks the status of the ACU/DCP communications link once per minute. CST results are displayed on the ACU/DCP COMM page of the OID. This test performs two checks: RADIO A OR L/D A and RADIO B OR L/D B. RADIO A OR L/D A checks the ACU radio A link for up to three DCP's. RADIO B OR L/D B does the same for ACU radio link B (Class II systems). The CST also identifies which link (modem or line driver) (A or B) is currently serving as the primary link in the ACU and all DCP's.

The rf communications test is based on a loop test. The ACU transmits a predefined pattern across the communications link and the DCP verifies the reception of the pattern by responding with an OK or ERROR acknowledgment. An incorrect reception signifies an error and a failed indication. A failed indication is also displayed if the DCP fails to respond at all to the ACU transmission.

3.4.3.3.2 **Line Drivers**. If dictated by the configuration, line drivers and an LD1/LD2 switching board (Figure 3.4.5, sheet 4) are used in place of rf modems and the rf modem switch. The line drivers in the DCP are connected by a direct line to corresponding line drivers in the ACU. The line drivers are commonly referred to as short haul modems and perform a function similar to that of the rf modems. Diagnostically, the line driver is tested in lieu of the rf modem and the status is displayed on the ACU/ DCP COMM status page. The diagnostic test is the same as that used for the rf modems. The self-test/diagnostic program utilizes the ACU/DCP COMM status page to display test results.

3.4.3.3A. **Pressure Sensors**. The pressure sensors are mounted in the upper right corner of the DCP. The pressure sensors provide barometric pressure in inches of mercury (inHg). The CPU communicates with pressure sensors via available SIO board RS-232 ports (Figure 3.4.5a). An adapter cable (W026) is used for pressure sensor data which adapts the 25-pin RS-232 connector for the optional SIO port to the 9-pin RS-232 connector on the pressure sensor. The sensor pressure connections are routed through the desiccant assembly to the pressure port located on top of the DCP.

The pressure sensor tray contains a small printed circuit card to monitor the internal temperature of the DCP to insure that the DCP does not output pressure data when the internal temperature of the DCP is outside of the calibration range of the pressure sensors.

DCP firmware changes the pressure data to missing if the temperature inside the DCP is below 35˚F ±3˚F or above 150˚F ±3˚F and will automatically (no technician intervention required) report pressure when temperature is between 35˚F to 150˚F. The pressure sensor maintenance screen displays why the pressure is marked missing. A $

remark is entered into the syslog when the sensor is marked missing and when it recovers.

3.4.3.4 **Fiberoptic Modules**. Up to 16 fiberoptic modules provide digital/optical data conversions necessary for DCP communication with up to 16 individual sensor assemblies. All fiberoptic communications are controlled by the primary CPU through VMEbus and the five SIO boards (Figure 3.4.6). Transmit data (TXD) output from an SIO channel are applied to the drive circuit of the corresponding fiberoptic module. The transmit data are converted from electrical to optical and output to the sensor through the module's Tx port. Conversely, optical data applied to the Rx port of the fiberoptic module are converted from optical to electrical and output to the SIO as receive data (RXD).

3.4.3.5 **DCP Power and Signal Monitoring**. The circuitry shown on the DCP power monitoring and digital I/O detailed block diagram (Figure 3.4.7) allows the system software to monitor both analog voltage signals and digital data points. Digital output ports are also provided whereby the system software can control the application of ac power to the sensors. The following paragraphs describe the operation of the DCP power monitoring and digital I/O circuitry.

The DCP power monitoring and digital I/O function consists of one or two A/D boards, one VME resistor board, and one digital I/O board. DCP's supporting between one and eight sensors require only one A/D board. The second A/D board is installed only in DCP's supporting more than eight sensors. These boards are very similar to the A/D board, the VME resistor board, and the digital I/O board in the ACU, and they perform the same function. The A/D board, the VME resistor board, and the digital I/O board provide an interface to the VMEbus for access by the system computer (P1). The VMEbus contains control and status logic that identifies and conducts all VMEbus data transfers with the boards. The A/D boards and the digital I/O board also provide second interfaces for analog and digital user-defined devices (P2).

A/D Board A9 is the primary A/D board and is used for DCP's that have eight or fewer sensors. The A/D board contains 16 input analog channels numbered from 0 to 15 on the user interface port (P2). An analog multiplexer, under software control, selects 1 of the 16 possible analog signals for application to the A/D converter. The selected analog signal is converted to a 12-bit digital data value by the A/D converter that is then read by the computer over the VMEbus via the control and status logic.

Analog input channels 1 through 6 of A/D Board A9 receive power supply monitor signals via VME Resistor Board A10.

The VME resistor board scales the ±12 vdc signals from the power supplies down to ±6 vdc levels for the A/D converter. The 5 vdc signals from the power supplies are passed through the VME resistor board unscaled. The voltages monitored at the actual power supply outputs are typically more than +5V and ±12V due to adjustments for losses between the power supplies and the loads.

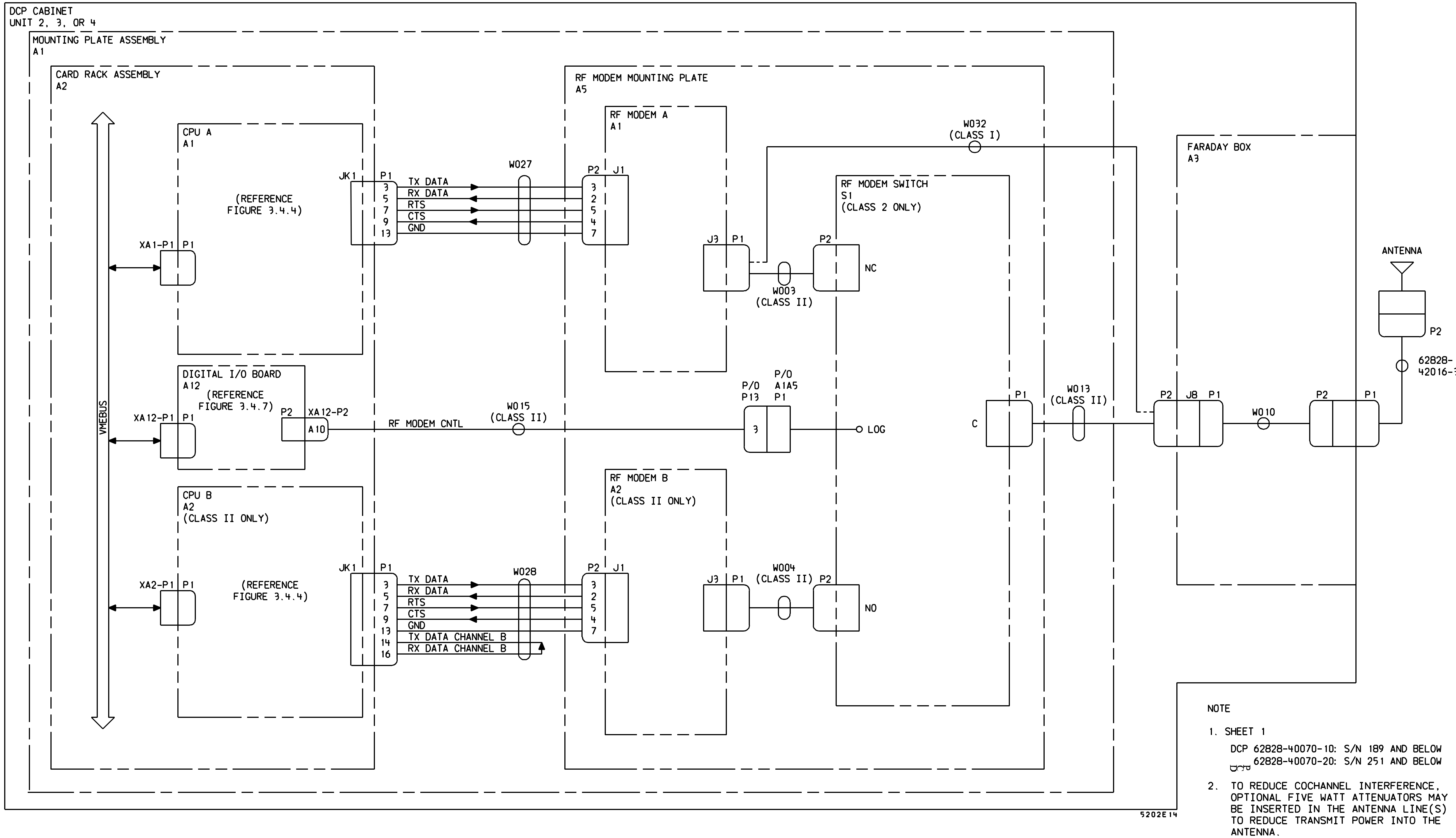
The VME resistor board contains a precision voltage source that outputs a 2.5 ±0.1 vdc reference voltage. This reference voltage is input on channel 0 of both A/D boards. The CPU selects this signal for conversion during the DCP CST to test the operation of the A/D converters on the A/D boards.

Analog input channels 8 through 15 of A/D Board A9 receive the current sensing output voltages of the circuit breaker modules associated with the first eight sensors (modules A1A3A2 through A9). These voltage levels represent the amount of ac current being used by the sensor associated with the circuit breaker module.

Digital I/O Board A12 contains two I/O port integrated circuits, identified as I/O port numbers 1 and 2. The primary CPU communicates with these ports via the VMEbus and address buffer and decode logic, a data buffer, and interrupt timing and control logic on the digital I/O board. The two I/O port IC's provide a total of four ports (ports A1, B1, A2, and B2), each of which communicates with external devices via a dedicated transceiver. Ports A1, B1, and A2 are defined as output only ports, and port B2 is configured for input.

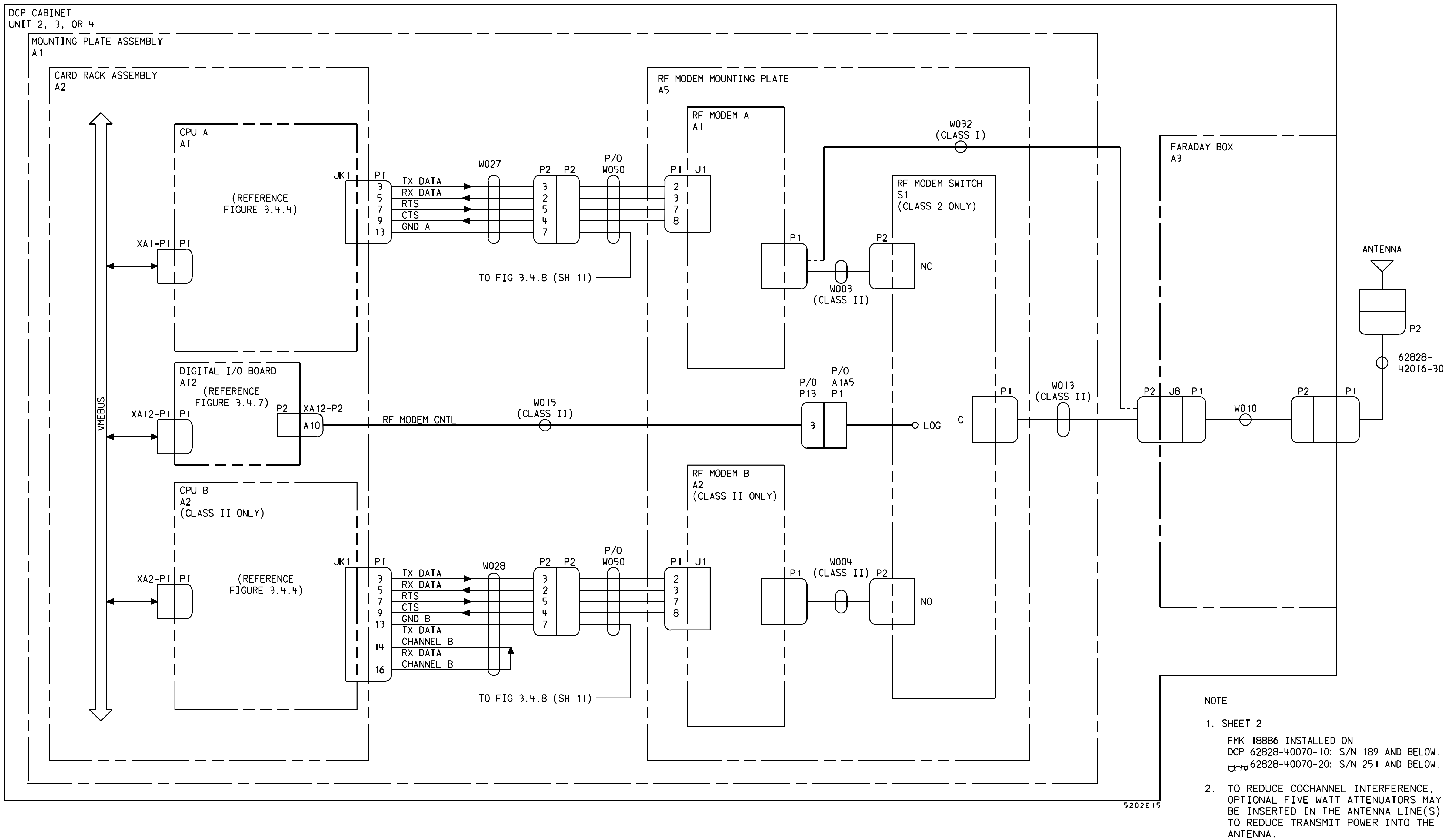
Output ports A1 and A2 allow the system software to control the application of ac power to up to 16 sensors via the circuit breaker modules. The computer writes control data to these I/O ports, which then output CONTROL bits that remove ac power from the associated sensor. Output port B1 is similarly used by the computer to send a control signal to the rf modem switch (or LD1/LD2 switching board).

VME Resistor Board A10 contains DCP SELECT switch S1. Because a single ACU can control up to three independent DCP's, this switch is set to identify its DCP as number 1, 2, or 3. The computer reads this identifier through input port B2 provided by Digital I/O Board A12.



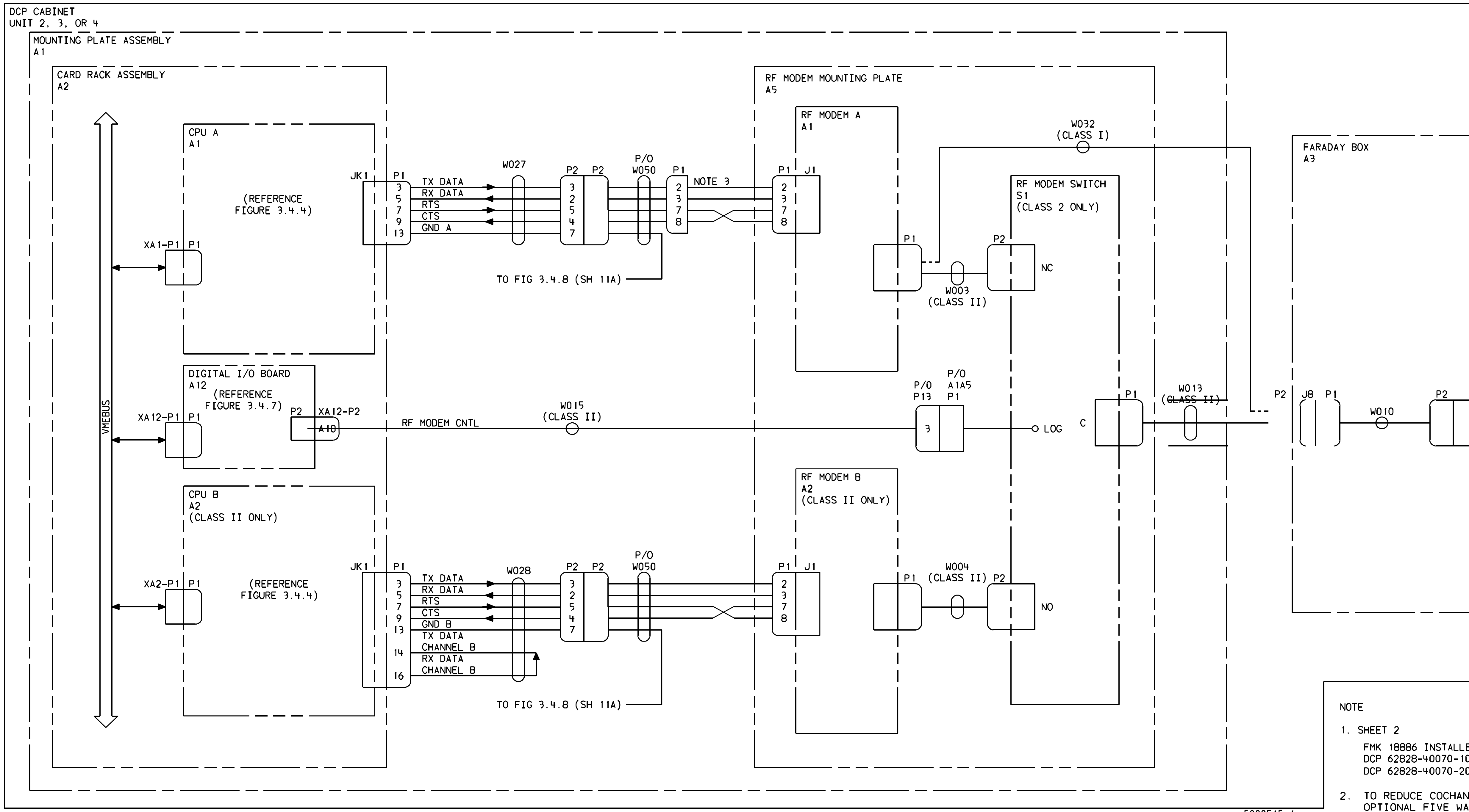
AAI MODEMS

Figure 3.4.5. DCP RF Modem/Line Driver Communications Link Detailed Block Diagram (Sheet 1 of 6)



SYSTEM CONVERTED FROM AAI
TO MOTOROLA MODEMS

Figure 3.4.5. DCP RF Modem/Line Driver Communications Link Detailed Block Diagram (Sheet 2)



NOTE

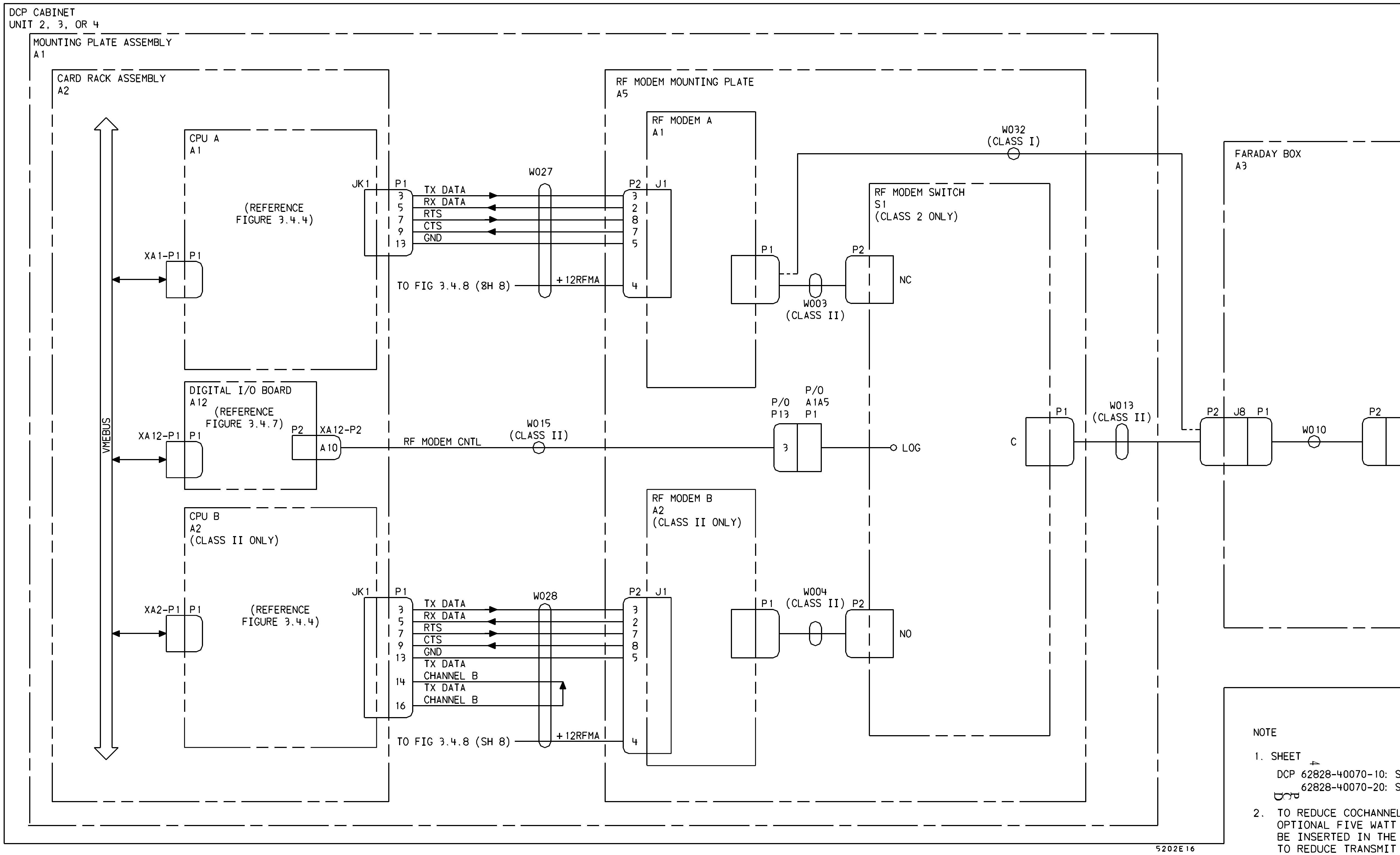
1. SHEET 2
FMK 18886 INSTALLED ON
DCP 62828-40070-10: S/N 189 AND BELOW.
DCP 62828-40070-20: S/N 251 AND BELOW.

2. TO REDUCE COCHANNEL INTERFERENCE, OPTIONAL FIVE WATT ATTENUATORS MAY BE INSERTED IN THE ANTENNA LINE(S) TO REDUCE TRANSMIT POWER INTO THE ANTENNA.

3. ADAPTER CABLE 62828-42110-10 INSTALLED BETWEEN W050P1 AND RF MODEM.

SYSTEM CONVERTED FROM AAI TO MOTOROLA MODEMS
EQUIPPED WITH JOHNSON DATA MODEMS

Figure 3.4.5. DCP RF Modem/Driver Communications Link Detailed Block Diagram (Sheet 3)



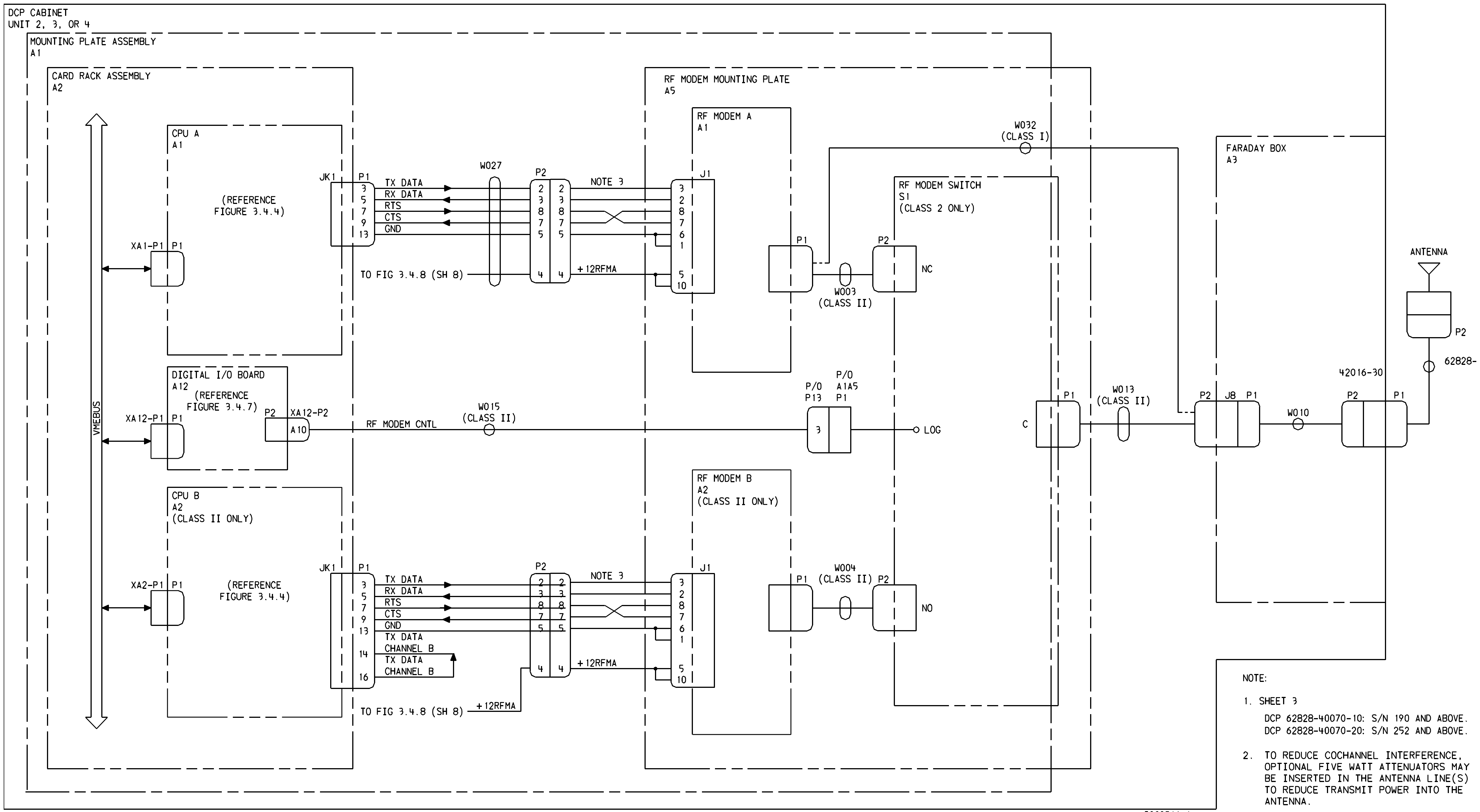
NOTE

1. SHEET 4
DCP 62828-40070-10: S/N 190 AND ABOVE
DCP 62828-40070-20: S/N 252 AND ABOVE

2. TO REDUCE COCHANNEL INTERFERENCE, OPTIONAL FIVE WATT ATTENUATORS MAY BE INSERTED IN THE ANTENNA LINE(S) TO REDUCE TRANSMIT POWER INTO THE ANTENNA.

MOTOROLA MODEMS

Figure 3.4.5. DCP RF Modem/Line Driver Communications Link Detailed Block Diagram (Sheet 4)



NOTE:

1. SHEET 3
   DCP 62828-40070-10: S/N 190 AND ABOVE.
   DCP 62828-40070-20: S/N 252 AND ABOVE.

2. TO REDUCE COCHANNEL INTERFERENCE, OPTIONAL FIVE WATT ATTENUATORS MAY BE INSERTED IN THE ANTENNA LINE(S) TO REDUCE TRANSMIT POWER INTO THE ANTENNA.

3. ADAPTER CABLE 62828-42110-10 INSTALLED BETWEEN W027 P2 AND MODEM.

CONVERTED FROM MOTOROLA MODEMS TO JOHNSON DATA MODEMS

Figure 3.4.5. DCP RF Modem/Line Driver Communications Link Detailed block Diagram (Sheet 5)

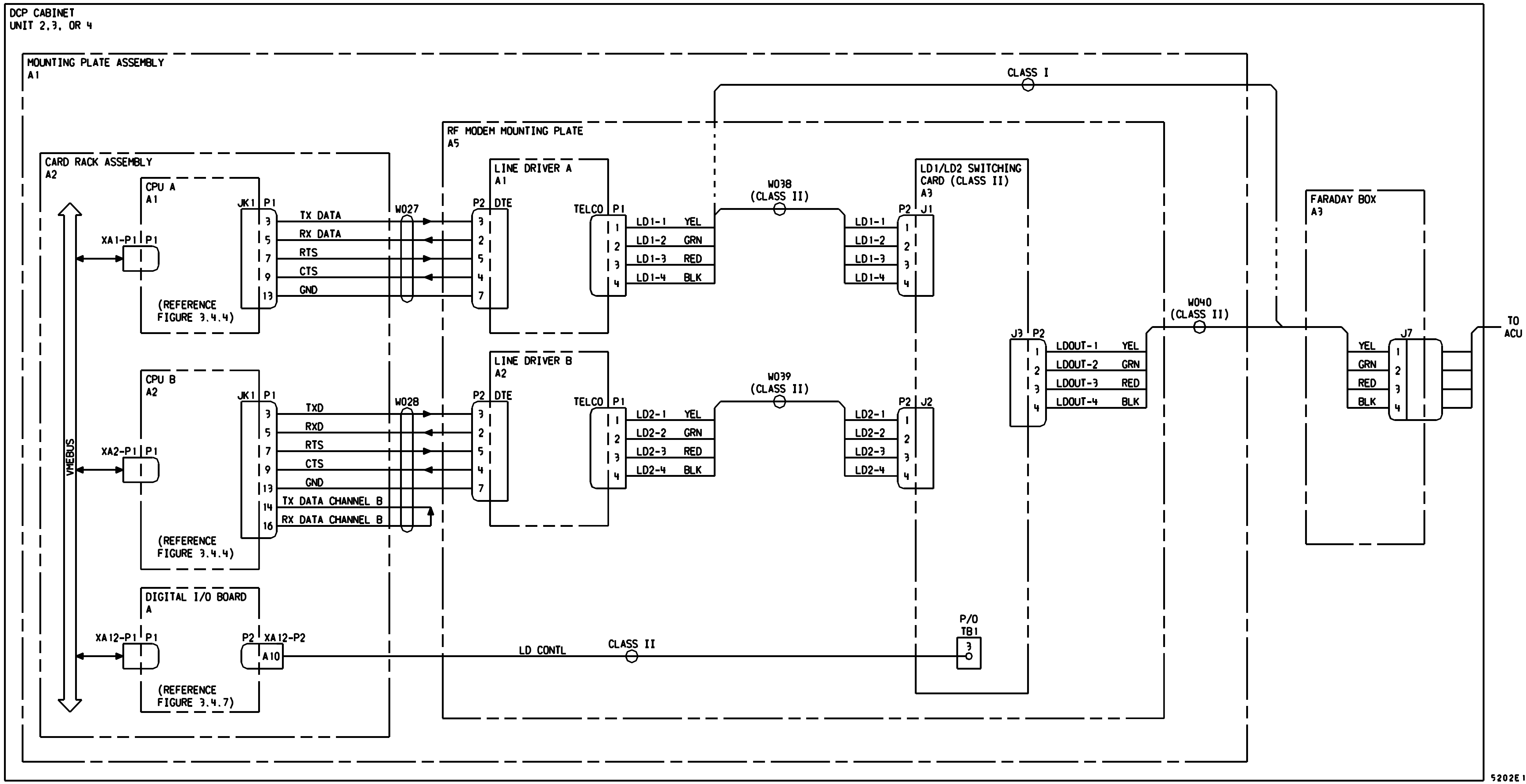


Figure 3.4.5. DCP RF Modem/Line Driver Communications Link Detailed block Diagram (Sheet 6)

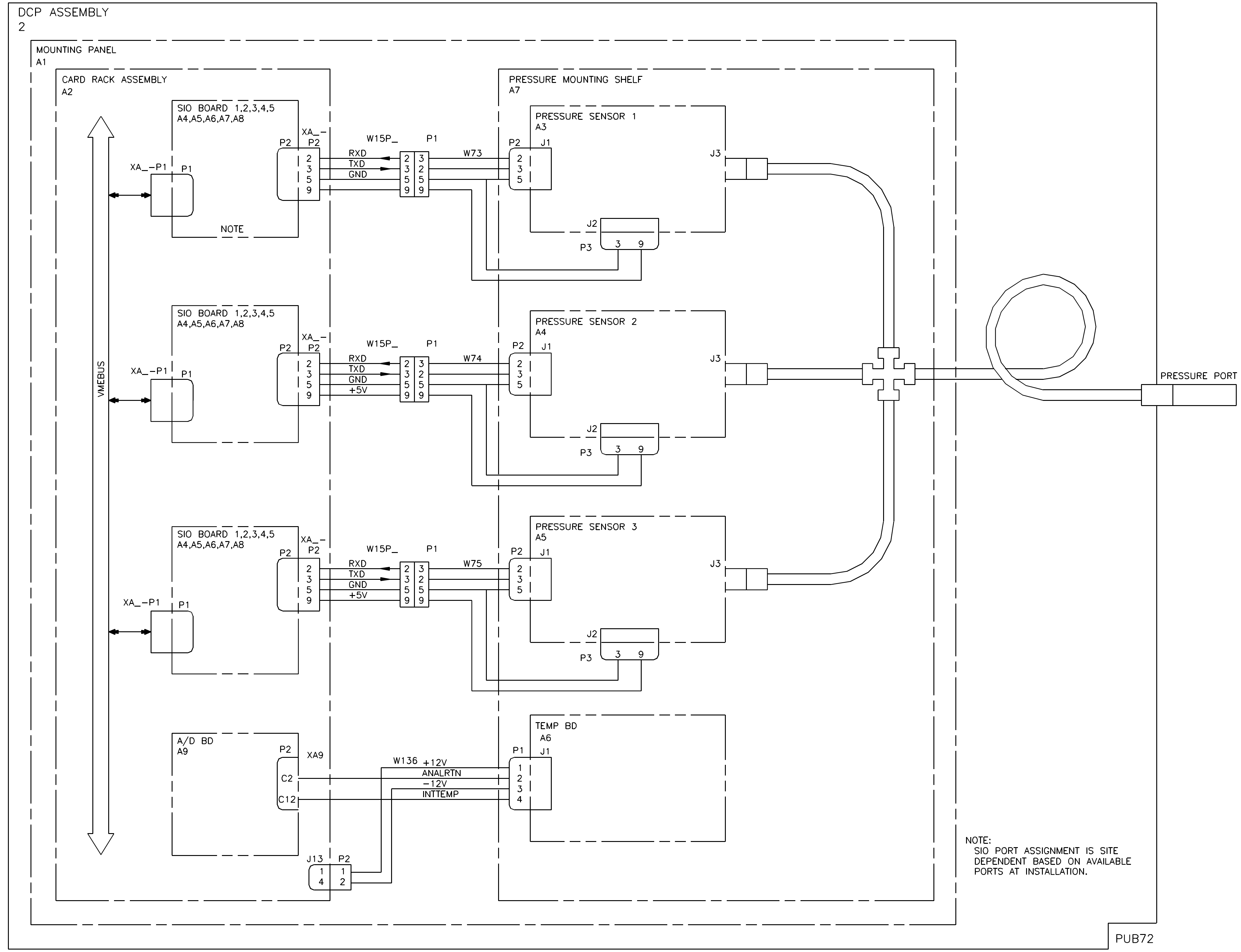
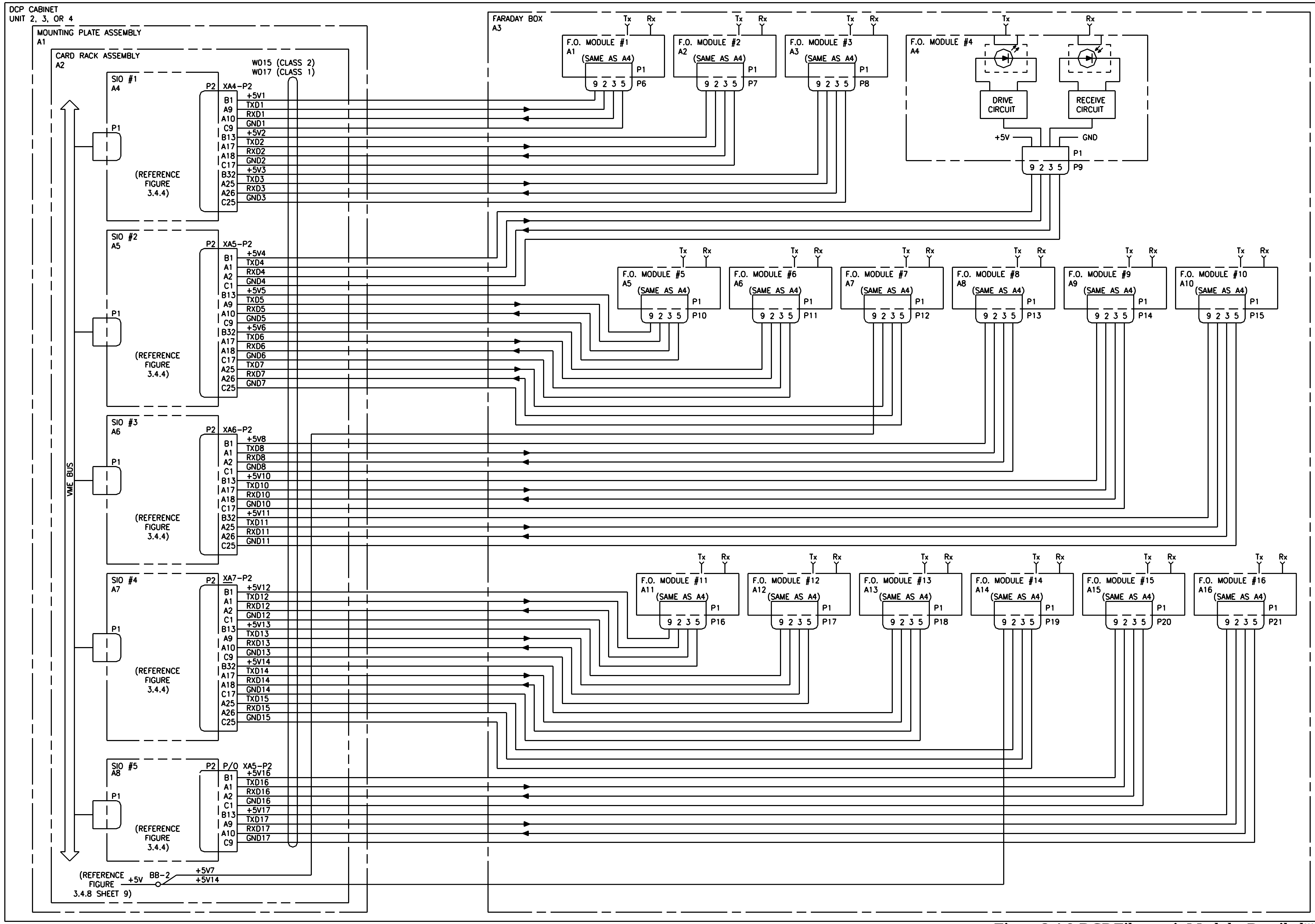


Figure 3.4.5a. DCP Pressure Sensors Detailed Block Diagram



NOTES:

1. DEPENDING UPON PORT AVAILABILITY AT SELECTED SITES WITH PRESSURE SENSORS LOCATED IN THE DCP, CONNECTORS AT FARADAY BOX A3 P6 – P21 COULD BE CONNECTED TO W73, W74 OR W75 FOR PRESSURE SENSORS P1, P2 AND P3 RESPECTIVELY.

Figure 3.4.6. DCP Fiberoptic Modules Detailed Block Diagram 202806

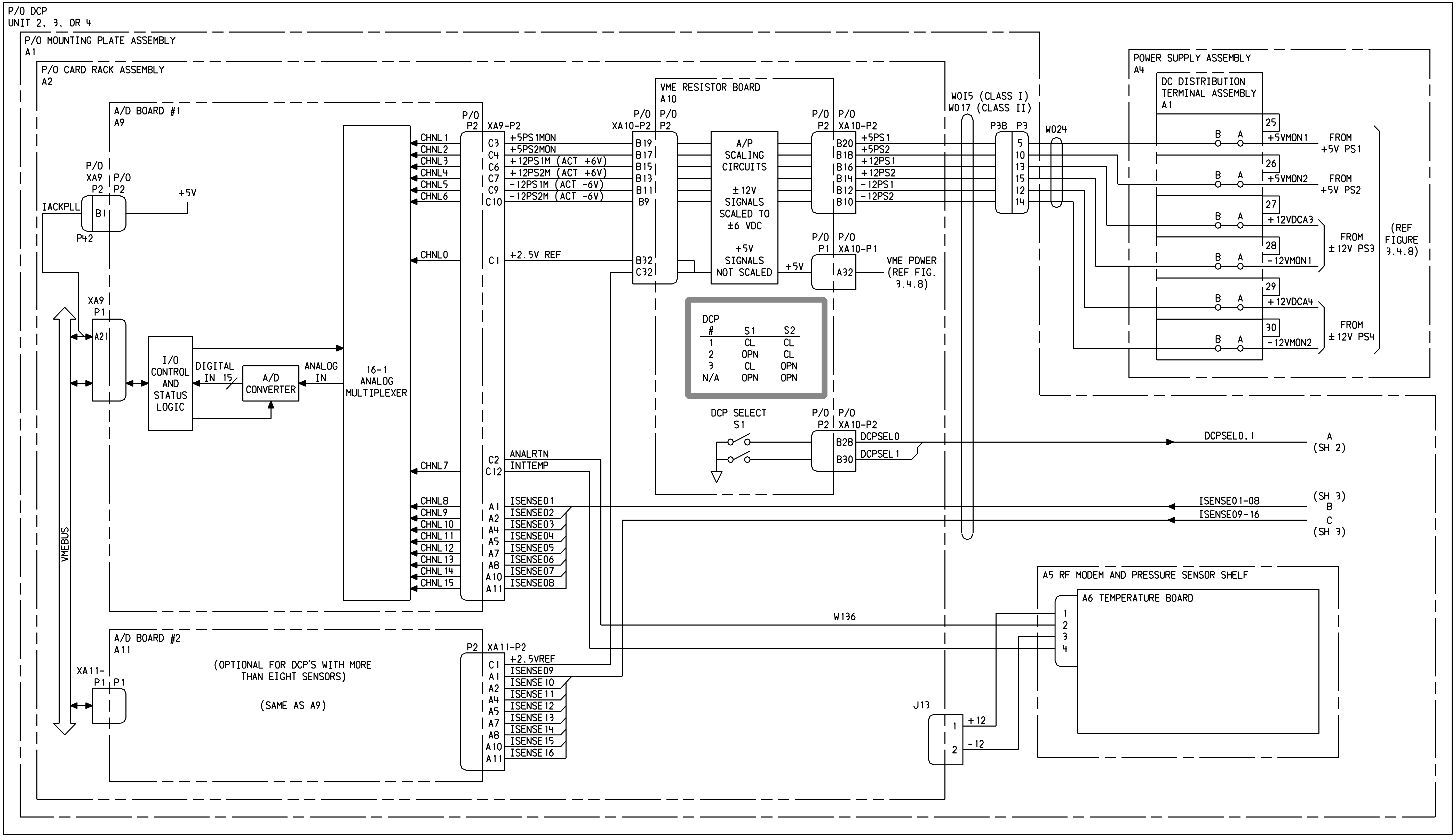


Figure 3.4.7. DCP Power Monitoring and Digital I/O Diagram (Sheet 1 of 3)

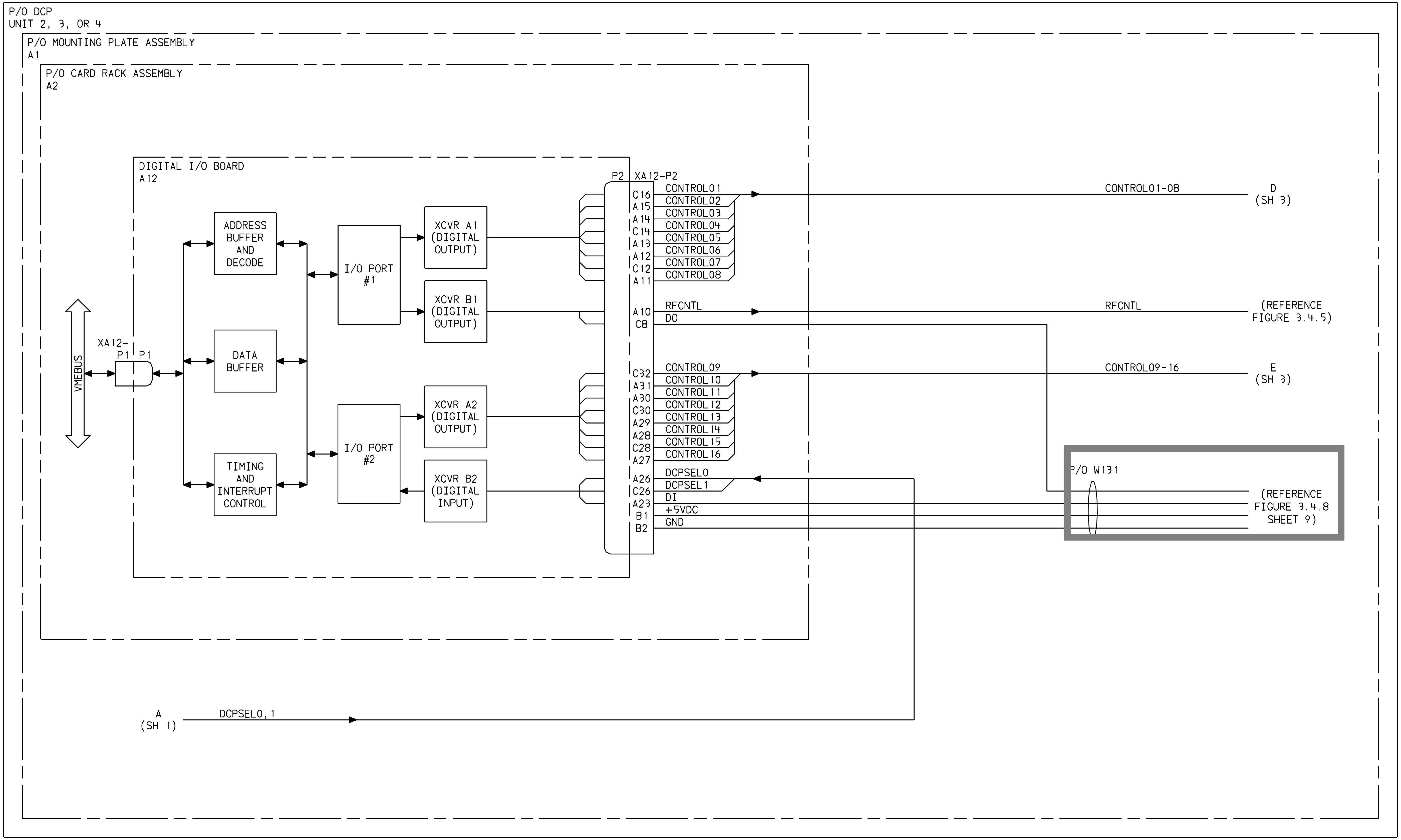


Figure 3.4.7. DCP Power Monitoring and Digital I/O Diagram (Sheet 2 of 3)

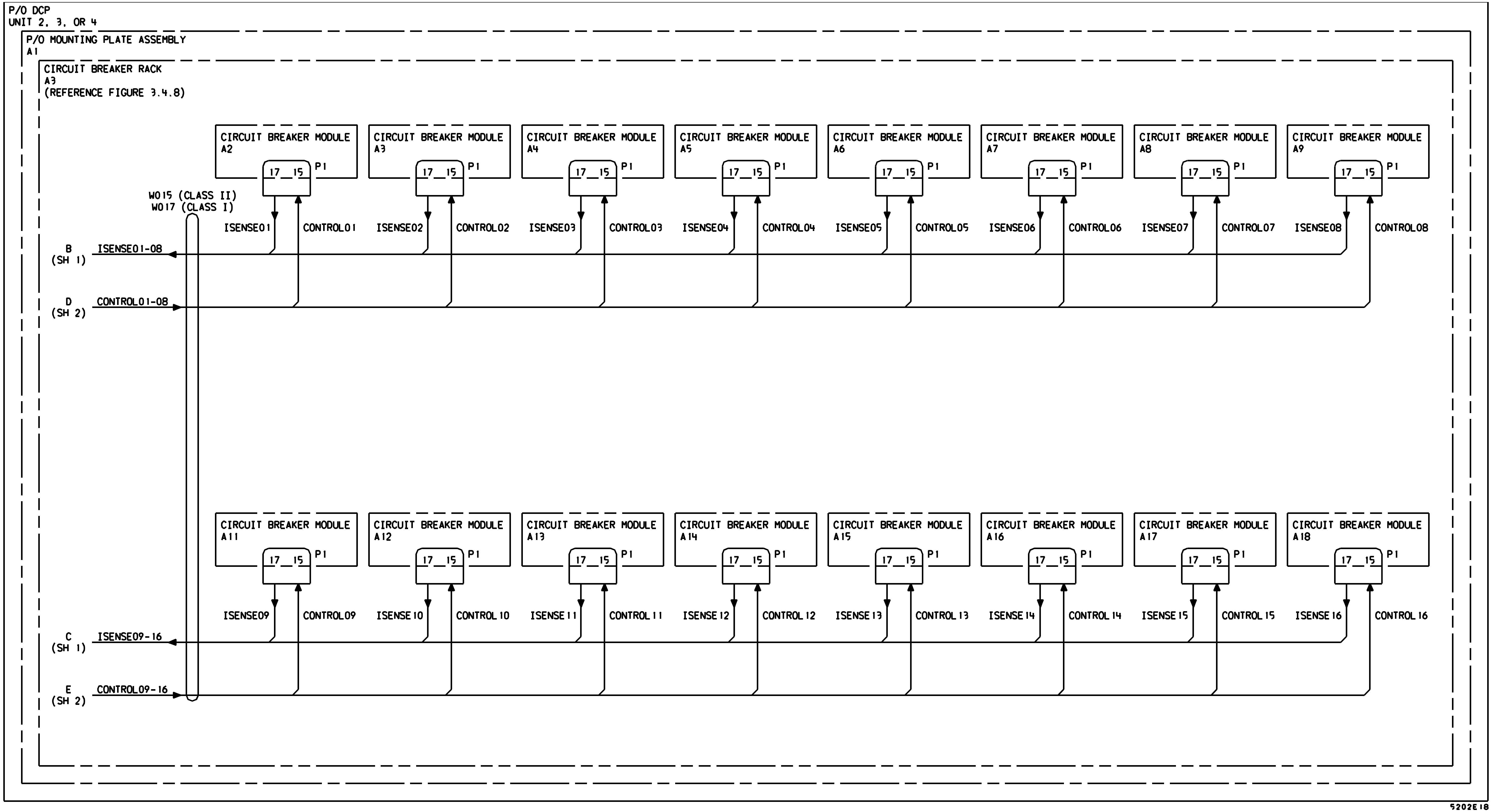


Figure 3.4.7. DCP Power Monitoring and Digital I/O Diagram (Sheet 3 of 3)

3.4.3.6 **Power Distribution and Control**.AC and dc power distribution are described using figure 3.4.8 which consists of several sheets that are divided to depict distinct sections of the power distribution circuitry. The ac wiring from the facility input power source to the DCP equipment cabinet is shown as well as the routing through the DCP Faraday box. The ac power distribution throughout the DCP, including the power reset assembly, UPS bypass circuit, UPS, and circuit breaker modules, is also depicted, with point-to-point wiring integrity. The dc power distribution circuitry throughout the DCP is shown, including fiberoptic modules and rf modems.

As previously described, there are three configurations for rf modem installation in the DCP. Sheets 7 and 9 of figure 3.4.8 show power distribution for original equipment AAI rf modems. Sheet 11 shows the differences for a system that has been modified for Motorola modems. Sheet 11A shows the differences for a system that has been modified for Motorola modems and equipped with Johnson Data modems. Sheet 8 corresponds to a system built with Motorola modems as original equipment.

Facility power is provided to the DCP via the ac junction box. The ac junction box contains a circuit breaker panel with circuit breakers for the DCP, auxiliary DCP, clearance lights, and a ground fault interrupt (GFI) receptacle. In addition, a main circuit breaker is provided for disconnecting all ac power. The DCP ac power is routed to the DCP power reset assembly and then distributed within the DCP Faraday box.

Power Reset Assembly A9 provides the DCP with proper power reset and (in Class II systems) UPS bypass capability. The assembly consists of a solid state Time Delay Relay A9K1, Digital I/O Module A9K2 (Class II only), and Power Relay A9K3 (Class II only). During initial turn-on, power is applied to solid state Time Delay Relay A9K1 which delays power application for approximately three seconds then distributes power throughout the DCP in Class I systems. In Class II systems power is applied to Power Relay A9K3 normal closed contacts and the UPS. Power to Power Relay A9K3 normally closed contacts is routed through AC Distribution Strips A17 and A18 where it is distributed to DCP assemblies.

After power is applied to Class II DCP assemblies, ASOS operational software monitors Power Relay A9K3 bypass status via Digital I/O Module A9K2 and Digital I/O Board A2XA12. When UPS status is good, Power Relay A9K3 is energized via Digital I/O Board A1A2XA12 and Digital I/O Module A9K2 to route power from the UPS output applied to Power Relay A9K3 normal open contacts to the DCP.

AC Distribution Strips A17 and A18 are used to break out the power for separate wiring, with AC Distribution Strip A17 designated for 110 vac (hot) distribution and AC Distribution Strip A18 designated for ac neutral distribution. Earth ground is provided by the rails upon which the individual distribution terminals are mounted. AC power is provided to the rest of the DCP via connectors J1 through J4 and J9. AC power for each of the sensors as well as their heaters is applied to the Faraday box at connectors J5 and J6. These connectors are wired to AC Distribution Strips A17 and A18 to provide separate ac power lines to the individual sensors external to the DCP. Individual distribution terminals (#3 through #26) provide built-in surge protection for these ac runs.

Faraday box connectors J1 through J4 and J9 provide ac power to the rest of the DCP over an internal wiring harness. Connectors J1 and J3 provide ac power for the primary (first eight) sensors and their internal heaters, respectively. Connectors J2 and J4 of the Faraday box provide ac power for the optional secondary (second group of eight) sensors and their internal heaters. Connector J9 provides ac power for the heaters in the DCP equipment cabinet itself. Circuit breakers A1 and A10 in Circuit Breaker Rack A1A3 are used to control the primary and secondary power inputs. The outputs of these circuit breakers provide ac power to separate terminals on AC Power Distribution Assembly A1A4. AC neutral lines from connectors J1 and J2 are connected directly to AC Power Distribution Assembly A1A4.

AC Power Distribution Assembly A1A4 is the breakout point for the ac power wiring within the DCP. This power distribution strip provides separate power wiring to assemblies within the DCP and provides room for additional wiring to a secondary UPS.
A secondary UPS is an option that would be installed in an auxiliary DCP equipment cabinet in the event that more than nine sensors were attached to a Class II DCP.

3.4.3.6.1 **AC Distribution - General**. Class II DCP cabinets contain uninterruptible power supplies, which provide UPS functions. Uninterruptible power supplies can be one of three types depending on the serial number of the DCP.

a. SOLA UPS 62828-90057 is installed in DCP serial numbers 438 and below.
b. Deltek UPS 62828-90338-10 or 62828-90338-20 is installed in DCP serial numbers 439 and above.

Class I DCP's have no uninterruptible power supplies. The following paragraphs describe the ac power distribution for the two uninterruptible power supplies.

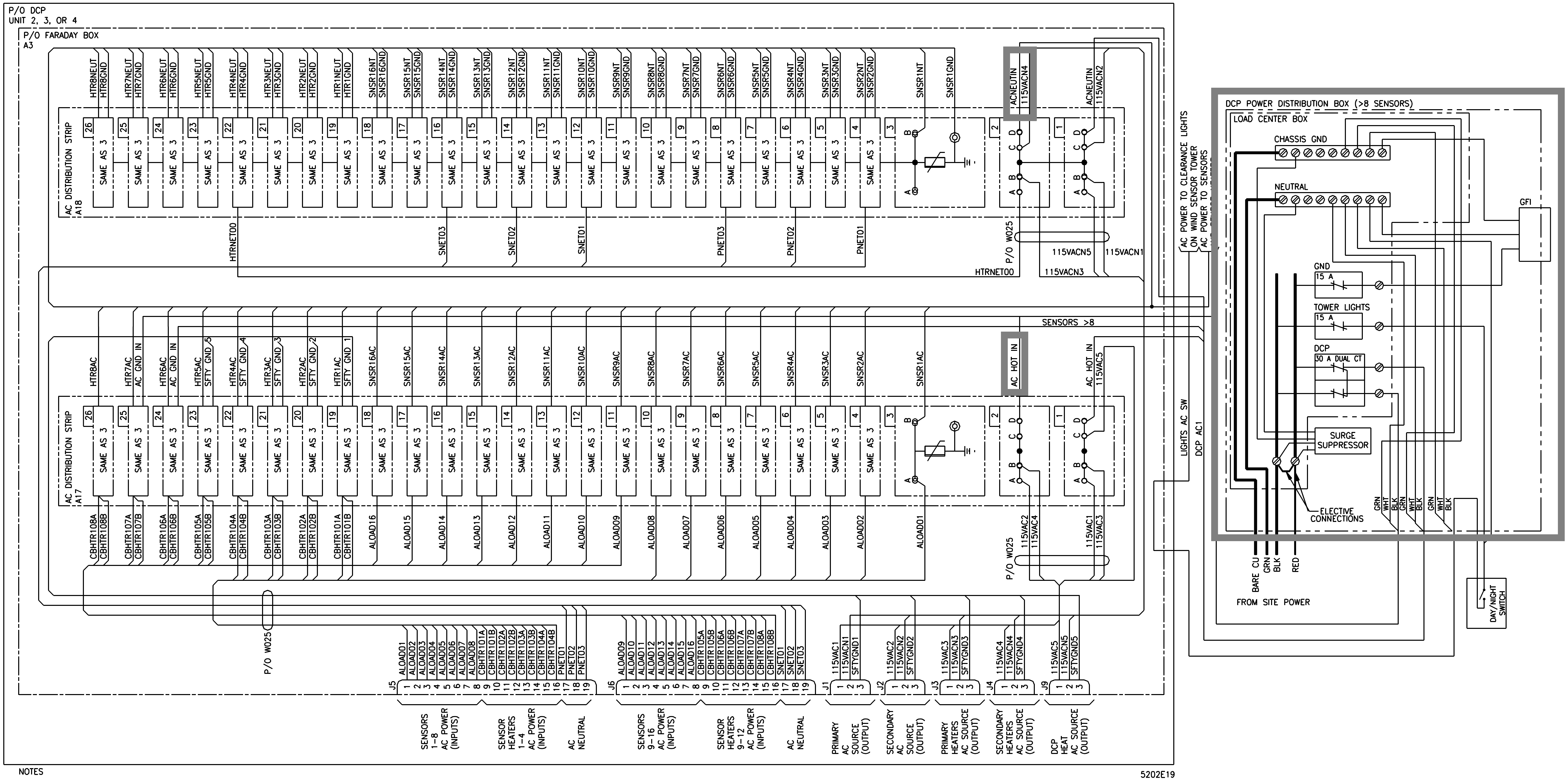
3.4.3.6.1.1 **AC Distribution for Uninterruptible Power Supply 62828-90057-10 (Figure 3.4.8, Sheet 3)**. For Class II systems, a UPS is mounted in the DCP to provide a backup ac power source for the DCP and up to nine sensors. If more than nine sensors are attached to the DCP, an optional secondary UPS is provided in an auxiliary DCP equipment cabinet. The UPS is not a unit in itself, but is the collection of the following FRU's:

a. 1.5 KVA Filter Board A1A6
b. 1.5 KVA Inverter Board A5
c. 1.5 KVA Transformer A1T1
d. Battery Box A2
e. Fuse A1F1
f. RS-232 Interface Board A1A8
g. Status Panel Board A1A7
h. UPS Fan A1B1

1.5 KVA Filter Board A1A6 receives the primary ac input power from the Faraday box via Circuit Breaker Module A1A3A1 and AC Power Distribution Assembly A1A4. 1.5 KVA Filter Board A1A6 filters the input line voltage and routes it to 1.5 KVA Inverter Board A5 on the WHT/BLK (neut) and BLK/RED (line) wires of W031.

During normal (noninterrupted power) operation, the inverter board monitors the input voltage from the filter board and regulates it to provide a constant 120 vac output signal. The inverter board uses transformer T1 to perform this regulation. The secondary coil of T1 has multiple taps that are routed to tap-switching triacs on the inverter board. If the inverter senses that the input line voltage is low, it causes one of the triacs to switch in a T1 secondary tap that steps up the voltage to the required level. The stepped-up voltage is then output from the BLK/WHT terminal of the inverter board to connector J10 of 1.5 KVA Filter Board A1A6. Similarly, if the inverter board senses that the input ac voltage is high, the T1 secondary tap is changed to step down the voltage to the required level, and the stepped-down voltage is output to the filter board. The filter board filters the inverter board ac voltage and outputs the regulated voltage from connector J7 as the UPS output ac signal.

When the inverter board senses a loss of its input ac signal, it uses transformer T1 to convert dc voltage from Battery Box A2 to a backup ac signal. Battery Box A2 contains five 12 vdc batteries wired in series to provide a total of 60 vdc. This dc voltage is applied through fuse A1F1 to the RED terminal of the inverter board, where it is then routed to the center tap of the primary coil of transformer T1. When the inverter board senses a loss in the input ac signal from the filter board, it alternatingly switches in the other two primary leads of transformer T1 (BLU2 and YEL2). This causes alternating current in the primary, which is induced to the secondary coil of transformer T1. The inverter board then uses its tap-switching triacs, as described above, to output a regulated ac voltage to the filter board.



NOTES

1. UNLESS OTHERWISE NOTED. ALL DCP CABINET WIRING IS PART OF HARNESS W015 (CLASS II) OR W017 (CLASS I).

Figure 3.4.8. DCP AC and DC Power Distribution Detailed Block Diagram (Sheet 1 of 12) $

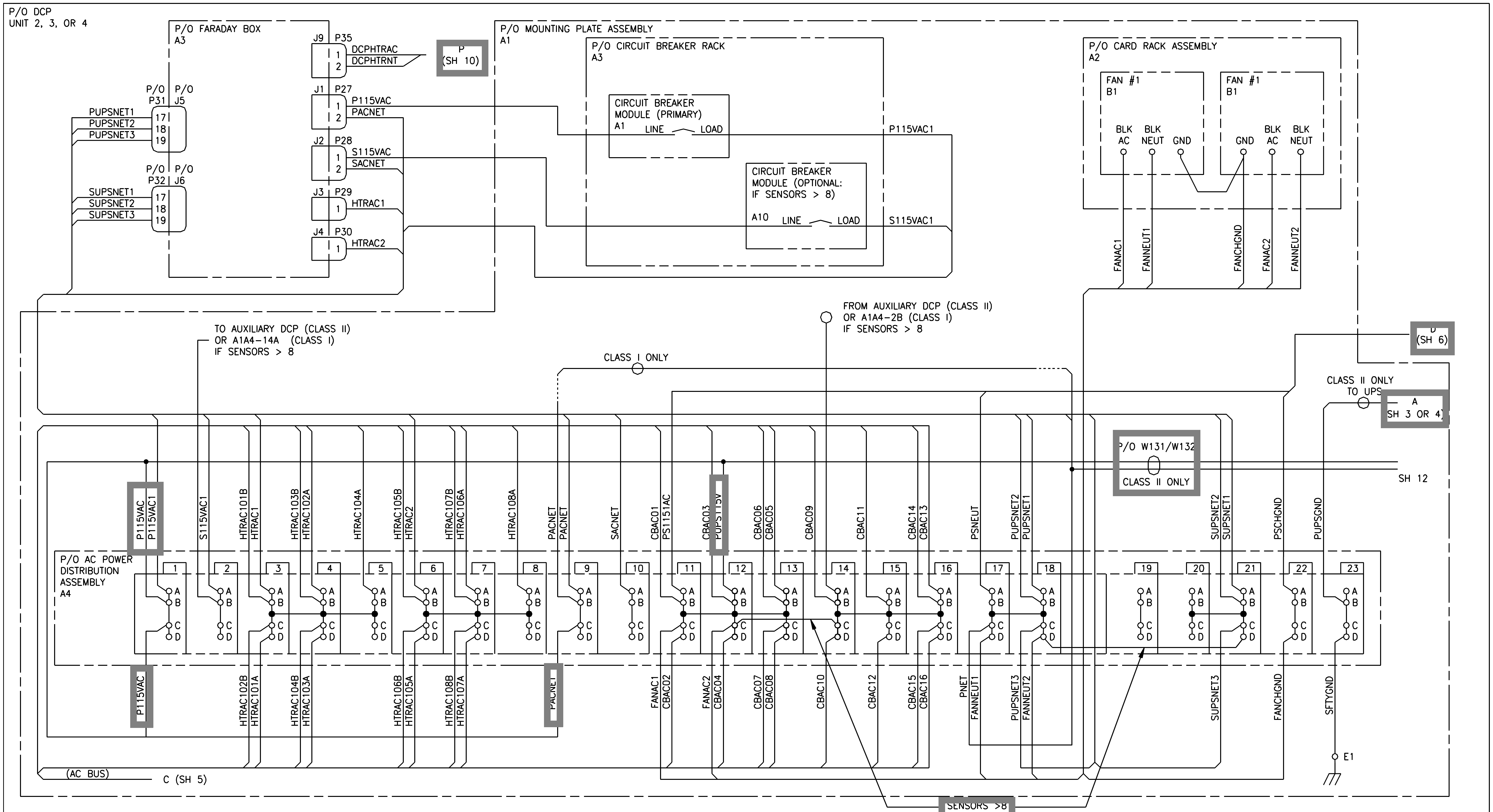


Figure 3.4.8. DCP AC and DC Power Distribution Detailed Block Diagram (Sheet 2)

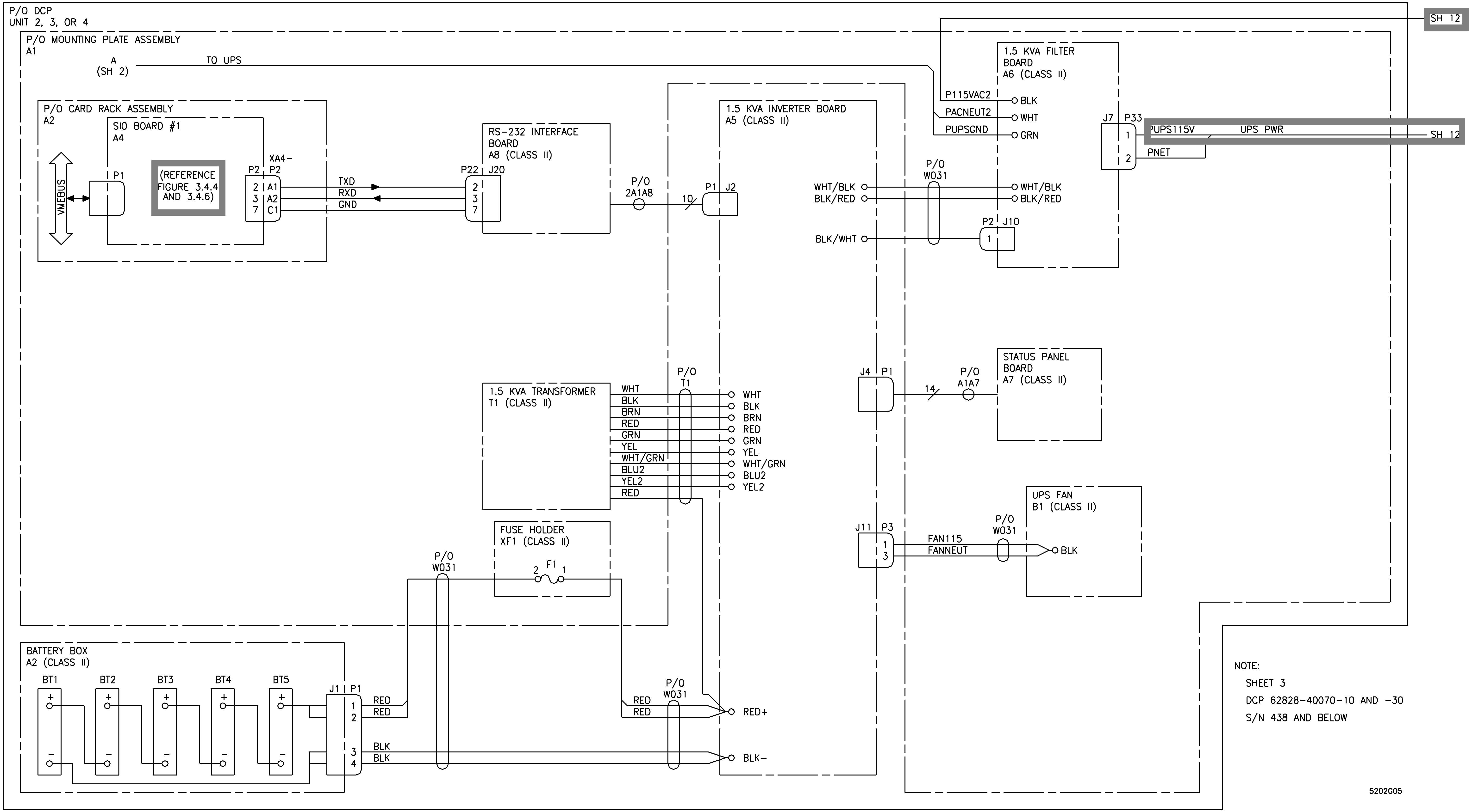


Figure 3.4.8. DCP AC and DC Power Distribution Detailed Block Diagram (Sheet 3)

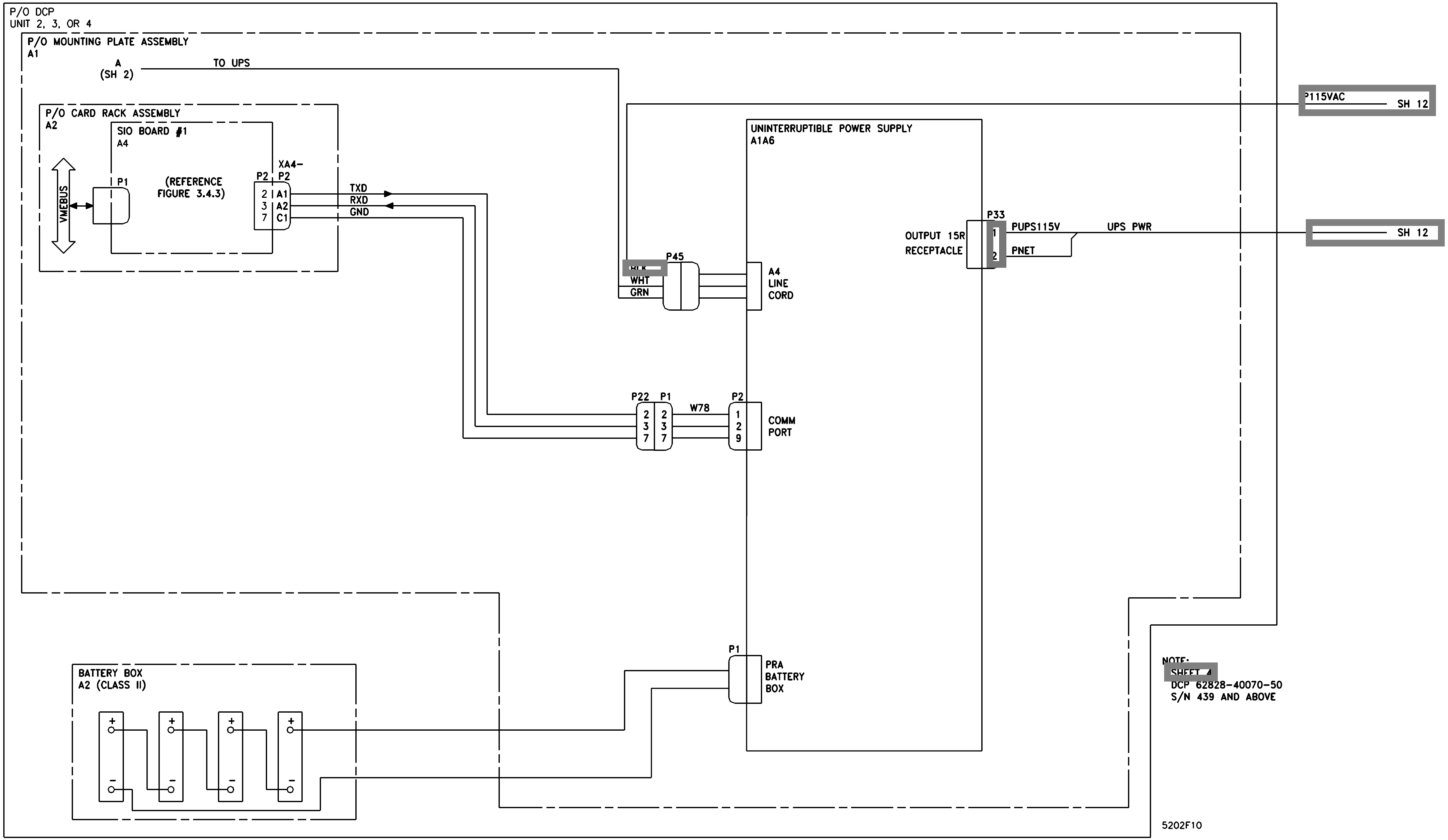


Figure 3.4.8. DCP AC and DC Power Distribution Detailed Block Diagram (Sheet 4)

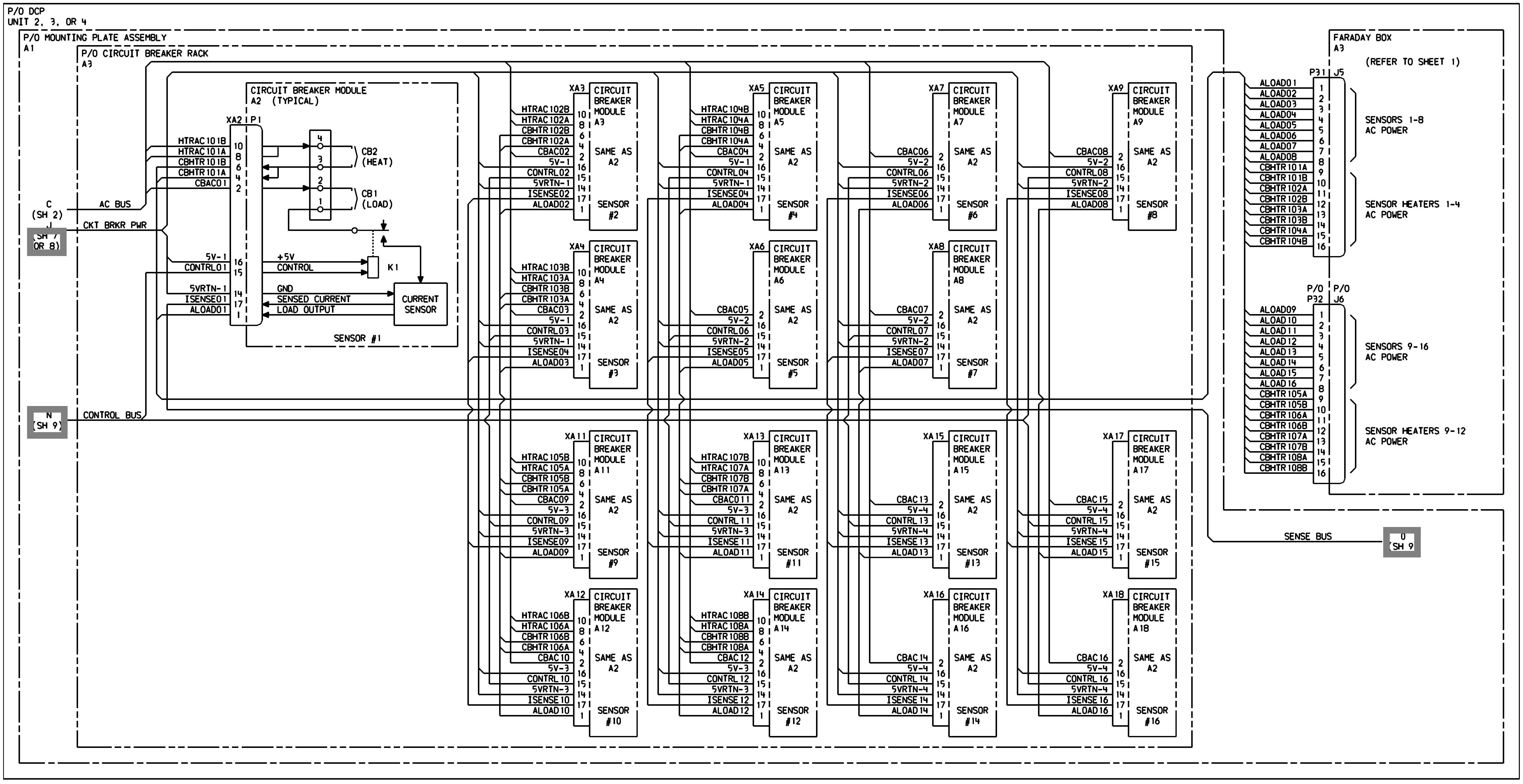


Figure 3.4.8. DCP AC and DC Power Distribution Detailed Block Diagram (Sheet 5)

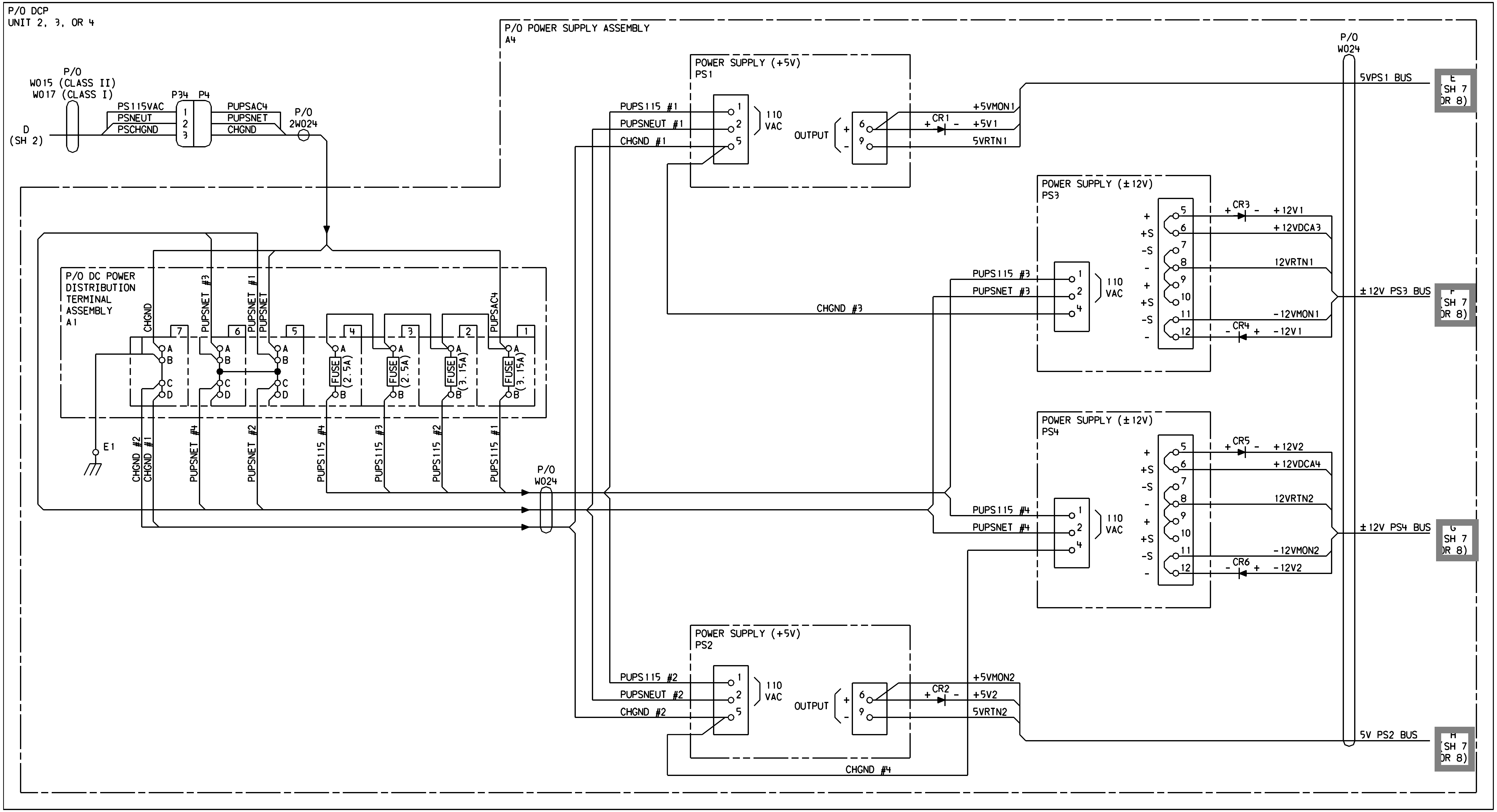
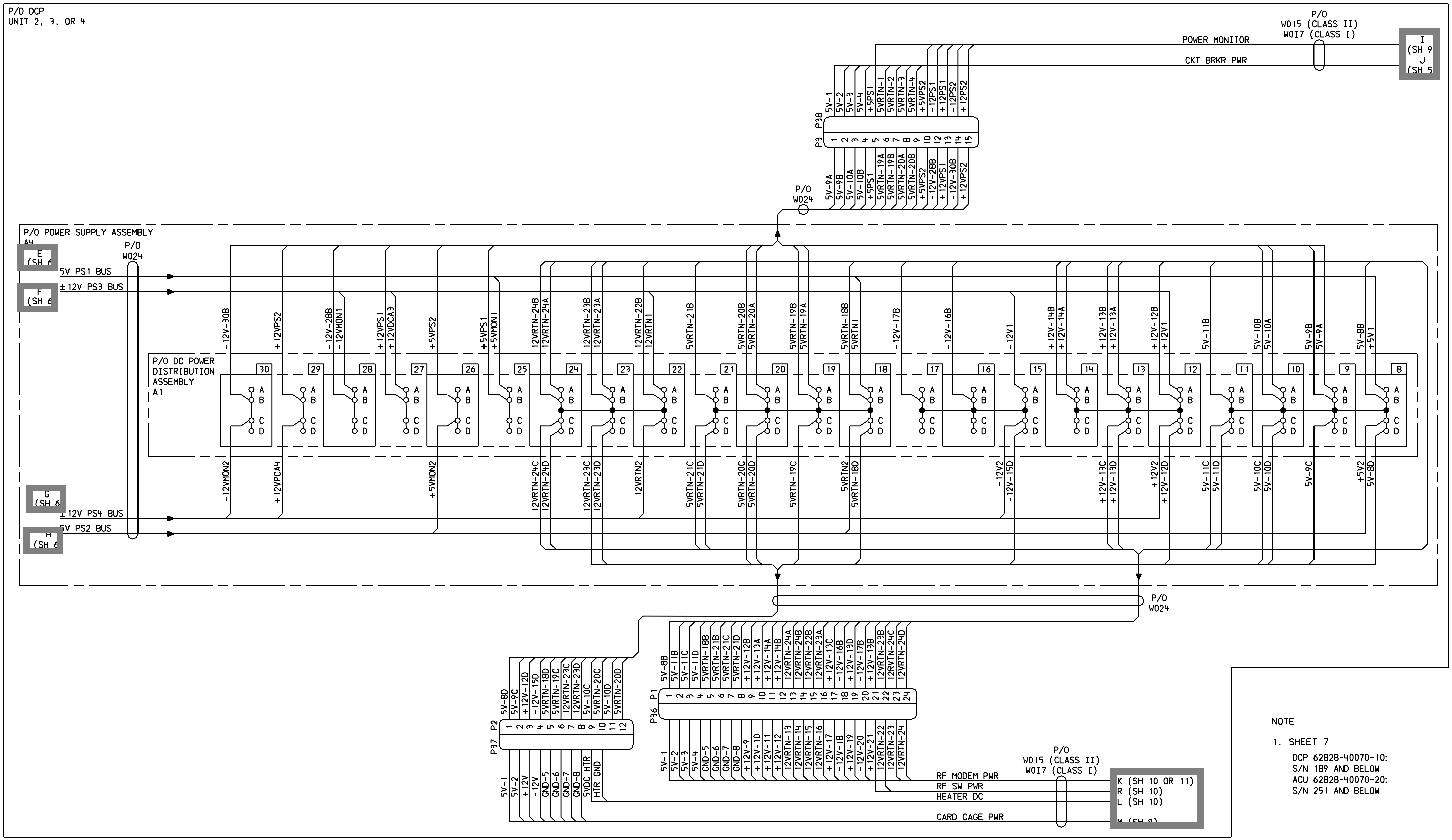
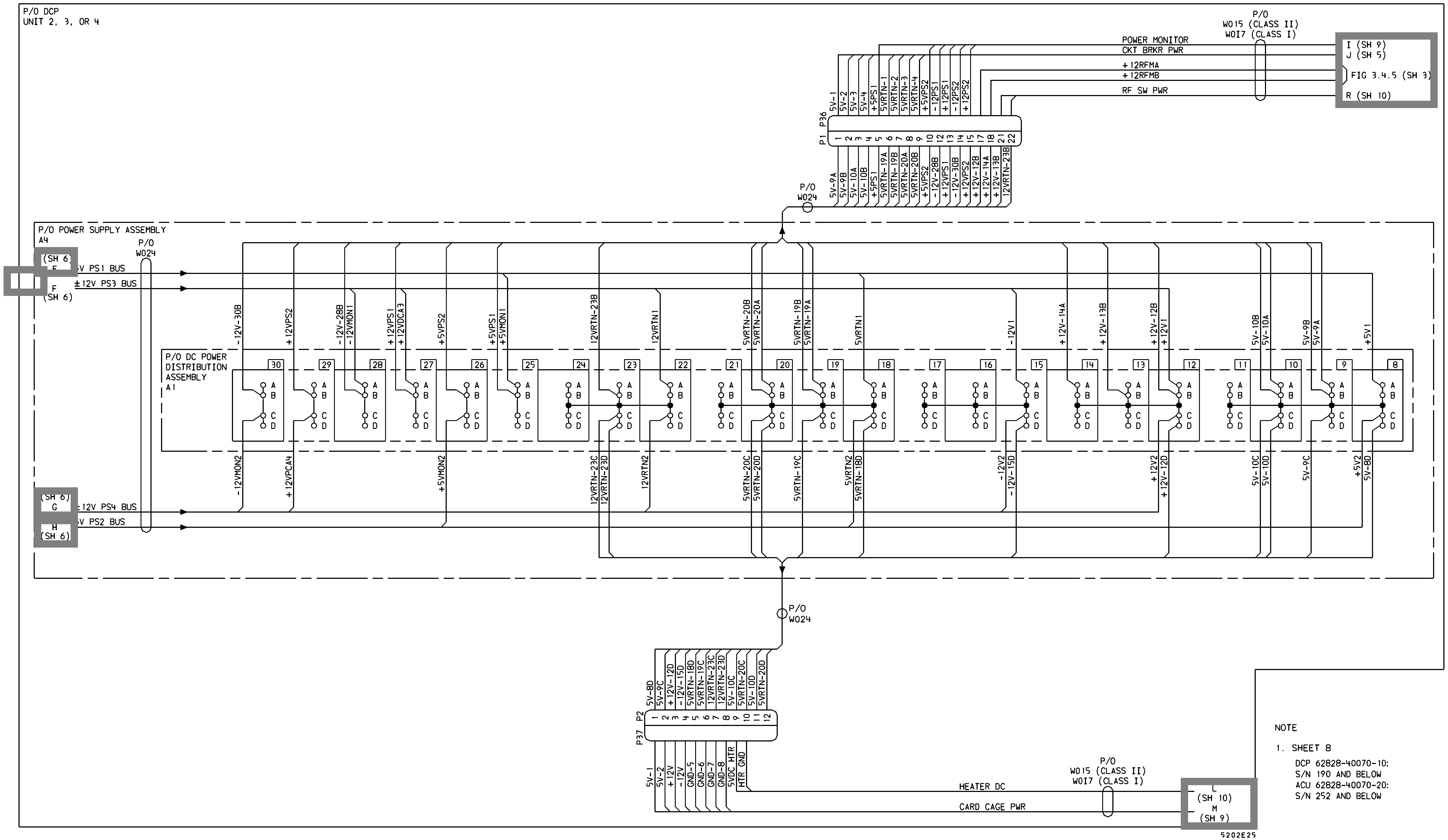


Figure 3.4.8. DCP AC and DC Power Distribution Detailed Block Diagram (Sheet 6)



DCP WIRED FOR AAI MODEMS

Figure 3.4.8. DCP AC and DC Power Distribution Detailed Block Diagram (Sheet 7)



DCP WIRED FOR MOTOROLA MODEMS

Figure 3.4.8. DCP AC and DC Power Distribution Detailed Block Diagram (Sheet 8)

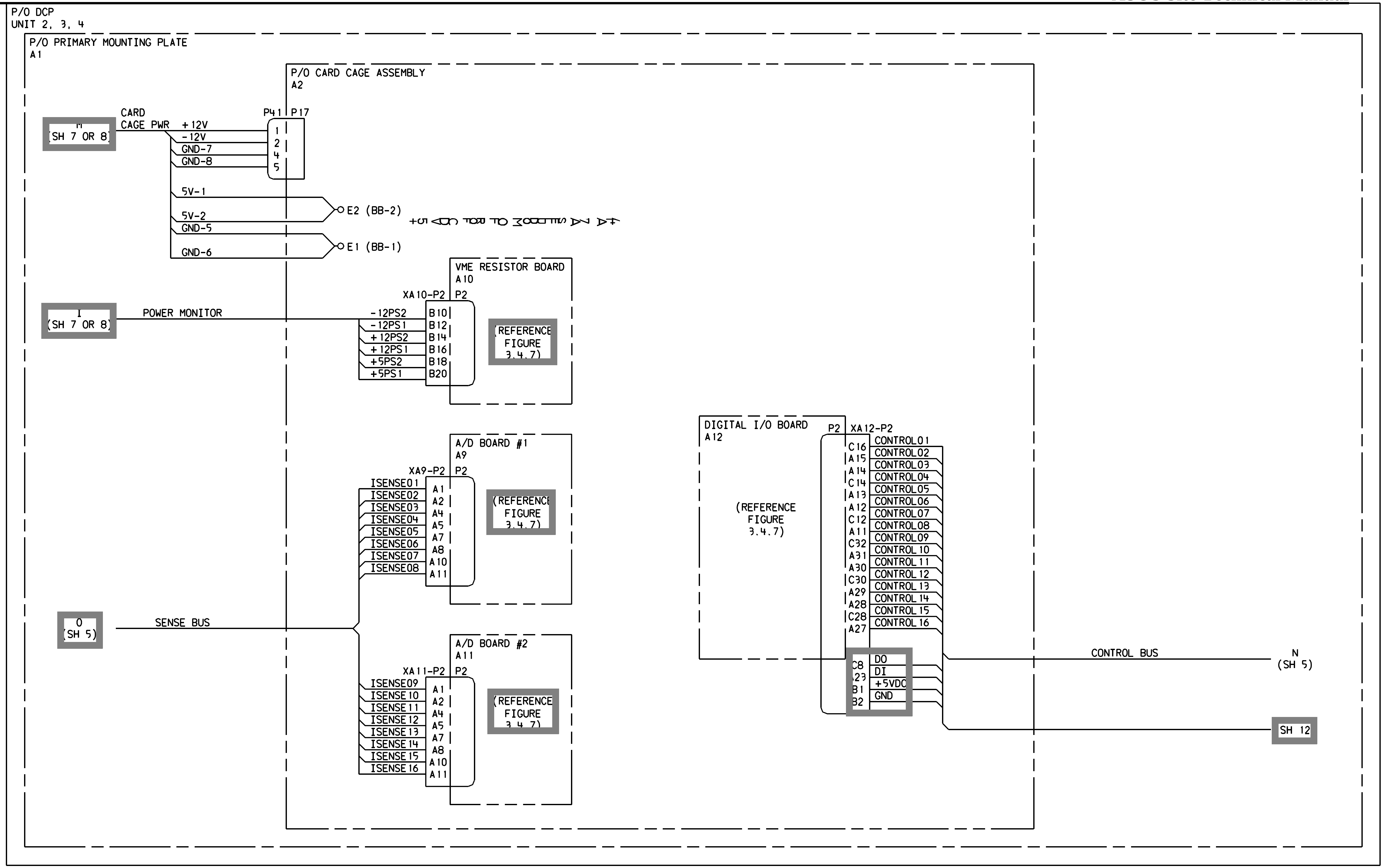


Figure 3.4.8. DCP AC and DC Power Distribution Detailed Block Diagram (Sht 9)

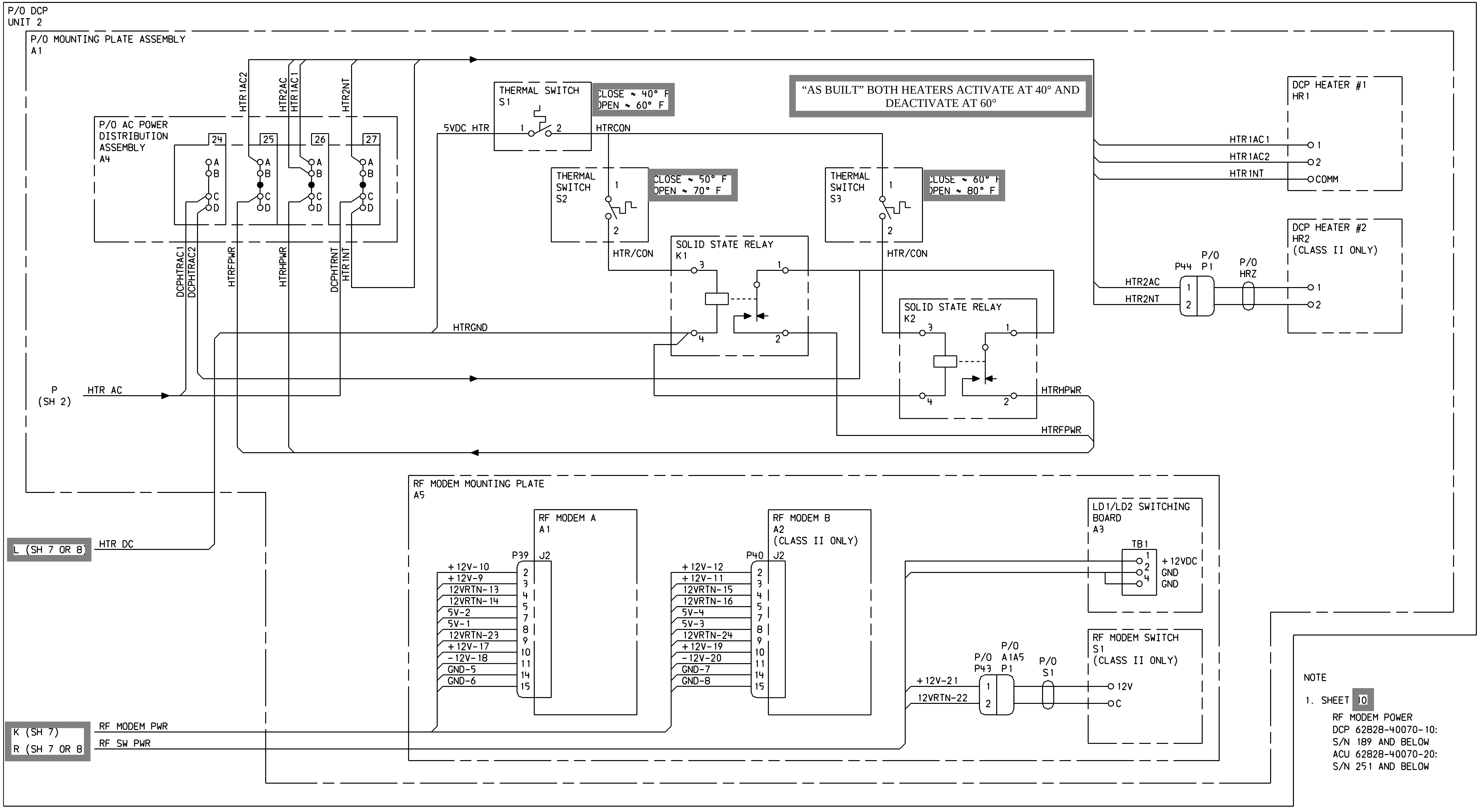


Figure 3.4.8. DCP AC and DC Power Distribution Detailed Block Diagram (Sht 10)

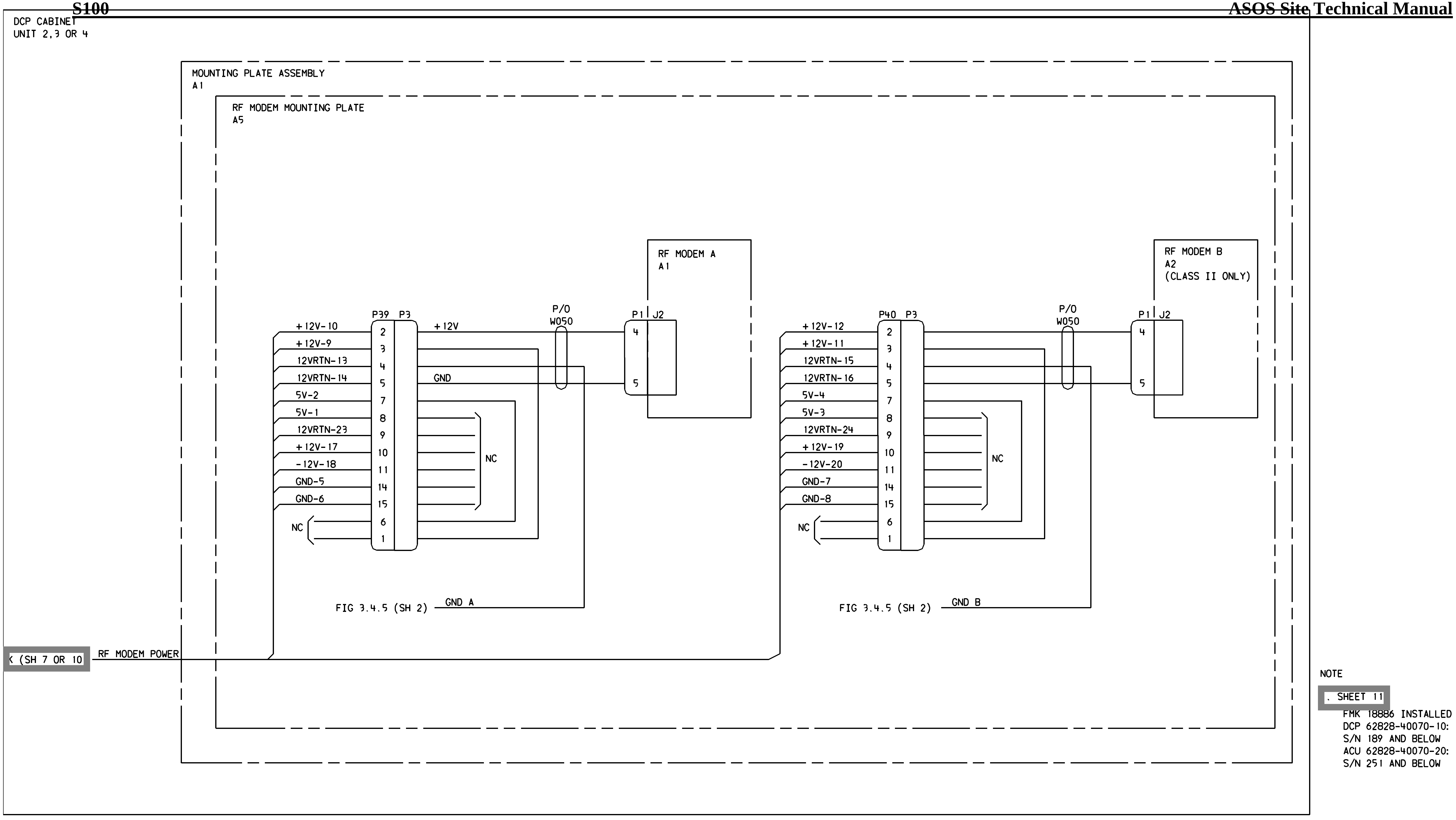
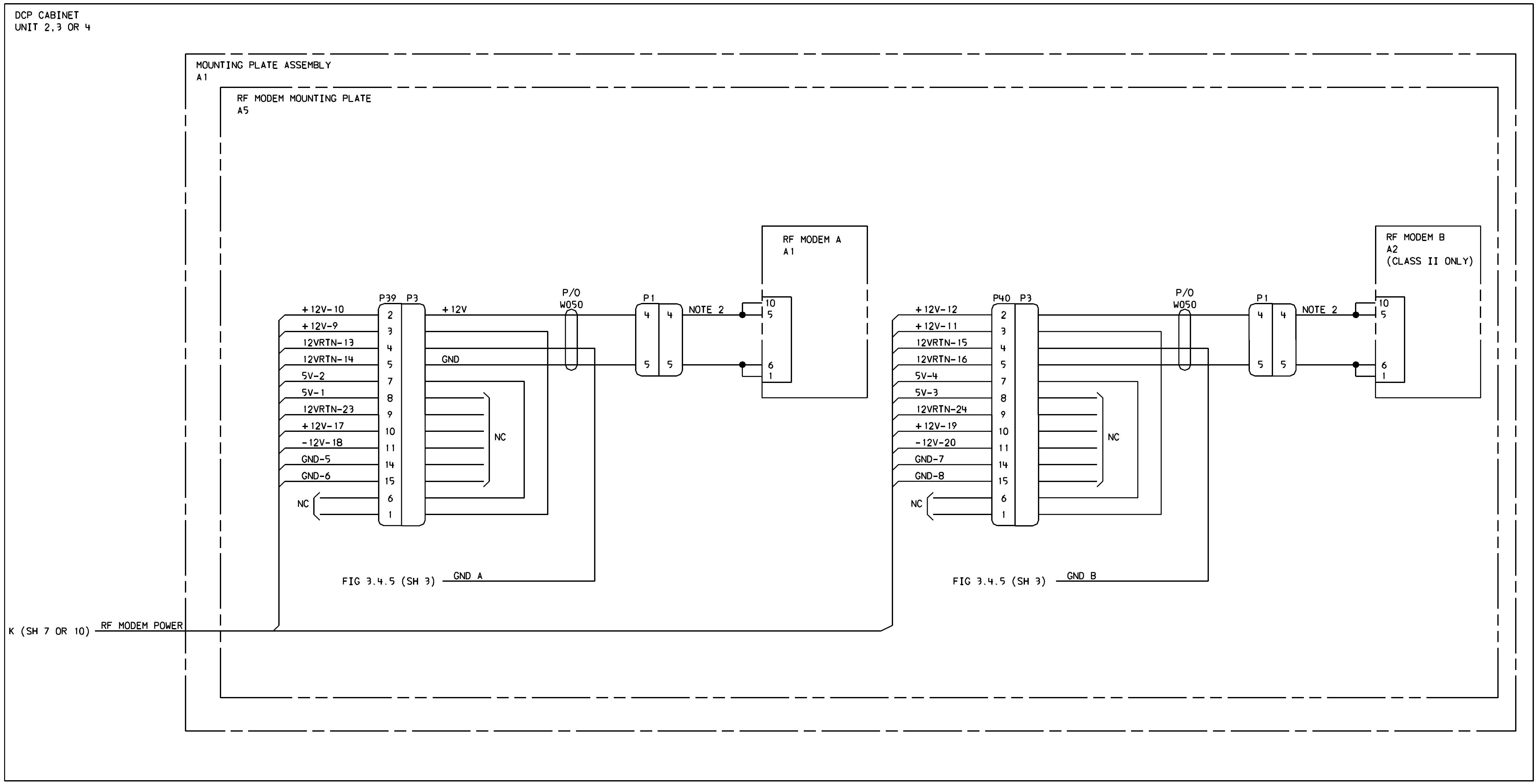


Figure 3.4.8. DCP AC and DC Power Distribution Detailed Block Diagram (Sheet 11)



NOTE

1. SHEET 11

FMK 18886 INSTALLED ON
DCP 62828-40070-10:
S/N 189 AND BELOW
DCP 62828-40070-20:
S/N 251 AND BELOW

2. ADAPTER CABLE 62828-42110-10
INSTALLED BETWEEN W050P1
AND RF MODEM.

SYSTEM CONVERTED FROM AAI TO MOTOROLA MODEMS
EQUIPPED WITH JOHNSON DATA MODEMS

Figure 3.4.8. DCP AC and DC Power Distribution Detailed Block Diagram (Sheet 11A)

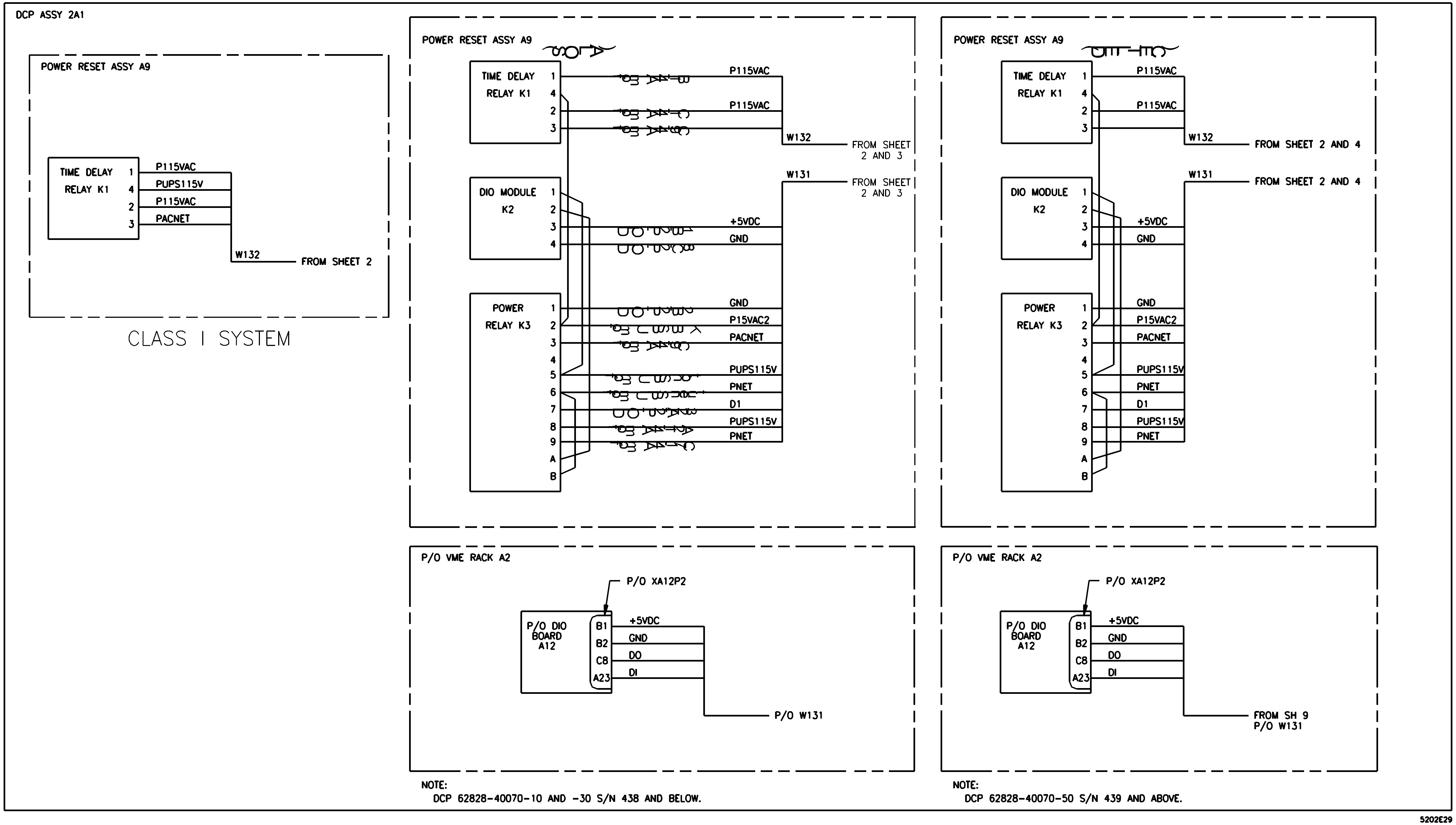


Figure 3.4.8. DCP AC and DC Power Distribution Detailed Block Diagram (Sheet 12)

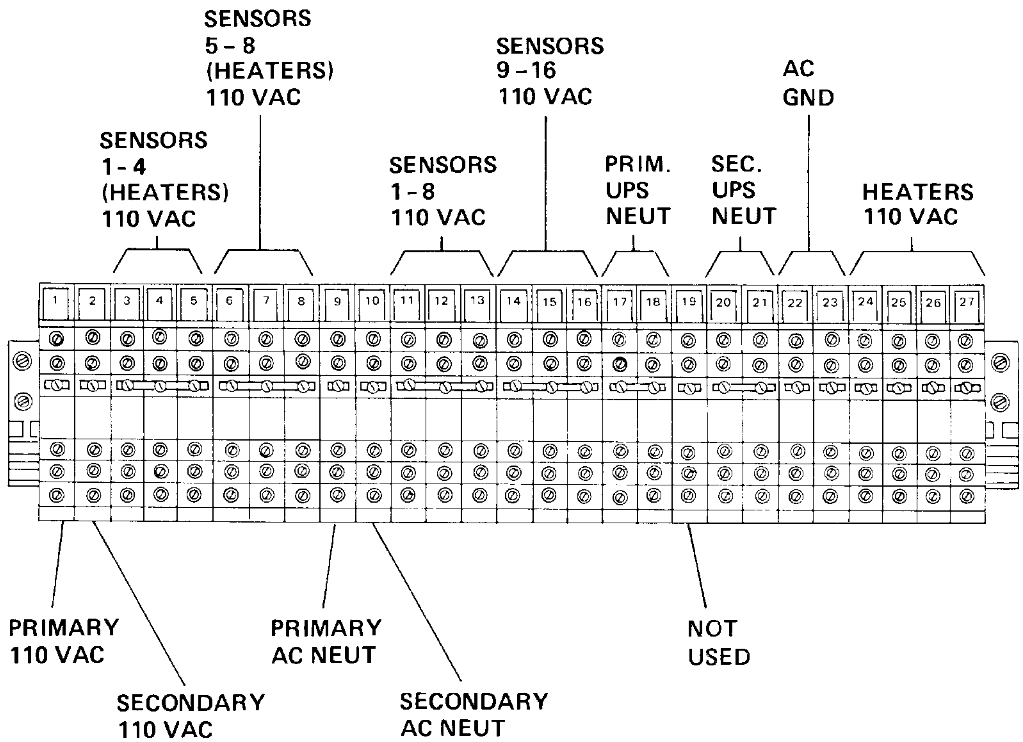


Figure 3.4.9. AC Power Distribution Assembly A1A4

The regulated, filtered UPS ac output signal from the filter board is routed to AC Power Distribution Assembly A1A4 for distribution to DCP assemblies. Units that receive the UPS output voltage from the distribution assembly are the dc power supplies, the card cage assembly, and circuit breaker rack (for use by sensor electronics only).

RS-232 Interface Board A1A8 allows the CPU to monitor the operational status of the UPS. The inverter board contains circuitry to monitor the status of the ac input and output voltages, battery voltages, tap-switching triac status, etc. During CST, the CPU communicates with the inverter board via the RS-232 interface board to obtain status data. The CPU analyzes the UPS data and displays the results on the OID DCP UPS page OID. A UPS bypass circuit in class II DCP's allows operation on primary input power if the UPS is inoperative or when commanded by software. The digital output line operates solid-state relay A9K2 which operates triple-pole, double-throw relay A9K3. Relay A9K3 selects ac power from the unconditioned input or from UPS output. A jumper can be placed across the solid-state relay contacts to inhibit the UPS bypass function. The third set of A9K3 contacts closes a ground signal path to the processor via the DIO board. A 3-second time-delay relay (A9K1) has also been included to ensure correct power-up reset in DCP equipment. The TD relay is energized by unconditioned primary ac power input. The TD relay releases with minimal delay upon momentary interruption of power, but requires power to be restored for at least 3 seconds before power is reapplied to DCP equipment and to the UPS input.

The above paragraphs describe the distribution of primary ac power for a DCP on a Class II system. Because a Class I DCP does not contain a UPS, jumpers are installed between the UPS input and UPS output terminals on AC Distribution Strip A1A4. That is, jumpers are installed between terminals 1B and 12A (115 vac), and between 9B and 17C (Neutral).

3.4.3.6.1.2 **AC Distribution for Uninterruptible Power Supply 62828-90338-10 or 62828-90338-20 (Figure 3.4.8, Sheet 4)**. For Class II systems, a UPS is mounted in the DCP to provide a backup ac power source for the DCP and up to nine sensors. If more than nine sensors are connected to the DCP, an optional secondary UPS is provided in an auxiliary DCP equipment cabinet. The UPS is an FRU. $ $ $

Input ac power is applied through connector P45. During normal (noninterrupted power) operation, the UPS assembly monitors the input signal internally and maintains a steady output voltage.

When the UPS assembly detects a loss of its input ac signal, it converts dc voltage from Battery Box A2 to a backup signal. Battery Box A2 contains four 12-vdc batteries wired in series to provide a total of 48 vdc.

The UPS regulated, filtered ac output signal is routed to Power Distribution Assembly A1A4 for distribution to DCP assemblies. Units that receive the UPS output voltage from the power distribution assembly are the dc power supply enclosure, card cage assembly, and circuit breaker rack (for use by sensor electronics only).

The RS-232 COMM PORT on the UPS allows the CPU to monitor the operational status of the UPS. The UPS contains circuitry to monitor the status of the ac input and output voltages, battery voltages, etc. During CST, the CPU communicates with the UPS to obtain these status data. The CPU analyzes these UPS data and displays the results on the DCP UPS page of the OID.

The ACU polls the DCP UPS every minute with a dump status command to obtain a current status of the UPS. BATTERY VOLTAGE status (provided as a numerical value) indicates the current voltages provided by the battery box. INPUT VOLTAGE status (provided as a numerical value) indicates the current value (in vac) of the facility input voltage being received by the UPS. OUTPUT VOLTAGE status (provided as a numerical value) indicates the current value (in vac) of the regulated ac voltage being output from the UPS. UPS OPERATION status indicates whether or not the UPS is functioning in a normal (indicated by a P (utility is OK, battery is OK, and UPS is in its normal state)) or abnormal operation (indicated by an F). ON AC LINE status indicates the power source on which the UPS is operating (P = facility input (ac line), F = UPS operating on battery backup). BATTERY status (provided as either P for pass or F for fail) indicates if the battery power is low from the battery box supply. INVERTER status indicates whether the internal inverter is operating in overvoltage or undervoltage condition. GROUND status (provided as either P for pass or F for fail) checks for a ground failure. UTILITY status (P for pass or F for fail) indicates an overvoltage or unsynchronized signal from facility power. When the UPS is on battery power and facility power returns, the UPS must synchronize the phasing from the inverter to match the phasing of the facility power before switching to UPS operation under facility power. TIMEOUT status (P for pass or F for fail) indicates a failure in the event that the CPU receives no response from the UPS. BATTERY MANAGEMENT status (provided as a word description) indicates if the current from the batteries is FLOATING (trickle charge), RESTING (not charging or discharging), CHARGING, or DISCHARGING. Finally, LINE REGULATION status (provided as a word description) indicates whether the UPS is maintaining a STEP-UP, STEP DOWN, or NORMAL voltage from facility power.

$ A UPS bypass circuit in class II DCP's allows operation on primary input power if the UPS is inoperative or when
$ commanded by software. The digital output line operates solid-state relay A9K2 which operates triple-pole,
$ double-throw relay A9K3. Relay A9K3 selects ac power from the unconditioned input or from UPS output. A
$ jumper can be placed across the solid-state relay contacts to inhibit the UPS bypass function. The third set of A9K3
$ contacts closes a ground signal path to the processor via the DIO board. A 3-second time-delay relay (A9K1) has
$ also been included to ensure correct power-up reset in DCP equipment. The TD relay is energized by
$ unconditioned primary ac power input. The TD relay releases with minimal delay upon momentary interruption
$ of power, but requires power to be restored for at least 3 seconds before power is reapplied to DCP equipment and
$ to the UPS input.

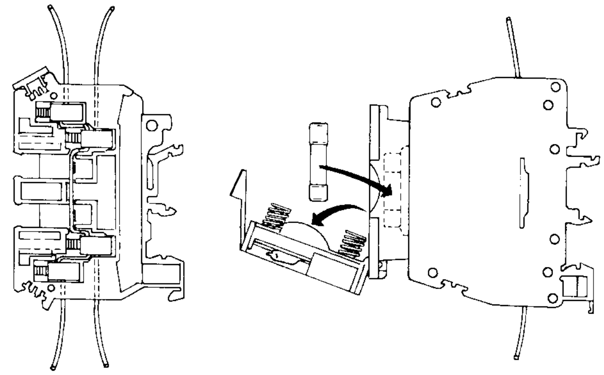
Because the Class I DCP does not contain a UPS, jumpers are installed between the UPS input and output terminals on AC Distribution Strip A1A4; that is, jumpers are installed between terminals 1B and 12A (115 vac) and between terminals 9B and 17C (neutral) to bypass the Class II UPS described above.

3.4.3.6.2 **DC Power Distribution**. Circuit Breaker Modules A2 through A9 and A11 through A18 control the application of ac power to each of the weather sensors. Circuit Breaker Modules A2 through A9 are designated for use as the primary DCP sensors (sensors 1 through 8). Circuit Breaker Modules A11 through A18 are designated for use by auxiliary DCP sensors. A full complement of circuit breaker modules may not be present, depending on the number of sensors connected for the DCP. Two different types of sensor circuit breaker modules are available to match the power requirements of the individual sensors. The main difference between the two types of circuit breaker modules is the number of circuit breakers they contain. Those sensors which require ac power for their electronics and their heaters are provided with circuit breaker modules containing two circuit breakers. Sensors that have no electronics or no heaters are provided with circuit breaker modules containing only one circuit breaker. Figure 3.4.8 illustrates a typical circuit breaker module and uses dashed lines to indicate that one or two circuit breakers may be used. Eight slots in Circuit Breaker Rack A1A3 are reserved for those sensors with both electronics and heaters. AC Power Distribution Assembly A1A4 provides the ac power source for application to the sensors. Circuit breaker CB2 in the circuit breaker module controls the application of ac power to the sensor heaters directly. Circuit breaker CB1 in the circuit breaker module is incorporated into a control and monitor circuit that allows software control of power to the sensor. A control signal from the CPU is applied via Digital I/O Board A1A2A12 to energize a normally closed relay on the circuit breaker module and disrupt ac power to the associated sensor. In addition, the circuit breaker module contains a current sensing circuit that produces a voltage level indicating the amount of ac current being used by the sensor load. This sensed current signal is applied to one of the two A/D boards (A1A2A9 or A1A2A11) in the card rack assembly for monitoring by the CPU. The ac power outputs of the circuit breaker modules are applied to connectors J5 and J6 of the Faraday box for application to the external sensors.

DC power for the DCP is provided by four power supplies located on Power Supply Assembly A4 in the DCP. These power supplies receive ac input power originating at AC Power Distribution Assembly A1A4 through DC Power Distribution Assembly A4A1. The terminal blocks on the dc distribution assembly provide fuse protection for the power supply ac inputs. The power supplies are wired in parallel at DC Distribution Assembly A4A1, with two supplies providing +5 vdc power (A4PS1 and A4PS2) and two supplies providing ±12 vdc power (A4PS3 and A4PS4). The power supply outputs are connected to DC Distribution Assembly A4A1 via diodes for current protection and isolation. DC Distribution Assembly A4A1 breaks out the dc power for separate runs to those DCP assemblies requiring dc power. Figure 3.4.10 identifies the dc power voltages provided according to the individual terminal blocks. The outputs of each of the power supplies are also distributed to VME Resistor Board A1A2A10 in the circuit card rack. The VME resistor board scales these power supply monitoring signals and passes them on to A/D Board A1A2A9 for monitoring by the CPU.

The DCP equipment cabinet heating system consists of two solid state relays, three thermal switches, and one or two heaters. Heater HR1 (Class I and Class II systems) contains two heating elements totaling 750-watts. Heater HR2 is a 350-watt silicon strip element provided in Class II systems only. The DCP equipment cabinet heaters are controlled by the three thermal switches and the two solid state relays. The solid state relay terminals are connected to these switches to control the application of power to the cabinet heaters. Switch S1 controls power to switches S2 and S3. Switch S2 controls power to half of HR1 and to HR2. Switch S3 controls power to the remaining half of HR1. Switch S1 closes to provide power to switches S2 and S3 when internal cabinet temperature falls to 40°F. At 40°F, S2 and S3 close to provide power to the heaters. When internal cabinet temperature climbs to 60°F, switches S2 and S3 open to remove power from cabinet heaters. Switch S1 also opens at 60°F disabling switches S2 and S3 to prevent over temperature conditions (should S2 or S3 fail to open). Both heaters will come on at 40°F and go off at 60°F.

In the special application DCP equipped with pressure sensors, S1 enables switches S2 and S3 when the temperature falls to 60°F. At 50°F, switches S2 and S3 close to turn on all heater power. When the temperature climbs to 70°F, switches S2 and S3 open to remove heater power. Should either S2 or S3 fail to open and cabinet temperature climbs to 80°, switch S1 opens to disable switches S2 and S3 and remove power from the heaters.



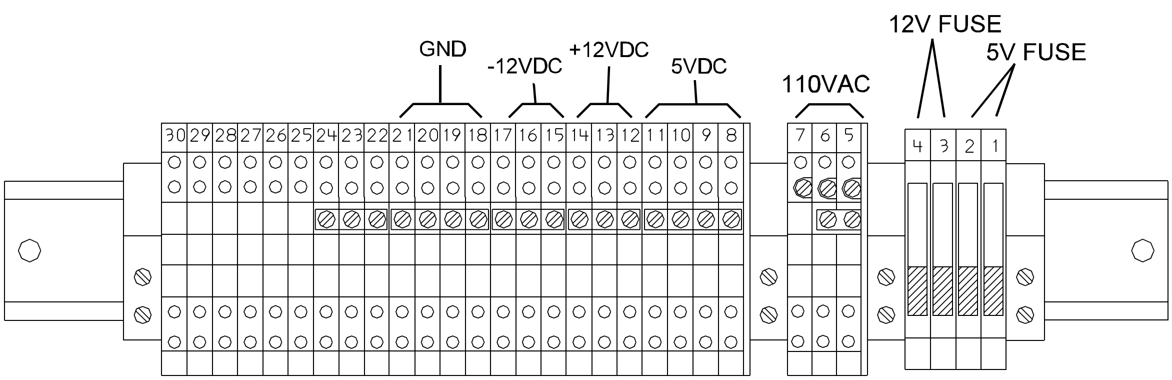


Figure 3.4.10. DC Power Distribution Assembly A4A1

SECTION V. MAINTENANCE

3.5.1 INTRODUCTION

This section contains the preventive and corrective maintenance procedures for the data collection package (DCP). Preventive maintenance identifies the periodic tasks required to maintain the DCP in peak operational condition. Corrective maintenance procedures are provided for performance of appropriate diagnostic routines, fault isolation procedures, and the removal and installation of faulty DCP field replaceable units (FRU's).

3.5.2 PREVENTIVE MAINTENANCE

Preventive maintenance consists of those procedures that are performed on a scheduled basis. All preventive maintenance tasks for the DCP and auxiliary DCP are identified in table 3.5.1. If the performance of any preventive maintenance tasks indicates a malfunction, corrective maintenance must be performed as described in paragraph 3.5.3.

Table 3.5.1. DCP Preventive Maintenance Schedule

Interval	What To Do	How To Do It
90 days	Clean and inspect cabinets.	Paragraph 3.5.2.1
Semiannually	Check/clean batteries.	Paragraph 3.5.2.2

3.5.2.1 **Cabinet Cleaning and Inspection**. Cleaning of the DCP equipment cabinet is required to remove dust and dirt that accumulates on the external surface and to remove any internal debris. At selected sites where pressure sensors are installed in the DCP, the desiccant is inspected. The DCP equipment cabinet cleaning and inspection procedure is provided in table 3.5.2.

3.5.2.2 **Check/Clean Batteries**. For Class II systems, there are three types of battery packs in Battery Box A2. $
Battery pack 62828-40062-10 contains five batteries and is used with SOLA UPS 62828-90057. Battery pack $
62828-40062-30 (4 batteries) or 62828-90360-10 (5 batteries) are used with either of the Deltek UPS, 62828- $
90038-10 or 62828-90338-20. The batteries should be checked and cleaned semiannually or whenever the CST $
indicates that the batteries have failed or are low. The individual batteries should be removed from the battery box per the battery removal procedure of table 3.5.17. The batteries should be checked for leakage or corrosion on the terminals and replaced according to the installation procedure of table 3.5.17. If a battery is found to be leaking, it should be replaced. If battery terminals are corroded, they should be cleaned with a terminal brush or other wire brush before the battery is reinstalled.

Table 3.5.2. DCP Equipment Cabinet Cleaning

Step	Procedure
	Tools and material required: Hand-held vacuum cleaner Mild detergent and water Lint-free cloths **WARNING** Death or severe injury may result if power is not removed from DCP equipment cabinet prior to performing maintenance activities inside the cabinet. Ensure that UPS POWER switch is set to 0 (off) and DCP primary circuit breaker module is set to off and that facility power is removed. **NOTE** Wring out cloth before washing surfaces.
1	Set UPS POWER switch S1 to off (0) position.
2	Set primary Circuit Breaker Module A1A3A1 to OFF position.

Table 3.5.2. DCP Equipment Cabinet Cleaning -CONT

Step	Procedure
3	Remove facility power from the DCP by setting DCP circuit breaker in ac junction box to off.
4	Clean external surfaces using lint-free cloth dampened with a mixture of mild detergent and water.
5	Dry surfaces using lint-free cloth.
6	Using hand-held vacuum cleaner, remove any loose debris inside DCP equipment cabinet.
6.1	Inspect desiccant in desiccant dryer (Dryer, figure 3.1.3 sheet 2). If indicated by color, remove and replace desiccant (refer to table 3.5.2A).
7	Apply facility power to DCP by setting DCP circuit breaker in ac junction box to on position.
8	Set primary Circuit Breaker Module A1A3A1 to on position.
9	Set UPS POWER switch on UPS status panel to 1 (on) position.

Table 3.5.2A. Dessicant Replacement Procedure

Step	Procedure
	Tools and material required: Hand-held vacuum cleaner Mild detergent and water Lint-free cloth(s). **CAUTION** Before handling the desiccant, the Material Safety Data Sheet (MSDS) for Davidson Blue Indicating Gel issued by W.R. Grace & Co., P.O. Box 2117, Baltimore, MD 21203 (telephone: 410-659-9000) or the current supplier should be obtained from the supervisor and read. **NOTE** Wring out cloth before washing screens.
1	At DCP cabinet, loosen dryer clamp ring, slide off metal bowl guard, and unscrew bowl from top housing.
2	Pour out used desiccant into plastic bag and seal bag for proper disposal.
3	Open new container and refill bowl, shaking or tapping bowl to settle desiccant to 1/2 inch from top of bowl. **CAUTION** Do not install the bowl without installing the metal bowl guard.
4	Replace bowl and bowl guard and clamp ring onto unit. Ensure that clamp ring is securely in place.

3.5.3 CORRECTIVE MAINTENANCE

3.5.3.1 **Introduction**. Corrective maintenance involves the isolation, removal, and replacement of faulty FRU's. The ASOS is equipped with a powerful automatic self-test program that is designed to isolate most faults to a single FRU. However, because of the system hardware configuration, there will be instances when the diagnostics can only isolate to a group of FRU's, such as a sensor or an I/O channel. The troubleshooting approach for single FRU and group FRU types of conditions is different.

When the FRU is specifically called out, the technician need only replace the faulty unit. When a group of FRU's is called out, the technician must isolate the failed FRU by referencing the theory of operation and associated drawings and following two basic procedures. The first procedure involves connector checks, which ensure that all boards, cables, and connectors are present and properly connected. The second procedure involves ac and dc power supply tests. Although the system monitors all critical power supply voltages in the ACU, DCP, and sensors, failure of a power supply may result in a loss of communications between the circuit powered by that supply and the rest of the system.

Power supplies are tested through both visual and mechanical inspection. Before measuring any voltages, the technician should visually inspect the suspected area for obvious signs of power supply failure. During this inspection, the technician should pay particular attention to circuit breakers, panel lights, and light emitting diode (LED) indicators on the units to ensure that they are functioning normally. The physical checks involve checking fuses and the power supply voltages using a digital multimeter (DMM). In most cases, these tests will isolate the fault.

After an FRU has been replaced, the technician must allow the ASOS to automatically initialize upon the application of primary power to the ACU and verify that the CST diagnostics run without failure. The technician should also display the corresponding maintenance page and the OID and ensure that the FRU passes its CST. Table 3.5.3 provides corrective maintenance symptom analysis information.

3.5.3.2 **UPS Checks**. In a Class II system with serial number 438 and below, the UPS provides ac power for all electronics in the DCP and associated sensors, but not for the heaters in the DCP and sensors. If power is not applied to the DCP when the UPS POWER switch on the UPS is set to ON (1) but the heaters still operate, there could be a failure in the UPS. During operation, there are a number of tools available to fault isolate the UPS. The CST continually checks the status of the UPS and provides status information on the DCP UPS page of the OID. Error messages are printed on the printer and entered into the maintenance log. Also, the status LED's on the UPS status panel provide valuable information for analyzing UPS problems. Table 3.5.4 provides methods for troubleshooting the UPS based on observed symptoms. Table 3.5.5 provides a procedure to prepare the UPS for maintenance and to return the UPS to operation following service.

In a Class II system with serial number 439 and above, the UPS provides the same functions except the troubleshooting procedures are conducted primarily from the OID page. Table 3.5.6 provides procedures for troubleshooting the UPS based on observed symptoms.

3.5.3.3 **VME Card Rack Check**. The DCP VME cards page displays the overall status of the DCP card rack boards. In a Class II system, the DCP is configured with redundant hardware for increased system availability. The technician must examine the maintenance log periodically to replace redundant faulty units to reduce the possibility of redundant malfunctions. When the CST identifies a single board as a faulty FRU, it must be replaced. Failure of all or multiple boards indicates that a failure on any board tied to VMEbus could exist. This is a catastrophic failure and requires the technician to isolate the malfunctioning board through board removal and replacement. Table 3.5.7 provides procedures to isolate the faulty FRU.

Table 3.5.3. Corrective Maintenance Symptom Analysis

Symptom	What to Do	How to Do It
System is completely dead	Check ac and dc power.	Reference DCP ac/dc power distribution diagram figure 3.4.8 and verify presence of ac and dc voltages. Check fuses on DC Power Distribution Assembly A4A1.
Loss of communication with ACU	Check ACU/DCP rf communications link.	Table 2.5.7
Problem with DCP uninterruptible power supply (UPS) in Class II system	Check UPS.	Paragraph 3.5.3.2
DCP computer does not initialize	Check VME card rack.	Paragraph 3.5.3.3
Loss of communication with a sensor	Check circuit breaker module.	Inspect Circuit Breaker Rack A1A3 for tripped sensor module.
	Check DCP/sensor fiberoptic link.	Paragraph 1.5.4.3
	Check DCP SIO board.	Paragraph 3.5.3.4
DCP equipment cabinet overheats or becomes too cold.	Check DCP heater circuit.	Paragraph 3.5.3.5

Table 3.5.4. DCP UPS Fault Isolation (62828-90057)

Step	Symptom	Checks/Corrective Actions
1	UPS will not turn on. Indicators on Status Panel Board A1A7 are all extinguished.	Ensure that facility power is applied to DCP, UPS bypass, and UPS. Check Circuit Breaker Module A1A3A1. If tripped, reset A1A3A1 and cycle OUTPUT POWER switch on status panel off and back on. Remove power from UPS and remove UPS cover per table 3.5.5. Visually inspect 1.5 KVA Filter Board A1A6 for damage. Replace filter board if damaged. Loosen screw at top of Circuit Breaker Rack A1A3 and swing rack down on hinges to access AC Power Distribution Assembly A1A4. Apply facility power to DCP by setting DCP circuit breaker in ac junction box to ON. Using DMM, verify 120 ±10% vac between terminals 1A and 9A of AC Power Distribution Assembly A1A4. If voltage is not present, replace Circuit Breaker CB1 on circuit breaker Module A1A3A1. Verify 120 ±10% vac between WHT/BLK and BLK/RED terminals of 1.5 KVA Filter Board A1A6. If voltage is not present, replace A1A6. Replace 1.5 KVA Inverter Board A5. If problem, persists, replace transformer A1T1.
2	UPS will not turn on. BATTERY indicator on status panel is on or blinking but OUTPUT indicator is off.	This is normal situation with OUTPUT POWER switch set to off (0). Therefore, ensure that OUTPUT POWER switch on Status Panel Board A1A7 is set to on (1) position. Remove power from UPS and remove UPS cover per table 3.5.5. Inspect ribbon cable on Status Panel Board A1A7 for damage or loose connections. Set OUTPUT POWER switch to on (1) position. Using DMM, ensure continuity across terminals of switch. Replace switch if no continuity. Set OUTPUT POWER switch to off (0) position. Install UPS cover per table 3.5.5. To ensure that problem was not due to cable connections, set OUTPUT POWER switch to on (1) position and attempt to operate UPS again. If problem is not corrected, Replace Status Panel Board A1A7. If problem persists, replace 1.5 KVA Inverter Board A5.

Table 3.5.4. DCP UPS Fault Isolation (62828-90057) - CONT

Step	Symptom	Checks/Corrective Actions
3	UPS operates, but CPU cannot communicate with RS-232 Interface Board A1A8. Failure indicated for TIMEOUT test or RS-232 test on DCP UPS page at OID.	Select DCP #1 SIO page on OID. From DCP #1 SIO page, press TEST key to run CST on this SIO board. If port #1 (the UPS port) fails LOOPBACK test or XMIT ERRORS test, replace SIO board #1 (A1A2A4). If both tests pass, continue. Loosen screw on top of Circuit Breaker Rack A1A3 and swing rack down on hinges to access UPS RS-232 connector. Disconnect W015 connector P22 from J20 of RS-232 Interface Board A1A8. Insert RS-232 test box between W015-P22 and J20 of RS-232 Interface Board A1A8. Select DCP UPS page at OID. From DCP UPS page, press TEST key to run CST on UPS. On RS-232 tester, ensure that transmit (TxD) and receive (RxD) signals are being passed between the UPS and the SIO board (at least once per minute). If both signals are active, replace one of the following (in order) and retry UPS. a. SIO board #1 (A1A2A4) b. UPS RS-232 Interface Board A1A8 If transmit signal is missing, replace SIO board #1 (A1A2A4). If receive signal is missing, continue. Remove power from UPS and remove UPS cover per table 3.5.5. Inspect ribbon cable between RS-232 Interface Board A1A8 and 1.5 KVA Inverter Board A5. Ensure that ribbon cable is not twisted or damaged. Reseat connectors to ensure proper connection. After checking ribbon cable, replace cover per table 3.5.5 and operate system again. If problem is not corrected, replace RS-232 Interface Board A1A8. If problem persists, replace 1.5 KVA Inverter Board A5.

Table 3.5.4. DCP UPS Fault Isolation (62828-90057) - CONT

Step	Symptom	Checks/Corrective Actions
4	ALARM indicator on Status Panel Board A1A7 is illuminated.	Overheat condition is likely. On UPS Status Panel Board A1A7, set OUTPUT POWER switch to off (0). Inspect inside of DCP equipment cabinet to ensure proper ventilation around UPS. Ensure that connector W031-P1 is securely attached to connector J1 on Battery Box A2. Allow UPS to cool. Set UPS OUTPUT POWER switch to on (1) position. If UPS operates after allowing to cool, check operation of UPS fan A1B1 by setting Circuit Breaker Module A1A3A1 to OFF. AC FAIL indicator on Status Panel Board A1A7 illuminates and UPS enters inverter mode to provide battery backup power. While UPS is operating in inverter mode, ensure that UPS fan A1B1 is operating. If not, proceed to step 11. If, after cooling, UPS fails to turn on and ALARM indicator remains illuminated, proceed to step 5.
5	With UPS cool, ALARM indicator on UPS Status Panel Board A1A7 is illuminated.	Set UPS OUTPUT POWER switch to off (0) position. Ensure connector W031-P1 is securely attached to connector J1 on Battery Box A2. Attempt to operate UPS by setting OUTPUT POWER switch to on (1) position. Remove power from UPS and remove UPS cover per table 3.5.5. **WARNING** Ensure that W031-P1 connector is disconnected from Battery Box A2 before attempting to test fuse A1F1 for continuity. Failure to disconnect battery box may result in injury to personnel or damage to equipment. Ensure that connector W031-P1 is disconnected from Battery Box A2. Inspect UPS fuse A1F1 and test for continuity using DMM. If fuse is good, proceed to next step. If fuse is open, replace fuse. If, after replacing fuse, problem persists and fuse again opens, replace 1.5 KVA Inverter Board A5. **WARNING** Exercise extreme caution when connecting UPS battery and taking measurements with UPS cover off. Death or severe injury may result if contact is made with battery terminals or wires. Connect battery cable W031-P1 to connector J1 on Battery Box A2. Using DMM, measure dc voltage at battery terminals (RED + and BLK -) of 1.5 KVA Inverter Board A5. Disconnect battery cable W031-P1 from connector J1 on Battery Box A2.

Table 3.5.4. DCP UPS Fault Isolation (62828-90057) - CONT

Step	Symptom	Checks/Corrective Actions
		If indication was less than 55 vdc, replace batteries BT1 through BT5 in Battery Box A2. If problem persists, replace 1.5 KVA Inverter Board A5. If battery voltage is above 55 vdc, replace 1.5 KVA Inverter Board A5.
6	After 24 hours of continuous charging (UPS has operated continually on facility power), BATTERY indicator on UPS Status Panel Board A1A7 blinks, indicating a low battery.	Remove power from UPS and remove UPS cover per table 3.5.5. **WARNING** Ensure that W031-P1 connector is disconnected from Battery Box A2 before attempting to test fuse A1F1 for continuity. Failure to disconnect battery box may result in injury to personnel or damage to equipment. Inspect UPS fuse A1F1 and test for continuity using DMM. If fuse is good, proceed to next step. If fuse is open, replace fuse. If, after replacing fuse, problem persists and fuse again opens, replace 1.5 KVA Inverter Board A5. Replace batteries BT1 through BT5 in Battery Box A2. If problem persists, replace 1.5 KVA Inverter Board A5. If problem persists, replace transformer A1T1.
7	One or more indicators on Status Panel Board A1A7 do not illuminate.	Remove power from UPS and remove UPS cover per table 3.5.5. Inspect ribbon cable on Status Panel Board A1A7 for damage or loose connections. After checking ribbon cable, install UPS cover per Table 3.5.5 and operate system again. If problem persists, replace Status Panel Board A1A7. If problem persists, replace 1.5 KVA Inverter Board A5.
8	UPS beeps when OUTPUT POWER switch is set to on (1) position.	Replace 1.5 KVA Inverter Board A5. **NOTE** Failure may be the result of Circuit Breaker Module A1A3A1 tripping below its rated value. If problem persists after performing the following corrective actions, A1A3A1 may be faulty.

Table 3.5.4. DCP UPS Fault Isolation (62828-90057) - CONT

Step	Symptom	Checks/Corrective Actions
9	Primary Circuit Breaker Module A1A3A1 continually trips when power is applied to DCP equipment cabinet from ac junction box.	With primary Circuit Breaker Module A1A3A1 set to off, remove Circuit Breaker Modules A1A3A2 through A9. Apply power to DCP and set Circuit Breaker Module A1A3A1 to on. If breaker does not trip, then there is a short circuit in circuit breaker modules or in associated sensors. If breaker still trips, problem is in UPS; continue. Remove power from UPS and remove UPS cover per Table 3.5.5. Inspect 1.5 KVA Filter Board A1A6 and 1.5 KVA Inverter Board A5 for signs of damage. Replace if necessary. On 1.5 KVA Filter Board A1A6, disconnect Circuit Breaker Module A1A3A1 load wire from BLK terminal. Reset Circuit Breaker Module A1A3A1. Apply facility power to DCP by setting DCP circuit breaker in ac junction box to ON. If Circuit Breaker Module A1A3A1 trips, replace circuit breaker CB1 on module. Remove facility power from DCP by setting DCP circuit breaker in ac junction box to off. Reconnect wire to BLK terminal of 1.5 KVA Filter Board A1A6. On 1.5 KVA Inverter Board A5, disconnect input wires from WHT/BLK and BLK/RED terminals. Apply facility power to DCP by setting DCP circuit breaker in ac junction box to ON. If Circuit Breaker Module A1A3A1 trips, replace 1.5 KVA Filter Board A1A6. Remove facility power from DCP by setting DCP circuit breaker in ac junction box to off. Reconnect wires to WHT/BLK and BLK/RED terminals of 1.5 KVA Inverter Board A5. On 1.5 KVA Filter Board A1A6, disconnect connector from J10. **WARNING** Ensure that W031-P1 connector is disconnected from Battery Box A2 before attempting to disconnect transformer T1. Failure to disconnect battery box may result in injury to personnel or damage to equipment. On 1.5 KVA Inverter Board A5, tag and disconnect 10 transformer T1 wires from their terminals.

Table 3.5.4. DCP UPS Fault Isolation (62828-90057) - CONT

Step	Symptom	Checks/Corrective Actions
		Apply facility power to DCP by setting DCP circuit breaker in ac junction box to on. If Circuit Breaker Module A1A3A1 trips, replace 1.5 KVA Inverter Board A5. Remove facility power from DCP by setting DCP circuit breaker in ac junction box to off. Reconnect 10 transformer wires to respective connectors on 1.5 KVA Inverter Board A5. Apply facility power to DCP by setting DCP circuit breaker in ac junction box to on. If Circuit Breaker Module A1A3A1 trips, replace transformer T1. Remove facility power from DCP by setting DCP circuit breaker in ac junction box to off. Reconnect connector to J10 on 1.5 KVA Filter Board A1A6. Disconnect W015 connector P13 from connector J7 on 1.5 KVA Filter Board A1A6. Apply facility power to DCP by setting DCP circuit breaker in ac junction box to on. If Circuit Breaker Module A1A3A1 trips, replace 1.5 KVA Filter Board A1A6. If not, problem is not in UPS components, but a short circuit probably exists in the DCP equipment cabinet wiring.
10	Failure indicated for TRIAC test on DCP UPS page at the OID.	Replace 1.5 KVA Inverter Board A5. If problem persists, replace transformer T1.
11	UPS fan A1B1 does not turn on when UPS is in inverter mode.	Replace fan A1B1. If problem persists, replace 1.5 KVA Inverter Board A5.
12	UPS fan A1B1 does not turn off when UPS is not in inverter mode.	Replace 1.5 KVA Inverter Board A5.

Table 3.5.5. DCP UPS (62828-90057) Pre-Service and Post-Service Procedures

Step	Procedure
PRE-SERVICE: REMOVING UPS POWER AND REMOVING COVER	
	Tools required: Small flat-tipped screwdriver No. 2 Phillips screwdriver **WARNING** Ensure that power is completely removed from UPS by performing the following steps. Death or severe injury may result if power is not completely removed from UPS prior to removing the cover in front of UPS components and performing maintenance on UPS subassemblies.
1	Set UPS POWER switch to off (0) position.
2	Set primary Circuit Breaker Module A1A3A1 to OFF position.

Table 3.5.5. DCP UPS (62828-90057) Pre-Service and Post-Service Procedures - CONT

Step	Procedure
3	Remove facility power from DCP equipment cabinet by setting DCP circuit breaker in ac junction box to off.
4	**WARNING** Sparks are generated when battery box connector J1 is connected or disconnected. Explosive fumes from battery box may be present when DCP cabinet is opened. Ensure that DCP cabinet is ventilated for at least 5 minutes before connecting or disconnecting J1. On Battery Box A2, disconnect cable connector W031-P1 from battery box connector J1. To remove cable connector, squeeze tabs on side of connector inward while rocking the connector free.
5	Wait at least 30 seconds while UPS capacitors discharge through bleeders and other drains.
6	**CAUTION** Be sure to hold UPS cover in place while removing screws and flat washers that secure cover to cabinet. Damage to UPS equipment may result if cover falls while being removed. While holding DCP cover in place, remove eight screws, lockwashers, and flat washers securing UPS cover to DCP.
7	**CAUTION** Status panel ribbon cable is delicate. Use caution when lifting cover and disconnecting cable to prevent damage to status panel cable. Carefully pull cover approximately 6 inches from DCP and disconnect status panel ribbon cable from connector J4 on 1.5 KVA Inverter Board A5.
8	Remove cover from DCP.
POST-SERVICE: INSTALLING UPS COVER AND APPLYING POWER TO UPS	
	Tools required: Small flat-tipped screwdriver No. 2 Phillips screwdriver **WARNING** Ensure that facility power is removed from DCP and that cable W031-P1 is disconnected from Battery Box A2 before performing maintenance on UPS. Death or severe injury may result if power is not completely removed from UPS prior to maintenance activities. **CAUTION** Status panel ribbon cable is delicate. Use caution when connecting cable and lowering cover to prevent damage to status panel cable. Ribbon connector is not keyed. Ensure that pin 1 on cable mates with pin 1 on board.
1	While holding cover approximately 6 inches in front of its normal position, carefully connect status panel ribbon cable to connector J4 on 1.5 KVA Inverter Board A5. Pin 1 on ribbon connector is marked with ink dot or other marking. Ensure that mark mates with pin 1 of inverter board.
2	Position cover in front of UPS components, taking care not to disturb or pinch status panel ribbon cable.

Table 3.5.5. DCP UPS (62828-90057) Pre-Service and Post-Service Procedures - CONT

Step	Procedure
3	**CAUTION** Be sure to hold UPS cover in place while installing screws and flat washers. Damage to UPS equipment may result if cover falls while being installed. While holding cover in position, install eight screws, lockwashers, and flat washers securing cover.
4	Ensure that UPS POWER switch is set to off (0) position.
5	**WARNING** Sparks are generated when battery box connector J1 is connected or disconnected. Explosive fumes from battery box may be present when DCP cabinet is opened. Ensure DCP cabinet is ventilated for at least 5 minutes before connecting or disconnecting J1. Connect battery cable W031-P1 to connector J1 on Battery Box A2.
6	Apply facility power to DCP equipment cabinet by setting DCP circuit breaker in ac junction box to on position.
7	Set Circuit Breaker Module A1A3A1 to ON position.

Table 3.5.6. UPS Fault Isolation (62828-90338-10 or 62828-90338-20)

Step	Symptom	Checks/Corrective Actions
1	UPS will not start.	Line cord is not connected. Connect line cord. UPS power switch is OFF. Turn switch ON. Input power is missing or incorrect. Using multimeter, check input voltage and set DIP switches (UPS 62828-90338-10 only) properly: DIP Switch Settings (UPS 62828-90338-10 only) Voltage / S1 / S2 127 / ON / OFF 120 / OFF / OFF (Default) 110 / OFF / ON Battery fuse or circuit is open. Turn UPS power switch to OFF. Replace battery fuse or set circuit breaker to ON. Turn UPS power switch to ON.
2	Alarm continues after ALARM SILENCE button is pushed.	Overheat condition likely. On UPS, set power switch to off position. Inspect inside of DCP cabinet to ensure proper ventilation around UPS and that DCP fan is working properly. Replace if necessary. Allow UPS to cool. Set power switch to on position. If UPS fails to turn on and alarm continues, set UPS power switch to off position and proceed to step 3.

Table 3.5.6. UPS Fault Isolation (62828-90338-10 or 62828-90338-20) - CONT

Step	Symptom	Checks/Corrective Actions
3	With UPS cool, ALARM continues when power is applied to DCP. UPS does not output power.	Ensure that connector P1 is securely attached to UPS. Attempt to operate UPS again by setting UPS power switch to on position.
4	Battery service LED is red.	Replace batteries. If problem persists, replace UPS.
5	Top LED above load symbol is solid red.	Determine if load(s) is defective or too many loads are connected to the UPS. Overload condition because of excessive current.
6	All LED's above load symbol are on.	High dc charging voltage. Turn UPS off and disconnect all loads connected to UPS. Connect loads one at a time back into UPS and turn power back on after each one is plugged in until problem returns. If problem persists, remove and replace UPS.
7	Red LED (top or bottom) above ac input voltage symbol is lit.	Line voltage is either too high or too low. UPS in battery operation. Correct input voltage if possible or be prepared to lose power to load in approximately 2 to 5 minutes after impending low battery LED turns on.
8	Red LED (top or bottom) above ac input symbol is flashing.	Line voltage has returned to normal, but RESET was not pushed. Wait until power returns to normal, then press RESET.

Table 3.5.7. DCP Card Rack Assembly Fault Isolation Procedures

Step	Procedure
1	Remove power from system by setting OUTPUT POWER switch on UPS status panel to off (0) position and setting Circuit Breaker Module A1A3A1 to OFF. Visually inspect Card Rack Assembly A1A2 for damage, loose power connections, etc. **NOTE** Reference paragraph 3.5.4 for the proper removal and installation procedures for the card rack circuit boards.
2	Replace CPU A (A1A2A1). Apply power to system by setting OUTPUT POWER switch and Circuit Breaker Module A1A3A1 to ON. If system initializes properly, CPU A is bad. If system does not initialize, proceed to step 3.
3	Replace Memory Board A1A2A3. Apply power to system by setting OUTPUT POWER switch and Circuit Breaker Module A1A3A1 to ON. If system initializes, Memory Board A1A2A3 is bad. If system does not initialize, proceed to step 4.
4	If DCP is Class II, replace CPU B (A1A2A2). Apply power to system by setting OUTPUT POWER switch and Circuit Breaker Module A1A3A1 to ON. If system initializes, CPU B is bad. If system does not initialize, proceed to step 5.
5	One at a time, replace each of the boards in slots A4 through A12 and apply power to the system. If the system initializes, board most recently replaced is bad. If system fails to initialize, card rack itself is bad.

3.5.3.4 **Serial I/O Board Checks**. The DCP CST checks the operation of the SIO boards once per minute. A LOOPBACK test and a TRANSMIT ERROR test is performed on each of the four ports of each SIO board. When a failure is discovered, an error message is printed on the printer and entered into the maintenance log. The error message identifies the SIO board and port, identifies the type of test failed, and gives instructions to replace the board. Also, an F indication is displayed on the appropriate DCP SIO page at the OID. For this type of SIO board failure, the technician need only replace the identified board to repair the system.

In addition to the definitive SIO board failures described above, general communications failures may occur between the DCP and one of its sensors. In these cases, the problem is either the fault of the sensor, an SIO port in the DCP, or in the fiberoptic link between the DCP and the sensor.

When such a loss in sensor communication occurs, the technician should first refer to the DCP fiberoptic modules detailed block diagram (Figure 3.4.6) to determine which SIO board is connected to the fiberoptic link for the failing sensor. The technician should then inspect all cable connections associated with the SIO board and the failing sensor.

If all cable connections appear to be good and the port is still not operating, an RS-232 test box can be used to check communication between the SIO board and the fiberoptic module or UPS that it communicates with. Paragraph 1.3.5.3 describes testing RS-232 signals for the fiberoptic modules. The DCP UPS fault isolation procedure of Table 3.5.4 does the same for UPS communications. The RS-232 test box is inserted in line with connector P1 on the fiberoptic module.

When using the RS-232 test box, the technician must verify the activity of the applicable RS-232 signals. For the sensor and UPS communications, these signals are the transmit data (TxD) and receive data (RxD) signals. Handshaking signals are not used for sensor communications and therefore need not be checked. However, the technician should check the 5 vdc and signal ground signals applied to the fiberoptic module being tested.

3.5.3.5 **DCP Equipment Cabinet Heater Troubleshooting**. Failures involving the DCP equipment cabinet heaters may be quite subtle in nature and may not become immediately evident. Basically, heater malfunctions present themselves in one of two possible symptoms. If the heaters do not come on as they are supposed to, then the cabinet temperature becomes too low. If the heaters come on and do not shut off as they are supposed to, then the cabinet becomes too hot. The difficulty in recognizing the fault symptoms is due to the fact that the symptoms are dependent on the ambient temperature at the installation site. For example, if the temperature at the site is quite cold and the heaters malfunction such that they are always on, the malfunction will not be noticeable until the temperature rises to the point where the heaters should turn off. Troubleshooting the DCP heating is performed using the DCP power distribution detailed block diagram and its accompanying text. The heaters are controlled by thermal switches and solid state relays. The ac power for the heaters should be verified at the inputs to solid state relays. The state (open or closed) of the thermal switches should then be checked. If the cabinet is overheating, then the heaters are stuck on and the thermal switches and the solid state relays are closed (they should be open). If the cabinet temperature is too low, then the heaters are not coming on and the thermal switches and solid-state relays are open (they should be closed). The proper operation of the heaters themselves is checked by feeling the heat output by each of the heater strips.

3.5.3.6 **Diagnostics**. The diagnostics on the DCP equipment cabinet run continuously in the background of the ASOS operating software as described in Chapter 1. The diagnostics complete a check of the system every 7 minutes. The test data received via the diagnostic program are displayed on the technician interface display pages, which are described in Chapter 1, Section III. If the diagnostics detect a failure, on-demand diagnostics of the affected unit are performed immediately and are repeated three times. If the unit fails at least two of the three tests, the unit is tagged as faulty and a message is entered into the maintenance log. Where redundant hardware is present (i.e., CPU's, rf modems, and line drivers), the faulty FRU is removed from the system and replaced with the operational unit via software. The technician must examine the maintenance log periodically, even if the system is up in operation, to replace redundant faulty units.

3.5.4 REMOVAL AND INSTALLATION PROCEDURES

The following chart is provided to facilitate safe and efficient removal and installation procedures for those assemblies and subassemblies found to be defective as a result of preventive maintenance and troubleshooting. This section does not include any obvious replacement procedures. Prior to the removal and installation of the assemblies as described in the following paragraphs, maintenance personnel should ensure that electrical power is removed from the DCP by setting the UPS OUTPUT POWER switch to off, setting the primary Circuit Breaker Module A1A3A1 to OFF, and setting the DCP breaker in the ac junction box (mounted beside the DCP) to off, as specified in the individual procedures. Procedures that are provided for the replacement of duplicate assemblies, such as VME cards and dc power supplies, are sufficient for maintenance of all similar units and are described for one assembly only. Removal/installation sequences of attaching hardware (screws, washers, nuts, etc) are reflected by the relative order of their presentation in the applicable step. Removal and installation of assemblies in the auxiliary DCP can be accomplished by substituting auxiliary DCP for DCP in the applicable procedural steps of the DCP removal and installation tables and by setting the circuit breaker located in slot A10 of the power control module rack to the off position.

Unit to Be Replaced	Removal/Installation/ table Reference
VME card rack circuit board	3.5.8
DCP UPS filter board	3.5.9
DCP UPS transformer	3.5.10
DCP UPS fuse	3.5.11
DCP UPS RS-232 interface board	3.5.12
DCP UPS 1.5 KVA inverter	3.5.13
DCP UPS fan	3.5.14
DCP UPS status panel board	3.5.15
DCP UPS OUTPUT POWER switch	3.5.16
Battery box and battery	3.5.17
DC power supply (+5 and +12)	3.5.18
RF modem	3.5.19
RF switch	3.5.20
RF antenna	3.5.21
Fiberoptic module	3.5.22
Power control module A1A3A2-A9 and A11-A18	3.5.23
Solid state relay	3.5.24
Heater HR1	3.5.25
DCP heater HR2	3.5.26
DCP thermostat switch	3.5.27
DCP fan	3.5.28
Primary and secondary circuit breakers A1A3A1CB1 and A1A3A10CB1	3.5.29
Power supply assembly diodes A4CR2-CR6	3.5.30
$ Uninterruptible power supply	3.5.31
$ Line Driver	3.5.32

Table 3.5.8. VME Card Rack Circuit Board Removal and Installation

Step	Procedure
REMOVAL	
	Tools required: Small flat-tipped screwdriver **CAUTION** Damage to equipment may result if power is not removed prior to removal or installation. Ensure that UPS POWER switch is set to off (0) position and primary Circuit Breaker Module A1A3A1 is set to OFF.
1	Set UPS POWER switch to off (0) position.
2	Set primary Circuit Breaker Module A1A3A1 to OFF.
3	Referring to figure 3.1.4, locate the slot containing board to be removed.
4	**CAUTION** To avoid damage to circuit boards, use proper ESD handling procedures to include the use of a grounding strap when performing the following procedures. Disconnect any cables that may be attached to front of board by pulling cable connector straight out of circuit board connector.
5	Using small flat-tipped screwdriver, loosen two captive screws located at top and bottom of board front.
6	**CAUTION** When removing a CPU board from rack, exert even force on both board handles. Failure to apply even force to both handles may result in board hitting bottom of card rack. If board is equipped with extractor handles, press handles in opposite directions to release the board. If board does not have extractor handles, gently rock board vertically while gently pulling board from rack.
7	**CAUTION** Jumper J34 on DCP Memory Board A1A2A3 must be moved to storage position (J34-A) prior to storing or shipping board. Failure to comply may result in discharge of battery. If board removed is DCP Memory Board A1A2A3, move battery jumper from operational position (J34-B) to storage position (J34-A).
INSTALLATION	
	Tools required: Small flat-tipped screwdriver **CAUTION** Damage to equipment may result if power is not removed prior to removal or installation. Ensure that UPS POWER switch is set to off (0) position and primary Circuit Breaker Module A1A3A1 is set to OFF. To avoid damage to circuit boards, use proper ESD handling procedures to include the use of a grounding strap when performing the following procedures.
1	Ensure that UPS POWER switch is set to off (0) position.
2	Ensure that primary Circuit Breaker Module A1A3A1 is set to OFF.
3	If board being installed is CPU A or B (A1A2A1 or A2) or SIO board #1 through #5 (A1A2A4 through A8), configure board jumpers for slot into which it is being installed (described in paragraph 3.5.5).
4	**NOTE** Jumper J34 on DCP Memory Board A1A2A3 must be moved to operational position (J34-B) to enable battery backup circuit. If board installed is DCP Memory Board A1A2A3, move battery jumper from storage position (J34-A) to operational position (J34-B).

Table 3.5.8. VME Card Rack Circuit Board Removal and Installation - CONT

Step	Procedure
5	Using two handles located at top and bottom of board, position board with component side facing right and carefully slide board into rack card guides. Align card with rack connector and press into place.
6	Using small flat-tipped screwdriver, tighten captive screws located at top and bottom of board.
7	If installing CPU A or CPU B, connect RS-232 cable to connector JK1 on front of CPU board.
8	Set primary Circuit Breaker Module A1A3A1 to ON.
9	Set UPS POWER switch to on (1) position.

Table 3.5.9. DCP UPS Filter Board Removal and Installation

Step	Procedure
	REMOVAL
	Tools required: No. 2 Phillips screwdriver No. 1 offset Phillips screwdriver **WARNING** Ensure that power is completely removed from UPS by performing procedure in table 3.5.5. Death or severe injury may result if power is not completely removed from UPS prior to removing cover in front of UPS components and performing maintenance on UPS subassemblies.
1	Remove DCP UPS cover in accordance with table 3.5.5.
2	At 1.5 KVA Filter Board A1A6, remove harness connectors from board connectors J5 and J10.
3	Tag and remove five single wires from 1.5 KVA Filter Board A1A6.
4	Using Phillips screwdrivers, remove four screws, flat washers, and lockwashers securing 1.5 KVA Filter Board A1A6 to standoffs.
5	Remove filter board from DCP.
	INSTALLATION
	Tools required: No. 2 Phillips screwdriver No. 1 offset Phillips screwdriver **WARNING** Ensure that power is completely removed from UPS by performing the procedure in table 3.5.5. Death or severe injury may result if power is not completely removed from UPS prior to removing cover in front of UPS components and performing maintenance on UPS subassemblies.
1	Verify that DCP UPS cover is removed in accordance with table 3.5.5.
2	Position 1.5 KVA Filter Board A1A6 on standoffs with connectors J5 and J10 positioned to the right.
3	Using Phillips screwdriver, install four screws, flat washers, and lockwashers securing filter board to standoffs.
4	Using tags as a guide, install five wires on filter board.
5	Install harness connectors on board connectors J5 and J10.
6	Install DCP UPS cover in accordance with table 3.5.5.

Table 3.5.10. DCP UPS Transformer Removal and Installation

Step	Procedure
	REMOVAL
	Tools required: No. 2 Phillips screwdriver 3/8-inch socket with ratchet 9/16-inch socket with ratchet **WARNING** Ensure that power is completely removed from UPS by performing the procedure in table 3.5.5. Death or severe injury may result if power is not completely removed from UPS prior to removing the cover in front of UPS components and performing maintenance on UPS subassemblies.
1	Remove DCP UPS cover in accordance with table 3.5.5.
2	On 1.5 KVA Inverter Board A5, tag and remove seven transformer wires with solderless (spade) connectors from spade connectors on inverter board.
3	Using 3/8-inch socket with ratchet, tag and remove three transformer wires from standoffs on 1.5 KVA Inverter Board A5.
4	**WARNING** Transformer is heavy equipment (weighs approximately 45 pounds) and requires a two-man or mechanical lift. Failure to comply may result in injury to personnel or damage to equipment. **CAUTION** Hold transformer in place while removing nuts and flat washers securing it to mounting plate. Damage to equipment may result if transformer falls while being removed. Using 9/16-inch socket with ratchet, remove four nuts and flat washers securing transformer to Mounting Plate Assembly A1.
5	Remove transformer from DCP.
	INSTALLATION
	Tools required: No. 2 Phillips screwdriver 3/8-inch socket with ratchet 9/16-inch socket with ratchet **WARNING** Ensure that power is completely removed from UPS by performing the procedure in table 3.5.5. Death or severe injury may result if power is not completely removed from UPS prior to removing cover in front of UPS components and performing maintenance on UPS subassemblies. **NOTE** This procedure applies to part number 62828-90057 only (installed in DCP's with serial numbers 438 and below).
1	Verify that DCP UPS cover is removed in accordance with table 3.5.5.

Table 3.5.10. DCP UPS Transformer Removal and Installation -CONT

Step	Procedure
	WARNING Transformer is heavy equipment (weighs approximately 45 pounds) and requires a two-man or mechanical lift. Failure to comply may result in injury to personnel or damage to equipment. **CAUTION** Hold transformer in place while installing nuts and washers securing it to mounting plate. Damage to equipment may result if transformer falls while being installed.
2	Position transformer on mounting plate assembly studs with three heavy gauge wires on bottom.
3	Using 9/16-inch socket with ratchet, install four nuts and washers securing transformer to mounting plate assembly.
4	Using 3/8-inch socket with ratchet and using tags as a guide, connect three transformer wires to standoffs on 1.5 KVA Inverter Board A5.
5	On 1.5 KVA Inverter Board A5 using tags as a guide, connect seven transformer wires to spade connectors on inverter board.
6	Install DCP UPS cover in accordance with table 3.5.5.

Table 3.5.11. DCP UPS Fuse Removal and Installation

Step	Procedure
REMOVAL	
	Tools required: Fuse puller **WARNING** Death or severe injury may result if power is not removed from DCP prior to maintenance activities. Ensure that UPS POWER switch is set to 0 (off) position, facility power is removed from DCP, and battery box connector is disconnected.
1	Set UPS POWER switch to off (0) position.
2	Set primary Circuit Breaker Module A1A3A1 to off position.
3	Remove facility power from DCP equipment cabinet by setting DCP circuit breaker in ac junction box to off.
	WARNING Sparks are generated when battery box connector J1 is connected or disconnected. Explosive fumes from battery box may be present when DCP cabinet is opened. Ensure DCP cabinet is ventilated for at least 5 minutes before connecting or disconnecting J1.
4	At DCP battery box, disconnect W031-P1 from J1.
5	Wait at least 30 seconds while UPS capacitors discharge through bleeders and other drains.
6	Using fuse puller, remove fuse F1 from fuse holder A1XF1.

Table 3.5.11. DCP UPS Fuse Removal and Installation -CONT

Step	Procedure
	INSTALLATION
	WARNING Death or severe injury may result if power is not removed from DCP prior to maintenance activities. Ensure that OUTPUT POWER switch is set to 0 (off) position, facility power is removed from DCP, and battery box connector is disconnected.
1	Ensure that UPS POWER switch is set to off (0) position.
2	Ensure that primary Circuit Breaker Module A1A3A1 is set to off position.
3	Ensure that DCP circuit breaker in ac junction box is set to off position.
4	**WARNING** Sparks are generated when battery box connector J1 is connected or disconnected. Explosive fumes from battery box may be present when DCP cabinet is opened. Ensure DCP cabinet is ventilated for at least 5 minutes before connecting or disconnecting J1. Ensure that battery box connector W031-P1 is disconnected from battery box.
5	Install replacement fuse F1 in fuse holder A1XF1.
6	**WARNING** Sparks are generated when battery box connector J1 is connected or disconnected. Explosive fumes from battery box may be present when DCP cabinet is opened. Ensure that DCP cabinet is ventilated for at least 5 minutes before connecting or disconnecting J1. At the DCP battery box, connect W031-P1 to J1.
7	Apply facility power to DCP equipment cabinet by setting DCP circuit breaker in ac junction box to on position.
8	Set primary Circuit Breaker Module A1A3A1 to on position.
9	Set UPS POWER switch to 1 (on) position.

Table 3.5.12. DCP UPS RS-232 Interface Board Removal and Installation

Step	Procedure
REMOVAL	
	Tools required: Large flat-tipped screwdriver Small flat-tipped screwdriver 3/16-inch nut driver **WARNING** Ensure that power is completely removed from UPS by performing the procedure in table 3.5.5. Death or severe injury may result if power is not completely removed from UPS prior to removing cover in front of UPS components and performing maintenance on UPS subassemblies. **NOTE** This procedure applies to part number 62828-90057 only (installed in DCP's with serial numbers 438 and below).
1	Remove DCP UPS cover in accordance with table 3.5.5.
2	Disconnect RS-232 interface board ribbon connector A1A8-P1 from connector J2 on 1.5 KVA Inverter Board A5 by grasping connector with thumb and index finger and executing upward force on connector.
3	Using large flat-tipped screwdriver, loosen captive screw and lower circuit breaker module rack.
4	Using small flat-tipped screwdriver, loosen retaining screws and remove connector W015-P22 from RS-232 interface board.
5	Using 3/16-inch nut driver, remove two lugs (standoffs) and flat washers securing RS-232 interface board to mounting bracket.
6	Remove RS-232 interface board from DCP.
INSTALLATION	
	Tools required: Large flat-tipped screwdriver Small flat-tipped screwdriver 3/16-inch nut driver **WARNING** Ensure that power is completely removed from UPS by performing the procedure in table 3.5.5. Death or severe injury may result if power is not completely removed from UPS prior to removing cover in front of UPS components and performing maintenance on UPS subassemblies.
1	Verify that DCP UPS cover is removed in accordance with table 3.5.5.
2	Carefully position RS-232 interface board in mounting bracket.
3	Using 3/16-inch nut driver, install two lugs (standoffs) and flat washers securing RS-232 interface board to mounting bracket.
4	Using small flat-tipped screwdriver, install connector W015-P22 to RS-232 interface board.
5	Connect RS-232 interface board ribbon connector A1A8-P1 to connector J2 on 1.5 KVA Inverter Board A5. Ensure that pin 1 on ribbon connector (marked with ink dot or other marking) mates with pin 1 of inverter board.
6	Raise circuit breaker module rack and secure captive screw.
7	Install DCP UPS cover in accordance with table 3.5.5.

Table 3.5.13. DCP UPS 1.5 KVA Inverter Board Removal and Installation

Step	Procedure
REMOVAL	
	Tools required: No. 2 Phillips screwdriver 3/8-inch nut driver 7/16-inch nut driver **WARNING** Ensure that power is completely removed from UPS by performing the procedure in table 3.5.5. Death or severe injury may result if power is not completely removed from UPS prior to removing cover in front of UPS components and performing maintenance on UPS subassemblies.
1	Remove DCP UPS cover in accordance with table 3.5.5.
2	Remove RS-232 ribbon cable connector A1A8-P1 from 1.5 KVA inverter board connector J2.
3	Remove blower cable connector A1B1-P3 from 1.5 KVA inverter board connector J11.
4	Tag and remove 10 wires with solderless (spade) connectors from 1.5 KVA inverter board.
5	Tag seven wires connected to four 1.5 KVA inverter board standoffs.
6	Using 3/8-inch nut driver, remove four nuts, four flat washers, four lockwashers, and seven wires from four 1.5 KVA inverter board standoffs.
7	Remove two screws, lockwashers, and flat washers securing mounting bracket to back of cabinet.
8	If cabinet is type with left door support blocking inverter board removal, using 7/16-inch nut driver, remove nut from door support and lower support out of the way.
9	Using Phillips screwdriver, remove three screws securing 1.5 KVA inverter board to mounting plate.
10	Carefully slide 1.5 KVA inverter board forward and remove from DCP.
11	Using Phillips screwdriver, remove four screws, flat washers, lockwashers, and nuts securing mounting bracket to insulator on top of inverter board heat sinks.
INSTALLATION	
	Tools required: No. 2 Phillips screwdriver 3/8-inch nut driver 7/16-inch nut driver **WARNING** Ensure that power is completely removed from UPS by performing the procedure in table 3.5.5. Death or severe injury may result if power is not completely removed from UPS prior to removing cover in front of UPS components and performing maintenance on UPS subassemblies.
1	Verify that DCP UPS cover is removed in accordance with table 3.5.5.
2	Using Phillips screwdriver, install four screws, flat washers, lockwashers, and nuts securing mounting bracket to insulator on top of inverter board heat sinks.
3	Carefully install 1.5 KVA inverter board into card guides.
4	Using Phillips screwdriver, install three screws and flat washers securing 1.5 KVA inverter board to mounting plate.
5	If cabinet left door support was disconnected and lowered during removal, using 7/16-inch nut driver, install nut securing support to cabinet door.
6	Using Phillips screwdriver, install two screws, lockwashers, and flat washers securing mounting bracket to back of cabinet.

Table 3.5.13. DCP UPS 1.5 KVA Inverter Board Removal and Installation - CONT

Step	Procedure
7	Using 3/8-inch nut driver and using tags as a guide, install four nuts, four flat washers, four lockwashers, and seven wires to four 1.5 KVA inverter board standoffs.
8	Using tags as a guide, install 10 wires with solderless (spade) connectors to 1.5 KVA inverter board terminals.
9	Install connectors A1A8-P1 and A1B1-P3 on 1.5 KVA inverter board connectors J2 and J11, respectively. Ensure that pin 1 of ribbon connector A1A8-P1 (marked with ink dot or other marking) mates with pin 1 of inverter board.
10	Install DCP UPS cover in accordance with table 3.5.5.

Table 3.5.14. DCP UPS Fan Removal and Installation

Step	Procedure
	REMOVAL
	Tools required: No. 2 Phillips screwdriver **WARNING** Ensure that power is completely removed from UPS by performing the procedure in table 3.5.5. Death or severe injury may result if power is not completely removed from UPS prior to removing cover in front of UPS components and performing maintenance on UPS subassemblies.
1	Remove 1.5 KVA Inverter Board A5 in accordance with table 3.5.13.
2	Using Phillips screwdriver, remove four screws, lockwashers, and flat washers securing fan to mounting plate assembly.
3	Remove fan from DCP.
	INSTALLATION
	Tools required: No. 2 Phillips screwdriver **WARNING** Ensure that power is completely removed from UPS by performing the procedure in table 3.5.5. Death or severe injury may result if power is not completely removed from UPS prior to removing cover in front of UPS components and performing maintenance on UPS subassemblies. **NOTE** This procedure applies to part number 62828-90057 only (installed in DCP's with serial numbers 438 and below).
1	Verify that DCP UPS cover is removed in accordance with table 3.5.5.
2	Verify that 1.5 KVA Inverter Board A5 is removed in accordance with table 3.5.13.
3	Orient fan so that airflow will be toward front of cabinet (across UPS components). Install fan on mounting plate assembly. Install four screws, lockwashers, and flat washers securing fan.
4	Install 1.5 KVA Inverter Board A5 in accordance with table 3.5.13.

Table 3.5.15. DCP UPS Status Panel Board Removal and Installation

Step	Procedure
REMOVAL	
	Tools required: 5/16-inch nut driver **WARNING** Ensure that power is completely removed from UPS by performing the procedure in table 3.5.5. Death or severe injury may result if power is not completely removed from UPS prior to removing cover in front of UPS components and performing maintenance on UPS subassemblies. **NOTE** This procedure applies to part number 62828-90057 only (installed in DCP's with serial numbers 438 and below).
1	Remove DCP UPS cover in accordance with table 3.5.5.
2	Tag and disconnect two wires from UPS POWER switch.
3	Using 5/16-inch nut driver, remove two nylon nuts and spacers securing status panel board to DCP UPS cover.
4	Remove status panel board from DCP UPS cover.
INSTALLATION	
	Tools required: 5/16-inch nut driver **WARNING** Ensure that power is completely removed from UPS by performing the procedure in table 3.5.5. Death or severe injury may result if power is not completely removed from UPS prior to removing cover in front of UPS components and performing maintenance on UPS subassemblies.
1	Verify that DCP UPS cover is removed in accordance with table 3.5.5.
2	Position status panel board on mounting screws.
3	Using 5/16-inch nut driver, install two nylon nuts and spacers securing status panel board to DCP UPS cover.
4	Using tags as a guide, connect two wires to UPS POWER switch.
5	Install DCP UPS cover in accordance with table 3.5.5.

Table 3.5.16. DCP UPS OUTPUT POWER Switch Removal and Installation

Step	Procedure
REMOVAL	
	WARNING Ensure that power is completely removed from UPS by performing the procedure in table 3.5.5. Death or severe injury may result if power is not completely removed from UPS prior to removing cover in front of UPS components and performing maintenance on UPS subassemblies. **NOTE** This procedure applies to part number 62828-90057 only (installed in DCP's with serial numbers 438 and below).
1	Remove DCP UPS cover in accordance with table 3.5.5.
2	Press plastic tabs on both sides of switch while pushing switch out front of panel.

Table 3.5.16. DCP UPS OUTPUT POWER Switch Removal and Installation -CONT

Step	Procedure
	INSTALLATION
	WARNING Ensure that power is completely removed from UPS by performing the procedure in table 3.5.5. Death or severe injury may result if power is not completely removed from UPS prior to removing cover in front of UPS components and performing maintenance on UPS subassemblies. **NOTE** This procedure applies to part number 62828-90057 only (installed in DCP's with serial numbers 438 and below).
1	Verify that DCP UPS cover is removed in accordance with table 3.5.5.
2	Push switch through front of status panel until plastic tabs lock switch into place.
3	At rear of switch, using tags as a guide, connect two wires to switch.
4	Install DCP UPS cover in accordance with 3.5.5.

Table 3.5.17. Battery Box and Battery Removal and Installation

Step	Procedure
	REMOVAL
	Tools required: Medium flat-tipped screwdriver Two 5/16-inch box wrenches 5/8-inch nut driver 3/8-inch nut driver No. 2 Phillips screwdriver **WARNING** Death or severe injury may result if power is not removed from DCP prior to maintenance activities. Severe injury may result if the negative and positive battery terminals are shorted together. Exercise caution while removing batteries. **NOTE** This procedure applies to part number 62828-90057 only (installed in DCP's with serial numbers 438 and below).
1	Set UPS POWER switch to off (0) position.
2	Set primary Circuit Breaker Module A1A3A1 to OFF position.
3	Remove facility power from the DCP equipment cabinet by setting DCP circuit breaker in ac junction box to off.

Table 3.5.17. Battery Box and Battery Removal and Installation - CONT

Step	Procedure
	WARNING Sparks are generated when battery box connector J1 is connected or disconnected. Explosive fumes from battery box may be present when DCP cabinet is opened. Ensure DCP cabinet is ventilated for at least 5 minutes before connecting or disconnecting J1.
4	Disconnect Battery Box A2. a. For battery box part number 62828-40062-10, squeeze tabs on side of connector J1 inward while rocking connector free. b. For battery box part number 62828-40062-30 or 62828-90360-10, pull battery box connector P1 out of UPS PRA BATTERY BOX connector.
5	Loosen hose clamp on battery box vent tube and remove tubing from top of battery box.
6	Wait at least 30 seconds while UPS capacitors discharge through bleeders and other drains.
7	Slide battery box forward as far as possible so that rear of box rests on front edge of DCP cabinet while box is retained by lanyards on either side.
8	Slide retaining straps off of left and right top of battery box.
	CAUTION When lifting top of battery box, do not pull the attached wires off the connector.
9	Carefully lift top of battery box and position top to gain access to battery terminals.
	WARNING Batteries contain corrosive fluid. Do not tip batteries during removal.
10	Using two 5/16-inch wrenches, remove bolt, flat washers, lockwasher, and nut from negative terminal of battery BT1 (connected to top of battery box via black wires). Remove black wires from negative terminal.
11	Using two 5/16-inch box wrenches, remove bolt, flat washers, lockwasher, and nut from positive terminal of battery (connected to top of battery box via red wires). Remove red wires from positive terminal, and remove top of battery box.
12	Using two 5/16-inch box wrenches, remove bolt, lockwasher, flat washers, and nuts from battery terminals. Remove all jumper wires.
13	Using strap tied around battery BT5 or packing material, remove battery from battery box.
14	Remove strap from battery and retain strap.
15	Remove additional batteries.
16	If battery box itself is to be replaced, remove two lanyards from battery box by using Phillips screwdriver and 3/8-inch nut driver to remove screws, two flat washers, and nut (four places).
17	If battery box itself is to be replaced, remove retaining straps by using Phillips screwdriver and 3/8-inch nut driver to remove screws, two flat washers, and nut securing straps to box.

Table 3.5.17. Battery Box and Battery Removal and Installation - CONT

Step	Procedure
	INSTALLATION
	Tools required: Medium flat-tipped screwdriver Two 5/16-inch box wrenches No. 2 Phillips screwdriver 3/8-inch nut driver 5/8-inch nut driver **WARNING** Death or severe injury may result if power is not removed from DCP prior to maintenance activities. Severe injury may result if the negative and positive battery terminals are shorted together. Exercise caution while removing batteries.
1	Ensure that UPS POWER switch is set to off (0) position.
2	Ensure that primary Circuit Breaker Module A1A3A1 is set to OFF position.
3	Ensure that DCP circuit breaker in ac junction box is set to off position.
4	If battery box itself is to be replaced, install retaining straps on new box using Phillips screwdriver and 3/8-inch nut driver to install screws, two flat washers, and nut securing straps to box. Ensure that screw heads are inside box and nuts are outside.
5	If battery box itself is to be replaced, install two lanyards on new box using Phillips screwdriver and 3/8-inch nut driver to install screws, two flat washers, and nut (four places). Ensure that screw heads are inside box and nuts are outside.
6	Slide empty battery box forward as far as possible so that rear of box rests on front edge of DCP cabinet while box is retained by lanyards on either side.
7	Using figure 2.1.1, install batteries in battery box.
8	Tie previously removed strap around battery BT5 or packing material to facilitate future removal. Leave slack in strap to allow approximately 2 inches of clearance between the top of battery and strap.
9	Using strap around battery BT5 or packing material, install in battery box.
10	**NOTE** Refer to figure 3.4.8 (sheet 3) for wiring diagram of battery box. Using markers as a guide and two 5/16-inch box wrenches, install jumpers on battery terminals, securing with bolt, flat washers, and nut.
11	Position top of battery box to allow connection of red wires to positive terminal and black wires to negative terminal.
12	Using markers as a guide and two 5/16-inch box wrenches, install bolts, flat washers, lockwashers, and nuts securing wires to their respective terminals.
13	Install top on battery box and press into place.
14	Pull two retaining straps over top of battery box to secure top.
15	Using flat-tipped screwdriver, install battery box vent tube.

Table 3.5.17. Battery Box and Battery Removal and Installation - CONT

Step	Procedure
16	**WARNING** Sparks are generated when battery box connector J1 is connected or disconnected. Explosive fumes from battery box may be present when DCP cabinet is opened. Ensure that DCP cabinet is ventilated for at least 5 minutes before connecting or disconnecting J1. **NOTE** Ensure that battery cable connector is fully seated and locked in place. Connect Battery Box A2. a. For battery box part number 62828-40062-10, position cable W030 connector P1 on top of battery box connector J1 and press connector into place. b. For battery box part number 62828-40062-30 or 62828-90360-10, insert battery box connector into UPS PRA BATTERY BOX connector.
17	Apply facility power to DCP equipment cabinet by setting DCP circuit breaker in ac junction box to on position.
18	Set primary Circuit Breaker Module A1A3A1 to ON position.
19	Set UPS POWER switch to 1 (on) position.

Table 3.5.18. DC Power Supply (+5 and ±12 VDC) Removal and Installation

Step	Procedure
REMOVAL	
	Tools required: Small flat-tipped screwdriver No. 2 Phillips screwdriver 3/8-inch socket and ratchet **WARNING** Death or severe injury may result if power is not removed from DCP prior to maintenance activities.
1	Set UPS POWER switch to off (0) position.
2	Set primary Circuit Breaker Module A1A3A1 to OFF position.
3	Remove facility power from the DCP equipment cabinet by setting DCP circuit breaker in ac junction box to off.
4	**WARNING** Sparks are generated when battery box connector J1 is connected or disconnected. Explosive fumes from battery box may be present when DCP cabinet is opened. Ensure that DCP cabinet is ventilated for at least 5 minutes before connecting or disconnecting J1. At DCP battery box, disconnect connector W031-P1 from J1.

Table 3.5.18. DC Power Supply (+5 and ±12 VDC) Removal and Installation -CONT

Step	Procedure
5	Referring to figure 3.1.3, locate power supply to be removed.
6	Disconnect cable connectors W024-P1 through W024-P4.
7	Using 3/8-inch socket and ratchet, remove six nuts, lockwashers, and flat washers securing Power Supply Assembly A4 to DCP equipment cabinet.
8	Carefully remove Power Supply Assembly A4 from DCP equipment cabinet.
9	Using No. 2 Phillips screwdriver, remove four countersunk screws securing power supply to mounting plate.
10	If +5 vdc power supply, remove terminal strip cover.
11	Using small flat-tipped screwdriver, tag and disconnect wires from power supply terminal strip.
12	If +5 vdc power supply, tag and remove wires from terminal studs using 3/8-inch socket and ratchet.
INSTALLATION	
	Tools required: Small flat-tipped screwdriver No. 2 Phillips screwdriver 3/8-inch socket and ratchet **WARNING** Death or severe injury may result if power is not removed from DCP prior to maintenance activities.
1	Ensure that UPS POWER switch is set to off (0) position.
2	Ensure that primary Circuit Breaker Module A1A3A1 is set to OFF position.
3	Ensure that DCP circuit breaker in ac junction box is set to off position.
4	**WARNING** Sparks are generated when battery box connector J1 is connected or disconnected. Explosive fumes from battery box may be present when DCP cabinet is opened. Ensure that DCP cabinet is ventilated for at least 5 minutes before connecting or disconnecting J1. At DCP battery box, ensure that connector W031-P1 is disconnected from J1.
5	If +5 vdc power supply, using wire tags/markers as a guide, connect wires to terminal studs using 3/8-inch socket and ratchet and install terminal strip cover.
6	Using small flat-tipped screwdriver and using wire tags/ markers as a guide, connect wires to power supply terminal strip.
7	Using No. 2 Phillips screwdriver, install four countersunk screws securing power supply to mounting plate.
8	Carefully position Power Supply Assembly A4 back in DCP equipment cabinet, ensuring that bottom of A4 plate rests on mounting support on bottom of right wall.
9	Using 3/8-inch socket, install six nuts, lockwashers, and flat washers securing power supply mounting plate assembly.
10	Connect cables to connectors W024-P1 through W024-P4.

Table 3.5.18. DC Power Supply (+5 and ±12 VDC) Removal and Installation -CONT

Step	Procedure
	WARNING Sparks are generated when battery box connector J1 is connected or disconnected. Explosive fumes from battery box may be present when DCP cabinet is opened. Ensure that DCP cabinet is ventilated for at least 5 minutes before connecting or disconnecting J1.
11	At DCP battery box, connect connector W031-P1 to J1.
12	Apply facility power to DCP equipment cabinet by setting DCP circuit breaker in ac junction box to on position.
13	Set primary Circuit Breaker Module A1A3A1 to ON position.
14	Set UPS POWER switch to 1 (on) position.

Table 3.5.19. RF Modem Removal and Installation

Step	Procedure	
REMOVAL		
	Tools required: Small flat-tipped screwdriver Short No. 2 Phillips screwdriver **CAUTION** Damage to rf modems may result if power is not removed from DCP prior to removal or installation. Ensure that UPS POWER switch is set to 0 (off) position and DCP primary circuit breaker module is set to off.	
1	Set UPS POWER switch to off (0) position.	
2	Set primary Circuit Breaker Module A1A3A1 to OFF position.	
3	Remove facility power from the DCP equipment cabinet by setting DCP circuit breaker in ac junction box to off.	
4	Using Phillips screwdriver, remove two screws, flat washers, and lockwashers securing rf modem mounting plate to mounting bracket.	
5	Slide rf modem mounting plate forward to access rf modem connectors.	$
6	Disconnect BNC connectors from rf modems. If modem being removed is Johnson Data model then remove SMAM-to-BNCF adapter.	$ $
7	Using small flat-tipped screwdriver, remove D connectors (two for AAI model, one for Motorola model) from rf modems and Johnson Data models) .	$ $
8	Remove rf modem mounting plate from guides.	$
9	Remove two mounting screws, lockwashers, and flat washers securing rf modem to mounting plate.	$

Step	Procedure
10	Remove rf modem. NOTE: A common anomaly with ACU/DCP communications is a failed DCP Radio B (or Line Driver B) after a completed download. The workaround for this specific failure is to deconfigure and then reconfigure Radio B (or Line Driver B). Proceed to the Hardware Configuration page (REVUE-SITE-CONFG-HDWE), sequence the DCP CPU to 1, press EXIT, then repeat this procedure and sequence the DCP CPU to 2. NOTE: When an AAI modem (62828-90013-XX) fails, and a replacement AAI modem is not available, ASN S100-FMK18886 must be ordered to replace the modem with the Motorola modem (62828-90315-XX). AAI modems cannot be replaced with the Johnson Data modems (62828-40506-X). When a Motorola modem (62828-90315-XX) fails and spare Motorola modems are not available, a Johnson Data modem (62828-40506-X), an adapter cable (62828-42110-10), and a SMAM-to-BNCF adapter must be ordered to replace the failing rf modem.

INSTALLATION	
	Tools required: Small flat-tipped screwdriver Short No. 2 Phillips screwdriver **CAUTION** Damage to rf modems may result if power is not removed from DCP prior to removal or installation. Ensure that UPS POWER switch is set to 0 (off) position and DCP primary circuit breaker module is set to off.
1	Ensure that UPS POWER switch is set to off (0) position.
2	Ensure that primary Circuit Breaker Module A1A3A1 is set to OFF position.
3	Ensure that DCP circuit breaker in ac junction box is set to off position.
4	Using Phillips screwdriver, install two mounting screws, lockwashers, and flat washers securing rf modem to mounting plate.
5	Slide rf modem mounting plate partway into guides to hold it in place for cable connection.
6	Using small flat-tipped screwdriver, install D connectors (two for AAI model, one for Motorola model) to rf modems.
7	Connect BNC connectors to rf modems.
8	Slide rf modem mounting plate fully into guides.
9	Using Phillips screwdriver, install two screws, flat washers, and lockwashers securing rf modem mounting plate to mounting bracket.
10	Apply facility power to DCP equipment cabinet by setting DCP circuit breaker in ac junction box to on position.
11	Set primary Circuit Breaker Module A1A3A1 to ON position.
12	Set UPS POWER switch to 1 (on) position.

Table 3.5.20. RF Switch Removal and Installation

Step	Procedure
REMOVAL	
	Tools required: No. 1 Phillips screwdriver **CAUTION** Damage to rf modems may result if power is not removed from DCP prior to removal or installation. Ensure that UPS POWER switch is set to 0 (off) position and DCP primary circuit breaker module is set to off.
1	Set UPS POWER switch to off (0) position.
2	Set primary Circuit Breaker Module A1A3A1 to OFF position.
3	Remove facility power from DCP equipment cabinet by setting DCP circuit breaker in ac junction box to off.
4	At rf switch, tag and remove three BNC connectors.
5	Disconnect rf switch in-line connector (A1A5-P1) from DCP harness connector P43.
6	Using Phillips screwdriver, remove two screws, flat washers, and lockwashers securing rf switch to standoffs.
INSTALLATION	
	Tools required: No. 1 Phillips screwdriver **CAUTION** Damage to rf modems may result if power is not removed from DCP prior to removal or installation. Ensure that UPS POWER switch is set to 0 (off) position and DCP primary circuit breaker module is set to off.
1	Ensure that UPS POWER switch is set to off (0) position.
2	Ensure that primary Circuit Breaker Module A1A3A1 is set to OFF position.
3	Ensure that DCP circuit breaker in ac junction box is set to off position.
4	Using Phillips screwdriver, install two screws, flat washers, and lockwashers securing rf switch to standoffs.
5	Connect rf switch in-line connector (A1A5-P1) to DCP harness connector P43.
6	Install three BNC connectors on rf switch.
7	Apply facility power to DCP equipment cabinet by setting DCP circuit breaker in ac junction box to on.
8	Set primary Circuit Breaker Module A1A3A1 to ON position.
9	Set UPS POWER switch to 1 (on) position.

Table 3.5.21. RF Antenna Removal and Installation

Step	Procedure
REMOVAL	
	Tools required: Flat-tipped screwdriver **CAUTION** Damage to rf modems may result if power is not removed from DCP prior to removal or installation. Ensure that UPS POWER switch is set to 0 (off) position and DCP primary circuit breaker module is set to off.
1	Set UPS POWER switch to off (0) position.
2	Set primary Circuit Breaker Module A1A3A1 to OFF position.
3	Remove facility power from DCP equipment cabinet by setting DCP circuit breaker in ac junction box to off.
4	Disconnect coaxial cable from rf antenna. If yagi antenna, observe antenna polarization relative to ground (vertical or horizontal) and note antenna orientation towards ACU or DCP rf modem antenna.
5	Using flat-tipped screwdriver and 3/8-inch nut driver, remove screw, two flat washers, lockwasher, and nut (two places) securing antenna to mounting bracket. Remove antenna.
INSTALLATION	
	Tools required: Flat-tipped screwdriver **CAUTION** Damage to rf modems may result if power is not removed from DCP prior to removal or installation. Ensure that UPS POWER switch is set to 0 (off) position and DCP primary circuit breaker module is set to off.
1	Ensure that UPS POWER switch is set to off (0) position.
2	Ensure that primary Circuit Breaker Module A1A3A1 is set to OFF position.

Table 3.5.21. RF Antenna Removal and Installation -CONT

Step	Procedure
2.1	Install replacement antenna. If yagi, orient vertically or horizontally as observed in removal step 4.
3	Using flat-tipped screwdriver and 3/8-inch nut driver, install screw, two flat washers, lockwasher, and nut (two places) securing antenna to mounting bracket. Ensure that one flat washer is installed under screw head on top side and one under lockwasher on underside of mounting bracket.
4	Connect coaxial cable to rf antenna.
4.1	Ensure that antenna orientation is pointed towards the ACU or DCP rf modem antenna (±10°) as noted in removal step 4
5	Apply facility power to DCP equipment cabinet by setting DCP circuit breaker in ac junction box to on position.
6	Set primary Circuit Breaker Module A1A3A1 to ON position.
7	Set UPS POWER switch to 1 (on) position.

Table 3.5.22. Fiberoptic Module Removal and Installation

Step	Procedure
REMOVAL	
	Tools required: Small flat-tipped screwdriver No. 1 Phillips screwdriver **WARNING** Death or severe injury may result if power is not removed from DCP prior to maintenance activities. Ensure that UPS POWER switch is set to 0 (off) position and facility power is removed from DCP.
1	Set UPS POWER switch to off (0) position.
2	Set primary Circuit Breaker Module A1A3A1 to OFF position.
3	Remove facility power from DCP equipment cabinet by setting DCP circuit breaker in ac junction box to off.
4	Using Phillips screwdriver, remove 22 screws and flat washers securing shielded cover assembly to Faraday box. Lower Faraday box cover.
5	Using flat-tipped screwdriver, loosen two integral screws securing connector to top of fiberoptic module. Remove connector from receptacle on fiberoptic module.
6	Accessing underside of faulty fiberoptic module through Faraday box, tag and disconnect fiberoptic transmit (TX) and receive (RX) cables.
7	Using small flat-tipped screwdriver, remove four screws and washers securing fiberoptic module to top of Faraday box.
8	Remove faulty fiberoptic module.
INSTALLATION	
	Tools required: Small flat-tipped screwdriver No. 1 Phillips screwdriver **WARNING** Death or severe injury may result if power is not removed from DCP prior to maintenance activities. Ensure that UPS POWER switch is set to 0 (off) position and facility power is removed from DCP.
1	Ensure that UPS POWER switch is set to off (0) position.
2	Ensure that primary Circuit Breaker Module A1A3A1 is set to OFF position.
3	Ensure that DCP circuit breaker in ac junction box is set to off position.
4	Orient new fiberoptic module to match previously mounted assemblies and align over mounting holes in top of Faraday box.
5	Using small flat-tipped screwdriver, install four screws and washers securing fiberoptic module to top of Faraday box.
6	Using tags as a guide, connect fiberoptic TX and RX cables to appropriate module connector though opened Faraday box.
7	Install connector into receptacle on top of fiberoptic module and secure two integral screws using flat-tipped screwdriver.
8	Using Phillips screwdriver, install 22 screws and flat washers securing shielded cover assembly to Faraday box.
9	Apply facility power to DCP equipment cabinet by setting DCP circuit breaker in ac junction box to on position.
10	Set primary Circuit Breaker Module A1A3A1 to ON position.
11	Set UPS POWER switch to 1 (on) position.

Table 3.5.23. Power Control Module A1A3A1A2-A8 and A9-A18 Removal and Installation

Step	Procedure
	REMOVAL
	Tools required: Large flat-tipped screwdriver **WARNING** Death or severe injury may result if power is not removed from DCP prior to maintenance activities. Ensure that UPS POWER switch is set to 0 (off) position, facility power is removed from DCP, and battery box connector is disconnected.
1	Set UPS POWER switch to off (0) position.
2	Set primary Circuit Breaker Module A1A3A1 to OFF position.
3	Remove facility power from DCP equipment cabinet by setting DCP circuit breaker in ac junction box to off.
4	**WARNING** Sparks are generated when battery box connector J1 is connected or disconnected. Explosive fumes from battery box may be present when DCP cabinet is opened. Ensure that DCP cabinet is ventilated for at least 5 minutes before connecting or disconnecting J1. At DCP battery box, disconnect connector W031-P1 from J1.
5	Using flat-tipped screwdriver, loosen two captive screws securing module retaining strip to power control module rack.
6	Remove module retaining strip from assembly.
7	Release module from connector by placing fingers behind module faceplate and pressing outward. Remove module from rack.
	INSTALLATION
	Tools required: Large flat-tipped screwdriver **WARNING** Death or severe injury may result if power is not removed from DCP prior to maintenance activities. Ensure that UPS POWER switch is set to 0 (off) position, facility power is removed from DCP, and battery box connector is disconnected.
1	Ensure that UPS POWER switch is set to off (0) position.
2	Ensure that primary Circuit Breaker Module A1A3A1 is set to OFF position.
3	Ensure that DCP circuit breaker in ac junction box is set to off position.
$ 4	**WARNING** Sparks are generated when battery box connector J1 is connected or disconnected. Explosive fumes from battery box may be present when DCP cabinet is opened. Ensure that DCP cabinet is ventilated for at least 5 minutes before connecting or disconnecting J1. Ensure that battery box connector W031-P1 is disconnected from battery box.
$ 5	Align module with rack-mounted guides. Carefully push module into rack until firmly seated in rack-mounted connector.
6	Hand-tighten two captive screws securing module retaining strip to power control module rack.

Table 3.5.23. Power Control Module A1A3A1A2-A8 and A9-A18 Removal and Installation

Step	Procedure
7	**WARNING** Sparks are generated when battery box connector J1 is connected or disconnected. Explosive fumes from battery box may be present when DCP cabinet is opened. Ensure that DCP cabinet is ventilated for at least 5 minutes before connecting or disconnecting J1. At DCP battery box, connect connector W031-P1 to J1.
8	Apply facility power to DCP equipment cabinet by setting DCP circuit breaker in ac junction box to on position.
9	Set primary Circuit Breaker Module A1A3A1 to ON position.
10	Set UPS POWER switch to 1 (on) position.

Table 3.5.24. Solid State Relay Removal and Installation

Step	Procedure
REMOVAL	
	Tools required: Small flat-tipped screwdriver No. 2 Phillips screwdriver **WARNING** Death or severe injury may result if power is not removed from DCP prior to maintenance activities. Ensure that UPS POWER switch is set to 0 (off) position and facility power is removed from DCP.
1	Set UPS POWER switch to off (0) position.
2	Set primary Circuit Breaker Module A1A3A1 to OFF position.
3	Remove facility power from DCP equipment cabinet by setting DCP circuit breaker in ac junction box to off.
4	Loosen captive screw in upper center of power control module rack and lower rack assembly.
5	Using flat-tipped screwdriver, remove wires from relay module connectors 1 through 4.
6	Using Phillips screwdriver, remove two screws, lockwashers, and flat washers securing relay module to Mounting Plate Assembly A1.
INSTALLATION	
	Tools required: Small flat-tipped screwdriver No. 2 Phillips screwdriver **WARNING** Death or severe injury may result if power is not removed from DCP prior to maintenance activities. Ensure that OUTPUT POWER switch is set to 0 (off) position and facility power is removed from DCP.
1	Ensure that UPS POWER switch is set to off (0) position.
2	Ensure that primary Circuit Breaker Module A1A3A1 is set to OFF position.
3	Ensure that DCP circuit breaker in ac junction box is set to off position.
4	Using Phillips screwdriver, install two screws, lockwashers, and flat washers securing relay module to DCP.
5	Using flat-tipped screwdriver and wire markers as a guide, install wires on relay module connectors 1 through 4.
6	Raise circuit breaker module rack and secure captive screw.

Table 3.5.24. Solid State Relay Removal and Installation - CONT

Step	Procedure
7	Apply facility power to DCP equipment cabinet by setting DCP circuit breaker in ac junction box to on position.
8	Set primary Circuit Breaker Module A1A3A1 to ON position.
9	Set UPS POWER switch to 1 (on) position.

Table 3.5.25. Heater HR1 Removal and Installation

Step	Procedure
REMOVAL	
	Tools required: No. 2 Phillips screwdriver 3/8-inch nut driver 7/16-inch nut driver **WARNING** Death or severe injury may result if power is not removed from DCP prior to maintenance activities. Ensure that UPS POWER switch is set to 0 (off) position and facility power is removed from DCP.
1	Set UPS POWER switch to off (0) position.
2	Set primary Circuit Breaker Module A1A3A1 to OFF position.
3	Remove facility power from DCP equipment cabinet by setting DCP circuit breaker in ac junction box to off.
4	Using Phillips screwdriver, remove three screws, lockwashers, and flat washers securing heat grill to mounting plate.
5	Using 3/8-inch nut driver, remove three wires from heater.
6	Using Phillips screwdriver, remove six screws and flat washers securing three heater mounting brackets.
7	Using 7/16-inch nut driver, remove two nuts, flat washers, and lockwashers securing heater to mounting plate.
8	Remove heater from DCP.
INSTALLATION	
	Tools required: No. 2 Phillips screwdriver 3/8-inch nut driver 7/16-inch nut driver **WARNING** Death or severe injury may result if power is not removed from DCP prior to maintenance activities. Ensure that UPS POWER switch is set to 0 (off) position and facility power is removed from DCP.
1	Ensure that UPS POWER switch is set to off (0) position.
2	Ensure that primary Circuit Breaker Module A1A3A1 is set to OFF position.
3	Ensure that DCP circuit breaker in ac junction box is set to off position.
4	Position heater in DCP over mounting holes.
5	Using 7/16-inch nut driver, install two nuts, lockwashers, and flat washers securing heater to mounting plate.
6	Using Phillips screwdriver, install six screws and flat washers securing three heater mounting brackets.
7	Using 3/8-inch nut driver and using markers as a guide, install wiring to heater.
8	Using Phillips screwdriver, install three screws, lockwashers, and flat washers securing heater grill to mounting plate.

Table 3.5.25. Heater HR1 Removal and Installation - CONT

Step	Procedure
9	Apply facility power to DCP equipment cabinet by setting DCP circuit breaker in ac junction box to on position.
10	Set primary Circuit Breaker Module A1A3A1 to ON position.
11	Set UPS POWER switch to 1 (on) position.

Table 3.5.26. DCP Heater HR2 Removal and Installation

Step	Procedure
REMOVAL	
	Tools required: No. 2 Phillips screwdriver Diagonal cutting pliers
1	Remove Battery Box A2 from DCP equipment cabinet in accordance with table 3.5.17.
2	Disconnect heater HR2 in-line connector (A1-P1) from DCP harness connector P44.
3	Using Phillips screwdriver, remove three screws, flat washers, and lockwashers securing heater to mounting plate assembly.
4	Remove heater from DCP.
INSTALLATION	
	Tools required: No. 2 Phillips screwdriver Wire stripper Crimping tool Butt splice connectors - M7928/5-3 **WARNING** Death or severe injury may result if power is not removed from DCP prior to maintenance activities. Ensure that UPS POWER switch is set to 0 (off) position and facility power is removed from DCP.
1	Ensure that UPS POWER switch is set to off (0) position.
2	Ensure that primary Circuit Breaker Module A1A3A1 is set to OFF position.
3	Ensure that DCP circuit breaker in ac junction box is set to off position.
4	Ensure that Battery Box A2 is removed from DCP in accordance with table 3.5.17.
5	Position heater in DCP. Using Phillips screwdriver, install three screws, flat washers, and lockwashers securing heater to mounting plate assembly.
6	Connect heater HR2 in-line connector (A1-P1) to DCP harness connector P44.
7	Install DCP battery in accordance with table 3.5.17.

Table 3.5.27. DCP Thermostat Switch Removal and Installation

Step	Procedure
REMOVAL	
	Tools required: Small flat-tipped screwdriver Solder iron **WARNING** Death or severe injury may result if power is not removed from DCP prior to maintenance activities. Ensure that UPS POWER switch is set to 0 (off) position and facility power is removed from DCP.
1	Set UPS POWER switch to off (0) position.
2	Set primary Circuit Breaker Module A1A3A1 to OFF position.
3	Remove facility power from DCP equipment cabinet by setting DCP circuit breaker in ac junction box to off.
4	Loosen captive screw in top of circuit breaker rack and lower rack to facilitate thermostat removal.
5	Tag wires to be removed from faulty thermostat.
6	Using solder iron, remove wires from faulty thermostat.
7	Using flat-tipped screwdriver, remove two screws, flat washers, lockwashers, and nuts securing thermostat to mounting bracket.
8	Remove thermostat from DCP.
INSTALLATION	
	Tools required: Small flat-tipped screwdriver Solder iron **WARNING** Death or severe injury may result if power is not removed from DCP prior to maintenance activities. Ensure that UPS POWER switch is set to 0 (off) position and facility power is removed from DCP.
1	Ensure that UPS POWER switch is set to off (0) position.
2	Ensure that primary Circuit Breaker Module A1A3A1 is set to OFF position.
3	Ensure that DCP circuit breaker in ac junction box is set to off position.
4	Position thermostat in mounting bracket.
5	Using flat-tipped screwdriver, install two screws, flat washers, lockwashers, and nuts securing thermostat to mounting bracket.
6	Using solder iron, install wires on thermostat.
7	Raise circuit breaker module rack and secure captive screw.
8	Apply facility power to DCP equipment cabinet by setting DCP circuit breaker in ac junction box to on position.
9	Set primary Circuit Breaker Module A1A3A1 to ON position.
10	Set UPS POWER switch to 1 (on) position.

Table 3.5.28. DCP Fan Removal and Installation

Step	Procedure
REMOVAL	
	Tools required: No. 1 Phillips screwdriver No. 2 Phillips screwdriver Small flat-tipped screwdriver 5/16-inch open-end wrench **WARNING** Death or severe injury may result if power is not removed from DCP prior to maintenance activities. Ensure that UPS POWER switch is set to 0 (off) position and facility power is removed from DCP.
1	Set UPS POWER switch to off (0) position.
2	Set primary Circuit Breaker Module A1A3A1 to OFF position.
3	Remove facility power from DCP equipment cabinet by setting DCP circuit breaker in ac junction box to off.
4	Loosen captive screw in top of circuit breaker rack and lower rack to facilitate fan removal.
5	Remove rf modem mounting plate (with modem(s) attached) in accordance with table 3.5.19.
6	Using flat-tipped screwdriver, remove fan wiring (four wires) from ac power distribution assembly.
7	Using Phillips screwdriver, remove screw and flat washer securing two ground wires to fan A2B2.
8	Using Phillips screwdriver, remove four screws, nuts, flat washers, and lockwashers securing fan assembly to card rack assembly.
9	Remove fan assembly from DCP.
10	Using Phillips screwdriver, remove four screws, nuts, flat washers, and lockwashers securing fan to mounting plate.
11	Remove fan from mounting plate.
INSTALLATION	
	Tools required: No. 1 Phillips screwdriver No. 2 Phillips screwdriver Small flat-tipped screwdriver **WARNING** Death or severe injury may result if power is not removed from DCP prior to maintenance activities. Ensure that UPS POWER switch is set to 0 (off) position and facility power is removed from DCP.
1	Ensure that UPS POWER switch is set to off (0) position.
2	Ensure that primary Circuit Breaker Module A1A3A1 is set to off position.
3	Ensure that DCP circuit breaker in ac junction box is set to off position.
4	Ensure that Circuit Breaker Rack A1A3 is lowered.
5	Ensure that rf modem mounting plate is removed.
6	Position fan on mounting plate.
7	Using Phillips screwdriver, install four screws, flat washers, lockwashers, and nuts securing fan and guard to mounting plate.
8	Position fan assembly in DCP under card rack assembly.
9	Using Phillips screwdriver, install four screws, nuts, flat washers, and lockwashers securing fan assembly to card rack assembly.
10	Using Phillips screwdriver, install screw and flat washer securing two ground wires to fan A2B2.
11	Using flat-tipped screwdriver, install fan wiring (four wires) to ac power distribution assembly.

Table 3.5.28. DCP Fan Removal and Installation

Step	Procedure
12	Raise circuit breaker module rack and secure captive screw.
13	Install rf modem mounting plate (with modem(s) attached) in rf mounting bracket in accordance with table 3.5.19.
14	Apply facility power to DCP equipment cabinet by setting DCP circuit breaker in ac junction box to on position.
15	Set primary Circuit Breaker Module A1A3A1 to ON position.
16	Set UPS POWER switch to 1 (on) position.

Table 3.5.29. Primary and Secondary Circuit Breakers A1A3A1CB1 and A10CB1 Removal and Installation

Step	Procedure
REMOVAL	
	Tools required: Large flat-tipped screwdriver No. 1 Phillips screwdriver **WARNING** Death or severe injury may result if power is not removed from DCP prior to maintenance activities. Ensure that UPS POWER switch is set to 0 (off) position, facility power is removed from DCP, and battery box connector is disconnected.
1	Set UPS POWER switch to OFF (0) position.
2	Set primary Circuit Breaker Module A1A3A1 to OFF position.
3	Remove facility power from DCP equipment cabinet by setting DCP circuit breaker in ac junction box to off.
4	**WARNING** Sparks are generated when battery box connector J1 is connected or disconnected. Explosive fumes from battery box may be present when DCP cabinet is opened. Ensure DCP cabinet is ventilated for at least 5 minutes before connecting or disconnecting J1. At DCP battery box, disconnect connector W031-P1 from J1.
5	Using flat-tipped screwdriver, loosen two captive screws securing module retaining strip to rack.
6	Remove module retaining strip from assembly.
7	Slide primary module A1A3A1 or secondary module A1A3A10 forward to gain access to solderless (spade) connectors behind circuit breaker CB1.
8	Disconnect spade connectors from circuit breaker CB1 and slide module out of rack.
9	Using Phillips screwdriver, remove two screws, lockwashers, and flat washers securing circuit breaker CB1 to module faceplate.

Table 3.5.29. Primary and Secondary Circuit Breakers A1A3A1CB1 and A10CB1 Removal and Installation

Step	Procedure
INSTALLATION	
	Tools required: Large flat-tipped screwdriver No. 1 Phillips screwdriver **WARNING** Death or severe injury may result if power is not removed from DCP prior to maintenance activities. Ensure that UPS POWER switch is set to 0 (off) position, facility power is removed from DCP, and battery box connector is disconnected.
1	Ensure that UPS POWER switch is set to OFF (0) position.
2	Ensure that DCP circuit breaker in ac junction box is set to off position.
3	**WARNING** Sparks are generated when battery box connector J1 is connected or disconnected. Explosive fumes from battery box may be present when DCP cabinet is opened. Ensure DCP cabinet is ventilated for at least 5 minutes before connecting or disconnecting J1. Ensure that battery box connector W031-P1 is disconnected from battery box.
4	**WARNING** Circuit breaker must be oriented so that power is removed from DCP when switch is in right position. Death or severe injury may result if circuit breaker is not properly oriented. Position circuit breaker CB1 on module faceplate. Ensure that breaker is oriented so that breaker turns off to right position (looking toward faceplate). In this position, LOAD connector of circuit breaker CB1 is on right and LINE connector is on left.
5	Using Phillips screwdriver, install two screws, lockwashers, and flat washers securing circuit breaker CB1 to module faceplate.
6	Slide module into position in Circuit Breaker Rack A1A3 far enough to connect wires to back of circuit breaker CB1.
7	Using markers as a guide, connect solderless (spade) connectors to LINE and LOAD terminals of circuit breaker CB1.
8	Slide module fully into circuit breaker rack.
9	Hand-tighten two captive screws securing module retaining strip to rack.
10	**WARNING** Sparks are generated when battery box connector J1 is connected or disconnected. Explosive fumes from battery box may be present when DCP cabinet is opened. Ensure that DCP cabinet is ventilated for at least 5 minutes before connecting or disconnecting J1. At DCP battery box, connect connector W031-P1 to J1.
11	Apply facility power to DCP equipment cabinet by setting DCP circuit breaker in ac junction box to on position.
12	Set primary Circuit Breaker Module A1A3A1 to ON position.
13	Set UPS POWER switch on UPS status panel to 1 (on) position.

Table 3.5.30. Power Supply Assembly Diodes A4CR1 Through A4CR6 Removal and Installation

Step	Procedure
	REMOVAL
	Tools required: 3/8-inch socket and ratchet 3/8-inch open end wrench Diagonal cutting pliers **WARNING** Death or severe injury may result if power is not removed from DCP prior to maintenance activities.
1	Set UPS POWER switch to off (0) position.
2	Set primary Circuit Breaker Module A1A3A1 to off position.
3	Remove facility power from the DCP equipment cabinet by setting circuit breaker in ac junction box to off.
4	At DCP battery box, disconnect connector W031-P1 from J1.
5	At Power Supply Assembly A4, disconnect harness connectors W024-P1 through W024-P4.
6	Using 3/8-inch socket and ratchet, remove six nuts, lockwashers, and flat washers securing Power Supply Assembly A4 to DCP equipment cabinet.
7	Carefully remove Power Supply Assembly A4 from DCP equipment cabinet.
8	Lay Power Supply Assembly A4 flat on a suiTable work surface at a location where soldering can be performed.
9	Locate diode to be removed (CR1 through CR6).
10	**NOTE** Anode of diode is canister end. Cathode is end with threaded shaft. Using diagonal cutting pliers, cut wire soldered to anode of diode (cut as close to anode terminal as possible).
11	**CAUTION** Diode is mounted to bracket using two film washers, one plastic insulator ring, one flat washer, and one 3/8-inch nut. Throughout this procedure, care must be taken not to damage or lose these parts. Using 3/8-inch open end wrench, remove nut from cathode of diode.
12	Carefully slide wire with terminal lug from threaded cathode shaft.
13	Carefully remove diode from mounting bracket, retaining flat washer, two film washers, and plastic insulator ring.
	INSTALLATION
	Tools required: 3/8-inch socket and ratchet 3/8-inch open end wrench Wire stripping tool Digital multimeter Soldering iron Solder, tin/lead alloy (specification QQ-S-571) **NOTE** Diode mounting hardware (two film washers, plastic insulator ring, metal flat washer, and 3/8-inch nut) is part of diode mounting kit 62828-90167-1. If hardware is damaged or lost, a new mounting kit must be obtained.
1	Place one film washer over diode-threaded shaft and seat against base of canister.

Table 3.5.30. Power Supply Assembly Diodes A4CR1 Through A4CR6 Removal and Installation - CONT

Step	Procedure
2	Insert diode (with film washer) into position in mounting bracket and hold in position (threaded cathode shaft faces center of Power Supply Assembly A4).
3	While holding diode in position, slide plastic insulator ring over threaded shaft and seat into position between threaded shaft and surrounding mounting bracket.
4	Slide second film washer over threaded shaft and seat flat against mounting bracket.
5	Slide metal flat washer over threaded shaft and seat flat against second film washer.
6	Slide terminal lug of cathode wire over threaded shaft and seat flat against metal flat washer.
7	Using 3/8-inch open end wrench, install nut onto threaded shaft to secure diode to mounting bracket.
8	Using digital multimeter, verify that diode is properly insulated from mounting bracket by verifying no continuity between anode terminal and bracket and between cathode shaft and bracket.
9	Using wire stripping tool, strip approximately ½ inch of insulation from anode wire that was previously cut from diode.
10	Using soldering iron and solder, tin exposed end of anode wire.
11	Using soldering iron and solder, solder anode wire to anode terminal of diode.
12	**WARNING** Death or severe injury may result if power is not removed from DCP prior to performing maintenance activities. Ensure that OUTPUT POWER switch S1 on UPS status panel is set to off (0) position and OUTPUT indicator is extinguished.
13	Ensure that primary Circuit Breaker Module A1A3A1 is set to OFF position.
14	Ensure that DCP circuit breaker in ac junction box is set to off position.
15	At DCP battery box, ensure that connector W031-P1 is disconnected from J1.
16	Carefully position Power Supply Assembly A4 in DCP equipment cabinet, ensuring that bottom of A4 plate rests on mounting support at bottom of right wall.
17	Using 3/8-inch socket and ratchet, install six nuts, lockwashers, and flat washers securing power supply mounting plate assembly.
18	Connect cables to connectors W024-P1 through W024-P4.
19	At DCP battery box, connect connector W031-P1 to J1.
20	Apply facility power to DCP equipment cabinet by setting DCP circuit breaker in ac junction box to on position.
21	Set primary Circuit Breaker Module A1A3A1 to ON position.
22	Set UPS POWER switch to 1 (on) position.

Table 3.5.31. Uninterruptible Power Supply Removal and Installation

	Step	Procedure
	REMOVAL	
		Tools required: Phillips screwdriver
		WARNING
$ $ $		Death or severe injury may result if power is not removed from the DCP prior to performing maintenance activities. Ensure that UPS POWER switch is set to off position and that facility power is removed from the DCP. Severe injury may result if the negative and positive battery terminals are shorted together. Exercise caution while removing batteries.
$	1	Set UPS power switch to off position.
$	2	Remove facility power from DCP cabinet.
	3	Disconnect UPS from wiring harness by removing connectors P45, P1, and P33.
	4	Using screwdriver, disconnect COMM PORT connector P2 by removing two screws.
	5	Unstrap UPS from backplate.
	6	Lift and pull UPS off of backplate.
	INSTALLATION	
		Tools required: Phillips screwdriver
		WARNING
$ $ $		Death or severe injury may result if power is not removed from the DCP prior to performing maintenance activities. Ensure that UPS POWER switch is set to off position and that facility power is removed from the DCP.
$	1	Verify that UPS power switch is set to off position.
$	2	Verify that facility power is removed from DCP.
	3	Place UPS on backplane.
	4	Secure UPS onto backplane with strap.
	5	Using screwdriver, connect COMM PORT connector P2 by securing two screws.
	6	Connect UPS to wiring harness by connecting connectors P45, P1, and P33.
	7	Apply facility power.
$	8	Set UPS power switch to on position.

3.5.5 **DCP CPU AND SIO (RS-232) BOARD JUMPER CONFIGURATIONS**

When replacing a DCP CPU board, the technician must configure jumpers on a basic XVME-601/6 CPU board (manufacturer's P/N 70601-006) for the slot in which it is to be installed. This changes the CPU part number to 62828-47006-XX, where XX is determined by the slot number. Similarly, when replacing a DCP-RS-232 SIO board, the technician must configure jumpers on a basic XVME-490/1 board (manufacturer's P/N 70490-001) to create the 62828-47014-XX part that corresponds to the slot in which it is to be installed. Altered item drawings for selected DCP circuit boards, which define the jumper configurations, are located at the end of Chapter 2, Section V (paragraph 2.5.8).

3.5.6 **SETTING UP LINE DRIVER MODEMS**

The model D19.2 line drivers are obsolete and are replaced by the model DDS/MR64. If a D19.2 line driver fails at a site and spare D19.2 line drivers are not available, then all the D19.2 line drivers must be replaced with the DDS/MR64 line drivers. After installation, the DDS/MR64 line drivers must be manually programmed to operate with the ASOS parameters by using the LCD display and the YES and NO pushbutton switches on the front panel of the modem (same as rack-mounted modems shown on figure 2.3.4). The LCD display presents main menus, submenus, and configuration options to the technician. The YES/NO pushbuttons are used to sequence through the main menus and submenus and to select appropriate options. The Installation and Operation Manual for the stand-alone line driver provides detailed information on all menus, submenus, and options available with the modem and provides instructions on their use. Table 3.5.33 identifies the settings that must be manually made for the model DDS/MR64 line driver. This table addresses only the settings that must be checked or changed by the technician. The table does not address options that are automatically set by the factory or are not required for ASOS operation. The actual menu and option titles that appear on the modem LCD display may vary, depending on the modem's internal firmware.

3.5.7 **JOHNSON DATA RF MODEM SETUP**

Johnson Data rf modem frequencies are assigned and setup at the depot. Order rf modem part number 62828-40506-1 for 410.075 MHz or 62828-40506-2 for 410.950 MHz.

$

Table 3.5.32. Line Driver Removal and Installation

Step	Procedure
REMOVAL	
	Tools required: Small flat-tipped screwdriver No. 2 Phillips screwdriver **WARNING** Death or severe injury may result if power is not removed from DCP prior to maintenance activities. Ensure that UPS POWER switch is set to 0 (off) position and facility power is removed from DCP.
1	Set UPS POWER switch to off (0) position.
2	Set primary Circuit Breaker Module A1A3A1 to OFF position.
3	Remove facility power from DCP equipment cabinet by setting DCP circuit breaker in ac junction box to off.
4	At DCP line driver, remove cables from line driver DDS and DDE connectors.
5	At AC Power Distribution Assembly A1A4, remove line driver power connections as follows: LD #1 (2A1A5A1) A1A4-12D (115VAC), A1A4-17D (NEUT), A1A4-23C (GND) LD#2 (2A1A5A2) A1A2-13D (115VAC), A1A4-18D (NEUT), A1A4-23D (GND)
6	Remove and retain hardware securing line driver from 2A1A5 bracket. Remove line driver.
INSTALLATION	
	Tools required: Small flat-tipped screwdriver No. 2 Phillips screwdriver **WARNING** Death or severe injury may result if power is not removed from DCP prior to maintenance activities. Ensure that OUTPUT POWER switch is set to 0 (off) position and facility power is removed from DCP.
1	Ensure that UPS POWER switch is set to off (0) position.
2	Ensure that primary Circuit Breaker Module A1A3A1 is set to OFF position.
3	Ensure that DCP circuit breaker in ac junction box is set to off position.
4	Remove cover from Line Driver and set switches and install jumpers per table 3.5.32. Replace cover.
5	At DCP, use hardware retained from removal step 6 to secure line driver to 2A1A5 bracket.
6	Install cables to line driver DDS and DDE connectors.
7	At AC Power Distribution Assembly A1A4, connect line driver power connections as follows: LD #1 (2A1A5A1) A1A4-12D (115VAC), A1A4-17D (NEUT), A1A4-23C (GND) LD#2 (2A1A5A2) A1A2-13D (115VAC), A1A4-18D (NEUT), A1A4-23D (GND)
8	Apply facility power to DCP equipment cabinet by setting DCP circuit breaker in ac junction box to on position.
9	Set primary Circuit Breaker Module A1A3A1 to ON position.
10	Set UPS POWER switch to 1 (on) position.

Table 3.5.33. Model DDS/MR64 Stand Alone Line Driver Setup $

Step	Procedure		
	NOTE D19.2 line drivers and DDS/MR64 line drivers are not compatible. If a D19.2 line driver fails and the failed line driver must be replaced with a DDS/MR64 line driver, all D19.2 installed in the system must be replaced with DDS/MR64 line drivers. Ensure that the line driver LCD does not display “ERROR”, if “ERROR” cannot be cleared the line driver may be defective. The line driver is configured by using the front panel push buttons. Use the NO push button to cycle through the menu options and the YES push button to select the submenus. Configuration options are selected by pressing YES or NO push buttons when prompted by LCD display with “CHANGE?”. Pressing YES activates the configuration option.		
1	Use front panel push buttons to configure the DDS/MR64 line driver as follows:		
	Display	**Press**	**Configures Option**
	“NO SIGNAL ASYNC DTE RATE” or “ASYNC RA 1200 2.4K BPS LINE”	HOME	(start configuration process)
	TEST	NO	N/A
	“SYNC DTE CHANGE?”	YES	ASYNC DTE
	“RATE ADAPTER DISABLED - CHANGE?”	NO	DISABLE
	“CHANGE TIMING ?”	YES	**DDS**
	“CHG LINE RATE?”	YES	2400 BPS
	“BITS PER WORD=09 CHANGE?”	YES	10
	“CHANGE CONTROL OPTIONS?”	YES	N/A
	“CHANGE RTS CONTROL?”	YES	NORMAL RTS
	“CHANGE SYNC BUFFER OPT?:”	YES	SYNC BUFFER DIS
	“CHANGE REMOTE LB OPT?”	YES	RMT LB ENABLED
	“CHANGE DSR OPTION?”	YES	DSR OPT ENABLED
	“CHANGE SYS STATUS OPT?”	YES	SS OPT DISABLED
	“CHANGE CA OTP?”	YES	CA OPT DISABLED
	“CHANGE RTS-CTS DELAY?”	YES	RTS-CTS NORMAL
	“CHANGE DTE RL OPT?”	YES	DTE RL DISABLED
	“CHANGE DTE LL OPT?”	YES	DTE LL DISABLED
	“CHANGE DTE TP OPT?”	YES	DTE TP DISABLED
	“CHANGE DTE RT OPT?”	YES	DTE RT DISABLED
	“CHANGE 64K SCRAM OPT?	YES	SCRAMBLER DIS
	“LOAD FACTORY OPTION SET?	NO	N/A
	“SAVE NEW CONFIGURATION?”	YES	N/A
2	Remove power from line driver.		

$ **Table 3.5.33. Model DDS/MR64 Stand Alone Line Driver Setup -CONT**

Step	Procedure
	NOTE In order to set internal jumpers, the line driver must be removed from the DCP and the line driver cover must be removed.
3	Remove cover from line driver as follows: a. Place line driver on its side on a flat surface and place small screwdriver blade in one of the rear latch slots. b. Gently push screwdriver while lightly twisting srewdriver back and forth to release lock prong from lock clip. Assist removal by using fingers to pry cover from chassis. c. Repeat steps a and b for remaining three latches.
4	Set line driver internal jumpers as follows (refer to figure 2.5.1A): SW1- RS232 Enable JP1 EN JP2 CH GND SW2- V.35 Enable SW3-1 OFF SW3-2 ON SW3-3 OFF SW3-4 OFF SW3-5 OFF SW3-6 OFF SW3-7 OFF SW3-8 OFF SW4-1 OFF SW4-2 OFF SW4-3 ON SW4-4 ON
5	Replace line driver cover by aligning rear panel slot guides and front panel lock tabs then pressing cover to the chassis until the lock prongs engage the lock clips.
6	Reinstall line driver, connect power and signal cables, and apply power to the line driver.

CHAPTER 4

WIND SENSOR

SECTION I. DESCRIPTION AND LEADING PARTICULARS

4.1.1 **INTRODUCTION**

This Chapter provides field service information for the wind sensor (an updated Model 2000 manufactured by Belfort Equipment Company). This information includes wind sensor physical description, sensor configurations, installation, operation, theory of operation, and preventive and corrective maintenance.

4.1.2 **PHYSICAL DESCRIPTION**

4.1.2.1 **Introduction**. The wind sensor measures current wind speed and direction relative to true north and computes 5-second averages of these measurements. Wind measurement data are output in response to request signals from the data collection package (DCP). Each response message includes diagnostic status signals generated by the sensor's internal, continuously running self-test.

4.1.2.2 **System Physical Components**. The wind sensor (Figure 4.1.1) consists of four major components: wind speed sensor, wind direction sensor, crossarm support, and wind sensor electronics enclosure. The wind speed sensor is made up of two components: a wind speed transducer and a cup assembly. Similarly, the wind direction sensor consists of a wind direction transducer and a vane assembly. All four of these items are field replaceable units (FRU's). The wind sensor crossarm assembly and electronics enclosure are also FRU's, as well as a processor board and power supply within the electronics enclosure. The wind speed sensor, wind direction sensor, and crossarm support are all mounted on a tipping tower to allow them to operate free from ground obstructions while still being easy to maintain.

The housings of the wind speed and direction sensors are fabricated out of Admiralty brass. The cups and vane are made of corrosion resistant stainless steel. All electrical connections to the sensors are through the crossarm support.

The wind sensor electronics enclosure provides electrical power to the wind sensor and a communications data link between the sensor and the DCP. The electronics enclosure houses the sensor's data processing board, power supply, fiberoptic module, and power input box (rf filter assembly). The wind sensor electronics enclosure is mounted on the sensor tower support.

Wind speed is measured by a rotating three-cup device that drives a photointerrupter device. Wind direction is measured by a direction vane assembly coupled to a precision potentiometer. The outputs from the wind direction and wind speed sensors are processed and converted to an RS-232C message format by a microprocessor module located in the wind sensor electronics enclosure. The RS-232C format is then converted to an optical signal by the fiberoptic module located in the wind sensor electronics enclosure for output to the DCP.

4.1.3 **WIND SENSOR CONFIGURATIONS**

This Section defines the configurations of the various field replaceable units (FRU’s) that make up the wind sensor. All versions of the FRU’s making up the wind sensor are interchangeable with one possible exception. Some early model vane and cup assemblies do not fit well on some later model transducer assemblies. (See the concentricity procedure in table 4.5.10.)

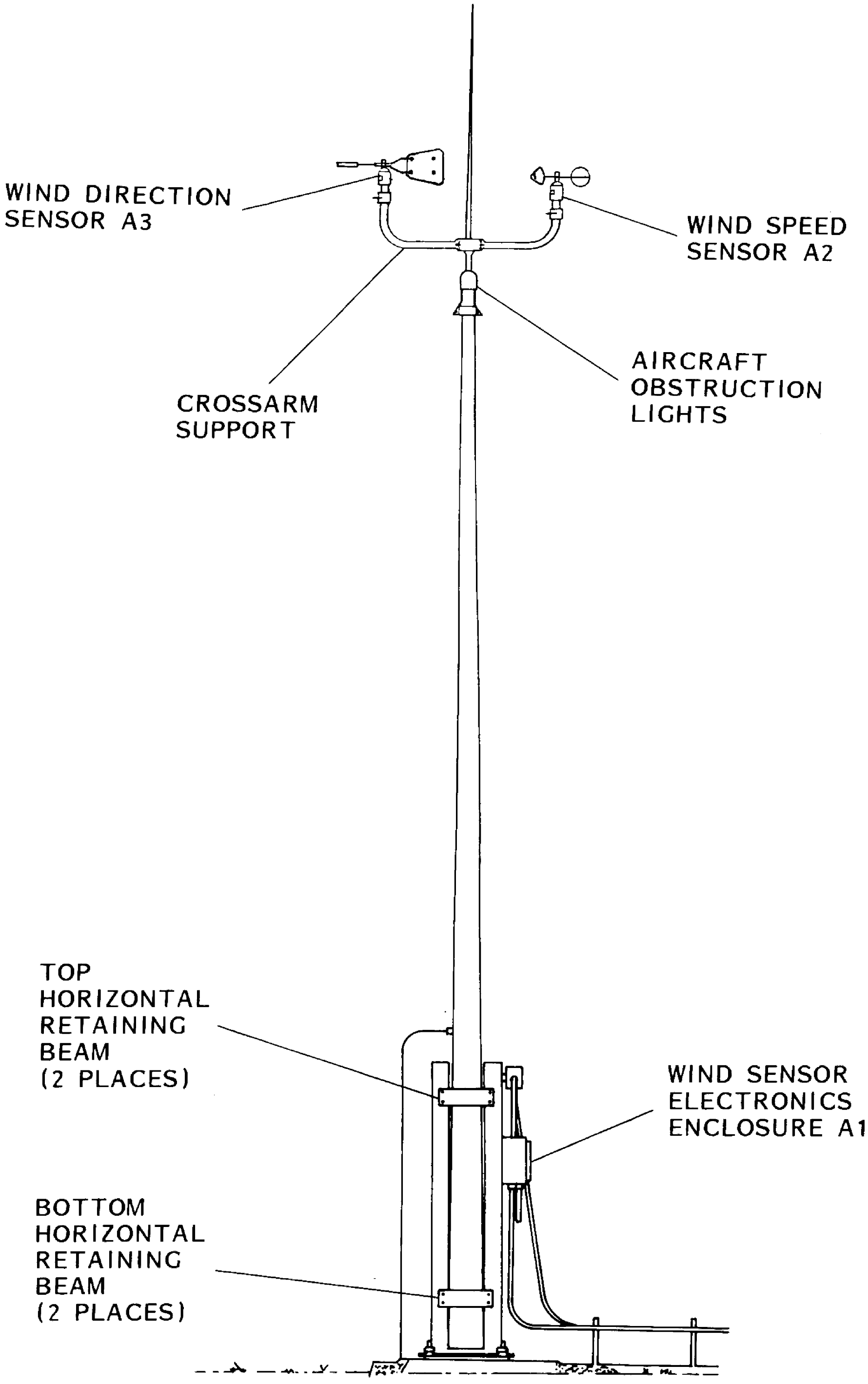


Figure 4.1.1. Wind Sensor Locational Diagram

4.1.3.1 **Wind Speed Sensor**. The wind speed sensor has six possible configurations dependent upon the combination of three versions of wind speed transducers and two versions of wind speed cup assemblies.

4.1.3.1.1 **Wind Speed Transducer**. There are three versions of wind speed transducers; Mod 0, Mod 1, and Mod 2, the latest production configuration.

The Mod 0 wind speed transducer is considered obsolete. It can be identified by the manufacturer's part number 32228 stamped onto the identification plate on the side of the unit. The Mod 0 wind speed transducer is subject to bearing failures, excessive torque, and moisture problems; for these reasons, it is suggested that any remaining Mod 0 units be replaced with Mod 1 or preferably, Mod 2 wind speed transducers upon failure of the unit.

The Mod 1 wind speed transducer can be identified by the manufacturer's part number 32228 MOD 1 stamped onto the identification plate on the side of the unit. The Mod 1 unit corrected the internal problems of the Mod 0 transducer; however, the relatively flat top of the Mod 0 and Mod 1 transducers can allow ice buildup which could degrade the performance of the unit in severe cold weather. For this reason, it is recommended that the Mod 1 wind speed transducer not be used in climates where icing is prevalent.

The Mod 2 wind speed transducer can be identified by the manufacturer's part number 33079 stamped onto the identification plate on the side of the unit and by the unit's steeply sloping top. The Mod 2 wind speed transducer operates well in all climates and is the recommended replacement for any failed wind speed transducer.

4.1.3.1.2 **Wind Speed Cup Assembly**. There are two versions of wind speed cup assemblies; basic and Rev. C.

The basic version of the wind speed cup assembly can be identified by the relatively short (0.125"), steep (45°) rain shield flair. This unit is susceptible to moisture problems during severe weather and should be replaced with the Rev. C version when a failure occurs.

The Rev. C version of the wind speed cup assembly can be identified by the relatively long (0.156"), shallow (20°) rain shield flair. Rev. C is the preferred version of the wind speed cup assembly and should be used whenever possible.

4.1.3.2 **<u>Wind Direction Sensor</u>**. The wind direction sensor has six possible configurations dependent upon the combination of three different versions of wind direction transducers and two different versions of wind direction vane assemblies.

4.1.3.2.1 **Wind Direction Transducer.** There are three versions of wind direction transducers; Mod 0, Mod 1, and Mod 2.

The Mod 0 wind direction transducer can be identified by the manufacturer's part number 32229 stamped onto the identification plate on the side of the unit. The Mod 0 wind direction transducer is subject to bearing failures, excessive torque, and moisture problems; for these reasons it is suggested that any remaining Mod 0 units be replaced with Mod 1 or preferably the Mod 2 wind direction transducers upon failure of the unit.

The Mod 1 wind direction transducer can be identified by the manufacturer's part number 32229 MOD 1 stamped onto the identification plate on the side of the unit. The Mod 1 unit corrected the internal problems of the Mod 0 transducer; however, the relatively flat top allows ice to build up and degrade the performance of the unit in severe weather. For this reason, it is recommended that the Mod 1 wind direction transducer not be used in climates where icing is prevalent.

Mod 2 of the wind direction transducer can be identified by the manufacturer's part number 33080 stamped onto the identification plate on the side of the unit and by the unit's steeply sloping top. The current configuration wind direction transducer operates well in all climates and is the recommended replacement for any failed wind direction transducer.

4.1.3.2.2 **Wind Direction Vane Assembly**. There are two versions of the wind direction vane assembly; basic and Rev. C.

The basic version of the wind direction vane assembly can be identified by the relatively short (0.125"), steep (45°) rain shield flair. This unit is susceptible to moisture problems during severe weather and should be replaced with the Rev. C version when a failure occurs.

The Rev. C version of the wind direction vane assembly can be identified by the relatively long (0.156"), shallow (20°) rain shield flair. Rev. C is the preferred version of the wind direction vane assembly and should be used whenever possible.

4.1.3.3 **Crossarm Assembly**. There are three versions of crossarm assemblies; basic, Rev. F, and Rev. G.

The basic version of the crossarm assembly can be identified by the front opening condulet and the aluminum adapters at the crossarm ends (sensor must be removed to view adapter). The aluminum adapters are subject to corrosion and the crossarms are subject to cracking at or near the condulet if mishandled. (Example: Releasing the tipping tower suddenly and allowing the sensors to attain a high rate of acceleration prior to being stopped could damage the crossarm assembly. It is best to control the tower's progress during the righting process with the rope installed for that purpose.) It is suggested that the crossarm assembly be replaced with the Rev. G version if the basic version is damaged or badly corroded.

The Rev. F version of the crossarm assembly can be identified by the front opening condulet and the brass adapters at the crossarm ends (sensor must be removed to view adapter). The brass adapters were added to reduce corrosion. The crossarms are subject to cracking at or near the condulet if mishandled. (Example: Releasing the tipping tower suddenly and allowing the sensors to attain a high rate of acceleration prior to being stopped could damage the crossarm assembly. It is best to control the tower's progress during the righting process with the rope installed for that purpose.) It is suggested that the crossarm assembly be replaced with the Rev. G version if the Rev. F version is damaged.

The Rev. G version of the crossarm assembly can be identified by the top opening on the condulet (the condulets on the other versions open on the side). The Rev. G crossarm has been built stronger to prevent damage caused by acceleration. This crossarm is the preferred version and is recommended as the replacement for failed units.

4.1.3.4 **Wind Sensor Electronics Enclosure**. There are two different versions of wind sensor electronics enclosures; basic and Rev. J.

The basic version of the wind sensor electronics enclosure can be identified by the two line filters present on the side of the Faraday box, inside the enclosure.

The Rev. J version of the wind sensor electronics enclosure can be identified by the single line filter present on the side of the Faraday box, inside the enclosure. The other line filter was removed to reduce system complexity.

SECTION II. INSTALLATION

4.2.1 INTRODUCTION

The modular design of the ASOS wind sensor enables simple assembly. The four basic components of the wind sensor (wind speed sensor, wind direction sensor, crossarm support, and wind sensor electronics enclosure) are secured to each other by bolts. The entire assembly mounts on the tower and is secured by locking bolts.

4.2.2 ASSEMBLY

The wind speed sensor and wind direction sensor are prewired to mating connectors; there are no interconnecting cables. The wind sensor may be assembled prior to installation, or it can be assembled after the crossarm support is installed on the tower. The following paragraphs provide procedures for assembling the wind sensor and installing it on the tower.

4.2.2.1 **Mounting Wind Sensor Electronics Enclosure**. The wind sensor electronics enclosure is mounted on the tower as shown on figure 4.2.1 using the procedures provided in table 4.2.1. Power and signal cables are connected through flexible conduits located at the bottom of the enclosure. The power connections from the DCP to the wind sensor power input box located in the electronics enclosure are identical for the one- and two-filter configurations. Section IV contains an illustration showing block diagrams for both configurations.

4.2.2.2 **Installing Crossarm Support on Tower**. The wind sensor was designed to mate with the tower top section. During installation of the crossarm support on the tower, the tower top section is accessed by lowering it to the horizontal position. Table 4.2.2 lists the procedures to install the crossarm support. Paragraph 4.5.3.3 provides procedures for lowering and raising the tower. The crossarm support post fits inside of the top section post. The crossarm support is aligned by pointing the wind direction sensor end of the crossarm support to due north. The direction survey is performed only once upon installation of the crossarm support. The shorter arm of the crossarm support (wind direction arm) is mechanically aligned to north when it is attached to the crossarm support given that the crossarm support is aligned and secured to the tower. Signal and power cables from the crossarm support are fed to the wind sensor electronics enclosure through the tower and a conduit. The wind direction and wind speed sensors should be installed after the crossarm support is mounted on the tower. Installation and removal of these sensors is described in paragraph 4.5.3.4.

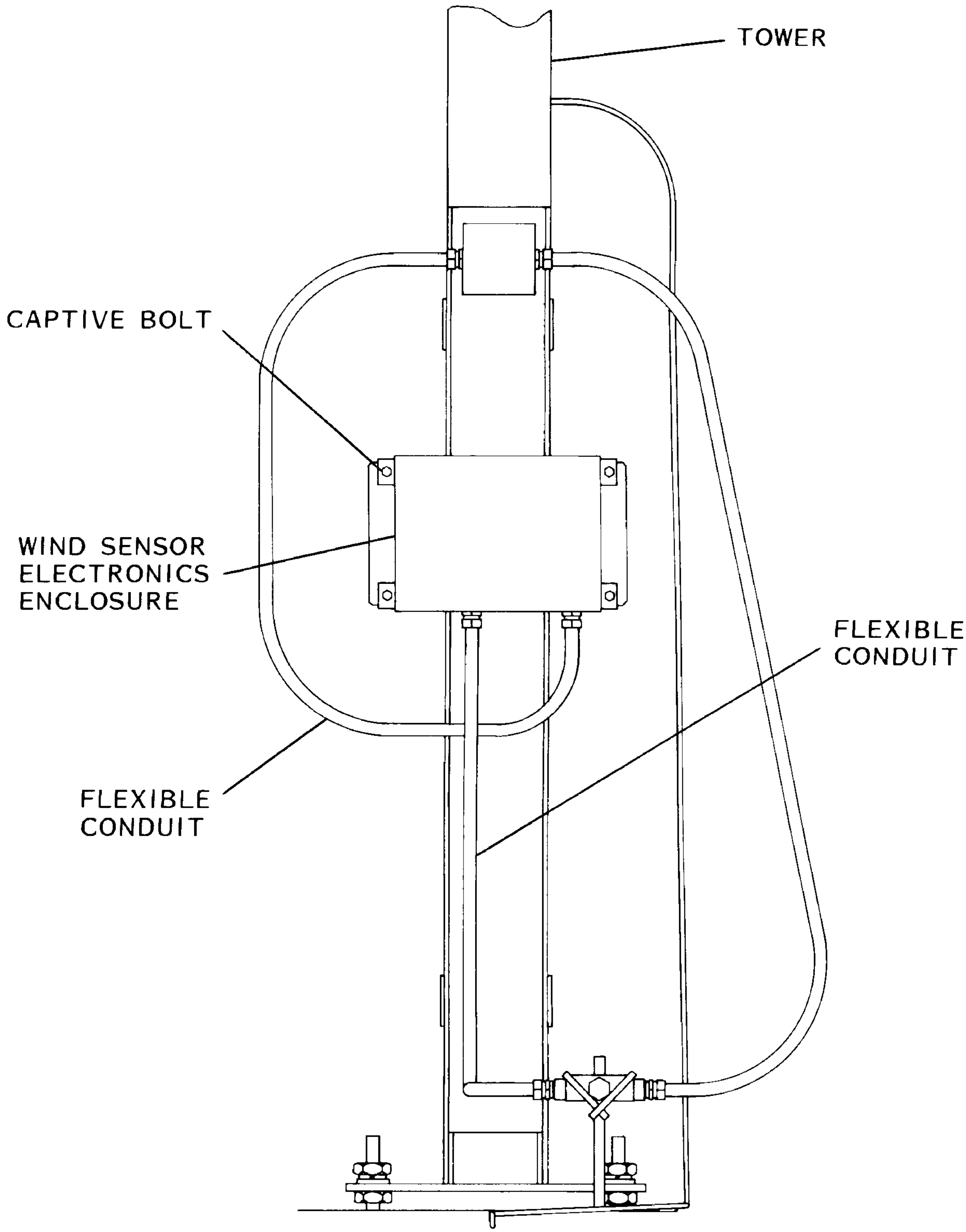


Figure 4.2.1. Wind Sensor Electronics Enclosure Installation (Sheet 1 of 2)

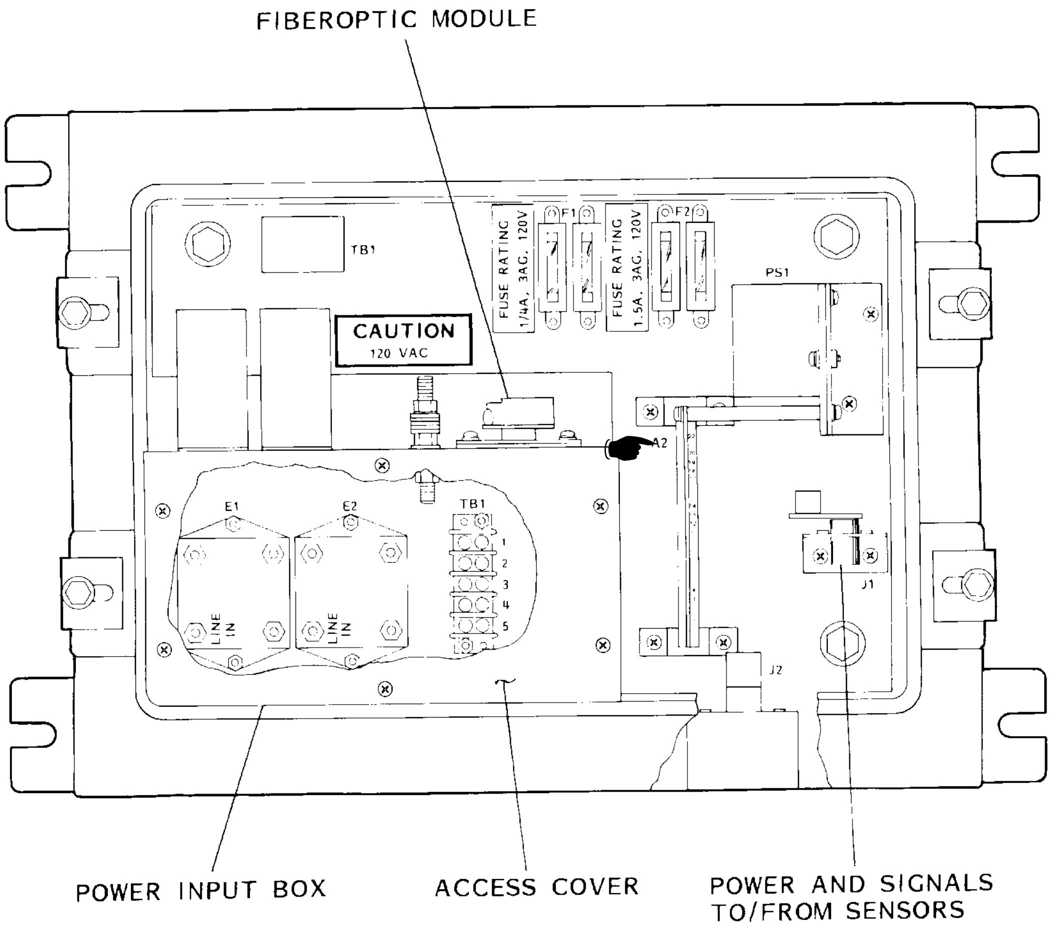


Figure 4.2.1. Wind Sensor Electronics Enclosure Installation (Sheet 2)

Table 4.2.1. Mounting Wind Sensor Electronics Enclosure

Step	Procedure
	Tools required: Large flat-tipped screwdriver No. 1 Phillips screwdriver Large adjusTable wrench **WARNING** Death or severe injury may result if power is not removed from wind sensor prior to maintenance activities. Ensure that circuit breaker (located in DCP) supplying power to wind sensor is set to off (right) position.
1	Inside DCP equipment cabinet, ensure that circuit breaker on wind sensor power control module is set to off (right) position.
2	Referencing figure 4.2.1, position wind sensor electronics enclosure on tower.
3	Tighten four bolts, washers, and nuts securing electronics enclosure to tower.
4	Using large flat-tipped screwdriver, open electronics enclosure access door.
5	Using Phillips screwdriver, remove six screws securing access cover to electronics enclosure power input box.

Table 4.2.1. Mounting Wind Sensor Electronics Enclosure -CONT

Step	Procedure
6	Remove access cover from power input box.
7	Carefully slide ac power and signal cables through holes in bottom of electronics enclosure. Using large adjusTable wrench, secure flexible conduits to enclosure.
8	Connect ac power wiring to terminal board TB1 in power input box according to the following connection chart: Wire color / Terminal / Function Black / TB1-1 / 110 vac White / TB1-2 / Neutral Green / TB1-3 / Chassis ground If power input box has two filters and surge suppressors, ensure that the following jumpers are also in place: From / To TB1-1 (black) / TB1-4 TB1-2 (white) / TB1-5
9	Remove protective plastic covers from fiberoptic cable connectors on underside of fiberoptic module.
10	Referring to stencils on fiberoptic module, connect transmitter cable (TX) to transmitter connector (XMTR) and receiver cable (RX) to receiver connector (RCVR).
11	Install access cover on power input box.
12	Using Phillips screwdriver, install six screws securing access cover to power input box.
13	Connect connectors P1 and P2 of tower signal cable W1 to connectors J1 and J2 in electronics enclosure.
14	Using large flat-tipped screwdriver, close and secure electronics enclosure access door.

Table 4.2.2. Installing Crossarm Support On Tower

Step	Procedure
	Tools required: 7/16-inch wrench ½-inch wrench RTV732 sealant (or equivalent) Wind tower shims (62828-40224)
1	Lower tower in accordance with paragraph 4.5.3.3 to gain safe access to top of tower.
2	Connect connector P3 of tower signal cable to connector J1 of crossarm support.
3	Install crossarm support in top of tower.
4	Rotate crossarm support such that wind direction sensor end of crossarm support points due north and holes in tower are aligned with holes in crossarm support.
5	Referencing figure 4.2.2, install two bolts, flat washers, and nuts securing crossarm support. Install the required number of wind tower shims to remove any excessive play between crossarm support and tower. Tighten two bolts to secure crossarm assembly to tower.
6	Using RTV732 sealant or equivalent, seal seam around base of crossarm support.
7	Raise tower in accordance with paragraph 4.5.3.3.

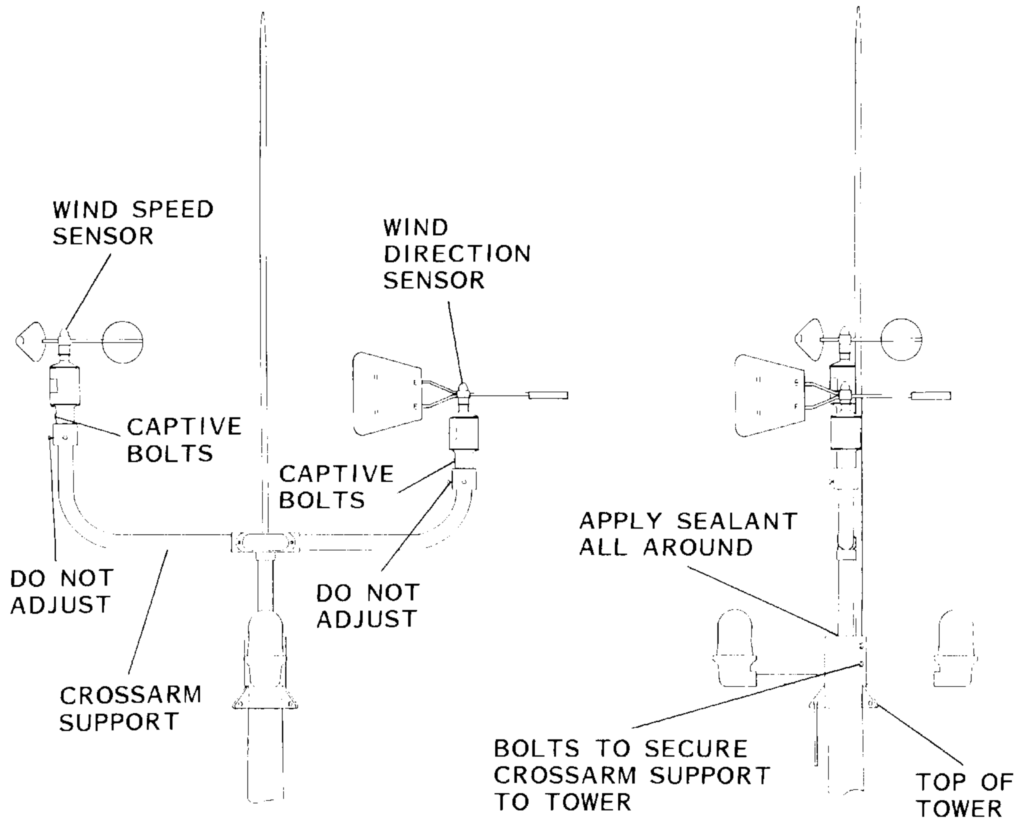


Figure 4.2.2. Wind Sensors and Crossarm Installation

SECTION III. OPERATION

4.3.1 INTRODUCTION

The wind sensor is precalibrated and requires no adjustment after it has been properly installed on the tower. ASOS uses the wind speed and wind direction sensors in a polled mode of operation where the wind sensor is automatically polled by the data collection package (DCP) to read the wind speed and wind direction data. A sensor status flag is included with the wind speed and wind direction data to indicate the results (pass/fail) of the wind sensor's internal diagnostics. The diagnostic test responses received from the wind sensor are displayed on the wind speed and direction sensor page, which is explained in Chapter 1. All communications with the wind sensor are performed via this diagnostic page. There are no special operating procedures for the wind sensor.

SECTION IV. THEORY OF OPERATION

4.4.1 INTRODUCTION

The wind sensor consists of four basic components: the wind speed sensor assembly, wind direction sensor, crossarm support, and wind sensor electronics enclosure. The ASOS wind speed and wind direction sensors, which use a separate cup and vane design, are updated versions of the Belfort Model F420 series sensor. The ASOS Model 2000 series sensors have additional capabilities for digital sensing, diagnostics, and digital communications. The wind speed and wind direction sensors are mounted to the crossarm support, which is physically aligned to north during installation and then secured to the tower. The sensors are easily removed from the crossarm support for replacement by unscrewing captive bolts. The housings of the sensors are keyed such that a replaced sensor on the crossarm support maintains true north alignment. The wind sensor electronics enclosure, which houses the data processing board, power supply, power input box (rf filter assembly), fiberoptic module, and tower signal cable W1 are mounted on the tower support. The data processing board, power supply, and fiberoptic module are field replaceable units (FRU's) that are easily removed for replacement by removing screws and disconnecting wires.

4.4.2 WIND SENSOR SENSING TECHNIQUES

4.4.2.1 **Wind Speed and Direction**. Figure 4.4.1 illustrates the sensing technique for both wind speed and wind direction. Wind speed is measured using an anemometer, which has a photointerrupter device installed on its shaft. The number of pulses produced by the photointerrupter in a given amount of time is directly proportional to the wind speed. Wind direction is determined using a precision potentiometer connected directly to the shaft of the wind vane. The voltage level of the potentiometer wiper is directly proportional to the wind direction. A micro controller on the data processing board collects data from both the wind speed and wind direction sensors, calculates wind speed and wind direction, formats the data for output, and communicates with the data collection package (DCP). The micro controller also runs diagnostic tests both continuously and upon demand from the DCP. The continuous diagnostic provides go/no go type testing of the wind sensor. The on-demand diagnostic performs a detailed operational checkout of the wind sensor.

4.4.2.2 **Temperature**. The temperature stabilization within the wind sensor electronics enclosure is provided by a thermostatically controlled heating element. This heater provides additional warming to the interior of the electronics enclosure such that wind sensor operation is not hampered by cold weather conditions.

4.4.3 BLOCK DIAGRAM DESCRIPTION

Wind sensor block diagrams are illustrated on figure 4.4.2. Sheet 1 is the block diagram for the wind sensor with the basic version of the electronics enclosure. Sheet 2 depicts the REV J version of the enclosure. The paragraphs below provide a block diagram level description of each of the functional areas.

4.4.3.1 **Wind Speed Sensor**. The sensing mechanism of the wind speed sensor consists of a photointerrupter mounted in the sensor housing (Figure 4.4.1). A slotted disk is attached directly to the wind cup assembly shaft. As the shaft rotates, the slots in the disk pass between a light source and light detector. An electrical pulse is output by the light detector each time the slot passes by. The electrical pulses created by the photointerrupter are input to the micro controller via a cable running inside the crossarm support. The micro controller counts the pulses for a period of time and then calculates the corresponding wind speed.

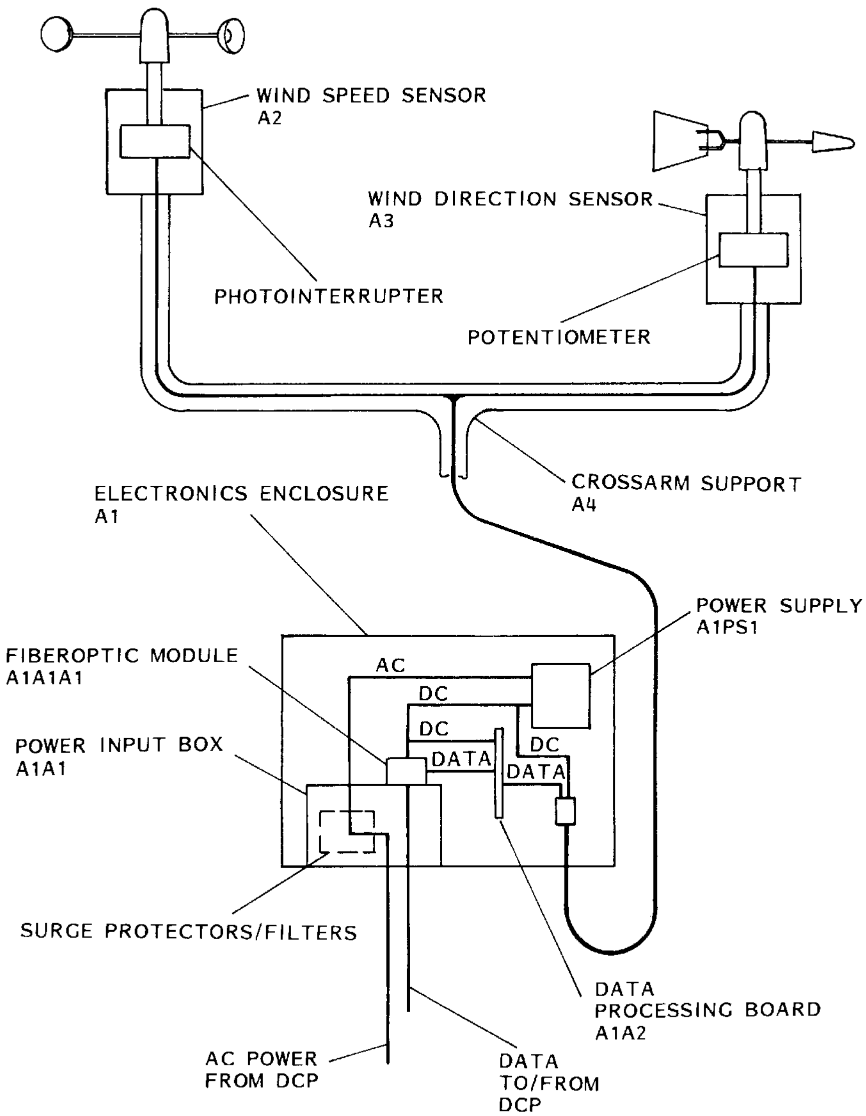


Figure 4.4.1. Wind Speed and Wind Direction Sensing Technique

4.4.3.2 **Wind Direction Sensor**. The sensing mechanism of the wind direction sensor is a precision potentiometer (Figure 4.4.2). The potentiometer is connected directly to the wind vane assembly shaft such that it rotates in unison with the wind vane. The voltage level output of the potentiometer is received by the data processing board, which compares the output to a reference voltage to determine the wind direction vector.

4.4.3.3 **Data Processing Board**. The wind sensor data processing board is located in the wind sensor electronics enclosure. The data processing board contains the wind sensor micro controller, which performs all of the data processing functions of the wind sensor apart from the actual sensing of the environment described above, including the following functions:

a. Accepts data from the photointerrupter and potentiometer to compute the wind speed and wind direction.

b. Accepts diagnostic data from the wind sensor electronics, temperature sensors, and power supply and warns the ASOS of a failure.

c. Performs self-test diagnostics and data quality checks (continuous and on-demand tests).

d. Communicates with the ASOS DCP.

4.4.3.4 **Fiberoptic Module**. The fiberoptic module located in the wind sensor electronics enclosure is the physical communication link between the wind sensor and the ASOS DCP. The wind sensor is capable of responding to an interrogation from the ASOS once every 5 seconds. The wind sensor receives ASCII commands from the ASOS through the fiberoptic module and formats the appropriate response. The fiberoptic module uses separate optical cables for transmitting (TX) and receiving (RX) data. The data format includes the following:

a. 1 start bit

b. 8 data bits

c. 1 stop bit

d. No parity

e. 2400 baud

f. Full duplex

g. Serial asynchronous

h. Configured as data terminal equipment (DTE)

4.4.3.5 **Wind Sensor Power Distribution**. Power for the wind sensor is provided from the DCP to the power input box and the power supply located in the wind sensor electronics enclosure. If one filter protrudes from the top of the power input box, the sensor is a one-filter configuration as illustrated on figure 4.4.2, sheet 2. If two filters protrude from the top of the power input box as illustrated on figure 4.4.2, sheet 1, the sensor is a two-filter configuration. DCP cables are connected to the sensor in an identical manner for both configurations. The power input box contains line surge protectors and rf filters to provide electromagnetic interference (EMI) protection. Low pass filters on the power lines are also used to filter out high frequency noise. The power supply converts the filtered 120V, 60 Hz ac power into 5 vdc power required by the wind sensor electronics.

4.4.3.6 **Obstruction Lights**. Figure 4.4.3 provides a detailed block diagram of the obstruction lights at the top of the wind sensor pole. The obstruction lights are controlled by a photo control (day/night switch) mounted above the ac junction box (beside the DCP). Power from this switch is routed through the Faraday box in the DCP where it is passed to an underground conduit to the wind sensor. At the wind sensor pad, power is passed through a flexible conduit to the junction box on the side of the wind sensor pole. From this junction box, power is routed up through the pole to the obstruction lights.

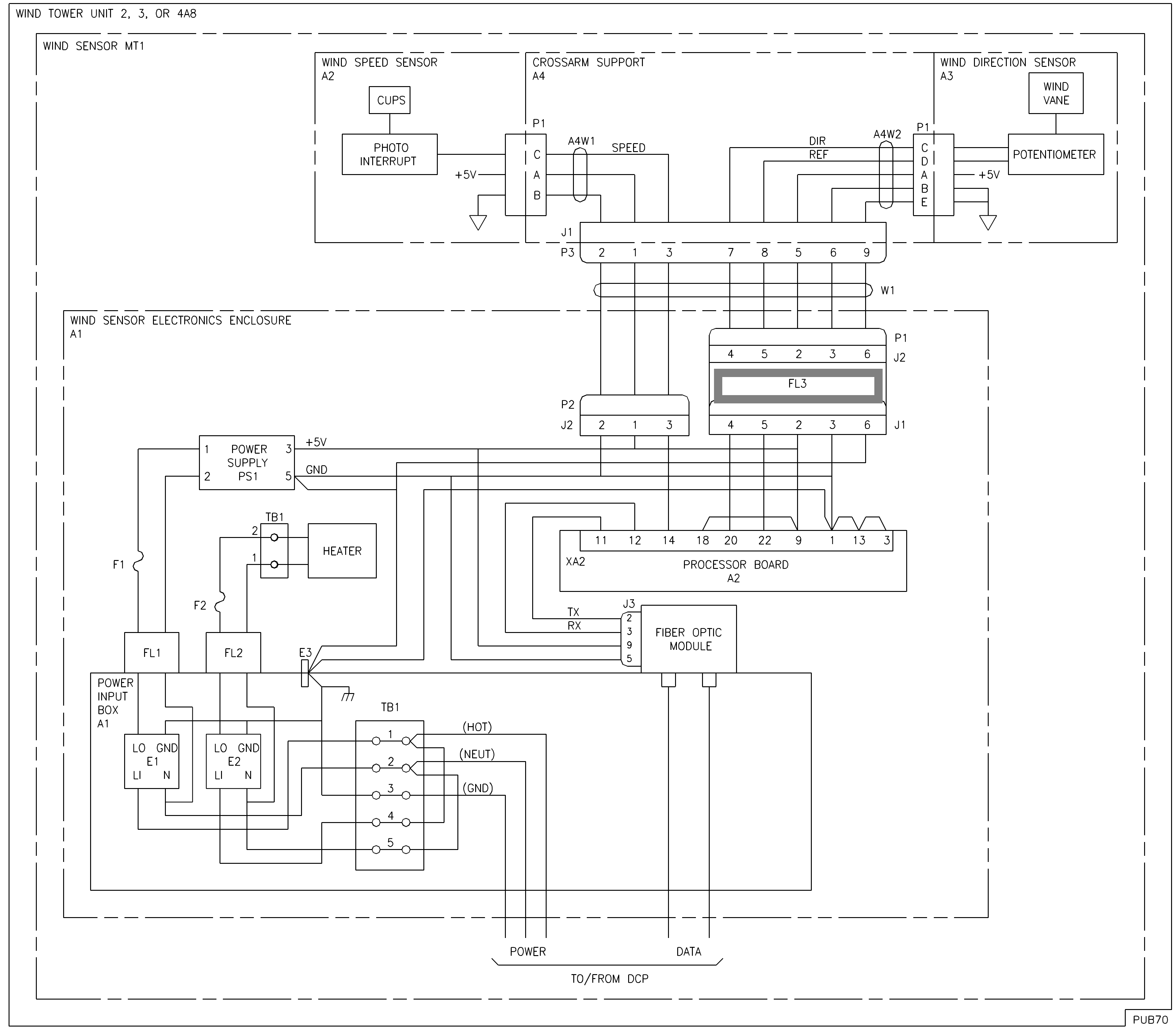


Figure 4.4.2. Wind Sensor Block Diagram (Sheet 1 of 2)

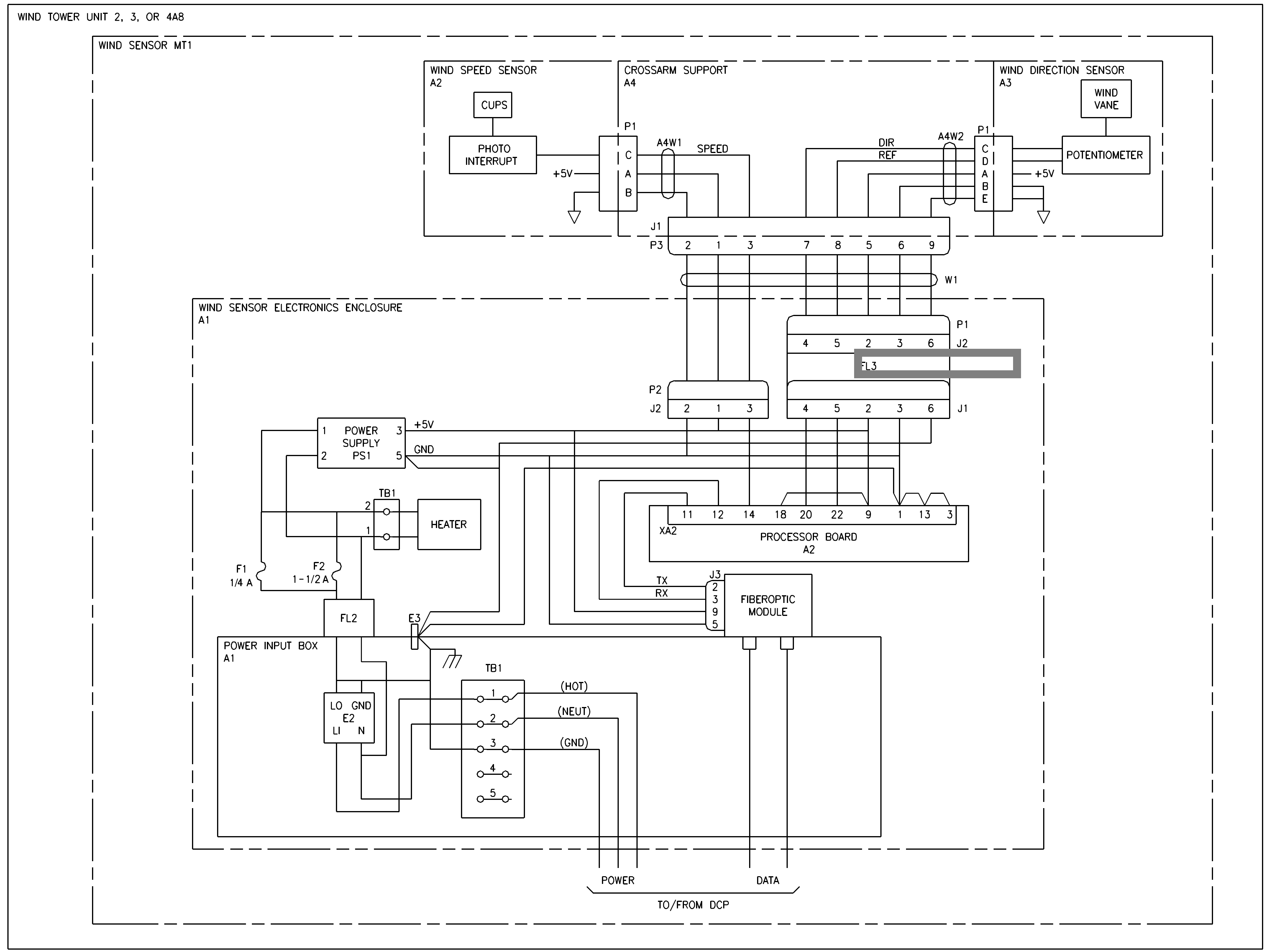


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Figure 4.4.2. Wind Sensor Block Diagram (Sheet 2)

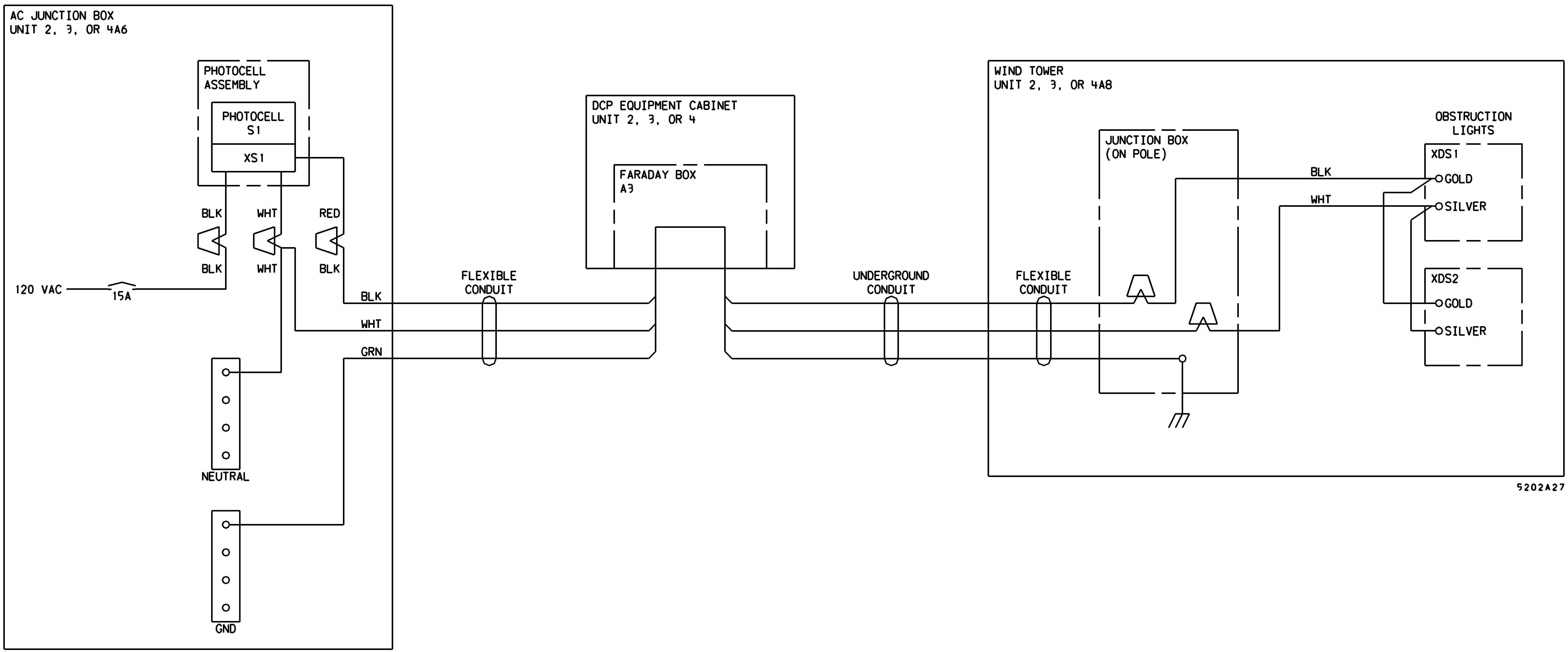

Figure 4.4.3. Wind Sensor Obstruction Lights Detailed Block Diagram

SECTION V. MAINTENANCE

4.5.1 INTRODUCTION

The wind sensor is designed to be easily maintained. There are two categories of wind sensor maintenance: preventive maintenance and corrective maintenance. Preventive maintenance consists of tasks and tests that ensure continued operation. Corrective maintenance consists of tasks that are followed to solve a problem with the unit. In both cases, the tasks are easy to perform. Furthermore, in the case of corrective maintenance, the wind sensor helps the technician locate the problem via diagnostics.

4.5.2 PREVENTIVE MAINTENANCE

The basic preventive maintenance concept includes routine inspection of the wind sensor, inspection of moving parts for damage or clogging from debris, checking of the obstruction lights, and a semiannual performance inspection of the bearings and cups. The wind sensor preventive maintenance schedule is provided in table 4.5.1.

4.5.2.1 **Routine Inspection**. Routine inspection is performed every 90 days or whenever a technician is at the site. Routine inspection consists of checking the cups and vane for physical damage and ensuring that they move freely in the wind. Any debris from insects, animals, or any other cause that shows up as a performance degradation or a potential performance degradation should be removed. Any other irregularities should be noted and any problems should be corrected. The maintenance log should be reviewed to ensure there are no electronic problems with the system.

4.5.2.2 **Obstruction Lights Check**. An operational check of the obstruction lights at the top of the wind sensor pole is performed every 90 days or whenever a technician is at the site. The obstruction lights are checked by using an opaque object to cover the photo control, which is located on top of the ac junction box beside the DCP. The obstruction lights should illuminate.

4.5.2.3 **Mechanical Operation Inspection**. Inspect the cup and vane assemblies for damage, free spin, and absence of drag to demonstrate that the bearings are operating properly and that the assemblies have not undergone any trauma since being originally balanced. Annually inspect crossarm assembly cable connector for corrosion. Table 4.5.2 provides the inspection procedures for the assemblies.

4.5.2.4 **Checking Wind Direction and Speed Data**. Semiannually, or sooner if there is a degradation of performance, the technician should check the alignment of the wind direction sensor using the procedure in table 4.5.3 or 4.5.4 and then check the data being output by the wind sensor. The wind direction data check is performed after the mechanical bearing and balance checks described above, and after the wind direction sensor has been properly aligned using the procedure in table 4.5.3 or 4.5.4. These checks use the DCP OID to observe data being reported by the direction and speed sensors. Table 4.5.5 provides the procedure to check wind direction and speed data. Wind speed performance is verified by testing the ASOS wind speed transducer, using a dual speed-driven F420 wind speed calibrator (ASN F850A-1). The calibrator uses a 60-cycle synchronous motor to provide 300, 600, and 900 rpm test speeds. The test verifies sensor electronics and throughput for the wind speed data collection package (DCP). Test results are reviewed and verified by the ASOS technician at the OID. The ASOS technician enters the results of the test in the ASOS SYSLOG. If the wind speed transducer fails to meet the specified calibration values, the wind speed transducer is replaced.

4.5.2.5 **<u>Wind Direction Sensor Alignment Procedure</u>**. The wind direction sensor's alignment to true north must be checked every 180 days or whenever maintenance is performed on the direction sensor or the crossarm assembly. Wind direction sensor alignment may be performed in two ways. The preferred method uses an NWS F420 translucent plastic orientation plate and adapter head to directly align the sensor based on the shadow cast at solar noon. The secondary method uses a Davis pelorus instrument to determine the offset of the wind sensor crossarm with respect to true north; the wind direction sensor is then adjusted based on the crossarm offset. The secondary method should be used when use of the preferred method is not possible. The following paragraphs provide the procedures for both of these methods.

4.5.2.5.1 **Solar Noon Wind Direction Sensor Alignment Procedure**. The preferred method of aligning the wind direction sensor is to use a special alignment tool (Figure 4.5.1) at the time of solar noon to cast a shadow at a known reference point on the tool. To perform this procedure, the maintenance technician must be able to calculate when solar noon will occur at the site. To do this, a special software program is used. The program is called SUN and runs on any laptop or PC. In order for the program to calculate solar noon for a given site, the maintenance technician must input the site's latitude and longitude, the Julian date, and the site's Greenwich Mean Time (GMT). Greenwich Mean Time is also called ZULU or UTC time. Latitude and longitude can be obtained from the ASOS site survey or the OID's site physicals page. Julian dates are shown on the Julian calendar, figure 4.5.2. With these inputs, the SUN program will provide the time that solar noon will occur for that day at that specific site. Because the sun casts a shadow at 0 degrees on the tool at solar noon, the technician must be aware of the time constraints of this procedure. When performing the procedure, the technician must calculate the time at which solar noon will occur, install the alignment tool on the wind tower, and raise the tower to a vertical position 20 minutes before solar noon occurs. At 20 minutes before solar noon, the shadow cast on the tool by the sun is checked; the shadow should occur at 5 degrees. If the shadow is not at the 5-degree mark on the “E” side of the calibration template, the technician must lower the tower, align the wind sensor's housing, and raise the tower as quickly as possible. For every 4 minutes that expire after 20 minutes before solar noon, the shadow moves approximately 1 degree; therefore, at 10 minutes before solar noon, the shadow is approximately at the 2.5-degree mark on the “E” side of the calibration template. When adjusting the wind sensor's housing, it is easy to adjust the housing in the wrong direction. If the tower is tilted to the west after servicing and the shadow is too far west at 20 minutes before solar noon, the technician must turn the housing down toward the west mark by the number of degrees that it is out. For example, if at 20 minutes before solar noon the shadow is pointing to approximately 12 degrees on the “E” side of the calibration template, the technician lowers the tower over to the west and corrects the alignment by adjusting the housing 7 degrees to the east. This is accomplished by moving the housing clockwise toward the "W" mark on the orientation plate of the tool. If the error is to the east, the technician corrects the alignment by moving the housing to the "E" mark. The solar noon alignment procedure is detailed in table 4.5.3.

4.5.2.5.2 **Davis Pelorus Instrument Wind Direction Sensor Alignment Procedure**. The secondary method of aligning the wind direction sensor uses a Davis pelorus instrument and a monocular to determine the offset of the wind sensor crossarm from true north. The wind direction sensor is then adjusted by the amount of the offset to align it to true north. To align the wind direction sensor to true north using the Davis pelorus instrument, perform the procedure in table 4.5.4.

4.5.2.6 **<u>Cleaning and Lubrication</u>**. The only cleaning required is to remove any debris from the wind sensor. Because all bearings are sealed, there is no requirement for lubrication. When any field replaceable unit (FRU) is removed, the connectors should be inspected for dirt and corrosion and cleaned if necessary.

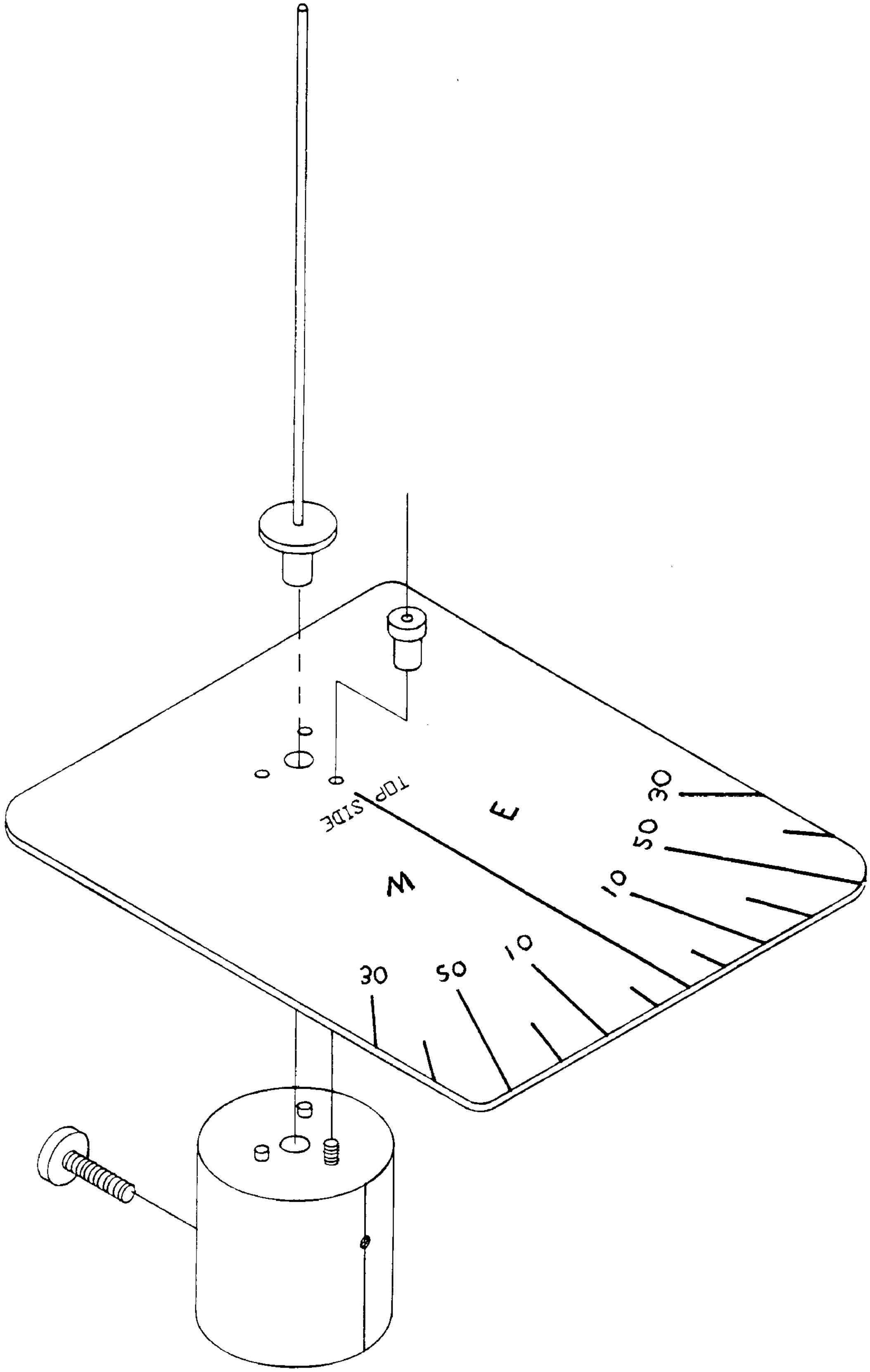

Figure 4.5.1. Wind Direction Sensor Alignment Tool

JAN		FEB		MAR		APR		MAY		JUN		JUL		AUG		SEP		OCT		NOV		DEC	
D	J	D	J	D	J	D	J	D	J	D	J	D	J	D	J	D	J	D	J	D	J	D	J
1	1	1	32	1	61	1	92	1	122	1	153	1	183	1	214	1	245	1	275	1	306	1	336
2	2	2	33	2	62	2	93	2	123	2	154	2	184	2	215	2	246	2	276	2	307	2	337
3	3	3	34	3	63	3	94	3	124	3	155	3	185	3	216	3	247	3	277	3	308	3	338
4	4	4	35	4	64	4	95	4	125	4	156	4	186	4	217	4	248	4	278	4	309	4	339
5	5	5	36	5	65	5	96	5	126	5	157	5	187	5	218	5	249	5	279	5	310	5	340
6	6	6	37	6	66	6	97	6	127	6	158	6	188	6	219	6	250	6	280	6	311	6	341
7	7	7	38	7	67	7	98	7	128	7	159	7	189	7	220	7	251	7	281	7	312	7	342
8	8	8	39	8	68	8	99	8	129	8	160	8	190	8	221	8	252	8	282	8	313	8	343
9	9	9	40	9	69	9	100	9	130	9	161	9	191	9	222	9	253	9	283	9	314	9	344
10	10	10	41	10	70	10	101	10	131	10	162	10	192	10	223	10	254	10	284	10	315	10	345
11	11	11	42	11	71	11	102	11	132	11	163	11	193	11	224	11	255	11	285	11	316	11	346
12	12	12	43	12	72	12	103	12	133	12	164	12	194	12	225	12	256	12	286	12	317	12	347
13	13	13	44	13	73	13	104	13	134	13	165	13	195	13	226	13	257	13	287	13	318	13	348
14	14	14	45	14	74	14	105	14	135	14	166	14	196	14	227	14	258	14	288	14	319	14	349
15	15	15	46	15	75	15	106	15	136	15	167	15	197	15	228	15	259	15	289	15	320	15	350
16	16	16	47	16	76	16	107	16	137	16	168	16	198	16	229	16	260	16	290	16	321	16	351
17	17	17	48	17	77	17	108	17	138	17	169	17	199	17	230	17	261	17	291	17	322	17	352
18	18	18	49	18	78	18	109	18	139	18	170	18	200	18	231	18	262	18	292	18	323	18	353
19	19	19	50	19	79	19	110	19	140	19	171	19	201	19	232	19	263	19	293	19	324	19	354
20	20	20	51	20	80	20	111	20	141	20	172	20	202	20	233	20	264	20	294	20	325	20	355
21	21	21	52	21	81	21	112	21	142	21	173	21	203	21	234	21	265	21	295	21	326	21	356
22	22	22	53	22	82	22	113	22	143	22	174	22	204	22	235	22	266	22	296	22	327	22	357
23	23	23	54	23	83	23	114	23	144	23	175	23	205	23	236	23	267	23	297	23	328	23	358
24	24	24	55	24	84	24	115	24	145	24	176	24	206	24	237	24	268	24	298	24	329	24	359
25	25	25	56	25	85	25	116	25	146	25	177	25	207	25	238	25	269	25	299	25	330	25	360
26	26	26	57	26	86	26	117	26	147	26	178	26	208	26	239	26	270	26	300	26	331	26	361
27	27	27	58	27	87	27	118	27	148	27	179	27	209	27	240	27	271	27	301	27	332	27	362
28	28	28	59	28	88	28	119	28	149	28	180	28	210	28	241	28	272	28	302	28	333	28	363
29	29	29	60	29	89	29	120	29	150	29	181	29	211	29	242	29	273	29	303	29	334	29	364
30	30			30	90	30	121	30	151	30	182	30	212	30	243	30	274	30	304	30	335	30	365
31	31			31	91			31	152			31	213	31	244			31	305			31	366

LEAP YEAR

JAN		FEB		MAR		APR		MAY		JUN		JUL		AUG		SEP		OCT		NOV		DEC	
D	J	D	J	D	J	D	J	D	J	D	J	D	J	D	J	D	J	D	J	D	J	D	J
1	1	1	32	1	60	1	91	1	121	1	152	1	182	1	213	1	244	1	274	1	305	1	335
2	2	2	33	2	61	2	92	2	122	2	153	2	183	2	214	2	245	2	275	2	306	2	336
3	3	3	34	3	62	3	93	3	123	3	154	3	184	3	215	3	246	3	276	3	307	3	337
4	4	4	35	4	63	4	94	4	124	4	155	4	185	4	216	4	247	4	277	4	308	4	338
5	5	5	36	5	64	5	95	5	125	5	156	5	186	5	217	5	248	5	278	5	309	5	339
6	6	6	37	6	65	6	96	6	126	6	157	6	187	6	218	6	249	6	279	6	310	6	340
7	7	7	38	7	66	7	97	7	127	7	158	7	188	7	219	7	250	7	280	7	311	7	341
8	8	8	39	8	67	8	98	8	128	8	159	8	189	8	220	8	251	8	281	8	312	8	342
9	9	9	40	9	68	9	99	9	129	9	160	9	190	9	221	9	252	9	282	9	313	9	343
10	10	10	41	10	69	10	100	10	130	10	161	10	191	10	222	10	253	10	283	10	314	10	344
11	11	11	42	11	70	11	101	11	131	11	162	11	192	11	223	11	254	11	284	11	315	11	345
12	12	12	43	12	71	12	102	12	132	12	163	12	193	12	224	12	255	12	285	12	316	12	346
13	13	13	44	13	72	13	103	13	133	13	164	13	194	13	225	13	256	13	286	13	317	13	347
14	14	14	45	14	73	14	104	14	134	14	165	14	195	14	226	14	257	14	287	14	318	14	348
15	15	15	46	15	74	15	105	15	135	15	166	15	196	15	227	15	258	15	288	15	319	15	349
16	16	16	47	16	75	16	106	16	136	16	167	16	197	16	228	16	259	16	289	16	320	16	350
17	17	17	48	17	76	17	107	17	137	17	168	17	198	17	229	17	260	17	290	17	321	17	351
18	18	18	49	18	77	18	108	18	138	18	169	18	199	18	230	18	261	18	291	18	322	18	352
19	19	19	50	19	78	19	109	19	139	19	170	19	200	19	231	19	262	19	292	19	323	19	353
20	20	20	51	20	79	20	110	20	140	20	171	20	201	20	232	20	263	20	293	20	324	20	354
21	21	21	52	21	80	21	111	21	141	21	172	21	202	21	233	21	264	21	294	21	325	21	355
22	22	22	53	22	81	22	112	22	142	22	173	22	203	22	234	22	265	22	295	22	326	22	356
23	23	23	54	23	82	23	113	23	143	23	174	23	204	23	235	23	266	23	296	23	327	23	357
24	24	24	55	24	83	24	114	24	144	24	175	24	205	24	236	24	267	24	297	24	328	24	358
25	25	25	56	25	84	25	115	25	145	25	176	25	206	25	237	25	268	25	298	25	329	25	359
26	26	26	57	26	85	26	116	26	146	26	177	26	207	26	238	26	269	26	299	26	330	26	360
27	27	27	58	27	86	27	117	27	147	27	178	27	208	27	239	27	270	27	300	27	331	27	361
28	28	28	59	28	87	28	118	28	148	28	179	28	209	28	240	28	271	28	301	28	332	28	362
29	29			29	88	29	119	29	149	29	180	29	210	29	241	29	272	29	302	29	333	29	363
30	30			30	89	30	120	30	150	30	181	30	211	30	242	30	273	30	303	30	334	30	364
31	31			31	90			31	151			31	212	31	243			31	304			31	365

NONLEAP YEAR

Figure 4.5.2. Julian Calendar

Table 4.5.1. Wind Sensor Preventive Maintenance Schedule

Interval	What To Do	How To Do It
90 days	Visual inspection	Paragraph 4.5.2.1
	Check obstruction lights	Paragraph 4.5.2.2
Semiannually	Mechanical operation inspection	Table 4.5.2
	Starting torque bearing test	Paragraph 4.5.3.11 and table 4.5.17
	Wind direction alignment	Table 4.5.3
	Check wind direction and speed data	Table 4.5.5
	Cleaning and lubrication	Paragraph 4.5.2.6
Annually	Inspect crossarm cable connector	Table 4.5.2

Table 4.5.2. Mechanical Operation Inspection

Step	Procedure
1	Remove any dirt from assemblies using soap, water, and a soft cloth.
2	Inspect cup assembly and vane assembly for any physical damage such as bent or dented cups, bent arm assemblies, bent fins, or seriously cracked or chipped paint.
3	Inspect hub to ensure that shroud is not bent or rubbing sensor housing.
4	Inspect end of each cup arm (on wind speed assembly) to ensure that ends are sealed.
5	Place sensors on a level table in an upright position.
6	Slowly spin cups (and vane). The cup and vane assemblies should rotate freely with no apparent drag, resistance, or noise (squeaking).
7	When rotated on the housing, the cup assembly and vane assembly should exhibit no wobble, which indicates bent parts.
8	Slowly spin cup assembly (and vane assembly). The cup and vane assemblies should slowly come to a stop with no noticeable drag. (Any air currents may prevent the assemblies from stopping completely.) If there is drag, replace FRU.
9	Tug lightly on the end of the cup and vane assembly. Verify that there is ≤1/16th inch windshaft endplay. If endplay >1/16th-inch, replace the FRU.
10	Annually inspect connector between collector assembly and lower case for corrosion. Remove corrosion if present and apply thin coat of DC-4 anti-corrosion compound to connector pins.

Table 4.5.3. Solar Noon Wind Direction Alignment Procedure

Step	Procedure
	Tools Required: Laptop computer w/ASOS calibration program installed ¾-inch socket and ratchet ¾-inch open-end wrench ½-inch open-end wrench 7/16-inch wrench NWS F420 direction adapter head NWS F420 opaque plastic orientation plate Alignment protractor **WARNING** Before proceeding, ensure safe clearance of wind tower from dangerous areas of the runways, taxiways, or restricted zones. **NOTE** Synchronize your watch with Local Tower Time before starting this procedure.
1	Using Julian calendar (Figure 4.5.2), determine Julian date.
2	If the ACU has been downloaded from the AOMC at the OID, access the site physical page and record site's latitude and longitude. If the ACU has not been downloaded from the AOMC, obtain this information from the site survey document.
3	At the DOS prompt, enter: ASOS; then, execute menu # 1 to run the solar noon program.
4	Enter latitude and longitude in degrees, minutes, and seconds as prompted. Press <ENTER>.
5	To transfer control to the left half of menu, press F10.
6	Press N. Obtain Julian date from figure 4.5.2 and enter in right half of menu; then, press <ENTER>.
7	Solar noon, in local standard time, will be displayed on the next menu line; record result. **NOTE** When using the ASOS calibration program to determine solar noon at a specified site, adjust the displayed solar noon value by subtracting 1 hour from the result for the following regions: Time Zone — Longitude Eastern — <75° 00'00" W Central — <90° 00'00" W Mountain — <105° 00'00" W Pacific — <120° 00'00" W
8	To quit, press F10 (to transfer control to the left side of the menu) and press Q.
9	**NOTE** Steps 5 through 8 should be performed approximately 30 minutes before solar noon. Using procedure in table 4.5.8, lower wind tower.
10	Using ½-inch open-end wrench, remove lightning rod from wind tower so that its shadow does not interfere with direction reading.
11	Using procedure in table 4.5.10, remove wind direction sensor.
12	Note two scribed lines on north end of crossarm, one on the direction sensor mounting adapter and one on the pipe that is part of the crossarm.

Table 4.5.3. Solar Noon Wind Direction Alignment Procedure -CONT

Step	Procedure
13	Place direction adapter head onto alignment pin on mounting adapter and tighten thumbscrew. Place translucent plastic adapter on mounting adapter and secure with supplied thumb nut. Place indicator tube in center of mounting adapter.
14	Using procedure in table 4.5.8, raise wind tower to vertical position.
15	**NOTE** The NWS translucent plastic plate and adapter with rod act as a sundial. The plate is divided into degrees east and west. The shadow cast by the rod onto the plate is easily visible from beneath the tower. At 20 minutes before true solar noon, determine if shadow is pointing to 5-degree east mark on translucent plate. If it is not, perform the following: a. Using procedure in table 4.5.8, lower tower. b. Locate scribed line on direction sensor mounting adapter. c. Position alignment protractor immediately beneath mounting adapter (at junction with crossarm assembly) so that 0-degree mark of protractor aligns with scribed line on mounting adapter. d. Using 7/16-inch wrench, loosen hex head bolts on direction sensor mounting adapter. **NOTE** The approximate solar motion is 1 degree per 4 minutes (duration is longer during the summer as latitude approaches 90°; duration is shorter during winter). Experience has shown that the time it takes to lower tower, make the required adjustment, and raise the tower is between 3 and 5 minutes. e. Rotate direction head the number of degrees it was off the 5-degree mark. f. Using 7/16-inch wrench, tighten two mounting adapter bolts. g. Using procedure in table 4.5.8, raise tower to vertical position and verify that shadow on translucent plastic plate is now within the 5-degree west mark. For every 4 minutes that have expired after 20 minutes before true solar noon, the shadow moves approximately 1 degree.
16	At 10 minutes before solar noon, verify that shadow is centered between the 5-degree on the "E" side of the calibration template and 0-degree marks (2.5 degrees).
17	Using procedure in table 4.5.8, lower tower.
18	Remove alignment tool. Using procedure in table 4.5.10, reinstall direction sensor.
19	Coat threads of lightning rod with antiseize compound. Using ½-inch open-end wrench, install lightening rod on wind tower.
20	Using procedure in table 4.5.8, raise wind tower to vertical position.

Table 4.5.4. Davis Pelorus Alignment Procedure

Step	Procedure
	Tools Required: Davis pelorus with tripod ¾-inch socket and ratchet ¾-inch open-end wrench ½-inch open-end wrench 7/16-inch wrench NWS F420 direction adapter head NWS F420 opaque plastic orientation plate Alignment protractor **WARNING** Before proceeding, ensure safe clearance of wind tower from dangerous areas of the runways, taxiways, or restricted zones.
1	Move 100 ft. to 200 ft. away from south side of wind sensor crossarm (side with three-cup anemometer).
2	Select a position aligned with crossarm assembly using figure 4.5.3 as a guide. A monocular can aid in obtaining this alignment, especially at 200 feet.
3	Position Davis pelorus instrument tripod on a flat surface at the position selected in step 1. Use the level built-in the Davis pelorus instrument to level the instrument.
4	Rotate the entire instrument so that the instrument's north and south white markings are in alignment with the wind sensor crossarm. The north markings should point directly towards the wind tower. Use the instrument sight assembly to obtain the exact orientation as shown in figure 4.5.4.
5	Determine true north by using the Solar Noon shadow or by using a compass and allowing for local magnetic deviation. Refer to table 4.5.3 to determine Solar Noon. Using a compass requires that the north reading from the compass be corrected by adding or subtracting a few degrees to correct for the local deviation of magnetic north from true north.
6	While maintaining the Davis pelorus instrument alignment with the wind tower, rotate the sight assembly to align with true north as shown in figure 4.5.5.
7	Measure and record the difference in degrees, CW or CCW, of true north with respect to the Davis pelorus instrument markings of north. This is the heading error. A CCW heading error corresponds to true north being on the left side of the instrument (Figure 4.5.5).
8	If the heading error is less than or equal to 2 degrees, then direction alignment need not be adjusted. If the heading error is greater than 2 degrees, then it must be corrected by performing the following steps.
9	Using the procedures in tables 4.5.7 and 4.5.9, lower the wind tower and remove the wind direction sensor.
10	Observe the two scribed lines on the north end of the crossarm (one on the direction sensor mounting adapter and one on the pipe part of the crossarm).
11	Position alignment protractor at interSection of crossarm pipe and sensor mounting adapter so that the protractor zero degree mark aligns with the scribed lines on the crossarm pipe and the mounting adapter.
12	Using a 7/16-inch wrench, loosen hex head bolts on the direction sensor mounting adapter.
13	If the heading error calculated in step 7 is CW, rotate the mounting adapter CW (looking down at the sensor) to the exact number of degrees recorded in step 7; if heading error is CCW, rotate mounting adapter CCW.
14	Using a 7/16-inch wrench, tighten two mounting adapter bolts then recheck heading error using a protractor. If necessary, remark the two scribed lines on the north end of the crossarm.
15	Using the procedure in table 4.5.10, install the wind direction sensor.
16	Using the procedure in table 4.5.8, raise wind tower to a vertical position.

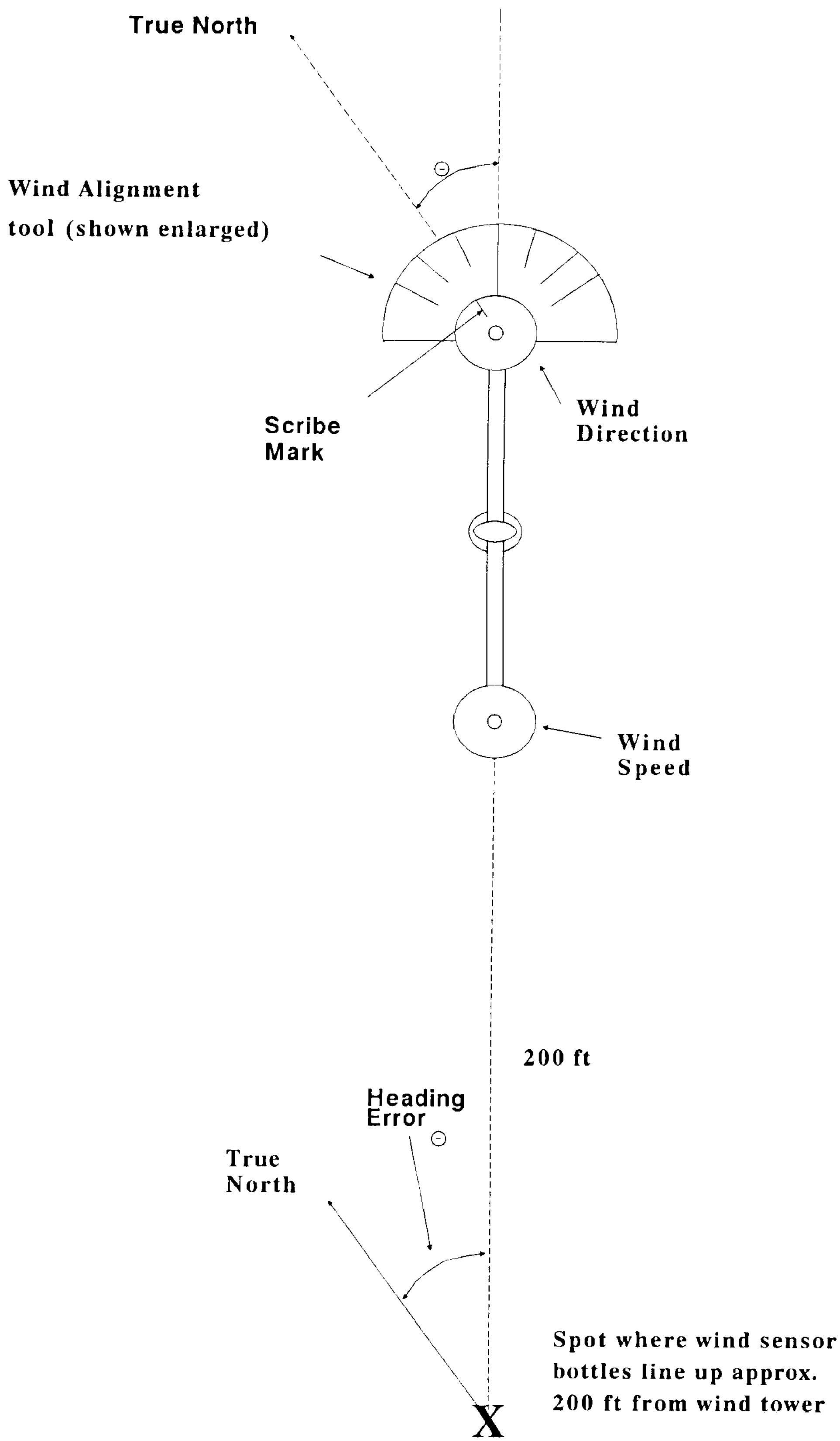

Figure 4.5.3. Wind Alignment Procedures

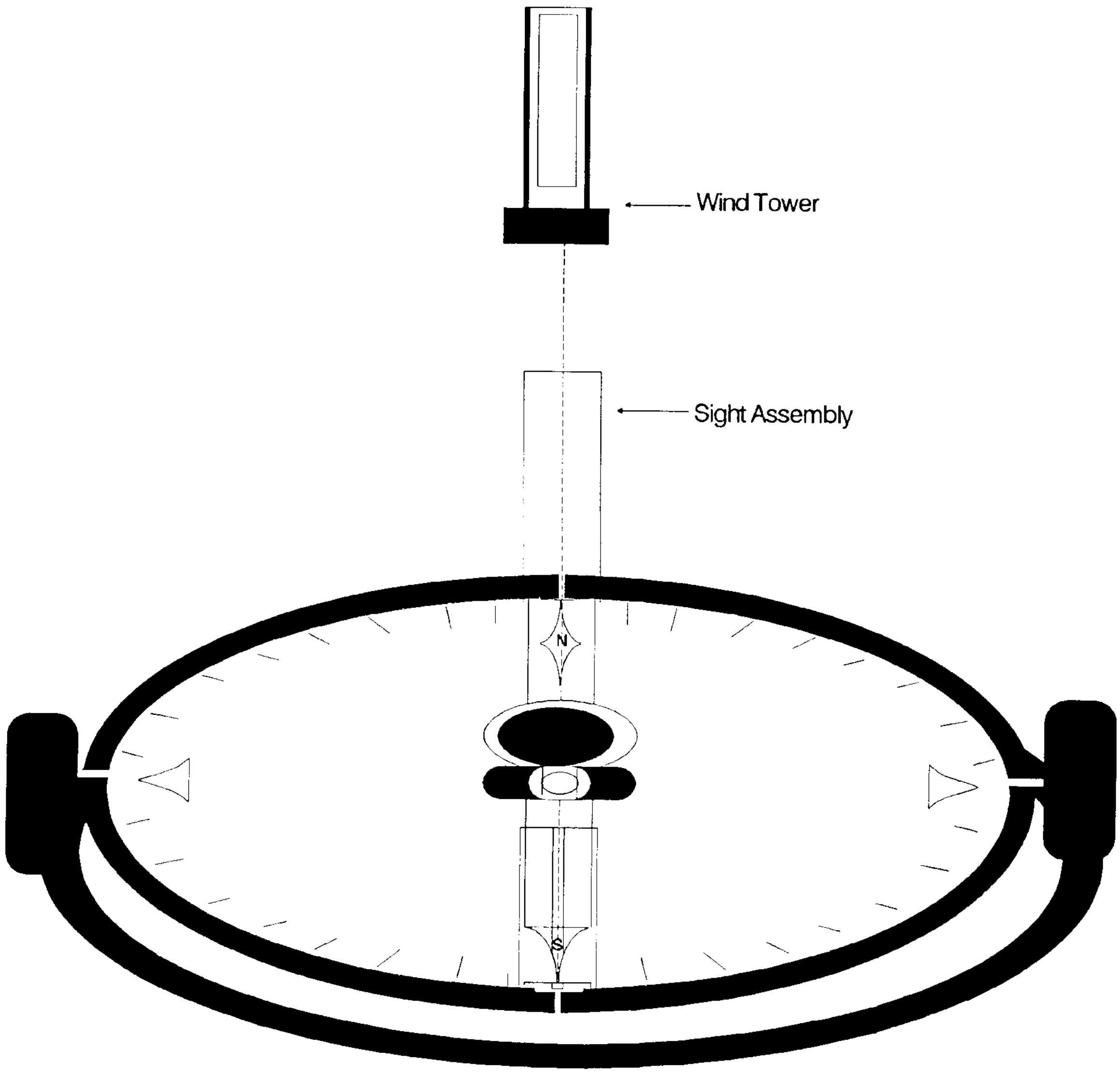

Figure 4.5.4. Davis Pelorus Instrument

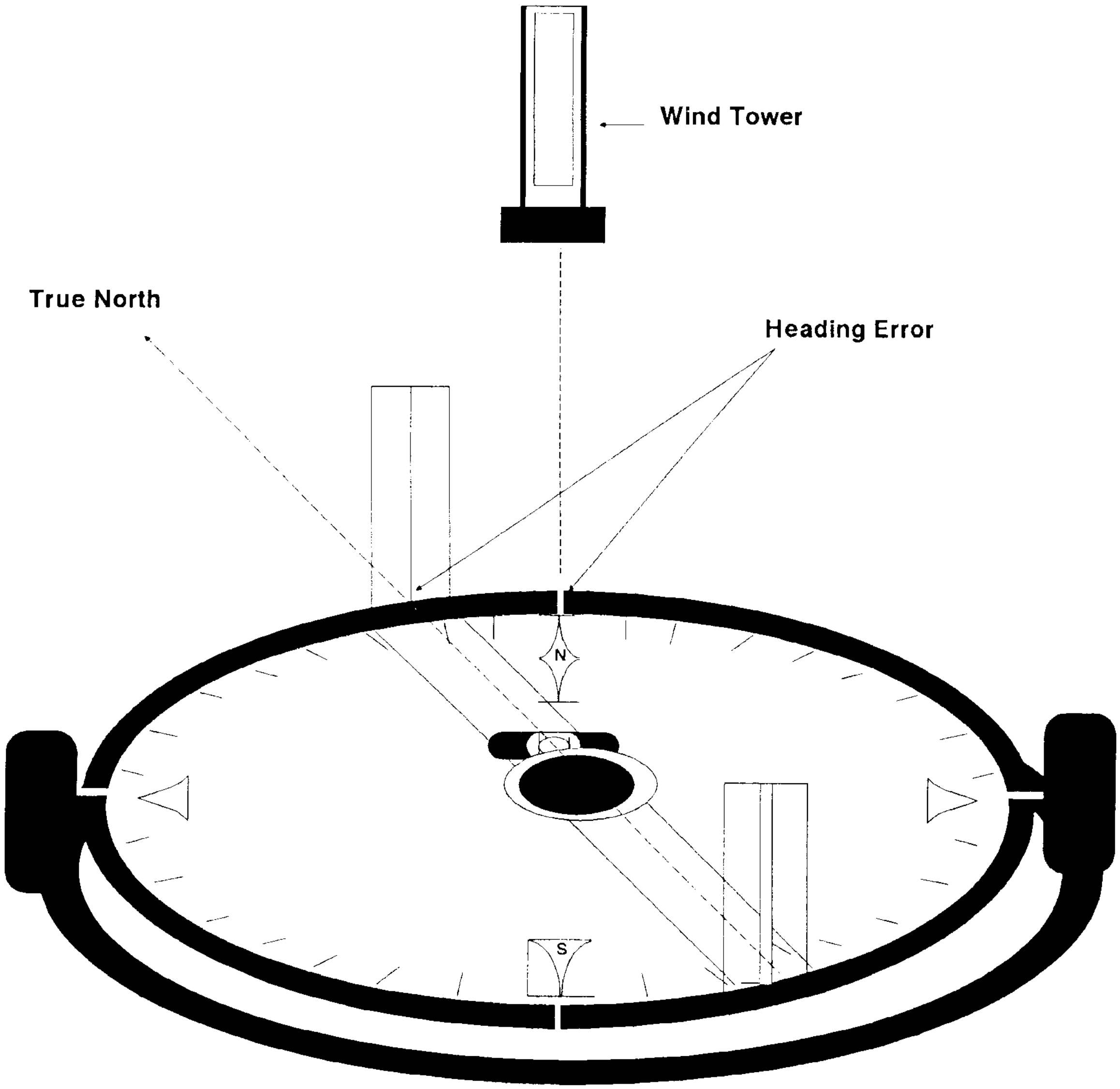

Figure 4.5.5. True North Alignment

Table 4.5.5. Checking Wind Direction and Speed Data

Step	Procedure
	NOTE Laptop computer initialized as DCP OID (paragraph 3.3.4), or any other available OID, may be used for the following procedure.
1	At OID, display sensor status page (sequentially press REVUE-SENSOR-STAT function keys from 1-minute display).
2	On sensor status page, set report processing for wind sensor to OFF.
3	Display first page of sensor 12-hour page (shows 5-second wind data) on OID (sequentially press REVUE-SENSOR-12 HR function keys from 1-minute display).
4	Inside DCP equipment cabinet, set circuit breaker on wind sensor power control module to on (left) position.
5	At wind direction sensor, rotate direction vane to align tail of vane to alignment (north) mark on body of direction sensor. Hold in position for 2 minutes.
6	On sensor 12-hour page at OID, verify that 5-second wind data for test period indicates 180 ±10 degrees.
7	Remove cup assembly from wind speed transducer. Refer to the procedure in table 4.5.10 for cup assembly removal.
8	Remove ASOS wind speed transducer using procedure of table 4.5.9.
9	Connect ASN S100-TE321 test cable between transducer and adapter head.
10	Place transducer in position onto calibrator blocks.
11	Couple transducer to F420 wind speed calibrator using flexible coupler No. L050. The 3:1 gear speed reducer is to be used when running the 600-rpm check. **NOTE** Note the time after completion of each rpm test. This will aid in locating the results at the OID.
12	While the transmitter is coupled to the F420 calibrator, run calibrator at speeds of 300, 600, and 900 rpm. The time for each speed will be 2 minutes and 15 seconds. Ensure that calibrator is turning transmitter in same direction as 3- cup rotor is normally driven.
13	On 12-hour page of OID, note data in WIND column. Use completion time recorded earlier to locate and verify calibration data. The calibration values that must be met are listed below. These knot values are valid only with Version 2.07 wind processor firmware. <u>RPM</u> <u>Knots</u> 300 27 ±2 knots 600 52 ±2 knots 900 77 ±3 knots If calibration values are not met, replace wind speed transducer. Repeat test; if the test still fails, follow standard procedures to locate and repair fault.
14	Remove F420 wind speed calibrator, remove calibrator blocks, disconnect ASN S100-TE321 test cable, connect transducer to the adapter head, and install cup assembly to transducer by repeating steps 11, 10, 9, 8, and 7.
15	Inside DCP equipment cabinet, set circuit breaker on wind sensor power control module to off (right) position.
16	Raise wind sensor tower and apply power to wind sensor in accordance with table 4.5.8.
17	AT OID, display sensor status page (sequentially press REVUE-SENSOR-STAT function keys from 1-minute display).
18	On sensor status page, set report processing for wind sensor to ON.

4.5.3 CORRECTIVE MAINTENANCE

4.5.3.1 **Diagnostics**. The ASOS implements diagnostics such that the type of repair is known to the technician before traveling to the field. The ASOS wind speed and wind direction sensors are provided with two types of diagnostics: continuous self-testing which runs automatically, and specific built-in tests which are executed upon demand from the ASOS. The results of both diagnostics are displayed on the wind speed/direction sensor page as described in Chapter 1.

4.5.3.2 **Troubleshooting**. The majority of wind sensor problems can be isolated by the diagnostics test. For these faults, the technician need only replace the faulty FRU as is indicated in the maintenance log. However, if a failure inhibits the diagnostics from running, it becomes the technician's responsibility to manually troubleshoot and repair the wind sensor. The troubleshooting procedures outlined in table 4.5.6 provide a basis from which the technician can isolate and repair the fault. Upon completing the repair of the wind sensor, the technician must run the on-demand diagnostics to ensure that the fault is corrected.

Table 4.5.6. Wind Sensor Troubleshooting

What To Do	How To Do It
Perform visual inspection of wind sensor.	Paragraph 4.5.2.1
Perform fiberoptic module test.	Paragraph 1.5.3.3
At DCP, verify that wind sensor ac power control module circuit breaker is set to on (left) position.	---
Perform wind sensor ac and dc power supply checks.	Table 4.5.7
If unit still does not function, troubleshoot wind sensor wiring.	Figure 4.4.2

4.5.3.3 **Lowering and Raising the Wind Tower**. Before performing certain corrective maintenance tasks, the wind tower must be lowered and secured using the polypropylene rope attached to the top of the wind tower. Technicians must stay clear of the tower while it is being lowered or raised. When the tower is secured in its horizontal position, the lightning rod must be covered to avoid severe cuts or punctures from its sharp tip. After performing maintenance actions, the tower must be raised and secured in the upright position. Table 4.5.8 provides the procedures to lower and raise the wind tower. This procedure is referenced as necessary from subsequent maintenance procedures.

4.5.3.4 **Wind Direction and Wind Speed Sensors Removal and Installation**. The wind direction and wind speed sensors are removed and installed in the same manner. Wind direction and wind speed sensors removal and installation procedures are provided in table 4.5.9. The wind speed transducer, cup assembly, direction transducer, and vane assembly are all FRU's. For this reason, the cup assembly or the vane assembly must be removed from its respective transducer before replacing one of the four FRU's. Table 4.5.10 provides procedures to remove and install a cup assembly or vane assembly. The cup assembly and vane assembly may be removed while the sensor is mounted on the crossarm assembly or after the sensor has been removed from the crossarm assembly.

4.5.3.5 **Power Supply Removal and Installation**. Removal and installation procedures for the power supply are provided in table 4.5.11.

4.5.3.6 **Fiberoptic Module Removal and Installation**. Removal and installation procedures for the fiberoptic module are provided in table 4.5.12.

4.5.3.7 **Processor Board Removal and Installation**. Removal and installation procedures for the processor board are provided in table 4.5.13.

4.5.3.8 **Wind Sensor Electronics Enclosure Removal and Installation**. Removal and installation procedures for the wind sensor electronics enclosure are provided in table 4.5.14.

4.5.3.9 **Wind Tower Signal Cable W1 Removal and Installation**. Removal and installation procedures for the tower signal cable W1 are provided in table 4.5.15.

4.5.3.10 **Crossarm Assembly Removal and Installation**. Removal and installation procedures for the crossarm assembly are provided in table 4.5.16.

4.5.3.11 **Starting Torque Bearing Test**. A performance check of the wind sensor includes performing a starting torque bearing test. The starting torque of the wind speed and wind direction housings is measured to detect bearing condition. As the bearings in each housing age, they tend to show an increase in friction which can be easily measured. Bearings that measure within the allocated starting torque values will ensure that the wind cups and vanes are responsive at low wind speeds. The starting torque bearing test is performed every 6 months and prior to installation of a new cup or vane assembly using the procedures in table 4.5.17.

Table 4.5.7. Wind Sensor AC and DC Power Supply Checks

Step	Procedure
	Tools required: No. 1 Phillips screwdriver **NOTE** AC and dc power supply checks should be performed on wind sensor as part of troubleshooting procedure when a malfunction interrupts communications between sensor and ASOS.
1	Inside DCP equipment cabinet, set circuit breaker on wind sensor power control module to off (right) position.
2	At wind sensor, open electronics enclosure access door.
3	At electronics enclosure, use No. 1 Phillips screwdriver to remove six screws securing power input box access cover.
4	Remove access cover from power input box.
5	Inside DCP equipment cabinet, set circuit breaker on wind sensor power control module to on (left) position.
6	**WARNING** Dangerous voltages are present within wind sensor electronics enclosure when wind sensor is powered on. Using digital multimeter (DMM), measure ac voltage between terminals 1 and 2 on terminal board TB1 in power input box. Voltage should be 110 vac ±10%. If correct voltage is not obtained, troubleshoot ac wiring back to DCP.
7	Using DMM, measure ac voltage between LINE OUT and NEUTRAL studs on line protector (E2) in power input box. Voltage should be 110 vac ±10%. If correct voltages are not obtained, replace wind sensor electronics enclosure.
8	Check fuse F2 (heater fuse) and replace if blown. If fuse blows again, replace wind sensor electronics enclosure.
9	Using DMM, measure dc voltage between power supply (PS1) terminals marked +OUT and -OUT. Voltage should be between 4.5 and 5.5 vdc. If correct voltage is not obtained, remove power, disconnect wires from +OUT and -OUT terminals, reapply power, and check voltage outputs again. If correct voltage is still not obtained, replace power supply PS1.

Table 4.5.7. Wind Sensor AC and DC Power Supply Checks -CONT

Step	Procedure
10	Inside DCP equipment cabinet, set circuit breaker on wind sensor power control module to off (right) position.
11	Install load wires to +OUT and -OUT terminals of power supply PS1.
12	Loosen screw securing data processing board A2 to vertical support post and remove data processing board from its edge connector.
13	Inside DCP equipment cabinet, set circuit breaker on wind sensor power control module to on (left) position.
14	Using DMM, measure dc voltage between power supply (PS1) terminals marked +OUT and -OUT. Voltage should be between 4.5 and 5.5 vdc. If correct voltage is obtained, replace data processing board A2. If correct voltage is still not obtained, replace wind sensor electronics enclosure.
15	Inside DCP equipment cabinet, set circuit breaker on wind sensor power control module to off (right) position.
16	Install data processing board on vertical support post and tighten screw.
17	Install power input box access cover and using No. 1 Phillips screwdriver, install six screws securing cover.
18	Inside DCP equipment cabinet, set circuit breaker on wind sensor power control module to on (left) position.

Table 4.5.8. Lowering and Raising Wind Tower

Step	Procedure
LOWERING TOWER	
Tools required: ¾-inch socket and ratchet ¾-inch open-end wrench	
1	Inside DCP cabinet, set circuit breaker on wind sensor circuit breaker module to off (right) position.
2	Select direction (east or west) to which tower is to be lowered.
3	At opposite side of tower (west or east), use socket, ratchet, and open-end wrench to remove two nuts, lockwashers, and bolts securing top horizontal retaining beam (Figure 4.1.1) to vertical supports. Remove top horizontal retaining beam.
4	Release lower end of tower guide rope.
5	**WARNING** Wind tower is counterbalanced and swings freely when horizontal retaining beams are removed. Death or severe injury may result if personnel are not kept out of travel path of wind tower. Throughout this procedure, use guide rope to control tower, and ensure that personnel are kept out of travel path of tower. Tower may move unpredictably in heavy winds or if counterbalance is distorted (due to ice accumulation, FRU's removed from sensor, etc). Use caution when lowering tower under such conditions. While maintaining control of tower guide rope, use socket, ratchet, and open-end wrench to carefully remove two nuts, lockwashers, and bolts securing bottom horizontal retaining beam to vertical supports. Remove bottom horizontal retaining beam.
6	Using tower guide rope, slowly lower tower until its travel is stopped by remaining upper horizontal retaining beam.

Table 4.5.8. Lowering and Raising Wind Tower -CONT

Step	Procedure
7	**WARNING** Tower must be secured in horizontal position using tower guide rope before removing sensors, crossarm assembly, counterbalance weights, or before performing other maintenance that affects counterbalance of tower. Failure to comply may result in death or severe injury. Secure tower in horizontal position by securing free end of tower guide rope to stationary object (such as nearest sensor pedestal).
8	**WARNING** The lightning rod is very sharp and can inflict serious injuries to technicians servicing the sensors. Prior to servicing the sensors while the tower is in the horizontal position, the lightning rod must be covered. Devise or obtain a covering having hollow dimensions suiTable to enclose lightning rod (7 inches deep by 1-1/2 inches in diameter). The cover can be made of plastic, styrofoam, wood, cardboard, or suiTable packing material. Cover lightning rod.
RAISING TOWER	
Tools required: 3/4-inch socket and ratchet 3/4-inch open-end wrench	
1	Inside DCP equipment cabinet, ensure that circuit breaker on wind sensor power control module is set to off (right) position.
2	**WARNING** Death or severe injury may result if personnel are not kept out of travel path of wind tower. Throughout this procedure, use guide rope to control tower, and ensure that personnel are kept out of travel path of tower. Tower may move unpredictably in heavy winds or if counterbalance is distorted (due to ice accumulation, FRU's removed from sensor, etc). Use caution when raising tower under such conditions. Remove lightning rod cover.
3	Release tower guide rope from stationary object.
4	Using tower guide rope, slowly raise tower to upright position.
5	**NOTE** Bolts are installed from outboard side of vertical supports. Lockwashers and nuts are installed from inboard side. While maintaining control of tower guide rope, use socket, ratchet, and open-end wrench to carefully install two bolts, lockwashers, and nuts securing bottom horizontal retaining beam to vertical supports.
6	Secure free end of tower guide rope to tower.
7	Using socket, ratchet, and open-end wrench, install two bolts, lockwashers, and nuts securing top horizontal retaining beam to vertical supports.
8	Inside DCP equipment cabinet, set circuit breaker on wind sensor power control module to on (left) position.

Table 4.5.9. Wind Direction and Wind Speed Sensors Removal and Installation

Step	Procedure
	REMOVAL
	Tools required: 7/16-inch wrench
1	Remove power from wind sensor and lower wind tower in accordance with table 4.5.8.
2	**CAUTION** When removing wind direction sensor, loosen only captive bolts on sensor itself. Do not loosen or adjust bolts securing mounting flange to crossarm. Failure to comply may alter sensor alignment. At base of sensor, use 7/16-inch wrench to loosen two captive bolts (Figure 4.2.1) until bolts are free of sensor housing. Ensure that bolts are disengaged from threads.
3	Firmly grasp sensor and pull straight off of crossarm support mounting flange.
	INSTALLATION
1	**CAUTION** When installing wind direction sensor, tighten only captive bolts on sensor itself. Do not tighten or adjust bolts securing mounting flange to crossarm assembly. Failure to comply may alter sensor alignment. Install new sensor by aligning guide pins and connector on sensor with mounting holes and receptacle in crossarm support mounting flange.
2	**CAUTION** Bolts securing sensor to crossarm support must be tightened as directed below. Failure to follow these procedures may result in cross threading of holes in sensor and damage to internal connectors. Tighten each captive bolt ½ turn.
3	Using 7/16-inch wrench, alternately tighten each captive bolt ½ turn at a time. Continue this process until both bolts are tight.
4	Raise wind sensor tower and apply power to wind sensor in accordance with table 4.5.8.

Table 4.5.10. Cup Assembly and Vane Assembly Removal and Installation

Step	Procedure
	REMOVAL
	Tools required: Large flat-tipped screwdriver 1/8-inch hex key wrench
1	If removing cup or vane assembly while respective sensor is still mounted to crossarm assembly, remove power from wind sensor and lower wind tower in accordance with table 4.5.8.
2	**NOTE** Cone-shaped cap on top of cup assembly or vane assembly is lefthand thread. Turn screwdriver clockwise to loosen and counterclockwise to tighten. Using large flat-tipped screwdriver, remove cone-shaped cap securing cup assembly or vane assembly to transducer shaft and remove Seeloc washer.

Table 4.5.10. Cup Assembly and Vane Assembly Removal and Installation -CONT

Step	Procedure
3	Using hex key wrench, loosen setscrew securing cup assembly or vane assembly to transducer shaft. Lift cup assembly or vane assembly from transducer shaft. **NOTE** The Mod 0 wind speed transducer is subject to bearing failures, excessive torque, and moisture problems; for these reasons it is suggested that any remaining Mod 0 units, upon failure of the unit, be replaced with Mod 1, or preferably, the Mod 2 wind speed transducers. The Mod 1 wind speed transducer can be identified by the manufacturers part number 32228 MOD 1 stamped onto the identification plate on the side of the unit. The Mod 1 unit corrected the internal problems of the Mod 0 transducer; however, the relatively flat top of the Mod 0 and Mod 1 transducers can allow ice buildup which could degrade the performance of the unit in severe cold weather. For this reason, it is recommended that the Mod 1 wind speed transducer not be used in climates where icing is prevalent.
INSTALLATION	
Tools required: 1/8-inch hex key wrench Test fixture S100-TE329 (NLSC)	
1	If installing cup assembly or vane assembly while respective transducer is mounted to crossarm assembly, ensure that power is removed from wind sensor and tower is lowered in accordance with table 4.5.8.
2	Attach the 0.374-in. diameter dowel (p/o test fixture S100-TE329) to the wind vane hub. Tighten the setscrew enough to hold the drill blank from rotating but do not overtighten. Slide the clearance gauge (p/o test fixture S100-TE329) onto the dowel.
3	Invert the wind vane assembly so that gravity causes the clearance gauge to fall into the skirt. Observe that the clearance gauge falls freely to the bottom of the skirt and is fully seated on the hub.
4	Repeat step 3 several times, and observe whether the clearance gauge contacts skirt sidewalls and/or fails to contact the hub. If either of these unsatisfactory conditions exists, the wind vane assembly should be rejected: it cannot be used on the MOD 2 wind bottle.
5	Remove the test fixture from the wind vane. If the wind vane passed the test of steps 3 and 4 above, attach it to a MOD 2 bottle and manually spin the wind vane while looking upward to inspect clearance; verify that there is no contact between skirt sidewalls and bottle neck.
6	Position vane assembly on shaft of corresponding transducer. Install wind direction vane, ensuring that setscrews are aligned with flat surface of wind direction bottle shaft. Using hex key wrench, tighten the setscrew that secures vane assembly to transducer shaft.
7	Attach the 0.374-in. diameter dowel to the windspeed cup hub by sliding the dowel into the center hole and tightening the setscrew until the dowel can not rotate but do not overtighten.
8	Slide clearance gauge onto dowel.
9	Hold the windspeed cup assembly inverted so that gravity causes the clearance gauge to fall into the skirt. Observe that the clearance gauge falls freely to the bottom of the skirt and is fully seated on the hub.
10	Repeat step 9 several times and observe whether the clearance gauge contacts the skirt sidewalls, and/or, fails to contact the hub. If either of these unsatisfactory conditions exists, the windspeed cup assembly should be rejected: it cannot be used on the MOD 2 wind bottle.

Table 4.5.10. Cup Assembly and Vane Assembly Removal and Installation -CONT

Step	Procedure
11	Remove the test fixture from the windspeed cup assembly. If the windspeed cup assembly passed steps 9 and 10 above, attach the windspeed cup to the MOD 2 (or current configuration) bottle. Hold this assembly upright and manually spin the cup assembly while looking upward under the skirt to verify that the skirt sidewalls do not contact the bottle neck. **NOTE** If either the wind vane assembly or the windspeed cup assembly were to fail the above concentricity tests, they should be identified accordingly and returned to NRC.
12	Position cup assembly on shaft of corresponding transducer. Using hex key wrench, tighten setscrew securing cup assembly to transducer shaft.
13	Install Seeloc washer on transducer shaft.
14	**NOTE** Cone-shaped cap on top of cup assembly or vane assembly is lefthand threaded. Turn screwdriver clockwise to loosen; counterclockwise to tighten. Using large flat-tipped screwdriver, install cone-shaped cap securing cup assembly or vane assembly to transducer shaft.
15	If transducer is already mounted to crossarm assembly, raise wind tower and apply power to wind sensor in accordance with table 4.5.8.

Table 4.5.11. Power Supply Removal and Installation

Step	Procedure
	REMOVAL
	Tools required: Large flat-tipped screwdriver Small flat-tipped screwdriver No. 0 Phillips screwdriver No. 1 Phillips screwdriver **WARNING** Death or severe injury may result if power is not removed from sensor prior to maintenance activities. Ensure that circuit breaker (located in DCP) supplying power to sensor is set to off (right) position.
1	Inside DCP equipment cabinet, set circuit breaker on wind sensor power control module to off (right) position.
2	Using large flat-tipped screwdriver, open wind sensor electronics enclosure access door.
3	Using flat-tipped screwdriver, tag and remove wires from power supply terminals.
4	Using No. 0 Phillips screwdriver, loosen screw securing data processing board to support post (standoff) such that data processing board is freed from post.
5	Using No. 1 Phillips screwdriver, remove two screws and flat washers securing power supply angle mount to wind sensor electronics enclosure. Carefully lift power supply with angle mount from electronics enclosure.
6	Using No. 0 Phillips screwdriver, remove four screws, lockwashers, and flat washers securing power supply to angle mount.

Table 4.5.11. Power Supply Removal and Installation -CONT

Step	Procedure
INSTALLATION	
	Tools required: Large flat-tipped screwdriver Small flat-tipped screwdriver No. 0 Phillips screwdriver No. 1 Phillips screwdriver **WARNING** Death or severe injury may result if power is not removed from sensor prior to maintenance activities. Ensure that circuit breaker (located in DCP) supplying power to sensor is set to off (right) position.
1	Inside DCP equipment cabinet, ensure that circuit breaker on wind sensor power control module is set to off (right) position.
2	Using No. 0 Phillips screwdriver, install four flat washers, lockwashers, and screws securing power supply to angle mount.
3	With terminals positioned to the left, slide power supply with angle mount into position.
4	Using No. 1 Phillips screwdriver, install two flat washers and screws securing power supply angle mount to wind sensor electronics enclosure.
5	Using flat-tipped screwdriver and tags as a guide, connect wires to power supply terminals.
6	Using No. 0 Phillips screwdriver, install screw securing data processing board to support post (standoff) on power supply mounting angle.
7	Close and secure wind sensor electronics enclosure access door.
8	Inside DCP equipment cabinet, set circuit breaker on wind sensor power control module to on (left) position.

Table 4.5.12. Fiberoptic Module Removal and Installation

Step	Procedure
REMOVAL	
	Tools required: Large flat-tipped screwdriver Medium flat-tipped screwdriver Small flat-tipped screwdriver No. 1 Phillips screwdriver (short) **WARNING** Death or severe injury may result if power is not removed from sensor prior to maintenance activities. Ensure that circuit breaker (located in DCP) supplying power to sensor is set to off (right) position.
1	Inside DCP equipment cabinet, set circuit breaker on wind sensor power control module to off (right) position.
2	Using large flat-tipped screwdriver, open wind sensor electronics enclosure access door.
3	Using small flat-tipped screwdriver, loosen two retaining screws on DB-9 connector located on top of fiberoptic module. Remove DB-9 connector.
4	Remove six screws and lockwashers securing power input box access cover.
5	Remove access cover from power input box.

Table 4.5.12. Fiberoptic Module Removal and Installation -CONT

Step	Procedure
6	Using counterclockwise (ccw) rotation, remove two fiberoptic cables from rear of fiberoptic module. Install protective plastic covers over fiberoptic connectors. **NOTE** Screws referenced in next step are located inside power input box.
7	At wind sensor electronics enclosure, use No. 1 Phillips screwdriver to remove four screws, lockwashers, flat washers, and nuts securing fiberoptic module mounting plate to power input box. Remove fiberoptic mounting plate and gasket.
8	Using small flat-tipped screwdriver, remove four screws, lockwashers, and gaskets securing fiberoptic module to mounting plate.
INSTALLATION	
	Tools required: Large flat-tipped screwdriver Medium flat-tipped screwdriver Small flat-tipped screwdriver No. 1 Phillips screwdriver (short) **WARNING** Death or severe injury may result if power is not removed from sensor prior to maintenance activities. Ensure that circuit breaker (located in DCP) supplying power to sensor is set to off (right) position.
1	Inside DCP equipment cabinet, ensure that circuit breaker on wind sensor power control module is set to off (right) position.
2	Using small flat-tipped screwdriver, install gaskets, four lockwashers, and screws securing fiberoptic module to mounting plate.
3	With DCP connector toward the front, position fiberoptic module mounting plate and gasket on power input box. Using No. 1 Phillips screwdriver, install four nuts, flat washers, lockwashers, and screws securing fiberoptic module to power input box.
4	Remove protective plastic covers from fiberoptic connectors and connect receive (RX) cable to front connector and transmit (TX) cable to rear connectors to fiberoptic module.
5	Install power input box access cover and secure using six lockwashers and screws.
6	Install signal cable to DB-9 connector on fiberoptic module. Using small flat-tipped screwdriver, tighten two retaining screws.
7	Using large flat-tipped screwdriver, close and secure wind sensor electronics enclosure access door.
8	Inside DCP equipment cabinet, set circuit breaker on wind sensor power control module to on (left) position.

Table 4.5.13. Processor Board Removal and Installation

Step	Procedure
REMOVAL	
	Tools Required: Large flat-tipped screwdriver No. 1 Phillips screwdriver **WARNING** Death or severe injury may result if power is not removed from sensor prior to maintenance activities. Ensure that circuit breaker (located in DCP) supplying power to sensor is set to off (right) position.
1	Inside DCP equipment cabinet, set circuit breaker on wind sensor power control module to off (right) position.
2	Using large flat-tipped screwdriver, open wind sensor electronics enclosure access door.
3	Using No. 1 Phillips screwdriver, remove screw securing processor board to standoff.
4	Carefully remove processor board by pulling it free from its connector.
INSTALLATION	
	Tools required: No. 1 Phillips screwdriver Large flat-tipped screwdriver **WARNING** Death or severe injury may result if power is not removed from sensor prior to maintenance activities. Ensure that circuit breaker (located in DCP) supplying power to sensor is set to off (right) position.
1	Inside DCP equipment cabinet, ensure that circuit breaker on wind sensor power control module is set to off (right) position.
2	Insert processor board into its corresponding connector inside electronics enclosure.
3	Using No. 1 Phillips screwdriver, install screw securing processor board to standoff.
4	Using large flat-tipped screwdriver, close and secure wind sensor electronics enclosure access door.
5	Inside DCP equipment cabinet, set circuit breaker on wind sensor power control module to on (left) position.

Table 4.5.14. Wind Sensor Electronics Enclosure Removal and Installation

Step	Procedure
REMOVAL	
	Tools required: Large flat-tipped screwdriver No. 1 Phillips screwdriver Large adjusTable wrench **WARNING** Death or severe injury may result if power is not removed from sensor prior to maintenance activities. Ensure that circuit breaker (located in DCP) supplying power to sensor is set to off (right) position.
1	Inside DCP equipment cabinet, set circuit breaker on wind sensor power control module to off (right) position.

Table 4.5.14. Wind Sensor Electronics Enclosure Removal and Installation -CONT

Step	Procedure
2	Using large flat-tipped screwdriver, open wind sensor electronics enclosure access door.
3	Using No. 1 Phillips screwdriver, remove six screws securing access cover to power input box. Remove access cover.
4	Disconnect ac power input wires from terminals TB1-1, TB1-2, and TB1-3 inside power input box.
5	Using ccw rotation, disconnect two fiberoptic cables from underneath fiberoptic module. Install protective plastic covers over fiberoptic cable connectors.
6	Disconnect connectors P1 and P2 of tower signal cable W1 from connectors J1 and J2 in electronics enclosure.
7	Using large adjusTable wrench, disconnect both flexible conduits from electronics enclosure.
8	Carefully retract flexible conduits while sliding signal and ac power cables out of electronics enclosure.
9	While supporting electronics enclosure, loosen four captive bolts securing electronics enclosure to tower.
10	Remove electronics enclosure.
INSTALLATION	
	Tools required: Large flat-tipped screwdriver No. 1 Phillips screwdriver Large adjusTable wrench **WARNING** Death or severe injury may result if power is not removed from sensor prior to maintenance activities. Ensure that circuit breaker (located in DCP) supplying power to sensor is set to off (right) position.
1	Inside DCP equipment cabinet, ensure that circuit breaker on wind sensor power control module is set to off (right) position.
2	Position wind sensor electronics enclosure on tower.
3	Tighten four captive bolts securing electronics enclosure to tower.
4	Using large flat-tipped screwdriver, open electronics enclosure access door.
5	Using No. 1 Phillips screwdriver, remove six screws securing power input box access cover. Remove access cover.
6	Carefully slide ac power and signal cables through holes in bottom of electronics enclosure. Using large adjusTable wrench, secure flexible conduits to electronics enclosure.
7	Connect ac power wiring to terminal board TB1 in power input box according to the following connection chart: Wire color — Terminal — Function Black — TB1-1 — 110 vac White — TB1-2 — Neutral Green — TB1-3 — Chassis ground If power input box has two filters and surge suppressors, ensure that the following jumpers are also in place: From — To TB1-1 (black) — TB1-4 TB1-2 (white) — TB1-5
8	Remove protective plastic covers from two fiberoptic cable connectors underneath fiberoptic module.
9	Referring to stencils on fiberoptic module, connect transmitter cable (TX) to transmitter connector (XMTR) and receiver cable (RX) to receiver connector (RCVR).
10	Install access cover on power input box and using No. 1 Phillips screwdriver, install six screws securing cover.
11	Connect connectors P1 and P2 of tower signal cable W1 to connectors J1 and J2 in electronics enclosure.
12	Using large flat-tipped screwdriver, close and secure electronics enclosure access door.

Table 4.5.14. Wind Sensor Electronics Enclosure Removal and Installation -CONT

Step	Procedure
13	Inside DCP equipment cabinet, set circuit breaker on wind sensor power control module to on (left) position.

Table 4.5.15. Wind Tower Signal Cable W1 Removal and Installation

Step	Procedure
	REMOVAL
	Tools required: Large flat-tipped screwdriver Medium flat-tipped screwdriver No. 1 Phillips screwdriver No. 3 Phillips screwdriver Large adjusTable wrench Electrical fishtape (optional) **WARNING** Death or severe injury could result if power is not removed from sensor prior to maintenance activities. Ensure that sensor circuit breakers CB1 and CB2 (located in DCP) are off (right position). **NOTE** It is recommended that two persons work together to accomplish this procedure.
1	Open AC Junction Box; turn off circuit breaker for obstruction lights.
2	Open DCP; set wind sensor power control module circuit breaker off (toward right).
3	Open wind sensor electronics enclosure door.
4	Unplug two signal cable connectors W1P1 and W1P2.
5	Attach pullcord or pullwire to cable connectors to aid in installation of replacement cable.
6	Remove cover of pivot junction box. (See figure 4.2.1.)
7	Remove tower access plate.
8	Pull cable W1 (and pullcord) back through pivot pipe to access plate opening. **NOTE** Obstruction light wires might have to be removed temporarily from pivot pipe to allow enough space for connectors to pass.
9	Remove crossarm. (Refer to table 4.5.16.) If tower is being lowered toward the side with the access plate (usually on the east side), be careful not to pinch cable between access plate opening edge and top horizontal retaining beam.
10	Pull cable W1 (and pullcord) back through top of tower and detach pull cord.
11	If installation will not be accomplished immediately, proceed as follows: a. Tie off both ends of pullcord. b. Connect obstruction light wires. c. Install tower access plate. d. Install pivot junction box cover. e. Raise tower. (Refer to table 4.5.8.) f. Close all three enclosures. g. Turn on obstruction lights circuit breaker.

Table 4.5.15. Wind Tower Signal Cable W1 Removal and Installation -CONT

Step	Procedure
	INSTALLATION
	Tools required: Large flat-tipped screwdriver Medium flat-tipped screwdriver No. 1 Phillips screwdriver No. 3 Phillips screwdriver Large adjusTable wrench Electrical fishtape (optional) **WARNING** Death or severe injury may result if power is not removed from sensor prior to maintenance activities. Ensure that circuit breaker (located in DCP) supplying power to sensor is set to off (right) position.
1	Repeat/check removal steps 1, 2, 3, 6, 7, and 9.
2	Use vinyl electrical tape to cover and protect connectors while pulling the cable. Use the pullcord installed in Removal step 5, or use an electrician's fishtape to pull replacement W1 cable into tower, pivot pipe, and flex conduit. Ensure that W1P3 will be positioned at tower top while W1P1 and W1P2 will be at the wind electronics enclosure.
3	Install crossarm. (Refer to table 4.5.16.)
4	At the tower access opening, leave slack in the cable to form a drip loop.
5	In the wind electronics enclosure, connect plugs W1P1 and W1P2 into A1J1 and A1J2, respectively.
6	Install tower access plate and pivot junction box cover.
7	Set circuit breakers on; verify that obstructions lights and wind sensor are operating.
8	Close all three enclosures and verify that obstruction lights and wind sensor continue operating.

Table 4.5.16. Crossarm Assembly Removal and Installation

Step	Procedure
	REMOVAL
	Tools required: 7/16-inch wrench **WARNING** Death or severe injury may result if power is not removed from sensor prior to maintenance activities. Ensure that circuit breaker (located in DCP) supplying power to sensor is set to the off (right) position.
1	Inside DCP equipment cabinet, ensure that circuit breaker on wind sensor circuit breaker module is set to off (right) position.
2	Using the procedures in table 4.5.8, lower wind tower.
3	At base of wind direction sensor, use 7/16-inch wrench to loosen two captive bolts (Figure 4.2.1) until bolts are free of sensor housing. Ensure that bolts are disengaged from threads.
4	Firmly grasp wind direction sensor and pull straight off crossarm support mounting flange.
5	At base of wind speed sensor, use 7/16-inch wrench to loosen two captive bolts (Figure 4.2.1) until bolts are free of sensor housing. Ensure that bolts are disengaged from threads.
6	Firmly grasp wind speed sensor and pull straight off crossarm support mounting flange.
7	Referring to figure 4.2.2, remove two bolts, flat washers, and nuts securing crossarm support to tower.

Table 4.5.16. Crossarm Assembly Removal and Installation -CONT

Step	Procedure
8	Carefully slide vertical section of crossarm support off top of tower and remove and retain any shims which may be present. Disconnect connector W1P3 of tower signal cable from connector J1 of crossarm support and remove crossarm from tower.
9	Clean off any RTV732 sealant that may remain on tower mounting post.
INSTALLATION	
	Tools required: RTV732 sealant (or equivalent) DC-4 anti-corrosion compound Wind tower shims (62828-40224) 7/16-inch wrench **WARNING** Death or severe injury may result if power is not removed from sensor prior to maintenance activities. Ensure that circuit breaker (located in DCP) supplying power to sensor is set to the off (right) position.
1	Inside DCP equipment cabinet, ensure that circuit breaker on wind sensor circuit breaker module is set to off (right) position.
2	**NOTE** Crossarm is mounted to top of tower such that wind direction sensor end of crossarm points due north and holes in tower are aligned with holes in crossarm support. Lower wind tower in accordance with table 4.5.8 to gain safe access to top of tower.
3	Apply thin coat of DC-4 anti-corrosion compound to connector pins and connect tower connector W1P3 signal cable to crossarm support connector J1.
4	Install crossarm support in top of tower.
5	Rotate crossarm support such that wind direction sensor end of crossarm support (lower arm) points due north and holes in tower are aligned with holes in crossarm support.
6	Referencing figure 4.2.2, install two bolts, flat washers, and nuts securing crossarm support to tower. Install the required number of wind tower shims to remove any excessive play between crossarm support and tower. Tighten two bolts securing crossarm support to tower.
7	Using RTV732 sealant or equivalent, seal seam around base of crossarm support. **CAUTION** When installing wind direction sensor, tighten only captive bolts on sensor itself. Do not tighten or adjust bolts securing mounting flange to crossarm assembly. Failure to comply may alter sensor alignment.
8	Install wind direction sensor by aligning guide pins and connector on sensor with mounting holes and receptacle in crossarm support mounting flange. **CAUTION** Bolts securing sensor to crossarm support must be tightened as directed below. Failure to follow these procedures may result in cross threading of holes in sensor and damage to internal connectors.
9	Tighten each captive bolt ½ turn.
10	Using 7/16-inch wrench, alternately tighten each captive bolt ½ turn at a time. Continue this process until both bolts are tight.
11	Install wind speed sensor by aligning guide pins and connector on sensor with mounting holes and receptacle in crossarm support mounting flange.

Table 4.5.16. Crossarm Assembly Removal and Installation -CONT

Step	Procedure
	CAUTION Bolts securing sensor to crossarm support must be tightened as directed below. Failure to follow these procedures may result in cross threading of holes in sensor and damage to internal connectors.
12	Tighten each captive bolt ½ turn.
13	Using 7/16-inch wrench, alternately tighten each captive bolt ½ turn at a time. Continue this process until both bolts are tight.
14	Raise wind tower in accordance with table 4.5.8.
15	Align wind direction sensor by performing procedure in table 4.5.3.
16	Inside DCP equipment cabinet, ensure that circuit breaker on wind sensor module is set to on (left) position.

Table 4.5.17. Starting Torque Bearing Test

Step	Procedure
	Tools required: Precision torque gauge (Seekonk model SO-3)
1	Using procedures in table 4.5.9, remove wind speed and wind direction sensors from crossarm support.
2	Position wind speed sensor on a flat surface in an area protected from wind or any air movement.
3	Using flat blade bit attached to torque gauge, install torque gauge in slot of nut that secures cups to housing shaft.
4	Holding torque gauge vertical, slowly turn clockwise and read indicated torque at which cups just begin to turn. Record reading.
5	Repeat step 4 two more times.
6	Repeat steps 4 and 5, but this time turn torque gauge in a counterclockwise direction.
7	Average six recorded values to determine starting torque of sensor. If value is greater that 0.25 inch-ounce, replace sensor.
8	Repeat steps 2 through 7 for wind direction sensor.
9	Using procedures in table 4.5.9, install wind speed and wind direction sensors.

CHAPTER 5

TEMPERATURE/DEWPOINT SENSORS

SECTION I. DESCRIPTION AND LEADING PARTICULARS

5.1.1 INTRODUCTION

This chapter provides field service information for the model H083R and 1088 temperature/dewpoint sensors (hygrothermometers). The only difference between the H083R and 1088 sensors is that the 1088 sensor is equipped with diagnostic circuitry and software. The H083R has no automatic diagnostic capability. The information in this chapter includes physical description, installation, operation, theory of operation, and preventive and corrective maintenance for both sensors. Any differences between the sensors are clearly noted in the text and drawings. A separate functional drawing for each sensor is provided.

5.1.2 PHYSICAL DESCRIPTION

5.1.2.1 **Introduction**. Each of the model H083R and 1088 hygrothermometers, developed by the Technical Services Laboratory for the National Weather Service (NWS), functions as a thermometer and dewpoint indicator. The sensors indicate dewpoint and ambient temperatures in the range of -80 to +130 degrees Fahrenheit (°F). Resolution is 0.1°F.

Temperature/dewpoint sensor accuracies are as follows:

Ambient temperature	±1 degree, -58°F to +122°F ±2 degrees through remainder of operational range
Dewpoint temperature	±2°F RMSE, +30°F to +86°F ±3°F RMSE, -10°F to +30°F ±4°F RMSE, -30°F to -10°F

5.1.2.2 **Physical Components**. Each of the sensors consists of two separate components, as shown in figure 5.1.1: an aspirator and a transmitter. The aspirator is mounted to the transmitter via a mounting bracket assembly. The transmitter is mounted to the sensor mounting pole via a 3-3/4 circular mounting sleeve. The transmitter is connected to the data collection package (DCP) via a power cable and two fiberoptic cables. The DCP receives temperature, dewpoint, and diagnostic data (model 1088 only) from the sensor via the fiberoptic cables. The DCP formats the temperature/dewpoint measurement data and diagnostic data and transmits these data to the acquisition control unit (ACU) via either line drivers or an rf communications link. The ACU processes the measurement data via the measurement algorithm and outputs the measurement results to the various ASOS peripheral devices.

5.1.2.3 **Principles of Operation**. The model H083R and 1088 hygrothermometers both use a chilled mirror method to measure dewpoint. By definition, the dewpoint of a sample of air is the temperature at which the water vapor in the air condenses. In the chilled mirror method, a mirror is cooled to the point where a fine film of condensate is present on the mirror's surface.

The temperature of the mirror at this condition is equal to the dewpoint temperature. The presence of condensation is detected by the reflection of an infrared light off the surface of the mirror. Internal circuits of the model H083R and model 1088 refrigerate a small mirror, and by using an optical feedback loop, maintain the mirror at exactly the temperature at which the mirror surface is slightly clouded with condensed water vapor from the sampled air. A precision thermal sensor embedded in the mirror measures the temperature. A similar thermal sensor located in a sample of the ambient air measures the ambient air temperature.

5.1.2.4 **Aspirator 2MT4A1**. The aspirator (figure 5.1.2) consists of two FRU's: Housing Assembly A1A2 (with built-in fan) and Dewpoint Sensor Assembly A1A1. The dewpoint sensor assembly consists of a sensor card (ambient and dewpoint sensing circuitry), its mounting frame, and the aspirator cable (connects to transmitter). The dewpoint sensor assembly contains additional diagnostic circuitry that monitors airflow through the aspirator and is used to detect a fan failure. This fan failure circuitry is monitored by model 1088 only.

5.1.2.5 **Transmitter 2MT4A2**. The transmitter (figure 5.1.3) consists of an outer protective housing, chassis subassembly, transmit logic board, calibrator assembly, +5 volt power supply, auxiliary power supply, ac input terminal block, signal out terminal block, line filter, main power switch, heat/cool switch, power fuse, autobalance module, and fiberoptic module.

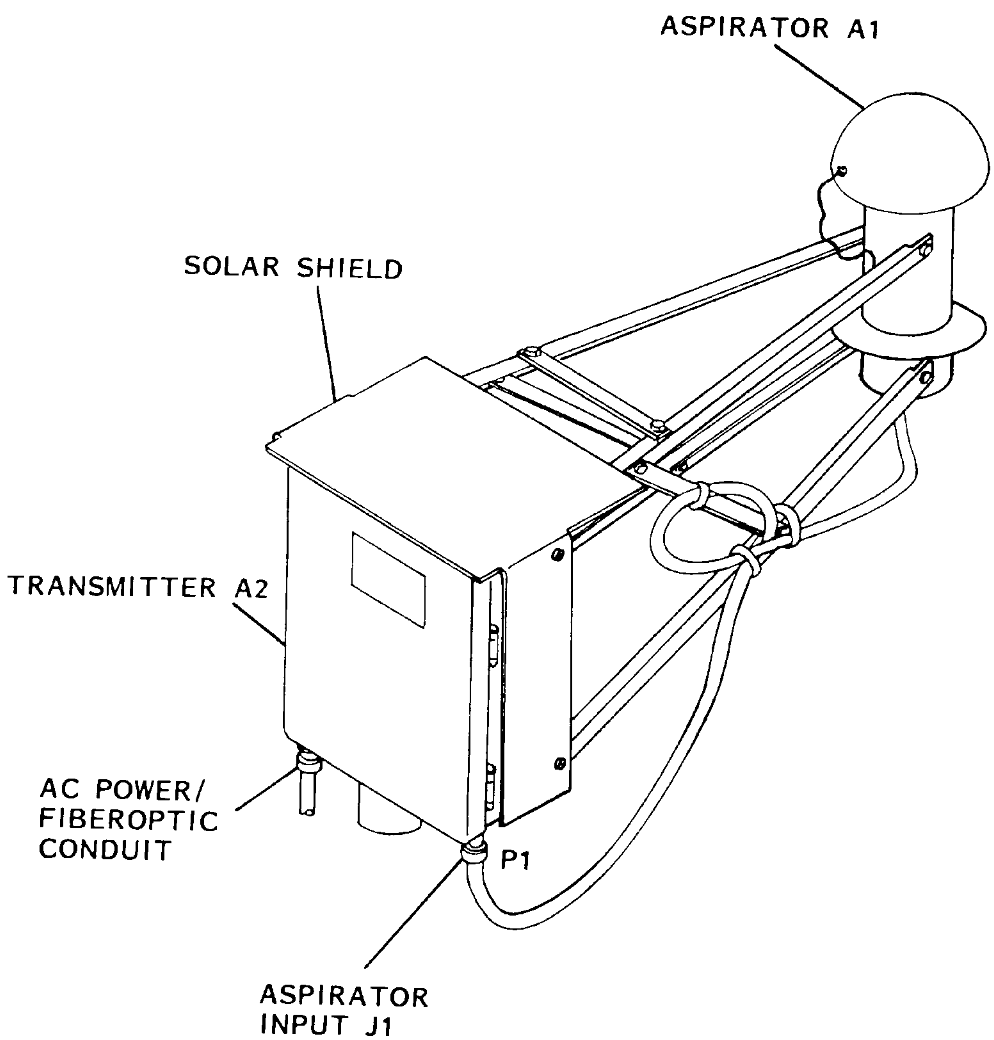

Figure 5.1.1. Temperature/Dewpoint Sensor Major Components

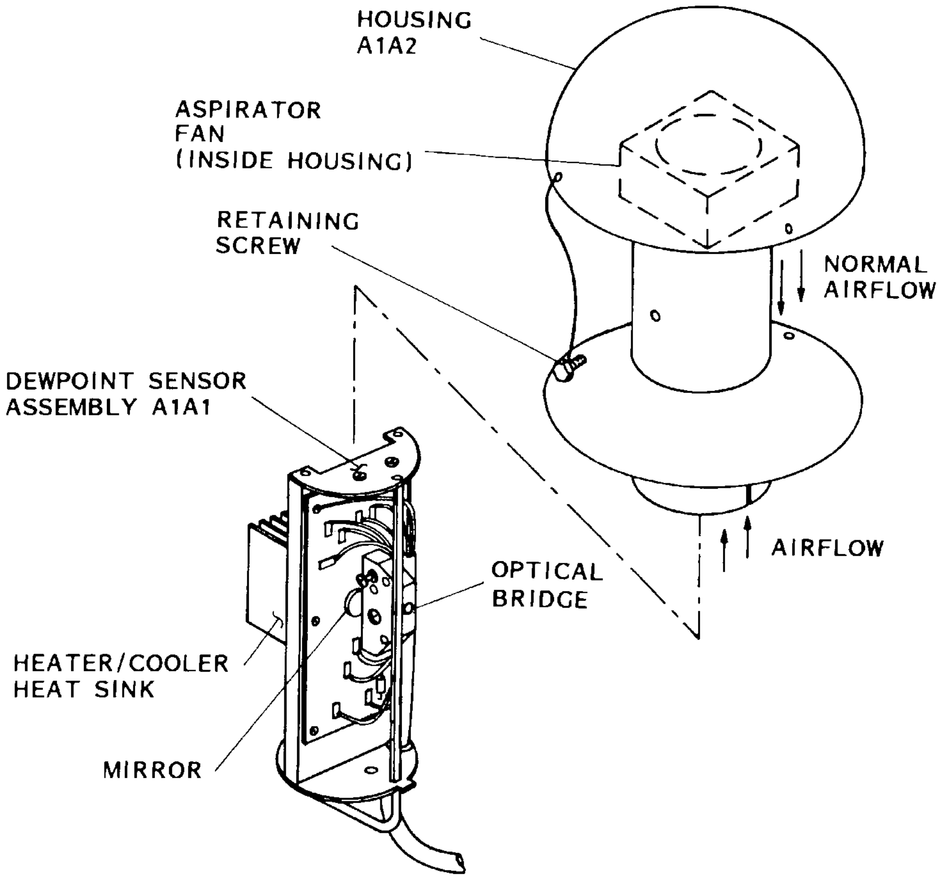

Figure 5.1.2. Aspirator Component Location

5.1.2.5.1 **Transmit Logic Board 2MT4A2A1**. The transmit logic board controls mirror heating and cooling to maintain dewpoint temperature at the mirror surface. It also processes the absolute and dewpoint temperature resistance sensor information into a serial digital data stream for transmission to the DCP. The transmit logic board contains a numeric data display for use in servicing the equipment. During system calibration, the transmit logic board receives a calibrated resistive value from the calibrator assembly in lieu of the ambient and dewpoint temperature resistive outputs. The model 1088 transmit logic board also contains self-test circuitry that enables it to test its power supplies and measurement circuits.

5.1.2.5.2 **Calibrator Assembly 2MT4A2A2**. The calibrator assembly consists of calibrator select switch S1 and associated calibrator resistors. The calibrator assembly enables the selection of fixed resistance values in place of the resistive temperature sensors for alignment and troubleshooting of the instrument's circuits. The model 1088 contains additional self-test selection circuitry that enables automatic selection of the calibrator resistors during diagnostic testing.

5.1.2.5.3 **+5 Volt Power Supply 2MT4A2A3**. The +5 volt power supply provides regulated 5V, 1.5-ampere power to the auxiliary power supply for the generation of ±12V power. It also provides the main logic power supply voltage for the circuits on the transmit logic board.

5.1.2.5.4 **Auxiliary Power Supply 2MT4A2A4**. The auxiliary power supply supplies power to the thermoelectric pump in the dewpoint sensor assembly and supplies ±12V power to the system. It also provides power to the lamp in the mirror/dewpoint sensor circuit. The auxiliary power supply receives a thermocontrol signal from the transmitter logic board and a power supply input signal from the +5 volt power supply. The thermocontrol signal controls the polarity of the control voltage applied to the thermoelectric pump. When the thermocontrol signal is positive, the pump signal is positive, indicating a heat condition. When the thermocontrol signal is negative, a cooling condition is indicated. Two models of auxiliary power supplies are used: 1063-2031 and 1063-06B. The applicable model number is stenciled in the upper right corner of the power supply board. The only difference between the models is how they generate the ±12V outputs. The model 1063-2031 uses an internal oscillator, which is powered by the +5 volt power supply. The model 1063-06B uses full wave rectifier power from the 115 vac input.

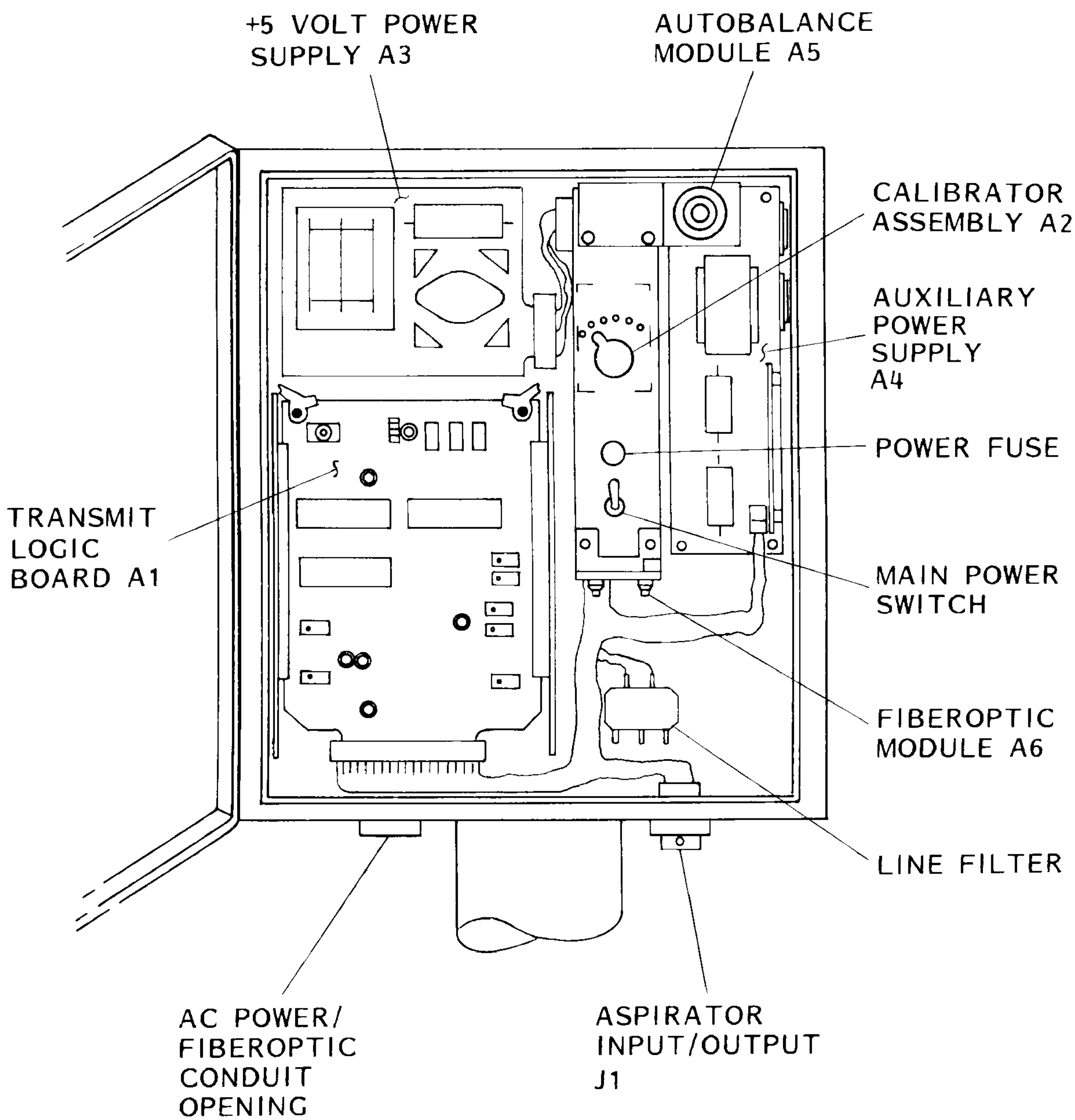

Figure 5.1.3. Transmitter Component Location

5.1.2.5.5 **Autobalance Module 2MT4A2A5**. The autobalance module automatically compensates for accumulated dirt and other visible contamination on the mirror surface, thereby increasing the time between maintenance cycles. The autobalance module is activated once each day to readjust the bias voltage on the mirror/dewpoint sensor circuit.

5.1.2.5.6 **Fiberoptic Module 2MT4A2A6**. The fiberoptic module handles the data transfers between the sensor and the DCP. For the 1088 sensor, data communication is half-duplex; i.e., the DCP polls the sensor for data and the 1088 responds. For the H083R, data communication is simplex (one way only), where the sensor outputs data at regular intervals.

5.1.3 TEMPERATURE/DEWPOINT SENSOR CONFIGURATIONS

The temperature/dewpoint sensor (P/N 62828-90114) has two possible configurations: the -30 (1088-20) and the -40 (R1063-20, Refurbished H083R). All FRU's in all configurations work similar to the descriptions given in Section 5.1.2. It should be noted however, that some FRU's are interchangeable between configurations and some are not. For this reason, the following information is given. See the parts list (located after the last chapter in volume II) for a complete listing of all parts in this sensor.

5.1.3.1 **FRU's Common to -30 and -40 Configurations**. There are six FRU's that are common to both configurations:

Power Supply, 5VDC	62828-90114-4
Power Supply, AUX	62828-90114-3
Autobalance Assy.	62828-90114-2
Aspirator Assy.	62828-90114-15
Dew Point Sensor Assy	62828-90114-21
Aspirator Housing Assy	62828-90114-22

5.1.3.2 **FRU's Unique to Each Configuration**. The following FRU's are unique to a particular configuration:

-10	(Modified by ECP F004 to become -30.)		
-20	(Modified by ECP F004 to become -40.)		
-30	Transmitter Enclosure 62828-90114-18		
		Transmitter Logic Card	62828-90114-16
		Calibration Assy.	62828-90114-17
-40	Transmitter Enclosure 62828-90114-19		
		Transmitter Logic Card	62828-90114-23
		Calibration Assy.	62828-90114-24

SECTION II. INSTALLATION

5.2.1 **INTRODUCTION**

This Section provides instructions for installing the aspirator and transmitter on the sensor pads. These procedures assume that all support structures and cabling have been previously installed. The installation of the model H083R and model 1088 temperature/dewpoint sensors is identical.

5.2.2 **TEMPERATURE/DEWPOINT SENSOR INSTALLATION**

Before the temperature/dewpoint sensor is installed on the sensor pad, the aspirator and transmitter must be connected to each other using the supplied support arm and the procedures provided in table 5.2.1. The temperature/dewpoint sensor can then be installed on the sensor pad using the procedures provided in table 5.2.2.

Table 5.2.1. Temperature/Dewpoint Sensor Preassembly

Step	Procedure
	Tools and materials required: No. 1 Phillips screwdriver 5/16-inch nut driver/wrench 3/8-inch nut driver/wrench ½-inch nut driver/wrench No. 2 Phillips screwdriver Cable tie wraps
1	Remove aspirator, transmitter, solar shield, and support arm assembly angle brackets with attached hardware from shipping crate.
2	Referencing figure 5.2.1, assemble left and right side angle brackets as follows: a. Separate three different sized angle irons. b. Locate two long angle irons with an X stamped on one end. c. Position angle irons on work surface. d. Locate medium sized angle iron with an X stamped on it. e. Position medium sized angle iron on top of two long angle irons as shown. Using two screws and locknuts, connect angle irons. Do not tighten locknuts. f. Repeat steps b through e for angle irons stamped with an O.
3	Connect mounting bracket stamped with an O to hinged side of transmitter. Install two ½-inch standoffs securing bracket. Do not tighten standoffs.
4	Connect mounting bracket stamped with an X to the other side of the transmitter. Install two ½-inch standoffs securing bracket. Do not tighten standoffs.
5	Position aspirator on mounting brackets with nameplate facing outward (away from transmitter). Install four 3/8-inch locknuts securing aspirator on mounting brackets. Do not tighten locknuts.
6	Using No. 1 Phillips screwdriver, install four screws and 5/16-inch locknuts securing small angle irons to top and bottom of support brackets. Do not tighten locknuts.
7	Using 5/16-inch nut driver and No. 1 Phillips screwdriver, tighten locknuts securing medium and small angle irons to bracket assembly.
8	Using 3/8-inch nut driver, tighten four locknuts securing mounting bracket to aspirator.

Table 5.2.1. Temperature/Dewpoint Sensor Preassembly -CONT

Step	Procedure
9	**CAUTION** Overtightening standoffs may cause threads to break off. Take care not to overtighten standoffs when securing them to transmitter. Using ½-inch nut driver, tighten four standoffs securing mounting bracket to transmitter. Take care not to overtighten standoffs.
10	Position solar shield over transmitter with longest side facing aspirator (figure 5.2.1).
11	Using No. 2 Phillips screwdriver, install four screws, lockwashers, and flat washers securing solar shield to standoffs on transmitter.
12	Connect connector P1 to connector J1 on transmitter.
13	Using cable tie wraps, secure aspirator cable to support arm assembly as shown on figure 5.2.1. Be sure to leave service loop to allow removal of dewpoint sensor assembly without cutting tie wraps.

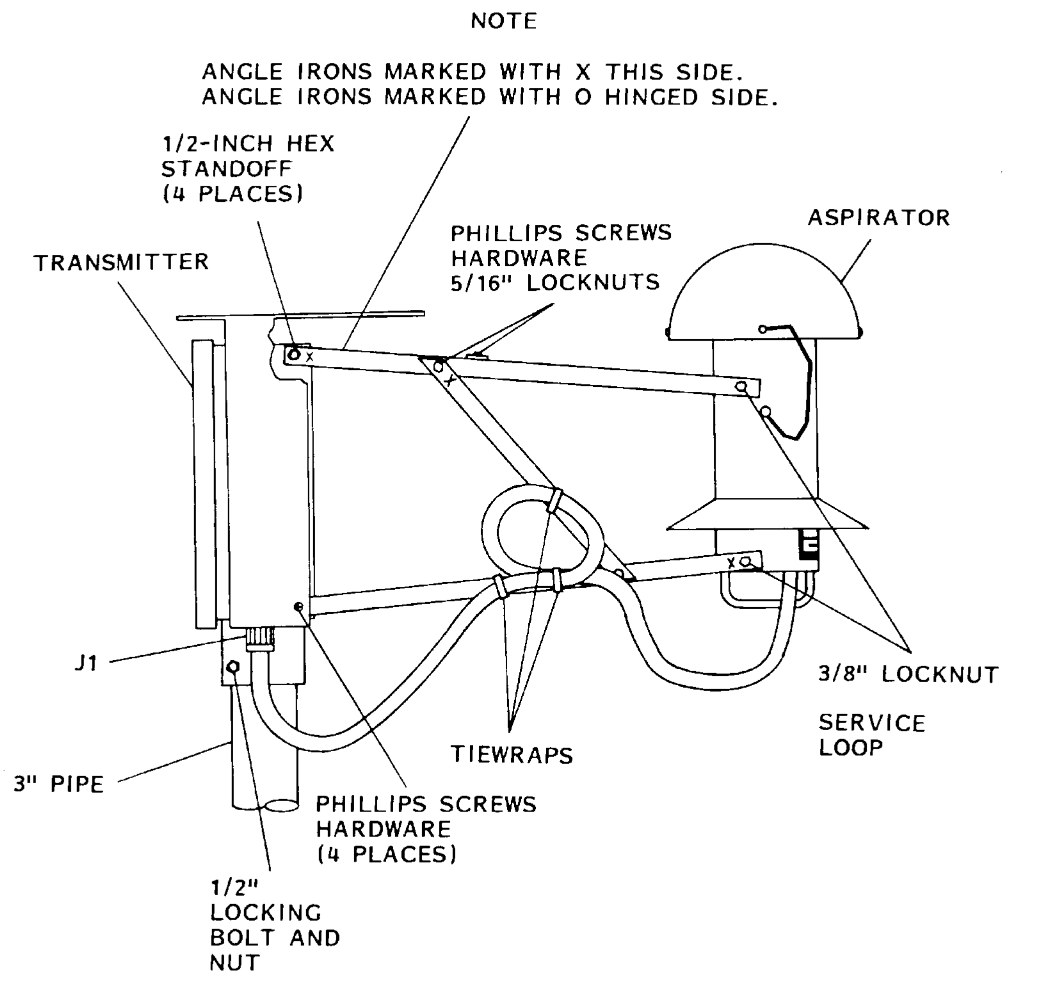

Figure 5.2.1. Temperature/Dewpoint Sensor Installation Diagram

Table 5.2.2. Temperature/Dewpoint Sensor Installation

Step	Procedure
	Tools required: ½-inch wrench Large adjustable wrench Flat-tipped screwdriver No. 1 Phillips screwdriver **WARNING** Death or severe injury may result if power is not removed from sensor prior to maintenance activities. Ensure that circuit breaker (located in DCP) supplying power to sensor is set to off (right) position.
1	Inside DCP equipment cabinet, ensure that circuit breaker on temperature/dewpoint sensor power control module is set to off (right) position.
2	**NOTE** Sensor must be mounted so that aspirator assembly is toward the south, over either grass or bare earth (whichever is the norm for the area, no gravel). Slide transmitter on sensor pad mounting pole and orient sensor so that aspirator faces south (transmitter access door opens north). Using ½-inch wrench, install three mounting bolts securing sensor to mounting pole. Tighten nuts against mounting column to lock mounting bolts in position.
3	Open transmitter access door.
4	Carefully slide ac power and fiberoptic cables through hole in bottom of transmitter. Using large adjustable wrench, secure flexible conduit to transmitter.
5	Using No. 1 Phillips screwdriver, remove two screws and plastic washers securing plastic safety shield over ac terminal board.
6	Connect ac power wiring to transmitter terminal board TB1 according to the following connection chart: Wire color — Terminal — Function Black — TB1-1 — 110 vac White — TB1-2 — Neutral Green — TB1-3 — Chassis ground
7	Using No. 1 Phillips screwdriver, install two screws and plastic washers securing plastic safety shield over ac terminal board.
8	Connect RX connector of fiberoptic cable to RX connector underneath fiberoptic module in transmitter (RX connector on module is nearest DB-9 electrical connector). Connect TX connector on fiberoptic cable to remaining connector on fiberoptic module.
9	At transmitter, set the following controls to the indicated positions: Control — Position Power on/off switch — On (up) Mode switch — OPR Autobalance dial — 000
10	Inside DCP equipment cabinet, set circuit breaker on temperature/dewpoint sensor power control module to on (left) position.
11	At temperature/dewpoint sensor, set power switch to on (up) position. Ensure that display on transmitter is illuminated and that fan in aspirator is operating (fan makes an audible sound). If the correct indications are not observed, remove power from sensor immediately and troubleshoot sensor using procedures provided in Section V of this chapter.
12	Using procedures provided in paragraph 5.5.2.6, check temperature/dewpoint sensor dc power supplies.

$ **Table 5.2.2. Temperature/Dewpoint Sensor Installation -CONT**

Step	Procedure
13	Using procedures provided in paragraph 5.5.2.2, inspect and clean aspirator air passage and mirror.
14	Using procedures provided in paragraph 5.5.2.3, perform optical loop adjustment.
15	Using procedures provided in paragraph 5.5.2.7, calibrate temperature/dewpoint sensor.
16	Using procedures provided in table 5.5.7, perform fan fail monitoring circuit adjustment for model 1088 sensor only. Skip this step for model H083R sensor.
17	Using six holddown clips, close access door at transmitter.
18	At OID, using procedures provided in paragraph 1.3.10, configure the system to accept sensor inputs.
19	Using procedures provided in Chapter 1, perform diagnostic testing of the sensor.
20	After allowing sensor to stabilize its operation, observe 1-minute display to verify sensor operation and data reporting.

SECTION III. OPERATION

5.3.1 INTRODUCTION

Automatic operation of the temperature/dewpoint sensor is controlled by the acquisition control unit (ACU) via the data collection package (DCP). This Section provides turn-on and turnoff procedures and information on operation, checkout, and diagnostic testing of the sensor.

5.3.2 CONTROLS AND INDICATORS

The temperature/dewpoint sensor contains maintenance controls and indicators on the transmit logic board and the calibrator assembly. Descriptions of the test data displayed as part of the system diagnostic test program are provided in Chapter 1. The temperature/dewpoint sensor controls/indicators are illustrated on figure 5.3.1 and described in table 5.3.1.

5.3.3 TURN-ON PROCEDURES

The temperature/dewpoint sensor is designed for continuous operation and normally remains on at all times, except for maintenance or repair. The temperature/dewpoint sensor turn-on procedures are provided in table 5.3.2.

5.3.4 CHECKOUT PROCEDURES

5.3.4.1 **Model H083R Checkout**. The ACU via the DCP continuously monitors the model H083R temperature/dewpoint sensor data for proper format and temperature limits. If the ACU detects a failure, it flags the temperature/dewpoint sensor off-line. Actual testing of the model H083R temperature/dewpoint sensor must be performed manually using the procedures provided in Section V of this chapter.

5.3.4.2 **Model 1088 Checkout**. The ACU via the DCP continuously monitors the model 1088 temperature/dewpoint sensor diagnostic output for failure indications. If the ACU detects a failure, it flags the temperature/dewpoint sensor off-line and enters the appropriate message in the system log. The technician can review the sensor's test data via Temperature/Dewpoint Sensor (Model 1088) Page on the OID, and can prompt specific responses by entering T commands per table 5.5.10. (Byte/bit formats for response words are given in the model 1088 vendor's manual.) For most failures, the diagnostic identifies the faulty field replaceable unit (FRU). If the diagnostic fails to indicate the faulty FRU, the troubleshooting procedures provided in Section V of this chapter should be performed for the model 1088 sensor.

5.3.5 RUNNING DIAGNOSTICS

The ASOS contains diagnostic pages for both the model H083R and 1088 sensors. Because the model H083R does not contain any detailed diagnostics, the display page for this model only provides data on transmission status and watchdog timer failures. The model 1088, however, does contain a complete diagnostic test, which can be performed by using an on-demand diagnostic test as explained in Chapter 1.

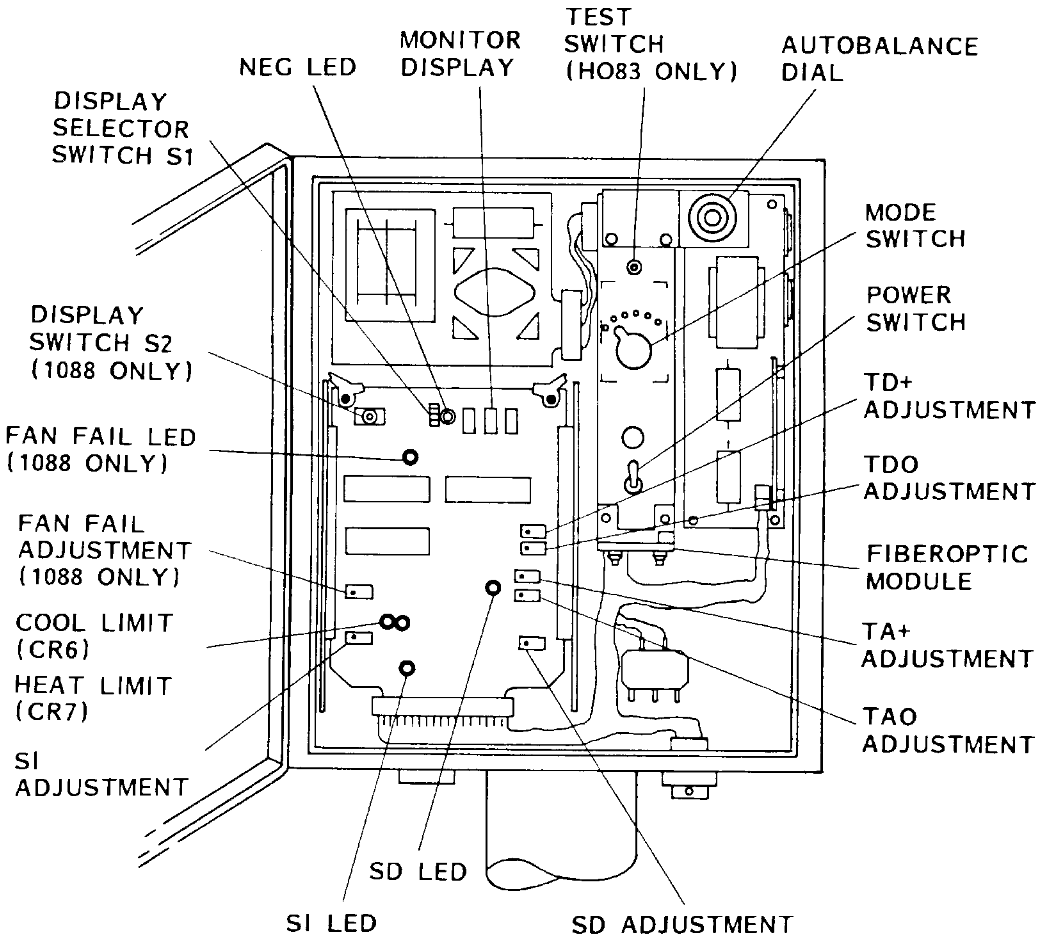

Figure 5.3.1. Temperature/Dewpoint Sensor Controls and Indicators

Table 5.3.1. Temperature/Dewpoint Sensor Controls and Indicators

Control/ Indicator	Type	Description
Transmit Logic Board 2MT4A2A1		
TD+	Variable resistor	Sets gain of dewpoint temperature scaling amplifier.
TDO	Variable resistor	Sets offset of dewpoint temperature scaling amplifier such that with a -5.0V signal applied to scaling amplifier input, output is 0 volts.
TA+	Variable resistor	Sets gain of ambient temperature scaling amplifier.
TAO	Variable resistor	Sets offset of ambient temperature scaling amplifier such that with a -5.0V signal applied to scaling amplifier input, output is 0 volts.
NOTE When DISPLAY SWITCH S2 (model 1088 only) is pressed, normal sensor data transmissions to the DCP are interrupted and the sensor processing algorithm or diagnostic program may log the sensor as missing.		
Monitor Display	Seven-segment display	Displays ambient temperature and dewpoint temperature values for sensor maintenance and calibration. Temperature/dewpoint or ambient temperature readings are selected via DISPLAY SELECT switch S1. For model 1088, DISPLAY SELECT switch S2 must be pressed to display selected temperature.

Table 5.3.1. Temperature/Dewpoint Sensor Controls and Indicators -CONT

Control/ Indicator	Type	Description
DISPLAY SELECTOR S1	Two-position slide switch	Selects either ambient temperature (TA) or dewpoint temperature (TD) values for display on the seven-segment display.
NEG. temperature	Light emitting diode (LED)	When illuminated, indicates that values being displayed on seven- segment display are negative.
COOL LIMIT	LED	When illuminated, indicates that system is in a maximum cooling condition.
HEAT LIMIT	LED	When illuminated, indicates that system is in a maximum heating condition.
SI GAIN	Variable resistor	Enables indirect sensor amplifier gain adjustment. During system calibration, SI GAIN is adjusted until SI LEVEL indicator illuminates.
SD GAIN	Variable resistor	Enables direct sensor amplifier gain adjustment. During system calibration, SD GAIN is adjusted until SD LEVEL indicator illuminates and then extinguishes.
SI LEVEL	LED	Indicates when indirect signal (SI) is above threshold. With a dry mirror, should be off. For normal operation, should be on.
SD LEVEL	LED	Indicates when direct signal (SD) is above threshold. With a dry mirror, should be on. For normal operation, should be off (or flickering).
FAN FAIL (model 1088)	LED	When illuminated, indicates a fan failure. Also used during fan sensor calibration to set threshold level of detection circuit.
FAN FAIL (model 1088)	Variable resistor	Enables detection threshold of fan sensor circuit to be adjusted.
NOTE When DISPLAY SWITCH S2 is pressed, normal sensor data transmissions to the DCP are interrupted and the sensor processing algorithm or diagnostic program may log the sensor as missing.		
DISPLAY SWITCH S2 (model 1088)	Momentary switch	When pressed, causes monitor display to indicate current dewpoint temperature or ambient temperature, as selected by DISPLAY SELECTOR switch S1.
TEST (model H083R)	Momentary toggle switch	When pressed, enables the temperature dewpoint mirror temperature to be forced to a high or low temperature for testing purposes. When released, returns to the center position, which enables the system to return automatic temperature control of the mirror.
MODE (model H083R)	Four-position rotary switch	Enables precision resistors to be substituted in place of the resistive temperature sensors for testing and checking the accuracy of the instrument circuits. During normal operation of the sensor, must be set to OPR.
Calibrator Assembly 2MT4A2A2		
MODE (model 1088)	Six-position rotary switch	When set to TEST 0 or TEST 50, enables precision resistors to be substituted in place of resistive temperature sensors for testing and checking accuracy of instrument circuits. During normal operation of the sensor, must be set to OPR. When set to HEAT or COOL, enables the temperature dewpoint mirror temperature to be forced to a high or low temperature for testing purposes. When set to SENSOR TEST, disables mirror cool circuitry, which enables mirror temperature to stabilize at ambient air temperature. Under this condition, TD and TA readings should be the same (±1 degree). This verifies that TD and TA sensors function properly.
Autobalance	Dial	Indicates current autobalance setting and allows manual reset of autobalance during calibration.
FUSE	Two-ampere main power fuse	Controls 115 vac power to aspirator and transmitter.
POWER	Two-position toggle switch	Controls 115 vac power to aspirator and transmitter. Power is applied when set to the up position.

Table 5.3.2. Temperature/Dewpoint Sensor Turn-On Procedures

Step	Procedure
	Tools required: Large flat-tipped screwdriver
1	Using large flat-tipped screwdriver, open temperature/dewpoint sensor transmitter access door.
2	On calibrator assembly, ensure that MODE switch is set to OPR and POWER switch is set to on (up) position.
3	Inside DCP equipment cabinet, set circuit breaker on temperature/dewpoint sensor power control module to on (left) position. Model H083R monitor display on transmit logic board illuminates and begins to update at 18.75-second interval. After approximately 5 minutes, the display stabilizes. Model 1088 monitor display illuminates and displays the word OFF.
4	Using large flat-tipped screwdriver, close and secure temperature/dewpoint sensor transmitter access door.

5.3.6 NORMAL OPERATING PROCEDURES

The temperature/dewpoint sensor is in continuous operation under the control of the DCP. The temperature and dewpoint temperature readings are displayed in the TEMP/DEWPT field on the 1-minute display at the OID.

5.3.7 TURNOFF PROCEDURES

The temperature/dewpoint sensor should be turned off for maintenance purposes only using the procedures provided in table 5.3.3.

Table 5.3.3. Temperature/Dewpoint Sensor Turnoff Procedures

Step	Procedure
	Tools required: Large flat-tipped screwdriver
1	Inside DCP equipment cabinet, set circuit breaker on temperature/dewpoint sensor power control module to off (right) position.
2	Using large flat-tipped screwdriver, open temperature/dewpoint sensor transmitter access door.
3	On calibrator assembly, set POWER switch to OFF (down) position.
4	Using large flat-tipped screwdriver, close and secure temperature/dewpoint sensor transmitter access door.

SECTION IV. THEORY OF OPERATION

5.4.1 **INTRODUCTION**

This Section describes how the model H083R and 1088 hygrothermometers convert physical stimuli (temperature and dewpoint), as received from the aspirator, into usable data for transmission to the data collection package (DCP). System theory of operation for both sensors is identical and is divided into two parts. The first part describes how the ambient temperature and dewpoint temperature measurements are performed within the aspirator. The second part describes the temperature/dewpoint sensor on a detailed block diagram level. The model 1088 diagnostic circuitry is explained separately.

5.4.2 **TEMPERATURE/DEWPOINT SENSOR MEASUREMENT SYSTEM CONCEPTS DESCRIPTION**

The temperature/dewpoint sensor uses a temperature-controlled mirror with an imbedded heat sensor and an optical system to detect temperature dewpoint levels. The temperature dewpoint sensor system is illustrated on figure 5.4.1 and contains a thermo/mirror module; an optical system consisting of a lamp, direct sensor, and indirect sensor; and a temperature module control circuit consisting of amplifier/detectors, a summing amplifier, and power amplifiers.

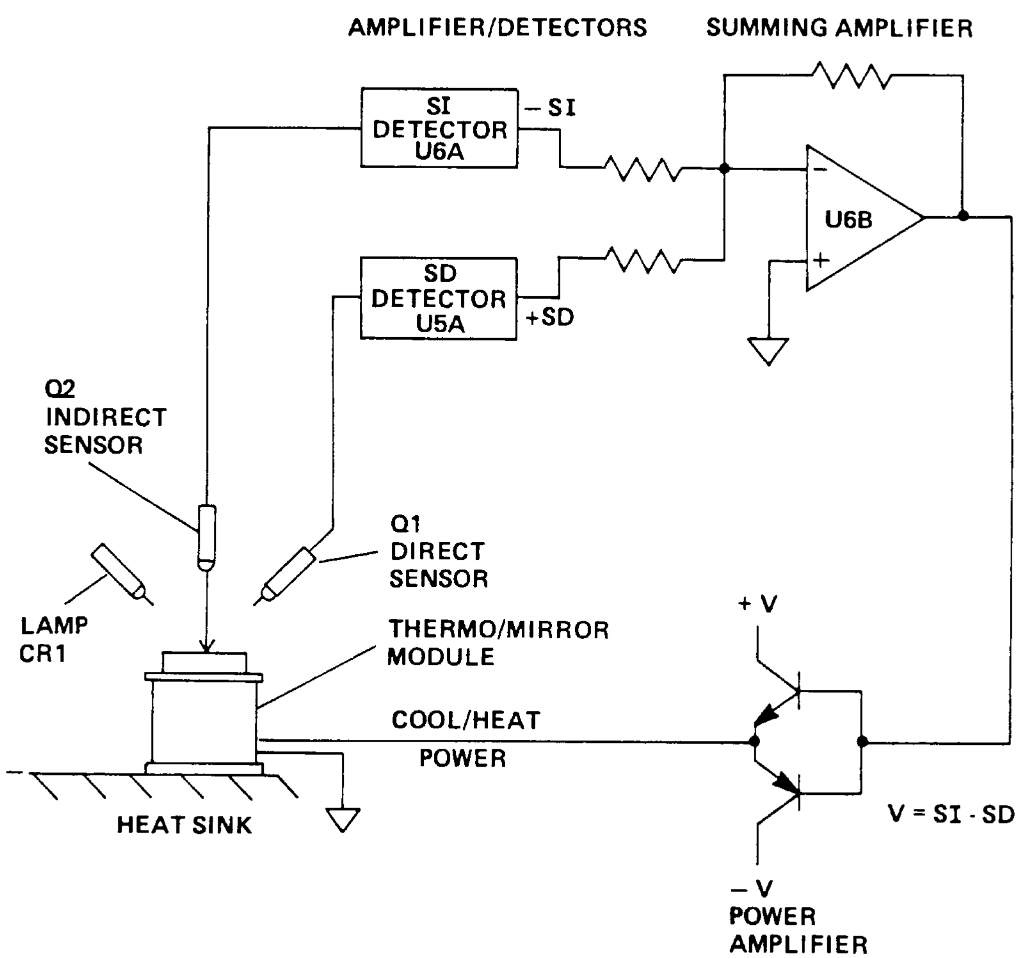

Figure 5.4.1. Dewpoint Temperature Thermal Control Loop

A light beam from a small infrared diode (CR1) is directed at the surface of a mirror at an angle of 45 degrees. Two photo transistors, Q1 and Q2, are mounted as shown to receive the reflected light. Transistor Q1, the direct sensor, is placed so that it receives a high degree of light when the mirror is clear. Transistor Q2, the indirect sensor, is placed so that it is sensitive to light that is scattered when the mirror is clouded with visible condensation. As the degree of cloudiness of the mirror surface increases, transistor Q1 tends to receive less light and Q2 tends to receive more light.

A pair of identical signal amplifier/detectors, U5A and U6A, drives a differential control amplifier, U6B. The output of this high-gain amplifier is negative when the mirror is clear and positive when the mirror is clouded because of the relative difference between the outputs of transistors Q1 and Q2.

The output of amplifier U6B, through a power amplifier, drives the mirror cooling module, U1. This device is an electronic heat pump that operates much like a thermocouple in reverse. With a dc voltage applied across the terminals, the module produces a temperature difference between its flat surfaces. Depending on the polarity of the applied voltage, the thermal module can produce a heating or cooling effect.

The feedback loop is effectively closed by the physical phenomenon of formation of condensate on the mirror as it is cooled by the thermal module. When the sensor is first turned on, the mirror is clear and transistor Q1 receives a high level of directly reflected light, and transistor Q2 receives little scattered light. This condition causes a large negative unbalance signal at the output of amplifier U6B, causing a heavy current to flow through the thermal module in the cooling direction. The unbalanced condition remains, typically for approximately 1 minute, until the mirror surface temperature has reached the dewpoint temperature. At the dewpoint temperature, the output of transistor Q1 decreases and the output of Q2 increases because of the visible effect of condensation on the mirror. The system then stabilizes at the dewpoint temperature, maintaining just enough cooling effect to keep the signal levels from transistors Q1 and Q2 in balance, with amplifier U6B and the power amplifier supplying just enough cooling current to maintain the mirror temperature at the dewpoint. If the dewpoint of the air changes or if the circuit is disturbed by noise, the loop makes the necessary corrections to restabilize at the dewpoint. The system is designed for continuous operation.

The basic operation of both the model H083R and 1088 hygrothermometers is performed by the simplified circuitry illustrated on figure 5.4.1. The remainder of the system contains the circuitry necessary to monitor the temperatures of the mirror and the ambient temperature. The system encodes that information and transmits it to the DCP. The system contains additional circuits for calibration and display of maintenance data. These circuits are described in the detailed block diagram description of the temperature/dewpoint sensor provided in paragraph 5.4.3.

5.4.3 **DETAILED BLOCK DIAGRAM DESCRIPTION**

5.4.3.1 **General**. The temperature/dewpoint sensor (figure 5.4.2 for H083R and 5.4.3 for 1088) makes ambient and dewpoint temperature readings, encodes the readings into a digital format, and transmits the digitally encoded measurement data to the DCP. The temperature/dewpoint sensor consists of two major assemblies: the aspirator and the transmitter.

5.4.3.2 **Aspirator 2MT4A1**. The aspirator contains two thermo resistors. One thermo resistor measures ambient temperature and the other measures dewpoint temperature. The ambient temperature resistor is mounted directly in the incoming air stream and is connected to the transmitter via a cable. The dewpoint temperature resistor is embedded in the mirror, whose temperature is electronically controlled to remain at the dewpoint. Temperature control of the mirror is performed by optical sensors and a thermoelectric heat pump. Optical sensor direct and indirect output signals are sent to the transmitter, which sends control signals via the auxiliary power supply to the thermoelectric heat pump to control the temperature of the mirror. The control signals are applied to the thermoelectric heat pump via pins P and R of connector J1. A positive voltage at pin J1-R indicates a heating condition; a negative voltage indicates a cooling condition.

5.4.3.3 **Transmitter 2MT4A2**. The transmitter contains the system power supply, control circuits, and calibration circuits. The transmitter receives the temperature data and converts the data into digital measurement data, which are transmitted to the DCP.

Calibrator Assembly MT4A2A2 routes the ambient sensor (TA) and the dewpoint sensor (TD) or special calibrator signals to the transmit logic board measurements circuits. In the model H083R, during system calibration or troubleshooting, the calibrator assembly enables the selection of one of three standard resistor values. These three values simulate temperatures of -50, 0, and +50 degrees Celsius (°C). When in the -50°C position, TA indicates -50 and TD indicates -55.5. The reason for the difference is that the dewpoint channel has been compensated to indicate dewpoint, not frost point, below 0°C. In the model 1088, during system calibration or troubleshooting, the calibrator assembly enables the selection of one of two standard resistor values. These values simulate temperatures of 0°C (32°F) and +50°C (122°F). The °F values are displayed on the monitor display (122 displayed as 22.0). In addition, the model 1088 sensor contains a calibration select circuit that enables the sensor to automatically select the calibration resistors when it runs its diagnostic test. The circuit consists of four relays that are controlled by calibration select signals, which are received from the transmit logic board. These control signals are active when the mode select switch is set to the OPR position. When a calibration check of model 1088 is performed automatically, the resulting TA and TD values are retained on the 1088 OID page.

The temperature input amplifiers receive the TA and TD sensor input signals and are configured as standard operational amplifiers. The TA and TD sensor resistive inputs serve as the feedback resistors for the amplifiers. A 6.2V reference signal is fed through 1240-ohm input resistors to the amplifiers. The output of the amplifiers depends on the ratio of the input resistors to the resistance of the TA and TD sensors. At 0°C, the sensor's resistance is 100 ohms; therefore, the output of the amplifiers is -0.5V. These signals are applied to the TA and TD scaling circuits, which offset the inputs by 0.5V such that a -0.5V input signal results in a 0V output from the scaling circuits. The gain of the scaling amplifiers is set such that a ±50°C input from the sensors results in a ±2V output signal from the scaling amplifiers. The TA0 and TD0 offset variable resistors enable the offset of the scaling circuit to be set at +0.5V. The TA+ and TD+ gain variable resistors enable the gain of the amplifiers to be set to 20. Proper adjustment of these resistors is performed during sensor calibration.

The TD/TA select logic receives the TA and TD signals from the scaling amplifiers and a temperature select signal from the temperature processing control processing unit (CPU). Based on the state of the temperature select signal, the TD/TA select logic selects either the TA or TD signal and applies it to the analog to digital (A/D) temperature converter.

The A/D temperature converter measures the TD/TA input and converts it to a 12-bit digital word, which is routed to the temperature processing CPU. The measurement cycle is started by the CPU, which issues a RUN command. During this measurement cycle, the A/D converter activates the status line with a busy signal, which remains active until the measurement cycle is completed. When the busy status is removed, the CPU activates the hold signal and reads the digitally encoded temperature data from the A/D converter. The cycle is then repeated. In addition to performing the measurement function, the A/D temperature converter also provides a 2.458 MHZ system clock signal to the measurement processing and display CPU's.

The heat pump control circuit receives the sensor direct and sensor indirect signals from the mirror/dewpoint temperature sensor circuit and sums these signals to generate heat/ cool commands for application to the auxiliary power supply. The heat pump control circuit also applies a signal to the heat limit detect circuit, which monitors the heat pump control circuit heat/cool circuitry. If either circuit fails, the heat limit detect circuit activates an error signal to the CPU, which responds by sending an error message to the DCP. The CPU also monitors the TD sensor measurement data. If this measurement indicates a TD reading of 65°C or greater, the CPU activates the cool protect command to force the heat pump control circuit into a cool condition to protect the mirror assembly. During system calibration, the heat pump control circuit is overridden by heat/cool switch S2 on the model H083R or the mode switch on the model 1088. Overriding the heat pump control circuit in this manner illuminates one of the heat limit indicators on the transmit logic board. This is a normal condition due to the 12V drive signal being applied to pin 5 during calibration.

The auxiliary power supply provides the heat/cool current to the thermoelectric heat pump, ac lamp voltage to the LED in the mirror/dewpoint temperature sensor circuit, and ±12V power to the autobalance module and transmit logic board. Two types of auxiliary power supplies are used in the temperature/dewpoint sensor. Although the power supplies perform the same functions and are interchangeable, the circuitry used to generate the ±12V outputs is different. The part numbers of these two supplies are the only way to distinguish between the two. The heat/cool current to the thermoelectric heat pump is controlled by the heat/cool command from the heat pump control circuit. When the heat/cool command is positive, the auxiliary power supply outputs a pulsating positive dc signal to the thermoelectric heat pump. When the heat/cool command is negative, the auxiliary power supply outputs a negative cool signal to the thermoelectric heat pump. Auxiliary power supply P/N 1063-2031 generates the ±12V outputs by utilizing an internal oscillator, which is driven by the +5V input from the +5 volt power supply. Auxiliary power supply P/N 1063-06B generates the ±12V output by utilizing a full wave rectifier, which is powered by the 115 vac input.

The maintenance display circuit consists of a display CPU, display select switch S1, display switch S2 (model 1088 only), a polarity indicator, and a 3-digit display. The display CPU receives the serial temperature data from the temperature processing CPU. The display CPU converts the data into the proper format to drive the 3-digit display. The display select switch enables either TD or TA temperature data to be displayed by routing the respective data strobe to the 3-digit display. For model 1088, display switch S2 must be pressed in order to display TA or TD as selected by display select switch S1. As shown on sheet 2 of figure 5.4.3, pressing display switch S2 also opens the path of serial data to the DCP. This may cause the DCP to miss responses to data requests. As such, the DCP CST may register transmission errors for the SIO port corresponding to the model 1088 sensor. This is a normal occurrence when display switch S2 is pressed and should not be considered as an actual sensor failure.

The temperature processing CPU controls measurement of the TA and TD data, transmits the TA and TD data to the display CPU and DCP, monitors the heat pump control circuit, and activates the autobalance circuit.

The autobalance module cancels the effects of contaminations on the mirror by applying a fixed dc offset voltage to the heat pump control circuit. The dc offset voltage cancels the indirect sensor error signal being received from the mirror/dewpoint temperature sensor circuit. The autobalance circuit is activated once every 24 hours by the temperature processing CPU. The balance cycle is initiated by the CPU, which activates the heat command signal that is applied to the heat pump control circuit, forcing the circuit into a heat mirror cycle. The heat command signal remains active for 5 minutes to ensure that all moisture has been driven off the mirror. The CPU then enables the balance enable signal, which in turn activates the autobalance circuit. If the mirror is dirty, the heat/cool signal remains in a heating state because the sensor circuit is still trying to clear the mirror. This positive signal is applied to the motor control circuit, which in turn generates a balance offset dc voltage. This voltage is applied back to the heat pump control circuit. The enable signal remains active for 15 seconds, which is adequate time for the autobalance circuit to stabilize. At the end of the cycle, the balance offset signal remains fixed and acts as an offset value to cancel the effects of the indirect sensor signal trying to drive the thermoelectric heat pump into a heat condition. Each time the autobalance circuit is activated, it attempts to eliminate the effects of contaminations on the mirror by repeating this cycle. During maintenance, after the mirror is cleaned, the technician must physically reset the autobalance circuit by returning the autobalance bias resistor to its zero position.

The model 1088 sensor diagnostic circuitry (figure 5.4.3) consists of a critical voltage monitoring circuit, a fan fail monitoring circuit, a dirty mirror monitoring circuit, and remote select logic circuitry. The model 1088 critical voltage monitoring circuit uses comparator circuitry to monitor the outputs from the +5 volt power supply and the auxiliary power supply. The critical voltage monitoring circuit receives +12V, -12V, +5V, and -5V values and compares the sum of these voltages to a fixed reference voltage. If any of the voltages falls below a predefined value, the comparator generates a critical voltage error signal, which is monitored by the temperature processing CPU.

The model 1088 fan fail monitoring circuit uses a comparator circuit to monitor the values of two thermal resistors located in the aspirator. Only one of these resistors is located in the airflow of the fan. The cooling effect of the airflow creates a resistive difference between the two resistors. The comparator monitors these resistive values. If the two values become equal, the fan fail monitoring circuit generates a fail signal and applies it to the temperature processing CPU.

The model 1088 dirty mirror monitoring circuit monitors the balance offset signal at pin 5 of the transmit logic board. When this signal exceeds approximately 0.5V, the dirty mirror monitoring circuit activates the dirty mirror signal and applies it to the temperature processing CPU. The 0.5V balance offset signal is reached when the value on the autobalance dial is between 450 and 550.

The model 1088 remote select logic circuitry enables the temperature processing CPU to select the TEST 0, TEST 50, and SENSOR TEST functions during the automatic diagnostic. The CPU activates one of the relay control signals, which applies a 5V drive signal to the respective select relay on the calibrator assembly. The CPU monitors the position of the calibrate switch via the op mode error signal, which is applied from the calibrator assembly to pin 7 on the transmit logic board. During normal system operation, the op mode error signal should be at a logic 0, indicating that the calibrate switch is set to the OPR position.

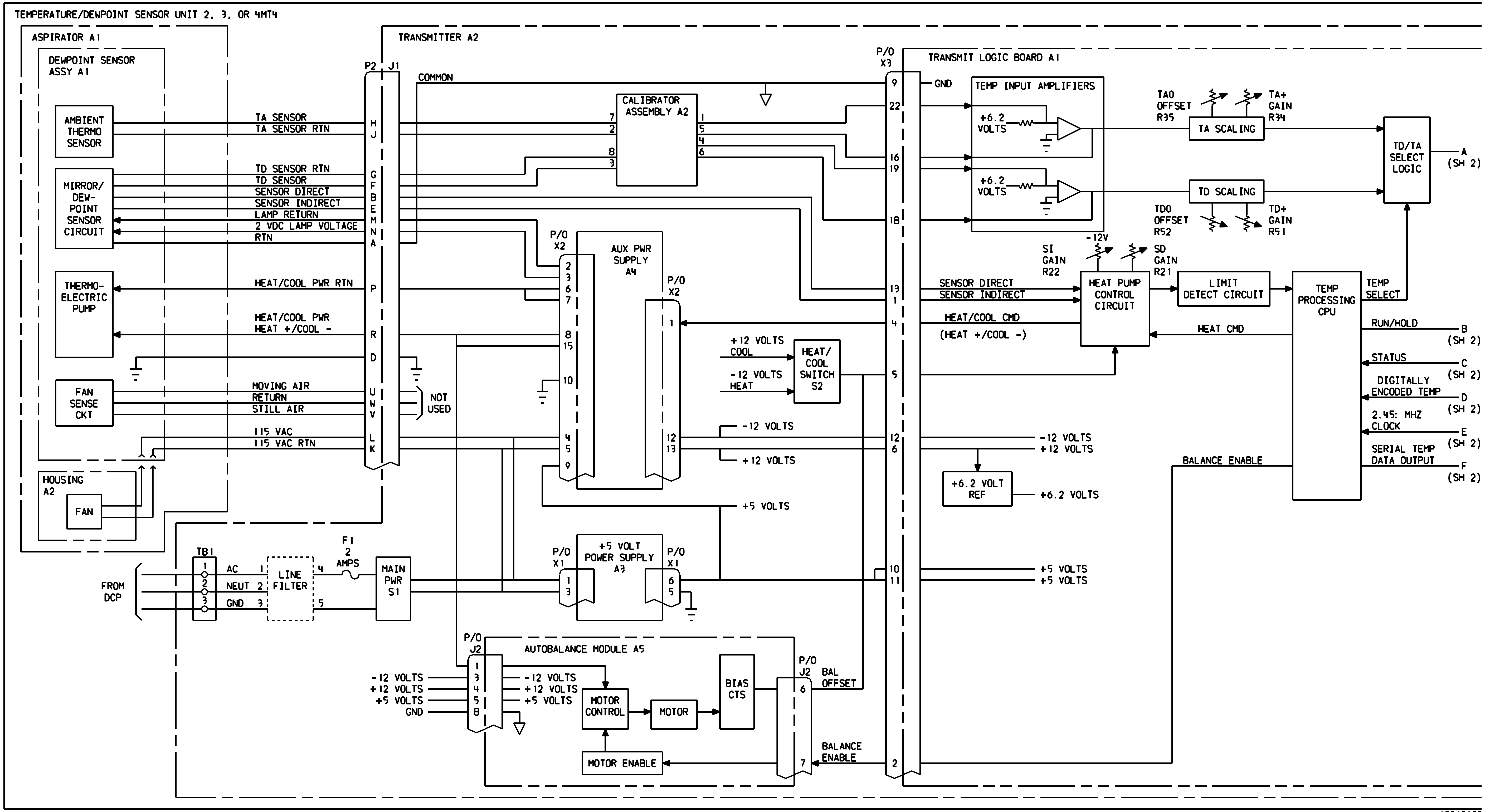

Figure 5.4.2. H083R Temperature/Dewpoint Sensor Detailed Block Diagram (Sheet 1 of 2)

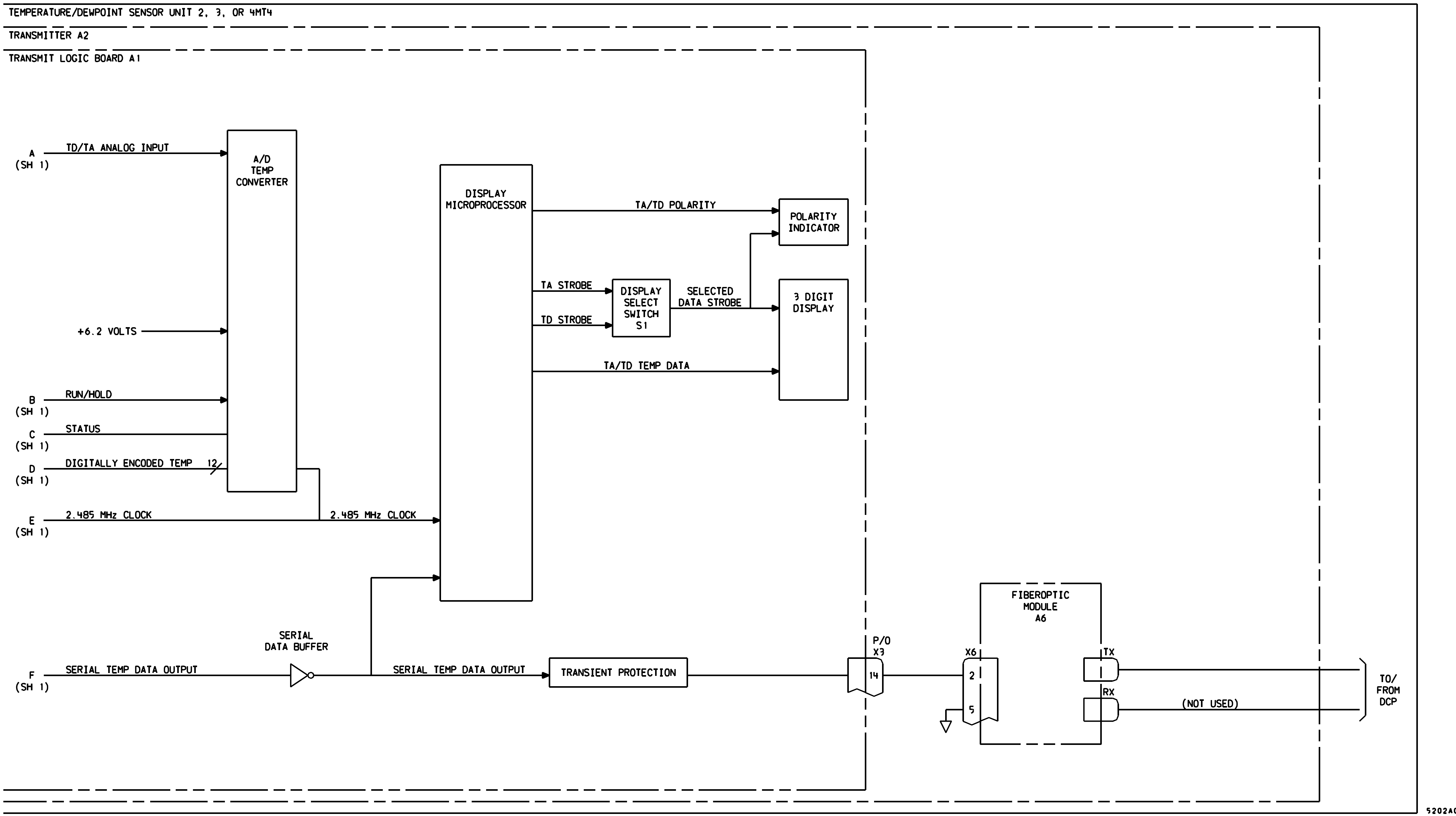

Figure 5.4.2. H083R Temperature/Dewpoint Sensor Detailed Block Diagram (Sheet 2)

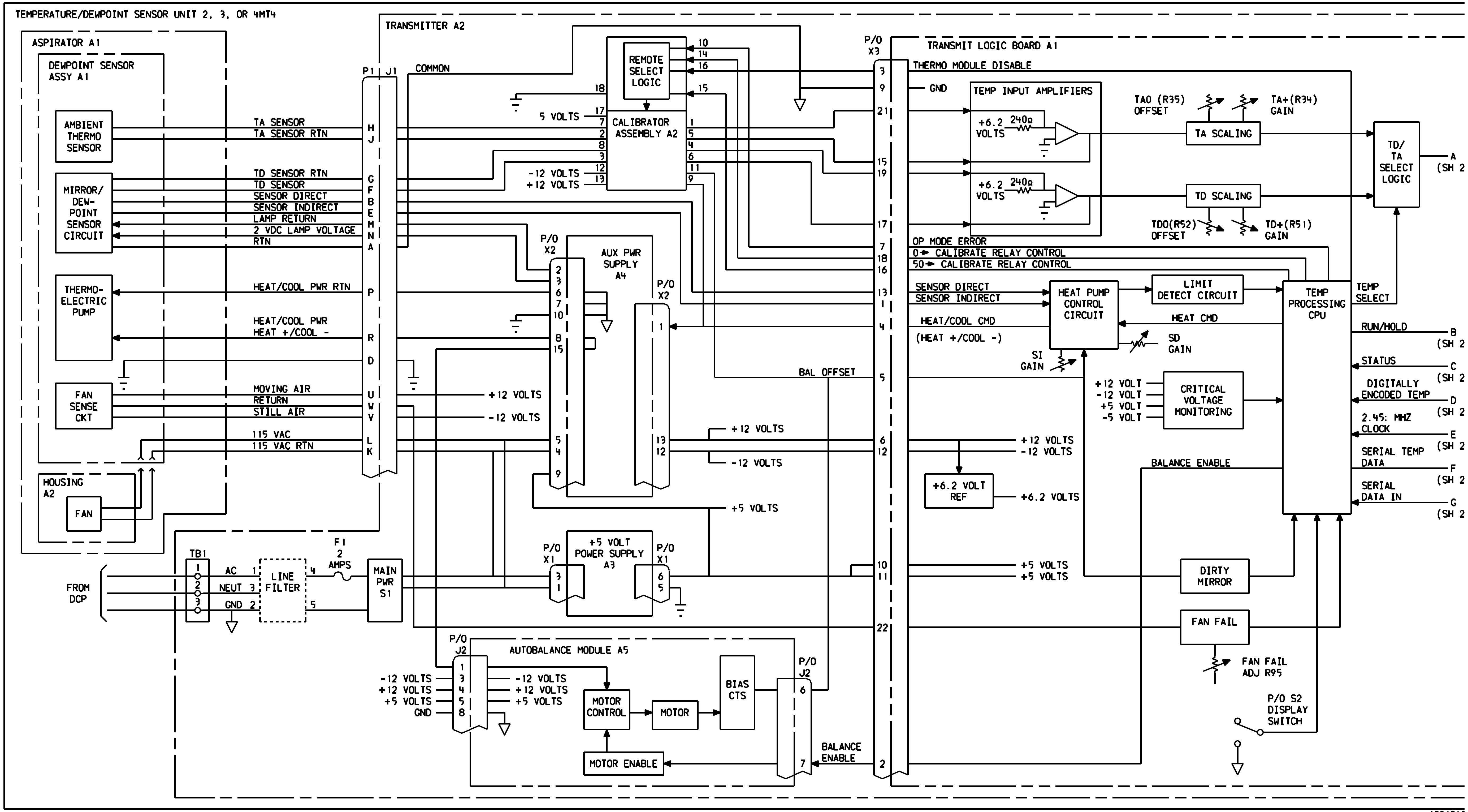

Figure 5.4.3. 1088 Temperature/Dewpoint Sensor Detailed Block Diagram (Sheet 1 of 2)

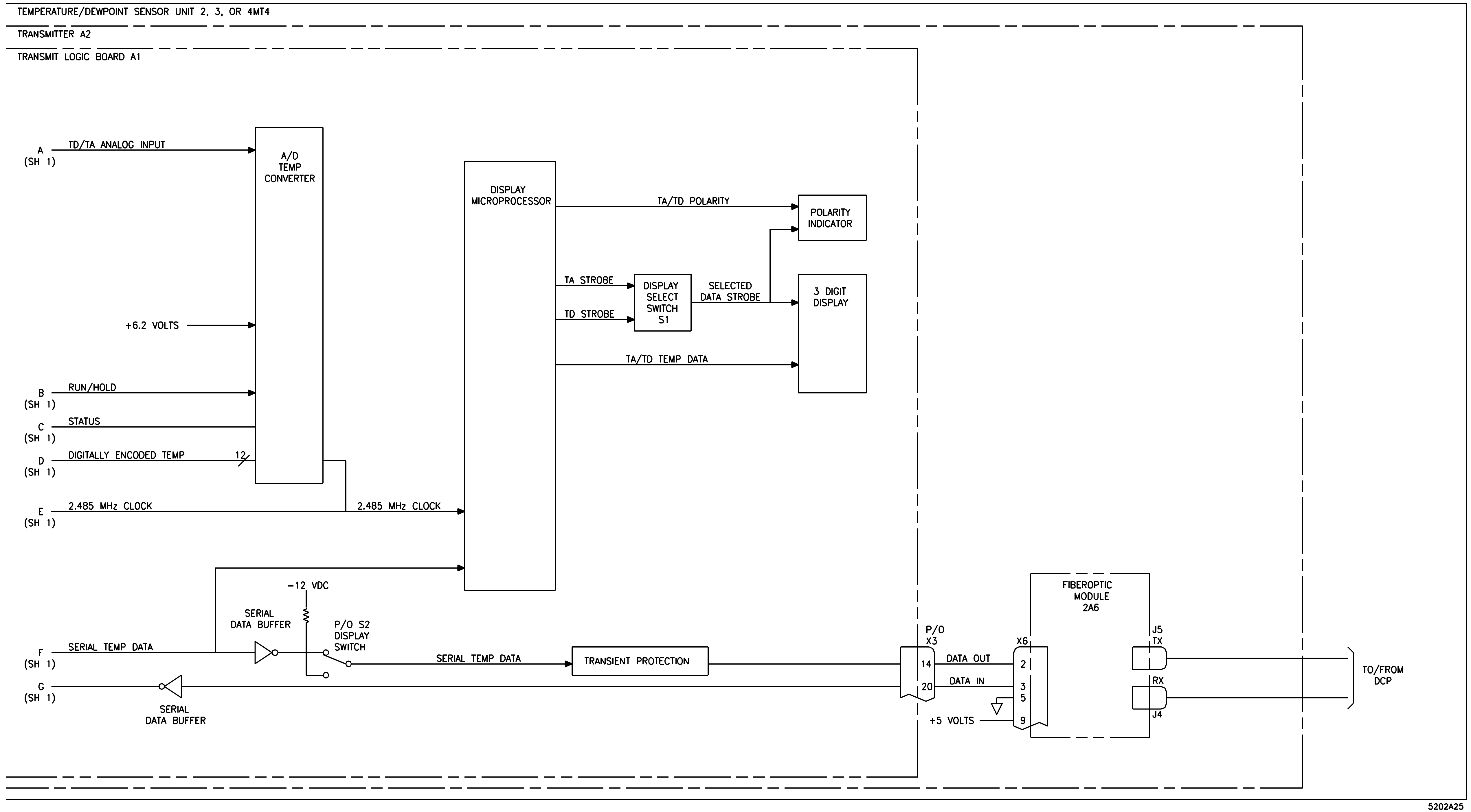

Figure 5.4.3. 1088 Temperature/Dewpoint Sensor Detailed Block Diagram (Sheet 2)

SECTION V. MAINTENANCE

5.5.1 INTRODUCTION

This Section contains the preventive and corrective maintenance procedures for the temperature/dewpoint sensor. Preventive maintenance consists of checking/cleaning the aspirator air passages and mirror and calibrating the instrument. Corrective maintenance consists of those procedures required to fault isolate to a faulty field replaceable unit (FRU) in the temperature/dewpoint sensor. Malfunctions within the temperature/dewpoint sensor are identified by the ASOS diagnostic test. When performing preventive and corrective maintenance on the model 1088 sensor, display switch S2 must be pressed to display TA or TD readings. Pressing this switch interrupts serial data to the DCP, which may result in SIO port failure indications. This is normal, and these failures should be cleared by the technician after completing maintenance actions.

5.5.2 PREVENTIVE MAINTENANCE

5.5.2.1 **General**. A list of the preventive maintenance functions for the temperature/dewpoint sensor is provided in table 5.5.1.

Table 5.5.1. Temperature/Dewpoint Sensor Preventive Maintenance Schedule

Interval	What To Do	How To Do It
90 days	Clean/inspect aspirator air passages.	Paragraph 5.5.2.2
	Clean/inspect aspirator mirror.	Paragraph 5.5.2.2
	Perform optical loop adjustment.	Paragraph 5.5.2.3
	Verify temperature and dewpoint readings.	Paragraph 5.5.2.4
Semiannually	Test and adjust fan fail monitoring circuit (1088 only).	Paragraph 5.5.2.5
	Check dc power supplies.	Paragraph 5.5.2.6
	Calibrate sensors.	Paragraph 5.5.2.7

5.5.2.2 **Aspirator Cleaning and Inspection**. Because of the continuous flow of outside air through the aspirator, the air passages on the aspirator may become clogged with dust, leaves, etc. The optical mirror also gradually acquires a film of contamination, which, if not removed, impairs performance. The performance of the dewpoint sensor is directly dependent on the use of the proper cleaning agents and procedures for the mirror. Many dewpoint maintenance problems can be traced directly to improper mirror cleaning even though they appear to be hardware failures. The various contaminants that can accumulate on the mirror surface have different effects on sensor performance. Contaminants that consist primarily of particles such as dust and pollen have the least effect on performance; the sensor tolerates a substantial layer of these contaminates because they have a relatively small effect on the formation of the dew layer. There are other types of contaminants, however, that have a disastrous effect on the sensor. The contaminants known to cause serious performance problems are cleaning compounds such as detergents, soaps, and ammonia; oily substances such as skin oil and petroleum products; and substances that have an affinity for water (e.g., any of the various salts including common salt). By interfering with the formation of the dew layer, these contaminants cause performance problems that include mirror icing and elevated dewpoint temperatures. To prevent these problems, the aspirator must be cleaned using the procedure provided in table 5.5.2.

Table 5.5.2. Aspirator Cleaning

Step	Procedure
	Tools and materials required: Large flat-tipped screwdriver Cotton swabs Distilled water Kit Carnauba Wax (Northern Labs Inc.) Isopropyl alcohol (ASN 052-C-12) **CAUTION** Internal components of aspirator are delicate and must be handled with care. Excessive mechanical shocks can cause permanent damage. **NOTE** Laptop computer initialized as DCP OID (Chapter 3) or any other available OID may be used for the following procedure. Wax the mirror after every cleaning. Do not wax the mirror if the mirror has not been cleaned. In a cold environment, the waxing procedure should be performed in a warm enclosed area.
1	At OID, sign on as a maintenance technician and display sensor status page (sequentially press REVUE-SENSOR-STAT function keys from 1-minute display).
2	On sensor status page, set report processing for temperature/dewpoint sensor to OFF.
3	Using large flat-tipped screwdriver, open transmitter access door and remove ac power by setting POWER switch to OFF (down) position.
4	Remove dewpoint sensor assembly from aspirator by loosening captive screw on side of unit. Slide dewpoint sensor assembly downward and out of aspirator housing.
5	Clean unit air passages by wiping with clean rag or blowing clean with compressed air.
6	**CAUTION** Do not scratch mirror surface when cleaning. Under no circumstances should soap or soapy detergent be used on the mirror. Soap seriously impairs the ability of the mirror surface to form a film of condensate necessary for dewpoint detection. Apply power to sensor by setting POWER switch to ON (up) position.
7	Set DISPLAY SELECTOR switch to TD position. While monitoring seven-segment display, heat mirror above ambient temperature (for model H083R, use TEST switch; for model 1088, use MODE switch). Remove power from sensor by setting POWER switch to OFF (down) position.
8	Set autobalance potentiometer to 0 position.
9	Using clean cotton swab and distilled water, thoroughly wet mirror surface and wash with gentle circular motion. Using clean dry swab, immediately wipe the wet surface until dry and all loosened material is removed. Continue the wet swab and dry swab process until it no longer has a cleaning effect. The use of the dry swab is essential to the cleaning process because it removes the loosened contaminants which would otherwise remain on the mirror. For colder temperatures, it may be necessary to disconnect dewpoint sensor assembly from transmitter enclosure and perform the cleaning in a warmer place.
10	Repeat step 9 using the approved isopropyl alcohol (ASN 052-C-12). Repeat the wet swab and dry swab process until it no longer has a cleaning effect.
11	Use a clean swab to apply a small amount of wax to mirror surface. Use a circular motion to ensure that a thin, even coat of wax is applied to the mirror surface. Use care to prevent wax from getting into the optic block holes for the LED and photo transistors.
12	Allow wax to dry to a hazy finish.
13	Use a clean swab to buff mirror to a smooth, shiny surface free of any excess wax.

Step	Procedure
14	Use another clean swab to clean up any access wax around the mirror especially around the edge of the card around the mirror and on the optical block. Confirm that the optic block holes for the LED and photo transistors are not blocked by wax.
15	Install sensor/fan assembly in aspirator housing and secure with captive screw.
16	At transmitter, apply ac power to sensor by setting POWER switch to ON (up) position. Seven-segment display illuminates and fan in aspirator begins to operate.
17	Repeat step 7 to heat mirror to 20 degrees Fahrenheit (°F) above ambient temperature or 52°F, whichever is higher.
18	Using procedures provided in paragraph 5.5.2.3, perform optical loop adjustment.

5.5.2.3 **Optical Loop Adjustment**. The optical loop adjustment consists of adjusting the gains of the direct and indirect sensor amplifiers so that the mirror thermocontrol loop can properly maintain the mirror temperature at dewpoint. The optical loop adjustment should be performed whenever the aspirator or transmit logic board is serviced or replaced. Optical loop adjustment procedures for the model H083R and model 1088 are provided in tables 5.5.3 and 5.5.4, respectively.

Table 5.5.3. Model H083R Temperature/Dewpoint Sensor Optical Loop Adjustment

Step	Procedure
	Tools required: Small flat-tipped screwdriver Large flat-tipped screwdriver **CAUTION** Internal components of aspirator are delicate and must be handled with care. Excessive mechanical shocks can cause permanent damage.
1	Clean aspirator using the procedure in table 5.5.2. Do not reapply ac power.
2	Install the sensor/fan assembly in aspirator housing and secure with captive screw.
3	Using large flat-tipped screwdriver, open temperature/dewpoint sensor transmitter access door.
4	Reset autobalance variable resistor to zero.
5	Apply power to sensor by setting POWER switch to ON (up) position.
6	**NOTE** The adjustments made in this Section must be performed with a completely dry mirror. Ensure that mirror is dry by heating it for a minimum of 1 minute initially, then keeping the mirror temperature above ambient (TA) using the HEAT position of the TEST switch. The measurements and adjustments described in steps 6 and 7 must not be made while heating the mirror. Therefore, it is necessary to monitor the mirror temperature (TD), via the seven-segment display, and heat as necessary to ensure that TD is greater than TA, while making the measurements and adjustments between the heating cycles. Turn SD GAIN variable resistor (R21) CCW until SD LEVEL LED (CR5) extinguishes then turn CW until SD LEVEL LED illuminates.
7	Adjust SI GAIN variable resistor (R22) CW until SI LEVEL LED (CR9) illuminates, then turn CCW until SI LEVEL LED extinguishes.
8	Ensure that CALIBRATOR switch is set to OPR position.
9	Using large flat-tipped screwdriver, close and secure temperature/dewpoint sensor transmitter access door.
10	On sensor status page at OID, turn on report processing for temperature/dewpoint sensor.

Table 5.5.4. Model 1088 Temperature/Dewpoint Sensor Optical Loop Adjustment

Step	Procedure
	Tools required: Small flat-tipped screwdriver Large flat-tipped screwdriver **CAUTION** Internal components of aspirator are delicate and must be handled with care. Excessive mechanical shocks can cause permanent damage.
1	Clean aspirator using the procedure in table 5.5.2. Do not reapply ac power.
2	Install the sensor/fan assembly in aspirator housing and secure with captive screw.
3	Using large flat-tipped screwdriver, open temperature/dewpoint sensor transmitter access door.
4	Reset autobalance variable resistor to zero.
5	Apply power to sensor by setting POWER switch to ON (up) position.
6	**NOTE** The adjustments made in this Section must be performed with a completely dry mirror. Ensure that mirror is dry by heating it for a minimum of 1 minute initially, then keeping the mirror temperature above ambient (TA) using the HEAT position of the TEST switch. The measurements and adjustments described in steps 6 and 7 must not be made while heating the mirror. Therefore, it is necessary to monitor the mirror temperature (TD), via the seven-segment display, and heat as necessary to ensure that TD is greater than TA, while making the measurements and adjustments between the heating cycles. Turn SD GAIN variable resistor (R21) CCW until SD LEVEL LED (CR5) extinguishes then turn CW until SD LEVEL LED illuminates.
7	Adjust SI GAIN variable resistor (R22) until SI LEVEL LED (CR9) illuminates, then back off until SI LEVEL LED extinguishes.
8	Ensure that MODE switch is set to OPR position.
9	Using large flat-tipped screwdriver, close and secure temperature/dewpoint sensor transmitter access door.
10	On sensor status page at OID, turn on report processing for temperature/dewpoint sensor.

5.5.2.4 **Verify ASOS Temperature and Dewpoint Readings**. The Temperature and Dewpoint Readings Test is a confidence test, which verifies that ASOS H083R/1088 air temperature and dewpoint temperature readings compare reasonably with readings taken by a Psychron Model 566-2 psychrometer. The 90-day test consists of recording psychrometer temperatures and recording ASOS H083R/1088 temperatures. Psychrometer temperatures are converted to air and dewpoint temperatures. These temperatures are then compared with ASOS H083R/1088 corresponding results to determine if the ASOS readings are within tolerance. The test procedure is provided in table 5.5.5.

Table 5.5.5. Verification of ASOS H083R/1088 Temperature/Dewpoint Sensor Readings Using Psychron Model 566-2 Psychrometer

Step	Procedure
	Test Equipment Required: Laptop Computer Psychron Model 566-2 Laptop Computer with BASIC Software Program "PSYCHRO411" **CAUTION** For Psychron Model 566-2, the center contact post of each battery must be inserted first to ensure correct rotation of the fan.
OBTAINING AND CONVERTING PSYCHRON MODEL 566-2 READINGS	
INITIAL PREPARATION	
1	Open sliding door halfway, remove water bottle, and close sliding door.
2	Remove sliding air intake.
3	Examine wet-bulb wick to ensure that it is clean. If it is clean, proceed to step 7. If it is dirty, remove old wicking, clean thermometer bulb, and install new wick by performing the following steps.
4	Slip a length of tubular wicking over bulb. Secure at top of bulb with a thread at the constriction between bulb and stem, using a loop and square knot.
5	Form a loop in a second thread and place it approximately in middle of bulb. Tighten thread and pull toward bottom of bulb, stretching wick firmly and snugly against bulb. Tie with a double loop and square knot.
6	Clip ends of thread and cut off excess wicking about 1/8 inch below bottom of bulb.
7	Thoroughly saturate wet-bulb wick, ensuring that water does not contact either thermometer tube or dry-bulb.
8	If water has contacted dry-bulb, remove and dry the dry-bulb, then reinstall it.
9	Replace sliding air intake, ensuring that small circular holes in air intake are positioned against thermometer holder. Replace water bottle.
OPERATION	
1	**NOTE** The following position is recommended during operation. While standing at the ASOS H083R/1088 unit, hold Psychron Model 566-2 at temperature/dewpoint sensor aspirator intake.

Table 5.5.5. Verification of ASOS H083R/1088 Temperature/Dewpoint Sensor Readings Using Psychron Model 566-2 -CONT

	Step	Procedure
	2	**CAUTION** The air intake and both exhaust ports must be entirely free of obstruction. Because the instrument samples the air to which it is exposed, care must be taken to use the psychrometer far enough away from any source that may cause erroneous thermometer indications. Turn switch knob clockwise to start aspiration.
	3	If thermometer illumination is desired, turn knob to extreme clockwise position.
	4	**CAUTION** Ensure that motor is turned off after each observation as unnecessary usage greatly shortens the life of the batteries. When wet-bulb temperature stabilizes at a minimum value, observe readings of both thermometers as well as time of readings, and switch motor off by turning knob fully counterclockwise. For a wet-bulb temperature below 32 degrees Fahrenheit, check if the wick is frozen. If wet-bulb temperature stabilization does not occur within 2-1/2 minutes of aspiration, the fan motor is probably running too slow due to weak batteries.
$		**VERIFYING ASOS H083R/1088 TEMPERATURE (T_a)/DEWPOINT (T_d) READINGS**
$	1	**NOTE** Wet-bulb temperature is not the dewpoint temperature. Wet-bulb temperature is used to derive the dewpoint temperature. Convert the psychrometer readings to a dewpoint (T_d) temperature using the ASOS calibration program.
	2	At the DOS prompt, type: ASOS then, enter menu item 3 to execute the psychrometer calculation program.
	3	**NOTE** Steps 3 through 7 are the written procedures that are performed in the psychrometer calculation program. Follow the instructions in the calculation program and use steps 3 through 7 as a reference. When the calculation program is complete, return to step 8 of this procedure. Enter the station pressure in inches of mercury and hit return.
	4	Enter the dry- and wet-bulb temperature readings obtained from Psychron Model 566-2 and hit return after each entry.
$	5	If a wet-bulb temperature is entered which is higher than the dry-bulb temperature (T_a) , the program will beep to alert the user that an invalid entry was entered. The cursor will return to the dry-bulb temperature location to enable the user to reenter the correct values.
	6	If the wet-bulb temperature is below freezing, the program will beep and ask the user if the wick is frozen. Enter a "y" or an "n" (The answer is not case sensitive).
	7	The dewpoint temperature and relative humidity will be displayed on the subsequent lines.
	8	Record the calculated dewpoint temperature for comparison with ASOS H083R/1088 dewpoint temperature.
$	9	Obtain ASOS H083R/1088 temperature (T_a) /dewpoint (T_d) readings. Record air temperature and dewpoint temperature in °F from the OID. Use 5-minute observation reading (from REVIEW-RPT-5MIN screen) closest in time to the time of the psychrometer readings.

Table 5.5.5. Verification of ASOS H083R/1088 Temperature/Dewpoint Sensor Readings Using Psychron Model 566-2 -CONT

Step	Procedure
10	After air temperatures and dewpoint temperatures for ASOS H083R/1088 and Psychron Model 566-2 have been obtained, use the following criteria to verify validity of ASOS H083R/1088 readings: a. If the difference between the ASOS H083R/1088 air temperature and the Psychron Model 566-2 air temperature is within ±5°F, the ASOS H083R/1088 reading is valid. If the difference is more than ±5°F, the ASOS H083R/1088 temperature reading is invalid and corrective maintenance should be performed. For corrective maintenance, perform procedure under "Symptom: Either the ambient or dewpoint temperature reading is incorrect" in table 5.5.12. b. For dewpoint comparison, use table 5.5.6 to determine maximum allowable difference between ASOS H083R/1088 dewpoint temperature and Psychron Model 566-2 dewpoint temperature recorded in step 8. c. If the difference between the ASOS H083R/1088 dewpoint temperature and the Psychron Model 566-2 dewpoint temperature is within the maximum allowable difference (determined from table 5.5.6), the ASOS H083R/1088 reading is valid. d. If the difference between the dewpoint temperatures exceeds the maximum allowable difference, the ASOS H083R/1088 reading is invalid and corrective maintenance should be performed. For corrective maintenance instructions, refer to the procedure in table 5.5.12, entitled: "Symptom: Either the ambient or dewpoint temperature reading is incorrect."

Table 5.5.6. Maximum Allowable Difference Between ASOS H083R/1088 and Psychron Model 566-2 Dewpoint Temperatures

Dewpoint Depression	If Dewpoint >32˚F	If Dewpoint ≤32˚F
$(T_a - T_d) \leq 23$˚F	6˚	10˚
23˚F < $(T_a - T_d)$ <36˚F	9˚	16˚
36˚F ≤ $(T_a - T_d)$	16˚	26˚

Example: If the ASOS H083R/1088 air temperature (T_a) and dewpoint temperature (T_d) are 55˚F and 30˚F respectively, the $(T_a - T_d)$ spread would be 25 and the maximum allowable difference between the ASOS H083R/1088 dewpoint and the Psychron Model 566-2 dewpoint would be ±16˚F. $

5.5.2.5 **Deleted.** $

Table 5.5.7. Deleted $

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5.5.2.6 **DC Power Supply Check**. The dc power supplies are checked by first checking fuse F1 on the transmitter and then testing the 5V and ±12V outputs from the 5-volt power supply and auxiliary power supply, respectively. The power supplies require no adjustment. If a power supply fails the check, it must be replaced. The outputs of the dc power supplies are checked using the procedures provided in table 5.5.8.

Table 5.5.8. DC Power Supply Check

Step	Procedure
TEST	
	WARNING Dangerous voltages (110 vac) are present within the models H083R and 1088 temperature/dewpoint sensors. Exercise standard safety procedures.
1	At temperature/dewpoint power control module in DCP, remove power from sensor by setting circuit breaker on power control module to the off (right) position.
2	At transmitter, open access door.
3	Check fuse F1.
4	Apply power to sensor by setting circuit breaker on power control module to the on (left) position.
5	**NOTE** Power supply checks are made with full heater power applied. For the model H083R sensor, the TEST switch must be manually held in HEAT position while voltage measurements are being made. Ensure that POWER switch S1 is set to ON (up) position. For model 1088 sensor, place MODE switch in HEAT position. For model H083R, hold TEST switch in HEAT position.
6	At terminal board TB1, set DMM for ac reading and connect between pins 1 and 2. DMM should indicate 120 ±10 vac. If correct indication is not obtained, check DCP. If correct indication is obtained, proceed to step 7.
7	At +5V power supply, connect DMM between pins 1 and 3. DMM should indicate 120 ±10 vac. If correct indication is not obtained, replace transmitter. If correct indication is obtained, proceed to step 8.

Table 5.5.8. DC Power Supply Check - CONT

Step	Procedure
8	At +5V power supply, set DMM for dc reading and connect between pins 6 (+) and 5 (-). DMM should indicate +5 ±0.5V. If correct indication is not obtained, perform the following: a. Remove power from sensor and remove transmitter board. b. Reapply power and check power supply output at pins 6 and 5. If normal indication is obtained, replace transmitter board. If normal indication is not obtained, proceed to step c. c. Remove power from sensor and disconnect connector X6 from Fiberoptic Module A5. d. Reapply power and check power supply output at pins 6 and 5. If normal indication is obtained, replace fiberoptic module. If not, proceed to step e. e. Remove power from sensor and disconnect aspirator cable P1 from J1. f. Reapply power and check power supply output at pins 6 and 5. If normal indication is obtained, replace dewpoint sensor. If not, proceed to step g. g. Remove power and replace +5V power supply. h. Reapply power and check power supply output at pins 6 and 5. If normal indication is obtained, remove power from sensor and connect or install the units removed or disconnected above. Reapply power and check power supply output. If normal indication is not obtained, replace transmitter.
9	**NOTE** When connecting DMM, use pin 9 as ground for the model 1088 and pin 7 as ground for the model H083R. At transmit logic board, connect DMM between pins 6 (+) and ground. DMM should indicate +12 ±0.5 vdc. Connect DMM between pins 12 (+) and ground. DMM should indicate -12 ±0.5 vdc. If correct indication is not obtained, perform the following: a. Remove power from sensor and remove transmitter board. b. Reapply power and check power supply outputs at pins 6 and ground and 12 and ground. If normal indications are obtained, replace transmitter board. If not, proceed to step c. c. Remove power from sensor and disconnect aspirator cable P1 from J1. d. Reapply power and check power supply outputs at pins 6 and ground and 12 and ground. If normal indications are obtained, replace dewpoint sensor. If not, proceed to step e. e. Remove power from sensor and replace auxiliary power supply. f. Reapply power and check power supply outputs at pins 6 and ground and 12 and ground. If normal indications are obtained, remove power from sensor and connect or install the units removed or disconnected above. Reapply power and check power supply outputs. If normal indication is not obtained, replace transmitter.

5.5.2.7 **Calibration**. The temperature/dewpoint sensor must be calibrated semiannually or whenever an FRU is replaced. The temperature/dewpoint sensor calibration procedures for the model H083R and model 1088 are provided in tables 5.5.9 and 5.5.11, respectively. For the model 1088 sensor, a calibration check can be performed automatically using extended diagnostics (pressing TEST key on 1088 page at OID), or the individual functions can be commanded by "T" commands from the 1088 page as listed in table 5.5.10. The results of the last automatic calibration check are retained on the 1088 page.

Table 5.5.9. Model H083R Temperature/Dewpoint Sensor Calibration

Step	Procedure
	Tools required: Large flat-tipped screwdriver Small flat-tipped screwdriver **NOTE** Laptop computer initialized on DCP OID (Chapter 3, Section III), or any other available OID, may be used for the following procedure.
1	At OID, display sensor status page (sequentially press REVIEW-SENSR-STAT function keys from 1-minute display).
2	On sensor status page, turn report processing for temperature/dewpoint sensor to off.
3	Using large flat-tipped screwdriver, open temperature/dewpoint sensor transmitter access door. With power on, set the calibrate switch to 0 position.
4	At transmit logic board, set DISPLAY SELECTOR switch S1 to TA position.
5	Adjust TA0 trimpot for a 32.0 ±0.1 indication on transmit logic board seven-segment display. This represents 0°C.
6	Set DISPLAY SELECTOR switch S1 to TD position and adjust TD0 trimpot for a 32.0 ±0.1 indication on transmit logic board seven-segment display. This represents 0°C.
7	Set the calibrate switch to +50 position. Set DISPLAY SELECTOR switch S1 to TA position.
8	Adjust TA+ trimpot for a 22.0 ±0.1 indication on transmit logic board seven-segment display.
9	Set DISPLAY SELECTOR switch S1 to TD position and adjust TD+ trimpot for a 22.0 ±0.1 indication on transmit logic board seven-segment display.
10	Set the calibrate switch to -50 position. Verify that transmit logic board seven-segment display indicates -67.7 ±0.5.
11	Set DISPLAY SELECTOR switch S1 to TA position and verify that transmit logic board seven-segment display indicates -58 ±0.5.
12	Using large flat-tipped screwdriver, close and secure temperature/dewpoint sensor transmitter access door.
13	On sensor status page at OID, turn report processing for temperature/dewpoint sensor to on.

Table 5.5.10. "T" Commands for Model 1088 Checkout

Command	Function
T1	Prompts current ambient temp (Ta) & dewpoint (Td); but during Autobalance cycle, prompts Mirror Temp response.
T2	At minute 50, prompts response of cal values Ta & Td @ 0°C, and again @50°C, so that the next following hourly observation will have been validated prior to transmission.
T3	Prompts Ta & Td diagnostic response in case of fail.
T4	Prompts diagnostic response in case of failure.
T5	Initiates an abbreviated, 24-hour cycle response, beginning with the Autobalance cycle. (Inhibits T6 and overrides all other commands.)
T6	Initiates mirror heat cycle.
T7	Initiates Autobalance cycle.

Table 5.5.11. Model 1088 Temperature/Dewpoint Sensor Calibration

Step	Procedure
	Tools required: Large flat-tipped screwdriver Small flat-tipped screwdriver **NOTE** Laptop computer initialized on DCP OID (Chapter 3, Section III), or any other available OID, may be used for the following procedure.
1	At OID, display sensor status page (sequentially press REVIEW-SENSR-STAT function keys from 1-minute display).
2	On sensor status page, turn report processing for temperature/dewpoint sensor to off.
3	Using large flat-tipped screwdriver, open temperature/dewpoint sensor transmitter access door. With power on, set MODE switch to TEST 0 position.
4	On transmit logic board, set DISPLAY SELECTOR switch S1 to TA position and press and hold DISPLAY switch S2.
5	Adjust TA0 trimpot for a 32.0 ±0.1 indication on transmit logic board seven-segment display.
6	Set DISPLAY SELECTOR switch S1 to TD position, press and hold DISPLAY switch S2, and adjust TD0 trimpot for a 32.0 ±0.1 indication on transmit logic board seven-segment display.
7	Set MODE switch to TEST 50 position. Set DISPLAY SELECTOR switch S1 to TA position and press and hold DISPLAY switch S2.
8	Adjust TA+ trimpot for a 22.0 ±0.1 indication on transmit logic board seven-segment display.
9	Set DISPLAY SELECTOR switch S1 to TD position, press and hold DISPLAY switch S2, and adjust TD+ trimpot for a 22.0 ±0.1 indication on transmit logic board seven-segment display.
10	Set MODE switch to OPR position.
11	Using large flat-tipped screwdriver, close and secure temperature/dewpoint sensor transmitter access door.
12	On sensor status page at OID, turn report processing for temperature/dewpoint sensor to on.

5.5.3 **CORRECTIVE MAINTENANCE**

5.5.3.1 **Troubleshooting Procedures**. Unlike the model 1088, the model H083R temperature/dewpoint sensor does not contain internal diagnostics. Therefore, standard troubleshooting procedures must be used. The troubleshooting procedures provided in table 5.5.12 assist the technician in isolating a fault to an FRU in the sensor. These procedures may also be used on the model 1088 if the diagnostic fails to identify the correct FRU.

5.5.3.2 **Running Diagnostics**. The model 1088 ASOS diagnostic program monitors the ambient and dewpoint temperature readings received from the temperature/dewpoint sensor. If the acquisition control unit (ACU) does not receive data from the sensor or the sensor readings are outside acceptable limits, the ACU flags the sensor as malfunctioning and marks it off-line. The fault condition is verified by running the temperature/dewpoint sensor diagnostic as described in Chapter 1, Section V.

5.5.3.3 **Dewpoint Sensor Assembly Removal and Installation**. The dewpoint sensor assembly removal and installation procedures are provided in table 5.5.13.

5.5.3.4 **Aspirator Housing Removal and Installation**. The aspirator housing removal and installation procedures are provided in table 5.5.14.

5.5.3.5 **Transmit Logic Board Removal and Installation**. The transmit logic board removal and installation procedures are provided in table 5.5.15.

5.5.3.6 **Autobalance Module Removal and Installation**. The autobalance module removal and installation procedures are provided in table 5.5.16.

5.5.3.7 **Power Supplies Removal and Installation**. The +5 volt power supply and auxiliary power supply removal and installation procedures are provided in tables 5.5.17 and 5.5.18, respectively.

5.5.3.8 **Fiberoptic Module Removal and Installation**. The fiberoptic module removal and installation procedures are provided in table 5.5.19.

Table 5.5.12. Temperature/Dewpoint Sensor Troubleshooting

Step	Procedure
	WARNING Dangerous voltages (110 vac) are present within the model 1088 and H083R temperature/dewpoint sensors. Exercise standard safety procedures.
Symptom -No measurement data being received from sensor. Seven-segment display is not illuminated.	
1	At transmitter, check fuse F1. Replace fuse if blown. If fuse blows a second time, fault isolate to either the +5V power supply, the auxiliary power supply, or the fan in the aspirator, and replace fuse.
2	With power applied to transmitter, remove power connector from J1 and connect DMM between pins A and B. DMM should indicate 120 ±10 vac. If correct indication is not obtained, troubleshoot cabling between DCP and sensor. If correct indication is obtained, install power connector and proceed to step 3.
3	Ensure that POWER switch S1 is set to on (up) position.
4	At +5V power supply, connect DMM between pins 1 and 3. DMM should indicate 120 ±10 vac. If correct indication is not obtained, replace transmitter. If correct indication is obtained, proceed to step 5.
5	At +5V power supply, connect DMM between pins 6 (+) and 5 (-). DMM should indicate +5 ±0.5 vdc. If correct indication is not obtained, replace +5 Volt Power Supply 2A3. If correct indication is obtained, proceed to step 6.
6	**NOTE** When connecting DMM, use pin 9 as ground for the model 1088 and pin 7 as ground for the model H083R. At transmit logic board, connect DMM between pin 6 (+) and ground. DMM should indicate +12 ±0.5 vdc. Connect DMM between pin 12 (+) and ground. DMM should indicate -12 ±0.5 vdc. If either reading is incorrect, replace auxiliary power supply.
Symptom -No measurement data being received at ACU. Seven- segment display on transmitter logic board is illuminated, but readings are incorrect.	
1	At +5V power supply, connect DMM between pins 6 and 5. DMM should indicate +5 ±0.5V. If correct indication is not obtained, replace +5 Volt Power Supply 2A3. If correct indication is obtained, proceed to step 2.
2	At auxiliary power supply, connect DMM between pins 13 and 10. DMM should indicate +12 ±0.5V. Connect DMM between pins 12 and 10. DMM should indicate -12 ±0.5V. If either indication is incorrect, replace auxiliary power supply.
3	On transmit logic board, set monitor display switch to TA position. If seven-segment display indicates the correct outside temperature, troubleshoot sensor-DCP fiberoptic link per Chapter 1, Section V).

Table 5.5.12. Temperature/Dewpoint Sensor Troubleshooting -CONT

Step	Procedure
4	At transmitter, set the calibrate switch to 0 position. Seven-segment display should indicate 32.0 ±0.3. Set the calibrate switch to -50 position. Seven-segment display should indicate -58 ±0.5. If either indication is incorrect, replace transmit logic board. If one of the indications is correct, a dirty or faulty calibrator switch is suspect. Clean the switch contacts and retest. If correct indication is still not obtained, replace temperature/dewpoint sensor.
Symptom -Either the ambient or dewpoint temperature reading is incorrect.	
1	At transmitter, set the calibrate switch to 0 position. Set monitor display switch to display the incorrect temperature value (TA or TD). Seven-segment display should indicate 32.0 ±0.3. If correct indication is not obtained, replace transmit logic board. If correct indication is obtained and sensor is measuring the TA values incorrectly, replace temperature/dewpoint sensor in the aspirator. If sensor is measuring TA values correctly and SI LEVEL LED is flashing, replace temperature/dewpoint sensor. If SI LEVEL LED is not flashing or if either or both of the LIMIT LED's are illuminated, replace transmit logic board.

Table 5.5.13. Dewpoint Sensor Assembly Removal and Installation

Step	Procedure
REMOVAL	
	Tools required: Diagonal cutting pliers **WARNING** Death or severe injury may result if power is not removed from sensor prior to maintenance activities. Ensure that circuit breaker (located in DCP) supplying power to sensor is set to off (right) position.
1	Inside DCP equipment cabinet, set circuit breaker on temperature/dewpoint sensor power control module to off (right) position.
2	Disconnect connector P1 of dewpoint sensor assembly cable from connector J1 of Transmitter A2.
3	Using diagonal cutting pliers, remove tie wraps securing dewpoint sensor assembly cable to aspirator support bracket.
4	**CAUTION** Dewpoint sensor assembly components are delicate and must be handled with care. Sensor can be permanently damaged by excessive mechanical shocks. Remove dewpoint sensor assembly from aspirator by loosening captive screw on side of unit. Slide dewpoint sensor assembly downward and out of aspirator housing.
INSTALLATION	
	Materials required: Cable tie wraps **WARNING** Death or severe injury may result if power is not removed from sensor prior to maintenance activities. Ensure that circuit breaker (located in DCP) supplying power to sensor is set to off (right) position.
1	Inside DCP equipment cabinet, ensure that circuit breaker on temperature/dewpoint sensor power control module is set to off (right) position.
2	Align key on dewpoint sensor assembly with slot in aspirator housing, and slide dewpoint sensor assembly into aspirator housing. Secure with captive screw.

Table 5.5.13. Dewpoint Sensor Assembly Removal and Installation -CONT

Step	Procedure
3	Connect connector P1 of dewpoint sensor assembly to connector J1 of Transmitter A2.
4	Using cable tie wraps, secure cable of dewpoint sensor assembly as shown on figure 5.2.1. Be sure to leave service loop to allow removal of dewpoint sensor assembly without cutting tie wraps.
5	Perform temperature/dewpoint sensor optical loop adjustment in accordance with table 5.5.3 (for model H083R) or table 5.5.4 (for model 1088).
6	Calibrate temperature/dewpoint sensor in accordance with table 5.5.9 (for model H083R) or table 5.5.11 (for model 1088).
7	Perform fan fail monitoring circuit test and adjustment in accordance with table 5.5.7 (model 1088 only).

Table 5.5.14. Aspirator Housing Removal and Installation

Step	Procedure
REMOVAL	
	Tools required: No. 1 Phillips screwdriver 5/16-inch nut driver 3/8-inch nut driver **WARNING** Death or severe injury may result if power is not removed from sensor prior to maintenance activities. Ensure that circuit breaker (located in DCP) supplying power to sensor is set to off (right) position.
1	Inside DCP equipment cabinet, set circuit breaker on temperature/dewpoint sensor power control module to off (right) position.
2	Remove Dewpoint Sensor Assembly A1A1 from aspirator housing in accordance with table 5.5.13. To prevent damage, store dewpoint sensor assembly in a safe place.
3	Using No. 1 Phillips screwdriver and 5/16-inch nut driver, loosen (but do not remove) hardware securing four angle irons on top, bottom, left, and right of aspirator mounting brackets.
4	Using 3/8-inch nut driver, remove four locknuts securing aspirator housing to mounting brackets. Carefully remove aspirator housing.
INSTALLATION	
	Tools and materials required: No. 1 Phillips screwdriver 5/16-inch nut driver 3/8-inch nut driver **WARNING** Death or severe injury may result if power is not removed from sensor prior to maintenance activities. Ensure that circuit breaker (located in DCP) supplying power to sensor is set to off (right) position.
1	Inside DCP equipment cabinet, ensure that circuit breaker on temperature/dewpoint sensor power control module is set to off (right) position.
2	To facilitate mounting of aspirator housing, ensure that hardware securing four angle irons to aspirator mounting brackets have been loosened (but not removed).
3	Position aspirator housing on mounting brackets with nameplate facing outward (away from transmitter).
4	Using 3/8-inch nut driver, install four locknuts securing aspirator on mounting brackets. Do not tighten locknuts.
5	Using 5/16-inch nut driver and No. 1 Phillips screwdriver, tighten locknuts securing angle irons to aspirator mounting brackets.

Table 5.5.14. Aspirator Housing Removal and Installation -CONT

Step	Procedure
6	Using 3/8-inch nut driver, tighten four locknuts securing mounting brackets to aspirator housing.
7	Install Dewpoint Sensor Assembly A1A1 into aspirator housing in accordance with table 5.5.13.
8	Perform temperature/dewpoint sensor optical loop adjustment in accordance with table 5.5.3 (for model H083R) or table 5.5.4 (for model 1088).
9	Calibrate temperature/dewpoint sensor in accordance with table 5.5.9 (for model H083R) or table 5.5.11 (for model 1088).
10	Perform fan fail monitoring circuit adjustment in accordance with table 5.5.7 (model 1088 only).

Table 5.5.15. Transmit Logic Board Removal and Installation

Step	Procedure
REMOVAL	
	Tools required: Large flat-tipped screwdriver **WARNING** Death or severe injury may result if power is not removed from sensor prior to maintenance activities. Ensure that circuit breaker (located in DCP) supplying power to sensor is set to off (right) position.
1	Inside DCP equipment cabinet, set circuit breaker on temperature/dewpoint sensor power control module to off (right) position.
2	Using large flat-tipped screwdriver, open temperature/dewpoint sensor transmitter access door.
3	Grasp ejector ears at top corners of board and turn outward to force the board out of its socket.
4	Slide board out on its guides.
INSTALLATION	
	Tools required: Large flat-tipped screwdriver **WARNING** Death or severe injury may result if power is not removed from sensor prior to maintenance activities. Ensure that circuit breaker (located in DCP) supplying power to sensor is set to off (right) position.
1	Inside DCP equipment cabinet, ensure that circuit breaker on temperature/dewpoint sensor power control module is set to off (right) position.
2	Slide new board on guides and press ejector ears toward socket until board is firmly seated.
3	Using large flat-tipped screwdriver, close and secure temperature/dewpoint sensor transmitter access door.
4	Inside DCP equipment cabinet, set circuit breaker on temperature/dewpoint sensor power control module to on (left) position.
5	Perform temperature/dewpoint sensor optical loop adjustment in accordance with table 5.5.3 (for model H083R) or table 5.5.4 (for model 1088).
6	Calibrate temperature/dewpoint sensor in accordance with table 5.5.9 (for model H083R) or table 5.5.11 (for model 1088).

Table 5.5.16. Autobalance Module Removal and Installation

Step	Procedure
REMOVAL	
	Tools required: Large flat-tipped screwdriver No. 0 Phillips screwdriver No. 2 Phillips screwdriver **WARNING** Death or severe injury may result if power is not removed from sensor prior to maintenance activities. Ensure that circuit breaker (located in DCP) supplying power to sensor is set to off (right) position.
1	Inside DCP equipment cabinet, set circuit breaker on temperature/dewpoint sensor power control module to off (right) position.
2	Using large flat-tipped screwdriver, open temperature/dewpoint sensor transmitter access door.
3	Using No. 0 Phillips screwdriver, remove two screws and lockwashers securing connector J2 to calibrator assembly.
4	Using No. 2 Phillips screwdriver, remove two screws and lockwashers securing autobalance module to top of calibrator assembly. Remove autobalance module.
INSTALLATION	
	Tools required: Large flat-tipped screwdriver No. 0 Phillips screwdriver No. 2 Phillips screwdriver **WARNING** Death or severe injury may result if power is not removed from sensor prior to maintenance activities. Ensure that circuit breaker (located in DCP) supplying power to sensor is set to off (right) position.
1	Inside DCP equipment cabinet, ensure that circuit breaker on temperature/dewpoint sensor power control module is set to off (right) position.
2	Position autobalance module in upper right corner of transmitter. Using No. 2 Phillips screwdriver, install two screws and lockwashers securing autobalance module to calibrator assembly.
3	Connect connector J2 to connector located on side of calibrator assembly. Using No. 2 Phillips screwdriver, install two screws and lockwashers securing connector J2.
4	Using large flat-tipped screwdriver, close and secure temperature/dewpoint sensor transmitter access door.
5	Inside DCP equipment cabinet, set circuit breaker on temperature/dewpoint sensor power control module to on (left) position.
6	Perform temperature/dewpoint sensor optical loop adjustment in accordance with table 5.5.3 (for model H083R) or table 5.5.4 (for model 1088).
7	Calibrate temperature/dewpoint sensor in accordance with table 5.5.9 (for model H083R) or table 5.5.11 (for model 1088).

Table 5.5.17. +5V Power Supply Removal and Installation

Step	Procedure
	REMOVAL
	Tools required: Large flat-tipped screwdriver No. 2 Phillips screwdriver **WARNING** Death or severe injury may result if power is not removed from sensor prior to maintenance activities. Ensure that circuit breaker (located in DCP) supplying power to sensor is set to off (right) position.
1	Inside DCP equipment cabinet, set circuit breaker on temperature/dewpoint sensor power control panel to off (right) position.
2	Using large flat-tipped screwdriver, open temperature/dewpoint sensor transmitter access door.
3	Disconnect 2X1 and lift +5V power supply out of chassis.
4	Using Phillips screwdriver, remove four corner mounting screws and insulated flat washers securing +5V power supply.
	INSTALLATION
	Tools required: Large flat-tipped screwdriver No. 2 Phillips screwdriver **WARNING** Death or severe injury may result if power is not removed from sensor prior to maintenance activities. Ensure that circuit breaker (located in DCP) supplying power to sensor is set to off (right) position.
1	Inside DCP equipment cabinet, ensure that circuit breaker on temperature/dewpoint sensor power control module is set to off (right) position.
2	Position +5V power supply on four corner mounting posts.
3	Connect 2X1 and using Phillips screwdriver, install four insulated flat washers and corner mounting screws securing +5V power supply to corner mounting posts.
4	Using large flat-tipped screwdriver, close and secure temperature/dewpoint sensor transmitter access door.
5	Perform temperature/dewpoint sensor optical loop adjustment in accordance with table 5.5.3 (for model H083R) or table 5.5.4 (for model 1088).
6	Calibrate temperature/dewpoint sensor in accordance with table 5.5.9 (for model H083R) or table 5.5.11 (for model 1088).

Table 5.5.18. Auxiliary Power Supply Removal and Installation

Step	Procedure
	REMOVAL
	Tools required: Large flat-tipped screwdriver No. 0 Phillips screwdriver No. 2 Phillips screwdriver **WARNING** Death or severe injury may result if power is not removed from sensor prior to maintenance activities. Ensure that circuit breaker (located in DCP) supplying power to sensor is set to off (right) position.
1	Inside DCP equipment cabinet, set circuit breaker on temperature/dewpoint sensor power control panel to off (right) position.
2	Using large flat-tipped screwdriver, open temperature/dewpoint sensor transmitter access door.
3	Using No. 0 Phillips screwdriver, remove two screws and lockwashers securing autobalance module connector J2 to calibrator assembly.
4	Using No. 0 Phillips screwdriver, remove two screws and lockwashers securing autobalance module to top of calibrator assembly. Remove autobalance module.
5	Using No. 2 Phillips screwdriver, remove four screws and lockwashers securing auxiliary power supply to transmitter mounting plate.
6	Disconnect connector X2 from auxiliary power supply. Remove auxiliary power supply.
	INSTALLATION
	Tools required: Large flat-tipped screwdriver No. 0 Phillips screwdriver No. 2 Phillips screwdriver **WARNING** Death or severe injury may result if power is not removed from sensor prior to maintenance activities. Ensure that circuit breaker (located in DCP) supplying power to sensor is set to off (right) position.
1	Inside DCP equipment cabinet, ensure that circuit breaker on temperature/dewpoint sensor power control module is set to off (right) position.
2	**CAUTION** When positioning auxiliary power supply in transmitter, do not crimp wires attached to the calibrator assembly. Connect connector X2 to auxiliary power supply and position auxiliary power supply over four mounting holes in transmitter mounting plate.
3	Using No. 2 Phillips screwdriver, install four screws and lockwashers securing auxiliary power supply to transmitter mounting plate.
4	Position autobalance module in upper right corner of transmitter. Using No. 0 Phillips screwdriver, install two screws and lockwashers securing autobalance module to top of calibrator assembly.
5	Connect connector J2 to the connector located on side of calibrator assembly. Using No. 0 Phillips screwdriver, install two screws and lockwashers securing connector J2.
6	Using large flat-tipped screwdriver, close and secure temperature/dewpoint sensor transmitter access door.

Table 5.5.18. Auxiliary Power Supply Removal and Installation -CONT

Step	Procedure
7	Inside DCP equipment cabinet, set circuit breaker on temperature/dewpoint sensor power control module to on (left) position.
8	Perform temperature/dewpoint sensor optical loop adjustment in accordance with table 5.5.3 (for model H083R) or table 5.5.4 (for model 1088).
9	Calibrate temperature/dewpoint sensor in accordance with table 5.5.9 (for model H083R) or table 5.5.11 (for model 1088).

Table 5.5.19. Fiberoptic Module Removal and Installation

Step	Procedure
REMOVAL	
	Tools required: Large flat-tipped screwdriver Small flat-tipped screwdriver No. 1 Phillips screwdriver No. 0 Phillips screwdriver **WARNING** Death or severe injury may result if power is not removed from sensor prior to maintenance activities. Ensure that circuit breaker (located in DCP) supplying power to sensor is set to off (right) position.
1	Inside DCP equipment cabinet, set circuit breaker on temperature/dewpoint sensor power control panel to off (right) position.
2	Using large flat-tipped screwdriver, open temperature/dewpoint sensor transmitter access door.
3	Using small flat-tipped screwdriver, loosen two retaining screws on connector located on side of fiberoptic module. Remove connector.
4	Using CCW rotation, remove two fiberoptic cables from bottom of fiberoptic module. Install protective plastic covers over board connectors.
5	Using No. 1 Phillips screwdriver, remove two screws and lockwashers securing fiberoptic module mounting bracket to calibrator assembly.
6	Using No. 0 Phillips screwdriver, remove two screws, lockwashers, and gaskets securing fiberoptic module to mounting bracket. Remove fiberoptic module.
INSTALLATION	
	Tools required: Large flat-tipped screwdriver Small flat-tipped screwdriver No. 1 Phillips screwdriver No. 0 Phillips screwdriver **WARNING** Death or severe injury may result if power is not removed from sensor prior to maintenance activities. Ensure that circuit breaker (located in DCP) supplying power to sensor is set to off (right) position.
1	Inside DCP equipment cabinet, ensure that circuit breaker on temperature/dewpoint sensor power control module is set to off (right) position.

Table 5.5.19. Fiberoptic Module Removal and Installation -CONT

Step	Procedure
2	Position fiberoptic module and gaskets over mounting holes in mounting bracket. Using No. 0 Phillips screwdriver, install two screws and lockwashers securing fiberoptic module to mounting bracket.
3	Using No. 1 Phillips screwdriver, install two screws and lockwashers securing fiberoptic module mounting bracket to calibrator assembly.
4	Remove any protective covers from fiberoptic connectors and install the receive (RX) and transmit (TX) connectors on fiberoptic module. RX cable mates with fiberoptic connector nearest DB-9 electrical connector.
5	Install signal cable on connector on fiberoptic module and using small flat-tipped screwdriver, tighten two retaining screws.
6	Using large flat-tipped screwdriver, close and secure temperature/dewpoint sensor transmitter access door.

CHAPTER 6

VISIBILITY AND DAY/NIGHT SENSOR

SECTION I. DESCRIPTION AND LEADING PARTICULARS

6.1.1 INTRODUCTION

The ASOS visibility and day/night sensor, hereinafter referred to as the visibility sensor, provides the means to automatically calculate the current visibility level and indicate current day/night conditions. The visibility sensor measures ambient meteorological optical range (visibility) using the forward scatter technique. This technique involves transmitting a flash of xenon light through a section of the atmosphere (which scatters the light) and measuring the scattered light level to determine the loss. An extinction coefficient is calculated from the amount of light received from the scattered xenon flash lamp light source. This coefficient is then translated into a value of visibility. The visibility sensor also computes and outputs a day or night indication as derived from an ambient light sensor. Both extinction coefficient and day/night data are output for use by the ASOS in response to request signals from the data collection package (DCP). Each response message also includes sensor operating status signals generated by the visibility sensor through a continuously running self-test.

6.1.2 PHYSICAL DESCRIPTION

The visibility sensor (Figure 6.1.1) is mounted on a single support. All of the processing and sensing electronics are mounted to the support, thereby eliminating the need for careful alignment between separate stations. The components of the visibility sensor are divided into two separate sections: an upper section and a lower section. The upper section contains all of the sensing elements. The lower section contains all of the processing, communications, and diagnostic electronics as well as the power supplies and electromagnetic interference (EMI) protection. The following paragraphs provide detailed descriptions of the two sections and the cabling of the entire unit.

6.1.2.1 **Upper Section**. The upper section is mounted above the electronics enclosure and contains all of the sensing elements of the visibility sensor: crossarm/support, transmitter hood assembly, receiver hood assembly, and day/night assembly.

6.1.2.1.1 **Crossarm/Support**. The crossarm and support hold the sensing elements at the appropriate height and relative orientation. The support is a pole mounted to the top of the enclosure mounting support with four bolts. The crossarm is mounted to the top of the support with four bolts. Two mounts provided on the support allow for the attachment of a scatter plate. The scatter plate is a calibration tool that, when mounted to the support (thereby extended into the scatter volume), creates an artificially high amount of scattered light for the receiver to detect. The location of the scatter plate mounts is such that the scatter plate is firmly held in the scatter volume. The crossarm is a welded assembly that consists of the hoods, arms, and plenum. The arms connect all of the other crossarm components. The hoods contain the transmitter and receiver units. They also contain heaters to prevent snow and ice buildup as well as fogging and icing of the lenses. The plenum is a small enclosed cavity where the support is attached and through which the sensor cables are passed to the electronics enclosure.

6.1.2.1.2 **Transmitter Assembly**. The transmitter assembly flashes a xenon bulb to produce visible light for scattering. Light is focused into the scatter volume by a fixed lens included with the transmitter assembly. The transmitter assembly consists of two basic parts: the canister and the cap. The canister is a field replaceable unit (FRU) that can be quickly and easily replaced for maintenance. The canister is an aluminum cylinder that contains all of the transmitter electronics and interface wiring in a single package. The canister slides into the transmitter hood and is keyed for correct insertion. Once the canister is fully inserted into the hood, the transmitter is aligned and ready to be connected to the system. The cap protects the canister by covering the end of the hood.

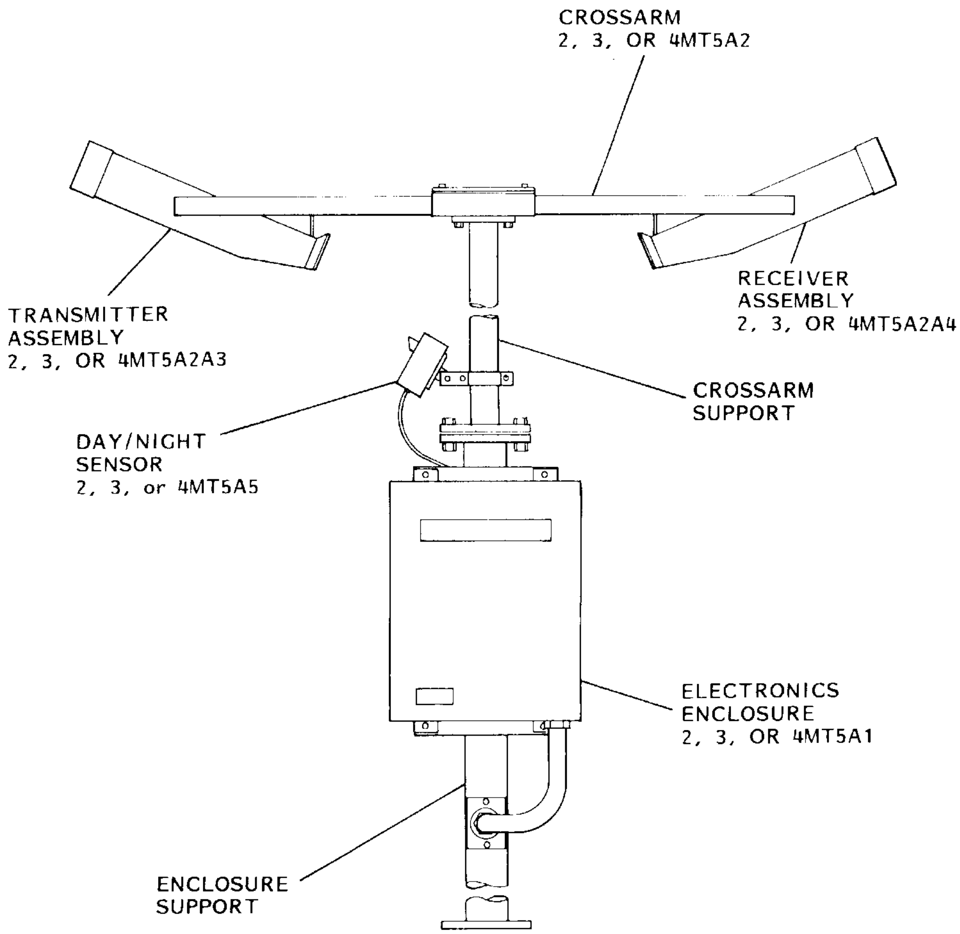

Figure 6.1.1. Visibility Sensor

6.1.2.1.3 **Receiver Assembly**. The receiver assembly is the unit that detects the transmitted xenon light after it is scattered by the atmosphere. The light is detected by a positive-intrinsic-negative (PIN) photodiode mounted in the receiver canister. Light is focused onto the photodiode by a fixed lens included with the receiver assembly. The photodiode converts the light energy into an electrical current signal for processing. The receiver assembly consists of two basic parts: the canister and the cap. The canister is an FRU that can be quickly and easily replaced for maintenance. The canister is an aluminum cylinder that contains all of the receiver electronics and interface wiring in a single package. The canister slides into the receiver assembly and is keyed for correct insertion. After the canister is fully inserted into the assembly, the receiver is aligned and ready to be connected to the system (presupposing previous factory alignment and calibration). The cap protects the canister by covering the end of the assembly.

6.1.2.1.4 **Day/Night Assembly**. The day/night assembly is a photometer designed to indicate daytime or nighttime conditions. The sensor mounts to the support pole just above the flange. Signal and power cables are contained within the hollow support. The connection for the signal cable is made inside the electronics enclosure. The connection for the power cable is made inside the plenum with free-hang connectors. The day/night assembly detects light via a photodiode mounted behind a clear window. The photodiode is positioned such that its field of view is 6 degrees above the horizon. A heater located on the inside of the small day/night assembly prevents the accumulation of snow or ice. The day/night assembly (an FRU) can be easily removed from the day/night mount for repair. The assembly is connected to the electronics enclosure by a cable. Removal is accomplished by unscrewing the assembly mounting screws, unplugging one connector, and removing the signal cable out through the support pole.

6.1.2.2 **Lower Section**. The lower section, which mates directly with the standard flange, consists of the electronics enclosure and the enclosure support. A flange at the top of the enclosure support mates with the bottom part of the upper section support.

6.1.2.2.1 **Electronics Enclosure**. The electronics enclosure (Figure 6.1.2) houses all of the processing and diagnostic electronics. The enclosure also houses all of the EMI filtering and power supplies. All of the internal components are accessed through a hinged front door. All external cables are connected to the enclosure at the bottom. The enclosure is mounted to the support with four bolts. Four mounting flanges are welded to the enclosure for this purpose. The power input box within the electronics enclosure contains either one filter and surge suppressor or two filters and surge suppressors. The two-filter configuration is illustrated in the figure. To determine the configuration, one or two filters are observed protruding from the top of the power input box. Visibility sensors with serial numbers A0358 and above have one filter; those numbered A0357 and below have two filters. The power input box wiring for the one- and two-filter configurations is illustrated in Section IV.

6.1.2.2.2 **Enclosure Support**. The enclosure support is a pipe with flanges at each end and mounting brackets for the enclosure box. The electronics enclosure attaches to the enclosure mounting brackets with four bolts. The visibility sensor is aligned relative to north by properly positioning the support on the mounting flange. The bottom flange is provided with holes at 30-degree intervals to allow for this alignment. The top flange mates with the bottom flange of the upper section support.

6.1.2.3 **Cabling**. Signal cables run between the electronics enclosure and the transmitter and receiver sections. These cables carry all of the data signals and DC power for the sensing sections and are physically located internal to the support. The heater power is included with these cables. Day/night sensor cables run internal to the support through an opening in the enclosure support. The sample trigger cable is the coax cable that runs between the transmitter and receiver sections. This cable runs internally through the crossarm.

6.1.3 SPECIFICATIONS

The visibility sensor meets the full range of ASOS outdoor environmental requirements during continuous operation. The visibility sensor is capable of providing an extinction coefficient equivalent to visibilities up to and including 10 miles, with sufficient accuracy and resolution to allow the acquisition control unit (ACU) to report the standard reporTable increments. The visibility sensor agrees with the 1,500-foot baseline National Weather Service (NWS) transmissometer according to table 6.1.1. The day/night assembly provided with the visibility sensor indicates day or night condition according to the ambient light level and operates for ambient light levels up to 50 foot candles (fc). The day/night sensor always indicates day for illumination greater than 3 fc and always indicates night for illumination less than 0.5 fc. The transition from indicating day to indicating night occurs once in the region from 3 to 0.5 fc (as illumination decreases). The transition from indicating night to indicating day occurs once in the region from 0.5 to 3 fc (as illumination increases). The day/night assembly is mounted such that it points in the same direction as the receiver. The design is such that snow and ice buildup is prevented from affecting operation.

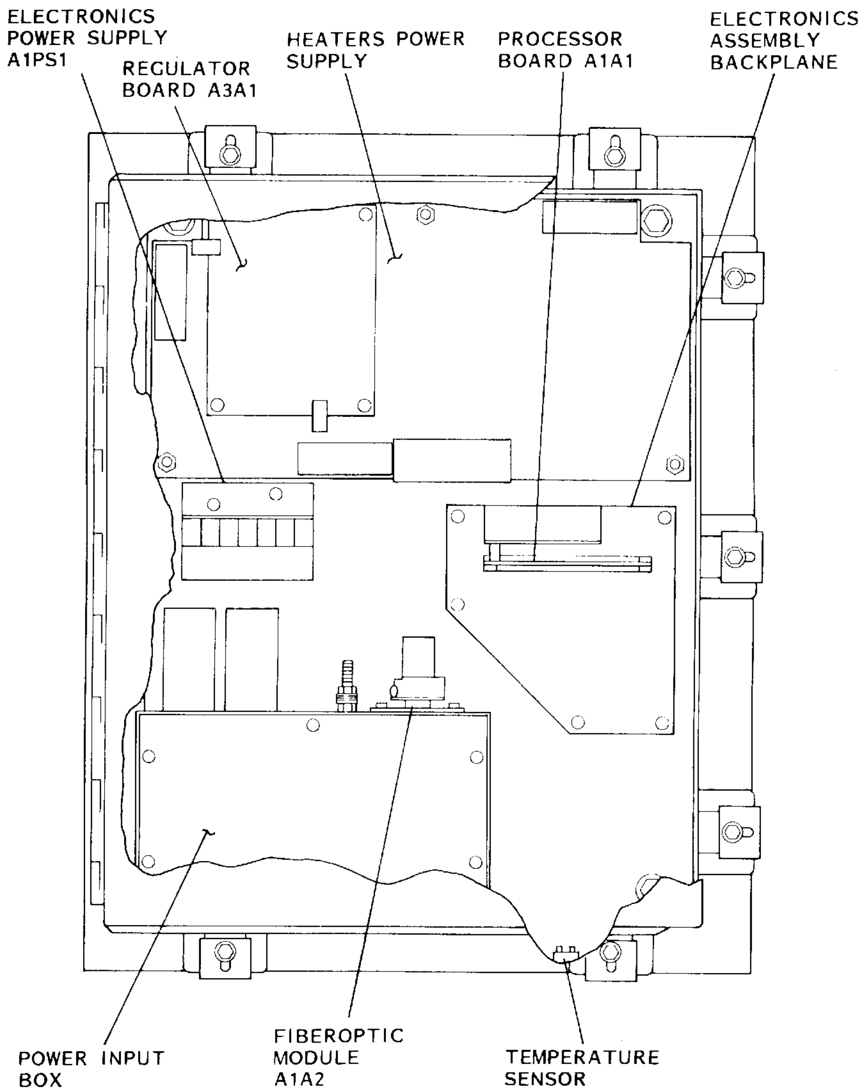

Figure 6.1.2. Visibility Sensor Electronics Enclosure

6.1.3.1 **Configurations**. There is only one configuration of the visibility sensor. This configuration is described in Section II.

Table 6.1.1. Visibility Sensor Accuracy*

Visibility of NWS Standard Transmissometer	Sensor Accuracy (Percent of All Data)		
	At Least 80%	No More than 18%	No More than 2%
0 to 1-¼	±¼	±½	±1
1-½ to 1-¾	+¼, -½	+½, -¾	±1
2 to 2-½	±½	±1	±1
3 to 3-½	+½, -1	+2 RI**/-1	+2 RI**/-1
4 to 10+	±1 RI**	±2 RI**	±2 RI**

*All units in miles except where noted with double asterisk.

**ReporTable increments (RI's) are used as units instead of miles.

SECTION II. INSTALLATION

6.2.1 INTRODUCTION

The modular design of the ASOS visibility sensor allows for simple assembly. All elements are wired with keyed connectors and are secured to each other with bolts. The entire single-pedestal assembly is secured to the standard mounting flange with locking bolts. The sensor head is mounted to the top of the pole and is interfaced with the electronics enclosure via supplied cables. When assembled, the scatter volume (the volume of air through which the flash transfers) is approximately 10 feet high in the air. The electronics enclosure is mounted on the support structure several feet off the ground to provide easy access for the servicing technician.

6.2.2 ASSEMBLY

6.2.2.1 **Hinge Plate Assembly**. The hinge plate assembly provides easy access to the visibility sensor's receiver and transmitter assemblies by permitting the visibility sensor to be lowered to a horizontal position. The hinge plate has a locking pin to secure the sensor in an upright position and a cable lanyard to support the sensor when it is lowered.

6.2.2.2 **Enclosure Support**. The base of the enclosure support consists of a flange containing 12 holes. Each of the holes is offset 30 degrees from adjacent holes to allow proper positioning of the enclosure support on the mounting hinge. The enclosure support is mounted on top of the hinge plate assembly using four 5/8-inch hex head bolts and associated hardware (figure 6.2.1 and table 6.2.1). Alignment of the enclosure support on the hinge plate is important to the operation of the unit. The visibility sensor should be installed such that the receiver optics and the day/night assembly are pointed away from direct sunlight. In the northern hemisphere, this aligns the receiver and day/night sensor to face north. Precise alignment of the visibility sensor may not be possible and is not considered critical; however, for the best performance, the hole pattern that provides the closest receiver alignment to face north should be selected.

6.2.2.3 **Electronics Enclosure**. Figure 6.2.1 identifies and locates the components used to install the electronics enclosure on the enclosure support. Installation procedures are provided in table 6.2.2.

6.2.2.4 **Crossarm Support**. The crossarm support is mounted on top of the enclosure support such that the calibration plate mounts face to the right of the enclosure. The crossarm support is secured to the enclosure support using four e - 11 by 2-½-inch HHCS's as shown on figure 6.2.2.

6.2.2.5 **Crossarm**. The crossarm is mounted to the top of the crossarm support such that the transmitter and receiver hoods are to the right of the electronics enclosure (on the same side of the support pole as the calibration plate mounts). The crossarm comes prewired for the head assemblies. As such, the wires from the crossarm need to be routed through the interior of the support pole prior to securing the crossarm to the support pole. The crossarm is secured to the crossarm support pole using four 3/8 - 16 by 1-¾-inch HHCS's as shown on figure 6.2.2.

6.2.2.6 **Day/Night Sensor**. The day/night sensor is installed by feeding the day/night heater and signal wires through the support columns, attaching the sensor ground and cable connections, and mounting the day/night sensor to the crossarm support such that the day/night sensor is pointed 6 degrees above the horizon (Figure 6.2.3). This installation procedure is described in table 6.2.3.

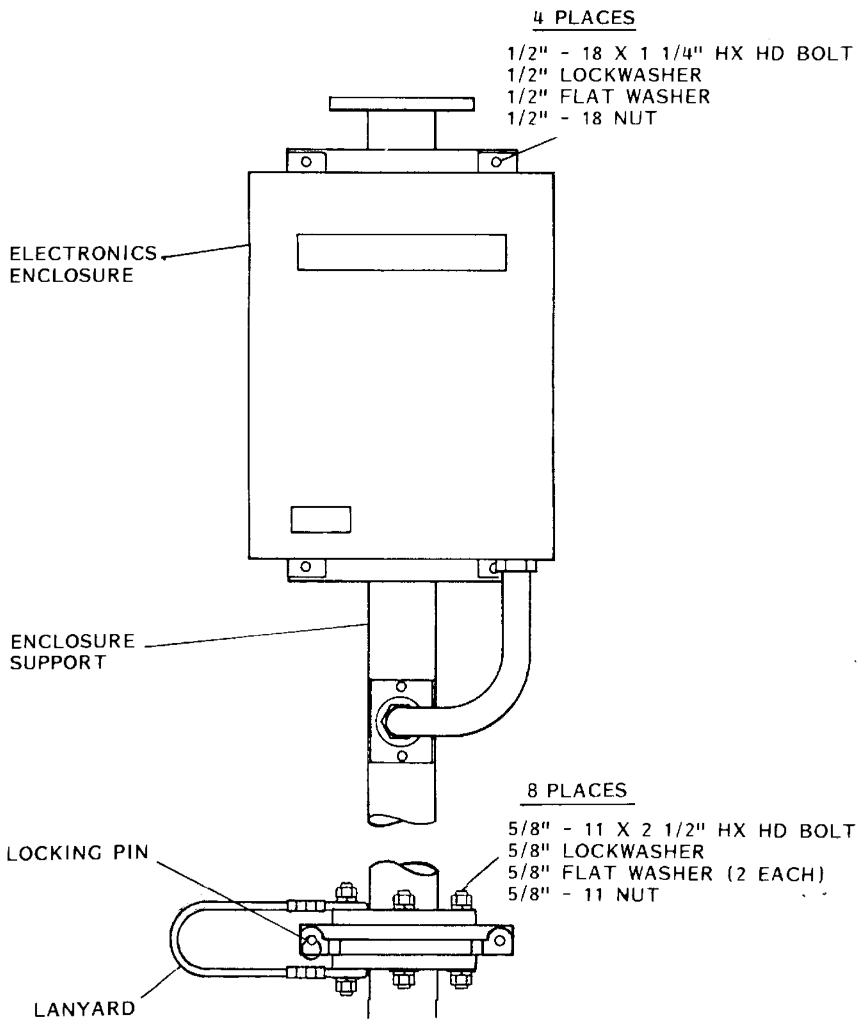

Figure 6.2.1. Electronics Enclosure Installation

Table 6.2.1. Enclosure Support Installation

Step	Procedure
1	Open hinge plate and position on mounting pedestal. For most sites, orient hinge plate so that when facing the door of enclosure, sensor tilts to right, away from other sensors (hinge side of plate is on right).
2	**NOTE** The lanyard must be oriented so that when the hinge plate is opened, the lanyard falls in hinge plate cutouts. Using one e-inch bolt, one nut, one lockwasher, and three flat washers, secure opening edge of hinge plate to pedestal, attaching one end of cable lanyard. Bolt is inserted from top down through pedestal with one flat washer under bolt head. On the underside of pedestal, lanyard loop must be secured between two flat washers with lockwasher and nut on outside. Do not fully tighten hardware.
3	Install three more sets of mounting hardware (i.e., bolt, two flat washers, lockwasher, and nut) on hinge plate. Tighten all four sets of mounting hardware.

Table 6.2.1. Enclosure Support Installation -CONT

Step	Procedure
4	Install washer on each bolt and slide four mounting bolts up through top of hinge plate. Temporarily install nut on each bolt and close hinge plate. Install hinge plate locking pin to hold hinge plate in closed position.
5	Remove nuts from four enclosure support mounting holes.
6	Position enclosure support on top of four mounting bolts taking care to properly position enclosure support.
7	**NOTE** The lanyard must be oriented so that when the hinge plate is opened, the lanyard falls in hinge plate cutouts. Using two flat washers, one lock washer, and one nut, secure front of hinge plate to enclosure support pole, attaching other end of cable lanyard. Lanyard loop must be secured between two flat washers with lockwasher and nut on outside. Do not fully tighten hardware.
8	Install remaining sets of mounting hardware (i.e., flat washer, lockwasher, and nut) on rear, left, and right of sensor support pole.
9	**WARNING** With locking pin removed from hinge plate, sensor pole is not firmly locked in upright position. Death or severe injury may result if personnel are not kept out of travel path of sensor. Lower enclosure support pole on hinge plate as follows: a. Remove locking pin from front part of hinge plate. b. From hinge side of sensor pole, firmly grasp pole with both hands and carefully lower support pole on hinge until lanyard catches and supports weight of pole.
10	Tighten all four sets of hardware securing support pole to hinge plate.
11	**WARNING** With locking pin removed from hinge plate, sensor pole is not firmly locked in upright position. Death or severe injury may result if personnel are not kept out of travel path of sensor. Raise enclosure support pole on hinge plate as follows: a. From behind hinged side of pole, firmly grasp support pole with both hands and carefully raise pole on hinge into upright position. b. Install locking pin into front of hinge plate.

Table 6.2.2. Electronics Enclosure Installation

Step	Procedure
1	**NOTE** Do not tighten screws in next step. Box flanges must be allowed to slip onto bolts. Install two sets of ½ - 18 by 1-¼-inch HHCS hardware into holes on lower bracket of enclosure support.
2	Position enclosure such that lower mounting flanges slip onto bolts and enclosure is resting on bolts.
3	Position box such that upper mounting flanges align with holes in upper mounting bracket.
4	Install hardware as shown on figure 6.2.1. Firmly tighten all four sets of bolts.

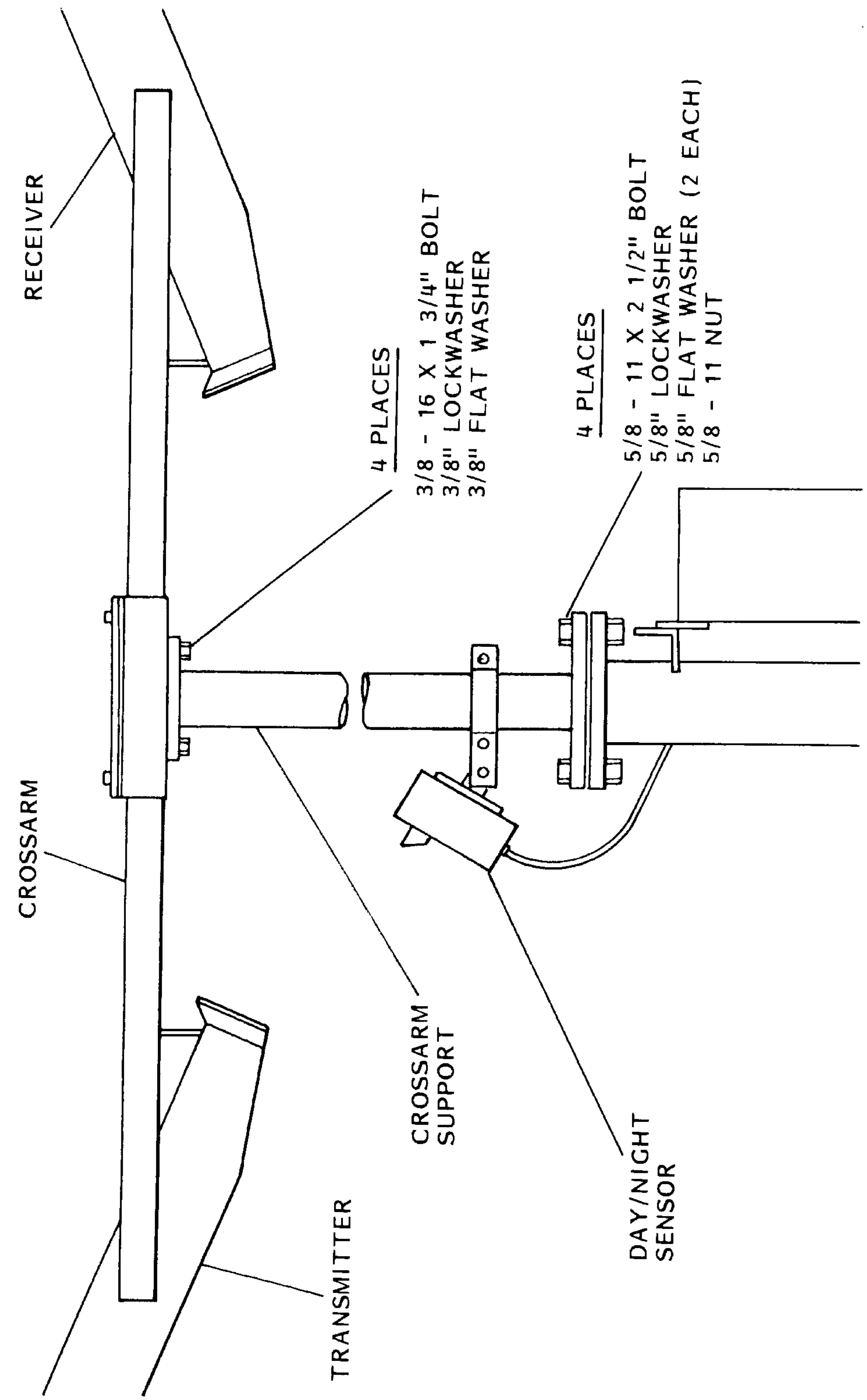

Figure 6.2.2. Crossarm/Support and Day/Night Sensor Installation

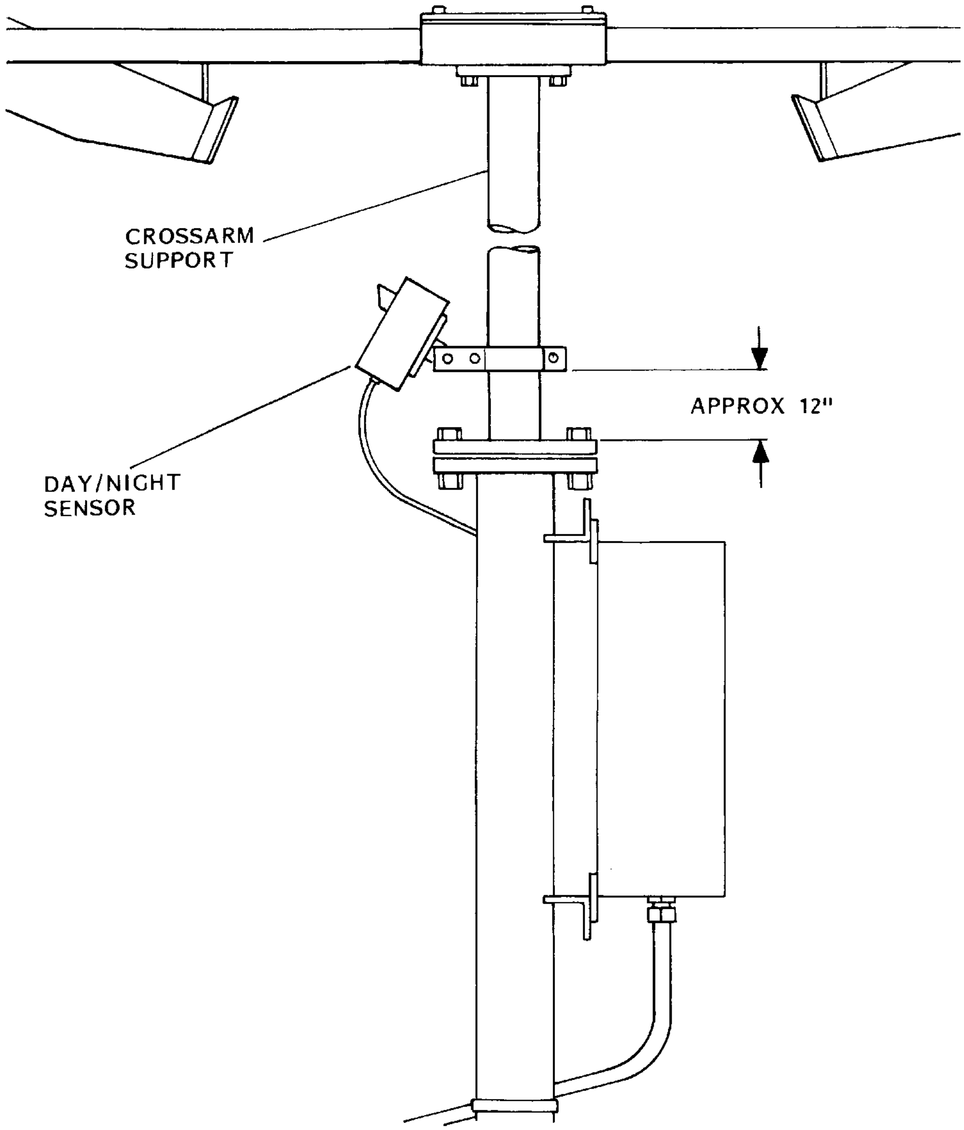

Figure 6.2.3. Day/Night Sensor Installation

Table 6.2.3. Day/Night Sensor Installation

Step	Procedure
	Tools required: 7/16-inch wrench
1	Using ¼-inch bolts and mounting hardware provided, mount day/night sensor on crossarm support pole approximately 12 inches above flange and sensor window facing same direction as receiver hood. Position sensor so that it points approximately 15 degrees above the horizon.
2	Connect day/night sensor signal and power cable A5W1-P1 to lower cable W2-P1 and route lower cable through support column and out access hole below electronics enclosure.
3	Using two ¼-inch bolts and flat washers, secure day/night sensor conduit connector to enclosure support pole.
4	Pass day/night sensor lower cable (W2) through lower conduit and into electronics enclosure.

Table 6.2.3. Day/Night Sensor Installation -CONT

Step	Procedure
5	Connect day/night sensor signal and power cable to connector J6 on backplane within electronics enclosure.
6	Secure lower conduit to support pole and electronics enclosure.

6.2.3 **CABLES**

All cables between the enclosure and the transmitter, receiver, and day/night sensor run through the interior of the support poles. All cables enter or exit the enclosure at the bottom of the enclosure. All cables to the transmitter or receiver connect directly to the modules within their respective hoods. Cable installation is easy and quick. After all of the cables are attached to their appropriate connectors, cable ties are installed as necessary. Table 6.2.4 provides details on installing the visibility sensor cables.

Table 6.2.4. Cable Installation

Step	Procedure
Receiver and Transmitter Cable Installation	
Tools required: 7/16-inch wrench Large pliers Flat-tipped screwdriver No. 1 Phillips screwdriver	
1	Remove large nut from end of flexible conduit and install conduit in right bottom side hole in main electrical enclosure. Install large nut securing conduit to main electrical enclosure. Do not tighten nut at this time.
2	Route receiver cable through support column and lower conduit into main electrical enclosure.
3	Connect receiver cable to connector J5 on motherboard located within main electrical enclosure.
4	Route transmitter cable through support column and lower conduit into main electrical enclosure.
5	Connect transmitter cable to connector J4 on motherboard located within main electrical enclosure.
6	Route ground wire through support column and lower conduit into main electrical enclosure.
7	Using 7/16-inch wrench, connect ground wire to wire lug E3 (located on top of power input box).
8	Remove mounting hardware from mounting bracket attached to flexible conduit. Discard nuts.
9	**CAUTION** Exercise care not to crimp wires when installing gasket. Locate EMI gasket and position gasket on rear of mounting bracket. Using 7/16-inch wrench, install two bolts, flat washers, and lockwashers securing mounting plate to column.
10	Using large pliers, tighten large nut securing conduit to main electrical enclosure.
Connecting System Cables to Enclosure	
1	**WARNING** Ensure that all power is disconnected from visibility sensor (turned off at DCP) before connecting cables. Using No. 1 Phillips screwdriver, open power input box within electronics enclosure by removing six Phillips screws that secure access cover.

Table 6.2.4. Cable Installation -CONT

Step	Procedure
2	Route ac power wires and fiberoptic cables from flexible conduit through opening in bottom of power input box.
3	Secure flexible conduit to bottom of electronics enclosure.
4	Using flat-tipped screwdriver, connect ac power wires to terminal board TB1 within power input box according to following chart: Wire — Connection Black (ac hot) — TB1-1 White (ac neut) — TB1-2 Green (ground) — TB1-3 If power input box has two filters and surge suppressors, ensure that following jumpers are also in place: From — To TB1-1 (ac hot) — TB1-4 TB1-2 (ac neut) — TB1-5
5	Connect transmit (TX) fiberoptic cable to TX connector on fiberoptic module.
6	Connect receive (RX) fiberoptic cable to RX connector on fiberoptic module.
7	Install access cover on power input box and secure using six Phillips screws.
8	Secure pedestal ground wire to ground stud located at bottom of electronics enclosure.
9	Close and secure sensor's electronics enclosure.

SECTION III. VISIBILITY SENSOR OPERATION

6.3.1 INTRODUCTION

Once the visibility sensor is installed and calibrated, only regularly scheduled maintenance is required unless a failure is detected by the ASOS. All operations, including diagnostics, are handled automatically by the ASOS.

6.3.2 CONTROLS AND INDICATORS

There are no maintenance significant controls and indicators on the visibility sensor. The sensor is designed for continuous operation and requires no operator or technician intervention.

6.3.3 TURN-ON PROCEDURES

The visibility sensor contains no power switch. Upon application of 120 vac, 60 Hz power from the data collection package (DCP), the sensor commences its startup sequence. Power is controlled via the visibility sensor circuit breaker module in the DCP.

6.3.4 NORMAL OPERATION

During normal operation, the DCP polls the visibility sensor once per minute for visibility data. Once polled, the visibility sensor quickly responds with the visibility data reports as described in Chapter 1. This polling is automatically performed by the ASOS system software and requires no user intervention. The diagnostic function of the sensor is also automatically performed by software, and occurs once each minute as controlled by the ASOS system software. The technician may also initiate a test of the sensor directly by exercising the TEST selection from the visibility sensor page display at the operator interface device (OID). This action is normally performed only in instances where a failure of the sensor has been detected.

6.3.5 TURNOFF PROCEDURES

The visibility sensor contains no power switch. Heater and electronics power is controlled via the visibility sensor circuit breaker module in the DCP.

SECTION IV. THEORY OF OPERATION

6.4.1 **INTRODUCTION**

This section provides a detailed description of how the visibility sensor functions to calculate the visibility level and detect day/night conditions. The operating principles of the sensor are introduced, followed by simplified block diagram descriptions of the sensor and its components. The theory describes the individual functional areas to a level of detail necessary for the isolation of a faulty FRU.

6.4.2 **SIMPLIFIED BLOCK DIAGRAM DESCRIPTION**

The following paragraphs describe the basic operation of the visibility sensor. The physical principles upon which the sensor bases it operation are described, followed by a simplified block diagram of the sensor. The simplified block diagram description introduces the basic system components and their functional relationships.

6.4.2.1 **Principles of Operation**. The Belfort visibility sensor is a forward-scatter class sensor that projects a pulsed beam of xenon light into a sample volume of the atmosphere. Aerosols in the illuminated sample region scatter light into a receiver, which looks toward the sample volume at an angle of approximately 45 degrees. It has been empirically shown that the amount of light scattered forward at approximately 45 degrees is proportional to the extinction coefficient regardless of the type or size of scattering media. The spacing of the detector from the transmitter and the optical focusing afford a large unobstructed sample volume (0.75 cubic feet). The downward-looking hoods aid in preventing ice and snow buildup and create an unattractive environment for birds and insects that cause contamination of the optical path. The use of xenon as a light source has several significant advantages. The bulb has an extremely long life expectancy (intensity half-life of 10.5 years). Also, the use of visible light accurately simulates human perception of visibility. The xenon light source has a component of blue light (short wave lengths) that allows scatter to occur from hazes and other small particles that are prevalent under higher visibility conditions. This permits the visibility sensor to report accurately under these conditions as well as during fog, rain, and snow. The optical system includes filtering to reduce the overabundance of blue and ultraviolet light and hence permits proportional levels of radiation at all critical wave lengths to fill the scatter volume.

6.4.2.2 **Visibility Sensor Basic Block Diagram Description**. The basic visibility measuring system is depicted in figure 6.4.1. The six major functional blocks are the transmitter assembly, receiver assembly, day/night assembly, processor board, current sense board, and fiberoptic module. Each functional block is a field replaceable unit (FRU) that can be easily removed and replaced for sensor repairs. All operations of the visibility sensor are directed by the processor board. The processor board sends commands to the transmitter assembly to initiate a flash, and then receives data from the receiver assembly to measure the scattered light. After data are received from the receiver assembly, age detect (part of the transmitter assembly) data, day/night data, and voltage monitor data are collected. The processor board combines all of these data to compute the extinction coefficient to determine visibility and detects daytime or nighttime conditions. The processor board then communicates these results via the fiberoptic module to the DCP. The software that controls the operations of the sensor, runs diagnostics, monitors heater operations, and calculates the proper output values is located on the processor board.

6.4.3 **DETAILED BLOCK DIAGRAM DESCRIPTION**

The following paragraphs describe the operation of the visibility sensor components to a detailed block diagram level. The simplified version of the operating theory provides the level of detail required to understand the operation of each FRU and is intended to assist the maintenance technician in servicing the unit. The detailed block diagram is provided in figure 6.4.2. The functional operation of each component is depicted and point-to-point signal wiring is shown.

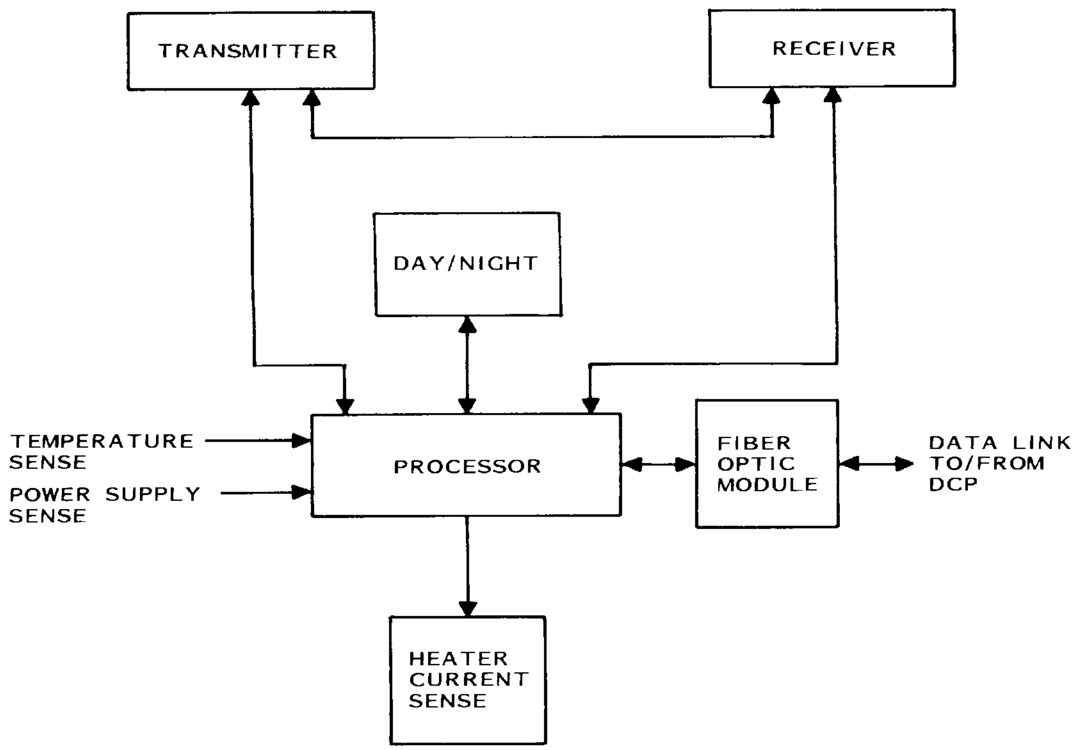

Figure 6.4.1. Visibility Sensor Basic Block Diagram

6.4.3.1 **Transmitter Assembly**. The transmitter assembly flashes a xenon flashlamp at a 2 Hz rate. The high voltage switching supply (located in the transmitter assembly) charges the energy storage (a storage capacitor) to full voltage. The trigger circuit sends a signal to the light pack to fire the xenon flashlamp. Light from the flashlamp is received by two detectors: the receiver assembly (paragraph 6.4.3.2) and the photodarlington transistor. The timing for the receiver sample is initiated by the photodarlington transistor, which outputs an electrical pulse when the xenon flash is generated. The photodarlington transistor output signal is used by the receiver assembly to detect the scattered light. Separate heater elements for the window and the hood are also provided in the transmitter assembly.

6.4.3.2 **Receiver Assembly**. The receiver assembly is used to detect the forward scattered light level from transmitted flashes and report the data to the controller board. The receiver diode receives scattered light from the sample volume through a lens. The light pulse strikes the receiver diode, causing the diode to create an electrical pulse proportional to the amplitude and duration of the scattered light pulse. The electrical signal from the diode is bandpass filtered and amplified and then input to a sample and hold circuit. The logic input to the sample and hold circuit is timed to catch the received signal at its peak. The sample and hold circuit is normally in the sample mode. The trigger signal from the transmitter assembly, created from the xenon light pulse, places the sample and hold circuit in the hold mode where it can take the light measurement. Once the received pulse is sampled at the peak of the signal and held there by the sample and hold circuit, an analog-to-digital converter transforms the voltage level into a digital value. The measured data is loaded into a first-in first-out (FIFO) memory, which, when full, is read by the processor board through a serial data interface for further processing. The processor board then places the sample and hold circuit back into the sample mode. After 33.3 milliseconds, the sample and hold circuit returns to the hold mode to measure the background (dark) light. The new data are then read in the same manner. Both light and dark measurements are required to calculate the extinction coefficient. This procedure is repeated for every flash. Separate heater elements for the window and the hood are also provided in the receiver assembly.

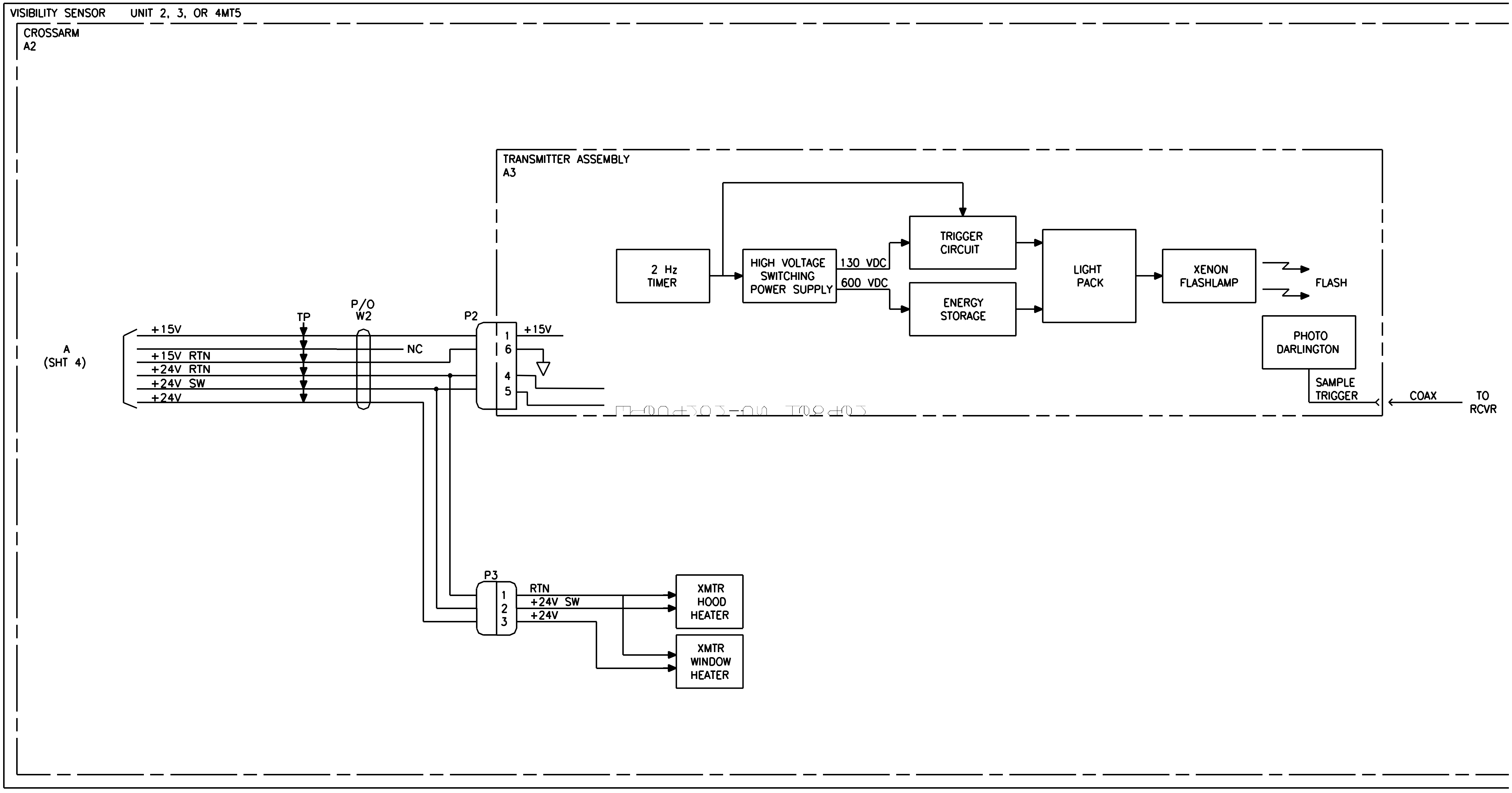

Figure 6.4.2. Visibility Sensor Detailed Block Diagram (Sheet 1 of 4)

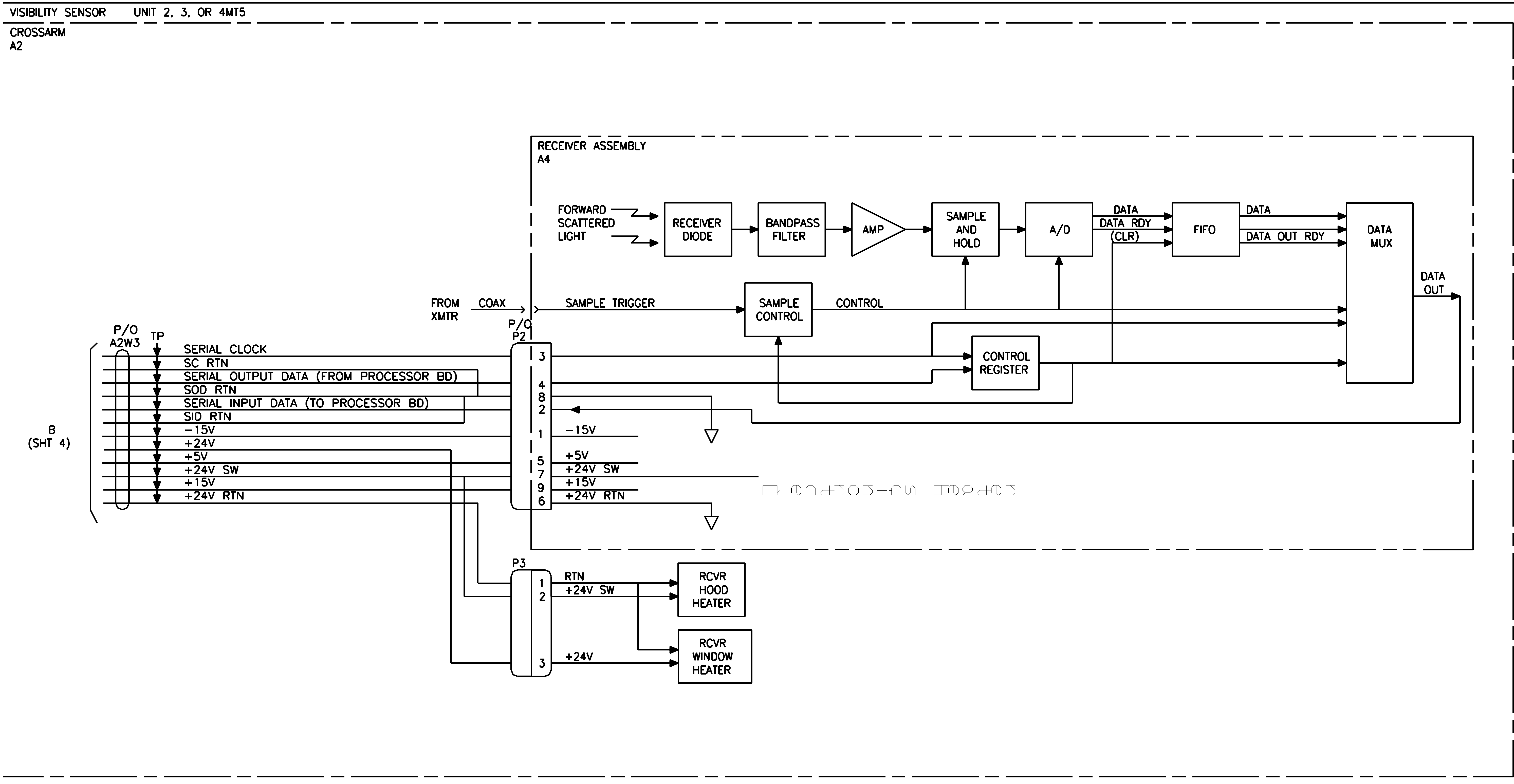

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Figure 6.4.2. Visibility Sensor Detailed Block Diagram (Sheet 2)

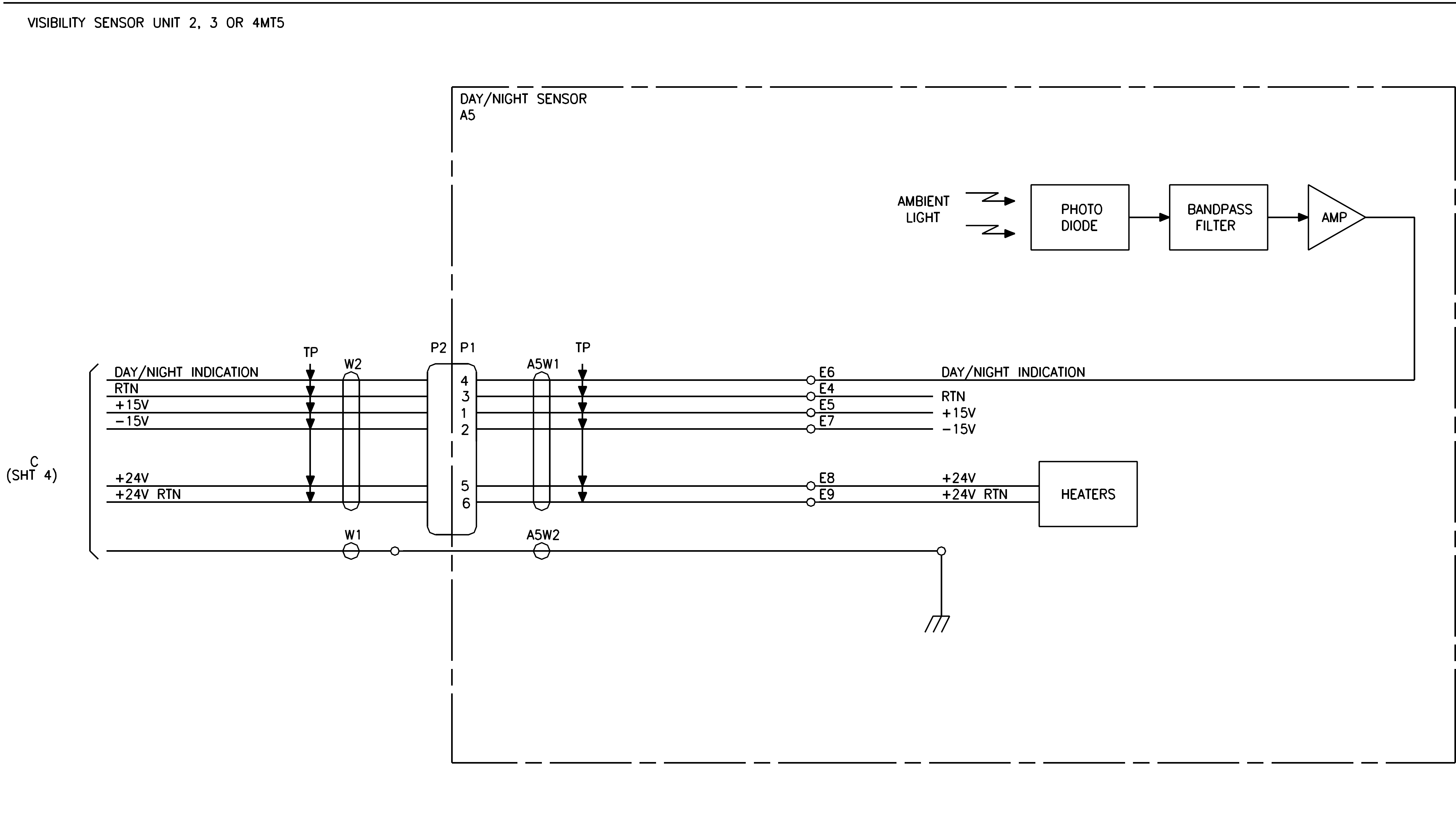
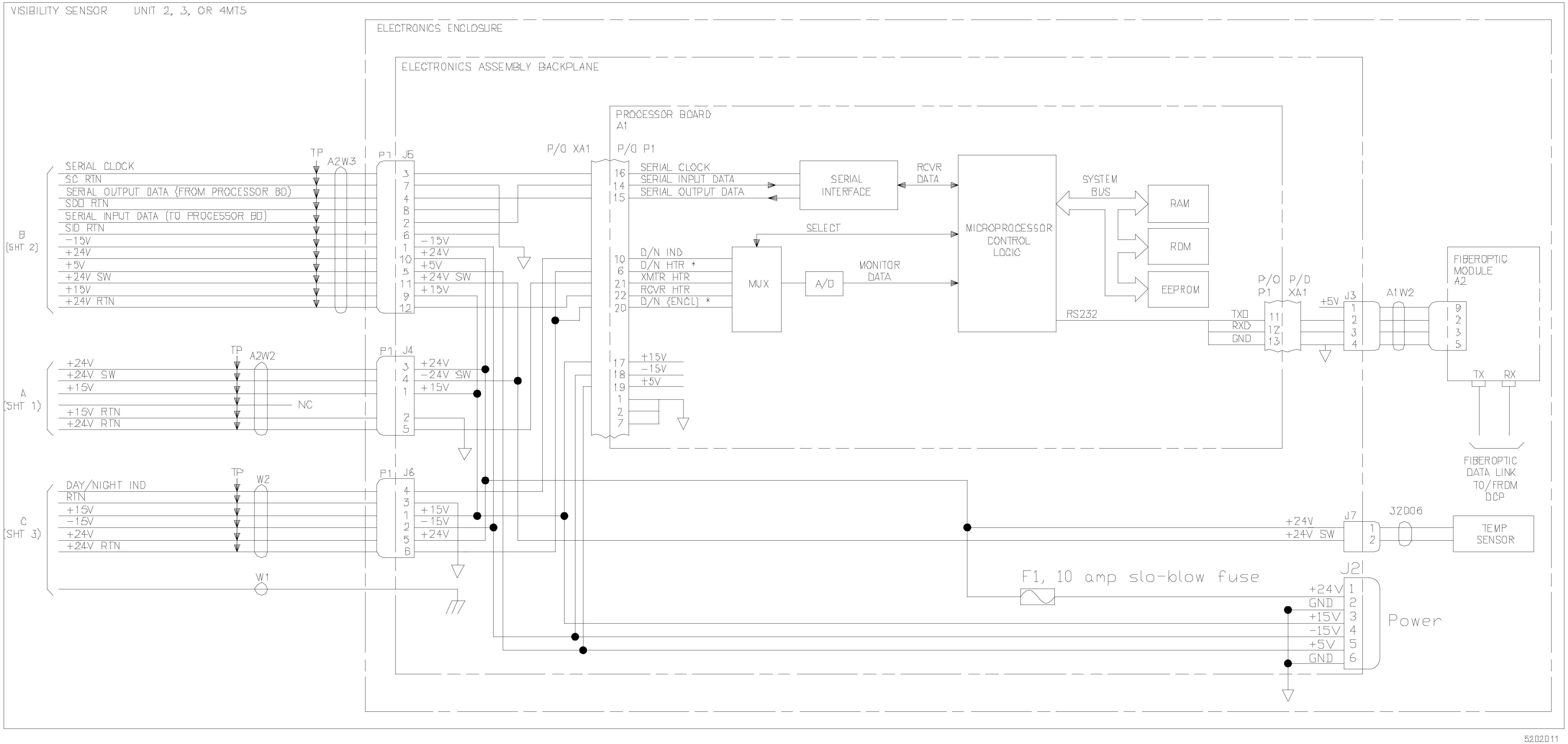


Figure 6.4.2. Visibility Sensor Detailed Block Diagram (Sheet 3)



* P1-6 IS UNUSED FOR 32194-1, -2 AND DAY/NIGHT HEATER RETURN FOR 32194-3 AND -4
P1-20 IS DAY/NIGHT HEATER RETURN FOR 32194-1, -2 AND ENCLOSURE HEATER RETURN FOR 32194-3 AND -4

Figure 6.4.2. Visibility Sensor Detailed Block Diagram (Sheet 4)

6.4.3.3 **Day/Night Assembly**. The day/night assembly is essentially an ambient light photometer. It detects light using a PIN receiver diode in the assembly such that light is received from the sky with a 6-degree viewing angle. The day/night receiver diode receives light through a window (not a lens) mounted in the day/night assembly. The light strikes the day/night receiver diode, causing the diode to create an electrical signal proportional to the amplitude of the ambient light. The electrical signal is then bandpass filtered and amplified. The voltage signal is then sent to the processor board for further processing. Separate heater elements for the window and the hood are also provided in the day/night assembly.

6.4.3.4 **Processor Board**. The processor board directs all of the actions of the visibility sensor. Its primary task is to take measurements of the sample volume and calculate the visibility extinction coefficient and day/night condition.

The extinction coefficient for the sample volume of atmosphere is proportional to the ratio of light energy received by the receiver diode to the light energy input to the sample volume by the xenon flash transmitter. Two measurements are performed during each sample cycle (½ second). During the first measurement (the light measurement), the transmitter sends a trigger signal to the receiver assembly as the flashlamp fires. The sample and hold circuit in the receiver assembly responds to the trigger signal to latch the receiver signal at its peak. This peak level is converted into a digital value that is read by the processor. The data collected during this first measurement period are directly proportional to the amount of light that was scattered into the receiver.

During the second measurement (the dark measurement), the sample and hold is returned to the sample mode by the processor. In the absence of the flash (no scattered signal reaching the receiver), the receiver level is sampled and held. This measurement is then converted to a digital form and read by the processor. The receiver data collected during this second measurement period are directly proportional to the amount of ambient background light (background noise) that was observed by the receiver. The difference between the two measurements is used to determine extinction coefficient. The subtraction cancels the effects of any possible offsets in the receiver assembly. The day/night signal is converted to digital form on the processor board. The processor uses the day/night data to determine if the ambient light indicates day. The day/night sensor always indicates day for illumination greater than 3 fc, and always indicates night for illumination less than 0.5 fc. The transition from indicating day to indicating night occurs once in the region from 3 to 0.5 fc (as illumination decreases). The transition from indicating night to indicating day occurs once in the region from 0.5 to 3 fc (as illumination increases). The day/night assembly is calibrated before installation. Two calibration factors are supplied with the calibrated day/night assembly: edge of day, which indicates the transition point for daytime, and edge of night, which indicates the transition point for nighttime.

The processor board also monitors the operation of the heaters. The board monitors the electrical current levels used by the heaters. The signals sensed indicate whether the associated heater element is on or off. When it is cold enough for the heaters to turn on (temperatures less than 40 degrees Fahrenheit), the heaters cycle on and off. The processor periodically verifies the operation of the heaters as a part of its normal processing.

6.4.3.5 **Fiberoptic Module**. A fiberoptic link provides for two-way serial communication between the visibility sensor and the DCP. The fiberoptic module performs the electrical-to-optical and optical-to-electrical conversions required. The electrical interface between the controller board and the fiberoptic module is an RS-232C serial interface. The fiberoptic link with the DCP consists of separate transmit and receive optic fibers.

6.4.3.6 **Power Distribution**. Both ac and dc power are present in the visibility sensor electronics enclosure (Figure 6.4.3). If one filter protrudes from the top of the power input box, the sensor is a one-filter configuration as illustrated on figure 6.4.3, sheet 2. If two filters protrude from the top of the power input box as illustrated on figure 6.4.3, sheet 1, the sensor is a two-filter configuration. DCP cables are connected to the sensor in an identical manner for either configuration. Two types of ac power are applied from the

DCP: electronics ac and heater ac. The electronics ac power is passed through surge suppression and EMI filter circuits and is applied to electronics power supply PS1. The ±15 vdc and +5 vdc output by the electronics power supply are applied to the sensor electronics via the electronics assembly. The heater ac power is passed through surge suppression and EMI filter circuits and applied to the heater power supply. The +24 vdc output of the heater power supply is applied to the electronics assembly where it is distributed to all of the heaters.

Take note that the F2 fuse in figure 6.4.3 is a ¼ amp fast blow fuse. Furthermore, the S1 temperature sensor in figure 6.4.3 is a cut-off switch that will open at 30°F and closes at 50°F. Should the electronics enclosure drop below 30°F, all power to the sensor will be terminated.

6.4.4 **COMMAND DESCRIPTION**

The visibility sensor responds to V commands issued by the DCP during normal operation and by the technician during calibration. The following paragraphs describe visibility sensor commands.

6.4.4.1 **<u>Quick Reference</u>**.

6.4.4.1.1 **Polled Mode**.

a. The V1 command reports sensor status, extinction coefficient, and day/night status.

b. The VL command reports sensor serial number; sensor status; day/night status; enclosure temperature; flash, dark, and day/night measurements; visibility in miles; and extinction coefficient in inverse kilometers.

6.4.4.1.2 **Continuous Output Mode**. The VP command sets the delay between output messages (delay of zero = >off) that report the measurement values of the most recent sample, visibility in miles, and extinction coefficient in inverse kilometers.

6.4.4.1.3 **Other**.

a. V0 displays sensor status and current firmware revision.

b. V2 is used as a communications check, causing known and unchanging values for extinction coefficient to be reported.

c. V3 is used to enter heater calibration mode. (Refer to table 6.5.3, step 9.)

d. V4 enables/disables the data quality algorithm.

e. VD calculates the standard deviation of the sensor's "zero drift".

f. VF allows the entry/modification of calibration coefficients and configuration information.

g. VH allows the entry/modification of initialization coefficients.

h. VG invokes extended diagnostics.

I. VE clears and initializes the EEPROM (nonvolatile RAM).

NOTE

If VE is performed, the sensor must be recalibrated unless calibration constants have been recorded otherwise (i.e., written down) and known to have not changed. The calibration constants must be reentered after VE or the sensor will not operate properly.

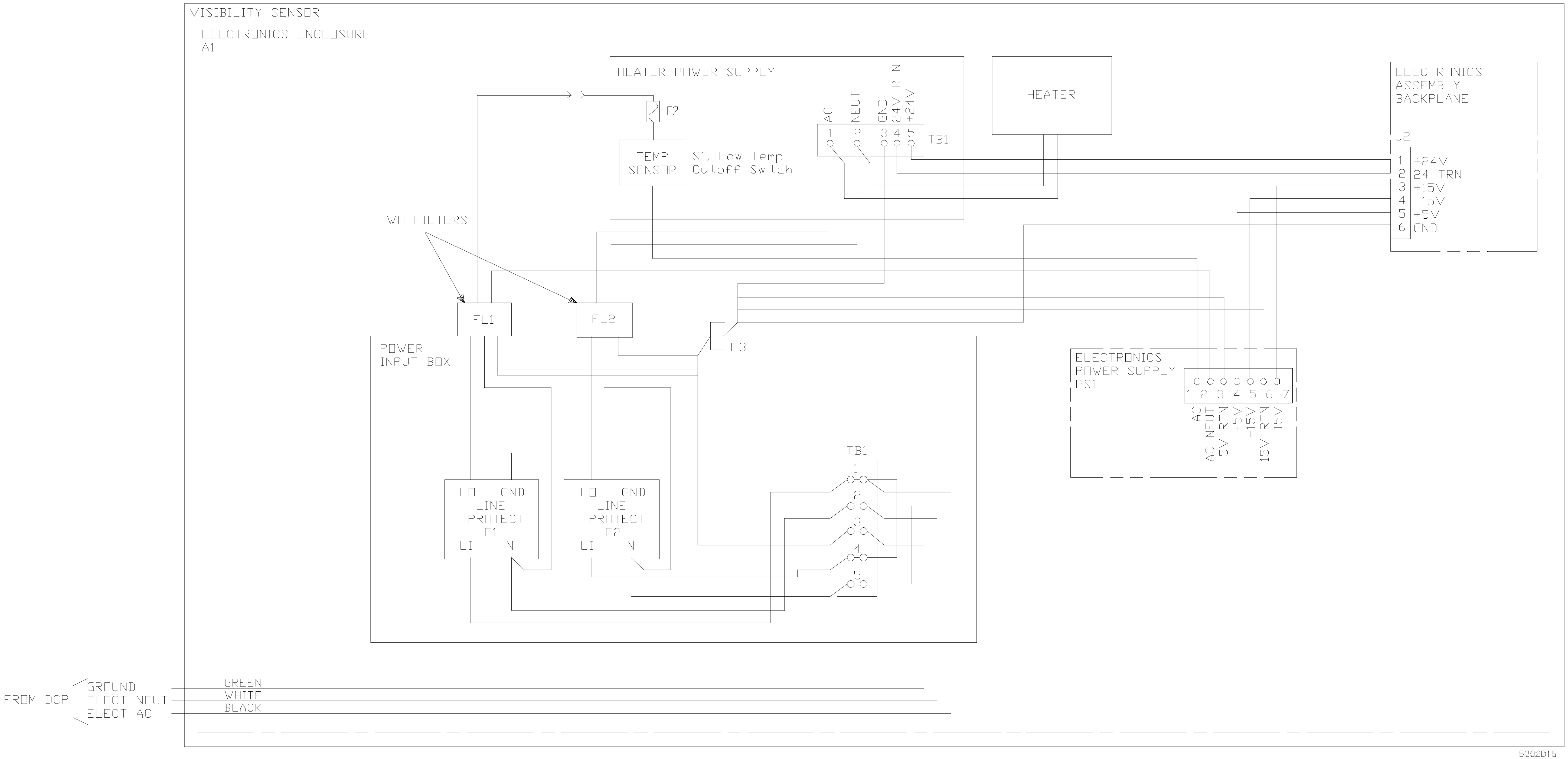


Figure 6.4.3. Visibility Sensor Electronics Enclosure Power Distribution Diagram (Sheet 1 of 2)

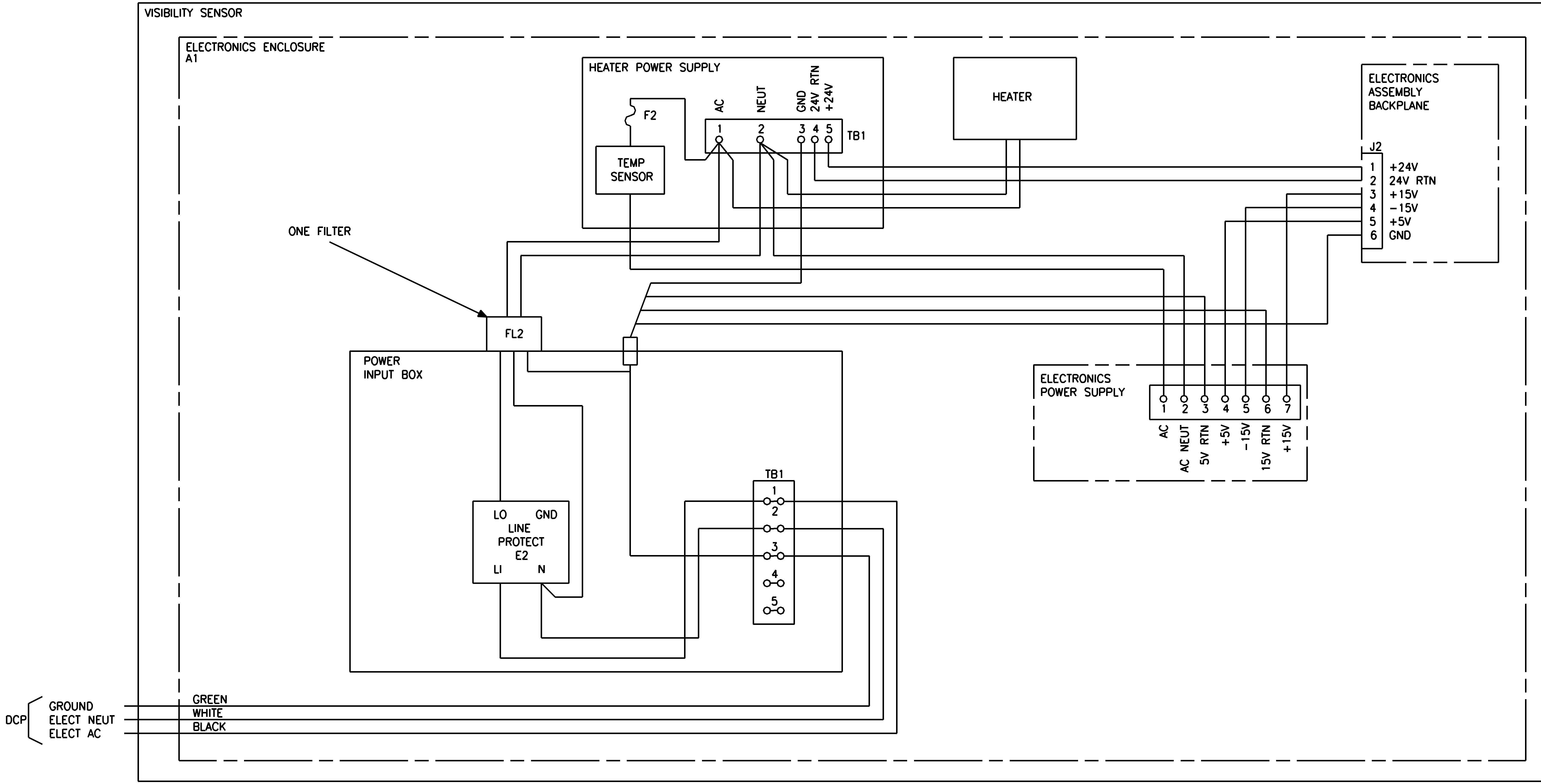


Figure 6.4.3. Visibility Sensor Electronics Enclosure Power Distribution Diagram (Sheet 2)

6.4.4.2 **Power Up/Reset Message**.

VIS VER 021

Total message length is 21 characters. The time for total message transmission at 2400 bps is 0.07 second.

6.4.4.3 **V0 Command (Roll Call)**.

Byte	Description	Value
1	Start of transmission	STX
2	Carriage return	CR
3	Line feed	LF
4	Sensor identification	V
5	Sensor status	P/F
6-8	ROM version	XXX
9-10	Checksum (in ASCII)	CHECKSUM
11	End of transmission	ETX
12	Carriage return	CR
13	Line feed	LF

Total message length is 13 characters. A sensor status of P indicates that the sensor has passed all diagnostic tests. A sensor status of F indicates that the sensor has failed one or more diagnostic tests. More information as to the nature of the failure is available by sending a VG command to the sensor.

6.4.4.4 **V1 Command (Extinction Coefficient)**.

Byte	Description	Value
1	Start of transmission	STX
2	Carriage return	CR
3	Line feed	LF
4	Sensor ID	V
5	Sensor status	P/F
6-10	Extinction coefficient	XXX.X
11	Day/night status	D/N
12-13	Checksum (in ASCII)	CHECKSUM
14	End of transmission	ETX
15	Carriage return	CR
16	Line feed	LF

The total message length is 16 characters. The extinction coefficient consists of five characters including the number and the decimal point. The position of the decimal point shifts, depending on the value of extinction coefficient to yield the most accurate reading in the available space. The extinction coefficient range is 186.4/km (52.8 feet) to 0.018/km (100 miles).

6.4.4.5 **V2 Command (Simulated Data)**.

Byte	Description	Value
1	Start of transmission	STX
2	Carriage return	CR
3	Line feed	LF
4	Sensor ID	V
5	Sensor status	P/F
6-10	Extinction coefficient	12.34

Byte	Description	Value
11	Simulated day/night status D	
12-13	Checksum (in ASCII)	CHECKSUM
14	End of transmission	ETX
15	Carriage return	CR
16	Line feed	LF

The total message length is 16 characters. This message is constant except that the sensor status reports the actual pass/fail status of the instrument to avoid confusion.

6.4.4.6 **V4 Command (Data Quality)**.

```
Data quality? (Y or N)[Y]>Y
New Cksum=9f
Old Cksum=9f
---> End of v4 >---
***************************************
```

This command is used to enable or disable the use of the data quality algorithm during visibility measurements. This data quality algorithm is designed to ignore errant readings that are caused by debris passing through the scatter volume temporarily (e.g., windblown leaves, windblown snow, birds, etc). The data quality algorithm causes the sensor to appear stuck temporarily if there is a sudden and significant change in ambient visibility but the sensor output data conform to the actual conditions within a 3-minute period.

6.4.4.7 **VD Command (Standard Deviation of Zero Drift)**. The firmware includes a function that calculates the standard deviation of the sensor indication about zero when in the zero state. This is the best possible means of determining zero drift and, thus, the overall accuracy of the individual instrument. The VD command calculates the standard deviation of a number of zero state samples. The number of samples is selecTable in the range of 2 to 65,535 with 120 samples as the default. To invoke VD, the opaque filter is placed on the receiver and the instrument is allowed to settle for at least 3 minutes. After settling time, the technician types VD. When prompted for the number of samples, the desired number is entered or ENTER is pressed to accept the default. The function then displays a countdown of the samples being used for the calculation. The results of the VD command are std_dev and VIS. std_dev is the calculated standard deviation of zero drift, which is consistent with the classical mathematical definition. VIS is the maximum visibility (in miles) at which there is a 90-percent statistical probability of being 10 percent accurate. The VIS output of the VD command should be no less than 100 miles. The value of FI calculated by the VZ command should be in the range of +1.0 to -1.0.

NOTE

It is normal for the extinction coefficient and visibility readings to go negative when in the zero state. This does not happen in actual ambient visibility and should not be construed as a malfunction of the device.

6.4.4.8 **VD Command (Calibration Coefficients/Configuration Information)**. The VF command, invoked by typing VF, allows the technician to enter the calibration coefficients and configuration information required for proper operation. The VF command responds as follows:

```
*************************************
E2PROM chk_sum    = 0

E0 = 19.399999...==>
F0 = 1.000000...==>
```

```
WINDOW = 113.999999...==>
VIS_SER_NO?    1...==>
Day/Night installed? (Y or N)[Y]>
Heaters installed? (Y or N)[Y]>
-------------------------------------
E0 = 19.399999
F0 = 1.000000
WINDOW = 113.999999
VIS_SER_NO = 1
D/N installed = Y
Htrs installed = Y
New Cksum=9f
Old Cksum=9f
---> End of vF <---
*************************************
```

a. E0 is the factory-initialized value for the standard extinction coefficient obtained from the calibration filter/scatter plate set. E0 is changed only when a new scatter plate/filter combination is used.

b. F0 is the factory-initialized value for the extinction coefficient adjustment factor. F0 is changed only when an FRU replacement calibration is performed. F0 is not used for measurement calculations; it is for reference only.

c. WINDOW is the time constant (in seconds) of the window averaging filter for extinction coefficient data. This should be set to 114. (The processor stores 114 as 113.999999 in floating point format.)

d. VIS_SER_NO? is the serial number of the visibility meter, which is shown on the Belfort ID marker.

e. Day/Night installed? allows the sensor to be configured with or without the day/night option. If day/night is not configured in, all day/night diagnostics pass and day/night status reads X instead of D or N.

f. Heaters installed? allows the sensor to be configured with or without the cold weather option. If heaters are not configured in, all heater diagnostics (except transmitter and receiver window heaters) pass.

g. Values are changed by entering a new value at the ...==> prompt.

h. The information below the dashed line is a verification of the data entered. The information also contains EEPROM checksum information.

i. If no data are to be changed in a particular field, <ENTER> is pressed. <ESC> is pressed to abort the remainder of the data entry.

6.4.4.9 **VL Command (Polled Mode, Extended Output Message)**.

SER001 AOK Night 26.1 001031 001024 000024 Vis: 23.40 Ext: 0.079646

The total message length is 72 characters (including CR/LF at the end). This message reports the serial number of the sensor, sensor status, day/night status, enclosure internal temperature, value of the latest flash and dark measurements, value of the latest day/night measurement, visibility in miles, and extinction coefficient in inverse kilometers.

6.4.4.10 **VG Command (Extended Diagnostics)**.

VPN 0.06553PPPP PPP PP PPP PPPP 26.4 9f

Byte	Description	Value
1	Start of transmission	STX
2	Carriage return	CR
3	Line feed	LF
4	Sensor ID	V
5	Sensor status	P/F
6	Day/night status	D/N
7-13	Latest extinction coefficient	XXX.XXX
14	ADD check	P/F
15	RAM check	P/F
16	ROM check	P/F
17	EEPROM check	P/F
18	Space	
19	Receiver operational status	P/F
20	Transmitter operational status	P/F
21	Day/night operational status	P/F
22	Space	
23	Receiver hood heater	P/F
24	Transmitter hood heater	P/F
25	Space	
26	Receiver window heater	P/F
27	Transmitter window heater	P/F
28	Day/night window heater	P/F
29	Space	
30	Receiver electronics heater	P/F
31	Transmitter electronics heater	P/F
32	Day/night electronics heater	P/F
33	Enclosure electronics heater	P/F
34	Space	
35-39	Inside ambient temperature	XXX.X
40	Space	
41-42	Checksum	XX
43	End of transmission	ETX
44	Carriage return	CR
45	Line feed	LF

The total message length is 45 characters. The processor is dedicated full-time to the test during the check period and is not available to output visibility data.

6.4.4.11 **VH Command (Calibration Factors)**.

```
FE = 0.873497...==>
FI = 0.408333...==>
EDGE_OF_DAY = 90.000000...==>
EDGE_OF_NIGHT = 30.000000...==>
DAY_NIGHT_ZERO = 10...==>
-------------------------------------
FE = 0.873497
FI = 0.408333
EDGE_OF_DAY = 90
EDGE_OF_NIGHT = 30
DAY_NIGHT_ZERO = 10
New Cksum=9f
Old Cksum=9f
---> End of vH <---
*************************************
```

a. FE is a calibration constant and is a multiplier in the equation that calculates the extinction coefficient. FE is directly proportional to the extinction coefficient.

b. FI is the zero offset. FI is subtracted out of the measurement data as a part of the extinction coefficient calculation.

c. EDGE_OF_DAY is the digital measurement that corresponds to an ambient light level of 3 foot-candles.

d. EDGE_OF_NIGHT is the digital measurement that corresponds to an ambient light level of 0.5 foot-candle.

e. DAY_NIGHT_ZERO is the minimum reading that the processor should obtain from the day/night sensor. DAY_NIGHT_ZERO is used for diagnostics.

6.4.4.12 **VP Command (Automatic Report)**. The VP command is used to provide a periodic output message that reports several operating values including the extinction coefficient in inverse kilometers and visibility in miles. This command also provides the capability to alter the delay between messages in increments of 1 second. The delay should be set to zero to turn off the output message. The following is an example of the response to the VP command:

```
Delay?  0...==>60
New Cksum=7c
Old Cksum=2e
---> End of vP <---
*************************************
001031 001024 000107 000024 N 004095   23.4    0.079646
001031 001024 000107 000024 N 004095   23.4    0.079646
```

The columns of data in the VP output message are as follows:

(1) The latest flash measurement
(2) The latest dark measurement
(3) Flash - dark + K (K is an arbitrary constant)
(4) The latest day/night measurement
(5) The latest day/night status
(6) Reserved
(7) The latest visibility in miles
(8) The latest extinction coefficient in inverse kilometers

6.4.4.13 **VR Command (Reset Sensor)**. The VR command invokes a reset of the processor, which initializes the visibility meter.

SECTION V. MAINTENANCE

6.5.1 INTRODUCTION

The visibility sensor requires a few, simple maintenance procedures. In general, the maintenance schedule depends upon the influence of local environmental factors near and about the installation site. Corrective maintenance is divided into two areas. The troubleshooting procedure is used when data transfer communications with the sensor have failed. The diagnostic procedure is used when data communications with the sensor are available. The source of any faults can thereby be quickly detected and identified.

6.5.2 PREVENTIVE MAINTENANCE

6.5.2.1 **General**. The preventive maintenance schedule for the visibility sensor is provided in table 6.5.1. Routine cleaning and inspection of the sensor, as described in table 6.5.2, should be performed every 90 days and whenever the maintenance technician visits the site. The maintenance log should be updated and any problems noted at each interval.

Table 6.5.1. Visibility Sensor Preventive Maintenance Schedule

Interval	What To Do	How To Do It
90 days	Routine cleaning and inspection	Table 6.5.2
	Calibration	Table 6.5.3

6.5.2.2 **Calibration**. The visibility sensor must be calibrated every 90 days or after any corrective maintenance action. Before the sensor can be calibrated, it must be properly installed and must pass its ASOS diagnostics checks. Table 6.5.3 provides the procedure to calibrate the visibility sensor. Calibration is performed using the laptop computer to issue "V_" commands and receive the sensor's responses. Paragraph 6.4.4 provides a detailed description of these responses.

6.5.3 CORRECTIVE MAINTENANCE

6.5.3.1 **General**. Corrective maintenance is performed only when a malfunction occurs. Manual troubleshooting as well as diagnostic testing procedures are provided for the sensor. The troubleshooting procedure is used when data transfer communications with the sensor have failed. The diagnostics procedure is used to automatically isolate faults when communications with the sensor are available.

6.5.3.2 **AC and DC Power Troubleshooting**. The dc and ac power checks used in troubleshooting are provided in tables 6.5.4 and 6.5.5, respectively. After all dc and ac power checks have been performed and the sensor communications are still not possible or are error prone, the fiberoptic module must be checked using the procedures in Chapter 1. If the fiberoptic module checks good, the failure must be located in the RS-232 link with the processor board. The processor board must then be removed and replaced.

6.5.3.3 **Heater** Troubleshooting. The visibility sensor has heater elements located in the main electrical enclosure, the day/ night sensor, the transmit head assembly, and the receiver head assembly. The heater power supply supplies power to all of these heater assemblies. A temperature sensor switch, located in the lower right corner of the main electrical enclosure, controls the application of heater power to the heating elements. During normal system operation, the temperature sensor switch closes when the temperature within the main electrical enclosure is below 40 degrees Fahrenheit and applies 24 volts to the heater elements. The processor board monitors the current flow through the heater elements and reports this status on the visibility sensor maintenance page. Five faults can affect proper operation of the heater circuitry: failure of the heater power supply, failure of one or more of the heater elements, failure of the regulator circuit board (3A1), failure of the processor card monitor circuit, or failure of the temperature sensor. The current status of the visibility sensor's maintenance page should be reviewed prior to troubleshooting the heater control circuit. The troubleshooting procedures provided in table 6.5.6 can then be used to troubleshoot the sensor.

Common visibility heater specifications, all with tolerances of +/- 5%:

Window Heater	-	115 ohms
Hood Heater	-	12 ohms
Electronics Heater	-	53.6 ohms thru 63 ohms
Day/Night Window Heater	-	115 ohms
Day/Night Electronics Heater	-	100 ohms

With all heaters on, nominal current draw is 2.4966 amps (maximum is 2.7594 amps).

6.5.4 **DIAGNOSTICS**

6.5.4.1 **Introduction**. The visibility sensor is provided with a continuous self-test (CST) that runs automatically as a part of normal ASOS operation. The technician can also selectively run a diagnostic test on demand. The operation of the CST software does not interfere with the collection, processing, storage, or reporting of data. All of the diagnostic capabilities of the sensor may be exercised by the technician from the OID. Processor Board, PN 32194-1, with V036 firmware loaded, contains a "V3" command. V3 guides the technician in a step-by-step procedure to measure current draw of each heater element, using a supplied jumper. Procedural instructions are included in the firmware so that the OID displays each procedural step. No special test equipment or fixtures are needed to perform the "V3" measurement, and the visibility sensor need not be in ASOS mode. Sensor calibration is not required after the "V3" measurement.

The diagnostic capability of the visibility sensor is designed to check and monitor the major signal paths of the sensor to detect any possible failures. Each of the sensor heaters is monitored by current sensors. The outdoor temperature is monitored, and if the range is such that heaters are to be operational, software algorithms look for cycling (on and off) of the heaters. Every power supply output voltage is monitored by the processor board through a multiplexer and sensing circuit. If any level is out of range, a software flag is set to notify the technician to replace the corresponding FRU.

Signals generated by the various detectors are monitored to check for out-of-range values. Any discrepancies result in the setting of a software flag that notifies the technician to replace the associated FRU. In addition, random access memory (RAM), read-only memory (ROM), electrically erasable programmable read-only memory (EEPROM), and address self-test checks are run by the processor board to continually monitor its own operation. All diagnostics are available to the technician at the OID during normal operation.

6.5.4.2 **Executing Diagnostics**. The visibility sensor executes its own diagnostic routine during normal operation to detect any failures in operation. The results of this diagnostic routine are reported to the ASOS system software as a part of its normal data gathering process. Any failures that are detected are displayed at the OID as well as reported in the maintenance log. The visibility sensor page displayed at the OID also allows the technician to perform a detailed diagnostic test on the sensor. The test is initiated by selecting the TEST option from the display. The results of the test process are then displayed for the technician at the OID. A description of the visibility sensor page and its fields is provided in Chapter 1.

6.5.5 FRU REMOVAL AND INSTALLATION

FRU removal and installation are easily accomplished with simple handtools.

6.5.5.1 **Receiver Assembly Removal and Installation**. The procedures required to remove and install the visibility sensor receiver assembly are provided in table 6.5.7.

6.5.5.2 **Transmitter Assembly Removal and Installation**. The procedures required to remove and install the visibility sensor transmitter assembly are provided in table 6.5.8.

6.5.5.3 **Processor Board Removal and Installation**. The procedures required to remove and install the processor board are provided in table 6.5.9.

6.5.5.4 **Day/Night Assembly Removal and Installation**. The procedures required to remove and install the day/night assembly are provided in table 6.5.10.

6.5.5.5 **Electronics Power Supply Removal and Installation**. The procedures required to remove and install the electronics power supply are provided in table 6.5.11.

6.5.5.6 **Fiberoptic Module Removal and Installation**. The procedures required to remove and install the fiberoptic module are provided in table 6.5.12.

6.5.5.7 **Crossarm Assembly Removal and Installation**. The procedures required to remove and install the crossarm assembly are provided in table 6.5.13.

6.5.5.8 **Electronics Enclosure Removal and Installation**. The procedures required to remove and install the electronics enclosure are provided in table 6.5.14.

6.5.5.9 **Regulator Board Removal and Installation**. The procedures required to remove and install the regulator board are provided in table 6.5.15.

Table 6.5.2. Visibility Sensor Cleaning and Inspection

Step	Procedure
	WARNING Death or severe injury may result if power is not removed from the sensor prior to maintenance activities. Ensure that circuit breaker supplying power to the sensor is in the OFF (right) position.
1	Inspect ac and signal wiring that supplies the visibility sensor enclosure and ac and signal cables that route from enclosure to sensor's transmitter, receiver, and day/night assemblies.
2	Ensure that all visibility sensor cable connectors are secure.
3	Inspect inside of transmitter, receiver, and day/night assembly housings (assemblies) for dirt, spider webs, birds' nests, or any other obstructing material that may disrupt optical path.
4	**NOTE** Spider webs can float in air currents and attach across sample volume. Webs may be almost invisible to the human eye but can severely effect performance of sensor. Using a soft cloth, remove any evidence of window fouling. Gently brush cloth over critical areas that may appear to be clean, such as lip of assembly and support pole where scatter plate attaches. Make several passes through sensing volume with an arm or pole to ensure that there is no contamination.
5	Using soft cloth and a commercially available glass cleaner, clean protective glass windows of transmitter, receiver, and day/night assemblies.

Table 6.5.3. Visibility Sensor Calibration

Step	Procedure
	NOTE Before running the Visibility Calibration Check, check continuity of all nine visibility sensor heaters per table 6.5.6. Figure 6.5.1 provides a sample visibility sensor calibration data sheet. Copies of this form should be made and used to record values as directed in this procedure. Tools required: Laptop computer with PROCOMM Plus installed Visibility sensor calibration kit Laptop interface (Y-shaped) cable Large flat-tipped screwdriver Small flat-tipped screwdriver Window cleaner and soft cloth Dark opaque cloth Tape measure **CAUTION** Adverse weather conditions can affect the accuracy of the visibility calibration. Calibration should only be performed under the following conditions: winds less than 10 knots, ambient visibility greater than 2.5 miles, and no precipitation or blowing snow.
	INITIAL SETUP PROCEDURE
1	Inside equipment cabinet, set circuit breaker on visibility sensor circuit breaker module to off (right) position.
2	During initial installation or TX/RX replacement only, verify that TX and RX canisters are fully seated in hood. This can be verified by measuring the distance from the back of the hood down to the end of TX or RX canister body. The distance should be at least 1.0 inch. If not, slide canister out 1 inch and then push canister back in until fully seated.
3	Using large flat-tipped screwdriver, open visibility sensor electronics enclosure access door.
4	Using small flat-tipped screwdriver, disconnect visibility sensor DB-9 connector from fiberoptic module inside electronics enclosure.
5	Using laptop computer interface (Y-shaped) cable, connect RS-232C (COM1) port of laptop computer to DB-9 connector removed from fiberoptic module.
6	Turn on laptop computer and initialize PROCOMM Plus program. After program initializes, press any key to enter terminal mode (blank) screen.
7	Using ALT-S command (setup facility), set up the following TERMINAL OPTIONS: a. Terminal emulation: VT220 b. Duplex: FULL c. Soft flow control (XON/XOFF): OFF d. Hard flow control (CTS/RTS): OFF e. Line wrap: OFF f. Screen scroll: ON g. CR Translation: CR h. BS Translation NON-DESTRUCTIVE i. Break length (milliseconds): 035 j. Enquiry: OFF k. EGA/VGA true underline: OFF l. Terminal width: 80 m. ANSI 7 or 8 bit commands: 8 BIT

Table 6.5.3. Visibility Sensor Calibration -CONT

Step	Procedure
8	Press ESC key to exit to terminal mode (blank) screen.
9	Using ALT-P command (line/port option), set CURRENT SETTINGS as follows: a. Baud rate: 2400 b. Parity: NONE c. Data bits: 8 d. Stop bits: 1 e. Port: COM1
10	Press ESC key to exit to terminal mode (blank) screen.
11	Set laptop computer CAPS LOCK to ON.
12	Inside equipment cabinet, set circuit breaker on visibility sensor circuit breaker module to on (left) position.
13	Verify that laptop computer displays sensor initialization message shown below: ***VIS VER XXX - 6220*** The XXX refers to sensor firmware version number and 6220 refers to sensor model number. Record firmware version number on calibration data sheet.
14	At laptop computer, enter VG <CR>. Sensor enters Extended Diagnostics (VG) mode and responds with: VPXXXXXXXXPPPP PPP PP PPP PPPP XXXX XX Sensor status bytes reported above should be all P's for pass. Values marked with X above may be any value (don't care), depending on prevailing visibility, ambient temperature, etc.
15	At laptop, press CTRL A then enter VF. Sensor responds with Need Password to disable ASOS mode: PASSWORD?...==>. **NOTE** CTRL A puts the sensor into Maintenance Mode. Be sure to press CTRL A again to put the sensor back into ASOS Mode before leaving.
16	Enter EIEIO <CR>. Sensor enters Calibration Coefficients/Configuration Information (VF) mode and displays information shown below (one line at a time). The table below also shows correct values for each line. If data in any line are incorrect, enter correct value at ==> prompt and enter <CR>. If data are correct or correct value is XXXXXX (don't care), enter <CR> to accept data as is. This should be performed at each line of VF command. <u>Sensor Response</u> — <u>Correct Value</u> E2PROM chk_sum = XX EO = XXXXXXXXX...==> — Note 1 FO = XXXXXXXX....==> — XXXXXX WINDOW = 113.999999...==> — 113.9999999 VIS_SER_NO? XXXX...==> — Note 2 Day/Night installed? (Y or N) [Y]> — Y Heaters installed? (Y or N) [Y]> — Y Note 1 - Enter Belfort Calibration Kit extinction coefficient (EXCO) value labeled on scatter plate and filters in EO field. EXCO is usually a 4-digit number (i.e., 1.572) and should be entered as such. EO is a 9-digit floating point field; therefore, up to 8 digits and a decimal point may be entered.

Table 6.5.3. Visibility Sensor Calibration -CONT

Step	Procedure
	Note 2 - Verify that sensor serial number on nameplate located on electronics enclosure door is the same as entered here. If not, enter correct serial number. Up to four digits may be entered in this field. After entering final <CR>, sensor retransmits corrected data entered above as well as the following: New Cksum = XX Old Cksum = XX ---> End of vF <---
17	At laptop computer, enter VH. Sensor enters Calibration Factors (VH) mode and responds with information shown below (one line at a time). The table below also shows correct values for each line. If data in any line are incorrect, enter the correct value at the ==> prompt and enter <CR>. If data are correct or correct value is XXXXXX (don't care), enter <CR> to accept data as is. This should be performed at each line of VH command. Record values for FE and FI on calibration data sheet. <u>Sensor Response</u> — <u>Correct Value</u> FE = 0.918000...==> — Note 1 FI = XXXXXXX...==> — -1.0 to +1.0 (Note 2) EDGE_OF_DAY = 90.000000...==> — 90.0 EDGE_OF_NIGHT = 30.000000...==> — 30.0 DAY_NIGHT_ZERO = 5...==> — 5 Note 1 - FE value will be whatever calibration constant was entered into sensor during last calibration, and will typically range from 0.50 to 1.80. Note 2 - If FI value is not between -1.0 and +1.0, noise is probable problem. Perform the following: a. Check all grounds on crossarm and electronics enclosure. b. There is a very small chance that the problem is in the processor board. Replace and retest. c. In fewer cases, the site ground, as a function of soil conditions and conductivity, is a factor. After entering final <CR>, sensor retransmits corrected data entered above as well as the following: New Cksum = XX Old Cksum = XX ---> End of vH <---
18	At laptop computer, enter VP. Sensor responds with request for delay. Enter 5 <CR> to put sensor into Automatic Reporting (VP) mode. Automatic Reporting mode transmits data to laptop computer every 5 seconds. Data are presented in eight columns as follows: XXXXXX XXXXXX XXXXXX XXXXXX X XXXXXX XXXX XXXXXXXX

Table 6.5.3. Visibility Sensor Calibration -CONT

Step	Procedure
	Columns of data in VP output message are as follows: <u>Group</u> <u>Contents</u> 1 Latest flash measurement 2 Latest dark measurement 3 (Flash counts - dark counts) + 100 4 Latest day/night measurement 5 Latest day/night status 6 Reserved 7 Latest visibility in miles 8 Latest extinction coefficient (EXCO) in /km Automatic Reporting mode and EXCO of column 8 is used throughout the rest of this procedure to aid in validating calibration steps.
	VISIBILITY ZERO ADJUSTMENT
1	At visibility sensor, place opaque filter from calibration kit over receiver window. **NOTE** You can also install the calibration plate now to save time. Verify the dark measurement in column 2 of VP is 512 ±5. If dark measurement is not within tolerance, the problem is in the receiver. Perform the following: a. Check opaque filter for cracks. This can best be done by removing opaque filter from receiver, installing it on transmitter, and looking for light leaks when the transmitter flashes. Ensure that O-ring is in place. b. Remove and replace receiver assembly.
2	With the opaque filter in place, wait 5 minutes for reading of column 8 of VP to stabilize to a value near zero. Reading may be considered stable when column 8 changes less than ±0.01 over six consecutive VP updates. If value in column 8 does not stabilize, noise is probable problem. Perform the following: a. Check all grounds on crossarm and electronics enclosure. b. Check opaque filter for cracks or leaks by removing opaque filter from receiver, installing it on transmitter, and looking for light leaks when transmitter flashes. Ensure that O-ring is in place. c. There is a possibility that the problem is in the processor board. Replace and retest. d. In fewer cases, the site ground, as a function of soil conditions and conductivity, is a factor.

Table 6.5.3. Visibility Sensor Calibration -CONT

Step	Procedure
3	At laptop computer, enter VZ. Sensor enters Zero State Calibration (VZ) mode and displays the following: FROM VZ-> OLD FI = XXXXXXXXX SAMPLE: XXX SAMPLE field counts down from 120 to 0 over a 1-minute period. Sensor then prompts to accept (Y) or reject (N) new zero calibration value FI. The perfect FI value is 0.00. If new FI value is between ±1.0, record new FI value and enter Y. Entering an N or doing nothing leaves the old number in FI. If new FI value is not between ±1.0, noise is probable problem. Perform troubleshooting actions described in step 2. If new FI value is >1.00, replace the receiver.
4	With opaque filter still in place, verify that sensor EXCO in column 8 of VP is between -0.005 and +0.005. Record this EXCO value on calibration data sheet. If EXCO is not within tolerance, repeat step 2. If acceptable EXCO value cannot be achieved, noise is probable problem. Perform troubleshooting actions described in step 2.
5	At laptop computer, enter VF. Sensor enters VF mode (as in initial setup procedure, step 15). Enter <CR> to bring up FO data line. Enter value of FI obtained in step 2 in FO line followed by <CR>. Enter <CR> four additional times to exit VF mode. This process stores zero calibration value for future reference; it is not used by sensor for measurement purposes.
6	At laptop computer, enter VD. Sensor responds with request for number of samples as shown below: From VD -> Number of samples? 120...==> To accept default of 120, press <CR>. Sensor enters Standard Deviation of Zero Drift (VD) mode and counts down from 120 to 0 over a 1-minute period. Sensor then displays the following: std_dev = XXXXXXXX Standard deviation VIS: XXXXXXXXXX ---> End of vD <--- Value of standard deviation VIS should be greater than 100. Record this value on calibration data sheet. If standard deviation VIS is not greater than 100, noise is probable problem. Perform troubleshooting actions as described in step 2.
7	Remove opaque filter from receiver and store in calibration kit.
VISIBILITY CALIBRATION CHECK	
1	Remove two neutral density filters from calibration kit. Verify that calibration plate is not warped or cracked. If it is, obtain complete new calibration kit (plate and both filters) before proceeding. Clean neutral density filters and calibration plate with soft cloth and window cleaner. Also, clean transmitter and receiver windows before installing filters. Install neutral density filter marked with TX over transmitter window and filter marked with RX over receiver window. **NOTE** During initial installation or when visibility head is replaced only, verify that calibration plate is centered equidistant between TX and RX heads. Use tape measure to measure from front tip of each head to upper corner of calibration plate. Distance should be ±¼ inch between sides.
2	Record EXCO value marked on calibration plate on calibration data sheet. Install calibration plate (with side labeled TOP upward) to top sensor support pole using knurled knobs. Using tape measure, ensure that calibration plate is mounted equidistant (±1 inch) between transmitter and receiver heads.

Table 6.5.3. Visibility Sensor Calibration -CONT

Step	Procedure
3	Wait 5 minutes and observe that column 8 of VP is within ±5% of value of EXCO written on calibration plate and filters.
4	At laptop computer, enter VS. Sensor enters Span State Calibration (VS) mode and displays the following: FROM VS-> OLD FE = XXXXXXXXX SAMPLE: XXX SAMPLE field counts down from 120 to 0 over a 1-minute period. Sensor then prompts to accept (Y) or reject (N) new span calibration value FE. If new FE value is between 0.5 and 4.0, enter Y. Entering N or doing nothing leaves old number in FE. Record new FE value on calibration data sheet. If new FE value is not between 0.5 and 4.0, problem is optical in nature. Perform the following: a. Pull transmitter and receiver assemblies and inspect and clean windows. Ensure that no foreign objects are in the optical path. b. Check for damage on calibration kit, including both calibration plate and neutral density filters. Ensure that both plate and filters are clean and have correct part number. c. Remove and replace transmitter assembly. d. Remove and replace receiver assembly.
5	Record final EXCO value from column 8 of VP on calibration data sheet. If step 4 was performed and adjustment was made, wait 10 minutes for EXCO value to stabilize before recording value.
DAY/NIGHT SENSOR CHECK	
1	Cover window of day/night sensor with dark cloth.
2	Observe that column 4 of VP decreases below 30 and that column 5 switches from D (day) to N (night).
SENSOR HEATER CALIBRATION	
NOTE Whenever the visibility crossarm, transmit canister, receiver canister, or day/night sensor have been replaced, the Heater Power Supply Check and the Heater Calibration procedure must be run, but first, check continuity of all nine heater elements per table 6.5.6.	
Heater Power Supply Check	
1	Disconnect hood/electronics heater thermostat from backplane connector J7.
2	Jumper contacts on electronics assembly backplane connector J7 together using jumper assembly supplied with visibility calibration kit. This connection enables the hood and electronics heaters.
3	Set DMM for dc volts and connect DMM (-) terminal to heater power supply capacitor C2 negative terminal. Connect DMM (+) lead to C2 positive terminal.
4	Adjust R4 at heater supply board for 24.00 vdc ±0.25 as read on DMM. If DMM shows no voltage, check ac power supply fuse (F2) and replace if necessary; otherwise, replace electronics power supply and repeat steps 3 and 4.
Heater Calibration	
5	Unlatch two fasteners and carefully remove transmitter assembly cap from back of transmitter assembly.
6	Using small flat-head screwdriver, slide locking mechanism (plate in front of connector) in transmitter assembly to unlock connector DB-9. Do not disconnect connector.
7	Repeat steps 5 and 6 for receiver assembly.

Table 6.5.3. Visibility Sensor Calibration -CONT

Step	Procedure
8	Enter V3. The sensor enters heater calibration mode and displays the following instructions: HEATER "CALIBRATION" PLEASE INSERT A JUMPER ACROSS THE CONTACTS OF J7 ON THE BACKPLANE. PRESS <ENTER> WHEN DONE **NOTE** Ensure the canisters are warm to the touch.
9	Jumper contacts on backplane connecter J7 together using jumper assembly supplied with visibility calibration kit. This connection enables hood and electronics heaters. Press <ENTER>. The system displays the following: READING ALL OF THE HEATERS FOR 10 SECONDS. RCV_HTR_VOLTS_AVE X.XXX XMT_HTR_VOLTS_AVE X.XXX (where X.XXX is the average voltage measured) PLEASE DISCONNECT THE "CANISTER" CONNECTOR IN THE RECEIVER HOOD. PRESS <ENTER> WHEN DONE
10	Disconnect connector DB-9 in receiver hood which was loosened in step 6. Press <ENTER>. The system displays the following: READING THE RECEIVER CROSSARM HEATERS FOR 10 SECONDS. ....DONE RX_XARM_HTR X.XXX (where X.XXX equals the average voltage read) PLEASE RECONNECT THE "CANISTER" CONNECTOR IN THE RECEIVER HOOD AND DISCONNECT THE HEATER CONNECTOR FROM THE RECEIVER HOOD PRESS <ENTER> WHEN DONE
11	Using small flat-head screwdriver, reconnect connector DB-9 in receiver hood and disconnect heater connector from receiver hood (molex connector). Press <ENTER>. The system displays the following: READING THE RECEIVER HEATER ELECTRONICS HEATER FOR 10 SECONDS. .... DONE RX_EL_HTR X.XXX (where X.XXX equals the average voltage measured) PLEASE RECONNECT THE HEATER CONNECTOR ON THE RECEIVER HOOD AND DISCONNECT THE "CANISTER" CONNECTOR ON THE TRANSMITTER HOOD. PRESS <ENTER> WHEN DONE

Table 6.5.3. Visibility Sensor Calibration -CONT

Step	Procedure
12	Reconnect heater connector on receiver hood and disconnect connector DB-9 on transmitter hood, which was loosened in step 6. Press <ENTER>. The system displays the following: READING THE TRANSMITTER CROSSARM FOR 10 SECONDS. ....DONE TX_XARM_HTR X.XXX (where X.XXX equals the average voltage read) PLEASE RECONNECT THE "CANISTER" CONNECTOR ON THE TRANSMITTER HOOD AND DISCONNECT THE HEATER CONNECTOR FROM THE TRANSMITTER HOOD. PRESS <ENTER> WHEN DONE
13	Using small flat-head screwdriver, reconnect connector DB-9 in transmitter hood and disconnect heater connector from transmitter hood. Press <ENTER>. The system displays the following: READING THE HEATER ELECTRONICS FOR 10 SECONDS. .... DONE TX_EL_HTR X.XXX (where X.XXX equals the average voltage measured) NEW CKSUM = NN OLD CKSUM = NN RX_HD = X.XX (receiver hood heater average voltage) RX_EL = X.XX (receiver electronics heater average voltage) RX_WN = X.XX (receiver window heater average voltage) TX_HD = X.XX (transmitter hood heater average voltage) TX_EL = X.XX (transmitter electronics heater average voltage) TX_WN = X.XX (transmitter window heater average voltage) DN_WN = X.XX (day/night sensor window heater average voltage) DON'T FORGET TO RECONNECT THE HEATER POWER CONNECTOR ON BOTH HOODS. **NOTE** Press ENTER before removing J7 jumper. You want to settle the current levels <u>before</u> J7 jumper is removed. DON'T FORGET TO RECONNECT THE HEATER THERMOSTAT TO BACKPLANE J7.
14	Reconnect heater power connectors on both hoods and reconnect heater thermostat to backplane connector J7.
15	Enter VG. The system displays the following: VFXXXXXXXXPPPP PFPOPP PPP PPPP XXXX XX ^ ^ NOTE: The symbol ^ denotes the bytes indicating failure. These symbols will not appear on the display.
16	Enter VG again. The system displays the following: VPXXXXXXXXPPPP PPPOPP PPP PPPP XXXX XX ^ ^
17	At DCP, turn visibility sensor circuit breaker to OFF.

Table 6.5.3. Visibility Sensor Calibration -CONT

Step	Procedure
18	Using small flat-head screwdriver at receiver assembly DB-9 connector, press up on locking mechanism to lock connector DB-9.
19	Repeat step 18 for transmitter assembly.
20	Install transmitter assembly cap and latch two fasteners.
21	Install receiver assembly cap and latch two fasteners.
22	Perform teardown procedure.
TEARDOWN	
1	**NOTE** Step 1 must be performed to reset sensor to ASOS operational mode. To exit calibration procedure, press CTRL-A. Sensor responds with: RESET TO ASOS MODE NEW CKSUM = XX OLD CKSUM = XX
2	Repeat initial setup procedure step 13 to verify that all sensor diagnostics pass.
3	At laptop computer, press ALT-X (exit) to exit PROCOMM Plus.
4	Turn off laptop computer.
5	Inside equipment cabinet, set circuit breaker on visibility sensor circuit breaker module to off (right) position.
6	Disconnect cables between laptop computer and visibility sensor.
7	Using small flat-tipped screwdriver, connect visibility sensor DB-9 connector to fiberoptic module.
8	Using large flat-tipped screwdriver, close and secure visibility sensor electronics enclosure access door.
9	Remove calibration plate and two filters and store in calibration kit.
10	Clean transmitter, receiver, and day/night windows to remove any fingerprints.
11	Inside equipment cabinet, set circuit breaker on visibility sensor circuit breaker module to on (left) position.

VISIBILITY SENSOR CALIBRATION PROCEDURE

DATA SHEET

SITE SID: ________________________ OPERATOR: ________________________

SENSOR S/N: ________________________ DATE: ________________________

REF. STEP	PARAMETER	EXPECTED VALUE	RECORDED VALUE
INITIAL SETUP PROCEDURE			
13	Firmware Ver.	≥034	
17	FE Value	0.50 - 1.80	
17	Current FI Value	≤1.0	
VISIBILITY ZERO ADJUSTMENT			
2	New F1 Value	between ±1.0	
3b	Zero EXCO	<±0.005	
5	Standard Deviation VIS	>100	
VISIBILITY CALIBRATION CHECK			
2	Cal Plate EXCO	XXXXX	
4*	New FE Value	0.50 - 1.80	
5	Sensor EXCO	±5% of Cal Plate	
DAY/NIGHT SENSOR CHECK			
2	D/N Switch	Yes	

(*) Only fill in a new FE value if step 4 (Span State Calibration) was performed; otherwise, mark with N/A.

Figure 6.5.1. Visibility Sensor Calibration Data Sheet

Table 6.5.4. DC Power Checks

Step	Procedure
	WARNING Dangerous voltage levels are present within visibility sensor's electronics enclosure. **NOTE** If output of any power supply is low, problem may be due to an overload by one or more of the FRU(s). In such a case, technician should disconnect load and recheck power supply output. If power supply output still fails, replace power supply. If power supply output is then good, troubleshoot to faulty load FRU using visibility sensor diagrams (figures 6.4.2 and 6.4.3).
1	Perform ac power check in accordance with table 6.5.5.
2	Using digital multimeter (DMM), connect positive lead to terminal TB1-4 on electronics power supply PS1 and negative lead on terminal TB1-3. Voltage should be +5 ±0.5 vdc. If correct voltage is not present, replace power supply PS1.
3	Using DMM, connect positive lead to terminal TB1-7 on electronics power supply PS1 and negative lead on terminal TB1-6. Voltage should be +15 ±1.5 vdc. If correct voltage is not present, replace power supply PS1.
4	Using DMM, connect positive lead to terminal TB1-5 on electronics power supply PS1 and negative lead on terminal TB1-6. Voltage should be -15 ±1.5 vdc. If correct voltage is not present, replace power supply PS1.
5	Using DMM, connect positive lead to terminal TB1-5 on heater power supply and negative lead on terminal TB1-4. Voltage should be +24 ±5 vdc. If correct voltage is not present, troubleshoot heater power supply using procedures in paragraph 6.5.3.3.

Table 6.5.5. AC Power Checks

Step	Procedure
	WARNING Dangerous voltage levels are present within visibility sensor electronics enclosure.
1	Using DMM, measure ac voltage between terminals 1 and 2 on electronics power supply PS1 in electronics enclosure. Voltage should be 104 to 127 vac. If correct voltage is not present, check fuse F2 (¼ amp, 250V) on heater power supply and replace if blown. If fuse is good and correct voltage is still not present, proceed to step 2.
2	Open power input box within electronics enclosure by removing six Phillips screws securing access cover to power input box.
3	Using DMM, measure ac power input between terminals 1 and 2 of terminal TB1 in power input box. Voltage should be 104 to 127 vac. If correct voltage is not present, troubleshoot power wiring back to DCP.
4	Using DMM, measure ac output between terminals L0 and N of line protector E2 in power input box. Voltage should be 104 to 127 vac. If correct voltage is not present, replace electronics enclosure in accordance with procedure in table 6.5.14. If voltage is 104 to 127 vac in a two-filter configuration, use DMM to measure output between terminals LO and N of line protector E1 in power input box. If correct voltage is not present, replace electronics assembly in accordance with procedure in table 6.5.14.
5	Install cover on power input box and secure using six Phillips screws.

Table 6.5.6. Heater Troubleshooting

<table>
<tr><th>Step</th><th>Procedure</th></tr>
<tr><td colspan="2">

WARNING

Death or severe injury may result if power is not removed from sensor prior to performing maintenance activities. Dangerous voltages (110 vac) are present within the visibility sensor. Exercise standard safety procedures.

</td></tr>
<tr><td>1</td><td>

Only one or two of the heater tests failed.

a. Using functional diagram (Figure 6.4.2), check for approximately 24 volts between heater input terminal and ground. If 24 volts is not present, proceed to step 2.

b. If 24-volt signal is present, set circuit breakers for Visibility Heaters and Visibility Electronics OFF.

c. At visibility sensor electronics assembly, disconnect connector/wires at the following points to check continuity of individual heater elements:

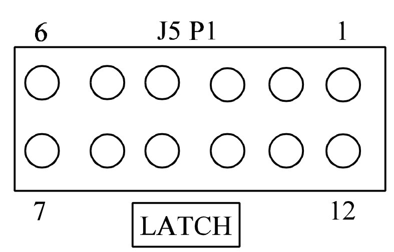
<table>
<tr><th>Connector/TB</th><th>Pins/Terminals</th><th>Heater Element</th></tr>
<tr><td>W2P3</td><td>1 - 2</td><td>Xmtr Hood</td></tr>
<tr><td>W2P3</td><td>1 - 3</td><td>Xmtr Window</td></tr>
<tr><td>W3P3</td><td>1 - 2</td><td>Rcvr Hood</td></tr>
<tr><td>W3P3</td><td>1 - 3</td><td>Rcvr Window</td></tr>
<tr><td>W2P2</td><td>E8 - E9</td><td>D/N Window & D/N Elec</td></tr>
<tr><td>Htr Pwr Sup TB1</td><td>1 - 2</td><td>Xmtr Elec Encl, Rcvr Elec Encl, Vis Sens Elec Encl</td></tr>
</table>

d. Perform the following resistance checks:

J5 - P1 Receiver Connector on Main Board - remove connector from the main board and measure on J5 which is wired to RX head.

Pins 10 and 12 - 115 ohms - Receiver Window Heater

Pins 11 and 12 - 12 ohms with both RX head connectors in place
58 ohms with only the white heater connector separated
14 ohms with only the DB-9 Canister connector removed from RX canister.



</td></tr>
</table>

Table 6.5.6. Heater Troubleshooting -CONT

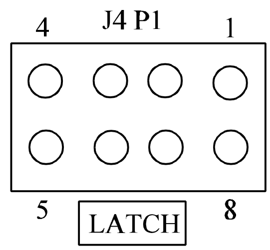
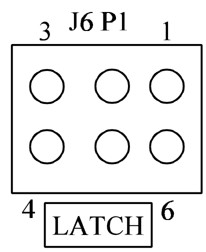
Step	Procedure
	J4 - P1 Transmitter Connector on Main Board - remove connector from the main board and measure on J4 which is wired to TX head. Pins 3 and 5 - 115 ohms - Transmitter Window Heater Pins 4 and 5 - 12 ohms with both TX head connectors in place 58 ohms with only the white heater connector separated 14 ohms with only the DB-9 Canister connector removed from TX canister.  J6 - P1 Day/Night Sensor on Main board - remove connector from the main board and measure on J6 which is wired to D/N Sensor. Pins 5 and 6 - 145 ohms heaters in D/N Sensor 

Table 6.5.6. Heater Troubleshooting -CONT

Step	Procedure
	e. If continuity or resistance tests fail, replace applicable FRU. f. If continuity and resistance checks pass, use figure 6.4.2 and check heater wiring. Repair as necessary. g. Set circuit breakers for visibility Heaters and Visibility Electronics ON.
2	All heater elements fail to operate and the temperature of the main electrical enclosure is below 40 degrees Fahrenheit. a. Check fuse F2 on heater power supply and fuse F1 on regulator circuit board (3A1) (15 amp, 32V). b. If fuse F2 on heater power supply is blown, replace fuse and reapply power to unit. If fuse blows again, remove power and disconnect wires from 3A1-TB1 on regulator circuit board. Replace fuse and reapply power. If fuse blows again, replace main electrical enclosure. c. If fuse F1 on regulator circuit board is blown, remove power, disconnect wires from 3A1-TB2, and replace fuse. Reapply power. If fuse blows again, replace regulator circuit board. If not, remove power and using DMM, measure resistance across terminals TB1-4 and TB1-5. DMM should indicate greater than 200 ohms. If reading is low, while observing DMM, disconnect connector J6. If correct reading is obtained, replace day/night sensor. If correct reading is still not obtained, connect connector J6 and disconnect connectors J4 and J5. If correct reading is obtained after disconnecting

Table 6.5.6. Heater Troubleshooting -CONT

Step	Procedure
	connector J4, connect connector J4 and disconnect connector J3 at transmitter assembly. If correct reading is obtained, replace transmitter assembly. If not, replace crossarm assembly. If correct reading is obtained after disconnecting connector J5, connect connector J5 and disconnect connectors P2 and P3 at receiver assembly. If correct reading is obtained, replace receiver assembly. If not, replace crossarm assembly. d. If fuses test good, use DMM and check for continuity across temperature sensor located in lower right corner of main electrical enclosure. If continuity check fails, replace main electrical enclosure. e. If continuity check passed, apply power to sensor and use DMM to check for the presence of 24 ±2.4 volts dc between each temperature sensor terminal and ground. f. If 24-volt test failed, use DMM to measure voltage across terminals on capacitor C1 on heater power supply. Capacitor C1 is located in lower right corner of heater power supply. If DMM indicates 24.00 ±2.4 volts, replace regulator circuit board (3A1), which is located on heater power supply. g. If correct voltage reading is not obtained in step 2f, disconnect wires from terminal board 3A1TB1 on regulator circuit board and repeat measurement across capacitor C1. If correct reading is obtained, replace regulator circuit board (3A1). If not, replace main electrical enclosure.

Table 6.5.7. Receiver Assembly Removal and Installation

Step	Procedure
	REMOVAL
	Tools required: No. 1 Phillips screwdriver Small flat-tipped screwdriver **CAUTION** Damage to equipment may result if power is not removed from sensor prior to maintenance activities. Ensure that circuit breaker supplying power to sensor is set to off (right) position.
1	Inside equipment cabinet, ensure that circuit breaker on visibility sensor circuit breaker module is set to off (right) position.
2	Locate receiver assembly (south end).
3	**WARNING** With locking pin removed from hinge plate, sensor is not locked in upright position. Death or severe injury may result if personnel are not kept out of travel path of sensor. Lower visibility sensor on hinge plate as follows: a. Remove locking pin from hinge plate. b. From hinge side of sensor, firmly grasp support pole with both hands and carefully lower sensor on hinge until lanyard catches and supports weight of sensor.

Table 6.5.7. Receiver Assembly Removal and Installation -CONT

Step	Procedure
4	**CAUTION** Do not strain crossarm wiring harness when removing or installing receiver assembly. Failure to comply may result in damage to hood or lens heater wiring. Unlatch two fasteners and carefully remove receiver assembly cap from back of receiver assembly.
5	Disconnect molex-type cable connector.
6	Disconnect trigger signal coax wire from receiver coax connector.
7	Using Phillips screwdriver, remove screw securing green ground wire to receiver module. Disconnect green wire.
8	Using small flat-tipped screwdriver, slide locking mechanism (plate at front of connector) downward to unlock DB-9 connector. Disconnect DB-9 connector.
9	Grasp receiver module and slide module out of assembly.
INSTALLATION	
	Tools required: Small flat-tipped screwdriver No. 1 Phillips screwdriver **CAUTION** Damage to equipment may result if power is not removed from sensor prior to maintenance activities. Ensure that circuit breaker supplying power to sensor is set to off (right) position.
1	Inside equipment cabinet, ensure that circuit breaker on visibility sensor circuit breaker module is set to off (right) position. **CAUTION** Do not strain crossarm wiring harness when removing or installing receiver assembly. Failure to comply may result in damage to hood or lens heater wiring.
2	Slide receiver module into assembly, seating module as far forward as possible (at least 1 inch down from back of hood).
3	Connect DB-9 connector to receiver module. Using small flat-tipped screwdriver, press up on locking mechanism to lock DB-9 connector.
4	Connect green ground wire to receiver module. Using Phillips screwdriver, install screw securing green ground wire to receiver module.
5	Connect trigger signal coax wire to receiver module.
6	Connect molex-type cable connector.
7	Slide receiver assembly cap over back of receiver assembly, being careful not to crush any wiring, and latch two fasteners securing cap.

Table 6.5.7. Receiver Assembly Removal and Installation -CONT

Step	Procedure
8	**WARNING** With locking pin removed from hinge plate, sensor is not locked in upright position. Death or severe injury may result if personnel are not kept out of travel path of sensor. Raise visibility sensor on hinge plate as follows: a. From behind hinged side of sensor, firmly grasp support pole with both hands and carefully raise sensor on hinge into upright sensor. b. Install locking pin into front of hinge plate.
9	Calibrate visibility sensor in accordance with table 6.5.3.

Table 6.5.8. Transmitter Assembly Removal and Installation

Step	Procedure
REMOVAL	
	Tools required: No. 1 Phillips screwdriver Small flat-tipped screwdriver **CAUTION** Damage to equipment may result if power is not removed from sensor prior to maintenance activities. Ensure that circuit breaker supplying power to sensor is set to off (right) position.
1	Inside equipment cabinet, ensure that circuit breaker on visibility sensor circuit breaker module is set to off (right) position.
2	Locate transmitter assembly. This is most easily accomplished by looking in assembly and locating clear colored window (receiver is yellow).
3	**WARNING** With locking pin removed from hinge plate, sensor is not locked in upright position. Death or severe injury may result if personnel are not kept out of travel path of sensor. Lower visibility sensor on hinge plate as follows: a. Remove locking pin from hinge plate. b. From hinge side of sensor, firmly grasp support pole with both hands and carefully lower sensor on hinge until lanyard catches and supports weight of sensor. **CAUTION** Do not strain crossarm wiring harness when removing or installing transmitter assembly. Failure to comply may result in damage to hood or lens heater wiring.
4	Unlatch two fasteners and carefully remove transmitter assembly cap from back of transmitter assembly.
5	Disconnect molex-type cable connector.
6	Disconnect trigger signal coax wire from transmitter coax connector.

Table 6.5.8. Transmitter Assembly Removal and Installation -CONT

Step	Procedure
7	Using Phillips screwdriver, remove screw securing green ground wire to transmitter module. Disconnect green wire.
8	Using small flat-tipped screwdriver, slide locking mechanism (plate at front of connector) downward to unlock DB-9 connector. Disconnect DB-9 connector.
9	Grasp transmitter module and slide module out of assembly.
	INSTALLATION
	Tools required: Small flat-tipped screwdriver No. 1 Phillips screwdriver **CAUTION** Damage to equipment may result if power is not removed from sensor prior to maintenance activities. Ensure that circuit breaker supplying power to sensor is set to off (right) position.
1	Inside equipment cabinet, ensure that circuit breaker on visibility sensor circuit breaker module is set to off (right) position.
2	**CAUTION** Do not strain crossarm wiring harness when removing or installing transmitter assembly. Failure to comply may result in damage to hood or lens heater wiring. Position the flat (on side of transmitter module) to right and slide transmitter module into assembly, seating module as far forward as possible (at least 1 inch down from back of hood).
3	Connect DB-9 connector to transmitter module. Using small flat-tipped screwdriver, press up on locking mechanism to lock DB-9 connector.
4	Connect green ground wire to transmitter module. Using Phillips screwdriver, install screw securing green ground wire to transmitter module.
5	Connect trigger signal coax wire to receiver module.
6	Connect molex-type cable connector.
7	Slide transmitter assembly cap over back of transmitter assembly, being careful not to crush any wiring, and latch two fasteners securing cap.
8	**WARNING** With locking pin removed from hinge plate, sensor is not locked in upright position. Death or severe injury may result if personnel are not kept out of travel path of sensor. Raise visibility sensor on hinge plate as follows: a. From behind hinged side of sensor, firmly grasp support pole with both hands and carefully raise sensor on hinge into upright sensor. b. Install locking pin into front of hinge plate.
9	Calibrate visibility sensor in accordance with table 6.5.3.

Table 6.5.9. Processor Board Removal and Installation

Step	Procedure
REMOVAL	
	Tools required: Large flat-tipped screwdriver No. 1 Phillips screwdriver **WARNING** Death or severe injury may result if power is not removed from sensor prior to maintenance activities. Ensure that circuit breaker supplying power to sensor is set to off (right) position.
1	Inside equipment cabinet, ensure that circuit breaker on visibility sensor circuit breaker module is set to off (right) position.
2	Using large flat-tipped screwdriver, open visibility sensor electronics enclosure access door.
3	Using Phillips screwdriver, remove screw securing processor board to standoff.
4	Carefully remove processor board by pulling it free from backplane connector XA1.
INSTALLATION	
	Tools required: No. 1 Phillips screwdriver Large flat-tipped screwdriver **WARNING** Death or severe injury may result if power is not removed from sensor prior to maintenance activities. Ensure that circuit breaker supplying power to sensor is set to off (right) position.
1	Inside DCP cabinet, ensure that circuit breaker on visibility sensor circuit breaker module is set to off (right) position.
2	Install processor board into backplane connector XA1.
3	Using Phillips screwdriver, install screw securing processor board to standoff.
4	Calibrate visibility sensor in accordance with table 6.5.3.

Table 6.5.10. Day/Night Assembly Removal and Installation

Step	Procedure
REMOVAL	
	Tools required: 7/16-inch socket and ratchet **WARNING** Death or severe injury may result if power is not removed from sensor prior to maintenance activities. Ensure that circuit breaker supplying power to sensor is set to off (right) position.
1	Inside equipment cabinet, ensure that circuit breaker on visibility sensor circuit breaker module is set to off (right) position.
2	Using 7/16-inch socket and ratchet, remove two bolts and flat washers securing flexible conduit connector for day/night sensor to enclosure support pole.

Table 6.5.10. Day/Night Assembly Removal and Installation -CONT

Step	Procedure
3	Disconnect day/night sensor cable connector A5W1-P1 from wiring harness located in support column W2-P2, being careful not to drop internal harness inside column.
4	Loosen three bolts, flat washers (two each), lockwashers, and nuts securing day/night sensor to crossarm support column. Remove sensor from column.
INSTALLATION	
Tools required: 7/16-inch socket and ratchet **WARNING** Death or severe injury may result if power is not removed from sensor prior to maintenance activities. Ensure that circuit breaker supplying power to sensor is set to off (right) position.	
1	Inside equipment cabinet, ensure that circuit breaker on visibility sensor circuit breaker module is set to off (right) position.
2	Mount day/night sensor on crossarm support column (with sensor window facing same direction as receiver hood). Tighten three bolts, flat washers (two each), lockwashers, and nuts securing sensor to column.
3	Connect day/night sensor cable connector A5W1-P1 to wiring harness located in support column W2-P2.
4	Using 7/16-inch socket and ratchet, install two bolts and flat washers securing flexible conduit connector to support column.
5	Calibrate visibility sensor in accordance with table 6.5.3.

Table 6.5.11. Electronics Power Supply Removal and Installation

Step	Procedure
REMOVAL	
Tools required: Large flat-tipped screwdriver Flat-tipped screwdriver No. 0 Phillips screwdriver No. 1 Phillips screwdriver **WARNING** Death or severe injury may result if power is not removed from sensor prior to maintenance activities. Ensure that circuit breaker supplying power to sensor is set to off (right) position.	
1	Inside equipment cabinet, set circuit breaker on visibility sensor power control module to off (right) position.
2	Using large flat-tipped screwdriver, open visibility sensor electronics enclosure access door.
3	Using flat-tipped screwdriver, tag and disconnect wires from power supply terminals.
4	Using No. 1 Phillips screwdriver, remove two screws, lockwashers, and flat washers securing power supply angle mount to visibility sensor electronics enclosure. Carefully lift power supply with angle mount from electronics enclosure.
5	Using No. 0 Phillips screwdriver, remove four screws, lockwashers, and flat washers securing power supply to angle mount.

Table 6.5.11. Electronics Power Supply Removal and Installation -CONT

Step	Procedure
INSTALLATION	
	Tools required: Large flat-tipped screwdriver Flat-tipped screwdriver No. 0 Phillips screwdriver No. 1 Phillips screwdriver **WARNING** Death or severe injury may result if power is not removed from sensor prior to maintenance activities. Ensure that circuit breaker supplying power to sensor is set to off (right) position.
1	Inside equipment cabinet, ensure that circuit breaker on visibility sensor circuit breaker module is set to off (right) position.
2	Using No. 0 Phillips screwdriver, install four flat washers, lockwashers, and screws securing power supply to angle mount.
3	With terminals positioned downward, slide power supply with angle mount into position.
4	Using No. 1 Phillips screwdriver, install two lockwashers, flat washers, and screws securing power supply angle mount to visibility sensor electronics enclosure.
5	Using flat-tipped screwdriver and tags as a guide, connect wires to power supply terminals.
6	Calibrate visibility sensor in accordance with table 6.5.3.

Table 6.5.12. Fiberoptic Module Removal and Installation

Step	Procedure
REMOVAL	
	Tools required: Large flat-tipped screwdriver Medium flat-tipped screwdriver Small flat-tipped screwdriver No. 1 Phillips screwdriver (short) **WARNING** Death or severe injury may result if power is not removed from sensor prior to maintenance activities. Ensure that circuit breaker supplying power to sensor is set to off (right) position.
1	Inside equipment cabinet, set circuit breaker on visibility sensor power control module to off (right) position.
2	Using large flat-tipped screwdriver, open visibility sensor electronics enclosure access door.
3	Using small flat-tipped screwdriver, loosen two retaining screws on DB-9 connector located on top of fiberoptic module. Remove connector DB-9.
4	Remove six screws and lockwashers securing power input box access cover.
5	Remove access cover from power input box.
6	Using clockwise (cw) rotation, remove two fiberoptic cables from underneath fiberoptic module. Install protective plastic covers over fiberoptic connectors.

Table 6.5.12. Fiberoptic Module Removal and Installation -CONT

Step	Procedure
7	At visibility electronics enclosure, use No. 1 Phillips screwdriver to remove four screws, lockwashers, and flat washers securing fiberoptic module mounting plate to power input box. Remove fiberoptic mounting plate and gasket.
8	Using small flat-tipped screwdriver, remove four screws, four lockwashers, and gasket securing fiberoptic module to mounting plate.
INSTALLATION	
Tools required: Large flat-tipped screwdriver Medium flat-tipped screwdriver Small flat-tipped screwdriver No. 1 Phillips screwdriver (short) **WARNING** Death or severe injury may result if power is not removed from sensor prior to maintenance activities. Ensure that circuit breaker supplying power to sensor is set to off (right) position.	
1	Inside equipment cabinet, ensure that circuit breaker on visibility sensor circuit breaker module is set to off (right) position.
2	Using small flat-tipped screwdriver, install four lockwashers, four screws, and gasket securing fiberoptic module to mounting plate. Ensure that DB-9 connector on module is oriented toward RCVR stencil on plate.
3	With DB-9 connector toward the front, position fiberoptic module mounting plate and gasket on power input box. Using No. 1 Phillips screwdriver, install four flat washers, lockwashers, and screws securing fiberoptic module to power input box.
4	Remove protective plastic covers from fiberoptic connectors and connect transmit (TX) cable to rear connector and receive (RX) cable to front connector of fiberoptic module.
5	Install power input box access cover and secure using six lockwashers and screws.
6	Install signal cable on connector DB-9 on fiberoptic module and using small flat-tipped screwdriver, tighten two retaining screws.
7	Using large flat-tipped screwdriver, close and secure visibility sensor electronics enclosure access door.
8	Inside equipment cabinet, set circuit breaker on visibility sensor circuit breaker module to on (left) position.

Table 6.5.13. Crossarm Assembly Removal and Installation

Step	Procedure
REMOVAL	
Tools required: Large flat-tipped screwdriver 7/16-inch wrench **WARNING** Death or severe injury may result if power is not removed from sensor prior to maintenance activities. Ensure that circuit breaker supplying power to sensor is set to the off (right) position.	

Table 6.5.13. Crossarm Assembly Removal and Installation -CONT

Step	Procedure
1	Inside equipment cabinet, ensure that circuit breaker on visibility sensor circuit breaker module is set to off (right) position.
2	Using large flat-tipped screwdriver, open visibility sensor electronics enclosure access door.
3	In electronics enclosure, disconnect transmitter cable from connector J4 on motherboard.
4	In electronics enclosure, disconnect receiver cable from connector J5 on motherboard.
5	On power input box, using 7/16-inch wrench, disconnect crossarm green ground wire from stud E3.
6	Using 7/16-inch wrench, disconnect flexible conduit from electronics enclosure and support column.
7	Carefully feed the cables disconnected above out of conduit.
8	**WARNING** With locking pin removed from hinge plate, sensor is not locked in upright position. Death or severe injury may result if personnel are not kept out of travel path of sensor. Lower visibility sensor on hinge plate as follows: a. Remove locking pin from hinge plate. b. From hinge side of sensor, firmly grasp support pole with both hands and carefully lower sensor on hinge until lanyard catches and supports weight of sensor.
9	Mark the orientation of receiver and transmitter heads on crossarm support column.
10	While supporting crossarm assembly and using 7/16-inch socket, remove four bolts, lockwashers, and flat washers securing crossarm assembly to crossarm support. Remove crossarm assembly and carefully pull three cables out of crossarm support.
INSTALLATION	
Tools required: 7/16-inch wrench **WARNING** Death or severe injury may result if power is not removed from sensor prior to maintenance activities. Ensure that breaker supplying power to sensor is to the off (right) position.	
1	Inside equipment cabinet, ensure that circuit breaker on visibility sensor circuit breaker module is set to off (right) position.
2	**NOTE** Crossarm is mounted to top of crossarm support such that transmitter and receiver hoods are to the right of electronics enclosure (on the same side of support pole as calibration plate mounts). At top of crossarm support, carefully feed wires coming out of base of crossarm assembly through interior of crossarm support and out of access hole located on bottom of electronics enclosure.
3	Using the marks placed on crossarm support column during removal of crossarm assembly, position crossarm assembly such that transmitter and receiver hoods are to the right of electronics enclosure. Ensure that receiver assembly is pointed away from direct sunlight. In the northern hemisphere, receiver should point north.
4	While supporting crossarm assembly and using 7/16-inch socket, install four bolts, flat washers, and lockwashers securing crossarm assembly to crossarm support.

Table 6.5.13. Crossarm Assembly Removal and Installation -CONT

Step	Procedure
5	At base of enclosure support, route receiver, transmitter, and ground cables through flexible conduit into electronics enclosure.
6	Using cable marker as a guide, connect transmitter cable to connector J4 on motherboard.
7	Using cable marker as a guide, connect receiver cable to connector J5 on motherboard.
8	Using 7/16-inch wrench, connect green ground cable to stud E3 on power input box.
9	Using 7/16-inch wrench, install two bolts, lockwashers, and flat washers securing lower conduit to support pole and electronics enclosure. Ensure that EMI gasket is in place.
10	Verify that TX and RX canisters are fully seated in hood by measuring the distance from the back of the hood down to the end of TX or RX canister body. The distance should be at least 1.0 inch. If not, slide canister out 1 inch and then push canister back in until fully seated.
11	**WARNING** With locking pin removed from hinge plate, sensor is not locked in upright position. Death or severe injury may result if personnel are not kept out of travel path of sensor. Raise visibility sensor on hinge plate as follows: a. From behind hinged side of sensor, firmly grasp support pole with both hands and carefully raise sensor on hinge into upright sensor. b. Install locking pin into front of hinge plate.
12	Calibrate visibility sensor in accordance with table 6.5.3.

Table 6.5.14. Electronics Enclosure Removal and Installation

Step	Procedure
REMOVAL	
	Tools required: Large flat-tipped screwdriver 7/16-inch wrench No. 1 Phillips screwdriver 9/16-inch wrench Large pliers ½-inch socket with ratchet **WARNING** Death or severe injury may result if power is not removed from sensor prior to maintenance activities. Ensure that circuit breaker supplying power to sensor is set to the off (right) position.
1	Inside equipment cabinet, ensure that circuit breaker on visibility sensor circuit breaker module is set to off (right) position.
2	Using large flat-tipped screwdriver, open visibility sensor electronics enclosure access door.
3	In electronics enclosure, disconnect receiver cable from connector J5 on motherboard.
4	In electronics enclosure, disconnect day/night sensor cable from connector J6 on motherboard.
5	In electronics enclosure, disconnect transmitter cable from connector J4 on motherboard.
6	Using 7/16-inch wrench, disconnect green ground wire from stud E3 located on top of power input box.

Table 6.5.14. Electronics Enclosure Removal and Installation -CONT

Step	Procedure
7	Using Phillips screwdriver, remove six screws securing access cover to power input box and remove access cover.
8	Disconnect the following ac power wires from terminal board TB1: Wire — Connection Black (ac hot) — TB1-1 White (ac neut) — TB1-2 Green (ground) — TB1-3
9	Disconnect transmit (TX) fiberoptic cable from TX connector on fiberoptic module.
10	Disconnect receive (RX) fiberoptic cable from RX connector on fiberoptic module.
11	Using 9/16-inch wrench, remove pedestal ground wire from ground stud located at bottom of electronics enclosure.
12	Using large pair of pliers, remove flexible conduit from base of electronics enclosure. Carefully pull wires out of enclosure.
13	Install access cover on power input box. Using Phillips screwdriver, install six screws securing access cover.
14	Using ½-inch socket and ratchet, loosen but do not remove four bolts securing electronics enclosure to support.
15	While supporting electronics enclosure, remove top two mounting bolts, four flat washers, two lockwashers, and two nuts and remove electronics enclosure from support.
INSTALLATION	
Tools required: Large flat-tipped screwdriver 7/16-inch wrench No. 1 Phillips screwdriver 9/16-inch wrench ½-inch socket with ratchet **WARNING** Death or severe injury may result if power is not removed from sensor prior to maintenance activities. Ensure that circuit breaker supplying power to sensor is set to the off (right) position.	
1	Inside equipment cabinet, ensure that circuit breaker on visibility sensor circuit breaker module is set to off (right) position. **NOTE** Do not tighten bolts in next step. Electronics enclosures box flanges must be allowed to slip onto bolts.
2	Ensure that bolt, two flat washers, lockwasher, and nut are installed in holes on lower bracket of enclosure support.
3	Position electronics enclosure such that lower mounting flanges slip onto bolts and enclosure is resting on bolts.
4	Position electronics enclosure such that upper mounting flanges align with holes in upper mounting bracket.
5	Install mounting bolt, two flat washers, lockwasher, and nut in each flange. Using ½-inch socket and ratchet, tighten four mounting bolts.
6	Using large flat-tipped screwdriver, open visibility electronics enclosure access door.
7	Remove protective plastic covers from fiberoptic cables. Connect transmit (TX) cable to rear connector of fiberoptic module and receive (RX) cable to front connector.

Table 6.5.14. Electronics Enclosure Removal and Installation -CONT

Step	Procedure
8	Using Phillips screwdriver, remove six screws securing access cover to power input box and remove access cover.
9	Route ac power wires into power input box.
10	Using flat-tipped screwdriver, connect the following ac power wires to terminal board TB1: Wire — Connection Black (ac hot) — TB1-1 White (ac neut) — TB1-2 Green (ground) — TB1-3 on the 2-filter configuration, ensure that the following jumpers are also in place: From — To TB1-1 (ac hot) — TB1-4 TB1-2 (ac neut) — TB1-5
11	Install access cover on power input box. Using Phillips screwdriver, install six screws securing access cover.
12	Using 9/16-inch wrench, connect pedestal ground wire to ground stud located at bottom of electronics enclosure.
13	Feed wires coming out of conduit through large access hole in bottom of electronics enclosure. Position conduit in hole and install large nut securing conduit to electronics enclosure.
14	Using cable marker as a guide, in electronics enclosure, connect receiver cable to connector J5 on motherboard.
15	Using cable marker as a guide, in electronics enclosure, connect transmitter cable to connector J4 on motherboard.
16	Using cable marker as a guide, in electronics enclosure, connect day/night sensor cable to connector J6 on motherboard.
17	Using 7/16-inch wrench, connect green ground wire to stud E3 located on top of power input box.
18	Inside equipment cabinet, set circuit breaker on visibility sensor circuit breaker module to on (left) position.
19	Calibrate visibility sensor in accordance with table 6.5.3.

Table 6.5.15. Regulator Board Removal and Installation

Step	Procedure
REMOVAL	
	Tools required: Large flat-tipped screwdriver No. 1 Phillips screwdriver **WARNING** Death or severe injury may result if power is not removed from sensor prior to maintenance activities. Ensure that circuit breaker supplying power to sensor is set to the off (right) position.
1	Inside equipment cabinet, ensure that circuit breaker on visibility sensor circuit breaker module is set to off (right) position.
2	Using large flat-tipped screwdriver, open visibility sensor electronics enclosure access door.
3	At regulator board, tag and disconnect wires from terminal board TB1 and TB2.
4	Using Phillips screwdriver, remove fours screws, flat washers, and lockwashers securing regulator board to heater power supply board. Remove regulator board.
INSTALLATION	
	Tools required: No. 1 Phillips screwdriver **WARNING** Death or severe injury may result if power is not removed from sensor prior to maintenance activities. Ensure that circuit breaker supplying power to sensor is set to the off (right) position.
1	Inside equipment cabinet, ensure that circuit breaker on visibility sensor circuit breaker module is set to off (right) position.
2	Using Phillips screwdriver, install four screws, lockwashers, and flat washers securing regulator board to heater power supply board.
3	**NOTE** The red wire terminals are marked with red paint. Using tags as a guide, connect wires to terminal board TB1 and TB2.
4	Calibrate visibility sensor in accordance with table 6.5.3.

CHAPTER 7

PRESENT WEATHER SENSOR

SECTION I. DESCRIPTION AND LEADING PARTICULARS

7.1.1 INTRODUCTION

The ASOS present weather sensor is a fully automated sensor that monitors and reports the current precipitation state. The present weather sensor uses weather-particle-induced optical scintillation of an infrared emitter diode (IRED) system to identify precipitation state and type (rain, snow, drizzle, etc) and measure precipitation intensity. The ASOS present weather sensor reports three precipitation conditions to the ACU: rain, snow, and precipitation undetermined. The present weather sensor also reports the intensity of the precipitation as light (-), moderate, or heavy (+). The omission of the plus or minus indication identifies the current precipitations as moderate. Refer to the ASOS Ready Reference Guide for present weather code designators.

7.1.2 PHYSICAL DESCRIPTION

7.1.2.1 **General**. The present weather sensor (Figure 7.1.1) contains two major assemblies: a U-shaped frame assembly and a main electrical enclosure assembly. The transmitter and receiver sensor heads are mounted at opposite ends of the frame assembly, 1 meter apart. The main electrical enclosure assembly houses all associated electronics components including the power supplies. A cable assembly is routed through the U-shaped frame assembly and connects the main electrical enclosure to the transmitter and receiver heads. The cable assembly has two connectors: J4 and J5. Connector J4 is connected to the receiver and connector J5 is connected to the transmitter. A hinge plate assembly is used to attach the sensor to the mounting support and enables the sensor to be lowered to a horizontal position for easier maintenance of the frame assembly.

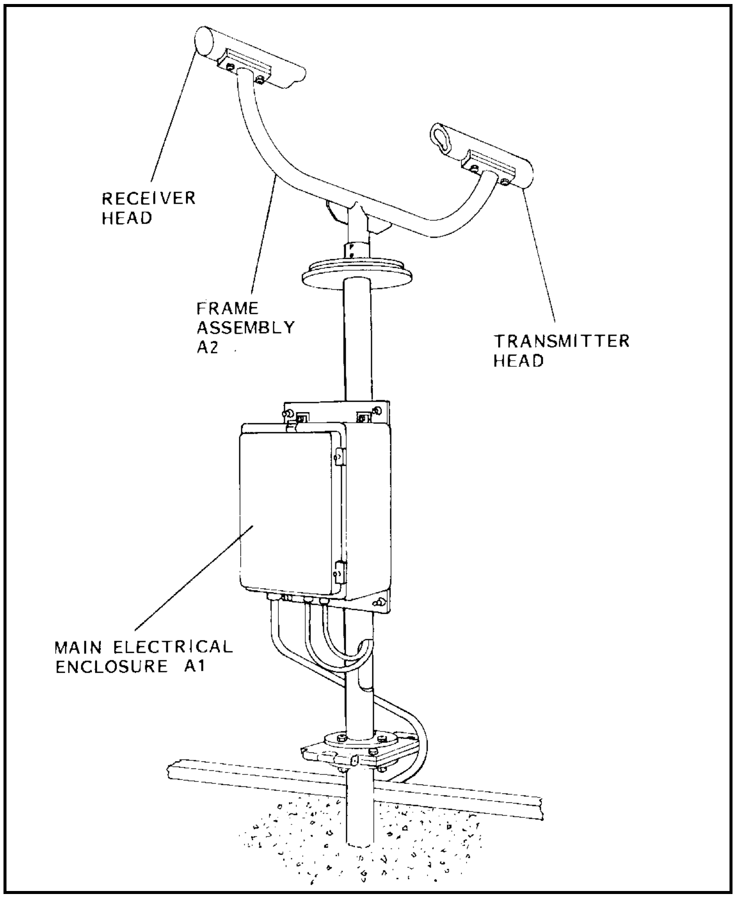


Figure 7.1.1. Present Weather Sensor

7.1.2.2 **Frame Assembly.** The frame assembly holds the transmitter and receiver heads, which contain the optical subassemblies that determine the different types of precipitation. An IRED with a die size 0.4 mm square is used as a source of infrared radiation. The transmitter and receiver heads use 175 mm/ f3.5 cemented achromatic lenses. A 1 mm horizontally-oriented slot and an infrared filter (No. 87C) are located behind the receiver lens. A positive-intrinsic-negative (PIN) photodiode with a 2.75 mm square area provides infrared detection. The frame assembly is replaced as a field replaceable unit (FRU).

7.1.2.3 **<u>Main Electrical Enclosure Assembly</u>.** The main electrical enclosure assembly (Figure 7.1.2) contains the subassemblies that generate the transmit frequency supplied to the transmitter head and the measurement and processing circuits that process the measurement data received from the receiver head. A fiberoptic module supplies an RS-232 communications link between the present weather sensor and the data collection package (DCP). The main electrical enclosure assembly also contains the system power supplies and temperature control circuitry. The signal processing circuitry consists of five printed circuit boards housed in a card rack. The board complement consists of a transmitter board, two signal processor boards (SP1 and SP2), a receiver AGC board, and a microprocessor board.

7.1.3 **PRESENT WEATHER SENSOR CONFIGURATIONS**

There is currently only one configuration of present weather sensor fielded. It is described in Section 7.1.2.

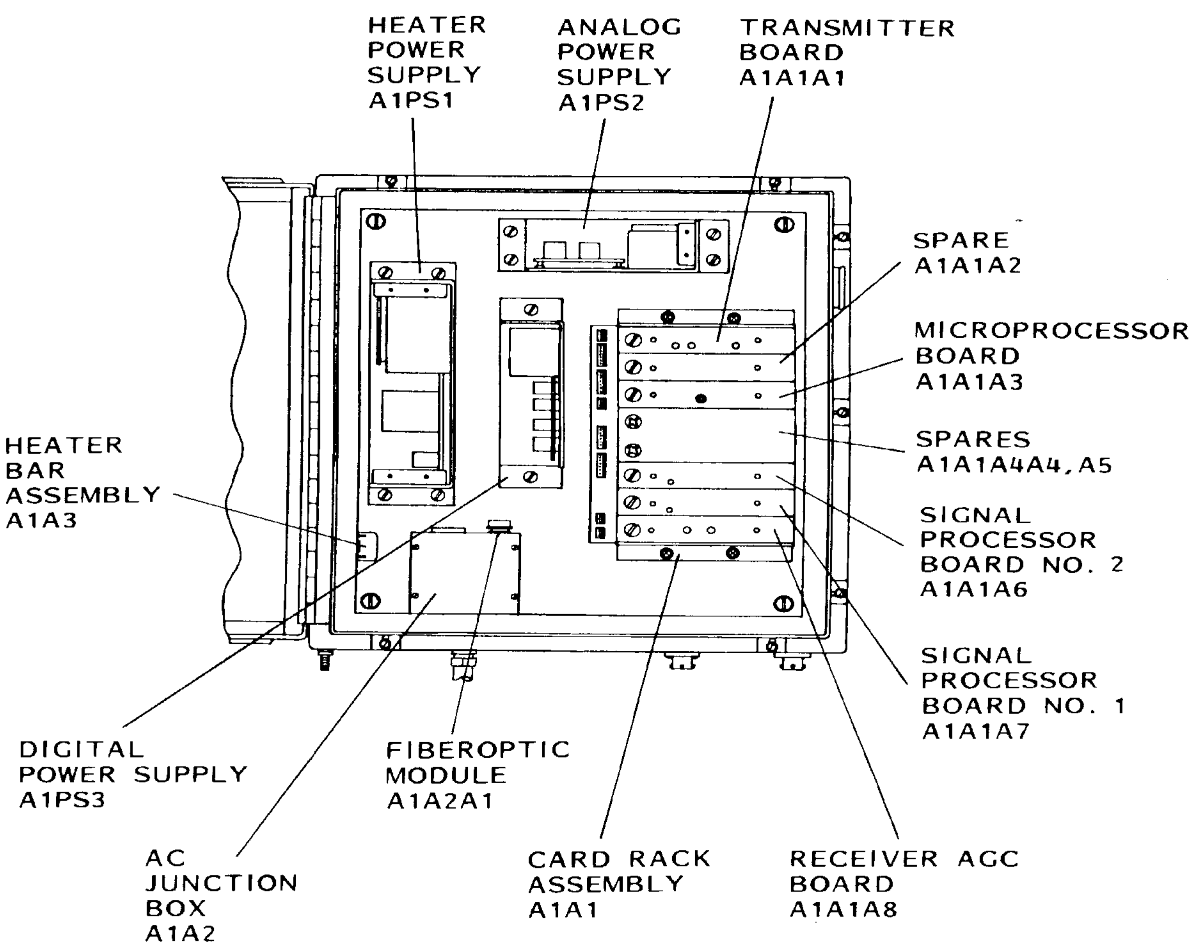


Figure 7.1.2. Present Weather Sensor

SECTION II. INSTALLATION

7.2.1 INTRODUCTION

The ASOS present weather sensor, commonly referred to as the LEDWI or Light Emitting Diode Weather Identifier, has a lightweight, modular design which allows for easy installation. The sensor is normally shipped partially assembled in three separate boxes. The boxes contain the sensor frame, main electronics enclosure, and mounting column. This section provides instructions for installing all of these present weather sensor assemblies. The procedures assume that the sensor pad support pedestal has been previously installed.

7.2.2 ASSEMBLY

The main electrical enclosure, frame assembly, and mounting column are preassembled units and do not require any additional assembly prior to installation. The present weather sensor is mounted to the support column using a hinge plate assembly. The hinge plate assembly provides easy access to the present weather sensor receiver and transmitter assemblies by permitting the present weather sensor to be lowered to a horizontal position.

7.2.3 INSTALLING THE PRESENT WEATHER SENSOR

The present weather sensor is installed on the sensor pad support pedestal shown in Section 7.2.1 using the procedures in table 7.2.1.

Table 7.2.1. Installing Present Weather Sensor

Step	Procedure
	Tools required: 15/16-inch wrench 3/4-inch wrench 9/16-inch wrench Large flat-tipped screwdriver No. 1 Phillips screwdriver **WARNING** Death or severe injury may result if power is not removed from sensor prior to performing installation procedures. Ensure that heater and primary power circuit breakers supplying power to sensor are set to off (right) positions.
1	Inside equipment cabinet, ensure that circuit breakers on present weather sensor circuit breaker module are set to off (right) position.
2	Open hinge plate and position on mounting pedestal. For most sites, orient hinge plate so that sensor will tilt backward away from walkway (hinge is opposite walkway). **NOTE** Lanyard must be oriented so that when hinge plate is opened, lanyard falls in hinge plate cutouts.
3	Using one 5/8-inch bolt, one nut, one lockwasher, and three flat washers, secure front of hinge plate to pedestal, attaching one end of cable lanyard. Bolt is inserted from top down through pedestal, with one flat washer under bolt head. On the underside of pedestal, lanyard opening must be secured between two flat washers, with lockwasher and nut on outside. Do not fully tighten hardware.

Table 7.2.1. Installing Present Weather Sensor - CONT

Step	Procedure
4	Install three more sets of mounting hardware (bolt, two flat washers, lockwasher, and nut) on rear, left, and right mountings of hinge plate. Tighten all four sets of mounting hardware.
5	Install washer on each bolt and slide four mounting bolts up from bottom of the top hinge plate. Temporarily install nut on each bolt and close hinge plate. Install hinge plate locking pin to hold hinge plate in closed position.
6	Remove nuts from four mounting bolts. Position enclosure support on top of four mounting bolts, taking care to properly position enclosure support so that it faces sensor pad walkway.
7	Using two flat washers, one lockwasher, and one nut, secure front of hinge plate to sensor support pole, attaching other end of cable lanyard. Lanyard opening must be secured between two flat washers, with lockwasher and nut on outside. Do not fully tighten hardware. **NOTE** Lanyard must be oriented so that when hinge plate is opened, lanyard falls in hinge plate cutouts.
8	Install remaining sets of mounting hardware (flat washers, lockwasher, and nut) on rear, left, and right of sensor support pole. Tighten all four sets of mounting hardware. **WARNING** With locking pin removed from hinge plate, sensor is not firmly locked in upright position. Death or severe injury may result if personnel are not kept out of travel path of sensor.
9	Lower sensor support pole on hinge plate as follows: a. Remove locking pin from front part of hinge plate. b. From rear of sensor, firmly grasp support pole with both hands and carefully lower support pole on hinge until lanyard catches and supports weight of support pole.
10	Tighten bolts securing sensor mounting post to hinge plate.
11	Referring to Section 7.2.2 and using 3/4-inch wrench, install but do not tighten three ½-inch mounting bolts and three rubber strips using six flat washers, nine neoprene washers, nine lockwashers, and three nuts to secure frame mounting plate to top of mounting column. Be sure to orient two flanges so that two 10-32 mounting holes for short grounding strap are aligned.
12	Tighten three mounting bolts quarter turn past finger tight (enough to slightly compress split lockwashers, but not enough to compress neoprene washers to less than 75% of original thickness).
13	Install 10-32 X 0.5 screw, lockwasher, and flat washer securing ground strap to flanges on mounting plate and mounting column.
14	Feed frame assembly cables from bottom of frame assembly down into mounting column and gently lower the frame assembly on to mounting column (Figure 7.2.1).
15	At mounting column access hole (below mount for main electrical enclosure), pull free ends of two frame assembly cables and frame assembly ground wire out of mounting column.
16	Position frame so that sensor head piece with horizontal slotted mask is facing north (±10°). Raise frame assembly up so that stem of frame is approximately 1/4 inch above bottom of mounting plate (not protruding out of mounting base).
17	Tighten four hex capscrews in collar of mounting base to secure frame. Do not overtighten screws; otherwise, lower end of mounting frame will become distorted and difficult to remove from mounting base.

Table 7.2.1. Installing Present Weather Sensor - CONT

Step	Procedure
18	Position main electrical enclosure on channel of mounting column. Using 9/16-inch wrench, install 3/8-inch bolt, two flat washers, lockwasher, and nut securing enclosure. **WARNING** With locking pin removed from hinge plate, sensor is not firmly locked in upright position. Death or severe injury may result if personnel are not kept out of travel path of sensor.
19	Raise present weather sensor on hinge plate as follows: a. From rear of sensor, firmly grasp support pole with both hands and carefully raise sensor on hinge into upright position. b. Install locking pin into front of hinge plate.
20	Connect frame cable connectors P4 and P5 to connectors J4 and J5 on main electrical enclosure.
21	Connect frame assembly (long white) ground wire and site ground wire to ground wire stud located on bottom of main electrical enclosure.
22	Using large flat-tipped screwdriver, open main electrical enclosure access door.
23	Using No. 1 Phillips screwdriver, remove four screws and lockwashers securing access cover to ac junction box.
24	Remove access cover from ac junction box.
25	Connect ac power wiring to terminal board in ac junction box according to the following connection chart: <u>Wire color</u> — <u>Terminal</u> — <u>Function</u> Black — TB1-1 — 120 vac (electronics) White — TB1-2 — Neutral (electronics) Green — TB1-3 — Chassis ground Red — TB1-4 — 120 vac (heater) Yellow — TB1-5 — Neutral (heaters)
26	Remove protective plastic covers from fiberoptic cable connectors on underside of fiberoptic module.
27	Connect RX connector on fiberoptic cable to RX connector on fiberoptic module (RX connector on module is nearest DB-9 electrical connector). Connect TX connector on fiberoptic cable to remaining connector on fiberoptic module.
28	Using large adjustable wrench and hardware supplied, connect flexible conduit to main electrical enclosure.
29	Using No. 1 Phillips screwdriver, install four screws and lockwashers securing access cover to ac junction box.
30	Calibrate present weather sensor in accordance with table 7.5.2.

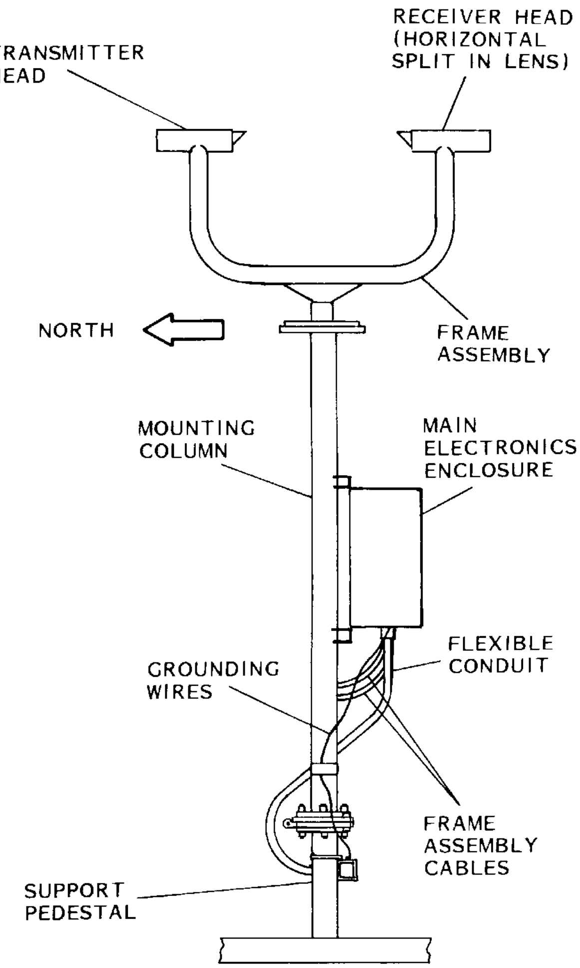


Figure 7.2.1. Present Weather Sensor Mounting Diagram

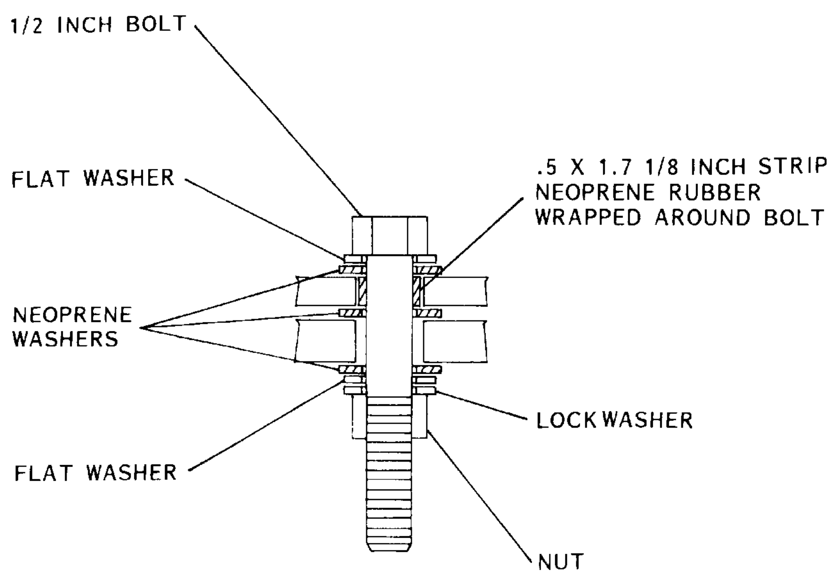


Figure 7.2.2. Frame Assembly Mounting Plate Hardware

SECTION III. OPERATION

7.3.1 INTRODUCTION

The present weather sensor is designed to operate continuously under complete control of the data collection package (DCP). The present weather sensor must be calibrated every 90 days. During this procedure, the low, high, and particle channels are adjusted and the carrier channel is monitored. Information to properly adjust the associated controls is contained within the calibration procedure. The sensor's self-test diagnostic data are displayed on the present weather maintenance page. Information defining the purpose of each field on that display is provided in Chapter 1, Section III.

SECTION IV. THEORY OF OPERATION

7.4.1 INTRODUCTION

This section describes how the ASOS present weather sensor functions to detect and identify precipitation. The operating theory is presented in two levels of detail. The first level introduces the principles of operation and describes sensor operation on a simplified block diagram level. The second level describes the sensor's individual functional areas in a detailed block diagram that allows isolation of faulty field replaceable units (FRU's).

7.4.2 SIMPLIFIED BLOCK DIAGRAM DESCRIPTION

The following paragraphs describe the basic operation of the present weather sensor, and the physical principles upon which the sensor is designed. A simplified block diagram of the sensor's operation introduces the basic sensor components and describes their functional relationships.

7.4.2.1 **Principles of Operation**. The ASOS present weather sensor detects the presence of precipitation by using an infrared light beam. A simplified illustration of the sensing technique is provided in Section 7.4.1. The infrared light is pulsed by the transmitter at a high rate (50 kHz) and passed through a volume of air where it is then detected by the receiver. The receiver uses a horizontal slit aperture, which maximizes its sensitivity to vertically falling precipitants. When there is no precipitation, the light pulses pass directly through the air. Thus, the frequency of the light pulses at the receiver is the same as the frequency of the light pulses transmitted. Also, with no precipitation, the power level received by the receiver is at a maximum. If there is any precipitation such as rain or snow in the volume of air, some of the light pulses are blocked by the precipitation particles. The result is a modulation of the light signal, which changes the frequency composition of the signal detected at the receiver. The physical properties of the precipitation such as the particle size, number, and falling velocity directly affect the frequency composition of the received signal. In actuality, the physical properties of the light pulses and the precipitation particles cause more of a partial shadowing than actual blocking of the light pulses. The effects, however, are still the same. Thus, by measuring the frequency components and power levels at the receiver, the presence and type of precipitation can be determined.

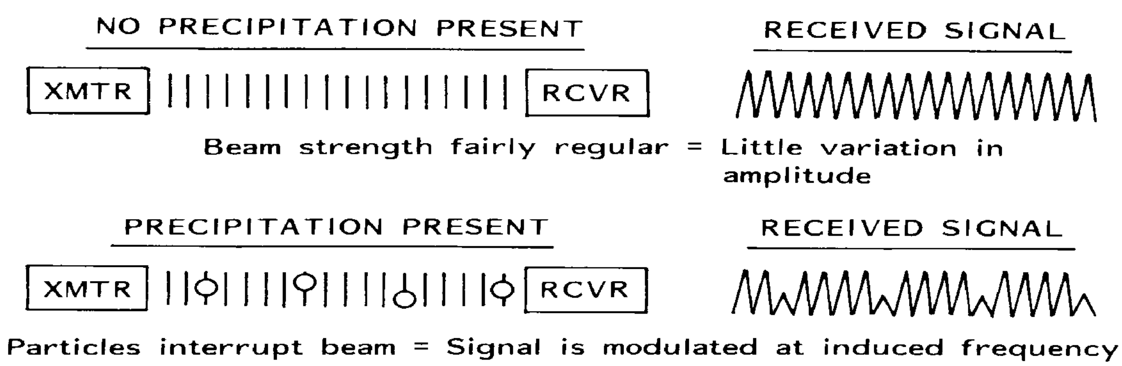


Figure 7.4.1. Precipitation Effects on Received Signal

7.4.2.2 **Simplified Block Diagram Description**. A simplified block diagram of the present weather sensor is provided in Section 7.4.2. The transmitter modulator in the main electrical enclosure assembly generates a 50 kHz transmit signal, which is output to the transmitter head. The infrared transmitter generates light pulses that are formed into a semicoherent beam by optics in the transmitter head. The transmitted light signal passes through a sample volume of air where it is detected by the receiver head. Optics in the receiver head focus incoming light onto an infrared detector where it is converted back into an electrical signal. The received signal is then amplified and output to an automatic gain control (AGC). The AGC compensates the received signal to overcome effects of temperature changes, component aging, dusty optics, and haze or fog. AGC output is demodulated and sent to the signal processors. Signal processors filter the demodulated signal to determine its frequency component content. There are actually four channels of signal processing: the low band (25 to 250 Hz) channel, the high band (1 to 4 kHz) channel, the particle count channel, and the carrier channel. The use of these channels is summarized as follows:

a. The particle count channel and the high and low band channels are used for precipitation state (yes/no) identification.

b. The ratio of high band to low band signal strength is used for precipitation type (snow/rain) identification.

c. The strength of the high band signal is used to determine intensity of rain (R-, R, or R+).

d. The strength of the low band signal is used to determine intensity of snow (S-, S, or S+).

e. The carrier channel is tuned to the carrier signal to monitor the received signal strength and detect accidental beam blocking or light source failure.

The outputs of the signal processing channels are applied to the microprocessor control logic where they are converted to digital form and processed. The microprocessor samples channel data once every 5 seconds and continually runs a present weather algorithm (once per minute). As part of the algorithm, the microprocessor maintains an adaptive baseline of 1-minute averages of the three data channels (low band, high band, and particle count). Because of this adaptive baselining technique, the sensor requires several minutes to stabilize (establish its baseline) after power up or calibration adjustments. When polled by the DCP, the microprocessor outputs its present weather data in RS-232 format to the fiberoptic module. The fiberoptic module relays all of the data messages between the present weather sensor and the DCP using a fiberoptic data link.

7.4.3 DETAILED BLOCK DIAGRAM DESCRIPTION

7.4.3.1 **General**. The present weather sensor (Figure 7.4.3) detects current precipitation conditions via an infrared light beam. The infrared beam is transmitted through a sample volume of air, detected by an infrared receiver, and then analyzed for frequency components that indicate precipitation. The results of these processes are then transferred in digital format to the DCP.

7.4.3.2 **Transmitter Board (2MT2A1A1A1)**. The transmitter board in the card rack assembly of the main electrical enclosure assembly generates the carrier frequency signal for the transmitter head. A voltage controlled oscillator (VCO) generates a 50 kHz signal that is amplified and output to trigger the transmitter's infrared light emitting diode (LED).

7.4.3.3 **Transmitter Head (Part of Frame Assembly 2MT2A2)**. The transmitter head houses the emitter board and transmitter optics. The carrier frequency modulation signal input from the transmitter board in the main electrical enclosure assembly card rack assembly is applied to an infrared LED. The LED emits infrared light pulses at the carrier frequency rate (50 kHz). The light pulses are then shaped into a semicoherent light beam by the transmitter optics and passed through a sample volume of air.

7.4.3.4 **Receiver Head (Part of Frame Assembly 2MT2A2)**. The receiver head houses the receiver optics, infrared detector, and signal preamplifier. The receiver optics focus the incoming infrared light signal onto a photodiode. This photodiode produces a low level electrical signal that contains all of the characteristics of the precipitation effects on the light beam. The low level electrical signal is then amplified and output to the receiver AGC board in the main electrical enclosure assembly card rack assembly.

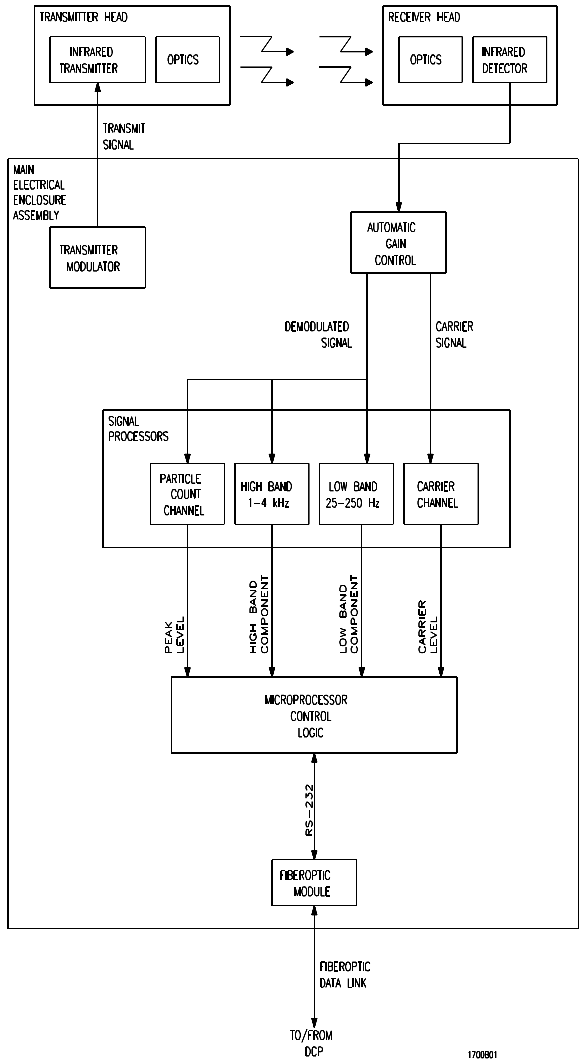


Figure 7.4.2. Present Weather Sensor Simplified Block Diagram

7.4.3.5 **Receiver AGC Board (2MT2A1A1A8)**. The receiver AGC board is located in the card rack assembly in the main electrical enclosure assembly. The receiver AGC board adjusts the signal level input from the receiver head and demodulates the received signal. The receiver AGC board uses a variable feedback amplifier to automatically adjust the signal level to an optimum level for output to the signal processor boards. This AGC amplifier circuit senses the amplitude of the incoming signal and adjusts the feedback (gain) of the amplifier to generate a normalized signal for further processing. The signal is then demodulated to separate the carrier signal component from the modulation signal component. These two signals are then output to the signal processor boards for further processing.

7.4.3.6 **Signal Processor Board No. 1 (2MT2A1A1A7)**. Signal processor board No. 1 contains the signal processing channels for the carrier signal and the low band (25 to 250 Hz) frequency components. The carrier channel is filter tuned to the carrier frequency and converts the carrier frequency component to a dc voltage signal for output to the microprocessor board. The carrier channel is used by the sensor to verify the presence of the carrier signal. If there is no signal output from this channel, then the sensor reports a failure due to optical path blockage or a transmitter/receiver failure. The low band frequency channel is tuned to the frequency band from 25 to 250 Hz. This channel converts any signal components in the low band range into a dc voltage signal that is output to the microprocessor board. The sensor uses this channel, in conjunction with the particle count and high band channels, to determine the state (yes/no) of precipitation. The ratio of this channel with respect to the high band channel is used to determine the type (rain/snow) of precipitation. Finally, the strength of the low band output signal is used to determine intensity of snow (S-, S, or S+).

7.4.3.7 **Signal Processor Board No. 2 (2MT2A1A1A6)**. Signal processor board No. 2 contains the signal processing channels for the particle count signal and the high band (1 to 4 kHz) frequency components. The output of the particle count channel is used to detect the start (yes/no) of a precipitation event. The high band frequency channel is tuned to the frequency band from 1 to 4 kHz. This channel converts any signal components in the high band range into a dc voltage signal that is output to the microprocessor board. The sensor uses this channel, in conjunction with the particle count and low band channels, to determine the state (yes/no) of precipitation. The ratio of this channel to the low band channel is used to determine the type (rain/snow) of precipitation. Finally, the strength of the high band output signal is used to determine intensity of rain (R-, R, or R+).

7.4.3.8 **Microprocessor Board (2MT2A1A1A3)**. The microprocessor board contains all of the control logic within the present weather sensor. The microprocessor control logic operates under sensor software control to sample the outputs of each of the signal processor channels and determine the presence and type of precipitation. The sampling of the signal processor channels is performed one channel at a time. The signal outputs of each of the channels are selected through an analog multiplexer for application to an analog-to-digital (A/D) converter. The A/D converter converts the analog voltage signal input into a digital output, which is then read and processed by the microprocessor control logic. This same circuit is used to monitor the power supply voltages used by the sensor electronics assemblies.

7.4.3.9 **Fiberoptic Module (2MT2A1A2A1)**. The fiberoptic module provides a two-way serial data communication link between the present weather sensor and the DCP. The module converts the optical data from the DCP to RS-232 serial data for the sensor's microprocessor control logic. The module also converts RS-232 data from the sensor's microprocessor control logic to optical data to be sent to the DCP. The fiberoptic link with the DCP consists of separate transmit and receive fiberoptic cables.

7.4.3.10 **Power Distribution**. The present weather sensor has two ac power inputs from the DCP (Figure 7.4.4). One ac power input is the power source for the sensor's bar heater assembly. The second ac power input is the power source for the sensor's digital and analog electronics. The heater power input from the DCP is controlled by two thermostats. The first (failsafe) thermostat closes at 80 degrees F to enable the heater circuit. The second thermostat then turns on the heater when enclosure temperature drops to 40 degrees and turns the heater off when the enclosure temperature rises to 60 degrees. The failsafe thermostat then opens to disable the heater circuit when the temperature of the enclosure rises to 110 degrees. Heater power supply PS1 generates +24 vdc heater power, which is routed to the card rack assembly. From the card rack assembly, the +24 vdc power is routed as +24V CONTINUOUS power to the lens heaters of both the transmitter and the receiver. The heater power supply also contains a relay that is controlled by Microprocessor Board A1A3. This relay switches +24 vdc power and routes it back to the card rack assembly, where it is applied as +24V HTR SW to the hood heaters on both the transmitter and receiver heads. This allows the microprocessor to control the hood heaters on the transmitter and receiver heads. Analog power supply PS2 provides +12 vdc and -12 vdc for Signal Processor Board No. 1 A1A7, Signal Processor Board No. 2 A1A6, Receiver AGC Board A1A8, and the receiver head. Digital power supply PS3 provides +12 vdc, -12 vdc, and +5 vdc power for Transmitter Board A1A1 and Microprocessor Board A1A3.

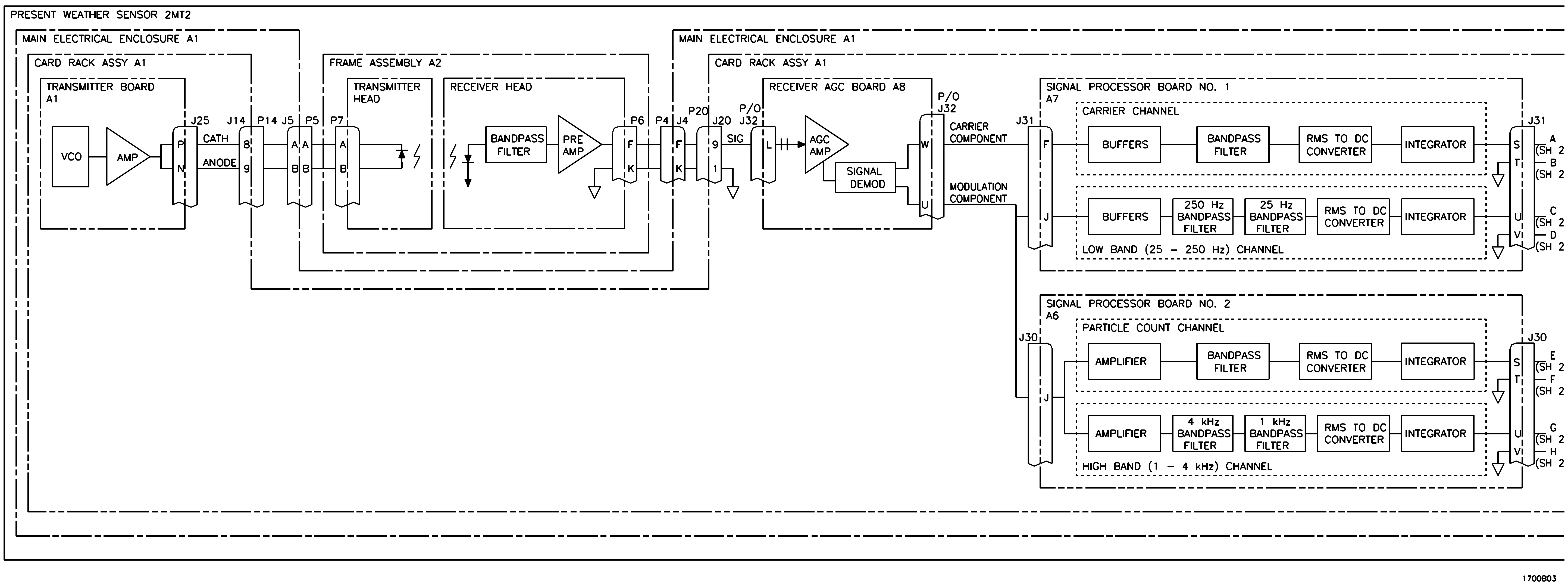


Figure 7.4.3. Present Weather Sensor Detailed Block Diagram (Sheet 1 of 2)

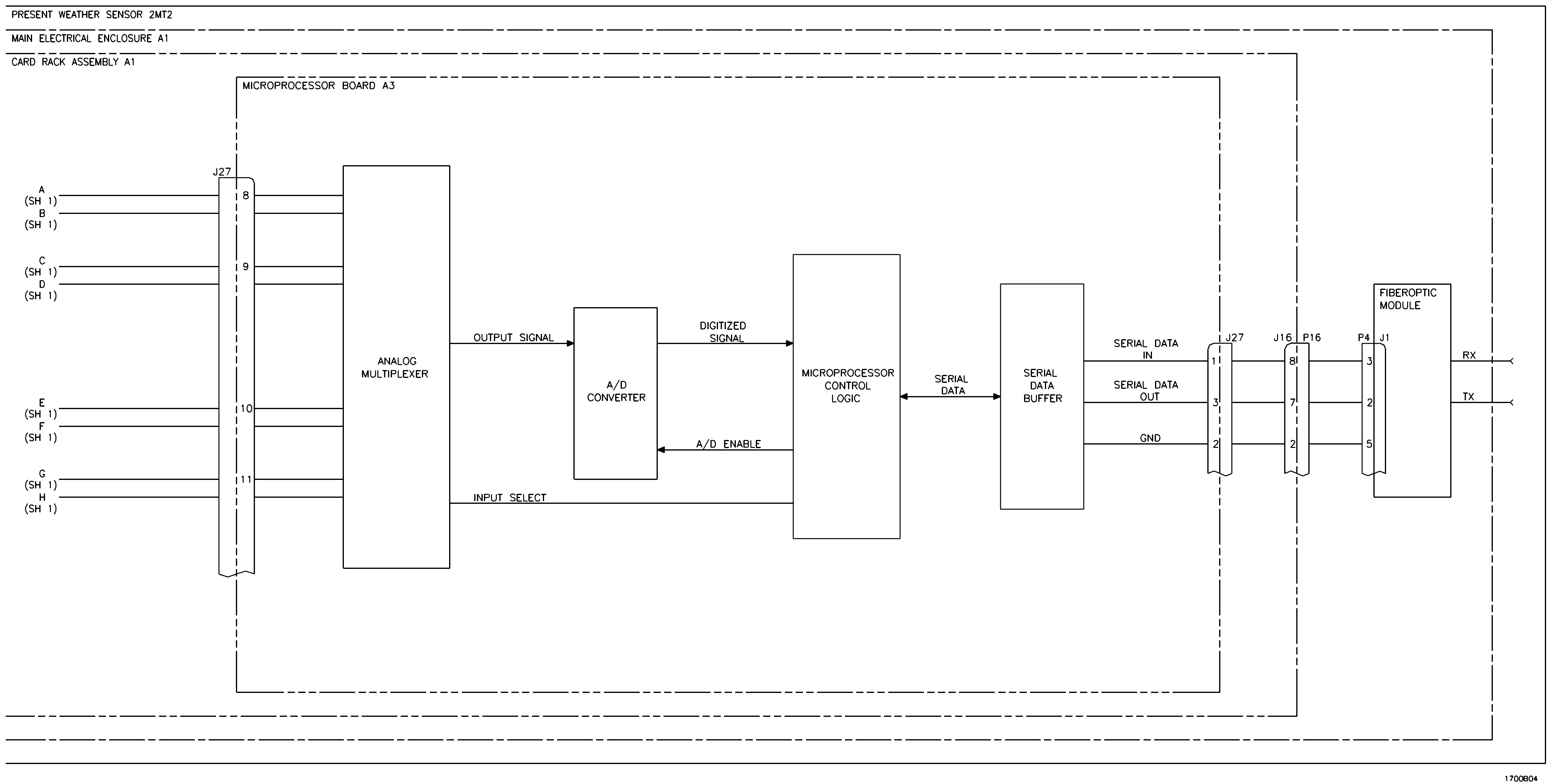


Figure 7.4.3. Present Weather Sensor Detailed Block Diagram (Sheet 2)

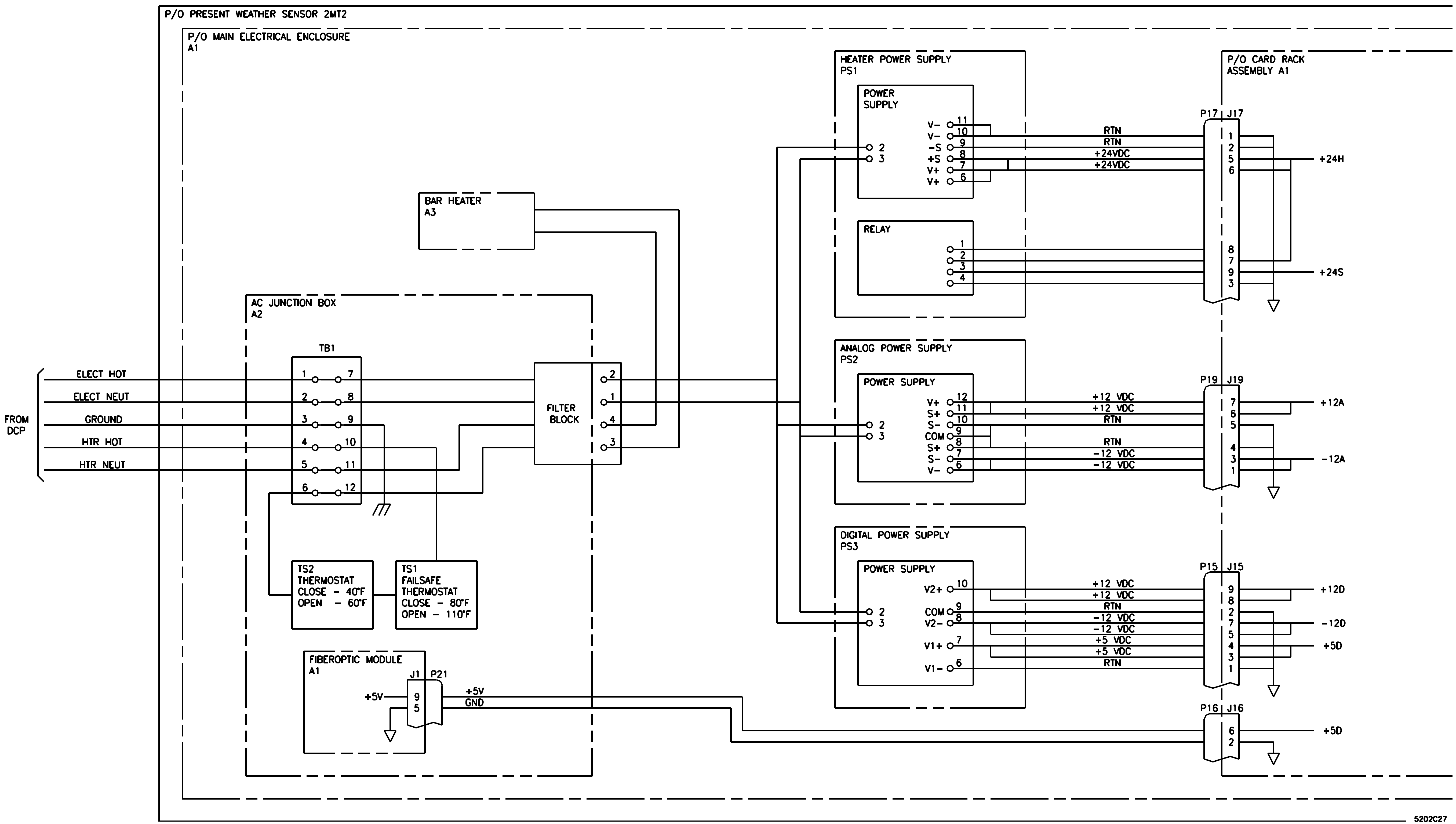


Figure 7.4.4. Present Weather Sensor AC/DC Power Distribution (Sheet 1 of 2)

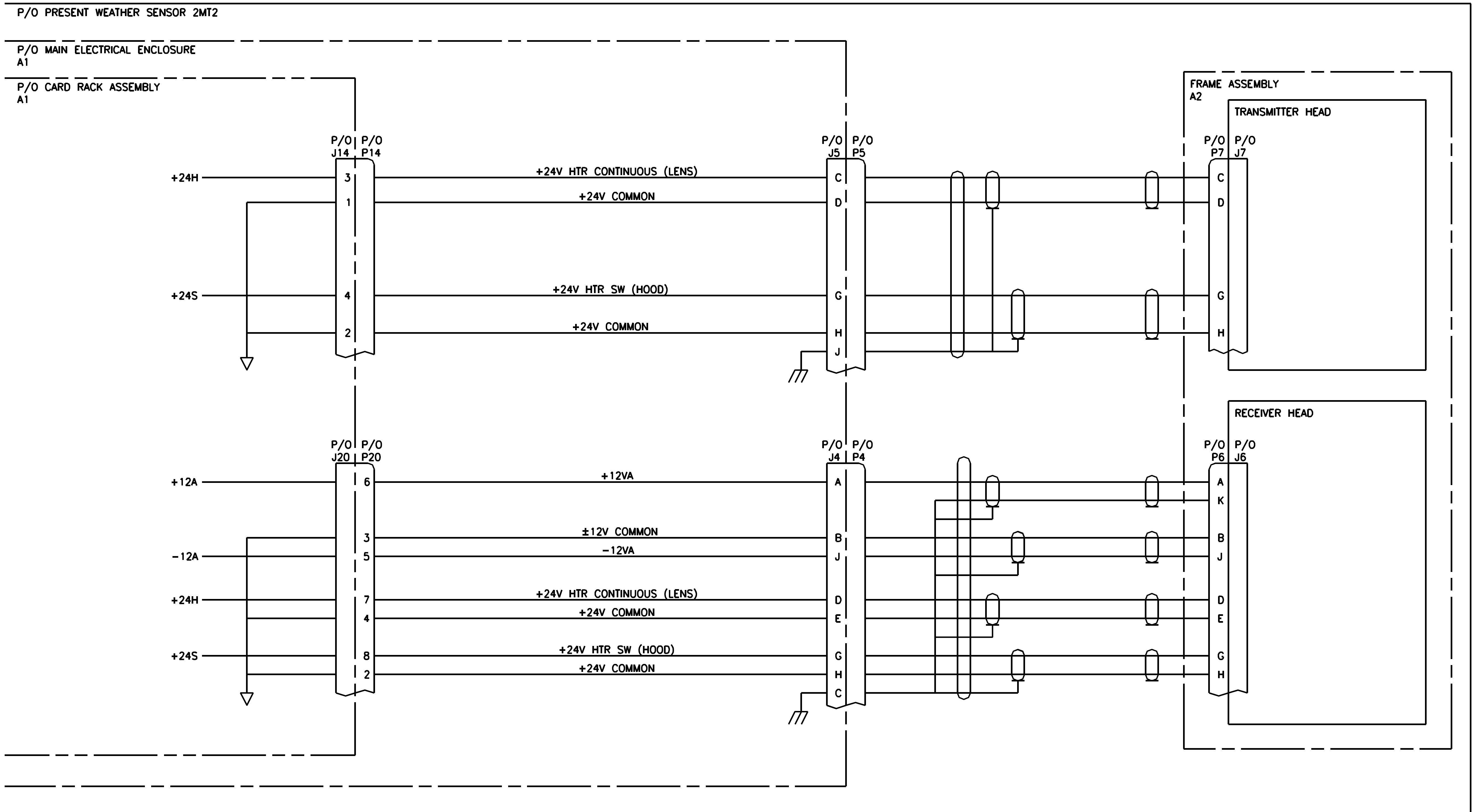


Figure 7.4.4. Present Weather Sensor AC/DC Power Distribution (Sheet 2)

7.4.4 POLL/FRAME FORMATS

The present weather sensor responds to three different types of single character ASCII polls issued by the DCP or the technician during calibration. The poll character transmitted to the present weather sensor should be a single character only (transmitted at 1200 baud, 1 start bit, 8 data bits, no parity, and 1 stop bit), not followed by any other characters or control codes. The poll codes and description are listed below:

DCP Request	Description
A	Send routine data
B	Send simulation data
C	Send data and raw data

The type A poll (short message format) is used for normal operation. This poll is issued once every 60 seconds by the DCP, and in response, the present weather sensor transmits a 17-character string that contains present weather, precipitation amount, sensor status, and frame checksum information. The type B poll (simulation data) is used for field test and diagnostic purposes during calibration. This mode outputs a fixed (never changing) string of 17 characters in the same format as above, but with fixed dummy data. The type C poll is a long (45 characters) output format which includes present weather, precipitation intensity, and full raw data along with status and checksum data. This poll is used for performing normal polls along with acquiring raw sensor data for evaluation or diagnostic purposes. Each of the three poll types are discussed in more detail in the sections below. The various fields, portions of which are common to all formats, are described in paragraph 7.4.4.4. Paragraph 7.4.4.5 details the status code field of the type C poll.

7.4.4.1 **Type A - Routine Data Poll**. This paragraph explains the format of the present weather sensor data frame that is transmitted in response to the type A poll. The present weather sensor ASCII routine data string is 17 bytes long and is formatted as follows:

Format	[STX]	W	w	w	P	p	p	p	p	S	s	s	s	s	c	c	[CR]
Byte	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17

Byte	Description	Value
1	Start of transmission	[STX]
2	Weather type marker	W
3-4	Present weather field	ww
5	Precipitation amount marker	P
6-9	Precipitation amount field	pppp
10	Status field marker	S
11-14	Status field	ssss
15-16	Checksum field	cc
17	Carriage return	[CR]

7.4.4.2 **Type B - Simulated Data Poll**. This paragraph explains the format of the present weather sensor data frame that is transmitted in response to the type B poll. The present weather sensor ASCII diagnostic data string is 17 bytes long and is formatted as follows:

Format	[STX]	W	N	P	P	1	2	3	4	S	5	6	7	8	9	0	[CR]
Byte	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17

Byte	Description	Value
1	Start of transmission	[STX]
2	Weather type marker	W
3-4	Present weather (dummy data)	NP
5	Precipitation amount marker	P
6-9	Precipitation amount (dummy data)	1234
10	Status field marker	S
11-14	Status field (dummy data)	5678
15-16	Checksum field (dummy data)	90
17	Carriage return	[CR]

7.4.4.3 **Type C - Full Raw Data Poll**. This paragraph explains the format of the present weather sensor data frame that is transmitted in response to the type C poll. The present weather sensor ASCII full raw data string is 45 bytes long and is formatted as follows:

Format	[STX]	W	w	w	P	p	p	p	p	S	s	s	s	s	c	c	X
Byte	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17

Format	n	n	n	z	z	z	L	n	n	n	b	b	b	K	n	n	n
Byte	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34

Format	b	b	b	H	n	n	n	b	b	b	[CR]
Byte	35	36	37	38	39	40	41	42	43	44	45

Byte	Description	Value
1	Start of transmission	[STX]
2	Weather type marker	W
3-4	Present weather field	ww
5	Precipitation amount marker	P
6-9	Precipitation amount field	pppp
10	Status field marker	S
11-14	Status field	ssss
15-16	Checksum field	cc
17	Carrier raw data field marker	X
18-20	Carrier 1 min average raw data	nnn
21-23	Low/particle/high lock indicator	zzz
24	Low raw data field marker	L
25-27	Low 1 min average raw data	nnn
28-30	Low baseline	bbb
31	Particle raw data field marker	K
32-34	Particle 1 min average raw data	nnn
35-37	Particle baseline	bbb
38	High raw data field marker	H
39-41	High 1 min average raw data	nnn
42-44	High baseline	bbb
45	Carriage return	[CR]

7.4.4.4 **Field Description**. This paragraph describes the format of the various fixed fields as they are used in the three formats above.

a. The capital letters W, P, S, X, L, K, and H above serve as place markers for the weather, precipitation, status, carrier, low, particle, and high data fields to follow. These markers are fixed in position and coding. They are included within the format to simplify manual interpretation of the sensor output.

b. w w is a 2-byte field indicating present weather. The weather code contained in this field will be one of the following:

L-	Light drizzle	S-	Light snow
L_	Moderate drizzle	S_	Moderate snow
R-	Light rain	S+	Heavy snow
R_	Moderate rain	P?	Unknown precipitation
R+	Heavy rain	ER	Error condition
__	No precipitation	P_	Mixed precipitation
--	Startup code		

The _ (underline) character represents an ASCII space character and is shown only for readability. The -- code will be output in this and other data fields during approximately the first 60 seconds after reset or power up of the sensor.

c. p p p p is a 4-byte field indicating the precipitation amount of equivalent water content for snow. Zero is formatted as four zeros (0000). The number is a floating point format, varying from 0.01 to 9999. Units are millimeters-per-hour rain rate, averaged over a 1-minute period.

d. s s s s is a four-character field containing ASCII encoded hex value reserved for error and status codes. Each character represents a 4-bit field of binary information. The 4-bit field contains status information of the FRU's. Paragraph 7.4.4.5 contains detailed breakdown.

e. c c is a 2-byte field containing ASCII encoded 8 bit hex value for a modulo 256 checksum of the data between but not including [STX] and c c.

f. n n n is a 3-byte ASCII numeric field indicating the corresponding 1-minute averaged raw data in tens of millivolts. Leading/unused positions are filled with zeros. Valid values are -99 to 999. Overflows and underflows are represented as 999 and -99, respectively.

g. z z z is a three-character ASCII numeric field indicating the lock on (0) or off (1) status of the low, particle counting, and high channels, respectively.

h. b b b is a 3-byte ASCII numeric field indicating the respective data channel adaptive baseline value in tens of millivolts for the current algorithm (1 minute) processing cycle. Leading/unused positions are filled with zeros. Valid values are -99 to 999.

7.4.4.5 **Status Field Encoding**. The status field, denoted by s s s s (4 bytes) in the present weather sensor data output format, is a 4-byte field of sensor status bytes. Each status byte is represented in the data field as an ASCII-encoded hex-formatted nibble (O-F). Each of the 4 bits, represented by each of the 4 nibbles, represents the status of a particular field replaceable unit (FRU) or of a particular system condition. Each status byte character must be converted to binary in order to identify which bits are set or cleared. Table 7.4.1 shows what the corresponding binary nibble is for each of the 16 possible hex characters that may be seen in the status string.

Table 7.4.1. Hex - Binary Nibble Conversion Chart

ASCII -Encoded Hex Character	Binary Nibble (msb)			(lsb)
0	0	0	0	0
1	0	0	0	1
2	0	0	1	0
3	0	0	1	1
4	0	1	0	0
5	0	1	0	1
6	0	1	1	0
7	0	1	1	1
8	1	0	0	0
9	1	0	0	1
A	1	0	1	0
B	1	0	1	1
C	1	1	0	0
D	1	1	0	1
E	1	1	1	0
F	1	1	1	1

Each bit is set (bit = 1) to indicate that a problem exists in that FRU or that a specified event or condition is true. A bit will be cleared (bit = 0) if that FRU is good or that condition is false. The actual meaning of each bit is given on Section 7.4.5. The bits shown as 0 are low and are reserved for future use. The RESET bit will normally be low (0), except after power-up or system reset (hardware or software reset). Upon such an event and for 5 minutes afterward, the RESET bit will be high (1). ASOS disregards data taken during these 5 minutes. (This time is required for the present weather sensor averaging routine to stabilize.) In normal operation (excluding the first 5 minutes after reset or power-up), the status bytes will be all low (0000). A non-zero character in any of the four positions indicates the suspected failure of an FRU which causes ASOS to take action to alert maintenance personnel of a problem. In addition, data from the present weather sensor will be disregarded and a missing report issued. (Note that the present weather sensor does not necessarily stop outputting data when a status bit flags an error condition.) A summary of the active status bits and the corresponding FRU's and assembly numbers are provided in table 7.4.2.

NOTE
Byte 0 is transmitted first.

Output String Position	Bit 3	Bit 2	Bit 1	Bit 0	Relative Position
Character 11	FRU8	FRU7	FRU2	FRU3	Byte 1
Character 12	FRU4	FRU5	FRU9	FRU1	Byte 2
Character 13	RESET	0	0	0	Byte 3
Character 14	0	0	0	0	Byte 4

Figure 7.4.5. OWI-240 Status Bit Identification

Table 7.4.2. Status Bit/FRU Summary

FRU Number	Item	Reference Designator
FRU1	Frame assembly	2MT2A2
FRU2	Transmitter board	2MT2A1A1A1
FRU3	Receiver AGC board	2MT2A1A1A8
FRU4	Signal processor board #1	2MT2A1A1A7
FRU5	Signal processor board #2	2MT2A1A1A6
FRU6	Microprocessor board	2MT2A1A1A3
FRU7	Analog power supply	2MT2A1PS2
FRU8	Digital power supply	2MT2A1PS3
FRU9	Heater power supply	2MT2A1PS1

SECTION V. MAINTENANCE

7.5.1 INTRODUCTION

This section provides the preventive and corrective maintenance procedures for the present weather sensor. Preventive maintenance consists of checking the lens and hood headers, cleaning lenses on the transmitter and receiver heads, and calibrating the sensor. Corrective maintenance is performed by running the system diagnostic test on the sensor to identify any faulty module. Failure of a power supply may prevent the system diagnostic test from running. Therefore, additional procedures are provided for checking power supply voltages. Detailed removal and installation procedures are provided for each field replaceable unit (FRU) in the present weather sensor.

7.5.2 PREVENTIVE MAINTENANCE

Preventive maintenance for the present weather sensor is performed every 90 days and consists of checking the lens and hood heaters, cleaning the lenses on the transmitter and receiver heads, and calibrating the sensor. Once each year the sensor must be treated with the insect paint.

7.5.2.1 **Checking Lens and Hood Heaters**. The present weather sensor lens and hood heaters are not automatically tested by the sensor's internal diagnostics. As such, the maintenance technician must manually check the heaters every 90 days and whenever a problem with the heaters is suspected. The lens heaters are on all the time. Hood heaters are turned on whenever the sensor is reporting snow (S) or heavy snow (S+) or whenever the beam is completely blocked. Since checking the heaters requires a touch test of the lens, the transmitter and receiver lenses should be cleaned after this test (paragraph 7.5.2.2). Table 7.5.1 provides the procedure to check the operation of the present weather sensor lens and hood heaters.

7.5.2.2 **Cleaning Transmitter and Receiver Lenses**. Generally, moderate dust buildup and scratches on the transmitter and receiver lenses will not effect sensor accuracy or sensitivity. However, as preventive maintenance, the lenses on the transmitter and receiver heads should be cleaned every 90 days. Individual sites may require more frequent cleaning if there are a significant number of problems noted due to dirty lenses. Before cleaning the lenses, power should be removed from the present weather sensor by setting the circuit breakers on sensor circuit breaker module (located in the DCP) to the off (right) position. After removing power, a soft optics brush should be used to remove dust or dirt that may scratch the lenses. The lenses are then cleaned using lint-free lens cleaning tissues and lens cleaning solution. A drop of cleaning solution is applied to the tissues, and the lenses are then cleaned by wiping each lens in a circular fashion.

7.5.2.3 **Calibration**. The present weather sensor must be calibrated every 90 days or after any corrective maintenance action. Before calibration, the sensor must be properly installed and must pass its ASOS diagnostic checks. Table 7.5.2 provides the procedures to calibrate the present weather sensor. Calibration is accomplished using the laptop computer to issue present weather sensor B and C commands and receive the sensor's responses. Paragraph 7.4.4 contains a detailed description of the sensor responses.

7.5.2.4 **Present Weather Sensor Spider Paint Application Procedure**. This procedure is used to treat (paint) the present weather sensor with an insecticide material. The sensor should be painted once each year. The entire sensor head (excluding hoods), sensor pole, and pedestal must be painted. The purpose is to create a long, treated path over which climbing insects have to traverse before reaching the optical path of the present weather sensor. The insecticide, a product called INSECTA, is a milky white, latex based liquid that, when dry, is relatively benign to humans but deadly to spiders and insects. The insecticide is present in crystals that are released when an insect walks on the treated surface. The present weather sensor spider paint application procedure is provided in table 7.5.3.

7.5.3 **CORRECTIVE MAINTENANCE**

The present weather sensor calibration should be checked using the INITIAL CALIBRATION check of table 7.5.2 prior to further corrective maintenance. The present weather sensor contains elaborate fault isolation circuitry and software that enable fault isolation to an FRU. Although these diagnostics are very reliable, if they fail to execute properly, the technician should troubleshoot the sensor using the procedures in table 7.5.4. Each procedure should be performed in the order listed until the problem is corrected. If the sensor cannot be repaired using these procedures, the sensor's detailed block diagrams should be referenced and troubleshooting performed. After repair, the on-demand test should be performed on the present weather sensor to verify system operation. The system should then be monitored until the continuous self-test (CST) completes its routine test of the complete system. After the completion of CST, the system maintenance log should be reviewed to ensure that the system is operating properly.

7.5.4 **FRU REMOVAL AND INSTALLATION**

7.5.4.1 **Frame Head Assembly Removal and Installation**. The procedures required to remove and install the present weather sensor frame assembly are provided in table 7.5.6.

7.5.4.2 **Heater Power Supply Removal and Installation**. The procedures required to remove and install the present weather sensor heater power supply are provided in table 7.5.7.

7.5.4.3 **Analog Power Supply Removal and Installation**. The procedures required to remove and install the present weather sensor analog power supply are provided in table 7.5.8.

7.5.4.4 **Digital Power Supply Removal and Installation**. The procedures required to remove and install the present weather sensor digital power supply are provided in table 7.5.9.

7.5.4.5 **Circuit Board Removal and Installation**. The procedures required to remove and install the present weather sensor circuit boards are provided in table 7.5.10.

7.5.4.6 **Fiberoptic Module Removal and Installation**. The procedures required to remove and install the present weather sensor fiberoptic module are provided in table 7.5.11.

7.5.4.7 **Heater Bar Assembly Removal and Installation**. The procedures to remove and install the heater bar assembly are provided in table 7.5.12.

7.5.4.8 **Card Rack Assembly Removal and Installation**. The procedures to remove and install the card rack assembly are provided in table 7.5.13.

7.5.4.9 **Main Electrical Enclosure Removal and Installation**. The procedures to remove and install the main electrical enclosure are provided in table 7.5.14.

Table 7.5.1. Lens and Hood Heater Touch Test

Step	Procedure
	WARNING While lens and hood heaters will be hot, they will not cause burns to skin if lightly touched for short periods of time. **NOTE** Laptop computer initialized as DCP OID (Chapter 3, Section III), or any other available OID, may be used for the following procedure.
1	At OID, display sensor status page (sequentially press REVUE-SENSOR-STAT) function keys from 1-minute display.
2	On sensor status page, set report processing for present weather sensor to OFF.
3	Briefly touch part of transmitter and receiver lenses where heater is attached from outside. Verify that heaters are warmer than ambient temperature.
4	Block beam between transmitter and receiver head for 3 to 5 minutes.
5	Briefly touch transmitter and receiver hood heaters and verify that heaters are warmer than ambient temperature. If lens (window) and/or hood heaters are not working, check 24-volt dc power supply for discontinuity in heater circuit as follows: a. Check 24-volt heater power supply located on the left side of LEDWI electronic box. Connect a DMM at power supply 2MT2A1PS1 V+ and V- pins. If 24 volts dc is not present, replace power supply; otherwise, check lens and hood heaters for continuity. b. Remove connectors J4 and J5 from electrical enclosure. Measure resistance on J5 connector (transmitter) between pins C and D (lens heater) and pins G and H (hood heater). Measure resistance on J4 connector (receiver) between pins D and E (lens heaters) and pins G and H (hood heater). Reference Section 7.4.4.
6	Clean transmitter and receiver lenses in accordance with paragraph 7.5.2.2.
7	On sensor status page at OID, set report processing for present weather sensor to ON.

Table 7.5.2. Present Weather Sensor Calibration

Step	Procedure
	Tools required: Large flat-tipped screwdriver STI LEDWI calibration kit Small flat-tipped screwdriver Laptop interface (Y-shaped) cable Laptop computer with PROCOMM Plus installed **NOTE** Power to the LEDWI must be cycled OFF, then ON anytime the beam is interrupted. This occurs during optics cleaning and when the adjustable tube is installed and removed.
	INITIAL SETUP PROCEDURE
1	Inside DCP equipment cabinet, set circuit breakers on present weather sensor circuit breaker module to off (right) position.
2	Clean lenses on transmitter and receiver heads in accordance with paragraph 7.5.2.2.
3	Install adjustable tube from calibration kit between transmitter and receiver heads.

Table 7.5.2. Present Weather Sensor Calibration -CONT

Step	Procedure
4	Using large flat-tipped screwdriver, open present weather sensor main electrical enclosure access door. **NOTE** After removing transmitter board, place it inside and at the bottom of the electrical enclosure to keep it warm and dry.
5	At present weather sensor main electrical enclosure, remove transmitter board from top slot of card rack and install TST-200 test modulator board from calibration kit into same slot.
6	Using small flat-tipped screwdriver, disconnect DB-9 connector from fiberoptic module inside main electrical enclosure.
7	Using laptop computer interface (Y-shaped) cable, connect RS-232C (COM1) port of laptop computer to DB-9 connector removed from fiberoptic module. Close electrical enclosure door as far as possible without damaging interface cable.
8	Turn on laptop computer and initialize PROCOMM Plus program. After program initializes, press any key to enter terminal mode (blank) screen.
9	Using ALT-S command (setup facility), set up the following TERMINAL OPTIONS: a. Terminal emulation: VT220 b. Duplex: FULL c. Soft flow control (XON/XOFF): OFF d. Hard flow control (CTS/RTS): OFF e. Line wrap: OFF f. Screen scroll: OFF g. CR translation: CR/LF h. BS translation: NON-DESTRUCTIVE I. Break length (milliseconds): 350 j. Enquiry: OFF k. EGA/VGA true underline: OFF l. Terminal width: 80 m. ANSI 7 or 8 bit commands: 8 BIT
10	Press ESC key to exit to terminal mode (blank) screen.
11	Using ALT-P command (line/port option), set CURRENT SETTINGS as follows: a. Baud rate: 1200 b. Parity: NONE c. Data bits: 8 d. Stop bits: 1 e. Port: COM1
12	Press ESC key to return to terminal mode (blank) screen.
13	Using ALT-F1 (open log) command, open log file to record calibration data. In response to prompt for file name, use the following format: PWMMDD.CAL where MMDD is current month/date.

Table 7.5.2. Present Weather Sensor Calibration -CONT

Step	Procedure
14	On laptop computer, set CAPS LOCK to ON. **CAUTION** The installation of the TST-200 test modulator board causes the hood heaters to be turned on continuously. Temperature of the hood and lens area can exceed 200 degrees Fahrenheit. Do not touch the hood or lens. Serious burns may result. Use extreme caution while installing and removing the calibration tube.
15	Inside DCP equipment cabinet, set circuit breakers on present weather sensor circuit breaker module to on (left) position. Wait at least 2 minutes for sensor to warm up and stabilize before proceeding.
16	At laptop computer, type B. Computer displays the following report: WNPP1234S567890 Verify that report is correct. Wait 10 minutes before proceeding.
INITIAL CALIBRATION CHECK	
1	Ten minutes after above step is completed, type C. Verify that sensor reports: WS+PxxxxSxxxxxxXxxx000L---xxxK---xxxH---xxx Data denoted by xx indicates that those values are irrelevant to this procedure and should be ignored. Data denoted by --- are values that will be adjusted as necessary during this procedure.
2	Subtract displayed value of high channel (H---) from value of low channel (L---). Record difference (L-H).
3	Compare displayed values of low channel, high channel, particle channel, and low/high difference with the following tolerances: Low Channel (L-) 240 +/- 4 Particle Channel (K-) 400 +/-10 High Channel (H-) 174 +/- 4 Difference Channel (L-H) 66 +/- 8 IMPORTANT !!! If all values are within tolerance and the difference between the L (low channel) and the H (high channel) is 66 ±8, proceed to transmit modulator calibration procedure. If not, continue with signal processing calibration procedure below.

Table 7.5.2. Present Weather Sensor Calibration -CONT

Step	Procedure
SIGNAL PROCESSING CALIBRATION PROCEDURE	
	NOTE When making the following adjustments, turn potentiometers no more than 1/4 turn, wait 3 minutes for sensor data averaging, and issue C command again. Repeat as necessary to bring value into specified tolerance. Electronics enclosure door should be closed as much as possible between potentiometer adjustments. Do not adjust carrier frequency. This will adversely affect sensor operation; also, adjusting carrier value could mask other malfunctions such as lens fogging, optical misalignment, or degradation of the signal processing cards 1 and 2, the transmitter, and the AGC card. If L value, H value, or L-H value was out of tolerance in previous check, both L and H values should be adjusted in the following steps. This is to keep L-H value within 66 ±8 tolerance. If K value was out of tolerance but other values were in tolerance, only K value need be adjusted below.
1	Low channel (L---) adjustment. Adjust LO potentiometer on signal processor No. 1 (SP1) printed circuit board for L indication of 240 ±4. Adjust LO potentiometer clockwise (cw) to decrease reading or counterclockwise (ccw) to increase reading. The second three digits in L field are not used in calibration.
2	Particle channel (K---) adjustment. Adjust PAR potentiometer on signal processor No. 2 (SP2) printed circuit board for K indication of 400 ±10. Adjust PAR potentiometer cw to decrease reading or ccw to increase reading. The second three digits in K field are not used in calibration.
3	High channel (H---) adjustment. Adjust HI potentiometer on signal processor No. 2 (SP2) printed circuit board for H indication of 174 ±4. Adjust HI potentiometer cw to decrease reading or ccw to increase reading. The second three digits in H field are not used in calibration. **NOTE** If L and H values were adjusted to proper tolerances, L-H value will automatically be within tolerance.
4	If adjustments were made to L and/or H value, recalculate L-H value and ensure that L-H value is within 66 ±8 tolerance. Repeat L and H adjustments as necessary to bring L-H value within tolerance.
TRANSMIT MODULATOR CALIBRATION CHECK PROCEDURE	
1	Inside DCP equipment cabinet, set circuit breakers on present weather sensor circuit breaker module to off (right) position.
2	Inside present weather sensor main electrical enclosure, remove TST-200 test modulator board and install transmitter board.
3	Inside DCP equipment cabinet, set circuit breakers on present weather sensor circuit breaker module to on (left) position. Wait at least 5 minutes for sensor to warm up and stabilize before proceeding.
4	Five minutes after above step is completed, type C. Verify that sensor reports: W+P0000SxxxxxxX---000LxxxxxxKxxxxxxHxxxxxx Data denoted by xx indicates that those values are irrelevant to this procedure and should be ignored. Data denoted by --- is the carrier channel value.

Table 7.5.2. Present Weather Sensor Calibration -CONT

Step	Procedure
5	Verify that first three digits after X (carrier value) is above 350, then proceed to teardown procedure. If value is below 350, remove and replace the following FRU's, in order, and retest carrier channel for value above 350. a. Receiver/AGC Board - AlAlA8 b. Transmitter Board - AlAlA1 c. Signal Processor 1 - AlAlA7 d. Microprocessor Board - AlAlA3 e. Frame Assembly A2 (This check can be completed with new frame assemblies resting on the ground. The cables must be connected to the electrical enclosure and the calibration tube installed.)
TEARDOWN PROCEDURE	
1	At laptop computer, use ALT-F1 command to close log.
2	At laptop computer, use ALT-X (exit) command to exit PROCOMM Plus.
3	Turn off laptop computer.
4	Inside DCP equipment cabinet, set circuit breaker on present weather sensor circuit breaker module to off (right) position.
5	Disconnect cables between laptop computer and present weather sensor.
6	Using small flat-tipped screwdriver, install present weather sensor DB-9 connector on fiberoptic module.
7	Using large flat-tipped screwdriver, close and secure present weather sensor main electrical enclosure access door. **CAUTION** The installation of the TST-200 test modulator board causes the hood heaters to be turned on continuously. Temperature of the hood and lens area can exceed 200 degrees Fahrenheit. Do not touch the hood or lens. Serious burns may result. Use extreme caution while installing and removing the calibration tube. The tube that is removed in the next step may be hot.
8	Remove adjustable tube from sensor heads.
9	Inside DCP equipment cabinet, set circuit breakers on present weather sensor circuit breaker module to on (left) position.

Table 7.5.3. Present Weather Sensor Spider Paint Application Procedure

Step	Procedure
	Tools and materials required: Water Clean cloths Eye protection Plastic gloves INSECTA liquid Hand soap **WARNING** Follow the recommended directions in this procedure and on the bottle of INSECTA regarding the handling and disposal of INSECTA. **NOTE** INSECTA should be applied after replacing present weather sensor head or installing new sensor if ambient temperature is above 55 degrees Fahrenheit (°F). If temperature is below 55°F, it is necessary to remove present weather sensor head and mounting pole and treat indoors at room temperature. Ensure that there is adequate ventilation before painting indoors. The procedure is the same whether present weather sensor is painted indoors or outdoors.
1	Inside DCP equipment cabinet, set circuit breakers on present weather sensor circuit breaker module to off (right) position. **WARNING** Death or severe injury may result if personnel are not kept out of travel path of sensor. With locking pin removed from hinge plate, sensor is not firmly locked in upright position.
2	Lower present weather sensor on hinge plate as follows: a. Remove locking pin from front part of hinge plate. b. From rear of sensor, firmly grasp support pole with both hands and carefully lower sensor on hinge until lanyard catches and supports weight of sensor. **CAUTION** When washing sensor head and pole, take care not to wash or otherwise contact sensor lenses. Failure to comply may result in damage to lenses.
3	Thoroughly wash present weather sensor head and pole with water to remove surface dirt and dry using clean cloth. **WARNING** Eye protection and plastic gloves must be worn when performing the following steps and any exposed skin must be covered.
4	Remove cap from INSECTA bottle and screw on applicator brush with black seal installed in applicator.

Table 7.5.3 Present Weather Sensor Spider Paint Application Procedure -CONT

Step	Procedure
5	Squeeze bottle until milky white liquid saturates brush. **NOTE** When painting surfaces, do not paint the inside or outside of the black hoods on the present weather sensor head. Apply an even, thick coat of INSECTA but avoid applying so much that it runs.
6	Using Section 7.5.1 as a guide, brush INSECTA on all white surfaces of present weather sensor head, both mounting plates (upper surface of top plate and lower surface of bottom plate), and pole. Also paint the 18-inch high galvanized mounting pedestal and hinge plate. It is not necessary to paint the main electrical enclosure box.
7	Allow treated surfaces to dry 2 to 3 hours before touching.
8	Using clean water and rags, clean up any spills and applicator brush. **WARNING** With locking pin removed from hinge plate, sensor is not firmly locked in upright position. Death or severe injury may result if personnel are not kept out of travel path of sensor.
9	Raise present weather sensor on hinge plate as follows: a. From rear of sensor, firmly grasp support pole with both hands and carefully raise sensor on hinge into upright position. b. Install locking pin into front of hinge plate.
10	Dispose of dirty rags, plastic gloves, and INSECTA bottle, when it is empty, by sealing in plastic bag and placing bag in trash can.
11	Use soap and water to thoroughly wash hands to remove any traces of INSECTA.
12	Inside DCP equipment cabinet, set circuit breakers on present weather sensor circuit breaker module to on (right) position.

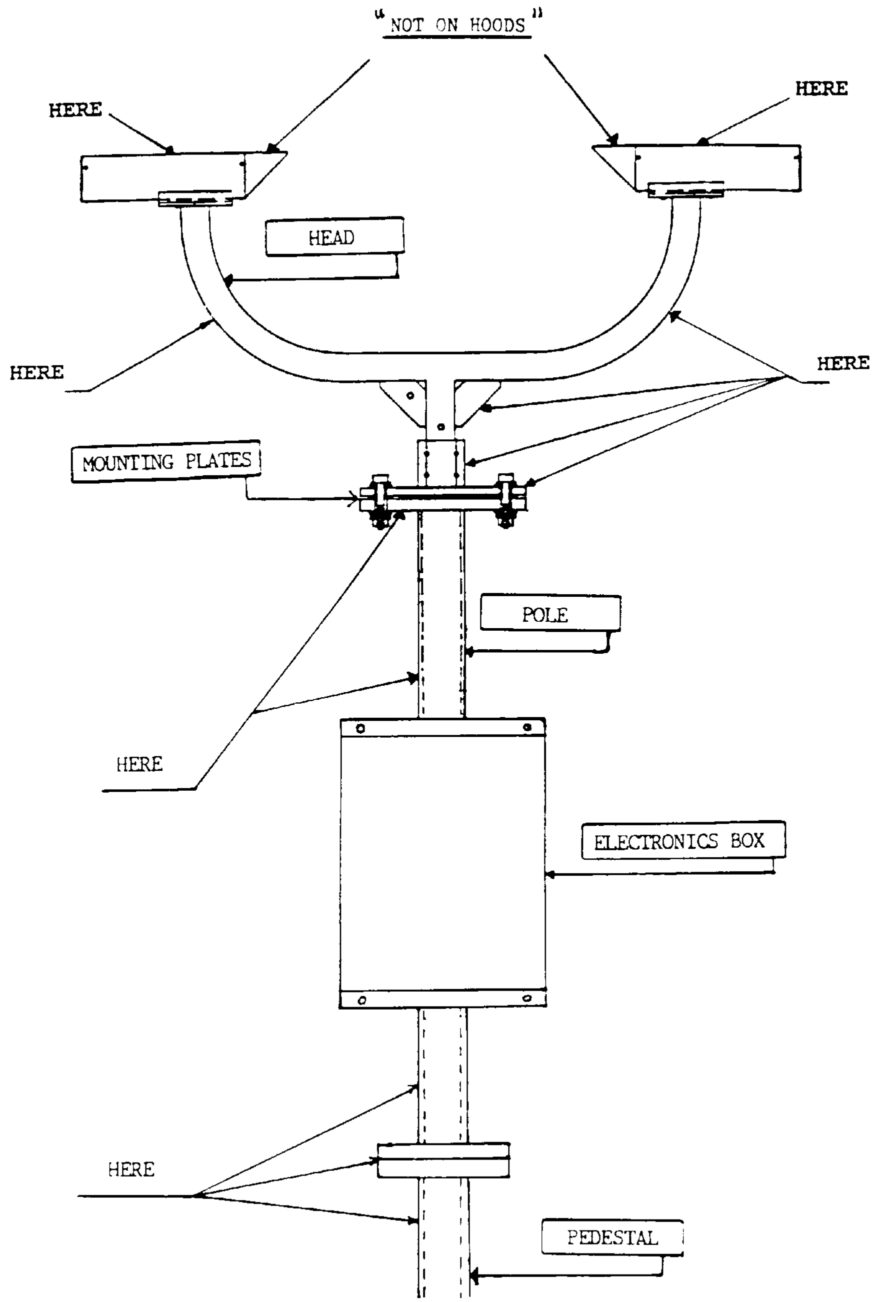


Figure 7.5.1. Present Weather Sensor Insect Treatment Areas

Table 7.5.4. Present Weather Sensor Troubleshooting

What to Do	How To Do It
Check system maintenance log and replace indicated FRU.	Tables 7.5.6 - 7.5.9
Perform fiberoptic module test.	Chapter 1, Section V
Perform present weather sensor power supply test	Table 7.5.5
Replace Microprocessor Board A1A3.	Table 7.5.10

Table 7.5.5. Present Weather Power Supply Test

Step	Procedure
	Tools required: Large flat-tipped screwdriver No. 1 Phillips screwdriver Digital multimeter (DMM) **WARNING** Hazardous voltages are present in present weather sensor. Exercise proper safety procedures to avoid possible injury or death. **NOTE** Because the microprocessor board is powered by digital power supply PS3, this power supply is tested first. If microprocessor is operating, it will report most failures of heater power supply PS1 and analog power supply PS2 during system continuous self-test (CST).
1	Using large flat-tipped screwdriver, open present weather sensor main electrical enclosure access door.
2	Using No. 1 Phillips screwdriver, remove four screws and lockwashers securing access cover to ac junction box.
3	Remove access cover from ac junction box.
4	With power applied to present weather sensor, use DMM to check for 115 vac power between terminals 1 and 2 and between terminals 4 and 5 of terminal board TB1 inside ac junction box. If power is present, proceed to step 5. If not, ensure that all cables are connected properly and then troubleshoot ac power cables between DCP and present weather sensor.
5	Using DMM, verify 115 vac between terminals 1 and 2 of filter block TB2 on top of ac junction box. If power is present, proceed to step 6. If not, replace ac junction box.
6	At card rack assembly, disconnect digital power supply connector P15 from connector J15.
7	Using DMM, check the following pins for indicated voltages: Negative lead / Positive lead / Reading P15-1 / P15-4 / +5.0 vdc ±0.2 vdc P15-2 / P15-9 / +12.0 vdc ±0.2 vdc P15-2 / P15-7 / -12.0 vdc ±0.2 vdc If any reading is incorrect, replace digital power supply PS3. If all readings are correct, reconnect P15 to J15 and proceed to step 8.
8	At card rack assembly, disconnect analog power supply connector P19 from connector J19.
9	Using DMM, check the following pins for indicated voltages: Negative lead / Positive lead / Reading P19-4 / P19-1 / -12.0 vdc ±0.2 vdc P19-4 / P19-7 / +12.0 vdc ±0.2 vdc If either reading is incorrect, replace analog power supply PS2. If both readings are correct, reconnect P19 to J19 and proceed to step 10.
10	At card rack assembly, disconnect heater power supply connector P17 from connector J17.

Table 7.5.5. Present Weather Power Supply Test -CONT

Step	Procedure
11	Using DMM, check the following pins for indicated voltages: Negative lead / Positive lead / Reading P17-1 / P17-5 / +24.0 vdc ±0.2 vdc If reading is incorrect, replace heater power supply PS1. If reading is correct, connect P17 to J17.
12	Using No. 1 Phillips screwdriver, install four screws and lockwashers securing access cover to ac junction box.
13	Using large flat-tipped screwdriver, close and secure present weather sensor main electrical enclosure access door.

Table 7.5.6. Frame Head Assembly Removal and Installation

Step	Procedure
REMOVAL	
	Tools required: 3/16-inch hex key wrench 15 feet of rope 5/8-inch wrench Sensor support device **WARNING** Death or severe injury may result if power is not removed from sensor prior to maintenance activities. Ensure that circuit breakers (located in DCP) supplying heater and primary power to sensor are set to off (right) position.
1	Inside DCP equipment cabinet, set circuit breakers on present weather sensor circuit breaker module to off (right) position.
2	Remove frame assembly (long white) ground wire from ground wire stud located on bottom of main electrical enclosure.
3	Disconnect frame cable connectors P4 and P5 from connectors J4 and J5 on main electrical enclosure. Feed all exposed cabling into access opening in sensor mounting column. **WARNING** Death or severe injury may result if personnel are not kept out of travel path of sensor. With locking pin removed from hinge plate, sensor is not firmly locked in upright position.
4	Lower present weather sensor on hinge plate as follows: a. Remove locking pin from front part of hinge plate. b. From rear of sensor, firmly grasp support pole with both hands and carefully lower sensor on hinge until lanyard catches and supports weight of sensor.
5	Using 3/16-inch hex key wrench at collar of frame mounting base plate, loosen four hex capscrews securing frame stem to mounting plate.

Table 7.5.6. Frame Head Assembly Removal and Installation -CONT

Step	Procedure
6	Gently raise frame assembly out of collar of mounting base plate, carefully pulling frame assembly cabling out behind it.
INSTALLATION	
	Tools required: 3/16-inch hex key wrench 15 feet of rope 5/8-inch wrench Sensor support device **WARNING** Death or severe injury may result if power is not removed from sensor prior to maintenance activities. Ensure that heater and primary power circuit breakers (located in DCP) supplying power to sensor are set to off (right) position.
1	Inside DCP equipment cabinet, ensure that circuit breakers on present weather sensor circuit breaker module are set to off (right) position.
2	Feed cables from sensor frame down through collar of frame assembly mounting base plate (down into mounting column) and gently lower stem of frame into collar of base plate.
3	At mounting column access hole (below main electrical enclosure), pull free ends of two frame assembly cables and frame assembly ground wire out of mounting column.
4	Position frame assembly so that sensor headpiece with horizontal slotted mask is facing north (±10 degrees). Raise frame assembly so that stem of frame is approximately 1/4 inch above bottom of mounting plate (not protruding out of mounting base).
5	Using 3/16-inch hex key wrench, tighten four hex capscrews in collar of mounting base to secure frame assembly. Do not overtighten screws; otherwise, lower end of mounting plate will become distorted and difficult to remove from mounting base.
6	Raise present weather sensor on hinge plate as follows: a. From rear of sensor, firmly grasp support pole with both hands and carefully raise sensor on hinge into upright position. b. Install locking pin into front of hinge plate.
7	Connect frame cable connectors P4 and P5 to connectors J4 and J5 on main electrical enclosure.
8	Connect frame assembly (long white) ground wire to ground wire stud located on bottom of main electrical enclosure.
9	Check operation of window heaters and hood heaters in accordance with paragraph 7.5.2.1.
10	Clean transmitter and receiver lenses in accordance with paragraph 7.5.2.2.
11	Calibrate present weather sensor in accordance with table 7.5.2.

Table 7.5.7. Heater Power Supply Removal and Installation

Step	Procedure
REMOVAL	
	Tools required: Large flat-tipped screwdriver No. 1 Phillips screwdriver Long-nosed pliers Long flat-tipped screwdriver **WARNING** Death or severe injury may result if power is not removed from sensor prior to maintenance activities. Ensure that circuit breakers (located in DCP) supplying heater and primary power to sensor are set to off (right) position.
1	Inside DCP equipment cabinet, set circuit breakers on present weather sensor circuit breaker module to off (right) position.
2	Using large flat-tipped screwdriver, open present weather sensor main electrical enclosure access door. **NOTE** Heater power supply A1PS1 is located on left side of main electrical enclosure.
3	Locate twisted pair of wires connecting heater power supply to terminals 1 and 2 of terminal board on top of ac junction box. Using No. 1 Phillips screwdriver, disconnect heater power supply wires from terminal board, but leave other wires connected to terminal board.
4	Using long-nosed pliers to grasp connector, on left side of card rack assembly, disconnect heater power supply cable from connector J17.
5	While supporting heater power supply, use long flat-tipped screwdriver to loosen four captive screws securing power supply to main electrical enclosure. **NOTE** Do not detach heater power supply from its own mounting plate.
6	Remove heater power supply from main electrical enclosure.
INSTALLATION	
	Tools required: Long flat-tipped screwdriver Long-nosed pliers No. 1 Phillips screwdriver Large flat-tipped screwdriver **WARNING** Death or severe injury may result if power is not removed from sensor prior to maintenance activities. Ensure that circuit breakers (located in DCP) supplying heater and primary power to sensor are set to off (right) position.
1	Inside DCP equipment cabinet, ensure that circuit breakers on present weather circuit breaker module are set to off (right) position.
2	Using long flat-tipped screwdriver, install new heater power supply and tighten four captive screws securing power supply to main electrical enclosure.
3	Using long-nosed pliers to grasp connector, on left side of card rack assembly, connect heater power supply cable to connector J17.

Table 7.5.7. Heater Power Supply Removal and Installation -CONT

Step	Procedure
4	Using No. 1 Phillips screwdriver, connect two twisted pair wires from heater power supply to terminals 1 and 2 of terminal board on top of ac junction box. Leave other wires connected to terminals.
5	Check heater power supply in accordance with table 7.5.5, step 11. If power supply does not read 24vdc, adjust R11 for 24vdc ±.2vdc.
6	Using large flat-tipped screwdriver, close and secure present weather sensor main electrical enclosure access door.

Table 7.5.8. Analog Power Supply Removal and Installation

Step	Procedure
	REMOVAL
	Tools required: Large flat-tipped screwdriver No. 1 Phillips screwdriver Long-nosed pliers Long flat-tipped screwdriver **WARNING** Death or severe injury may result if power is not removed from sensor prior to maintenance activities. Ensure that circuit breakers (located in DCP) supplying heater and primary power to sensor are set to off (right) position.
1	Inside DCP equipment cabinet, set circuit breakers on present weather sensor circuit breaker module to off (right) position.
2	Using large flat-tipped screwdriver, open present weather sensor main electrical enclosure access door. **NOTE** Analog power supply A1PS2 is located toward top of main electrical enclosure.
3	Locate twisted pair of wires connecting analog power supply to terminals 1 and 2 of terminal board on top of ac junction box. Using No. 1 Phillips screwdriver, disconnect analog power supply wires from terminal board, but leave other wires connected to terminal board.
4	Using long-nosed pliers to grasp connector, on left side of card rack assembly, disconnect analog power supply cable from connector J19.
5	While supporting analog power supply, use long flat-tipped screwdriver to loosen four captive screws securing power supply to main electrical enclosure. **NOTE** Do not detach analog power supply from its own mounting plate.
6	Remove analog power supply from main electrical enclosure.

Table 7.5.8. Analog Power Supply Removal and Installation -CONT

Step	Procedure
INSTALLATION	
	Tools required: Long flat-tipped screwdriver Long-nosed pliers No. 1 Phillips screwdriver Large flat-tipped screwdriver **WARNING** Death or severe injury may result if power is not removed from sensor prior to maintenance activities. Ensure that circuit breakers (located in DCP) supplying heater and primary power to sensor are set to off (right) position.
1	Inside DCP equipment cabinet, ensure that circuit breakers on present weather circuit breaker module are set to off (right) position.
2	Using long flat-tipped screwdriver, install new analog power supply and tighten four captive screws securing power supply to main electrical enclosure.
3	Using long-nosed pliers to grasp connector, on left side of card rack assembly, connect analog power supply cable to connector J19.
4	Using No. 1 Phillips screwdriver, connect two twisted pair wires from analog power supply to terminals 1 and 2 of terminal board on top of ac junction box. Leave other wires connected to terminals.
5	Check analog power supply in accordance with table 7.5.5, Step 9.
6	Calibrate present weather sensor in accordance with table 7.5.2.
7	Using large flat-tipped screwdriver, close and secure present weather sensor main electrical enclosure access door.

Table 7.5.9. Digital Power Supply Removal and Installation

Step	Procedure
REMOVAL	
	Tools required: Large flat-tipped screwdriver No. 1 Phillips screwdriver Long-nosed pliers Long flat-tipped screwdriver **WARNING** Death or severe injury may result if power is not removed from sensor prior to maintenance activities. Ensure that circuit breakers (located in DCP) supplying heater and primary power to sensor are set to off (right) position.
1	Inside DCP equipment cabinet, set circuit breakers on present weather sensor circuit breaker module to off (right) position.
2	Using large flat-tipped screwdriver, open present weather sensor main electrical enclosure access door. **NOTE** Digital power supply A1PS3 is located in middle of main electrical enclosure.

Table 7.5.9. Digital Power Supply Removal and Installation -CONT

Step	Procedure
3	Locate twisted pair of wires connecting digital power supply to terminals 1 and 2 of terminal board on top of ac junction box. Using No. 1 Phillips screwdriver, disconnect digital power supply wires from terminal board, but leave other wires connected to terminal board.
4	Using long-nosed pliers to grasp connector, on left side of card rack assembly, disconnect digital power supply cable from connector J15.
5	While supporting digital power supply, use long flat-tipped screwdriver to loosen four captive screws securing power supply to main electrical enclosure. **NOTE** Do not detach digital power supply from its own mounting plate.
6	Remove digital power supply from main electrical enclosure.
INSTALLATION	
	Tools required: Long flat-tipped screwdriver Long-nosed pliers No. 1 Phillips screwdriver Large flat-tipped screwdriver **WARNING** Death or severe injury may result if power is not removed from sensor prior to maintenance activities. Ensure that circuit breakers (located in DCP) supplying heater and primary power to sensor are set to off (right) position.
1	Inside DCP equipment cabinet, ensure that circuit breakers on present weather circuit breaker module are set to off (right) position.
2	Using long flat-tipped screwdriver, install new digital power supply and tighten four captive screws securing power supply to main electrical enclosure.
3	Using long-nosed pliers to grasp connector, on left side of card rack assembly, connect digital power supply cable to connector J15.
4	Using No. 1 Phillips screwdriver, connect two twisted pair wires from digital power supply to terminals 1 and 2 of terminal board on top of ac junction box. Leave other wires connected to terminals.
5	Check digital power supply in accordance with table 7.5.5, Step 7.
6	Calibrate present weather sensor in accordance with table 7.5.2.
7	Using large flat-tipped screwdriver, close and secure present weather sensor main electrical enclosure access door.

Table 7.5.10. Circuit Board Removal and Installation

Step	Procedure
REMOVAL	
	Tools required: Large flat-tipped screwdriver Small flat-tipped screwdriver **WARNING** Death or severe injury may result if power is not removed from sensor prior to maintenance activities. Ensure that circuit breakers (located in DCP) supplying heater and primary power to sensor are set to off (right) position.
1	Inside DCP equipment cabinet, set circuit breakers on present weather sensor circuit breaker module to off (right) position.
2	Using large flat-tipped screwdriver, open present weather sensor main electrical enclosure access door.
3	At card rack assembly, locate circuit board to be removed. Using small flat-tipped screwdriver, loosen captive screws and remove circuit card.
INSTALLATION	
	Tools required: Large flat-tipped screwdriver Small flat-tipped screwdriver **WARNING** Death or severe injury may result if power is not removed from sensor prior to maintenance activities. Ensure that circuit breakers (located in DCP) supplying heater and primary power to sensor are set to off (right) position.
1	Inside DCP equipment cabinet, ensure that circuit breakers on present weather circuit breaker module are set to off (right) position.
2	Position new circuit card in correct slot and using small flat-tipped screwdriver, tighten captive screws.
3	Calibrate present weather sensor in accordance with table 7.5.2.
4	Using large flat-tipped screwdriver, close and secure present weather sensor main electrical enclosure access door.

Table 7.5.11. Fiberoptic Module Removal and Installation

Step	Procedure
REMOVAL	
	Tools required: Large flat-tipped screwdriver Small flat-tipped screwdriver No. 1 Phillips screwdriver **WARNING** Death or severe injury may result if power is not removed from sensor prior to maintenance activities. Ensure that circuit breakers (located in DCP) supplying heater and primary power to sensor are set to off (right) position.

Table 7.5.11. Fiberoptic Module Removal and Installation -CONT

Step	Procedure
1	Inside DCP equipment cabinet, set circuit breakers on present weather sensor power control module to off (right) position.
2	Using large flat-tipped screwdriver, open present weather sensor main electrical enclosure access door.
3	Using small flat-tipped screwdriver, loosen two retaining screws on DB-9 connector located on top of fiberoptic module. Remove connector DB-9.
4	Using No. 1 Phillips screwdriver, remove four screws and lockwashers securing ac junction box access cover.
5	Remove access cover from ac junction box.
6	Disconnect two fiberoptic cables from underneath fiberoptic module. Install protective plastic covers over fiberoptic connectors. **NOTE** Screws referenced in next step are located inside ac junction box.
7	Using small flat-tipped screwdriver, remove four screws, four lockwashers, and two gaskets securing fiberoptic module to ac junction box.
INSTALLATION	
	Tools required: Small flat-tipped screwdriver No. 1 Phillips screwdriver Large flat-tipped screwdriver **WARNING** Death or severe injury may result if power is not removed from sensor prior to maintenance activities. Ensure that circuit breakers (located in DCP) supplying heater and primary power to sensor are set to off (right) position.
1	Inside DCP equipment cabinet, ensure that circuit breakers on present weather sensor circuit breaker module are set to off (right) position.
2	With DB-9 connector toward the front, position fiberoptic module mounting plate and gasket on ac junction box. Using small flat-tipped screwdriver, install four lockwashers, four screws, and two gaskets securing fiberoptic module to ac junction box. **NOTE** Screws referenced in next step are installed inside (beneath module) ac junction box.
3	Remove protective plastic covers from fiberoptic connectors and install receive (RX) cable to front connector and transmit (TX) cable to rear connector on fiberoptic module.
4	Install access cover on ac junction box and using No. 1 Phillips screwdriver, install four screws and lockwashers securing access cover.
5	Install signal cable on connector DB-9 on fiberoptic module and using small flat-tipped screwdriver, tighten two retaining screws.
6	Using large flat-tipped screwdriver, close and secure present weather sensor main electrical enclosure access door.
7	Inside DCP equipment cabinet, set circuit breakers on present weather sensor circuit breaker modules to on (left) position.

Table 7.5.12. Heater Bar Assembly Removal and Installation

Step	Procedure
REMOVAL	
	Tools required: Large flat-tipped screwdriver 7/16-inch socket with ratchet 10-inch extension bar **WARNING** Death or severe injury may result if power is not removed from sensor prior to maintenance activities. Ensure that circuit breakers (located in DCP) supplying electronics and heater power to sensor are set to the off (right) position.
1	Inside DCP equipment cabinet, ensure that electronics and heater circuit breakers on present weather sensor circuit breaker module are set to off (right) position.
2	Using large flat-tipped screwdriver, open present weather sensor main electrical enclosure access door. **NOTE** Heater bar is located on left side of main electrical enclosure.
3	Disconnect heater bar from main cable. **CAUTION** When removing nut from rear of heater bar, exercise care not to damage thermal switches or wires located on rear of ac junction box.
4	At heater bar, using 7/16-inch socket with ratchet and 10-inch extension bar, remove two nuts, lockwashers, and flat washers and remove heater bar.
INSTALLATION	
	Tools required: 7/16-inch socket with ratchet 10-inch extension bar Large flat-tipped screwdriver **WARNING** Death or severe injury may result if power is not removed from sensor prior to maintenance activities. Ensure that circuit breakers (located in DCP) supplying electronics and heater power to sensor are set to the off (right) position.
1	Inside DCP equipment cabinet, ensure that electronics and heater circuit breakers on present weather sensor circuit breaker module are set to off (right) position. **CAUTION** When installing nut from rear of heater bar, exercise care not to damage thermal switches or wires located on rear of ac junction box.
2	Using 7/16-inch socket with ratchet and 10-inch extension bar, install two nuts, flat washers, and lockwashers securing heater bar to main electrical enclosure supports.
3	Connect cable from heater bar to the associated main harness connector.
4	Using large flat-tipped screwdriver, close and secure present weather sensor main electrical enclosure access door.
5	Inside DCP equipment cabinet, set circuit breakers on present weather sensor circuit breaker module to on (left) position.

Table 7.5.13. Card Rack Assembly Removal and Installation

Step	Procedure
	REMOVAL
	Tools required: Large flat-tipped screwdriver Small flat-tipped screwdriver Long-nosed pliers No. 2 Phillips screwdriver **WARNING** Death or severe injury may result if power is not removed from sensor prior to maintenance activities. Ensure that circuit breakers (located in DCP) supplying electronics and heater power to sensor are set to the off (right) position.
1	Inside DCP equipment cabinet, ensure that electronics and heater circuit breakers on present weather sensor circuit breaker module are set to off (right) position.
2	Using large flat-tipped screwdriver, open present weather sensor main electrical enclosure access door.
3	At card rack assembly, using small flat-tipped screwdriver, loosen captive screws on each circuit board and remove circuit board.
4	Using long-nosed pliers to grasp connectors, tag and disconnect cables located on left side of card rack.
5	Using small flat-tipped screwdriver, loosen two retaining screws on DB-9 connector located on top of fiberoptic module. Remove cable.
6	While supporting card rack and using No. 2 Phillips screwdriver, remove four screws, flat washers, and lockwashers and remove card rack.
	INSTALLATION
	Tools required: Small flat-tipped screwdriver Large flat-tipped screwdriver Long-nosed pliers No. 2 Phillips screwdriver **WARNING** Death or severe injury may result if power is not removed from sensor prior to maintenance activities. Ensure that circuit breakers (located in DCP) supplying electronics and heater power to sensor are set to the off (right) position.
1	Inside DCP equipment cabinet, ensure that electronics and heater circuit breakers on present weather sensor circuit breaker module are set to off (right) position.
2	Using No. 2 Phillips screwdriver, install four screws, lockwashers, and flat washers securing card rack to main electrical enclosure.
3	Using long-nosed pliers and tags as a guide, connect main harness cables to connectors on left side of card rack. These connectors are keyed and can only be installed one way.
4	Using Section 7.1.2 as a guide, install circuit boards in card rack. Tighten captive screw securing each board to card rack.
5	Calibrate present weather sensor in accordance with table 7.5.2.

Table 7.5.14. Main Electrical Enclosure Removal and Installation

Step	Procedure
REMOVAL	
	Tools required: No. 1 Phillips screwdriver Large adjustable wrench Large flat-tipped screwdriver Small flat-tipped screwdriver 7/16-inch wrench 9/16-inch wrench **WARNING** Death or severe injury may result if power is not removed from sensor prior to maintenance activities. Ensure that circuit breakers (located in DCP) supplying electronics and heater power to sensor are set to the off (right) position.
1	Inside DCP equipment cabinet, ensure that electronics and heater circuit breakers on present weather sensor circuit breaker module are set to off (right) position.
2	Using No. 1 Phillips screwdriver, remove four screws and lockwashers securing cover to ac junction box. Remove cover.
3	Using large adjustable wrench, disconnect flexible conduit from main electrical enclosure.
4	Using large flat-tipped screwdriver, open present weather sensor main electrical enclosure access door.
5	Using small flat-tipped screwdriver, tag and disconnect power input wires from terminal strip located inside ac junction box.
6	Disconnect two fiberoptic cables from underneath fiberoptic module. Install protective plastic covers over fiberoptic cable connectors. Pull fiberoptic and power cables out of enclosure.
7	Disconnect frame cable connectors P4 and P5 from connectors J4 and J5 on main electrical enclosure.
8	Using 7/16-inch wrench, disconnect frame assembly (long white) ground wire and site ground wire from ground stud located on bottom of main electrical enclosure.
9	Using 9/16-inch wrench, loosen but do not remove two bottom bolts securing main electrical enclosure to mounting column.
10	While supporting main electrical enclosure and using 9/16-inch wrench, remove two bolts, four flat washers, two lockwashers, and two nuts securing top of main electrical enclosure to mounting column and remove main electrical enclosure.
INSTALLATION	
	Tools required: 9/16-inch wrench 7/16-inch wrench Large flat-tipped screwdriver No. 1 Phillips screwdriver Large adjustable wrench Small flat-tipped screwdriver **WARNING** Death or severe injury may result if power is not removed from sensor prior to maintenance activities. Ensure that circuit breakers (located in DCP) supplying electronics and heater power to sensor are set to the off (right)position
1	Inside DCP equipment cabinet, ensure that electronics and heater circuit breakers on present weather sensor circuit breaker module are set to off (right) position

Table 7.5.14. Main Electrical Enclosure Removal and Installation - CONT

Step	Procedure
2	Position main electrical enclosure on two mounting bolts located in channel of mounting column.
3	Using 9/16-inch wrench, install two bolts, four flat washers, two lockwashers, and two nuts securing main electrical enclosure to mounting column. Tighten two mounting bolts located on bottom of main electrical enclosure.
4	Connect frame cable connectors P4 and P5 to connectors J4 and J5 on main electrical enclosure.
5	Using 7/16-inch wrench, connect frame assembly (long white) ground wire and site ground wire to ground stud located on bottom of main electrical enclosure.
6	Using large flat-tipped screwdriver, open main electrical enclosure access door.
7	Using No. 1 Phillips screwdriver, remove four screws and lockwashers securing access cover to ac junction box. Remove cover.
8	Route ac power wiring and fiberoptic cables through access hole in bottom of main electrical enclosure into ac junction box.
9	Using large adjustable wrench and hardware supplied, connect flexible conduit to main electrical enclosure.
10	Using small flat-tipped screwdriver, connect ac power wiring to terminal board in ac junction box according to the following connection chart: Wire color / Terminal / Function Black / TB1-1 / 120 vac (electronics) White / TB1-2 / Neutral (electronics) Green / TB1-3 / Chassis ground Red / TB1-4 / 120 vac (heater) Yellow / TB1-5 / Neutral (heaters)
11	Remove protective plastic covers from fiberoptic cable connectors underneath fiberoptic module and from fiberoptic cables.
12	Connect RX connector on fiberoptic cable to RX connector on fiberoptic module. Connect TX connector on fiberoptic cable to remaining connector on fiberoptic module.
13	Using No. 1 Phillips screwdriver, install four screws and lockwashers securing access cover to ac junction box.
14	Calibrate present weather sensor in accordance with table 7.5.2.

CHAPTER 8

PRESSURE SENSOR

SECTION I. DESCRIPTION AND LEADING PARTICULARS

8.1.1 INTRODUCTION

This chapter describes the operation and maintenance of the ASOS pressure sensor. The ASOS pressure sensor configuration consists of two or three model 470 digital pressure transducers, manufactured by Setra Corporation. Each pressure transducer is a highly accurate pressure measurement instrument that uses advanced microcomputer-based electronics and firmware, resulting in a 0.02% full scale accuracy.

8.1.2 PHYSICAL DESCRIPTION

Two or three pressure sensors are mounted on the rf/pressure mounting shelf inside the acquisition control unit (ACU) or data collection package (DCP) as shown in figures 8.1.1 and 8.1.2. Refer to Chapter 14 for the position of pressure sensors in the Single Cabinet ASOS (SCA). The Class II ASOS system contains three pressure sensors. The Class I system typically contains two pressure sensors, but a third pressure sensor is available as an option. The pressure sensors share a common 3/8-inch tygon sensor tube for sensing barometric pressure. This configuration ensures reliable reporting of barometric pressure information. The tygon air tube is routed to the pressure drawer from a pressure port located on the connector panel. At some sites, the pressure port on the connector panel may be connected to an outside pressure vent via additional tubing. This outside vent eliminates the barometric pressure effects of inside environmental factors (such as heating and air-conditioning systems) on the pressure readings. During normal operation, the ASOS reads the pressure value from each of the sensors and compares the values to verify the accuracy of the measured data.

Pressure sensors that are installed in Class I ACU cabinets must be equipped with threshold detectors, which may be either internal (built into the sensor) or external. A threshold detector ensures that the pressure sensor resets completely in the event of a dc undervoltage fluctuation (when its power drops below 4.55 vdc). Threshold detectors are not required on Class II systems because the ACU's uninterruptible power supply prevents such fluctuations. Internal threshold detectors were built into pressure sensors with serial numbers 358495, 358509, and 363914 and above. Internal detectors are added to all sensors when (and if) the internal circuit boards are replaced during depot repair. In these cases, a label is applied to the repaired sensor, indicating that an internal detector has been added. External threshold detectors are installed in Class I systems via FMK #027. The external detector is a small module that is mounted to the sensor's DB-9 power connector (J2). The external detector then becomes part of the pressure sensor and should not be removed (it is not an FRU). As part of the FMK, a label is placed on the pressure sensor stating: "EXTERNAL THRESHOLD DETECTOR REQUIRED".

8.1.3 PRESSURE SENSOR CONFIGURATIONS

There are two possible configurations of the pressure sensor: the model 470 (part number 90110-10), which has an operating temperature range of 55°F to 100°F and the model 470T (part number 90110-20) which has an extended operating temperature range of 35°F to 150°F. Each sensor configuration has three possible variations: the sensor with no threshold detector, the sensor with an internal threshold detector, and the sensor with an external threshold detector.

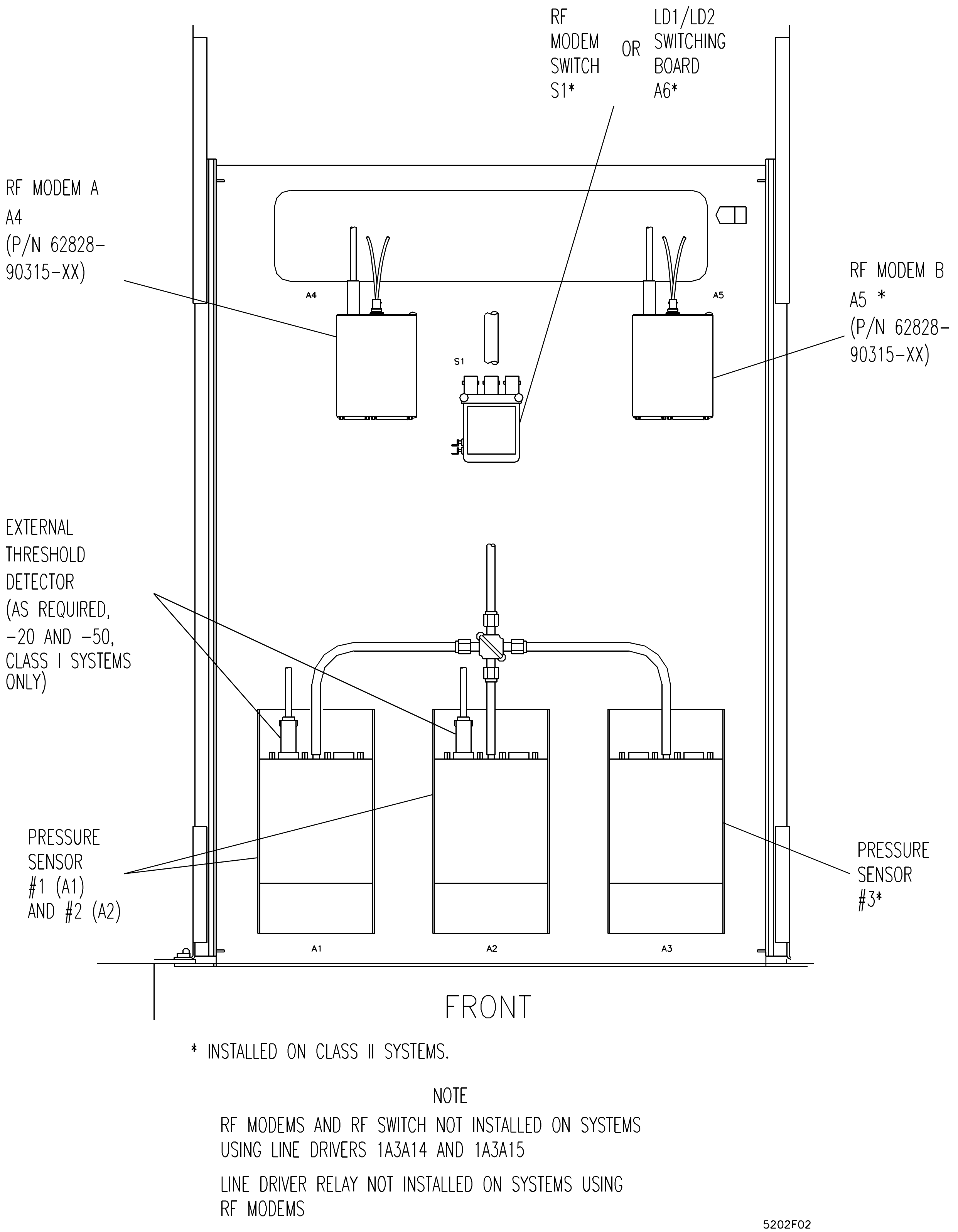


Figure 8.1.1. ASOS ACU RF/Pressure Sensor Mounting Shelf

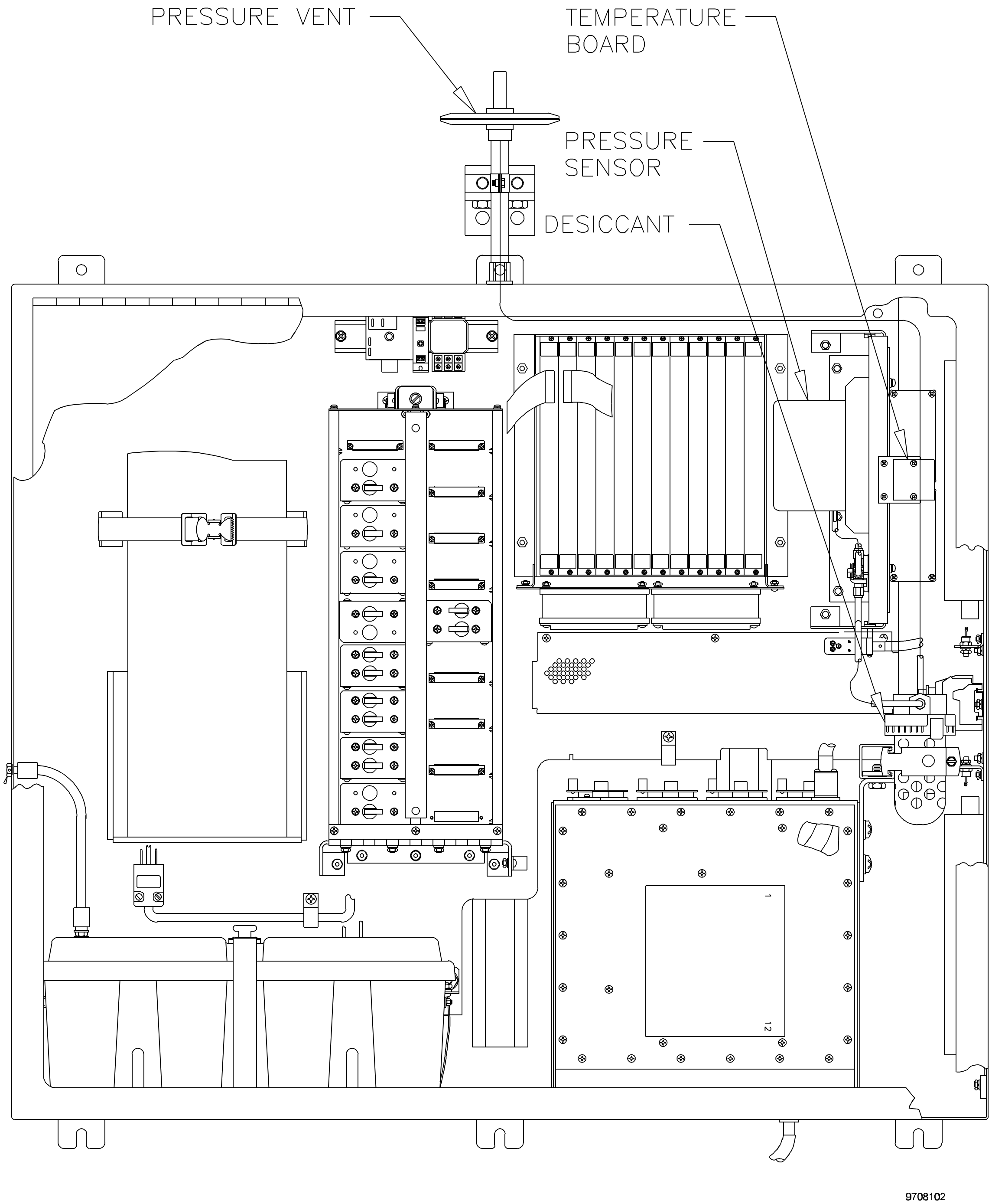


Figure 8.1.2. ASOS DCP RF/Pressure Sensor Mounting Shelf $

8.1.3.1 **Class I System Pressure Sensors**. Model 470 pressure sensors that are installed in Class I ACU cabinets must be equipped with threshold detectors, which may be either internal (built into the sensor) or external. A threshold detector ensures that the pressure sensor resets completely in the event of a dc power undervoltage condition. Internal threshold detectors were built into pressure sensors with serial numbers 358495, 358509, and 363914 and above. Internal threshold detectors are being added to sensors when they are returned to the depot for repair. External threshold detectors were installed on Class I systems via FMK #027. The external detector is a small module that is mounted to the sensor's DB-9 power connector (J2). The external threshold detector then becomes part of the pressure sensor and should not be removed (it is not an FRU). As part of the FMK, a label is placed on the pressure sensor stating "EXTERNAL THRESHOLD DETECTOR REQUIRED".

8.1.3.2 **Class II System Pressure Sensors**. Model 470 pressure sensors that are installed in Class II systems do not require threshold detectors because the uninterruptible power supply in the ACU prevents dc power undervoltage fluctuations. Model 470 pressure sensors with threshold detectors can be installed in Class II systems.

8.1.3.3 **Model 470T Extended Range Pressure Sensor**. The extended range of the model 470T allows it to be installed in the data collection package (DCP), SCA, or in other locations exposed to temperature extremes. The Model 470T has three possible variations as well (no threshold detector, internal threshold detector, and external threshold detector). If an external threshold detector is required in a particular application, the pressure sensor must be labeled "EXTERNAL THRESHOLD DETECTOR REQUIRED". Once an external threshold detector is installed, it becomes a permanent part of the 470T pressure sensor (it is not an FRU). The 470T can be installed in Class I and Class II systems. The 470T is the replacement unit of choice if a pressure sensor should fail. There are special applications that require the pressure sensors be installed in the DCP; the 470T pressure sensor must be used in these cases.

8.1.3.4 **Single Cabinet ASOS Pressure Sensor**. Refer to Chapter 14 for a description of pressure sensors installed in the SCA.

8.1.3.5 **Data Collection Package Pressure Sensor**. Refer to Chapter 3 for a description of pressure sensors installed at special application DCP sites.

SECTION II. INSTALLATION

8.2.1 **INTRODUCTION**

The ASOS pressure sensor is installed in the acquisition control unit (ACU), data collection package (DCP), or in the Single Cabinet ASOS (SCA) at the factory. Thus, there are no user installation procedures required. The procedures for removal and installation of an individual pressure transducer are provided as part of the maintenance procedures contained in Section V.

SECTION III. OPERATION

8.3.1 **INTRODUCTION**

The ASOS pressure sensor is an automatic sensor without controls or indicators. The ASOS acquisition control unit (ACU), data collection package (at special application sites), or Single Cabinet ASOS (at single cabinet sites) processor reads each of the pressure transducers to obtain barometric pressure data. This function is performed automatically by the ASOS software and requires no operator intervention. The barometric pressure data displayed and reported by the ASOS are described in the ASOS Ready Reference Guide.

8.3.2 **TURN-ON PROCEDURES**

The ASOS pressure sensor is designed for continuous operation and normally remains powered on at all times. There are no power control switches on the pressure transducers. All power is provided by the ACU's dc power supplies (or Single Cabinet ASOS dc power supplies at single cabinet sites).

8.3.3 **TURNOFF PROCEDURES**

The ASOS pressure sensor is normally turned off only for maintenance purposes. Power is removed from the pressure transducers either by turning off cabinet power or by unplugging the pressure sensor power connector (J2). The pressure sensor should only be turned off for removal and installation of a faulty pressure sensor. These procedures are included in the maintenance procedures provided in Section V.

8.3.4 **NORMAL OPERATION**

During normal operation, each of the pressure transducers is polled every 10 seconds by ASOS for barometric pressure data. The ASOS software checks each of the barometric pressure data reports to determine accurate barometric pressure data as well as to detect the failure of any one of the pressure transducers. This processing is automatically performed by the ASOS such that no user actions are required. The reported barometric pressure data become part of the ASOS weather database that is reported to the weather observer.

SECTION IV. THEORY OF OPERATION

8.4.1 **INTRODUCTION**

This section provides a brief description of how the ASOS pressure sensor functions to sense the ambient barometric pressure. Each ASOS barometric pressure transducer is considered a field replaceable unit (FRU); therefore, only a simplified block diagram description is provided in this chapter. This description is intended to provide basic familiarity with the operation of a pressure transducer and does not describe the detailed operation of the internal electronics of the pressure sensor. Additional information on the operation of the pressure sensor within the ACU is provided in Chapter 2, within the DCP is provided in Chapter 3, and within the Single Cabinet ASOS (SCA) in Chapter 14.

8.4.2 **SIMPLIFIED BLOCK DIAGRAM DESCRIPTION**

The ASOS pressure sensor is actually a configuration of separate barometric pressure sensing devices. A simplified block diagram of the ASOS pressure sensor configuration is provided on figure 8.4.1. The ambient barometric pressure is input to each pressure transducer through a shared tygon sensor tube. This ensures that each pressure transducer receives the same barometric pressure input level. A transducer assembly internal to each unit converts the pressure level into an electrical signal level. This level is then monitored and translated by a microprocessor-based circuit within the pressure sensor to produce a barometric pressure value. Each pressure transducer is polled individually by the central processing unit (CPU) and sends its calculated barometric pressure value in a data transfer over an RS-232 interface. This same RS-232 interface provides the means for the CPU to send and receive other commands and data to/from the pressure sensor. Each of the pressure transducers receives its electrical power supply from the power distribution circuit.

As previously described, pressure sensors installed on Class I systems must be equipped with undervoltage threshold detectors. Where internal detectors are not built into the sensor, an external detector is mounted to the power connector (J2) of the sensor. The external detector is then considered part of the sensor itself and should not be removed by the technician.

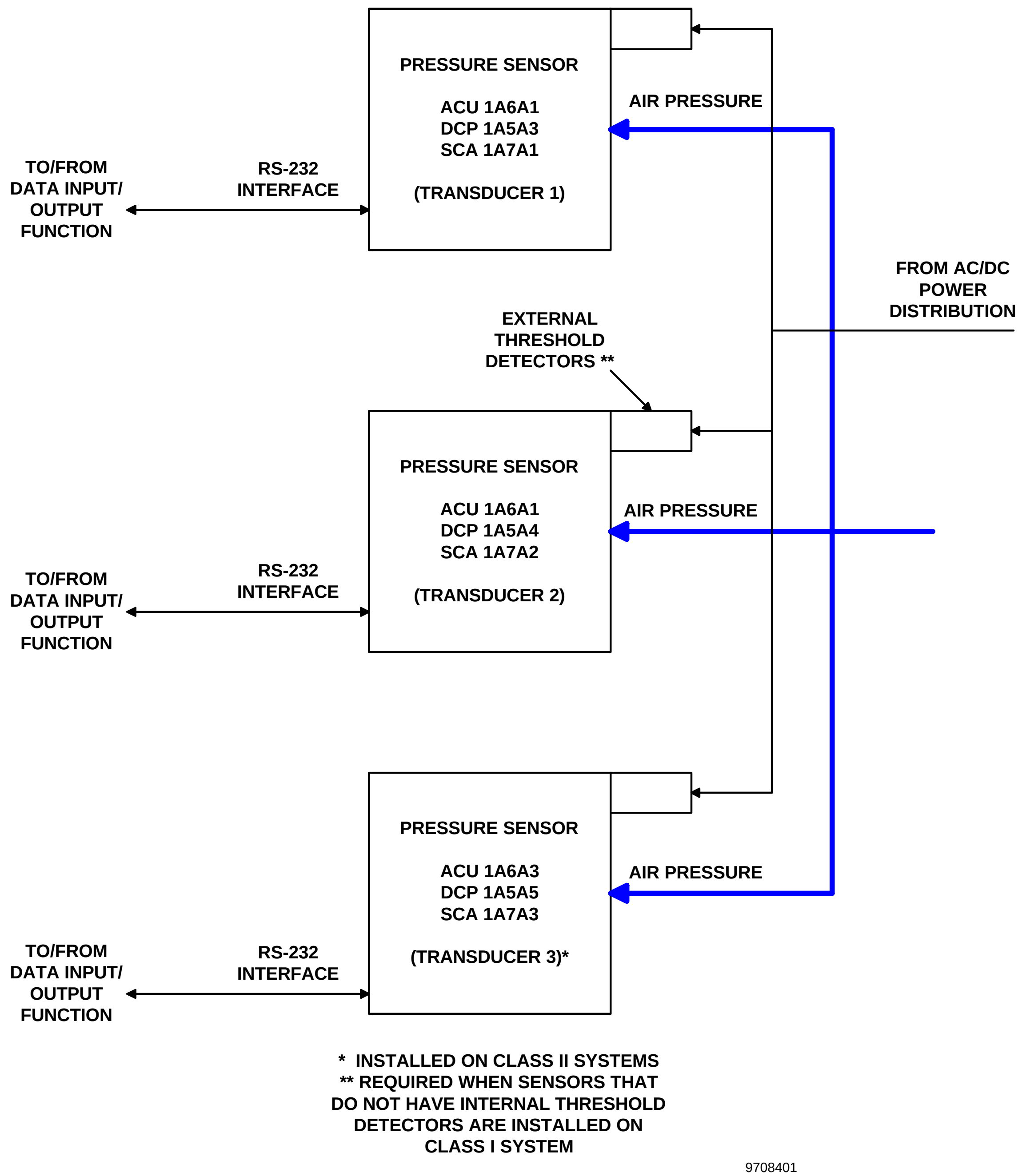


Figure 8.4.1. ASOS Pressure Sensor Simplified Block Diagram

SECTION V. MAINTENANCE

8.5.1 INTRODUCTION

This section provides the preventive and corrective maintenance procedures for the ASOS pressure sensor. Preventive maintenance consists of checking and cleaning the pressure sensor and verifying the accuracy of pressure sensor data. Corrective maintenance consists of the procedures required to troubleshoot and fault isolate the pressure sensor. This section also provides the procedures to remove and install a pressure sensor, to turn on pressure sensor report processing, and to clear pressure sensor data quality failures.

8.5.2 PREVENTIVE MAINTENANCE

8.5.2.1 **General**. A list of the pressure sensor preventive maintenance functions is provided in table 8.5.1.

Table 8.5.1. Pressure Sensor Preventive Maintenance Schedule

Interval	What To Do	How To Do It
90 days	Clean and inspect pressure sensor. Check DCP/SCA desiccant. Verify accuracy of pressure sensor data.	Paragraph 8.5.2.2 Paragraph 3.5.2.1, 14.5.2.1 Paragraph 8.5.2.3

8.5.2.2 **Pressure Sensor Cleaning and Inspection**. Pressure sensor accuracy relies on the tygon tubing from the sensors to the PRESSURE VENT inlets. At some sites, external copper tubing may also be used to vent the PRESSURE VENT to the outdoor environment. For proper performance, all tubing must be clear of obstructions and not be crimped or pinched by any other structures. All pressure vent tubing must be visually inspected to ensure that there is no foreign matter in the tube and that the tube is not pinched or cut. Any damaged tubing must be replaced. The DCP and SCA use desiccant dryers. Refer to paragraphs 3.5.2.1 and 14.5.2.1 respectively for desiccant dryer information. The drawer should also be cleaned to remove any dirt or dust that may be present.

8.5.2.3 **Verifying Accuracy of Pressure Sensor Data**. A technician must verify the accuracy of data from the pressure sensors as follows:

a. Every 90 days

b. Whenever pressure sensor report processing has been turned off (paragraph 8.5.5)

c. Whenever a pressure sensor data quality failure has occurred (paragraph 8.5.6)

d. After performing pressure sensor corrective maintenance (troubleshooting, replacing a pressure sensor, etc)

Pressure sensor data are verified by comparing pressure sensor output data (as shown on the sensor status page at the OID) against a calibrated portable pressure standard. Table 8.5.2 provides procedures to verify output data from the pressure sensors.

8.5.2.3.1 **Use of the Portable Pressure Standard**. The portable pressure standard used with ASOS is Paroscientific model 760-16B, part number 1107-101. This portable pressure standard incorporates a 6-volt, 3 ampere-hour sealed lead acid battery for portable operation. Some characteristics of the battery circuit and operation of the portable pressure standard are listed below.

a. A nominal charge for the battery is 6.3 to 6.7 volts.

b. The expected life of the battery is 100 hours between charges.

CAUTION

The portable pressure standard must not be used when a low battery indication is given. Readings may continue to be taken if the portable pressure standard is plugged into an ac power outlet. The battery will also be charged during this period.

c. A low battery voltage (i.e., 5.1 volts) is indicated by decimals being placed after each numeric digit being displayed.

(1) Example of a good reading: 14.4567 psi

(2) Example of a low voltage display reading: 1.4.4.5.6.7

d. The model 760-16B portable pressure standard charges at a controlled rate up to 180 mA. A partially discharged battery (5.1-volt low battery) takes approximately 6 to 8 hours to become fully charged.

e. A fully discharged battery (0 to 3 volts) may not necessarily recover when charged. In this case, the LCD display shows a series of dashes. If the battery does not accept a charge, the portable pressure standard is to be returned to the pressure laboratory at the address listed below:

National Weather Service
1325 East/West Highway
Silver Spring, MD 20910
RM 2378 Attn: Bernard Morningstar

All units being returned must be shipped Federal Express Overnight.

f. The charging circuit is on when the portable pressure standard is plugged into an ac power outlet. The ON/OFF switch does not have to be ON.

g. The LCD power-on sequence with a fully charged battery goes through a stage where all LCD segments are ON (8.8:8.8:8.8), then OFF -----, then the pressure reading is displayed.

h. The front panel ZERO SET switch is actually a mathematical TARE switch. This means that a software zero will be set for the portable pressure standard. When switched ON, it reads the pressure displayed and subtracts that amount from subsequent measurements. The display then indicates the difference from the original value. When the ZERO SET switch is switched OFF, this function is disabled. For use with ASOS, the ZERO SET switch must be left in the OFF position before turning the standard on.

8.5.3 CORRECTIVE MAINTENANCE

8.5.3.1 **Introduction**. Corrective maintenance consists of fault isolation and removal and replacement of faulty pressure sensors. The pressure sensors are considered critical reporting items. For this reason, corrective maintenance for a pressure sensor typically generates a data quality failure, which essentially takes the sensor off-line. The system WILL NOT automatically clear the data quality failure following the maintenance action. The technician MUST use a portable pressure standard to verify the accuracy of pressure sensor data (paragraph 8.5.2.3), then manually clear the data quality failure (paragraph 8.5.6) before the system will place the sensor back on-line.

8.5.3.2 **Troubleshooting**. Troubleshooting the pressure sensors consists of isolating faults to a particular pressure sensor, the internal plastic (and, at some sites, external copper) sensor tubing, power to the sensor, or the serial input/output (SIO) interfaces to the sensors. The pressure sensor maintenance page (Chapter 1, Section III) indicates when the corresponding sensor fails the sensor response check and the system data quality check. A sensor response failure indicates a pressure sensor power failure or an SIO interface failure. The ac/dc power distribution description in Chapter 2 (ACU), Chapter 3 (DCP), or Chapter 14 for SCA provides pressure sensor power troubleshooting information. The pressure sensor and SIO descriptions in Chapter 2 (ACU), Chapter 3 (DCP), or Chapter 14 for SCA describe troubleshooting pressure sensor SIO interfaces. A data quality failure may indicate that the sensor is reporting data that are out of tolerance with the other pressure sensors in the system (paragraph 8.5.6) and should therefore be replaced.

Table 8.5.2. Verifying Accuracy of Pressure Sensor Data

Step	Procedure
	Tools required: Portable pressure standard **CAUTION** The portable pressure standard LCD display will freeze at temperatures below 15°F (-10°C). When using the pressure standard outdoors in a cold climate, ensure that the pressure standard is placed in a location that will prevent the LCD from freezing.
1	Open portable pressure standard and remove cap from PRESSURE INPUT port. Ensure that ZERO SET switch is in OFF position. Position pressure standard near cabinet, at same elevation as pressure sensor. **CAUTION** Do not use portable pressure standard on battery power when a low battery indication is given (decimals or dashes on LCD display). In such cases, pressure standard may be used if plugged into an ac outlet (standard also recharges during this period).
2	Turn on portable pressure standard. If standard is at room temperature, allow approximately 5 minutes for portable pressure standard to stabilize. If standard is not at room temperature, allow it to warm up before proceeding.
3	If PRESSURE VENT on I/O Connector Panel 1A9 (at rear of ACU cabinet) is vented to outside by copper tubing, perform steps 4 through 6. If PRESSURE VENT is not vented or if sensor is installed in the DCP or SCA, proceed to step 7.
4	At OID, display sensor status page (sequentially press REVIEW-SENSR-STAT function keys from 1-minute screen).
5	On sensor status page, set report processing for pressure sensors to OFF.
6	Disconnect outside vent tubing from PRESSURE VENT inlet of I/O Control Panel 1A9.
7	At OID, display second page (shows pressure data) of sensor 12-hour set (sequentially press REVUE-SENSR-12HR-PAGE function keys from 1-minute screen).
8	On 12-hour page, compare most recent reading for pressure sensors 1, 2, and 3 (if applicable) with value displayed on portable pressure standard.

Table 8.5.2. Verifying Accuracy of Pressure Sensor Data -CONT

Step	Procedure
9	Ensure that all sensor values are within ±0.020 of the value on the portable pressure standard. If individual sensor is out of tolerance, replace sensor. If all sensors are out of tolerance (by the same amount), inspect and clear all pressure sensor vent tubing and recheck. If all sensors are still out of tolerance, portable pressure sensor may be out of calibration.
10	If external copper vent tubing was previously disconnected, connect external tubing to PRESSURE VENT inlet on I/O Connector Panel 1A9.
11	Turn pressure sensor report processing on in accordance with table 8.5.4.
12	Turn off portable pressure standard, install cap on PRESSURE INPUT port, and install lid.

8.5.4 **PRESSURE SENSOR REMOVAL AND INSTALLATION**

The replacement of a faulty pressure transducer is easily accomplished using simple handtools. When a pressure sensor is replaced, the loss of sensor data results in a data quality failure for that sensor. Before the system places the new sensor on-line, the technician MUST use a portable pressure standard to verify the accuracy of the new sensor (paragraph 8.5.2.3) and clear the data quality failure (paragraph 8.5.6). The procedures required to remove and install a pressure sensor are provided in table 8.5.3.

8.5.5 **PRESSURE SENSOR REPORT PROCESSING PROCEDURES**

Report processing for the pressure sensors may be turned off in one of two ways:

a. Like other sensors, report processing for pressure sensors may be turned off (from OID sensor status page) by an observer, air traffic controller, technician, or system manager.

b. Unlike other sensors, the system automatically turns off report processing for the pressure sensors whenever an observer edits the ALTIMETER field on the 1-minute screen.

Whenever pressure sensor report processing is off (for either reason), the system assumes that the pressure data may not be accurate and therefore should not be used. The system then allows only a technician to turn back on pressure sensor report processing. Before turning pressure sensors report processing on, the technician MUST use a portable pressure standard to verify that pressure sensors are providing accurate data (paragraph 8.5.2.3). Table 8.5.4 provides procedures to turn on pressure sensor report processing.

8.5.6 **CLEARING PRESSURE SENSOR DATA QUALITY FAILURES**

ASOS software performs the following two data quality checks against the data received by the pressure sensors. Data quality failures, when they occur, are indicated on the maintenance page for the failing sensor (Chapter 1, Section III) and on the sensor status page (REVUE-SENSR-STAT).

a. A data quality failure occurs if the data from one pressure sensor is more than ±0.040 inHg apart from the other(s). In a system with three pressure sensors, the out-of-tolerance sensor is logged as a data quality failure. In a system with two pressure sensors, it is impossible to determine which of the two is out of tolerance, so the system logs both as data quality failures.

b. Each pressure sensor is polled for data once every 10 seconds. If a pressure sensor fails to respond more than once in a 1-minute period or fails to respond more than twice in a 12-hour period, a data quality failure is logged for that sensor. Because corrective maintenance tasks such as troubleshooting or replacing a pressure sensor require longer than 20 seconds, such tasks typically generate data quality failures.

8.5.6.1 **<u>Effect of Data Quality Failures on Altimeter Report</u>**. If a data quality failure occurs in a system with only two pressure sensors, the ASOS stops reporting altimeter settings (altimeter goes missing). In a three-sensor system, a single data quality failure does not interrupt altimeter reporting. The ASOS continues to report altimeter settings based on the data from the two remaining pressure sensors.

8.5.6.2 **<u>Clearing Pressure Sensor Data Quality Failures</u>**. For other ASOS sensors (visibility, ceilometer, etc.), the system automatically clears data quality failures after the sensor reports a sufficient number of valid data samples. The pressure sensors, because they are critical to aircraft safety, require the technician to take a positive action to clear the data quality failure and bring the sensor on-line. This is achieved by deconfiguring and reconfiguring the pressure sensor from the sensor configuration page (paragraph 1.3.16.2) of the OID. Prior to this action, however, the technician MUST use a portable pressure standard to verify that the sensor is reporting accurate data (as described in paragraph 8.5.2.3). Table 8.5.5 provides procedures to clear a pressure sensor data quality failure by deconfiguring and reconfiguring the sensor.

Table 8.5.3. Pressure Sensor Removal and Installation

Step	Procedure
	REMOVAL
	Tools required: Large flat-tipped screwdriver Small flat-tipped screwdriver No. 2 Phillips screwdriver **WARNING** Pressure sensors are safety-critical devices. Pressure sensors may output erroneous readings if damaged or if plastic vent tubing is damaged or obstructed. Throughout this procedure, exercise caution to avoid damage to pressure sensors and vent tubing. **NOTE** Internal threshold detectors were built into pressure sensors with serial numbers 358495, 358509, and 363914 and above. Other sensors modified with internal detectors are labeled as such. All other sensors, when used on Class I systems, require external threshold detectors.
1	**NOTE** In the DCP and SCA, the pressure mounting shelf is not secured. Proceed to step 2. Using large flat-tipped screwdriver, remove four screws, lockwashers, and flat washers securing rf/pressure mounting shelf slide mount to frame.
2	Slide mounting shelf out until slides lock in fully extended position.
3	Locate pressure sensor to be removed.
4	Using small flat-tipped screwdriver, remove power and signal cables from pressure sensor.
5	Disconnect pressure sensor tube from pressure sensor.
6	Using Phillips screwdriver, remove four screws, lockwashers, and flat washers securing pressure sensor to shelf. Remove pressure sensor.
7	If pressure sensor is equipped with an external threshold detector, disconnect detector from sensor. Pack and ship detector in container with sensor.

Table 8.5.3. Pressure Sensor Removal and Installation -CONT

Step	Procedure
	INSTALLATION
	Tools required: Large flat-tipped screwdriver No. 2 Phillips screwdriver Small flat-tipped screwdriver **WARNING** Pressure sensors are safety-critical devices. Pressure sensors may output erroneous readings if damaged or if plastic vent tubing is damaged or obstructed. Throughout this procedure, exercise caution to avoid damage to pressure sensors and vent tubing. **NOTE** Internal threshold detectors were built into pressure sensors with serial numbers 358495, 358509, and 363914 and above. Other sensors modified with internal detectors are labeled as such. All other sensors, when used on Class I systems, require external threshold detectors. $ In the DCP and SCA, the pressure mounting shelf is not secured. Proceed to step 2.
1	Slide mounting shelf out until slides lock in fully extended position. **NOTE** If installing pressure sensor on a Class I system, ensure that replacement sensor is equipped with an undervoltage threshold detector (internal or external). If replacement sensor requires an external threshold detector, install detector onto pressure sensor power connector (J2).
2	Position pressure sensor over four mounting holes in mounting shelf. Using Phillips screwdriver, install four screws, lockwashers, and flat washers securing pressure sensor to shelf.
3	Using small flat-tipped screwdriver, install power and signal cables to pressure sensor.
4	Connect pressure sensor tube to pressure sensor. **WARNING** Pressure sensors may output erroneous values if plastic vent tubing binds or crimps when shelf is closed. Exercise caution when closing shelf to prevent damage to pressure sensor vent tubing.
5	$ **NOTE** $ In the DCP and SCA, the pressure mounting shelf is not secured. Proceed to step 7. $ While taking care not to damage or crimp pressure sensor vent tubing, release mounting shelf slide locks and push mounting shelf back into cabinet. After closing shelf, ensure that pressure tubing is properly connected to PRESSURE VENT on ACU I/O Panel Assembly 1A9 and is not damaged or crimped.
6	Using large flat-tipped screwdriver, install four screws, lockwashers, and flat washers securing mounting shelf to frame (ACU only).
7	**WARNING** Accuracy of pressure sensor data is critical to aircraft safety. Technician must verify the accuracy of pressure sensor data after installing pressure sensor. Verify accuracy of data from all pressure sensors in accordance with table 8.5.2.
8	At OID, display sensor status page (sequentially press REVUE-SENSR-STAT function keys from 1-minute screen).
9	Check DATA QUALITY status of pressure sensor just installed. If status is F (fail), clear data quality failure in accordance with table 8.5.5.

Table 8.5.4. Turning Pressure Sensor Report Processing On

Step	Procedure
	WARNING Accuracy of pressure sensor data is critical to aircraft safety. Technician must verify the accuracy of pressure sensor data before turning pressure sensor report processing on.
1	Verify the accuracy of data from all pressure sensors in accordance with table 8.5.2.
2	At OID, display sensor status page (sequentially press REVUE-SENSR-STAT function keys from 1-minute screen).
3	Using PREV and NEXT keys, move cursor to select one of the pressure sensors.
4	Press PROC function key. Message SYSTEM MODIFICATIONS flashes at top of screen and system prompts for technician to enter initials.
5	Enter two- or three-character initials. After entering initials, RPT PROC field for all pressure sensors changes to ON and SYSTEM MODIFICATION message is removed.
6	Press EXIT to return to 1-minute screen. System begins reporting ALTIMETER data within 1 minute (provided that at least two pressure sensors have report processing on and pass data quality verification).

Table 8.5.5. Clearing Pressure Sensor Data Quality Failures

Step	Procedure
SENSOR DECONFIGURATION	
	WARNING Accuracy of pressure sensor data is critical to aircraft safety. Technician must verify the accuracy of pressure sensor data before clearing data quality failure.
1	Verify accuracy of data from all pressure sensors in accordance with table 8.5.2.
2	At OID, display sensor status page (sequentially press REVUE-SENSR-STAT function keys from 1-minute screen).
3	From sensor status page, determine which pressure sensor (#1, #2, or #3) has data quality failure.
4	At OID, display sensor configuration page (sequentially press REVUE-SITE-CONFIG-SENSR function keys from 1-minute screen).
5	On sensor configuration page, press CHANG key. A cursor is displayed and message SYSTEM MODIFICATIONS flashes at top of screen.
6	Using PREV and NEXT keys, move cursor to highlight code (P1, P2, or P3) for pressure sensor with data quality failure.
7	To deconfigure sensor, enter two asterisks (**) in place of highlighted sensor code.
8	Press BACK key. Cursor and SYSTEM MODIFICATIONS message are removed from screen.
9	Press EXIT key to return to 1-minute screen and cause system to accept change.
SENSOR RECONFIGURATION	
1	At OID, again display sensor configuration page (sequentially press REVUE-SITE-CONFIG-SENSR keys).
2	On sensor configuration page, press CHANG key. Cursor is displayed and message SYSTEM MODIFICATIONS flashes at top of screen.
3	Using PREV and NEXT keys, move cursor to highlight asterisks (**) entered when sensor was deconfigured.
4	To reconfigure sensor, enter two-character code (P1, P2, or P3) for pressure sensor in place of asterisks.

Table 8.5.5. Clearing Pressure Sensor Data Quality Failures -CONT

Step	Procedure
5	Press BACK key. Cursor and SYSTEM MODIFICATIONS message are removed from screen.
6	Press EXIT key to return to 1-minute screen and cause system to accept change.
7	Display sensor status page (sequentially press REVUE-SENSR-STAT function keys from 1-minute screen). Verify that data quality field shows pass status for pressure sensor just reconfigured (within 2 minutes).
8	Press exit to return to 1-minute screen. System begins reporting ALTIMETER data within 4 minutes after reconfiguring (provided that at least two pressure sensors have report processing on and pass data quality verification).

CHAPTER 9

CLOUD HEIGHT SENSOR (CEILOMETER)

SECTION I. DESCRIPTION AND LEADING PARTICULARS

9.1.1 INTRODUCTION

The ASOS cloud height sensor, hereinafter referred to as the ceilometer, senses and reports cloud levels in the atmosphere. The ceilometer is a VAISALA model CT12K that uses invisible laser radiation to detect cloud levels. The ceilometer basically works by transmitting a pulse of laser light into the atmosphere and sensing the light return as it is reflected back toward the ceilometer by objects in its path. By timing the interval between the transmission and reception, the height of particles (such as water droplets or ice crystals in clouds) above the ceilometer is calculated and reported to the data collection package (DCP). This chapter provides information on the physical description, installation, operation, theory of operation, and both preventive and corrective maintenance for the ceilometer.

9.1.2 PHYSICAL DESCRIPTION

9.1.2.1 **General Description**. The CT12K ceilometer (figure 9.1.1) consists of a single housing assembly mounted on a support pedestal. The pedestal is high enough to provide clearance in deep snow accumulations, and is hinged in the middle to facilitate maintenance. (A quick-release pin secures the hinge plates together.) The cabinet houses the sensor optics and electronics. The equipment cover protects the equipment cabinet assembly from the environment. The top of the equipment cover provides two window openings for the ceilometer optics. A window conditioner is mounted on the top of the equipment cover to protect the windows from dust and precipitation. The warm airflow output by the window conditioner and two internal heaters warm the entire ceilometer during periods of cold temperatures. The physical and operational specifications of the ceilometer are provided in table 9.1.1.

9.1.2.2 **System Components**. The equipment cabinet assembly contains all of the physical system components of the ceilometer (figure 9.1.2), which are divided into two subassemblies: the optics subassembly and the electronics subassembly. The optics subassembly, which contains the optics housing as a frame, consists of a transmitter board, a receiver board, associated optics adjustment hardware, a light monitor board, transmitter and receiver lenses, a temperature compensation transformer, two temperature control heaters, and an optional solar shutter. The optics subassembly is mounted on the electronics subassembly with six screws and is electrically connected using seven separate cables and four attached connectors. The electronics subassembly uses an equipment base, high voltage power supply housing, and board frame as its mechanical structure and consists of a high voltage power supply, processor board, unregulated power supply board, I/O connector board, and fiberoptic module. An external temperature sensor (and snow shield, if required) and the four connectors are mounted to the equipment base and connect to the various internal subassemblies via cables.

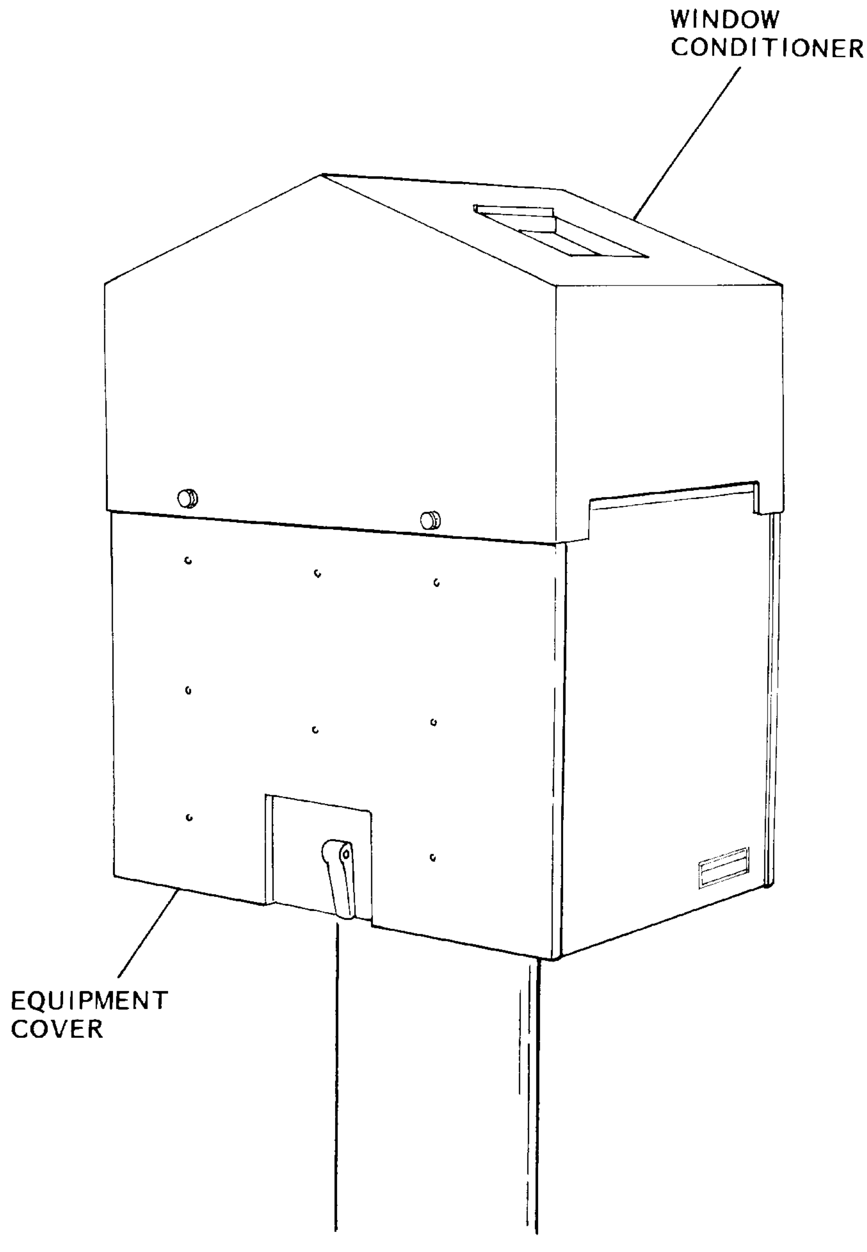


Figure 9.1.1. Ceilometer (CT12K)

Table 9.1.1. Ceilometer Specifications

Parameter	Specification
PHYSICAL:	
Height	52.8 in. (with pedestal), 29.1 in. (without pedestal)
Width	22.8 in.
Depth	16.5 in.
Weight	156 lb (with pedestal), 135 lb (without pedestal)
ELECTRICAL:	
AC power	116V ±10%, 45 to 65 Hz, 800 watts (7 amperes) max
TRANSMITTER OPTICS:	
Laser source	Gallium Arsenide (GaAs)
Diode wavelength	904 nm nominal
Operating mode	Pulsed
Initial transmitted pulse energy	6.6 microwatts ±5% (factory-adjusted)
Peak pulse power	40 watts (typical)
Pulse width @ 50% peak	135 nanoseconds (typical)
Repetition rate	620 to 1,120 Hz, processor-controlled for constant average power
Average power	5 milliwatts
Maximum irradiance	50 microwatts/cm^2 measured with 7 mm dia aperture
Laser classification	Class I in compliance with FDA CFR 1040.10 (Subsection e,3)
Laser source dimensions	50 mil sq (1.3 x 1.3 mm)
Transmitter optics focal length	14.45 inches (367 mm)
Transmitter effective lens dia	4.65 inches (118 mm)
Transmitter beam divergence	±2.5 mrad maximum
Lens transmittance	90% typical
Window transmittance	97% typical, clean
RECEIVER OPTICS:	
Detector	Silicon Avalanche Photodiode
Responsivity at 904 nm	40 A/W (factory adjustment)
Surface diameter	0.0314 in. (0.8 mm)
Interference filter	904 nm
50% pass band	880 to 940 nm typical
Transmissivity @ 904 nm	85% typical, 60% minimum
Focal length	5.91 inches (150 mm)
Reception lens effective diameter	4.65 in. (118 mm)
Field of view divergence	±2.7 mrad
Lens transmittance	90% typical
Window transmittance	97% typical, clean
OPTICAL SYSTEM:	
Lens distance, transmitter - receiver	12.2 in. (301 mm)
Laser beam, entering receiver field of view	100 feet (30 meters)
Laser beam 90% within receiver field of view	1,000 feet (300 meters)
PERFORMANCE:	
Measurement range	0 to 12,650 feet
Resolution	50 feet
12,000 ft acquisition time	30 seconds maximum
System bandwidth	10 MHZ at low gain (-3 db), 3 MHZ at high gain (-3 db)
Tolerance of precipitation	To 0.3 inch (7.5 mm) per hour, range-limited
ENVIRONMENTAL CONDITIONS:	
Ambient temperature	-60 to +120 degrees F (-51 to +49 degrees C)
Humidity	100% relative humidity
Salt spray	MIL-STD-810C Method 509.1
Wind	100 kt (50 m/s)
Shock	4 inches (10 cm) drop

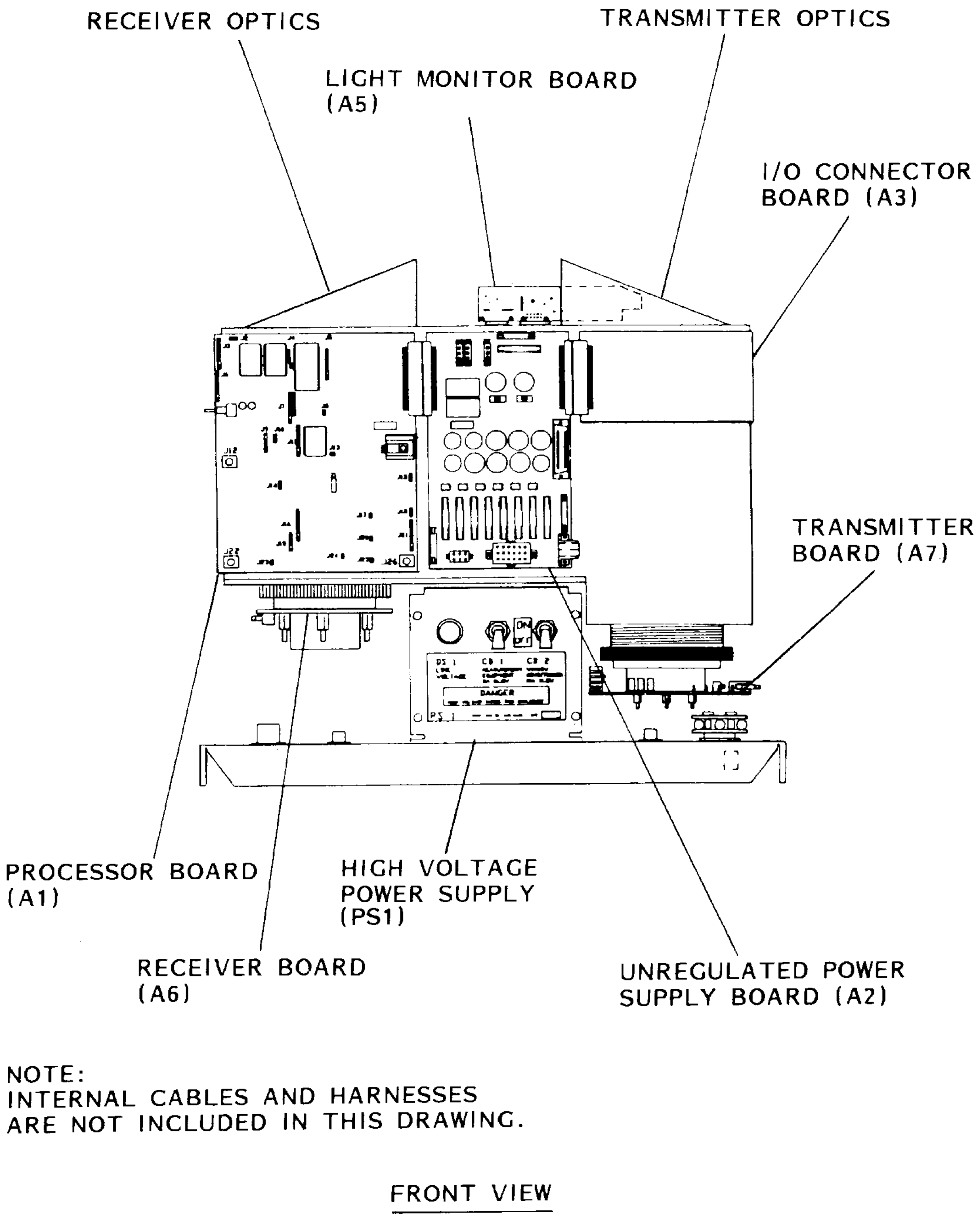


Figure 9.1.2. Ceilometer System Components (Sheet 1 of 3)

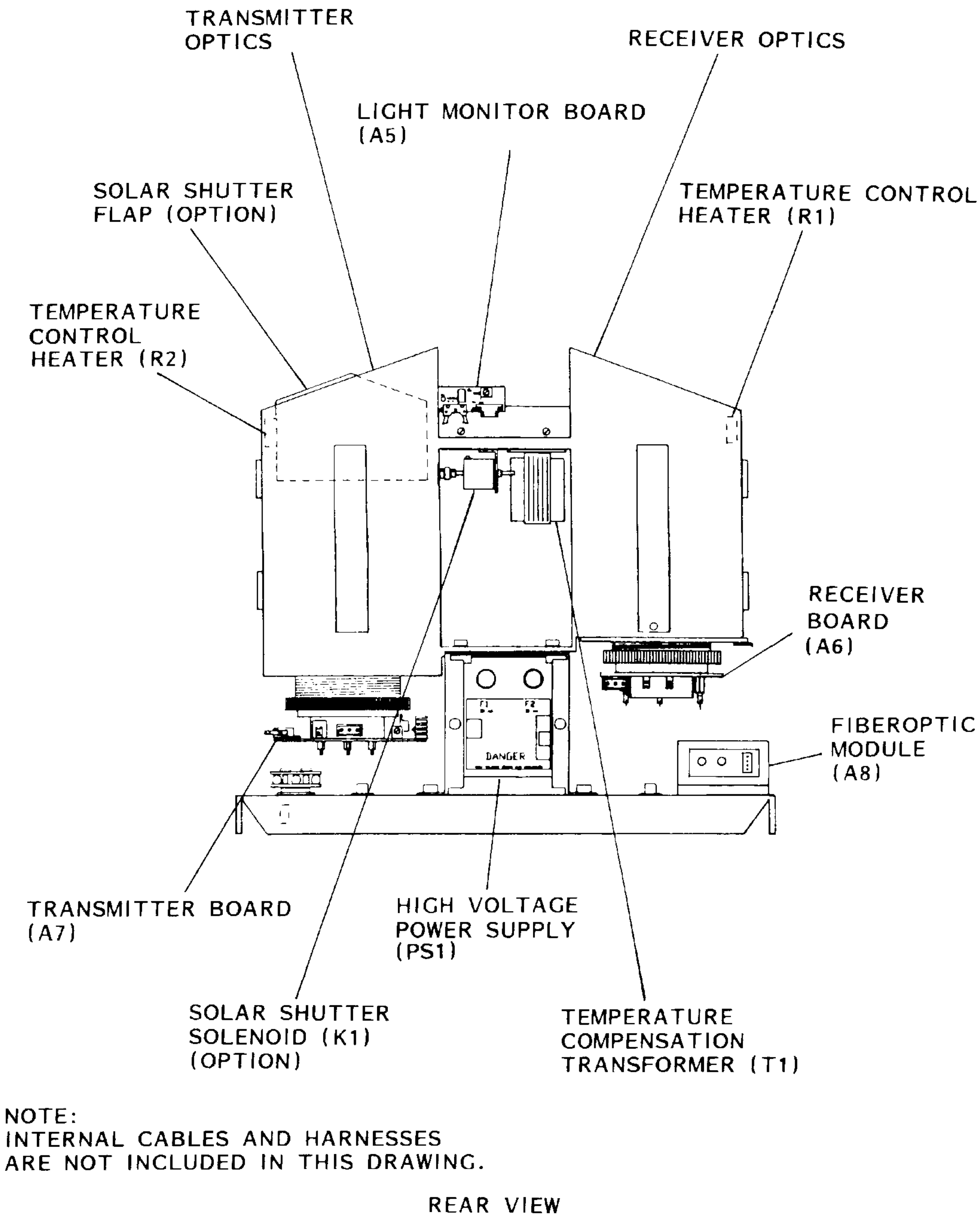


Figure 9.1.2. Ceilometer System Components (Sheet 2)

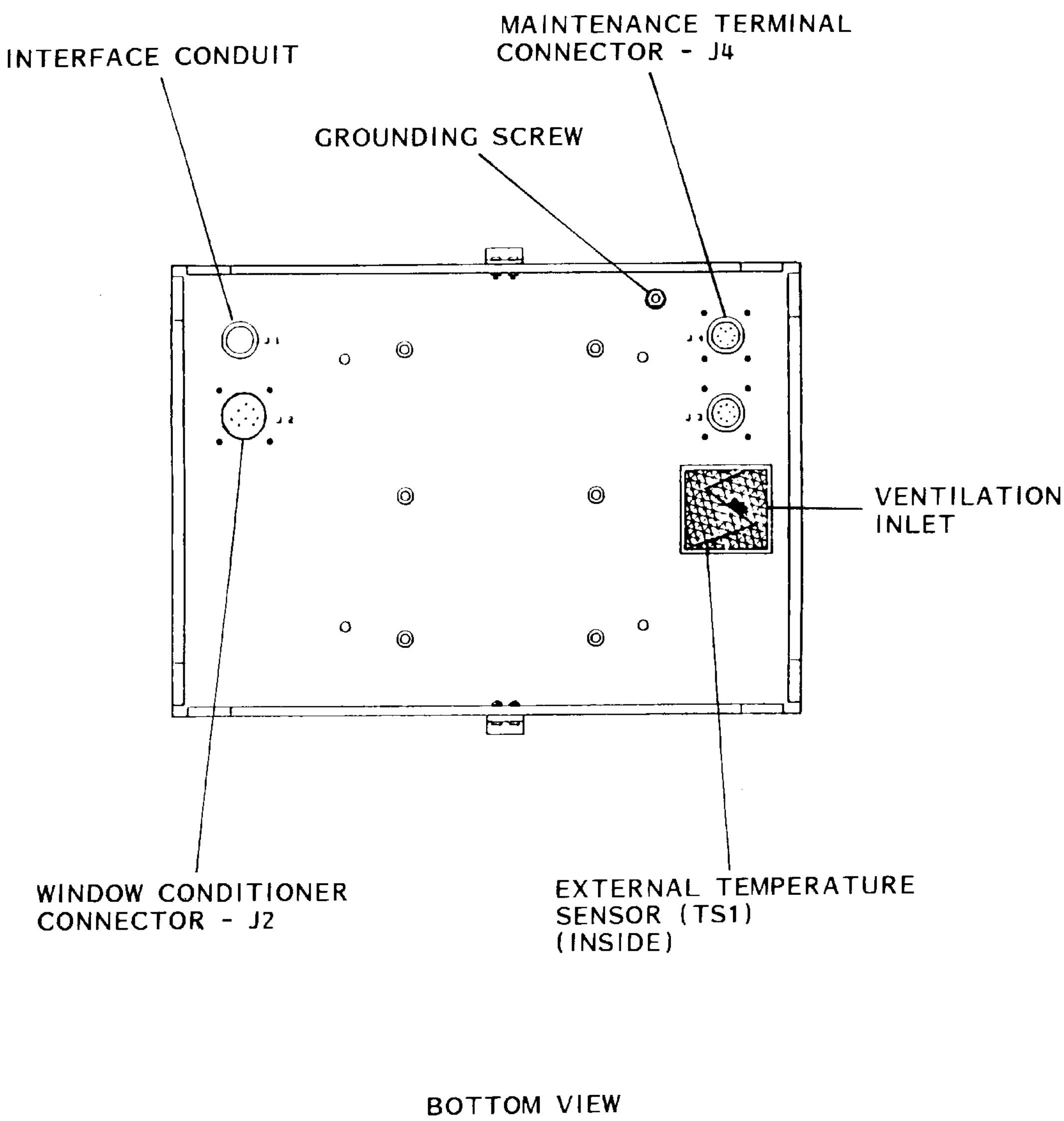


Figure 9.1.2. Ceilometer System Components (Sheet 3)

9.1.2.3 **Ceilometer Configurations**. Some ceilometers are equipped with a solar shutter assembly on the transmit side of the ceilometer (figure 9.1.2). Solar shutters are installed on ceilometers used in tropical regions from 30 degrees North latitude to 30 degrees South latitude. The shutter protects the transmit laser from damage by direct sunlight. The solar shutter closes over the transmit lens during times when direct sunlight can enter the lens system. Ceilometers equipped with solar shutters are also equipped with tropical receiver assemblies. The tropical receiver assembly has a different filter and mounting block than the filter installed on the standard receiver assembly. The ceilometer is installed in one of four configurations with each configuration assigned a unique part number. (Refer to the Parts List located after the last chapter in volume II.) The part numbers identify the original and refurbished configurations both with and without solar shutters. Original and refurbished configurations with solar shutters are identical as are original and refurbished configurations without solar shutters. Table 9.1.2 identifies the different ceilometer configurations and associated receiver assemblies. Some ceilometers are equipped with a snow radiation shield (part number 50-20663 Rev. H) covering the ambient air temperature sensor on the bottom of the unit. The snow shield prevents sunlight, reflected by snow, from inadvertently causing heating of the temperature sensor. The snow shield will require cleaning each Fall, prior to the winter season. See table 9.5.33 for the snow radiation shield removal and installation procedure.

Table 9.1.2. Ceilometer Configurations

Ceilometer Configuration	Part Number	RCVR Assy Nomenclature	Part No.
Original with no solar shutter	62828-90112-10	Standard	62828-90112-4
Original with solar shutter PN 62828-90112-9	62828-90112-20	Tropical	62828-90112-4
Refurbished - no solar shutter	62828-90112-30	Standard	62828-90112-4
Refurbished - with solar shutter PN 62828-90112-9	62828-90112-40	Tropical	62828-90112-4
Refurbished - with solar shutter PN 62828-90112-9 & tropical filter	62828-90112-50	Tropical	62828-90112-11
Refurbished - with solar shutter PN 62828-90112-9 & tropical filter	62828-90112-60	Tropical	62828-90112-11
Ceilometer FMK#073, Rev A, snow shield installation	50-20663 (CAGEC 65653)		

SECTION II. INSTALLATION

9.2.1 **INTRODUCTION**

The ceilometer has a modular design which allows for easy installation. The ceilometer is normally shipped partially assembled in two boxes. The boxes contain the ceilometer, electronics box, mounting column, and blower assembly. This section provides instructions for installing all of the ceilometer assemblies. The procedures assume that the support pedestal has been installed.

9.2.2 **ASSEMBLY**

The ceilometer, electronics box, mounting column, and blower assembly are preassembled units and do not require any additional assembly prior to installation.

NOTE
If pedestal is equipped with a hinge, leave the hinge closed and pinned during installation.

9.2.3 **INSTALLING THE CEILOMETER**

The ceilometer is installed on the support pedestal using the procedures in table 9.2.1 and referencing figures 9.2.1 and 9.2.2.

Table 9.2.1. Ceilometer Installation

Step	Procedure
	Tools required: 5/8-inch socket, flat screwdriver **WARNING** Death or severe injury may result if power is not removed from sensor prior to maintenance activities. Ensure that heater and primary power circuit breakers (located in DCP) are set to off (right) position.
1	Inside DCP equipment cabinet, ensure that circuit breakers on ceilometer circuit breaker module are set to off (right) position.
2	Install four bolts and washers securing mounting column to bottom of ceilometer. If ceilometer is to be equipped with a snow radiation shield, it should be installed using the procedure in table 9.5.33.
	WARNING Ceilometer is heavy equipment (weighs approximately 150 pounds) and requires two-man or mechanical lift. Failure to comply may result in injury to personnel or damage to equipment.
3	Carefully lift mounting column with ceilometer attached and position base over mounting flange of support pedestal.
4	Orient the receiver side of ceilometer to face away from the sun (in the northern hemisphere, face toward north and in the southern hemisphere, face toward south).

Table 9.2.1. Ceilometer Installation -CONT

Step	Procedure
5	Install 5/8-inch hardware securing mounting column to support pedestal flange.
6	Pass free end of site cables through interface conduit hole (figure 9.2.2) on bottom of electronics box and up through enclosure.
7	Connect site conduit connector to interface conduit hole (figure 9.2.2) on bottom of electronics box.
8	Connect transmit fiberoptic cable to TX connector on fiberoptic modem and connect receive fiberoptic cable to RX connector on fiberoptic modem (RX connector on module is nearest DB-9 electrical connector).
9	Connect site wiring (TB-1) in electronics box and secure Faraday box cover plate. On high voltage power supply PS1, set CB1 and CB2 circuit breakers to ON position. On Processor Board A1, set A1S1 to NORMAL (middle position). On Unregulated Power Supply Board A2, set A2S1 to ON position and A2S2 to NORMAL position.
10	Attach ground wire to ground stud located on bottom of electronics box (figure 9.2.2).
11	Remove any temporary dust covers from the optics and carefully install lens cover assembly over ceilometer.
12	Snap latches closed securing lens cover.
13	Carefully install blower assembly and route blower assembly electrical wire down the side to blower power connector J2 on bottom of ceilometer (figure 9.2.2).
14	Tighten screws securing blower assembly to lens cover.
15	Connect blower ac power cable to blower power connector J2 on ceilometer.
16	At DCP circuit breaker module, apply power to ceilometer.

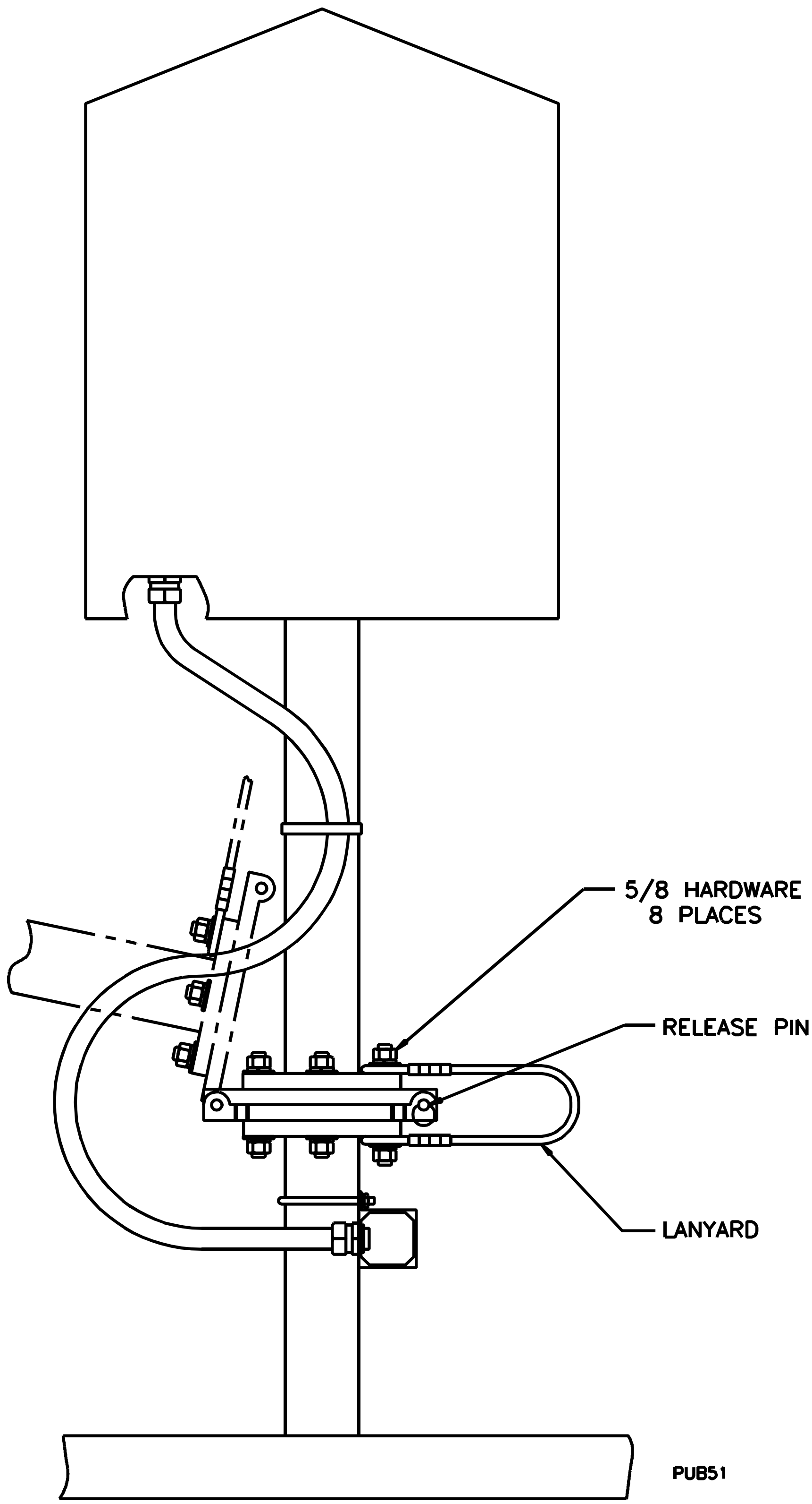


Figure 9.2.1. Ceilometer Mounting Diagram

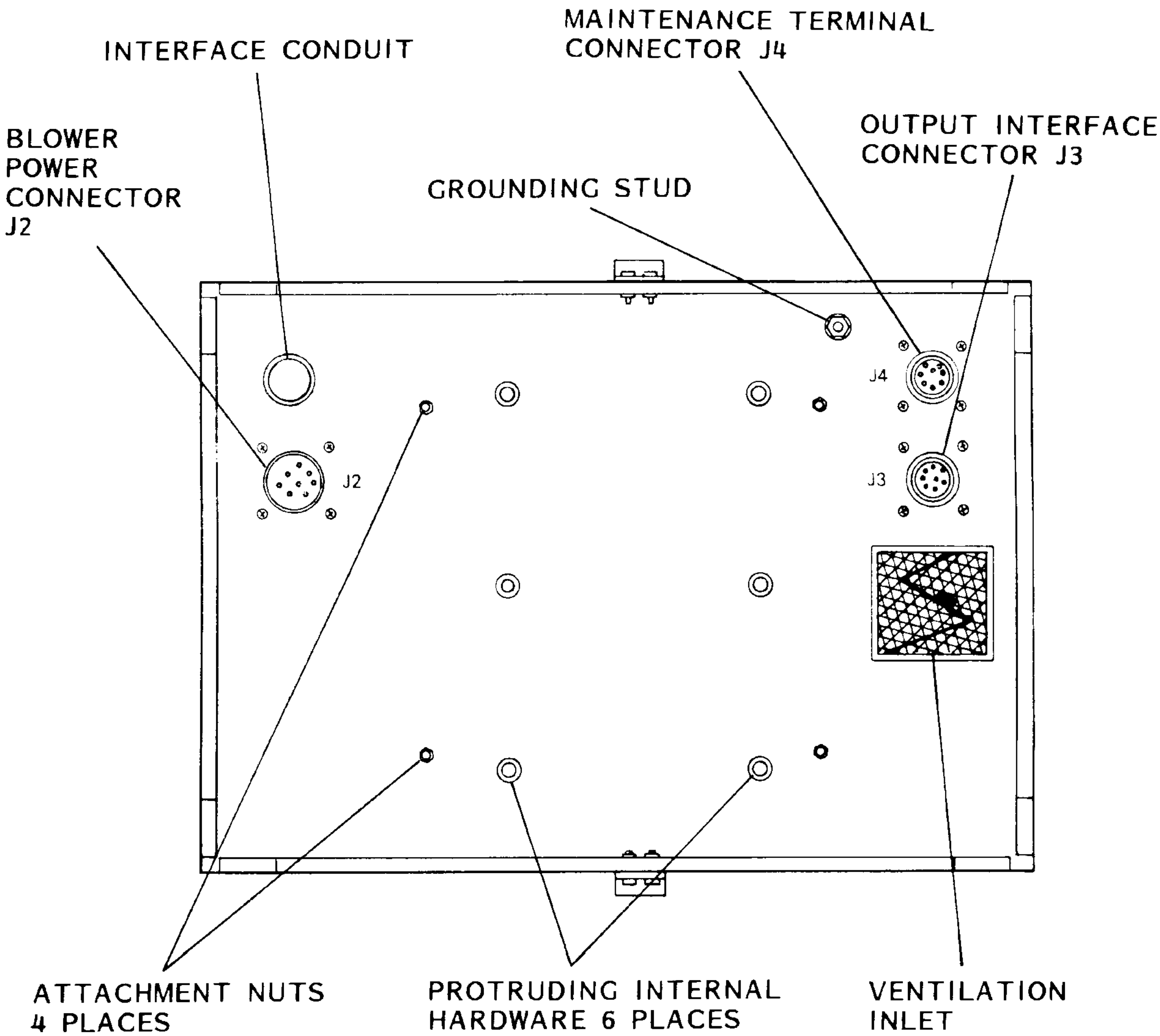


Figure 9.2.2. Ceilometer Connections (Bottom)

SECTION III. OPERATION

9.3.1 INTRODUCTION

The normal operation of the ceilometer is fully automatic and requires no operator intervention. The digital data message sent by the ceilometer to report cloud information is automatically issued as a response to sensor polling by the data collection package (DCP) at predetermined timed intervals. This data message is transferred from the ceilometer to the DCP and ultimately to the acquisition control unit (ACU) for broadcast and display.

9.3.2 CONTROLS AND INDICATORS

The ceilometer is intended for continuous operation and normally remains on at all times, with the exception of maintenance or repair requirements. The digital communications interface with the ceilometer allows the system to automatically detect and report the majority of possible malfunctions through software displays. As such, the ceilometer contains only a few controls and indicators which require setting or monitoring by the technician. These controls and indicators are illustrated on figure 9.3.1 and described in table 9.3.1.

9.3.3 TURN-ON PROCEDURES

The ceilometer is designed for continuous operation and normally remains on at all times, except for maintenance or repair activities. The turn-on procedures for the ceilometer require that the cover of the equipment cabinet assembly be removed, power applied, proper operation of the ceilometer verified, power removed, the cover installed, and power applied. These procedures prohibit the dangers involved with installing the ceilometer equipment cover with the system powered on. The ceilometer turn-on procedures are provided in table 9.3.2.

9.3.4 TURNOFF PROCEDURES

The ceilometer is normally turned off only for maintenance purposes using the procedures provided in table 9.3.3. These procedures remove electrical power from the ceilometer equipment to ensure safe disassembly of the ceilometer and safe removal/replacement of field replaceable units (FRU's).

9.3.5 NORMAL OPERATION

The ceilometer normally operates in automatic mode with the polling mode on (PMOD ON), which requires no operator intervention. A digital message is sent from the ceilometer to the DCP each time that the DCP polls the ceilometer with a SEND command. The content of these messages may be viewed on the ceilometer page of the OID. A description of the OID display is provided in Chapter 1. There are three possible message outputs from the ceilometer, which are described in the following paragraphs.

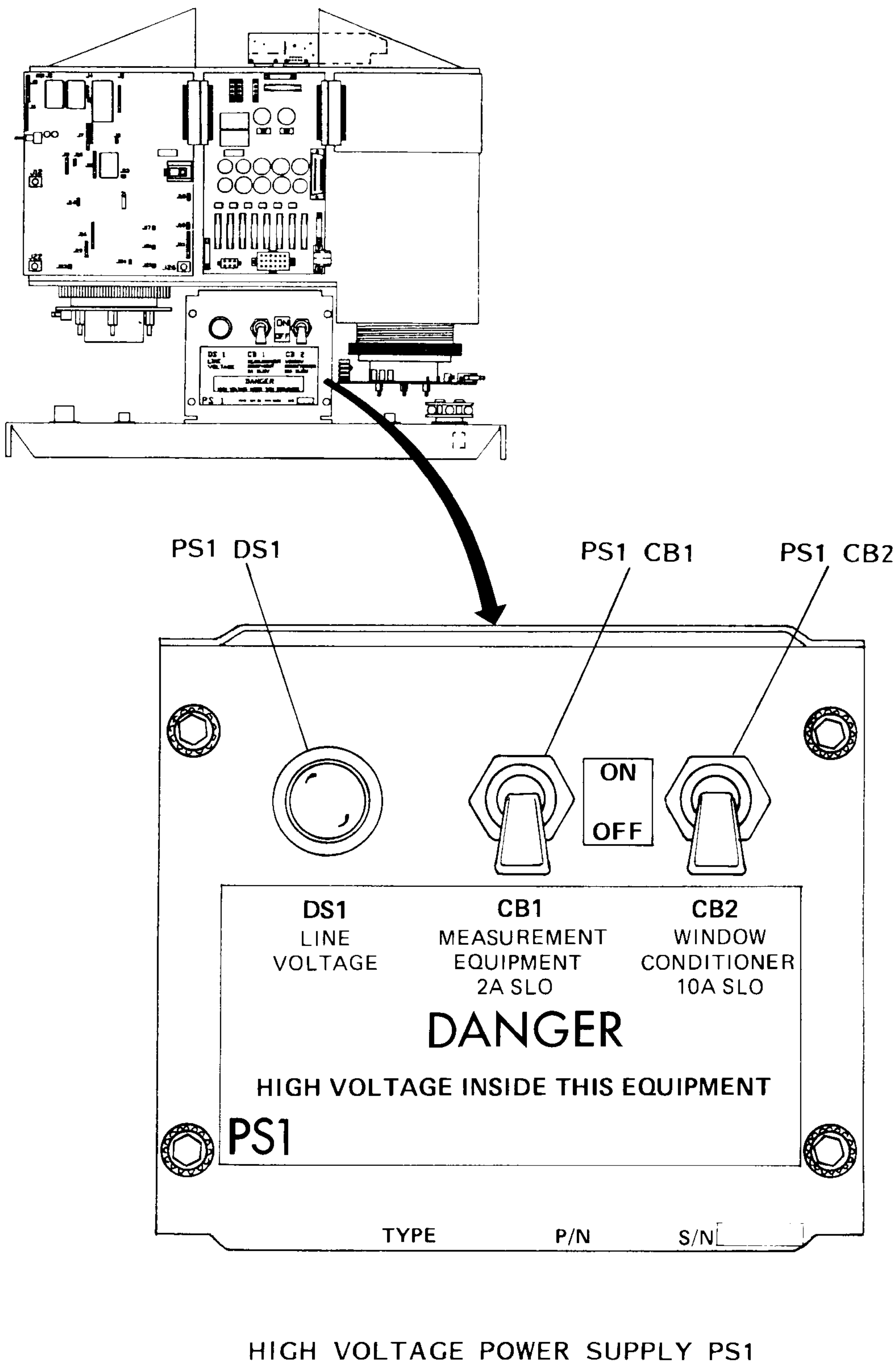


Figure 9.3.1. Ceilometer Controls and Indicators (Sheet 1 of 4)

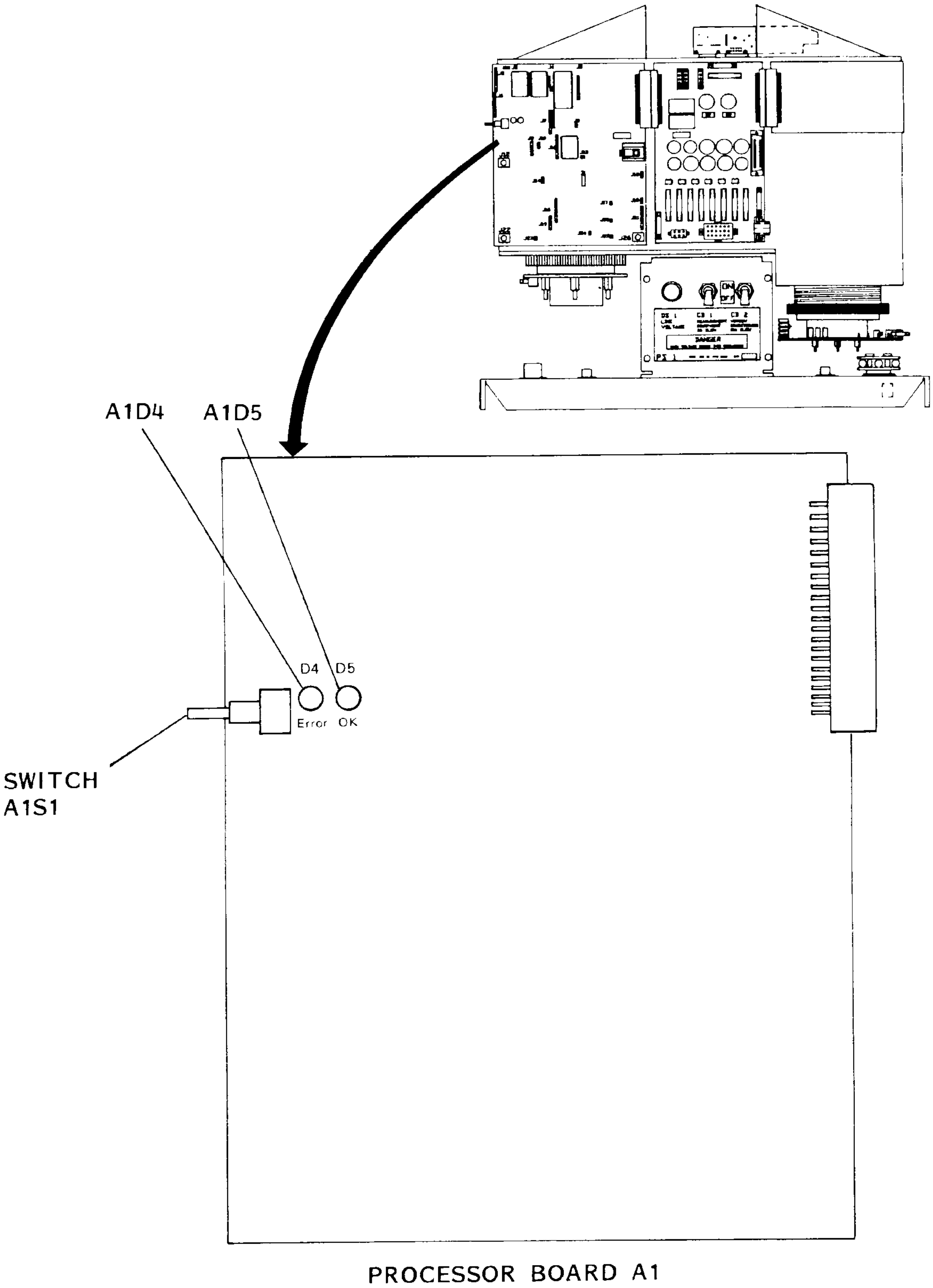
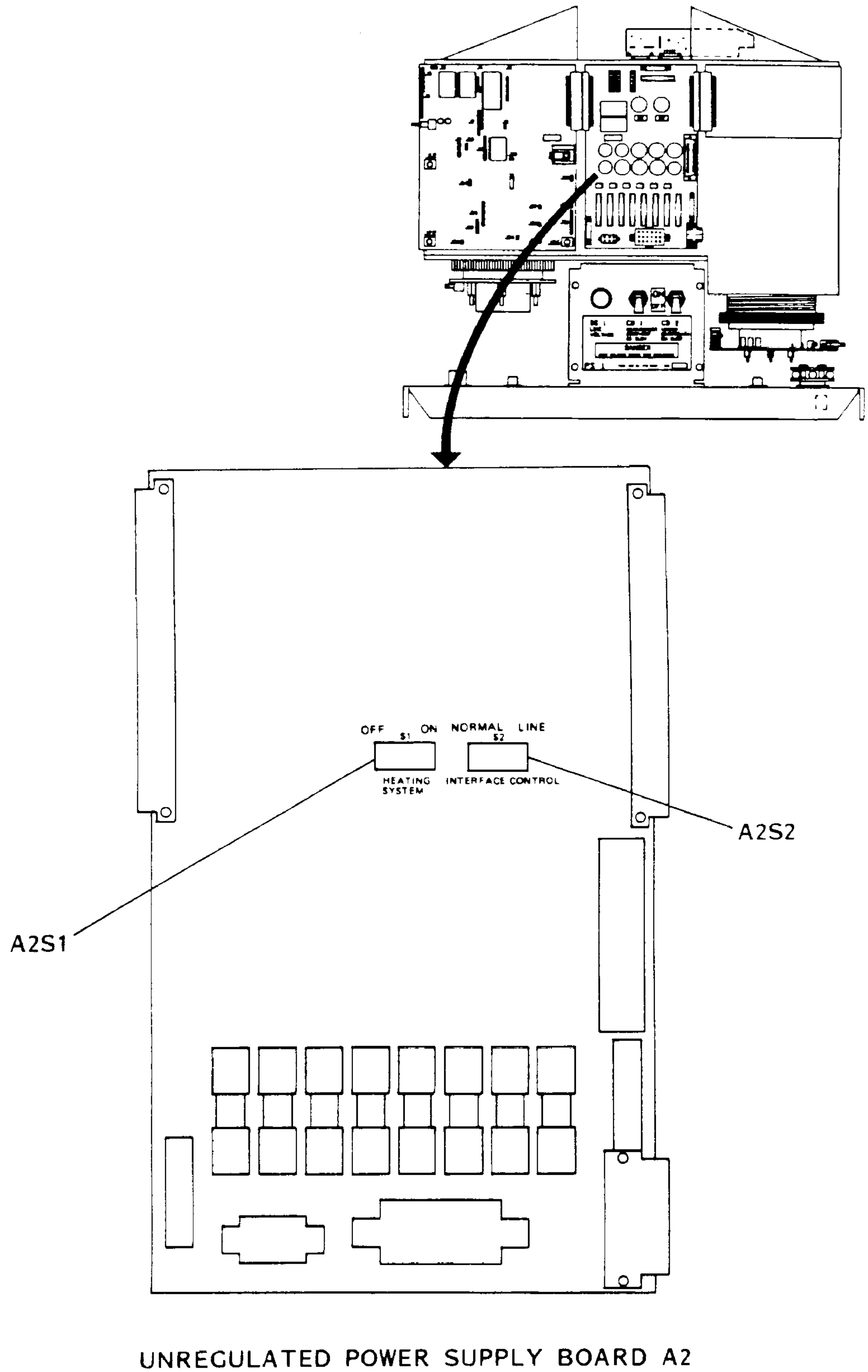


Figure 9.3.1. Ceilometer Controls and Indicators (Sheet 2)



UNREGULATED POWER SUPPLY BOARD A2

Figure 9.3.1. Ceilometer Controls and Indicators (Sheet 3)

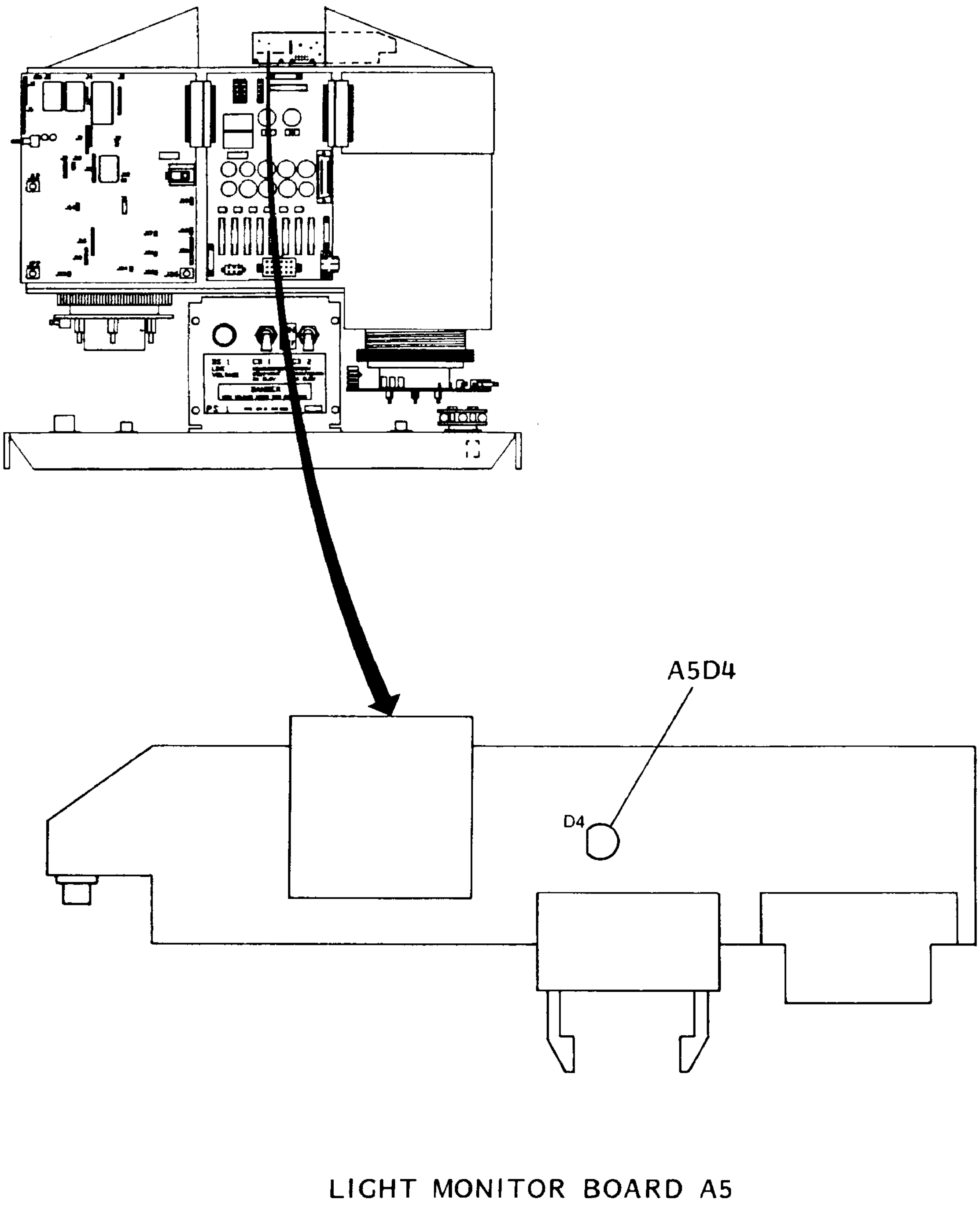


Figure 9.3.1. Ceilometer Controls and Indicators (Sheet 4)

Table 9.3.1. Ceilometer Controls and Indicators

Control/Indicator	Description	Normal Condition
PS1 CB1 ON/OFF	AC power circuit breaker	ON (up)
PS1 CB2 ON/OFF	Window conditioner ac power circuit breaker	ON (up)
PS1 DS1 LINE VOLTAGE	AC power indicator	On (illuminated)
A1S1	Reset/normal/(spare) switch	Normal = middle, Reset = up
A1D4	Processor alarm indicator	Normally off (extinguished)
A1D5	Processor OK indicator	Blinking once per second
A2S1 HEATING SYSTEM ON (auto)/OFF	Internal heating switch	ON (right)
A2S2 INTERFACE CONTROL NORMAL/LINE	Switch	NORMAL (left)
A5D4	Laser power indicator	Illuminates except if optional solar shutter is on

Table 9.3.2. Ceilometer Turn-On Procedures

Step	Procedure
1	Inside DCP equipment cabinet, set circuit breakers on ceilometer circuit breaker module to off (right) position.
2	At ceilometer, disconnect window conditioner cable from connector J2 on the underside of equipment cabinet assembly.
3	Loosen four knurled screws securing window conditioner to equipment cabinet assembly.
4	Lift window conditioner from equipment cabinet assembly and carefully place assembly on the ground.
5	Unfasten two latches at lower edge of ceilometer equipment cabinet assembly.
6	**CAUTION** The glass windows on the cover of the equipment cabinet assembly are specially manufactured optics. Damage to these windows, including scratches and cracks, may result in operational failure of the ceilometer. Carefully lift cover from equipment cabinet assembly and place cover on the ground.
7	Verify that all interface cables other than the window conditioner power supply cable are connected properly to the underside of equipment cabinet assembly.
8	Observe that LINE VOLTAGE indicator PS1 DS1 is extinguished.
9	Set MEASUREMENT EQUIPMENT circuit breaker PS1 CB1 and WINDOW CONDITIONER circuit breaker PS1 CB2 to OFF position.
10	Inside DCP equipment cabinet, set circuit breakers on ceilometer circuit breaker module to on (left) position.
11	At ceilometer, observe that LINE VOLTAGE indicator PS1 DS1 is illuminated, indicating the application of ac power.

Table 9.3.2. Ceilometer Turn-On Procedures -CONT

Step	Procedure
12	Set MEASUREMENT EQUIPMENT circuit breaker PS1 CB1 to ON position and observe the following: a. Processor alarm indicator A1D4 illuminates for approximately 5 seconds, indicating that a system reset is in progress. b. After processor alarm indicator A1D4 extinguishes, processor OK indicator A1D5 begins blinking approximately once each second to indicate that system software is operating.
13	Inside DCP equipment cabinet, set circuit breakers on ceilometer circuit breaker module to off (right) position.
14	At ceilometer, observe that LINE VOLTAGE indicator PS1 DS1 is extinguished.
15	Set WINDOW CONDITIONER circuit breaker PS1 CB2 to ON position.
16	**CAUTION** Glass windows on equipment cabinet assembly cover are specially manufactured optics. Damage to these windows, including scratches and cracks, may result in ceilometer operational failure. Install cover on ceilometer equipment cabinet assembly and secure two latches.
17	Install window conditioner on equipment cabinet assembly and tighten four knurled screws securing window conditioner.
18	Connect window conditioner cable to connector J2 on the underside of equipment cabinet assembly.
19	Inside DCP equipment cabinet, set circuit breakers on ceilometer circuit breaker module to on (left) position.

Table 9.3.3. Ceilometer Turnoff Procedures

Step	Procedure
1	Inside DCP equipment cabinet, set circuit breakers on ceilometer circuit breaker module to off (right) position.
2	At ceilometer, disconnect window conditioner cable from connector J2 on the underside of equipment cabinet assembly.
3	Loosen four knurled screws securing window conditioner to equipment cabinet assembly.
4	Lift window conditioner from equipment cabinet assembly and carefully place assembly on the ground.
5	Unfasten two latches at lower edge of ceilometer equipment cabinet assembly.
6	**CAUTION** Glass windows on equipment cabinet assembly cover are specially manufactured optics. Damage to these windows, including scratches and cracks, may result in ceilometer operational failure. Carefully lift cover from equipment cabinet assembly and place cover on the ground.
7	Observe that LINE VOLTAGE indicator PS1 DS1 is extinguished.
8	Set MEASUREMENT EQUIPMENT circuit breaker PS1 CB1 and WINDOW CONDITIONER circuit breaker PS1 CB2 to off (right) position.

9.3.5.1 **Startup Message**. Upon startup, the ceilometer automatically performs a series of self-tests during its initialization sequence. The results of these tests and ceilometer operating status are reported in a data message. A sample startup message is provided on figure 9.3.2.

9.3.5.2 **Digital Message No. 2**. This message contains the measured cloud return and internal monitoring data that are the normal sensor output for the ASOS configuration. The message is output every time that the DCP polls the ceilometer. The same message is output in response to the SEND 2 and MES commands in maintenance mode. The message consists of 13 lines and is shown on figure 9.3.3.

9.3.5.3 **Digital Message No. 3**. This message consists of status line 1 (identical to that described for digital message No. 2) and one single range gate data line indicating the presence or absence of backscatter in the range gate. This message is output in response to the SEND 3 command in maintenance mode. The message format is shown on figure 9.3.4.

```
VAISALA CT12K VERSION 2.46 SN:97023   DATA MEMORY OK
SEQUENCE OK
?
EEPROM OK

CT12K STATUS
00 ///// ///// ///// ///// 0000000010
POWER STATUS
P10D   8.5 P20I 21.1  M201 -20.4 P25V 27.3
M20A -20.6 P20A 19.3  P12M  12.9 P10X 9.8
PXHV 140   P10R 10.1  MRHV -380
SIGNAL STATUS
LLAS   145 LSKY     0 GND      0
TEMPERATURE STATUS
TL     30 TE     18 TI     32 TB     20
HEATER OFF
BLOWER OFF
AUTOMATIC MODE
GAIN 0
LASER FREQUENCY 3
```

NOTE

All values shown are for sample purposes only. Values for version, serial number, and parameters may vary from unit to unit.

Figure 9.3.2. Sample Startup Message

Message format: <status data line 1>
<status data line 2>
<data table line 1>
<data table line 2>
!
!
<data table line 13>

Status Data Line 1 format:

$NSB\_H_1H_1H_1H_1H_1\_T_1T_1T_1T_1T_1\_H_2H_2H_2H_2H_2\_T_2T_2T_2T_2T_2\_S_1S_2S_3S_4S_5S_6S_7S_8S_9S_{10}$

N =0 No significant backscatter (clear sky)
N =1 One layer detected
N =2 Two layers detected
N =3 Sky is fully obscured but no cloud base can be detected from echo signal received (e.g., fog or precipitation)
N =4 Sky is partially obscured and no cloud base is detected

S = 0 No alarm status bits S1...S4 ON for more than 5 minutes
S = 1 At least one alarm status S1...S4 ON for more than 5 minutes

B =_ Space if S = 0

B = 'bel' character if S = 1. Because 'bel' is a nonprinting character, the alarming line appears one character shorter in a printout than normally.

N = 0 or 4: $H_1=H_2=T_1=T_2$ = ///// (not defined)

N = 1 or 2: $H_1H_1H_1H_1$H1= Lowest detected cloud height in 5 digits. Leading zeros not suppressed.

$T_1T_1T_1T_1T_1$ = Range of backscatter of first layer; ///// if not defined

N = 2: $H_2H_2H_2H_2H_2$ = Second cloud height; ///// if not defined

$T_2T_2T_2T_2T_2$ = Range of backscatter of second layer; ///// if not defined

N = 3: $H_1H_1H_1H_1H_1$ = Calculated vertical visibility

$T_1T_1T_1T_1T_1$ = Signal range (i.e., height of highest detected backscatter)

STATUS INDICATORS:

S_1 = 1: Hardware alarm
S_2 = 1: Supply Voltage alarm
S_3 = 1: Laser power low
S_4 = 1: Temperature alarm
S_5 = 1: Solar shutter On
S_6 = 1: Blower On
S_7 = 1: Heater On
S_8 = 0: Unit is feet
1: Unit is meters
S_9 = 1: Not used (permanently set to 1)
S_{10} = 1: Polling Mode on

Figure 9.3.3. Digital Message No. 2 (Sheet 1 of 2)

Status Data Line 2 format:

G_F_N.NN_SUM_IIN_LAS_TL.x_OF.FS_XX_PP

G = 0 Gain used is 250
G = 2 Gain used is 930
F = 0 Laser pulse frequency used is 620 Hz (minimum)
!
!
!
F = 7 Laser pulse frequency is 1120 Hz (maximum)

N.NN = Noise RMS voltage is units of ADC increments, computed from the latest 12 s measurement period. One digit, two decimals.

SUM = Sum of total backscattered power per unit solid angle (i.e., range and instrument normalization applied). Three digits, no decimals. Leading zeros replaced by space characters.

IIN = Algorithm related internal processing information. Three digits.

LAS = Measured Laser Power in units of ADC increments (LLAS). Three digits.

TL.x = Internal variable indicating transmitter temperature. Two digits, one decimal; preceded by minus sign if negative. Degrees Celsius.

OF.FS = Offset of zero signal relative to Data Table minimum (=0), in units of ADC increments. Two digits, two decimals.

XX = Algorithm related internal processing information. Two digits.

PP = A 2-digit number representing calculated extinction coefficient values of 10 lowest range gates (0...500 ft). This 2-digit number determines if the obscuration is ground based.

Data Table Line format:

$HHD_0D_1D_2D_3$ ....D_{19}

Data scaled to hexadecimal number 0...FE (decimal 0...254). Overflow indicated by FF. Leading zero replaced by space character.

Data values are presented for each 50 ft range gate.

Height of first value in line in thousands of feet. Two digits; leading zero replaced by space. Twenty 50 ft values per line starting with 0 ft, next line 1000 ft. 13 lines altogether. Last line (12,000 ft) has 10 values.

Sample Message:

10_04200_00150_/////_/////_0000011010 (Status Data Line 1)

2_3_0.08_36_12_168_23.9_4.56_20_10 (Status Data Line 2)

_0DD...................DD (Data Table Line 1)
_1 !
_2 !
_3 !
_4 !
_5 !
_6 (DATA VALUES) !
_7 !
_8 !
_9 !
10 !
11 !
12DD.............DD (Data Table Line 13)

Figure 9.3.3. Digital Message No. 2 (Sheet 2)

Message format: <status data line 1>
<backscatter data line>

Status Data Line 1 format:

$NSB\_H_1H_1H_1H_1H_1\_T_1T_1T_1T_1T_1\_H_2H_2H_2H_2H_2\_T_2T_2T_2T_2T_2\_S_1S_2S_3S_4S_5S_6S_7S_8S_9S_{10}$

N = 0 No significant backscatter (clear sky)
N = 1 One layer detected
N = 2 Two layers detected
N = 3 Sky is fully obscured but no cloud base can be detected from echo signal received (e.g., fog or precipitation)
N = 4 Sky is partially obscured and no cloud base is detected

S = 0 No alarm status bits S1...S4 ON for more than 5 minutes
S = 1 At least one alarm status S1...S4 ON for more than 5 minutes

B = _ Space if S = 0

B = 'bel' character if S = 1. Because 'bel' is a nonprinting character, the alarming line appears one character shorter in a printout than normally.

N = 0 or 4: $H_1=H_2=T_1=T_2$ = ///// (not defined)

N = 1 or 2: $H_1H_1H_1H_1H_1$ = The lowest detected cloud height in 5 digits. Leading zeros not suppressed.

$T_1T_1T_1T_1T_1$ = Range of backscatter of first layer; ///// if not defined

N = 2: $H_2H_2H_2H_2H_2$ = Second cloud height; ///// if not defined

$T_2T_2T_2T_2T_2$ = Range of backscatter of second layer; ///// if not defined

N = 3: $H_1H_1H_1H_1H_1$ = Calculated vertical visibility

$T_1T_1T_1T_1T_1$ = Signal range (i.e., height of highest detected backscatter)

STATUS INDICATORS:

S_1 = 1: Hardware alarm
S_2 = 1: Supply Voltage alarm
S_3 = 1: Laser power low
S_4 = 1: Temperature alarm
S_5 = 1: Solar shutter On
S_6 = 1: Blower On
S_7 = 1: Heater On
S_8 = 0: Unit is feet
1: Unit is meters
S_9 = 1: Not used (permanently set to 1)
S_{10} = 1: Polling Mode on

Figure 9.3.4. Digital Message No. 3 (Sheet 1 of 2)

Backscatter Data Line format:

$D_1D_2D_3D_4$..................D_{64}

D_n Where n=1 to 64 is single ASCII-coded hexadecimal character 0...F where each bit of the 4-bit nibble of the hex character expressed in binary form represents one range gate.

With EMOD ON, range gate bit is 1 if ceilometer determined extinction coefficient at that range gate exceeds a value corresponding to a horizontal visibility of approximately 10 km (6 miles) except for three lowest range gates which have higher thresholds.

D_1 represents the four lowest 50 ft range gates (i.e., 0 ft, 50 ft, 100 ft, 150 ft), D_2 represents the four next 50 ft range gates (i.e., 200 ft, 250 ft, 300 ft, 350 ft), etc.

For example:

0 (0000) indicates no detectable backscatter in four adjacent range gates.
F (1111) indicates backscatter in all four range gates.
8 (1000) indicates backscatter in the lowest range gate only.
1 (0001) indicates backscatter in the highest range gate only.

All other characters indicate a gate-by-gate combination of backscatter according to the binary nibble, converted to hexadecimal.

Sample Message:

```
10_04200_00150_/////_/////_0000011010      (Status Data Line 1)
0001FFF80000000000007A000.. ..000          (Backscatter Data Line)
```

Figure 9.3.4. Digital Message No. 3 (Sheet 2)

9.3.6 CEILOMETER DIRECT DIALOGUE COMMANDS

9.3.6.1 **Introduction**. The maintenance procedures for the ceilometer rely heavily on the sensor's diagnostic capability. The maintenance technician is provided with the capability to communicate directly with the ceilometer's microprocessor to issue commands and receive messages. This function is referred to as direct dialogue mode. Direct dialogue mode can be invoked from the operator interface device (OID) ceilometer page using the DIALG key select. From this point, the technician can issue commands (ENTER COMMAND area) and receive (Direct Dialogue Message Received) messages using the OID. Technicians should be patient when operating in dialogue mode from an OID. The processing of some commands may take up to 90 seconds. Chapter 1 provides additional information on using direct dialogue mode from the OID. The technician uses direct dialogue mode to control and monitor the ceilometer locally.

9.3.6.2 **Line Open and Line Closed**. A single serial data interface is used for both ceilometer measurement data reports and maintenance communications with the sensor. To distinguish between these two uses, the interface has two states:

LINE CLOSED - Normal operation state. This is the default state upon power up. Measurement data messages are transmitted automatically when sensor is in Automatic Mode (paragraph 9.3.6.3). All commands other than SEND <CR> and OPEN <CR> (to OPEN the line) are ignored.

LINE OPEN - Direct dialogue mode. Ceilometer accepts and executes all commands entered at the > prompt.

The following examples show the command syntaxes and ceilometer responses for opening and closing the line:

Line Opened for Direct Dialogue	Line Closed for Normal Operation
`<ENTER>`	`>CLOS`
`LINE OPENED FOR OPERATOR COMMANDS`	`LINE CLOSED`
	`(measurement data messages resume)`
`>(ready for input)`	

NOTE

In Automatic Mode (paragraph 9.3.6.3), the line automatically closes if no entries are made within 1 minute.

Line may be opened in the middle of a message; however, the > prompt does not appear until the current message display is completed.

9.3.6.3 **Automatic Mode and Maintenance Mode**. There are two basic operating modes to the ceilometer:

Automatic Mode - There are two options under Automatic Mode:

Polling Mode Off (PMOD OFF): A measurement cycle and data message report is output at specified intervals. Internal monitoring and controls are updated every 15 seconds. The digital data messages are not displayed if the line is opened for direct dialogue.

Polling Mode On (PMOD ON): This is the normal operating mode for the ASOS ceilometer. The measurement cycles and internal monitoring function normally. Data outputs only occur when a SEND command is received by the sensor (from the DCP).

Maintenance Mode - Used for checking sensor operation. Measurement cycles are halted. Internal settings and controls may be operated and checked using specific commands.

The following examples show the command syntaxes and ceilometer responses for invoking the ceilometer operating mode:

To Invoke Maintenance Mode	To Invoke Automatic Mode
`>AUTO OFF`	`>AUTO ON`
`WAIT FOR SEQUENCE STOP`	`AUTOMATIC MODE`
`MAINTENANCE MODE`	`>(ready for next input)`
`>(ready for next input)`	

NOTE

The current measurement cycle is completed before switching to Maintenance Mode. The mode selected remains in effect over a sensor power down or restart.

9.3.6.4 **Command Descriptions**. The following paragraphs describe each of the commands available to the maintenance technician for use in direct dialogue with the ceilometer. Each command is briefly described, although only a few are of practical use to the maintenance technician due to the ASOS configuration. The use of these commands for troubleshooting and maintenance purposes is provided specifically in the maintenance section of this chapter.

9.3.6.4.1 **AUTO (ON/OFF)**. This command is used to define the operating mode of the ceilometer. Automatic mode is the normal operating mode and is automatically selected by the ASOS system software during normal operation. The maintenance technician can also select this mode by entering AUTO ON. As previously described (paragraph 9.3.6.3), the polling mode option can be either on or off while the sensor is in automatic mode. For the ceilometer to operate with ASOS, the polling mode option must be set to on using the PMOD command (paragraph 9.3.6.4.2). AUTO OFF is used to select the maintenance mode of operation for the ceilometer. This mode allows the technician to perform sensor checks and operations manually. During maintenance mode, the normal measurement cycle is halted and no measurement reports are generated. The maintenance mode also doubles as the standby mode so that the ceilometer halts operations until further commands are entered.

9.3.6.4.2 **PMOD (ON/OFF)**. This command allows the technician to turn polled mode on and off. The polled mode option is a subset of Automatic Mode (paragraph 9.3.6.3). For ASOS operation, polled mode must be set to on. In this case, the ceilometer outputs data only in response to SEND command requests (polls) from the DCP. When polled mode is turned off, the ceilometer automatically outputs data at regular intervals.

9.3.6.4.3 **STA**. This command allows the technician to request a status report from the ceilometer and is used to obtain more detailed information from the ceilometer when an alarm is reported at the ceilometer OID display. The status data display reports the monitored voltage levels, signal and temperature levels, heater and blower status, operating mode, receiver gain, and laser pulse repetition frequency. An asterisk (*) immediately following any value on the status data display indicates an alarm value. A sample of the STA command display is shown on figure 9.3.5.

```
>STA
CT12K STATUS

00 ///// ///// ///// ///// 0000000010
POWER STATUS
P10D   8.5 P20I 21.5  M20I -20.7 P25V 27.9
M20A -20.9 P20A 19.3  P12M  13.1 P10X  9.9
PXHV 140   P10R 10.2  MRHV -382

SIGNAL STATUS
LLAS  155   LSKY  1     GND    0
TEMPERATURE STATUS
TL    30    TE    20    TI    34    TB    22
HEATER OFF
BLOWER OFF
AUTOMATIC MODE
GAIN 2
LASER FREQUENCY 3
>(next input)
```

NOTE
All values shown are for sample purposes only.

Figure 9.3.5. Status (STA) Command Display

9.3.6.4.4 **ALIM**. This command allows the technician to request the alarm limit message. Alarms are generated by comparing measured values against the alarm limit values. Voltage levels produce alarms when the measured voltage is below the alarm limit voltage value. Temperatures (in degrees Celsius) produce alarms when the measured value exceeds the limit value. The laser power level is in units of the analog-to-digital (A/D) converter circuit and produces an alarm when the measured value is less than the limit value. The sky light power level is of no practical significance and is allowed to be the full range of 0 through 255. The electrical ground reference is measured for self-test purposes and produces an alarm if the measured value exceeds the alarm limit value. The alarm limit values for all of the displayed values can be temporarily changed using the ALIM command. ALIM is entered, followed by the alarm limit to change, followed by the new value. For example, to change the external temperature alarm value to 105 degrees, the following command is entered: ALIM TE 105. Alarm limits that are changed in this manner are temporary; they are not retained by the system. Limits are returned to the default values by resetting the ceilometer or cycling power to the ceilometer. An example of the ALIM command display is shown on figure 9.3.6.

```
>ALIM
ALARM LIMITS
POWER LIMITS

P20I  15.0  P10X  7.5   M20A  15.0  P10R   7.0
MRHV  -150  P12M  8.0   P10D   6.0  P25V  20.0

PXHV  52    P20A 15.0   M20I -15.0
SIGNAL LIMITS

LLAS  155   LSKY  255   GND      4
TEMPERATURE LIMITS
TI    100 TE      100   TL      70  TB    80

>ALIM PXHV  54
NEW LIMIT         54.0

>(ready for input)
```

NOTE
All values shown are for sample purposes only.

Figure 9.3.6. Alarm Limits (ALIM) Command Display

9.3.6.4.5 **LASE (ON/OFF)**. This command controls the laser enable signal to the laser transmitter. This command is only possible in maintenance mode. LASE OFF disables the laser trigger enable signal, which prevents the ceilometer from transmitting. LASE ON enables the laser trigger signal to be generated; however, the SEQ command is also required to provide the timing sequence signals for a transmission. The command is automatically cleared after each measurement cycle. An example of the LASE command display is shown on figure 9.3.7.

```
>LASE ON
LASER IS ENABLED

>(ready for input)
```

Figure 9.3.7. Laser Control (LASE) Command Display

9.3.6.4.6 **SEQ (ON/OFF**). The SEQ command controls the timing sequence generator circuit of the ceilometer. This command is only possible in maintenance mode. SEQ OFF disables the sequence generator and thereby halts the transmit and receive cycles. SEQ ON enables the sequence generator to produce the required timing signals; however, transmission cycles also require the LASE command to output laser pulses. The command is automatically cleared after each measurement cycle. An example use of the SEQ command display is shown on figure 9.3.8.

```
>SEQ ON
SEQ ON

>(ready for input)
```

Figure 9.3.8. Sequence Control (SEQ) Command Display

9.3.6.4.7 **FREQ**. This command is used to check and specify the pulse repetition frequency for the laser pulse transmissions. The command may only be used in maintenance mode. The frequency is selected by entering a number (from 0 to 7) after the FREQ command. Entering the command alone allows the current frequency to be displayed. An example of the FREQ command display is shown on figure 9.3.9.

```
>FREQ
LASER FREQ COUNT 2
>FREQ 5
LASER FREQ COUNT 5
>(next input)
```

NOTE

The allowable values for selecting the ceilometer nominal frequencies are:

Number	Frequency (in Hz)
0	620
1	660
2	710
3	770
4	830
5	910
6	1000
7	1120

Figure 9.3.9. Frequency Control (FREQ) Command Display

9.3.6.4.8 **GAIN (0/2)**. This command specifies the gain of the receiver measurement amplifier. GAIN 0 specifies a gain of 250; GAIN 2 specifies a gain of 930. When the GAIN command alone is entered, the present gain (0 or 2) is returned. This command is only available in maintenance mode. An example of the GAIN command display is shown on figure 9.3.10.

```
>GAIN
GAIN SELECT
0
>GAIN 2
GAIN SELECT
2
>(ready for input)
```

Figure 9.3.10. Receiver Gain Control (GAIN) Command Display

9.3.6.4.9 **HEAT (ON/OFF)**. This command allows the technician to interrogate and control the operation of the window conditioner heater. When the HEAT command alone is entered, the present status (heater on or heater off) of the window conditioner is returned. The HEAT OFF command forces the heater off; HEAT ON forces the heater on. The HEAT ON command, however, only functions if the window conditioner blower is on. An example of the HEAT command display is shown on figure 9.3.11.

```
>HEAT
HEATER OFF

>HEAT ON
HEATER ON

>(ready for input)
```

Figure 9.3.11. Heater Control (HEAT) Command Display

9.3.6.4.10 **BLOW (ON/OFF)**. This command allows the technician to interrogate and control the operation of the window conditioner blower. When the BLOW command alone is entered, the present status (blower on or blower off) of the window conditioner is returned. The BLOW OFF command forces the blower unit off; BLOW ON forces the blower on. The BLOW OFF command also disables the window conditioner heater to protect the sensor from overheating. An example of the BLOW command display is shown on figure 9.3.12.

```
>BLOW
BLOWER OFF

>BLOW ON
BLOWER ON

>(ready for input)
```

Figure 9.3.12. Blower Control (BLOW) Command Display

9.3.6.4.11 **SHUT (ON/OFF)**. This command is used to interrogate and control the optional solar shutter of the ceilometer. When the SHUT command alone is entered, the present status (shutter on or shutter off) of the solar shutter is returned. The SHUT OFF command forces the solar shutter open; SHUT ON forces the shutter closed. If the ceilometer is not equipped with the optional solar shutter, the message NO SHUTTER is returned. An example of the SHUT command display is shown on figure 9.3.13.

```
>SHUT
SHUTTER IS OFF
>SHUT ON
SHUTTER IS ON

>(ready for input)
```

NOTE

In Automatic Mode, the command is canceled within 15 seconds due to the automatic operation sequence.

The SHUT OFF cannot cancel an ON state controlled by Light Monitor Board A5.

If ceilometer is not equipped with optional solar shutter, message NO SHUTTER is returned.

Figure 9.3.13. Solar Shutter Control (SHUT) Command Display

9.3.6.4.12 **TIME (HH MM SS)**. This command is used to interrogate and set the ceilometer's internal clock. The time is entered in the following format: HH MM SS

where: HH = Hours (0 to 23)
MM = Minutes (0 to 59)
SS = Seconds (0 to 59)

Spaces are used to separate the number groups, and the seconds group can be omitted. The time counting starts from zero following a system reset or cycling of power. The clock does not need to be set for the ceilometer to operate properly.

9.3.6.4.13 **DATE (YYYY MM DD)**. This command is used to interrogate and set the ceilometer's internal calendar. The date is entered in the following format: YYYY MM DD

where: YYYY = Year (four digits, such as 1990)
MM = Month (1 to 12)
DD = Day (1 to 31)

Spaces are used to separate the number groups. The system automatically accounts for leap years. The date starts from zero following a system reset or cycling of power. The calendar does not need to be set for the ceilometer to operate properly.

9.3.6.4.14 **RESE**. This command allows the technician to reset the ceilometer. The command halts all operations of the ceilometer and in approximately 5 seconds, initializes the ceilometer to the startup sequence.

9.3.6.4.15 **CAL (time**). This command is used to perform offset calibration for the ceilometer. The offset calibration is required following the replacement of any parts of the ceilometer. The time field specified is in seconds, with values from 120 to 240 recommended. The ceilometer performs an automatic calibration sequence for the time interval, stores the values in electrically erasable programmable read-only memory (EEPROM), and displays the values. Instructions for using this command are provided in Section V.

9.3.6.4.16 **HELP**. This command results in a display of the ceilometer command set. The commands TAB, GRAP, CAL, SERN, and SEND are not listed. Each command is followed by a brief description of its function. An example of the HELP command display is shown on figure 9.3.14.

```
>HELP
VAISALA CT 12K VERSION 2.46 SN: 87023

TIME       (HH MM(SS))
DATE       (YYYY MM DD)
MES        AUTOMATIC DATA MESSAGE
PAR        DISPLAY PARAMETERS
STA        STATUS MESSAGE
CONF       SYSTEM CONFIGURATION
CLIM       <LIMIT> CLOUD LIMIT
SLIM       <LIMIT> SIGNAL LIMIT
DEV        SET/DISPLAY DEVICE SCALE
TOTAL      <SIGNAL SUM> SET /DISPLAY THE NORMALIZED SIGNAL SUM LIMIT
NSCA       SET/DISPLAY NOISE SCALE
SCAL       SET/DISPLAY OUTPUT SCALE
LNOR       SET/DISPLAY THE LASER POWER NORM
PMOD       ON/OFF POLLING MODE
AUTO       ON/OFF AUTOMATIC MODE
BAUD       <RATE> SET/DISPLAY BAUD RATE (300, 1200, OR 2400)
RESET
LASE       ON/OFF LASER ENABLE DISABLE
SEQ        ON/OFF SEQUENCE START STOP
MEAS       <TIME S> LASER MEASUREMENT
HOFF       <HEIGHT> SET/DISPLAY OFFSET VALUE FOR THE MEASURED HEIGHTS
FREQ       0...7 SET/DISPLAY LASER PULSE FREQUENCY
NOIS       SAMPLE NOISE DISPLAY
AN         0...17 ANALOG TEST
GAIN       SELECT GAIN 0/2
HEAT       ON/OFF BLOWER HEATER CONTROL
BLOW       ON/OFF BLOWER CONTROL
SHUT       ON/OFF SOLAR SHUTTER MANUAL CONTROL
ALIM       <ID><VALUE> SET/DISPLAY ALARM LIMITS
RECT       RECORDER TEST OUTPUT UNTIL ESC
```

NOTE
Software version and serial number display may vary from those shown.

Figure 9.3.14. Help Message (HELP) Command Display

9.3.6.4.17 **MEAS (time)**. This command is used to manually force the ceilometer to take measurement samplings for the time specified. This command is only available in maintenance mode. The time field is specified in seconds, with 1 second the default value if none is specified. Upon completion of the measurement sequence, the raw range gate data values are available in table 0 of the ceilometer. The TAB command can be referenced for information on this table. An example of the MEAS command display is shown on figure 9.3.15.

```
>MEAS 12
BACK SCATTERED POWER
(12 sec. terminal inactivity)
INPUT DATA AV        15.9488

>(ready for input)
```

NOTE
Values shown are for example purposes only.

Figure 9.3.15. Measurement (MEAS) Command Display

9.3.6.4.18 **TAB n (si ci)**. This command displays the contents of the ceilometer internal data tables. The value specified in the field n selects the data table as follows:

n	Data table
0	Raw data in flash A/D converters
1	Intermediate calculation table
2	Final range and instrument normalized data values
3	Static offset data table
4	Instrument-only normalized data table

The si entry specifies the starting index (range from 0 to 253) that corresponds to the 50-foot range gate number from which output data start. Zero is the default value if none is specified. The ci entry specifies the cycling index (1 to 254) that corresponds to the number of range gates selected for continuous cyclic output. If not specified, the output is once. When specified, the output cycles continuously until aborted by the ESC key. The output of the table starts with the latest cloud heights and penetration in the form in Digital Message Status Line 1. Non-cloud obstruction heights are not indicated. Output lines contain the height of the first sample in the line, followed by five samples. An example of the TAB command display is shown on figure 9.3.16.

```
>TAB 3 17 13
LASER PULSE COUNT     10907
///// ///// ///// /////
850 16.0043 16.0010 15.9978 15.9945 15.9913
1100 15.9880 15.9848 15.9815 15.9783 15.9750
1350 15.9745 15.9740 15.9735

///// ///// ///// /////
850 16.0043 16.0010 15.9978 15.9945 15.9913
1100 15.9880 15.9848 15.9815 15.9783 15.9750
1350 15.9745 15.9740 15.9735

///// ///// ///// /////
850 16.0043 16.0010 15.9978 15.9945 15.9913

<ESC>
>(ready for input)
```

NOTE
All values shown are for sample purposes only.

Figure 9.3.16. Data Tables (TAB) Command Display

9.3.6.4.19 **GRAP n (sc si ic**). This command produces a semigraphic output of the internal measurement data. The n field specifies the data table to be graphed (refer to TAB command). The sc field is the scaling factor that specifies how many horizontal character positions equal the value 1.0000 in the table. If none is specified, 200 is the default value. The si field is the start index, which is the same as for si for the TAB command. If si is not specified, 10 (500 feet) is the default value. The ic field is the index counter (from 0 to 254) that specifies how many range gates (50-foot increments) are displayed. If not specified, the output is to end of range. Output is only once, with no cycling available. Output may be aborted using the ESC key. The display of range gate data is output one gate per line, starting from the start index. Each line contains the height points, one per character position, and an asterisk (*) as a mark for the data value of that range gate. An example of the GRAP command display is shown on figure 9.3.17.

```
>GRAP 0 100 0 12
  0 .......*
 50 *
100 ..............*
150 *
200 ....*
250 .......*
300 ..............*
350 ..............*
400 ....*
450 ....*
500 .......*
550 .........*

>(ready for input)
```

NOTE
All values shown are for sample purposes only.

Figure 9.3.17. Graphic Output (GRAP) Command Display

9.3.6.4.20 **MES**. This command outputs the data message from the ceilometer. In automatic mode, the message is that of the last completed measurement. In maintenance mode, a correctly formatted message is output, but only internal monitoring data are updated. The MEAS command is required to update the measurement data.

9.3.6.4.21 **PAR**. This command allows the technician to view the ceilometer system parameters. The resulting display shows each of the parameters, followed by its command and value. An example of the PAR command display is shown on figure 9.3.18. The value of any parameter is changed by entering the corresponding parameter command and the selected value or state. These parameters become stored in nonvolatile memory in the ceilometer and become the default values used by the system following a reset or cycling of power. Descriptions and examples for each parameter are provided in table 9.3.4.

```
>PAR
SYSTEM PARAMETERS
CLOUD LIMIT     CLIM       0.1000
SIGNAL LIMIT    SLIM       0.2000
DEVICE SCALE    DEV        1.2400
NOISE SCALE     NSCA       4.5000
OUTPUT SCALE    SCAL       100.0000
LASER NORM      LNOR       164
TOTAL SIGNAL    TOTAL      10.0000

HEIGHT OFFSET   HOFF       0
DATA UNIT FT

POLLED MESSAGES, PMOD ON
```

NOTE
Standard values are shown for example purposes; actual values may vary.

Figure 9.3.18. Parameter (PAR) Command Display

Table 9.3.4. Ceilometer Parameters

Parameter	Definition	Description
CLIM	Cloud limit	Sets the minimum increase in calculated extinction coefficient in ceilometer specific units that must be present over a short range for cloud base condition.
	EXAMPLE:	>CLIM CLOUD LIMIT CLIM 0.1600 >CLIM .1 CLOUD LIMIT CLIM 0.1000
SLIM	Signal limit	Sets the minimum in calculated extinction coefficient value in ceilometer specific units that must be present in one range gate for cloud base condition.
	EXAMPLE:	>SLIM SIGNAL LIMIT SLIM 0.2600 >SLIM .25 SIGNAL LIMIT SLIM 0.2500

Table 9.3.4. Ceilometer Parameters -CONT

Parameter	Definition	Description
DEV	Device scale EXAMPLE:	Multiplying scaling factor applied to all range gate values after normalization and prior to application of cloud detection algorithms and output. >DEV DEVICE SCALE DEV 1.20000 >DEV 1 DEVICE SCALE DEV 1.0000
NSCA	Noise scale EXAMPLE:	Multiplying scaling factor which, when multiplied with the RMS noise calculated from the 12-second measurement scan, sets the limit for discriminating between true signal and noise. Decreasing NSCA increases sensitivity but causes more noise hits. >NSCA NOISE SCALE NSCA 2.5000 >NSCA 3 NOISE SCALE NSCA 3.0000
SCAL	Scale EXAMPLE:	Multiplying scaling factor used to scale the value of PP. >SCAL OUTPUT SCALE SCAL 20.0000 >SCAL 10 OUTPUT SCALE SCAL 10.000
LNOR	Laser normal power level EXAMPLE:	Device specific parameter for 100% nominal laser power, in units of monitor A/D converter. Measured laser power (LLAS) is compared with this value for laser power control and measurement normalization. >LNOR LASER NORM LNOR 162 >LNOR 164 LASER NORM LNOR 164
TOTA	Total signal sum limit EXAMPLE:	Limit for determining full, partial, or no obscuration. For every 12-second scan, all range and equipment normalized range gate backscatter values are added to provide current signal sum (SUM). If SUM exceeds TOTA, full obscuration is concluded. If SUM is less than TOTA but greater than 0.4 x TOTA (40% of TOTA), partial obscuration is concluded. If SUM is less than 0.4 x TOTA, no significant obscuration is detected. >TOTA TOTAL SIGNAL LIMIT 6.00 CURRENT SIGNAL SUM 25.63 >TOTA 5 TOTAL SIGNAL LIMIT 5.00 CURRENT SIGNAL SUM 25.63

Table 9.3.4. Ceilometer Parameters -CONT

Parameter	Definition	Description
HOFF	Height Offset EXAMPLE:	Parameter for offsetting heights reported when ceilometer is installed considerably higher (positive value) or lower (negative value) than the desired level of interest (i.e., ceilometer is mounted on a rooftop, and the reports are to be in feet above runway ground level). The HOFF value must be in the same units as the data output (either feet or meters). >HOFF HEIGHT OFFSET HOFF 0
CONF	Configuration EXAMPLE:	Determines if the output is in feet (F) or meters (M) and indicates whether a solar shutter is installed (Y) or not (N). This command is interactive; i.e., the operator is prompted with questions. >CONF SELECT UNIT M/F ?F SHUTTER OPTION Y/N ?N END OF CONFIGURATION
SEND	Send message EXAMPLE:	Selects the digital signal message data output format (refer to paragraphs 9.3.5.2 and 9.3.5.3). >SEND AUTOMATIC MESSAGE: 3 >SEND 2 AUTOMATIC MESSAGE: 2 >SEND 2 AUTOMATIC MESSAGE: 2
AUTO	Automatic mode EXAMPLE:	Sets the ceilometer operating mode to automatic or maintenance mode (refer to paragraph 9.3.6.3). >AUTO MAINTENANCE MODE >AUTO ON AUTOMATIC MODE
PMOD	Polled mode EXAMPLE:	Sets the polled mode (subset of automatic mode) to on or off (refer to paragraph 9.3.6.3). For ASOS operator, polled mode should be ON. >PMOD ON POLLED MESSAGES, PMOD ON >PMOD OFF AUTOMATIC MESSAGES, PMOD OFF
SERN	Serial No. EXAMPLE:	Arbitrary serial number option. Only numbers from 0 to 999999 are allowed. Has no effect on operation. >SERN VAISALA CT 12K VERSION 2.44 SN:0 >SERN 87023 NEW VAISALA CT 12K VERSION 2.44 SN:87023

9.3.6.4.22 **AN (Channel)**. This command provides a continuous display output of analog monitored signals. The value displayed is the A/D converter output and is in the range of 0 to 255. Output is aborted using the ESC key. If no channel number is specified, the A/D converter internal self-test channel is displayed (normal value is 125 to 131). The channel number specifies which analog signal is monitored and displayed as follows:

Channel	Signal	Normal value
0	P20I	192 ±32
1	P20A	179 ±32
2	P25V	172 ±27
3	P10D	131 ±33
4	P10R	155 ±33
5	P10X	155 ±33
6	P12M	196 ±41
7	PXHV*	82 ±20
8	LLAS	77 to 230
9	LSKY	0 to 255
10	TE*	152 ±3
11	TB*	152 ±3
12	TI*	152 ±3
13	TL*	152 ±3
14	M20I	184 ±32
15	MRHV*	158 ±41
16	M20A	184 ±32
17	GND	0 to 1

* These voltages are temperature dependent and may vary from the given ranges depending on the installation temperature.

9.3.6.4.23 **NOIS**. This command provides a continuous output of the highest, average, and lowest receiver data measurement sample recorded after the final phase of the last completed scan. This gives the light noise levels detected by the receiver. The data displayed are in units of the A/D converter. Data updates are instantaneous in maintenance mode, and once every 12 seconds in automatic mode. The message output is terminated by the escape key <ESC>. An example of the NOIS command display is shown on figure 9.3.19.

```
>NOIS
NOISE MEASUREMENT
19   16   13
19   16   13
19   16   13
!
!
!
<ESC>
>(ready for input)
```

Figure 9.3.19. Noise (NOIS) Command Display

SECTION IV. THEORY OF OPERATION

9.4.1 INTRODUCTION

This section provides a detailed explanation of how the CT12K ceilometer functions to detect clouds, calculate their heights, and report the results. The operating theory is presented on two levels. The first level describes the principles of operation for the ceilometer and identifies the basic functional areas on a block diagram level. The second level describes the individual functional areas to a level of detail that enables isolation of a faulty field replaceable unit (FRU).

9.4.2 SIMPLIFIED BLOCK DIAGRAM DESCRIPTION

The following paragraphs describe the basic operation of the ceilometer and the basic physical principles used by the ceilometer during operation. A simplified block diagram including the ceilometer components is also provided to describe the basic system configuration and operation sequences.

9.4.2.1 **Principles of Operation**. The CT12K ceilometer operating principles are based on measuring the amount of time it takes a pulse of light to travel from the ceilometer transmitter through the atmosphere, reflect off a cloud, and return to the ceilometer receiver. By starting a timer when the transmitter outputs a pulse of light and stopping the timer when the receiver detects the reflected pulse return, the distance traveled by the pulse (at the speed of light) can be calculated. Because the total distance traveled includes a path from the transmitter to the cloud and back again, the actual height of the cloud (from the transmitter) is actually one-half of the total distance. The calculation can be expressed as: $h = ct/2$

where: h = Height of cloud
c = Speed of light (9.8356×10^8 feet/second)
t = Time from transmission to reception

Example: Cloud return detected 24.4 microseconds (μs) after transmission indicates a cloud at 12,000 ft.

In practical application, particles in the atmosphere reflect and scatter the transmitted light pulse. These particles (dust, smoke, or water droplets) have a degrading effect on the reception of the light pulse. However, these effects can also be useful in detecting the presence of fog or precipitation. Therefore, the signals transmitted and received are related as depicted on figure 9.4.1. The ceilometer compensates for the attenuation effects on the pulse due to particles in the atmosphere to minimize their influence. The CT12K ceilometer samples the return signal at a 100-nanosecond rate to cover a time frame of 25.4 μs. As a result, the ceilometer is able to detect clouds up to a height of 12,500 feet with a 50-foot resolution. This resolution is considered adequate since visibility within the densest clouds is on the order of 50 feet.

For safety and economic reasons, the laser power used by the ceilometer is so low that components of ambient light (noise) typically exceed the laser light pulse received at the ceilometer receiver. To overcome this problem, the ceilometer uses several transmission/reception cycles in its measurements and sums the results. As a result of this technique, the actual pulse return is strengthened in detection (because it is relatively constant), while the noise tends to cancel itself out (because it is random in nature). This concept is illustrated on figure 9.4.2, which shows three separate transmission and reception cycles. Sample 1 provides a relatively clean return, with the majority of the received signal due to the cloud return. Sample 2 provides a noisy return, where the cloud return is virtually indistinguishable from the noise. Sample 3 provides a moderate noise level, where the cloud return is presented amidst the noise. The sum of these three samples results in a significantly higher return signal level over only one range of time. This distinction in the sum is produced due to the cloud return component present in each sample as compared to the noise component, which varied in each sample. Compensations such as this are also applied to the samples to filter out returns due to other obstructions in the light pulse path.

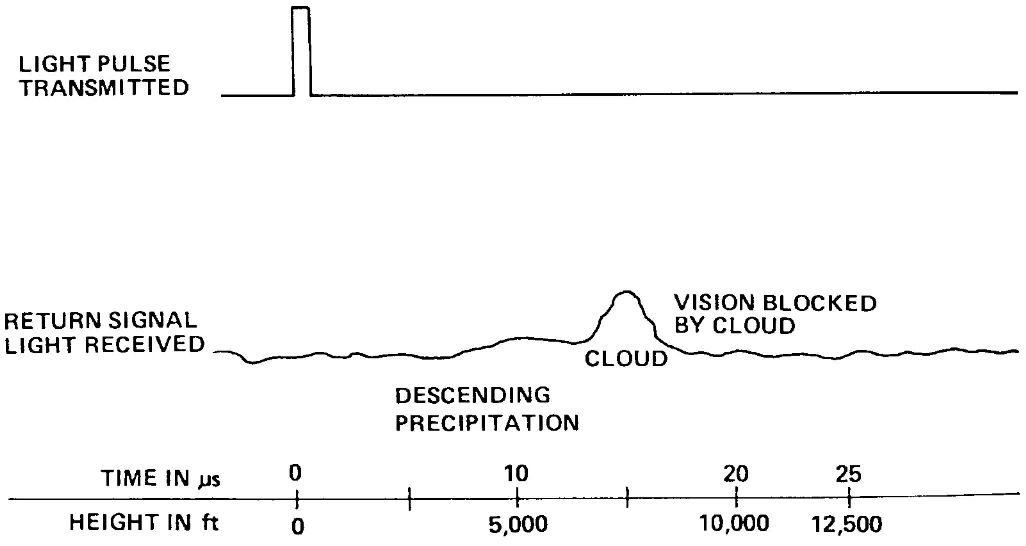


Figure 9.4.1. Ceilometer Laser Transmission/Reception Cycle

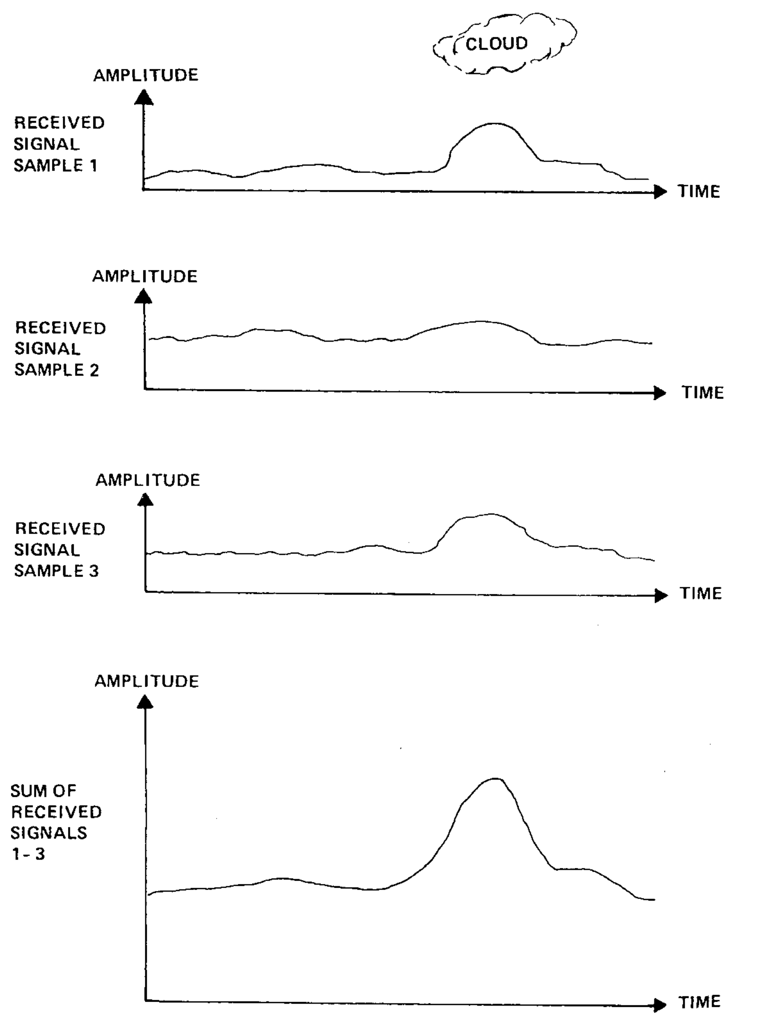


Figure 9.4.2. Received Signal Sampling Noise Cancellation

9.4.2.2 **Simplified Block Diagram Description**. A simplified block diagram of the CT12K ceilometer is provided on figure 9.4.3. The operation of the ceilometer is basically performed by seven functional areas: the measurement circuit, output interfaces, internal temperature control, internal monitoring, power supply section, window conditioner, and solar shutter option.

9.4.2.2.1 **Measurement Circuit**. The measurement circuit is the main operational part of the ceilometer and functions to actually measure the atmosphere. The measurement circuit involves the processor, its operational software, and its memory. The processor begins a measurement cycle by signaling the laser sequence control to issue a laser trigger pulse. The pulse frequency and duration are also specified. The laser transmitter executes the trigger signal to force a laser diode to emit a short, high intensity pulse of infrared single-wave radiation. The laser pulse is focused through the transmitter optics to produce a parallel beam. The laser power monitor senses the emitted laser pulse as it leaves the enclosure and outputs a voltage signal (back to the processor) that is proportional to the average power level of the laser. The emitted laser pulse then travels through the atmosphere and small amounts of the radiation are backscattered by any non-gaseous particles in the atmosphere. The reflected signals are then detected by the receiver.

The receiver optics are designed to focus the incoming light onto a silicon avalanche photodiode. Because only the wavelength of the transmitted pulse (904 nanometers (nm)) is needed, a filter built into the receiver circuit blocks out the majority of the extraneous signals. The photodiode converts the light signals into a small electrical current. The preamplifier in the receiver circuit converts this current into a larger voltage signal for easier processing by the system. Data acquisition circuitry in the measurement function contains another amplifier, an analog to digital (A/D) converter, and a sample accumulator circuit. At the same moment that the transmitter emits a pulse, the data acquisition circuit is initialized to start sampling the received light. The received light is converted to an electrical voltage signal by the receiver and sampled by the A/D converter to produce a digital value. This digital value is then stored in the sample accumulator and the next sample is processed. As a result, a digitized sample of incoming light is stored in memory every 100 nanoseconds for 25.4 μs (254 total samples). This represents backscattered returns from 0 to 12,650 feet in the atmosphere, with each sample resulting from returns 50 feet above the previous return.

As described in the principles of operation, the received light signal is typically buried within noise signals. The noise effects, due to their random nature, can be overcome by taking multiple samples and summing them. Hence, the ceilometer emits several pulses to conduct its sampling. Before the second pulse (and all successive pulses) are transmitted, the digitized sample results from the previous transmission are stored in a sample summing memory circuit. When the next pulse is transmitted, the received signals are digitized as before and stored in the sample memory. When all 254 samples are stored, they are added to the contents in the sample summing memory to accumulate the results. This process continues until the desired number of pulses (as directed by the processor) have been processed. Typically, the number of samples taken falls into the number of thousands. For example, 10,000 pulses can be processed and accumulated to provide results that permit separation of cloud signal returns from noise. Statistically, this results in providing signal returns from clouds that are approximately 100 times stronger than the noise level, and thus easily discerned. After the sampling, digitizing, and summing process, the summing memory contains the raw profile of the atmosphere. The data are then transferred to the processor memory and the sample accumulator is cleared to begin the next acquisition cycle.

Before the next acquisition cycle begins, the processor uses the A/D converter to check the average laser power measured by the laser power monitor during the transmission cycle. Based on the laser power value measured, the processor calculates a new value for the pulse frequency to adjust the average laser power as close as possible to the optimum value. Average laser power is thus controlled automatically by adjusting the pulse repetition rate. In addition, before the next acquisition cycle, the processor checks the measurement signal and noise levels and selects the gain to be used for the next cycle. High gain is desirable, but the active resolution range of the A/D converter must not be exceeded. The processor then starts a new measurement cycle and begins to process the raw data just accumulated to construct the cloud data for report to the DCP.

9.4.2.2.2 **Output Interfaces**. The CT12K ceilometer provides two different output interfaces. An RS-232C interface is the primary interface used on the ceilometer for both sensor reporting and maintenance purposes. The ASOS configuration for the ceilometer adds a fiberoptic modem module interfaced to the RS-232C interface to provide the fiberoptic data link with the DCP.

9.4.2.2.3 **Internal Temperature Control**. The internal temperature of the ceilometer cabinet is controlled by two heaters in the cabinet. The two heaters are connected to control circuitry that enables one of three possible configurations depending on the heating requirements of the cabinet. The temperature controller monitors the ceilometer internal air temperature and generates a corresponding voltage level. This voltage level is applied to voltage comparators that are set for reference voltages equal to 32 degrees Fahrenheit (°F) (0 degrees Celsius (°C)) and 68°F (20°C). The output of the comparators drives relays that apply power to the heaters. When the air temperature is above 68°F, power is removed from both heaters. When the temperature is between 32°F and 68°F, the heaters are powered and configured in series, providing approximately 20 watts of heating power. When the temperature falls below 32°F, the heaters are powered and configured in parallel, providing approximately 80 watts of heating power. Without heating, the cabinet internal temperature is typically 10°F to 20°F above the ambient temperature. With full heating, the cabinet internal temperature is typically 40°F to 60°F above the ambient temperature.

9.4.2.2.4 **Internal Monitoring**. Internal monitoring consists of the circuitry required to monitor voltage levels and signals produced by the ceilometer during normal operation. The analog monitoring section includes a signal selector and an A/D converter. The signal selector is used to select which of the input voltage signals is applied to the A/D converter. The A/D converter processes the selected analog voltage to produce a digital data value. This data value is then applied to the processor for analysis to detect malfunctioning assemblies and components.

9.4.2.2.5 **Power Supply Section**. The power supply section consists of a high voltage power supply and an unregulated power supply that provide the unregulated power to all of the electronics assemblies in the ceilometer. All of the assemblies are provided with local voltage regulators. The temperature control transformer is used to provide the power required by the cabinet heaters.

9.4.2.2.6 **Window Conditioner**. The window conditioner consists of a heater and blower that provide warm airflow across the optics windows of the ceilometer. This airflow keeps the windows clean and dry and permits optimum performance of the system. A temperature sensor in the window conditioner monitors the operation of both the heater and the blower and reports to the internal monitoring circuit. For safety considerations, the heater is provided with a thermostat that is set to remove power if the temperature reaches 250°F (120°C).

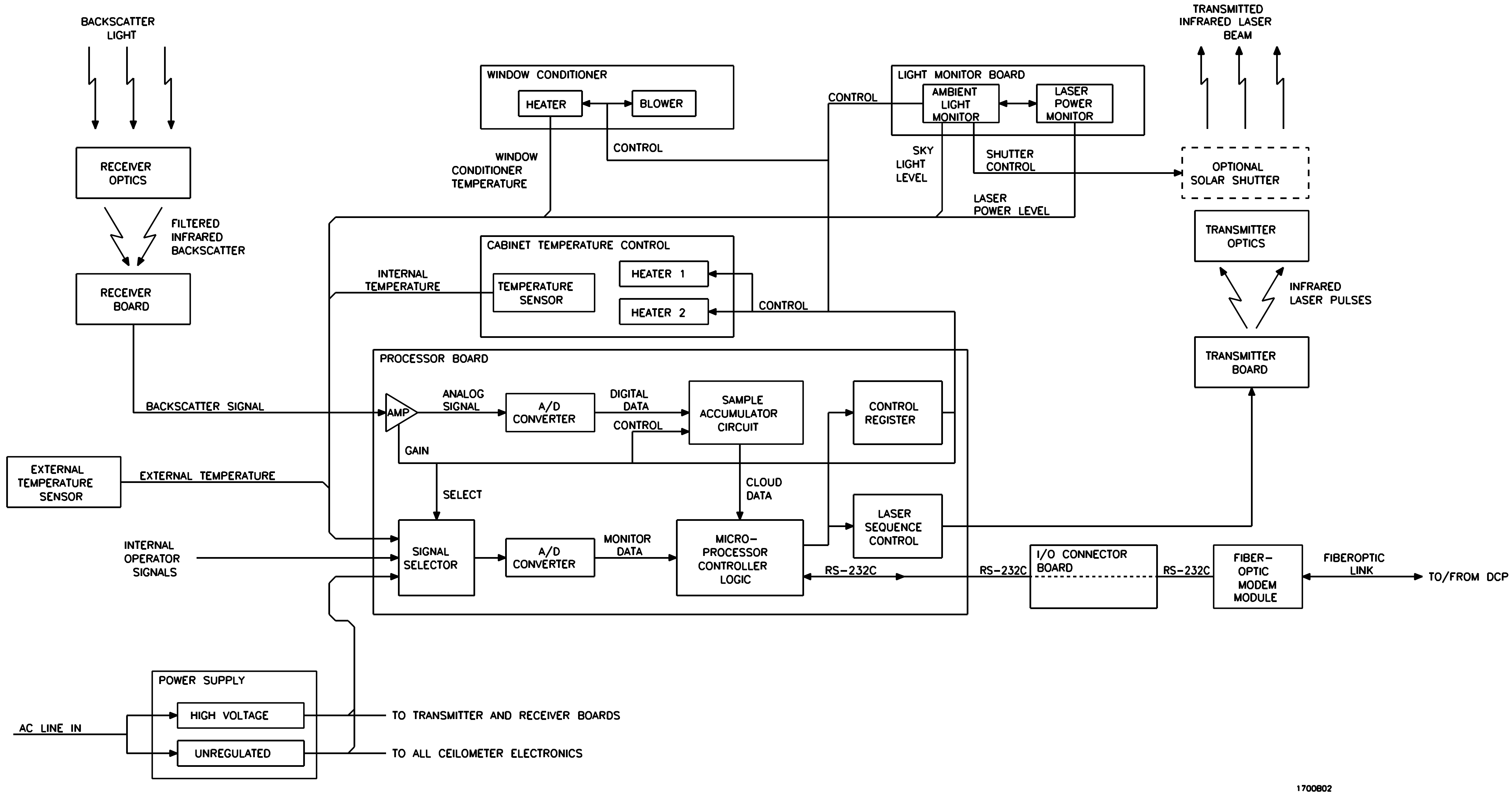


Figure 9.4.3. Ceilometer, Simplified Block Diagram

9.4.2.2.7 **Solar Shutter Option**. The solar shutter is an optional assembly to the CT12K ceilometer. It is installed on ceilometers located in the region of 30 degrees North latitude to 30 degrees South latitude to protect the transmit laser from the effects of direct sunlight. A tropical receiver board (part No. 62828-90112-11) is installed in ceilometers that are equipped with the solar shutter assembly (table 9.1.2). The tropical receiver board has a different filter and mounting block than the receiver board filter used on ceilometers without a solar shutter. The solar shutter closes during periods when direct sunlight can enter the transmitter lens system and when a laser pulse is not being transmitted. The solar shutter assembly consists of a control solenoid and a flap that are located above the transmitter and a light sensor and electronics that are installed on the light monitor board. The light sensor and control electronics determine when the shutter should be shut and activate the solenoid to move the shutter.

9.4.2.2.8 **Snow Radiation Shield Option**. The snow radiation shield is an optional assembly to the CT12K ceilometer. It is installed on ceilometers that are susceptible to having their external ambient air temperature sensors inadvertently heated by snow reflected solar radiation. The snow radiation shield consists of stainless steel plating bent into a rectangular box shape with the short sides left open to allow for airflow into the resultant enclosure. The snow radiation shield is painted white to reflect solar radiation. Figure 9.1.2 shows the snow radiation shield in place. Table 9.5.33 contains installation and removal procedures for the snow radiation shield.

9.4.3 DETAILED BLOCK DIAGRAM DESCRIPTION

9.4.3.1 **Introduction**. The ceilometer is composed of two basic subsystems: the optics subsystem and the electronics subsystem. The optics subsystem consists of the windows and lenses required for laser transmission and light energy reception. The optics subsystem supports several separate, but interrelated, electronics assemblies. A detailed block diagram of these assemblies is illustrated on figure 9.4.4 and described in the following paragraphs.

9.4.3.2 **Processor Board**. Processor Board A1 is the main control circuit for the ceilometer. The processor board is a microprocessor-based design that performs all of the following functions:

a. Provides software-controlled laser pulse triggering.

b. Buffers and amplifies (software-controlled gain) backscatter reflections sensed by the receiver board.

c. Samples, converts, and stores amplified echo signals.

d. Processes the stored echo signal data to calculate cloud base levels and other relevant atmospheric information.

e. Transfers data and commands through the onboard RS-232C serial interface.

f. Monitors unregulated power supply voltages, transmitter and receiver board operating voltages, laser power level, ambient light level, and operating temperatures throughout the ceilometer.

g. Controls the operation of the window conditioner and the optional solar shutter via the light monitor board.

h. Automatically controls internal heating of the ceilometer.

The electrical power required by the processor board is derived from dc power inputs provided by the unregulated power supply board. Voltage regulator circuits on the processor board stabilize these dc power inputs for use by the processor board electronics. In addition, some of these regulated voltages are output by the processor board for application to the I/O connector board. Several onboard precision voltage references are also derived for measurement needs by circuits on the processor board.

The main data processing is performed by the central processing unit (CPU) and its related control logic. The operating system and programmed instruction set are stored in erasable programmable read-only memory (EPROM) for use by the CPU. A section of random access memory (RAM) provides the CPU with data workspace and temporary data storage. Onboard EEPROM is used for nonvolatile data storage for ceilometer scaling factors and other important parameters.

Through an integral asynchronous communications port, the processor board maintains serial data communications with the DCP. System timing sequences are also maintained onboard, with a special watchdog timer provided to force system resets in the event of a temporary processor hangup. Two light emitting diodes (LED's) on the processor board indicate the operating status of the CPU. A green LED flashes at an approximate 1-second interval to indicate that the system is operating normally. A red LED illuminates when the CPU is in a reset condition.

The primary function of the processor board is to initiate laser transmissions, collect the reflected cloud echoes, and process the received signals to detect and report the presence of clouds. The transmit/receive cycles of the ceilometer are synchronized by a timing sequencer located on the processor board. The transmission cycle is started by activating the pulse trigger generator circuit. This circuit outputs a trigger pulse signal that fires the laser located on the transmitter board. The pulse trigger generator is controlled by a signal from the CPU and output control latch that allows the processor to enable and disable the generation of laser pulse transmissions.

The echo signal from the receiver board is first amplified and then converted into digital format by an A/D converter. The conversion process is performed synchronous to transmission cycles and produces a digitized sample corresponding to every 50 feet above the ceilometer. Each sample is stored in a specific RAM location dedicated for current samples. After all 254 samples (12,650 feet total) have been taken, the samples are added to the sums of previous cycles. The resulting accumulated values for each 50-foot increment are then stored in a section of RAM reserved for summed samples. After the required number of transmit/receive cycles have been completed, the CPU reads the accumulated sample sums and processes the data to generate the cloud report data that are transmitted to the DCP.

The processor board also monitors the ceilometer power supply voltages and other important system signals. The checking of these signals is an integral part of the self-test capability of the ceilometer, which is capable of detecting and isolating the majority of faults that may occur within the system. The voltages and signals are monitored by an analog multiplexer and A/D converter circuit. The CPU selects the signal to be monitored using control lines to the multiplexer. The selected signal is then patched to the input of the A/D converter where it is digitized. The CPU reads the resulting digitized signal data and processes the data to determine if within tolerance limits or other suitable parameters. The actual signals monitored by the processor board are identified and described in the paragraphs for each of the other ceilometer components.

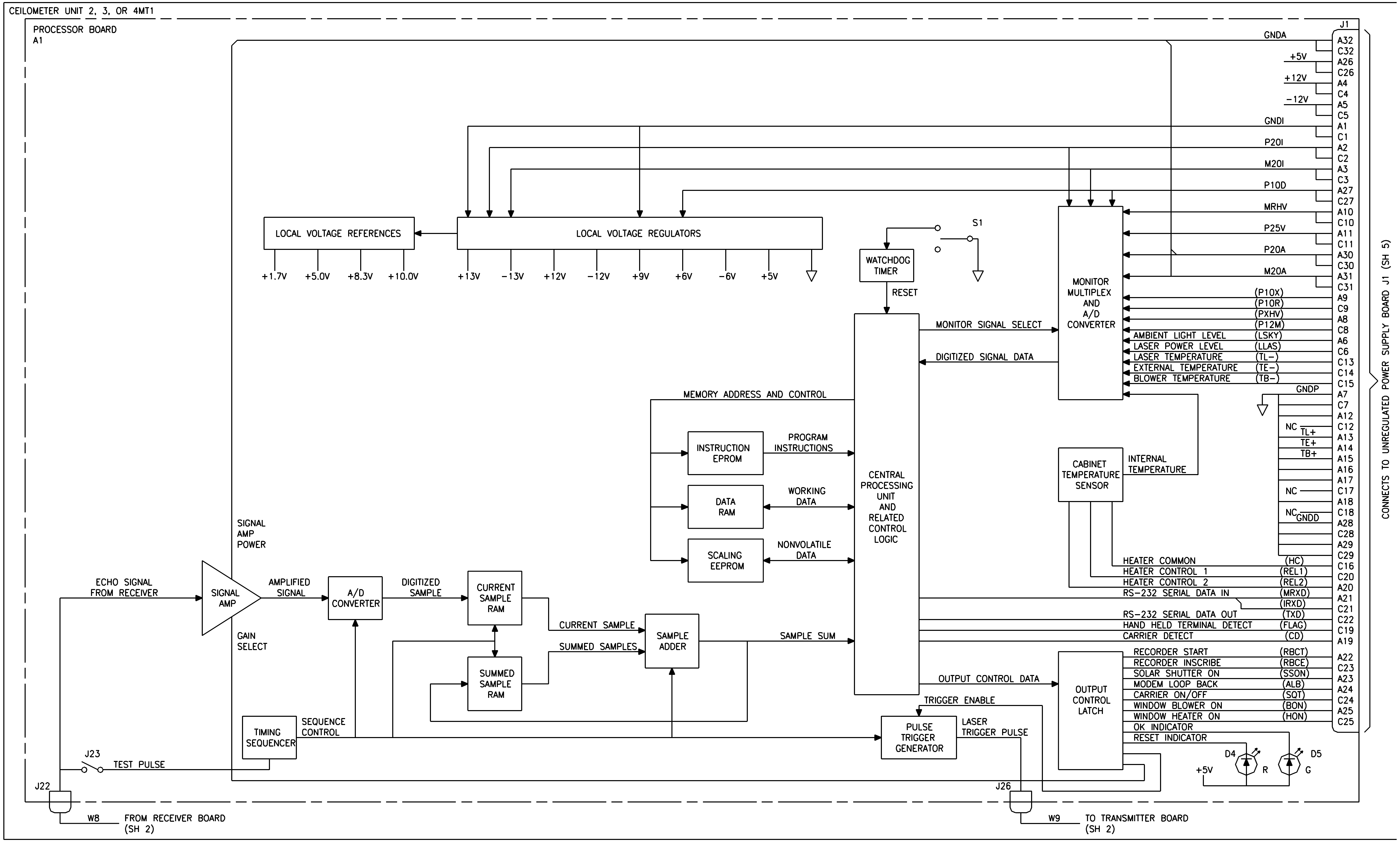


Figure 9.4.4. Ceilometer Detailed Block Diagram (Sheet 1 of 6)

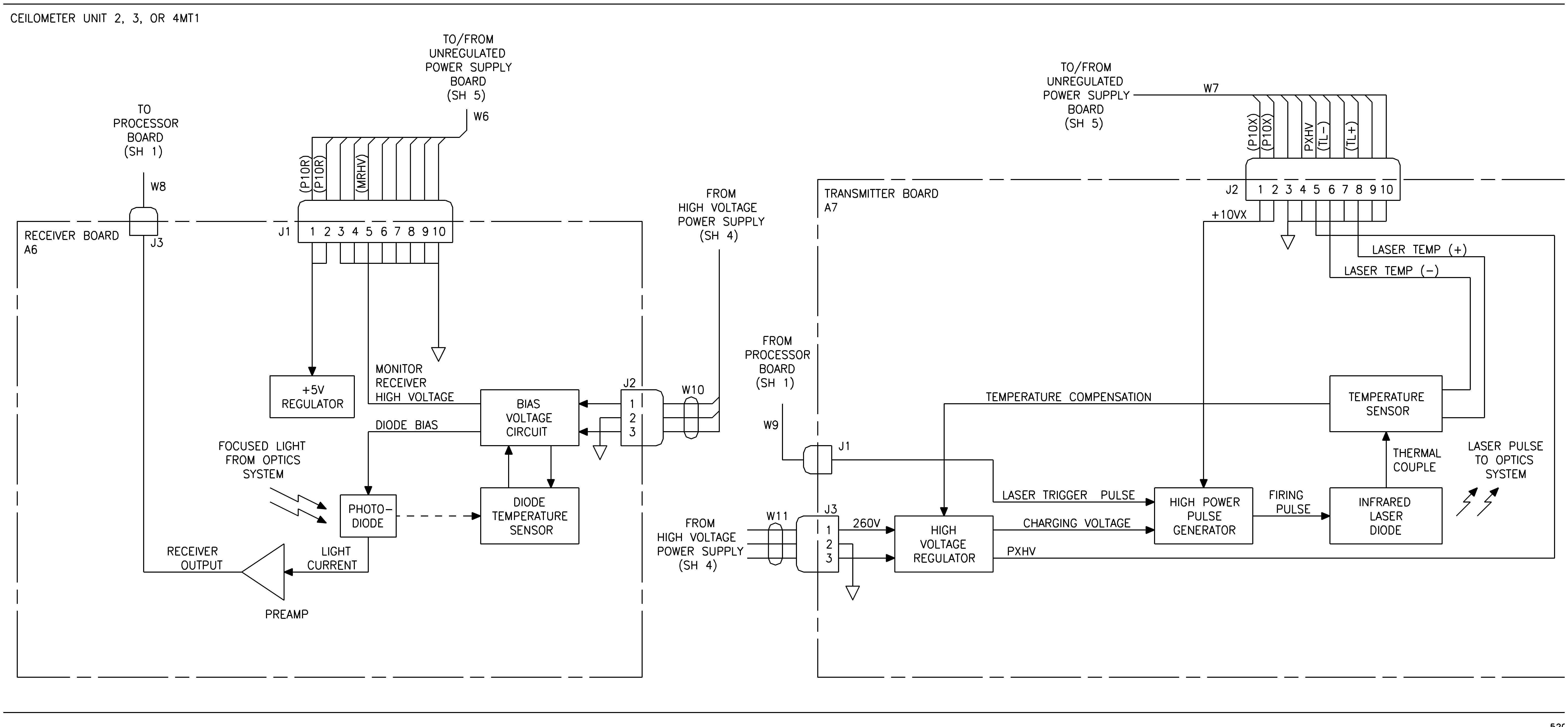


Figure 9.4.4. Ceilometer Detailed Block Diagram (Sheet 2)

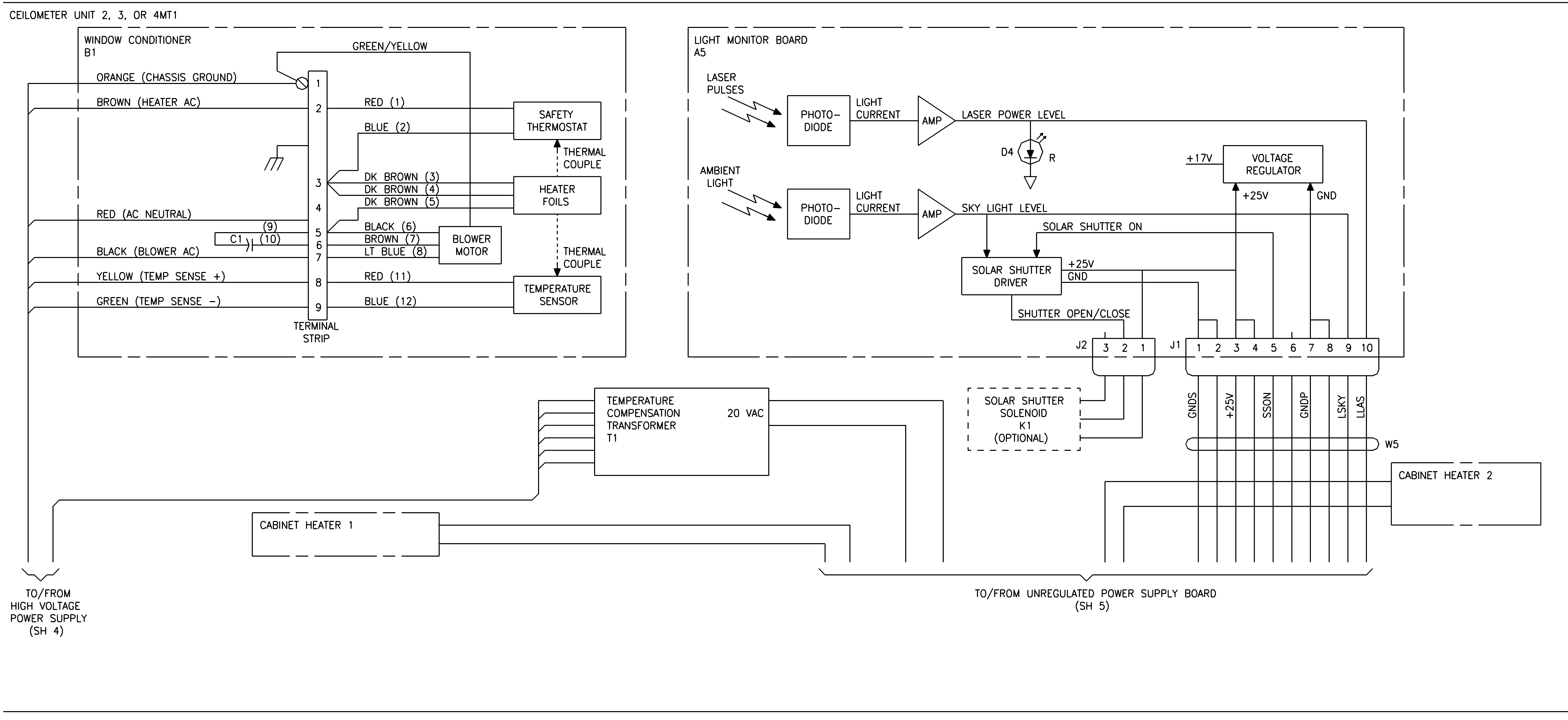


Figure 9.4.4. Ceilometer Detailed Block Diagram (Sheet 3)

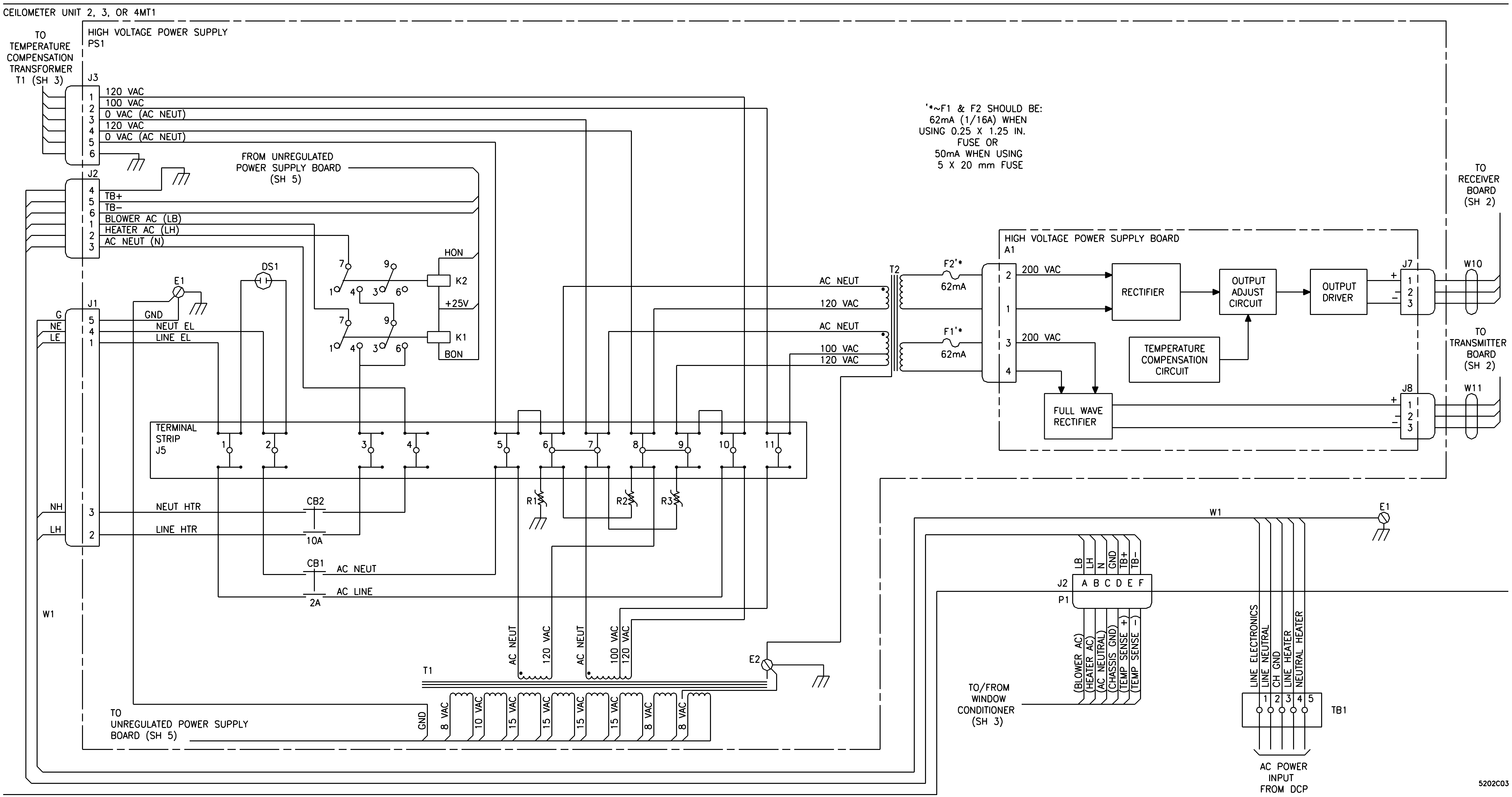


Figure 9.4.4. Ceilometer Detailed Block Diagram (Sheet 4)

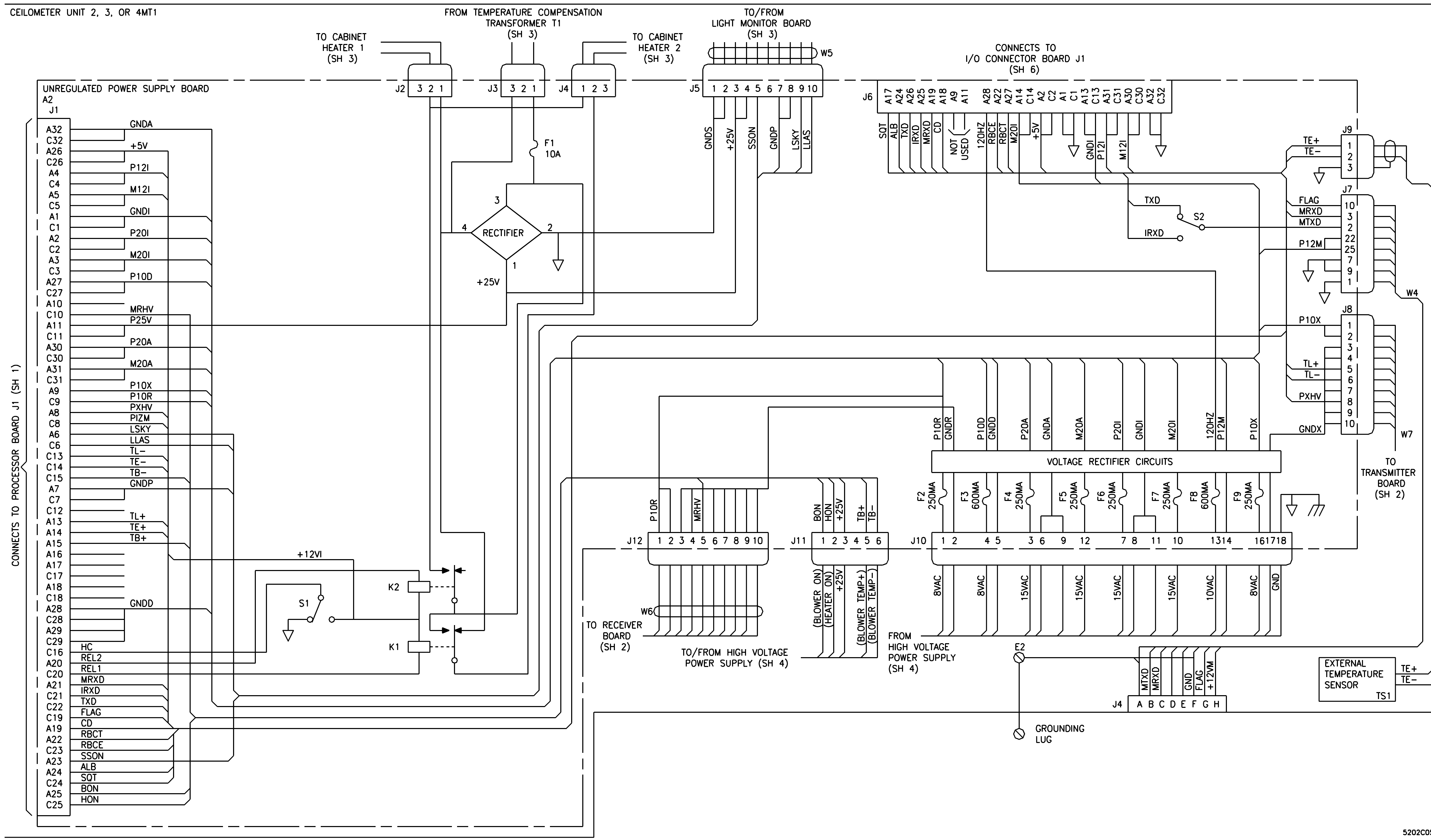


Figure 9.4.4. Ceilometer Detailed Block Diagram (Sheet 5)

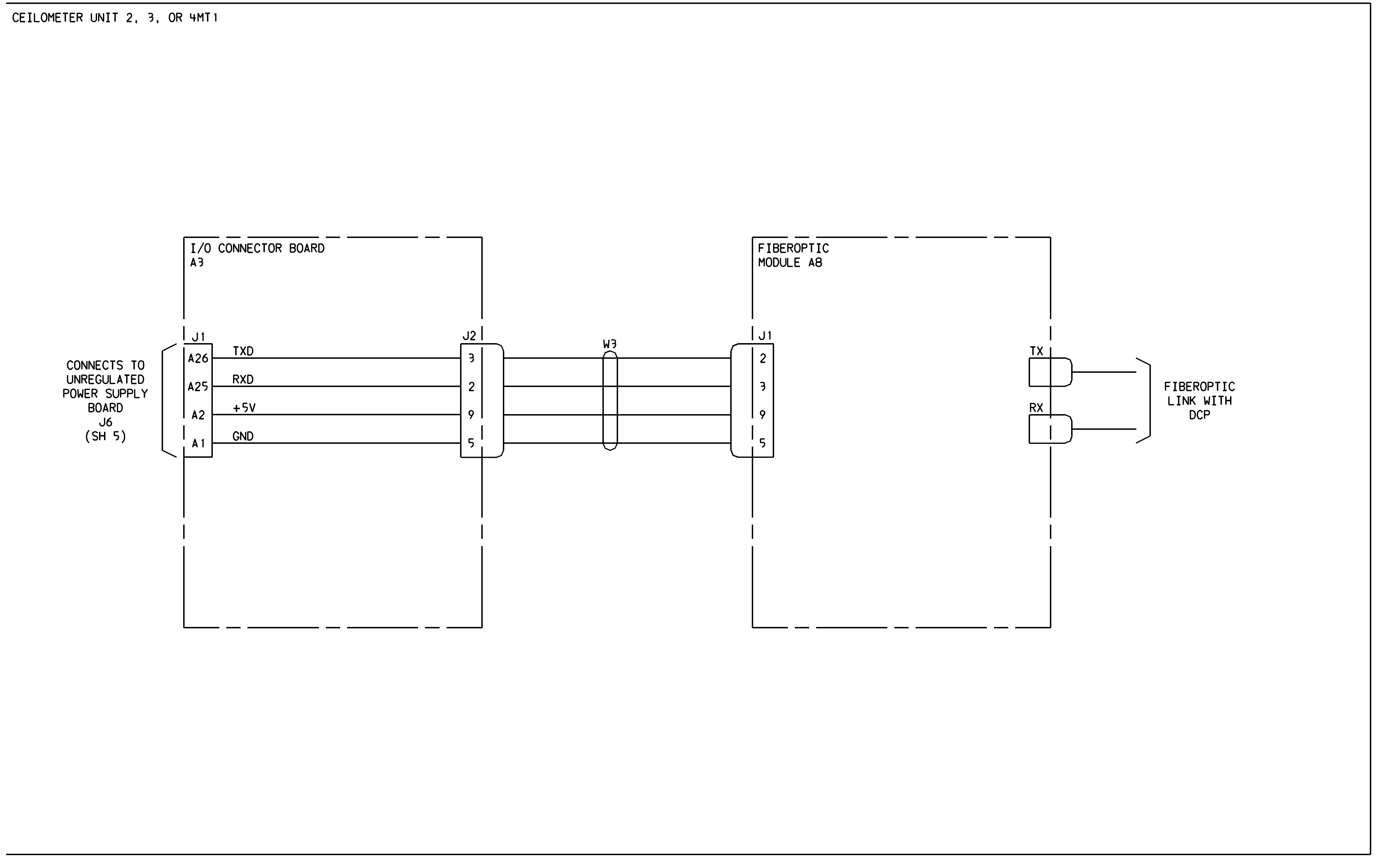


Figure 9.4.4. Ceilometer Detailed Block Diagram (Sheet 6)

The processor board is designed to be easily maintained. In addition to the automatic self-test capability of the system, test points are provided throughout the board (78 total). Many of these test points allow fault isolation down to the component level; however, for ASOS applications, only a subset of these test points is required for isolating faulty field replaceable units (FRU's). The actual test points are identified as a part of the corrective maintenance procedures provided in Section V.

9.4.3.3 **Transmitter Board**. Transmitter Board A7 generates the infrared laser light pulses used by the ceilometer to detect clouds. The laser pulses output by the transmitter board are focused by the ceilometer optics for transmission into the atmosphere. Each laser pulse is generated under processor control as a part of the overall ceilometer operating sequence. The operation of the transmitter board is also monitored for report back to the processor board.

The transmitter board receives high voltage power from the high voltage power supply and low voltage power from the unregulated power supply. The low voltage power (+10VX) is used to bias the high power pulse generator circuits. The high voltage (+260 vdc) power is applied to an on-board high-voltage regulator. This regulator circuit provides stable high-voltage power for transmitter board circuitry. Both the low- and high-voltages for the transmitter board are monitored by the processor board for diagnostic purposes. The low voltage power (+10VX) is monitored by the processor board directly from the unregulated power supply board. The high-voltage regulator circuit on the transmitter board is monitored using a scaled test signal (PXHV), which is routed to the processor board via the unregulated power supply board.

The laser light pulses are produced by the infrared laser diode on the transmitter board. When the ceilometer is to produce a laser pulse, a pulse trigger generator on the processor board outputs a laser trigger pulse to the transmitter board. This pulse causes the high power pulse generator on the transmitter board to output a high voltage firing pulse to the infrared laser diode. The firing pulse causes the diode to emit a pulse of infrared light. The light pulse is then output to the atmosphere via the ceilometer optics.

The operation of the infrared laser diode is affected by temperature. As the temperature of the diode increases, a greater voltage is required to fire the diode. For this reason, the transmitter board contains a temperature compensating circuit. A temperature sensor monitors the operating temperature of the laser diode. This sensor outputs a temperature compensation feedback signal that is applied to the high voltage regulator circuit, where it adjusts the voltage output by the regulator. This design provides continual compensation for the temperature of the laser diode to obtain consistent performance. The temperature of the laser diode is also monitored by the processor board using two laser temperature signals (TL+ and TL-) provided by the temperature sensor circuit. These signals are routed to the unregulated power supply board, where they are passed to the processor board. This allows the processor board to detect proper operation of the laser diode transmitter automatically.

9.4.3.4 **Receiver Board**. Receiver Board A6 detects reflections of the transmitted laser pulses. Light energy from the sky above the ceilometer is focused by the ceilometer optics onto a photodiode located on the receiver board. The receiver board converts this light energy to an electrical voltage signal for output to the processor board. The processor board uses this voltage signal to determine the presence and location of clouds. The operation of the receiver board is also monitored and reported to the processor board. A tropical receiver board (part No. 62828-90112-11) is installed on ceilometers that are equipped with a solar shutter and a standard receiver board (part No. 62828-90112-4) is installed on ceilometers without a solar shutter. The difference between the tropical and standard receiver boards is that the tropical receiver board is equipped with a type of filter that protects the transmitter optics from the effects of direct sunlight.

The operation of the receiver board requires both a high voltage power supply and a low voltage power supply. The low voltage power (+10 vdc) is applied from the unregulated power supply board to the local voltage regulator on the receiver board. This power source is used to derive the +5 vdc power required by the receiver board circuitry. A high voltage bias for the photodiode (ranging from -250 to -425 vdc) is provided by the high voltage power supply in the ceilometer. Both of these power sources are monitored by the CPU on the processor board. The low voltage power (+10VR) is monitored directly from the unregulated power supply board. The high voltage power is routed from the regulated high-voltage power supply, passed through the receiving board scaling resistors, unregulated power supply board (MRHV), and is applied to the processor board. This allows the CPU to detect power supply failures involving the receiver board.

The focused light energy on the receiver photodiode causes the photodiode to generate a low level electrical current. The more light energy applied to the photodiode, the more electrical current output. This low level dc current is applied to a preamplifier circuit that produces a corresponding voltage level output to the processor board. The processor board samples the receiver board output voltage to detect the presence of cloud reflections resulting from the laser pulse transmissions.

The response of the photodiode on the ceilometer receiver board is highly sensitive to both bias voltage and temperature. A diode temperature sensor monitors the photodiode level and adjusts the photodiode bias voltage circuit to compensate for the photodiode operating temperature. As a result, the receiver operates with constant sensitivity and improved performance.

9.4.3.5 **Light Monitor Board**. Light Monitor Board A5 is located between the laser transmitter lens and the instrument cover window. The circuit functions to monitor both the average power level of the laser transmission pulses as well as the ambient light level of the sky. In addition, the light monitor board is used to drive the optional solar shutter. All electrical power required by the circuitry is derived from the unregulated power supply board. Local voltage regulators on the light monitor board control the power input to provide stable dc supply power.

The average laser power level is detected by a photodiode that is pointed toward the laser transmitter. The photodiode converts a portion of the laser-radiated light pulses into low-level electrical current pulses, the peaks of which are passed through Schottky diode D2 and filtered by capacitor C2. D2 blocks the low-level photovoltage produced by ambient light entering the transmitter optics, but laser light pulses are passed by D2 and converted to an analog voltage which varies proportionally with pulse intensity, duration, and repetition rate.

This dc voltage is applied to the noninverting input of differential comparator U1A. Threshold voltage for U1A is applied by Monitor Gain Adjust potentiometer R6, which also provides offset compensation. The dc output voltage of differential comparator U1A, which can be measured at TP1, is termed the Laser Power Signal (LLAS). LLAS is routed through the unregulated power supply board for application to the processor board. The CPU on the processor board monitors the laser power level via an A/D converter. The LLAS voltage also drives a red LED (D4) located on the light monitor board.

The ambient light level of the sky is processed in a similar manner. Photodiode D3 is pointed skyward to convert ambient skylight into electrical current, which develops a positive dc voltage level across resistor R4 and capacitor C3. Voltage follower U1B provides a voltage gain of 1 for the high-impedance photodiode but a low-impedance output to drive the analog Sky Light (LSKY\) signal line, which is routed to the processor board, via the unregulated power supply board, for monitoring by the CPU.

The sky light voltage (LSKY) is also applied to the solar shutter driver circuit on the light monitor board. This positive voltage level, compared in differential comparator U1D to a threshold level derived from potentiometer R13, determines whether the solar shutter (if installed) should be closed to protect the laser transmitter. Normally, R13 is adjusted for 2.0V at TP4, which corresponds to an incident skylight power of 32W/m^2. If LSKY exceeds reference voltage level (indicating considerable direct sunlight into the ceilometer) the solar shutter solenoid will be deactivated to close the shutter and protect transmitter optics. When the solar shutter solenoid is activated, it opens; conversely, when deactivated, it closes. This design protects transmitter optics in the event of a malfunction or power loss to the ceilometer.

The processor board also controls activation of the solar shutter in response to the Sky Light (LSKY) signal from the light monitor board to protect the transmitter against focused skylight from zenith. It uses fail-safe logic so that the microprocessor can close the shutter when it should be closed but cannot open the shutter when it should be closed as determined by the sky light monitor circuit on the light monitor board. The SOLAR SHUTTER ON signal (SSON) is generated by the output control latch on the processor board. SSON is routed through the unregulated power supply board to the solar shutter driver circuit on the light monitor board, where it is applied to the base of PNP transistor Q1. When SSON is high (inactive state), Q1 is on to drive PNP Darlington pair Q2 to saturation. Q2 collector current then keeps solar shutter solenoid K1 energized to hold the shutter open - provided that the skylight monitor circuit is not detecting excessive ambient skylight. Because SSON signal is active (low), transistor Q1 will be off and the shutter will normally be closed unless the processor opens it by activating SSON; if analog signal LSKY is of sufficient amplitude (positive), then the inverting input of differential comparator U1D will cause its output to swing negative, thereby cutting Darlington pair Q2 off to keep the shutter solenoid deenergized (closed), regardless of the state of SSON from the processor board. This feature prevents the transmitter optics from being damaged by focused light during transmission cycles.

9.4.3.6 **Window Conditioner**. Window Conditioner B1 performs two functions for the ceilometer: it keeps the windows on the ceilometer clear of precipitation and dust and assists in regulating the cabinet temperature of the ceilometer. The window conditioner is controlled by the processor board via two power relays in the high voltage power supply.

AC power for the window conditioner is controlled by high voltage power supply circuit breaker CB2 and relays K1 and K2. The circuit breaker provides current limiting protection for the window conditioner while also providing a convenient means to manually remove power from the window conditioner. Relays K1 and K2 control the heater and blower components of the window conditioner, respectively. These relays are configured such that power cannot be applied to the window conditioner heater unless the blower is on. The heater assembly in the window conditioner provides 600 watts nominal heating power. The blower housing is designed to move air over the heater and sweep it across the windows. The combination of warmed, moving air evaporates moisture from the windows while helping to prevent dust and dirt buildup on the window surface.

The operation of the window conditioner is controlled by the processor board. As a part of this processing, the processor board monitors the external air temperature using the external temperature sensor located on the underside of the ceilometer. The sensed temperature signals (TE+ and TE-) report the air temperature to the processor board via the unregulated power supply board. In response to this input and other processing criteria, the processor outputs the WINDOW BLOWER ON signal (BON) and WINDOW HEATER ON signal (HON). These signals are routed through the unregulated power supply board and are applied to relays K1 and K2 in the high voltage power supply. HON and BON energize their respective relays and thereby connect ac power to the window conditioner heater and blower.

The operation of the window conditioner is also monitored by the processor board. A temperature sensor in the window conditioner provides a voltage signal that is routed from the window conditioner and through the high voltage power supply and unregulated power supply board and is applied to the processor board (TB+ and TB-). The processor board monitors this signal to determine the desired operating mode for the window conditioner, as well as to detect failures of the window conditioner. As an additional precaution, the window conditioner also contains a safety thermostat. The safety thermostat removes ac power from the heater in the event of a malfunction that causes an overtemperature condition (256 ±6°F or 124 ±3°C) in the window conditioner. The processor board receives no direct report of safety thermostat operation.

The ceilometer operating software continually monitors the external temperature and blower temperature to switch the window conditioner heater and blower on and off as required. These two data inputs are also used to determine malfunctions involving the window conditioner. In addition, the software uses time references to switch the blower on and off by itself during periods when window heating is not necessary. This keeps the windows free from dust and debris. The heat and airflow are also used to regulate cabinet temperature conditions. In cold weather (below 14°F or -10°C), the heater and blower are constantly on to help heat the ceilometer cabinet. In hot weather (above 86°F or 30°C), the heater remains off and the blower remains on. This helps to combat heating of the ceilometer by solar radiation.

9.4.3.7 **High Voltage Power Supply**. High voltage power supply PS1 is the ac line power entry point for the ceilometer. The high voltage power supply performs three basic functions. First, the ac input power is transformed into low voltage ac power needed to supply the ceilometer electronics. Second, the ac input power is rectified, filtered, and partially regulated to generate the high power dc voltages required by the transmitter and receiver boards. Finally, the ac line power is switched and controlled for application to the ceilometer window conditioner.

The ac line power is input to the ceilometer at connector J1. The power is then routed to the high voltage power supply for application to terminal strip J5, LINE VOLTAGE indicator DS1, and circuit breakers CB1 and CB2. The ac power indicator is wired in front of the circuit breakers to show the presence of ac power regardless of the state of the circuit breakers. The circuit breakers double as on/off switches and circuit protectors. The dual pole configuration of the circuit breakers allows the use of a floating or nonspecified line voltage. Circuit breaker CB2 controls the application of ac power for the window conditioner power via relays K1 and K2. Operation of these relays is described in the operating theory for the window conditioner. Circuit breaker CB1 controls the application of ac power for the ceilometer electronics. The ac power is distributed by terminal strip J5, where surge protectors R1 through R3 are located. This power is distributed to transformers T1 and T2 and to the temperature control transformer via terminal strip J3. Transformer T1 supplies the low voltage ac power to the unregulated power supply board. Transformer T2 provides the ac power required by the high voltage power supply board. These ac power lines are current-protected by fuses. The values of these fuses are critical to the operation of the ceilometer and are noted as such on the detailed block diagram.

The high voltage power supply board in the high voltage power supply generates the high voltage dc power required by the ceilometer transmitter and receiver boards. The transmitter power is derived by full wave rectifying the ac input voltage. This produces an unregulated dc power level in the range of +260V. The receiver power is also generated by rectifying the ac input power. The resulting dc power is then partially regulated and compensated for temperature effects to provide an output dc power source of +250 to +425 vdc.

9.4.3.8 **Unregulated Power Supply Board**. Unregulated Power Supply Board A2 is a central support board for the ceilometer. The board rectifies and filters several low voltage ac power sources for use by the various electronics. The board also provides signal routing between the ceilometer component boards and contains the relays that control ceilometer cabinet heating.

The unregulated power supply board receives low voltage ac power from the ceilometer high voltage power supply at connector J10 and from the temperature compensation transformer at connector J3. All of the ac power inputs are fuse protected, rectified, and filtered. All of the resulting dc voltages are unregulated; line inputs and load fluctuations cause variations in the actual dc voltages obtained. The dc power is applied to the other ceilometer electronics where local voltage regulators stabilize the power. The dc voltages produced on the unregulated power supply board are also applied to the processor board where they are monitored as a part of the automatic testing of the ceilometer.

Ceilometer cabinet temperature is controlled by two relays (K1 and K2) located on the unregulated power supply board. The relays are controlled by a cabinet temperature sensor circuit located on the processor board. This circuit monitors the ceilometer internal cabinet temperature and reports the temperature to the processor via the monitor multiplex A/D conversion circuit. The circuit also generates the heater control signals required to energize relays K1 and K2 on the unregulated power supply board. These control signals are generated independently from the processor and are not controllable by software. The relays function to switch 20 vac power input from temperature compensation transformer T1 to the two cabinet heater elements. At temperatures above approximately 68°F (20°C), power to both heaters is removed. At cabinet temperatures between 32°F and 68°F (0°C and 20°C), relay K1 is activated. This connects the two cabinet heaters in series and provides two 10-watt sources of heat. At cabinet temperatures below 32°F (0°C), relay K1 is off and relay K2 is activated. This connects the two cabinet heaters in parallel and provides two 40-watt sources of heat. An override switch (S1) is provided on the unregulated power supply board. By setting the switch to the off position, relays K1 and K2 cannot be activated, and power is removed from the cabinet heaters. This switch is intended for temporary maintenance activities, and is therefore kept in the on position for normal operation.

9.4.3.9 **Fiberoptic Module**. The fiberoptic module added to the ceilometer for the ASOS provides the data communications link with the DCP. The fiberoptic module is interfaced to connector J4 on the ceilometer, which is normally reserved for the ceilometer maintenance terminal. For the ASOS, however, the maintenance terminal is not required for normal operation, which allows connector J4 to be available for the fiberoptic module. The fiberoptic module converts electrical data signals (RS-232 serial data) to light pulse signals that are transferred to the DCP. The RS-232 interface data transmit signal (TXD) originates on the processor board and carries the data messages from the ceilometer to the DCP. The signal is routed through the unregulated power supply board to interface connector J4. Switch S2 on the unregulated power supply board is normally set to connect the TXD signal to provide the MTXD signal to the fiberoptic module. In the other position, switch S2 passes the received data signal (IRXD) from the I/O connector board to the fiberoptic module. The TXD signal is also connected to the I/O connector board. The RS-232 interface data received signal (MRXD) is input from the fiberoptic module and carries the data messages from the DCP to the ceilometer. The MRXD signal is routed through the unregulated power supply board and is applied to the processor board. The MRXD signal is also applied to the I/O connector board.

9.4.3.10 **I/O Connector Board**. I/O Connector Board A3 is the communications link circuit of the ceilometer. In the ASOS configuration, the I/O connector board provides the RS-232 interface required for the fiberoptic module. All data transmissions from the ceilometer originate from the processor board. The RS-232 serial transmitted data signal (TXD) is routed from the processor board to the I/O connector board via the unregulated power supply board. The data signal is applied to a standard DB-9 connector for output to the fiberoptic module. The ceilometer receives data via the same circuitry used for transmitting data. The data signal is input from the fiberoptic module and applied to the DB-9 connector on the I/O connector board. The received data signal is output as IRXD and routed through the unregulated power supply board to the processor board.

SECTION V. MAINTENANCE

9.5.1 INTRODUCTION

This section provides the preventive and corrective maintenance procedures for the ceilometer. Preventive maintenance consists of those procedures performed on a periodic basis to keep the ASOS operational, which includes routine cleaning and inspection. Corrective maintenance consists of those procedures required to isolate a fault in the ceilometer down to the field replaceable unit (FRU) level.

9.5.2 PREVENTIVE MAINTENANCE

9.5.2.1 **General**. Preventive maintenance for the ceilometer consists of two basic procedures, which are listed in table 9.5.1. The maintenance log should be updated after each procedure to record any problems or repairs that were required.

Table 9.5.1. Ceilometer Preventive Maintenance Schedule

Interval	What To Do	How To Do It
90 days	Routine inspection and cleaning	Paragraph 9.5.2.2
	Ceilometer cleaning and window conditioner checks	Paragraph 9.5.2.3
Semiannually	Check ceilometer calibration	Paragraph 9.5.2.4
Annually	Clean snow radiation shield	Paragraph 9.5.2.5

9.5.2.2 **Routine Inspection**. Routine visual inspection of the ceilometer should be performed every 90 days or each time the technician visits the installation site. This inspection consists of checking the ceilometer for signs of physical damage, wear, mold, mildew, or corrosion.

CAUTION

Mold or mildew can form at base of ceilometer near top of the mounting pole. Examine for mold or mildew. If present, remove with a putty knife and scrub area with a detergent/water solution. Treat any rust present in accordance with paragraph 1.5.3.4.

Any debris from insects, animals, or such that may potentially degrade performance should be removed. All power and signal cabling to the ceilometer should be checked to ensure that it is secure and undamaged.

9.5.2.3 **Ceilometer Cleaning and Window Conditioner Checks**. Cleaning the ceilometer windows, blowers, and exhaust screens and checking the operation of the window conditioner are maintenance procedures vital to optimum ceilometer performance. These procedures are provided in table 9.5.2.

9.5.2.4 **Calibration**. The calibration of the ceilometer must be checked every 180 days or after replacing Transmitter Board A7 or Receiver Board A6. Before the sensor can be calibrated, it must be properly installed and must pass its ASOS diagnostic checks. Table 9.5.3 provides the procedure to check ceilometer calibration.

9.5.2.5 **Clean Snow Radiation Shield**. The snow radiation shield must be cleaned annually, in the fall, prior to the winter season. The snow radiation shield cleaning procedure is contained in table 9.5.4.

Table 9.5.2. Cleaning and Inspection

Step	Procedure
	WARNING Do not look into the ceilometer optics with magnifying glass, binoculars, or any other magnifying optics. The transmitter emits an invisible infrared laser pulse that can cause damage to human eyes. Death or severe injury may result if power is not removed from sensor prior to maintenance activities. Ensure that heater and primary power circuit breakers (located in DCP) are set to off (right) position.
1	Inside DCP equipment cabinet, set circuit breakers on ceilometer circuit breaker module to off (right) position.
2	Visually inspect ceilometer windows for damage (scratches, chips, or cracks) and dirt (film, streaks, or particles). Replace damaged windows by replacing the ceilometer electronics assembly.
3	Disconnect window conditioner by unplugging the cable from connector J2 located on the underside of the equipment cabinet assembly.
4	Loosen four knurled screws securing window conditioner to equipment cabinet assembly.
5	Carefully lift window conditioner from equipment cabinet assembly and gently set on the ground. Check that heater resistance between pins B and C of the window conditioner cable is 22 ±3 ohms. If resistance is not within tolerance, replace window conditioner assembly.
6	Using soft brush or clean linen cloth, gently dust off all loose particles from windows.
7	Using cleaning alcohol, soak window surfaces, allowing the surface to remain damp for a few minutes.
	CAUTION Avoid rubbing window surface to prevent scratching the window.
8	Gently wipe cleaning alcohol from windows. Turn cloth over and wipe the surface dry.
9	Inspect window conditioner for signs of obvious wear or damage.
10	Check thickness of rubber foam strips located on the underside of the heater/blower subassembly base plate. Replace compressed or worn strips using NWS ASN K220-1B1MP1. Brown burn marks in top of equipment cover indicates that the rubber foam strips need to be replaced.
11	Remove heater/blower subassembly and inspect for insects or other debris, especially at the blower exhaust screens. Remove any accumulated foreign material.
	CAUTION Be aware of razor-sharp edges on subassembly screens.
12	Carefully install window conditioner on equipment cabinet assembly and tighten four knurled screws.
13	Connect window conditioner cable to connector J2 on the underside of equipment cabinet assembly.
14	The operation of the blower can be observed by listening to the sound of the blower motor and feeling the air movement across the surface of the windows.

Table 9.5.3. Ceilometer Calibration Check Procedure

Step	Procedure
	Tools required: CTX-16 ceilometer calibration kit Small flat-tipped screwdriver Laptop interface (Y-shaped) cable Laptop null cable Laptop computer with PROCOMM Plus installed Two jumper wires
	INITIAL SETUP PROCEDURE
1	Remove ceilometer window conditioner, clean windows, and reinstall window conditioner in accordance with table 9.5.2.
2	**CAUTION** The CTX-16 reflector hood attenuates the ceilometer laser beam and reflects it back to the receiver. Damage to inside surfaces of hood will alter the transmissivity characteristics and recalibration may be necessary. Use special care when assembling or disassembling instrument. Open CTX-16 calibration kit and remove folded reflector hood. Unfold hood and set it on its edge.
3	**CAUTION** Do not disturb position of hex nuts at ends of two male and two female rods. Hex nuts at end of four rods are factory adjusted so that after reflector hood is assembled, two top panels are at a 90-degree angle to each other. Remove two female rods and two male rods from calibration kit. Do not disturb position of hex nuts on ends of four rods. Connect one female rod to one male rod at their knurled ends. Repeat to connect second pair of rods.
4	Insert both ends of one male/female rod assembly through holes on one side of reflector hood. Secure ends of rod assembly by loosely installing two 3/8-inch wingnuts from calibration kit. Repeat to install other rod assembly on other side of calibration reflector. Tighten all wingnuts.
5	Mount CTX-16 calibration reflector hood on top of ceilometer.
6	Inside DCP equipment cabinet, identify fiberoptic module dedicated to ceilometer. If necessary, perform the following: a. Refer to sensor configuration page on OID (sequentially press REVUE-SITE-CONFG-SENSOR function keys from 1-minute display). b. Refer to Chapter 3, Section IV to identify corresponding fiberoptic module.
7	Using small flat-tipped screwdriver, disconnect DB-9 connector from ceilometer fiberoptic module in DCP.
8	Using small flat-tipped screwdriver, install jumper between TB1-1 (on orange terminal block) on ceilometer fiberoptic module (A1) and TB1-1 on adjacent fiberoptic module. Install second jumper between terminals TB1-2 of ceilometer fiberoptic modules and adjacent module containing first jumper.
9	Using laptop interface (Y-shaped) cable and laptop null cable, connect RS-232C (COM1) port of laptop computer to DB-9 connector of ceilometer fiberoptic module.
10	Turn on laptop computer and initialize the PROCOMM Plus program. After program initializes, press any key to enter terminal mode (blank) screen.

Table 9.5.3. Ceilometer Calibration Check Procedure - CONT

Step	Procedure
11	Using ALT-S command (setup facility), set up the following TERMINAL OPTIONS: a. Terminal emulation: VT220 b. Duplex: FULL c. Soft flow control (XON/XOFF): OFF d. Hard flow control (CTS/RTS): OFF e. Line wrap: ON f. Screen scroll: ON g. CR translation: CR h. BS translation: NON-DESTRUCTIVE I. Break length (milliseconds): 350 j. Enquiry: OFF k. EGA/VGA true underline: OFF l. Terminal width: 80 m. ANSI 7 or 8 bit commands: 7 BIT
12	Press ESC key to exit to terminal mode (blank) screen.
13	Using ALT-P command (line/port option), set CURRENT SETTINGS as follows: a. Baud rate: 2400 b. Parity: NONE c. Data bits: 7 d. Stop bits: 1 e. Port: COM1
14	Press ESC key to exit to terminal mode (blank) screen.
CALIBRATION PROCEDURE	
	NOTE All commands used in this procedure (except SEND) require an open line to ceilometer. Line, when opened, times out after 30 seconds. Throughout this procedure, it may be necessary to use OPEN command before issuing other commands.

1	Turn Caps Lock ON. Type OPEN <CR>. Ceilometer responds with LINE OPENED FOR OPERATOR COMMANDS. Type PAR <CR>. Parameter values are displayed. Verify that the values are as follows:
	
	`CLIM        0.1000`
	`SLIM        0.2000`
	`NSCA        4.5000`
	`SCAL      100.0000`
	`TOTAL      10.0000`
	`HOFF        0`
	`DATA UNIT   FT`
	`POLLED      MESSAGES`
	
	If the stored parameter values do not agree with those listed above, enter the above values.

2	Mount CTX-16 calibration reflector. Allow ceilometer to be powered up for at least 10 minutes in automatic mode so that laser power can stabilize. Perform the following steps as one sequence within 60 seconds so that laser power does not change significantly during test.
3	Type AUTO OFF <CR> to set ceilometer to maintenance mode.
4	Type GAIN 0 to set ceilometer to Gain 0.
5	Activate measurement cycle in ceilometer by typing MEAS 12 command and using MES command to observe output. Use commands at least twice to verify that measurement is stable.

Table 9.5.3. Ceilometer Calibration Check Procedure - CONT

Step	Procedure
6	Use the STA command and from output, record values for FREQ and LLAS.
7	Type LNOR <CR>. Ceilometer responds with current laser normal (LNOR) value (e.g., LASER NORM LNOR 134). Subtract 5 from LNOR value and record LNOR - 5 value (e.g., 134 - 5 = 129).
8	Using FREQ value recorded above, obtain corresponding relative frequency percentage as follows: FREQ — RELATIVE FREQUENCY (%) 0 — -0.195 1 — -0.143 2 — -0.078 3 — 0.0 4 — +0.078 5 — +0.182 6 — +0.299 7 — +0.455

9	Calculate and record adjusted LLAS value by multiplying recorded LLAS value by relative frequency value obtained above, and subtracting result from original LLAS value. That is:
	LLAS (adj) = LLAS - [(relative freq) * LLAS]
	
	For example, if LLAS is 117 at FREQ = 5, then
	
	LLAS (adj) = 117 - [(.182)(117)] = 117 - 21 = 96
	
	If sign of relative frequency value is negative, then negative value sign must be included in calculation (result is added instead of subtracted).
	
	For example, if LLAS is 117 at FREQ = 2, then
	
	LLAS (adj) = 117 - [(-0.078)(117)] = 117 + 9 = 126

10	Calculate and record percentage difference of operating laser power (LLAS) from nominal (LNOR - 5) by subtracting LLAS (adj) value from LNOR - 5 value, dividing result by LLAS (adj) value, and multiplying by 100 to obtain percentage. That is: PCT DIFF = [((LNOR-5) - LLAS (adj))/LLAS(adj)] * 100 For example, if LNOR = 134, then LNOR - 5 = 129. If LLAS(adj) is 96 as above, then: PCT DIFF = [((129 - 96)/96] *100 = 0.34 * 100 = 34%

Table 9.5.3. Ceilometer Calibration Check Procedure - CONT

Step	Procedure

11	Type MES <CR>. Ceilometer responds with printout of two status lines followed by 13 data lines (numbered 0 through 12) in the following format:
	
	`30 00050 00050 ///// ///// 0000010011`
	`0 3 0.01 747   7 100 22.0 1.46 10 98`
	` 0D1B61F 2 7 5 5 0 2 2 4 1 0 2 3 2 1 1 2 3`
	` 1`
	` 2`
	` 3`
	` 4`
	` 5`
	` 6          (DATA PRINTOUT)`
	` 7`
	` 8`
	` 9`
	`10`
	`11`
	`12 6 6 6 7 7 6 7 7 6 7`

12	Using reflector response percentage table supplied with calibration kit, locate first two digits from data line 0 (e.g., D1 above) on list along top of form.
13	Locate second two digits from line 0 (e.g., B6 above) on list along left side of reflector response percentage table.
14	Record sensitivity (S) value at intersection of top column and left row noted above.
15	Type DEV <CR>. Ceilometer responds with current device scale (DEV) value (e.g., DEVICE SCALE DEV 1.0908). Record displayed DEV value. If DEV value is lost, refer to table 9.5.3a.
16	Calculate and record scaled sensitivity value for ceilometer by multiplying S value obtained from reflector response percentage table by DEV value obtained above. For example, if value from table was 71 and DEV was as above: S (scaled) = (71) * (1.0908) = 77.4
17	Calculate final sensitivity by adding PCT DIFF value (from calibration step 10 above) to S (scaled) value. That is: S (final) = S (scaled) + PCT DIFF For example: S (final) = 77.4 + 34 = 111.4
18	Verify that S (final) value is 100 ±15%.
19	If S (final) value is not within tolerance, replace transmitter board and recalibrate. If resulting S (final) value is still not within tolerance, replace receiver board.
20	Type AUTO ON to return ceilometer to automatic mode. **NOTE** Failure to perform step 20 to return the ceilometer to automatic mode will result in the ceilometer erroneously reporting the calibration values obtained in this calibration procedure as cloud data. ASOS will not detect this false condition.

Table 9.5.3. Ceilometer Calibration Check Procedure - CONT

CALCULATIONS	
1	At DOS prompt, type ASOS <CR> to initialize the ASOS calibration program.
2	Enter menu item 4 of the ASOS calibration program.
3	Enter the recorded LLAS, FREQ, and LNOR values when prompted, pressing <CR> after each entry.
4	The program will calculate the adjusted LLAS (LLAS [adj]) and percentage difference (PCT DIFF) and display them on the next line. Record these values.
5	Enter the recorded LLAS, FREQ, and LNOR values when prompted, pressing <CR> after each entry.
6	Enter the DEV value at the prompt and press <RT>.
7	The program calculates the scaled sensitivity and displays the result on the next line.
8	The program will then calculate and display the final sensitivity and verify that the S (final) value is 100 ±15%. If the value is within tolerance, a message will appear stating that the value is within tolerance. If the value is higher or lower than the tolerance, the program will beep and display a warning message.
TEARDOWN	
1	Remove, disassemble, and store reflector hood, hardware, and instructions in calibration kit carrying case.
2	At laptop computer, use ALT-X (exit) command to exit PROCOMM Plus.
3	Turn off laptop computer.
4	Disconnect cables between laptop computer and fiberoptic module.
5	Remove two jumpers between fiberoptic modules.
6	Using small flat-tipped screwdriver, install DB-9 connector to ceilometer fiberoptic module in DCP.

Table 9.5.3a. Device Scale Calculation Procedure

NOTE All lenses and windows must be cleaned before starting this procedure.	
1	Mount CTX-16 Calibration Reflector hood on top of ceilometer. Allow ceilometer to be powered up for at least 15 minutes in the Automatic Mode so that Laser Power can stablilize. Perform the following steps as one sequence within 60 seconds so that the Laser Power does not change significantly during test.
2	Type AUTO OFF <CR> to set ceilometer to enter maintenance mode.
3	Type DEV 1.0000 <CR>.
4	Type GAIN 0 <CR> to set ceilometer Gain
5	Type MEAS 12 to activate measurement cycle.

Table 9.5.3a. Device Scale Calculation Procedure - CONT

6	Type MES <CR>. Ceilometer responds with a printout of status lines followed by 13 data lines (numbered 0 thru 12) in the following format: 30 0050 0050 //// //// 0000010011 0 3 0.01 747 7100 22.0 1.46 10 98 0D1B61F 2 7 5 5 0 2 2 4 1 0 2 3 2 1 1 2 3 1 2 3 4 5 6 7 8 9 10 11 12 6 6 6 7 7 6 7 7 6 7
7	Using the Reflector Response Percentage Table supplied with the Calibration Kit, locate the first two digits from the data line 0 (e.g., D1, above and underlined) along TOP of percentage table.
8	Locate second two digits from data line 0 (e.g., B6, above and underlined) along LEFT side of percentage table.
9	Record SENSITIVITY (S) value at intersection of TOP column and LEFT row.
10	This value is (S) WITH COVERS, record this value.
11	Type AUTO ON >CR< to set ceilometer to automatic mode.
12	Remove CTX-16 Calibration Reflector Hood.
13	Turn DCP ceilometer circuit breakers to OFF.
14	Remove both ceilometer equipment cabinet covers as described in table 9.5.13. Turn DCP ceilometer circuit breakers to ON.
15	Mount CTX-16 Calibration Reflector Hood on top of ceilometer.
16	Repeat Steps 1 thru 12, this second value is (S) WITHOUT COVERS, record this value.
17	Calculate the DEVICE SCALE factor by dividing (S) WITHOUT COVERS by (S) WITH COVERS. Example: 105 / 98 = 1.0714 (DEV)
18	Type OPEN <CR>.
19	Type DEV X.XXXX <CR> (X.XXXX is the value in step 17). Record this value for future reference. If the DEV exceeds 1.2500 the window cover needs to be replaced.
20	Turn DCP ceilometer circuit breakers to OFF.
21	Reinstall ceilometer equipment cabinet covers as described in table 9.5.13.
22	Turn DCP ceilometer circuit breakers to ON.

Table 9.5.4. Snow Radiation Shield Cleaning Procedure

Step	Procedure
	Tools required: Clean clothes Portable vacuum cleaner 3-inch brush
1	Remove snow radiation shield from the ceilometer using the procedure in table 9.5.33.
2	Clean bottom of ceilometer and entire snow radiation shield with a damp cloth.
3	Remove dust and debris from external temperature sensor housing using a portable vacuum cleaner and 3-inch brush.
4	Install snow radiation shield onto ceilometer using the procedure in table 9.5.33.

9.5.3 **CORRECTIVE MAINTENANCE**

The ceilometer is supported by a set of internal automatic diagnostics that are executed by the ceilometer processor board and reported in the data messages transferred to the DCP and ultimately reported to the ACU. These diagnostic messages provide the basis for all corrective maintenance for the ceilometer. If the operation of the ceilometer is questionable, yet no alarm messages are received, an intermittent fault or data transfer fault may exist. In either case, the maintenance technician must perform troubleshooting of the ceilometer to isolate and replace the faulty FRU and return the system to operation.

9.5.3.1 **Fault Symptoms**. The symptoms of a fault involving the ceilometer generally fall under one of the following four categories:

a. Data Message Contains Alarm. This symptom is reported to the operator on the ceilometer page display at the operator interface device (OID).

b. RS-232C Interface Nonoperational. This symptom is evidenced by loss of reports (data missing) from the ceilometer, which may be consistent or intermittent.

c. Cloud Detection Missing. This symptom is evidenced by the ceilometer reporting no clouds present, when the observer knows that there is cloud cover.

d. Superfluous Detection. This symptom is evidenced by conflicts in ceilometer reports, such as drastic, unrealistic changes in the detected cloud bases.

The troubleshooting and repair procedures for the ceilometer are performed by identifying the fault symptom from one of those listed in table 9.5.5. The table defines the detailed fault isolation procedures to be followed. These procedures are provided in the following paragraphs. These procedures isolate the fault to the FRU level. The replacement procedures for each FRU are provided at the end of this section.

9.5.3.2 **Data Message Contains Alarm**. When the automatic self-test routine of the ceilometer detects a malfunction, it is reported to the operator on the OID ceilometer page display. The alarm status indicators include: hardware alarm, supply voltage alarm, laser power low alarm, and temperature alarm. In addition to these alarms, the same display indicates the status of the following ceilometer components: solar shutter (optional) on/off, blower on/off, heater on/off, pulse frequency (pulse repetition frequency) value, and gain (receiver amplifier gain) value.

9.5.3.2.1 **Hardware Alarm**. A hardware alarm is indicated by an F in the HARDWARE field on the OID ceilometer page. When a general hardware alarm is detected by the system, the maintenance technician should open a line of communication (direct dialogue mode) with the ceilometer and request status from the processor. Direct dialogue mode is entered by using the DIALG key at the OID display. Direct dialogue mode is also available when using the maintenance laptop computer. The status of the ceilometer is requested by entering the STA command in the ENTER COMMAND area on the display. The status message reply from the ceilometer may contain one or more of the messages listed in table 9.5.6. The status message displayed should be located in the table and the verification and replacement procedures provided for the identified FRU's performed. If none of these messages apply, the direct dialogue RESET command should be entered at the OID (or ceilometer power is cycled for a moment). When the ceilometer initialization sequence is complete, the startup message should be observed. If the ceilometer initialization sequence detects an error, the message received may contain one of the messages identified in table 9.5.7. The error message should be located in the table and the verification and replacement procedures provided for the identified FRU's performed. If no error message is displayed, the system may have detected a temporary or intermittent fault. If so, the ceilometer should be reset and its operation observed. If an intermittent fault is still observed, troubleshooting should be performed using the theory of operation as the basis for fault analysis and the verification and replacement procedures for isolating the fault and replacing the FRU performed.

Table 9.5.5. Ceilometer Troubleshooting

Symptom	What to Do	How to Do It
Data message contains hardware alarm	Isolate fault using direct dialogue.	Paragraph 9.5.3.2.1
Data message contains supply voltage alarm	Isolate fault using direct dialogue.	Paragraph 9.5.3.2.2
Data message contains laser power low alarm	Isolate fault using direct dialogue.	Paragraph 9.5.3.2.3
Data message contains temperature alarm	Isolate fault using direct dialogue.	Paragraph 9.5.3.2.4
No response from ceilometer module	Check fiberoptic.	Chapter 1, Section IV
	Replace fiberoptic module.	Paragraph 9.5.4.13
	Check ceilometer RS-232C interface.	Paragraph 9.5.3.3
	Check ac/dc power.	Paragraph 9.5.3.2.2
	Replace Processor Board, A1.	Paragraph 9.5.4.1
Ceilometer not detecting clouds	Troubleshoot	Paragraph 9.5.3.4
Superfluous cloud detections	Troubleshoot	Paragraph 9.5.3.5

Table 9.5.6. General Hardware Alarm Messages

Message	Suspect FRU
SKY MONITOR SUSPECTED	A5, A6, or A1
AD MONITOR ERROR	A1
SEQUENCE ERROR	A1
INTERNAL HEATING SUSPECTED	T1, R1, R2, A1, or A2
BLOWER/HEATER ERROR	B1, PS1, TS1, or A1
SHUTTER CONTROL SUSPECTED	K1 or A5

Table 9.5.7. Initialization Error Messages

Message	Suspect FRU
EX XXXXX XX XX (X=hex char.)	A1
OFFSET ERROR	A1
AMPLIFIER ERROR	A1
NOISE ERROR	A1, A6, or W8
SEQ RAM NOT CLEARED	A1
SEQ PULSE COUNTER ERROR	A1
ANALOG MONITOR ERROR	A1
LASER POWER LOW	A7, A5, K1, or PS1
SEQUENCE HALT	A1
EEPROM ERROR	A1
SIGNAL ERROR	A1

9.5.3.2.2 **Supply Voltage Alarm**. A supply voltage alarm is indicated by an F in the SUPPLY VOLTAGE field on the OID ceilometer page. When a supply voltage alarm is detected by the system, the maintenance technician should open a line of communication (direct dialogue mode) with the ceilometer and request status (STA command) from the processor board. The displayed status message contains one or more voltages that are detected as being below the alarm limit (as set by the ALIM command). The voltage(s) that triggered the alarm are identified by an asterisk (*) after the voltage value. Table 9.5.8 provides the voltage levels that should be detected at each power supply monitoring point. The voltage points are also depicted on the detailed block diagram (figure 9.4.4 sheet 3). If the voltage displayed is within the specified limits, the alarm limit specified for the system should be checked (using the ALIM command). If the specified alarm limit is correct (within the normal operating range specified in the table), connector faults or line voltage variances are possible. If a specified voltage point is out of limit, reference should be made to table 9.5.9, which identifies the ac power inputs, fuses, and loads associated with each monitored dc power point. The maintenance technician should manually check the power supply points at the ceilometer installation site to isolate the fault. Table 9.5.10 provides a general troubleshooting procedure for the power supplies.

Table 9.5.8. Power Supply Monitored Voltage Levels

Voltage Point	Normal Value	Alarm Limit	Acceptable Max
P20I	+20 vdc	+15 vdc	+24 vdc
P10X	+10 vdc	+7.5 vdc	+12 vdc
M20A	-20 vdc	-15 vdc	-24 vdc
P10R	+10 vdc	+7 vdc	+13 vdc
MRHV*	-300 vdc	-150 vdc	-450 vdc
P12M	+12 vdc	+8 vdc	+15 vdc
P10D	+10 vdc	+6.5 vdc	+12 vdc
P25V	+25 vdc	+20 vdc	+30 vdc
PXHV*	+130 vdc	+52 vdc	+200 vdc
P20A	+20 vdc	+15 vdc	+24 vdc
M20I	- 20 vdc	-15 vdc	-24 vdc

* These voltages are temperature-dependent and are adjusted at 72°F (22°C) to the values marked on the respective circuit boards.

Table 9.5.9. Monitored Power Test Points, Fuses, and Loads

Voltage Point	Check Fuses	Voltage Test Point	AC Input at A2	Power Loads
P10D	A2F3	A2TP4	8 vac	A1
P20I	A2F6 or F7	A2TP3	30 vac	A1
M20I	A2F6 or F7	A2TP2	30 vac	A1
P25V	A2F1	A2TP1	20 vac	R1, R2, A1, A5, T1, or PS1
M20A	A2F4 or F5	A2TP5	30 vac	A1
P20A	A2F4 or F5	A2TP6	8 vac	A1
P12M	A2F8	A2TP7	10 vac	A1
P10X	A2F9	A2TP9	8 vac	A1 or A7
PXHV	PS1F1	PS1 A1 J8	N/A	A7
P10R	A2F2	A2TP8	8 vac	A1 or A6
MRHV	PS1F2	PS1 TP1-TPGND	N/A	A6

Table 9.5.10. Power Supply General Troubleshooting Procedure

Step	Procedure
1	Check fuse(s) and replace if blown.
2	If replaced fuse blows, remove circuit load(s).
3	If fuse blows without load, suspect unregulated power supply board A2 (except for high voltage power points PXHV and MRHV, where power supply PS1 is suspect).
4	Replace suspected FRU as cause of blown fuse.
5	If voltage at test point is low and its ac input is okay, suspect unregulated power supply A2 (except for high voltage points PXHV and MRHV, where power supply PS1 is suspect).
6	If single or several ac inputs are low while ac line input is 103 vac or better, suspect power supply PS1 (except for P25V ac point, where temperature compensation transformer T1 is suspect).
7	If PXHV at high voltage power supply PS1 connector J8 is above alarm limit but alarm persists, check for bad ground connection through W9.
8	If MRHV at high voltage power supply board PS1A1 test points TP1 and TP2 is above alarm limit but alarm persists, check for bad ground connection through W8.
9	If all voltages check within limits but alarm persists, suspect processor board A1.
10	If input line voltage is below 103 vac, check ac input power from DCP.

9.5.3.2.3 **Laser Power Low Alarm**. A laser power low alarm is indicated by an F in the LASER POWER field on the OID ceilometer page. This alarm displays when the light monitor board detects a low value of average laser power (LLAS). A laser power low alarm normally indicates a failure of either the transmitter board or the light monitor board. When a laser power low alarm is detected by the system, the maintenance technician should open the direct dialogue mode with the sensor and request the sensor status (STA) command. The measured value for LLAS is included in the status display.

9.5.3.2.3.1 **LLAS Value Close to Zero**. If the LLAS value (indicated in the STA display) is close to zero, the following should be performed:

a. Inspect to ensure that there are no obstructions between the transmitter lens and the light monitor board (especially at the solar shutter, if installed).

b. Check the value of the laser normal (LNOR) parameter through direct dialogue using the PAR or LNOR command. Verify that displayed LNOR is same as factory-calibrated mark on the transmitter board (record number from transmitter board for future use). The LNOR value should be entered as required to match the transmitter board marking.

c. If there is no obstruction and the LNOR parameters match, check the supply voltages to the transmitter board and the light monitor board.

d. Check the voltages on Transmitter Board A7 test points TP4, TP7, TP3, and TP6-TP5 in accordance with paragraph 9.5.4.6.1.

e. Ensure that laser is on (AUTO ON) and check the following test points on Light Monitor Board A5:

(1) Measure TP3 (+) to TP5 (-) (GND) for 17 ±1 vdc. If not in range, measure cathode of diode D7 (or connector J2-1) for +25 vdc. If +25 vdc is present but TP3 is not present or out of tolerance, replace Light Monitor Board A5. If +25 vdc is not present, suspect Unregulated Power Supply Board A2.

(2) If ceilometer is providing positive cloud detection (with clouds in sky), measure TP1 (+) to TP5 (-) (GND) for between 1.5 and 4 vdc (with laser on). If not correct, suspect Light Monitor Board A5. If in tolerance, suspect Unregulated Power Supply Board A2 or Processor Board A1.

f. If above checks do not identify fault, replace Transmitter Board A7 and recheck laser power level. If fault remains, replace Light Monitor Board A5.

9.5.3.2.3.2 **LLAS Value Not Close to Zero**. If the LLAS value (indicated in the STA display) is below the alarm limit but not close to zero, the following should be performed:

a. Using direct dialogue, check that the pulse repetition frequency parameter is set to maximum (FREQ = 7). If it is, verify LNOR is the proper value. Replace Transmitter Board A7 if LNOR was correct.

b. Check that the value of the laser temperature (TL in STA output) is less than 140 degrees F. If temperature is above this value, interrupt operation (AUTO OFF) for a few minutes to allow ceilometer to cool. After cooling, set AUTO ON and allow ceilometer to run for a few minutes and check the temperature and power alarm again. If the temperature again is high, the transmitter board is suspect.

c. If TL value is well below 140 degrees F and the alarm persists, check calibration of ceilometer in accordance with paragraph 9.5.2.4. If ceilometer calibration is out of tolerance, replace Transmitter Board A7. If ceilometer calibration is within tolerance, proceed to next step.

d. Ensure that laser is on (AUTO ON). If ceilometer is not reporting cloud detection (while clouds are present), replace transmitter board. If ceilometer is reporting clouds, measure the following on Light Monitor Board A5:

(1) Measure TP3 (+) to TP5 (-) (GND) for 17 ±1 vdc. If not in range, measure cathode of diode D7 for +25 vdc. If +25 vdc is present but TP3 is not present or out of tolerance, replace Light Monitor Board A5. If +25 vdc is not present, suspect Unregulated Power Supply Board A2.

(2) If ceilometer is providing positive cloud detection, measure TP1 (+) to TP5 (-) (GND) for between 1.5 and 4 vdc (with laser on). If not correct, suspect Light Monitor Board A5. If in tolerance, suspect Unregulated Power Supply Board A2 or Processor Board A1.

e. If above checks do not identify fault, replace Transmitter Board A7 and recheck laser power level. If fault remains, replace Light Monitor Board A5.

9.5.3.2.4 **Temperature Alarm**. A temperature alarm is indicated by an F in the TEMPERATURE field on the OID ceilometer page. Temperature alarms result when the processor board senses component temperatures or temperature differences that are above the specified alarm limit parameters (ALIM). When a temperature alarm is detected, the maintenance technician should open direct dialogue with the ceilometer to request status (STA). The resulting status display identifies the detected temperature alarm sensed point by an asterisk (*) after the sensed value. Table 9.5.11 lists the temperature references, their normal stable value range, and their alarm limit values. If the sensed temperature is within the limits of the table, the alarm limit parameter (ALIM) should be checked. If both of these values are correct, a wiring or connector fault is probable. If the sensed temperature is abnormal or out of limits, the associated sensor and wiring should be checked. The temperature sensors convert heat energy to electrical energy, using the following formula to convert temperatures expressed in degrees Celsius to the equivalent temperatures expressed in degrees Fahrenheit:

T(degrees Fahrenheit) = 1.8 x T(degrees Celsius) + 32

A temperature alarm occurs if the sensed voltage exceeds the preset alarm limit. An open temperature sensing circuit indicates an approximate temperature reading of 200°C (a sensed voltage of 5 vdc). The voltage output of an operational temperature sensor is expressed as:

V = (T(degrees Celsius) + 273) x 10 mV

Table 9.5.11. Temperature Alarm References

Temperature Reference	Normal Range (Stabilized)	Alarm Limit (Specified)
TE	Up to 5°C above ambient	100°C
TI	+5°C to +15°C above ambient when ambient is above 0°C, or +10°C to +30°C above ambient when ambient is below 0°C	100°C
TL	Equal to TI (±5°C)	70°C
TB	Up to 20°C above TE when unit is in sunshine with heaters and blower both off. Up to 5°C above TE when heaters are off and blower is on. Between 5°C and 10°C above TE with both heaters and blower on.	80°C

The following are typical values for reference purposes:

Temperature (T) Degrees Fahrenheit	Temperature (T) Degrees Celsius	Sensor Voltage (vdc)
+140	+60	+3.33
+104	+40	+3.13
+68	+20	+2.93
+32	+0	+2.73
-4	-20	+2.53
-40	-40	+2.33

If, after sufficient stabilization time (minutes for the TE and TB references and hours for the TI and TL references), the temperature alarm persists, the course of action is determined by the category of the sensed temperature. If a high temperature is sensed (close to 200°C may indicate an open circuit), table 9.5.12 should be referenced for voltage test points. If the sensed temperature seems to be within reasonable range yet the alarm persists, table 9.5.13 should be used for fault isolation procedures. The cables and connectors referenced in these tables are depicted in the ceilometer detailed block diagram (figure 9.4.4).

Table 9.5.12. Temperature Alarm With High Temperature

Temperature Reference	Check Test Points
TL	A7, TP6 - TP5; A2J1, A13 - C13; connectors A7J2, A2J8, A2J1, and A1J1; Cable W7
TE	A2J9, 1 - 2;A2J1, a14 - c14; connectors TS1P1, A2J9, A2J1, and A1J1
TI	None, replace A1
TB	B1E1, 8 - 9; A2J1, a15 - c15; connectors B1E1, B1P1, W2J2, W2P1, PS1J2, PS1P2, A2J11, A2J1, and A1J1; cables W2 and B1W1

Table 9.5.13. Temperature Alarm With Reasonable Temperatures

Temperature Reference	Procedure
TL > 70°C (158°F)	If ambient temperature is close to 49°C (120°F) and solar radiation is intense, check that window conditioner blower is on and heat is off. If not, troubleshoot window conditioner.
TB > 80°C (176°F) or TB-TE > 40°C (72°F)	Check that the window conditioner or blower is on and functional. If not, troubleshoot window conditioner.

9.5.3.3 **RS-232C Interface Nonoperational**. The RS-232C interface of the ceilometer is the primary data communications interface for the ASOS configuration. This interface is connected to a fiberoptic module added to the ceilometer to provide the fiberoptic link with the DCP. A failure in this link could cause a total loss of communications with the ceilometer or cause intermittent data transfer errors with the sensor. If communications with the ceilometer become difficult, the maintenance technician should troubleshoot the data link starting at the DCP. (Chapter 1 provides instructions for testing the DCP fiberoptic modules.) If the DCP tests okay, the ceilometer must be checked. Before the RS-232C interface is checked at the ceilometer, the ceilometer equipment cabinet covers must be removed as described in table 9.5.14 to gain access to the electronics. Once the covers are removed, the line voltage indicator (DS1) and the equipment circuit breakers (CB1 and CB2) on high voltage power supply (PS1) are checked. The line voltage indicator should be illuminated and both circuit breakers in the ON (up) position. If power is available to the ceilometer, the ERROR and OK indicators (D4 and D5) on Processor Board A1 should be checked. The OK indicator should be flashing (about 1 Hz rate) and the ERROR indicator should be extinguished. If the ERROR indicator is illuminated, then reset the processor board using the RESET switch located on the board. If the ERROR indicator remains illuminated, then replace the processor board. If both the ERROR and OK indicators are extinguished, then perform power checks on the processor board (refer to paragraph 9.5.4.1) and the unregulated power supply board (refer to paragraph 9.5.4.2). Should the indicators and power check out okay, the ceilometer detailed block diagram (figure 9.4.4) should be referenced to check the wiring and connectors along the RS-232C data path.

9.5.3.4 **Cloud Detection Missing**. If clouds are definitely present and within the detectable range of the ceilometer but are not reported by the ceilometer, the message reports from the ceilometer must be checked for any alarm messages. It may be necessary to reset the ceilometer (by using the RESET command in direct dialogue mode or by cycling power) and check the status messages upon initialization. Using direct dialogue with the ceilometer, the parameters should be checked (using the PAR command) to verify that they are correct for the current configuration of the system. Any incorrect value should be adjusted as required. The ceilometer windows and lenses should be checked for possible obstructions. If these activities do not correct the problem, the transmitter, receiver, and processor boards are suspect. The technician should check for proper operation by referring to the theory of operation provided in Section IV and to the board verification and replacement procedures provided in this section.

Table 9.5.14. Ceilometer Equipment Cabinet Cover Removal and Installation

Step	Procedure
REMOVAL	
	Tools required: None **WARNING** Death or severe injury may result if power is not removed from sensor prior to maintenance activities. Ensure that heater and primary power circuit breakers (located in DCP) are set to off (right) position. **CAUTION** Prevent dust, precipitation, dirt, or other obstructions from accumulating on the ceilometer windows and lenses. Damage to the optics may render the ceilometer inoperable.
1	Inside DCP equipment cabinet, set circuit breakers on ceilometer circuit breaker module to off (right) position.
2	Disconnect window conditioner by unplugging cable from connector J2 located on the underside of the equipment cabinet assembly.
3	Loosen four knurled screws securing window conditioner to equipment cabinet assembly.
4	Carefully remove window conditioner by lifting from equipment cabinet assembly and gently set on the ground.
5	Release two latches at the lower edge of the ceilometer equipment cabinet cover.
6	Carefully raise equipment cabinet cover over the ceilometer electronics assembly and set on the ground.
INSTALLATION	
	WARNING Death or severe injury may result if power is not removed from sensor prior to maintenance activities. Ensure that heater and primary power circuit breakers (located in DCP) are set to off (right) position.
1	Inside DCP equipment cabinet, ensure that circuit breakers on ceilometer circuit breaker module are set to off (right) position.
2	Carefully install ceilometer equipment cabinet cover over ceilometer electronics assembly and lower to its normal position.
3	Secure two latches at lower edge of ceilometer equipment cabinet cover.
4	Carefully install window conditioner on equipment cabinet assembly.
5	Tighten four knurled screws securing window conditioner to equipment cabinet assembly.
6	Connect window conditioner cable to connector J2 located on underside of equipment cabinet assembly.
7	Inside DCP equipment cabinet, set circuit breakers on ceilometer circuit breaker module to on (left) position.

9.5.3.5 **Superfluous Detection**. If repeated miss-hits are reported by the ceilometer with no apparent cause, the system could possibly be experiencing intermittent malfunctions. The first step in isolation of these malfunctions is to check the alarm messages received from the ceilometer. It may be necessary to reset the ceilometer (by using the RESET command or by cycling power) to check the status messages reported by system initialization. The ceilometer parameters should also be checked (using the PAR command) to verify that they are correct for the current configuration of the system. If the system checks out without alarms or parameter problems and the malfunction persists, the maintenance technician should refer to the theory of operation provided in this chapter as well as the board verification and replacement procedures to troubleshoot the system.

9.5.4 BOARD VERIFICATION AND REPLACEMENT PROCEDURES

The following paragraphs provide detailed procedures to verify the operation of the ceilometer circuit boards. Procedures are also provided for the removal and replacement of each board. To perform the verification and replacement procedures, the ceilometer equipment cabinet cover must be removed to gain access to the electronics. Table 9.5.14 provides the procedures to remove and install the ceilometer equipment cabinet cover.

9.5.4.1 **Processor Board A1 Verification and Replacement**.

9.5.4.1.1 **Verification**. The processor board is a microprocessor-based design that functions as the central control element of the ceilometer. In some instances, the actual malfunction may be caused by a temporary condition that confuses the processing software. Therefore, it is recommended that the ceilometer first be reset (using the RESET command, cycling power, or activating the reset switch on the processor board) and then observed to check if the condition is corrected. The microprocessor-based design also provides the onboard processor capability of detecting the majority of faults through self-test diagnostics. These tests report detected failures through hardware alarm messages that are displayed as previously described. Several onboard voltage regulator circuits provide electrical power and reference voltages to the processor board. The source power for these local regulators is monitored by the sensor software and can be observed using the STA (status) command in the direct dialogue mode. The local regulator outputs can be checked at the points provided in table 9.5.15. If any of the onboard voltages is out of tolerance, the processor board should be replaced.

9.5.4.1.2 **Replacement**. The processor board removal and installation procedures are provided in table 9.5.16.

Table 9.5.15. Processor Board Operating Voltage Checkpoints

Checkpoint	Voltage	Description
J6 pin 8	+5 ±0.25	Logic supply
J5 pin 10	+12.2 ±0.8	Interface supply
J5 pin 9	-12.2 ±0.8	Interface supply
J9 pin 5	+9 ±0.5	Flash A/D supply
J14 pin 2	+12.7 ±0.8	Analog high supply
J19 pin 6	-12.7 ±0.8	Analog high supply
J19 pin 3	+6.1 ±0.3	Analog low supply
J19 pin 4	-6.1 ±0.3	Analog low supply
J6 pin 7	+5 ±0.05	Monitor A/D reference
J9 pin 4	+8.3 ±0.1	Flash A/D high reference
J9 pin 3	+1.7 ±0.05	Flash A/D low reference
J9 pin 2	+0.9 ±0.1	Flash A/D input
J16 pin 10	+7.1 ±0.3	Level shift source
J16 pin 9	+1.9 ±0.3	Level shift return
J19 pin 7	-4.3 ±0.3	Amplifier test point 2
J19 pin 5	+3 ±0.5	Amplifier test point 1

Table 9.5.16. Processor Board Removal and Installation

Step	Procedure
REMOVAL	
	Tools required: None **NOTE** A laptop computer initialized as DCP OID (Chapter 3, Section III) or any other available OID may be used for the following steps.
1	Using ceilometer dialog page, enter the following command: LNOR For measurement normalization during installation of the new processor board, record LNOR parameter displayed; then, enter the following command: DEV
2	Record LNOR and DEV values returned. If the values are not returned, proceed to step 3.
3	Disconnect ac power from ceilometer and remove ceilometer equipment cabinet covers as described in table 9.5.14.
4	Unplug cable W8 from connector J22 on the processor board.
5	Unplug cable W9 from connector J26 on the processor board.
6	Disconnect processor board A1 from unregulated power supply board.
7	Remove processor board from ceilometer.
INSTALLATION	
	Tools required: None
1	Ensure that all jumpers on new processor board are positioned the same as the processor board being replaced.
2	Connect new processor board into its connector on unregulated power supply board.
3	Connect cables W8 and W9 to connectors J22 and J26, respectively, on the processor board.
4	Apply power to the ceilometer and observe LED indicators D4 and D5 on Processor Board A1. The red LED (D4) should be extinguished and the green LED (D5) should blink about once per second.
5	Using the PAR (parameter) command, verify that the following system parameters values are stored: CLIM 0.1000 SLIM 0.2000 NSCA 4.5000 SCAL 100.0000 TOTAL 10.0000 HOFF 0 DATA UNIT FT POLLED MESSAGES If stored parameter values do not agree with those listed above, then enter the above values.

Table 9.5.16. Processor Board Removal and Installation -CONT

Step	Procedure
6	If LNOR and DEV values were recorded in step 2 of removal procedure, proceed to step 7. If LNOR and DEV values were not recorded in step 2 of removal procedure, or have not been previously recorded, disconnect AC power form the ceilometer. Remove U5 from new processor board installed in step 1 above, and U5 from processor board removed in Removal step 7; swap U5's. Reapply power, use the ceilometer dialogue page to enter the following commands: LNOR DEV Record LNOR and DEV. Disconnect AC power form the ceilometer, and swap U5's to their original boards. Reapply power.
7	Use ceilometer dialogue page to enter the following commands: LNOR XXX (where XXX is the LNOR value recorded in step 6 of the installation procedure, or step 2 of the removal procedure, or the logged values). DEV X.XXXX (where X.XXXX is the DEV value recorded in step 6 of the installation procedure, or step 2 of the removal procedure, or the logged values).
8	If LNOR for the system cannot be retrieved by the above methods, the ceilometer transmitter board must be replaced with a new board using the transmitter board removal and installation procedures. This will establish a new correct LNOR for the system.
9	Install ceilometer equipment cabinet covers as described in table 9.5.14 and apply power to ceilometer.
10	Perform the offset calibration procedures as described in table 9.5.35.

9.5.4.2 **Unregulated Power Supply Board A2 Verification and Replacement**.

9.5.4.2.1 **Verification**. Malfunctions involving the unregulated power supply board are generally detected by supply voltage alarms reported by the ceilometer. A supply voltage alarm is indicated by an F in the SUPPLY VOLTAGE field on the OID ceilometer page. When a supply voltage alarm is detected by the system, the technician should open a direct dialogue line with the ceilometer (select OID dialogue page) and request status (STA command) from the processor board. The displayed status message contains one or more voltages that are detected as being below the alarm limit (as set by the alarm command). The voltage(s) that triggered the alarm are identified by an asterisk (*) after the voltage value. Table 9.5.17 provides the voltage levels that should be detected at each power supply monitoring point. If the voltage displayed is within the limits shown in the table, the technician should check the alarm limit entered into the system (using the ALIM command). If the system alarm limit is correct (within the normal operating range specified in the table), connector faults or line voltage variances are possible. If one specific voltage point is out of limit, reference should be made to table 9.5.18, which identifies the ac power inputs, fuses, and loads associated with each monitored dc power point. The technician should check corresponding fuses and manually check the power supply points at the ceilometer to isolate the fault. Table 9.5.10 provides additional information on checking system power supplies. In addition to the power supplies, the unregulated power supply board provides an extensive number of signal paths between the other circuit boards in the ceilometer. These signal paths can be verified by checking their continuity using an ohmmeter. The temperature control relays on the unregulated power supply board can only be checked by simulating heating conditions using a cold spray to cool the temperature sensor (U16 on Processor Board A1). The operation of the relays may be heard, and after the relays are energized, the voltage outputs can be checked using a multimeter.

9.5.4.2.2 **Replacement**. The unregulated power supply board removal and installation procedures are provided in table 9.5.19.

Table 9.5.17. Unregulated Power Supply Voltage Limits

Voltage Point	Normal Value	Alarm Limit	Acceptable Max
P20I	+20 vdc	+15 vdc	+24 vdc
P10X	+10 vdc	+7.5 vdc	+12 vdc
M20A	-20 vdc	-15 vdc	-24 vdc
P10R	+10 vdc	+7 vdc	+13 vdc
P12M	+12 vdc	+8 vdc	+15 vdc
P10D	+10 vdc	+6.5 vdc	+12 vdc
P25V	+25 vdc	+20 vdc	+30 vdc
P20A	+20 vdc	+15 vdc	+24 vdc
M20I	-20 vdc	-15 vdc	-24 vdc

Table 9.5.18. Unregulated Power Supply Voltage Test Points and Loads

Voltage Point	Check Fuses	Voltage Test Point	AC Input at A2	Power Loads
P10D	A2F3	A2TP4	8 vac	A1
P20I	A2F6 or F7	A2TP3	30 vac	A1
M20I	A2F6 or F7	A2TP2	30 vac	A1
P25V	A2F1	A2TP1	20 vac	R1, R2, A1, A5, T1, or PS1
M20A	A2F4 or F5	A2TP5	30 vac	A1
P20A	A2F4 or F5	A2TP6	8 vac	A1
P12M	A2F8	A2TP7	10 vac	A1
P10X	A2F9	A2TP9	8 vac	A1 or A7
P10R	A2F2	A2TP8	8 vac	A1 or A6

Table 9.5.19. Unregulated Power Supply Board Removal and Installation

Step	Procedure
REMOVAL	
Tools required: No. 1 Phillips screwdriver Needle-nosed pliers	
1	Disconnect ac power from ceilometer and remove ceilometer equipment cabinet covers as described in table 9.5.14.
2	Disconnect Processor Board A1 and I/O Connector Board A3 from unregulated power supply board as described in tables 9.5.16 and 9.5.21.
3	Disconnect all cables and wiring harnesses from unregulated power supply board connectors.
4	Remove four screws securing unregulated power supply board to frame.
5	Unplug unregulated power supply board from two plastic standoffs, using pliers to press plastic springs.

Table 9.5.19. Unregulated Power Supply Board Removal and Installation -CONT

Step	Procedure
	INSTALLATION
	Tools required: No. 1 Phillips screwdriver Needle-nosed pliers
1	Ensure that new unregulated power supply board has switch S1 set to ON position and switch S2 set to NORMAL position.
2	Install new unregulated power supply board on two plastic standoffs using pliers to press plastic springs.
3	Install four screws securing unregulated power supply board to frame.
4	Connect all cables and wiring harnesses to unregulated power supply board connectors as required.
5	Connect Processor Board A1 and I/O Connector Board A3 to unregulated power supply board as described in tables 9.5.16 and 9.5.21.
6	Install the ceilometer equipment cabinet covers as described in table 9.5.14 and apply power to ceilometer.
7	Perform the offset calibration procedures provided in table 9.5.35.

9.5.4.3 **I/O Connector Board A3 Verification and Replacement**.

9.5.4.3.1 **Verification**. The supply voltage test points for the I/O connector board are identified in table 9.5.20. The only supply voltage on the board is the +5 vdc supply. Continuity checks on the RS-232 transmit (TXD) and receive (RXD) data signal paths can be performed by referring to detailed block diagram, figure 9.4.4.

9.5.4.3.2 **Replacement**. The removal and replacement procedures for the I/O connector board are provided in table 9.5.21.

Table 9.5.20. I/O Connector Board Voltage Test Points

Voltage Reference	Test Point	Value
+5V	J2-9	+5 vdc
GND	J2-5	Ground ref

Table 9.5.21. I/O Connector Board Removal and Installation

Step	Procedure
	REMOVAL
	Tools required: None
1	Disconnect ac power from ceilometer and remove ceilometer equipment cabinet covers as described in table 9.5.14.
2	Disconnect cable W3 from connector J2 on I/O connector board.
3	Unplug I/O Connector Board A3 from Unregulated Power Supply Board A2.
	INSTALLATION
1	Plug I/O Connector Board A3 on unregulated power supply board.
2	Connect cable W3 to connector J2 on output interface board.
3	Install ceilometer equipment cabinet covers as described in table 9.5.14 and apply power to ceilometer.

9.5.4.4 **Light Monitor Board A5 Verification and Replacement**.

9.5.4.4.1 **Verification**. Before the light monitor board can be checked, there should be no obstructions that would prevent the board from monitoring the laser transmitter light or the ambient sky light. The supply voltage test points for the light monitor board are listed in table 9.5.22. Both the laser power level voltage and the sky light level voltage are monitored by the processor board. If either of these circuits should malfunction, the processor board issues an alarm message for display. The solar shutter driver and optional solar shutter can be verified using the SHUT ON and SHUT OFF commands in direct dialogue with the ceilometer if the shutter option is installed. The solar shutter driver can be further checked by covering D3 and checking that the voltage at TP4 is approximately 2v ±0.1v. Adjustment is made at R13 if necessary. Driver Q2 should be fully conducting (i.e., solenoid is energized and flap is open); if it is not, force on signal SSON is verified as low. If force is low, A5 should be replaced; otherwise, A1, A2, or W5 may be faulty. Processor control status should be verified as SHUTTEROFF. If the shutter driver must be replaced, the procedure in table 9.5.23 is performed.

9.5.4.4.2 **Replacement**. The light monitor board removal and installation procedures are provided in table 9.5.24.

Table 9.2.22. Light Monitor Board Voltage Test Points

Voltage reference	Test point	Value
P25V	J2-1	+25 vdc
+17V	TP3	+17 vdc (±1 vdc)
GNDP	TP5	Ground ref

Table 9.5.23. Solar Shutter Driver Removal and Installation

Step	Procedure
REMOVAL	
Tools required: No. 10 flat-tipped screwdriver Allen wrench (.050)	
1	Disconnect power from ceilometer and remove ceilometer equipment cover as described in table 9.5.14. **NOTE** The shutter flap is in the closed position when ceilometer power is OFF. The flap is open when power is ON and the light intensity threshold is not exceeded.
2	Place protective cloth over lens to protect lens from any tools or hardware that may be inadvertently dropped on lens during removal procedure.
3	Disconnect solar shutter driver (i.e., solenoid) cable from connector J1 on light monitor board.
4	Loosen sleeve at solenoid end of flexible coupling using .050 Allen wrench.
5	Remove two screws that secure solenoid to ceilometer frame and remove solenoid from ceilometer.
6	Move flap back and forth by hand to ensure that flap is unobstructed.
INSTALLATION	
1	Slide armature of solenoid into coupling sleeve. Leave sleeve loose.
2	Secure solenoid to frame with two machine screws.
3	Tighten sleeve on coupling.
4	Reconnect solenoid cable to connector J1 on light monitor board.
5	Replace ceilometer equipment cover in accordance with procedure in table 9.5.14.
6	Turn ON ceilometer power.

Table 9.5.24. Light Monitor Board Removal and Installation

Step	Procedure
REMOVAL	
Tools required: No. 1 Phillips screwdriver	
1	Disconnect power from ceilometer and remove ceilometer equipment cabinet covers as described in table 9.5.14.
2	Disconnect cable W5 from connector J1 on light monitor board.
3	Disconnect solar shutter relay solenoid cable (if installed) from connector J2 on light monitor board.
4	Place protective cloth over lens to protect lens from any tools or hardware that may be inadvertently dropped during this procedure.
5	Remove two screws securing light monitor board to optics frame assembly.
6	Lift light monitor board from electronics assembly.
INSTALLATION	
1	Place protective cloth over lens to protect lens from any tools or hardware that may be inadvertently dropped during this procedure.
2	Install new light monitor board. Install two screws securing light monitor board to optics frame assembly.
3	Connect solar shutter relay solenoid cable (if installed) to connector J2 on light monitor board.
4	Connect cable W5 to connector J1 on light monitor board.
5	Install ceilometer equipment cabinet covers as described in table 9.5.14 and apply power to ceilometer.

9.5.4.5 **Receiver Board A6 Verification and Replacement**.

9.5.4.5.1 **Verification**. The same verification and replacement procedure is used for the standard and tropical receiver boards. The supply voltage test points for the receiver board are listed in table 9.5.25. In addition to these supply voltages, the high voltage power can be checked at test point TP2. The value of the high voltage power is temperature dependent. The receiver board is factory calibrated at 25°C (77°F) and the TP2 voltage for this temperature is identified by a sticker located on the board. With the voltage/temperature relationship of 2.3 volts/°C (1.3 volts/°F), the voltage that should be measured at test point TP2 can be calculated using the following equations:

$$V(TP2) = V_b + ((T_p(°C) - 25) \times 2.3)$$
$$V(TP2) = V_b + ((T_p(°F) - 77) \times 1.3)$$

where: V(TP2) = Voltage measured at TP2
V_b = Voltage on board sticker
T_p = Present temperature

If the voltage level measured is not close to the calculated level, high voltage power supply PS1 or cable W10 is suspect. The receiver photodiode can also be checked by measuring the voltage between test points TP1 and TP2. With the receiver lens covered, this value should be less than 1 millivolt. With the lens uncovered in bright daylight, the level may be as high as 0.5 volt, but not significantly higher. Artificial light may be used in instances when bright daylight is not available.

9.5.4.5.2 **Replacement**. The receiver board removal and installation procedures are provided in table 9.5.26. Use extreme care when removing the receiver board. Damage to fiberoptic connectors can be prevented by removing the receiver housing.

Table 9.5.25. Receiver Board Voltage Test Points

Voltage Reference	Test Point	Value
WARNING High voltage is accessible on the receiver board.		
+5V	TP3	+5 vdc (+0.5 vdc)
P10R	J1-1	+10 vdc (+2 vdc)
GNDR	TP GND	Ground ref

Table 9.5.26. Receiver Board Removal and Installation

Step	Procedure
REMOVAL	
Tools required: 9/32-inch open end wrench	
1	Disconnect ac power from ceilometer and remove ceilometer equipment cabinet covers as described in table 9.5.14.
2	**CAUTION** Use extreme care when removing receiver board. Damage to fiberoptic connectors can be prevented by removing receiver housing. Disconnect cable W8 from connector J3 on receiver board.
3	Disconnect cable W6 from connector J1 on receiver board.
4	Disconnect cable W10 from connector J2 on receiver board.
5	Remove hex spacer nuts securing receiver board to optics frame assembly.
6	**CAUTION** Avoid touching the mirror-like infrared light interference filter when installing receiver board. Upon removal of receiver board from optics frame assembly, immediately store board in a bag or box to protect light filter from damage. Carefully lower receiver board to clear the long screws and remove board from optics frame assembly.
INSTALLATION	
Tools required: 9/32-inch open end wrench	
1	**CAUTION** Avoid touching the mirror-like infrared light interference filter when installing receiver board. **NOTE** Install tropical receiver board (part No. 62828-90112-11 on ceilometers equipped with solar shutter assembly and standard receiver board (part No. 62828-90112-4) on ceilometers that are not equipped with solar shutter assembly. Install receiver board in optics frame assembly by raising into position over the long screws.
2	Install hex spacer nuts securing receiver board to optics frame assembly.

Table 9.5.26. Receiver Board Removal and Installation -CONT

Step	Procedure
3	Connect cable W10 to connector J2 on receiver board.
4	Connect cable W6 to connector J1 on receiver board.
5	Connect cable W8 to connector J3 on receiver board.
6	Install ceilometer equipment cabinet covers as described in table 9.5.14 and apply power to ceilometer.
7	Perform offset calibration procedures as provided in table 9.5.35.
8	Verify ceilometer calibration in accordance with table 9.5.4.

9.5.4.6 **Transmitter Board A7 Verification and Replacement**.

9.5.4.6.1 **Verification**. The absence of laser power can be detected by persistent missing cloud returns or by a low monitored laser power level (LLAS). The ceilometer processor board monitors the LLAS voltage signal and issues an alarm message when LLAS is low. The supply voltage test points for the transmitter board are listed in table 9.5.27. If the voltage level measured at TP4 is too low, Unregulated Power Supply Board A2 or wiring harness W7 is suspect. If the high voltage input at TP7 is too low, high voltage power supply PS1 or cable W11 is suspect. In addition to these supply voltages, the high voltage power can be checked at test point TP3. This voltage should be checked with laser power off (use AUTO OFF command). The value of the high voltage power at TP3 is temperature dependent. The transmitter board is factory calibrated at 21°C (70°F) and the TP3 voltage for this temperature is identified by a sticker located on the board. With the voltage/temperature relationship of 1.8 volt/°C (1.0 volt/°F), the voltage that should be measured at test point TP3 can be calculated using the following equations:

$$V(TP3) = V_b + ((T_p(°C) - 21) \times 1.8)$$
$$V(TP3) = V_b + (T_p(°F) - 70)$$

where: V(TP3) = Voltage measured at TP3
V_b = Voltage on board sticker
T_p = Present temperature

If the voltage level measured is not close to the calculated level, high voltage power supply PS1 or cable W11 is suspect. If the high voltage measured at TP7 is okay, but TP3 is close to zero, power should be removed from the unit for a few seconds and then reapplied. TP7 and TP3 should then be rechecked. If TP3 is still close to zero, Transmitter Board A7 should be replaced. The laser temperature sensor voltage can be measured across TP6-TP5. At 70°F, the voltage at TP6 should be +2.94 vdc. The voltage level at TP6-TP5 is temperature sensitive, with a temperature coefficient of 5.5 mv/°F (10 mv/°C). If the voltage measured at TP6 is too low, Processor Board A1, Unregulated Power Supply Board A2, or cable harness W7 is suspect.

9.5.4.6.2 **Replacement**. The transmitter board removal and installation procedures are provided in table 9.5.28.

Table 9.5.27. Transmitter Board Voltage Test Points

Voltage reference	Test point	Value
WARNING High voltage is present on the transmitter board.		
+10VX	TP4	+10 (±1.5) vdc
+260V	TP7	+260 (±40) vdc
GNDX	TP GND	Ground ref

Table 9.5.28. Transmitter Board Removal and Installation

Step	Procedure
REMOVAL	
Tools required: 9/32-inch open end wrench	
1	Disconnect ac power from ceilometer and remove ceilometer equipment cabinet covers as described in table 9.5.14. Remove transmitter cover (black knob underneath).
2	Disconnect cable W11 from connector J3 on transmitter board.
3	Disconnect cable W7 from connector J2 on transmitter board.
4	Disconnect cable W9 from connector J1 on transmitter board.
5	Remove three hex spacer nuts securing transmitter board to optics frame assembly.
6	Carefully lower transmitter board to clear the long screws and remove from optics frame assembly.
INSTALLATION	
Tools required: 9/32-inch open end wrench	
1	Install transmitter board in optics frame assembly by raising into position over the long screws.
2	Install three hex spacer nuts securing transmitter board to optics frame assembly.
3	Connect cable W9 to connector J1 on transmitter board.
4	Connect cable W7 to connector J2 on transmitter board.
5	Connect cable W11 to connector J3 on transmitter board.
6	Note the diffuser value marked on the diffuser and install diffuser over transmitter lens such that the four notches in the diffuser ring are lined up with the three pairs of support screws on the lens plate (diffuser ring must rest flat on the lens plate).
7	Install ceilometer equipment cabinet covers as described in table 9.5.14 and apply power to ceilometer.
8	Allow ceilometer to warm up for at least ½ hour with equipment cabinet covers in place.
NOTE LNOR is used by the system to adjust the laser output power to a standard value. Standard laser power is essential to uniform cloud detection. The uniform power provides a consistent result among LBC's and the sky condition is reported consistently between ASOS systems. LNOR should be determined only when a new transmitter board is installed. That value of LNOR should be used throughout the life of that transmitter board. A new LNOR should not be determined using a transmitter that has been used in the system. New transmitter cards have a calibrated standard output power and can be used to establish LNOR for the LBC system. Laptop computer, initialized as DCP OID (Chapter 3, Section III) or any other available OID, may be used for the following steps.	

Table 9.5.28. Transmitter Board Removal and Installation - CONT

Step	Procedure
9	At OID, display ceilometer dialogue page.

10	Using ceilometer dialogue page, enter the following commands:
	`AUTO OFF` (which enters maintenance mode)
	`FREQ 3`
	`SEQ ON`
	`LASE ON`
	`AN LLAS`

11	Observe laser power level values displayed to visually estimate the average value. If the average displayed value does not match the value listed on the diffuser (tolerance = ±3), terminate the output by pressing ESC and enter the following commands according to the observed display values:
	
	If displayed average is less than diffuser value, enter:
	`FREQ 4`
	`SEQ ON`
	`LASE ON`
	`AN LLAS`
	
	If displayed average is greater than diffuser value, enter:
	`FREQ 2`
	`SEQ ON`
	`LASE ON`
	`AN LLAS`

12	Observe the values displayed to visually estimate the average value. Repeat steps 10 and 11 as necessary, each time increasing or decreasing the FREQ value by one, until the average value matches the diffuser value (±3).
13	When the displayed average value and the diffuser value match, do not terminate the output display on the maintenance monitor terminal.
	WARNING The high voltage ac and dc power are accessible on the ceilometer electronics assembly. Use extreme caution when removing the equipment cabinet covers with power applied to the ceilometer.
14	Remove equipment cabinet covers.
	CAUTION When removing diffuser from lens plate, avoid scratching the lens or hitting the light monitor board.
15	Carefully remove diffuser from lens plate.
16	Observe LLAS values displayed on screen to visually estimate the average value displayed.
17	Terminate the display output.
18	Increase the average value determined in step 16 by adding five (LLAS + 5).
19	Using ceilometer dialogue page, enter the following command: LNOR XXX where: XXX = the value obtained in step 18 Record the LNOR value in a permanent log book for the transmitter card.
20	Observe that the system displays the same value. If not, repeat step 19.

Table 9.5.28. Transmitter Board Removal and Installation - CONT

Step	Procedure
21	Using ceilometer dialogue page, enter the following command to return ceilometer to normal operation: AUTO ON
22	Install equipment cabinet covers and perform offset calibration procedures as provided in table 9.5.35.
23	Verify ceilometer calibration in accordance with table 9.5.3.

9.5.4.7 **High Voltage Power Supply PS1 Verification and Replacement**.

9.5.4.7.1 **Verification**. The operation of the high voltage power supply is verified by checking the input ac power and the power supply outputs. The point-to-point wiring of the high voltage power supply is depicted on the ceilometer detailed block diagram (figure 9.4.4), which should be referenced when checking the power supply. The operation of the window conditioner heater and blower relays that are a part of the high voltage power supply can also be verified. The following commands are entered at the maintenance monitor terminal: AUTO OFF (to enter the maintenance mode), BLOW ON, and HEAT ON. These commands instruct the processor to activate the relays and turn the window conditioner blower and heater on.

9.5.4.7.2 **Replacement**. The high voltage power supply removal and installation procedures are provided in table 9.5.29.

Table 9.5.29. High Voltage Power Supply Removal and Installation

Step	Procedure
REMOVAL	
Tools required: 5mm hex key wrench	
1	Disconnect ac power from ceilometer and remove ceilometer equipment cabinet covers as described in table 9.5.14.
2	Disconnect cable W1 from connector J1 on high voltage power supply.
3	Disconnect cable W2 from connector J2 on high voltage power supply.
4	Disconnect temperature compensation transformer T1 wiring harness from connector J3 on high voltage power supply.
5	Disconnect cable W10 from connector J7 on high voltage power supply.
6	Disconnect cable W11 from connector J8 on high voltage power supply.
7	Using Allen (hex) key, remove four screws from front and two screws from rear securing high voltage power supply to frame assembly.
8	Slide high voltage power supply out from front of cabinet.

Table 9.5.29. High Voltage Power Supply Removal and Installation -CONT

Step	Procedure
	INSTALLATION
	Tools required: 5mm hex key wrench
1	Install high voltage power supply from front of cabinet.
2	Using Allen (hex) key, install four screws at front and two screws at rear securing high voltage power supply to frame assembly.
3	Connect cable W11 to connector J8 on high voltage power supply.
4	Connect cable W10 to connector J7 on high voltage power supply.
5	Connect temperature compensation transformer T1 wiring harness to connector J3 on the high voltage power supply.
6	Connect cable W2 to connector J2 on high voltage power supply.
7	Connect cable W1 to connector J1 on high voltage power supply.
8	On high voltage power supply PS1, adjust R13 to its maximum (fully clockwise) limit.
9	Install ceilometer equipment cabinet covers as described in table 9.5.14 and apply power to ceilometer.
10	Perform the offset calibration procedures as provided in table 9.5.35.

9.5.4.8 **Temperature Compensation Transformer T1 Verification and Replacement**.

9.5.4.8.1 **Verification**. The temperature compensation transformer is verified by checking the voltage output to the unregulated power supply board. The transformer output (secondary) should provide 20 vac (±3 vac). The input voltage to the transformer can be verified at connector J3 of the high voltage power supply. These voltage levels are provided on the ceilometer detailed block diagram (figure 9.4.4).

9.5.4.8.2 **Replacement**. The temperature compensation transformer removal and installation procedures are provided in table 9.5.30.

Table 9.5.30. Temperature Compensation Transformer Removal and Installation

Step	Procedure
	REMOVAL
	Tools required: Diagonal cutting pliers No. 2 Phillips screwdriver
1	Disconnect ac power from ceilometer and remove ceilometer equipment cabinet covers as described in table 9.5.14.
2	Disconnect wiring harness from connector J3 on unregulated power supply board.
3	Disconnect wiring harness from connector J3 on high voltage power supply.
4	Open cable clamp securing transformer secondary wiring harness to optics frame assembly.
5	Cut wiring bundle ties securing transformer primary wiring harness to optics frame assembly.
6	Lift plastic feed-through bushing that guides transformer secondary wiring harness through the top of optics frame assembly.
7	Feed transformer secondary wiring harness through the top of optics frame assembly.
8	Remove two screws securing temperature compensation transformer to optics frame assembly and remove transformer.

Table 9.5.30. Temperature Compensation Transformer Removal and Installation -CONT

Step	Procedure
INSTALLATION	
Tools and materials required: Diagonal cutting pliers No. 2 Phillips screwdriver Cable ties	
1	Install new temperature compensation transformer using two screws to secure the transformer to the optics frame assembly.
2	Feed transformer secondary wiring harness through the top of optics frame assembly.
3	Install plastic feed-through bushing that guides transformer secondary wiring harness through the top of optics frame assembly.
4	Close cable clamp securing transformer secondary wiring harness to optics frame assembly.
5	Connect transformer secondary wiring harness to connector J3 on unregulated power supply board.
6	Connect transformer primary wiring harness to connector J3 on high voltage power supply.
7	Install wiring bundle ties securing transformer primary wiring harness to optics frame assembly.
8	Install ceilometer equipment cabinet covers as described in table 9.5.14 and apply power to ceilometer.

9.5.4.9 <u>Cabinet Heaters R1 and R2 Verification and Replacement</u>.

9.5.4.9.1 **Verification**. The cabinet heaters are resistive heater elements whose operation can be verified by checking their resistance values. The heater elements must be disconnected from unregulated power supply board connectors J2 and J4 before resistance is measured. The resistance measured across the heater element should read 10 ohms ±5%.

9.5.4.9.2 **Replacement**. The cabinet heater removal and installation procedures are provided in table 9.5.31.

Table 9.5.31. Cabinet Heater Removal and Installation

Step	Procedure
REMOVAL	
Tools required: No. 1 Phillips screwdriver	
1	Disconnect ac power from ceilometer and remove ceilometer equipment cabinet covers as described in table 9.5.14.
2	Disconnect heater element wiring harness from unregulated power supply board (connector J2 for heater R1 and connector J4 for heater R2).
3	Pull out feed-through bushing from hole in optics frame assembly.
4	Remove two screws securing heater to optics frame assembly. Remove heater.
INSTALLATION	
1	Transfer as much of the heat conducting silicon grease as possible from replaced heater to new heater, adding more grease as necessary.
2	Install heater on optics frame assembly and secure using two screws.
3	Install feed-through bushing in hole in optics frame assembly.
4	Connect heater element wiring harness to unregulated power supply board (connector J2 for heater R1 and connector J4 for heater R2).
5	Install ceilometer equipment cabinet covers as described in table 9.5.14 and apply power to ceilometer.

9.5.4.10 **External Air Temperature Sensor TS1 Verification and Replacement**.

9.5.4.10.1 **Verification**. The external air temperature sensor is verified by checking power (voltage and current) levels where it interfaces with the unregulated power supply board (connector J9). The voltage level present across the sensor is a function of the air temperature. At 70°F (21°C), the voltage level between pins J9-1(+) and J9-2(-) should be approximately 2.94 ±0.020 vdc. The voltage level that should be measured at other temperatures can be calculated according to the following equations:

$V_t = 2.94 + (T_a - 70) \times 0.0055$ for Fahrenheit
$V_t = 2.94 + (T_a - 21) \times 0.010$ for Celsius

where: V_t = Voltage measured for that temperature
T_a = Present air temperature

If the voltage measured does not match the calculated value, the sensor should be disconnected from connector J9 of the unregulated power supply board, and the voltage level across pins 1 and 2 of connector J9 should be checked. The voltage should measure approximately 5 vdc. The current level measured across shorted pins 1 and 2 of connector J9 should measure 2 milliamps. If either the voltage or current level is not correct, Processor Board A1 or Unregulated Power Supply Board A2 is suspect. If both voltage and current level are correct, the sensor TS1 should be replaced.

9.5.4.10.2 **Replacement**. The external air temperature sensor removal and installation procedures are provided in table 9.5.32.

Table 9.5.32. External Air Temperature Sensor Removal and Installation

Step	Procedure
REMOVAL	
Tools required: Diagonal cutting pliers	
1	Disconnect ac power from ceilometer and remove ceilometer equipment cabinet covers as described in table 9.5.14.
2	Disconnect temperature sensor wiring harness from connector J9 on unregulated power supply board.
3	Cut wiring harness bundle ties.
4	Remove air filter from cabinet air vent.
5	Lift temperature sensor from cabinet air vent.
INSTALLATION	
Materials Required: Cable ties	
1	Install temperature sensor in cabinet air vent.
2	Install air filter in cabinet air vent.
3	Connect temperature sensor wiring harness to connector J9 on Unregulated Power Supply Board A2.
4	Install new wiring harness bundle ties securing temperature sensor wiring harness as required.
5	Install ceilometer equipment cabinet covers as described in table 9.5.14 and apply power to ceilometer.

9.5.4.10.3 **Removal and Installation of Snow Radiation Shield**. The snow radiation shield is held in place by a tab on the edge of the shield. It is installed on the under side of the ceilometer with one edge parallel to the edge of the ceilometer base and the other edge with the tab against the pedestal top plate. The tab fits between the top of the pedestal and the bottom of the ceilometer. It is mounted at the end opposite from the fan cable and connector. It is mounted midway between the sides and over top of the ambient air sensor housing which protrudes out of the bottom of the ceilometer. See figure 9.1.2. The snow radiation shield removal and installation procedures are provided in table 9.5.33.

Table 9.5.33. Snow Radiation Shield Removal and Installation

Step	Procedure
REMOVAL	
Tools required: 5mm hex key	
1	Coordinate with site observer, if applicable, and make an entry in SYSLOG.
2	Locate end of ceilometer opposite fan cable entry on bottom of ceilometer. Remove two screws that secure ceilometer to pedestal on that end of ceilometer.
3	On end of the ceilometer where fan cable enters ceilometer base, loosen, but do not remove two screws which secure this end to pedestal. Loosen so there is about 1/16 inch between head of screw and pedestal.
4	Ensure that thumbscrews which secure blower assembly and two latches which secure ceilometer cover to base plate are in place and tight.
5	Locate end of ceilometer where temperature sensor housing is located (same end where two screws were removed). Ceilometer will be tilted away from this end.
6	In one hand, hold snow radiation shield. With other hand, lift at side of ceilometer while placing your shoulder against side of ceilometer to aid in lifting and pushing (if lifting hand is at end of ceilometer, it will be in the way when shield is being removed.). Tilt ceilometer away from you.
7	Remove shield from between inside edge of ceilometer and pedestal top assembly. Lower ceilometer.
8	Install two screws that were removed in step 3.
9	Tighten four screws that secure ceilometer to pedestal.
10	Coordinate with site observer, if applicable, and clear any maintenance flags generated, making an entry in SYSLOG.
INSTALLATION	
Tools required: 5mm hex key	
1	Coordinate with site observer, if applicable, and make an entry in SYSLOG.
2	Locate end of ceilometer opposite fan cable entry on bottom of the ceilometer. Remove two screws that secure ceilometer to pedestal on that end of ceilometer.
3	On end of ceilometer where fan cable enters ceilometer base, loosen, but Do not remove two screws which secure this end to pedestal. Loosen so there is about 1/16 inch between head of screw and pedestal.
4	Ensure thumbscrews which secure blower assembly and two latches which secure ceilometer cover to base plate are in place and tight.
5	Locate end of ceilometer where temperature sensor housing is located (same end where two screws were removed). Ceilometer will be tilted away from this end.

Table 9.5.33. Snow Radiation Shield Removal and Installation -CONT

Step	Procedure
6	In one hand, hold snow radiation shield so that tab is toward pedestal, and ceilometer is tilted away. With other hand, lift at side of ceilometer while placing shoulder against side of ceilometer to aid in lifting and pushing. (If lifting hand were at the end of ceilometer, it would be in the way when shield is put in place.)
7	Insert shield between inside edge of ceilometer and pedestal top assembly so tab fits over top of pedestal. Lower ceilometer to secure snow radiation shield.
8	Check that shield is positioned midway with respect to sides of ceilometer. Move as necessary by sliding.
9	Install two screws that were removed in step 3.
10	Tighten four screws that secure ceilometer to pedestal.
11	Coordinate with site observer, if applicable, and clear any maintenance flags generated, making an entry in SYSLOG.

9.5.4.11 **Window Conditioner Verification and Replacement**.

9.5.4.11.1 **Verification**. The operation of the window conditioner blower and heater can be verified through software commands to the ceilometer using direct dialogue in maintenance mode. In maintenance mode (AUTO OFF), the window conditioner BLOW ON and HEAT ON commands force the window conditioner blower and heater on. Within a few minutes, the blower temperature displayed (TB) should read approximately 12°F (7°C) above the ambient temperature display (TE). If the temperature rises considerably more, blower operation is suspect. If the temperatures read approximately the same value, heater operation is suspect. The isolation of the fault to the window conditioner can be performed by resistance checks across the blower and heater circuits. These circuits are depicted in point-to-point wiring on the ceilometer detailed block diagram (figure 9.4.4). With the window conditioner cable disconnected from connector J2 on the ceilometer, the blower circuit and the heater circuit should measure approximately 60 ohms and 22 ohms, respectively. If these resistance levels check okay, high voltage power supply PS1, Processor Board A1, or Unregulated Power Supply Board A2 is suspect.

9.5.4.11.2 **Replacement**. The window conditioner removal and installation procedures are provided in table 9.5.34.

Table 9.5.34. Window Conditioner Removal and Installation

Step	Procedure
	REMOVAL
	Tools required: Diagonal cutting pliers Small flat-tipped screwdriver **WARNING** Death or severe injury may result if power is not removed from sensor prior to maintenance activities. Ensure that heater and primary power circuit breakers (located in DCP) are set to off (right) position. **CAUTION** Prevent dust, precipitation, dirt, or other obstructions from accumulating on the ceilometer windows and lenses. Damage to the optics may render the ceilometer inoperable.
1	Inside equipment cabinet, set circuit breakers on ceilometer circuit breaker module to off (right) position.

Table 9.5.34. Window Conditioner Removal and Installation -CONT

Step	Procedure
2	Disconnect window conditioner by unplugging cable from connector J2 located on underside of equipment cabinet assembly.
3	Loosen four knurled screws securing window conditioner to equipment cabinet assembly.
4	Carefully remove window conditioner by lifting from equipment cabinet assembly and gently set on the ground.
5	Remove window conditioner cable from the guiding clamp inside the cover.
6	Remove four screws securing heater-blower to cover housing.
7	Remove heater-blower from cover housing.
INSTALLATION	
Tools required: Small flat-tipped screwdriver **WARNING** Death or severe injury may result if power is not removed from sensor prior to maintenance activities. Ensure that heater and primary power circuit breakers (located in DCP) are set to off (right) position.	
1	Inside equipment cabinet, ensure that circuit breakers on ceilometer circuit breaker module are set to off (right) position.
2	Install new heater-blower in cover housing and install four screws securing heater-blower.
3	Install window conditioner cable in the guiding clamp inside the cover.
4	Carefully install window conditioner on equipment cabinet assembly.
5	Tighten four knurled screws securing window conditioner to equipment cabinet assembly.
6	Connect window conditioner cable to connector J2 located on the underside of the equipment cabinet assembly.
7	Inside equipment cabinet, set circuit breakers on ceilometer circuit breaker module to on (left) position.

9.5.4.12 **Offset Calibration**. The ceilometer instrument offset has been factory calibrated and under normal circumstances requires no need for recalibration. However, the replacement of any part of the ceilometer that has an effect on internal noise behavior requires recalibration after restoring to operation. Parts influencing noise behavior are:

a. Processor Board A1
b. Unregulated Power Supply Board A2
c. Receiver Board A6
d. Transmitter Board A7
e. High voltage power supply PS1
f. Receiver low-voltage cable W6
g. Transmitter low-voltage cable W7
h. Receiver signal cable W8
i. Transmitter control cable W9

A recalibration may also be performed to correct operations where the cloud data are excessively noisy. The procedures for performing the offset calibration are provided in table 9.5.35.

Table 9.5.35. Offset Calibration Procedures

Step	Procedure
	Tools and materials required: Small flat-tipped screwdriver Laptop computer w/Procomm Y-interface cable Laptop null cable Dark non-reflective cloth
1	Inside equipment cabinet, identify fiberoptic module dedicated to ceilometer. If necessary, perform the following on an OID: a. Refer to sensor configuration page on OID (sequentially press REVUE-SITE-CONFG-SENSOR function keys from 1-minute display). b. Refer to Chapter 3, Section IV to identify corresponding fiberoptic module.
2	Using small flat-tipped screwdriver, disconnect DB-9 connector from ceilometer fiberoptic module.
3	Using small flat-tipped screwdriver, install jumper between TB1-1 (on orange terminal block) on ceilometer fiberoptic module (A1) and TB1-1 on adjacent fiberoptic module. Install second jumper between terminals TB1-2 of ceilometer fiberoptic modules and adjacent module containing first jumper.
4	Using laptop interface (Y-shaped) cable and laptop null cable, connect RS-232C (COM1) port of laptop computer to DB-9 connector of ceilometer fiberoptic module.
5	Turn on laptop computer and initialize the PROCOMM Plus program. After program initializes, press any key to enter terminal mode (blank) screen.
6	Using ALT-S command (setup facility), set up the following TERMINAL OPTIONS: a. Terminal emulation: VT220 b. Duplex: FULL c. Soft flow control (XON/XOFF): OFF d. Hard flow control (CTS/RTS): OFF e. Line wrap: ON f. Screen scroll: ON g. CR translation: CR h. BS translation: NON-DESTRUCTIVE i. Break length (milliseconds): 350 j. Enquiry: OFF k. EGA/VGA true underline: OFF l. Terminal width: 80 m. ANSI 7 or 8 bit commands: 7 BIT
7	Press ESC key to exit to terminal mode (blank) screen.
8	Using ALT-P command (line/port option), set CURRENT SETTINGS as follows: a. Baud rate: 2400 b. Parity: NONE c. Data bits: 7 d. Stop bits: 1 e. Port: COM1
9	Press ESC key to exit to terminal mode (blank) screen.
10	Turn Caps Lock ON.
11	From the laptop computer, check that noise conditions are such that the difference between the two smallest numbers (average and minimum) seen with command NOIS are 8 or higher (with GAIN of 2) and 2 or higher (with GAIN of 0.) Use artificial light into the receiver if necessary.

Table 9.5.35. Offset Calibration Procedures -CONT

Step	Procedure
12	With equipment in normal operating configuration, cover the transmitter aperture of the window conditioner with a dark, nonreflecting cloth.

13	**NOTE**
	This procedure requires stable ambient light conditions. If performed outdoors, wait for a clear sky or a long break in the clouds if there is broken cloud cover. If performed indoors, use a steady light source such as a desk lamp positioned over the receiver.
	
	From the ceilometer dialogue page, perform the following command sequence:
	`AUTO OFF`
	`GAIN 0`
	`LASE ON`
	`SEQ ON`
	`CAL 240`

14	After 4 minutes, the unit has performed the calibration and responds with: `OFFSET TO EEPROM` and starts listing the offset values obtained. The listing may be interrupted by pressing the <ESC> key.

15	From the ceilometer dialogue page, enter the following commands to return the unit to normal operation:
	
	`AUTO ON`
	`CLOS`

16	Observe the performance of the unit for a period of time to verify its operation.
17	At laptop computer, use ALT-X (exit) command to exit PROCOMM Plus.
18	Turn off laptop computer.
19	Disconnect cables between laptop computer and fiberoptic module.
20	Remove two jumpers between fiberoptic modules.
21	Using small flat-tipped screwdriver, install DB-9 connector to ceilometer fiberoptic module in DCP.

9.5.4.13 **Fiberoptic Module Removal and Replacement**. The fiberoptic module removal and replacement procedures are provided in table 9.5.36.

Table 9.5.36. Fiberoptic Module Removal and Installation

Step	Procedure
REMOVAL	
Tools required: Small flat-tipped screwdriver	
1	Disconnect ac power from ceilometer and remove ceilometer equipment cabinet covers as described in table 9.5.14.
2	Using small flat-tipped screwdriver, loosen two retaining screws on DB-9 connector located on top of fiberoptic module. Remove connector DB-9.
3	Using clockwise (cw) rotation, remove two fiberoptic cables from fiberoptic module. Install protective plastic covers over fiberoptic connectors.
4	Using small flat-tipped screwdriver, remove four screws, four lockwashers, and two gaskets securing fiberoptic module to mounting plate.

Table 9.5.36. Fiberoptic Module Removal and Installation -CONT

Step	Procedure
INSTALLATION	
Tools required: Small flat-tipped screwdriver	
1	Ensure that ac power is disconnected and ceilometer equipment cabinet covers are removed as described in table 9.5.14.
2	Using small flat-tipped screwdriver, install four screws, four lockwashers, and two gaskets securing fiberoptic module to mounting plate.
3	Remove protective plastic covers from fiberoptic connectors and connect receive (RX) cable to receive connector on fiberoptic module (nearest DB-9 connector) and transmit (TX) cable to transmit connector on fiberoptic module.
4	Install signal cable on connector DB-9 on fiberoptic module and using small flat-tipped screwdriver, tighten two retaining screws.
5	Install ceilometer equipment cabinet covers as described in table 9.5.14 and apply power to ceilometer.

CHAPTER 10

LIQUID PRECIPITATION ACCUMULATION SENSOR (RAIN GAUGE)

SECTION I. DESCRIPTION AND LEADING PARTICULARS

10.1.1 INTRODUCTION

The liquid precipitation accumulation sensor (rain gauge) is a heated tipping bucket rain gauge manufactured by the Frise Engineering Company. The rain gauge is a custom ASOS configuration, modified Model 7405HA. This section describes the modified Model 7405HA used in the ASOS and its physical attributes.

10.1.2 PHYSICAL DESCRIPTION

The rain gauge (Figure 10.1.1) is a free-standing receptacle for measuring precipitation. The rain gauge contains an open top, which measures approximately 1 foot in diameter, that allows precipitation to fall into the upper portion, referred to as the collector. The collector is heated to melt any frozen precipitation, such as snow or hail, for collection. Collected water is funneled to a mechanical device (tipping bucket), which incrementally measures the accumulation and causes the momentary closure of a switch (either a reed switch or a mercury switch) for each increment. The tipping bucket is designed to measure in increments of 0.01 inch of rain. As water is collected, the tipping bucket fills to the point where it tips over. This action empties the bucket in preparation for additional measurements, closes the momentary switch, and signals another 0.01 inch of precipitation to the DCP. Water discharged by the tipping bucket passes out of the rain gauge through a lower funnel to the ground below. The physical design provides for the adaptation of the rain gauge to the standard ASOS mounting flange, with the collector portion located approximately 48 inches above the ground. At specified sites, a 48-inch diameter wind shield is installed around the rain gauge. The wind shield reduces wind updrafts and wind streamlines that alter rain trajectories.

10.1.3 RAIN GAUGE CONFIGURATIONS

Four configurations of the rain gauge (part number 90116) have been manufactured. Some earlier configuration gauges have been, and the rest are being, upgraded to the newest (-40) configuration.

-10 This configuration can be identified by the mercury switch, mounted in a bracket to the bucket frame assembly. The mercury switch requires special consideration and handling during adjustment and shipping. If the mercury switch fails, it should be replaced by the reed switch.

-20 This configuration can be identified by the reed switch and bracket mounted to the bucket frame assembly, the funnel extension added to the top funnel, and the brass stops on the tipping bucket.

-30 This configuration is identical to the -20 assembly except that the tipping bucket has polyethylene stops instead of brass stops. The brass stops were susceptible to sticking to the bucket frame. For this reason, brass stops have been replaced with polyethylene stops secured by a screw and adhesive.

$ -40 This configuration replaces the magnet and magnet holder with a magnet/holder
$ combination. It also uses a self-tapping screw to mount the polyethylene stop to the bucket
$ instead of a screw and adhesive.

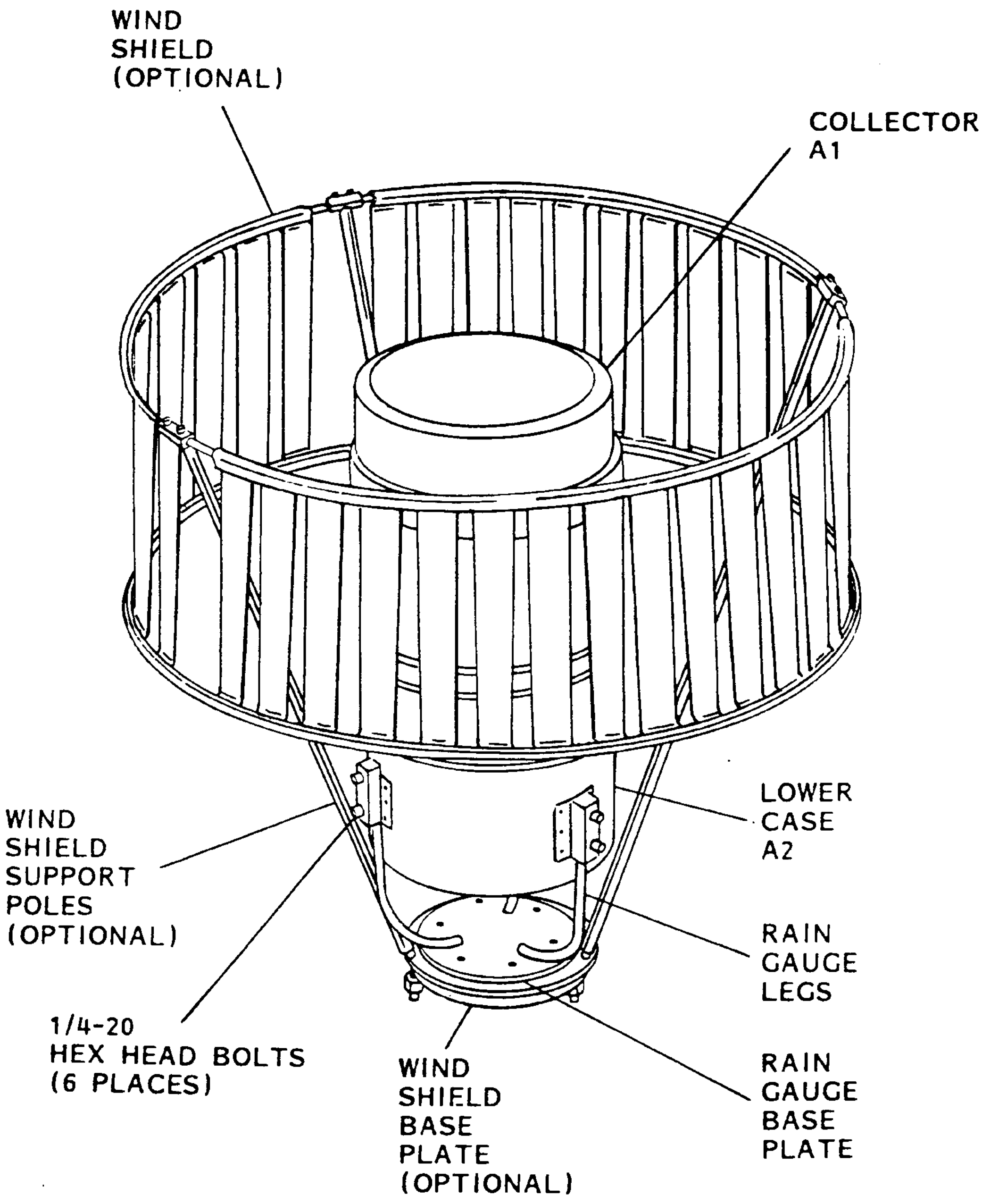


Figure 10.1.1. Liquid Precipitation Accumulation Sensor (Rain Gauge) (Sheet 1 of 3)

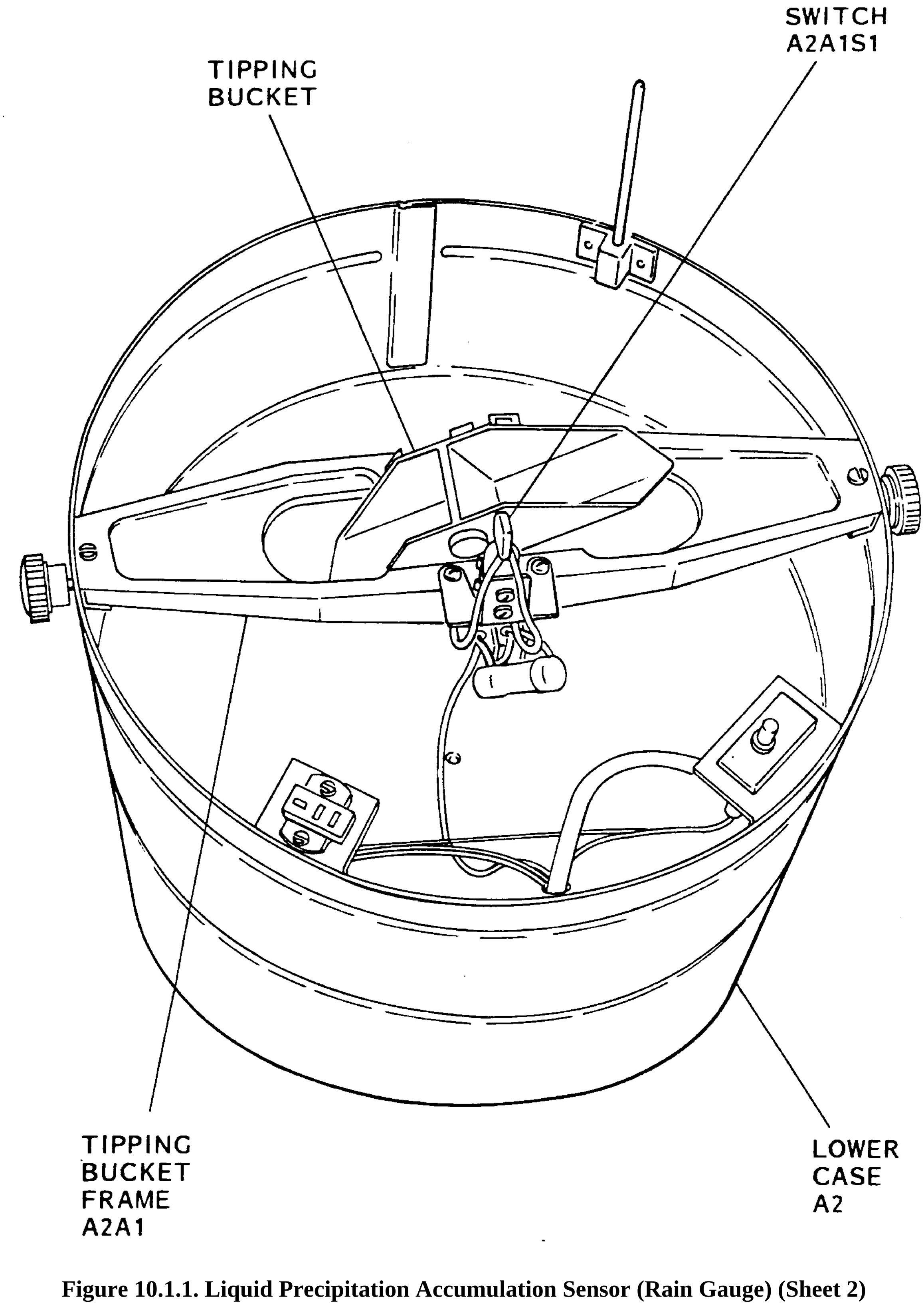


Figure 10.1.1. Liquid Precipitation Accumulation Sensor (Rain Gauge) (Sheet 2)

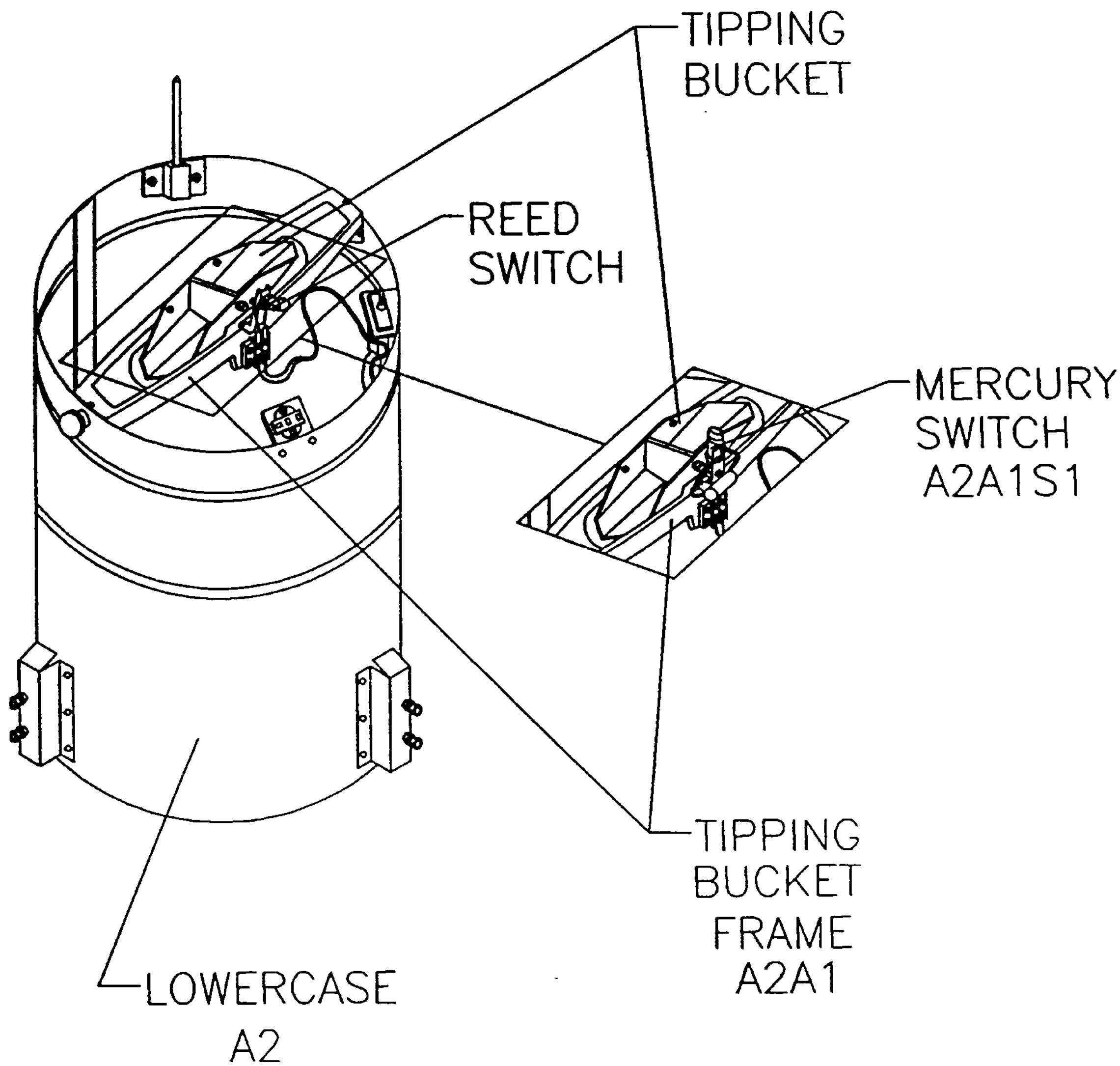


Figure 10.1.1. Liquid Precipitation Accumulation Sensor (Rain Gauge) (Sheet 3)

SECTION II. INSTALLATION

10.2.1 INTRODUCTION

The rain gauge is a relatively simple, single-unit sensor that mounts directly on a sensor pedestal at the site. The only preparation required is assembly of the support stand, installation of the tipping bucket switch, and installation of the tipping bucket. The only cabling required is the connection of heater power and one fiberoptic signal line.

10.2.2 INSTALLATION

Installation procedures for the rain gauge are provided in table 10.2.1. Figure 10.2.1 provides an illustration of the tipping bucket and tipping bucket switch installation. Locational drawings of the wind shield and the fiberoptic transmitter are provided in Section I of this chapter. A wiring diagram for the sensor is provided in Section IV of this chapter.

Table 10.2.1. Liquid Precipitation Accumulation Sensor Installation Procedures

Step	Procedure
	Tools required: 15/16-inch wrench Small flat-tipped screwdriver Digital multimeter (DMM) Large flat-tipped screwdriver Large adjustable wrench **WARNING** Death or severe injury may result if power is not removed from sensor prior to maintenance activities. Ensure that heater circuit breaker (located in DCP) supplying power to sensor is set to off (right) position.
1	Inside DCP equipment cabinet, ensure that circuit breaker on rain gauge circuit breaker module is set to off (right) position.
2	Using 15/16-inch wrench, install four 5/8 - 11 bolts, flat washers (two places), lockwashers, and nuts securing rain gauge base plate and windshield mounting plate (if required) to sensor pedestal.
3	Install three 1/4 - 20 hex head bolts and flat washers securing three sensor legs to sensor base plate. Do not tighten legs to base plate. Legs should be free to rotate and will be tightened after lower case is installed.
4	Using small flat-tipped screwdriver, remove Bottom Plate A2A2 from Lower Case A2.
5	At flexible conduit for rain gauge pedestal, remove large nut from end of conduit using large adjustable wrench. Ensure that gasket (rubber gasket with metal gasket holder) is in place on metal conduit cap (rubber gasket toward sensor).
6	Route ac wiring and fiberoptic cable from DCP through wiring hole (not the center drain hole) in Bottom Plate A2A2 and slide threaded end of flexible conduit cap through same hole. Using large adjustable wrench, secure flexible conduit to bottom plate by attaching nut to conduit cap.
7	Apply thin coat of DC-4 anti-corrosion compund to connector pins in cable connector between collector assembly and lower case pins.

Table 10.2.1. Liquid Precipitation Accumulation Sensor Installation Procedures -CONT

Step	Procedure
8	Connect heater ac wiring from DCP to terminal block (Figure 10.4.1) on Bottom Plate A2A2 as follows: Wire — Terminal Jumper — 1 to 2 Green (ground) — 3 Red (ac line) — 4 Yellow (ac neut) — 5
9	Connect fiberoptic cable from DCP to Transmitter Board A2A2A1 on Bottom Plate A2A2.
10	Install Bottom Plate A2A2 on Lower Case A2.
11	Position Lower Case A2 on sensor support legs.
12	Secure sensor earth ground to grounding stud on Bottom Plate A2A2.
13	Install six 1/4 - 20 hex head bolts and jamnuts (two each leg) in holes in leg supports on lower case
14	Level lower case and secure in position by tightening six 1/4 - 20 hex head bolts and jamnuts as necessary.
15	Mount Tipping Bucket Frame A2A1 to top of lower case.
16	Install two 8-32 X 5/8 screws and washers securing Tipping Bucket Frame A2A1.
17	Adjust Tipping Bucket Frame 2MT6A2A1 using a level and adjust legs if required. **CAUTION** Tipping bucket mercury switch is very sensitive. Care should be taken when moving switch to keep the wire leads up to avoid getting the mercury pool stuck in top of switch.
18	Mount tipping bucket on tipping bucket frame with magnet facing switch.
19	Tip bucket several times by hand to ensure that it moves freely. As the bucket tips and the magnet passes the switch, a momentary contact occurs in the switch. Visually inspect the magnet during tipping to ensure that it passes within 0.25 inch of the switch but does not contact the switch. (Adjust switch position, if necessary, to achieve required spacing.)
20	Connect an ohmmeter between the two output connectors on the back of the reed switch.
21	While tipping the bucket by hand, observe the ohmmeter. As bucket tips, magnet should cause switch to momentarily close and then open, causing the ohmmeter output to display a momentary short circuit reading. Ensure that switch operates properly for both tipping directions. If switch does not close and open properly, adjust by moving up or down in bracket and adjust bracket by loosening screws securing bracket to frame.
22	Using collector locating pin and alignment arrow on lower case as a guide, mount collector on lower case and tighten two retaining knobs on sides of lower case.
23	If sensor is equipped with wind shield, perform the following: a. Install three windshield support poles to windshield base plate by sliding poles over three base plate pins. b. Obtain three nylon sections of windshield, three sections of bottom ring, and three sections of top ring. **NOTE** Top side of each nylon section is side where individual nylon strips are widest. c. Slide one section of top ring through top of each section of nylon shield. d. Slide one section of bottom ring through bottom of each section of nylon shield.

Table 10.2.1. Liquid Precipitation Accumulation Sensor Installation Procedures -CONT

Step	Procedure
	e. Using large flat-tipped screwdriver, loosen two setscrews in connector at the top of each support pole. f. Install top ring of one wind shield section into connectors at top of support poles. Secure each end of section by tightening two setscrews. Repeat for other two sections of wind shield. g. Install bottom ring of windshield by sliding each section into a bottom section of the windshield. Connect all three bottom ring sections together and tighten all setscrews.
24	Inside DCP equipment cabinet, set circuit breaker on rain gauge circuit breaker module to on (left) position.
25	Check tipping bucket calibration in accordance with table 10.5.1.

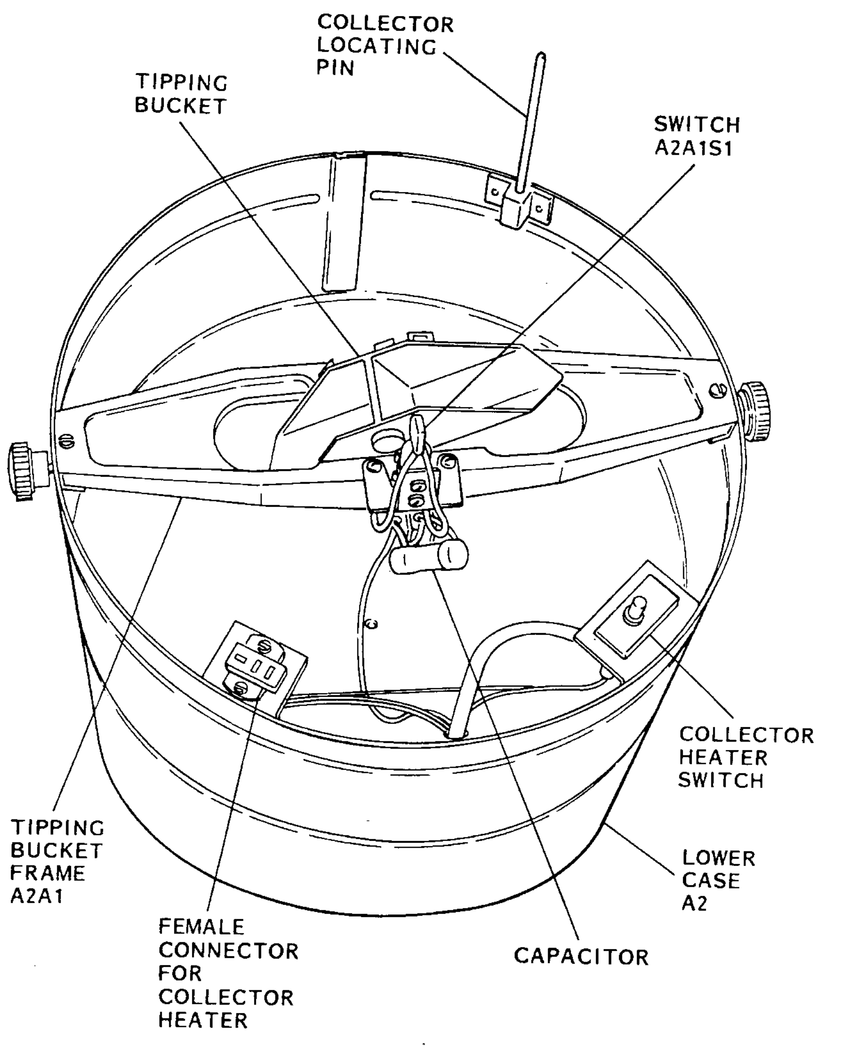


Figure 10.2.1. Tipping Bucket Installation

SECTION III. OPERATION

10.3.1 INTRODUCTION

The rain gauge is fully automatic, and has no controls or indicators. The internal electronics monitor the bucket for tips. Each time a tip occurs, a pulse signal is issued to the data collection package (DCP) via the fiberoptic module. The heaters are thermostatically controlled to provide automatic heating of the rain gauge, as required.

SECTION IV. THEORY OF OPERATION

10.4.1 **INTRODUCTION**

The rain gauge for the ASOS operates in the same manner as all tipping bucket rain gauges, but has been modified to transmit light pulses for each tip of the bucket back to the ASOS data processing system. With the rain gauge part of a computer-based system, compensation can be made for rain-rate dependent errors, which results in increased rain gauge accuracy and dependability. This section describes the tipping bucket sensor and the error correction. A wiring diagram of the sensor is provided as figure 10.4.1 to depict the sensor's operation.

10.4.2 **DESCRIPTION OF OPERATION**

The tipping bucket is located under a funnel in the collector housing. The bucket is a two-chamber container that pivots. Precipitation flows through the funnel into one compartment until 0.01 inch of rain (18.5 grams) is accumulated. That amount of weight causes the bucket to tip on its pivots, dumping the collected water and moving the other chamber under the funnel. The tipping motion activates a switch, thereby establishing a momentary closure for each 0.01 inch of rain. Rain gauge output is one electrical pulse for each 0.01 inch of precipitation collected. Fiberoptic Transmitter A2A2A1 converts the electrical pulse to a light pulse suitable for fiberoptic transmission to the data collection package (DCP). Power to produce the light pulses is supplied by a 3.6-volt lithium battery, which is part of Fiberoptic Transmitter A2A2A1. A pulse is transmitted each time the tipping bucket fills. The sensor is heated by two electrical heaters: a 150-watt, 110-volt flexible heating element is cemented to the back of the collector funnel, and a 175-watt, 110-volt band heater is mounted on the drain tube. Each heater is controlled by its own thermostat, which is set to close (turn the heater on) at temperatures below 40°F. A third thermostat (located on the sensor bottom plate) is normally closed and opens at temperatures below -20°F. This thermostat removes power from the heaters to conserve energy under conditions when precipitation would not normally occur. The thermostat closes again as the temperature rises above -12°F to return power to the heaters. The DCP provides all of the required heater ac power. A safety switch is mounted on the rim of the lower case. This switch removes power from the collector heater female plug when the collector is removed, thus removing a potential electrical hazard. The safety switch does not remove power from the drain tube heater. As such, the technician must ensure that rain gauge power is removed at the DCP circuit breaker module before servicing the rain gauge. Also, the technician must use caution to avoid thermal burns when working near the heaters.

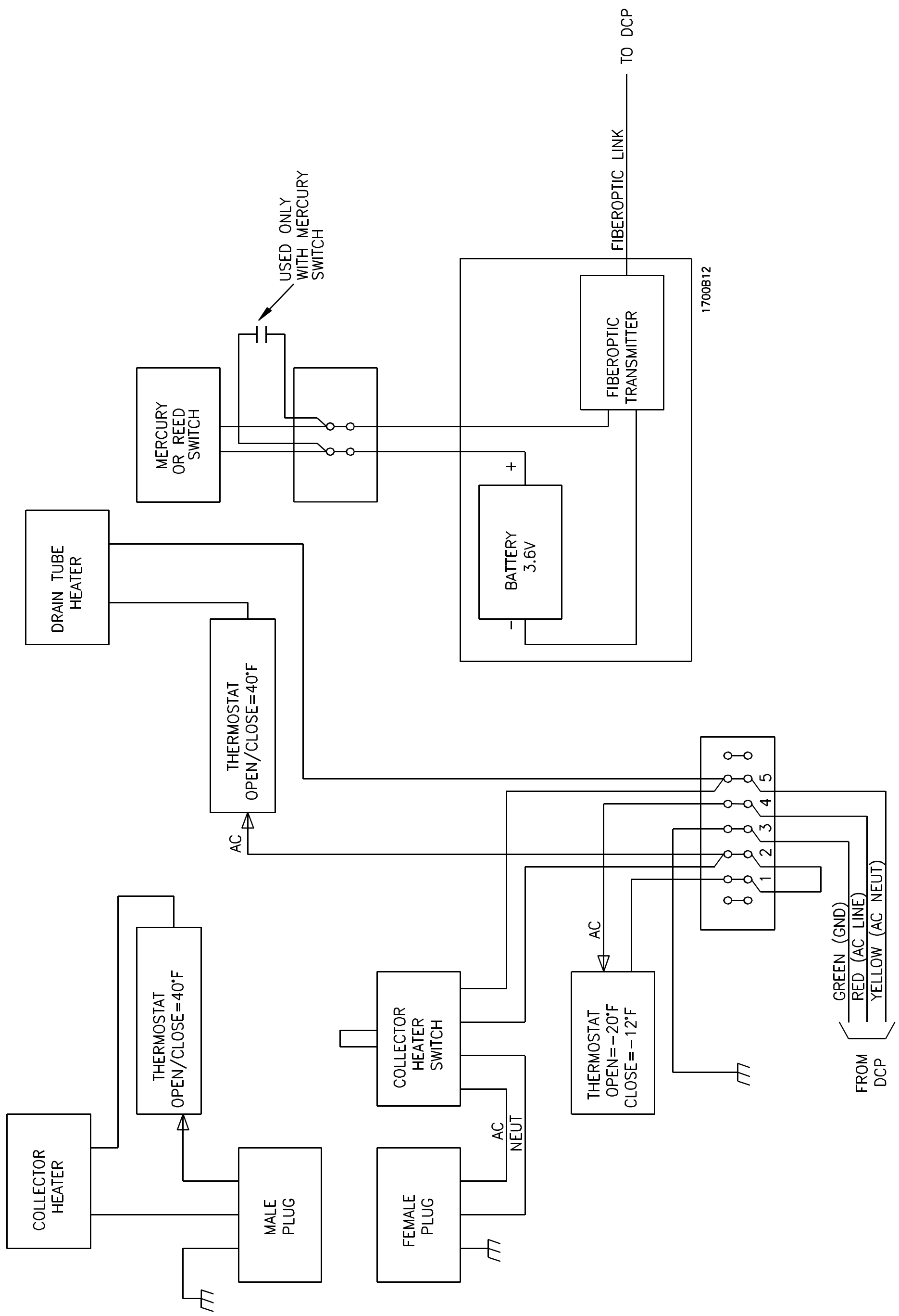


Figure 10.4.1. Liquid Precipitation Accumulation Sensor Wiring Diagram

SECTION V. MAINTENANCE

10.5.1 INTRODUCTION

Preventive maintenance for the rain gauge consists of keeping both the collector and discharge water flow paths free of obstructions. Occasional cleaning and inspection of the tipping bucket is also necessary to ensure that the bucket operates properly. Due to its simple design, troubleshooting is performed via manual inspection.

10.5.2 PREVENTIVE MAINTENANCE

The frequency of an inspection and maintenance schedule depends on the environment of the rain gauge installation. Any malfunctions or damage that are detected should be corrected using the corrective maintenance procedure provided in this chapter. The maintenance log should be updated after each visit to record any maintenance required by the rain gauge. Recommended routine maintenance consists of visually inspecting the rain gauge and checking its calibration every 90 days to ensure proper operation and inspecting the connector between the collector assembly and the lower case annually for corrosion. Table 10.5.1 provides a procedure to accomplish this.

10.5.3 CORRECTIVE MAINTENANCE

10.5.3.1 **Introduction**. Corrective maintenance of the rain gauge consists of a visual inspection, testing the heater circuit, testing the fiberoptic module interfaced to the rain gauge, and removing and installing the rain gauge. Faults within the rain gauge are automatically detected by the data quality algorithm. If the present weather sensor is reporting moderate or heavy liquid precipitation and the rain gauge fails to indicate any accumulation, the system diagnostics log a rain gauge failure.

10.5.3.2 **Rain Gauge Testing**. Rain gauge testing includes visual inspection as defined in preventive maintenance, checking for proper heater operation, and testing the fiberoptic module in the DCP, which receives data from the rain gauge. A faulty rain gauge is isolated using the procedures provided in table 10.5.2.

10.5.3.3 **Rain Gauge Removal and Installation**. When a fault is isolated to the rain gauge (other than a tipping bucket switch or fiberoptic transmitter failure), the entire sensor must be replaced. The replacement sensor uses the same mounting hardware as the faulty sensor. The rain gauge removal and installation procedures are provided in table 10.5.3.

10.5.3.4 **Tipping Bucket Switch Removal and Installation**. The procedures required to remove and install the rain gauge tipping bucket switch are provided in table 10.5.4.

10.5.3.5 **Fiberoptic Transmitter Removal and Installation**. The procedures required to remove and install the rain gauge fiberoptic transmitter are provided in table 10.5.5.

Table 10.5.1. Rain Gauge Inspection and Calibration Check

Step	Procedure
INSPECTION	
	Tools required: Large flat-tipped screwdriver Carpenter's level Laboratory beaker Water **NOTE** Laptop computer initialized as DCP OID (Chapter3, Section III), or any other available OID, may be used for the following procedure.
1	At OID, display sensor status page (sequentially press REVIEW-SENSOR-STAT function keys from 1-minute display).
2	On sensor status page, set report processing for tipping bucket to OFF. **WARNING** Death or severe injury may result if power is not removed from sensor prior to maintenance activities. Ensure that heater circuit breaker (located in DCP) supplying power to sensor is set to off (right) position.
3	Inside DCP equipment cabinet, set circuit breaker on rain gauge circuit breaker module to off (right) position.
4	If sensor is equipped with wind shield, remove one section of wind shield to access rain gauge by performing the following: a. Using large flat-tipped screwdriver, loosen setscrews securing one section of bottom ring. b. Using large flat-tipped screwdriver, loosen setscrews securing one section of top ring to two support poles. Remove section of wind shield.
5	Ensure that rain gauge Collector A1 is free of obstructions.
6	Loosen two knurled retaining knobs securing collector to lower case.
7	**WARNING** Heater on underside of collector funnel may be hot. Do not touch heater when removing collector. Failure to comply may result in thermal burns. Lift Collector A1 straight up and remove from lower case.
8	Ensure that lower funnel is free of obstructions.
9	Check Tipping Bucket Frame A2A1 for level and adjust legs if required.
10	Ensure that tipping bucket is clean and tips freely.
11	Ensure that tipping bucket switch is intact and operating.
12	Using collector pin and alignment arrow on lower case as a guide, mount collector on lower case and tighten two retaining knobs on sides of lower case.
13	Annually inspect cable connector between collector assembly and lower case for corrosion. Remove corrosion if present and apply thin coat of DC-4 anti-corrosion compund to connector pins.
CALIBRATION CHECK	
$ 1	Using laboratory beaker, pour 195 milliliters of water slowly into rain gauge over a 1-minute period. Ensure that this causes 10 ±1 tips.

Table 10.5.1. Rain Gauge Inspection and Calibration Check -CONT

Step	Procedure
2	At OID, display second page of 12-hour archive (sequentially press REVUE-SENSOR-12 HR function keys from 1-minute display). Verify that precipitation amount (total for 2 adjacent minutes) matches the number of tips that occurred as follows: No. of tips — Precipitation 9 — 0.09 to 0.10 10 — 0.10 to 0.11 11 — 0.11 to 0.12
WRAP UP	
1	If sensor is equipped with windshield, install open section of wind shield by performing the following: a. Install top ring of wind shield in connectors at top of two support poles. Using large flat-tipped screw driver, tighten two setscrews securing each end of section. b. Connect bottom ring of windshield to two adjacent sections. c. Using large flat-tipped screwdriver, tighten two setscrews securing each end of section.
2	Inside DCP equipment cabinet, set circuit breaker on rain gauge circuit breaker module to on (left) position.
3	At OID, display sensor status page (sequentially press REVIEW-SENSOR-STAT function keys from 1-minute display).
4	On sensor status page, set report processing for tipping bucket to ON.

Table 10.5.2. Liquid Precipitation Accumulation Sensor Fault Isolation

Step	Procedure
	Tools required: RS-232 Test Tool Digital multimeter (DMM) Small flat-tipped screwdriver
1	Visually inspect rain gauge using guidelines of table 10.5.1, steps 1 through 11.
2	In conditions of freezing temperatures, check input funnel of rain gauge for the presence of ice. If ice is present, perform the following: The nominal resistance of both heaters is approximately 0.010 ohm. a. At power control module in DCP, ensure that rain gauge heater circuit breaker is set to ON position. **WARNING** AC power is present at rain gauge when DCP power control module is set to ON position. Use extreme care when working on equipment with ac power applied. **NOTE** Do not short the leads to the tipping bucket switch or cause the tipping bucket switch to be closed for long periods of time. Do not leave the DMM connected across the tipping bucket switch for longer than 30 seconds to measure current flow. These actions will drain the battery at a faster rate and shorten the life expectancy of the battery. b. At rain gauge, remove the sensor's bottom plate and referring to wiring diagram in Section IV, connect DMM across heater ac input. DMM should indicate between 107 and 130 volts ac. If so, replace rain gauge. If reading is not correct, replace rain gauge heater circuit breaker module in DCP (refer to Chapter 3).

Table 10.5.2. Liquid Precipitation Accumulation Sensor Fault Isolation -CONT

Step	Procedure
3	Place leads of DMM (in current mode) across terminals of tipping bucket switch (with switch open). A current of 8 mA or higher is an indication of a good battery. If the current is below 8 mA, replace Fiberoptic Transmitter A2A2A1.
4	Check operation of tipping bucket switch by performing the following: a. Using small flat-tipped screwdriver, disconnect one leg of tipping bucket switch A2A1S1 from terminal on side of Tipping Bucket Frame A2A1. b. Connect DMM across both legs of tipping bucket switch. c. Rock tipping bucket back and forth to actuate tipping bucket switch. Ensure that DMM indicates continuity when switch is actuated. If continuity is not observed, replace tipping bucket switch A2A1S1. d. If tipping bucket switch is operating properly, reconnect free leg of switch to terminal.
5	Check operation of rain gauge/DCP fiberoptic link by performing the following: a. At OID, access sensor configuration page. Determine the SIO port to which the rain gauge is assigned. Refer to the list of port assignments for DCP SIO boards (Chapter3, Section IV) to identify the corresponding fiberoptic module. b. In DCP, connect RS-232 test tool in line with rain gauge fiberoptic module (between fiberoptic module and corresponding DB-9 connector from cabinet harness). c. Actuate tipping bucket switch A2A1S1 in rain gauge and verify that RxD indicator on RS-232 test tool illuminates. If RxD indicator illuminates (and rain gauge data are not being received by the system), replace corresponding SIO board in DCP. If RxD indicator on test tool fails to illuminate while the tipping bucket switch is actuated, remove and replace the following, in order, until the problem is corrected: (1) Fiberoptic module in DCP (2) Fiberoptic transmitter in rain gauge

Table 10.5.3. Liquid Precipitation Accumulation Sensor Removal and Installation

Step	Procedure
REMOVAL	
	Tools required: Large flat-tipped screwdriver Small flat-tipped screwdriver 7/16-inch socket Adjustable wrench **NOTE** Laptop computer initialized as DCP OID (Chapter 3, Section III), or any other available OID, may be used for the following procedure.
1	At OID, display sensor status page (sequentially press REVIEW-SENSOR-STAT function keys from 1-minute display).

Table 10.5.3. Liquid Precipitation Accumulation Sensor Removal and Installation -CONT

Step	Procedure
2	On sensor status page, set report processing for tipping bucket to OFF. **WARNING** Death or severe injury may result if power is not removed from sensor prior to maintenance activities. Ensure that heater circuit breaker (located in DCP) supplying power to sensor is set to off (right) position.
3	Inside DCP equipment cabinet, set circuit breaker on rain gauge circuit breaker module to off (right) position.
4	If sensor is equipped with windshield (Figure 10.2.1, sheet 1), remove one section of windshield to access rain gauge by performing the following: a. Using large flat-tipped screwdriver, loosen setscrews securing one section of bottom ring. b. Using large flat-tipped screwdriver, loosen setscrews securing one section of top ring to two support poles. Remove section of wind shield.
5	Loosen two knurled retaining knobs securing Collector A1 to lower case.
6	Lift Collector A1 straight up and remove from Lower Case A2.
7	Carefully remove tipping bucket by tilting and lifting from Bucket Frame A2A1.
8	Using small flat-tipped screwdriver, remove two screws securing Bucket Frame A2A1 to lower case. **CAUTION** If tipping bucket switch is of the mercury type it is very sensitive. Remove the bracket and switch assembly together, holding the assembly with the switch lead wires up; otherwise, the mercury pool could get stuck in the top end of the switch. The mercury switch is readily identifiable by the transparent vial which is vertically positioned in its bracket, while the reed switch is opaque and cylindrical and is mounted horizontally in its bracket.
9	Carefully lift Bucket Frame A2A1 to gain access to terminal board located on side.
10	Disconnect sensor wiring harness (two wires from fiberoptic transmitter) from Bucket Frame A2A1 terminal board.
11	To remove tipping bucket switch A2A1S1: a. Disconnect terminals from terminal board. b. Remove screws from switch bracket and remove assembly intact; if switch is mercury, hold assembly with wires up.
12	Using 7/16-inch socket, loosen six 1/4 - 20 bolts and jamnuts (two on each leg) securing lower case to legs.
13	Using small flat-tipped screwdriver, remove four screws securing Bottom Plate A2A2 to lower case.
14	Disconnect heater ac input wiring from terminals 3, 4, and 5 on bottom plate terminal board.
15	Disconnect fiberoptic cable from bottom plate Fiberoptic Transmitter A2A2A1.
16	Disconnect flexible conduit and remove wires through hole in bottom plate.
17	Remove lower case from sensor support legs.
18	Remove 1/4 - 20 bolt and flat washer securing each sensor support leg to base plate. Remove three sensor support legs.

Table 10.5.3. Liquid Precipitation Accumulation Sensor Removal and Installation -CONT

<table>
<tr><th>Step</th><th>Procedure</th></tr>
<tr><td colspan="2">INSTALLATION</td></tr>
<tr><td colspan="2">Tools required:
7/16-inch socket
Small flat-tipped screwdriver
Adjustable wrenches</td></tr>
<tr><td>1</td><td>At OID, ensure that report processing for tipping bucket is set to OFF.

WARNING

Death or severe injury may result if power is not removed from sensor prior to maintenance activities. Ensure that heater circuit breaker (located in DCP) supplying power to sensor is set to off (right) position.</td></tr>
<tr><td>2</td><td>Inside DCP equipment cabinet, ensure that circuit breaker on rain gauge circuit breaker module is set to off (right) position.</td></tr>
<tr><td>3</td><td>Install three 1/4 - 20 bolts and flat washers securing sensor support legs to base plate. Legs should be free to rotate and will be tightened after sensor is mounted.</td></tr>
<tr><td>4</td><td>Using 7/16-inch socket, install, but do not tighten, six 1/4 - 20 bolts and jamnuts in mounting holes on lower case leg brackets.</td></tr>
<tr><td>5</td><td>Using small flat-tipped screwdriver, remove four screws securing bottom plate to lower case.</td></tr>
<tr><td>6</td><td>Using large adjustable wrench at flexible conduit for rain gauge pedestal, remove large nut from end of conduit. Ensure that gasket (rubber gasket with metal gasket holder) is in place on metal conduit cap (rubber gasket toward sensor).</td></tr>
<tr><td>7</td><td>Route ac wiring and fiberoptic cable from DCP through wiring hole (not center drain hole) in Bottom Plate A2A2 and slide threaded end of flexible conduit cap through same hole. Using large adjustable wrench, install attaching nut to conduit cap securing flexible conduit to bottom plate.</td></tr>
<tr><td>8</td><td>Connect heater ac wiring from DCP to terminal block on Bottom Plate A2A2 as follows:

<table><tr><th><u>Wire</u></th><th><u>Terminal</u></th></tr><tr><td>Jumper</td><td>1 to 2</td></tr><tr><td>Green (ground)</td><td>3</td></tr><tr><td>Red (ac line)</td><td>4</td></tr><tr><td>Yellow</td><td>5</td></tr></table></td></tr>
<tr><td>9</td><td>Connect fiberoptic cable to bottom plate Fiberoptic Transmitter A2A2A1.</td></tr>
<tr><td>10</td><td>Using small flat-tipped screwdriver, install four screws securing bottom plate to lower case.</td></tr>
<tr><td>11</td><td>Position Lower Case A2 on sensor support legs.</td></tr>
<tr><td>12</td><td>Connect sensor earth ground to grounding stud on Bottom Plate A2A2.</td></tr>
<tr><td>13</td><td>Level lower case and tighten three bolts securing legs to base plate and six bolts securing lower case to legs.
<u>CAUTION</u>
If tipping bucket switch is of the mercury type, be careful to hold the switch and bracket assembly with the wire leads upward; otherwise, the mercury pool could get stuck in the top end of the switch.</td></tr>
<tr><td>14</td><td>Place tipping bucket switch A2A1S1 intact with its mounting bracket on tipping bucket frame and secure with mounting screws.</td></tr>
<tr><td>15</td><td>Connect terminal lugs of tipping bucket switch to Bucket Frame A2A1 terminal board. If a mercury type tipping bucket switch is to be replaced connect the capacitor to Bucket Frame A2A1 terminal board.</td></tr>
</table>

Table 10.5.3. Liquid Precipitation Accumulation Sensor Removal and Installation -CONT

Step	Procedure
16	Connect sensor wiring harness (two wires from fiberoptic transmitter) to Bucket Frame A2A1 terminal board. **CAUTION** If tipping bucket switch is of the mercury type it is very sensitive. Care should be taken when handling the switch and bracket assembly to keep the lead wires up; otherwise, the mercury pool could get stuck in the top end of the switch.
17	Position Bucket Frame A2A1 on brackets in top of lower case.
18	Using small flat-tipped screwdriver, install two screws securing bucket frame to brackets.
19	Install tipping bucket in bucket frame with magnet facing tipping bucket switch.
20	Tip the tipping bucket several times by hand to ensure that it moves freely in Bucket Frame A2A1. At each tip, the magnet's passing the tipping bucket switch causes a momentary contact in switch. Magnet should not touch switch. If necessary, position of mercury switch can be adjusted by loosening screws securing switch to frame casting and again tightening them after moving switch and bracket assembly. If necessary, position of reed type switch can be adjusted by loosening plastic nuts securing switch to bracket assembly and again tightening them after moving switch.
21	Using locating pin and arrows on outside of Collector A1 as guides, carefully mount collector on lower case.
22	Tighten two knurled retaining knobs.
23	Perform rain gauge inspection and calibration check in accordance with table 10.5.1.

Table 10.5.4. Tipping Bucket Switch Removal and Installation

Step	Procedure
REMOVAL	
	Tools required: Large flat-tipped screwdriver Small flat-tipped screwdriver Adjustable wrench **NOTE** Laptop computer initialized as DCP OID (Chapter 3, Section III), or any other available OID, may be used for the following procedure.
1	At OID, display sensor status page (sequentially press REVIEW-SENSOR-STAT function keys from 1-minute display).
2	On sensor status page, set report processing for tipping bucket to OFF. **WARNING** Death or severe injury may result if power is not removed from sensor prior to maintenance activities. Ensure that heater circuit breaker (located in DCP) supplying power to sensor is set to off (right) position.
3	Inside DCP equipment cabinet, set circuit breaker on rain gauge circuit breaker module to off (right) position.

Table 10.5.4. Tipping Bucket Switch Removal and Installation -CONT

Step	Procedure
4	If sensor is equipped with wind shield, remove one section of wind shield to access rain gauge by performing the following: a. Using large flat-tipped screwdriver, loosen setscrews securing one section of bottom ring. b. Using large flat-tipped screwdriver, loosen setscrews securing one section of top ring to two support poles. Remove section of wind shield.
5	Loosen two knurled retaining knobs securing Collector A1 to lower case.
6	**WARNING** Heater on underside of collector funnel may be hot. Do not touch heater when removing collector. Failure to comply may result in thermal burns. Lift Collector A1 straight up and remove from Lower Case A2.
7	Carefully remove tipping bucket by tilting and lifting from Bucket Frame A2A1.
8	Using small flat-tipped screwdriver, remove two screws securing Bucket Frame A2A1 to lower case. **CAUTION** If tipping bucket switch is of the mercury type, it is very sensitive. Care should be taken when moving switch to avoid getting mercury stuck in top of switch.
9	Carefully lift Bucket Frame A2A1 to gain access to terminal board located on side.
10	Remove tipping bucket switch A2A1S1 by: a. Disconnecting the two terminal lugs from the terminal board. b. If the tipping bucket switch is of the mercury type, remove the capacitor from the terminal board and pull the switch from mounting socket. c. If the tipping bucket switch is of the reed type, remove the switch from mounting bracket by loosening the two plastic retaining nuts with an adjustable wrench and then remove one of the plastic nuts from the reed switch. Remove the reed switch from the mounting bracket.
INSTALLATION	
Tools required: Small flat-tipped screwdriver Adjustable wrench	
1	At OID, ensure that report processing for tipping bucket is set to OFF.
2	**WARNING** Death or severe injury may result if power is not removed from sensor prior to maintenance activities. Ensure that heater circuit breaker (located in DCP) supplying power to sensor is set to off (right) position. Inside DCP equipment cabinet, ensure that circuit breaker on rain gauge circuit breaker module is set to off (right) position.
3	Ensure that tipping bucket is removed from Bucket Frame A2A1.

Table 10.5.4. Tipping Bucket Switch Removal and Installation -CONT

Step	Procedure
4	Ensure that Bucket Frame A2A1 is loosened from lower case to gain access to terminal board on side of frame. **CAUTION** If the tipping bucket switch is of the mercury type, it is very sensitive. Care should be taken when moving switch to avoid getting mercury stuck in top of switch.
5	Slide tipping bucket switch A2A1S1 into mounting bracket.
6	If tipping bucket switch is of the mercury type, connect capacitor and mercury switch terminal lugs to Bucket Frame A2A1 terminal board. If tipping bucket switch is of the reed type, install plastic retaining nuts on switch on either side of mounting bracket. Adjust switch to allow magnet to pass within 1/4" of switch. Install switch terminal lugs to Bucket Frame A2A1 terminal board.
7	Position Bucket Frame A2A1 on brackets in top of lower case.
8	Install tipping bucket in bucket frame with magnet facing tipping bucket switch.
9	Using small flat-tipped screwdriver, install two screws securing bucket frame to brackets.
10	Tip the tipping bucket several times by hand to ensure that it moves freely in Bucket Frame A2A1. At each tip, the magnet's passing the tipping bucket switch causes a momentary contact in switch. Magnet should not touch switch. If necessary, position of mercury switch can be adjusted by loosening screws securing switch to frame casting and again tightening them after moving switch and bracket assembly. If necessary, position of reed type switch can be adjusted by loosening plastic nuts securing switch to bracket assembly and again tightening them after moving switch.
11	Using locating pin and arrow on outside of Collector A1 as guides, carefully mount collector on lower case.
12	Tighten two knurled retaining knobs.
13	Perform rain gauge inspection and calibration check in accordance with table 10.5.1.

Table 10.5.5. Fiberoptic Transmitter Removal and Installation

Step	Procedure
REMOVAL	
	Tools required: Flat-tipped screwdriver Small flat-tipped screwdriver 7/16-inch socket **NOTE** Laptop computer initialized as DCP OID (Chapter 3, Section III), or any other available OID, may be used for the following procedure.
1	At OID, display sensor status page (sequentially press REVIEW-SENSOR-STAT function keys from 1-minute display).
2	On sensor status page, set report processing for tipping bucket to OFF. **WARNING** Death or severe injury may result if power is not removed from sensor prior to maintenance activities. Ensure that heater circuit breaker (located in DCP) supplying power to sensor is set to off (right) position.

Table 10.5.5. Fiberoptic Transmitter Removal and Installation - CONT

Step	Procedure
3	Inside DCP equipment cabinet, set circuit breaker on rain gauge circuit breaker module to off (right) position.
4	If sensor is equipped with wind shield, remove one section of wind shield to access rain gauge by performing the following: a. Using large flat-tipped screwdriver, loosen setscrews securing one section of bottom ring. b. Using large flat-tipped screwdriver, loosen setscrews securing one section of top ring to two support poles. Remove section of wind shield.
5	Loosen two knurled retaining knobs securing Collector A1 to lower case. **WARNING** Heater on underside of collector funnel may be hot. Do not touch heater when removing collector. Failure to comply may result in thermal burns.
6	Lift Collector A1 straight up and remove from Lower Case A2.
7	Carefully remove tipping bucket by tilting and lifting from Bucket Frame A2A1.
8	Using small flat-tipped screwdriver, remove two screws securing Bucket Frame A2A1 to lower case. **CAUTION** If tipping bucket switch is of the mercury type, it is very sensitive. Care should be taken when moving switch to avoid getting mercury stuck in top of switch.
9	Carefully lift Bucket Frame A2A1 to gain access to terminal board located on side.
10	Using small flat-tipped screwdriver, disconnect sensor wiring harness (two wires from fiberoptic transmitter) from bucket frame terminal board.
11	Remove Bucket Frame A2A1 (with tipping bucket switch) from lower case.
12	Using 7/16-inch socket, loosen six 1/4 - 20 bolts and jamnuts (two each leg) securing lower case to legs.
13	Using small flat-tipped screwdriver, remove four screws securing Bottom Plate A2A2 to lower case.
14	Remove Lower Case A2 from sensor support legs to gain access to Fiberoptic Transmitter A2A2A1.
15	Disconnect fiberoptic cable from bottom plate Fiberoptic Transmitter A2A2A1.
16	Using small flat-tipped screwdriver, remove four screws, plastic spacers, lockwashers, and nuts securing Fiberoptic Transmitter A2A2A1 to mounting shelf on Bottom Plate A2A2.
INSTALLATION	
	Tools required: Small flat-tipped screwdriver Carpenter's level 7/16-inch socket Adjustable wrench
1	At OID, ensure that report processing for tipping bucket is set to OFF. **WARNING** Death or severe injury may result if power is not removed from sensor prior to maintenance activities. Ensure that heater circuit breaker (located in DCP) supplying power to sensor is set to off (right) position.
2	Inside DCP equipment cabinet, ensure that circuit breaker on rain gauge circuit breaker module is set to off (right) position.
3	Using small flat-tipped screwdriver, install four screws, plastic spacers, lockwashers, and nuts securing Fiberoptic Transmitter A2A2A1 to mounting shelf on Bottom Plate A2A2.
4	Connect fiberoptic cable to bottom plate Fiberoptic Transmitter A2A2A1.

Table 10.5.5. Fiberoptic Transmitter Removal and Installation - CONT

Step	Procedure
5	Position Lower Case A2 on sensor support legs.
6	Feed two wires from fiberoptic transmitter through tube in Lower Case A2.
7	Using small flat-tipped screwdriver, install four screws securing Bottom Plate A2A2 to lower case.
8	Level lower case and using 7/16-inch socket, tighten six 1/4 - 20 bolts and jamnuts securing lower case to legs. **CAUTION** If tipping bucket switch is of the mercury type, it is very sensitive. Care should be taken when moving switch to avoid getting mercury stuck in top of switch.
9	Position Bucket Frame A2A1 (with tipping bucket switch) on brackets in top of lower case.
10	Using small flat-tipped screwdriver, connect two wires from fiberoptic transmitter to terminal board on side of Bucket Frame A2A1.
11	Install tipping bucket in bucket frame with magnet facing tipping bucket switch.
12	Using flat-tipped screwdriver, install two screws securing Bucket Frame A2A1 to brackets.
13	Tip the tipping bucket several times by hand to ensure that it moves freely in Bucket Frame A2A1. At each tip, the magnet's passing the tipping bucket switch causes a momentary contact in switch. Magnet should not touch switch. If necessary, position of mercury switch can be adjusted by loosening screws securing switch to frame casting and again tightening them after moving switch and bracket assembly. If necessary, position of reed type switch can be adjusted by loosening plastic nuts securing switch to bracket assembly and again tightening them after moving switch.
14	Using locating pin and arrow on outside of Collector A1 as guides, carefully mount collector on lower case.
15	Tighten two knurled retaining knobs.
16	Perform rain gauge inspection and calibration check in accordance with table 10.5.1.

CHAPTER 11

FREEZING RAIN SENSOR

SECTION I. DESCRIPTION AND LEADING PARAMETERS

11.1.1 **INTRODUCTION**

The ASOS freezing rain sensor is manufactured by Rosemount Aerospace, Inc. of Burnsville, Minnesota, uses an ultrasonically vibrating probe to detect the presence of icing conditions. The vibrating frequency of the probe decreases with the accumulation of ice. The sensor communicates with the data collection package (DCP) via a fiberoptic serial data link. The DCP polls the sensor for status once every 60 seconds, and the sensor responds with the current operating frequency of its probe. The DCP, in turn, passes the frequency data to the acquisition control unit (ACU). When the ACU receives a frequency from the freezing rain sensor indicating ice formation, the ACU confirms that the present weather sensor (also known as a light emitting diode weather indicator (LEDWI)) is indicating precipitation. The indications from these two sensors confirm ice formation on the freezing rain sensor probe. In addition to probe frequency data, the freezing rain sensor provides built in-test (BIT) results that are interpreted by the ASOS continuous self-test (CST) to detect sensor failures.

11.1.2 **PHYSICAL DESCRIPTION**

The freezing rain sensor (figure 11.1.1) consists of Electronics Enclosure 2MT3A1 installed on a mounting pole. The mounting pole itself is considered to be part of the supporting structure for the sensor and does not have a reference designator. The electronics enclosure (figure 11.1.2) contains all of the sensor field replaceable units (FRU's), which include Probe Assembly A1A1, Electronics Processor Board A1A2, and the Fiberoptic Module A1A2A1.

11.1.2.1 **Probe Assembly and Heat Sink**. Probe Assembly A1A1 is mounted to a heat sink made of 4.5 pounds of anodized aluminum, which, in turn, is mounted to the electronics enclosure. Heaters are built into the tip of the probe assembly and strut. After ice has accumulated on the probe to a predetermined thickness, ASOS instructs the sensor to turn on the probe assembly heaters to deice the probe. During deicing, maximum heater power is 400 watts. The deicing system is capable of completely melting approximately 3.8mm of ice on the probe and strut within 30 seconds at -20 degrees Celsius (°C). The heat sink dissipates the heat from the probe assembly following a deice cycle. The heat sink provides a recovery time (i.e., the time required for the sensor to revert to ambient temperature) of 10 minutes following a deice cycle. The heat sink also thermally isolates the probe assembly from the electronics, which allows accurate measurement at temperatures at or close to 0°C (32°F).

11.1.2.2 **Electronics Processor Board**. Electronics Processor Board A1A2 is the central controller for the freezing rain sensor. The electronics processor board is a microcontroller-based device with its controller program stored as firmware on an erasable programmable read only memory (EPROM) chip. The primary functions of the Electronics Processor board are to stimulate and read the probe assembly, control the probe assembly heaters, communicate with the DCP via the fiberoptic module, and perform sensor calibration when commanded. The Electronics Processor board also performs BIT on itself and the probe assembly and performs sensor calibration when commanded by the technician. The results of BIT are reported to the DCP and are ultimately displayed to the technician on the freezing rain page at the operator interface device (OID). The technician uses the laptop computer to issue calibration and other freezing rain sensor commands.

11.1.2.3 **Fiberoptic Module**. Fiberoptic Module A1A2A1 enables communication between the DCP and the electronics processor board. The fiberoptic module is identical to the one used in the DCP and other ASOS sensors. It converts DCP fiberoptic data signals to RS-232 format for the Electronics Processor board and vice versa.

11.1.3 FREEZING RAIN SENSOR CONFIGURATIONS

There are two configurations of the freezing rain sensor; the 0872C2 and 0872C3. The 0872C2 model freezing rain sensor uses a floating ground which requires a ground fault check (paragraph 11.5.2.1) prior to initial power-on and all maintenance activities. The 0872C3model uses a chassis ground and does not require a ground fault check.

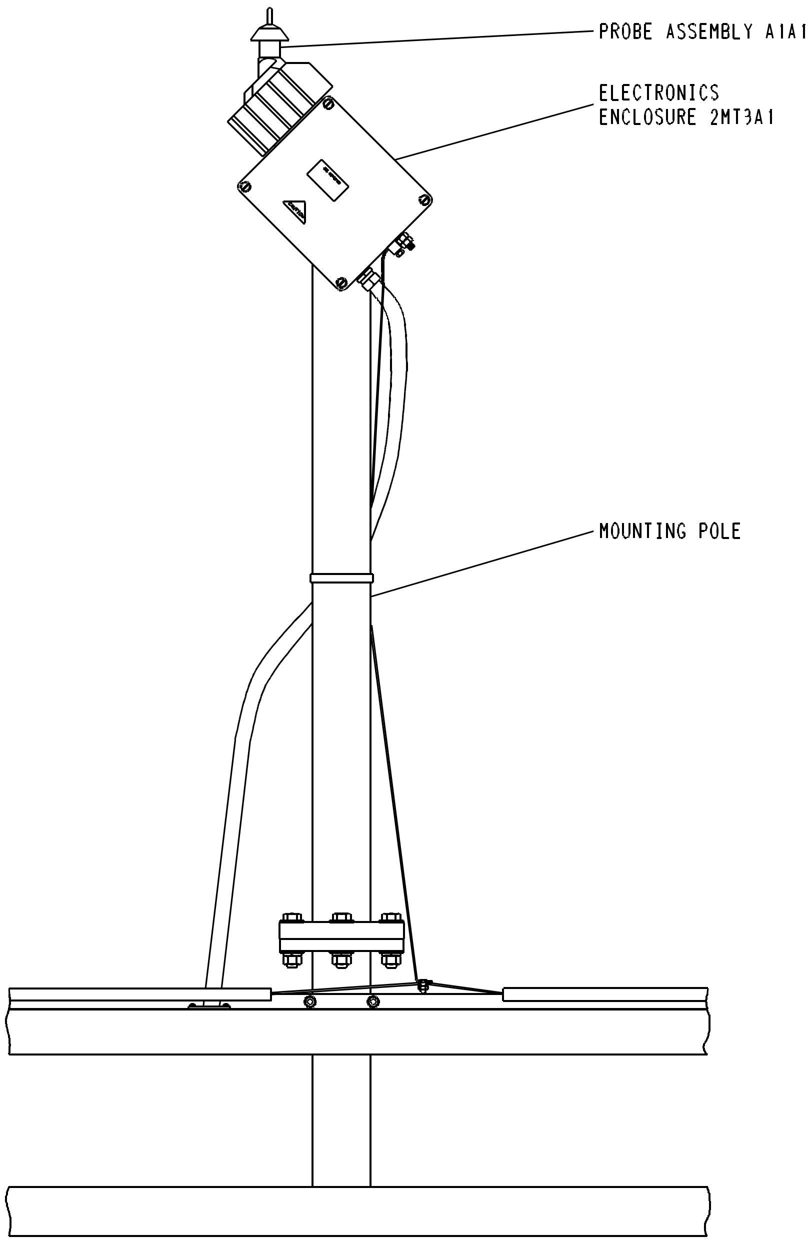


Figure 11.1.1. Freezing Rain Sensor

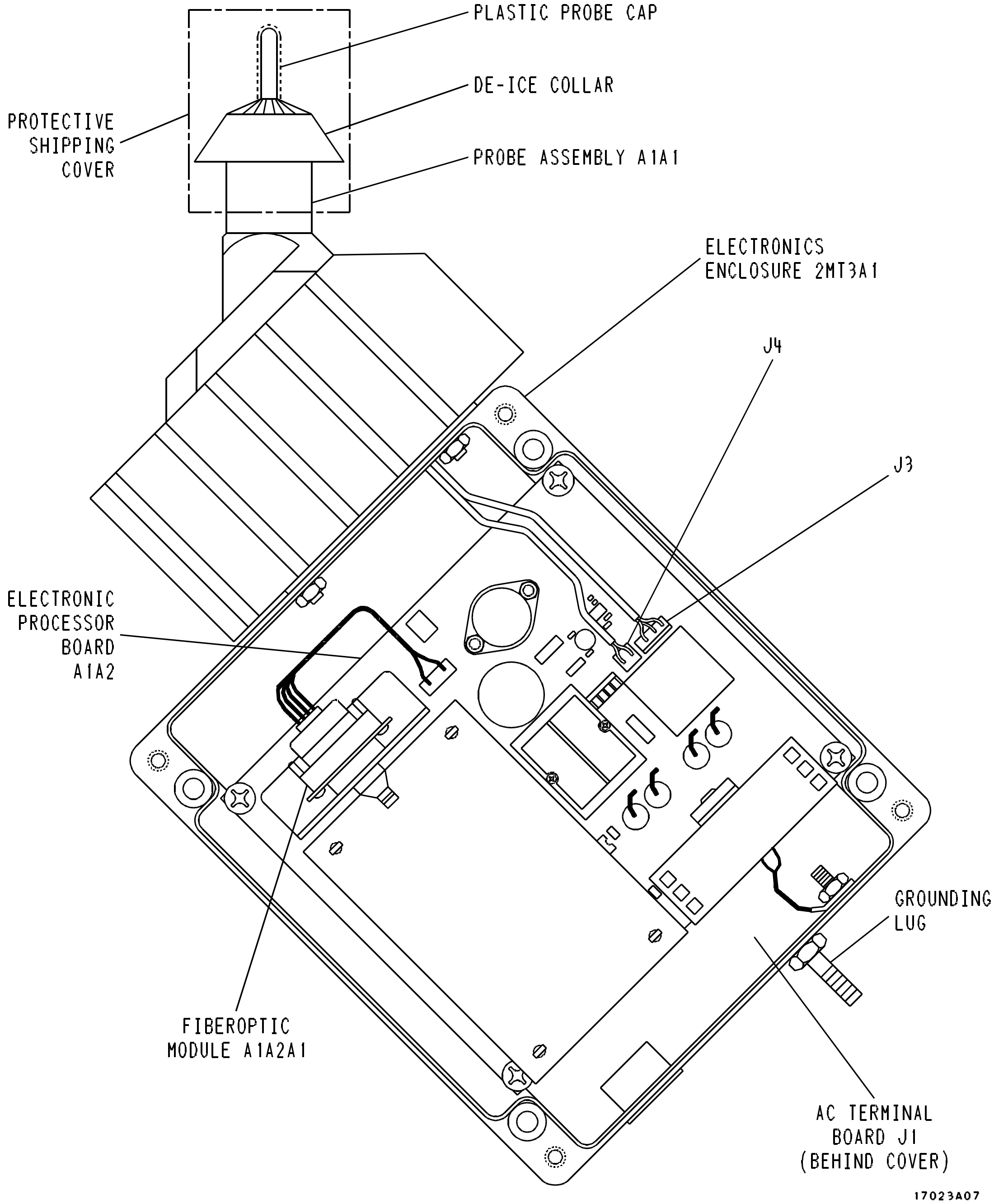


Figure 11.1.2. Electronics Enclosure

SECTION II. INSTALLATION

11.2.1 INTRODUCTION

To install the freezing rain sensor, the mounting pole is first installed onto the site pedestal. The electronics enclosure is then installed on the mounting pole, and finally, electrical connections are made. Following installation, the sensor must be inspected in accordance with the instructions contained in Section V. Table 11.2.1 provides the step-by-step freezing rain sensor installation procedure as shown in figure 11.2.1.

Table 11.2.1. Freezing Rain Sensor Installation Procedures

Step	Procedure
	Tools and Materials Required: Two 15/16-inch wrenches 7/16-inch wrench and torque driver 11/32-inch wrench Large flat-tipped screwdriver Large pliers (12 inch, 2-1/4 inch capacity, curved jaw) 7/16-inch hex key wrench and torque driver Cable ties **WARNING** Death or severe injury may result if power is not removed from sensor prior to maintenance activities. Ensure that circuit breakers (located in DCP) supplying power to sensor are set to off (right) position. The circuit breakers are labeled. **CAUTION** This sensor requires that a proper ground be established and maintained for safe operation. DO NOT apply AC power or perform maintenance until the ground condition is verified in accordance with paragraph 11.5.2.1. **NOTE** Freezing rain sensor installation should only be accomplished when environmental conditions are as specified for field calibration; otherwise, the unit cannot be field-calibrated immediately after installation.
1	Ensure that circuit breakers on freezing rain sensor circuit breaker module inside DCP equipment cabinet are set to off (right) position.
2	Position sensor mounting pole onto site mounting pedestal. Orient mounting pole so that electronics enclosure opens toward walkway.
3	Using two 15/16-inch wrenches, four bolts, eight washers, four lockwashers, and four nuts, secure mounting pole to pedestal. For each bolt, use one washer on top side of mounting pole flange and one on bottom side of pedestal flange. Place lockwasher on underside of bottom washer and secure with nut.
4	Ensure that plastic probe cap and protective shipping cover are installed over sensor Probe Assembly A1A1.
5	Position electronics enclosure on mounting pole.
6	While supporting electronics enclosure and using a 7/16-inch hex key wrench, secure enclosure to pole by tightening four captive bolts. Using torque driver, torque bolts to 45 inch-pounds.

Table 11.2.1. Freezing Rain Sensor Installation Procedures -CONT

Step	Procedure
7	Using flat-tipped screwdriver, loosen four captive bolts securing hinged sensor access door and open door.
8	Locate and remove ESD protective conduit cap from next to the external ground stud.
9	Route ac power wiring and fiberoptic cables through access hole in bottom of electronics enclosure.
10	Using large pliers and supplied hardware, connect flexible conduit to electronics enclosure.
11	Using pliers and split bolt connector, connect 10 American wire gauge (AWG) sensor ground wire to raceway ground strap.
12	**NOTE** When installing site ground wire to sensor, ensure that sufficient slack exists to allow ground wire to be secured to sensor mounting pole. Using 7/16-inch wrench, remove sensor-supplied nut from ground stud located at bottom right of enclosure. Use nut to connect other end of sensor ground wire to ground stud. Torque nut to 7 foot-pounds.
13	Using cable ties, secure sensor ground wire and cable conduit to mounting pole.
	CAUTION Electronics Processor Board A1A2 is a Class I electrostatic discharge (ESD) component. To avoid damage to electronics processor board, use proper ESD handling procedures including the use of a ground strap while performing the following steps.
14	Using small flat-tipped screwdriver, release catches holding plastic cover in front of ac terminal board connector J1. Remove plastic cover.
15	On model 0872C3 only, using 11/32 inch wrench, connect green wire (chassis ground) to E1.
16	Using flat-tipped screwdriver, connect ac power wiring to ac terminal board connector J1 as follows: Wire color / Terminal / Function Black / J1-1 / 115 vac (electronics) White / J1-2 / Neutral (electronics) Green / J1-3 / Chassis ground (model 0872C2 only) Red / J1-4 / 115 vac (heater) Yellow / J1-5 / Neutral (heater)
17	Install protective plastic cover in front of ac terminal board connector J1.
18	Remove plastic covers from fiberoptic cables and connect transmit (TX) cable to TRANSMIT connector of fiberoptic module and receive (RX) cable to RECEIVE connector.
19	Using large flat-tipped screwdriver, close and secure freezing rain sensor access door.
20	Remove plastic probe cap and protective shipping cover from probe assembly, taking care not to touch probe.
21	Check sensor frequency using either OID REVUE-SENSOR-12HR page or laptop computer (Z1 command). If ambient temperature is 0°C ±10°C, verify that frequency is 40,000 ±10 hertz.

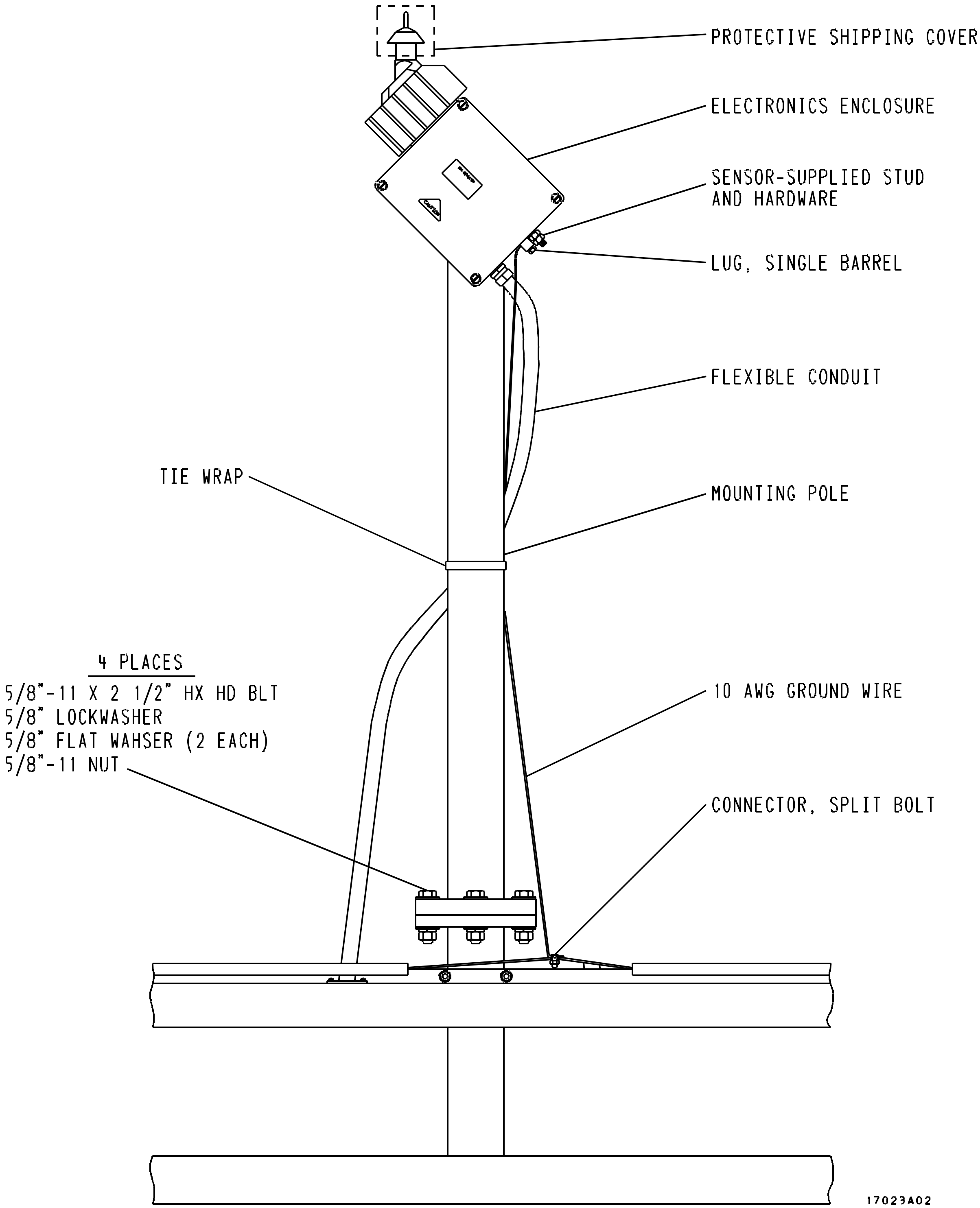


Figure 11.2.1. Freezing Rain Sensor Installation

SECTION III. OPERATION

11.3.1 **INTRODUCTION**

Only regularly scheduled maintenance is required after freezing rain sensor installation, unless a failure is detected by the ASOS. All operations, including diagnostics, are handled automatically by the ASOS.

11.3.2 **CONTROLS AND INDICATORS**

There are no maintenance significant controls and indicators on the freezing rain sensor. The sensor is designed for continuous operation and requires no operator or technician intervention.

11.3.3 **POWER-ON**

The freezing rain sensor contains no power switch. Upon application of 115 vac, 60 Hz power from the DCP, the sensor begins its startup sequence. Power is controlled via the freezing rain sensor circuit breaker module in the DCP.

11.3.4 **NORMAL OPERATION**

During normal operation, the DCP polls the freezing rain sensor once per minute for data. After it is polled, the sensor responds with the data. This polling is automatically performed by ASOS software and requires no user intervention. The diagnostic status of the sensor is also reported to ASOS once each minute. Results of diagnostic interrogations are displayed on the freezing rain page at the OID.

11.3.5 **POWER OFF**

The freezing rain sensor contains no power switch. Heater and electronics power is controlled via the freezing rain sensor circuit breaker module in the DCP.

SECTION IV. THEORY OF OPERATION

11.4.1 PRINCIPLES OF OPERATION

The ASOS freezing rain sensor uses an ultrasonic axially vibrating probe to detect the presence of icing conditions. This sensing probe is a nickel alloy tube mounted in the strut at its midpoint with 1 inch (25.4mm) exposed to the atmosphere. This tube exhibits magnetostrictive properties and expands and relaxes under the influence of a variable magnetic field. A magnetic bias field is provided by a magnet mounted inside the strut and modulated by a drive coil surrounding the lower half of the tube. A magnetostrictive oscillator (MSO) circuit (figure 11.4.1) is created by the addition of a pickup coil and operational amplifier. The ultrasonic axial movement of the tube resulting from the activation of the drive coil causes a current to be induced in the pickup coil. The current from the pickup coil drives the operational amplifier, which provides the signal for the drive coil. The oscillation frequency of the circuit is determined by the natural resonant frequency of the sensor tube, which is tuned to approximately 40,000 hertz. As the ice detector encounters an icing environment, ice collects on the sensing probe. The added mass of accreted ice causes the frequency of the sensing probe to decrease in accordance with the laws of classical mechanics. A 0.02-inch (0.5mm) thickness of ice on the probe causes the operating frequency of the probe to decrease by approximately 133 hertz. The ice detector control circuitry utilizes a microprocessor to monitor probe frequency when instructed by ASOS. The ice detector deices itself through internal heating elements in both the strut and probe. After the ice detector is deiced, the sensing probe cools quickly and is ready to sense ice formation again.

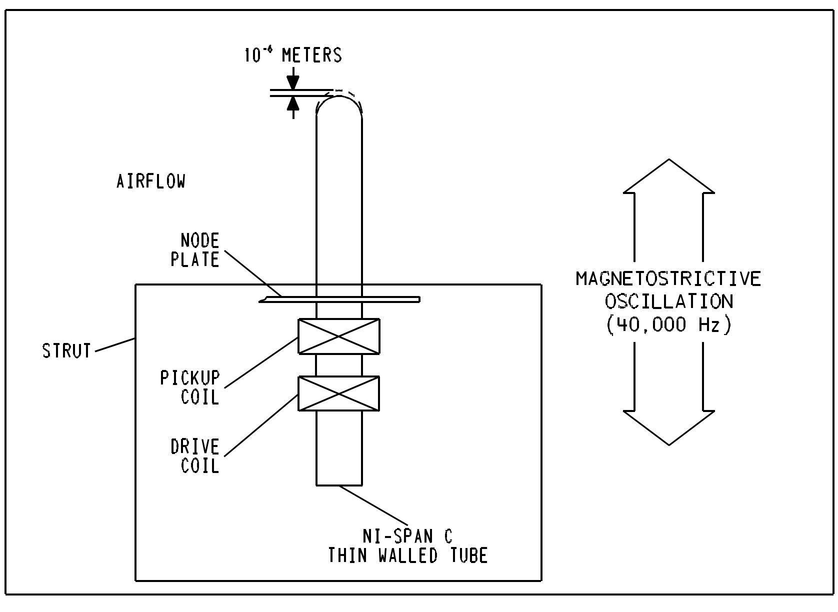


Figure 11.4.1. Magnetostrictive Oscillator Circuit

11.4.1.1 **Probe Assembly**. The probe assembly consists of the probe (sensing element), the strut, and the deice collar. The strut contains pickup and drive coils, cartridge heaters, a magnet, and a retaining spring. The probe assembly minimizes the flat area around the probe and contains radial grooves machined in the conical portion of the strut. This design prevents water droplets from collecting around the probe nodal area in still air conditions. The deice collar aids in breaking up ice that may form on the heat sink (refer to paragraph 11.4.1.3). The sensor water shedding ability eliminates false signals due to water refreezing at the base when the atmosphere does not contain liquid water to actually form ice on the probe element.

11.4.1.2 **Heaters**. Deicing is accomplished using a heater brazed in the interior of the probe. A pair of cartridge heaters deice the strut. During deicing, the maximum power drain is 400 watts. The deicing system is capable of completely melting approximately 3.8mm of ice on the strut and probe within 30 seconds at -20°C.

11.4.1.3 **Heat Sink**. The heat sink consists of a 4.5-pound (2.05 kilograms) mass of anodized 6061 aluminum that separates the electronics and probe strut. The heat sink provides heat dissipation for the probe and strut during deicing. The purpose of the heat sink is to achieve a recovery time (defined as the time required for the sensor to revert to ambient temperature after being deiced). The heat sink thermally isolates the sensing element from the electronics heat, which allows accurate measurement at temperatures at or close to 0°C.

11.4.2 SIMPLIFIED BLOCK DIAGRAM DESCRIPTION

Figure 11.4.2 provides a simplified block diagram of the freezing rain sensor. All circuitry is contained on Electronics Processor Board A1A2 or in Probe Assembly A1A1.

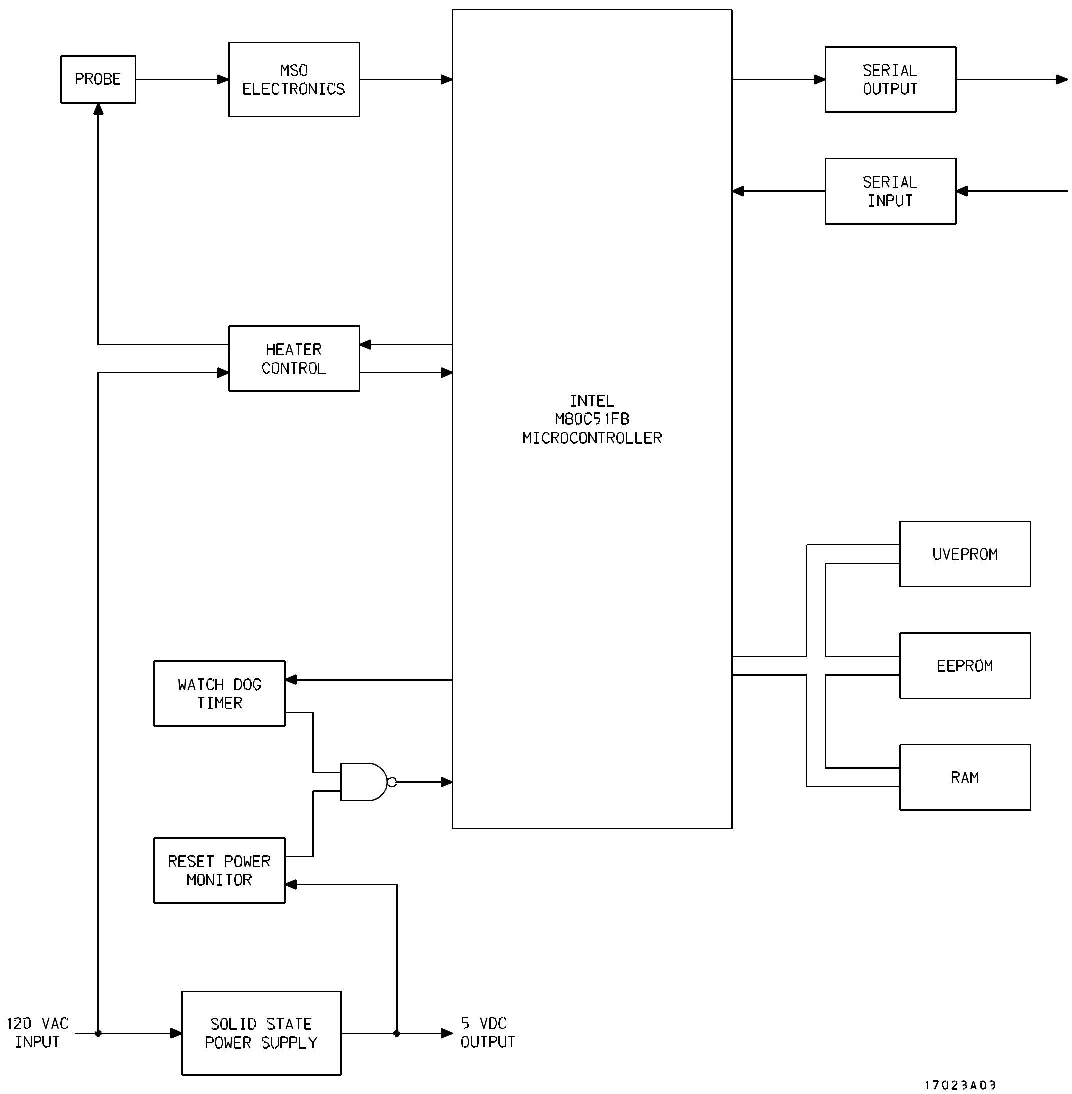


Figure 11.4.2. Freezing Rain Sensor Simplified Block Diagram

11.4.2.1 **Electrical Input Requirements**. The sensor utilizes 115vac (103.5 to 126.5 vrms), 55- to 65-hertz input power. Normal operation continues for power interruptions of less than 10 milliseconds. Power interruptions greater than 10 milliseconds cause the sensor to go into a reset condition. Under this condition, the sensor resumes operation automatically after power is reapplied and the power up test sequence completes. Terminals 1 and 2 and terminals 4 and 5 are on separate circuit breakers, respectively. The ac power terminal connections for the sensor are as follows:

Terminal	Function
1	115 vac, hot, electronics
2	115 vac, neutral, electronics
3	Chassis ground (model 0872C2 only)
4	115 vac, hot, heater
5	115 vac, neutral, heater
E1	Chassis ground(model 0872C3 only)

11.4.2.2 **Communications Link**. The freezing rain sensor communicates with the DCP via fiberoptic cables. In the sensor, Fiberoptic Module A1A2A1 provides the interface between optical signals of the DCP and the RS-232 electrical signals applied to the sensor Electronics Processor board. The DCP polls the sensor for data every 60 seconds. The sensor responds with the requested ice condition and self-test status.

11.4.2.3 **Microcontroller**. The sensor uses an M80C51FB 8-bit microcontroller. This chip contains an internal RS-232 interface, which greatly simplifies the interface to the DCP. The unit's firmware is contained on a separate ultraviolet erasable programmable read only memory (UVEPROM) chip mounted on a socket. This permits the unit's software to be easily changed in the field by removing the UVEPROM chip from its socket and replacing it with a chip containing the new program. An electrically erasable programmable read only memory (EEPROM) is used to store data and tables used in computation. The unit also features a nonvolatile read and write memory (RAM) chip that permits any detected failure codes to be stored in the unit. A failed unit can be brought back to a repair facility and the failure code read to determine how the unit failed.

11.4.2.4 **Watchdog Timer/Reset Power Monitor**. A single chip combines the function of watchdog timer and power monitor. The purpose of the watchdog timer is to monitor the operation of the microcontroller. The microcontroller must output a pulse into the watchdog timer approximately every second or the watchdog timer causes the microcontroller to go into a reset condition, which reinitializes the microcontroller. The power monitor circuit causes the microcontroller to reset any time that the voltage drops below 4.65 vdc, which is the lower operational voltage for the memory circuits. Any time that the voltage drops below 4.25 vdc, it is possible for the memory circuits to lose memory. The power monitor maintains the microcontroller in a reset condition until the supply voltage is above 4.65 vdc.

11.4.2.5 **Heater Control**. The heater control circuit consists of a mechanical relay with a solid-state interface circuit to the microcontroller. When ice has accreted on the probe to a predetermined thickness (typically 2.0mm), ASOS instructs the heater circuit to furnish 115 vac to the heaters in the probe and strut, causing the ice to melt. A mechanical relay is used instead of a solid state relay to avoid any leakage current that might flow through the heater circuit when the relay is in a deenergized state. A leakage current would cause some heating of the probe, which would have an adverse effect on freezing rain detection, especially around 0°C ambient air temperature. There is a feedback circuit to the microcontroller to ensure that the relay is operating properly.

11.4.3 **COMMAND DESCRIPTION**

The freezing rain sensor responds to commands issued by the DCP during normal operation and by the technician during maintenance. The following paragraphs describe these commands.

11.4.3.1 **Quick Reference**. There are four different requests that the freezing rain sensor responds to over its RS-232 communications link. These commands are summarized as follows:

Command	Description
Z1	Send routine data
Z3XX	Perform deice cycle for "XX" seconds (minimum 01 second, maximum 60)
Z4	Perform extended diagnostics
F5	Field calibration

11.4.3.2 **Power Interruptions**. After a power interruption (greater than 50 milliseconds), the freezing rain sensor takes 30 seconds to initialize and an additional 15 seconds to calculate an averaged frequency for output. If a Z1 command is issued within 30 seconds of power-on, the sensor does not respond. If the sensor fails to respond to any Z command, an additional 30 seconds is required before the command can be reissued.

11.4.3.3 **Z1 Request (Send Routine Data)**. The Z1 command is the request sent from the DCP once per minute to obtain sensor data. The sensor responds to the Z1 command with the sensor frequency normalized over a 1-minute period. The sensor provides status (pass/fail/deice), a failure code, and a checksum value. Figure 11.4.3 illustrates the format of the sensor response. The Z1 request should not be issued more often than once per minute. If it is, the sensor response will be unchanged from the previous response until the 1-minute normalization period has passed.

If a BIT failure is detected (F in status byte), the sensor does not respond correctly to Z1 or Z3 commands. The sensor will, however, respond to Z4 and F5 commands.

If the Z1 request is issued within 5 minutes of a deice cycle, the sensor responds with "ZD 40000CB", a software-generated response that does not indicate the actual frequency of the sensor.

Z1 RESPONSE

ZXYZZZZZHH

X Sensor status
- P - Pass BIT
- F - Fail BIT
- D - Recent deice command

Y Fail code (displayed only if sensor status = F)
- 1 - Probe Failure
- 2 - Probe Deicing Heater Failure
- 3 - Electronics Failure

ZZZZZ Normalized frequency between 38,400 and 40,100

HH Checksum value (hexadecimal)

Figure 11.4.3. Format of Z1 (Send Routine Data) Response

11.4.3.4 **Z3XX Request (Perform Deice Cycle)**. This command causes the freezing rain sensor to initiate a deice cycle. The probe and strut heaters are activated for 1 to 60 seconds as determined by the number typed after "Z3". All communication with the sensor is locked out for 2 minutes following a Z3 command. The operator should wait for at least 5 minutes before attempting any other command.

WARNING

Serious injury could result if the probe is contacted within 30 minutes after issuing the Z3 command. Do not touch the probe for 30 minutes after issuing the Z3 command.

The sensor responds to a Z3 command with "ZDOKHH". "OK" indicates that sensor heaters are operating satisfactorily, and "HH" is a checksum value. The heater did not turn on properly if the sensor does not respond. If "OK" indication is not received, a Z4 command should be issued to determine if the heater failed.

The probe assembly becomes hot following a Z3 command; therefore personnel should wait at least 30 minutes after the command before touching the probe assembly. The heat generated in response to a Z3 command may damage the probe assembly, especially if the ambient temperature is above the sensor normal operating range. For this reason, the following guidelines must be followed when turning the heater on using the Z3 command.

Temperature Range	Duration
Below 5°C (41°F)	Do not turn heater on for more than 45 seconds.
Between 5 and 15°C (41 and 59°F)	Do not turn heater on for more than 5 seconds.
Above 15°C (59°F)	Do not turn heater on.

11.4.3.5 **Z4 Request (Perform Extended Diagnostics)**. The Z4 command causes the freezing rain sensor to perform an on-demand self-test. The test performed is an extended version of the test regularly performed with the Z1 command. Specifically, the Z4 command performs a more detailed check of the sensor memory circuits and exercises more of the heater circuitry. The format for the Z4 response is "ZXYHH". "X" represents sensor status (P, F, or D), "Y" is the fail code (1, 2, or 3), and "HH" is the checksum value.

11.4.3.6 **F5 Request (Field Calibration)**. The F5 command causes the freezing rain sensor to perform an automatic calibration. Sensor calibration is not a periodic task and is not authorized for field use. Calibration is performed only at the National Reconditioning Center (NRC) after replacing the probe assembly, electronics processor board, or if frequency is outside the range of 39,990 to 40,010 Hz. Calibration is performed only when the probe is clean and dry and environmental conditions are acceptable.

The format of the sensor's response to the F5 command is "ZXYZZZZZ". "X" indicates sensor status (P or F), "Y" is the fail code (1, 2, or 3), and "ZZZZZ" is the calibration frequency. The calibration frequency must be between 39,900 and 40,100 hertz. A failure is indicated if the calibration frequency is outside these limits. After issuing the F5 command, the maintenance technician must wait at least 3 minutes before issuing any other command and the calibration frequency must be 40,000 ±10 Hz.

SECTION V. MAINTENANCE

11.5.1 **INTRODUCTION**

This section provides preventive and corrective maintenance procedures for the freezing rain sensor. Preventive maintenance consists of sensor inspection and cleaning (if necessary). Corrective maintenance consists of fault isolation using the ASOS freezing rain page and removing and replacing the sensor.

11.5.2 **PREVENTIVE MAINTENANCE**

The freezing rain sensor is inspected and the probe is cleaned if necessary every 90 days. Table 11.5.1 provides the procedure for sensor inspection and cleaning. The probe is cleaned only when it is contaminated with foreign material such as dirt, oil, fingerprints, etc. If environmental conditions are acceptable, the output frequency of the sensor is checked. If the output frequency is out of tolerance, the sensor must be replaced. Every six months, the model 0872C2 ground path conductivity must be measured as described in paragraph 11.5.2.1.

11.5.2.1 **Model 0872C2 Ground Fault Check**. Verify the freezing rain sensor ground path as follows:

a. At equipment cabinet, set freezing rain sensor circuit breaker to off (right) position.

b. At model 0872C2 freezing rain sensor, check internal chassis ground inside freezing rain enclosure by verifying J1-3 (green wire) is tight.

c. Second ground is electronics enclosure (case) ground and is 10 American Wire Gauge (AWG) ground wire connected to single barrel lug on electronics enclosure (case). Check ground wire connection at raceway ground wire. Check for corrosion on both lugs. If corrosion is detected, clean by using a wire brush.

d. Third ground is mounting pole connected to pedestal and provides earth ground. Check that all bolts and nuts are installed and tight.

e. After the ground connections are checked and verified, set the freezing rain circuit breaker in the DCP to the ON position.

CAUTION

Do not touch sensor case until voltage check has been completed in step h.

g. At the OID, go to the REVUE-SITE-CONFG-SENSR page. Configure the freezing rain sensor in the appropriate position.

h. Using a DVM, check the AC and DC voltages between the case of the freezing rain enclosure and the 10 AWG copper wire located at the raceway. If the voltage measures more than 0.25 volts AC or DC, remove power from the freezing rain sensor by turning OFF the circuit breaker in the DCP. Call Bobby McCormick at 301-713-1835 X 120 and report the problem.

11.5.3 **CORRECTIVE MAINTENANCE**

Freezing rain sensor corrective maintenance consists of troubleshooting failures and sensor removal and replacement. In order to communicate with the sensor for calibration (and troubleshooting), the maintenance technician must connect a laptop computer to the sensor.

11.5.3.1 **Using the Laptop Computer With the Freezing Rain Sensor**. In order to communicate with the sensor for calibration and other tasks, the maintenance technician must use the laptop computer. Table 11.5.2 provides the procedure to set up the laptop computer to communicate with the sensor. Paragraph 11.4.3 provides detailed descriptions of individual sensor commands.

11.5.3.2 **Troubleshooting**. The FREEZING RAIN maintenance page at the OID is the primary troubleshooting tool for the freezing rain sensor. Although diagnostic commands can be issued directly from the laptop computer, these commands provide no additional information other than what is displayed on the OID. Table 11.5.3 provides a summary of troubleshooting actions for different failure indications. Table 11.5.4 provides additional troubleshooting steps for heater failures. The heater checks should be performed only after a heater failure is indicated on the freezing rain page (or by a Z1 or Z3 command) or if a "no response" condition occurs after a Z3 command is issued. Remove and replace the electronics enclosure when fault isolation identifies the sensor as the source of the failure.

11.5.3.3 **Calibration**. The sensor is calibrated at the authorized repair facility by using the laptop computer to issue an F5 command (paragraph 11.4.3.6). **Sensor field calibration is not authorized**. The freezing rain sensor should be calibrated only when sensor F1 frequency is less than 39,990 hertz or greater than 40,010 hertz. Calibration may be performed only when the probe assembly is clean and dry and when environmental conditions are acceptable. Calibration should not be performed under any of the following conditions:

a. When ice, snow, or liquid water is visible on the probe or at the base of the probe or when the probe is dirty. These substances cause the frequency of the probe to deteriorate.

b. When ambient temperature is below -10°C (14°F) or above +10°C (50°F). Temperatures outside this range cause contraction or expansion of the metallic probe, thereby modifying its frequency.

c. Within 20 minutes of a Z3 request. A Z3 request initiates a deice cycle and the probe needs time to return to ambient temperature.

d. When a fail condition is indicated on the freezing rain sensor page on the OID (or by Z1 or Z4 commands). The sensor cannot be calibrated in a failed condition or when responding to data requests or when performing self-diagnostics.

e. More than once every 90 days. More frequent calibration under normal operating conditions is unnecessary.

Table 11.5.5 provides the procedure to calibrate the freezing rain sensor.

11.5.4 **FRU REMOVAL AND INSTALLATION**

Removal and installation procedures identified on the following chart by table number are provided to facilitate safe and efficient removal of sensor FRU's.

Unit to be replaced	Table
Electronics enclosure	11.5.6 (field level)
Electronics Processor board	11.5.7 (depot level)
Probe assembly	11.5.8 (depot level)
Fiberoptic module	11.5.9 (depot level)

Table 11.5.1. Freezing Rain Sensor Inspection and Cleaning

Step	Procedure
	Tools and Materials Required: Soft cotton cloth Isopropyl alcohol (ASN 052-C-12) Laptop computer with PROCOMM Plus installed Laptop interface (Y-shaped) cable Large flat-tipped screwdriver No. 1 Phillips screwdriver **WARNING** Death or severe injury may result if power is not removed from sensor prior to maintenance activities. Ensure that circuit breakers (located inside DCP equipment cabinet) supplying power to sensor are set to off (right) position.
1	Set circuit breakers on freezing rain sensor circuit breaker module inside DCP equipment cabinet to off (right) position. The freezing rain sensor circuit breaker module is labeled.
2	**WARNING** Freezing rain sensor probe assembly will be hot if sensor recently completed a deice cycle. Ensure that probe assembly has cooled before cleaning probe. At freezing rain sensor, inspect surface of probe for contaminants such as dirt, oil, fingerprints, etc. If any contaminants are present, clean probe using isopropyl alcohol and soft cotton cloth.
3	Set circuit breakers on freezing rain sensor circuit breaker module inside DCP equipment cabinet to on (left) position.
4	Check sensor frequency using either REVUE-SENSOR-12HR page of OID or laptop computer (Z1 command).
5	**NOTE** If temperature is out of range, frequency tolerance (±10 hertz) may not be applicable. Do not perform calibration when temperature is out of range. If ambient temperature is 0°C ±10°C, verify that frequency is 40,000 ±10 hertz. If frequency is out of tolerance, remove and replace the electronics enclosure.

Table 11.5.2. Using the Laptop Computer With the Freezing Rain Sensor

Step	Procedure
	INITIAL SETUP PROCEDURE
	Tools Required: Laptop computer with PROCOMM Plus installed Laptop interface (Y-shaped) cable Laptop null cable Large flat-tipped screwdriver No. 1 Phillips screwdriver
1	Set circuit breakers on freezing rain sensor circuit breaker module inside DCP equipment cabinet to off (right) position.

Table 11.5.2. Using the Laptop Computer With the Freezing Rain Sensor -CONT

Step	Procedure
	WARNING Probe Assembly A1A1 will be hot if sensor recently completed a deice cycle. Ensure that probe assembly has cooled before proceeding to step 2.
2	Using flat-tipped screwdriver, loosen four captive bolts securing hinged sensor access door and open door.
3	Using No. 1 Phillips screwdriver, disconnect DB-9 connector from fiberoptic module inside electronics enclosure.
4	Using laptop computer null cable and interface (Y-shaped) cable, connect RS-232C (COM1) port of laptop computer to DB-9 connector removed from fiberoptic module.
5	Turn on laptop computer and initialize PROCOMM Plus program. After program initializes, press any key to enter terminal mode (blank) screen.
6	Using ALT-S command (setup facility), set up the following terminal options: a. Terminal emulation: VT220 b. Duplex: FULL c. Soft flow control (XON/XOFF): OFF d. Hard flow control (CTS/RTS): OFF e. Line wrap: OFF f. Screen scroll: ON g. CR translation: CR h. BS translation: NON-DESTRUCTIVE I. Break length (milliseconds): 035 j. Enquiry: OFF k. EGA/VGA true underline: OFF l. Terminal width: 80 m. ANSI 7 or 8 bit commands: 8 BIT
7	Press ESC key to exit to terminal mode (blank) screen.
8	Using ALT-P command (line/port option), set current settings as follows: a. Baud rate: 2400 or 9600 (depending on modem used) b. Parity: NONE c. Data bits: 8 d. Stop bits: 1 e. Port: COM1
9	Press ESC key to exit to terminal mode (blank) screen
10	Set laptop computer CAPS LOCK to ON.
11	Set circuit breakers on freezing rain sensor circuit breaker module inside DCP equipment cabinet to on (left) position
	NOTE After a power interruption, the freezing rain sensor takes 30 seconds to initialize and an additional 15 seconds to calculate an averaged frequency. If a Z1 command is issued within 30 seconds of power-on, the sensor will not respond. If the sensor fails to respond to any Z command, allow an additional 30 seconds and reissue the command.
12	The freezing rain sensor is now available for legal commands from the laptop computer. Refer to paragraph 11.4.3 for detailed descriptions of sensor commands and for specific restrictions on their use.

Table 11.5.2. Using the Laptop Computer With the Freezing Rain Sensor -CONT

Step	Procedure
	TEARDOWN
1	At laptop computer, press ALT-X (exit) to exit PROCOMM Plus.
2	Turn off laptop computer.
3	Set circuit breakers on freezing rain sensor circuit breaker module inside DCP equipment cabinet to off (right) position.
4	Disconnect cables between laptop computer and freezing rain sensor.
5	Using No. 1 Phillips screwdriver, connect freezing rain sensor DB-9 connector to fiberoptic module.
6	Using large flat-tipped screwdriver, close and secure freezing rain sensor access door.
7	Set circuit breakers on freezing rain sensor circuit breaker module inside DCP equipment cabinet to on (left) position.

Table 11.5.3. Freezing Rain Sensor Troubleshooting

Symptom	What to Do
Sensor does not respond. **(Field Level)**	Connect laptop computer and issue Z1 command. If sensor responds, perform fiberoptic module test (Chapter 1, Section V). If sensor fails to respond, replace sensor (Electronics Processor Board A1A2 failure).
PROBE STATUS failure **(Depot Level)**	Replace Probe Assembly A1A1. If failure continues, replace Electronics Processor Board A1A2.
ELECTRONICS STATUS failure **(Depot Level)**	Replace Electronics Processor Board A1A2.
HEATER STATUS failure **(Depot Level)**	Perform heater resistance test (table 11.5.4). If resistance is out of tolerance, replace Probe Assembly A1A1. If resistance is within tolerance, replace Electronics Processor Board A1A2.

Table 11.5.4. Depot Level Probe Assembly Heater Troubleshooting

Step	Procedure
	Tools and Materials Required: Large flat-tipped screwdriver Tweezers Digital multimeter **WARNING** Death or severe injury may result if power is not removed from sensor prior to maintenance activities. Ensure that circuit breakers (located in DCP) supplying power to sensor are set to off (right) position.
1	At equipment cabinet, set freezing rain sensor circuit breaker module to off (right) position.
2	**WARNING** Probe Assembly A1A1 will be hot if sensor recently completed a deice cycle. Ensure that probe assembly has cooled before proceeding to step 2. Using flat-tipped screwdriver, loosen four captive bolts securing hinged cover to sensor and open cover.

Table 11.5.4. Depot Level Probe Assembly Heater Troubleshooting -CONT

Step	Procedure
3	**CAUTION** Use caution when removing probe connectors. Heater on Electronics processor board may be damaged if too much side pressure is exerted. Using tweezers, disconnect probe assembly electrical connectors J3 and J4 from electronics processor board. (Refer to figure 11.1.2). To disconnect connector J4, press latch and pull connector straight out.
4	Using digital multimeter, measure resistance between pins 1 and 2 of connector J4. Verify that resistance is 42 ±5 ohms. If resistance is out of tolerance, replace Probe Assembly A1A1. If resistance is within tolerance, replace Electronics Processor Board A1A2.

Table 11.5.5. Depot Level Freezing Rain Sensor Calibration

Step	Procedure
	Tools and Materials Required: Laptop computer with PROCOMM Plus installed Laptop interface (Y-shaped) cable Laptop null cable Large flat-tipped screwdriver No. 1 Phillips screwdriver **CAUTION** Probe must be clean and dry and environmental conditions must be acceptable (paragraph 11.5.3.3). Sensor calibration under less than optimum conditions may result in inaccurate sensor operation.
1	Connect and initialize laptop computer for communication to freezing rain sensor in accordance with table 11.5.2.
2	At laptop computer, type Z4 <CR>. Verify that sensor responds with "ZP HH". If failure (F) is indicated, troubleshoot and repair sensor (based on indicated error code) before performing calibration.
3	Type F5 <CR>. Sensor responds with "ZPXXXXX" where "XXXXX" is the calibration frequency between 39,990 and 40,010 hertz.
4	Wait a minimum of 3 minutes, then type Z1 <CR>. Sensor responds with "ZP XXXXXHH". If failure (F) is indicated, troubleshoot and repair sensor (based on indicated error code) before performing calibration.
5	Verify that frequency ("XXXXX") is 40,000 ±10 hertz. If frequency is out of tolerance, replace the following FRU's in order and recalibrate until the required tolerance is met. Allow at least 1 hour for probe to obtain ambient temperature when replacing probe or sensor. a. Probe Assembly A1A1 b. Electronics Processor Board A1A2 c. Freezing rain sensor
6	Disconnect laptop computer and return sensor to operation in accordance with table 11.5.2.

Table 11.5.6. Electronics Enclosure Removal and Installation

Step	Procedure
	REMOVAL
	Tools and Materials Required: Flat-tipped screwdriver 7/16-inch wrench Large pliers (12 inch, 2-1/4 inch capacity, curved jaw) 3/16-inch hex key wrench **WARNING** Death or severe injury may result if power is not removed from sensor prior to maintenance activities. Ensure that circuit breakers (located in DCP) supplying power to sensor are set to off (right) position. **NOTE** Electronics enclosure replacement should be accomplished only when environmental conditions are as specified for field calibration; otherwise, the unit cannot be field-calibrated immediately after replacement.
1	Set circuit breakers on freezing rain sensor circuit breaker module inside DCP equipment cabinet to off (right) position.
2	**WARNING** Probe Assembly A1A1 will be hot if sensor recently completed a deice cycle. Ensure that probe assembly has cooled before proceeding to step 2. Place plastic probe cap protective cover over probe assembly.
3	Using flat-tipped screwdriver, loosen four captive bolts securing hinged sensor access door and open door. **CAUTION** Electronics Processor Board A1A2 is a Class I ESD component. To avoid damage to electronics processor board, use proper ESD handling procedures, including the use of a ground strap, when performing the following steps.
4	Remove two fiberoptic cables from underneath fiberoptic module by turning counterclockwise (ccw). Install protective plastic covers over fiberoptic connectors.
5	Using small flat-tipped screwdriver, release catches holding plastic cover over ac terminal board connector J1. Remove plastic cover.
6	Using flat-tipped screwdriver, remove five ASOS power and chassis ground wires from terminal board connector J1. Do not disconnect sensor chassis ground wire from terminal No. 3. After removing ASOS wires and fiberoptic cables, reinstall terminal screws.
7	Install protective plastic cover over ac terminal board connector J1.
8	Using 7/16-inch wrench, remove pedestal ground wire from ground stud located at bottom right of enclosure.
9	Using large pliers, remove flexible conduit from base of electronics enclosure. Carefully pull wires and fiberoptic cables out of enclosure.
10	Using large flat-tipped screwdriver, close and secure freezing rain sensor access door.
11	While supporting electronics enclosure and using 3/8-inch hex key wrench, loosen three captive screws on mounting pole behind enclosure. When enclosure is free from screws, carefully lift enclosure off mounting pole.

Table 11.5.6. Electronics Enclosure Removal and Installation -CONT

Step	Procedure
	INSTALLATION
	Tools and Materials Required: Flat-tipped screwdriver 7/16-inch wrench and torque driver Large pliers 3/8-inch hex key wrench and torque driver **WARNING** Death or severe injury may result if power is not removed from sensor prior to maintenance activities. Ensure that circuit breakers (located in DCP) supplying power to sensor are set to off (right) position. **NOTE** Electronics enclosure replacement should be accomplished only when environmental conditions are as specified for field calibration (refer to paragraph 11.4.3.6); otherwise, the unit cannot be field-calibrated immediately after replacement.
1	Ensure that circuit breakers on freezing rain sensor circuit breaker module inside DCP equipment cabinet are set to off (right) position. Circuit breaker module will be labeled.
2	Ensure that protective tube is installed over Probe Assembly A1A1 of replacement enclosure.
3	Position electronics enclosure on mounting pole.
4	While supporting electronics enclosure and using 3/8-inch hex key wrench, secure enclosure to pole by tightening three captive bolts. Using torque driver, torque bolts to 45 inch-pounds.
5	Using flat-tipped screwdriver, loosen four captive bolts securing hinged sensor access door and open door.
6	Route ac power wiring and fiberoptic cables through access hole in bottom of electronics enclosure.
7	Using large pliers and hardware supplied, connect flexible conduit to electronics enclosure.
8	Using 7/16-inch wrench, remove sensor-supplied nut from ground stud located at bottom right of enclosure. (Refer to figure 11.1.2.) Use nut to connect sensor pedestal 10 AWG ground wire to ground stud. Do not torque nut more than 7 foot-pounds.
9	**CAUTION** Electronics Processor Board A1A2 is a Class I ESD component. To avoid damage to electronics processor board, use proper ESD handling procedures, including the use of a ground strap, when performing the following steps. Using small flat-tipped screwdriver, release catches holding plastic cover over ac terminal board connector J1. Remove plastic cover.
10	On model 0872C3 only, using 11/32 inch wrench, connect green wire (chassis ground) to E1.
11	Using flat-tipped screwdriver, connect ac power wiring to ac terminal board connector J1 as follows: Wire color / Terminal / Function Black / J1-1 / 115 vac (electronics) White / J1-2 / Neutral (electronics) Green / J1-3 / Chassis ground (model 0872C2 only) Red / J1-4 / 115 vac (heater) Yellow / J1-5 / Neutral (heater)
12	Install protective plastic cover over ac terminal board connector J1.

Table 11.5.6. Electronics Enclosure Removal and Installation -CONT

Step	Procedure
13	Remove plastic covers from fiberoptic cables and connect transmit (TX) cable to TRANSMIT connector of fiberoptic module and receive (RX) cable to RECEIVE connector.
14	Remove protective cover from probe assembly.
15	Check sensor frequency using either OID REVUE-SENSOR-12HR page or laptop computer (Z1 command).If ambient temperature is 0°C ±10°C, verify that frequency is 40,000 ±10 hertz.

Table 11.5.7. Depot Level Electronics Processor Board Removal and Installation

Step	Procedure
REMOVAL	
	Tools and Materials Required: Flat-tipped screwdriver Small flat-tipped screwdriver No. 3 Phillips screwdriver Tweezers **WARNING** Death or severe injury may result if power is not removed from sensor prior to maintenance activities. Ensure that circuit breakers (located in DCP) supplying power to sensor are set to off (right) position. **CAUTION** Processor board is a Class I ESD component. To avoid damage to circuit boards, use proper ESD handling procedures, including the use of a ground strap, when performing the following steps. **NOTE** Electronics processor board replacement should be accomplished only when environmental conditions are as specified for field calibration; otherwise, the unit cannot be field-calibrated immediately after replacement.
1	Set circuit breakers on freezing rain sensor circuit breaker module inside DCP equipment cabinet to off (right) position. Circuit breaker module will be labeled.
	WARNING Probe Assembly A1A1 will be hot if sensor recently completed a deice cycle. Ensure that probe assembly has cooled before proceeding to step 2.
2	Using flat-tipped screwdriver, loosen four captive bolts securing cover sensor and open cover. Cover is hinged to enclosure.
	CAUTION Electronics Processor Board A1A2 is a Class I ESD component. To avoid damage to electronics processor board, use proper ESD handling procedures, including the use of a ground strap, when performing the following steps.
3	Remove two fiberoptic cables from underneath fiberoptic module by turning ccw. Install protective plastic covers over fiberoptic connectors.
4	Using small flat-tipped screwdriver, release catches holding plastic cover over ac terminal board connector J1. Remove plastic cover.

Table 11.5.7. Depot Level Electronics Processor Board Removal and Installation - CONT

Step	Procedure
5	Using flat-tipped screwdriver, remove five power and chassis ground wires from terminal board connector J1.
6	**CAUTION** Use caution when removing probe connectors. Heater on electronics processor board may be damaged if too much side pressure is exerted. Disconnect probe assembly electrical connectors from electronics processor board connectors J3 and J4. Use tweezers to press latch and pull connector straight out.
7	**CAUTION** Use caution when removing capacitor connectors. Heater on electronics processor board may be damaged if too much side pressure is exerted. **NOTE** Capacitors C7 and C9 are matched to Probe Assembly A1A1 and should be retained to use on the replacement electronics processor board. Disconnect and tag select capacitors C7 and C9 of Electronics processor board. Use tweezers to press latch and pull connector with capacitor mounted straight out.
8	Using No. 3 Phillips screwdriver, remove four screws securing Electronics Processor Board A1A2 to electronics enclosure.
	INSTALLATION
	Tools and Materials Required: Flat-tipped screwdriver Small flat-tipped screwdriver No. 3 Phillips screwdriver Tweezers **WARNING** Death or severe injury may result if power is not removed from sensor prior to maintenance activities. Ensure that circuit breakers (located in DCP) supplying power to sensor are set to off (right) position. **CAUTION** Processor board is a Class I ESD component. To avoid damage to circuit boards, use proper ESD handling procedures, including the use of a ground strap, when performing the following steps. **NOTE** Electronics processor board replacement should be accomplished only when environmental conditions are as specified for field calibration; otherwise, the unit cannot be field-calibrated immediately after replacement.
1	Ensure that circuit breakers on freezing rain sensor circuit breaker module inside DCP equipment cabinet are set to off (right) position.
2	Position Electronics Processor Board A1A2 in electronics enclosure so that terminal board connector J1 is toward bottom and screw holes in board align with holes in enclosure.
3	Using No. 3 Phillips screwdriver, install four screws securing Electronics processor board to electronics enclosure.
4	**NOTE** Select capacitors C7 and C9 should be retained from previously removed board. Using tweezers and tags as a guide, install select capacitors C7 and C9 onto Electronics Processor board.

Table 11.5.7. Depot Level Electronics Processor Board Removal and Installation - CONT

Step	Procedure
5	Using tweezers, install probe assembly electrical connectors onto Electronics Processor board connectors J3 and J4.
6	On model 0872C3 only, using 11/32 inch wrench, connect green wire (chassis ground) to E1.
7	Using flat-tipped screwdriver, connect ac power wiring to ac terminal board connector J1 as follows: Wire color / Terminal / Function Black / J1-1 / 115 vac (electronics) White / J1-2 / Neutral (electronics) Green / J1-3 / Chassis ground (model 0872C2 only) Red / J1-4 / 115 vac (heater) Yellow / J1-5 / Neutral (heater)
8	Install protective plastic cover over ac terminal board connector J1.
9	Remove protective plastic covers from fiberoptic cables. Connect transmit (TX) cable to TRANSMIT connector of fiberoptic module and receive (RX) cable to RECEIVE connector.
10	Calibrate freezing rain sensor in accordance with table 11.5.5.

Table 11.5.8. Depot Level Probe Assembly Removal and Installation

Step	Procedure
	REMOVAL
	Tools and Materials Required: Flat-tipped screwdriver No. 1 Phillips screwdriver Tweezers **WARNING** Death or severe injury may result if power is not removed from sensor prior to maintenance activities. Ensure that circuit breakers (located in DCP) supplying power to sensor are set to off (right) position. **NOTE** Probe assembly replacement should be accomplished only when environmental conditions are as specified for field calibration; otherwise, the unit cannot be field-calibrated immediately after replacement.
1	Set circuit breakers on freezing rain sensor circuit breaker module inside DCP equipment cabinet to off (right) position.
	WARNING Probe Assembly A1A1 will be hot if sensor recently completed a deice cycle. Ensure that probe assembly has cooled before proceeding with step 2.
2	Place protective cover over probe assembly.
3	Using flat-tipped screwdriver, loosen four captive bolts securing cover to sensor and open cover. Cover is hinged to enclosure.

Table 11.5.8. Depot Level Probe Assembly Removal and Installation - CONT

Step	Procedure
4	**CAUTION** Use caution when removing probe connectors. Heater on electronics processor board may be damaged if too much side pressure is exerted. Using tweezers, disconnect probe assembly electrical connectors from electronics processor board connectors J3 and J4. For connector J4, press latch and pull connector straight out.
5	**CAUTION** Probe assembly cables and connectors are fragile. Remove cables and connectors slowly so that cables do not catch as they are guided through the housing or heat sink. **NOTE** An O-ring that is used between the probe assembly and heat sink may come out when probe assembly is removed. Retain O-ring for installation of replacement probe assembly. Using No. 1 Phillips screwdriver, remove four screws securing Probe Assembly A1A1 to heat sink. Carefully lift probe assembly from heat sink, guiding cables through housing and heat sink. Retain O-ring.
6	**CAUTION** Use caution when removing capacitor connectors. Heater on electronics processor board may be damaged if too much side pressure is exerted. **NOTE** Select capacitors C7 and C9 are a matched set and are packed and shipped with replaced probe assembly. New capacitors should be obtained from probe replacement kit. Disconnect and tag select capacitors C7 and C9 from electronics processor board. Use tweezers to press latch and pull connector with capacitor mounted straight out.
INSTALLATION	
	Tools and Materials Required: Flat-tipped screwdriver No. 1 Phillips screwdriver Tweezers **WARNING** Death or severe injury may result if power is not removed from sensor prior to maintenance activities. Ensure that circuit breakers (located in DCP) supplying power to sensor are set to off (right) position. **NOTE** Probe assembly replacement should be accomplished only when environmental conditions are as specified for field calibration; otherwise, the unit cannot be field-calibrated immediately after replacement.
1	Ensure that circuit breakers on freezing rain sensor circuit breaker module inside DCP equipment cabinet are set to off (right) position.
2	**NOTE** Replacement capacitors C7 and C9 are provided with replacement probe assembly. Obtain probe assembly field replaceable kit (P/N 00872-0277). Ensure that kit contains replacement capacitors C7 and C9 and that protective cover is installed over probe assembly.

Table 11.5.8. Depot Level Probe Assembly Removal and Installation - CONT

Step	Procedure
3	**CAUTION** Electronics Processor Board A1A2 is a Class I ESD component. To avoid damage to electronics processor board, use proper ESD handling procedures, including the use of a ground strap, when performing the following steps. Using tweezers, install replacement select capacitors C7 and C9 onto electronics processor board.
4	Place O-ring into channel on top of heat sink.
5	**CAUTION** Probe assembly cables and connectors are fragile. Use caution so that cables do not catch as they are guided through the heat sink or housing. While holding probe assembly with one hand, carefully guide two cables though hole in heat sink and into electronics enclosure.
6	Using No. 1 Phillips screwdriver, install four screws securing probe assembly to heat sink.
7	Using tweezers, install probe assembly electrical connectors onto electronics processor board connectors J3 and J4.
8	Remove protective cover from probe assembly.
9	Calibrate freezing rain sensor in accordance with table 11.5.5.

Table 11.5.9. Fiberoptic Module Removal and Installation

Step	Procedure
REMOVAL	
	Tools and Materials Required: Flat-tipped screwdriver Small flat-tipped screwdriver No. 1 Phillips screwdriver **WARNING** Death or severe injury may result if power is not removed from sensor prior to maintenance activities. Ensure that circuit breakers (located in DCP) supplying power to sensor are set to off (right) position.
1	Set circuit breakers on freezing rain sensor circuit breaker module inside DCP equipment cabinet to off (right) position.
2	Using flat-tipped screwdriver, loosen four captive bolts securing hinged sensor access door and open door.
3	Using No. 1 Phillips screwdriver, loosen two retaining screws on DB-9 connector located on top of fiberoptic module. Remove DB-9 connector.
4	Install signal cable on fiberoptic module DB-9 connector. Using No. 1 Phillips screwdriver, tighten two retaining screws.
5	Using small flat-tipped screwdriver, remove four screws securing fiberoptic module to mounting plate.

Table 11.5.9. Fiberoptic Module Removal and Installation -CONT

Step	Procedure
	INSTALLATION
	Tools and Materials Required: Flat-tipped screwdriver Small flat-tipped screwdriver No. 1 Phillips screwdriver **WARNING** Death or severe injury may result if power is not removed from sensor prior to maintenance activities. Ensure that circuit breakers (located in DCP) supplying power to sensor are set to off (right) position.
2	With DB-9 connector toward the front (RECEIVE) and using small flat-tipped screwdriver, install four screws to secure fiberoptic module to mounting plate.
3	Remove plastic covers from fiberoptic connectors and connect transmit (TX) cable to TRANSMIT connector and receive (RX) cable to RECEIVE connector.
4	Remove two fiberoptic cables from underneath fiberoptic module by turning ccw. Install protective plastic covers over fiberoptic connectors.
5	Using large flat-tipped screwdriver, close and secure freezing rain sensor access door.
6	Set circuit breakers on freezing rain sensor circuit breaker module inside DCP equipment cabinet to on (left) position.

CHAPTER 12

GROUND-TO-AIR RADIO

SECTION I. DESCRIPTION AND LEADING PARTICULARS

12.1.1 **INTRODUCTION**

This chapter provides field service information for the ground-to-air (GTA) radio system that is installed at selected sites. The GTA radio continuously transmits regularly updated information to pilots and other listeners. The system manager may select either 1-minute data, hourly METAR's or SPECI's for broadcast. This chapter includes a physical description, installation and operation instructions, theory of operation, and preventive and corrective maintenance procedures.

12.1.2 **PHYSICAL DESCRIPTION**

The GTA radio is installed in the acquisition control unit (ACU) at location 1A10 below the RF/pressure mounting shelf (figure 12.1.1). Chapter 2 provides a complete description of the ACU. The I/O panel assembly is the interface for the GTA radio to the antenna with connector J43 as the GTA radio output connection plug to the antenna. Connector J43 is a surge suppressor that is located on the I/O panel next to connector J39. Connector J43 provides protection for the GTA radio system from outside interference. Peripheral cable assembly W79, installed on the back of the ACU behind location 1A4, provides power for the radio. The radio interfaces with the voice recorder/playback board via cable W076. The radio is also connected to the SIO board via the same adapter cable for RS-232 communications. The RS-232 cable applies serial data to the radio for self-test and setup information.

The antenna is a Government-furnished Collinear antenna, the dipole elements are mounted one above the other in a common axis. These dipoles are sealed in a single fiberglass radome that provides both mechanical stability and environmental protection. The Collinear antenna is lightweight, rugged, and weatherproof and provides a vertically polarized, omnidirectional azimuth pattern with 6 dB of gain. The antenna operates over a frequency range of 116 to 137 MHz. An antenna cable connects the antenna to connector J43. The length of the cable varies from site to site.

At some single-cabinet combined ASOS sites, an alternative GTA Antenna Kit (62828-40507-10) may be installed in lieu of the collinear antenna. This alternative antenna is a ground-plane antenna mounted near the top of the wind tower. The type and location of this antenna reduces GTA radio voice-modulated transmission interference with the Present Weather Sensor. Refer to Chapter 14 for descriptions and replacement procedures for this antenna.

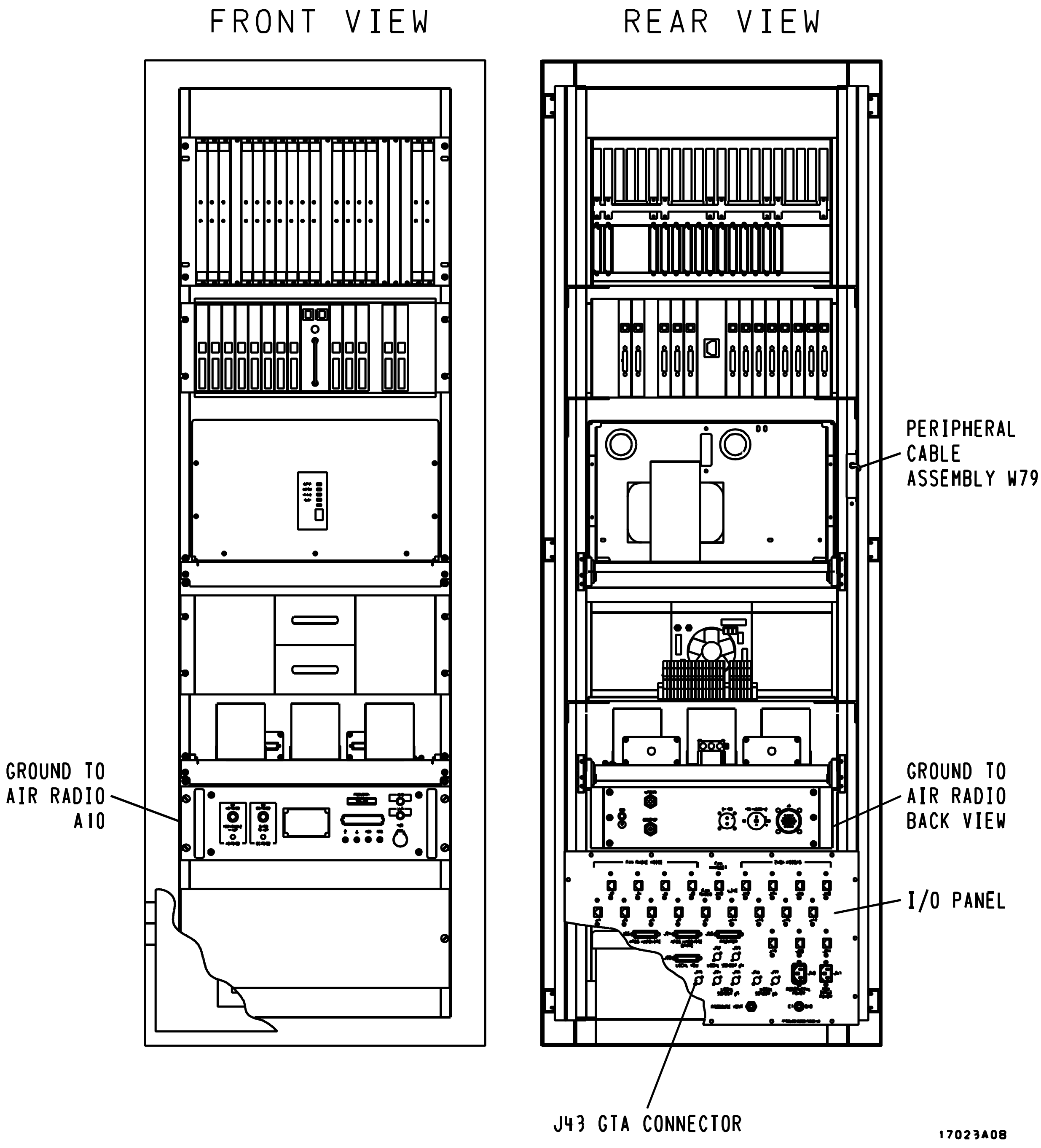


Figure 12.1.1. Acquisition Control Unit (ACU)

SECTION II. INSTALLATION

The site technician is not responsible for the installation of the GTA radio; however, installation instructions are provided in AAI Systems Management, Inc. Field Modification Kit 051. Section V contains removal and replacement procedures for the GTA radio.

SECTION III. OPERATION

12.3.1 INTRODUCTION

The GTA radio normally operates in automatic mode, which requires no operator intervention. A message is continuously transmitted over the air waves via the GTA radio antenna. Maintenance control of the system is performed from the operator interface device (OID) where the user can monitor self-test results, adjust broadcast power level and frequency, initiate diagnostic tests, review and update the maintenance log, and configure the GTA radio. In addition to the OID displays, the GTA radio contains controls and indicators that can be used during system maintenance.

12.3.2 CONTROLS AND INDICATORS

12.3.2.1 **General**. The GTA radio contains only a few controls and indicators, which may require setting or monitoring by the technician. There is a liquid crystal display (LCD) on the front panel of the radio that provides an alphanumeric display showing operating modes, frequency, messages, and measurements. These controls and indicators are illustrated on figure 12.3.1 and described in table 12.3.1. Figure 12.3.2 illustrates rear panel connectors.

12.3.2.2 **Using the Front Panel Controls and Indicators**. The following paragraphs describe the procedures used to enable and disable the display so that configuration changes can be made to the GTA radio.

When the GTA radio is powered up, the display is enabled and the frequency select mode is displayed as shown in table 12.3.2. The pushbuttons are also enabled, and the operator can make configuration and mode changes using the MOD and up and down arrow pushbuttons. Table 12.3.2 describes all possible modes for the GTA radio.

If the pushbuttons and display are disabled (i.e., display is blank), the display can be enabled by pressing the enable (ENB) pushbutton. The enable display mode is displayed as shown in table 12.3.2. This display shows the current operating frequency and prompts the operator to press the ENB pushbutton two more times. If the ENB pushbutton is not pressed a second time within 10 seconds or if any other pushbutton is pressed, the display and pushbuttons return to the disabled mode.

The ENB pushbutton is pressed twice in quick succession. The display and pushbuttons are then enabled and frequency select mode is displayed as shown in table 12.3.2. If the presses occur more than 1/2 second apart or if any other pushbutton is pressed, the display and pushbuttons return to the disabled mode.

After it is enabled, the display can be disabled by pressing the ENB pushbutton three times; if no pushbutton presses occur for 2 minutes, timeout occurs and the display and pushbuttons are automatically disabled.

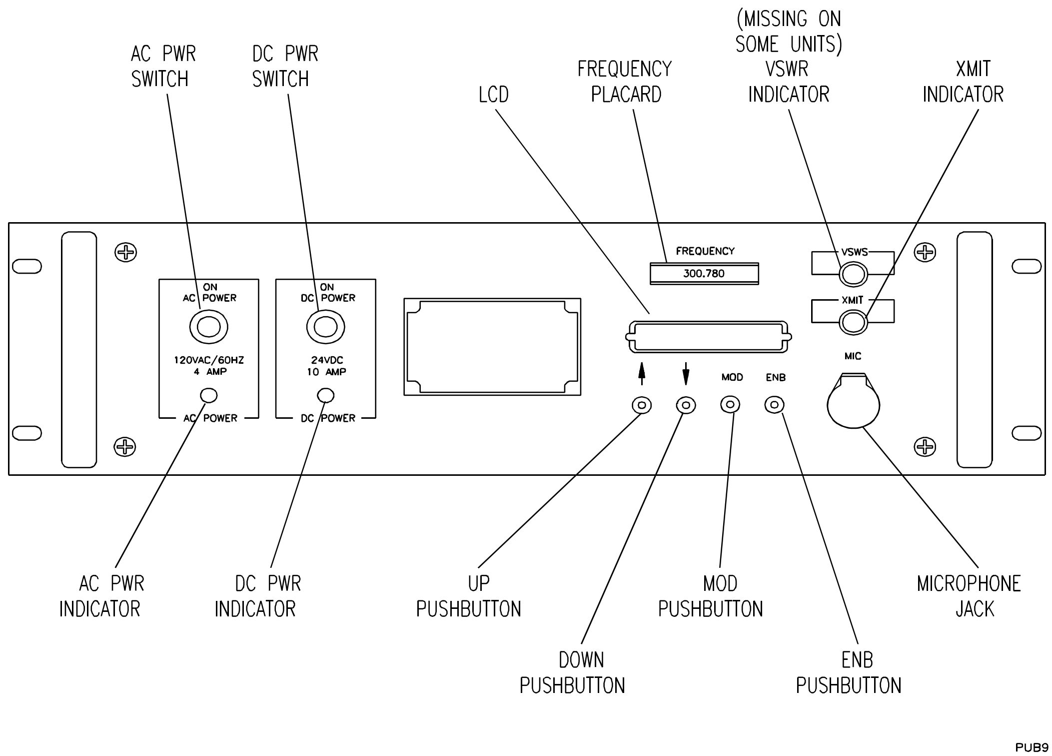


Figure 12.3.1. GTA Radio Front Panel Controls and Indicators

Table 12.3.1. GTA Radio Front Panel Controls and Indicators

Control/Indicator	Type	Description
XMIT	Green light emitting diode (LED) indicator	Illuminates when the transmitter is keyed.
MIC	Audio connector	Not used by ASOS.
ENB	Pushbutton	Enables the operator interface pushbutton switches and display if the display is blank and the switches are disabled. Disables the interface switches and display if they are active.
MOD	Pushbutton	Selects between the display/control modes.
Down arrow	Pushbutton	Used in conjunction with the MOD switch to make changes to the operating parameters of the GTA radio. Decrements the parameter by one unit.
Up arrow	Pushbutton	Used in conjunction with the MOD switch to make changes to the operating parameters of the GTA radio. Increments the parameter by one unit.
DC PWR	Green LED indicator	Not used by ASOS.
AC PWR	Green LED indicator	Illuminates when ac power is applied to the GTA radio.
AC/PWR ON (120 VAC/60 HZ)	Power switch/circuit breaker	Applies ac power to the GTA radio and provides overcurrent protection for the ac line.
DC/PWR ON (24 VDC)	Power switch/circuit breaker	Not used by ASOS.
LCD	2 x 16 alphanumeric display	Shows operating modes, frequency, messages, and measurements
VSWR	Red LED indicator	Illuminates when voltage standing wave ratio (VSWR) exceeds 2.8:1. (This indicator is not installed on all units.)

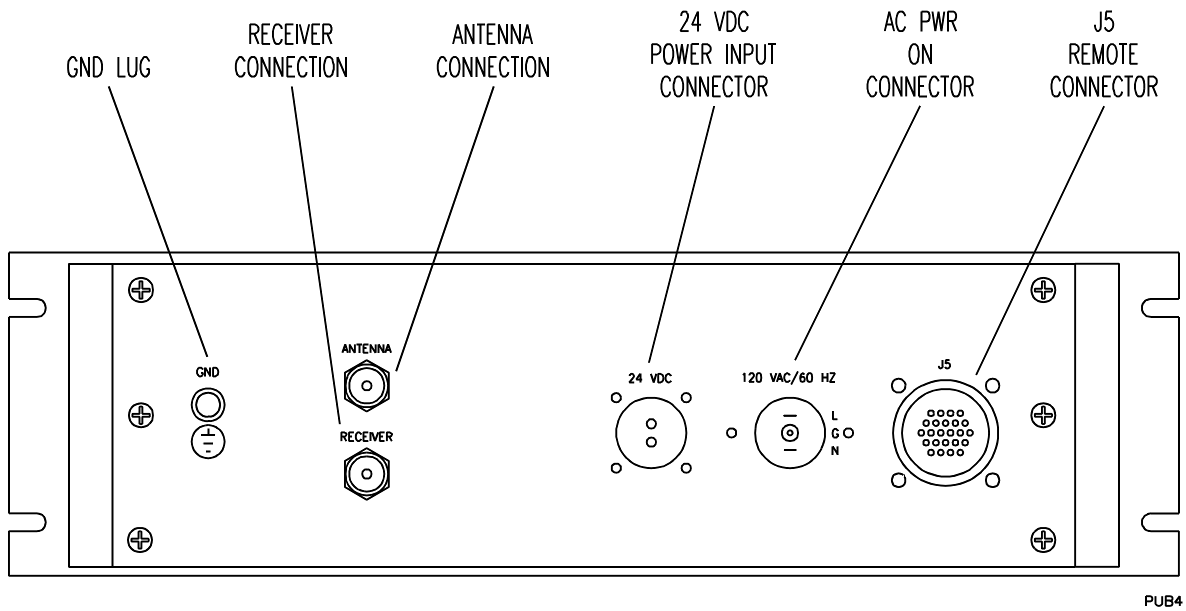


Figure 12.3.2. GTA Radio Rear Panel Connectors

Table 12.3.2. Display/Control Modes (Panels)

Mode	LCD Display	Function
Disabled		Disables any mode or configuration from the pushbuttons. The ENB pushbutton is the only active pushbutton when display is disabled.
Enable display	Freq 119.600 MHz Press ENB twice	Displayed after ENB pushbutton is pressed once. Two additional presses enable push-buttons and display for configuration changes.
Frequency select	Frequency -- MHz 119.600	Displays current operating frequency and allows operator to change operating frequency using pushbuttons.
Monitor Functions		
Signal strength meter	**OOOG** Signal Meter	The bar graph displays relative transmit signal strength. The maximum number of bars is 16.
+5V test	Freq 119.600 MHz +5V Level 4.78	Displays internal measured operating voltage for +5V supply line.
+12V test	Freq 119.600 MHz +12V Level +11.6	Displays internal measured operating voltage for +12V supply line.

Table 12.3.2. Display/Control Modes (Panels) -CONT

Mode	LCD Display	Function
-12V test	Freq 119.600 MHz -12V Level -11.6	Displays internal measured operating voltage for -12V supply line.
+80V test	Freq 119.600 MHz +80V Level +79.7	Displays internal measured operating voltage for +80V supply line.
Transmit timeout adjust	Freq 119.600 MHz Xmit Timeout 00	Allows operator to set duration of timeout in 10-second intervals from 0 to 300 seconds. In ASOS environment, transmission is continuous. Timeout is not used.
Transmit power adjust	OOOOOG Xmit Power 105	Allows operator to adjust transmit output power level.
Modulation index adjust	Freq 119.600 MHz Mod Index 90	Allows operator to adjust percent of AM modulation based on a 1- kHz, -15-dBm (600-ohm) audio modulation signal.
Crystal warp adjust	Freq 119.600 MHz Warp Setting 16	Allows operator to adjust reference crystal oscillator warp factor to align oscillator frequency within tolerance limits.

12.3.3 TURN-ON PROCEDURES

The GTA radio is designed for continuous operation and normally remains on at all times, except for maintenance or repair activities. The GTA radio is normally powered on or powered off when the ACU is turned on or off. (Chapter 2 describes ACU power-on and power-off.) To turn on the GTA radio manually, the front panel door of the ACU is opened and the AC PWR switch is pressed; a green LED then illuminates, showing that ac power has been applied.

12.3.4 TURNOFF PROCEDURES

The GTA radio is normally turned off only for maintenance purposes. When the ACU cabinet is opened and the AC PWR switch is pressed, the green LED extinguishes, indicating that ac power is no longer being applied.

12.3.5 GTA RADIO CONFIGURING/OID CONTROL

The following paragraphs describe the manner in which the GTA radio is configured and controlled from the OID pages. The transmission frequency of the radio cannot be changed in the field unless the site is licensed for the new frequency.

12.3.5.1 **Configuring the GTA Radio - General**. The GTA radio must be configured into ASOS via the REVUE-CONFG-COMMS page in order for the CPU in the ACU to communicate with the GTA radio. The configuration is accomplished by using the CHANGE function to assign the GTA radio to an available RS-232 SIO port. When using the CHANGE function, the maintenance technician is prompted to enter serial communications parameters (1200 baud rate, no parity, 8-bit words, 1 stop bit, and no handshaking). The connection is hard-wired (lease line if the GTA radio is not installed in the ACU). In addition to these setup parameters, the maintenance technician must also enter a frequency and power level. The valid frequency values are from 117.975 to 136.975. Valid power values are from 0 to the maximum power setting of the specific radio; however, each GTA radio has a unique maximum value (e.g., 180, 220, etc) that could be less than 255. In any case, the maximum power value for a given radio is 10 watts. Power is not set or adjusted arbitrarily, but is done using a power meter at the antenna (paragraph 12.5.2.1). The GTA radio has erasable programmable read only memory (EPROM) so that in the event that the radio loses power, it retains the configuration data. Configuring the GTA radio in ASOS affects only the RS-232 connection. If the GTA radio is disabled or deconfigured from the OID, the CPU will not communicate with it even though the GTA radio continues to broadcast. The only way to stop the GTA radio from transmitting is to turn it off at the front panel on the radio.

12.3.5.2 **Alternative Means of Adjusting Power and Frequency**. The maintenance technician may have to periodically set or adjust power or frequency (preventive maintenance, installation, and troubleshooting). The GTA radio power and frequency may be adjusted from the COMMS page as described above. Because an OID may not be in the same location as the GTA radio, ASOS allows the maintenance technician to make some adjustments from the LCD display at the radio itself (refer to paragraph 12.3.2.2). When adjustments to power and frequency are made from the GTA radio, the ACU copies and reads the current setting and stores it as the final setting. The latest setting is displayed on the COMMS page, whether or not it was changed from the OID or the GTA radio itself.

12.3.5.3 **AOMC Frequency Storage**. For each site, the ASOS Operations and Monitoring Center (AOMC) stores the GTA radio configuration data, including communications setup (e.g., baud rate, parity, etc) and the RF frequency. Whenever these parameters are changed in the field (by the OID or from the GTA radio panel), the current configuration is uploaded to the AOMC. The RF frequency may not be changed unless the site is licensed for the new frequency. It is available for later download request. The power setting is not uploaded to the AOMC, because the power setting is variable between radios and is dependent on cable length and other factors.

SECTION IV. THEORY OF OPERATION

12.4.1 INTRODUCTION

This section provides a detailed description of the manner in which the GTA radio interfaces with the ACU and other components in the cabinet.

12.4.2 SIMPLIFIED BLOCK DIAGRAM

The simplified block diagram (figure 12.4.1) illustrates the basic system components and their functional relationships. The GTA radio receives serial data for self-test and setup information from an available RS-232 port (SIO boards 4 through 8). The GTA radio also receives ANALOG VOICE data from the voice recorder/playback board. The GTA radio amplifies the input voice signal and sends it through its connector J4 via coaxial cable to ACU I/O panel connector J43. The GTA radio antenna is connected via coaxial cable W9 to I/O panel connector J43.

12.4.3 DETAILED BLOCK DIAGRAM

This section contains a description and detailed block diagram (figure 12.4.2) of the GTA radio configuration. Power distribution and control is described using detailed block diagrams of the distribution of ac voltage to the GTA radio.

12.4.3.1 **SIO Board**. The SIO board transmits data from the VMEBUS through its connector P1, processes the information, then transmits the information from its connector P2 via the RS-232 DATA line to cable assembly W076 connector P2 to GTA radio pin P1 to jack J5. (Chapter 2, Section IV, provides detailed information on the SIO board.)

12.4.3.2 **Voice Recorder/Playback Board**. The voice recorder/playback board receives power interface logic from the VMEBUS on connector P1 to connector P2. Digitized voice information is supplied from Voice Processor Board A20. This information is transmitted via connector P2 to connector P67 of the ring/tip to connector P3 of cable W076 to the GTA radio from connector P1 to jack J5. (Chapter 2, Section IV, provides additional information on the voice recorder/playback board.)

12.4.3.3 **Power Distribution Assembly**. The power distribution assembly receives ac power from the facility main power line and distributes ac power to the GTA radio on jack J1 via cable assembly W79.

12.4.3.4 **I/O Panel**. The I/O panel is used as the master connection point for all inputs to and outputs from the ACU. The output signal from connector J4 on the GTA radio is fed via coaxial cable to connector J43 on the I/O panel. Connector J43 also contains a surge suppressor. From connector J43, the signal is fed via coaxial cable W9 to the antenna.

12.4.4 GTA RADIO SELF-TEST

The GTA radio self-test is performed when the ACU requests data from the radio. The SIO board is connected to the GTA radio by the RS-232 cable and cable W076. The ACU sends a data request to the SIO board, which, in turn, sends it to the GTA radio. The GTA radio replies, sending the response back through the RS-232 cable to the SIO board, which sends the response to the ACU. The ACU then polls the radio every 15 minutes to verify that all systems are operating correctly. If there is a problem detected by the ACU, a fault is displayed on the OID screen. RADIO ID NUMBER, TRANSMIT FREQUENCY, POWER LEVEL

SETTING, and MAX POWER SETTING are displays of the values that have already been entered into the system. The RADIO ID NUMBER is the designator specific to each radio. TRANSMIT FREQUENCY is the value equal to the command frequency (117.975 to 136.975 in increments of 0.025). The POWER LEVEL SETTING value is equal to the commanded power level of 0 to the maximum power setting for a specific radio. MAX POWER SETTING displays the maximum power setting for the radio actually installed in the ACU. The power setting is different for each radio and is between 0 and the maximum power setting for a specific radio. The POWER SUPPLY STATUS test consists of four individual tests. The +5V test indicates that the internal measured operating voltage is within 3V and 7V. The +12V test indicates that the internal measured operating voltage is within 9.6V and 14.4V. The -12V test indicates that the internal measured operating voltage is within -14.4V and -9.6V, and the -80V test indicates that the internal measured operating voltage is within -96V and -64V. If the test results on the POWER SUPPLY STATUS test are outside the tolerances, the test fails. The VFWD and VRFD values are digital representations of the forward and reflected voltages, respectively, as measured by the GTA radio. These digital values may range from 0 to the maximum power setting and do not represent actual voltage values. The ASOS continuous self-test (CST) performs a comparison calculation of these values. As long as the VRFD value is less than 75 percent of the VFWD value, a pass indication is displayed for both the VFWD and VRFD field. If the VRFD value is greater than or equal to 75 percent of the VFWD value, the test failure indicator (F) is displayed for both fields. The RADIO RESPONSE test indicates if the ACU is capable of communicating with the GTA radio.

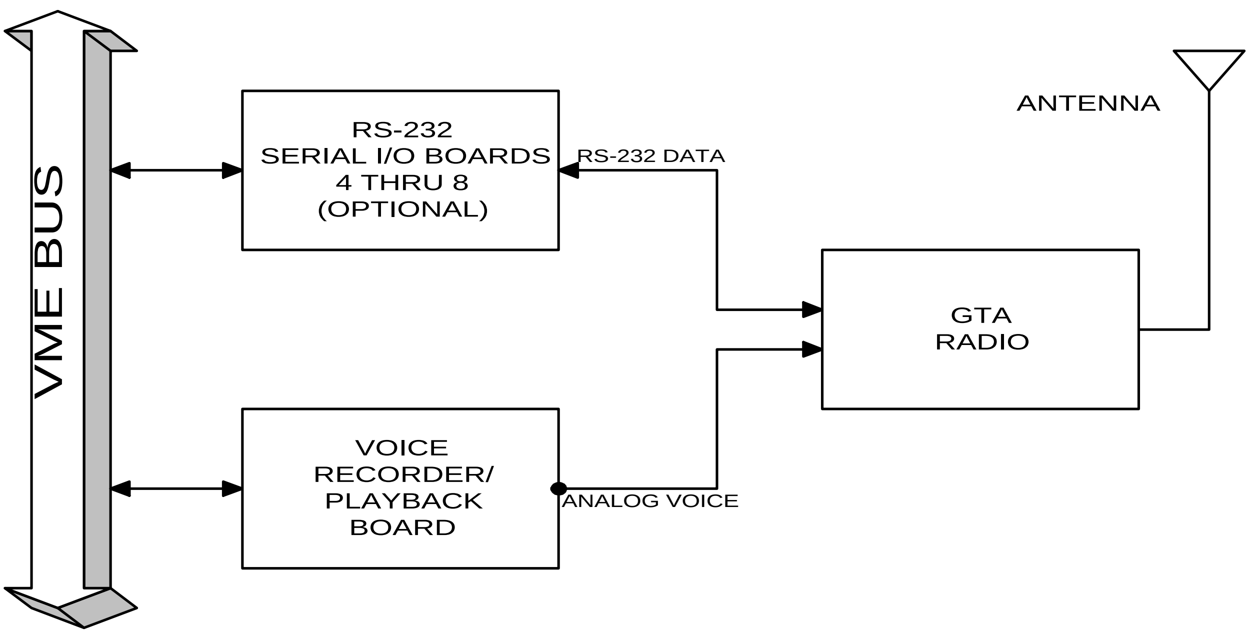
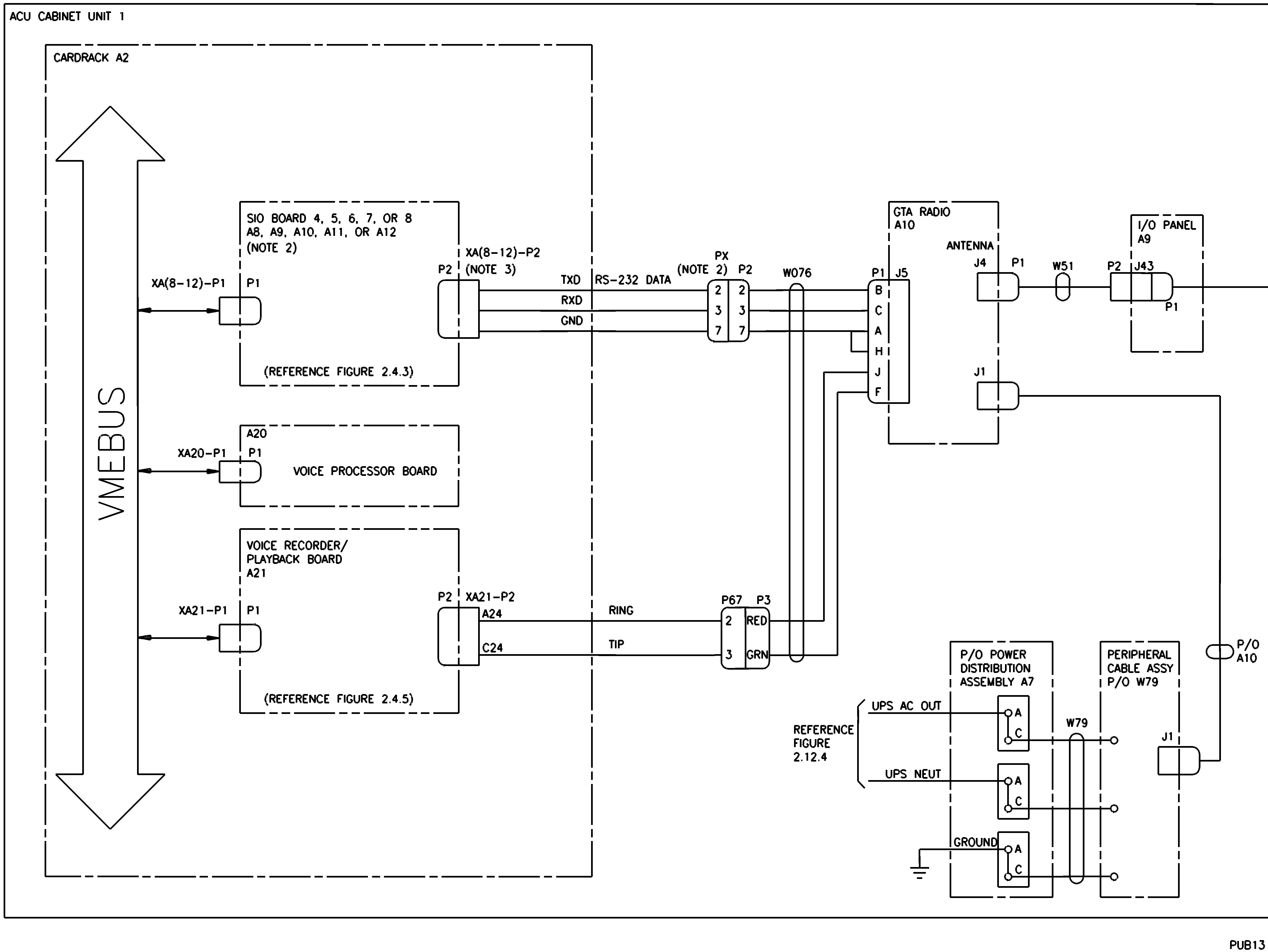


Figure 12.4.1. GTA Radio Simplified Block Diagram



NOTES

1. UNLESS OTHERWISE NOTED, ALL ACU CABINET WIRING IS PART OF HARNESS W014 (CLASS II) OR W016 (CLASS I).
2. W014/W016 CONNECTOR (PX) ATTACHED TO GTA RADIO DEPENDS UPON WHICH SIO PORT THE GTA RADIO IS ASSIGNED (VIA ACU SERIAL COMMS DISPLAY ON OID). REFERENCE FIGURE 2.4.4 FOR SIO PORT-TO-PX RELATIONSHIP.
3. REFERENCE FIGURE 2.4.4 FOR PIN-TO-PIN WIRING BETWEEN SIO BOARD AND W014/W016 DESTINATION CONNECTORS (PX).

Figure 12.4.2. GTA Radio, Detailed Block Diagram

SECTION V. MAINTENANCE

12.5.1 INTRODUCTION

This section provides the preventive and corrective maintenance procedures for the GTA radio. Preventive maintenance consists of the RF power output check, modulation level check, VSWR at transmitter output check, and frequency stability check. Corrective maintenance consists of fault isolation using the ASOS GTA radio maintenance display and removal and replacement of field replaceable units (FRU's).

12.5.2 PREVENTIVE MAINTENANCE

Preventive maintenance consists of those procedures that are performed on a scheduled basis to maintain the GTA radio in an operational state. Table 12.5.1 lists the regularly required performance checks necessary to ensure operation within established tolerances and limits and provides a schedule for their performance.

12.5.2.1 **RF Power Output Check**. This check (table 12.5.2) is performed at the antenna and is designed to verify that the RF power output of the GTA radio is the required amount at the antenna. The test equipment is connected as shown on figure 12.5.1.

12.5.2.2 **Modulation Level Check**. This check (table 12.5.3 Preferred or 12.5.3 Alternative) ensures a constant level of modulation. The test equipment is connected as shown on figure 12.5.2.

12.5.2.3 **VSWR at Transmitter Output Check**. This check (table 12.5.4) ascertains that the VSWR, as measured at the GTA radio, does not exceed 1.8:1. The test equipment is connected as shown on figure 12.5.3.

12.5.2.4 **Frequency Stability Check**. This check (table 12.5.5) determines if the transmitter output frequency is within ±0.0005 percent tolerance. The test equipment is connected as shown on figure 12.5.4.

12.5.2.5 **Antenna Cable Insulation Verification**. This check (table 12.5.6) performed annually, verifies the antenna cable insulation integrity. Test equipment is connected as shown in figure 12.5.5.

Table 12.5.1. Periodic Performance Checks

Interval	What To Do	How To Do It
90 days	RF Power Output Check	Table 12.5.2
	Modulation Level Check	Table 12.5.3
	VSWR at Transmitter Output Check	Table 12.5.4
	Frequency Stability Check	Table 12.5.5
Annually	Verify Antenna Cable Conductance and Insulation	Table 12.5.6

Table 12.5.2. RF Power Output Check

Step	Procedure
	Tools and Materials Required: RF power meter w/10-watt, 100-250 MHz element One N-N test cable
1	At front of GTA radio, press AC PWR switch to remove GTA radio power.
2	At I/O panel on ACU, disconnect antenna cable W9 from connector J43.
3	Connect antenna cable W9 from ACU I/O panel to RF power meter output side.
4	Install 10-watt, 100-250 MHz element into RF power meter. Ensure that arrow points toward antenna.
5	Using N-N test cable, connect RF power meter input to I/O panel J43.

Table 12.5.2. RF Power Output ChecK -CONT

Step	Procedure
6	At front of GTA radio, press AC PWR switch to apply GTA radio power.
7	Observe and verify that RF power meter forward power reading is 2.5 ±1 watt plus the insertion loss of the antenna cable. The 'maximum nominal power' required at the antenna base is 2.5 ±1 watt however, the power output will be site specific. Insertion Loss Of The Antenna Cable = {Output Power at TXM (watts) - Output Power at Base of Antenna (watts)} Record power reading. If reading is not within tolerance, perform steps 8 through 12; if reading is correct, proceed to step 13.
8	At front of GTA radio, press ENB pushbutton twice.
9	Press MOD pushbutton four times to display XMIT power display.
10	If power reading is too low, press up arrow to increase power output, then observe RF power meter to verify that power reading is within tolerance.
11	If power reading is too high, press down arrow to decrease power output, then observe RF power meter to verify that power reading is within tolerance.
12	If power reading cannot be corrected to within specified tolerances, remove and replace GTA radio in accordance with table 12.5.11.
13	At front of GTA radio, press AC PWR switch to remove GTA radio power.
14	Remove antenna cable W9 from output side of RF power meter.
15	Remove N-N test cable from RF power meter and I/O panel.
16	Connect antenna cable W9 to I/O panel J43.
17	Remove 10-watt, 100-250 MHz element from RF power meter and return it to storage.
18	At front of GTA radio, press AC PWR switch to apply GTA radio power.

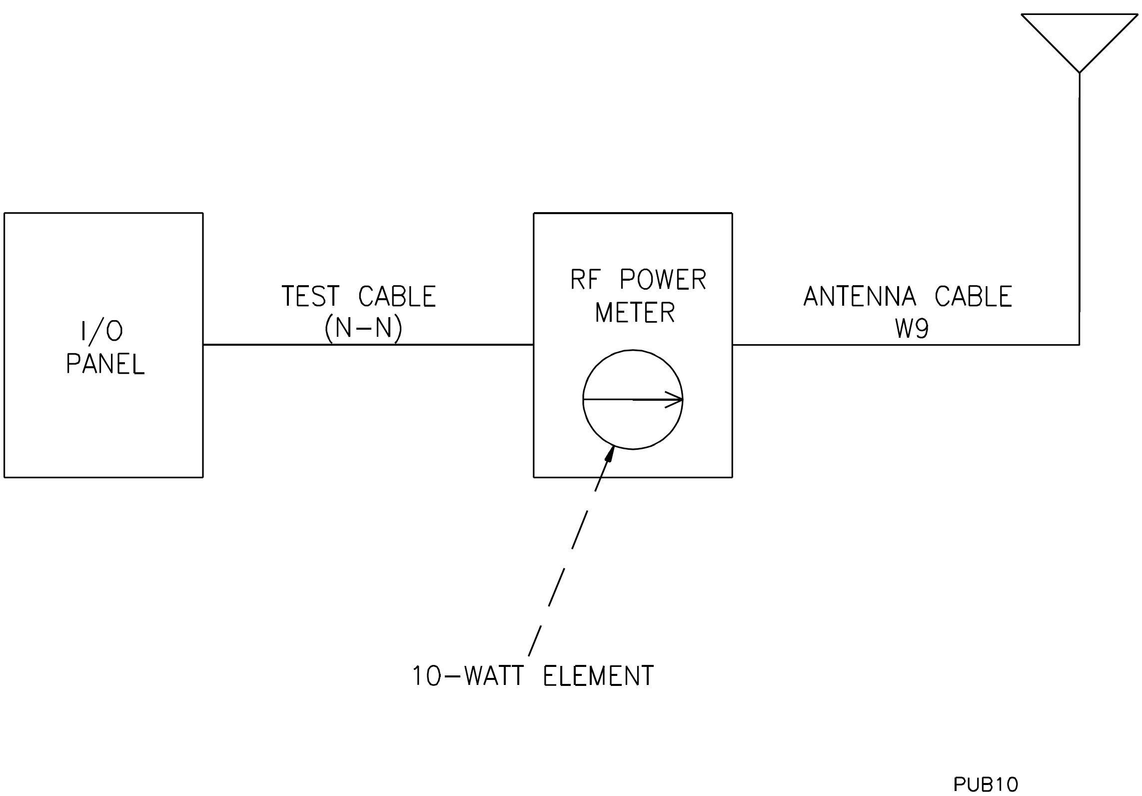


Figure 12.5.1. RF Power Output Check

Table 12.5.3. Modulation Level Check (Preferred)

Step	Procedure
	Tools and Test Equipment Required: RF power meter, w/RF sampler element Oscilloscope Test cable (BNC-BNC) Two N-N test cables Dummy Load (25 watts, 50 ohms) **NOTE** This procedure requires firmware VERSION 2.10 or greater.
1	At front of GTA radio, press AC PWR switch to remove GTA radio power.
2	Refer to figure 12.5.2 and disconnect antenna cable W9 from J43 connector on I/O panel. Connect RF power meter input to connector J43 on I/O panel using N-N test cable. Connect RF power meter output to N-N test cable and dummy load. Install RF sampler element into RF power meter.
3	Connect BNC-BNC test cable from RF sampler to channel 1 input on oscilloscope.
4	Disconnect ACU harness connector P67 from radio adapter cable W076-P3 to remove the audio signal from the carrier.
5	At GTA radio, press AC PWR switch to apply GTA radio power.
6	Set oscilloscope time base for 200µ SEC/DIV. Manually adjust oscilloscope so that the carrier amplitude is equal to 5 DIV.
7	Reconnect ACU harness connector P67 to the radio adapter cable W076-P3.
8	**NOTE** This procedure uses the ACU voice processor board to generate a 1 kHz tone for setting the percent modulation. ASOS generates a tone of 30 seconds duration when the system manager holds the SHIFT key and enters ~TONE. At the OID, sign on as SYSTEM MANAGER.
9	Press and hold SHIFT and enter ~TONE. Observe that the oscilloscope displays a 1 kHz tone within 60 seconds. If the tone is not displayed, repeat this step.
10	**NOTE** Repeat step 9 if the 1 kHz tone terminates while adjusting percent modulation. Observe and verify that modulated peaks are at an optimum of 90% ±5%. Modulated peaks should be between 22 (88%) and 23 (92%) minor divisions. With peaks set to five major divisions of graticule, there are 25 minor divisions, each representing four percent modulation. If readings are not within tolerance, perform steps 11 and 12. If readings are within tolerance, proceed to step 13.
11	Press MOD pushbutton five times.
12	While observing oscilloscope, press down arrow to decrease percent modulation or up arrow to increase percent modulation as required.
13	At front of GTA radio, press AC PWR switch to remove GTA radio power.
14	Disconnect BNC-BNC test cable from oscilloscope and RF sampler.
15	Disconnect N-N test cable from connector J43 to input side of RF power meter.
16	Reconnect antenna cable W9 to connector J43 on I/O panel.
17	Disconnect N-N test cable from input side of RF power meter.
18	Disconnect N-N test cable from output side of RF power meter.
19	Remove RF sampler from RF power meter and return to storage.
20	Remove RF terminator from N-N test cable.
21	At GTA radio, press AC PWR switch to apply GTA radio power.

Table 12.5.3a. Modulation Level Check (Alternative)

Step	Procedure
	Tools and Test Equipment Required: RF power meter, w/RF sampler element Oscilloscope Test cable (BNC-BNC) Two N-N test cables Dummy Load (25 watts, 50 ohms) Audio Test Tone Generator w/ Test Leads (must have pure sine wave output)
1	Inside the back of the ACU, remove the cover from the RJ11 phone jack that feeds audio to the ground to air transmitter.
2	Connect oscilloscope probe to the red and green wires inside the RJ11 phone jack.
3	Measure the peak to peak amplitude of the ASOS voice audio. Should be approximately 2.0 VPP. (If NO signal present, connect the scope ground to the other terminal reversing the connections of the scope probe.)
4	At front of GTA radio, press AC PWR switch to remove GTA radio power.
5	Refer to figure 12.5.2 and disconnect antenna cable W9 from J43 connector on I/O panel. Connect RF power meter input to connector J43 on I/O panel using N-N test cable. Connect RF power meter output to N-N test cable and dummy load. Install RF sampler element into RF power meter.
6	Disconnect ACU harness connector P67 from the RJ11 phone jack that feeds audio to the ground to air transmitter to remove audio signal from the carrier.
7	At GTA radio, press AC PWR switch to apply GTA radio power.
8	Connect the ouput of the audio generator to the red and green wires inside the RJ11 phone jack. Make sure the ground of the signal generator and the oscilloscope are connected to the same point.
9	Adjust the audio generator for 1000 Hz at the same Peak to Peak amplitude as measured in step 3 for the ASOS voice audio.
10	Connect BNC-BNC test cable from RF sampler element to channel 1 input on oscilloscope.
11	Turn OFF the audio signal generator.
12	Set oscilloscope time base for 200µ SEC/DIV. Manually adjust the oscilloscope so that the carrier amplitude is equal to 5 division.
13	Turn ON the audio signal generator.
14	Set oscilloscope time base for 0.5m SEC/DIV.
15	Observe and verify that modulated peaks are at an optimum of 90% $\pm$ 5%. If readings are not within tolerance, perform steps 16 and 17. If readings are within tolerance, proceed to step 18.
16	With MOD pushbutton go to MOD Index on LCD display.
17	While observing oscilloscope, use UP and DOWN arrow buttons to set modulation to 90% $\pm$ 5%. $\text{Percent (\%) Modulation} = \frac{(\text{Peak to Peak}) - (\text{Trough to Trough})}{(\text{Peak to Peak}) + (\text{Trough to Trough})}$ The easiest way to set modulation: Use an IFR Service Monitor and display percent of modulation, with the Second Function Meter feature, while its receiver is tuned to the GTA radio frequency.
18	At front of GTA radio, press AC PWR switch to remove GTA radio power.
19	Disconnect RF test equipment and cables and reconnect antenna cable.
20	Disconnect audio generator from the RJ11 phone jack and replace the cover to the jack.
21	Reconnect the voice audio to the RJ11 phone jack.
22	Reapply power to the GTA radio.

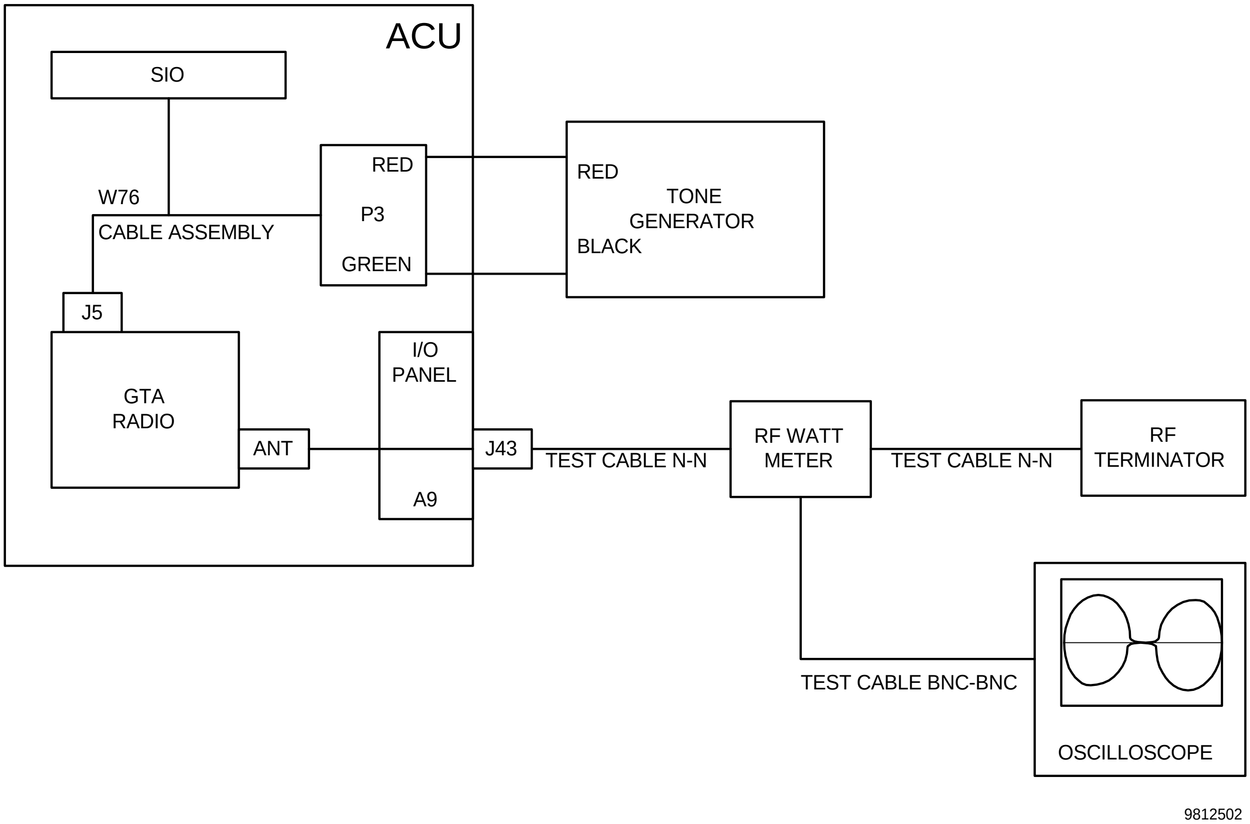


Figure 12.5.2. Modulation Level Check

Table 12.5.4. VSWR at Transmitter Output Check

Step	Procedure
	Tools and Materials Required: Laptop computer with ASOS calibration program installed RF power meter w/1-watt 110-160 Mhz element and 10-watt, 100-250 Mhz element N-N test cable
1	At front of GTA radio, press AC PWR switch to remove GTA radio power.
2	At ACU, disconnect antenna cable W9 from antenna connector J43 on I/O panel.
3	Install a 10-watt, 100-250 MHz element in RF power meter with arrow pointing toward the antenna.
4	Connect RF power meter output to antenna cable W9.
5	Connect RF power meter input to antenna connector J43 on I/O panel with N-N test cable.
6	At front of GTA radio, press AC PWR switch to apply GTA radio power.
7	Using laptop, type ASOS <CR> at the DOS prompt.
8	Type menu item 5 on ASOS menu calibration program and enter forward power value at prompt. Hit return.
9	**CAUTION** Be sure to turn the arrow (←) on the 10 watt, 100-250MHZ element toward the GTA TXM and insure there is < 1 watt of power. At front of GTA radio, press AC PWR switch to remove GTA radio power.
10	Remove 10-watt, 100-250 MHz element from RF power meter and replace with 1-watt, 110-160 MHz element.

Table 12.5.4. VSWR at Transmitter Output Check -CONT

Step	Procedure
	CAUTION To prevent damage to 1-watt, 110-160 MHz element, ensure that arrow is in direction of GTA radio.
11	At front of GTA radio, press AC PWR switch to apply GTA radio power.
12	Observe and record reflected power.
13	Enter reflected power at ASOS calibration program prompt.
14	The program calculates VSWR, displays result, and indicates if VSWR is within tolerance.
15	If VSWR is outside of prescribed tolerance, a beep sounds and a warning message is displayed.
16	If reading is not within tolerance, press GTA radio AC PWR switch to remove GTA radio power; then, troubleshoot radio antenna cable, EMI/EFI filters, or GTA radio.
17	Disconnect N-N test cable from input side of RF power meter and connector J43 on the I/O panel.
18	Connect antenna cable W9 to J43 connector on I/O panel.
19	At front of GTA radio, press AC PWR switch to apply GTA radio power.
20	Remove N-N test cable from output side of RF power meter.
21	Remove 1-watt, 110-160 MHZ element from RF power meter and secure it properly.

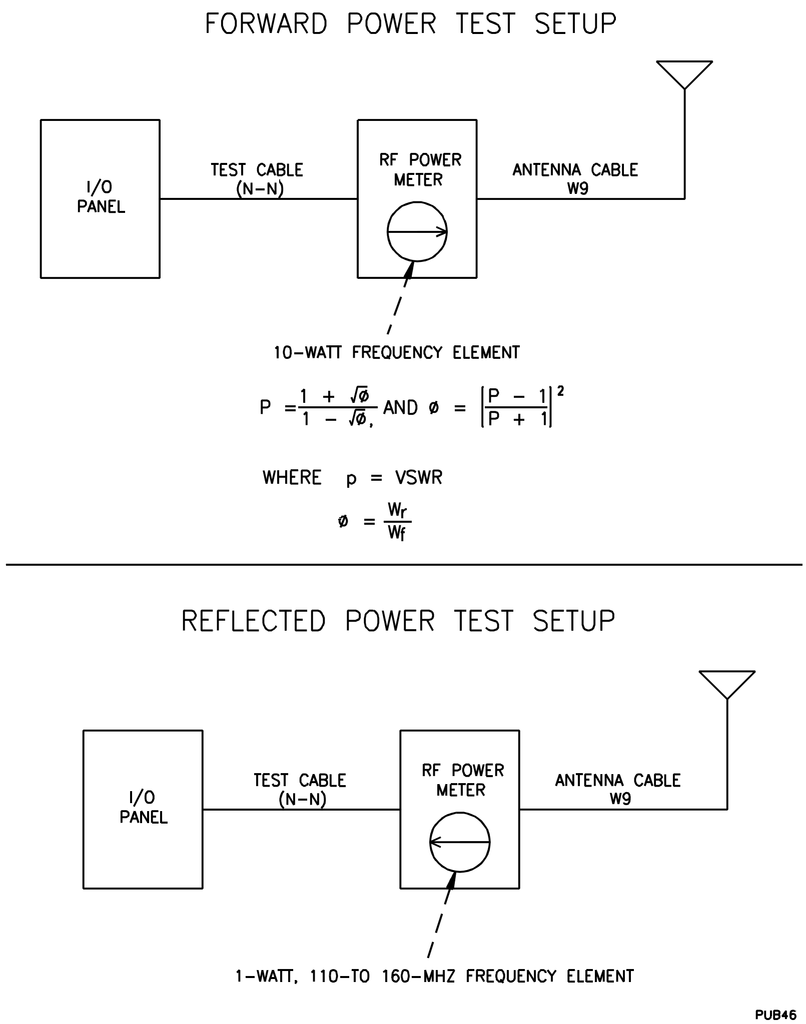


Figure 12.5.3. VSWR at Transmitter Output Check

Table 12.5.5. Frequency Stability Check

Step	Procedure
	Tools and Materials Required: RF power meter w\RF sampler element Two N-N test cables BNC-BNC test cable Frequency counter Laptop computer w/ASOS program installed
1	At front of GTA radio, press AC PWR switch to remove GTA radio power. Disconnect audio input at cable W76 connector P67 from connector P3.
2	At ACU, disconnect antenna cable W9 from antenna connector J43 on I/O panel.
3	Install RF sampler element into RF power meter.
4	Using N-N test cable, connect RF power meter input to antenna connector J43 on I/O panel.
5	Using N-N test cable, connect RF terminator to output side of RF power meter.
6	Connect BNC-BNC test cable to RF sampler element.
7	Connect frequency counter, input C, to BNC-BNC test cable.
8	At front of GTA radio, press AC PWR switch to apply GTA radio power.
9	Observe and verify that frequency count is within 0.0005 percent of assigned frequency using example provided below. If frequency is not within tolerance, perform steps 10 through 15. If frequency is within tolerance, proceed to step 16. **NOTE** Press the Function Key on the Frequency Counter until “Freq C” has been selected. Example: 118.025 MHz x 0.000005 = ±590.125 Hz Carrier frequency x percentage = tolerance level Alternate Method: a. To initialize ASOS calibration program, use laptop PC as follows. At DOS prompt, enter: ASOS, <ENTER> b. Choose menu item number 6 to execute GTA frequency tolerance program. c. Note frequency indicated on frequency counter and enter this value at prompt. d. The program calculates frequency tolerance and displays upper and lower frequency limits.
10	At GTA radio front panel, press ENB pushbutton twice.
11	Verify that frequency is set to correct setting.
12	Press MOD pushbutton three times to display warp setting.
13	If frequency setting is too high/low, press up/down arrow, respectively, to change warp setting.
14	Verify that frequency level has either increased or decreased to within tolerance.
15	If frequency level cannot be corrected, remove and replace GTA radio in accordance with table 12.5.11.
16	At front of GTA radio, press AC PWR switch to remove GTA radio power.
17	Remove N-N test cable from connector J43 on I/O panel.
18	Connect antenna cable W9 to connector J43 on I/O panel.
19	Remove N-N test cable from input side of RF power meter.
20	Remove BNC-BNC test cable from RF sampler element.
21	Remove RF sampler element from RF power meter and return it to storage.
22	Remove BNC-BNC test cable from frequency counter.
23	At front of GTA radio, press AC PWR switch to apply GTA radio power.

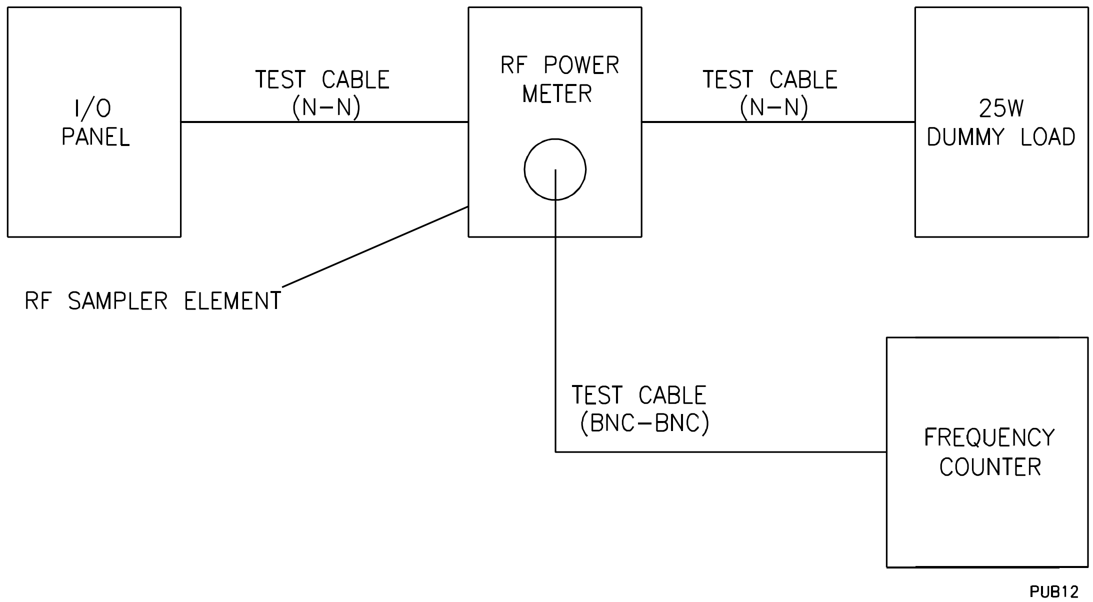


Figure 12.5.4. Frequency Stability Check

Table 12.5.6. Coax Cable Conductance and Insulation Check

Step	Procedure
	Tools and Materials Required: DMM Megger Adapter, N-BNC Adapter, BNC-Banana
1	At front of GTA radio, press AC PWR switch to remove GTA radio power.
2	At ACU, disconnect antenna cable W9 from antenna connector J43 on I/O panel.
3	Connect N-BNC adapter to W9 RF antenna connector as shown figure 12.5.5.
4	Connect BNC-banana adapter to the N-BNC connector.
5	Connect megger to antenna cable W9 with Banana adapter.
6	Disconnect RF coax connector from the antenna.
7	At the megger, press the trigger button and verify that reading is >50 megohms.
8	Observe and record the reading.
9	Remove megger.
10	Short the shield to the center conductor at the banana adapter.
11	Using the DMM, verify that the center conductor to outer shield, loop resistance at the antenna side of the cable is ≤5 ohms.

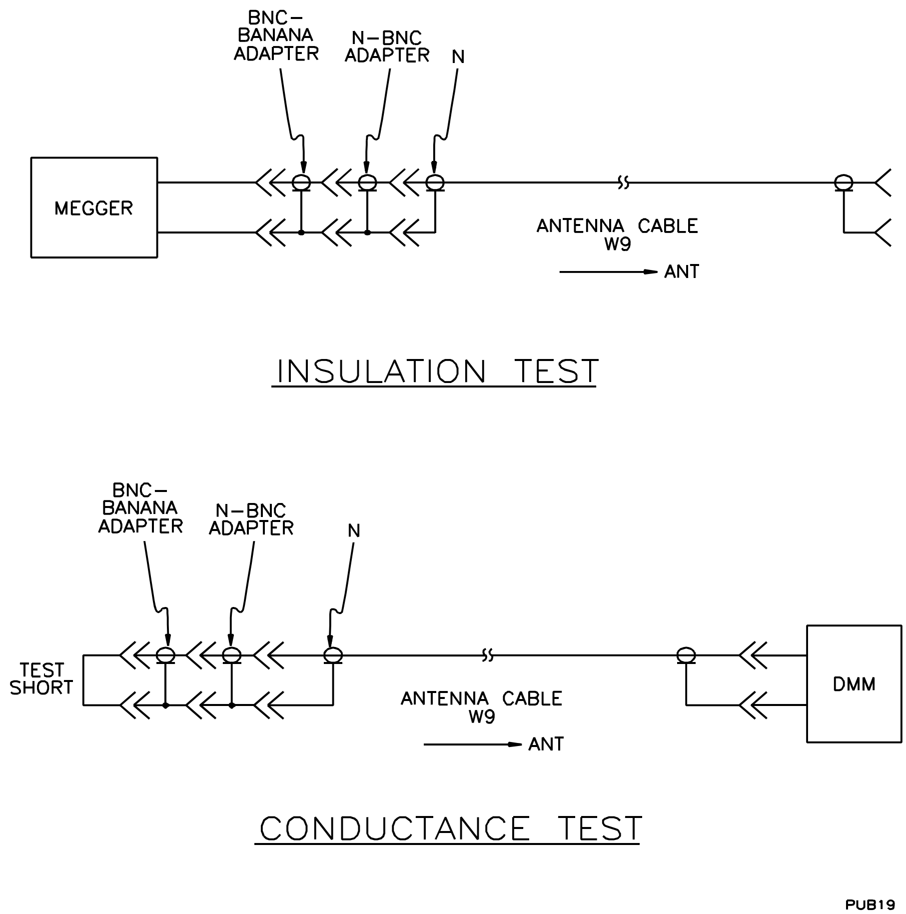


Figure 12.5.5. Coaxial Cable Insulation and Conductance, Test Setup

12.5.3 **CORRECTIVE MAINTENANCE**

Corrective maintenance consists of three major tasks: troubleshooting, voice card adjustment, and removal and replacement of the GTA radio and other FRU's.

12.5.3.1 **Troubleshooting**. Troubleshooting involves the isolation and removal and replacement of faulty FRU's. ASOS is equipped with a continuous self-test (CST) program that isolates the majority of faults to a single FRU. However, due to the system hardware configuration, there will be instances when the diagnostics can isolate a problem only to the GTA radio. Table 12.5.7 provides corrective maintenance symptom analysis information for the GTA radio.

12.5.3.1.1 **Troubleshoot the GTA Radio RF (Table 12.5.8)**. When there is a deterioration of the broadcast signal, it is not normally picked up until an aircraft reports that there is no message or a deteriorated message on the defined frequency. The technician must first confirm that the radio is powered on; when that is ascertained, he must verify that the cables are properly connected and the antenna is not damaged. If the problem is not the antenna or loose cabling, the technician must then perform the RF power output, frequency, and modulation checks at test points designated by the troubleshooting procedures to determine the FRU.

12.5.3.1.2 **Troubleshoot the GTA Radio RS-232 Data Link (Table 12.5.9)**. This type of failure is normally observed as a no-response failure on the GTA radio page of the OID. When there is a communications problem between the ACU and the radio, the configuration of the radio to the ACU is checked first on the COMMS page on the OID. If the radio is configured to the ACU incorrectly, the ACU does not receive data back from the GTA radio. The technician must install the RS-232 tester next to verify that the data link between the ACU and the SIO board is functioning correctly. If the SIO board is not operating correctly, it must be removed; if the SIO board is operating correctly, the radio must be removed and replaced.

12.5.3.1.3 **GTA Radio BERT Program**. The RS-232 data link can also be tested using the Bit Error Rate Tester (BERT) program located on the technician's laptop PC in the ASOS directory. Access the BERT program by typing the phrase ASOS at the command line prompt and selecting item number 2 from the menu. The technician then follows the Bit Error Rate Tester instructions in Chaprer 13, section V.

12.5.3.2 **Voice Recorder/Playback Board Check**. This check, which adjusts the voice board output, is performed when the GTA radio has been replaced, when the voice board(s) have been replaced, or when called out as a part of a troubleshooting procedure.

12.5.3.3 **Removal and Installation Procedure**. Table 12.5.11 provides the procedure for removing and installing the GTA radio. Removal and replacement procedures for the CPU, audio, and SIO boards are provided in Chapter 2, Section V.

Table 12.5.7. Corrective Maintenance Symptom Analysis

Symptom	What To Do	How To Do It
Loss of broadcast weather voice	Troubleshoot GTA radio RF.	Paragraph 12.5.3.1.1 and table 12.5.8
GTA radio does not respond to ACU data test	Troubleshoot GTA RS-232 data link.	Paragraph 12.5.3.1.2 and table 12.5.9
Failure of GTA self-test	Remove and replace the GTA radio.	Table 12.5.11

Table 12.5.8. Loss of Broadcast Weather Voice

Step	Test	Corrective Action
1	Check that GTA radio has power.	If power is turned off, press AC PWR switch to apply power to the GTA radio.
2	Check cable connections associated with GTA radio.	
3	Connect RF power meter to output connector between connector J43 and cable W9 on I/O panel and measure RF output power. Verify that output power is $\geq$5 watts.	If power is approximately 0 watt or if it is evident that the radio is not transmitting, proceed to step 4. If power is less than 5 watts, use ENB, MOD, and arrow pushbuttons to adjust power. After adjusting power at I/O panel, perform RF power output check in accordance with paragraph 12.5.2.1. If power is within tolerance, proceed to step 6.

Table 12.5.8. Loss of Broadcast Weather Voice -CONT

Step	Test	Corrective Action
4	Disconnect power meter from connector J43 and reconnect antenna cable W9. Connect RF power meter to connector J4 of GTA Radio 1A10. Verify that output power is ≥5 watts.	If power is present, replace the following components in sequence and retest system: a. Connector J43 filters b. Antenna cable W51 If power is still not present, proceed to step 5.
5	Turn off GTA radio. Disconnect adapter cable W076 connector P1 from GTA radio connector J5. Verify continuity between pins A and H of cable W76 connector P1.	If continuity is present, remove and replace GTA Radio 1A10. If there is no continuity, remove and replace adapter cable W076.
6	Perform frequency stability checks in accordance with table 12.5.5. Verify that carrier frequency is identical to assigned frequency.	If carrier frequency is not identical to assigned frequency, remove and replace GTA radio.
7	Perform modulation level check in accordance with table 12.5.3. Adjust level as necessary. Verify that modulation level is within tolerance.	If the modulation level is not within tolerance, proceed to step 10.
8	Check cable connections at antenna.	
9	At antenna, perform RF power output check in accordance with table 12.5.2.	If power output is correct, remove and replace antenna. If power output is incorrect, remove and replace antenna cable W9.
10	Perform voice recorder/playback board check in accordance with table 12.5.10.	If the voice is OK, perform the following steps in sequence: a. Check cable W076 for continuity. b. Remove and replace GTA radio. If the voice is not OK, perform the following steps in sequence: a. Reseat Voice Recorder/Playback Board A21. b. Remove and replace the Voice Recorder/Playback Board A21.

Table 12.5.9. GTA Radio Does Not Respond to ACU Data Test

Step	Test	Corrective Action
1	Check SIO configuration on OID display.	If not configured correctly, correct configuration at OID.
2	If configured correctly, check SIO board self-test page at the OID; verify that self- test is passing.	If SIO board does not pass self-test, remove and replace SIO board.
3	Perform RS-232 test. Connect input side of RS-232 tester to ACU harness connector DB-25 corresponding to assigned SIO port. Connect output side of RS-232 tester to connector P2 of cable W076.	If transmit line from SIO board is not active, remove and replace SIO board. If receive line is not active, check condition of cable W076. If cable checks out, remove and replace GTA radio.

Table 12.5.10. Voice Recorder/Playback Board Check

Step	Procedure
	Tools and Materials Required: 600-ohm resistor Oscilloscope Terminal block, telephone, screw terminal VME extender board
1	Power off ACU.
2	Attach 600-ohm load resistor between terminals on telephone jack as shown in figure 12.5.6.
3	Disconnect connector P67 from connector P3.
4	Connect connector P67 to 600-ohm load assembly female jack (42A block).
5	Connect oscilloscope probe across 600-ohm load assembly terminals. Set oscilloscope input to AC at 1V/DIV and set sweep to 5MS/DIV.
6	Power on ACU and wait for system to initialize.
7	Observe audio on oscilloscope. Verify that amplitude is 2 ±0.2 V p-p. If amplitude is not in tolerance, resistor R22 on audio board 1A2A21 may be adjusted for 2.0 ±0.2 V p-p. If amplitude cannot be reached, remove and replace Voice Board 1A2A20.
8	Power off ACU.
9	Disconnect oscilloscope from 600-ohm load assembly terminals.
10	Disconnect 600-ohm load assembly from connector P67.
11	Connect connector P3 to connector P67.
12	Power on ACU.

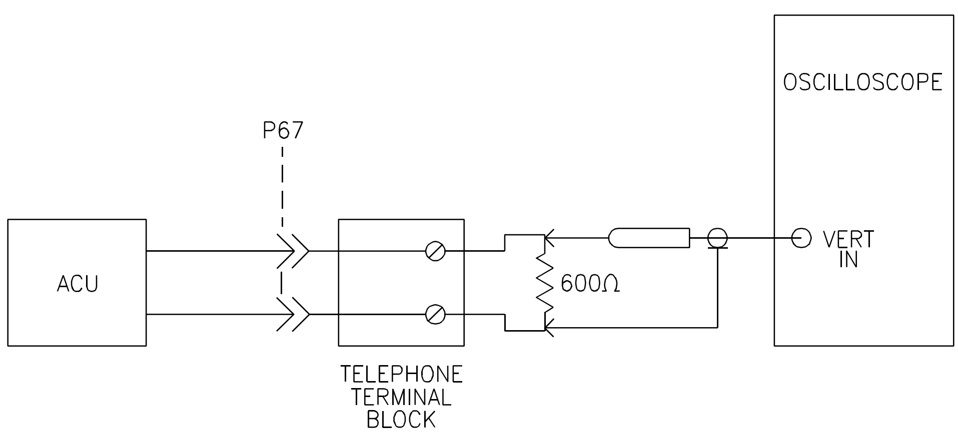


Figure 12.5.6. Voice Recorder/Playback Board, Test Setup

Table 12.5.11. GTA Radio Removal and Installation

Step	Procedure
	REMOVAL
	Tools required: Small flat-tipped screwdriver **CAUTION** Damage to equipment may result if power is not removed prior to removal or installation. Ensure that the power switch on the GTA radio is set to the off (0) position.
1	At front of GTA radio, press AC PWR switch to remove GTA radio power.
2	Open ACU rear cabinet door.
3	Disconnect ground lug E1.
4	Disconnect antenna connector J4.
5	Disconnect ac power connector J1.
6	Disconnect remote connector J5.
7	Remove four screws located on front of GTA radio that secure GTA radio to cabinet.
8	Slide GTA radio from cabinet until catches are secured.
9	Reaching around both sides of GTA radio, release levers that secure GTA radio to permanent slides mounted to cabinet.
10	Slowly slide GTA radio from cabinet using both hands and place GTA radio onto suitable work surface.
	INSTALLATION
	Tools required: Small flat-tipped screwdriver **CAUTION** Damage to equipment may result if power is not removed prior to removal or installation. Ensure that the power switch on the GTA radio is set to the off (0) position.
1	Carefully place GTA radio into slide slots.
2	Slide GTA radio completely back into cabinet so that slide locks engage. (This prevents the GTA radio from sliding completely out of the ACU cabinet.)
3	Locate and secure four screws that secure GTA radio to ACU cabinet.
4	Open ACU rear cabinet door.
5	Connect ground lug E1.
6	Connect antenna connector J4.
7	Connect ac power connector J1.
8	Connect remote connector J5.
9	Close ACU rear cabinet door.
10	At front of GTA radio, press AC PWR switch to apply GTA radio power.
11	Verify that AC PWR indicator is illuminated.
12	Perform voice recorder/playback board check in accordance with table 12.5.10.
13	Perform RF power output check in accordance with table 12.5.2.
14	Perform modulation level check in accordance with table 12.5.3.
15	Perform VSWR at transmitter output check in accordance with table 12.5.4.
16	Perform frequency stability check in accordance with table 12.5.5.

CHAPTER 13

CODEX 3600 SERIES MODEM

SECTION I. DESCRIPTION AND LEADING PARTICULARS

13.1.1 **INTRODUCTION**

The Codex 3600 Series modem (figure 13.1.1) supports both point-to-point and multipoint circuits for analog and digital applications. In the ASOS environment, the 3600 modem interfaces with the Federal Aviation Administration (FAA) ADAS via the Data Multiplexer Network in both point-to-point and multipoint circuits. The particular circuit is ASOS site-specific. Typical point-to-point and multipoint circuits are described in Section IV.

When operating as an analog leased line device, the 3600 modem can achieve speeds in excess of the industry standard of 19.2 kbps. This extended rate capability is achieved through a coding/equalization technique called Trellis Precoding. This extended rate also provides for line testing and transmission speed adjustment depending on prevailing line conditions, enabling the device to support speeds of 21.6 kbps. A speed of 24.0 kbps can be achieved under optimum line conditions. In addition to these higher speeds, the 3600 modem offers improved performance at 19.2 kbps. Through its Digital Interface option, the 3600 modem operates at both substrate (2.4, 4.8, 9.6, and 19.2 kbps) and standard rate (56.0 kbps) digital transmission speeds.

The 3600 modem is a modular system that can be customized with a variety of hardware and software options to expand in step with communications requirements. These options enable the 3600 modem to be custom-configured as an analog leased line device or as a digital service unit, both with time division multiplexing and integrated restoral backup. Different Flex-cartridge operating sets and options can be used to provide varying levels of control in 3600 Series applications. The Flex-cartridge is removable and can be replaced with a cartridge containing software updates and configuration changes to accommodate new communications circuits. In the ASOS environment, one of two Flex-cartridges is used: Premium or Standard. These cartridges are ASOS site-specific. The Premium Flex-cartridge provides for point-to-point communications using TURBO PP mode at 19.2 kbps, and the Standard Flex-cartridge provides for multipoint operation in multipoint-slave (MP-S) mode of operation at 4.8 kbps. It should be noted that Premium Flex-cartridge mode V.33 is used on some FAA circuits. Table 13.1.1 lists the Codex 3600 Series operating set characteristics.

13.1.2 **PHYSICAL DESCRIPTION**

13.1.2.1 **General Description**. The 3600 modem is Government-furnished equipment (GFE) measuring 3.5 inches high, 17.25 inches wide, and 17.5 inches deep and is installed in position 1A1 above the VME rack in the acquisition control unit (figure 13.1.2).

The modem is self-operating and, under normal conditions, needs no operator intervention. The front panel of the device, normally covered with a dress panel (figure 13.1.3), is hinged so that it can be opened to gain access to the circuit boards of the modem as well as a removable component housing (called a Flex-cartridge) containing multiple banks of memory devices. The initial Flex-cartridge is factory-installed; however, software upgrades can be installed by removing and replacing the Flex-cartridge.

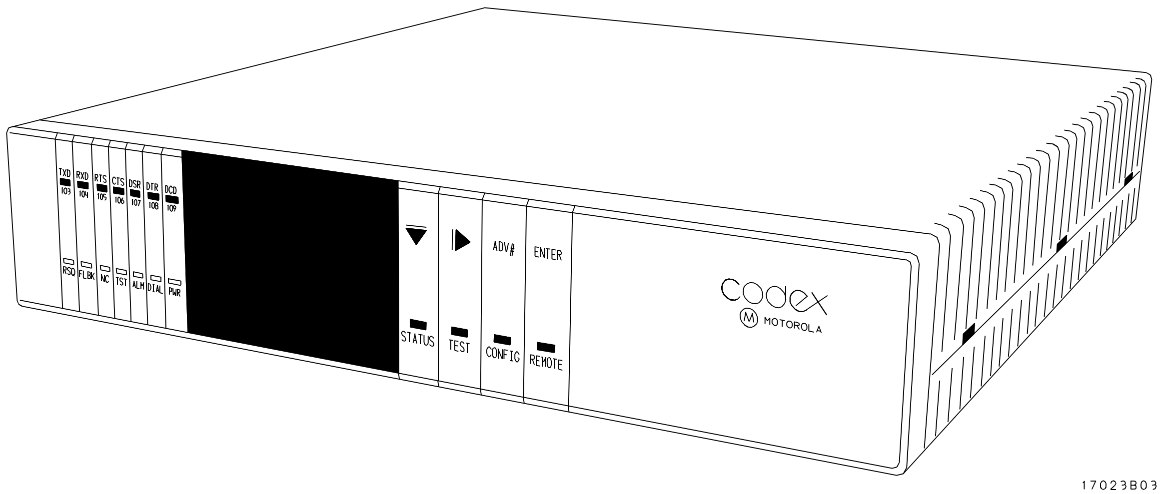


Figure 13.1.1. Codex Series 3600 Modem

Table 13.1.1. Codex 3600 Series Modem Specifications

Operating Mode	Data Rate (kbps)	Transmit Carrier Mode	Point-to-Point/ Multipoint	Training Time	Baud Rate (Hz)	Equalization Recovery Method	Unique Features
TURBO PP	24.0 21.6 19.2* 16.8 14.4 12.0 9.6	Constant	Point-to-point	Normal/ short	3200 2954 2743* 2400	Round robin (3 to 7 sec)	Extended high-speed performance through combination of Trellis Precoding and line probing
V.33	14.4 12.0	Constant	Point-to-point	1393 ms	2400	Round robin (2.6 to 4 sec)	End-to-end compatible with any CCITT V.33 device (without network control)
PP/CI	9.6 7.2 4.8	Constant	Point-to-point	253 ms	2400	Round robin (1 to 2 sec)	Improved signal constellation (compared to V.29)
V.29	9.6 7.2 4.8	Constant	Point-to-point	253 ms	2400	Round robin (1 to 2 sec)	End-to-end compatible with any CCITT V.29 device (without network control)
MP-M (master)	9.6 7.2 4.8	Constant	Multipoint	253 ms	2400	None (Retrain expected with each outbound message)	Ability to accept different inbound rates from slaves (MIR) MQSB
MP-S (slave)	4.8	Controlled (switched)	Multipoint	17 ms	2400*	Train on data (2 to 15 sec)	Train on data (TOD)

*ASOS configuration

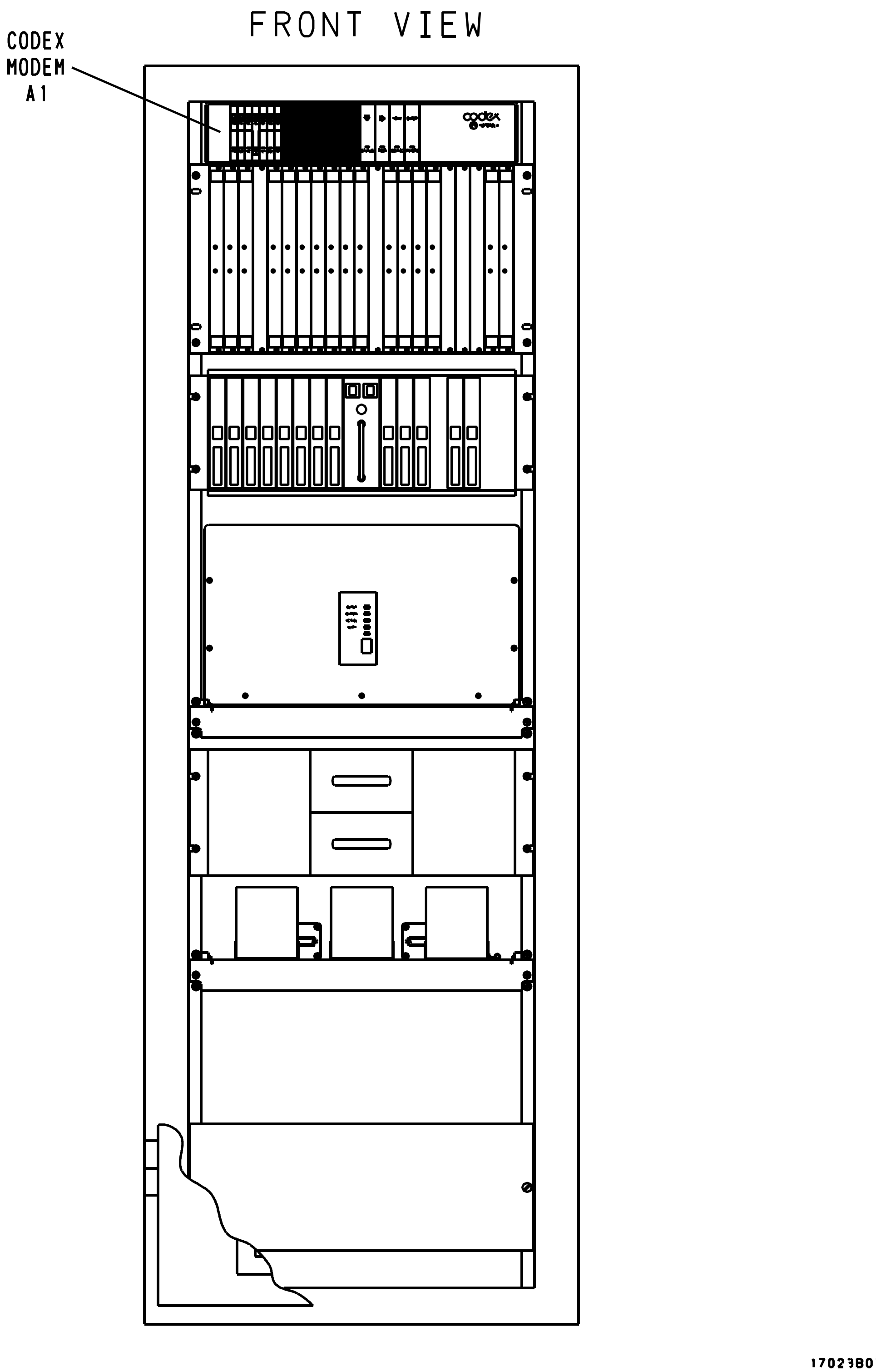


Figure 13.1.2. Codex 3600 Series Modem Location in the ACU

13.1.2.2 **System Components**. The Codex 3600 Series modem consists of the 3600 modem, including the circuit boards contained in the 3600 modem enclosure, and the Flex-cartridge. The modem with its Flex-cartridge and the Flex-cartridge itself are field replaceable units (FRU's). Figure 13.1.4 illustrates the 3600 modem components.

13.1.2.2.1 **3600 Series Enclosure**. The Codex 3600 Series modem enclosure includes the front panel, power supply, cooling fan, and backbone slots for all of the cards. The front panel is used to configure the device and includes light emitting diodes (LED's), touch-sensitive control keys, and an 8-character alphanumeric display. The rear panel includes the power switch, fuse, power cord, voltage selection jumper, telephone company connections, hardware interfaces to network control, and data terminal equipment connections.

13.1.2.2.2 **Flex-Cartridge**. The Flex-cartridge consists of multiple banks of memory devices packaged in a component housing. These memory banks contain the associated operating programs that perform specific functions. The memory size varies, depending on the number of installed software options. The initial Flex-cartridge is factory-installed. If software upgrades are required, the cartridge is removed and replaced with the cartridge containing the new software. Each cartridge plugs into a Flex-cartridge carrier on the front right side of the processor card. ASOS sites that communicate with ADAS in a point-to-point circuit have Premium Flex-cartridges, and those communicating in a multipoint circuit have Standard cartridges.

13.1.3 **CODEX CONFIGURATIONS**

There are two possible configurations of the Codex Modem: Standard (one mode: MP-S) and Premium (two modes: Turbo PP and V.33). The configuration of a particular CODEX is determined by which of two Flex-cartridges (Standard or Premium) has been installed in the Codex. The Standard Flex-cartridge is used when the Codex is connected to ADAS in a multipoint configuration. The Premium Flex-cartridge is used when the Codex is connected to ADAS in a point-to-point configuration. More information can be learned about Flex-cartridges and their effect on Codex configurations in section IV.

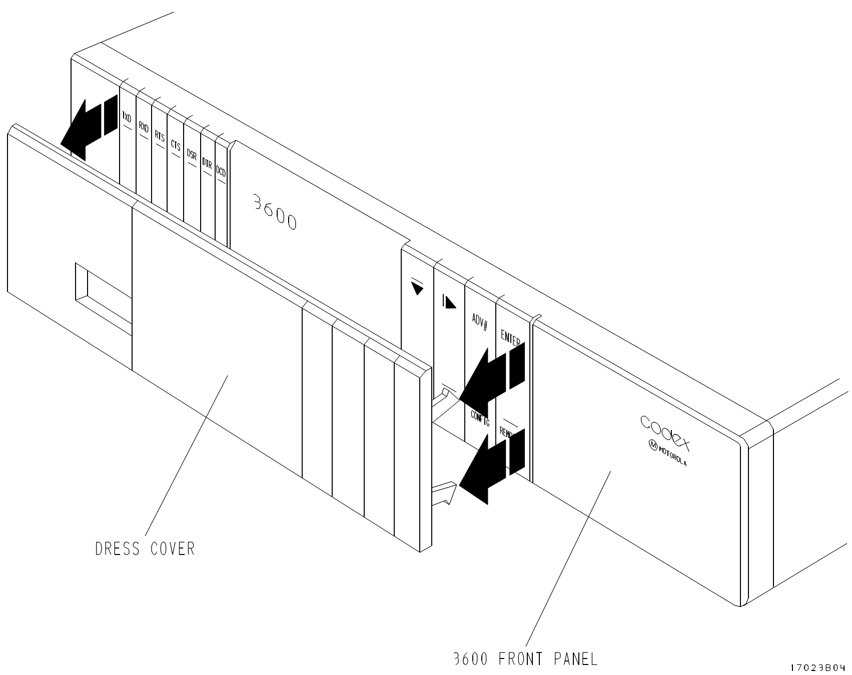


Figure 13.1.3. Codex 3600 Series Modem Dress Panel

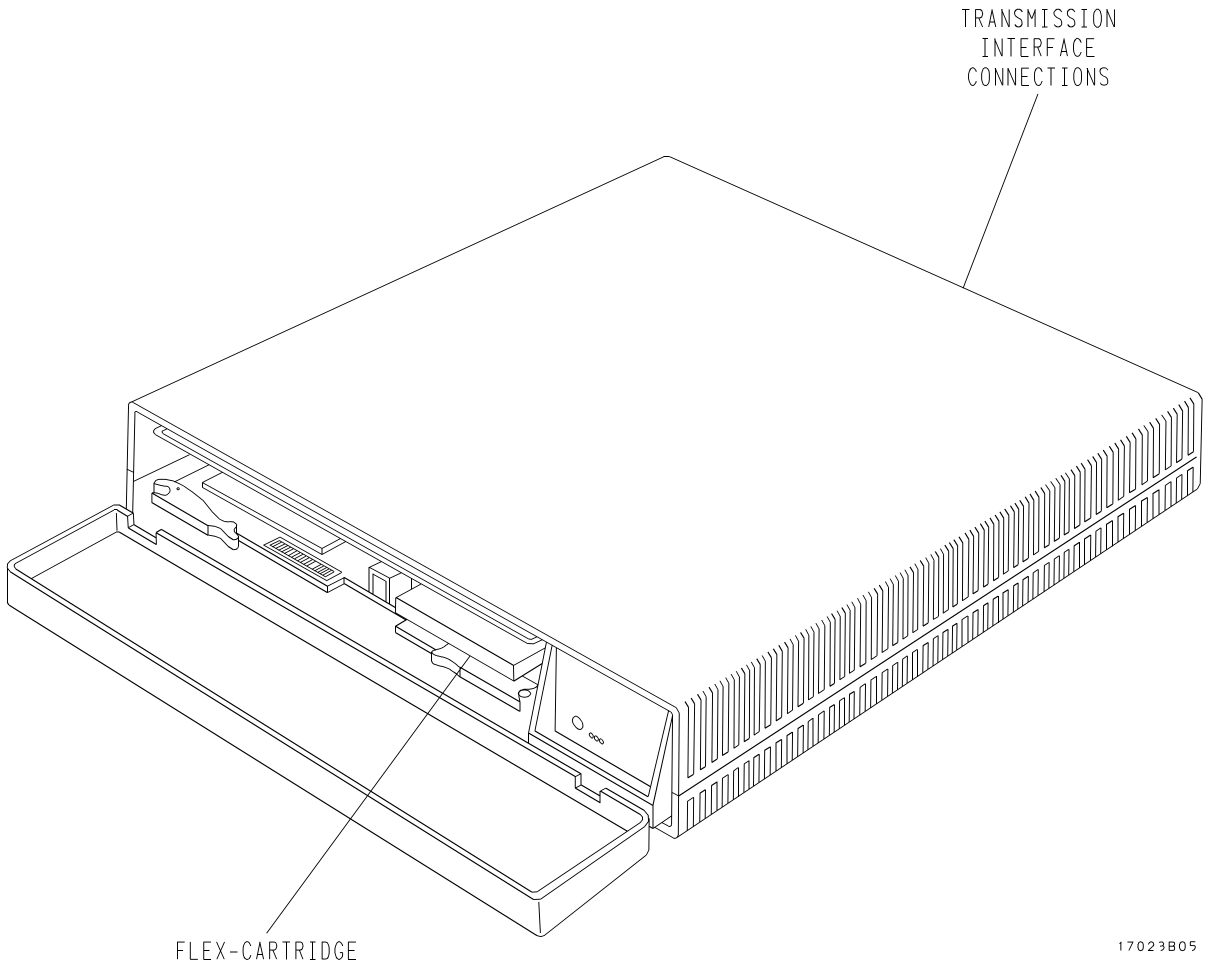


Figure 13.1.4. Codex 3600 Series Modem Components

SECTION II. INSTALLATION

Installation of the Codex 3600 Series modem is not the responsibility of the ASOS site maintenance technician; the unit is Government-furnished equipment (GFE). The procedures for removing and replacing the field replaceable units (FRU's) associated with the device are contained in Section V.

SECTION III. OPERATION

13.3.1 INTRODUCTION

The Codex 3600 Series modem is configured and operated through the front panel of the device (figure 13.3.1) or remotely from another 3600 modem. In the ADAS environment, the modem at the ASOS site is controlled by a 3600 modem at the ADAS network control center. The front panel of the remote 3600 modem at the network control center becomes the logical front panel of the ASOS site modem being controlled. Network control can be overridden; the procedure for overriding network control to enable local configuration of the front panel is described in Section V. The device is software-controlled through a hierarchical menu accessed by pressing the appropriate control keys on the front panel.

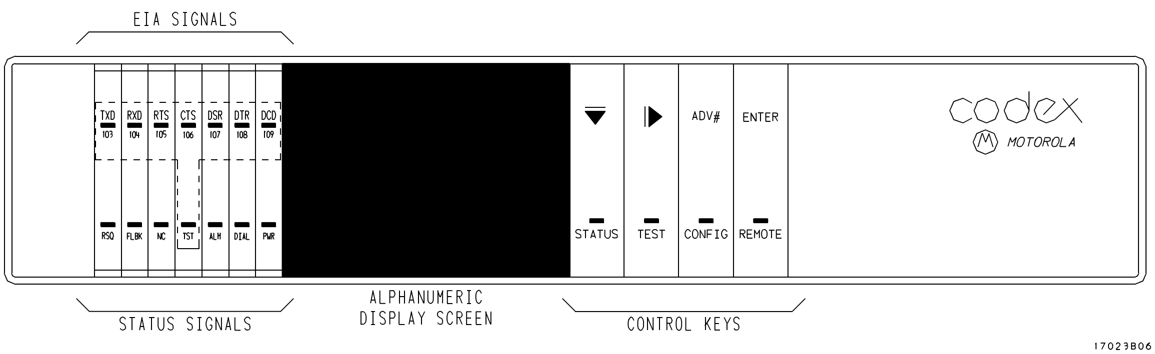


Figure 13.3.1. Codex 3600 Series Modem Controls and Indicators

13.3.2 CONTROLS AND INDICATORS

Table 13.3.1 identifies the controls and indicators on the front panel of the Codex 3600 Series modem. The eight control keys, which enable the operator to configure, test, and review the operational status of the 3600 modem, are divided into two groups: menu keys and movement keys. Menu keys enable the operator to access the software menus (STATUS, TEST, CONFIG, and REMOTE), and the movement keys enable the operator to move across parameters within menus and make selections. The light emitting diodes (LED's) on the front panel display conditions relating to data transmission, power, network control, and alarm conditions. Modem responses to the repeated pressing of the menu keys are displayed on the 8-character display screen located on the front panel. Figure 13.3.2 illustrates the top level software menu hierarchy of the Codex 3600 Series modem for each of the main menu categories (i.e., STATUS, TEST, CONFIG, and REMOTE).

Table 13.3.1. Codex 3600 Series Modem Controls and Indicators

Control/ Indicator	Description	Normal Condition
LED's		
TXD (green)	Transmit data	Illuminates when transmitting data.
RXD (green)	Receive data	Illuminates when receiving data.
RTS (green)	Request to send	Illuminates when DTE connected to selected port is requesting to send data to the 3600 modem.
CTS (green)	Clear to send	Illuminates when 3600 modem indicates that it is ready to receive data.
DSR (green)	Data set ready	Illuminates when DTE attached to the 3600 modem is active but not in a data interruptive mode.

Table 13.3.1. Codex 3600 Series Modem Controls and Indicators - CONT

Control/ Indicator	Description	Normal Condition
DSR (green)	Data set ready	Illuminates when DTE attached to the 3600 modem is active but not in a data interruptive mode.
DTR (green)	Data terminal ready	Illuminates when the DTE attached to the 3600 modem is connected and ready to send or receive data.
DCD (green)	Data carrier detect	Illuminates when device is receiving an acceptable signal from the remote device.
TST (red)	Test	Illuminates when 3600 modem is in test mode.
Status Indicators		
RSQ (green)	Receive signal quality	Indicates that the 3600 modem is detecting a good signal quality. Flashing LED indicates marginal signal quality.
FLBK (yellow)	Fallback	Indicates that the 3600 modem is operating at a rate lower than that configured at the MAX RTE parameter.
NC (green)	Network control	Indicates that the 3600 modem is under the control of a network management system or a remote front panel (LED remains ON). Flashes when a message is received from a remote source.
ALM (red)	Alarm	Indicates device failure.
DIAL (red)	Restoral operation	Indicates that the 3600 modem is operating over a restoral connection. Flashes when 3600 modem is dialing.
PWR (green)	Power	Indicates that the power supply is operational and that 3600 modem is receiving ac power.
Software Menu Keys		
STATUS	STATUS menu access	Used to access the STATUS menu.
TEST	TEST menu access	Used to access the TEST menu.
CONFIG	CONFIGURATION menu	Used to access the CONFIG menu.
REMOTE	REMOTE menu access	Used to access the REMOTE menu.
Movement Keys		
▼	Used to move through the different selections of the selected menu area or through a series of lead parameters.	
▶	Used to move through a series of parameters within a category.	
ADV#	Used to increment digits for numeric entry. This key advances the flashing digit in the numerical display.	
ENTER	Used to store a selection or numerical entry in nonvolatile memory. The selection blinks after it is entered correctly.	
Alphanumeric Display Screen		
LED	Used with the control keys to display various menu selections, error messages, and system responses during testing and troubleshooting. When not being used, the alphanumeric display displays the specified transmission speed of the 3600 modem.	

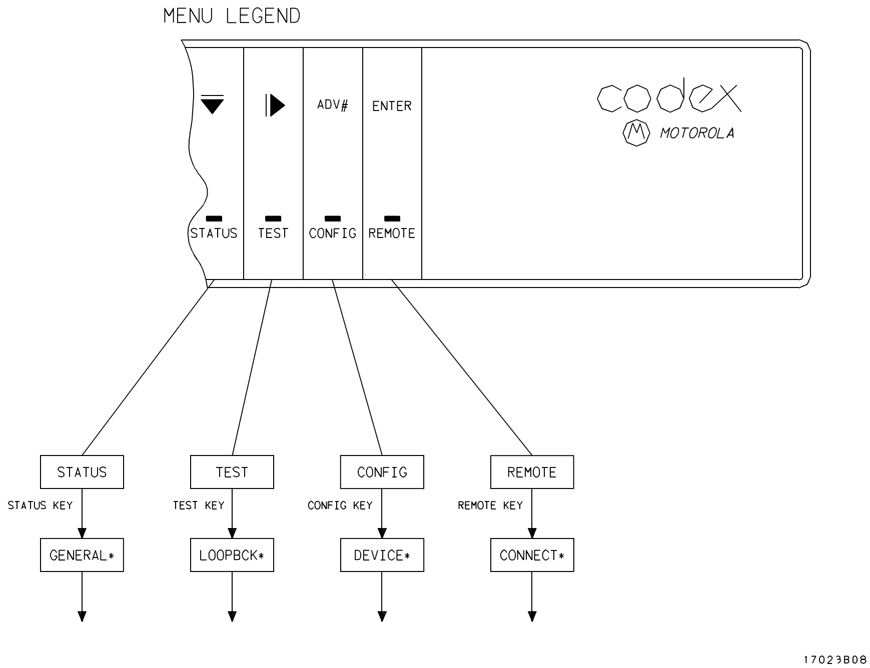


Figure 13.3.2. Top Level Software Menu

13.3.2.1 **STATUS Menu**. Pressing the STATUS key (figure 13.3.3) enables the operator to access the STATUS menu and examine the menu categories. The categories that are accessed and the figures illustrating the parameters that can be displayed within those categories are identified as follows:

Category	Figure No.
GENERAL*	13.3.4
DIAGNOS*	13.3.5
CQMS*	13.3.6
PRT SEL*	13.3.7

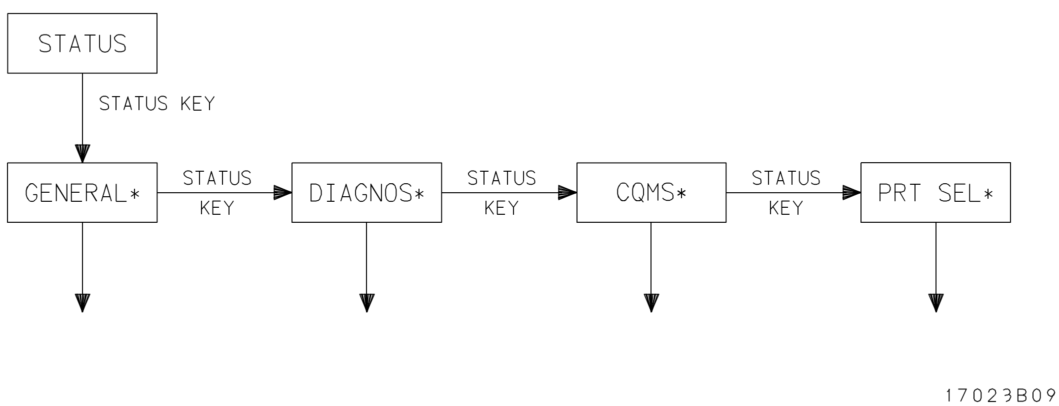


Figure 13.3.3. STATUS Menu - Top Level

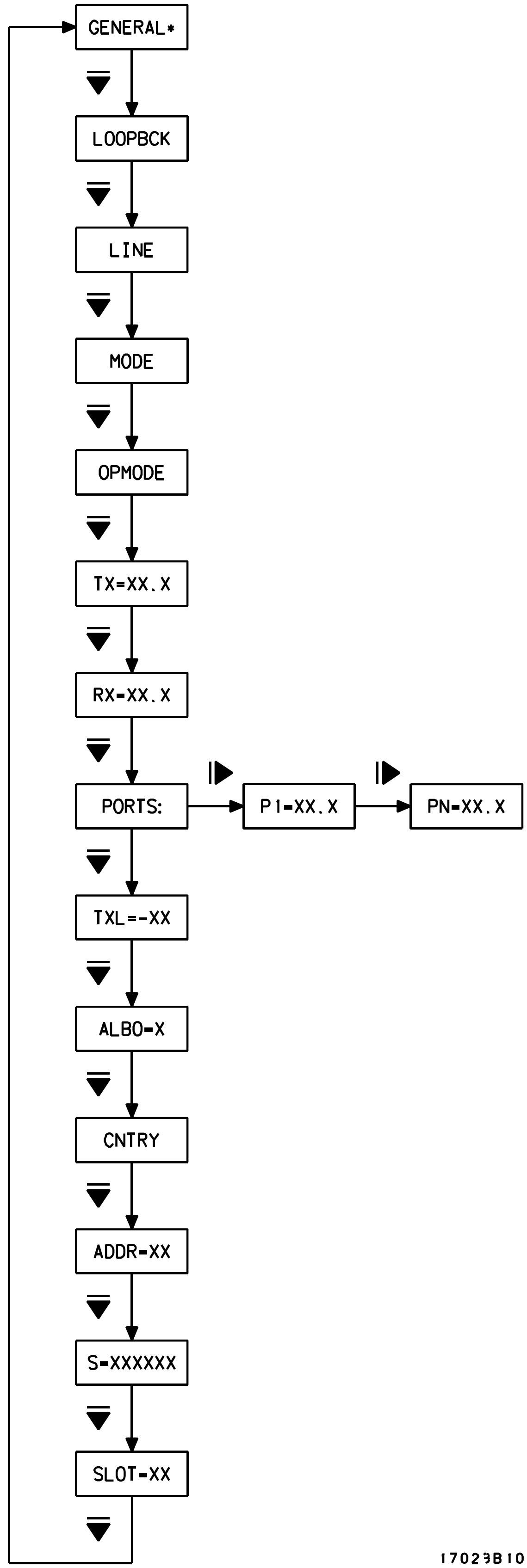


Figure 13.3.4. STATUS Menu - GENERAL* Category

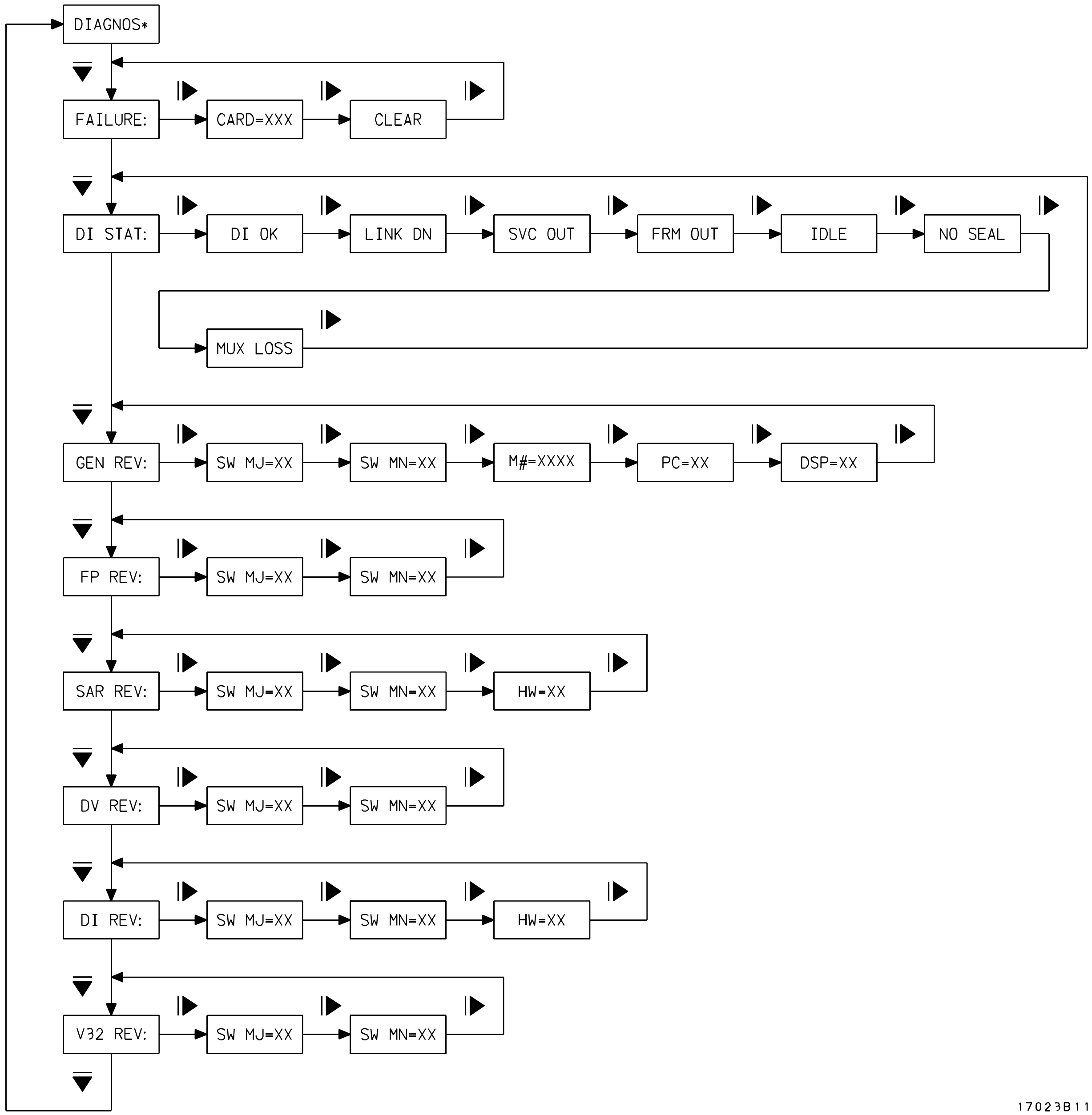


Figure 13.3.5. STATUS Menu - DIAGNOS* Category

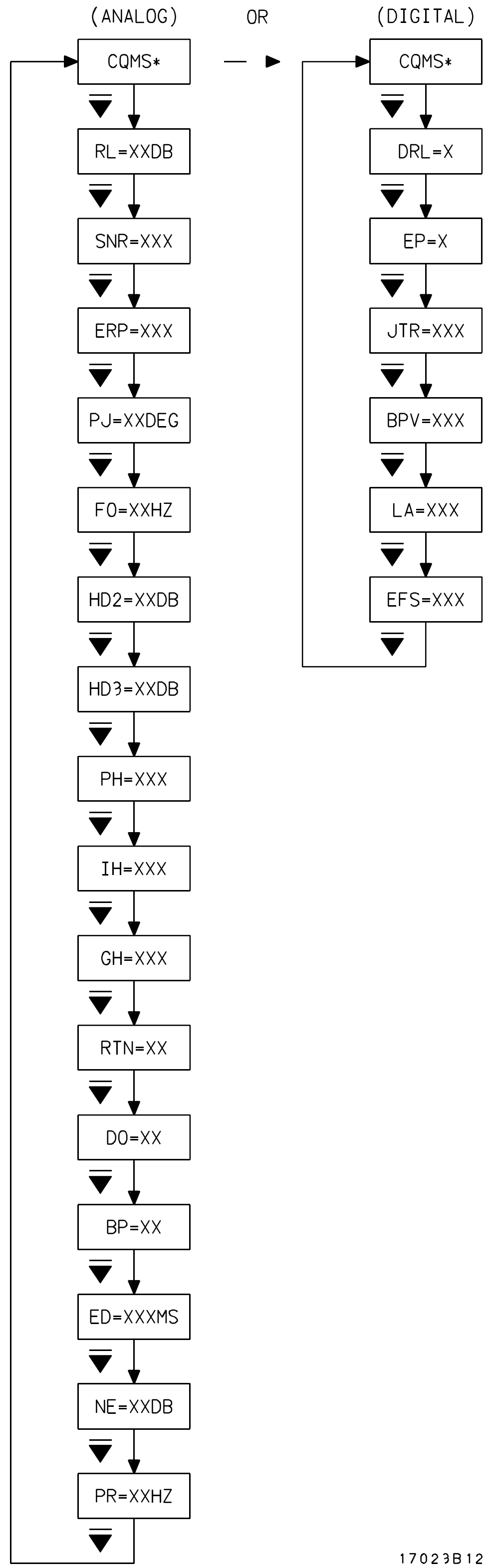


Figure 13.3.6. STATUS Menu - CQMS* Category

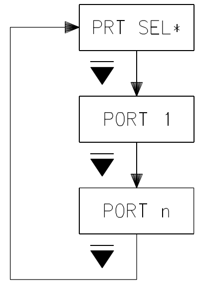


Figure 13.3.7. STATUS Menu - PRT SEL* Category

13.3.2.2 **TEST Menu**. Pressing the TEST key (figure 13.3.8) enables the operator to access the TEST menu and examine the menu categories. The only test category that the ASOS site technician needs to access is the SELF* category, the parameters of which are illustrated on figure 13.3.9.

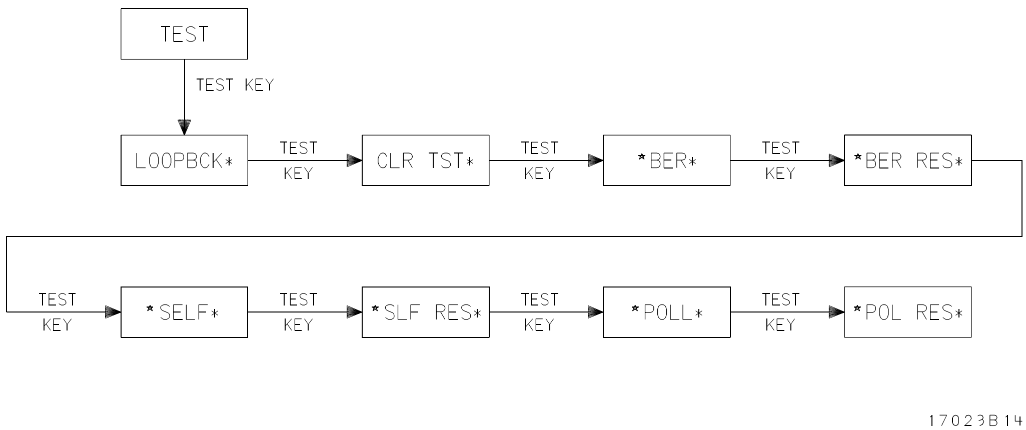


Figure 13.3.8. TEST Menu - Top Level

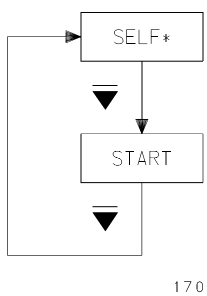


Figure 13.3.9. TEST Menu - SELF* Category

13.3.2.3 **CONFIG Menu**. Pressing the CONFIG key (figure 13.3.10) enables the operator to access the CONFIG menu and examine the menu categories. The categories that are accessed and the figures illustrating the parameters that can be displayed within those categories are identified as follows:

Category	Figure No.
DEVICE*	13.3.11
ANALOG*	13.3.12
PORTS*	13.3.13
NWK CTL*	13.3.14

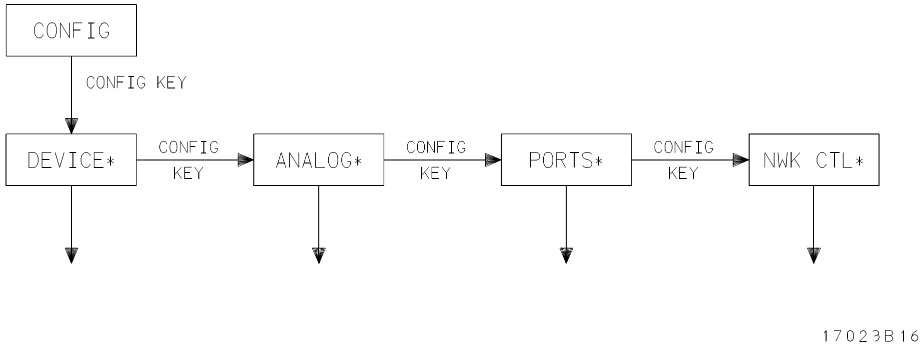


Figure 13.3.10. CONFIG Menu - Top Level

13.3.2.4 **REMOTE Menu**. The REMOTE menu is used by the ASOS site technician only to disable and enable remote control when configuring or testing the modem locally. Pressing the REMOTE key (figure 13.3.15) enables the operator to access the REMOTE menu and examine the menu categories. The categories that are accessed and the figures illustrating the parameters that can be displayed within those categories are identified as follows:

Category	Figure No.
MISC*	13.3.16

13.3.3 **TURN-ON PROCEDURES**

The Codex 3600 Series modem receives ac power from acquisition control unit (ACU) input. Modem power is ON when both the ACU power is ON and the modem power switch is ON.

13.3.4 **TURNOFF PROCEDURES**

The Codex 3600 Series modem ac power is OFF when the ACU AC power is OFF regardless of the position of the modem power switch. The modem is turned OFF separately by setting the power switch on the rear of the modem to OFF (position 1).

13.3.5 **NORMAL OPERATION**

The Codex 3600 Series modem is self-operating. A front dress cover is installed over the modem front panel concealing the display screen, all control keys, and all LED's with the exception of the ALM, DIAL, and PWR LED's. The modem is normally under network control.

13.3.6 **MONITORING AND VERIFYING CODEX 3600 SERIES MODEM AT OPERATOR INTERFACE DEVICE**

The only indication of a possible malfunction of the modem provided at the operator interface device (OID) is a MODEM HAS LOST POLL FROM ADAS message sent to the SYSLOG. The ASOS central processing unit (CPU) does not check any self-test status on the modem. The operator can only verify the pass/fail status of the SIO board to which the modem is assigned by using the OID, accessing the maintenance page for the SIO boards, and ensuring that no F or C flags are set (SIO/port is assigned as ADAS for the Codex 3600 Series modem).

13.3.7 MONITORING AND VERIFYING CODEX 3600 SERIES MODEM BY VISUAL INSPECTION

The operation of the Codex 3600 Series modem can also be monitored by observing that the DCD LED on the front panel is illuminated, the ALM LED is extinguished, and the PWR indicator is illuminated. The NC LED on the front panel will also be lit on the modem currently being addressed.

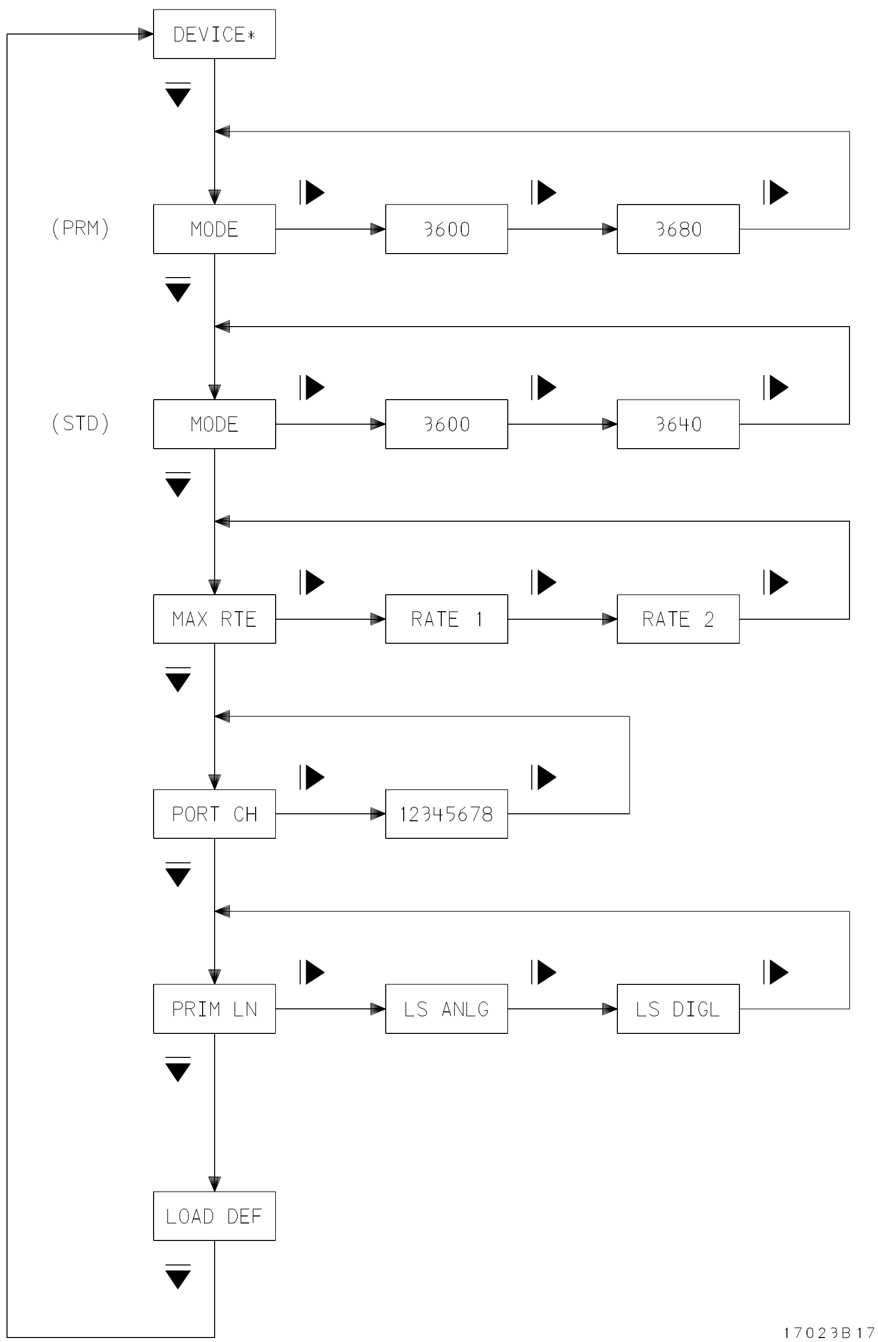


Figure 13.3.11. CONFIG Menu - DEVICE* Category

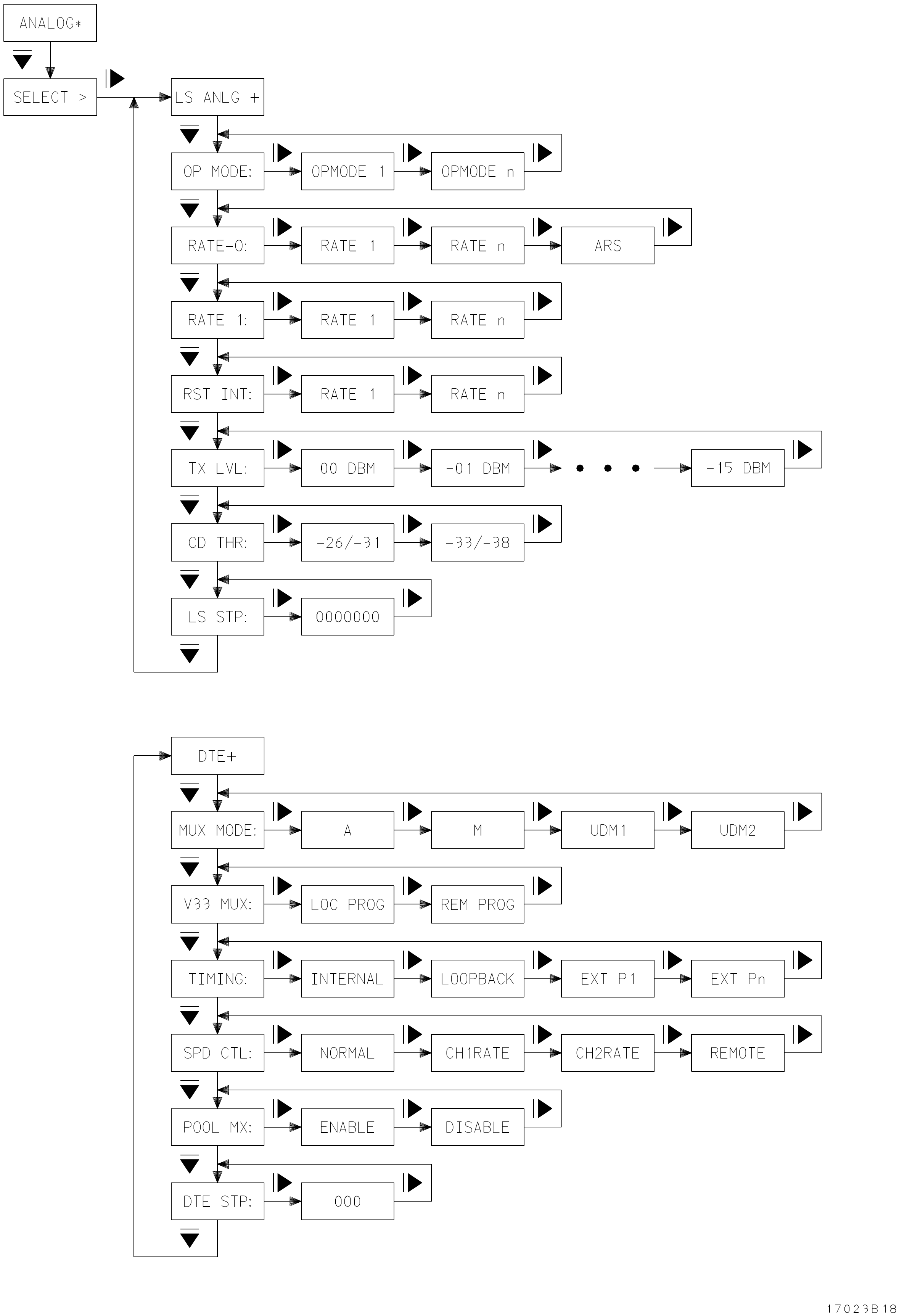


Figure 13.3.12. CONFIG Menu - ANALOG* Category (Sheet 1 of 2)

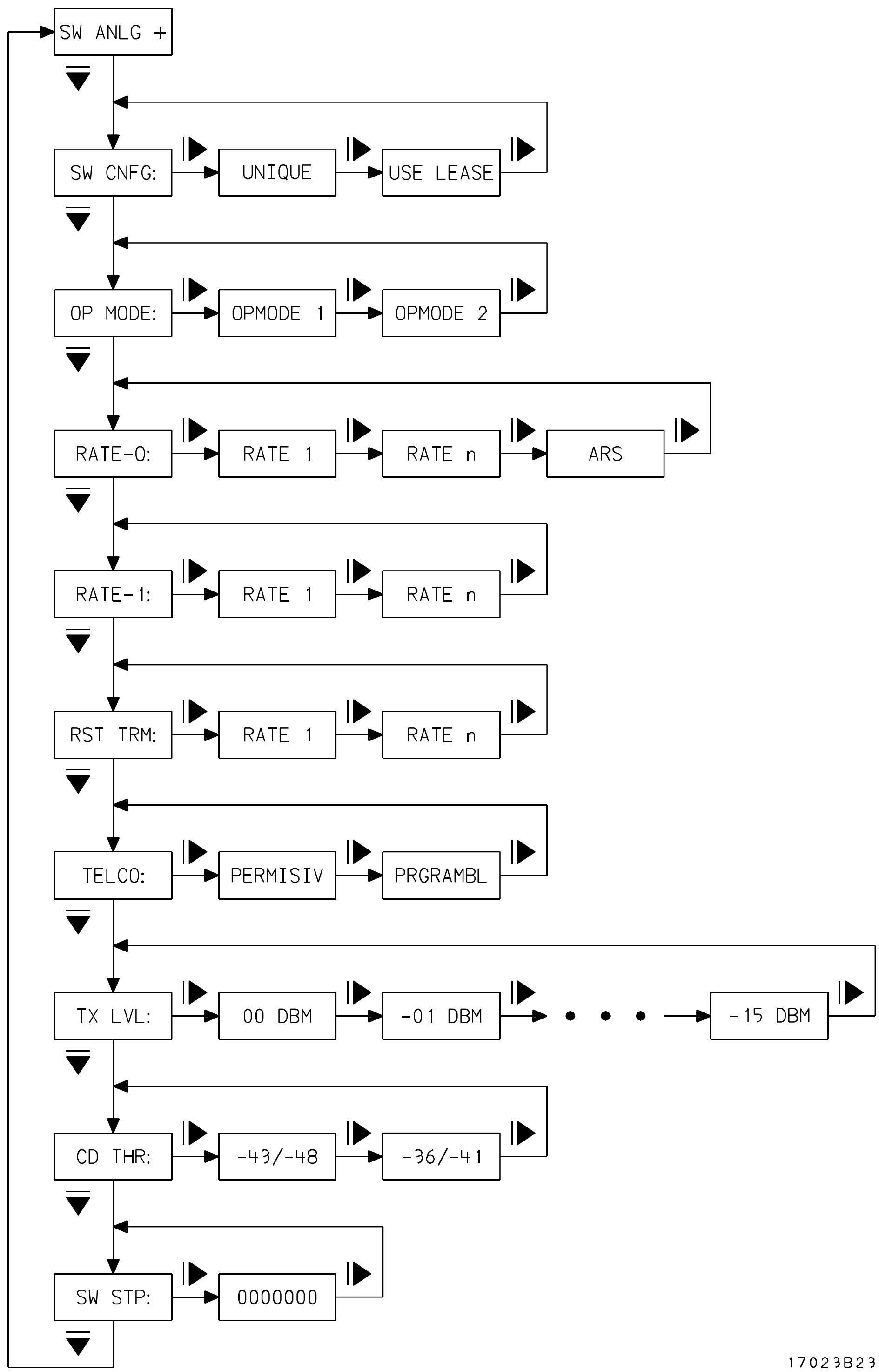


Figure 13.3.12. CONFIG Menu - ANALOG* Category (Sheet 2)

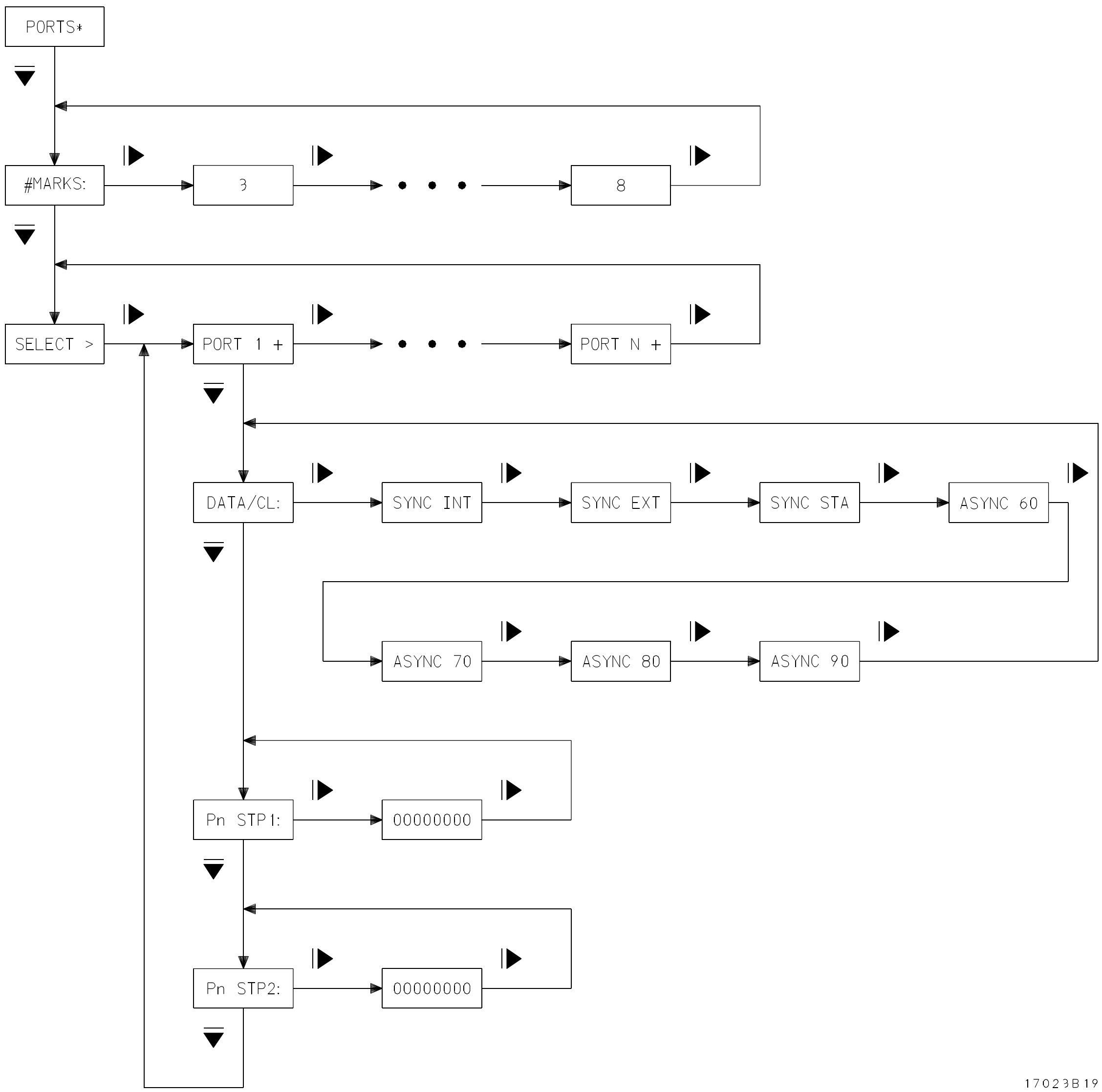


Figure 13.3.13. CONFIG Menu - PORTS* Category

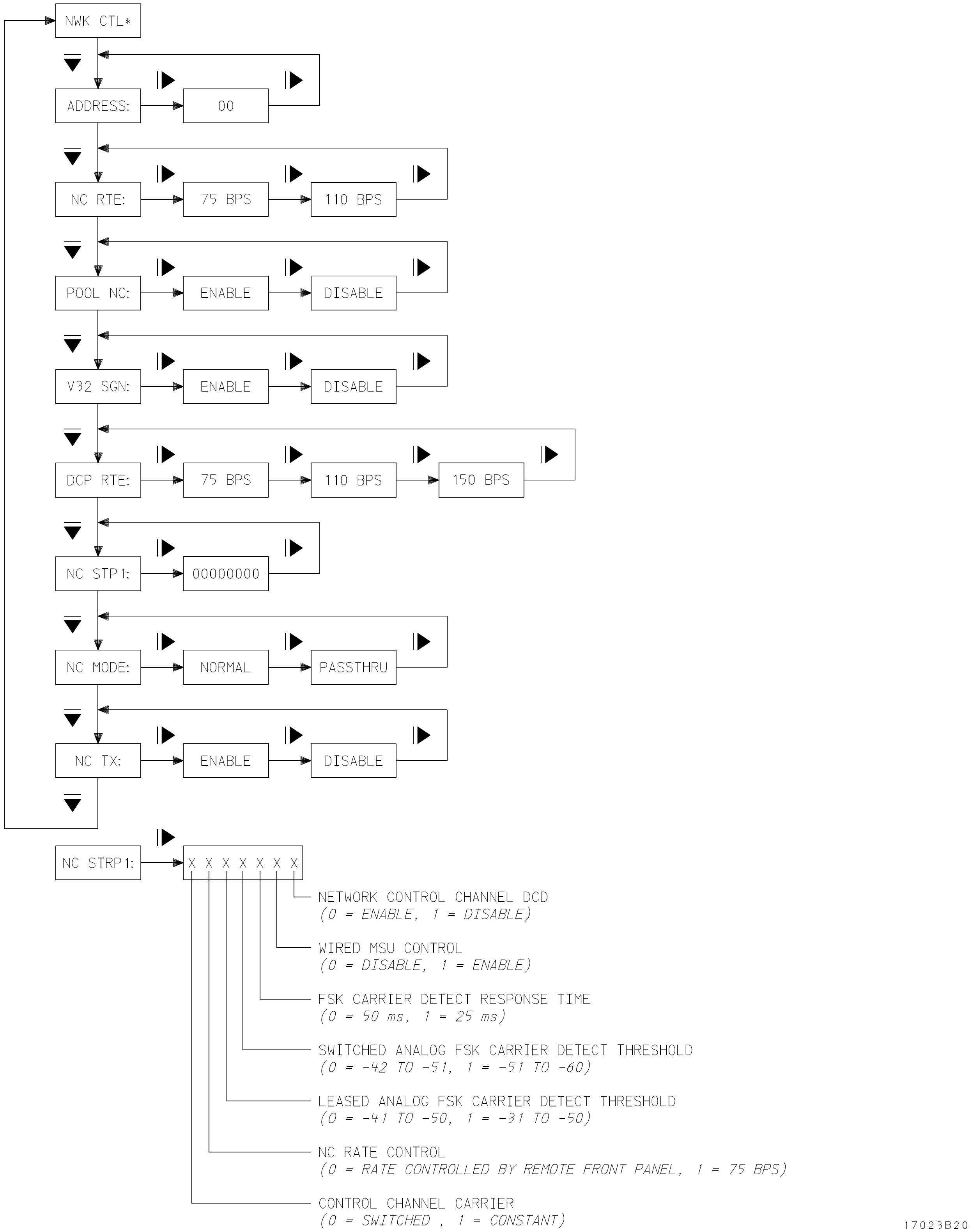


Figure 13.3.14. CONFIG Menu - NWK CTL* Category

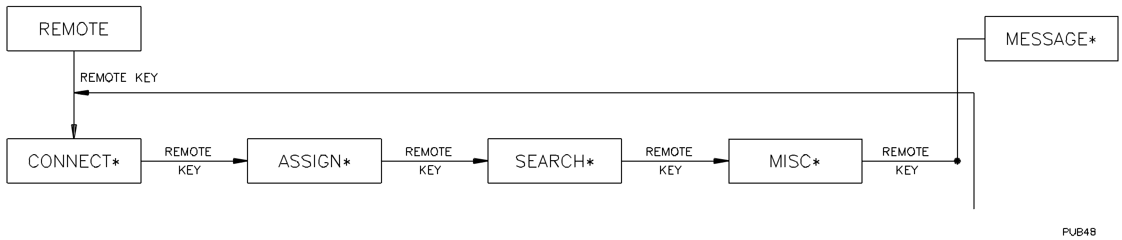


Figure 13.3.15. REMOTE Menu - Top Level

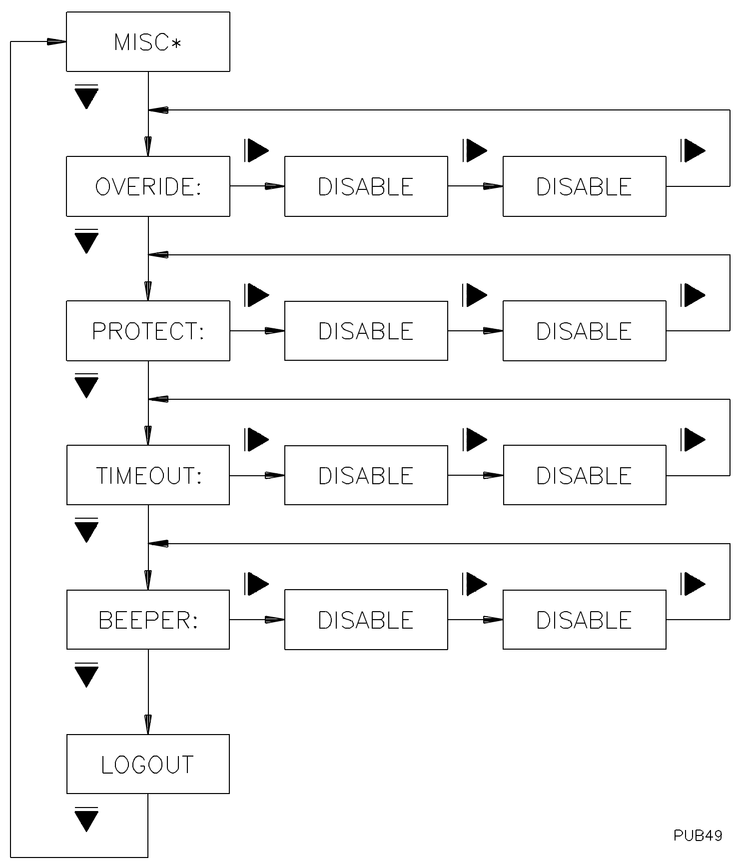


Figure 13.3.16. REMOTE Menu - MISC* Category

SECTION IV. THEORY OF OPERATION

13.4.1 INTRODUCTION

The Codex 3600 Series modem configured for ASOS operation is operated in one of two circuits: point-to-point or multipoint. The circuit varies from site to site. The ASOS point-to-point circuit uses a Premium Flex-cartridge and TURBO PP operating mode at a maximum transmission rate of 19.2 kbps or the V.33 operating mode at 14.4 kbps or 12 kbps. The ASOS multipoint circuit uses a Standard Flex-cartridge and multipoint-slave (MP-S) operating mode at a maximum transmission rate of 4.8 kbps. In either a point-to-point or multipoint circuit, ASOS responds to data requests (polls) from the Federal Aviation Administration (FAA) ADAS communications network with requisite data. Figure 13.4.1 illustrates the topology of the ADAS network.

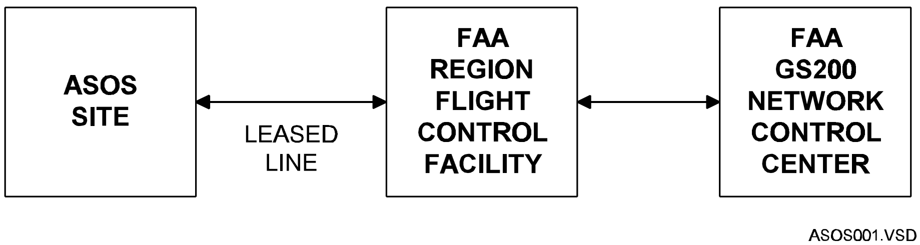


Figure 13.4.1. ADAS Network Topology

The Codex 3600 Series modem is transparent to ASOS. In either operating circuit, the local modem front panel can be controlled locally or from a remote 3600 modem on the ADAS network. The modem is normally under network control. The following chart summarizes the ASOS circuits and operating modes.

Circuit	Operating Mode	Max Transmission Rate	Flex-Cartridge (ASOS Site -Specific)
Point-to-point	TURBO PP	19.2 kbps	Premium
	V.33	14.4 kbps	Premium
	V.33	12.0 kbps	Premium
Multipoint	MP-S	9.6 kbps	Standard

Figure 13.4.2 illustrates the ASOS/ADAS point-to-point and multipoint connections.

13.4.2 TURBO POINT-TO-POINT AND V.33 COMMUNICATIONS

The Codex 3600 Series modem configured for ASOS with a Premium Flex-cartridge uses the TURBO PP operating mode and a transmission speed of 19.2 kbps, enabling communications at a high performance level under a variety of operating conditions. TURBO PP supports transmission rates from 9.6 kbps to 24.0 kbps. A line probing feature automatically adjusts the carrier frequency and the baud rate of the modem to extract maximum performance from the communications line. To withstand high degrees of distortion at the transmission band edges, the TURBO PP operating mode uses a Codex proprietary technique called Trellis Precoding. The TURBO PP operating mode also uses an adaptive rate capability using the line probing feature with an adaptive rate system (ARS). Upon power up, line probing determines the highest possible data rate that current line conditions can support. Line probing then instructs the modem to run at that rate. The modem continually monitors its received error rate. As line conditions improve or deteriorate, the modem adjusts its speed and transmission band to provide the optimum throughput. The Codex 3600 Series modem uses a process called point-to-point training to initialize and synchronize point-to-point devices before transmission can begin. During training, the modem sends a predetermined training sequence.

Knowing how the training sequence should appear, the receiving device can recognize how specific line conditions have distorted the training pattern and compensate for the distortion using a technique known as equalization. Equalization is the reduction of the effects of attenuation or time delay or both on the various frequencies in the transmission band. The FAA may also utilize PP V.33 mode to improve reliability and HDLC recovery attempts in some circuits.

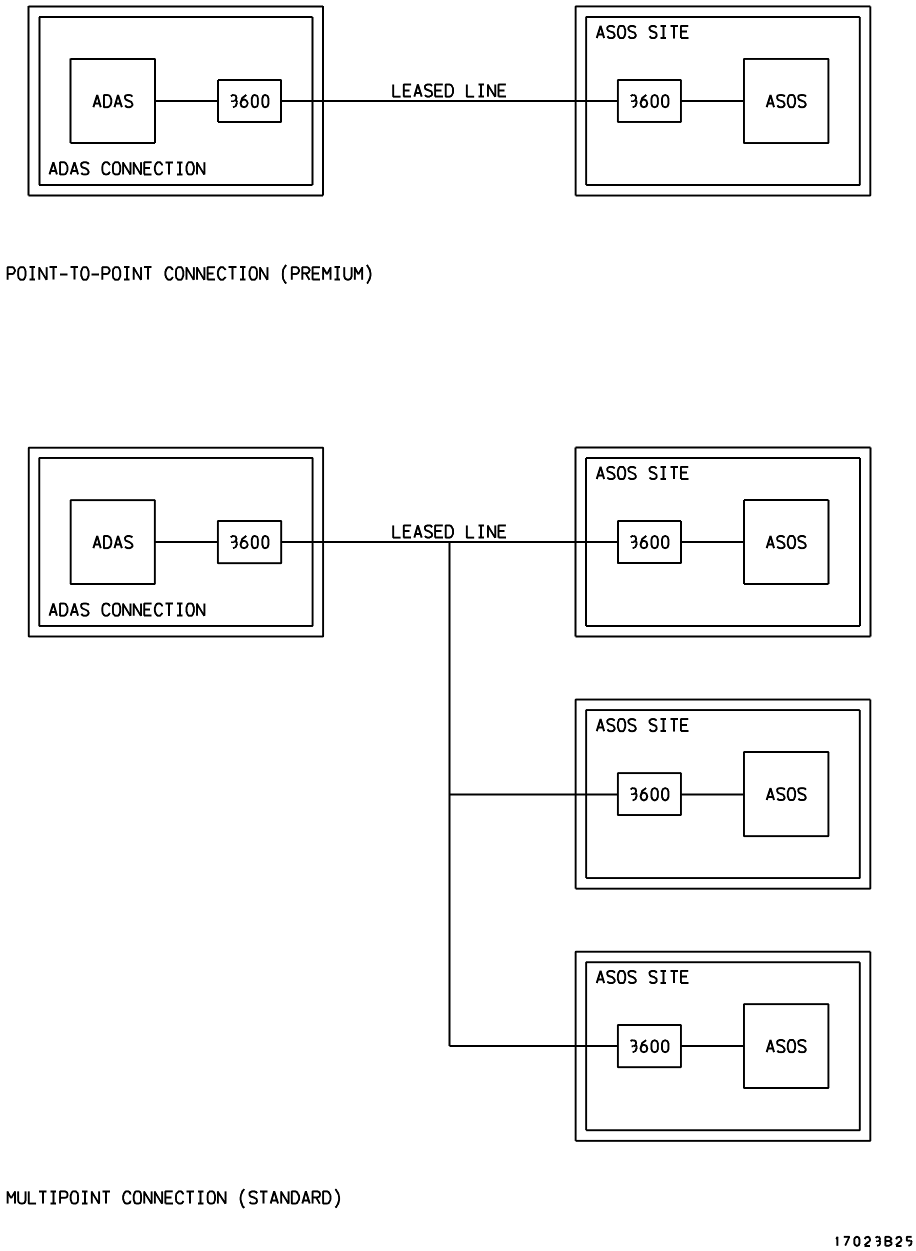


Figure 13.4.2. ASOS/ADAS Point-to-Point and Multipoint Connections

13.4.3 MULTIPOINT-SLAVE (MP-S) OPERATING MODE

The Codex 3600 Series modem configured for ASOS with a Standard Flex-cartridge uses the MP-S operating mode and a transmission speed of 9.6 kbps. The MP-S mode enables leased line operations at 4.8 kbps over unconditioned analog transmission lines. This mode of operation is used in a standard multipoint polling circuit. In the ASOS environment, the ASOS sites operating in the MP-S mode are slaves and the master 3600 modem is at an ADAS site. The MP-S mode enables asymmetrical operation so that the outbound rate can be configured differently from the inbound rate. In addition, the inbound rate from each slave is separately selectable using the mixed inbound rates (MIR) feature. The outbound direction uses a 253-ms training sequence, which enables the 3600 modem slaves to learn all significant channel characteristics. In the inbound direction, the master receiver has a very short training sequence (17 ms), which improves speed in responding to polls. Throughput in multipoint application is increased with training on data (TOD). TOD eliminates data-disruptive retrains by enabling slave devices to equalize on the data being transmitted. The elimination of retraining improves throughput and reduces response time in a multipoint circuit. Codex modems at ASOS sites are configured for 4.8 kbps.

SECTION V. MAINTENANCE

13.5.1 **INTRODUCTION**

This section contains the preventive and corrective maintenance procedures for the Codex 3600 Series modem. Preventive maintenance consists of periodic visual inspections for physical damage and cleaning the device with a clean cloth to remove dust. The Codex 3600 Series modem and its Flex-cartridge are field replaceable units (FRU's). The Flex-cartridge may be replaced to correct a defective cartridge, or a new Flex-cartridge may be installed to provide software updates. The Codex 3600 Series modem is a low maintenance item.

13.5.2 **PREVENTIVE MAINTENANCE**

13.5.2.1 **Routine Inspection and Cleaning**. The Codex 3600 Series modem is inspected and cleaned every 90 days in the same manner as other components of the acquisition control unit (ACU) (Chapter 2, Section V). Cleaning of the Codex 3600 Series modem outer case is required to prevent dust and debris buildup on the unit. The front dress panel must be properly secured (figure 13.1.3). The modem must not be removed from its rack for inspection and cleaning.

13.5.3 **CORRECTIVE MAINTENANCE**

13.5.3.1 **Corrective Maintenance Philosophy**. The first indication that the operator may observe of a possible modem problem is that ASOS has not received a request for data (poll) from ADAS in a predetermined period of time (5 minutes in ACU S/W version 2.0 and 6 minutes in ACU S/W version 2.2); in this case, ASOS writes a message to the SYSLOG to this effect. This does not mean that the modem is malfunctioning. The ADAS network operation may be causing a suspension of polling. If polling is not resumed, the ASOS site technician notifies the cognizant ADAS network personnel that ASOS is not receiving the ADAS poll. The modem can then be checked via the network and, if possible, the problem corrected. If the problem cannot be corrected, the cognizant ADAS personnel can advise the ASOS site technician of the action to be taken. The Codex 3600 Series modem with its Flex-cartridge is an FRU. After coordinating with cognizant ADAS personnel, the ASOS site technician may be asked to check the modem locally; in this case, the technician may perform the troubleshooting procedures described in paragraph 13.5.3.3. In coordination with ADAS network management, the ASOS site technician may be asked to perform maintenance procedures for the Codex 3600 Series modem, which requires the use of the BERT (Bit Error Rate Tester) software package and the technicians laptop computer.

13.5.3.2 **Bit Error Rate Tester**. The BERT is a software program resident in the ASOS directory of the technician's laptop computer. The BERT is used to perform error rate tests of the Codex modem. The BERT can count the number of bit errors, calculate the percentage of error-free seconds and sync lost seconds, and sync lost occurrences. The BERT transmits and receives RS-232 compatible signals. The device generates 5 pseudorandom repeating sequences from 63 to 32,767 bits in length and generates FOX messages (i.e., quick brown fox).

13.5.3.3 **CODEX 3600 Series Modem Troubleshooting**. Troubleshooting of the modem is performed in coordination with cognizant ADAS network personnel for the purpose of isolating the modem as the source of a problem. In this case, the procedures described in this paragraph are performed to isolate the modem as the cause of the problem. A three-step approach is used. First, the quick check procedures (table 13.5.1) are performed. If no problem is found, menu-driven tests from the local front panel (Signal Quality Test and Self Test) are performed in accordance with the procedures described in tables 13.5.2 and 13.5.3, respectively.

Third, if the modem passes its menu-driven tests and the problem persists, the BERT Test (table 13.5.4) is performed when installing a new modem. If any problem is found as result of any test and the problem cannot be corrected or if after all tests have been conducted, the problem persists, the modem is replaced in accordance with the procedure described in table 13.5.5. The testing procedures used in troubleshooting the Codex 3600 Series modem are summarized as follows:

Test	Procedure Table Reference
Quick Check	13.5.1
Signal Quality Test	13.5.2
Self Test	13.5.3
BERT Test	13.5.4

13.5.4 REMOVAL AND INSTALLATION PROCEDURES

13.5.4.1 **General**. The table references for the removal and installation procedures for the modem and Flex-cartridge are as follows:

Unit To Be Replaced	Removal/Installation Table Reference
Codex 3600 Series Modem	13.5.5
Flex-cartridge	13.5.6

13.5.4.2 **Codex 3600 Series Modem Removal and Installation**. The removal and installation procedures for the Codex 3600 Series modem provided in table 13.5.5 include instructions for configuring the replacement modem (described in table 13.5.7) and for the use of the pocket BERT for testing the replacement modem (described in table 13.5.4).

Table 13.5.1. Codex 3600 Series Modem Quick Checks

Problem	Cause	Solution
Cabling problems exist	This occurs when operating over restoral lines or if a new piece of equipment has recently been added to network.	Check all cable connections and electrical outlets.
TST LED is ON	Local or remote device may be running a diagnostic test.	Clear test in progress by pressing NO LOOP, or ENTER? and CLT TST* category.
The device continuously retrains.	Slaves are not turned on or are disconnected.	Power on slave and verify processing.
	Receive level is too high.	Lower transmit level at Master or increase carrier detect threshold.
	CD threshold is too high.	Lower carrier detect threshold through CD THR: parameter located under LS ANGL+ lead parameters. Restart and monitor operation.
Blind time is too short.		Reconfigure round robin blind time through LS STP: parameter located under ANLG + lead parameter.

Table 13.5.1. Codex 3600 Series Modem Quick Checks -CONT

Problem	Cause	Solution
Improper configuration (refer to table 13.5.7).	Improper configuration has been entered.	Review CONFIG menu to ensure correct selections as shown in table 13.5.7 and change any nondefault parameters as necessary.
Device has no power.	DC inhibit switch is in STANDBY position.	Place dc inhibit switch in ON position.
TESTING is displayed continuously on front panel.	Poor handling during shipment.	Reseat cards, including Flex-cartridge and turn device OFF, then ON. Check DIAGNOS* category for possible failures.
ALM LED is ON.		Check DIAGNOS* category for possible failures.

Table 13.5.2. Codex 3600 Series Modem Signal Quality Test

Step	Procedure
1	Observe RSQ LED on front panel. a. RSQ ON reflects good signal. b. RSQ flashing reflects marginal signal quality. c. RSQ OFF reflects poor signal quality.
	NOTE When RSQ remains off for any length of time, it may indicate that the device is operating at a data rate that is too high for current line conditions. The ASOS maintenance technician can confirm that a problem exists in the telephone lines by checking the signal-to-noise (SNR) ratio and error probability (ERP) in the CQMS* category of the STATUS menu (figure 13.3.3). In order to configure or test the modem from its own front panel, the ASOS maintenance technician must first remove the device from network control by using the REMOTE menu, the MISC* category, and the OVERIDE parameter (figure 13.3.16). The following steps assume that the technician has properly logged onto the modem using his password.
2	Press REMOTE key on front panel four times. MISC* is displayed.
3	Press down arrow. OVERIDE is displayed.
4	Press right arrow. ENABLE is displayed.
5	Press <ENTER>. The ENABLE indicator flashes, indicating that network control has been overridden.
6	Press STATUS key on front panel three times. CQMS* is displayed.
7	Press down arrow twice. SNR=XXX is displayed, where XXX equals the SNR in decibels. The SNR is measured after it has passed through the receiver's equalizer. It is not the SNR of the telephone line, as the equalizer reduces the effects of certain types of channel distortion.
8	Press down arrow once. ERP=XXX is displayed where XXX equals the probability of error in percent. Error probability, which acts as a confirmation of line deterioration, increases as the amount of distortion increases. The ASOS maintenance technician evaluates the ERP as follows: a. 0 to 30% = Good b. 31 to 70% = Fair c. 71 to 99% = Marginal 100% triggers the RSQ indicator to turn off, indicating that the unit cannot pass data.

Table 13.5.2. Codex 3600 Series Modem Signal Quality Test -CONT

Step	Procedure
	NOTE The ASOS maintenance technician must disable OVERIDE in order to restore network control by performing the following steps.
9	Press REMOTE key on front panel. MISC* is displayed.
10	Press down arrow. OVERIDE is displayed.
11	Press right arrow. ENABLE is displayed.
12	Press right arrow. DISABLE is displayed
13	Press <ENTER>. The DISABLE indicator flashes, indicating that network control has been restored (i.e., OVERRIDE of network control has been disabled). The NC LED on the front panel is illuminated.

Table 13.5.3. Codex 3600 Series Modem Self-Test

Step	Procedure
	NOTE Review the TEST menu on figure 13.3.8. If power has been turned off to the modem, the password may have to be reentered in order to access the test menu. When the TEST menu key is pressed and if the modem asks for a password, reenter password using the right arrow key and enter 5215. When the display shows WELCOME, complete the following steps. During the self-test, the device disconnects itself from network control, generates test patterns through the internal circuitry, and displays the test results on the front panel.
1	Press TEST key five times to display SELF*. SELF* is displayed.
2	Press down arrow. START is displayed.
3	Press <ENTER>. TESTING is displayed. The modem performs an internal loopback test. When complete, PASSED or FAILED is displayed. If FAILED is displayed, replace modem. If PASSED is displayed, inform ADAS network manager that modem has passed self-test.

Table 13.5.4. BERT Test

Step	Procedure
	NOTE The technician's laptop computer, the BERT software program, and this procedure are used to test the modem. The Serial BERT (Async) software program should already be loaded onto the technician's laptop; if not, it should be installed using the instructions contained in the documentation accompanying the BERT software package.
1	Place modem power switch at rear of unit to OFF (position 0).
2	Connect laptop (with FRONTLINE Serial BERT Async) to modem as shown on figure 13.5.1. a. Connect serial port on laptop to Port 1 on modem. b. Plug an RJ-11 connector with pin 1 looped to pin 3 and pin 2 looped to pin 4 into connector J8 on the I/O panel of the ACU.
3	Configure the BERT as follows: a. Pattern = 2047 b. Block size = 10k c. Test length = 5 minutes d. Insert errors = 0 seconds e. Parity = None

Table 13.5.4. BERT Test -CONT

Step	Procedure
	f. Word length = 8 g. Stop BITS = 1 h. Baud RATE = 2400 (for premium, 1200 for standard) I. Port = COM1: j. Full duplex k. Flow Cntl = None l. Code = ASCII m. Sliding user message = No
4	At rear of modem, apply power by setting modem rocker power switch to ON (position 1).
5	Verify that modem completes power-on diagnostics and its ALM indicator is extinguished. If necessary, refer to table 13.5.7 to configure modem.
5.1	On modem front panel configure the modem as follows: a. Press CONFIG until DEVICE* is displayed. Press down arrow until LOAD DEF is displayed. Press ENTER. b. Press CONFIG until ANALOG* is displayed. Press down arrow until SELECT> is displayed. Press right arrow until LS ANGL + is displayed. Press down arrow until TX LVL: is displayed. Press right arrow until -13 DBM is displayed. Press ENTER. c. Press CONFIG until ANALOG* is displayed. Press down arrow until SELECT> is displayed. Press right arrow until DTE + is displayed. Press down arrow until MUX MOD: is displayed. Press right arrow until M is displayed. Press ENTER. d. Press CONFIG until PORTS* is displayed. Press down arrow until SELECT> is displayed. Press right arrow until PORT1 + (or proper port) is displayed. Press down arrow until DATA/CL: is displayed. Press right arrow until ASYNC 8D is displayed. Press ENTER. Proceed with BERT test.
6	Execute the BERT "RUN" command and verify that modem is in synch (DCD indicator on front panel is illuminated and not blinking). Verify that BERT status is "IN LOCK". Clear BERT display of any errors and allow system to run for approximately 5 minutes. The system must run without any errors. If an ERROR occurs, replace modem, reconfigure new modem, and repeat BERT test.
7	Remove laptop serial connection from modem.
8	If the BERT test has failed, replace modem in accordance with removal and installation procedures described in table 13.5.5.

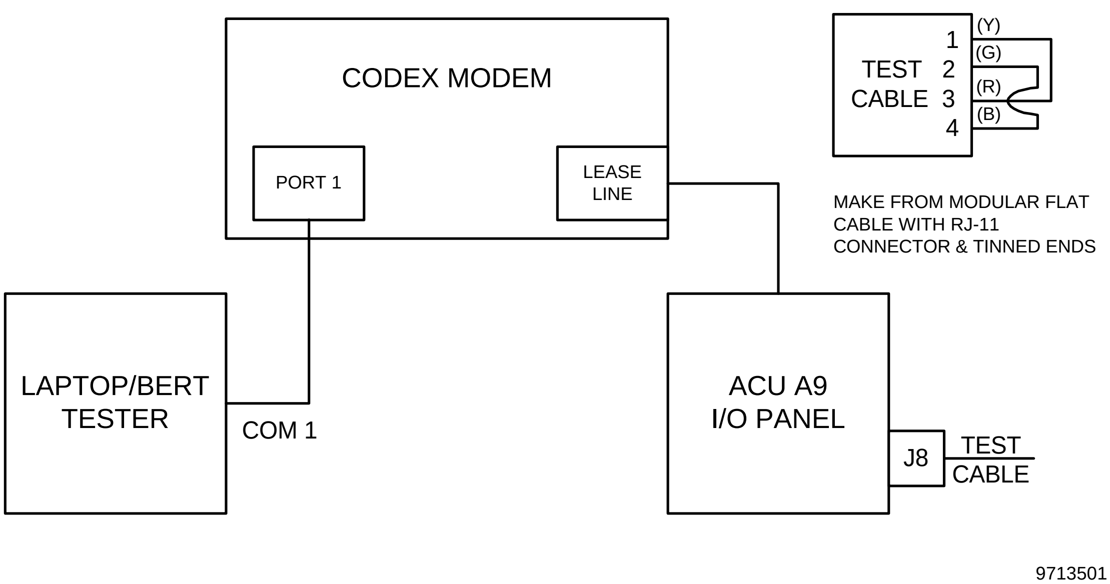


Figure 13.5.1. BERT Test Setup

Table 13.5.5. Codex 3600 Series Modem Removal and Installation

Step	Procedure
REMOVAL	
Tools Required: None	
1	If ACU is a Class I system, turn facility power to ACU OFF. If ACU is a Class II system, set UPS POWER SWITCH on UPS (1A4) to OFF.
2	Place modem power switch at rear of unit to OFF (position 0).
3	Disconnect all cables and power cord from rear panel of modem.
4	Loosen restraining strap holding modem in place.
5	Slide modem out of ACU rack.
INSTALLATION	
Tools Required: None	
1	If ACU is a Class I system, turn facility power to ACU OFF. If ACU is a Class II system, set UPS POWER SWITCH on UPS (1A4) to OFF.
2	Slide modem into ACU rack in position 1A1 onto brackets.
3	Secure modem in place by running strap (62828-90341-3) through 1-inch slot in angle brackets and fastening strap over modem.
4	Run modem power cord behind brackets to peripheral cable assembly (W79) and plug into empty socket.
5	If ACU is a Class I system, turn facility power to ACU ON. If ACU is a Class II system, set UPS POWER SWITCH on UPS (1A4) to ON.
6	Place modem power switch at rear of unit to ON (position 1).
7	Verify that modem completes power-on diagnostics by observing that ALM indicator on front panel is not illuminated.
8	Using procedure described in table 13.5.7, configure modem, then perform the following steps.
9	At rear of modem, remove power by setting modem rocker power switch to OFF (position 0).
10	If ACU is a Class I system, turn facility power to ACU OFF. If ACU is a Class II system, set UPS POWER switch on UPS (1A4) to OFF.
11	Locate cable from SIO board used for modem being replaced and connect cable to DTE PORT 1 connector on rear panel of modem being installed.
12	Connect RJ-45 connector end of phone cable (62828-42045-10) to LEASE port on rear panel of modem being installed.
13	Install RJ-11 connector end of phone cable (62828-42045-10) installed in step 12 to phone filter on ACU I/O panel at connector J8.
14	If ACU is a Class I system, turn facility power to ACU ON. If ACU is a Class II system, set UPS POWER switch on UPS (1A4) to ON.
15	At rear of modem, apply power by setting modem power rocker switch to ON (position 1).
16	Verify power up by performing the following steps: a. After WAITING indication extinguishes on alphanumeric display and transmission rate (9.6 for a Standard modem and 19.2 for a Premium modem) appears, press STATUS key. b. Press STATUS key again. DIAGNOS* appears. c. Using down arrow, drop to PASSED. If PASSED is displayed, perform the following steps. If FAILURE is displayed, notify ADAS cognizant personnel.

Table 13.5.5. Codex 3600 Series Modem Removal and Installation - CONT

Step	Procedure
	NOTE The ASOS maintenance technician must disable OVERIDE in order to restore network control by performing the following steps.
17	Press REMOTE key on front panel. MISC* is displayed.
18	Press down arrow. OVERIDE is displayed.
19	Press right arrow. ENABLE is displayed.
20	Press right arrow. DISABLE is displayed.
21	Press <ENTER>. The DISABLE indicator flashes, indicating that network control has been restored (i.e., OVERRIDE of network control has been disabled). The NC LED on the front panel is illuminated.

Table 13.5.6. Flex-Cartridge Removal and Installation

Step	Procedure
	REMOVAL
	Tools Required: None **NOTE** The 3600 modem is shipped from Codex with the Flex-cartridge installed.
1	Open front panel.
2	**CAUTION** Ensure that the dc inhibit switch is in STANDBY position prior to removing the flex cartridge. Failure to comply could result in equipment damage. Place dc inhibit switch in STANDBY position (refer to figure 13.5.2) to disable dc power. This allows removal of the cartridge without disconnecting the modem.
3	Firmly grasp left and right sides or top and bottom of Flex-cartridge and pull it from its rear connector (refer to figure 13.5.3). Hold processor card in place during this step to prevent processor card from becoming dislodged.
	INSTALLATION
	Tools Required: None **CAUTION** Ensure that the dc inhibit switch is in STANDBY position prior to removing the flex cartridge. Failure to comply could result in equipment damage.
1	Align new Flex-cartridge with left and right guides and firmly slide cartridge into place until it engages rear connectors.
2	Place dc inhibit switch in ON position.
3	Close front panel.

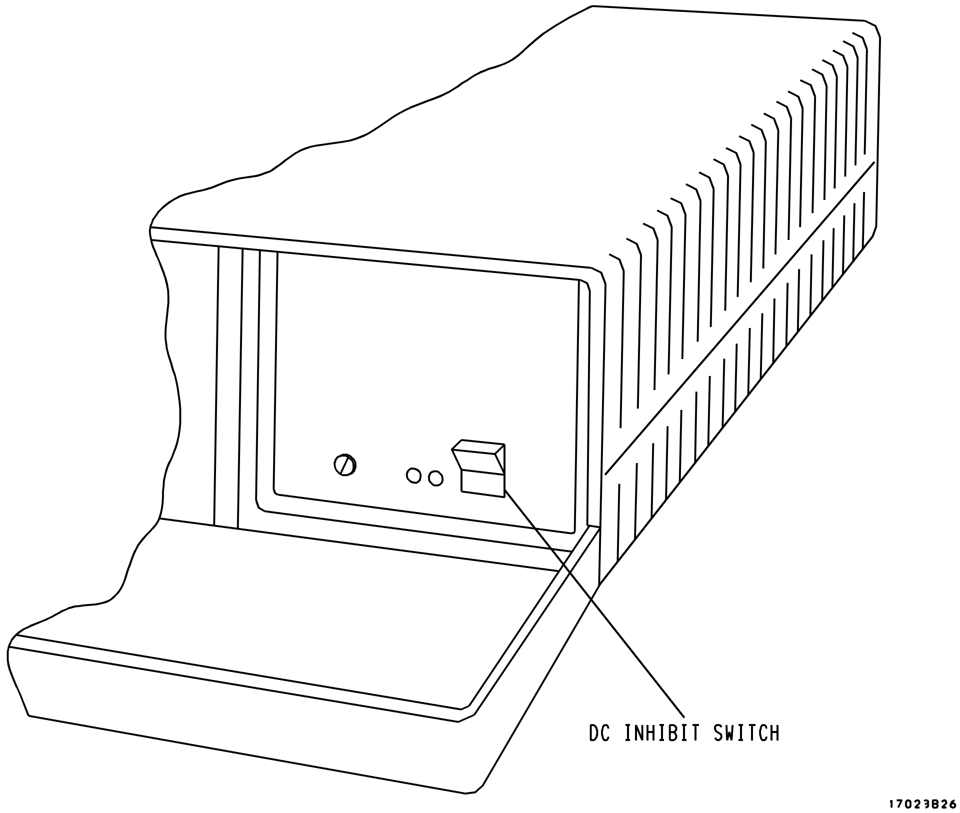


Figure 13.5.2. Disabling DC Power Through the DC Inhibit Switch

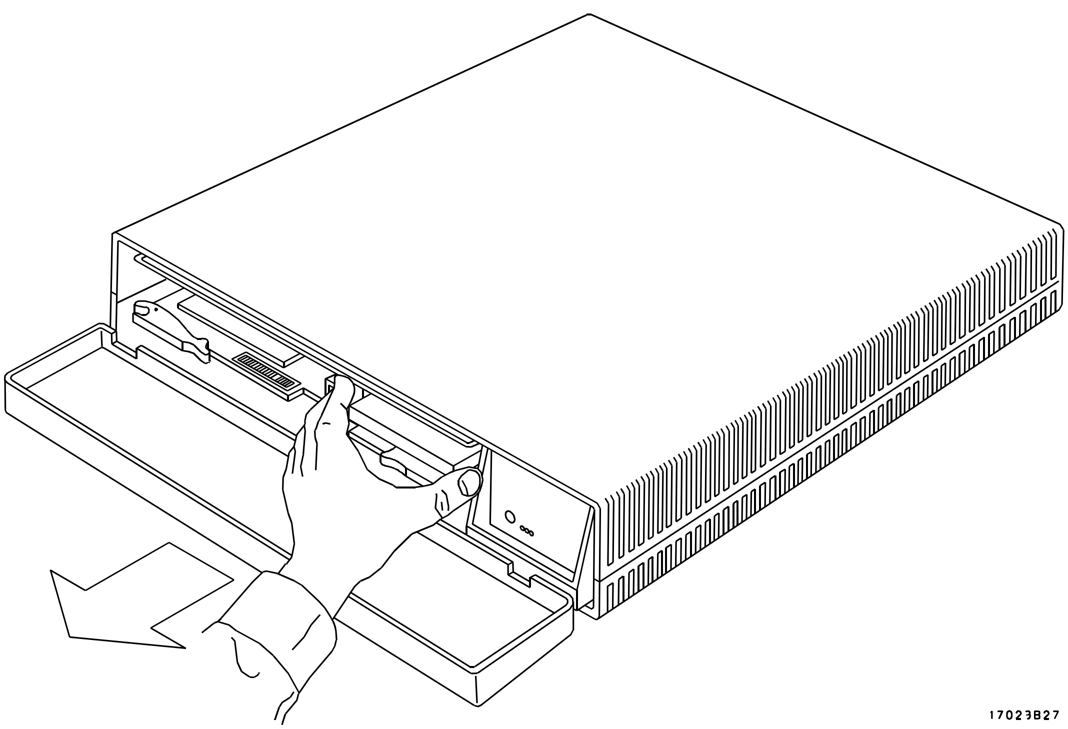


Figure 13.5.3. Removing and Installing the Flex-Cartridge

Table 13.5.7. Configuring the Codex 3600 Series Modem

Step	Procedure
	NOTE Review the menu hierarchy described in Section III before configuring the modem in accordance with the following steps. Use the menu hierarchy as a guide in configuring the modem. There are two configuration setups for the Codex modem: Standard (multipoint) and Premium (point-to-point). Follow the strapping instructions for the particular Flex-cartridge (Standard or Premium) in the Codex modem.
	STANDARD MODEM
1	Apply power to the modem and turn power on.
2	Press REMOTE. ENTR PSW is displayed. Enter 5215 as the password. To enter the password: a. Press right arrow. The left-most digit now flashes, indicating that it may be changed. b. Press ADV# key to change value of current digit until correct value is displayed. c. Press the right arrow to advance to the next digit. d. Continue performing steps b and c until all four digits (5215) have been entered. e. Press ENTER when correct password is displayed. WELCOME displays on the LED screen.
3	Press REMOTE four times or until MISC* is displayed. Press the down arrow once or until OVERIDE: is displayed. Press the right arrow twice or until ENABLE is displayed. Press ENTER.
4	Press CONFIG once or until DEVICE* is displayed. If ENTR PSW is displayed, enter 5215 as in step 2. Use the down arrow to sequence through the following selections. Verify/set : LOAD DEF: Press ENTER to signify yes. Press down arrow. MODE: Press right arrow until 3600 is displayed, then press ENTER. Press down arrow. MAX RTE: Press right arrow until 4.8 is displayed, then press ENTER. Press down arrow. PORT/CH: Press right arrow, use ADV# and right arrow to input 12345678. Press ENTER.
5	Press CONFIG twice or until ANALOG * is displayed. Press the down arrow once, SELECT > is displayed. Press the right arrow once or until LS ANLG+ is displayed. Use the down arrow to sequence through the following selections. Verify/set : OP MODE: Press right arrow until MP-S is displayed. Press ENTER. Press down arrow. RATE_0: Press right arrow until 4.8 is displayed. Press ENTER. Press down arrow. TX LEVEL: Press right arrow until -13 DBM is displayed. Press ENTER.
6	Press CONFIG until ANALOG * is displayed. Press the down arrow once, SELECT > is displayed. Press the right arrow three times or until DTE + is displayed. Use the down arrow to sequence through the following selections. Verify/set : MUX MODE: Press right arrow until B is displayed. Press ENTER. Press down arrow. TIMING: Press right arrow until LOOPBACK is displayed. Press ENTER. Press down arrow. SPD CTL: Press right arrow until REMOTE is displayed. Press ENTER

Table 13.5.7. Configuring the Codex 3600 Series Modem - CONT

Step	Procedure
7	Press CONFIG until PORTS* is displayed. Press the down arrow once, SELECT > is displayed. Press the right arrow until PORT 1 + is displayed. Use the down arrow to sequence through the following selections. Verify/set : DATA CL: Press right arrow until SYNC EXT is displayed. Press ENTER. Press down arrow. P1 STP1: Press right arrow once. Use right arrow and ADV# keys to display 00000000. Press ENTER. Press down arrow. P1 STP2: Press right arrow once. Use right arrow and ADV# keys to display 00000010. Press ENTER.
8	Press CONFIG until NWK CTL* is displayed. Use down arrow to sequence through the following selections. Verify/set : ADDRESS: Use right arrow and ADV# keys to display default address. Press ENTER. Press down arrow. NC STP1: Press right arrow once. Use right arrow and ADV# keys to display 00000000. Press ENTER.
9	Press REMOTE until MISC* is displayed. Use the down arrow to sequence display to OVERIDE. Press right arrow until DISABLE is displayed. Press ENTER. Codex is now configured.
PREMIUM MODEM	
1	Apply power to the modem and turn power on.
2	Press REMOTE. ENTR PSW is displayed. Enter 5215 as the password. To enter the password: a. Press right arrow. The left-most digit now flashes, indicating that it may be changed. b. Press ADV# key to change value of current digit until the correct value is displayed. c. Press right arrow to advance to next digit. d. Continue performing steps b. and c. until all four digits (5215) have been entered. e. Press ENTER when correct password is displayed. WELCOME displays on LED screen.
3	Press REMOTE four times or until MISC* is displayed. Press the down arrow once or until OVERIDE: is displayed. Press the right arrow twice or until ENABLE is displayed. Press ENTER.
4	Press CONFIG until DEVICE * is displayed. If ENTR PSW is displayed, enter 5215 as in step 2. Use the down arrow to sequence through the following selections. Verify/set : LOAD DEF: Press ENTER to signify yes. Press down arrow. MODE: Press right arrow until 3600 is displayed, then press ENTER. Press down arrow. MAX RTE: Press right arrow until 19.2 is displayed, then press ENTER. Press down arrow. PORT/CH: Press right arrow, use ADV# and right arrow to input 12345678. Press ENTER.
5	Press CONFIG twice or until ANALOG * is displayed. Press the down arrow once, SELECT > is displayed. Press the right arrow until LS ANLG+ is displayed. Use the down arrow to sequence through the following selections. Verify/set : OP MODE: Press right arrow until TURBO is displayed. Press ENTER. Press down arrow. RATE_0: Press right arrow until 19.2 is displayed. Press ENTER. Press down arrow. TX LEVEL: Press right arrow until -13 DBM is displayed. Press ENTER.

Table 13.5.7. Configuring the Codex 3600 Series Modem - CONT

Step	Procedure
6	Press CONFIG until ANALOG* is displayed. Press the down arrow once, SELECT > is displayed. Press the right arrow until DTE + is displayed. Use the down arrow to sequence through the following selections. Verify/set : MUX MODE: Press right arrow until UDM1 is displayed. Press ENTER. Press down arrow. TIMING: Press right arrow until LOOPBACK is displayed. Press ENTER. Press down arrow. SPD CTL: Press right arrow until REMOTE is displayed. Press ENTER
7	Press CONFIG until PORTS* is displayed. Press the down arrow once, SELECT > is displayed. Press the right arrow until PORT 1 + is displayed. Use the down arrow to sequence through the following selections. Verify/set : DATA CL: Press right arrow until SYNC EXT is displayed. Press ENTER. Press down arrow. P1 STP1: Press right arrow once. Use right arrow and ADV# keys to display 00001000. Press ENTER. Press down arrow. P1 STP2: Press right arrow once. Use right arrow and ADV# keys to display 00000010. Press ENTER.
8	Press CONFIG until NWK CTL* is displayed. Use the down arrow to sequence through the following selections. Verify/set : ADDRESS: Use right arrow and ADV# keys to display default address. Press ENTER. Press down arrow. NC STP1: Press right arrow once. Use right arrow and ADV# keys to display 00000000. Press ENTER.
9	Press REMOTE until MISC * is displayed. Use down arrow to sequence display to OVERIDE. Press right arrow until DISABLE is displayed. Press ENTER. Codex is now configured.

CHAPTER 14

SINGLE-CABINET ASOS (SCA) AND ASSOCIATED EQUIPMENT

SECTION I. DESCRIPTION AND LEADING PARTICULARS

14.1.1 INTRODUCTION

The single-cabinet ASOS (SCA) contains both the Acquisition Control Unit (ACU) and data collection package (DCP) within one cabinet and is designed for outdoor installation. The same peripherals and sensors are used on the SCA as on the standard ASOS. This chapter documents the SCA cabinet and associated equipment. The table of contents is referenced for the chapters containing sensors and optional equipment used by both the SCA and the standard ASOS.

14.1.2 SITE DESCRIPTION

A typical SCA site, figure 14.1.1, has the SCA cabinet (with ACU and DCP equipment) located outdoors. The single-cabinet ASOS configuration need not be located at an airfield: any clear site with 115 Vac, 1ϕ, and telephone service will suffice.

NOTE

The SCA discussed in this chapter is different from the standard ASOS Class I reduced capability configuration. The SCA contains both the ACU and DCP in an equipment cabinet designed for outdoor use. The ASOS Class I reduced capability configuration uses the standard indoor ACU equipment cabinet (which requires shelter) and contains internal (local) DCP interface for sensors located close to the shelter. Chapter 2 is referenced for ASOS Class I reduced capability configuration.

14.1.3 PURPOSE OF CHAPTER

This chapter serves as the primary source of technical information for site maintenance personnel engaged in maintaining the SCA. SCA theory presented in this chapter is similar to the theory for the standard ASOS discussed in Chapter 1. Information provided in this chapter enables maintenance personnel to quickly remedy any problem and restore the SCA to service. This chapter must be used with other chapters in this ASOS Site Maintenance Manual (STM) and other publications listed in paragraph 14.1.5.

14.1.4 SCOPE OF CHAPTER

This chapter provides all information neg15
cessary for SCA on-site maintenance support. Included are preventive maintenance instructions, operation, fault isolation, and removal/installation of field replaceable units (FRU's). For information on sensor subsystems, the respective chapters of this Site Technical Manual (STM) are referenced. Chapter 14 includes five sections as described in the following paragraphs.

14.1.4.1 **<u>Section I, Description and Leading Particulars</u>**. This section provides an overview of the system/subsystem and should be used to gain a general understanding of the SCA configuration or to obtain physical descriptions and location information.

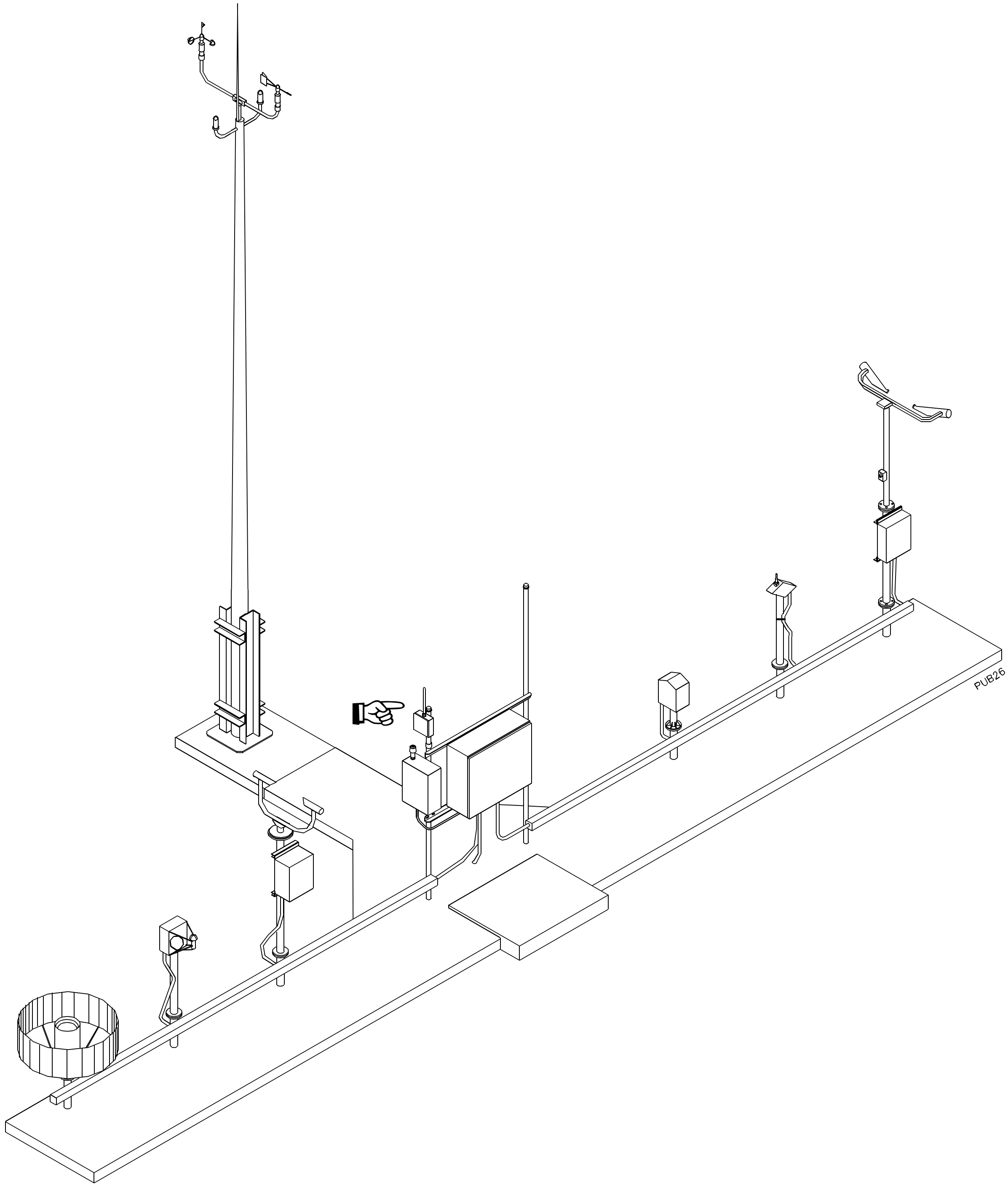


Figure 14.1.1. Typical ASOS Site, Single-Cabinet Configuration

14.1.4.2 **Section II, Installation**. Section II assumes that the SCA FRU's were previously installed by the factory installation team and that all mounting hardware and electrical wiring is in place.

14.1.4.3 **Section III, Operation**. Section III provides procedures for sequencing power, initializing, determining operational status, and operating the SCA. This information enables maintenance personnel to effectively use the SCA, but does not repeat information contained in Chapter 1, Section III which applies generally to SCA sites as well as for standard ASOS sites. Standard operating procedures (SOP's) are provided in the ASOS Software Users Manual.

14.1.4.4 **Section IV, Theory of Operation**. Section IV provides detailed SCA theory of operation and contains basic and detailed block diagrams.

14.1.4.5 **Section V, Maintenance**. Section V provides SCA corrective and preventive maintenance procedures for cleaning and inspection, adjustment, calibration, troubleshooting using resident diagnostic firmware, and failed FRU removal/replacement. The SCA parts lists are **located after the last chapter in volume II** . SCA sites may also include up to three remote DCP's and associated sensors. Section 14.5 should be used as a troubleshooting guide or when performing SCA scheduled or corrective maintenance.

14.1.5 **RELATED PUBLICATIONS**

In addition to this chapter, the SCA site is supported by the other chapters of ASOS Technical Manual (STM) S100, in addition to the following manuals:

- ASOS Software User's Manual - Provides detailed information on ASOS operation and ASOS OID displays.
- ASOS Ready Reference Guide - Contains ASOS operator reference information.
- Link MC70 User's Guide - Provides OID vendor support information.
- Panasonic dot matrix printer model KX-P3123 Operating Instructions Manual - Provides dot matrix printer vendor support information.
- UDS 2440 Installation and Operation - Provides model 2440 stand-alone telephone modem vendor support documentation.
- UDS V.3225 Installation and Operation - Provides model V.3225 stand-alone telephone modem vendor support documentation.
- UDS V.3400 Installation and Operation - Provides vendor support documentation for the model V.3400 stand-alone telephone modems.

14.1.6 **SCA FUNCTIONAL DESCRIPTION**

As shown in the basic block diagram (figure 14.1.2), the typical SCA consists of a central cabinet, sensors that gather weather information, and modems that communicate with user facilities. Optional peripherals may include a laptop computer (not supplied) that allows data access and equipment control during maintenance activities. An optional, standard FAA handset allows voice messages to be appended to the computerized observation message to convey special information for pilots (e.g., Notice to Airmen Messages (NOTAM's)).

Other optional terminal equipment available for the standard ASOS is also available for the SCA. Regardless of configuration type, all ASOS sites contain at least three major units: ACU or SCA, sensors, and peripherals. The SCA and standard ASOS ACU cabinet may be supplemented by up to three (optional) DCP's at sites where remote data collection is required.

The SCA can accommodate a ground-to-air (GTA) radio and a Codex Modem. A weatherproof auxiliary box (aux box) is provided to accommodate either or both of these units plus a second (optional) uninterruptible power supply (UPS) unit. When required, the aux box will be installed with the SCA. $

SCA ASOS sites differ in the quantity of each component type included in the configuration but all sites include only one SCA cabinet. The SCA site may include any of the standard or optional equipment items listed in the parts list. Chapter 3 contains information on DCP's. Each sensor performs a specialized function in gathering local raw surface weather data. At a minimum, the typical ASOS site has sensors to collect pressure, temperature/dewpoint, wind, and precipitation data. At the typical SCA site, the SCA houses all on-site equipment and the pressure sensors. Sensors, other than the pressure sensors, are mounted external to the SCA.

The entire SCA is designed to operate outdoors. Data and phone lines may be routed to an airport terminal (or other building) where one operator interface device (OID) and/or one video display unit (VDU) may be located (but not more than 100 feet from the SCA). Sensors are either polled by the SCA or automatically transfer data to the SCA for incorporation into the ASOS data processing scheme. Up to 13 local sensors (in addition to the pressure sensors) can be connected directly to the SCA. At sites where an optional DCP is
$ installed, up to 16 additional sensors may be added per DCP.

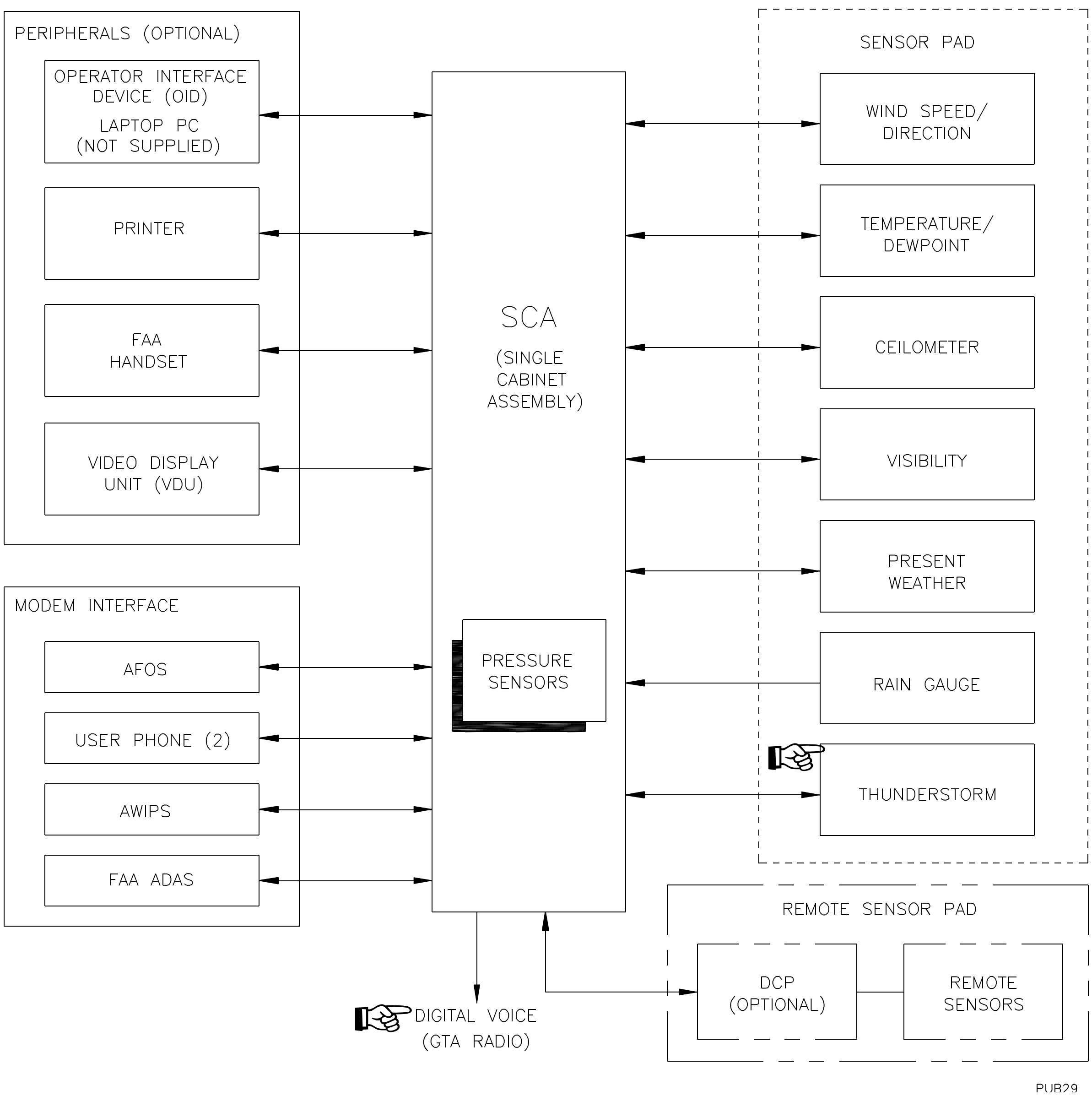


Figure 14.1.2. Single-Cabinet ASOS, Basic Block Diagram

14.1.7 **SCA CONFIGURATION**

Each SCA is configured to meet specific site-peculiar requirements. The established site configuration can be reviewed by accessing the site configuration screens via an operator interface device (OID), laptop personal computer (PC), or remote terminal. This site maintenance manual provides maintenance documentation for all assemblies and subassemblies included in the ASOS but does not relate to any specific configuration. The technician should consult the configuration pages and site specific documentation to determine sensor configuration, sensor pad configuration, assigned peripherals, facility power, and signal cable routing.

SCA sites can be equipped with a wide variety of equipment, depending upon operational requirements and customer options. To accommodate site requirements, core equipment complements have been established to which sensor subsystems, peripheral equipment, and options can be added by selecting kits. These kits are a collection of assemblies and parts needed to install those assemblies. Shelters are not required for any SCA configuration. Core single-cabinet systems are designated as follows:

S1 - Class I SCA, for small airports. SCA core equipment complement includes power delay relay, two pressure sensors, precipitation identification, cloud height, visibility, rain gauge, temperature/dewpoint, and wind sensors. May have the aux box if site includes codex modem or GTA Radio.

S2 - Class II SCA, for special nonairport sites. SCA includes UPS with power delay and UPS bypass, may have up to three DCP's (each with a UPS), and may have the aux box (and an additional UPS). S2 SCA includes three pressure sensors, wind, temperature/dewpoint, visibility, cloud height, precipitation ID, rain gauge sensors. An OID is also standard equipment at S2 sites.

SR - Class I SCA with reduced capability (no optical sensors), includes power delay relay, two pressure sensors, rain gauge, temperature/dewpoint, and wind sensors.

14.1.8 **SCA PHYSICAL DESCRIPTION**

The SCA houses and interconnects the FRU's which are identified on figure 14.1.3 and in table 14.1.1. The SCA parts list **(located after the last chapter in volume II)** contains part number information.

14.1.8.1 **Mounting Plate Assembly 7A1A1**. Most of the SCA electronic assemblies are located on Mounting Plate Assembly 7A1A1. The mounting plate is secured on studs against the inside back surface of the SCA. The following FRU's are mounted on Mounting Plate Assembly 7A1A1:

14.1.8.1.1 **VME Rack 7A1A1A2 Description**. The VME rack assembly, shown in figure 14.1.4, contains 2 rows of 96-pin connector sockets on the backplane for up to 21 printed circuit card assemblies (CCA's). Reference designators for each card are located on a marker strip at the top-front of the rack. The top row of connectors are for the 32-bit VME data bus, while the lower row provides interconnections and operating voltages. Three exhaust fans are mounted beneath the rack to force cooling air upward, between, and around installed CCA's.

14.1.8.1.2 **Circuit Breaker Panel 7A1A1A3 Description**. The circuit breaker panel is located below the VME rack. The panel contains 22 single-pole magnetic circuit breakers and a DB-25F connector socket (J1) for connecting the primary OID. At most SCA sites, the only OID will be the technicians laptop PC. An optional DB-25 to telco adapter (PN 62828-90197-1) is available for RS-232 interface to the PC via 4-conductor telephone cable.

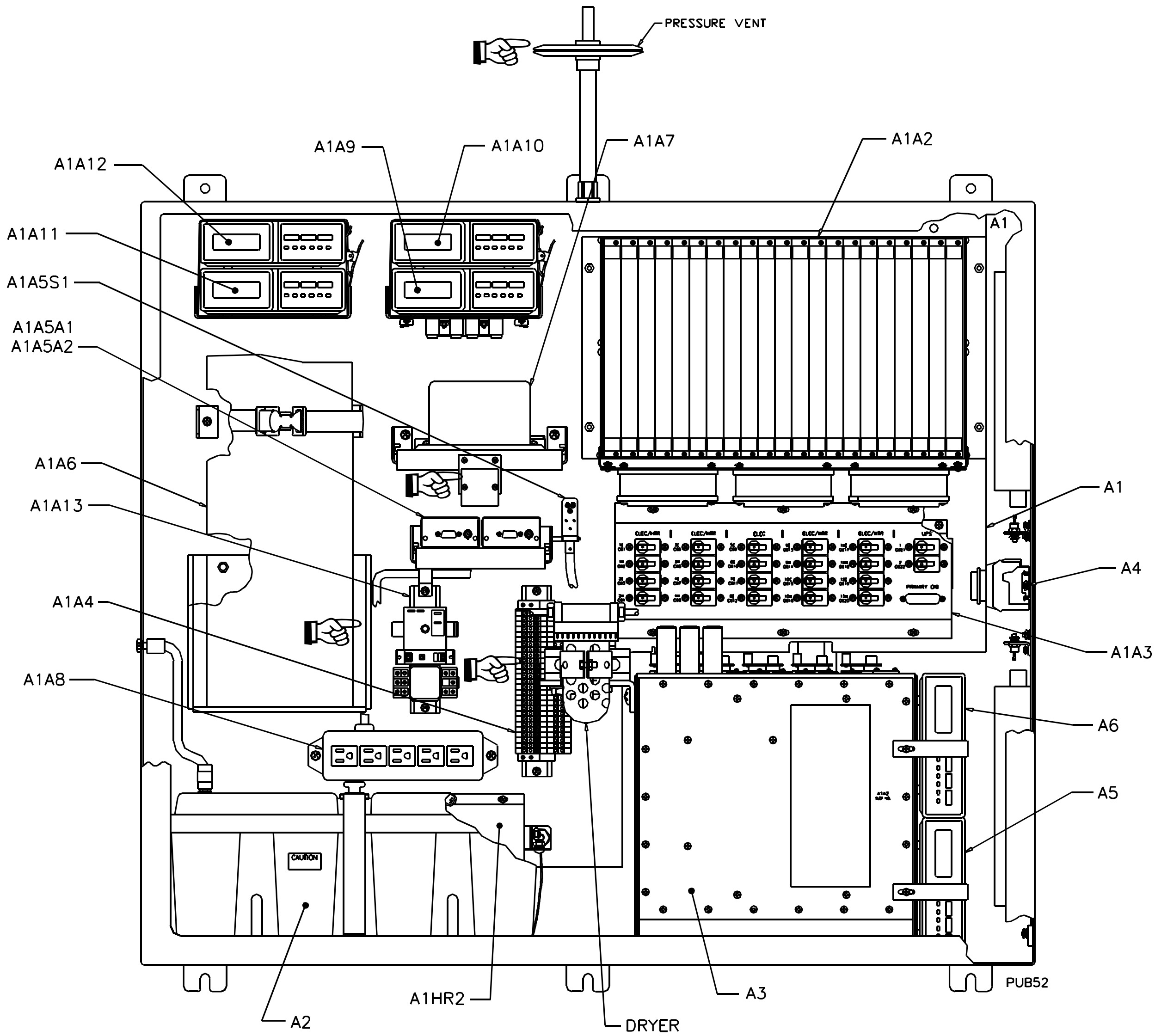


Figure 14.1.3. SCA Cabinet 7A1, Interior View

Table 14.1.1. SCA (7A1) Major Components

	Ref Des	Description	Ref Des	Description
	7A1A1	Mounting Plate Assembly	7A1A1A9,A10	User Modems #1, #2 (Optional)
$	7A1A1A2	VME Rack Assembly	7A1A1A11	Optional Modem
$	7A1A1A3	Circuit Breaker Panel	7A1A1A12	Optional Modem
$	7A1A1A4	AC Power Distribution Assembly	7A1A1A13	Power Reset Assembly
	7A1A1A5	RF Modem Shelf (Optional)	7A1A1HR2	Heater, Battery (Optional)
	7A1A5A1,A2	RF Modem #1, #2 (Optional)	7A1A2	Battery Box Assembly (Optional)
	7A1A1A5S1	RF Modem Switch (Optional)	7A1A3	Faraday Box
	7A1A1A6	UPS (Optional)	7A1A4	Power Supply Mounting Plate
$	7A1A1A7	Pressure Shelf Assembly	7A1A5,A6	Optional Modem
	7A1A1A8	Power Outlet Strip		

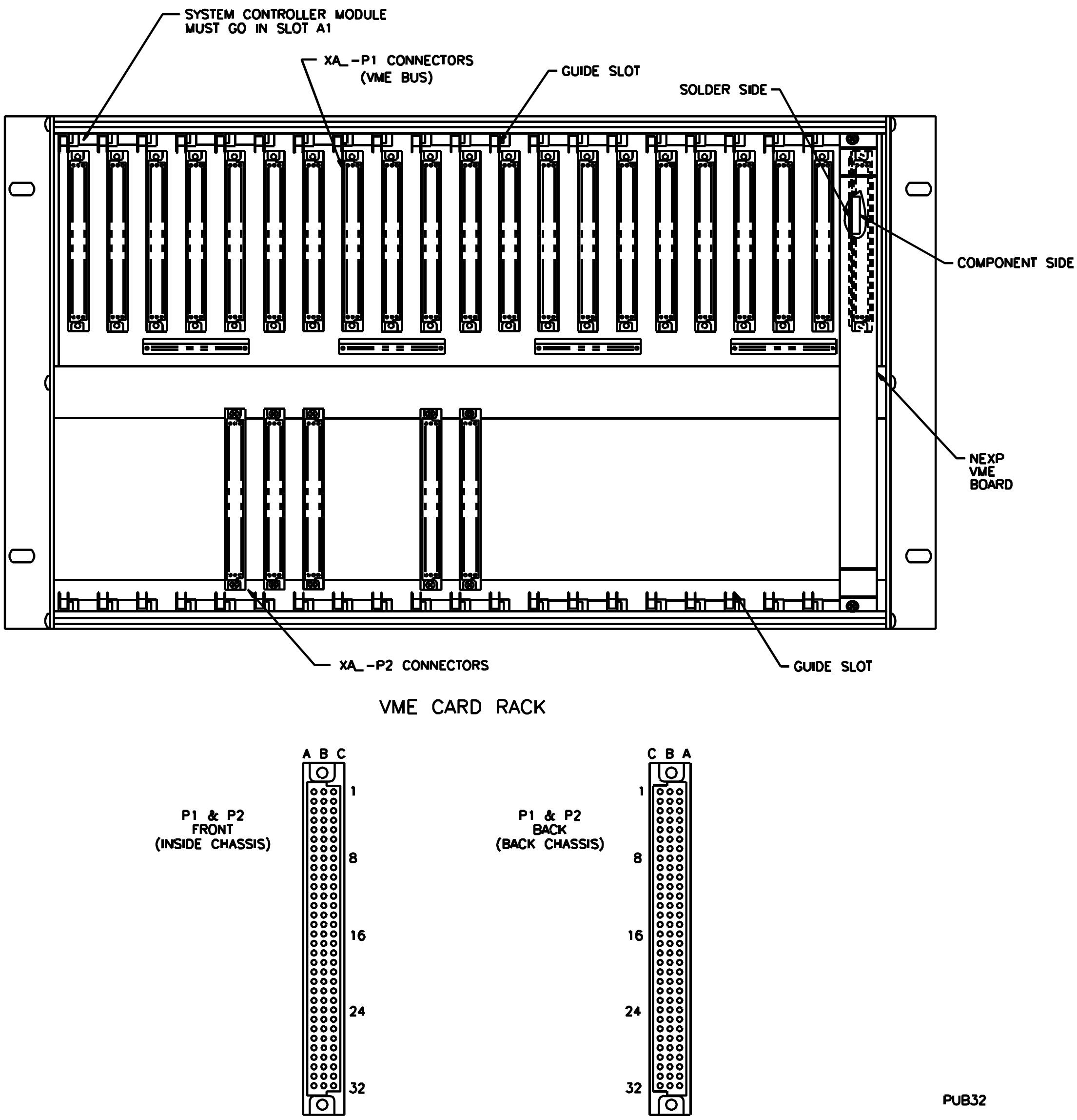


Figure 14.1.4. VME Rack 7A1A1A2, Front View

14.1.8.1.3 **AC Power Distribution Assembly 7A1A1A4 Description**. The AC power distribution assembly is mounted vertically at the center of the cabinet. The assembly contains 27 rail-mounted terminal blocks. Each terminal block has four screw-swaged wire terminals to provide connections for 115 VAC, neutral, and ground wires.

14.1.8.1.4 **RF Modem Shelf 7A1A1A5 Description**. The rf modem shelf (optional) is located above the ac power distribution assembly in the center of the cabinet. The rf modem shelf provides mounts and interconnections for up to two rf modems (optional) and RF Switch 7A1A1A5S1. The rf modem provides the communications link between the SCA and DCP's when the site configuration includes DCP's. The second rf modem and rf switch provide a redundant communications link between the SCA and DCP in the event that the primary rf modem fails.

$
$
$

NOTE

When a Motorola modem (62828-90315-XX) fails and spare Motorola modems are not available, a Johnson Data modem (62828-40506-X), an adapter cable (62828-42110-10), and a SMAM-to-BNCF adapter must be ordered to replace the failing modem. Kit part number 62828-40378-xx can be ordered the first time that the Johnson Data modem is installed in the SCA.

The original equipment SCA rf modem shelf must be replaced with rf modem shelf 62828-40322-20 to support mounting both the Motorola and Johnson Data modems (Motorola and Johnson Data modems can coexist within the SCA).

The adapter cable and SMAM-to-BNCF adapter must be removed if a Johnson Data modem fails and a Motorola modem is installed.

14.1.8.1.4A **Uninterruptible Power Supply 7A1A1A6 Description**. A UPS is included in the Class II SCA to provide a backup ac power source for the SCA and up to nine sensors. If more than nine sensors are associated with a Class II SCA, a secondary UPS is installed in an optional auxiliary box. Either Deltek UPS 62828-90338-10 or Deltek UPS 62828-90338-20 may be installed.

14.1.8.1.5 **Pressure Mounting Assembly 7A1A1A7 Description**. The pressure mounting assembly is located above the rf modem shelf. The assembly provides mounts and interconnections for three identical pressure sensor assemblies (7A1A1A7A1, A2, and A3) as shown on figure 14.1.5. Temperature sensor board (7A1A1A7A4) is mounted on the front of the pressure sensor shelf. Plastic vent tubes from each sensor are joined under the pressure shelf to a tube cross and then routed to the pressure port at the top of the cabinet.

14.1.8.1.6 **Power Outlet Strip 7A1A1A8 Description**. The outlet strip is mounted below the UPS, on the bottom left side of the cabinet. The outlet strip is rated at 15 amperes, continuous, and provides connection for up to five ac power plugs (with grounding pins)

14.1.8.1.7 **User Modems 7A1A1A9, A10 Description**. The user modems are located at the top of the cabinet, next to the VME rack. User modems operate as stand-alone 2400, 9600, or 28800 baud modems that connect to dedicated lines. User 1 Modem 7A1A1A9 is supplied with each system and is used to connect to the AOMC. Optional User 2 Modem 7A1A1A10 provides an additional dedicated line connection to the SCA.

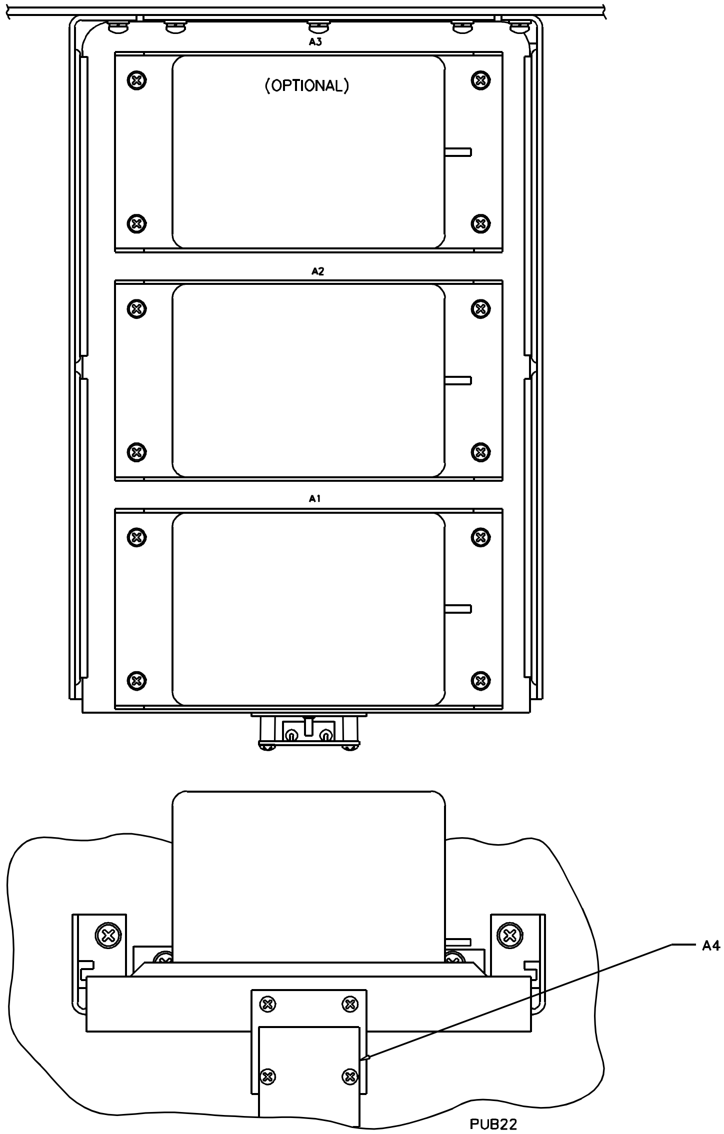


Figure 14.1.5. Pressure Sensor Shelf 7A1A1A7, Front View

14.1.8.1.8 **Optional Modems 7A1A1A11, A12 Description**. The optional modems are located in the upper left corner of the cabinet. The optional modems can be 2400, 9600 or 28800 baud. The optional modems are used to connect to AFOS, OID's, VDU's, printer, or telco.

14.1.8.1.9 **Power Reset Assembly 7A1A1A13 Description**. Power Reset Assembly 7A1A1A13 is located to the left of the ac power distribution assembly. The power reset assembly contains a Time Delay Relay 7A1A1A13K1 (Class I and Class II), Digital I/O Module 7A1A1A13K2 (Class II only), and Power Relay 7A1A1A13K3 (Class II only). The time delay relay ensures that the SCA resets properly after power is interrupted by delaying power application approximately three seconds. The digital I/O module and power relay provide the Class II SCA with UPS bypass capabilities.

14.1.8.2 **Faraday Box 7A1A3 Description**. The Faraday box is located in the lower right corner of the cabinet, beneath the circuit breaker panel. All SCA external signal and power lines pass through flex conduits in the bottom of the Faraday Box to prevent rain water from entering the cabinet. Fiber optic cables that enter the Faraday Box connect to fiber optic modems located on the top of the Faraday box. The Faraday box also contains two columns of track-mounted terminal blocks on the back side of the hinged front cover that terminate external power and signal lines. The Faraday box has an internal cable assembly that connects the terminals to connectors mounted on the top or left side surfaces of the box as shown on figure 14.1.6. Mating connectors are part of SCA wiring harness 7A1W106. Dependent upon the site specific SCA equipment configuration, blank cover plates are used in place of connectors not used by the SCA.

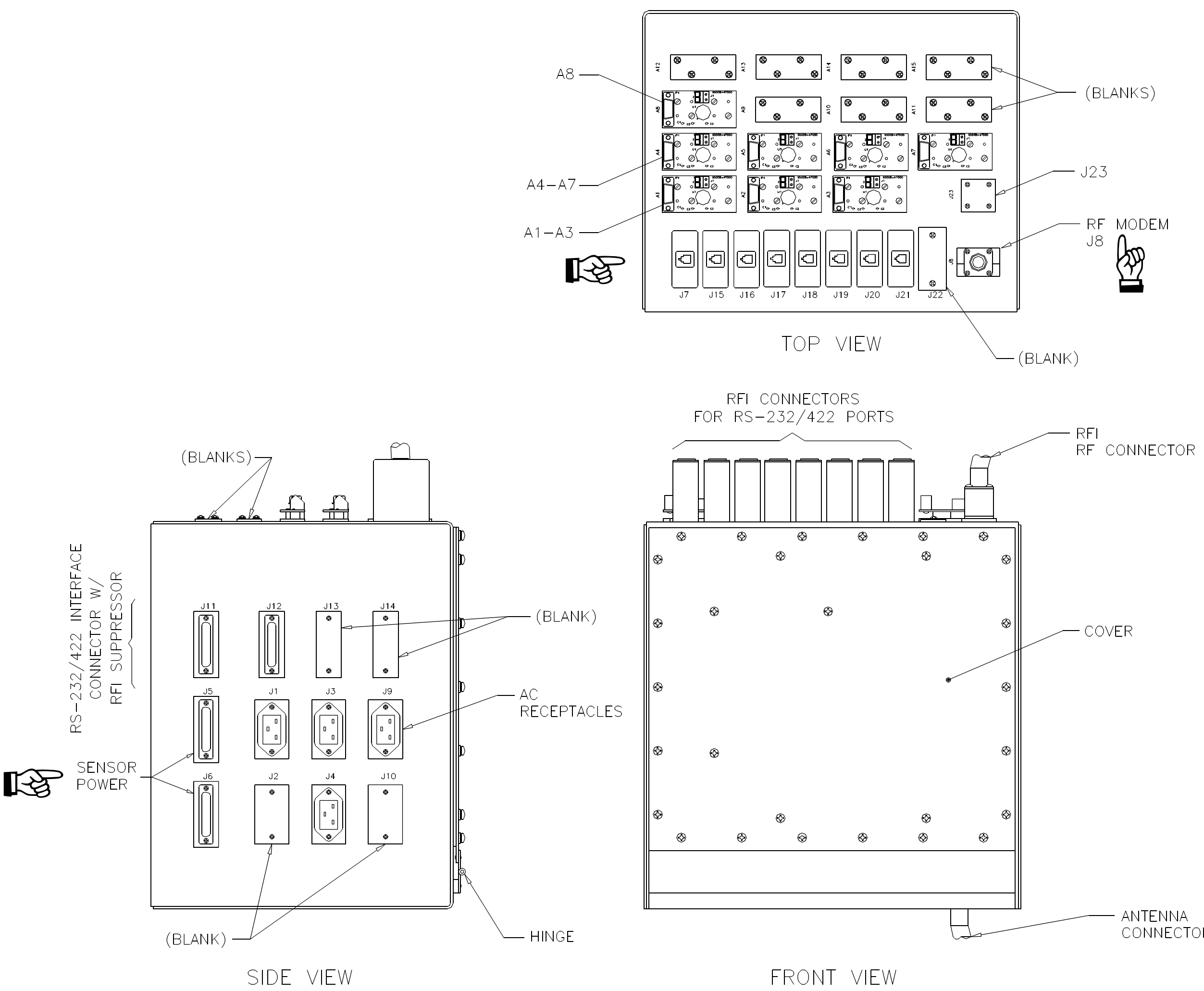


Figure 14.1.6. Faraday Box A3, Panel Views

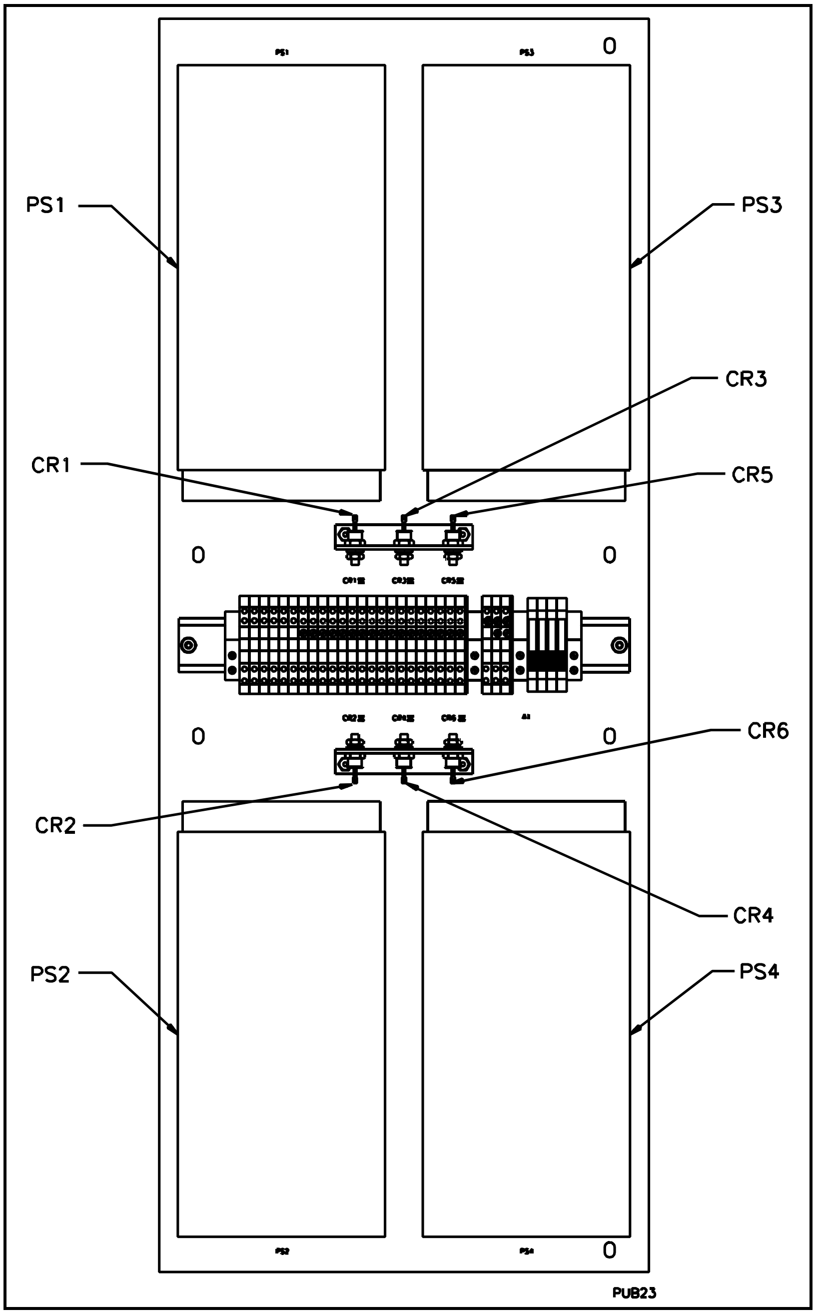


Figure 14.1.7. Power Supply Assembly A4, Front View

14.1.8.3 **Power Supply Mounting Plate 7A1A4**. The power supply mounting plate (figure 14.1.7) is mounted against the SCA right side interior and supplies all dc operating voltages (-12V, +12V, and +5V) for the other assemblies in the SCA. Each of two 12V supplies output both -12V and +12V, while the two 5V supplies output positive voltage only. Supply outputs are paired by OR diodes, so that loss of either supply of a pair can not affect the operating voltage. The power supply mounting plate also includes DC Power Distribution Assembly 7A1A4A1, which distributes all dc operating voltages and protects the power supply inputs with 3.15A fuses on the 5V supply inputs and 2.5A fuses on the 12V supply inputs.

14.1.8.4 **Modems 7A1A5, A6 Description**. These optional, additional modems are located in the lower right corner of the cabinet. The type and use of these modems are established for each site by the customer.

14.1.8.5 **Optional Solar Shield**. A solar shield kit (P/N 62828-40409-10) is available for SCA sites that experience intense solar load and high temperatures. $ $ $

14.1.9 **AUXILIARY BOX PHYSICAL DESCRIPTION**

14.1.9.1 **Enclosure**. The auxiliary box (figure 14.1.8 and table 14.1.2) is a weather-resistant enclosure that measures approximately 42 inches in width and 36 inches high, exclusive of mounting tabs.

14.1.9.2 **Auxiliary Box Standard Equipment**. Supplied as standard equipment in Auxiliary Box 7A2 are AC Power Distribution Strip 7A2A1A4, Modem Mounting Shelf 7A2A1A5 (without the modems), and Heater Strip 7A2A1HR1. All other equipment components to be installed in the aux box are customer-ordered options, delivered as separate kits. $ $

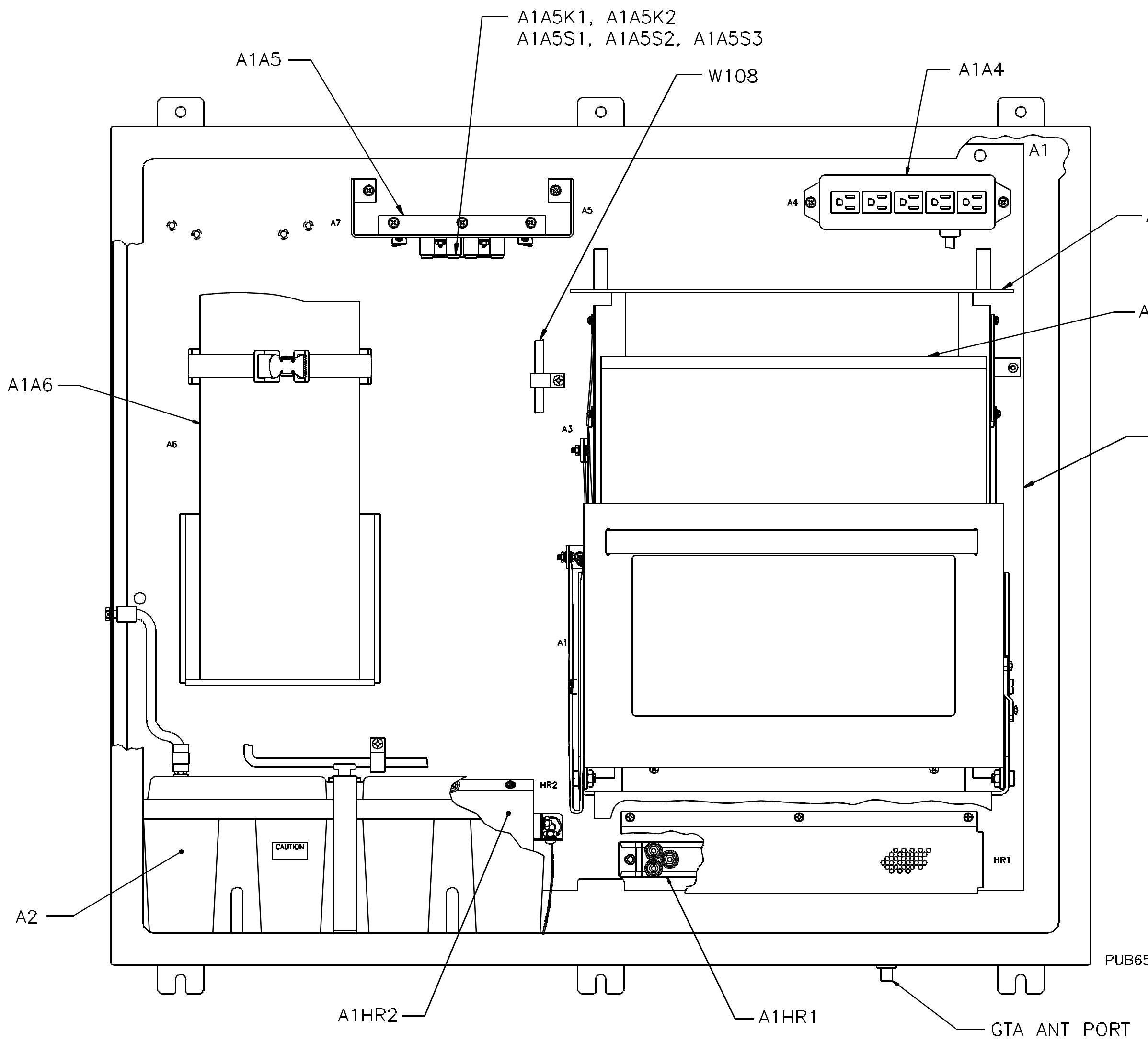


Figure 14.1.8. Auxiliary Box 7A2, Interior View

Table 14.1.2. Auxiliary Box (7A2) Major Components

Ref Des	Description	Ref Des	Description
7A2A1	Mounting Plate Assembly	7A2A1A5K1, K2, S1-S3	Heater control circuit
7A2A1A1	Codex Modem (Optional)	7A2A1A6	UPS (Optional)
7A2A1A2	UPS Bypass Assembly (Optional)	7A2A1HR1	Heater, Battery
7A2A1A3	GTA Radio (Optional)	7A2A1HR2	Heater, Battery (Optional)
7A2A1A4	Power Outlet Strip	7A2A2	Battery Box Assembly (Optional)
7A2A1A5	Modem Shelf	7A2W108	Wiring Harness

14.1.9.2.1 **Mounting Plate Assembly 7A2A1**. Most of the aux box assemblies are located on Mounting Plate Assembly 7A2A1. The mounting plate is secured on studs against the inside back surface of the aux box. The following FRU's are mounted on Mounting Plate Assembly 7A2A1.

14.1.9.2.2 **Power Outlet Strip 7A2A1A4 Description**. The outlet strip is mounted in the upper right corner of the cabinet. The outlet strip is rated at 15 amperes, continuous, and provides connection for five ac power plugs (with grounding pins) including the GTA radio and Codex modem.

14.1.9.2.3 **Modem Shelf 7A2A1A5 Description**. The modem shelf (optional) in the top center of the cabinet. The modem shelf provides mounts and interconnections for up to two additional modems (optional future expansion). The shelf also mounts the aux box heater control circuitry.

14.1.9.3 **Auxiliary Box Optional Equipment**. Available optional kits are:

- Codex Modem Kit 7A2A1A1
- Auxiliary UPS Kit, including UPS 7A2A1A6 and Battery Box 7A2A2
- GTA Radio Kit, including GTA Radio 7A2A1A3

$ 14.1.10 **ALTERNATIVE GTA RADIO ANTENNA MOUNTING KIT**
$
$ At some SCA combined sites where interference between the GTA radio and the installed sensors is possible,
$ an alternative GTA Radio Mounting Kit (Part Number 62828-40507-10) is installed. This antenna is a unity
$ gain omnidirectional antenna that is precision field-tuned to the GTA frequency. The antenna is mounted
$ near the top of the wind tower. The type and height of the antenna prevents radio frequency interference
$ from the GTA radio with the operation of the present weather sensor.

SECTION II. INSTALLATION

14.2.1 INTRODUCTION

Single-cabinet ASOS (SCA) installation is not the responsibility of the site technician. Information concerning installation, removal, and replacement of various field replaceable units (FRU's) and sensors is provided in the respective chapter of this ASOS Site Technical Manual (STM).

14.2.2 SOLAR SHIELD (OPTIONAL) $

$

An optional solar shield kit (P/N 62828-40409-10) can be added to those SCA installations that endure $
intense solar load and high temperatures. Sites to receive the shields are as directed in letter ASOS-II-97- $
0243 dated April 1, 1997. $

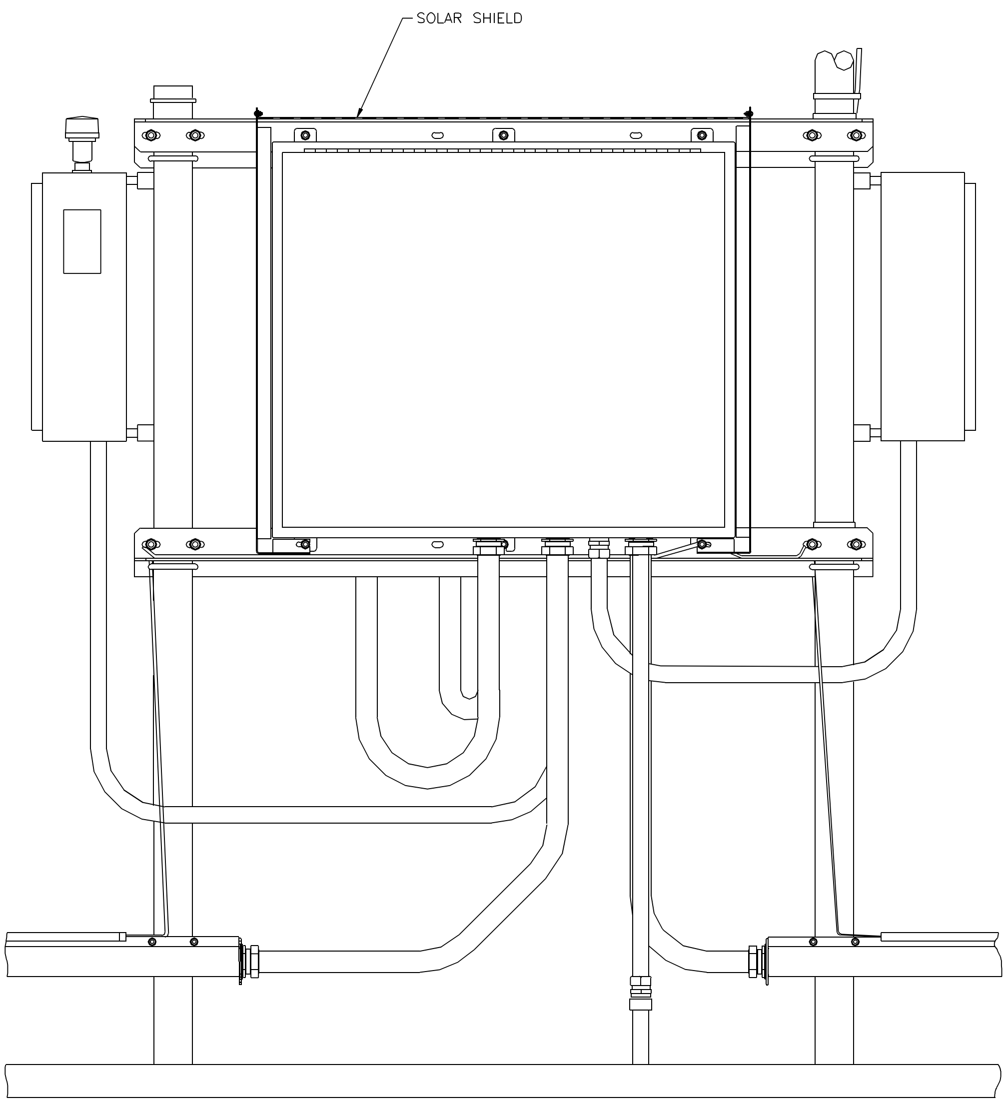


Figure 14.2.1. SCA Solar Shield (Optional) $

14.2.3 **ALTERNATIVE GTA RADIO ANTENNA KIT**

Some SCA sites with GTA radios may experience radio frequency interference to the Present Weather sensor. When the GTA is transmitting, the transmit frequency may cause interference in the LEDWI and create false LEDWI outputs (such as showing "rain" on a clear day). At these sites, it may be necessary to install Field Modification Kit FMK 114B. This kit (part number 62828-40507-10) replaces the present GTA radio antenna mounted on the DCP/SCA support structure with a ground plane antenna mounted near the top of the wind tower. The antenna cable is re-routed from the auxilliary box through underground conduit to the wind tower location.

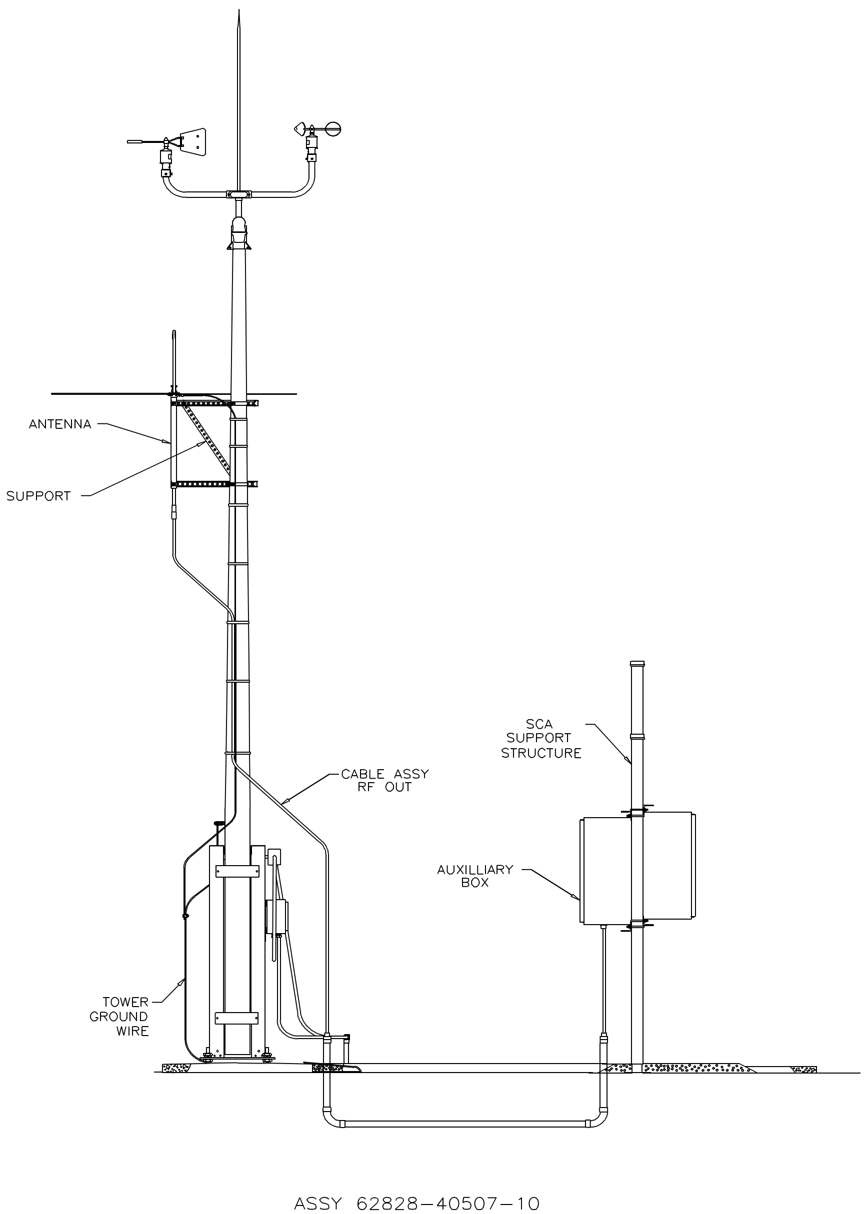


Figure 14.2.2. Alternative GTA Radio Antenna Kit

SECTION III. OPERATION

14.3.1 INTRODUCTION

During system maintenance, the single-cabinet ASOS (SCA) is controlled and monitored from a laptop personal computer (PC) connected to the primary OID connector located at the right side of Circuit Breaker Assembly 7A1A1A3. The laptop PC functions as the technician's operator interface device (OID). Dependent upon the site specific configuration, one or more OID devices may be installed. From the laptop PC, the technician can:

- Access diagnostic program displays that are an integral part of the system
- Change system configuration
- Change output port assignments, parameters, and message formats
- Change communications port characteristics
- Enable and disable communications ports
- Select pulse or tone telephone dialing mode
- Request 2-hour archive of 5-minute observations
- Enable sensors and/or sensor report processing
- Change selected site constants such as date, time, latitude, longitude, and elevation
- Make system log entries
- Reset the system

By using an optional handset in conjunction with the laptop, the technician also can record, play back, and control automated voice messages. Functions available to a user depend on how the user signs onto the system. At the SCA site, the only user might be the technician. As with the standard ASOS, however, four levels of users may sign onto the system: observers, air traffic controllers (ATC's), system managers, and technicians. Additionally, unsigned users also have certain limited capabilities on the system. Some functions are available to more than one type of user. For example, the technician and system manager have the same maintenance capabilities under the MAINT (maintenance) function. The ASOS Ready Reference Guide and Software User's Manual identify the functions granted to each type of user. This section provides control and indicator information for the OID and printer, descriptions of all maintenance pages, and detailed system maintenance operating procedures. Additional information on the other ASOS screens and operating procedures are provided in the ASOS Ready Reference Guide and Software User's Manual.

14.3.2 CONTROLS AND INDICATORS

All controls and indicators in the cabinet are considered to be maintenance-related. Only certified technicians are permitted to open the cabinet. Sensor subsystem controls and indicators are listed and illustrated in the respective chapters of this ASOS Site Technical Manual (STM).

14.3.2.1 **Circuit Breaker Panel 7A1A1A3, Controls and Indicators**. Circuit breakers and their functions are illustrated on figure 14.3.1 and described in table 14.3.1.

14.3.2.2 **VME Rack 7A1A1A2, Controls and Indicators**. VME CCA controls and indicators and their functions are illustrated on figure 14.3.2 and described in table 14.3.2.

14.3.2.2A **RF Modems**. RF data modems provide communications between the SCA and DCP cabinets. Only $
the Johnson Data rf modem (62828-40506-X) has controls and indicators as shown on figure 14.3.3 and $
described in table 14.3.3. $
$

14.3.2.3 **Operator Interface Device (OID), Controls and Indicators**. The OID controls and indicators are described in Chapter 1, Section III.

14.3.2.4 **Auxiliary Box 7A2, Controls and Indicators**. The aux box does not contain controls or indicators but may contain a GTA radio or Codex Modem. Chapter 12 Section 3 contains GTA radio controls and indicators and Chapter 13 Section 3 contains Codex modem controls and indicators.

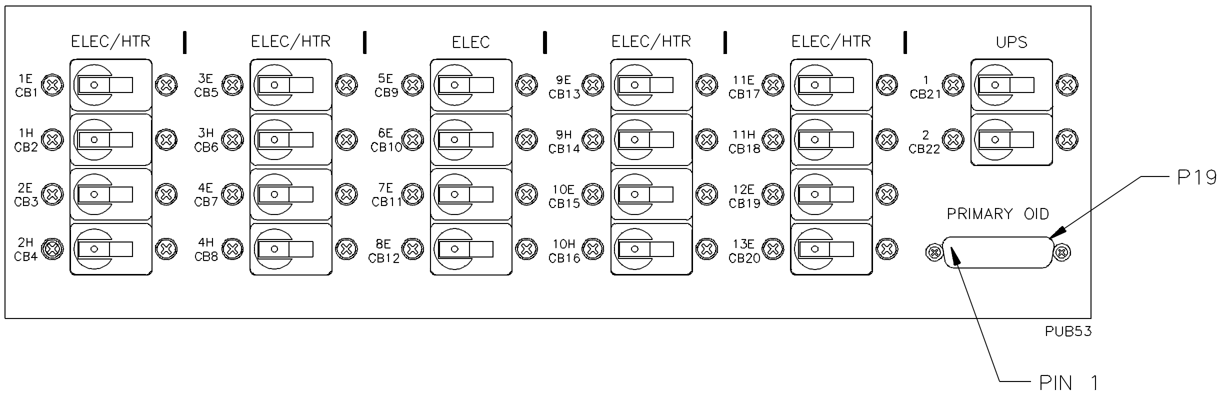


Figure 14.3.1. Circuit Breaker Panel 7A1A1A3, Controls

Table 14.3.1. Circuit Breaker Panel 7A1A1A3 Controls and Indicators

Ref Des	Placard	Type	Function
CB1	ELEC/HTR 1E	Circuit Breaker	CHI
CB2	ELEC/HTR 1H	Circuit Breaker	CHI HTR
CB3	ELEC/HTR 2E	Circuit Breaker	FZR (TS[1])
CB4	ELEC/HTR 2H	Circuit Breaker	FZR HTR (TS HTR[1])
CB5	ELEC/HTR 3E	Circuit Breaker	PWI
CB6	ELEC/HTR 3H	Circuit Breaker	PWI HTR
CB7	ELEC/HTR 4E	Circuit Breaker	SPARE
CB8	ELEC/HTR 4H	Circuit Breaker	TB HTR
CB9	ELEC 5E	Circuit Breaker	WIND
CB10	ELEC 6E	Circuit Breaker	TEMP/DEWPOINT
CB11	ELEC 7E	Circuit Breaker	VIS
CB12	ELEC 8E	Circuit Breaker	SPARE
CB13	ELEC/HTR 9E	Circuit Breaker	TS[1]
CB14	ELEC/HTR 9H	Circuit Breaker	TS HTR[1]
CB15	ELEC/HTR 10E	Circuit Breaker	SPARE
CB16	ELEC/HTR 10H	Circuit Breaker	SPARE
CB17	ELEC/HTR 11E	Circuit Breaker	SPARE
CB18	ELEC/HTR 11H	Circuit Breaker	SPARE
CB19	ELEC/HTR 12E	Circuit Breaker	SPARE
CB20	ELEC/HTR 13E	Circuit Breaker	SPARE
CB21	UPS 1	Circuit Breaker	AC MAIN
CB22	UPS 2	Circuit Breaker	AC to Aux UPS

[1] CB13 and CB14 are used for TS if site configuration includes FZR .

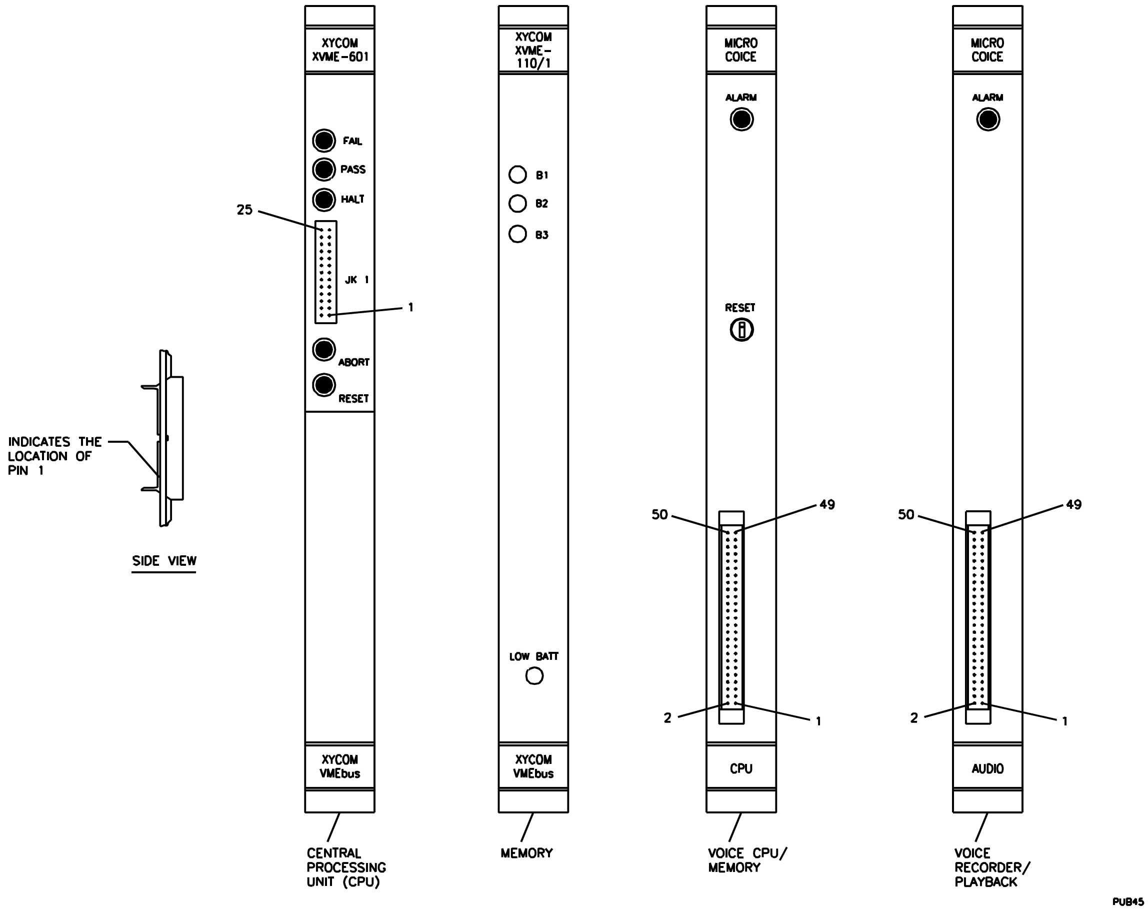


Figure 14.3.2. VME CCA's, Controls and Indicators

Table 14.3.2. VME Rack 7A1A1A2 Controls and Indicators

Ref Des	Placard	Type	Function
A1,A2 (CPU #1, #2)	FAIL	LED (r)	Self-test fail
	PASS	LED (gn)	Self-test pass (FAIL and PASS both light during self-test)
	HALT	LED (amb)	CPU halted
	ABORT	Push switch	Do not use. If inadvertently pressed, then press RESET. Resets CPU and VME bus.
A3 (Memory)	B1	LED (gn)	Bank #1 memory addressed
	B2	LED (gn)	Bank #2 memory addressed
	B3	LED (gn)	Bank #3 memory addressed
	LOW BATT	LED (r)	Memory board backup battery low, replace board
A20 (Voice CPU)	ALARM	LED	Audio CPU failure
	RESET	Push switch	Resets audio CPU only
A21 (Voice Audio Bd)	ALARM	LED	No audio output for 30 to 60 seconds

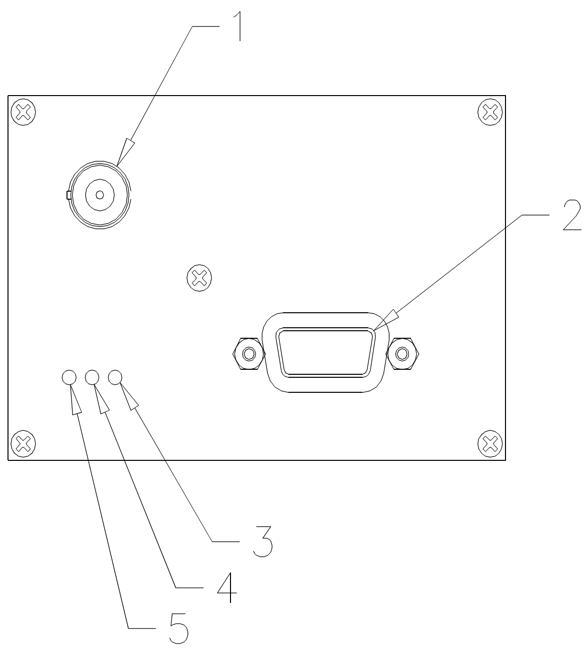


Figure 14.3.3. Johnson Data RF Modem Controls and Indicators

Table 14.3.3. Johnson Data RF Modem Controls and Indicators

Index	Control/ Indicator	Description
1	SMA Connector	RF output (requires SMAM-to-BNCF adapter)
2	HDB-15 Connector	High density 15 pin female power/communications connector (requires adapter cable 62828-42110-10)
3	RX LED (Yellow)	Illuminates when receiving data
4	TX LED (Red)	Illuminates when transmitting data
5	PWR LED (Green) (Flashing)	Illuminates when power is applied Illuminates when setup mode is active

14.3.3 **MAINTENANCE DISPLAY PAGES**

Using either the OID or a laptop PC, the ASOS technician accesses maintenance display pages to monitor the ASOS continuous self-test (CST) program, which runs during normal system operation. The hierarchy of maintenance display pages and the page presentations are illustrated in Chapter 1, Section III.

14.3.4 **OPERATING PROCEDURES**

Chapter 1, Section III contains operating procedures.

SECTION IV. THEORY OF OPERATION

14.4.1 **INTRODUCTION**

This section describes, at system level, the single-cabinet ASOS (SCA). Information on common subassemblies that are also used at multicabinet ASOS sites is provided in respective chapters of this STM. Each ASOS is configured to meet the specific requirements of a given site. To configure an SCA system, a site survey must first be made in which the following factors must be considered:

- ! If the site is at an airport, appropriately locate sensor groups by considering runway patterns and lengths
- ! Mapping areas of frequent meteorological discontinuity
- ! Locating backup sensor group(s) for optimum system reliability
- ! Identifying the most suitable location for the SCA
- ! Identifying required sensors
- ! Measuring distances from planned sensor group(s) to SCA and from SCA to the air traffic controller (ATC) or operations area
- ! Assessing commercial power availability and reliability
- ! Specifying the number and types of users that need to access system data and control system functions. (Typically, the maintenance technician will be the only local user at single-cabinet ASOS sites; however, some sites could have other local users. The technician can control and monitor the system from a laptop PC when the PC data cable is connected to SCA P19.)

NOTE

SCA is used herein as an acronym for the single-cabinet ASOS to distinguish the SCA cabinet from the standard ASOS ACU cabinet.

14.4.2 **SCA BLOCK DIAGRAM**

The typical SCA houses all equipment (except external sensors) required for stand-alone, automatic, surface weather data acquisition, reporting, and archiving. At Class II sites, an auxiliary box (aux box) is added when needed to house certain optional equipment. At Class I sites and reduced-capability sites, the aux box is an optional add-on.

As shown on the simplified block diagram (figure 14.4.1) the SCA receives sensor data, processes data in accordance with programmed instructions (algorithms) suitable for each sensor type, outputs data to peripheral devices and users, and archives data in internal memory. The SCA also contains a speech processor which digitizes English words that have been humanly vocalized and recorded. Digitized words (rather than phonemes, i.e., phonetic sounds, as in most synthesizers) are then syntactically assembled in accordance with current weather observation data to convey routine meteorological reports (METAR’s), or special meteorological reports (SPECI’s) for transmission over telephone lines or radio. The SCA mounts all data processing boards in 21-slot VME Rack 7A1A1A2.

NOTE

In the following paragraphs, reference designators for VME circuit card assemblies (CCA’s) are abbreviated to identify only the CCA number within the VME rack.

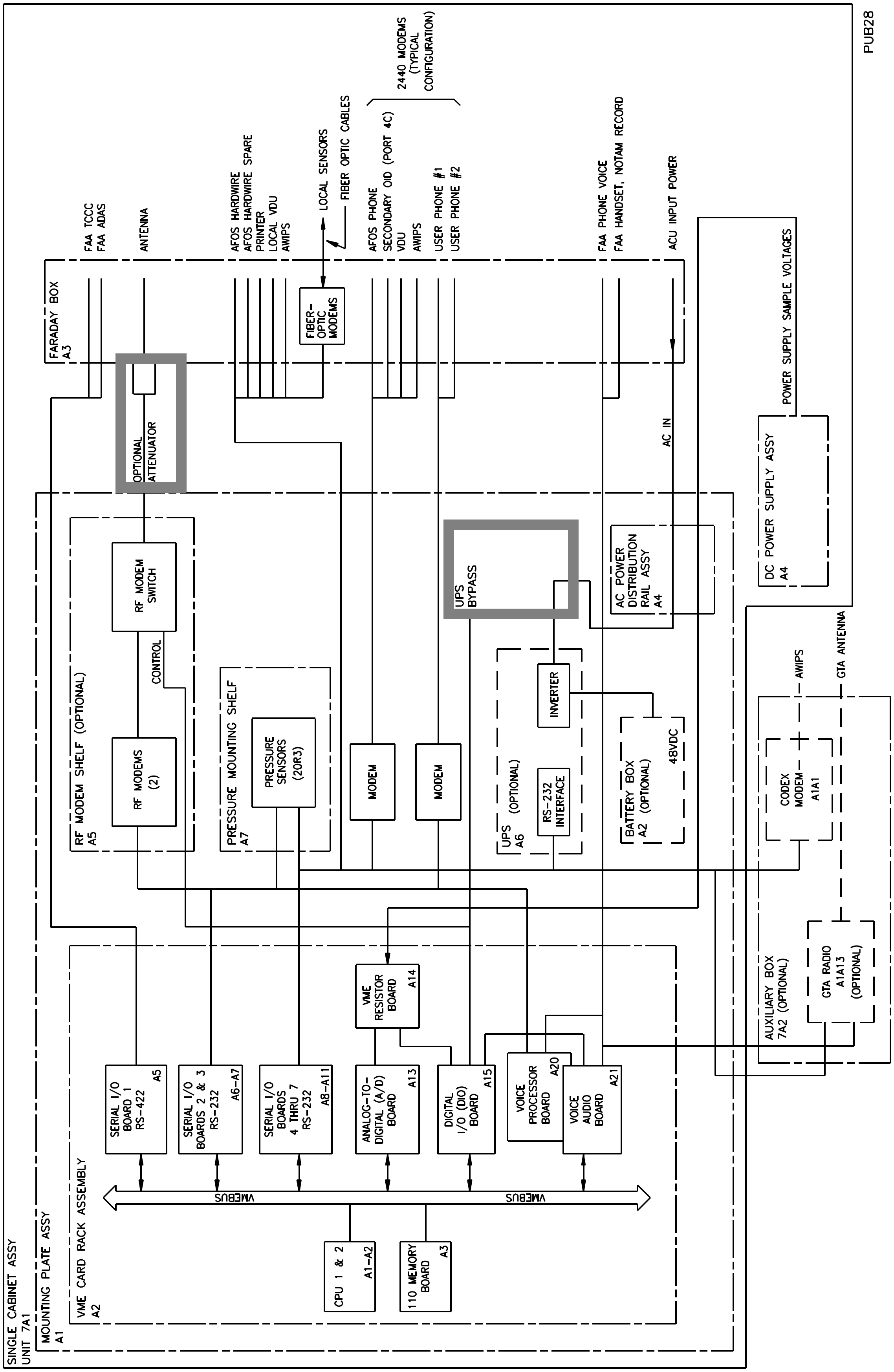


Figure 14.4.1. SCA Simplified Block Diagram

14.4.2.1 **CPU CCA's A1 and A2**. The SCA contains two CPU's and other data processing CCA's in a VME rack. The VME rack printed-wiring backplane contains 2 rows of board connectors: one for the 32-bit VME data bus, and one for interconnections and operating voltages. The two CPU CCA's are similar and provide redundancy. One CPU CCA serves as the primary processor while the second CPU CCA is in standby. Each CPU monitors the other processor. If the primary processor fails a self-test, it is automatically switched offline and the backup CPU assumes the role of primary.

Two pushbuttons (RESET and ABORT) are mounted on the front frame of the CPU CCA: these switches are not used in the field. ABORT halts program execution without resetting the CPU. In the event that ABORT is inadvertently pressed, press RESET to reset the CPU's and activate SYSRESET which resets all other VME boards. Resetting the CPU does not affect DRAM contents.

The following paragraphs describe the CPU functional block diagram (figure 14.4.2). Each CPU CCA contains:

- A 68010 series microprocessor running at 10 MHZ
- EPROM
- Dynamic random access memory (DRAM)
- Two RS-232 ports
- A 16-bit timer

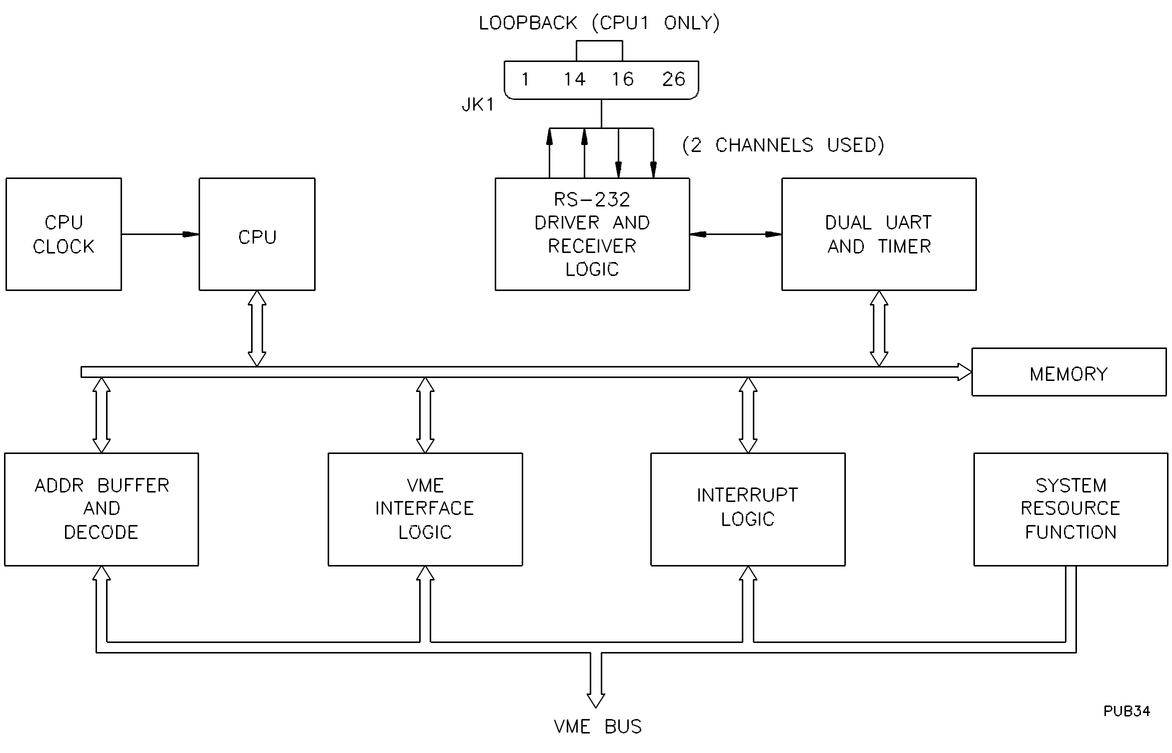


Figure 14.4.2. CPU, Simplified Block Diagram

During system operation one CPU CCA is the primary CPU that performs all processing and I/O functions while the other CPU functions in standby. Initially CPU #1 is the primary CPU.

The CPU CCA consists of nine functional areas: system resource function, two dual universal asynchronous receiver-transmitters (UART's), timer, RS-232 transmitter-receiver, CPU clock, microprocessor, interrupt logic, VME interface logic, address buffer and decoder, and memory. The system resource function on the primary CPU provides system clock, system reset, bus arbitration, bus timer and functions as the VME bus controller. The corresponding system resource function on the secondary CPU is not used unless it becomes the online CPU.

The dual UART's and timer provides two RS-232 serial communication channels, a timer, and two I/O and control ports. The RS-232 driver and receiver logic interfaces UART channels A and B to external devices via connector J1 on the CPU by providing standard transmit and receive lines. (CPU's #1 and #2 each provide two additional UART channels that are not presently used.) CPU #1 is connected as the primary CPU with a loopback jumper installed between channel B transmit and receive lines (JK1 pins 14 and 16). When power is applied both CPU's issue a message from their respective UART channel B. CPU #1 immediately receives this message via the loopback jumper installed on the CCA front panel connector JK1. Both CPU's examine their receive lines and CPU #1 detects that it has received the loopback signal and assumes the role of the online CPU. Conversely, when CPU #2 detects that it has not received the loopback signal, it assumes the role of the standby CPU. The standby CPU continuously monitors CPU status by examining a location on the memory board where a tally count is stored. The online CPU updates this count on a periodic basis. Failure to update the count indicates a CPU failure which causes the standby CPU to become the primary CPU. The CPU operates from an internally generated 10 MHZ clock to execute ASOS operational firmware in the memory board EPROM's. Interrupt logic monitors the dedicated interrupt lines and informs the CPU when an interrupt line is active. The interrupts are prioritized and processed on a first-come, first-serve basis. VME interface logic provides standard address, data, and control signals for system bus communication.

The address buffer-decoder addresses all devices for microprocessor read/write operations. CPU onboard memory consists of 128K bytes of EPROM and 512K bytes of DRAM. Refresh circuitry for the DRAM is not disabled during a RESET; therefore, the CPU may be reset without affecting memory contents.
The SCA continuous self-test (CST) checks CPU status once per minute; results are displayed on the CPU page of the OID. The CST checks the following areas of both CPU's:

- DRAM
- EPROM
- BUS ERRORS
- SERIAL PORTs #1 and #2 LOOPBACK
- SERIAL PORTs #1 and #2 XMIT ERRORS

For the online CPU, test pass/fail status is displayed for each functional areas. The backup CPU test status is displayed for the overall board. The technician can manually run the CPU test from the CPU page at any time. A "T" status is displayed for each test category until the test is rerun during the next CST cycle. After each cycle, test status is updated and displayed, and the fail count (if applicable) is incremented.

The DRAM test is based on an alternating pattern of addressing memory locations. Data output to the DRAM are read back and evaluated, and the test status is then displayed. The EPROM test is based on a checksum. The checksum is compared to the last byte in the EPROM, the result is evaluated, and test status is displayed. The BUS ERRORS test is based on a memory write to a specific address; contents of the addressed memory location are evaluated, and test status is displayed. SERIAL PORT #1 and #2 LOOPBACK tests ensure that the CPU can communicate with its internal UART. The CPU reads the UART interrupt vector register and checks for bus errors.

Test status is displayed as "P" (pass) if no bus errors occur. For SERIAL PORTs #1 and #2 XMIT ERRORS test, the CPU reads the contents of the status register for the corresponding port. This register contains information on transmission errors detected by the UART during RS-232 communications. Specifically, the CPU checks the status register for parity errors, framing errors, and overrun errors that might have occurred.

If such errors occur for three consecutive CST cycles, an "F" (fail) is displayed for test status; otherwise, test status is "P" (pass).

14.4.2.2 **Memory Board A3**. As shown on the memory board block diagram (figure 14.4.3), the VME-110 memory board contains three memory banks. Each bank is independently configured via jumpers to specify VME address/memory chip size, device speed, device pinout, and backup power. The following paragraphs provide a detailed block diagram description of the memory board. (Digitized voice input is stored in Voice Audio Board A21.) The memory board includes nine functional areas: banks 1, 2, and 3 memory devices; VME/bank address decode and control; battery backup; data buffer; bus cycle control; address buffer and decode logic; and system real-time clock. The first bank contains up to 4 megabytes of EPROM which stores the operational software program run by the CPU.

Bank 1 also stores data collection package (DCP) software load that is transferred to the DCP in the event that a DCP loses its program load and requires initialization. Banks 2 and 3 contain up to 2 megabytes of static random access memory (SRAM). SRAM provides storage for ASOS weather archives. Address and control signals used to address memory locations are generated by the VME/bank address decode and control. The memory boards are configured with a battery backup to provide an alternate power source in the event of a power loss.

The data buffer, bus cycle control, and address buffer and decoder provide standard address, data, and control signals for system bus communication. The real-time clock maintains clock calendar timing, which is accessed by the CPU upon initialization. When initialized, the CPU maintains a real-time clock via software.

The SCA CST checks status of the memory board once per minute. CST results are displayed on the memory page of the operator interface device (OID). CST performs an EPROM test and an SRAM test. The technician can manually run the memory test from the memory page at any time. "T" status is displayed for each test category until the test is run again during the next CST cycle. After the cycle, the latest test status is displayed and the fail count (if applicable) is incremented.

The EPROM test is based on a checksum, which is compared to the last byte in the EPROM. The result is evaluated and the test status is displayed. The SRAM test ensures that the CPU can read data from the SRAM on the memory board without encountering bus errors.

14.4.2.3 **Serial I/O (SIO) Boards A5 through A11**. Seven serial I/O (SIO) boards communicate with other equipment. SIO #1, A5, communicates in RS-422 format, while the remaining six boards all use the RS-232 format. The SIO boards communicate with the CPU on a character-by-character basis. The CPU must process interrupts on each and every transmitted and received character. The detailed block diagram of the SIO board (figure 14.4.4) is described in the following paragraphs.

The SIO board consists of six functional areas: two serial communication controllers (SCC's), interrupt logic, data buffer, bus cycle control, and address buffer and decode logic. The SCC's provide a variety of communication modes. Upon power up, the CPU initializes the SCC's to the proper communication modes.

Interrupts are generated via the interrupt logic. An interrupt could signify that a received character is available, that the transmit buffer is empty, or that an external status change has occurred.

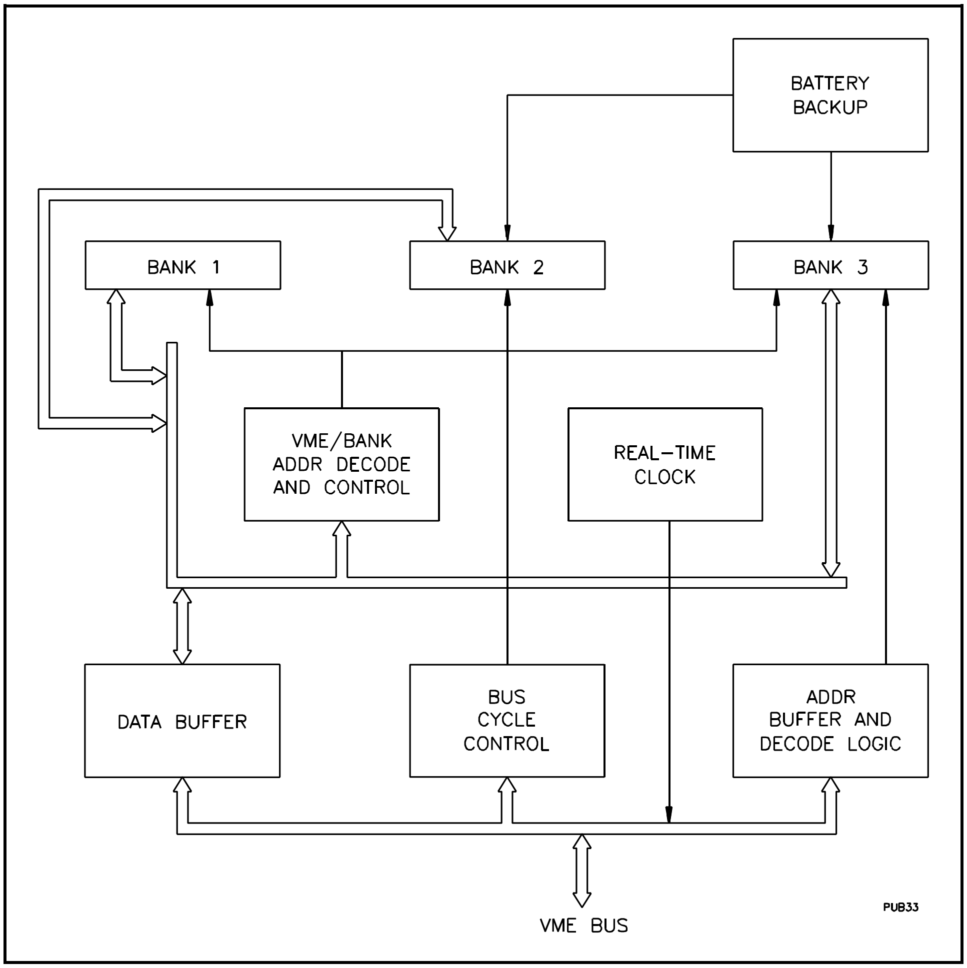


Figure 14.4.3. Memory Board, Functional Block Diagram

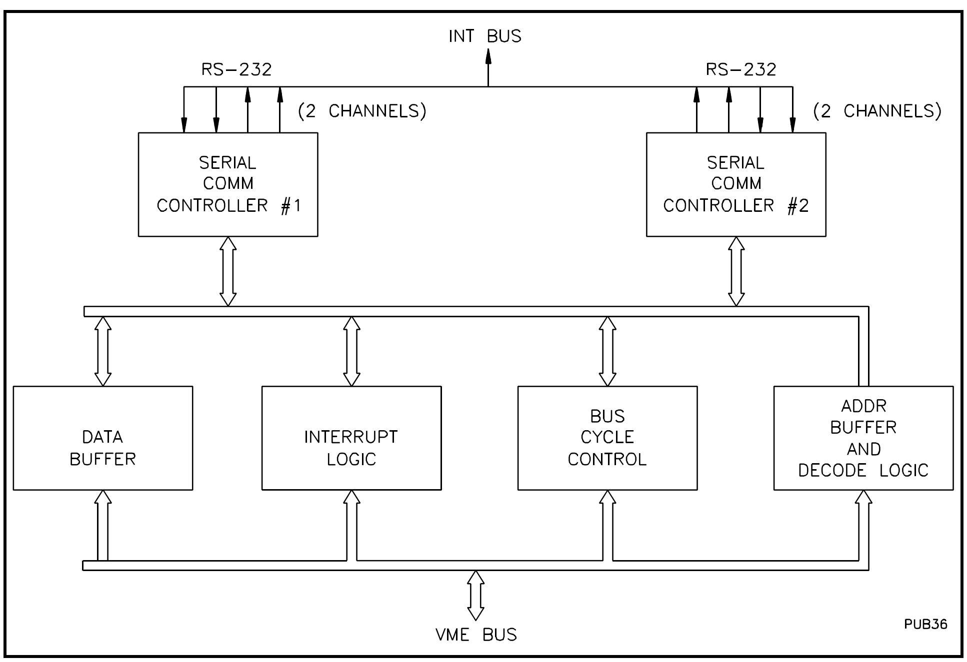


Figure 14.4.4. SIO Board, Functional Block Diagram

The data buffer, bus cycle control, and address buffer and decoder logic provide standard address, data, and control signals for system bus communication.

The four ports of SIO boards 1 through 3 are factory assigned to specific devices. Their ports are dedicated to these devices via corresponding connectors on the SCA main wiring harness. Although these ports can be reassigned via the SCA serial communications page of the OID, the technician should not reassign them; assigning these ports to other field replaceable units (FRU's) would invalidate their corresponding harness markers. Table 14.4.1 identifies each port of the SIO boards and lists the corresponding harness connector and device to which it is connected.

Unlike SIO boards 1 through 3, SIO boards 4 through 8 are installed only as required depending upon sensor complement. Most systems will not have all 8 SIO boards installed. The ports of SIO boards 4 through 8 are not factory assigned to specific devices. Rather, these ports are assigned to various devices during the initial configuration of the system. This assignment is made via the SCA serial communications page of the OID.

Table 14.4.1 identifies the ports of SIO boards 4 through 8 and identifies the W106 connector that \$ corresponds to each. The devices attached to the connectors correspond to the device assigned to that port by the SCA serial communications page. Figure 14.4.5 identifies pin-to-pin wiring with signal function between each of the SIO boards and their respective connectors.

Table 14.4.1. SIO Port Assignments

SIO	Data Format	Ref Des	Interface	Function
1-1	RS-422	7A1A1A2A5	P59	FAA
1-2	RS-422	7A1A1A2A5	P60	FAA
1-3	RS-422	7A1A1A2A5	P61	FAA
1-4	RS-422	7A1A1A2A5	P62	FAA
2-1	RS-232	7A1A1A2A6	P13	RF Modem #1
2-2	RS-232	7A1A1A2A6	P14	Pressure #1
2-3	RS-232	7A1A1A2A6	P15	User #1 (A1A9)
2-4	RS-232	7A1A1A2A6		Voice
3-1	RS-232	7A1A1A2A7	P16	RF Modem #2
3-2	RS-232	7A1A1A2A7	P17	Pressure #2
3-3	RS-232	7A1A1A2A7	P18	User #2 (A1A10)
3-4	RS-232	7A1A1A2A7	A1A3J1	Primary OID
4-1	RS-232	7A1A1A2A8	P20	(UPS)
4-2	RS-232	7A1A1A2A8	P21	Pressure #3
4-3	RS-232	7A1A1A2A8	P22	*
4-4	RS-232	7A1A1A2A8	P23	*
5-1	(IAW sensor)		P1M/W A3A1J1	Sensor #1
5-2	(IAW sensor)		P2 M/WA3A2J1	Sensor #2
5-3	(IAW sensor)		P3 M/WA3J1	Sensor #3
5-4	(IAW sensor)		P4 M/W A4J1	Sensor #4
6-1	(IAW sensor)		P5 M/W A5J1	Sensor #5
6-2	(IAW sensor)		P6 M/W A6J1	Sensor #6
6-3	(IAW sensor)		P7 M/W A7J1	Sensor #7
6-4	(Not used)		P8 M/W A3A8J1	*Sensor #8

Table 14.4.1. SIO Port Assignments -CONT

SIO	Data Format	Ref Des	Interface	Function
7-1	RS-232		P24	
7-2	RS-232		P25	
7-3	RS-232		P26	
7-4	RS-232		P27	

* Customer Option

The SCA CST checks the status of the SIO boards once per minute. CST results are displayed on the SCA SIO display pages of the OID (one page for each SIO board). The CST performs the LOOPBACK test and XMIT ERRORS test on each of the four ports of an SIO board. The technician can manually run the SIO test from an SIO page at any time. "T" status is displayed for both test categories until the test is run again during the next CST cycle. After the cycle, the latest test status is displayed and the fail count (if applicable) is incremented.

For the LOOPBACK test, the CPU reads an interrupt vector register on the SIO board to ensure that it can communicate with the SIO port. For the XMIT ERRORS test, the CPU reads the contents of the SCC status register for the corresponding port. This register contains information on transmission errors detected by the SCC during RS-232 communications. Specifically, the CPU checks the status register for parity errors, framing errors, and overrun errors that may have occurred. For both LOOPBACK and XMIT ERRORS tests, CST status is displayed as either P (pass), F (fail), or D (degraded). A status of D is displayed if five or more errors have been detected and the port is currently passing the test. At 0600 LST each day, the number of accumulated failures is summarized in the system (maintenance) log.

14.4.2.4 **A/D Board A13**. The A/D board, shown functionally on figure 14.4.5, monitors power supply outputs and quantifies them to provide digital measurements for data processing. From voltage divider networks on the VME resistor board, the A/D board receives dc voltage samples and converts them to digital values to be read by the CPU via the VME bus.

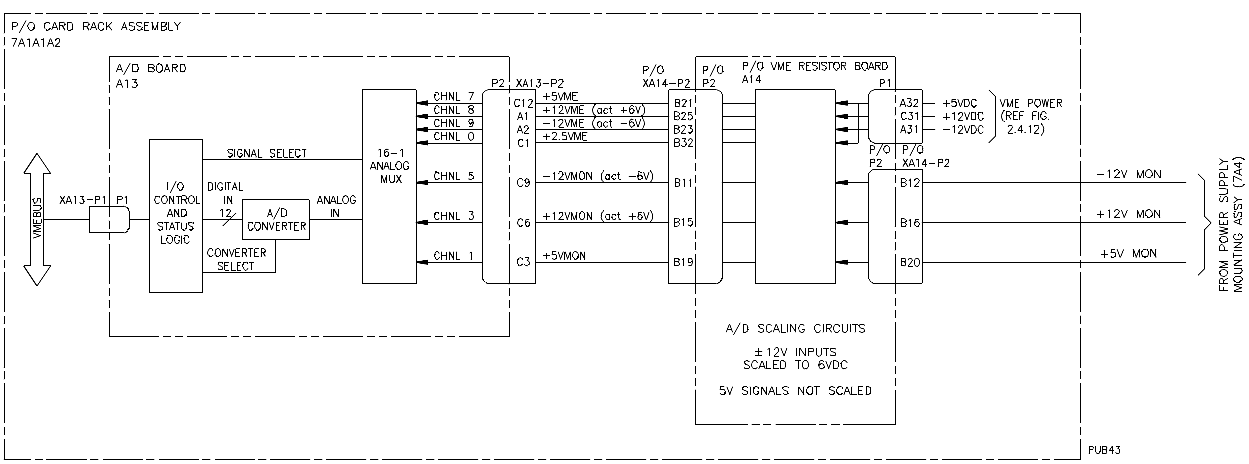


Figure 14.4.5. A/D Board, Functional Block Diagram

14.4.2.5 **VME Resistor Board A14**. The VME resistor board mounts discrete resistors used by the other VME CCA's for pull-ups, loads, and voltage dividers and a precision voltage source for the A/D board. $

14.4.2.6 **DIO Board A15**. The digital I/O (DIO) board, shown functionally on figure 14.4.6, provides address buffer and control, data buffer, timing and interrupt control, two dual I/O data port integrated circuits (IC's) (#1 and #2), and four data transceiver IC's. The DIO board has an input bit that selects SCA mode of operation (APCSEL).

The DIO board communicates with the CPU via the address buffer and decoder, data buffer, and timing and interrupt control logic. Two dual I/O port IC's provide a total of four ports (designated A1, B1, A2, and B2), each of which communicates with external devices via a dedicated data transceiver IC. Configured as an input-only port, A1 is used by the CPU to input a watchdog timer signal from the Voice Processor Board A20, status bits for the dc power supplies (via the VME Resistor Board A14), and the UPS bypass circuit. $
Port B1 is configured as an output-only port. This port is used by the CPU to output control signals to the $
voice recorder/playback board, the rf modem switch (or line driver relay), and the UPS bypass circuit. (Two $
additional ports on the DIO board, A2 and B2, are not used in the SCA.) Notice that the SCA CST does not check status of the DIO board.

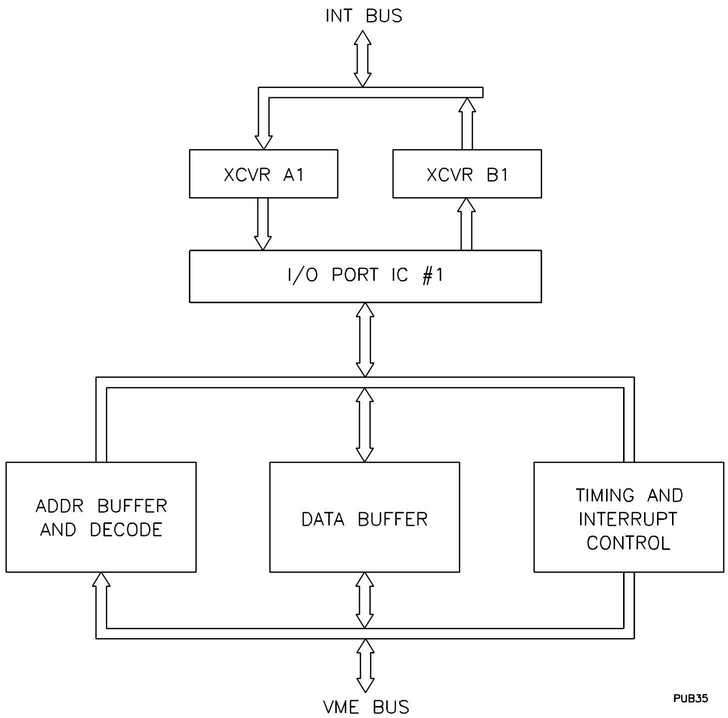


Figure 14.4.6. DIO Board, Function Block Diagram

14.4.2.7 **Digitized Voice Processor System**. As shown in figure 14.4.7, the digitized voice processor subsystem includes Voice Processor Board A20 and Voice Audio Board A21. These two boards operate together as a system and are tested together. Both boards are connected to the VME bus for power and system reset purposes, but they do not communicate with the CPU via the VME bus. The CPU/voice system communication is accomplished via the RS-232 link between SIO board #2 and the voice processor board. Digital voice processing consists of three operations:

- Recording an operator-generated addendum up to 90-seconds long
- Using a stored vocabulary of voiced words to assemble a verbal report in accordance with current ASOS data
- Producing an output message consisting of the verbal report plus the addendum.

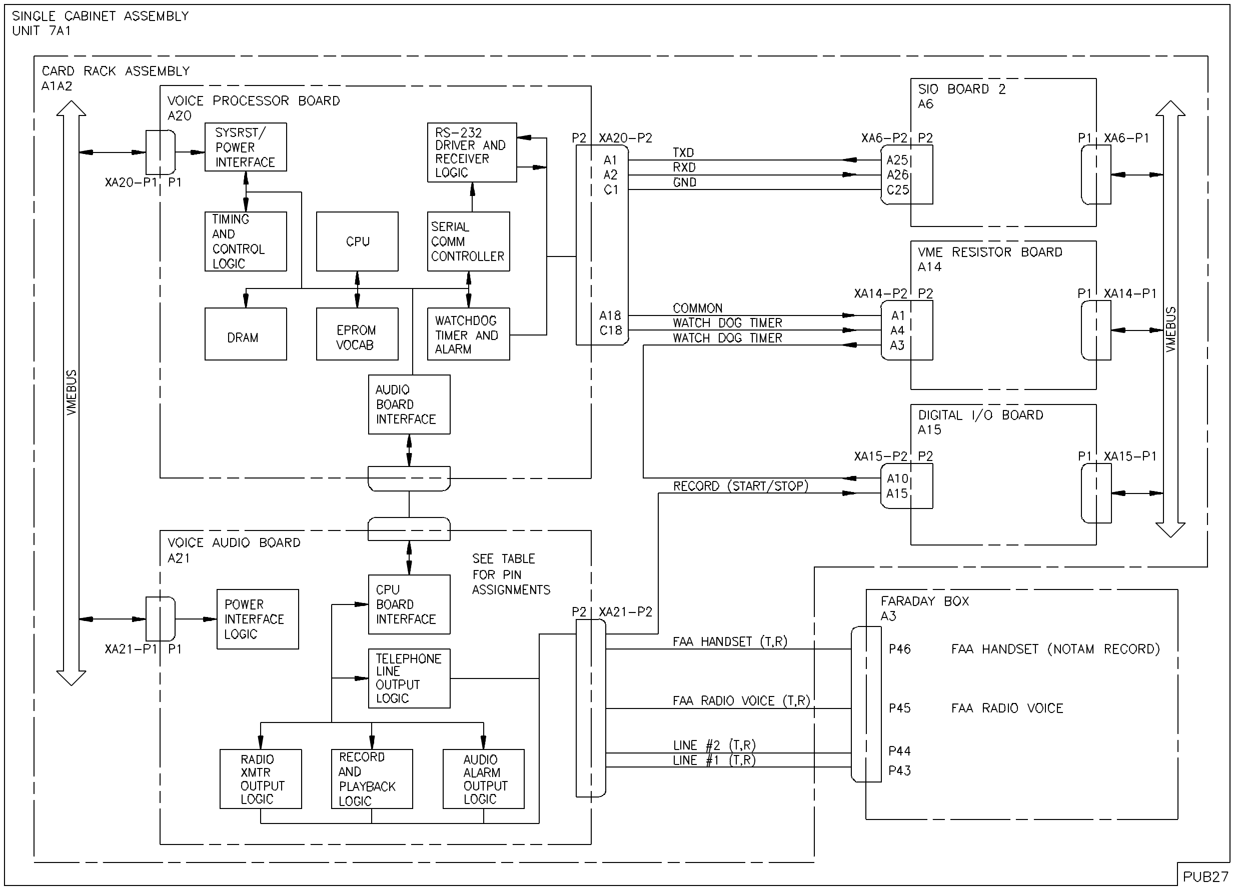


Figure 14.4.7. Digitized Voice Processor, Functional Block Diagram

14.4.2.7.1 **Voice Processor Board A20.** The voice processor board contains a Z80XXX series (Z80 thousand series) microprocessor and the necessary DRAM to execute the firmware stored in onboard erasable programmable read only memory (EPROM). These instructions reconstruct digitized human voice, create voice reports, and receive operator-generated digitized audio from the voice audio board. The voice processor board communicates with the VME bus directly for power and system reset but indirectly via SIO board #2 for system communication. The following paragraphs provide a detailed block diagram description of the voice processor board. The voice processor board consists of nine functional areas: system reset/power interface, DRAM, EPROM vocabulary, CPU, audio board interface, timing and control logic, serial communications controller, RS-232 driver and receiver logic, and watchdog timer and alarm. Upon receipt of a system reset signal from the VME bus, when the RESET pushbutton (on the front of the CCA) is pressed, or when power is applied, the system reset/power interface logic generates an internal reset. This internal reset disables message broadcast until a play message string is received from the CPU via SIO board 2. The VME bus interface for power and ground requirements is also provided by the system reset/power interface. DRAM provides 1 megabyte of memory for message/file storage: this is the memory area where digitized voice messages from the FAA handset are stored. These messages are appended to the automatically generated observation messages. The EPROM vocabulary consists of 512 kilobytes of EPROM for voice files.

Voice Processor Board A20 executes the operational software to execute new message strings and to monitor the eight telephone lines. Interface between Voice Processor Board A20 and Voice Audio Board A21 is provided by 50-pin connectors on the front of the boards and a ribbon cable. Timing and interface signals required by the CPU and peripherals are provided by the timing and control logic section of Voice Processor Board A20. The serial communications controller provides the RS-232 serial communication channel, while the RS-232 driver and receiver logic section provides the standard RS-232 receive and transmit lines. The watchdog timer and alarm provides an alarm signal to the primary CPU (via Digital I/O Board A15) whenever a CPU software or hardware failure occurs.

14.4.2.7.2 **Voice Audio Board A21**. Voice Audio Board A21 receives digitized voice from Voice Processor Board A20 and converts it into audio. Audio is output as a weather data message for dial-in weather requests and is broadcast by a ground-to-air (GTA) radio transmitter for aviation use. In addition, the voice audio board receives voice audio from the FAA handset, quantifies it, and transmits digitized audio to Voice Processor Board A20 for message processing. The following paragraphs provide a detailed block diagram description of Voice Audio Board A21which consists of six functional areas: CPU board interface, power interface logic, radio transmitter output logic, record and playback logic, telephone line output logic, and audio alarm output logic.

Pinouts for the output of the voice audio board (XA21-P2) are provided in table 14.4.2. The signal mnemonics and pins associated with row A and row C of XA21-P2 are listed with the associated plug connector. For example, the RING signal of the FAA handset line can be monitored at pin 20 of XA21-P2 or pin 2 of plug 46 (P46). The CPU board interface provides the communication path to the voice processor board via the 50-pin connector on the front of the board. The VME bus interface for power and ground requirements is provided by the power interface logic. Radio transmitter output logic and record and playback logic digitize audio input and synthesize digitized voice words to form audio clauses or sentences. Interface circuits to the telephone outputs and line output peripherals are provided by the telephone line output logic section. The audio alarm output logic section drives an audio ALARM indicator. One of the audio line outputs is continually monitored by the alarm circuit. A loss of audio for a predetermined period causes the indicator on Voice Audio Board A21 to illuminate. Chapter 12 provides information on GTA radio pin-to-pin connections.

Table 14.4.2. Digitized Audio Connections

Function	I/O Conn	VME Rack 7A1A1A2-	Signal Mnemonic
Call-in Line #1, ring	P43-2	XA21P2-A32	L1-RING
Call-in Line #1, tip	P43-3	XA21P2-C32	L1-TIP
Call-in Line #2, ring	P44-2	XA21P2-A31	L2-RING
Call-in Line #2, tip	P44-3	XA21P2-C31	L2-TIP
FAA Radio, ring	P45-2	XA21P2-A24	FAA RADIO RING
FAA Radio, tip	P45-3	XA21P2-C24	FAA RADIO TIP
NOTAM Record, ring	P46-2	XA21P2-A20	NOTAM RECORD RING
NOTAM Record, tip	P46-3	XA21P2-C20	NOTAM RECORD TIP

14.4.2.7.3 **Digital Voice Processing System Self-Tests**. The SCA CST checks the status of the digital voice processing system once per minute. CST results are displayed on the voice page of the OID. The CST performs four tests on the voice processing system: CPU, AUDIO OUTPUT, AUDIO STATUS, and TIMEOUT. At any time, the technician can manually run the voice processing test from the VOICE page. A "T" status is displayed for the four test categories until the test is run again during the next CST cycle. After the cycle, the latest test status is displayed and the fail count (if applicable) is incremented. The CPU test checks operational status of the voice processor board. The TIMEOUT test checks operational status of the watchdog timer. The AUDIO OUTPUT and AUDIO STATUS tests check operation of the voice audio board and indirectly test the voice processor board. The AUDIO OUTPUT test is based on an internal audio test that checks audio circuitry. The AUDIO STATUS test is based upon a monitored audio line. The status of each of these tests is evaluated and test status is displayed.

14.4.2.8 **Pressure Sensor Shelf 7A1A1A7**. Pressure sensor shelf 7A1A1A7 mounts either two or three identical atmospheric pressure sensors. Cable W106 provides the electrical connections to the sensors as shown on figure 14.4.8. Plastic vent tubes from each sensor are joined under the pressure shelf to a tube cross and then routed to the pressure port at the top of the cabinet. Because the SCA is installed outdoors, a temperature sensor board (7A1A1A7A4) is mounted on the front of the pressure sensor shelf to monitor internal cabinet temperature. The board sends an analog temperature signal to the processor via A/D Board A2A13 to be used in the pressure algorithms.

14.4.3 AC POWER DISTRIBUTION

AC power service entrance into the SCA is through a stuffing tube in the bottom of Faraday Box A3; termination is to terminal blocks A3A17 and A3A18, which are mounted on the back side of the hinged front cover. AC power is routed to Power Reset Assembly A1A13 (figure 14.4.8A) which delays power application for three seconds before distributing the power to SCA assemblies (Class I systems) or the UPS bypass circuit (Class II systems). The Class II SCA UPS bypass circuit consists of a power relay (which routes site power or UPS output to SCA assemblies) and a digital I/O module (which provides ASOS operational software with UPS bypass monitoring and control).

As shown on figure 14.4.9, Faraday box connectors J1, J2, and J3 apply power to the main SCA cable harness W106. J1 supplies power through main circuit breaker A1A3CB1 (via the UPS bypass circuit in Class II systems). Connector A3J3 provides heater power for primary sensors (sensors 1-4). Connector A3J9 provides cabinet heater power. Connector A3J10 provides heater power for the aux box. AC power for aux box components is provided through short conduits from Faraday Box 7A1A3. The aux box is installed with most Class II single-cabinet systems, but is an available option on Class I and reduced capability systems. A secondary UPS, 7A2A1A6, is an option for installation in the aux box.

14.4.3.1 **Power Reset Assembly A1A13**. Power from the power distribution assembly is routed to Power Reset Assembly A1A13 Time Delay Relay K1 (figure 14.4.9 sheet 4) which provides a three second delay before distributing the power to the SCA assemblies (Class I systems) or UPS bypass circuit (Class II systems). The three second delay enables the pressure sensors and rf modems to reset after power is interrupted. In Class II systems, the UPS bypass circuit consists of Digital I/O Module K2 and Power Relay K3. Power from Time Delay Relay K1 is applied to Power Relay K3 normal closed contacts and to UPS A1A6. Power to Power Relay K3 normally closed contacts is routed to the AC Power Distribution Assembly where it is distributed to the SCA assemblies. UPS output power is routed to Power Relay K3 normally open contacts.

After power is applied to the SCA assemblies, ASOS operational software monitors the bypass status of Power Relay K3 via Digital I/O Module K2 and Digital I/O Board A1A2XA15. When UPS A1A6 status is good, Power Relay 7A1A1A13K3 is energized (via Digital I/O Board A1A2XA15 and Digital I/O Module A1A13K2) which enables UPS output power to be distributed to the SCA assemblies. During turn on and when the UPS status is bad, the power relay is deenergized allowing site power to be applied directly to the SCA assemblies.

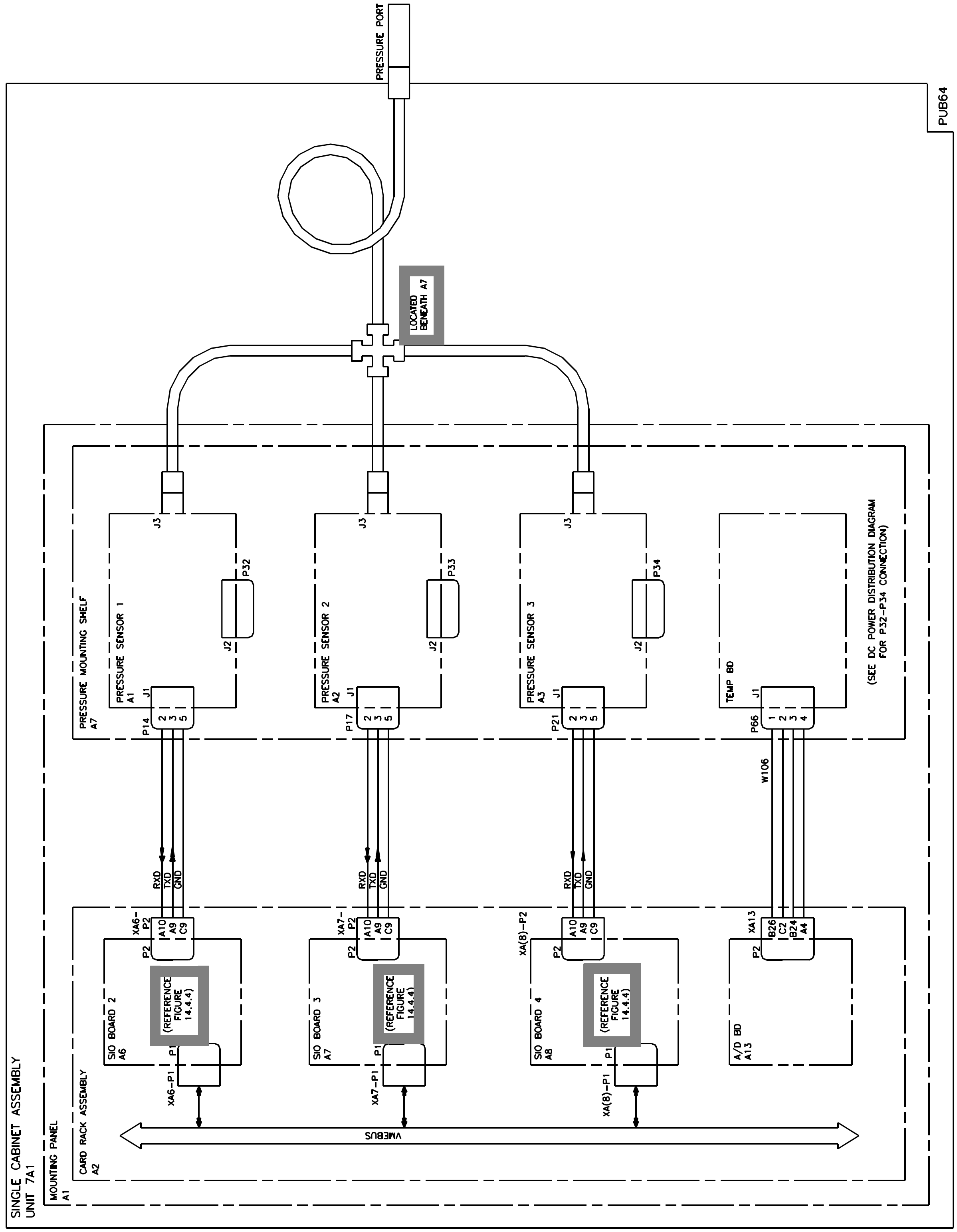


Figure 14.4.8. Pressure Sensor Shelf, Functional Diagram

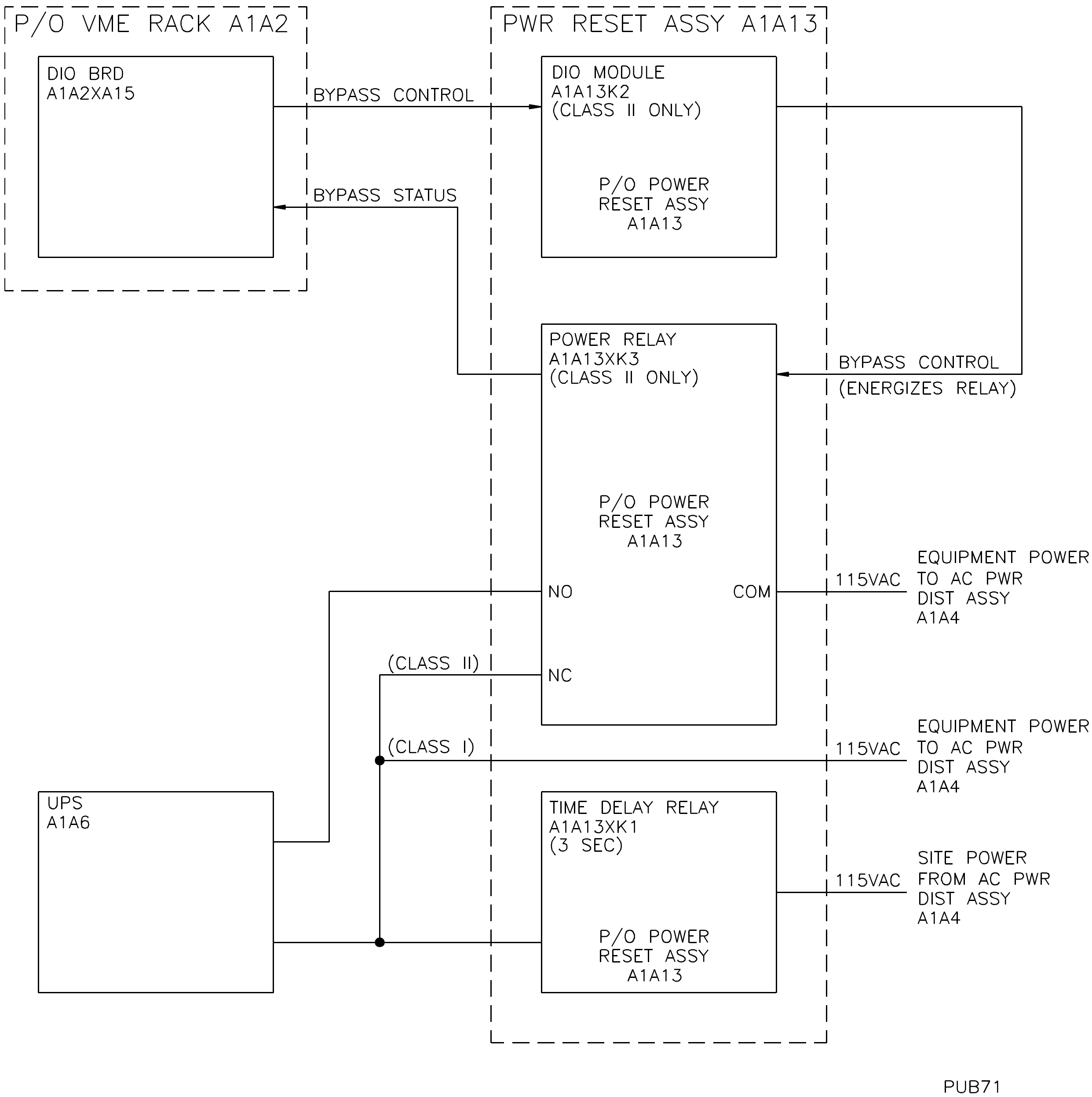


Figure 14.4.8A. SCA Power Reset Assembly

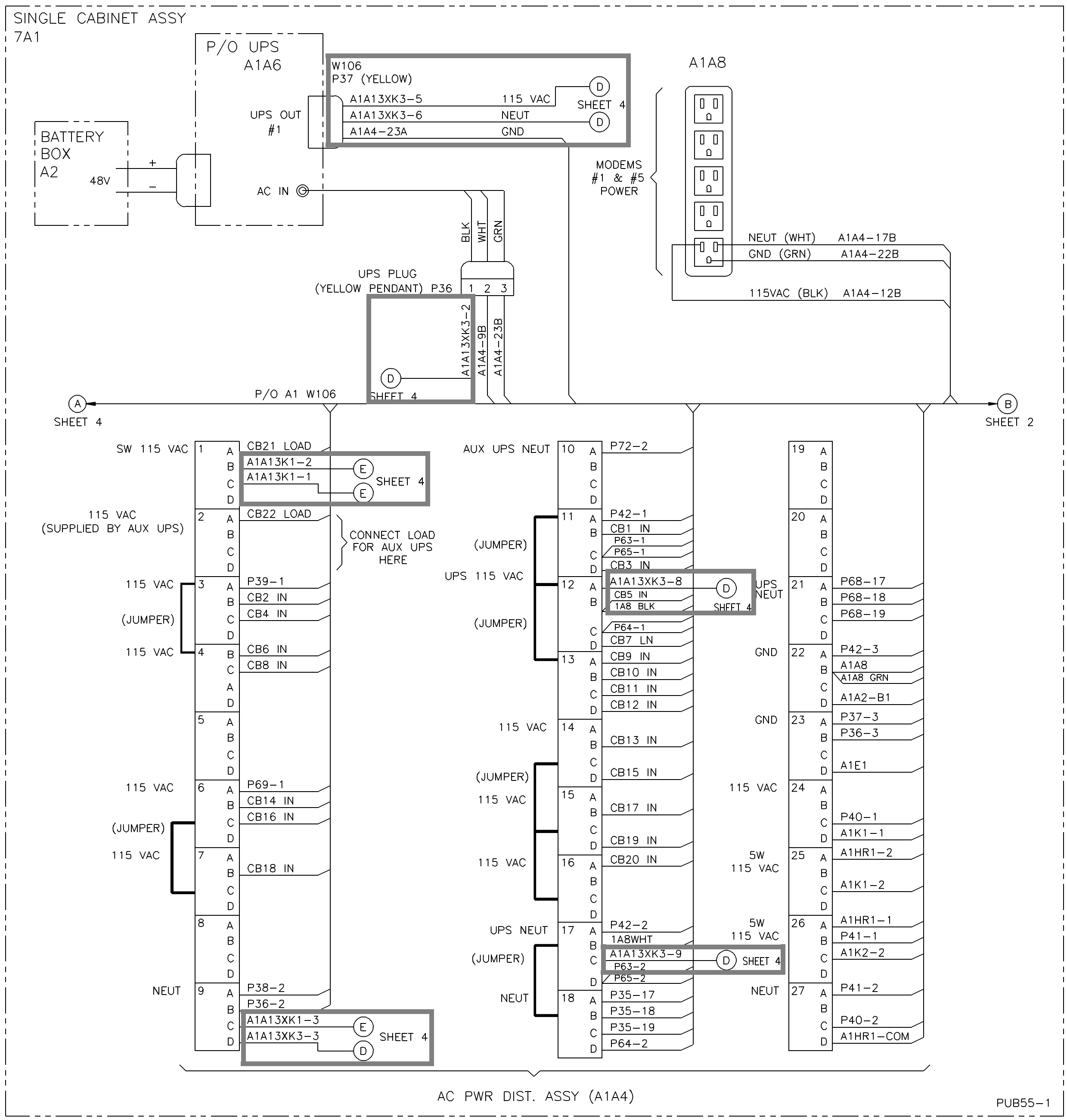


Figure 14.4.9. AC Power Distribution Diagram (Sheet 1 of 4)

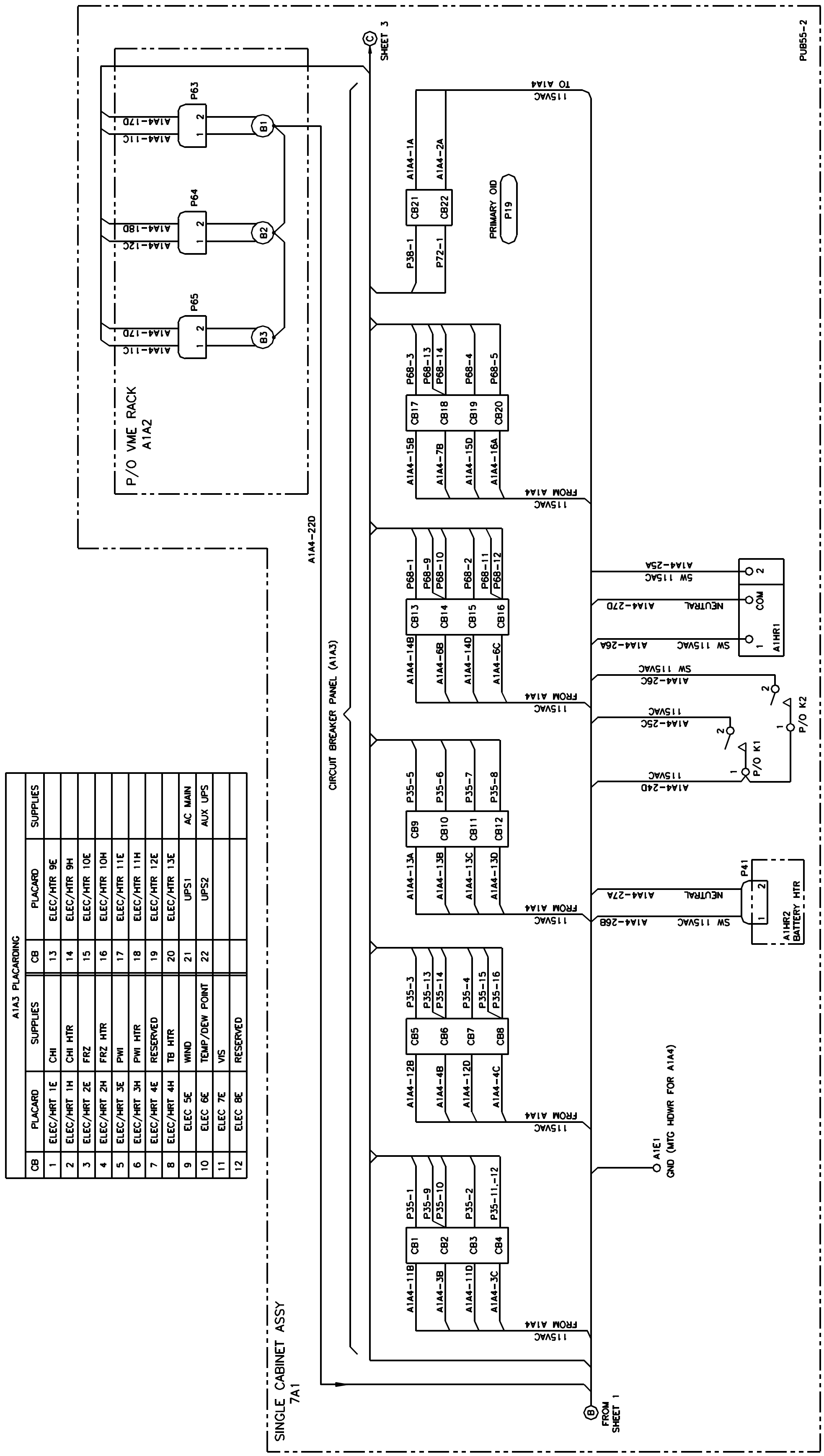


Figure 14.4.9. AC Power Distribution Diagram (Sheet 2)

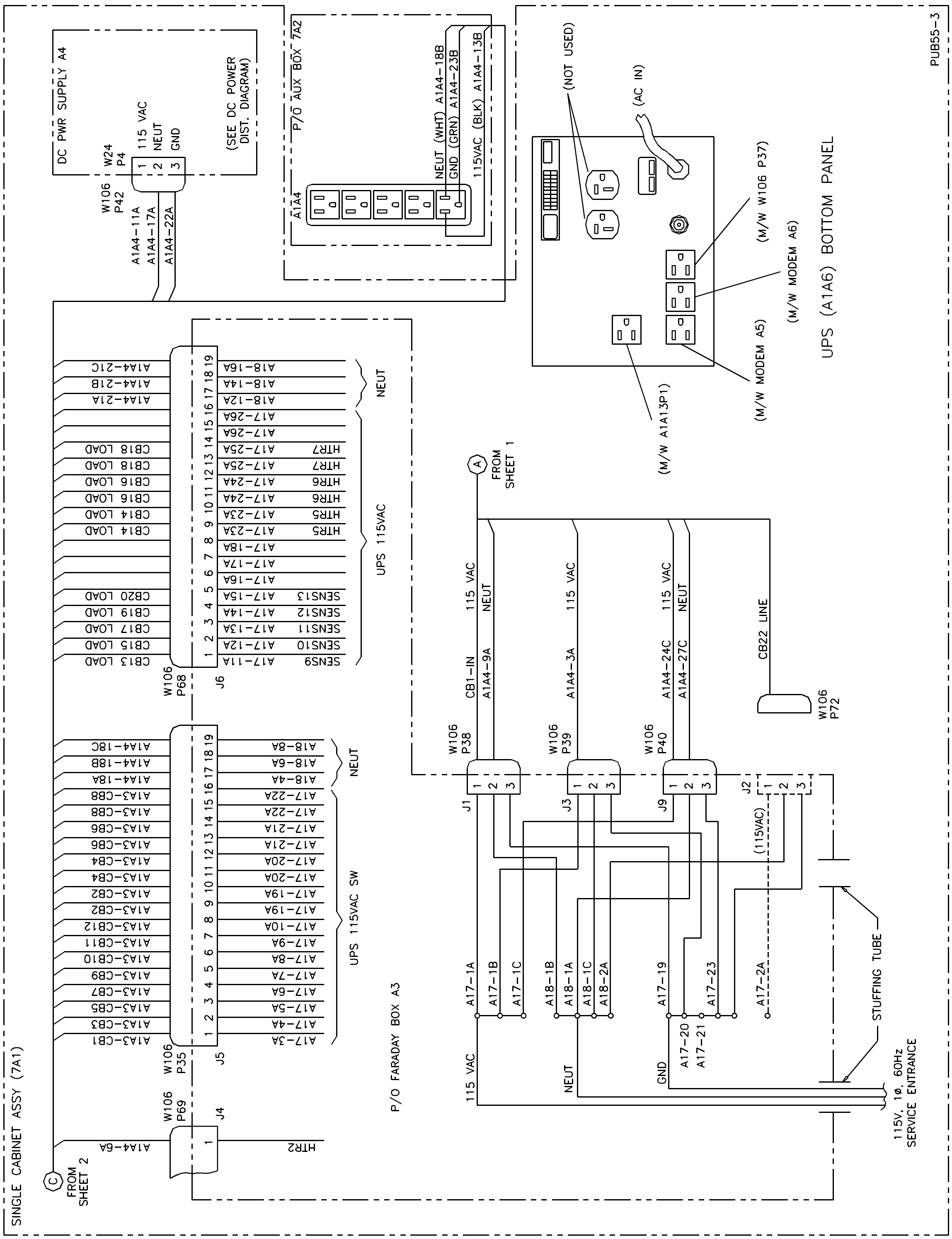


Figure 14.4.9. AC Power Distribution Diagram (Sheet 3)

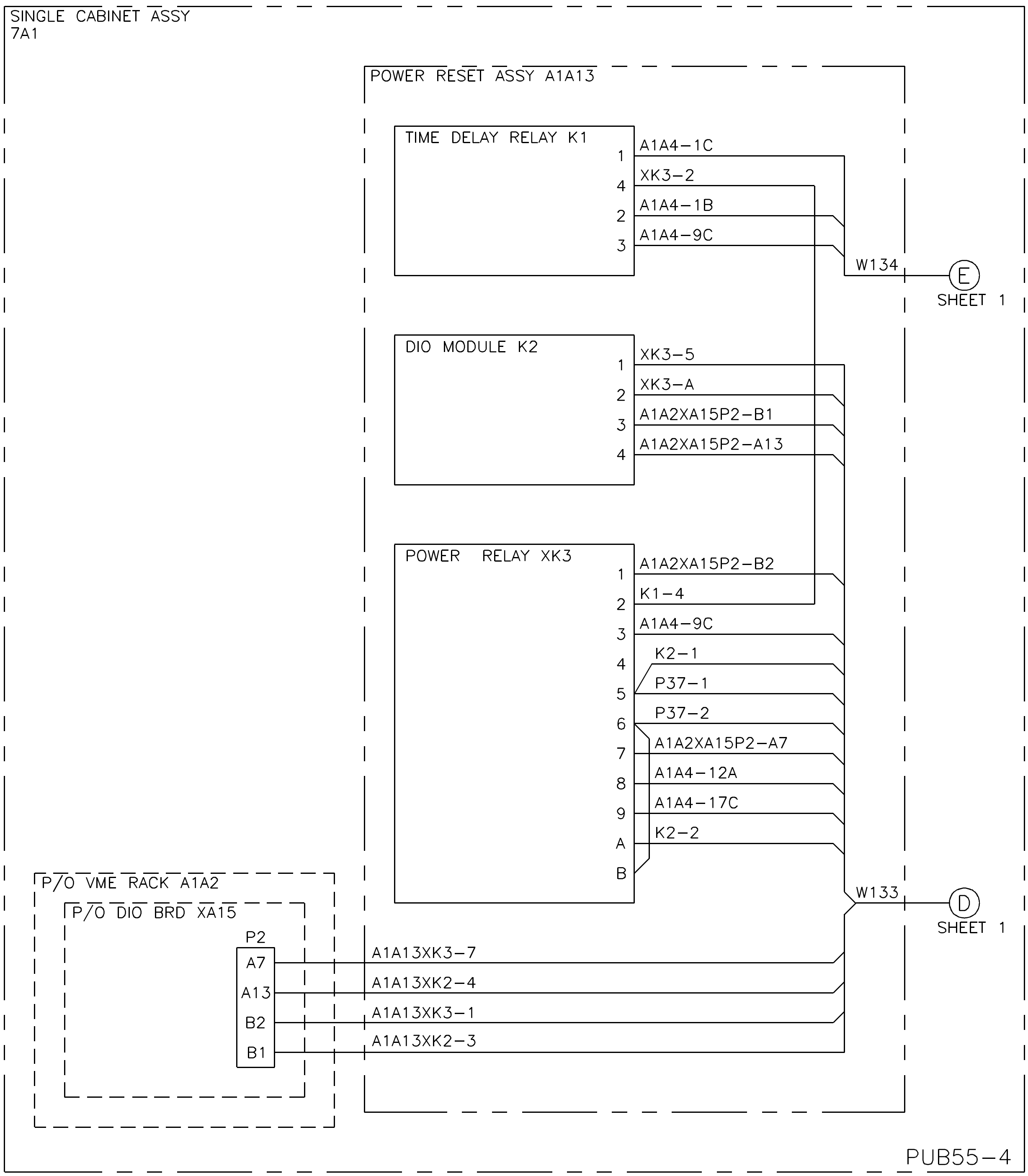


Figure 14.4.9. AC Power Distribution Diagram (Sheet 4)

14.4.4 **SCA CABINET HEATERS**

Because the SCA must operate out-of-doors in all climatic conditions, electrical heaters are included to ensure accurate, reliable operation in cold weather. As shown on figure 14.4.10, separate heaters are mounted on the 7A1A1 mounting assembly, with cabinet heater 7A1A1HR1 behind Circuit Breaker Panel 7A1A1A3, and battery heater 7A1A1HR2 at bottom left of Mounting Panel 7A1A1. These heaters operate from 115 vac which is applied through solid-state relays 7A1A1K1 and 7A1A1K2. The relays are controlled by three thermostatic switches, which also are mounted on 7A1A1 behind the circuit breaker extrusion. Cabinet heater 7A1A1HR1 includes two 325-Watt heating elements (metal strips), while 7A1A1HR2 is a 350-Watt silicon strip. When ambient temperature in the cabinet falls to 60°F, thermostatic switch 7A1A1S1 closes to apply +5V to 7A1A1S2 and 7A1A1S3. If the temperature falls to 50°F, S3 closes to energize relay 7A1A1K2 and 7A1A1S2 closes to energize relay 7A1A1K1. Relay 7A1A1K2 contacts then applies 115 vac power to heater 7A1A1HR2 and one element of cabinet heater 7A1A1HR1. Relay 7A1A1K2 contacts apply 115 vac to the other half of cabinet heater 7A1A1HR1. At 70°F S2 and S3 open to deenrgize relays K1 and K2. At 80°F, S1 opens to ensure removal of all heating power.

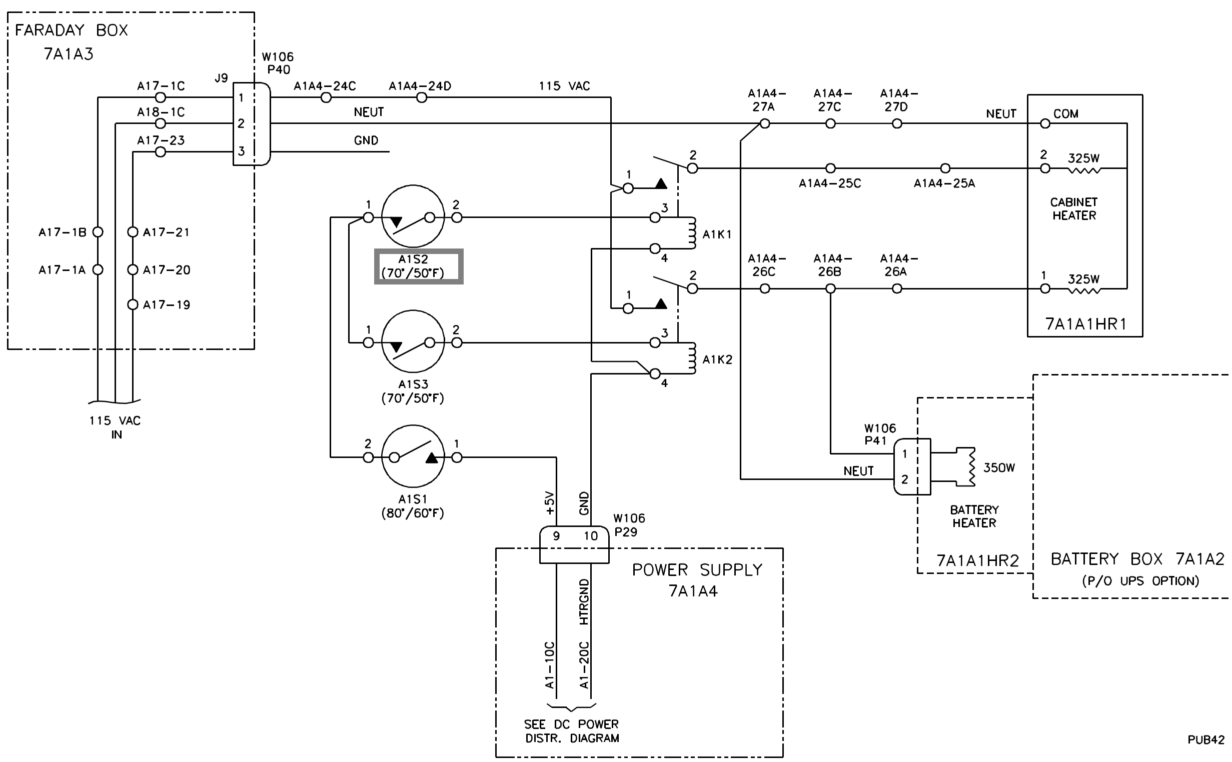


Figure 14.4.10. SCA Cabinet, Heater Control Circuit

14.4.5 AUXILIARY BOX CABINET HEATERS

The Aux box cabinet heater control circuit is shown in figure 4.4.11, and is similar to that in the SCA.

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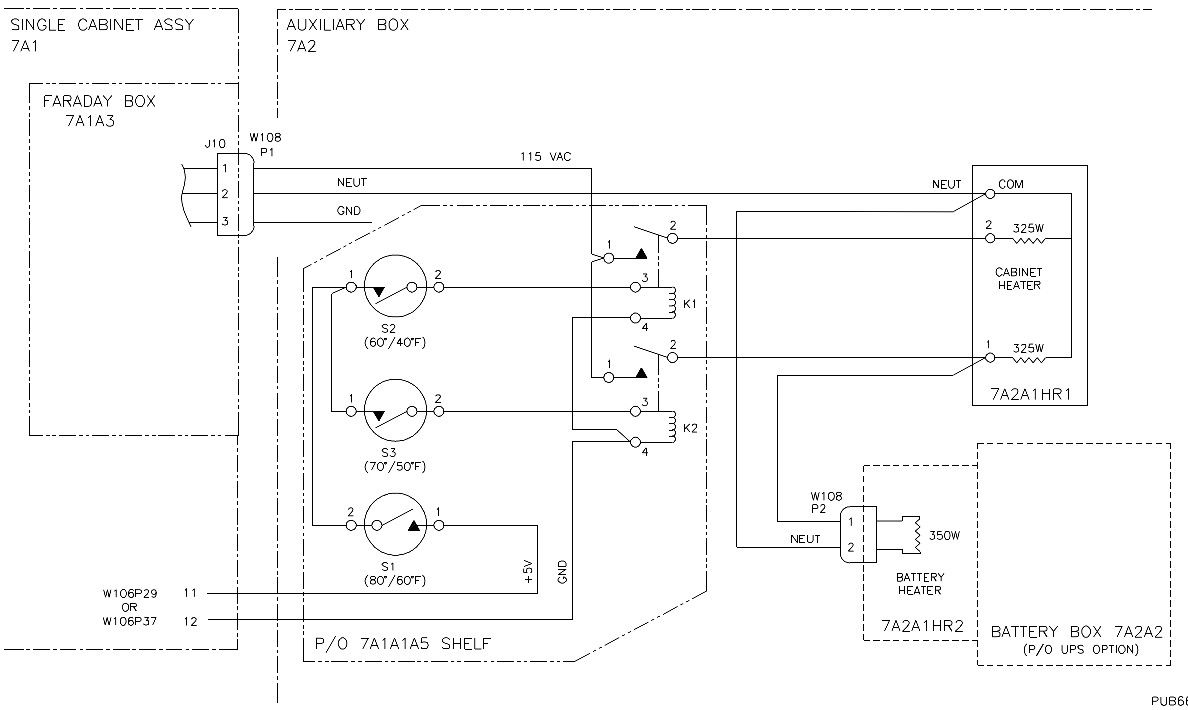


Figure 14.4.11. Auxiliary Box, Heater Control Circuit

14.4.6 DC POWER DISTRIBUTION AND MONITORING

Figure 14.4.12 illustrates dc power distribution within the SCA. DC power for the SCA is provided by paired power supplies located in DC Power Supply Plate Assembly A4. These power supplies receive ac input power from UPS output (or bypass circuit) to provide +5 vdc, +12 vdc, and -12 vdc. Paired outputs are OR'ed together by diodes to ensure that one supply continues to provide power if the other fails and that the failed supply is isolated from the output line. AC input power to each of the four supplies is separately fused on DC Distribution Assembly A4A1, with 3.15A fuses F1 and F2 protecting PS1 and PS2, respectively, while 2.5A fuses F3 and F4 protect PS3 and PS4, respectively. The wiring harness for Power Supply Mounting Assembly A4 is designated W024.

Power supply output voltages are distributed from Power Distribution Assembly 7A1A1A4, shown on figure 14.4.13. There they are distributed by cable harness W024 (part of Power Supply Mounting Assembly A4) and wire harness W106, which interconnects the assemblies on Mounting Panel 7A1A1. To accommodate monitoring by system software, power supply outputs are connected to VME Resistor Board 7A1A1A2A14, which applies voltage samples to the A/D board for access. DC power applied to the rf modems is monitored in the same manner.

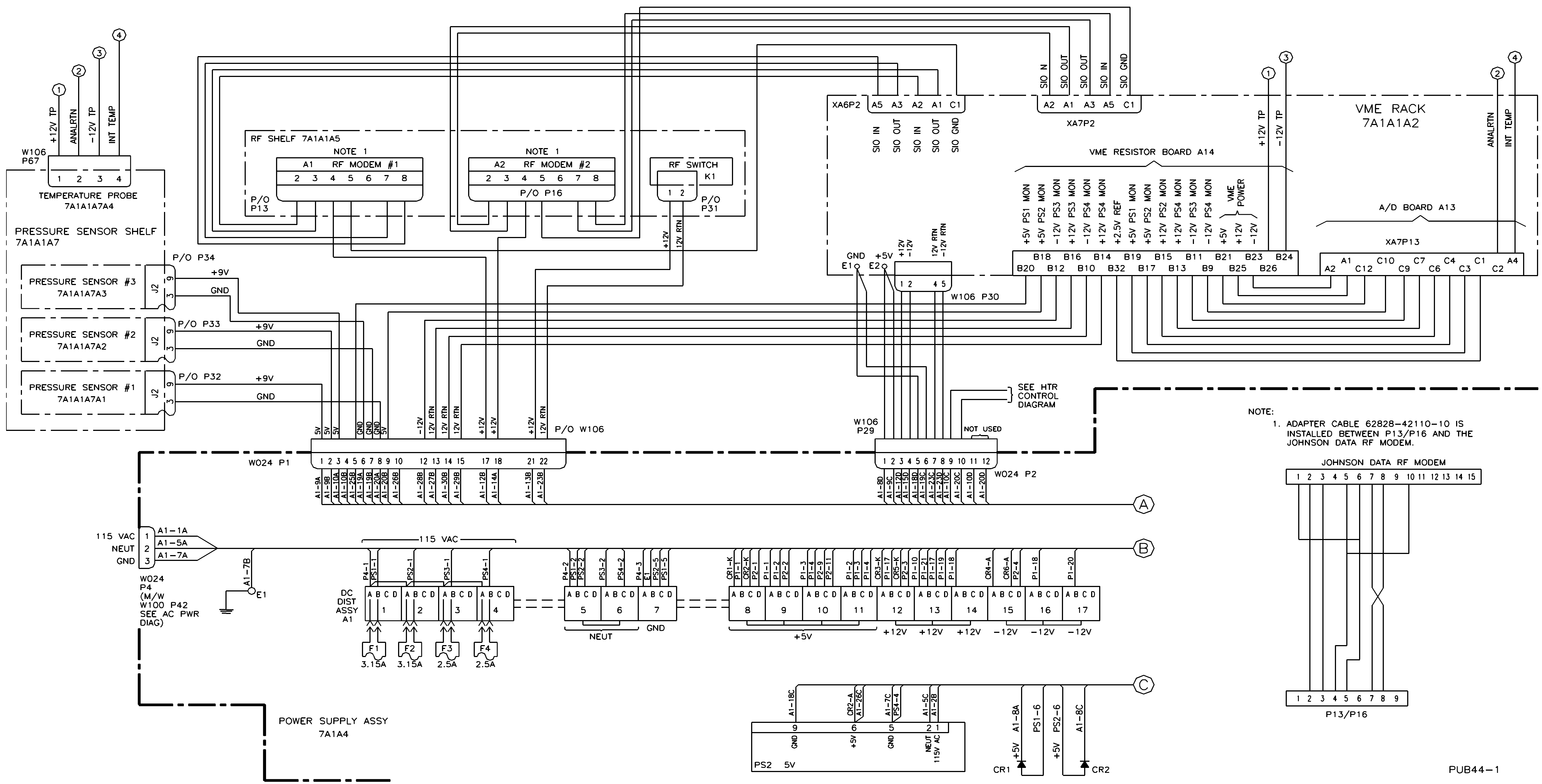


Figure 14.4.12. DC Power Distribution Diagram (Sheet 1 of 2)

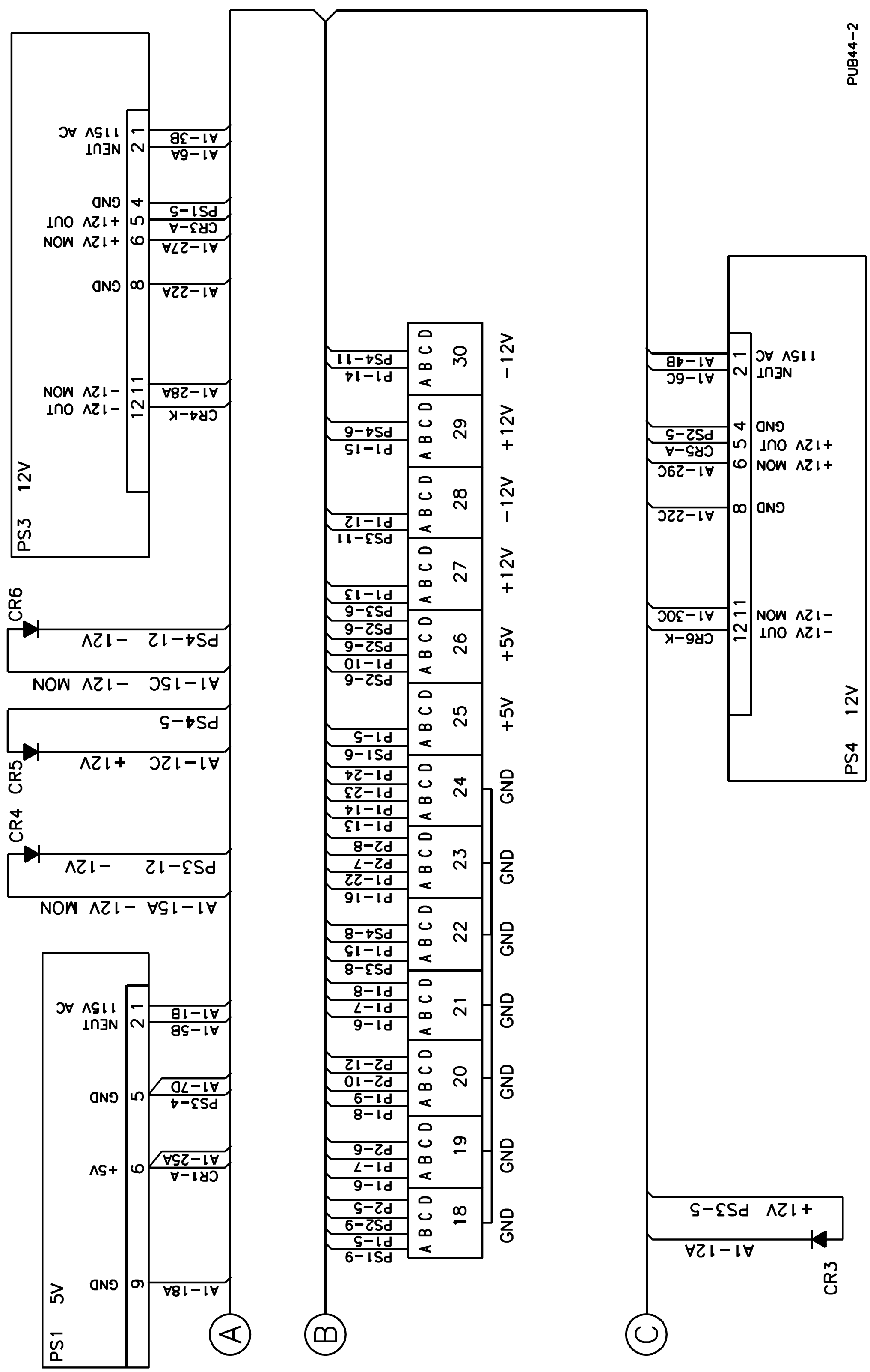


Figure 14.4.12. DC Power Distribution Diagram (Sheet 2)

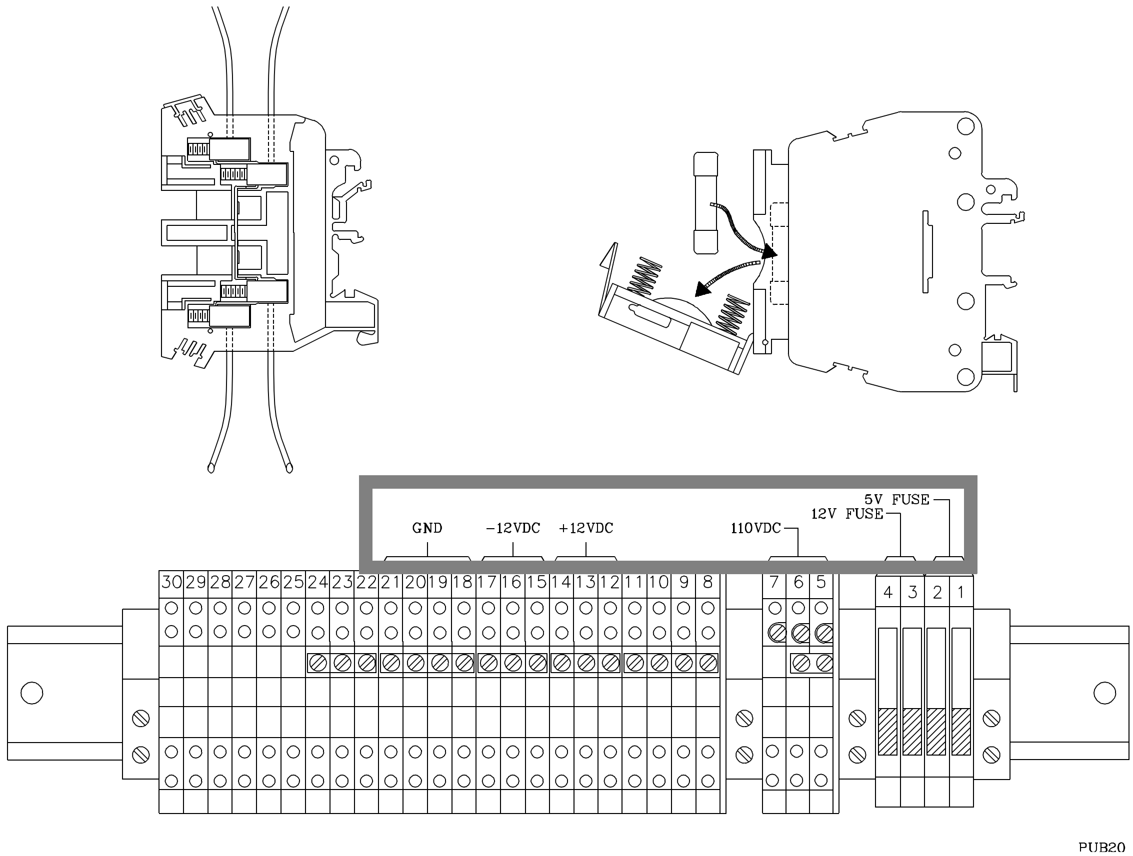


Figure 14.4.13. DC Power Distribution Assembly

14.4.7 **SENSORS**

The complement of sensors includes the pressure sensors that are mounted in the SCA and up to 13 additional sensors. Sensors are customer-selected to accommodate site requirements. Fiberoptic Transducer Modules 7A1A3A1 through 7A1A3A13, located in the Faraday box, interconnect up to 13 sensors. These transducers are paired with identical transducers in the respective sensor cabinets. Each pair communicates in RS-232 format via fiberoptic cables. The SCA fiberoptic transducer modules connect through SIO Boards #5, #6, and #8 (A9, A10, and A12), each interfacing up to four modems.

The sensor complement installed at any particular site reflect requirements of that site as determined by the customer. Some sites may be provided with more than one type of sensor. Cloud height and visibility sensors are often duplicated at a site, with a maximum of three each possible. Usually, each touchdown zone is provided with cloud height and visibility sensors to ensure that current ceiling and visibility conditions at that specific runway are reported accurately.

14.4.8 **PERIPHERALS**

Peripheral devices are not supplied as standard equipment with the SCA. Any laptop PC can be connected to serve as an OID for maintenance purposes. The maintenance technician uses a laptop PC to check ASOS system status, to reconfigure the system, and to run on-demand diagnostic tests on specific elements of the system. Optionally, an OID and/or a video display unit (VDU) could be installed in an adjacent building, provided that it is within 200 feet of the SCA. All other outputs from ASOS are via direct connection (hardwire) or telephone modems. A modem also interfaces with the NWS Automation of Field Operations & Services (AFOS) system.

A digitized voice output is routed via phone modems to dial-in users (or via the GTA radio) to provide local weather and pressure data to pilots at or near the airport. The GTA radio continuously transmits current local meteorological observations on assigned VHF comm frequencies to pilots.

The FAA handset enables air traffic control specialists to append a NOTAM onto the digitized voice output for the local weather observation message. The printer provides hard copy data output of weather summaries, routine METAR's, SPECI's, and log messages. Log messages identify system status. The system maintenance log provides the technician with the maintenance history of the system and provides the results of each self-test performed on the system. If an SCA unit fails self-test, the log records the source of failure.

14.4.9 **MODEMS**

Three categories of modems provide I/O interfaces: phone line, dedicated line (for stand-alone modems), and rf. Table 14.4.3 lists the complement of standard and optional modems available in the SCA. All sites are equipped with data communication for one user via stand-alone modem. A second user can be accommodated by an additional (optional) 2400 baud or 28800 baud stand-alone modem.

14.4.9.1 **Telephone Modems**. The SCA contains up to six telephone modems which provide communications to external devices over leased lines or public, switched-telephone networks. All data transfers are under the control of the SIO boards that communicate with data terminal equipment (DTE) ports of those modems which use RS-232 protocol. The telephone modems operate in a 2-wire, full-duplex mode. These modems operate at data rates of 2400, 9600, or 28800 baud.

Modems available for the single-cabinet ASOS are listed in table 14.4.3. These additional modems can be installed, as required, to provide the connections to AFOS phone, proximity user OID, ADAS, or other user requirements.

14.4.9.2 **RF Modems**. The rf modems are used by the SCA for intercabinet communications at sites equipped with DCP's. The rf modems operate in the UHF range through an omnidirectional antenna or Yagi $
antenna (used in conjunction with 3 dB, 6 dB, 10 dB, 20dB, or 30 dB attenuators at sites where co-channel $
interference exists). A second, redundant, rf modem can be added, together with RF Switch 7A1A1A5S1. $
The rf switch (DPST coaxial relay) is installed at all sites where two rf modems are used. The rf switch connects the active rf modem to the antenna. The rf switch is controlled by the CPU via DIO board A15. When the CPU senses a failure in the rf modem communications link, it writes a selection word to the DIO board to toggle the switch. The CPU communicates with modem RF #1 through SIO board #2 and with RF #2 through SIO board #3.

Table 14.4.3. Modem Complement

Ref Des	Modem #	Category	Function/Type	CAGE	Model/PN
7A1A1A5A1*	RF #1	RF	DCP Communications		90315-10 or -20
7A1A1A5A2*	RF #2	RF	DCP Communications		90315-10 or -20
7A1A1A9	User #1	Stand-alone	User #1, 2400 Baud	97384	90051-1
7A1A1A10*	User #2	Stand-alone	User #2, 2400 Baud or 28800 Baud	97384	90051-1 or 90431-1
7A1A1A11*	#3	Telephone line	2400 or 9600 Baud	97384	90050-1, 90051-1
7A1A1A12*	#4	Telephone line	2400 or 9600 Baud	97384	90050-1, 90051-1
7A1A5*	#5	(Optional category & use.)				$
7A1A6*	#6	(Optional category & use.)				$
7A2A1A1*		Stand-alone	Codex Modem	97384	90362-10 or -20

* Optional

SECTION V. SCA MAINTENANCE

WARNING

Before attempting to service any ASOS equipment, the technician must perform the following:

Upon arrival at an airport, notify airport security and gain access to the system by following local procedures.

Adhere to all airport traffic regulations.

Before crossing any runway, radio the tower (ground control) and request clearance.

Proceed only after obtaining clearance from ground control and only after illuminating the caution light mounted atop the vehicle.

14.5.1 GENERAL

This section contains corrective and preventive maintenance procedures for the single-cabinet ASOS (SCA). Preventive maintenance procedures identify quarterly and semiannual tasks required to keep the SCA in peak operating condition. Corrective maintenance procedures include those for performing system diagnostic test, fault isolation, and removing and installing field replaceable units (FRU's). The system diagnostic test runs continuously and automatically and prints a system operational status message after each self-test cycle. If self-test detects a failure, the suspected FRU is identified in the system maintenance log by reference designator. The technician's first step in restoring system operability is to replace the identified FRU. The corrective maintenance table in this section is used if the system does not automatically identify an FRU.

14.5.1.1 **Tools and Test Equipment**. Tools and test equipment required to perform maintenance on the system are listed in Chapter 1, Section V. These are preferred items that the technician should have available to perform maintenance on the system. If the specific item listed in the table is not available, an equivalent item may be substituted. Specific tools required for removal and installation of each FRU are specified in each procedure.

14.5.1.2 **Consumable Materials List**. Consumables needed to maintain the SCA are the same as for the standard multicabinet ASOS listed in Chapter 1, Section V. Although the Source column lists a recommended source for some consumable items, the technician may substitute equivalent products.

14.5.1.3 **Maintenance Action Recording and Documentation**. Whenever a maintenance technician performs maintenance tasks, all actions must be documented in the system maintenance log. For the purpose of entering unit or assembly identification numbers the procedure in table 14.5.1 is performed.

Table 14.5.1. Maintenance Documentation Procedures

Step	Procedure
1	Sign onto system as TECH.
2	Press MAINT key. Observe that maintenance display screen is displayed.
3	Press ACT key and observe that maintenance action screen is displayed.
4	Press START to store a maintenance action message in system maintenance log (SYSLOG) page in preparation for maintenance action which is to follow.
5	Select required maintenance action, categorized as either preventive maintenance, corrective maintenance, calibration, or field modification kit installation.
6	Upon completion of required maintenance task, select appropriate maintenance page (PREVT, CORR, CAL, or FMK).
7	Enter appropriate identification numbers and exit screen.
8	From 1-minute screen, select REVUE followed by SYSLOG. Enter any additional maintenance data or messages into SYSLOG and verify that all maintenance actions performed have been entered in SYSLOG.
9	Sign off of ASOS.

14.5.2 **PREVENTIVE MAINTENANCE**

ASOS preventive maintenance is performed at two intervals: 90 days and semiannually. Chapter 1 contains general information about preventive maintenance of ASOS systems and equipment. SCA preventive maintenance tasks consist of visual inspection procedures (table 14.5.2), SCA facilities maintenance (table 14.5.3), and cleaning (table 14.5.4).

14.5.2.1 **Desiccant**. A desiccant dryer is installed in the center of the SCA cabinet, in the air line leading from the pressure sensors to the pressure sensing port. The desiccant is a silica gel (i.e., a drying agent). The gel is a consumable item in powdered form that is contained and if necessary, replaced in the bowl unit of the dryer. Before handling the desiccant, the Material Safety Data Sheet (MSDS) for Davidson Blue Indicating Gel issued by W.R. Grace & Co., P.O. Box 2117, Baltimore, MD 21203 (telephone: 410-659-9000) or the current supplier should be obtained from the supervisor and read. The gel should be replaced with new desiccant when necessary in accordance with table 14.5.2A.

Table 14.5.2. Visual Inspection Procedures

Step	Procedure
1	With power applied, ensure that fan (on rear of UPS), and muffin fans (on bottom of VME card rack) are operating correctly.
2	With power applied, at wind sensor tower, cover light sensor on tower light control box and ensure that clearance lights (at top of tower) illuminate.
3	Remove power from system, inspect interior of all cabinets for signs of pinched or chafed wiring, loose hardware, and proper connector mating.
4	With power off, check outside of all enclosures for signs of corrosion.
5	With power off, at sensor pad, ensure that all hardware securing sensors to pad is tight. Check each mounting column for visual signs of wear or corrosion. Ensure that there are no cracks in columns.
6	Inspect desiccant in desiccant dryer (Dryer, figure 14.1.3). If indicated by color, remove and replace desiccant (refer to table 14.5.2A).
NOTE After performing visual inspection procedure, reapply power to the system and wait until the system initializes and successfully completes its diagnostic check before leaving the area.	

Table 14.5.2A. Desiccant Replacement Procedure $

Step	Procedure
	Tools and material required: Hand-held vacuum cleaner Mild detergent and water Lint-free cloth(s). **<u>CAUTION</u>** Before handling the desiccant, the Material Safety Data Sheet (MSDS) for Davidson Blue Indicating Gel issued by W.R. Grace & Co., P.O. Box 2117, Baltimore, MD 21203 (telephone: 410-659-9000) or the current supplier should be obtained from the supervisor and read. **NOTE** Wring out cloth before washing screens.
1	At SCA cabinet, loosen dryer clamp ring, slide off metal bowl guard, and unscrew bowl from top housing.
2	Pour out used desiccant into plastic bag and seal bag for proper disposal.
3	Open new container and refill bowl, shaking or tapping bowl to settle desiccant to 1/2 inch from top of bowl. **<u>CAUTION</u>** Do not install the bowl without installing the metal bowl guard.
4	Replace bowl, bowl guard, and clamp ring onto unit. Ensure that clamp ring is securely in place.

Table 14.5.3. Facilities Maintenance Checklist

Item	Task	Period
Towers and pedestals	Inspect for corrosion	Semiannually
Fasteners	Paint	Semiannually, Yearly
Foundations	Inspect condition	Yearly
Fencing	Inspect condition Paint	Yearly Yearly
Signage	Inspect condition Paint	Yearly Yearly
Lightning protection system	Inspect condition	Semiannually
Roads and walkways	Inspect condition: Snow removal:	Yearly Quarterly (in season)
Land	Inspect ground cover: Inspect grass height: Snow removal:	Yearly Quarterly (in season) Quarterly (in season)
Electrical equipment & cables	Inspect condition: Check operation:	Semiannually Quarterly

Table 14.5.4. Cleaning Procedure

Step	Procedure
	Tools and material required: Hand-held vacuum cleaner Mild detergent and water Lint-free cloth(s). **WARNING** Ensure that power has been removed from any peripheral device before cleaning that device. **NOTE** Wring out cloth before washing screens.
1	Using soft cloth dampened with mixture of mild detergent and water, clean CRT display screens and external cases of peripheral devices. Using lint-free cloth, dry screens and cases.
2	Using small hand-held vacuum cleaner, remove dust from OID keyboard and printer.

14.5.3 CORRECTIVE MAINTENANCE

Corrective maintenance involves isolation, removal, and replacement of faulty FRU's. The ASOS is equipped with an automatic self-test program designed to isolate most faults to a single FRU; however, due to system hardware configuration, there will be instances when the diagnostics can only isolate to a group of FRU's, such as a sensor or an I/O channel. The troubleshooting approach for these two types of conditions is very different. When the FRU is specifically identified, the technician need only replace the faulty unit.

14.5.3.1 **Warmup and Initialization**. To ensure proper operation of the system, the technician must allow the SCA to automatically initialize after application of primary power and then verify that the continuous self-test diagnostics run without failure. Table 14.5.5 provides corrective maintenance symptom analysis information.

14.5.3.1.1 **System Diagnostics**. System diagnostics run continuously in the background. The diagnostics complete a check of the entire system every 7 minutes. Test data received from the diagnostic program is displayed on the technician interface display screens. Error messages are also entered into the system log and printed on the printer.

14.5.3.1.2 **Preliminary Troubleshooting Checks**. When the diagnostics program identifies two or more FRU's as the trouble source, the technician must isolate the failed FRU. Using Section IV theory of operation and associated drawings as references, the following two basic procedures are performed:

a. Check connectors to ensure that all boards, cables, and connectors are present and correctly connected.

b. Check AC and DC power.

Although ASOS monitors all critical power supply voltages in the SCA, sensors, and DCP's, failure of a power supply could result in loss of communications between circuits powered by that supply and the rest of the system. Power supplies are tested by both visual inspection and electrical checks. Before measuring voltages, the technician should visually inspect the area of the suspected FRU for obvious signs of power supply failure. During this inspection, the technician should pay particular attention to circuit breakers, panel lights, and light emitting diodes (LED's) to ensure that they are functioning normally then use a digital multimeter (DMM) to check voltages at fuses and power supply output terminals. In most cases, these tests will isolate the faulty FRU.

Table 14.5.5. Symptom Analysis

Symptom	What To Do	How To Do It
SCA system is completely dead.	Check ac and dc power.	Refer to SCA ac/dc power distribution diagram (figure 14.4.9 and 14.4.12) and use DMM to verify voltages.
Problem with UPS.	Check UPS operation.	Refer Chapter 2, Section V.
SCA computer does not initialize.	Check VME card rack.	Refer Chapter 2, Section V.
SCA heaters do not work.	Check heater circuit.	Refer Chapter 2, Section V.
Loss of SCA communications.	Check communications links.	Refer Chapter 2, Section V.
SIO CCA failure or communications loss with a peripheral or user.	Check SIO boards.	Refer Chapter 2, Section V.
WIND SENSOR does not respond.	1. Check fiberoptic modules. 2. Troubleshoot sensor.	Refer to paragraph 14.5.3.2. Refer Chapter 4, Section V.
TEMPERATURE/DEWPOINT SENSOR does not respond.	1. Check fiberoptic modules. 2. Troubleshoot sensor.	Refer to paragraph 14.5.3.2. Refer to Chapter 5, Section V.
VISIBILITY SENSOR does not respond.	1. Check fiberoptic modules. 2. Troubleshoot sensor.	Refer to paragraph 14.5.3.2. Refer to Chapter 6, Section V.
PRESENT WEATHER SENSOR does not respond.	1. Check fiberoptic modules. 2. Troubleshoot sensor.	Refer to paragraph 14.5.3.2. Refer to Chapter 7, Section V.
PRESSURE SENSORS All 3 incorrect. 1 or 2 incorrect. 1 sensor does not respond.	 Clean pressure port. Replace sensor(s). Troubleshoot sensor.	 Refer to Chapter 8, Section V. Refer to Chapter 8, Section V. Refer to Chapter 8, Section V.
CEILOMETER does not respond.	1. Check fiberoptic modules. 2. Troubleshoot sensor.	Refer to paragraph 14.5.3.2. Refer to Chapter 9, Section V.
TIPPING BUCKET does not report rain accumulation.	Test the rain gauge.	Refer to Chapter 10, Section V.

14.5.3.2 **Fiberoptic Module Test**. The SCA communicates with sensors via fiberoptic data links. Each fiberoptic link is made up of a fiberoptic module in the SCA, a corresponding module in the sensor, and two fiberoptic cables linking the two modules. These modules are optoelectric transducers that convert RS-232 serial digital data in electric media to optical media and vice versa. The model H083 temperature/ dewpoint sensor operates in simplex mode where data is periodically sent to the SCA. Communications mode for the rain gauge sensor is half-duplex, but it does not communicate in RS-232 or any other digital format: it merely sends an optical pulse over the inbound link each time the rain bucket tips. All other sensors use full-duplex communication mode, where simultaneous unidirectional messages pass over the paired fiberoptic links.

In full-duplex communication mode, each link of the fiberoptic pair is unidirectional. In half-duplex RS-232 communication, the SCA polls the sensor via one link, then the sensor responds with the requested data over the other link. In simplex communication, the links are redundant, with time-shared bidirectional message transfer over each link. Fiberoptic links are not tested automatically: they must be tested with an RS-232 test tool as directed in table 14.5.6 for the half-duplex link and table 14.5.7 for the HO-83 link.

Table 14.5.6. Fiberoptic Link Testing - Half-Duplex Link

Step	Procedure
1	At OID, access sensor configuration page. Determine assigned SIO port. Refer to SIO port assignments (table 14.4.1) and identify corresponding fiberoptic module.
2	Connect RS-232 test tool in line with fiberoptic module.
3	Using RS-232 test tool, verify periodic activity on TxD pin. If pin is active, proceed to step 4; if inactive, problem is in SIO board.
4	Using RS-232 test tool, verify activity on RxD pin in response to TxD signals. If TxD and RxD pins both are active, problem is in SIO board. If RxD pin is inactive, proceed to step 5.
5	Remove RS-232 test tool from fiberoptic module and reconnect DB-9 connector to module.
6	At failing sensor, connect RS-232 test tool in line with sensor fiberoptic module (between fiberoptic module and corresponding DB-9 connector from cabinet harness).
7	Verify periodic activity on TxD signal on RS-232 test tool. If signal is active, continue with step 8. If signal is not active, proceed to step 9.
8	Using RS-232 test tool, verify RxD pin activity in response to TxD signals. If no activity on RxD signal, problem is sensor serial data interface circuits. If both TxD and RxD pins are active, proceed to step 9.
9	Remove RS-232 test tool from sensor fiberoptic module and reconnect DB-9 connector to module. One at a time, remove and replace following units and retest system until problem is corrected: a. Fiberoptic module in SCA (or DCP) b. Fiberoptic module in sensor c. If TxD signal was missing (step 7), replace transmit fiberoptic cable between DCP (or SCA) and sensor (transmit cable is farthest from DB-9 connector on fiberoptic module)
10	If all signals were active through step 9, replace receive fiberoptic cable between DCP (or SCA) and sensor (receive cable is nearest to DB-9 connector on fiberoptic module).

Table 14.5.7. Fiberoptic Link Testing - HO83 Link

Step	Procedure
1	At HO83 sensor, connect RS-232 test tool in line with sensor fiberoptic module (between fiberoptic module and corresponding DB-9 connector from cabinet harness).
2	Verify periodic activity of RxD signal on RS-232 test tool. If RxD is active, proceed to step 3; if RxD is inactive, problem is in HO83 sensor serial data interface.
3	Remove RS-232 test tool from HO83 fiberoptic module and reconnect DB-9 connector to module.

Table 14.5.7. Fiberoptic Link Testing - HO83 Link -CONT

Step	Procedure
4	At OID, access sensor configuration page. If HO83 sensor is associated with a remote DCP, determine sensor's assigned SIO port. Refer to list of Port Assignments for DCP SIO Boards (table 3.4.1) and identify corresponding fiberoptic module. If HO83 sensor is associated with SCA, refer to SIO Port Assignments (table 14.4.1) and identify corresponding fiberoptic module.
5	At DCP (or SCA), connect RS-232 test tool in line with fiberoptic module for HO83 sensor (between fiberoptic module and corresponding DB-9 connector from cabinet harness).
6	Verify periodic activity of RxD pin on RS-232 test tool. If RxD is active, problem is in SIO board. If RxD is inactive, proceed with step 7.
7	Remove RS-232 test tool from fiberoptic module and reconnect DB-9 connector to module. One at a time, remove and replace following units and retest system until problem is corrected: a. Fiberoptic module in cabinet. b. Fiberoptic module in sensor. c. Receive fiberoptic cable.

14.5.3.3 **Modem Setup**. SCA modems must be set up after installation by configuring the SCA serial communications. Additionally, stand-alone modems connecting remote peripherals to the SCA by leased line must be set up manually. The following paragraphs describe setting up the SCA modems and stand-alone modems.

14.5.3.3.1 **Setting Up SCA Modems**. SCA modems are configured via the SCA serial communications page after installation. From this page, the modem is assigned a function, assigned to an SIO port, assigned a baud rate, and specified for leased line operation. The baud rate for the model 2440 modem is 2400 for OID's, VDU's, and printers. The baud rate is 9600 for the model V.3225 modem and 28800 for the model V.3400 modem. After the modem is installed and configured on the SCA serial communications page, the SCA program automatically programs the modem for operation. No other action is required on the part of the technician.

14.5.3.3.2 **Setting Up Stand-Alone (S/A) Modems**. After the S/A modem is installed at the peripheral end, it must be manually programmed to operate in leased line mode with the correct parameters. The LCD display and the YES and NO pushbutton switches on the front panel of the modem (same as standard ASOS rack-mounted modems) are used to program the modem. The modem LCD displays main menus, submenus, and configuration options to the technician. The YES/NO pushbuttons are used to sequence through the main menus and submenus and to select appropriate options. The Installation and Operation Manual for the stand-alone modem provides detailed information on all menus, submenus, and options available with the modem.
$ Refer to Paragraph 2.5.5.2 for model 2440, V.3225, and V.3400 stand-alone modem settings.

These tables address only the settings that must be checked or changed by the technician. They do not address options that are automatically set by the factory or are not required for ASOS operation. The menu and option titles that appear on the LCD display vary from site-to-site, depending on modem firmware.

$ 14.5.3.3.3 **Setting Up Johnson Data RF Modem**. Johnson Data rf modem frequencies are assigned
$ and setup at the depot. Order rf modem part number 62828-40506-1 for 410.075 MHz or 62828-40506-2 for
$ 410.950 MHz.

14.5.3.4 **FRU and Subassemblies Removal and Installation**. Removal and installation procedures for most FRU's and subassemblies are the same as those for the standard ASOS system, which are listed in Chapter 2, Section V. Those procedures that are unique to the SCA configuration are given in the following paragraphs.

14.5.3.4.1 **Removal and Replacement of VME 7A1A1A2 CCA's**. Typical assignment of CCA's to VME slots is shown on figure 14.5.1, but an SCA for any particular site could be equipped with additional, optional, CCA'S depending upon site requirements. Procedures for circuit card removal and installation is the same as given for the standard ASOS in Chapter 2, Section V. Each CCA has a board puller lever located at the top and bottom which forcibly extracts the CCA from the slot and backplane connectors.

14.5.3.4.2 **Removal and Replacement of Memory Board 7A1A1A2A3**. Before removing Memory Board 7A1A1A2A3, blank panel 7A1A1A2A4 must be removed to gain access to Memory Board 7A1A1A2A3.

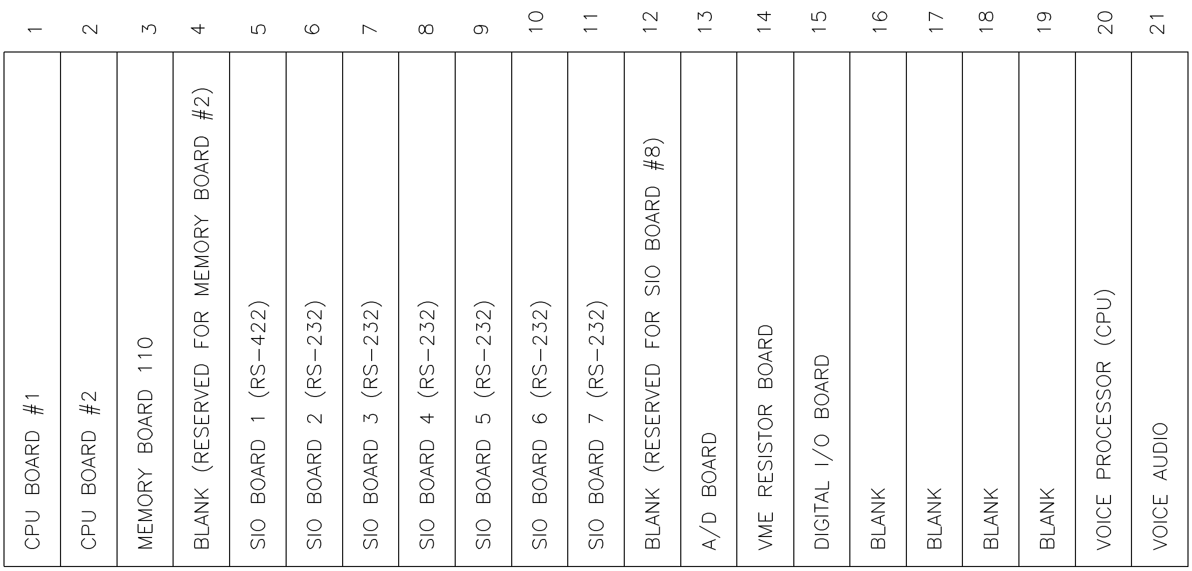
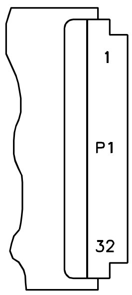


Figure 14.5.1. VME CCA Locations

14.5.3.4.3 **Removal and Replacement of SCA UPS 7A1A1A6**. The following tables remove UPS 7A1A1A6 (table 14.5.8), install UPS 7A1A1A6 (table 14.5.9, and set the UPS DIP switches (table 14.5.10).

Table 14.5.8. UPS 7A1A1A6 Removal Procedure

Step	Procedure
1	Set ASOS facility power breaker OFF and tag breaker.
2	Raise SCA cover and set support arms.
3	At Circuit Breaker Panel 7A1A1A3, set UPS CB1 OFF; then set UPS switch (on 7A1A6 control panel, on bottom) to OFF.
4	On Circuit Breaker Panel 7A1A1A3, set all other circuit breakers OFF.
5	Prior to disconnecting UPS, record UPS connections to ensure correct connection upon installation.
6	Disconnect battery power connector from UPS, and disconnect ac power cord with yellow pendant connector from cabinet harness connector W106P36.
7	Disconnect yellow UPS ac output plug, W106P37, from UPS bottom panel, then disconnect remaining ac plugs from UPS bottom panel receptacles.
8	Disconnect RS-232 connector W106P20.
9	Loosen UPS strap.
10	Lift UPS out of the SCA.



PIN NUMBER	ROW A SIGNAL MNEMONIC	ROW A SIGNAL MNEMONIC	ROW A SIGNAL MNEMONIC
1	D00	BBSY	D08
2	D01	BCLR	D09
3	D02	ACFAIL	D10
4	D03	BG0IN	D11
5	D04	BG0OUT	D12
6	D05	BG1IN	D13
7	D06	BG1OUT	D14
8	D07	BG2IN	D15
9	GND	BG2OUT	GND
10	SYSCLK	BG3IN	SYSFAIL
11	GND	BG3OUT	BERR
12	DS1	BR0	SYSRESET
13	DS0	BR1	LWORD
14	WHITE	BR2	AM5
15	GND	BR3	A23
16	DTACK	AM0	A22
17	GND	AM1	A21
18	AS	AM2	A20
19	GND	AM3	A19
20	IACK	GND	A18
21	IACKIN	SERCLK(1)	A17
22	IACKOUT	SERDAT(1)	A16
23	AM4	GND	A15
24	A07	IRQ7	A14
25	A06	IRQ6	A13
26	A05	IRQ5	A12
27	A04	IRQ4	A11
28	A03	IRQ3	A10
29	A02	IRQ2	A09
30	A01	IRQ1	A08
31	−12V	+5V STDBY	+12V
32	+5V	+5V	+5V

PUB37

Figure 14.5.2. VME CCA Connector Pin Assignment

Table 14.5.9. UPS 7A1A1A6 Installation Procedure

Step	Procedure
1	Ensure that ASOS facility power breaker is OFF and breaker is tagged.
2	With SCA cover raised, check that all wires and cables are clear of UPS mounting shelf.
3	Lift UPS into place on mounting shelf.
4	Fasten UPS mounting strap.
5	Connect RS-232 connector W106P20.
6	Connect UPS outputs as recorded per table 14.5.8 step 5.
7	Refer to table 14.5.10 and set UPS DIP switches (Deltek UPS 62828-90338-10 only: Deltek 62828-90338-20 does not have dip switches).

Table 14.5.10. UPS DIP Switch Setup (Deltek UPS 62828-90338-10 Only)

Sw	Set to Position	Position Functions	Alternate Position Functions
1	1 & 2 OFF 1 OFF, 2 ON	120 V input 127 V input	
2	1 & 2 ON 2 OFF, 1 ON	120 V input w/ext range 110 V input w/ext range	
3	OFF	Enable Site Warning Alarm	Disable Site Warning Alarm

Table 14.5.10. UPS DIP Switch Setup (Deltek UPS 62828-90338-10 Only) -CONT $

Sw	Set to Position	Position Functions	Alternate Position Functions
4	OFF	Backup time ≈2 minutes	4 →ON, backup time ≈5 minutes
5	OFF	Enable <5% load auto shutdown	5 →ON disables <5% load auto shutdown
6	OFF	(Not used.)	
7	OFF	Baud rate=1200	7 -ON Baud rate =9600
8	OFF	60 Hz input select	8 -OFF = 50 Hz (Not used.)

14.5.3.4.4 **Removal and Installation of Faraday Box 7A1A3 Subassemblies**. Figure 14.5.3 identifies connectors and subassemblies of Faraday Box Assembly 7A1A3. The fiberoptic modules are socket-mounted on top of the box. Table 14.5.11 describes Faraday box internal wiring and terminals.

Table 14.5.11. Faraday Box Access Procedure

Step	Procedure
1	Ensure that ASOS facility power breaker is OFF and breaker is tagged.
2	At SCA Circuit Breaker Panel 7A1A1A3, set all circuit breakers OFF.
3	Set UPS power switch OFF.
4	At Faraday Box 7A1A3 front cover, remove perimeter screws and remove front cover.

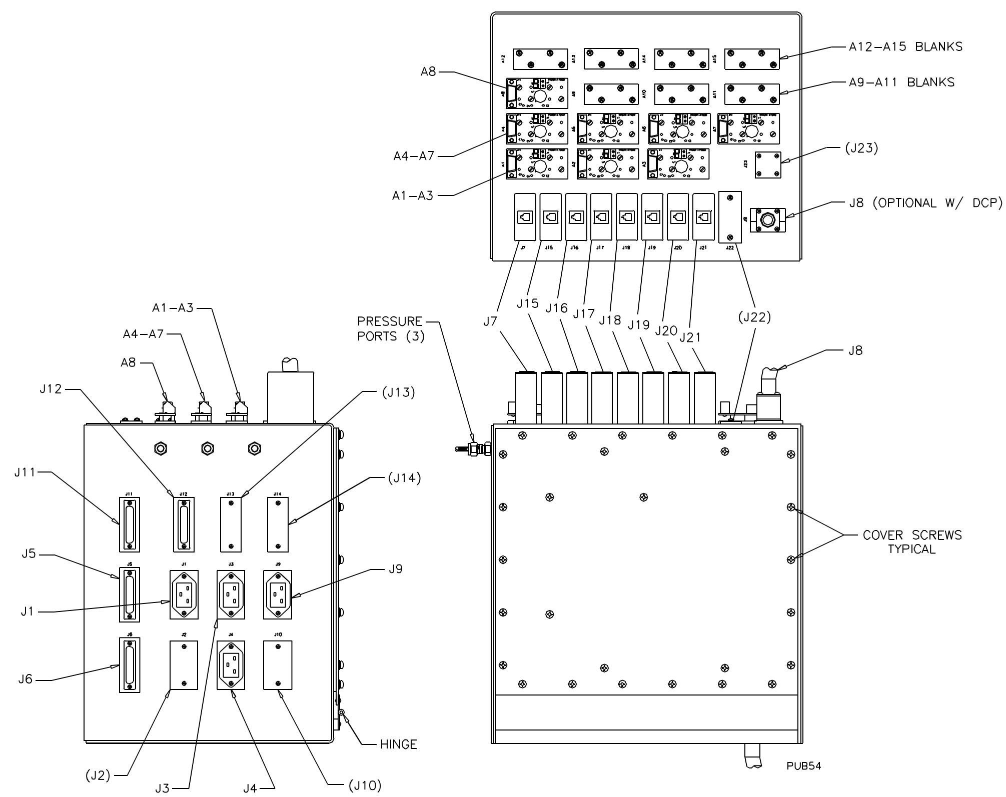


Figure 14.5.3. Faraday Box Assembly A3, Parts Location Diagram

14.5.3.4.5 Removal and Installation of Alternative GTA Antenna. At SCA sites where the alternative GTA antenna (ground plane antenna mounted on the wind tower) is installed, use the procedures in table 14.5.12 for replacement of the antenna.

Table 14.5.12. Removal and Installation of Alternative GTA Antenna

Step	Procedure
	REMOVAL
	Tools required: #1 Flat blade screwdriver #1 Phillips screwdriver #2 Phillips screwdriver 3/8" socket wrench Hacksaw Tape measure
1	At auxilliary box, remove power from GTA radio.
2	Using the procedures in table 4.5.8, lower the wind tower to gain access to the antenna.
3	Remove the weather shield from the antenna cable connection and disconnect the antenna cable from the bottom of the antenna. Retain the NF/NF cable adapter.
4	Loosen the terminal lug that holds the ground wire. Remove the ground wire from the antenna.
5	Refer to figure 14.5.4, remove the two 1" pipe straps that secure the antenna pipe to the mounting bracket. Remove the antenna from the bracket.
	INSTALLATION
1	**CAUTION** The aternative antenna must be field tuned for the operating frequency assigned to the GTA radio. DO NOT cut the antenna elements unless the assigned operating frequency is known. Refer to figure 14.5.6 and table 14.5.13 to determine the proper lengths to cut the antenna ground plane radials and antenna radiating element . Using a hacksaw, cut the radials and radiating element to the proper lengths for the assigned frequency.
2	Using the removed antenna as a model; assemble the new antenna, attaching the terminal lug under the nut of one of the u-bolts that secure the ground plane radials. Arrange so that the antenna grounding wire can go into the barrel of the terminal lug.
3	Loosely fasten the antenna support pipe to the mounting bracket using the 1" pipe straps. Adjust so that the antenna axis is parallel to the wind tower axis at a distance of 17" to 19" from the tower.
4	Refer to figure 14.5.5. Orient the antenna so the radials are at a 45 degree angle with the wind tower. Tighten the two pipe straps to secure the antenna in this position.
5	Connect the antenna cable to the bottom of the antenna using the NM connector and NF/NF adapter. Cover the connectors using the weather shield provided on the antenna terminal extension.
6	Fasten the antenna grounding wire in the terminal lug barrel.
7	Using the procedures in table 4.5.8, raise the tower.
8	In the auxilliary box, apply power to the GTA radio.
9	Refer to chapter 12. Verify proper operation of GTA radio.

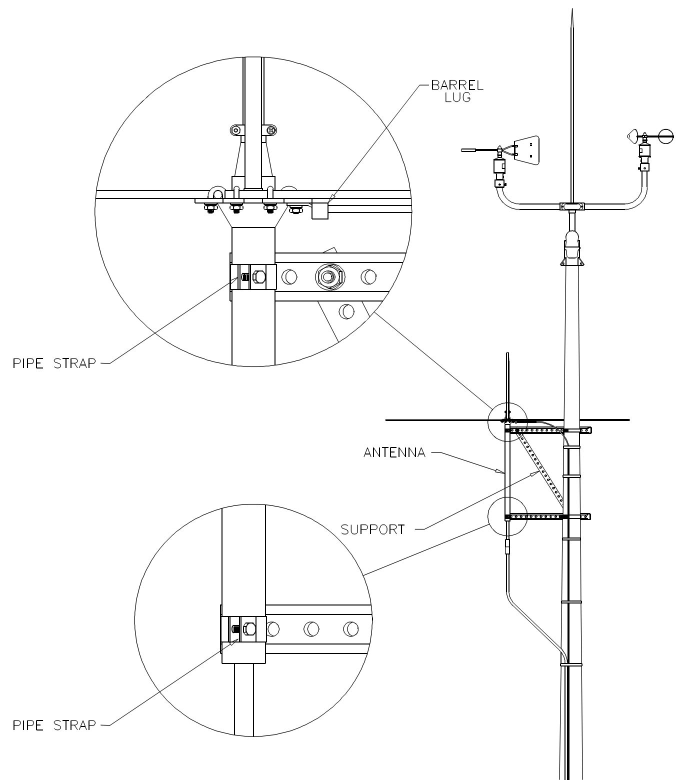


Figure 14.5.4. Alternative Antenna Installation

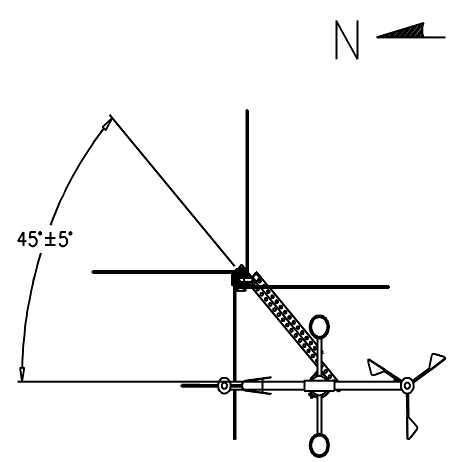


Figure 14.5.5. Orienting Antenna Radials with Wind Tower

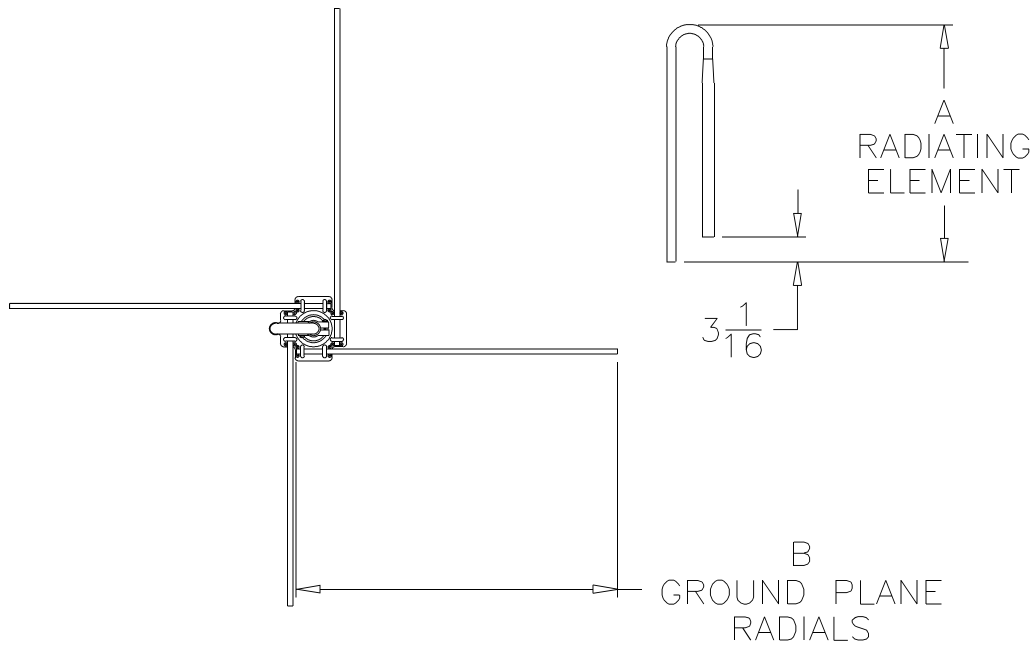


Figure 14.5.6. Ground Plane Radials and Radiating Element

Table 14.5.13. Length of Radiating Element and Ground Plane Radials

GTA FREQ (MHZ)	RADIATING ELEMENT	GROUND PLANE RADIALS	GTA FREQ (MHZ)	RADIATING ELEMENT	GROUND PLANE RADIALS
118	22-3/16"	33-1/2"	128	20-15/32"	30-31/32"
119	22-1/32"	33-7/32"	129	20-5/16"	30-23/32"
120	21-27/32"	32-15/16"	130	20-5/32"	30-1/2"
121	21-11/16"	32-11/16"	131	20-1/32"	30-1/4"
122	21-17/32"	32-7/16"	132	19-7/8"	30-1/16"
123	21-7/32"	32-5/32"	133	19-3/4"	29-7/8"
124	21-1/16"	31-7/8"	134	19-19/32"	29-21/32"
125	20-29/32"	31-11/16"	135	19-7/16"	29-7/16"
126	20-3/4"	31-7/16"	136	19-5/16"	29-1/4"
127	20-19/32"	31-7/32"	137	19-5/32"	29-1/32"

CHAPTER 15

PORT SHARING DEVICE

SECTION I. DESCRIPTION AND LEADING PARTICULARS

15.1.1 INTRODUCTION

The port sharing device (PSD) is a software task executing within the acquisition control unit (ACU) that enables the single port on the remote terminal to AFOS (RTA) to communicate with both ASOS and the auxiliary backup terminal (ABT). The PSD performs the communications management functions necessary for forwarding messages between the RTA and ABT and between the RTA and ASOS. In order to provide the buffering necessary to support PSD functions, an additional memory board has been installed in the ACU at those installations where the PSD has been implemented.

15.1.2 PHYSICAL DESCRIPTION

PSD functions are performed as a task in the ASOS software. Figure 15.1.1 illustrates the communications paths between the PSD, ASOS, RTA, and ABT. An additional memory board is required for PSD operation. Figure 15.1.2 illustrates the position of the memory board in location A4 of the ACU card rack assembly. Two leased line modems will also be installed in cases where the RTA and the ABT are remote from the ACU (i.e., more than 100 feet). The RTA and ABT are co-located in all cases so that these devices will both be remote or both local. A detailed diagram illustrating the pin-to-pin connection between the ACU Serial I/O (SIO) boards and connectors on the RTA and ABT is provided in Section IV.

15.1.3 FUNCTIONAL DESCRIPTION

The PSD handles message traffic between the RTA and ABT and between ASOS and the RTA. The following general categories of message-types handled by the PSD are as follows:

a. ASOS/RTA messages

b. ABT to RTA data requests

c. ABT to RTA status messages

d. RTA to ABT data replies

e. RTA to ABT unsolicited messages

The PSD acknowledges each message (i.e., requests, replies, or status messages) received from either the ABT or the RTA; however, messages received from ASOS are not acknowledged. The communications procedures utilized by the PSD to handle message traffic is described in detail in Section IV. The use of the DIAG function to monitor PSD communications is described in Section V.

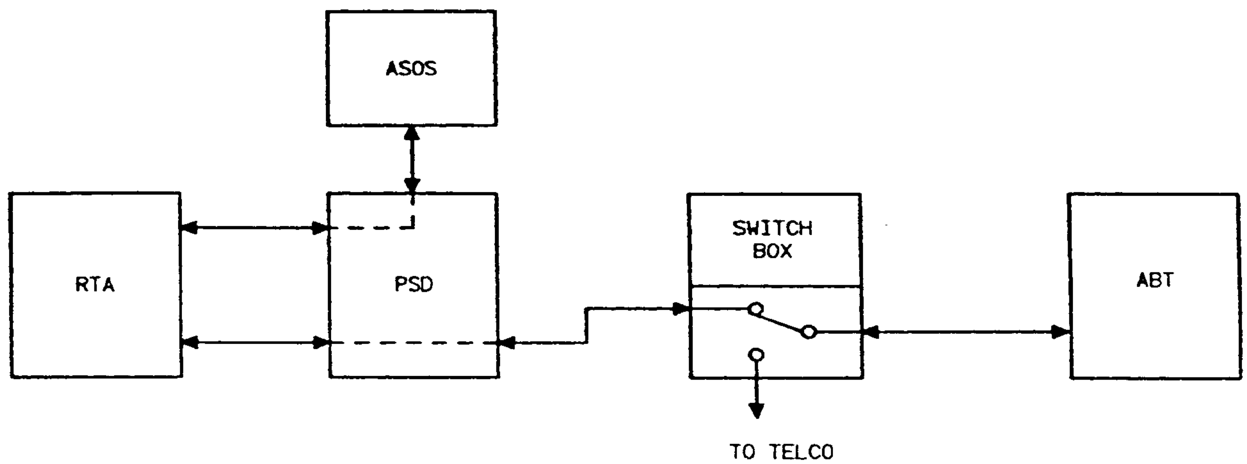


Figure 15.1.1. PSD Communications

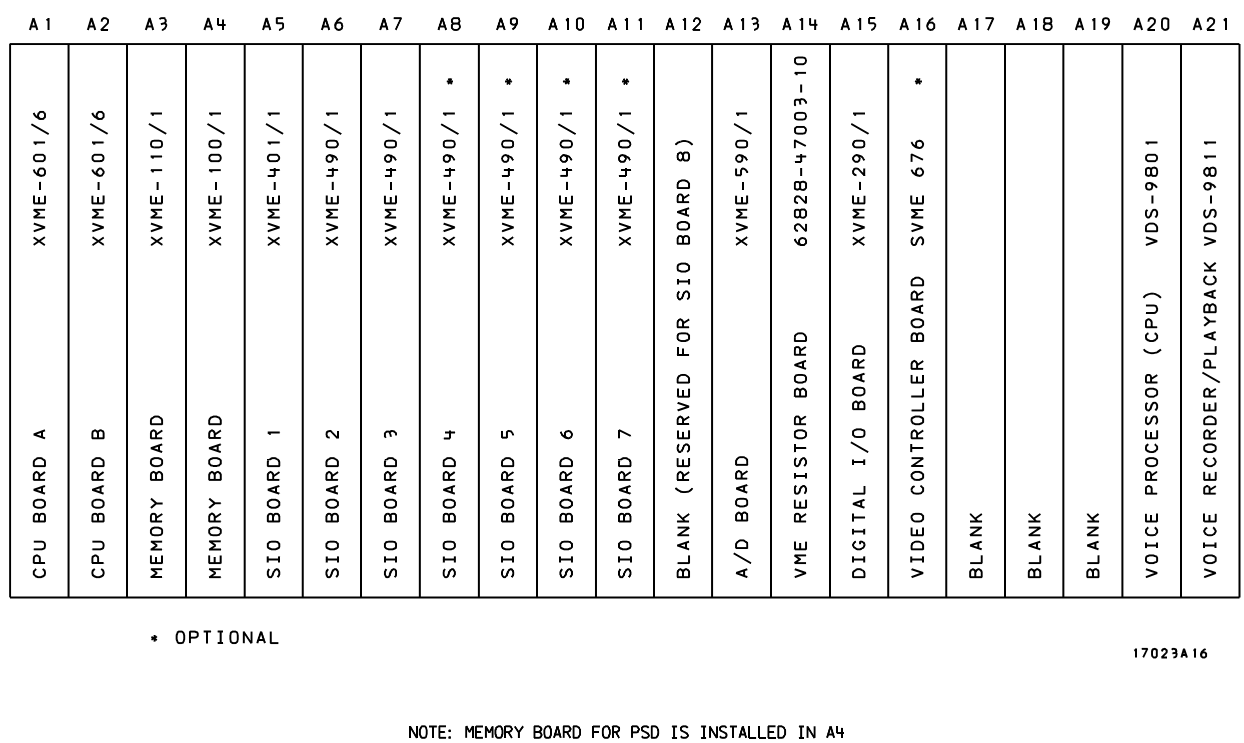


Figure 15.1.2. PSD Memory Board Location

SECTION II. INSTALLATION

Installation instructions for the PSD are not applicable to this Chapter; however, installation instructions for the hardwired PSD are contained in ASOS Field Modification Kit (FMK) No. 057-1, AAI Systems Management, Inc., February 24, 1994, and for the leased line PSD in ASOS Field Modification Kit (FMK) No. 057-2, AAI Systems Management, Inc., February 24, 1994. Instructions for installation of the memory board associated with the PSD are provided in Chapter 3. The following documents provide technical information on the RTA and ABT (Volume 2 refers to the RTA and Volume 4 to the ABT):

a. AFOS Handbook 2, Operator's Handbook, Volume 4, Remote Terminals to AFOS (RTA), Auxiliary/Backup Terminal, 3rd Edition, U.S. Department of Commerce, National Oceanic and Atmospheric Administration, July 1989

b. AFOS Handbook 2, Operator's Handbook, Volume 2, Remote Terminals to AFOS, Part 1 Synchronous Remote Terminals to AFOS, U.S. Department of Commerce, National Oceanic and Atmospheric Administration, July 1986

SECTION III. OPERATION

15.3.1 INTRODUCTION

The operation of the PSD is transparent to the user. Message management by the PSD, including acknowledgment and retransmission, occurs automatically with no operator intervention. The PSD also creates necessary queues to process the message traffic.

15.3.2 CONTROLS AND INDICATORS

The operator has no direct interface with or control over the PSD. All operator functions associated with the PSD, including configuring the RTA and ABT, viewing the PSD memory board self-test status, and using the PSD DIAG function are performed using the operator interface device (OID) display pages. The memory board in location A4 is the only new hardware component associated with PSD operation. The memory board is identical to the memory board installed in the DCP. The indicators on the memory board, which, when illuminated, indicate when the ASOS ACU is accessing bank 1 or bank 2, are illustrated in Chapter 2, Section III and are as described in Chapter 3, Section III.

SECTION IV. THEORY OF OPERATION

15.4.1 PSD FUNCTIONAL DESCRIPTION

The PSD is an intelligent software (firmware) device that manages RTA/ABT and ASOS/RTA communications. The messages sent and received to/from these units consist of hourly observations, specials, and SHEF's. The PSD uses asynchronous protocol and provides for bidirectional product transmissions and specific request/reply capability. The PSD also enables the ABT to receive spontaneous asynchronous routing products from the RTA. The following paragraphs describe the PSD traffic management scheme as well as the physical connections within the ACU and the pin-to-pin connections between the SIO board in the ACU and the connectors on the RTA and ABT, respectively. The PSD, acting as a transparent communications management task on the ACU, maintains the same protocols for RTA/ABT communications as if the RTA and ABT were connected directly to each other. The following paragraphs also describe the way in which the PSD manages ASOS/ RTA and RTA/ABT message traffic. The PSD DIAG function is utilized to monitor PSD messages (paragraph 15.5.3.2.3).

15.4.1.1 **PSD Message Traffic Management**. The message traffic between the PSD and ASOS, RTA, and ABT follows a particular sequence that depends on the origin of the message. The PSD acknowledges messages received from the RTA and ABT; however, messages received from ASOS are not acknowledged. The sequence of messages traveling over the PSD link is illustrated on figure 15.4.1 and described in the following paragraphs. Examples of message traffic are provided in Section V, following paragraph 15.5.3.2.5.

15.4.1.1.1 **ASOS/RTA Communications**. ASOS sends status messages, (e.g., METAR's and SHEF's) to the RTA via the PSD. The RTA acknowledges the receipt of messages from the PSD. After 2 minutes, ASOS sends a request to the RTA via the PSD for a copy of the last message sent. The RTA responds to the PSD with an acknowledgment. The RTA subsequently sends the message copy to the PSD and the PSD acknowledges receipt. The PSD then sends the copy to ASOS. ASOS compares the last message sent with the copy received and, if they are equal, treats the situation as an acknowledgment. ASOS does not acknowledge receipt of the copy to the PSD. When the PSD is communicating with the RTA (e.g., urgent specials), the PSD is also able to handle ABT to RTA communications, including multiple ABT to RTA requests and RTA to ABT replies. The PSD also handles ASOS/RTA communications when the ABT is disconnected or otherwise unavailable.

15.4.1.1.2 **RTA/ABT Communications**. All RTA/ABT communications are via the PSD and are grouped into the following generic message-types:

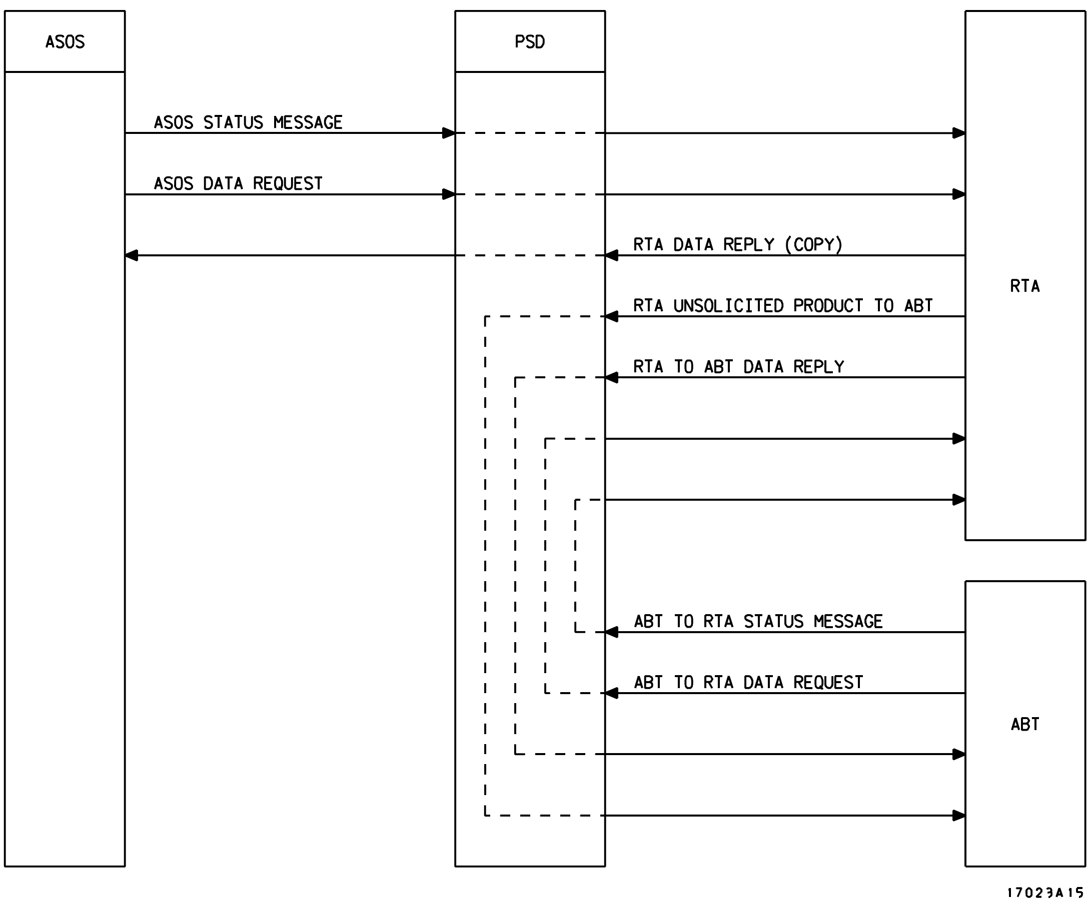
a. ABT to RTA data requests

b. RTA to ABT replies

c. RTA unsolicited messages to the ABT

d. ABT to RTA unsolicited messages

When the PSD receives a data request from the ABT, the PSD forwards the request to the RTA, acknowledges receipt to the ABT, and receives an acknowledgment from the RTA. When the PSD receives a reply from the RTA, the PSD forwards the reply to the ABT, acknowledges receipt to the RTA, and receives an acknowledgment from the ABT. When the PSD receives an unsolicited message (i.e., not in response to an ASOS or ABT request) from the RTA, the PSD forwards the message to the ABT, acknowledges the message from the RTA, and receives an acknowledgment from the ABT. When the PSD receives an unsolicited message from the ABT (i.e., not in response to an ASOS or RTA request), the PSD forwards the message to the RTA, acknowledges the message to the ABT, and receives an acknowledgment from the RTA. The order in which the PSD retransmits and acknowledges messages may be affected by the instantaneous volume of message traffic (including ASOS/RTA traffic). In order to maintain uninterrupted communications, particularly when handling long messages, the PSD maintains sufficient queues (normally 64 KB, which is four times the maximum product size for each port). If either the RTA or the ABT rejects products (indicated by a negative acknowledgment), the PSD continues to transmit the product until it is acknowledged or until the PSD buffer is 80 percent exhausted, at which time the PSD on a first in first out (FIFO) basis attempts to transmit the next product for the port. This routine permits the PSD to accommodate the ABT off or disconnected condition without relying on control signals from the ABT. The PSD shares transmissions to the RTA between ASOS and the ABT on a reciprocal basis. At the end of each block transmission (including the acknowledgment), the other user (either ABT or ASOS) has an equal opportunity to send. The PSD accomplishes the ASOS RTA port sharing via a FIFO store-and-forward queue to which products received from ASOS or the ABT are appended. The PSD, RTA, and ABT retransmit unacknowledged messages at approximately 5-second intervals.



NOTE: ACKNOWLEDGMENTS ARE NOT SHOWN. THE PSD ACKNOWLEDGES ALL RTA AND ABT MESSAGES, BUT DOES NOT ACKNOWLEDGE MESSAGE FROM ASOS.

Figure 15.4.1. PSD Message Traffic

15.4.1.1.3 **PSD Connectivity**. Figure 15.4.2 illustrates the physical connection of the ACU components used to accomplish the PSD function. Figure 15.4.3 illustrates the end-to-end connection between the SIO board pins in the ACU and the pins on the RTA and ABT connectors. The port/pin assignments of SIO boards 4 through 8 are also identified in Chapter 2, Section IV. The particular physical connection between the RTA and/or ABT and the PSD depends on whether the RTA and ABT are remote from the ACU. If the RTA and ABT are remote from the ACU, the connection to each unit is via a leased line with the appropriate modem installed in the ACU modem rack. The PSD is transparent to the RTA or ABT and processes RTA/ABT messages in either direction using the same signals on the same pins as if the RTA and ABT were communicating directly. The PSD communicates with the RTA and ABT using RS-232C level signaling, which terminates in 25-pin D-type connectors. The RTA and ABT are equipped with modular Telco adapters, however, so that the units are connected to the ACU using 8-wire telephone cables with Telco adapters.

NOTE

The PSD programs CTS and DTR HI on its ABT connector so that transmissions for the ABT are not interrupted.

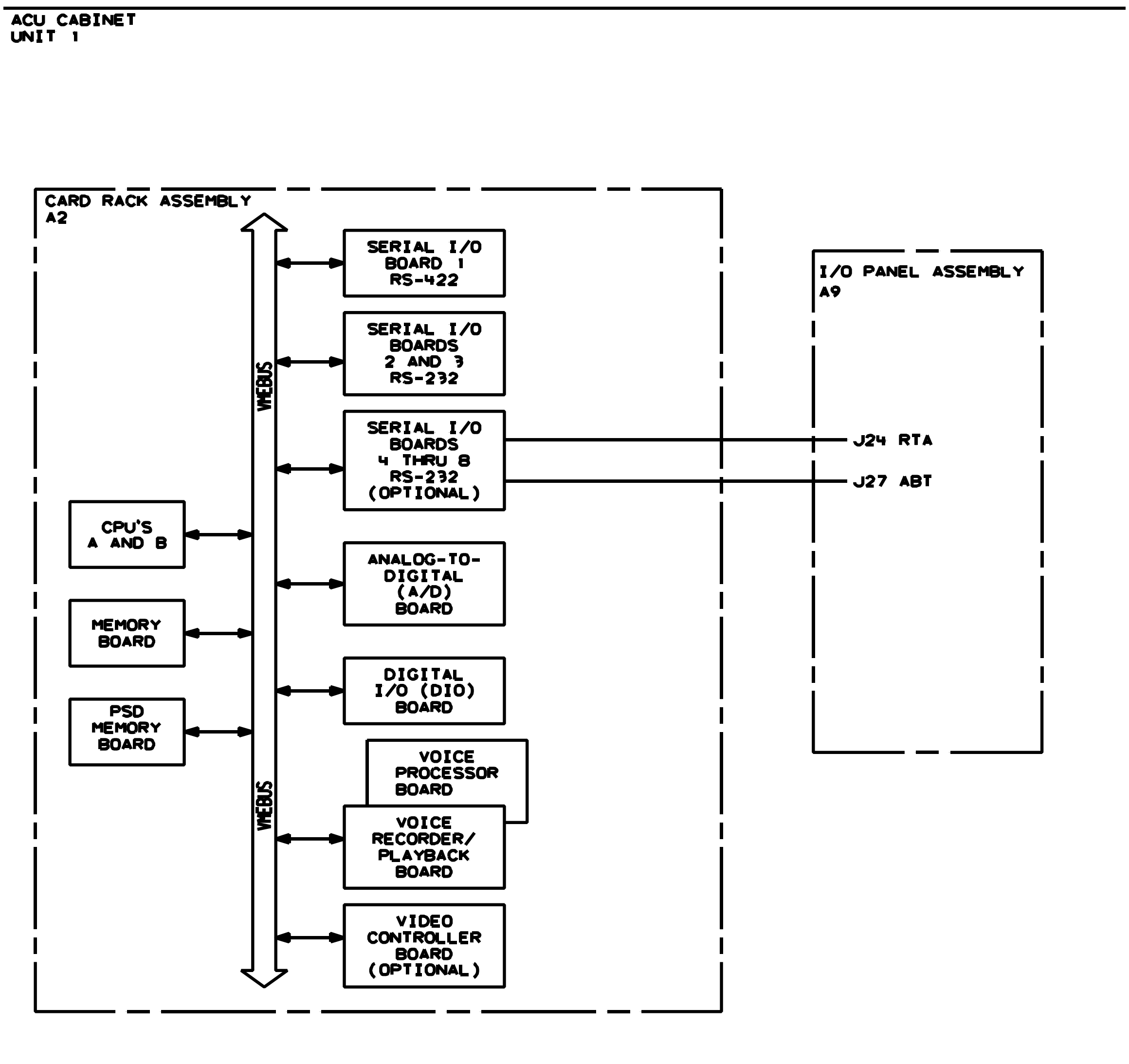


Figure 15.4.2. PSD Hardware Connectivity Within the ACU

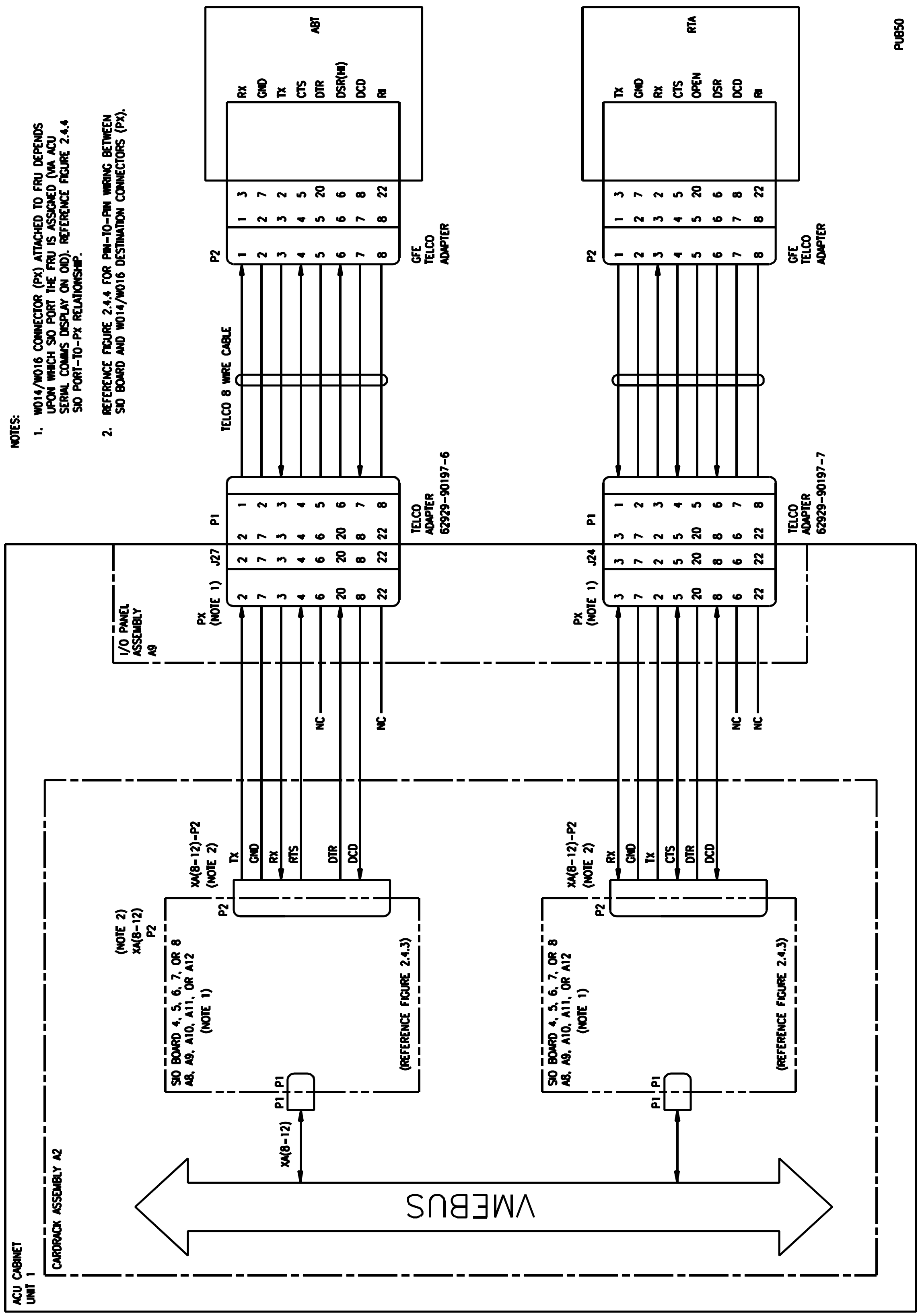


Figure 15.4.3. RTA and ABT to PSD Physical Connections

SECTION V. MAINTENANCE

15.5.1 **INTRODUCTION**

The PSD is an ASOS software task executing on the ACU. There are no preventive maintenance procedures for the PSD; therefore, the PSD is not maintained in the same manner as a hardware component. The only hardware component directly associated with the PSD is a memory board used for message queuing. In cases where the RTA and/or ABT is connected to the ACU via leased line modems, however, the operation of the modem(s) may need to be verified. PSD maintenance consists of verifying that the software functions of the PSD are properly performed. Because these functions require the proper operation and functioning of the memory board, RTA, ABT, and modems, the maintenance philosophy of the PSD is to isolate a potential fault to these components and/or to the connectivity between them. The proper operation of those components located within the ACU that could affect PSD functions is verified using the same standard self-test features of ASOS, as would be used to test the operation of any ASOS component, regardless of whether the PSD was installed. The following paragraphs describe the corrective maintenance procedures that should be used to monitor, verify, and, if necessary, restore and maintain performance of PSD functions.

15.5.2 **PREVENTIVE MAINTENANCE**

There are no preventive maintenance procedures for the PSD.

15.5.3 **CORRECTIVE MAINTENANCE**

15.5.3.1 **General**. Because the PSD is a transparent function in the communication path between ASOS and the RTA and between the RTA and ABT, the cause of any inability to communicate can be attributed to the PSD, ASOS, RTA, or ABT or where the RTA and/or ABT are in close proximity to the ACU, in the cables connecting the units to the ACU. The process of corrective maintenance begins with the isolation of the PSD as the cause of the problem. If possible, the RTA and ABT should be connected directly together and the technician should attempt to perform the function that is exhibiting the symptom of the problem. If the problem continues to exist, the PSD is not at fault. If the problem is in ASOS/RTA communications, and the RTA or ABT, including cables, is not at fault, the following procedures are performed to isolate and correct the problem.

15.5.3.2 **PSD Troubleshooting**.

15.5.3.2.1 **Determining SIO Board Assignments of the PSD**. When performing corrective maintenance on the PSD, the first task of the maintenance technician is to determine the SIO board assignments of the PSD as described in the following paragraphs. The SIO boards for the PSD are assigned at installation time; in order to properly diagnose a fault condition, however, the particular SIO boards assigned to the PSD must be determined as follows:

a. On OID with the 1-minute display displayed, enter REVUE-SITE-CONFG-COMMS. This sequence displays the COMMS page on the OID.

b. Locate "RTA" and "ABT" in the function column of the COMMS page.

c. Record the SIO board assignments of the RTA and ABT and verify that both are enabled and configured with the proper COMM values.

NOTE

If a leased line arrangement is used between the ACU and/or the RTA and ABT, modems are indicated in the COMMS page.

15.5.3.2.2 **Verifying ASOS Operating Condition**. The operating condition of each component should be determined using the maintenance menus as described in Chapter 2, paragraph 2.5.3. If a component failure is indicated, the component is removed and replaced in accordance with the procedures contained in Chapter 2, paragraph 2.5.4. If replacement of any component is necessary, the component should be retested to ensure proper operation. When it is established that there are no failures indicated on ASOS, the PSD should be tested using the DIAG function of the PSD as described in the following paragraph.

15.5.3.2.3 **Using the PSD Diagnostic (DIAG) Function**. The PSD DIAG function is available if there is a printer or video display unit (VDU) configured in the system. The feature is used to display or print all messages between the ASOS and the RTA or ABT. To use the PSD DIAG feature, the following steps must be performed:

a. On OID with 1-minute display displayed, enter REVUE-SITE-CONFG-COMMS. This sequence displays the COMMS page on the OID.

b. Move cursor to printer, VDU, or spare SIO port to be used to print or display messages.

c. Press CHANG and set up port as follows:

NOTE

Entries are shown in bold.

	FUNCTION	PSD DIAG	
STATUS	**ENABLED**	HANDSHAKE	**NONE**
BAUD RATE	**9600***	CONNECTION	**HARDWIRE****
PARITY SELECT	**NONE**		
BITS/CHAR	**8**		
STOP BITS	**1**		

*Baud rate of connected device
**Will indicate leased if modems are used.

d. Press EXIT. The PSD DIAG feature is now ready to display or print messages being handled by the PSD.

NOTE

When PSD corrective maintenance is complete, configure the SIO port for its original assignment.

15.5.3.2.4 **PSD Hardware Connectivity Within the ACU**. The ACU hardware signaling scheme, including the site-specific SIO boards that have been assigned to the PSD, are described and illustrated in Chapter 2, Section IV. Figure 15.4.2 illustrates the PSD hardware connectivity within the ACU.

15.5.3.2.5 **Monitoring PSD Message Traffic**. The following examples illustrate typical PSD message traffic that appears on the display or printer used as the PSD DIAG monitoring device.

EXAMPLE 1. ASOS/RTA MESSAGES

00:01:12 Received No Special Product Id: DENSAODEN from ASOS
00:01:13 Transmitting No Special Product Id: DENSAODEN to RTA
00:01:15 Received Positive Acknowledgment from RTA
00:53:13 Received Request for Product Id. DENSAODEN from ASOS
00:54:00 Transmitting Request For Product Id. DENSAODEN to RTA
00:54:01 Received Positive Acknowledgment from RTA
00:54:03 Received Reply to Request For Product Id. DENSAODEN from RTA
00:54:04 Transmitting Reply to Request For Product Id. DENSAODEN to ASOS
00:54:12 Transmitting Positive Acknowledgment to RTA

NOTE

As shown above, the PSD does not acknowledge messages received from ASOS.

EXAMPLE 2. ABT TO RTA STATUS MESSAGES

00:01:12 Received No Special Product Id. DENSAODEN from ABT
00:01:13 Transmitting No Special Product Id. DENSAODEN to RTA
00:01:14 Transmitting Positive Acknowledgment to ABT
00:01:15 Received Positive Acknowledgment from RTA

EXAMPLE 3. ABT TO RTA DATA REQUESTS

00:01:12 Received Request For Product Id. DENSAO4LJ from ABT
00:01:13 Transmitting Request For Product Id. DENSAO4LJ to RTA
00:01:14 Transmitting Positive Acknowledgment to ABT
00:01:15 Received Positive Acknowledgment from RTA

EXAMPLE 4. RTA TO ABT DATA REPLIES

00:01:12 Received Reply to Product Id. DENSAO4LJ from RTA
00:01:13 Transmitting Reply to Product Id. DENSAO4LJ to ABT
00:01:14 Transmitting Positive Acknowledgment to RTA
00:01:14 Received Positive Acknowledgment from ABT

EXAMPLE 5. RTA TO ABT UNSOLICITED MESSAGES

00:01:12 Received No Special Product Id: DENSAOAKO from RTA
00:01:13 Transmitting No Special Product Id: DENSAOAKO to ABT
00:01:15 Transmitting Positive Acknowledgment to RTA
00:01:17 Received Positive Acknowledgment from ABT

In practice, the messages shown in the examples do not follow one another directly. The device connected to the PSD DIAG port actually logs transmissions to and from the PSD in time order. The PSD manages messages concurrently to and from ASOS, the RTA, and the ABT. The log, therefore, reflects the time order of all transmissions. For example, there may be some intervening transmissions between a request for a particular product and the reply to the product requested. Multiple transmissions not acknowledged are also shown on the transmission log.

15.5.4 **FIELD REPLACEABLE UNIT (FRU) REMOVAL AND REPLACEMENT**

WARNING

Severe injury or death may result if power is not removed from the equipment prior to maintenance activities. Ensure that the output power switch is set to the zero (0) (OFF) position and that facility power is removed from the ACU.

15.5.4.1 **PSD Memory Removal and Replacement**. The only unique hardware item in the ACU that supports the PSD is the memory board installed in location 1A2A4. This board is identical to the memory board installed in the DCP in location A2A3. The corrective maintenance procedures for the two boards are identical and are described in Chapter 2, Section V.

15.5.4.2 **Modem Removal and Replacement**. One or two modems may be installed to support remote connection of the RTA and ABT. The locations and operating status of the modems can be determined by accessing the COMMS page. Removal and replacement procedures for the modem(s) are described in Chapter 2, Section V.

CHAPTER 16

THUNDERSTORM SENSOR

SECTION I. DESCRIPTION AND LEADING PARAMETERS

16.1.1 INTRODUCTION

The ASOS thunderstorm sensor is a model TSS-924 electro-optical short-range thunderstorm detector manufactured by Global Atmospherics, Inc. of Tucson, Arizona. The sensor detects and differentiates between cloud-to-ground (CG) and cloud lightning discharges. The sensor provides a range estimate for CG lightning discharges from thunderstorms that occur within approximately thirty miles. The sensor indicates the count and range of CG discharges in three range categories of 0-5, 5-10, and 10-30 miles.

The sensor communicates with the data collection package (DCP), or Single Cabinet ASOS (SCA) via a fiberoptic serial data link. The DCP or SCA polls the sensor once every 60 seconds, and the sensor responds with the current flash count and sensor status. The DCP, in turn, passes the data to the acquisition control unit (ACU). When the ACU receives a flash count indicating lightning, the ACU issues a SPECI with a thunderstorm onset message. In addition to flash count data, the thunderstorm sensor provides built-in test (BIT) results that are interpreted by the ASOS continuous self-test (CST) to detect sensor failures.

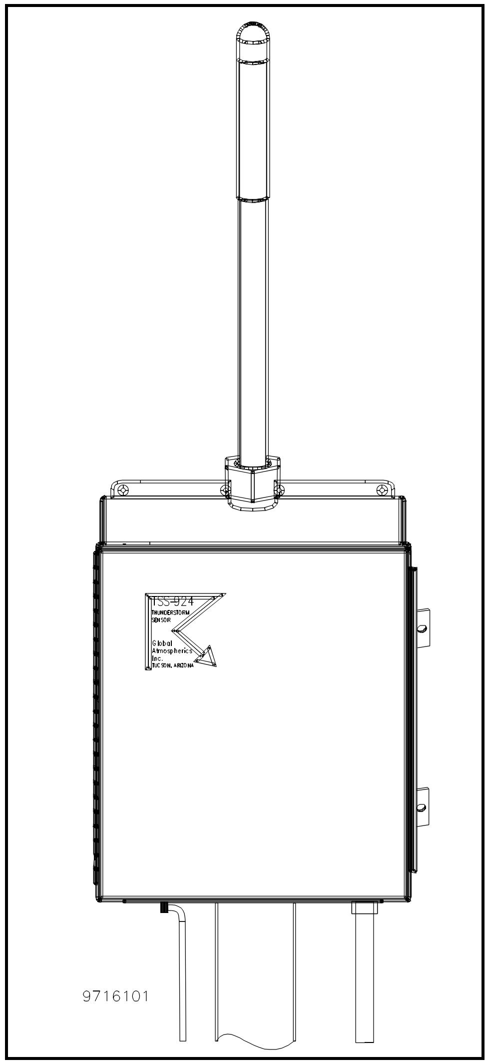


Figure 16.1.1. Thunderstorm Sensor

16.1.2 PHYSICAL DESCRIPTION

The thunderstorm sensor (figure 16.1.1) consists of a main enclosure installed on a mounting pole. The mounting pole itself is a part of the supporting structure for the sensor and does not have a reference designator. The main enclosure contains all sensor field replaceable units (FRU's), which include an electro-optical antenna assembly, power and communications module (power/comm module), an electronics module, and a fiberoptic module.

The antenna assembly supplies signals to the electronics module, the electronics module interprets and processes these signals, and the power/comm module provides power for the sensor and communications with the outside world. The main enclosure is a specially designed, weather-proof box with a hinged and gasket-sealed door held closed with two stainless steel fasteners. When closed, the box is air-tight and water-tight. The main enclosure contains the electronics module and the power/comm module. The electronics module contains the analog board and the processor board. The power/comm module consists of the power/comm board, the fiberoptic modem, and the heater, all of which are mounted on a special mounting plate.

16.1.3 **THUNDERSTORM SENSOR CONFIGURATIONS**

There is only one configuration of the thunderstorm sensor; the TSS 924.

Table 16.1.1. Operational specifications

OPERATIONAL SPECIFICATIONS		
Detection Efficiency	Thunderstorm detection	100% for thunderstorms within 10 miles with 3 or more cloud-to-ground discharges
	Cloud-to-ground flashes	Approximately 90% for flashes within 0-10 miles
False Lightning Reports		None. False lightning reports do not occur for properly installed and properly maintained sensors
Thunderstorm Range Resolution (user selections available)		0-5, 5-10, 10-30 miles
		0-5, 5-10, 10-30 nautical miles
		0-8, 8-16, 16-50 kilometers
Sensing Transducers		Wideband electric field change meter describing local thunderstorm conditions
Sensor Output		Serial ASCII alphanumeric message describing local thunderstorm conditions (automatic one-minute intervals or polled)
ELECTRICAL SPECIFICATIONS		
115 VAC Power Option		90-120 VAC, 50/60 Hz, 6 Watts maximum without heater, 80 Watts maximum with heater
230 VAC Power Option		180-250 VAC, 50/60 Hz, 6 Watts maximum without heater, 80 Watts maximum with heater
12 VDC Power Option		11.5-16.5 VDC available on special request
ELECTRICAL SPECIFICATIONS		
Communications line		Metallic or fiberoptic cable
Data type		Serial ASCII
Data transfer		9600 baud
Parity		None
Data bits		8
Stop bits		1
ENVIRONMENTAL SPECIFICATIONS		
Maximum wind load		120 knots, 222 kilometers/hour (standard mast mount)
Humidity		0-100% (Stainless steel NEMA 4X enclosure provides complete protection against corrosion and severe weather.)
Temperature		-40° to +60° C (with heater)
ELECTRICAL SPECIFICATIONS		
Ground mount		Standard mast (3-inch (~7.6 cm) inside diameter schedule 80 aluminum pipe, 4 feet (1.2 m) tall)
Mast mount		Mast-mounting brackets, outside diameter 4.5 inches (11.43 cm)
Maximum height		9.8 feet (3 m) maximum recommended
SENSOR DIMENSIONS		
Height		32.5 in (82.5 cm)
Width		11.0 in (27.9 cm)
Depth		8.0 in (20.3 cm)
Weight		28.0 lbs (12.6 kg)

SECTION II. INSTALLATION

16.2.1 INTRODUCTION

To install the thunderstorm sensor, the mounting pole is installed, the main enclosure is installed on the mounting pole, the sensor is assembled, and electrical connections are made. Following installation, the sensor must be configured. Refer to table 16.2.1 and figures 16.2.1 through 16.2.3 for installation and table 16.2.2 to configure the sensor. After installation, refer to instructions contained in Section V for inspecting the sensor.

Table 16.2.1. Thunderstorm Installation Procedure

Step	Procedure
	Tools and Materials Required: Two 15/16-inch wrenches 7/16-inch wrench and torque driver 11/32-inch wrench Large flat-tipped screwdriver Large pliers (12 inch, 2-1/4 inch capacity, curved jaw) 7/16-inch hex key wrench and torque driver Cable ties **WARNING** Death or severe injury may result if power is not removed from sensor prior to maintenance activities. Ensure that circuit breakers supplying power to sensor are set to off (right) position. **NOTE** DCP Thunderstorm sensor installation requires prior or concurrent ECP E96SM05F189 (DCP Power Expansion) installation. ECP E96SM05F192 (ACU/SCA Firmware Version 2.45 and DCP Firmware Version 1.80) is also required.
1	At DCP (SCA), open equipment cabinet door, set UPS power switch to 0 (OFF) on CLASS II systems only, and turn off UPS POWER circuit breaker A1A3A1 (DCP) or A1A3CB21/CB22 (SCA).
2	Open DCP (SCA) Power Distribution Panel and turn off DCP (SCA) power. This removes all DCP (SCA) and sensor power.
3	Open DCP (SCA) Faraday box to access sensor power wiring and fiberoptic modems.
4	For the DCP, insert circuit breaker module (62828-40155-100) into A1A3A2 position. For the SCA, install ½A breaker (62828-90037-6) in A1A1A3CB13 and 1A breaker (62828-90037-1) in A1A1A3CB14, using screws (MS51957-27), lock washers (AA55610-136), and flat washers (MS15795-805) supplied. For SCA, connect wires (W106) to circuit breaker terminals as marked.
5	Remove blank cover from A3A1(DCP) or A3A8 (SCA) (on Faraday Box) position and save gasket.
6	Install fiberoptic modem (62828-90006-1) and gasket in position A1 (DCP) or A8 (SCA) using screws (62828-90075-1) and washers (62828-90174-1).
7	Locate SIO connector in harness marked M/WA3A1J1 (DCP) or P8 M/W A3A8J1 (SCA). Attach connector to fiberoptic modem installed in position A1 (DCP) or A8 (SCA) and tighten connector screws.
8	Remove protective plug from 3/4" hole on bottom of DCP (SCA). If Line Drivers are installed, a conduit outlet tee (62828-90257-1, 62828-90258-1, 62828-90259-1) must be installed at DCP (SCA) end of conduit running to wind sensor using a conduit hub (62828-90426-1) and close nipple (MS51953-97), with conduit adapters (62828-90260-1) to connect tee to hub and liquidtight conduit connectors. Note locations of existing wire and cable terminations to wind sensor for reconnection after tee installation (when used).
9	Install connector (62828-62828-90097-1) and O Ring gasket (62828-90293-1). Route fiberoptic cable, power wiring, and flex conduit through hole on bottom of DCP (SCA). Secure flex conduit to connector.

Table 16.2.1. Thunderstorm Installation Procedure -CONT

Step	Procedure
10	Connect fiberoptic cable to fiberoptic modem installed in Step 6. Ensure that RX and TX are properly connected.
11	Connect sensor power wires as follows. Strip insulation back ¼inch from wire ends. **Wire** / **DCP Terminal** / **SCA Terminal** M16878/1BJE0 (black) — A17-3 — A17-11 M16878/1BJE9 (white) — A18-3 — A18-11 M16878/1BJE5 (green) — A17-GND — A17-GND M16878/1BJE2 (red) — A17-19 — A17-23 M16878/1BJE4 (yellow) — A18-19 — A18-23
12	In SCA (only), connect jumpers as follows. Strip insulation back ¼inch from wire ends. **Wire** / **From** / **To** M16878/1BJE0 (Black) — A1A4-5B — A1A4-8B M16878/1BJE0 (Black) — A1A4-12C — A1A4-14C M16878/1BJE9 (White) — A1A4-17A — A1A4-20A
13	At top of left DCP (SCA) mounting pole, remove end cap.
14	Install pipe extension (62828-40418-1) using pipe coupler (MS39233-11).
15	Reinstall pipe cap on top of extension.
16	Using hardware supplied with sensor, install thunderstorm sensor mounting brackets on sensor (figure 16.2.1) and mount sensor on pole extension .
17	Remove retaining nut from end of flex conduit and install gasket P/N 62828-90097-1 on conduit. Route fiberoptic cable, power wiring, and flex conduit through entry hole on sensor. Secure flex conduit to sensor using retaining nut removed at beginning of this step.
18	At thunderstorm sensor, open main enclosure door.
19	Remove plastic seal protecting liquid-tight coupler at top of enclosure. Loosen large hexagonal nut at top of enclosure several turns. Do not completely unscrew large hexagonal nut. **CAUTION** To avoid breaking glass diffuser at end of antenna, do not remove protective rubber tubing on antenna until sensor is mounted.
20	Arrange antenna cable to hang freely from bottom of antenna housing. Carefully feed connector end of cable into liquid-tight coupler and pull cable through to inside of enclosure and guide antenna end into opening in liquid-tight coupler. While holding antenna perpendicular to top of enclosure, slowly and gently push antenna into liquid-tight coupler until fully seated as shown in figure 16.2.2.
21	**CAUTION** Failure to properly tighten liquid-tight coupler nut will result in moisture damage. Hand tighten hex nut on liquid-tight coupler.
22	Route antenna cable under clamps and connect to electronics module J104 as shown in figure 16.2.3.
23	Connect spade lug to ground terminal located below antenna mounting coupler.
24	Connect sensor power wires as follows. Strip insulation and install lug (62828-90132-11) on wire. **Wire** / **Terminal** M16878/1BJE0 (Black) — TB1-1 M16878/1BJE9 (White) — TB1-2 M16878/1BJE5 (Green) — TB1-3 M16878/1BJE2 (Red) — TB1-4 M16878/1BJE4 (Yellow) — TB1-5
25	Connect fiberoptic cable to fiberoptic modem in sensor making sure RX and TX are installed properly.

Table 16.2.1. Thunderstorm Installation Procedure -CONT

Step	Procedure
26	Install lug (62828-90253-1) on 10 ga. solid wire (QQW343S10S1B). Connect wire to ground stud on sensor using hardware supplied with sensor. Connect other end of ground wire to system ground wire running across bottom of DCP (SCA) using split bolt connector (62828-90254-1).
27	Secure flex conduit and ground wire to DCP (SCA) pole using cable ties (62828-90256-1) as required.
28	**NOTE** Perform this step only when all actions requiring access to the interior of the sensor enclosure are complete. The desiccant bag must be removed from airtight outer packaging (DO NOT open the desiccant bag containing desiccant granules) and flattened by shaking and patting to evenly distribute its contents so that it may be placed on top of electronics module. Ensure that desiccant bag does not interfere with door or other internal assemblies. Turn sensor ON using switch S1 inside enclosure; close and secure sensor door. Remove protective rubber tubing on antenna.
29	At DCP (SCA), close Faraday box and secure using original hardware.
30	Set thunderstorm sensor circuit breakers A1A3A2 (DCP) or A1A3CB13/CB14 (SCA) to "ON".
31	At DCP Turn UPS "OUTPUT POWER" A1A3A1 to "ON". Set UPS power switch to 1 (ON) CLASS II SYSTEMS ONLY. (At SCA turn UPS#1 “OUTPUT POWER” A1A3CB21 to “ON”.)
32	Turn ON DCP (SCA) Power Circuit Breaker in Power Distribution Panel. Close and secure Power Distribution Panel Door. Power is now restored to DCP (SCA) and all sensors. Secure all doors.

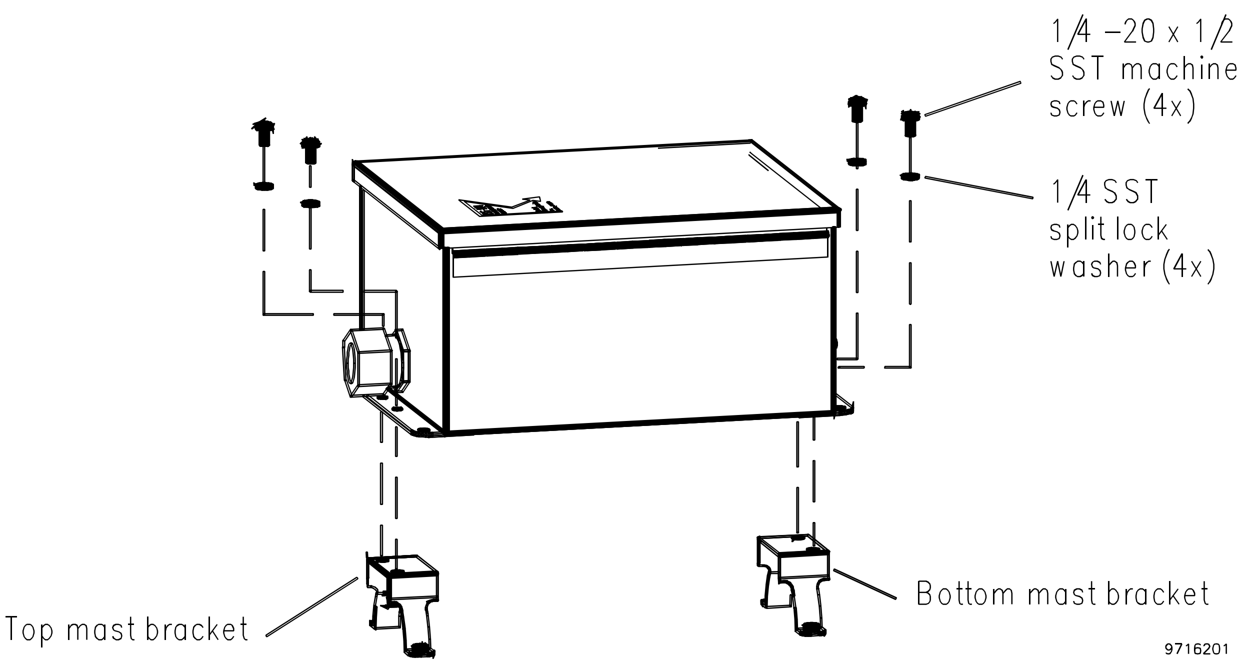


Figure 16.2.1. Thunderstorm Sensor Top and Bottom Mounting Brackets Assembly

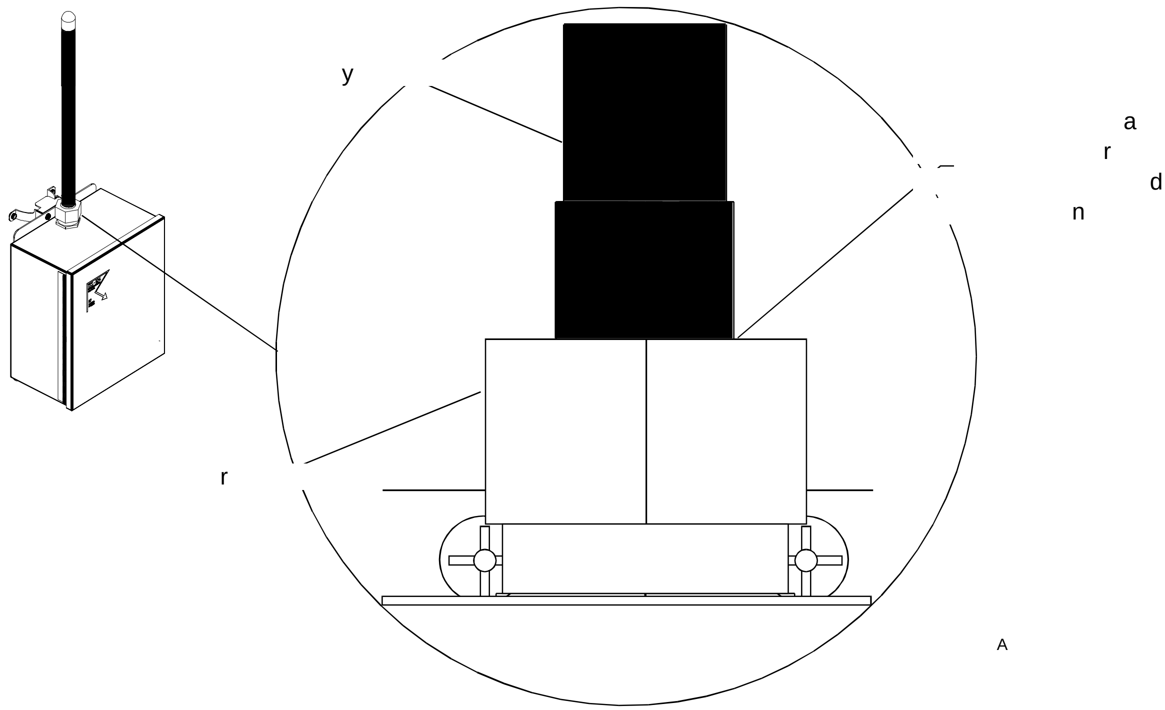


Figure 16.2.2. Thunderstorm Sensor Antenna Seating

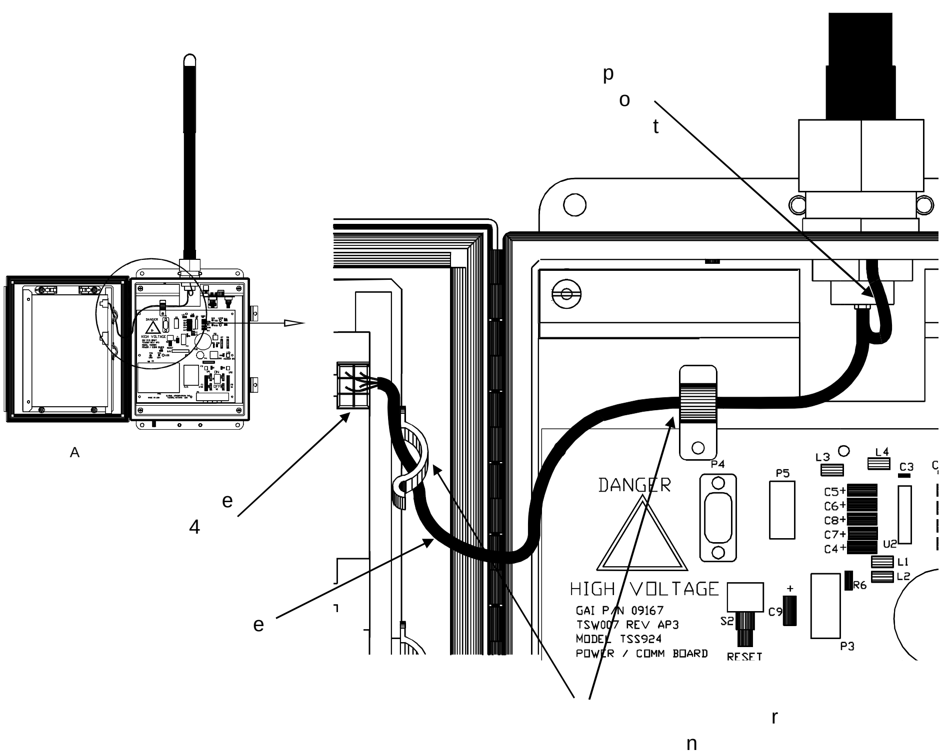


Figure 16.2.3. Thunderstorm Sensor Antenna Cable Routing

SECTION III. OPERATION

16.3.1 INTRODUCTION

Automatic thunderstorm sensor operation is controlled by the acquisition control unit (ACU) via the data collection package (DCP) or the single cabinet ASOS (SCA). This section provides turn-on and turnoff procedures and information on operation, checkout, and diagnostic testing of the sensor.

16.3.2 CONTROLS AND INDICATORS

The thunderstorm sensor contains maintenance controls and indicators on the power/comm module and electronics module. Descriptions of the test data displayed as part of the system diagnostic test program are provided in Chapter 1. The thunderstorm sensor controls/indicators are illustrated on figures 16.3.1 and 16.3.2 and described in tables 16.3.1 through 16.3.4.

16.3.3 TURN-ON PROCEDURES

The thunderstorm sensor is designed for continuous operation and normally remains on at all times, except for maintenance or repair. The sensor turn-on procedures are provided in table 16.3.5.

16.3.4 CHECKOUT PROCEDURES

The ACU via the DCP (or the SCA) continuously monitors the thunderstorm sensor diagnostic output for failure indications. If the ACU (SCA) detects a failure, it flags the sensor off-line and enters the appropriate message in the system log. The technician can review the sensor's test data via thunderstorm sensor screen on the OID. For most failures, the diagnostic identifies the faulty field replaceable unit (FRU). If the diagnostic fails to indicate the faulty FRU, the troubleshooting procedures provided in Section V of this chapter should be performed.

The sensor should be powered up only after complete assembly and checkout of all electrical power and communications connections. If the sensor has been disassembled for any reason before the first power-up, then all electrical connections must be remade and checked. Refer to figure 16.3.1 and table 16.3.1 for power/comm module indicators.

16.3.5 RUNNING DIAGNOSTICS

The ASOS contains diagnostic pages for the thunderstorm sensor. The diagnostic test can be performed by using an on-demand diagnostic test as explained in Chapter 1.

16.3.6 NORMAL OPERATING PROCEDURES

The thunderstorm sensor is in continuous operation under the control of the DCP (SCA). The thunderstorm indications are displayed in the PRESENT WX field on the 1-minute display at the OID.

16.3.7 TURNOFF PROCEDURES

The thunderstorm sensor should be turned off for maintenance purposes only using the procedures provided in table 16.3.6.

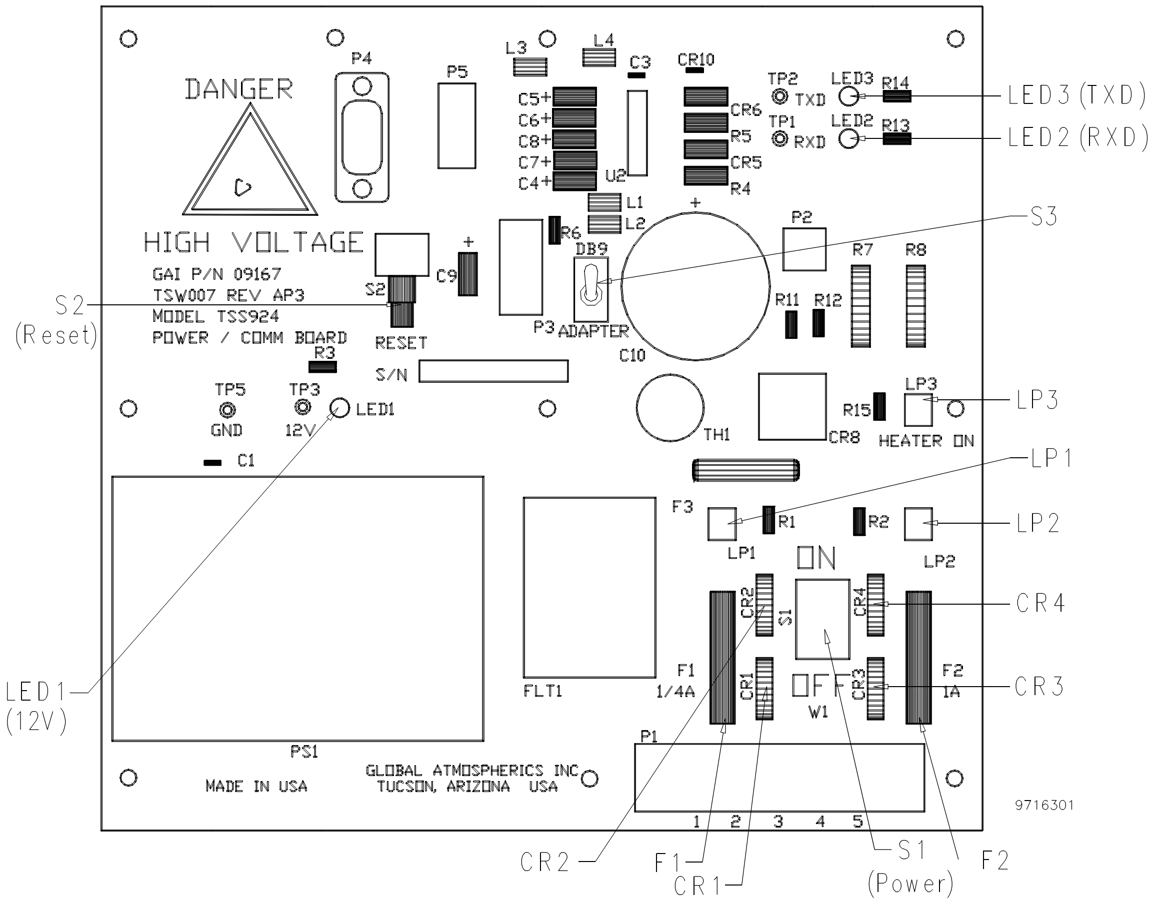


Figure 16.3.1. Power/Comm Module Controls and Indicators

Table 16.3.1. Power/Comm Module Controls and Indicators

Indicator	Description
CR1-CR4	Transient suppressors (MOV's)
F1	1/4A +12V supply fuse
F2	1A heater fuse
S1	Power switch
S2	Reset switch
S3	Data input select switch (ASOS default is UP, DB9)
LED1	LED indicator that illuminates when 12V is present
LED2	RXD active LED indicator that illuminates when RS-422 data is received from DCP (SCA)
LED3	TXD active LED indicator that illuminates when RS-422 data is transmitted to DCP (SCA)
LP1	Neon lamp status indicator that illuminates when switch S1 is ON, fuse F1 is good, and power is applied to the 12V power supply
LP2	Neon lamp status indicator that illuminates when switch S1 is ON, fuse F2 is good, and power is applied to heater circuit
LP3	Neon lamp status indicator that illuminates when power/comm module temperature is less than 32°F (0°C)

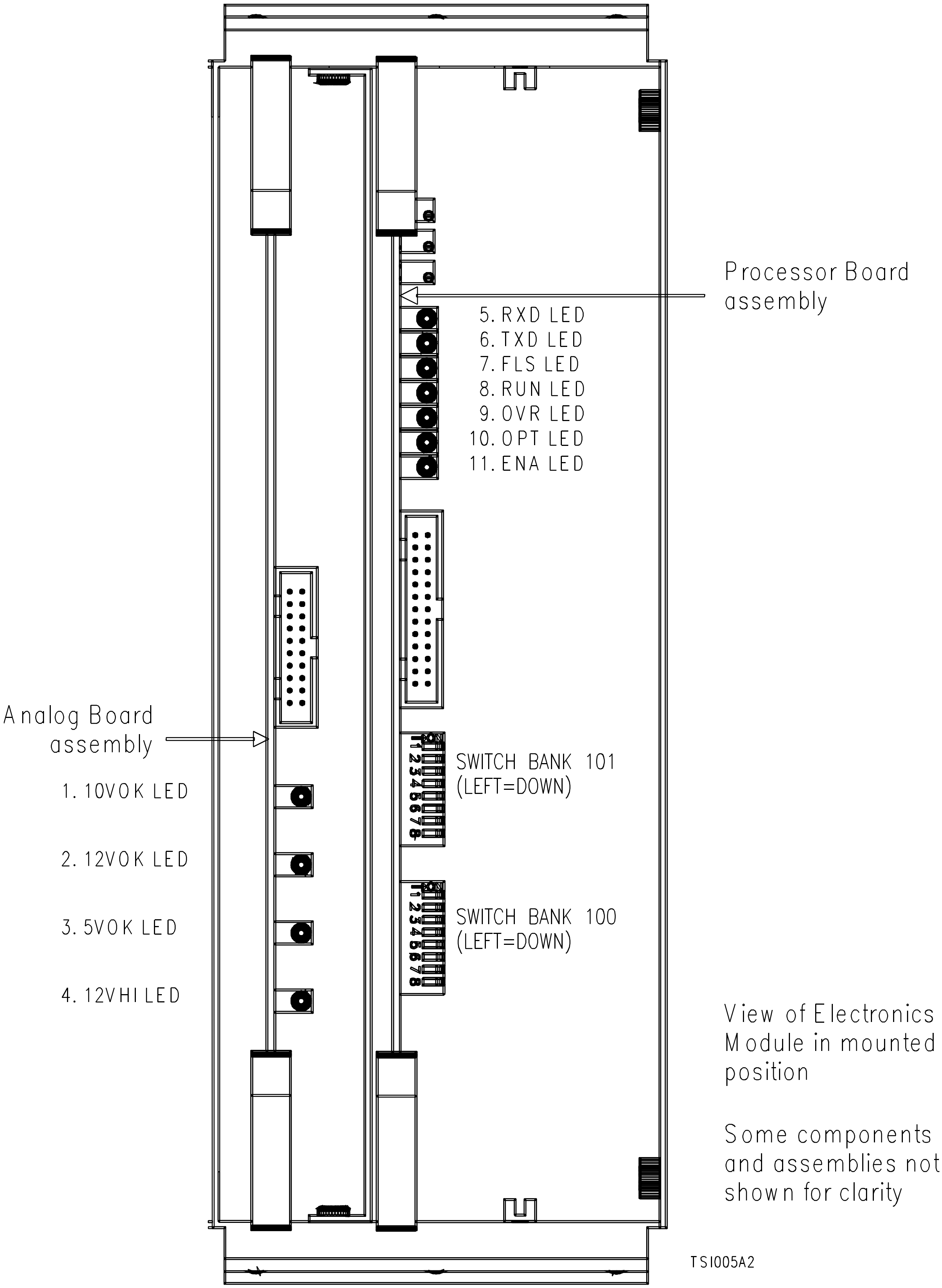


Figure 16.3.2. Analog Board and Processor Board Indicators

Table 16.3.2. Analog Board and Processor Board Controls and Indicators

Indicator	Description
ANALOG BOARD INDICATORS	
10VOK	LED indicator illuminated when 10V level is OK
12VOK	LED indicator illuminated when 12V level is OK
5VOK	LED indicator illuminated when 5V level is OK
12VHI	LED indicator illuminated when 12V level is high
PROCESSOR BOARD INDICATORS	
RXD	LED indicator illuminated when processor board receives data from the data/comm board
TXD	LED indicator illuminated when processor board transmits data from the data/comm board
FLS	LED indicator flashes when lightning is detected
RUN	LED indicator illuminated during normal CPU activity
OVR	LED indicator illuminated when there is activity on the overrange signal
OPT	LED indicator illuminated when optical activity is detected
ENA	LED indicator illuminated when electrical activity that enables flash identification is detected

Table 16.3.3. Processor Board Switch Bank 101 Settings

Switch Bank 1	Positions 1 - 8	Output Modes
Pos1	***UP***	VT100 terminal (ASOS required setting)
Pos2	***UP***	One-minute message (ASOS required setting)
Pos3	***UP***	Reserved, always leave up (ASOS required setting)
Pos4	***UP***	Flash message output (ASOS required setting)
Pos5	***UP***	Simulator command set enabled (ASOS required setting)
Pos6	***DOWN***	Host command set enabled (ASOS required setting)
Pos7	***UP***	24-hour history message not cleared (ASOS required setting)
Pos8	***UP***	Reserved, always leave up (ASOS required setting)

Table 16.3.4. Processor Board Switch Bank 100 Settings

Positions 1 2 3	Diagnostic Test
UP UP UP	Normal operation (ASOS required setting)
UP UP DN	Self-test @ 1sec
UP DN UP	Echo test
UP DN DN	Watchdog timeout test
DN UP UP	Switch test
DN UP DN	Type test
DN DN UP	Reserved
DN DN DN	Reserved
Position 4	**(not defined)**
UP	(ASOS required setting)
Positions 5-6	**Units of Measure**
UP UP	Miles (ASOS required setting)
UP DN	Nautical miles
DN UP	Kilometers
DN DN	Miles
Positions 7- 8	**Flash Aging Interval**
UP UP	15 minutes (ASOS required setting)
UP DN	10 minutes
DN UP	5 minutes
DN DN	30 minutes

Table 16.3.5. Thunderstorm Sensor Turn-On Procedures

Step	Procedure
	Tools required: No. 2 Phillips screwdriver
1	At DCP (SCA) equipment cabinet, set thunderstorm sensor circuit breaker module to off (right) position.
2	At thunderstorm sensor, use No. 2 Phillips screwdriver to loosen two captive bolts securing hinged sensor access door and open door.
3	At power/comm board, set S1 power switch to ON (up) position.
4	Using No. 2 Phillips screwdriver, close and secure thunderstorm sensor access door.
5	At DCP (SCA), set thunderstorm sensor circuit breakers on circuit breaker module to on (left) position.

Table 16.3.6. Thunderstorm Sensor Turnoff Procedures

Step	Procedure
	Tools required: No. 2 Phillips screwdriver
1	At DCP (SCA) equipment cabinet, set thunderstorm sensor circuit breaker module to off (right) position.
2	At thunderstorm sensor, use No. 2 Phillips screwdriver to loosen two captive bolts securing hinged sensor access door and open door.
3	At power/comm board, set S1 power switch to OFF (down) position.
4	Using No. 2 Phillips screwdriver, close and secure thunderstorm sensor access door.

SECTION IV. THEORY OF OPERATION

16.4.1 PRINCIPLES OF OPERATION

The thunderstorm sensor (figure 16.4.1) consists of three major components contained in the main enclosure:

- Antenna assembly
- Power/Comm module
- Electronics module

The main enclosure is a specially designed, weather-proof box with a hinged and gasket-sealed door held closed with two stainless steel fasteners. When closed, the box is air-tight and water-tight. The main enclosure contains the electronics module and the power/communications module (power/comm module). The electronics module contains the analog board and the processor board. The power/comm module contains the power/comm board, heater, and fiberoptic modem.

The antenna assembly supplies signals to the electronics module which interprets and processes these signals. The power/comm module provides power for the sensor and communications with the outside world.

16.4.2 SIMPLIFIED BLOCK DIAGRAM DESCRIPTION

A functional block diagram of the thunderstorm sensor is shown in figure 16.4.2. The thunderstorm sensor consists of an electro-optical antenna assembly, power/comm module , and an electronics module. The antenna assembly detects the electric field signal generated by lightning discharges while the antenna optical sensor detects the associated flash. These two inputs are processed in the electronics module analog board. The main functions of the analog board are:

- Separate noise and lightning signals
- Determine if lightning is “cloud to cloud” or “cloud to ground”
- Estimate range of “cloud to ground” lightning

After these functions are performed, the analog signal is routed to the processor board. The analog board and the processor board are the main components of the electronics module. The processor board performs both analog and digital functions. The analog signals from the analog board are shaped and converted to digital format required by the processor board’s microprocessor circuitry. The following functions are performed by the processor board:

- Convert lightning data into message format for transmission to the ACU, DCP, or SCA
- Store lightning and self-test data and include into reports
- Fiberoptic modem data input/output (I/O) handling
- Microprocessor housekeeping functions

The processor board sends data to the power/comm module, where the data is converted to the RS-232 format and sent to the fiberoptic modem. The power/comm module also provides 12-volt power for the sensor and processes data communications with the DCP (SCA). Each field replaceable unit (FRU) is easily replaced and interchangeable with other thunderstorm sensors.

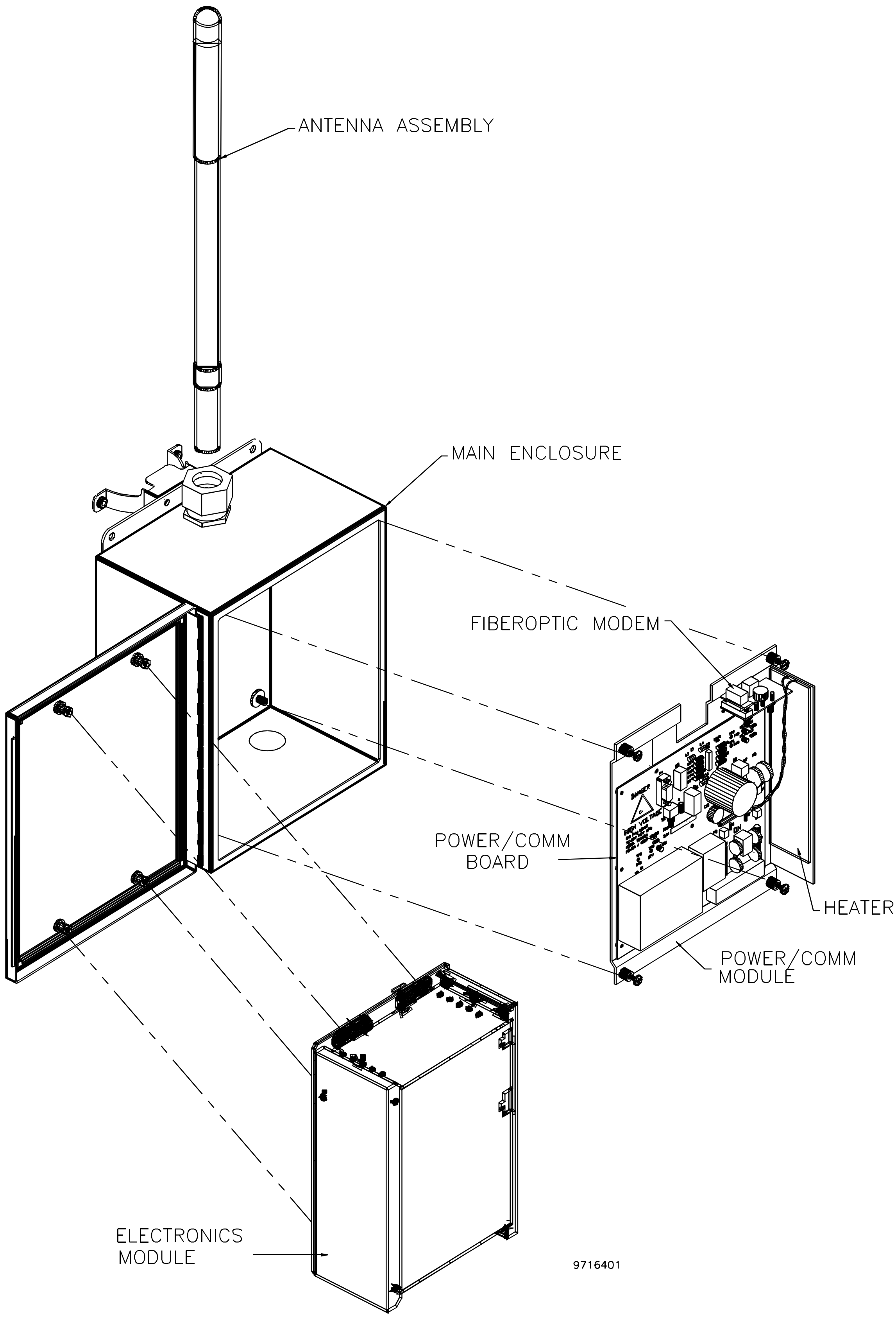


Figure 16.4.1. Thunderstorm Sensor Modules

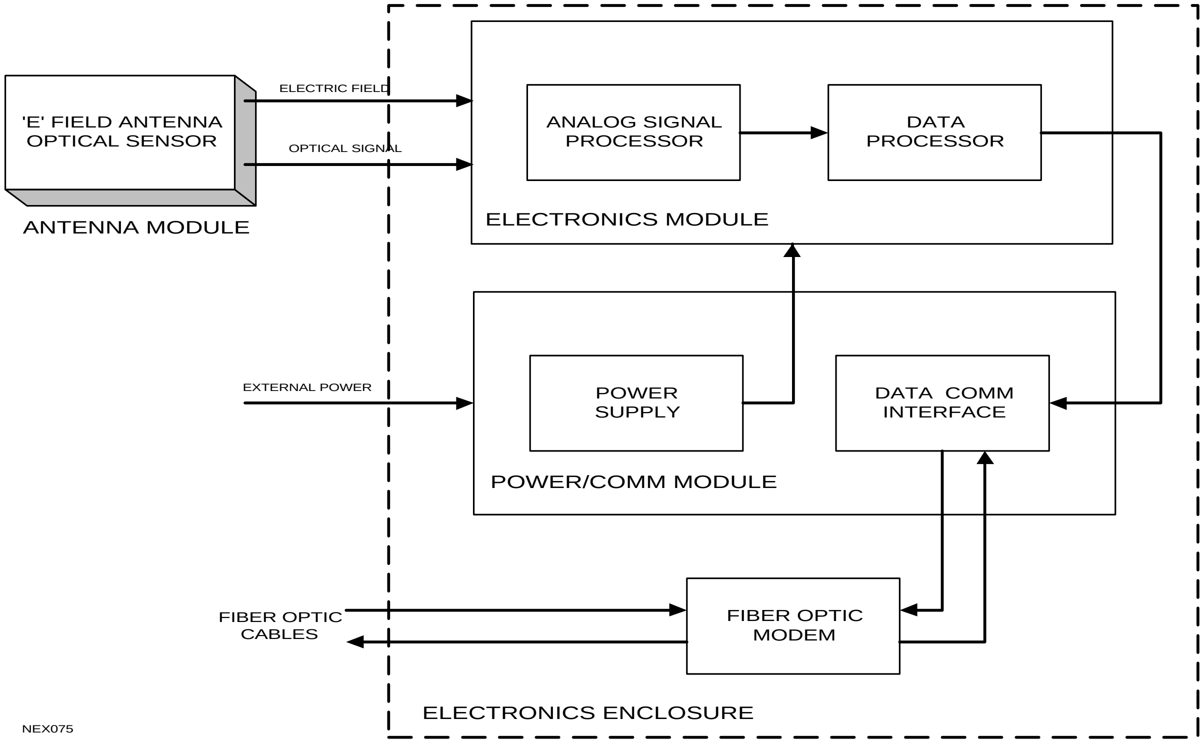


Figure 16.4.2. Functional Block Diagram

16.4.2.1 **Power and Power Supplies**. Power is supplied to all circuitry by a linear, 12 VDC power supply. AC power is brought on to the power/comm module where it is fused, switched, over-voltage limited, and filtered before being passed to the power supply. The regulated 12 VDC output is supplied to the circuitry where additional regulation to other power supply voltages is performed. The power/comm module also manages the power for the heater. Power is supplied to the heater by a separate AC circuit on the power/comm module that is switched in common with the main circuit power. AC for the heater is passed through a full-wave rectifier, filtered, current limited, and supplied to a heating element through a thermostat mounted to the power/comm module. Inrush current limiters are used in the heater circuit to slow the turn-on transient of the heater.

16.4.2.2 **Communications**. The power/comm module also handles data communications to the outside world. TTL level transmit and receive data signals are converted to RS-232 levels on the power/comm module. RS-232 level data lines are passed to the fiberoptic modem.

16.4.2.3 **Self-tests**. Given a healthy sensor in a normal sensor site, failed self-tests are rare. An occasional failed self-test does not necessarily indicate a defective unit. Occasionally, a self-test fails because of external interference.

The self-test exercises the majority of the circuitry in the sensor. Every 30 minutes and upon command from a host computer or terminal, the sensor injects simulated lightning signals into the electric field channel and simultaneously injects a simulated lightning light pulse into the optical sensor. These signals are acted upon by circuitry on the analog board and processor board in the electronics module and a self-test result is generated. The processor board keeps track of a bit that indicates that the signal in process is from a self-test and not from natural lightning.

The sensor reports that a self-test has failed only after successive failed self-tests, not on a single failed self-test (which can occur in normal sites with a healthy sensor due to transient, external noise interference). When the sensor fails a single self-test, it repeats the self-test four times. The self-test result reported is the majority value of the results of the five self-tests. After the sensor reports a failed self-test, it does not continue to report lightning.

If the sensor is unable to perform a self-test, it tries four more times (as with a failed self-test). If unsuccessful after five attempts, the sensor reports a failed self-test and puts the sensor in the DOWN state. Due to an approximate 2-second time-out, the total delay from the time a self-test is requested until a response is received may be 10-14 seconds if a self-test cannot be performed on all five attempts. In the DOWN state, the sensor will attempt to do a self-test once each minute. After the sensor reports a failed self-test, it does not continue to report lightning.

16.4.2.4 **Lightning Categories**. The sensor detects two types of lightning: cloud-to-cloud and cloud-to-ground (CG) lightning. CG lightning is further categorized according to its range. As set at the factory, CG lightning within zero to five miles of the sensor is categorized as Overhead, lightning within five to ten miles is categorized as Near, and lightning within ten to thirty miles is categorized as Distant.

16.4.2.5 **Processing Strokes and Flashes**. A CG lightning discharge is actually made up of one or more individual discharges occurring in rapid succession. The total CG discharge is called a flash. Each individual discharge within a flash is called a stroke.

The sensor detects individual lightning strokes. The sensor groups stroke messages into flashes. All stroke messages received within one second of the first stroke message are considered to be part of a single flash. A flash counter is increased by one for each flash detected, regardless of the number of stroke messages that were received within one second of the first stroke of the flash.

The sensor reports the range of a flash as the range of the nearest stroke in that flash. Signals from different CG discharges that occur at nearly the same time may occasionally be grouped together and counted as one flash. Cloud discharges that occur during the one-second period for flash grouping are not considered part of the CG discharge.

The algorithm used in the sensor for processing bursts of lightning stroke data was designed to identify and classify lightning in much the same way that a diligent, omniscient human lightning observer would.

16.4.2.6 **Signal Processing**. The sensor antenna responds to changes in the electric field and to optical impulses. The electronics module inside the sensor processes both of these signals in order to determine if they were caused by lightning. If so, the signals are further processed to determine whether their source was a cloud or a CG discharge. If the signals were caused by CG lightning, additional processing determines the approximate range and polarity of the lightning.

All of the functions listed above are provided by fast, low-power analog signal processing circuitry on the analog board and pulse-shape logic on the processor board.

The data about each stroke of each lightning flash is supplied to the microcontroller portion of the processor board where the following functions are performed:

- Stroke data messages are sorted into sensible flash counts.
- Flash counts are aged.
- All data I/O is handled.
- Housekeeping functions (self-test, error counting, and history accounting) are performed.

16.4.3 COMMAND DESCRIPTION

16.4.3.1 **Host Mode**. The thunderstorm sensor host mode uses two-way (duplex) communications with a laptop computer connected to the sensor (refer to Section V). Host mode is enabled when switch 6 of SW101 is Down. Table 16.4.1 shows the requests or commands that a host computer can send to the sensor. These requests are made by sending a single, upper-case, ASCII character to the sensor. The Host mode commands are further described in the following paragraphs.

Table 16.4.1. Host Command Set

ASCII Character	Function
A	Send a present Weather Message
B	Send a Status message
C	Perform a Self-Test
D	Perform a Reset
E	Perform a Type Test
F	Send system Run Time
G	Send Version Message

16.4.3.2 **Send Present Weather Message**. When the host computer issues the ASCII character A to the sensor in the Host mode, the sensor sends a present weather message with flash count and status information as shown in table 16.4.2.

Table 16.4.2. Response to Command A: Present Weather Message

Byte	Description	Value
1	Overhead flash counts label	O
2-6	Overhead flash counts	0-29999
7	Near flash counts label	N
8-12	Near flash counts	0-29999
13	Distant flash counts label	D
14-18	Distant flash counts	0-29999
19	Cloud flash counts label	C
20-24	Cloud flash counts	0-29999
25	Total flash counts label	T
26-30	Total flash counts	0-29999
31	Self-test results: P = passed F = failed ? = no self-test performed	P F ?
32-33	Status byte (see section 5.2.5.3.1)	00-FF
34	Hex radix delimiter	H
35	Carriage return	<CR>
36	Line feed	<LF>
C Format String `"O%5uN%5uD%5uC%5uT%5u%c%2xH\n"`		
Example: `O 7N 1D 2C 2T 12PC6H<CR><LF>`		

16.4.3.3 **Send Status Message**. By sending the ASCII character B, the host may request from the sensor a status message that consists of accumulated status, flash, and stroke counts. The accumulated counts are strictly for diagnostic purposes as they do not reflect the current storm counts, but rather the history of lightning counts and housekeeping information. The history accumulates during a cycle of the sensor's internal clock. When the sensor is powered up or reset, the internal clock is started; the clock rolls over every 24 hours. The status message counts are cleared (set to zero) at power-up, reset, and normally at rollover of the 24-hour clock. The status message format is described in table 16.4.3.

If switch 7 on SW101 is Down, the status message is not cleared at clock rollover; counts will accumulate until the sensor is reset or powered up.

Table 16.4.3. Response to Command B: Status Message

Line	Byte	Description	Value
1	1	Overhead flashes label	O
	2-6	Overhead flashes	0-29999
	7	Near flashes label	N
	8-12	Near flashes	0-29999
	13	Distant flashes label	D
	14-18	Distant flashes	0-29999
	19	Cloud flashes label	C
	20-24	Cloud flashes	0-29999
	25	Total flashes label	T
	26-30	Total flashes	0-29999
	31	Carriage return	<CR>
	32	Line feed	<LF>
2	33	Overhead strokes label	o
	34-38	Overhead strokes	0-29999
	39	Near strokes label	n
	40-44	Near strokes	0-29999
	45	Distant strokes label	d
	46-50	Distant strokes	0-29999
	51	Cloud strokes label	c
	52-56	Cloud strokes	0-2999
	57	Total strokes label	t
	58-62	Total strokes	0-29999
	63	Carriage return	<CR>
	64	Line feed	<LF>
3	65	Passed self-tests label	p
	66-70	Passed self-tests	0-29999
	71	Failed self-tests label	f
	72-76	Failed self-tests	0-29999
	77	Lost real strokes label	l
	78-82	Lost real strokes	0-29999
	83	Lost simulated strokes label	l
	84-88	Lost simulated strokes	0-29999
	89	Total of row label	t
	90-94	Total of row	0-29999
	95	Carriage return	<CR>
	96	Line feed	<LF>

C Format String:
```
"O%5uN%5uD%5uC%5uT%5u\n"
"o%5un%5ud%5uc%5ut%5u\n"
"p%5uf%5ul%5ul%5ut%5u\n"
```

Example:
```
O   7N   1D   2C   2T   12<CR><LF>
o  35n   1d   7c   2t   45<CR><LF>
p  16f   0l   0l   0t   16<CR><LF>
```

16.4.3.4 **Perform Self-test**. The sensor performs a self-test every 30 minutes; the status byte in the Present Weather message indicates the results of the most recent self-test. The host computer may initiate a self-test at any time by sending the ASCII character C to the sensor. The results of the self-test are described in table 16.4.4.

Table 16.4.4. Response to Command C: Self-test Message

Byte	Description	Value
1	Self-test result P = passed F = failed ? = no self-test performed	P F ?
2-3	Status byte (see section 5.2.5.3.1)	00-FF
4	Hex radix delimiter	H
5	Carriage return	<CR>
6	Line feed	<LF>
C Format String: "%c%2xH\n"		
Example: PC6H<CR><LF>		

Self-test commands that are issued too frequently may interfere with the reception of natural lightning signals. If a natural lightning signal is “in process” at the time that a self-test command is issued, the sensor completes the processing of the natural lightning signal.

The self-test may fail during a thunderstorm because of high levels of background noise. Therefore, self-test results should be ignored during thunderstorms until all lightning counts have aged out of the count fields. The host computer must monitor and make decisions about the status byte that is shown in the present weather message.

16.4.3.4.1 **Self-test Status Byte**. The eight-bit status byte gives information about the state of the electronics and power supplies in the sensor. The status byte, contained in the response to the ASCII character C, can be scanned for diagnostic information about the sensor as shown in table 16.4.5.

Table 16.4.5. Self-test Status Byte

Bit	Description
0	0: Input voltage greater than approximately 11V 1: Input voltage less than approximately 11V, analog board shutdown
1	0: Input voltage greater than approximately 13V 1: Input voltage less than approximately 13V
2	0: Sensor is in reset mode 1: Sensor is running
3	0: Sensor is ready for lightning 1: A stroke is being processed
4	0: 5V supply OK 1: 5V supply low
5	0: 10V supply OK 1: 10V supply low
6	1: Always 1
7	1: Always 1

16.4.3.5 **Perform Reset**. Turning power on and off resets the sensor. As an alternative, the host computer may issue a reset command (the ASCII character D) to cause the sensor to reset (CPU and hardware). Because this command resets the sensor, no serial response is issued from the sensor. Other than for EPROM program storage and DIP switches for option selection, there is no nonvolatile memory in the sensor.

16.4.3.6 **Perform Type Test**. A type test has been included in the Host mode command set to allow troubleshooting of communications links. The type test is initiated by sending the ASCII character E to the sensor. The type test output is shown in table 16.4.6.

Table 16.4.6. Response to Command E: Type Test Output

Byte	Description	Value
1-37	Test string	ABCDEFGHIJKLMNOPQRSTUVWXYZ O123456789
38	Carriage return	<CR>
39	Line feed	<LF>
C Format String: `"ABCDEFGHIJKLMNOPQRSTUVWXYZ 0123456789\n"`		
Example: `ABCDEFGHIJKLMNOPQRSTUVWXYZ 0123456789<CR><LF>`		

16.4.3.7 **Send System Run Time**. The sensor has a system clock which indicates the length of time the sensor firmware has been running. The system clock message, described in table 16.4.7, is sent when the ASCII character F is sent to the sensor by the host.

Table 16.4.7. Response to Command F: System Run Time Message

Byte	Description	Value
1	Days label	D
2-4	Days	0-999
5	Hours label	H
6-7	Hours	0-24
8	Minutes label	M
9-10	Minutes	0-59
11	Seconds label	S
12-13	Seconds	0-59
14	Carriage return	<CR>
15	Line feed	<LF>
C Format String: `"D%3uH%2uM%2uS%2U\n"`		
Example: `D  0H  1M26S 6<CR><LF>`		

16.4.4 **DIAGNOSTIC TESTS**

Using SW100, the user may select diagnostic tests, units of measure for ground discharge range estimates, and the aging interval. The switch settings in SW100 for diagnostic tests are shown in table 16.4.8. The diagnostic tests are further described in the following paragraphs. Once a diagnostic has been entered, the only way to exit the diagnostic is to change the switches and reset the sensor.

Table 16.4.8. SW100 Switches 1-3: Diagnostic Tests

SW100			Diagnostic Test
1	**2**	**3**	
Up	Up	Up	Normal operation
Up	Up	Down	Self-test @ 1 per second
Up	Down	Up	Echo test
Up	Down	Down	Watchdog timer test
Down	Up	Up	Switch test
Down	Up	Down	Type test
Down	Down	Up	Reserved
Down	Down	Down	Reserved

16.4.4.1 **Self-test**. The self-test diagnostic (switch 1 Up, switch 2 Up, and switch 3 Down on SW100) causes a self-test to occur once per second. Self-test results are transmitted (in hex) every second, one result per line. Note that there are certain sensor failure modes that prevent it from performing a self-test.

16.4.4.2 **Echo Test**. The echo test (switch 1 Up, switch 2 Down, and switch 3 Up on SW100) continuously polls the receiver of the serial port for input from the attached terminal or computer. In the echo test, every character sent to the sensor is sent back (retransmitted or "echoed") to the terminal, and carriage returns are expanded to a carriage return/line feed. Since there are no spaces inserted between echoed characters, what is typed is what is echoed. The echo test may be useful for troubleshooting problems with data communications links.

16.4.4.3 **Watchdog Timer Test**. To prevent the CPU from remaining in a hung-up or non-running condition, a timer (referred to as the watchdog timer) is implemented in the hardware to periodically issue a reset to the CPU. The watchdog timer test (switch 1 Up, switch 2 Down, and switch 3 Down on SW100) puts the CPU into an idle state that allows the watchdog timer to reset it. Failure of this test implicates the watchdog timer function of the CPU on the processor board.

16.4.4.4 **Switch Test**. The switch test (switch 1 Down, switch 2 Up, and switch 3 Up on SW100) continuously reads each of the switches in SW101 and SW100 and displays their values in hex each time they change. This test also causes the status byte to be read and output.

16.4.4.5 **Type Test**. The type test (switch 1 Down, switch 2 Up, and switch 3 Down on SW100) causes a continuous string of alphanumeric characters to be sent out the serial port. The type test is useful for checking out communications links between the sensor and the host computer, data terminal, or data collection platform. Because there is no delay inserted between transmissions, slow computers may experience buffering problems with this test.

SECTION V. MAINTENANCE

16.5.1 **INTRODUCTION**

This section provides preventive and corrective maintenance procedures for the thunderstorm sensor. Preventive maintenance consists of sensor inspection, cleaning (if necessary), and desiccant replacement. Corrective maintenance consists of fault isolation using the ASOS thunderstorm screen and removing and replacing sensor field replaceable units (FRUs) or removing and replacing the sensor.

16.5.2 **PREVENTIVE MAINTENANCE**

The thunderstorm sensor is inspected and cleaned every 90 days. Sensor desiccant is replaced annually. Table 16.5.1 provides the procedure for sensor inspection, cleaning, and desiccant replacement.

16.5.3 **CORRECTIVE MAINTENANCE**

Thunderstorm sensor corrective maintenance consists of troubleshooting failures and sensor FRU removal and replacement. The technician can review the sensor's test data via Thunderstorm sensor Screen on the OID. For most failures, the diagnostic identifies the faulty field replaceable unit (FRU). The technician can also communicate with the sensor directly by connecting a laptop computer to the sensor.

16.5.3.1 **Using the Laptop Computer With the Thunderstorm Sensor**. In order to communicate with the sensor, the maintenance technician must use the laptop computer. Table 16.5.2 provides the procedure to set up the laptop computer to communicate with the sensor. Section IV, paragraph 16.4.3 provides detailed descriptions of individual sensor commands.

16.5.3.2 **Troubleshooting**. The OID Thunderstorm sensor maintenance screen is the primary troubleshooting tool. Although diagnostic commands can be issued directly from the laptop computer, these commands provide no additional information other than what is displayed on the OID. Table 16.5.3 provides a summary of troubleshooting actions for different failure indications. Remove and replace the sensor when fault isolation identifies the antenna or electronics module as the source of the failure.

16.5.4 **CALIBRATION**.

There are no procedures for calibrating the thunderstorm sensor. The sensor must be returned to the authorized repair facility for calibration

16.5.5 **FRU REMOVAL AND INSTALLATION**

The thunderstorm sensor consists of an electronics enclosure and three FRUs; Antenna module, electronics module, and power/comm module. Removal and installation procedures identified on the following chart by table number are provided to facilitate safe and efficient removal of sensor FRU's.

Unit to be replaced	Table
Antenna Module	16.5.4
Electronics Module	16.5.5
Power/Comm Module	16.5.6
Fiberoptic Module	16.5.7

Table 16.5.1. Thunderstorm Sensor Inspection and Cleaning

Step	Procedure
	Tools and Materials Required: 1" Wrench Soft cotton cloth Large flat-tipped screwdriver No. 2 Phillips screwdriver **WARNING** Death or severe injury may result if power is not removed from sensor prior to maintenance activities. Ensure that circuit breakers (located inside DCP or SCA equipment cabinet) supplying power to sensor are set to off (right) position.
1	Set circuit breakers on thunderstorm sensor circuit breaker module inside DCP (SCA) equipment cabinet to off (right) position. The thunderstorm sensor circuit breaker module is labeled.
2	At thunderstorm sensor, ensure that ground wires and connections are short, direct, and electrically continuous. Grasp wire near ground clamps and pull slowly and firmly to verify attachment. Repeat on ground rod end of wire. If connection is loose, tighten it using appropriate tools. Ensure that all grounding hardware and ground connections are free of corrosion. Replace grounding hardware that shows any signs of corrosion.
3	Inspect two sensor enclosure lid hold-down clamps. Verify that each is securely in place on edge of lid. Inspect all enclosure-to-mast mounting hardware for corrosion and replace weakened fasteners. Tighten any loose mounting hardware screws.
4	Wipe dust off optical sensor at tip of antenna with a damp, soft cloth.
5	Inspect all electronic components in sensor enclosure and electronics module that are easily visible. Check for cracked, discolored, charred, or broken components and for darkening of the printed circuit boards, especially under components mounted directly on a board.
6	Verify that transient suppressors (MOVs) on power line (CR1, CR2. CR3. and CR4 in figure 16.3.1) on power/comm module are not damaged. Burn marks, cracking, and/or external carbon are evidence of failure. Slight damage to these devices is cumulative as they shunt brief transients to ground. A prolonged surge will blow power input circuit fuse. Eventually, transient suppressors lose heat dissipation and recovery properties and will fail (short) and open the fuse after shunting a transient.
7	If desiccant has not been replaced for a year, replace desiccant, and properly reseal enclosure. New desiccant bag must be removed from airtight outer packaging (DO NOT open desiccant bag containing desiccant granules) and flattened by shaking and patting to evenly distribute contents and place on top of the electronics module. Ensure that desiccant bag does not interfere with door or other internal assemblies.

Table 16.5.2. Using the Laptop Computer With the Thunderstorm Sensor

Step	Procedure
	INITIAL SETUP PROCEDURE
	Tools Required: Laptop computer with PROCOMM Plus installed Laptop interface (Y-shaped) cable Laptop null cable Large flat-tipped screwdriver No. 1 Phillips screwdriver No. 2 Phillips screwdriver **WARNING** Death or severe injury may result if power is not removed from sensor prior to maintenance activities. Ensure that circuit breakers (located inside DCP or SCA equipment cabinet) supplying power to sensor are set to off (right) position.
1	At DCP (SCA) equipment cabinet, set thunderstorm sensor circuit breaker module to off (right) position.

Table 16.5.2. Using the Laptop Computer With the Thunderstorm Sensor -CONT

Step	Procedure
2	Using No. 2 Phillips screwdriver, loosen two captive bolts securing hinged sensor access door and open door.
3	Using No. 1 Phillips screwdriver, disconnect DB-9 connector J4 from power/comm P4.
4	Using laptop computer null cable and interface (Y-shaped) cable, connect RS-232C (COM1) port of laptop computer to DB-9 connector removed from fiberoptic module.
5	Turn on laptop computer and initialize PROCOMM Plus program. After program initializes, press any key to enter terminal mode (blank) screen.
6	Using ALT-S command (setup facility), set up the following terminal options: a. Terminal emulation: VT220 b. Duplex: FULL c. Soft flow control (XON/XOFF): OFF d. Hard flow control (CTS/RTS): OFF e. Line wrap: OFF f. Screen scroll: ON g. CR translation: CR h. BS translation: NON-DESTRUCTIVE i. Break length (milliseconds): 035 j. Enquiry: OFF k. EGA/VGA true underline: OFF l. Terminal width: 80 m. ANSI 7 or 8 bit commands: 8 BIT
7	Press ESC key to exit to terminal mode (blank) screen.
8	Using ALT-P command (line/port option), set current settings as follows: a. Baud rate: 9600 b. Parity: NONE c. Data bits: 8 d. Stop bits: 1 e. Port: COM1
9	Press ESC key to exit to terminal mode (blank) screen
10	Set laptop computer CAPS LOCK to ON.
11	Set circuit breakers on thunderstorm sensor circuit breaker module inside DCP (SCA) equipment cabinet to on (left) position
12	**NOTE** Bad, spurious, erroneous, or false data may be transmitted from sensor when power is turned on or off. Ignore all data transmissions from sensor that occur at power on or power off. The thunderstorm sensor is now available for legal commands from the laptop computer. Refer to paragraph 16.4.3 for detailed descriptions of sensor commands and for specific restrictions on their use.
TEARDOWN	
1	At laptop computer, press ALT-X (exit) to exit PROCOMM Plus.
2	Turn off laptop computer.
3	At DCP (SCA), set thunderstorm sensor circuit breakers on circuit breaker module to off (right) position.
4	Disconnect cables between laptop computer and thunderstorm sensor.
5	Using No. 1 Phillips screwdriver, connect DB-9 connector J4 to power/comm P4.
6	Using No. 2 Phillips screwdriver, close and secure thunderstorm sensor access door.
7	At DCP (SCA), set thunderstorm sensor circuit breakers on circuit breaker module to on (left) position.

Table 16.5.3. Thunderstorm Sensor Troubleshooting

Symptom	What to Do
Sensor does not respond (communications failure)	If TXD LED (figure 16.3.1) and RXD LED on electronics module processor board are not active, electronics module is bad. Replace sensor. If the TXD LED and RXD LED on power/comm module are not active, but the TXD LED and RXD LED on the processor board in the electronics module are active, the power/comm module is bad or the DC cable is bad. Replace the power/comm module first; if the TXD LED and RXD LED are still not active, replace the DC cable. If both sets of LEDs are active, the fiberoptic modem or cable is bad. Replace fiberoptic modem or cable.
Electronics module Processor Board Enable signal (ENA LED, figure 16.3.1) shows unusual activity (e.g., the ENA LED is lit when there is no lightning activity or is not lit when there is lightning activity)	Disconnect antenna to see if abnormal enable signal activity is internally caused or externally caused. If activity persists when antenna is disconnected, cause is internal, and electronics module is bad. Replace sensor. If the activity does not persist when antenna is disconnected, cause is external (external electric field problem), and site must be changed or fixed. Change or fix site.
Fuse failure	Indicates a power supply or a transient suppression circuit problem. Replace power/comm module.
Lightning is not detected but self-tests are passed	Check optical sensor for opaque covering such as dirt, mud, bird droppings, etc. Clean optical sensor.
Electronics module Processor Board Optical signal (OPT LED (figure 16.3.1) shows unusual activity (e.g., the OPT LED is lit when there is no lightning activity or is not lit when there is lightning activity)	Place a cover over optical sensor. If activity stops, problem is external. If activity persists, cause is probably internal or may be an external electric field problem. An external electric field problem usually causes unusual activity on the enable signal (ENA LED) on electronics module processor board as well. Replace sensor or change/fix site.
Electronics Module Processor board RUN LED (figure 16.3.1) blinks or is not lit but power supplies are OK	Indicates an electronics module problem. Replace sensor.
Self-test failure (failed self-test result)	Indicates an electronics module problem. Replace sensor.
Self-test failure (no self-test performed)	Indicates an Antenna Module or electronics module problem. Replace sensor.
Voltage failure (5 VDC or 10 VDC)	Indicates an electronics module problem. Replace sensor.
Voltage failure (12 VDC measures below 11 VDC or above 13 VDC)	Indicates a power supply problem if input voltage is OK. Replace power/comm module if input AC power is OK; otherwise, determine cause of AC failure.

Table 16.5.4. Electro-optical Antenna Removal and Installation

Step	Procedure
REMOVAL	
	Tools Required: No. 2 Phillips screwdriver **WARNING** Death or severe injury may result if power is not removed from sensor prior to maintenance activities. Ensure that circuit breakers (located inside DCP or SCA equipment cabinet) supplying power to sensor are set to off (right) position.
1	At DCP (SCA) equipment cabinet, set thunderstorm sensor circuit breaker module to off (right) position.
2	At thunderstorm sensor, use No. 2 Phillips screwdriver to loosen two captive bolts securing hinged sensor access door and open door.
3	Disconnect plug P104 from electronics module J104.
4	Disconnect ground spade lug from bottom of coupler.
5	Loosen hex nut on liquid tight coupler.
6	Remove antenna from enclosure.
INSTALLATION	
	Tools Required: No. 2 Phillips screwdriver **WARNING** Death or severe injury may result if power is not removed from sensor prior to maintenance activities. Ensure that circuit breakers (located inside DCP or SCA equipment cabinet) supplying power to sensor are set to off (right) position.
1	At thunderstorm sensor, arrange antenna cable to hang freely from bottom of antenna housing. Carefully feed connector end of cable into liquid-tight coupler and pull cable through to inside of enclosure and guide antenna end into opening in liquid-tight coupler. While holding antenna perpendicular to top of enclosure, slowly and gently push antenna into liquid-tight coupler until fully seated as shown in figure 16.2.2.
2	**CAUTION** Failure to properly tighten the nut on the liquid-tight coupler will result in moisture damage to the sensor. Hand tighten hex nut on liquid-tight coupler.
3	Route antenna cable under clamps and connect J104 to electronics module P104 as shown in figure 16.2.3.
4	Connect spade lug to ground terminal located below the antenna mounting coupler.
6	Using No. 2 Phillips screwdriver, close and secure thunderstorm sensor access door.
7	At DCP (SCA), set thunderstorm sensor circuit breakers on circuit breaker module to on (left) position.

Table 16.5.5. Electronics Module Removal and Installation

Step	Procedure
REMOVAL	
	Tools Required: No. 2 Phillips screwdriver **WARNING** Death or severe injury may result if power is not removed from sensor prior to maintenance activities. Ensure that circuit breakers (located inside DCP or SCA equipment cabinet) supplying power to sensor are set to off (right) position.
1	At DCP (SCA) equipment cabinet, set thunderstorm sensor circuit breaker module to off (right) position.
2	At thunderstorm sensor, use No. 2 Phillips screwdriver to loosen two captive bolts securing hinged sensor access door and open door.
3	Remove J103 and J104 from electronics module connectors P103 and P104.
4	Disconnect electronics module chassis ground strap from spade lug near door hinge.
5	Slide clamps at top of electronics module securing module to front cover and remove module.
INSTALLATION	
	Tools Required: No. 2 Phillips screwdriver **WARNING** Death or severe injury may result if power is not removed from sensor prior to maintenance activities. Ensure that circuit breakers (located inside DCP or SCA equipment cabinet) supplying power to sensor are set to off (right) position.
1	At thunderstorm sensor, position electronics module on front cover and slide top clamps to secure module.
2	Connect electronics module chassis ground strap to spade lug near door hinge.
3	Route antenna cable under clamps as shown in figure 16.2.3.
4	Connect J103 and J104 to electronic module connectors P103 and P104.
5	Using No. 2 Phillips screwdriver, close and secure thunderstorm sensor access door.
6	At DCP (SCA), set thunderstorm sensor circuit breakers on circuit breaker module to on (left) position.

Table 16.5.6. Power/Comm Board Removal and Installation

Step	Procedure
REMOVAL	
	Tools Required: Large flat-tipped screwdriver No. 2 Phillips screwdriver **WARNING** Death or severe injury may result if power is not removed from sensor prior to maintenance activities. Ensure that circuit breakers (located inside DCP or SCA equipment cabinet) supplying power to sensor are set to off (right) position.
1	At DCP (SCA) equipment cabinet, set thunderstorm sensor circuit breaker module to off (right) position.
2	At thunderstorm sensor, use No. 2 Phillips screwdriver to loosen two captive bolts securing hinged sensor access door and open door.
3	At power/comm board, loosen four thumb screws securing plexiglass shield over power strip P1 and remove shield.
4	Tag and disconnect five 115V ac power connectors from P1.
5	Disconnect cables J4, J3, and J2 from connectors P4, P3, and P2.
6	At power/comm module, using ccw rotation, remove two fiberoptic cables from bottom of fiberoptic module. Install plastic protective covers over board connectors.
7	Loosen four captive screws and remove power/comm board from power/comm module.
INSTALLATION	
	Tools Required: Large flat-tipped screwdriver No. 2 Phillips screwdriver **WARNING** Death or severe injury may result if power is not removed from sensor prior to maintenance activities. Ensure that circuit breakers (located inside DCP or SCA equipment cabinet) supplying power to sensor are set to off (right) position.
1	At thunderstorm sensor, position power/comm board on power/comm module and tighten four captive screws securing board to module.
2	Connect cables J4, J3, and J2 to connectors P4, P3, and P2.
3	Connect five 115V ac power connectors to P1.
4	Position plexiglass shield over power strip P1 and secure by tightening four thumb screws.
5	Remove any protective covers from fiberoptic connectors and install the receive (RX) and transmit (TX) connectors on fiberoptic module. RX cable mates with fiberoptic connector nearest DB-9 electrical connector.
6	Using No. 2 Phillips screwdriver, close and secure thunderstorm sensor access door.
7	At DCP (SCA), set thunderstorm sensor circuit breakers on circuit breaker module to on (left) position.

Table 16.5.7. Fiberoptic Module Removal and Installation

Step	Procedure
REMOVAL	
	Tools and Materials Required: Flat-tipped screwdriver Small flat-tipped screwdriver No. 1 Phillips screwdriver No. 2 Phillips screwdriver **WARNING** Death or severe injury may result if power is not removed from sensor prior to maintenance activities. Ensure that circuit breakers (located inside DCP or SCA equipment cabinet) supplying power to sensor are set to off (right) position.
1	At DCP (SCA) equipment cabinet, set thunderstorm sensor circuit breaker module to off (right) position.
2	At thunderstorm sensor, use No. 2 Phillips screwdriver to loosen two captive bolts securing hinged sensor access door and open door.
3	At power/comm module, using ccw rotation, remove two fiberoptic cables from bottom of fiberoptic module. Install plastic protective covers over board connectors.
4	Using No. 1 Phillips screwdriver, remove screws securing fiberoptic module mounting plate to power/comm module.
5	Using small flat-tipped screwdriver, loosen two retaining screws on DB-9 connector located on top of fiberoptic module. Remove DB-9 connector.
6	Using No. 1 Phillips screwdriver, remove screws securing fiberoptic module to mounting plate. Remove fiberoptic module.
INSTALLATION	
	Tools and Materials Required: Flat-tipped screwdriver Small flat-tipped screwdriver No. 1 Phillips screwdriver No. 2 Phillips screwdriver **WARNING** Death or severe injury may result if power is not removed from sensor prior to maintenance activities. Ensure that circuit breakers (located in DCP) supplying power to sensor are set to off (right) position.
1	Position fiberoptic module and gaskets on mounting plate. Using No. 1 Phillips screwdriver, install screws and lockwashers securing fiberoptic module to mounting plate.
2	Install signal cable removed in removal step 5 to DB-9 connector on fiberoptic module and using small flat-tipped screwdriver, tighten two retaining screws.
4	Using No. 1 Phillips screwdriver, secure fiberoptic module mounting plate to power/comm module.
3	Remove any protective covers from fiberoptic connectors and install the receive (RX) and transmit (TX) connectors on fiberoptic module. RX cable mates with fiberoptic connector nearest DB-9 electrical connector.
4	Using No. 2 Phillips screwdriver, close and secure thunderstorm sensor access door.
5	At DCP (SCA), set thunderstorm sensor circuit breakers on circuit breaker module to on (left) position.

CHAPTER 17

MAINTENANCE DRAWINGS

17.1 INTRODUCTION

This chapter describes the use of ASOS oversize maintenance drawings, including detailed block diagrams, power distribution diagrams, and cabling interconnect diagrams. These drawings are provided with and support the theory of operation provided in Sections IV of the previous chapters. The drawings are intended to aid in the understanding of ASOS system operation and to assist maintenance personnel in the troubleshooting and repair of affected assemblies.

17.2 DRAWING FORMAT

Explanations of the symbology and referencing methods used in the maintenance drawings are provided to facilitate their use. Simplified block diagrams show a basic level operating relationship of individual assemblies and are straightforward in presentation. The basic processing depicted in the simplified block diagrams is expanded upon and presented in detailed block diagrams. The detailed block diagrams depict specific signal and data processing by using certain drawing conventions to simplify the circuitry and assemblies involved. This simplification provides an easier means to understand the more complex circuit operations. The drawing format and conventions used for the detailed block diagrams are depicted in a sample provided as figure 1. This sample shows typical applications of the drawing conventions, each of which is described in following paragraphs. All pin-to-pin wiring is shown on the detailed block diagrams, including circuit board, panel, assembly, and cable pin numbers. Mnemonics are used to identify particular signal paths. The mnemonics are derived from engineering source data and typically indicate the purpose or function of the signal.

17.2.1 **Unit Assembly Identification (1, Figure 1)**. The top left corner of the illustration contains the assembly name of the top level unit. The unit reference designator is also included following the unit name. The assembly level is indicated through the use of dashed generation lines, with the top level represented by a solid line.

17.2.2 **Subunit Assembly Identification (2)**. The subunit assemblies are identified by the same method as the unit assemblies. The assembly name and reference designator are located in the top left corner of the depicted assembly. The number of dashes in the subunit assembly generation lines represents the assembly level. For example, the first subunit level uses a single-dash line, second subunit level uses a two-dash line, etc.

17.2.3 **Circuit Board Assembly Identification (3, Figure 1)**. The top left corner of the illustrated box contains the circuit board assembly name and reference designator. For rack-mounted circuit boards, the reference designator depicts the physical location of the board in the card rack. For example, the reference designator A6 indicates that the board is located in the sixth card slot of the card rack.

17.2.4 **Functional Representation of Circuitry (4)**. Circuit elements or groups of circuit elements in a particular assembly are represented by boxes or simplified logic symbols. These representations do not suggest the quantity, complexity, or physical appearance of the circuit elements. They do, however, depict the operational function of the circuitry. When circuitry is functionally represented by a rectangular box, the box is assigned a name that identifies the purpose or function performed by the associated circuitry. Signals that interact with the functional boxes and symbols are assigned names to further identify their purpose or function. Arrowheads are used on signal paths to depict the flow of data through the circuitry. The purpose of the functional diagrams is to describe the basic signal and data flow through the various functional areas. Therefore, no effort is made to depict the critical timing relationships essential to the operation of the circuitry.

17.2.5 **Intrafunctional Referencing (5)**. When signal connections cannot be shown in their entirety because a circuit is depicted on more than one sheet, a reference letter is assigned to the signal line. This letter matches a letter on a following sheet and locates the continuation of the signal path. At the source, the letter follows the signal line; at the destination, the letter precedes the signal line.

17.2.6 **Bundled Signals (6)**. For ease of routing, both internally and externally to circuit board assemblies, multiple signal lines are often bundled into a single representative line. These bundled signals are then separated as necessary to connect their interface points.

17.2.7 **Cable/Connector Identification (7)**. The drawings depict all interfunctional equipment cabling. The cable number and its connector designations are identified adjacent to the associated cable/connector. In instances where only a portion of a particular cable or assembly is shown, the designation P/O (to indicate part of) is used.

17.2.8 **Signal Names (8)**. The signal mnemonics used at the input and output connections of the electronics assemblies are the same signal names used in the engineering source data. The signal mnemonics are generally an abbreviation of the signal's function. In addition, as in the case of address and data bus signals, numbers may be incorporated into the mnemonic. These numbers are used to indicate bit position, or bit weight, of that signal with respect to the associated signals. In this convention, the lower the number, the lower the bit weight. For example, the signal MDAT0 represents the least significant bit, while MDAT15 represents the most significant bit. The active state of a signal or voltage level may also be indicated by the mnemonic. This is typically indicated by a + or - sign in the signal name.

17.2.9 **Supplementary Names (9, Figure 1)**. Occasionally, a given signal or group of signals performs one or more particular functions with a circuit. The mnemonic for the signal may also not readily indicate the particular function. For these reasons, supplemental names or mnemonics are assigned to signals internal to the circuit assembly. In instances where the supplemental name and the actual signal name appear together, the supplemental name is contained within parentheses.

17.2.10 **Connector Pin Numbers (10)**. Signals applied to circuit board or cable connectors have the pin designation identified. These pin identifications may consist of either letters or numbers and reflect the identification markings on the physical cable or connector.

17.2.11 **Interfunctional Referencing (11)**. The signal interfacing with other functional areas of the system is shown by references to the titles of those areas. In these instances, the associated area is identified by both name and figure number when possible. For signals that interface with equipment other than ASOS equipment, only a general name of the associated area is referenced.

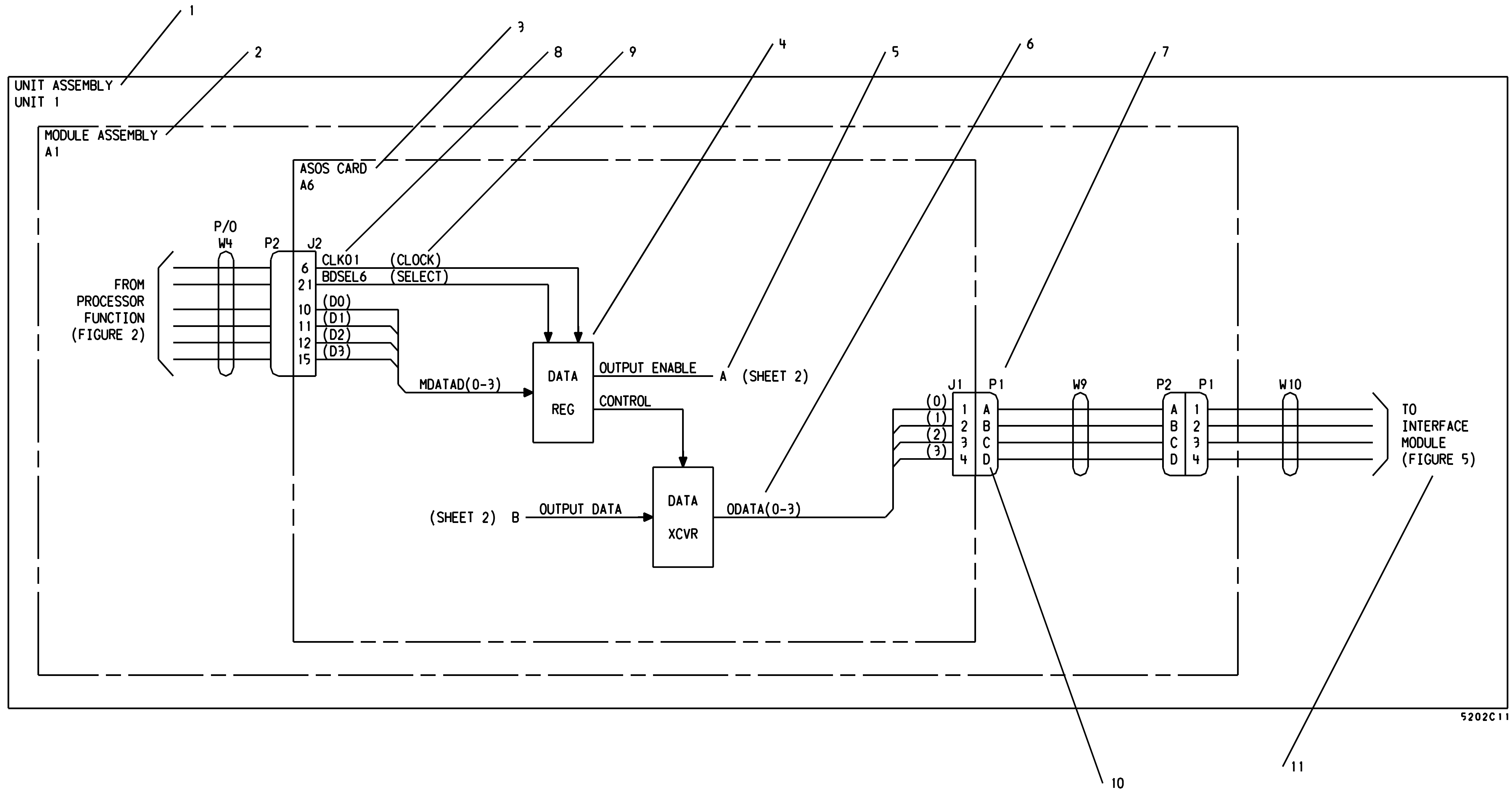


Figure 1. ASOS Drawing Format and Conventions

CHAPTER 18

STANDARD ASOS PARTS LIST

18.1 INTRODUCTION

This parts list provides a listing of field replaceable units (FRU's) and related items used to maintain ASOS system installations at the organizational level of maintenance by field service technicians. This parts list has been modified from previous versions of the ASOS Site Technical Manual in order to present a clearer description of each item while reducing unnecessary clutter. The All the items in this list can also be found in the NWS Engineering Handbook No.1.

NOTE

This parts list is subject to change but is current as of August 25, 2000. Refer to EHB-1 for continuing updates.

18.2 DESCRIPTION OF PARTS LIST

The ASOS parts list provides a list of items located within the major assemblies of the ASOS installations. Each item is identified by its National Stock Number (NSN), Agency Stock Number (ASN), and description. The entire list as a whole is sorted by the ASN column.

18.2.1 **Agency Stock Number (ASN)**. This column identifies the unique number assigned by the NWS to identify equipment, components, supplies, etc.

18.2.2 **National Stock Number (NSN)**. This column identifies the unique identifier assigned to each stock item. It is normally a federally asigned number comprised of a Federal Supply Class (FSC), North Atlantic Treaty Organization (NATO) code, and a sequential number cataloged in the Federal Supply Cataloging System.

18.2.3 **Description**. This column is used to provide some description of each item.

18.3 SOFTWARE VERSION COMPATIBILITIES

Before replacing any CPU, Memory, or Voice cards, consult the following table for compatibility between the software versions (example: to upgrade the ACU memory to version 2.6, you must also upgrade the ACU CPU to 1.81, the ACU Voice card to 4.0, and the the DCP CPU to 1.90).

Table 18.1 Software Compatibilities

ACU/SCA MEMORY	ACU/SCA CPU	ACU/SCA VOICE	DCP CPU
2.4	1.81	3.0	1.70
2.42	1.81	3.0	N/A
2.49	1.81	3.0	1.80
2.6	1.81	4.0	1.90

ASN	NSN	Description
S100-1-1	6660-01-390-2144	ACU cabinet
S100-10-1	5895-01-368-4615	2440 Modem
S100-10-2	5895-01-368-4614	V.3225 Modem
S100-10-3	5920-01-438-3444	AC Wall Mount, RJ-11 Surge Protector
S100-10-4	5895-01-462-1911	Stand Alone 28.8 High Speed Modem
S100-102A1	5975-01-452-0552	Electrical Equipment Cabinet
S100-11-1	5895-01-390-2666	OID Keyboard
S100-11-1A	7025-01-451-6477	OID Keyboard
S100-11-2	7025-01-424-0696	OID Monitor
S100-12	7025-01-368-4592	Panasonic Printer, Model KX-P1180I
S100-12-2	7025-01-411-9533	Panasonic Printer, Model KX-P3123
S100-1A1-1	5895-01-364-6861	CODEX Modem
S100-1A1-2	5895-01-364-6864	Premium CODEX Modem
S100-1A10	5820-01-369-1352	GTA Radio Transmitter, VHF Model CM-200VT
S100-1A1A1-1	5895-01-411-9983	CODEX Flex Cartridge
S100-1A1A1-2	5895-AS-200-0067	Premium CODEX Flex Cartridge
S100-1A2-T	5985-01-462-7521	VME Terminator
S100-1A2A1	5998-01-368-8655	CPU Board
S100-1A2A1-U29	5962-AS-200-0155	ACU CPU EPROM, Revision 1.81
S100-1A2A11	5975-01-472-8456	VME Front Panel with Handle
S100-1A2A13-1	5998-01-390-2153	A/D Converter Board, Model XVME590/1
S100-1A2A14	5905-01-431-8054	VME Resistor Board
S100-1A2A15-1	5998-01-390-2151	Digital I/O Board
S100-1A2A16	5998-01-368-8654	Graphics Counter
S100-1A2A20	5998-01-390-2148	Voice Processor, VR-9800
S100-1A2A20-U11A	7025-AS-000-0160	Voice Processor EPROM, Revision 3.0
S100-1A2A20-U11B	NWS9-81-410-0002	Voice Processor EPROM, Revision 4.0
S100-1A2A3	5998-01-368-8651	ACU Memory Board, XVME-110/1
S100-1A2A3-U8B	NWS9-61-140-0002	ACU Memory EPROMs, Revision 2.40
S100-1A2A3-U8D	NWS9-81-410-0004	ACU Memory EPROMs, Revision 2.60
S100-1A2A5	5998-01-368-8653	Serial I/O Board, RS422
S100-1A2A6-1	5998-01-368-8652	Serial I/O Board, RS232
S100-1A2MP2	5340-01-472-7674	Line Driver Mounting Plate

S100-1A2MP3	5340-01-472-7676	Line Driver Mounting Plate
S100-1A3	5895-01-358-4452	ACU Modem Rack Assembly
S100-1A3A1	5895-01-368-8662	Rack Mount 2440 Modem
S100-1A3A1-2	5895-01-308-2794	Rack Mount V.3225 Modem
S100-1A3A1-3	5895-01-445-3519	Rack Mount 28.8 Modem (High Speed)
S100-1A3A13	5998-01-368-8657	ACU Rack Mount Line Driver
S100-1A3PS1	6130-01-299-2561	ACU Modem Rack Power Supply
S100-1A3XA1	5935-01-389-8232	Rack Mount Modem Adapter; 1 DB25, 1 RJ-45
S100-1A3XA2	5895-01-450-8660	Rack Mount Modem Adapter: 1 DB25, 2 RJ-25
S100-1A4A1	5998-AS-000-0015	UPS Status Panel Board, SOLA
S100-1A4A1-2	6130-01-411-5252	UPS Power Supply, DELTEC
S100-1A4A1MP3	5975-01-411-9547	UPS Mounting Strap, DELTEC
S100-1A4A2-1	5998-01-369-4730	UPS RS232 Interface Board, SOLA
S100-1A4A3	5915-01-389-3012	UPS 1.5 KVA Filter Board, SOLA
S100-1A4A4	5998-01-368-4595	UPS 1.5 KVA Inverter Board, SOLA
S100-1A4CB1	5925-01-389-6136	UPS 20 Amp Circuit Breaker, SOLA
S100-1A4F1	5920-00-998-2231	UPS Fuse, SOLA
S100-1A4S1	5895-01-411-9538	UPS Power Switch, SOLA
S100-1A4T1	5950-AS-000-0014	UPS 1.5 KVA Transformer, SOLA
S100-1A5	6130-01-454-5212	DC Power Supply Enclosure
S100-1A5B2	4140-01-407-3985	5 Bladed Axial Tube Fan (Power Supply Fan)
S100-1A5PS1	6130-01-368-8643	DC Power Supply
S100-1A6-MP2	4930-01-451-6809	Static Pressure Vent
S100-1A6A1	6685-01-368-4611	Setra Model 470 Pressure Sensor
S100-1A6A1-1	6685-01-424-0671	Setra Model 470-T Pressure Sensor
S100-1A6A1-2	6110-01-423-1328	External Threshold Detector
S100-1A6A4-3	5895-01-381-0769	RF Modem, 410.075 MHz (Motorola)
S100-1A6A4-4	5895-01-381-0771	RF Modem, 410.950 MHz (Motorola)
S100-1A6A4-5	NWS9-81-880-0007	RF Modem, 410.075 MHz (Johnson Data)
S100-1A6A4-6	NWS9-81-880-0008	RF Modem, 410.950 MHz (Johnson Data)
S100-1A6A6	5895-01-449-8433	LD1/LD2 Switching Board
S100-1A6MP1	4330-AS-200-0140	Pressure Vent Kit
S100-1A6MP10	4720-00-818-3478	Pressure Vent Tubing
S100-1A6MP12	5340-01-277-5032	ACU Mounting Bracket, 4" Long

S100-1A6MP13	5340-01-242-5172	ACU Mounting Bracket, 8.5" Long
S100-1A6MP14	5340-01-389-1343	Chassis Slide; 24" long closed, 49"long opened
S100-1A6MP7	4730-00-834-7434	Cross Tube Fitting
S100-1A6MP9	4730-01-286-8840	Insert Tube Fitting
S100-1A6S1	5895-01-411-5106	RF Modem Switch
S100-1A6W1	5995-01-389-2451	ACU RF Modem 1 Cable Assembly
S100-1A6W2	5995-01-389-2470	ACU RF Modem 2 Cable Assembly
S100-1A6W26	5995-01-389-2439	Pressure Sensor Cable Assembly
S100-1A7A12-1	5940-01-390-2561	Terminal Block
S100-1A7A12-20	5940-01-390-2558	Ground Terminal Block
S100-1A7A12MP3	5340-01-389-9815	Din Rail End Clamp
S100-1A7A12MP4	6150-01-389-8917	Conductor Bus
S100-1A7A12MP8	5340-01-389-1349	End Plate
S100-1A7A1MP7	5340-01-390-5846	Din Rail
S100-1A7K1	5945-01-451-6807	ACU Solid-State Time Delay Module
S100-1A8A1-1	6160-01-406-7503	ACU UPS 5-Battery Box, SOLA
S100-1A8A1-2	6160-01-411-4536	ACU UPS 4-Battery Box, DELTEC
S100-1A8BT1	6140-01-389-6178	Battery
S100-1A9-W1	NWS9-60-180-0001	Fiber Optic Cable Assembly, 175'
S100-1A9A1-1	5935-01-426-3801	RJ-11/RS232 Adapter
S100-1A9A5	6110-01-389-2467	Video Surge Protector
S100-1A9A6MP2	5999-01-396-5464	EMI Gasket
S100-1A9A6MP3	5330-01-432-9937	EMI Gasket
S100-1A9J1	5935-01-399-2558	RJ-11 EMI Surge Connector
S100-1A9J22	5935-01-399-2554	EMI Surge Adapter (RS232 DB25 Connector)
S100-1A9J39	5920-01-445-3521	RF Surge Detector
S100-1A9J40	5915-01-389-3113	UPS Output Filter
S100-1A9J41	5915-01-389-3004	AC Line Filter
S100-1A9J9-12	NWS9-93-510-0021	Module Adapter
S100-1A9MP18	4730-00-011-2969	Tube Nipple
S100-1A9W1	5995-01-459-5548	Power Strip Cable Assembly with ACU Power Plug
S100-1A9W12	5995-01-407-8410	ACU RF SW Out Cable Assembly
S100-1ACU-UPS	NWS9-93-510-0018	ACU UPS Bypass Kit Assembly
S100-1A9W77	5995-01-446-9779	ACU Adapter Cable

S100-1B1	4140-01-114-9097	ACU Blower
S100-1E1	5985-01-389-1785	ACU/DCP Antenna Assembly
S100-1E1MP1	5340-01-436-8776	Antenna Mounting Bracket
S100-1E2	5985-01-050-7522	GTA Radio Antenna, Omnidirectional, 50 Ohm
S100-1E3	5985-01-146-0911	YAGI Antenna
S100-1E3W1	5915-01-440-9260	Band Pass Filter
S100-1MP038	5340-01-389-1338	Blank Cover
S100-1MP039	5340-01-390-1179	Fiber Optic Module Blank Cover
S100-1MP040	5340-01-389-1306	DB25 Blank Cover
S100-1MP16	5310-00-531-1580	Lockwasher, 0.195 X 0.25
S100-1MP17	5305-01-411-9536	Roundhead Screw, 0.31" Long
S100-1W1	5995-01-444-3711	3 Conductor AC Cable
S100-1W11	5995-01-436-8770	Local Sensor Cable Assembly
S100-1W6P1	5935-01-343-8839	Electrical Plug Connector
S100-1W6P2	5935-01-381-8081	Electrical Power Plug
S100-1W72	5995-01-389-2014	TELCO Modem Cable
S100-2-1	5975-01-369-5862	DCP Cabinet, Class I
S100-2-2	5975-01-440-9261	DCP Cabinet, Class 2
S100-2-2MP1	5330-01-457-1202	DCP Gasket, Top
S100-2-2MP2	5330-01-457-1205	DCP Gasket, Bottom
S100-2-2MP3	5330-01-457-1206	DCP Gasket, Side
S100-2-3	5975-01-449-8412	DCP Cabinet, Class2, New Backplate with DELTEC UPS
S100-2-4	5975-01-449-8410	DCP Cabinet, Class 1, with DELTEC UPS
S100-2-OMNI-KIT	NWS9-93-510-0019	Omni Antenna Kit
S100-2-UPS-KIT	NWS9-93-510-0020	DCP UPS Bypass Kit Assembly
S100-2A131	1290-TM-000-0007	HO83 Sun Shield
S100-2A1A2A1	5998-01-368-8658	CPU Board, with Firmware Revision 1.90
S100-2A1A2A10	5905-01-431-8056	VME Resistor Board
S100-2A1A2A1U29	NWS9-71-550-0001	DCP Firmware Revision 1.80
S100-2A1A2A1U29A	NWS9-81-410-0003	DCP Firmware Revision 1.90
S100-2A1A2A3	5998-01-368-4601	XVME-100/02 Memory Board
S100-2A1A2MP01	5998-01-411-7109	VME Back Plane
S100-2A1A2MP10	5340-01-389-1351	Circuit Card Rack Hinge
S100-2A1A2MP6	4140-00-100-4563	Fan Guard

S100-2A1A3A1	5925-01-389-2981	Circuit Breaker Module, Primary
S100-2A1A3A2	5925-01-406-4090	Circuit Breaker Module, Ceilometer
S100-2A1A3A3-1	5925-01-406-4093	Circuit Breaker Module, Freezing Rain Sensor
S100-2A1A3A3CB1	5925-01-432-0547	Circuit Breaker, 0.5 Amp
S100-2A1A3A4	5998-01-368-8649	Circuit Breaker Module, Present Weather Sensor (LEDWI)
S100-2A1A3A5	5998-01-369-4727	Circuit Breaker Module, Tipping Bucket
S100-2A1A3A5CB1	5925-01-462-2209	Circuit Breaker, 6 Amp
S100-2A1A3A6	5998-01-368-4594	Circuit Breaker Module, Wind Sensor
S100-2A1A3A7	5925-01-390-2150	Circuit Breaker Module, Temperature/Dewpoint Sensor
S100-2A1A3A8	5998-01-368-8648	Circuit Breaker Module, Visibility Sensor
S100-2A1A3A9	5925-01-441-7595	Circuit Breaker Module, Thunderstorm Sensor
S100-2A1A3CB9	5925-01-468-3322	Circuit Breaker, 1 Amp
S100-2A1A3MP3-2	5305-00-429-4414	Captive Screw
S100-2A1A3MP4	9510-01-389-6496	Retention Bar
S100-2A1A3MP4-2	5305-00-140-2379	Captive Screw
S100-2A1A4MP7	5340-01-390-5848	Power Distribution Rail
S100-2A1A5A1-1	5895-01-411-9529	Stand Alone Line Driver
S100-2A1B1	4140-01-388-9742	Fan
S100-2A1HR1	4540-01-245-4803	Heater Element
S100-2A1HR2	4540-01-411-8854	Battery Box Heater Pad
S100-2A1K1	5945-01-104-7652	DCP Solid-State Time Delay Relay
S100-2A1MP-1	5340-01-349-5543	Latch
S100-2A1MP-2	5340-01-387-0854	Over-Center Latch
S100-2A1MP59	4010-01-389-4199	Circuit Breaker Panel Lanyard Restraint
S100-2A1S1	5930-01-332-1095	Thermal Switch, 60/40
S100-2A1S2	5930-01-391-2510	Thermal Switch, 70/50
S100-2A1S3	5930-01-391-2511	Thermal Switch, 80/60
S100-2A2A1	6160-01-406-7502	5-Battery Box, SOLA
S100-2A2A1-1	6160-01-411-5230	4-Battery Box, DELTEC
S100-2A2A1A1	6160-AS-200-0111	Battery Box Lid, SOLA
S100-2A2MP12	4730-01-412-0007	Polypropylene Nozzle, Battery Box
S100-2A2MP13	4010-01-411-8857	Battery Box Lanyard
S100-2A3A1-1	6030-01-411-8853	Fiber Optic Modem
S100-2A3A17-10	5940-01-390-2559	Power Distribution Block

S100-2A3A17MP1	5940-01-389-1644	Terminal Block End Cap
S100-2A3A17MP6	6150-01-389-8905	ACU Power Distribution Mounting Rail, 9.69 X 0.22 X 9.25
S100-2A3MP1	5999-01-389-9559	EMI Gasket, DB-9 Connector
S100-2A3MP2	5999-01-389-9496	EMI Gasket, Power Plug Connector
S100-2A3MP3	5999-01-389-9578	EMI Gasket, Fiber Optic Module Connectors
S100-2A3MP4	5999-01-389-9562	EMI Gasket, TELCO Connector
S100-2A3MP9	5999-01-388-8552	EMI Gasket, Antenna Connector
S100-2A3W10	5995-01-389-3539	DCP Faraday Box Cable Assembly
S100-2A3W42	5995-01-389-2473	DCP Antenna Cable Assembly
S100-2A4A1-1	5920-01-432-2743	Fuse Plug Terminal Block
S100-2A4A1F1	5920-01-431-9363	Fast Blow Fuse, 2.5 Amp, 250 V, 5 X 20 mm
S100-2A4A1F2	5920-01-431-9364	Fast Blow Fuse, 3.15 Amp, 250 V, 5 X 20 mm
S100-2A4A1MP3	5920-01-389-4077	Fuse Plug
S100-2A4A1MP7	5340-01-390-5844	DCP Power Distribution Mounting Rail, 7.5 X 0.25 X 11.0
S100-2A4CR1	5961-AS-000-0063	MBR3535 Diode
S100-2A4CR3	5961-01-016-8485	Motorola Semiconductor
S100-2A4PS1	6130-01-186-4853	+5V Power Supply
S100-2A4PS3	6130-01-390-2201	+12V Power Supply
S100-2A5A1W3	5995-01-407-8411	Class II DCP RF Modem 1 Cable Assembly
S100-2A5A2W4	5995-01-397-6345	Class II DCP RF Modem 2 Cable Assembly
S100-2A5S1W13	5995-01-407-8412	DCP RF SW OUT Cable Assembly
S100-2A6	5975-01-411-7106	AC Junction Box
S100-2A6S1	6210-01-411-8882	Photo Control
S100-2A6XS1	5935-00-232-2576	Receptacle Connector
S100-2A8DS-1	6210-00-223-8477	Hughey & Phillips Obstruction Light
S100-2A8DS1MP1	6210-01-329-2448	UNR-ROHN Lens
S100-2A8DS2	6240-00-842-2887	Incandescent Lamp, C-9, 8000 hours, 120 V, 114 W, 0.950 Amp
S100-2A8MP1-1	5365-01-389-4249	Wind Tower Shim
S100-2A8MP1-2	5920-01-462-7524	Lightning Rod, 72"
S100-2A8MT1A1	6660-01-375-5146	Wind Sensor Enclosure Assembly
S100-2A8MT1A1A1MP1	5330-01-411-3937	Fiber Optic Modem Gasket
S100-2A8MT1A1A1MP2	5330-01-411-3928	Fiber Optic Module Gasket
S100-2A8MT1A1A2-1	5998-01-432-3079	Mod 2 Wind Transmitter Processor Controller Card, Firmware 4.0
S100-2A8MT1A1A2-U7A	5962-01-436-0441	Wind Sensor EPROM, Revision 4.0, Chip U7

S100-2A8MT1A1PS1	6130-01-368-4591	Wind Sensor Power Supply, 5 VDC, 500 mA
S100-2A8MT1A2A1-1	6660-01-411-9548	Mod 2 Wind Speed Transmitter Bottle
S100-2A8MT1A2A2	5895-01-432-3075	Cup Assembly, Small Skirt
S100-2A8MT1A2A2-1	6660-01-424-0664	Cup Assembly, Large Skirt
S100-2A8MT1A2MP1	5310-01-411-5242	Decorative Nut Sleeve
S100-2A8MT1A2MP2	5305-01-389-5960	Setscrew
S100-2A8MT1A2MP3	5310-01-411-9543	Flatwasher, 1" OD
S100-2A8MT1A3A1-1	6660-01-411-9545	Mod 2 Wind Direction Transmitter Bottle
S100-2A8MT1A3A2	6660-01-390-7357	Vane Assembly, Small Skirt
S100-2A8MT1A3A2-1	5985-01-431-9010	Vane Assembly, Large Skirt
S100-2A8MT1A4	5975-01-370-3054	Crossarm Assembly
S100-2A8MT1MP1	5340-01-444-3709	Wind Tower Rain Shield
S100-2A8MT1W1	5995-01-411-9485	Wind System Retrofit Cable Assembly
S100-2A8XDS1	6210-00-060-7321	Obstruction Light Assembly for mounting on 1" pipe
S100-2A8MTKIT01	NWS9-93-510-0003	Mounting Kit
S100-2A9	8145-01-461-8118	Auxiliary Box Assembly (AUX BOX)
S100-2DS1	5980-01-018-6273	Optoelectronic Display
S100-2MP037	4010-01-411-5239	Lanyard
S100-2MP038	4010-01-424-0685	Lanyard, 16" X 0.25 OD
S100-2MP1	5975-01-412-0013	Electronics Equipment Mounting Frame with 2 switches
S100-2MP2	NWS9-80-930-0002	Black Keeper for the DCP
S100-2MT1-1	6660-01-375-4809	Ceilometer with Pole
S100-2MT1-2	NWS0-00-750-0001	Refurbished Ceilometer with Solar Protection Package
S100-2MT1A1	5998-01-420-6855	Data Processor Board, Firmware 2.46
S100-2MT1A2	5998-01-248-3596	Unregulated Power Supply
S100-2MT1A5	5998-01-248-3598	Light Monitor
S100-2MT1A6	5998-01-248-3593	Receiver
S100-2MT1A6-2	5998-01-406-3915	Receiver Filter Board, 30 Degree
S100-2MT1A7	5998-01-248-3594	Transmitter
S100-2MT1B1	4120-01-249-1431	Window Conditioner
S100-2MT1B1MP1	6515-93-000-0019	Ceilometer Adhesive Strips
S100-2MT1HR1	5999-01-352-6561	Heater Foils
S100-2MT1J1	5935-01-115-0215	Ceilometer AC Connector Accessory
S100-2MT1J4	5935-00-403-7661	Ceilometer RS232 Connector Accessory

S100-2MT1K1	6660-01-248-5525	Solar Shutter Option
S100-2MT1MP1	5895-01-450-8657	Ceilometer GFE Hinge Kit
S100-2MT1MP2	5999-01-411-9537	Ceilometer Snow Radiation Shield
S100-2MT1MP3	5985-01-472-8399	Stainless Steel Ceilometer Pedestal
S100-2MT1MS1	6660-01-367-7677	Tropical Filter
S100-2MT1MS2	6660-01-367-1036	Tropical Filter/Block Conversion Kit
S100-2MT1PS1	6130-01-390-2202	Power Supply Assembly
S100-2MT1R1	4520-01-250-0151	Temperature Control Heater (2 required per unit)
S100-2MT1SP1	6625-01-352-6579	Equipment Cover
S100-2MT1T1	5950-01-248-8454	Temperature Control Transformer
S100-2MT1TE1	4320-01-349-7982	Ceilometer Diffuser
S100-2MT1TE2	6660-01-331-4152	Optical Coupling Fixture, CTX-16
S100-2MT1TS1	5905-01-248-5495	Temperature Sensor
S100-2MT1W1	5999-01-352-6589	Main Harness
S100-2MT1W10	6145-01-352-6458	Receiver HI-V Cable
S100-2MT1W11	6145-01-352-6459	Transmitter HI-V Cable
S100-2MT1W18	6020-01-389-6053	Fiber Optic Cable Assembly, 19'
S100-2MT1W2	5999-01-352-6590	Window Conditioner Harness
S100-2MT1W3	6150-01-248-5474	Output Harness
S100-2MT1W5	5995-01-352-7328	Light Monitor Cable
S100-2MT1W6	6145-01-352-6455	Receiver LO-V Cable
S100-2MT1W7	6145-01-352-6456	Transmitter LO-V Cable
S100-2MT1W8	5995-01-352-6541	Receiver Signal Cable
S100-2MT1W9	6145-01-352-6457	Transmitter Control Cable
S100-2MT2	6660-01-368-4828	Present Weather Sensor (LEDWI)
S100-2MT2A1	5975-01-390-2213	Electronics Enclosure
S100-2MT2A1A1A1	5998-01-375-4810	Transmitter Card
S100-2MT2A1A1A3	5998-01-368-4596	Microprocessor Card, Firmware 3.64
S100-2MT2A1A1A3-U11	5962-01-411-9987	LEDWI Firmware Revision 3.64, Chip U-11
S100-2MT2A1A1A6	5998-01-368-4598	Signal Processing Card II
S100-2MT2A1A1A7	5998-01-368-4597	Signal Processing Card I
S100-2MT2A1A1A8	5998-01-375-4811	AGC Receiver Card
S100-2MT2A1A2	5975-01-368-4581	AC Switchbox
S100-2MT2A1PS1	6130-01-369-4723	Hood Heater Power Supply

S100-2MT2A1PS2	6130-01-369-4725	Analog Power Supply
S100-2MT2A1PS3	6130-01-369-4724	Digital Power Supply
S100-2MT2A2	6660-01-368-4825	Sensor Head
S100-2MT2A2A1A3	4540-01-412-0006	Heater Bar
S100-2MT2MS1	8010-01-442-8269	Insecta Paint, 16 oz.
S100-2MT2MS2	8010-01-442-8265	Insecta Paint, 128 oz.
S100-2MT3-1	6660-01-441-1830	Freezing Rain Sensor
S100-2MT3A2	NWS9-93-510-0006	Spool Installation Kit
S100-2MT3MP1-2	4710-01-448-6236	Aluminum Mounting Pole
S100-2MT3MP1-3	5340-01-457-7048	Vinyl Protective Cap, 1" X 0.75"
S100-2MT3MP1-4	NWS9-82-050-0001	Freezing Rain Sensor Hardware Kit
S100-2MT4-MP1-KIT	nws9-93-510-0005	Mounting Kit
S100-2MT4A1A1-1	6660-01-412-2335	Dewpoint Sensor, 1088
S100-2MT4A1A1-2	6660-01-437-8888	Dewpoint Sensor, 1088 (slightly different components than in -1)
S100-2MT4A1A1MP1	6660-01-228-1210	Neoprene O-Ring, 0.25" ID, HO83
S100-2MT4A1A2	5999-01-411-7107	Aspirator Housing Assembly, 1088
S100-2MT4A1A2B1	4140-01-304-4728	Pabst Fan
S100-2MT4A1A2W1	5995-01-455-1723	Fan Adapter Wire
S100-2MT4A1R7	6625-01-423-1323	Auto Balance Module
S100-2MT4A2	4940-01-436-8772	Electronics Enclosure, 1088
S100-2MT4A2-1	4940-01-436-6222	Electronics Enclosure, 1063
S100-2MT4A2A1-1	5998-01-375-4812	Transmit Logic Card, 1088
S100-2MT4A2A1-2	5998-01-369-4728	Transmit Logic Card, Firmware B91A and F91, R1063
S100-2MT4A2A3	6130-01-208-5925	5 V DC Power Supply, 1063
S100-2MT4A2A4	6130-01-205-6975	Auxiliary Power Supply, 1063
S100-2MT4MP1	5305-01-432-2746	Stainless Steel Enclosure Screw, 5/8" long
S100-2MT4MP2	5340-01-464-9134	Insect Skirt
S100-2MT4W21	6015-01-390-0234	Fiber Optic Cable Assembly, 26.5'
S100-2MT5A1	5975-01-375-4808	Visibility Sensor Electronics Emclosure
S100-2MT5A1A1	5998-01-368-4599	Processor Board with Firmware 040
S100-2MT5A1A1-U2A	NWS9-72-660-0001	Visibility EPROM, Revision 039
S100-2MT5A1A1-U2B	NWS9-92-290-0001	Visibility EPROM, Revision 040
S100-2MT5A1A3A1	5998-01-368-4608	24 V Regulator Board
S100-2MT5A1A3A1F1	5920-00-284-7134	Slow-Blow Fuse, 32 V, 15 Amp

S100-2MT5A1A3A1XF1	5920-01-391-4658	Fuse Carrier
S100-2MT5A1PS1	6130-01-390-2211	5 V Electronics Power Supply
S100-2MT5A2	5340-01-368-4827	Crossarm Assembly with End Caps
S100-2MT5A2A3	6660-01-369-5858	Optical Transmitter
S100-2MT5A2A3A2	5340-01-389-1359	Cap
S100-2MT5A2A4	6660-01-369-5857	Optical Detector
S100-2MT5A2MP1	5310-01-448-6234	Master Seal Washer
S100-2MT5A5	6695-01-368-4826	Day/Night Sensor
S100-2MT5MP36	5999-01-391-2515	Hinge Plate Assembly
S100-2MT5MP36-1	5315-01-424-0665	Quick Release Pin
S100-2MT6-1B1	6135-01-471-7325	3.6 V Lithium Battery
S100-2MT6-2	6660-01-441-1826	Heated Tipping Rain Gauge
S100-2MT6-S1	6685-01-445-3517	Thermostat
S100-2MT6A2A1-1	5975-01-436-8774	Frame Assembly with a Reed Switch
S100-2MT6A2A1-OLD	6660-AS-200-0135	Frame Assembly
S100-2MT6A2A2A1	6025-01-369-7460	Fiber Optic Transmitter
S100-2MT6A3MP1	5975-01-432-3074	Windscreen Panel, 47.5" X 17"
S100-2MT6FMK01	6685-01-445-3518	Heated Tipping Bucket Thermostat
S100-2MT6MP3	6660-01-390-9548	Rain Shield Assembly
S100-2MT6MP4	NWS9-90-570-0001	Aluminum Connector
S100-2MT7	6350-01-441-7596	Thunderstorm Sensor (Single-Site Lightning Detection Sensor)
S100-2RF-KIT	NWS9-93-510-0022	RF Surge Suppressor Kit
S100-2T240/480	5950-01-411-9542	Transformer, 3KVA, 120-240V or 480V
S100-2T480-2	5950-00-635-7414	Transformer, 5KVA, 240-480V
S100-2T600-1	5950-01-411-9541	Transformer, 3KVA, 120-600V
S100-2T600-2	5950-01-411-9540	Transformer, 5KVA, 120-600V
S100-2W25	5995-01-411-9522	RF Cable Assembly
S100-2W27	5995-01-472-8410	DCP CPU 1 Cable Assembly
S100-2W28	5995-01-389-2441	DCP CPU 2 Cable Assembly
S100-2W35-2	6020-01-411-9493	Fiber Optic Cable Assembly, 75'
S100-3A3J1	4130-01-472-7515	Blank Cover
S100-41	7025-01-368-8646	Video Display Unit
S100-4A3J11	NWS9-93-510-0008	Telephone Jack Assembly
S100-4MT1KIT	6660-AS-200-0119	Ceilometer Backup Kit

S100-5	5805-01-389-9541	FAA Handset
S100-6	6660-01-368-4829	Observer Notification Device
S100-6-1	6240-01-412-0012	Special Festoon Lamp Bulb, 12V, 10W
S100-6PS1	6130-01-389-5888	Tamura AC to DC Power Supply
S100-7	NWS9-82-300-0001	Single Cabinet Assembly ASOS
S100-7-1A2A14	5905-01-465-6027	VME Resistor Board
S100-7A1-1	5998-01-451-6812	Temperature Sensing Board Assembly
S100-7A1-DES	6850-01-358-5837	Activated Desiccant
S100-7A1-LABEL	7530-01-451-0144	Single Cabinet Assembly Label
S100-7A1-MP1	4440-01-451-6813	Desiccant Dryer
S100-81	6660-01-369-5856	Controller Video Display Unit
S100-AN565AC8H8	5305-00-582-9466	Setscrew, MIL Spec AN565AC8H8
S100-F/O-10	6020-01-451-6481	Fiber Optic Cable Assembly, 10'
S100-F/O-100	6020-01-451-6787	Fiber Optic Cable Assembly, 100'
S100-F/O-110	6020-01-451-6788	Fiber Optic Cable Assembly, 110'
S100-F/O-180	6020-01-451-6789	Fiber Optic Cable Assembly, 180'
S100-F/O-20	6020-01-451-6490	Fiber Optic Cable Assembly, 20'
S100-F/O-240	6020-01-451-6790	Fiber Optic Cable Assembly, 240'
S100-F/O-30	6020-01-451-6492	Fiber Optic Cable Assembly, 30'
S100-F/O-300	6020-01-451-6791	Fiber Optic Cable Assembly, 300'
S100-F/O-40	6020-01-451-6493	Fiber Optic Cable Assembly, 40'
S100-F/O-50	6020-01-451-6781	Fiber Optic Cable Assembly, 50'
S100-F/O-60	6020-01-451-6782	Fiber Optic Cable Assembly, 60'
S100-F/O-70	6020-01-451-6783	Fiber Optic Cable Assembly, 70'
S100-F/O-80	6020-01-451-6785	Fiber Optic Cable Assembly, 80'
S100-F/O-90	6020-01-451-6786	Fiber Optic Cable Assembly, 90'
S100-FMK-039	5340-AS-200-0117	Brass Adapter
S100-FMK-048-1	5995-01-411-9523	Cable Adapter for FMK048
S100-FMK-090	5895-01-450-8658	Thunderstorm Sensor Kit
S100-FMK-50	NWS9-81-410-0001	Voice EPROM Revision 4.0
S100-FMK-60	5915-01-436-0446	Wind System Filter
S100-FMK028-038	3431-AS-200-0087	Battery Box Lid
S100-FMK028-LABEL	7530-AS-200-0088	Label
S100-FMK040	NWS9-80-060-0001	D-ATIS VDU Port Kit

S100-FMK048	5895-AS-200-0070	V.3225 9600 Baud Modem
S100-FMK049B	NWS9-61-080-0001	Tipping Bucket Funnel Extension and Label
S100-FMK059	NWS9-60-170-0004	ACU Memory Upgrade
S100-FMK077C	5945-01-451-6814	Class I SCA Solid-State Time Delay Relay Kit
S100-FMK098	5895-01-450-8659	DCP Power Upgrade Kit
S100-FMK102	NWS9-81-400-0002	Temperature Probe Board Upgrade Kit
S100-FMK109	5895-01-451-2987	SCA Vent Kit
S100-FMK109CLII	NWS9-73-380-0010	Third Pressure Sensor Adapter, SCA
S100-FMK70	NWS0-00-870-0001	GTA Radio Aux Box Installation Kit
S100-FMK95ACU	5945-01-451-6804	Class II ACU UPS Bypass Kit
S100-FMK95DCP	5945-01-451-6805	Class II DCP UPS Bypass Kit
S100-FMK95SCA	5945-01-451-6806	Class II SCA UPS Bypass Kit
S100-H083-BX	5330-AS-200-0072	Packing Box for the HO83 Transmitter/Aspirator
S100-MS25281-R10	5340-00-989-3032	Cable Bundle Loop Clamp, 5/8" Diameter
S100-MS25281-R16	5340-00-807-1065	Cable Bundle Loop Clamp, 1.00" Diameter
S100-MS25281-R5	5340-00-721-5315	Cable Bundle Loop Clamp, 5/16" Diameter
S100-TE300	6625-01-354-3026	RS232 Communication Signal Polarity Test Box
S100-TE301	6625-01-354-3025	Torque Watch Gauge
S100-TE303	6605-01-196-6971	Magnetic Compas
S100-TE304	6640-01-383-1098	Beaker
S100-TE305	6625-01-354-3015	Visibility Sensor Calibration Kit
S100-TE305-1	6110-AS-200-0079	Molex Connection Jumper for the Visibility Calibration Kit
S100-TE305-2	6625-01-440-1773	Portable Light Source for the Visibility Sensor
S100-TE307	5995-01-366-6300	“Y” Interface Laptop Cable
S100-TE308	6625-01-354-3017	Present Weather Sensor Field Tester
S100-TE309	5995-01-366-6278	Nulling Interface Cable
S100-TE315	6685-00-840-6317	Aspirated Psychrometer, Battery Operated
S100-TE316	5180-01-412-0008	Solar Noon Alignment Kit
S100-TE318	7030-01-436-7410	SerialBERT® Bit Error Rate Testing Software by Frontline®
S100-TE318-1	7030-AS-200-0158	ASOS Calibration Software, Version 2.03
S100-TE318-2	7030-01-462-1909	ProComm Plus® Version 4.7, CD-ROM
S100-TE320	6625-00-978-6012	Directional RF Wattmeter, Type N Connectors
S100-TE320-1	5985-01-432-2240	50 Ohm RF Terminator, 25 W, Type N Connector
S100-TE320-2	6625-00-949-5382	10 W Element, 100-250 MHz

S100-TE320-3	6625-00-497-2912	5 W Element, 200-500 MHz
S100-TE320-4	6625-01-080-5452	Directional Coupler Detecting Element
S100-TE321	5995-01-432-2245	Wind Speed Test Cable
S100-TE323-1	7035-01-412-0004	T1910 Laptop Carrying Case
S100-TE327	3010-00-857-2090	Flexible Coupling Shaft
S100-TE329	6685-AS-200-0138	Wind Skirt Concentricity Tester Gauge
S100-TE330	7035-01-412-0005	HP Carrying Case
S100-TE331	NWS9-82-530-0001	Computer Carrying Case, Heated
S100-TE335	6625-01-432-2346	1 Watt Element, 110-160 MHz
S100-TE350	6625-01-411-9539	Tone Test Set
S100-TE351	5935-01-412-0009	Surface Mounted RJ-11 Jack
S100-TE352	5935-01-411-5249	N-Plug to BNC Adapter
S100-TE353	5935-01-411-5250	BNC to Binding Post Plug
S100-TE356	6625-01-411-9530	Biddle Merger
S100-TE357	6625-01-411-5232	Audio Generator, 20-150 Hz
S100-TE360	4940-01-454-2259	Heat Enclosure for the DCP Sensors
S100-TE361	4520-01-454-5204	Heat Mounting Assembly
S100-TE362-1	6760-01-457-0844	A/C Adapter
S100-TE401	7035-01-412-0002	Carrying Case
S100-TE401-1	6625-01-360-3380	Frequency Counter, 120-160 MHz
S100-TE402	5340-01-411-9980	Front Cover
S100-TE403	6625-01-411-9532	Digitizing Oscilloscope, 200 MHz, 2 Channel
S100-W43	5995-01-472-8423	Line Driver Cable Assembly, 84" Long
S100-W44	5998-01-472-8429	Line Driver Cable Assembly, 84" Long
S100-W45	5995-01-472-8436	Line Driver Cable Assembly, 48" Long
S100-W46	5995-01-472-8438	Line Driver Cable Assembly, 24" Long
S100-W47	5995-01-472-8444	Line Driver Cable Assembly, 24" Long
S100-W48	5995-01-472-8447	Line Driver Cable Assembly, 24" Long
S100-W49	5995-01-472-8451	Line Driver Cable Assembly, 24" Long
S100-W78	5995-01-411-9515	UPS Adapter Cable Assembly
S100-W85	5995-01-472-7503	Audio Adjust Ribbon Cable

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