



Operations and Maintenance Manual

for

Aviation Weather Observing Stations (AWOS)

Version 1.0

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Submitted by

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SAMPLE



ARRANGEMENT OF MANUAL.

SAFETY AWARENESS

EQUIPMENT RETURN PROCEDURES

REVISIONS

CONVENTIONS USED

WARNINGS, CAUTIONS AND NOTES

REFERENCES

TABLE OF CONTENTS

Chapter 1, System Overview, provides a brief overview of the AWOS components.

Chapter 2, Theory of Operation, describes the AWOS components in detail and analysis of major functions, including signal flow and theory of operation.

Chapter 3, Maintenance, provides recommended procedures for repairing and maintaining the AWOS, suggested maintenance intervals, functional test procedures and a listing of special tools and support equipment.

Chapter 4, Component Removal and Replacement Procedures, provides detailed removal and replacement (installation) instructions.

Chapter 5, RLIM, provides information about the Runway Lighting Intensity Monitor.

Chapter 6, Parts List, provides repair part information.

Appendix A, Drawings and Schematics, includes system schematics, mechanical drawings and wiring.

Appendix B, COTS Sensor Manuals, provides COTS sensor manufacturer's manuals.

Aviation Intercept™ is © 2004-2010 Coastal Environmental Systems, Inc. including all weather algorithms, which resides on the AWOS server; the FDCU operating system known as "Zenosoft ®," and all other ancillary software that is part of the FDCU and server software, exclusive of other third party software.



SAFETY AWARENESS

ELECTRIC SHOCK – RESCUE METHODS

Alternating current tends to cause a person's muscles to contract often preventing him from letting go. Voltages as low as 25 or 30 volts have been known to cause this muscle contraction by burning the skin and eliminating skin resistance. When skin resistance is low, current flows more readily and, depending upon the duration of the electric contact, the severity of electric shock is determined.

Therefore, electrical accidents call for prompt, intelligent action, promptness if the victim is to be saved, and intelligence if two casualties rather than one are to be avoided:

ACT AT ONCE – DELAY OR INDECISION MAY BE FATAL

1. Remove source or casualty from electrical contact.
2. Commence artificial respiration immediately.
3. Treat for burns, bleeding and shock.

REMOVING A CASUALTY FROM ELECTRICAL CONTACT

Low voltage – 0 to 240 volts (Household use)

Switch off the current if possible and if time permits. If the switch cannot be located and the supply is through a flexible cord or cable, the current may be shut off by removing the plug or even breaking the cable or wrenching it free. Never attempt to shut off current by cutting cord with a knife or scissors.

If the current cannot be shut off, the greatest care is necessary in removing the casualty, household rubber gloves, rubber or plastic water hose, (if there is no water present), a dry unpainted stick or a clean dry rope can be used to free victim.

High voltage – 240 volts and up (industrial machines and power lines)

Do not touch any person or equipment in contact with a wire.

Use a dry unpainted pole, clean dry rubber or plastic water hose to separate the person from the contact.

Keep as far away as possible and do not touch the person until he or she is free.



EQUIPMENT RETURN PROCEDURES

All equipment being returned should be marked “field return” and addressed to:

Coastal Environmental Systems, Inc.
820 First Avenue South
Seattle, WA 98134
Attn: Customer Service

This will ensure proper attention to the request and will expedite the dispatch of replacements.

Please include: Name of equipment system

Type number of equipment system

Serial number of equipment system

Name of assembly

Type number of assembly

Serial number of assembly

Name of part

Part number

Number of hours in use

Nature of defect

Return address

Manufacturer

Country of Manufacture

Station: _____

Equipment Serial Number: _____

Date Installed: _____

REVISIONS

[illegible]



CONVENTIONS USED.

In this manual, text or field names that appear on a computer display screen are indicated by **bold** type. Text or commands that are entered into a computer via a keyboard are indicated by *italic* type. Keyboard single stroke inputs are indicated by brackets, such as <*enter*> or <↑>.

SAMPLE



WARNINGS, CAUTIONS AND NOTES.

WARNING and **CAUTION** statements are strategically placed throughout this text prior to operating procedures, practices, and/or conditions, which are considered essential to ensure the protection of personnel (**WARNING**) or equipment and property (**CAUTION**). A **WARNING** or **CAUTION** will appear each time the related step is repeated. Prior to starting any task, the **WARNINGS** or **CAUTIONS** included in the text before the task shall be reviewed and understood.

- a. A warning identifies a procedural step that, if not correctly followed, will result in injury, loss of life or destruction of equipment.
- b. A caution identifies a procedural step that, if not correctly followed, may result in damage to equipment.
- c. A note identifies information, operating procedure, etc. requiring special emphasis.

Examples of notes, warnings and cautions are as follows:

NOTE

Be sure to disconnect FDCU battery leads before opening FDCU AC Power switch. This process prevents FDCU battery from supplying power to FDCU circuits when main AC power is removed.

WARNING

DO NOT WEAR JEWELRY

Remove earrings, watches, and other metallic objects that may cause shock or burn hazards.

CAUTION

Do not short or bridge battery terminals with any object. Do not operate UPS without battery.



REFERENCES

A soft copy of the following Commercial-Off-The-Shelf (COTS) sensor manuals are provided in Appendix B to this manual:

1. WindSonic Wind Sensor, User Manual, Doc No 1405 PS 0019 Issue 10 Gill Instruments Ltd, April 2004.
2. Humidity and Temperature Probes models HMP50, Operating Manual, U274en-1.2, Vaisala, 29 September 1997.
3. Ceilometer model CL31 User's Guide, M21048EN-B, Vaisala, October 2004.
4. Barometric Pressure Sensor model 270, Operating Instructions, Rev D, Setra, June 1998.
5. Present Weather Detector model PWD22, User's Guide, M210543-EN-B, Vaisala, January 2004.

SAMPLE



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SECTION 1 - SYSTEM OVERVIEW

1.1 Introduction

This manual contains operations and maintenance instructions for the Aviation Weather Observing Stations (AWOS).

AWOS is an automated meteorological system that provides 24/7 weather data used in the production of Hourly Aviation Weather Reports (METARs) and Special Aviation Weather Reports (SPECIs).

The complete AWOS measures or calculates and reports the following information:

- Wind speed
- Wind direction
- Wind gust
- Visibility
- Present weather
- Cloud base heights
- Cloud coverage
- Temperature
- Dew point temperature
- Atmospheric pressure
- Reporting of Runway Visual Range

The AWOS includes both hardware (sensors, data collection equipment, data processing and display, cables, backup power sources, etc.) and software (data collector, algorithm processing, database, main Graphical User Interface (GUI), also referred to as the Observer GUI, Administrator GUI, Maintenance GUI, message engine and logging engine). System components will be covered in detail in the subsequent sections.



1.2 Sensors

1.2.1 Wind Sensor

The AWOS wind sensor is a Gill WindSonic Wind Sensor. This sensor consists of a wind speed and wind direction sensor combined into a single unit with no moving parts.



Figure 1-1 – Gill WindSonic Wind Sensor

Wind data are displayed on the Observer GUI. Wind direction is displayed in degrees true to the nearest 10 degrees, wind speed is displayed in knots (kts) to the nearest 0.1 kt.. The units are the same for all wind data shown on the Observer GUI. The wind sensor outputs two parameters: wind speed and wind direction, each updated every five seconds. The following parameters are displayed on the GUI:

- a. **Instant** – wind direction and speed values at the time the wind sensor is polled.
- b. **2 minute mean**– once every 5 seconds, the average values of wind speed and direction are calculated using the 5-second averages from the previous 2 minutes.
- c. **10 minute mean**– once every 5 seconds, the average values of wind speed and direction are calculated using the 5-second averages from the previous 10 minutes.
- d. **2 minute Peak** – the highest wind speed during the previous 2 minutes
- f. **10 minute Gust** – wind gust speed computed during the previous 10 minutes.
- g. **10 min VRB** – variation in wind direction during the previous 10 minutes.

Wind data are also shown in graphic form at the right of the GUI. The instantaneous wind speed is shown at the center of the display. The instantaneous wind direction is indicated by an arrow on the inside of the display. The 10-minute variability (VRB) is shown by the arc on the inside of the display. Wind data are shown on the GUI after 75% of the time necessary to produce averages has passed.



1.2.2 Ambient Temperature/Relative Humidity (AT/RH) Sensor

The relative humidity and ambient temperature sensors are installed in the RM Young aspirated radiation shield as a single unit.



Figure 1-2 – AT/RH Sensor Mounted in Aspirated Shield

Input data are averaged over 5 minutes to minimize the effect of small-scale temperature perturbations. The ambient air temperature and relative humidity data are used to calculate the dew point temperature. Temperature data is also used by other calculations within the algorithms. Values of **Temp**, **DP** and **RH** are updated every 60 seconds on the GUI. The following parameters are displayed on the GUI:

- a. Ambient Temperature (**Temp**): Temperature of free air, reported to the nearest 0.1°C. The value reported in this field is a five-minute average temperature.
- b. Dewpoint Temperature (**DP**): Cooling temperature at which saturation occurs, reported to the nearest 0.1°C.
- c. Relative Humidity (**RH**): Ratio of actual to saturation vapor pressure, reported to nearest %RH.



1.2.3 Present Weather Detector

The sensor is a Vaisala Present Weather Detector PWD22. This sensor is used for providing visibility, luminance and precipitation detection and identification.



Figure 1-3 – Vaisala PWD22 Present Weather Detector

The **Present Weather** field of the GUI displays the code from the PWD22. These codes are documented in the sensor manual. This field may also contain “TS” for thunderstorm or “VCTS” for thunderstorm in the vicinity, which the algorithms produce from data received from the thunderstorm sensor.

1.2.4 Ceilometer

The ceilometer is a Vaisala CL31 Laser Ceilometer that detects clouds, precipitation and other obstructions to vision. Displayed on the Observer GUI (in feet) are cloud cover (**Instant base**) and amount and height (**Amount/Height**) for up to 4 cloud layers.



Figure 1-4 – Vaisala CL31 Ceilometer



1.2.5 **Barometer**

The barometers are Setra model 270 Barometric pressure sensors, housed in the FDCU. They provide precise and stable atmospheric pressure measurement. Every second, three values are obtained. Every 5 seconds, an average is computed and sent to the DPU where algorithms compute and display 60 second averages of **ASI** (altimeter setting), **QFE** (field pressure) and **SENSOR** (raw pressure).



Figure 1-5 – R M Young Barometric Pressure Sensor

1.3 **FDCU**

The Field Data Collection Unit (FDCU) is the outdoor component of the AWOS. It contains data acquisition and processing equipment that sends polling signals to the sensors and receives data from the sensors, performs processing and error checking, then formats and passes the messages to the SSEM.



Figure 1-6 – Inside the FDCU

The FDCU consists of a ZENO[®]3200 Datalogger, a Serial Sensor Expansion Module (SSEM), various communications links, and power supply circuitry in an aluminum enclosure.

The ZENO[®]3200 Datalogger is a general purpose datalogger that accepts and stores sensor data from the AT/RH Sensor, Pressure sensor and wind sensor. It also checks alarms and control functions (diagnostic inputs) including ZENO[®]3200 Datalogger power monitor, battery charger/load/voltage/charge monitors, FDCU DC power monitor, and FDCU AC power failure.

The SSEM is a microcomputer that expands the capability of the ZENO[®]3200 Datalogger. It accepts RS-232 serial data from the Present Weather Detector and Ceilometer. It also accepts diagnostic data and data from the other sensors via the ZENO[®]3200 Datalogger.

1.4 **DPU**

The Data Processing Unit (DPU) consists of a Dell server, monitor, keyboard and mouse. The DPU software includes a data collector, a database, algorithm processing, a graphical user interface and a message engine for sending messages. The DPU software runs on a Dell server running the Windows Server 2003 operating system. The Communications Sub System (CSS) is built into the DPU software. Communications components include the recorder that takes incoming data and passes it on to the appropriate handler and the messenger that sends out messages.



1.5 Graphical User Interfaces (GUI)

There are three user types for AWOS that restrict access to certain screens. The types are Observer, Maintenance and Administrator.

1.5.1 Observer GUI

The Observer GUI shows the weather data and basic status information about each of the attached sensors. The GUI also displays the most recent message sent from the system.

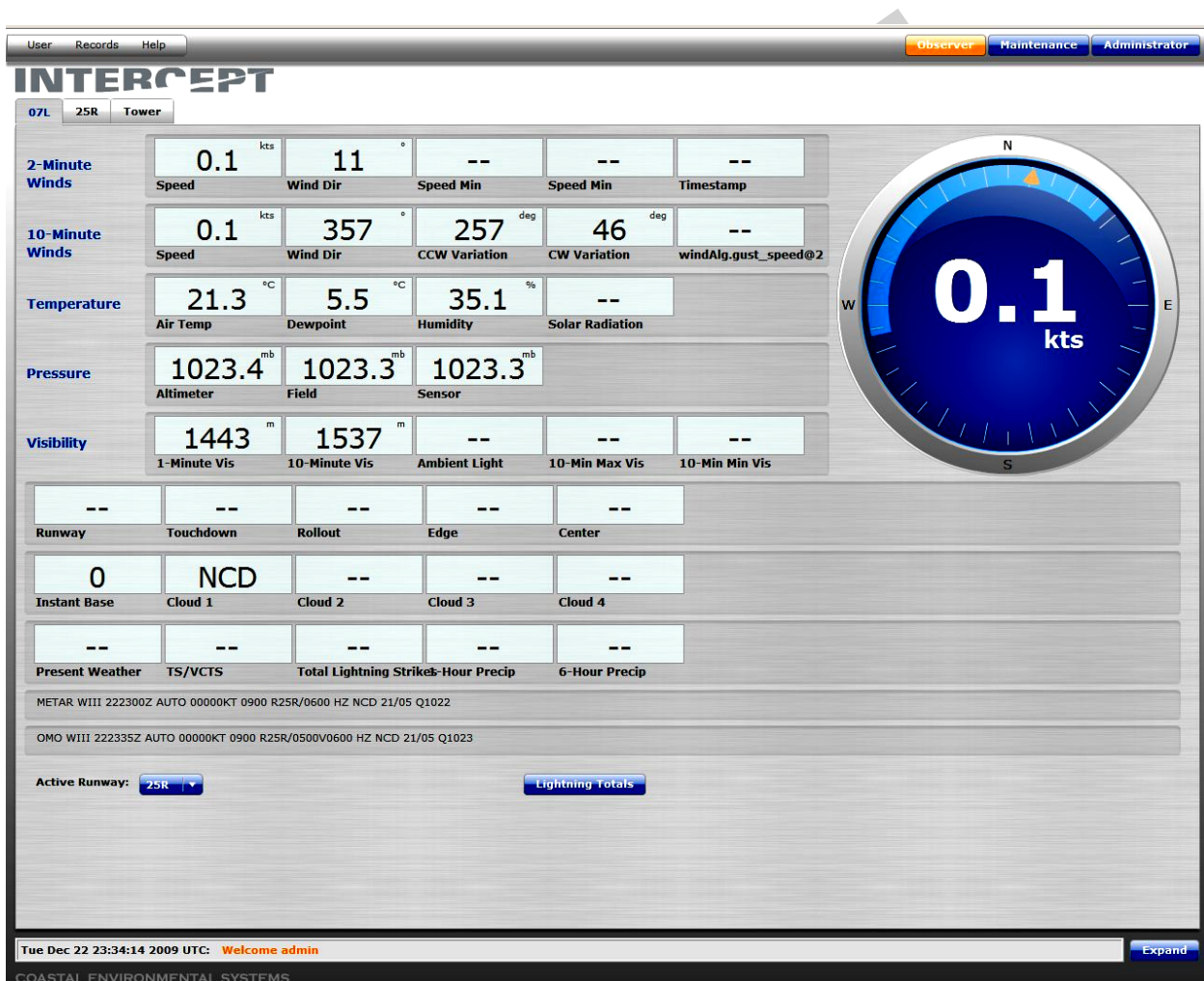


Figure 1-7 – Observer GUI



1.5.1.1 **Lightning Totals**

By clicking on the **Lightning Totals** button at the bottom of the Observer GUI, a popup window appears with a graphical display of lightning data within the last 15 minutes.

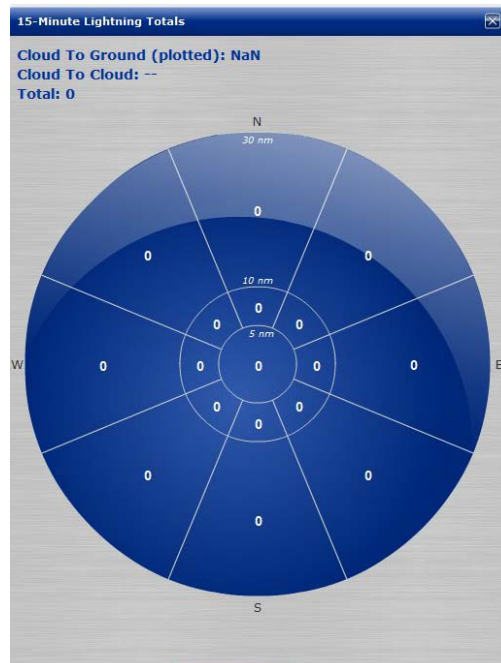


Figure 1-8 – Lightning Totals



1.5.1.2 **User Profile**

Click on the **User** tab and select **User Profile** to display the User Profile popup where you can edit your username, password and choose day or night skin. See [Figure 1-11](#) for an example of night skin view.

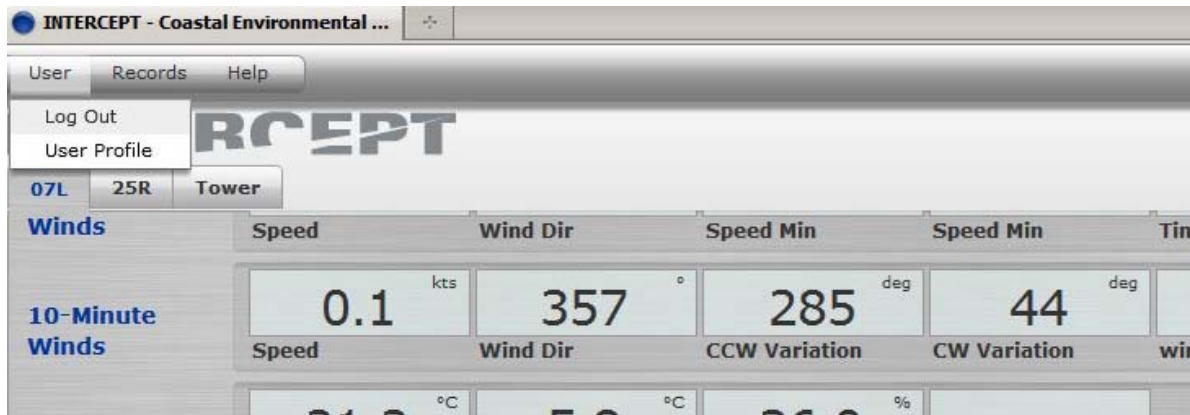


Figure 1-9 – User Profile



Figure 1-10 – User Profile Window



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Figure 1-11 – Night Skin

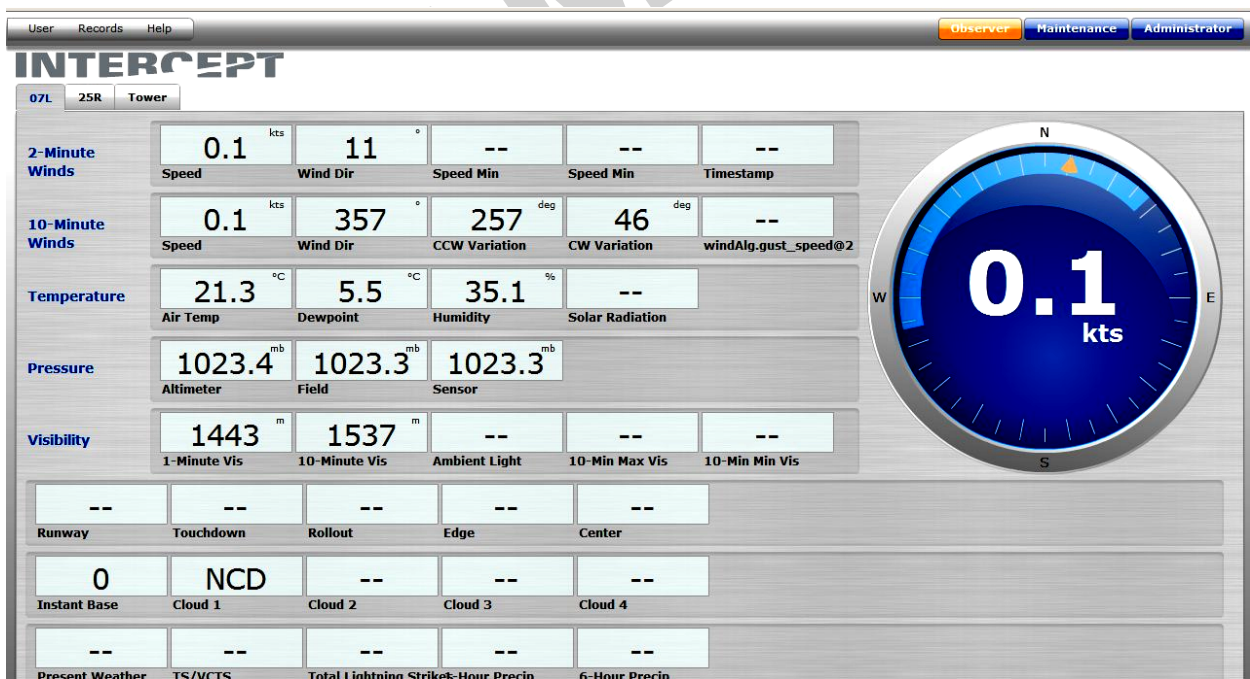


Figure 1-12 – Day Skin



1.5.1.3 User Logs

Click on the **Records** tab and select **View Logs** to display the Log View popup where you can display system data logs.

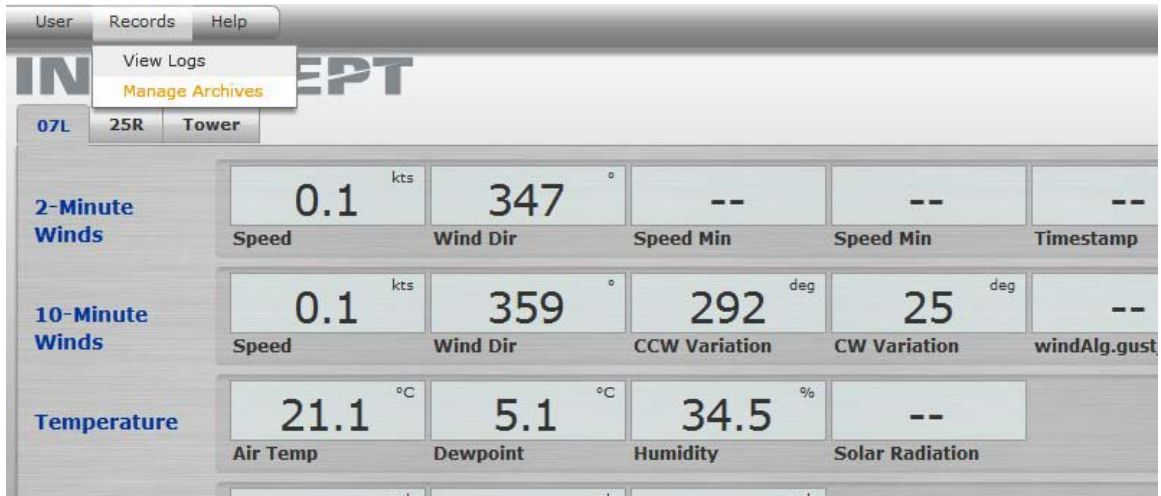


Figure 1-13 – User Logs

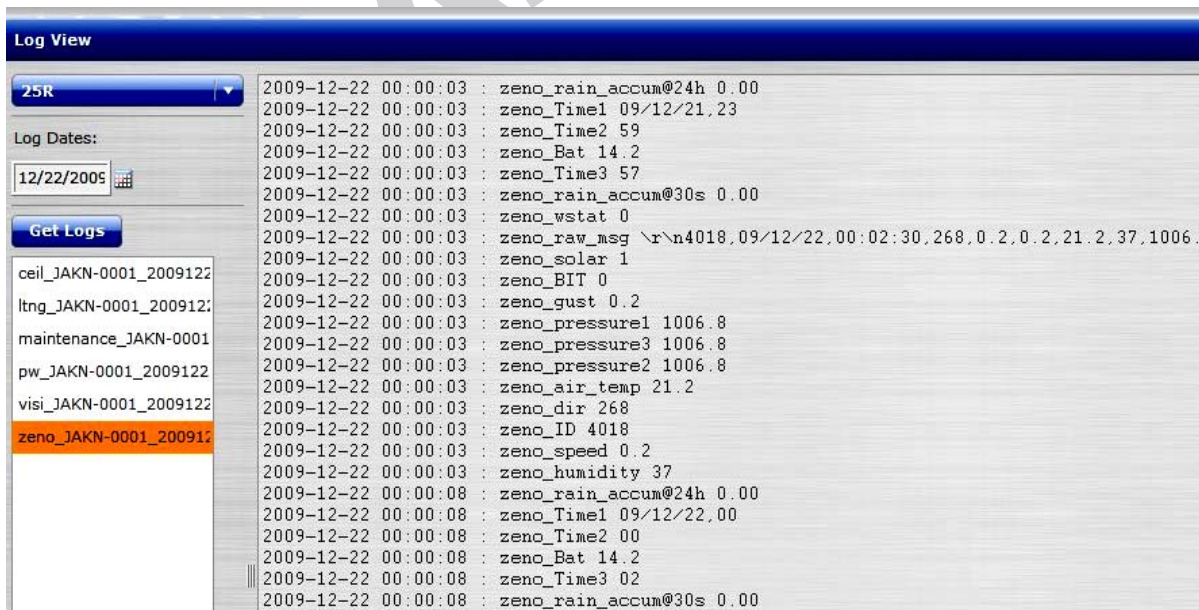


Figure 1-14 – Raw Logs



1.5.2 Maintenance GUI

The Maintenance GUI is used by users with maintenance privileges to view system conditions and edit system settings.

1.5.2.1 Aviation Dashboard

Select the **Aviation Dashboard** tab to see a graphical display of the overall system status. Green bubbles indicate normal condition. Red bubbles indicate an alarm for that particular item. Click on the icon to display a popup window that gives detailed information about the alarm.

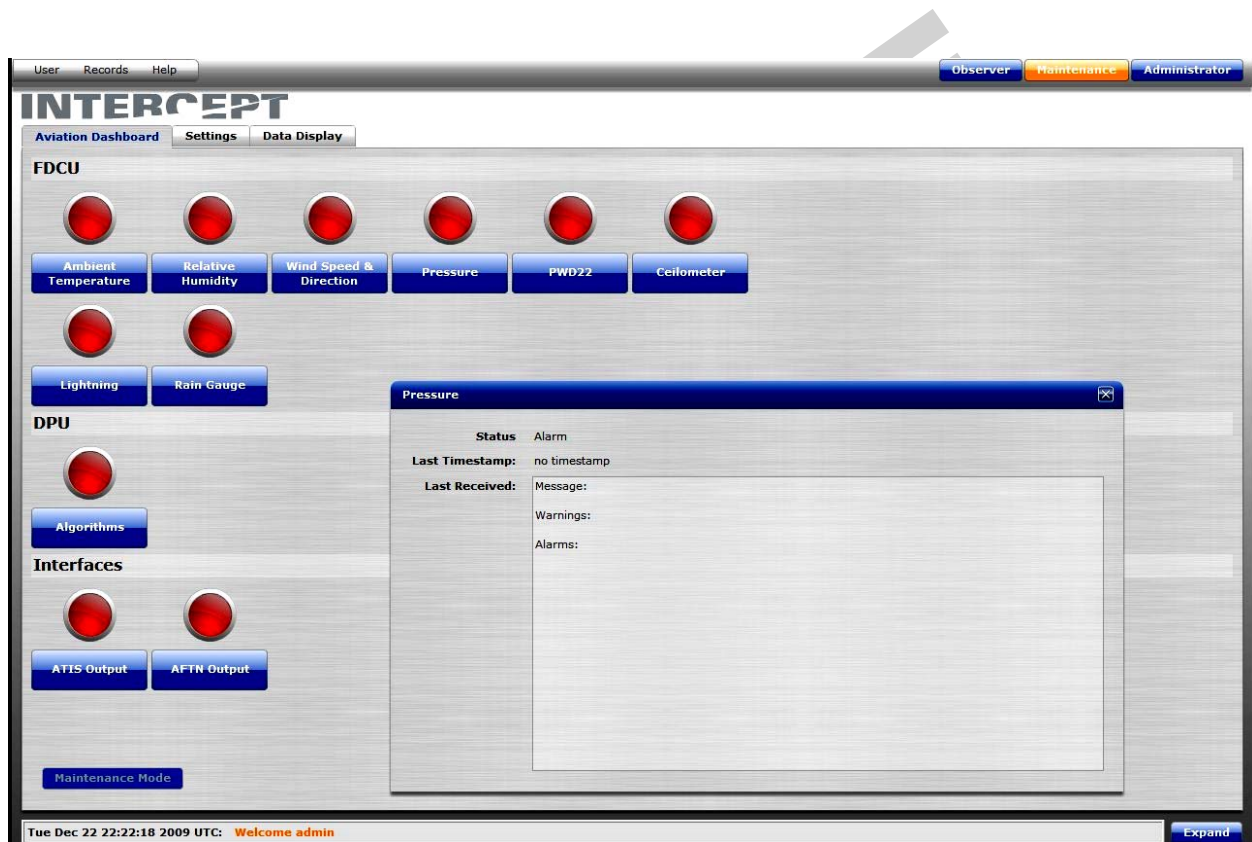


Figure 1-15 – Maintenance Dashboard with Pressure Window Displayed



1.5.2.2 Settings

Select the **Settings** tab, then the **Aviation** window to adjust specific system information.

The screenshot displays the 'INTERCEPT - Coastal Environmental Systems' web application. The top navigation bar includes 'User', 'Records', and 'Help' menus, along with 'Observer', 'Maintenance', and 'Administrator' buttons. The main content area is titled 'INTERCEPT' and has tabs for 'Aviation Dashboard', 'Settings', and 'Data Display'. The 'Settings' tab is selected, and the 'Aviation' section is active. The 'Set Runways' section contains input fields for 'Primary End' (07L) and 'Secondary End' (25R), with a 'Save Runways' button below. The 'Reports' section lists various system parameters with dropdown menus and input fields: 'ATIS Station' (Select station:), 'ATIS COM Baud Rate' (Select rate:), 'AFTN Station' (Select station:), 'AFTN COM Baud Rate' (Select rate:), 'ICAO ID' (text input), 'METAR Interval' (30), 'METAR Generation Time' (0), 'SYNOP Initial Generation' (0), 'SYNOP Generation Time' (0), 'SPECI Sky Thresholds' (four 0 inputs), 'SPECI Visibility Thresholds' (four 0 inputs), 'TAF Initial Generation' (0), 'TAF Report Frequency' (0), and 'TAF Validity Interval' (0). The bottom status bar shows 'Tue Dec 22 22:22:18 2009 UTC: Welcome admin' and an 'Expand' button.

Figure 1-16 – Aviation Settings



1.5.2.3 Data Display

Select the **Data Display** tab to create and edit user-selected alerts for specific weather conditions.

Figure 1-17 – Alerts



1.5.3 Administrator GUI

The Administrator GUI allows users with administrator privileges to create and edit users of the system.

Figure 1-18 – User Administration



1.6 **Summary of Equipment Power Requirements**

Table 1-1 – Outdoor Equipment Power Requirements

Device	Voltage	Current
FDCU	120 Vac	3000W
Ceilometer	120Vac	310W

Table 1-2 – Indoor Equipment Power Requirements

Device	Voltage	Current
RLIM	120Vac	30W
DPU	120 Vac	2000W



SECTION 2 - THEORY OF OPERATION

2.1 Introduction

This section provides detailed information about the AWOS components and their interactions.

2.2 System Signal and Data Flow

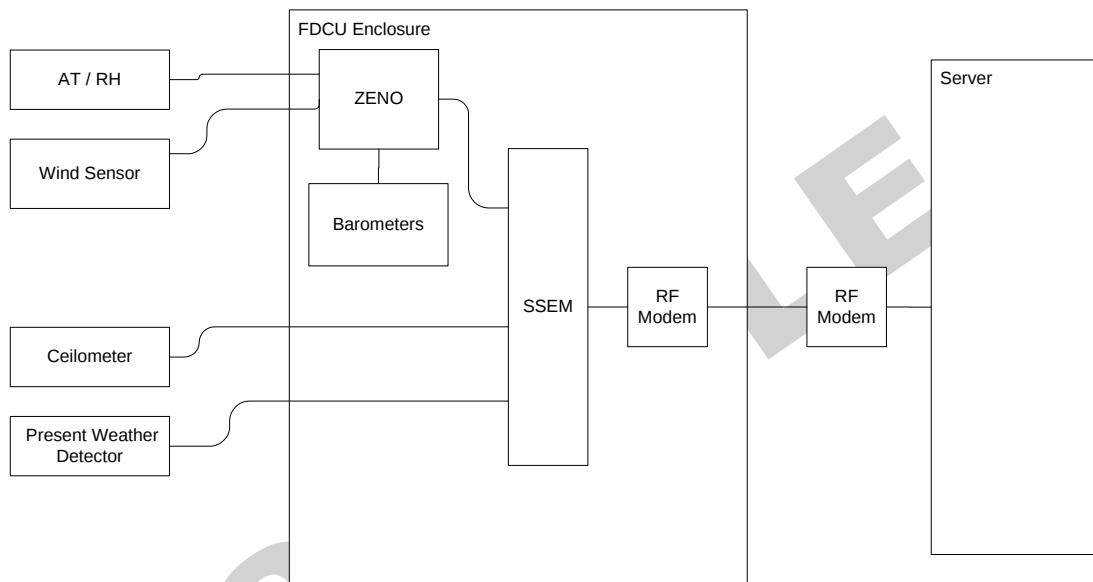


Figure 2-1 – AWOS Signal Flow Diagram

2.3 Sensors

The AWOS uses COTS sensors. A brief description of each sensor, including sensor specifications, is provided in the following sections.

2.3.1 Wind Sensor

The wind sensor measures both horizontal wind speed and wind direction. The wind sensor is mounted at the top of a 10 m tower so that disturbance from ground objects is minimized. The wind sensor has an array of four equally spaced transducers in a horizontal plane used to determine horizontal wind speed and direction. The measurement principle is based on transit time, the time it takes for the ultrasound to travel from one transducer to another. Transit time is affected by wind speed along the ultrasonic path. The transit time is measured in both directions. For zero wind speeds, both the forward and reverse transit times are equal.



Table 2-1 - Wind Sensor Specification Data

Operating temperature range	-35 °C to +70 °C
Measuring range	<5% to 100 %RH
Wind Speed Range	0-60 m/s
Wind Speed Accuracy	±2%
Wind Speed Resolution	0.01 m/s
Wind Direction Range	0-359°
Wind Direction Accuracy	±3°
Wind Direction Resolution	1°

2.3.2 **Ambient Temperature/Relative Humidity (AT/RH) Sensor.**

The AT/RH sensor consists of a Vaisala model HMP50 relative humidity/temp probe installed into the aspirated radiation shield as a single unit. The output voltage of the probe ranges from 0 to 1 VDC. Output signals from both the sensor are sent to the ZENO[®]3200 in the FDCU for processing via an integral cable.

The AT/RH sensor is mounted vertically in an R.M. Young Model 43408 aspirated radiation shield. The shield protects the sensor from incoming short wave solar radiation as well as outgoing long wave radiation and provides excellent sensor contact with the incoming ambient air. The shield employs concentric downward-facing intake tubes for thermal separation and isolation of the sensors. Intake air is drawn by a blower and flows between the inner and outer shield tubes as well as across the sensor to minimize heat transfer from outer to inner surfaces. The shield material provides low thermo conductivity and low heat retention. A secondary radiation shield mounted below the temperature sensor blocks reflected radiation during the day and minimizes overnight cooling during the night. A switch, which is essentially a paddle on the end of the airflow tube, is pushed open by the correct amount of airflow. This switch is electronically monitored and its status (open or closed) included in the output data stream, allowing the operator to tell not only if the fan is operating, but also if there is severe blockage of the air passage due to insects, debris, etc.



Table 2-2 - AT/RH Sensor Specification Data

Operating temperature range	-10 °C to +60 °C
Measuring range	0 to 98 %RH
Output scale	0 ... 100 %RH equals 0 ... 1 VDC
RH accuracy at 20 °C	$\pm 3\%$ RH
Temp accuracy at 20°C	$\pm .6^{\circ}\text{C}$
Supply voltage	10-28 VDC

2.3.3 Present Weather Detector

The sensor is a Vaisala Present Weather Detector PWD22. The PWD22 identifies precipitation type by estimating the water content of precipitation with a capacitive device (Vaisala RAINCAP[®] sensor element) and combining this information with optical forward scatter and temperature measurements. The PWD22 has a single RAINCAP[®] sensor element. This sensor is used to provide precipitation detection and identification. It is also used for visibility and luminance measurements.

Table 2-3 - PWD22 Specification Data

Operating Principle	Forward scatter measurement
Instrument consistency	+5%
Time constant	60 s
Update interval	15 s
Operating temperature	-40°C to +55°C
Operating Humidity	up to 100% RH
Wind speed	up to 60 m/s
Precipitation detection sensitivity	0.05 mm/h or less, within 10 min
Weather type identification	4 different types of precipitation: rain, drizzle, snow, ice pellets Precipitation (unknown type) Fog, mist, haze



Precipitation intensity measurement	Range 0.00 ... 99.99 mm/h
Precipitation amount measurement	Range 0.00 ... 99.99 mm
Amount of new snow	Range 0.00 ... 99.99 mm
Maximum power consumption	6 W, 12-50 VDC
Dimensions	404 mm wide x 695 mm long x 119 mm high
Weight	3 kg (6.61 lbs)

The PWD22 detects the presence (or absence) of precipitation. The PWD22 uses an infrared LED as a light source. Two photo-detector sensors detect and analyze the measured scintillation produced when precipitation falls through the light beam. This scintillation analysis then determines precipitation occurrence, type, and intensity (sensor present weather report).

2.3.4 **Ceilometer**

The ceilometer is a Vaisala CL31. The Vaisala CL31 Laser Ceilometer is a general-purpose cloud height sensor employing LIDAR technology for detection of clouds, precipitation and other obstructions to vision. The CL31 provides reliable determination of cloud height up to 25,000 feet (7.5 km) thus covering most heights where dense clouds appear. The CL31 is capable of reporting up to three cloud layers simultaneously. It detects the cloud base reliably also in fog, rain, snow and haze. In case the cloud base is obscured, the CL31 measures and reports the vertical visibility. The laser meets Class 1 laser product (eye-safe) Class 1M (IEC/EN 60825-1).

Table 2-4 - Ceilometer Specification Data

Property	Description / Value
At nominal line voltage	230 V
Power consumption (typical):	
Total	310 W
Measurement unit	15 W
Internal heater	100 W
Window conditioner heater	175 W



Window blower	20 W
Frequency	45-65 Hz
Power connector (J2)	Type Binder series 693, 09-4223-00-04 4-pin (male)
Mating connector type	Type Binder series 693, 99-4222-70-04 (female) elbow
No-break power supply	12 V Sealed Lead Acid Battery, 2 Ah
Over voltage protection	Low-pressure filter , VDR

Table 2-5 - Ceilometer CL31 Mechanical Specifications

Property	Description / Value
Measurement unit Dimensions	620 × 235 × 200 mm (24 × 9 1/4 × 8 1/4 in.)
Height with shield	1190 mm (47 1/4 in.)
Measurement unit Weight	12 kg (26.5 lb.)
Shield and blower Weight	18.5 kg (41 lb.)
Plywood transport Container size	1400 x 490 x 450 mm (55 x 19 1/4 x 17 3/4 in.)
Plywood transport Container weight	52 kg (115 lb.)

2.3.5 **Barometer**

The RM Young 61302V Barometric Pressure Sensor is housed in the FDCU enclosure. The data is sent to the ZENO where it is processed. The system uses atmospheric pressure and site-specific constants to compute altimeter setting.

The sensor is a versatile electronic barometer featuring high accuracy, low power, wide operating temperature range, and a calibrated voltage output. An accuracy of ± 0.3 hPa rms is maintained over the entire specified operating pressure and temperature range. Full scale voltage output (2.5V or 5V) may be set to span any portion of the 500 to 1100 hPa operating range.

Table 2-6 - Barometer Specification Data

Operating temperature range	-18°C to +80°C
Operating pressure ranges	600 to 1100 hPa
Accuracy	±0.05 hPa
Output voltage	0-5 VDC
Current consumption (operating mode)	8 mA (0.2 Watts)

2.4 **Field Data Collection Unit (FDCU)**

The FDCU consists of a ZENO® 3200 Datalogger, a serial sensor expansion module (SSEM), a barometer, various communications links, and power supply circuitry in an aluminum enclosure. The FDCU sends control and polling signals to the sensors and receives data signals from the sensors. Sensor data are received by the FDCU in the formats shown in Table 2-7.

The FDCU operates on DC voltage from 10 to 35 Vdc, but uses a standard 120 –volt AC input. The power supply is a Mil-grade switching power supply.

A battery is included in the FDCU. Once power is applied to the system it regulates and supplies power to all the other sensors and components of the system. If the FDCU loses power or resets due to a power surge, it will automatically return to normal operation without human intervention. Normal operation is resumed within thirty seconds, with all weather parameters achieving normal indications within ninety seconds.

FDCU power circuitry includes the components that regulate the line voltage supplied to the entire system and also distribute the power to the various sensors. The FDCU power components include; a single-phase transformer, the power supply (an AC/DC converter), a 4/20 Amp battery charger, and a 12 Vdc, 17 AH battery. The FDCU is powered by 110 to 240 Vac, 45 - 65 Hz, single-phase power source.



Table 2-7 - Sensor/FDCU Data Specification Formats

Sensor	Data Format	Received By
Present Weather Detector	Serial RS-232	SSEM
Ceilometer	Serial RS-232	SSEM
AT/RH Sensor	DC Volts	ZENO [®] 3200 Datalogger
Wind Sensor	Serial RS-485	ZENO [®] 3200 Datalogger
Barometer	DC Volts	ZENO [®] 3200 Datalogger

2.4.1 **ZENO[®]3200 Datalogger**

The ZENO[®]3200 Datalogger accepts and stores sensor data from the AT/RH Sensor, Barometer and Wind Sensor. It also checks alarms and control functions (diagnostic inputs) including ZENO[®]3200 Datalogger power monitor, FDCU battery charger/load/voltage/charge monitors, FDCU DC power monitor, and FDCU AC power fail. Analog data are converted to serial digital data with low (12 bit, 10,000 samples/s, 2 channels maximum), high (15 bit, 10 samples/s), or ultra-high (18 bit, 2 samples/s) resolution. The ZENO[®]3200 Datalogger processes the sensor data in a 32-bit microcontroller with 1 MB flash memory and 1 MB static random access memory (SRAM), and sends the processed sensor and other data to the SSEM in RS-232 serial format. The microcontroller allows extremely fast and powerful computing of multiple routines and uses advanced power management for very low power consumption. A true real-time executive is used to achieve multi-tasking which samples and communicates simultaneously. The ZENO[®]3200 Datalogger operates using embedded firmware. The SRAM stores all sensor and program settings. Functions include analog signal conversion, digital input/output, serial communication, programming, and data memory. A real-time clock is also provided.

The ZENO[®]3200 Datalogger is normally not turned off. If main power is disrupted, the ZENO[®]3200 Datalogger operates on the FDCU's battery back up. If power and the FDCU's battery back-up are lost, the ZENO[®]3200 Datalogger automatically reboots on power restoration using only the configuration data previously stored in 8 kB of electrically erasable programmable read-only memory (EEPROM). Settings and changes stored in SRAM are retained by a battery within the ZENO[®]3200 Datalogger.

2.4.2 **Serial Sensor Expansion Module (SSEM)**

The SSEM is essentially a microcomputer that expands the capability of the ZENO[®]3200 Datalogger. The SSEM accepts RS-232 serial digital sensor data inputs from the Present Weather Detector and Ceilometer. It also accepts diagnostic data and digitized serial data from the other sensors via the ZENO[®]3200 Datalogger. Maximum data rate is 15 kbits/s. System memory is 32 MB with 48 MB of non-volatile storage memory. The SSEM uses a 32-bit microcontroller to direct data transfer into and out



of a 16-bit buffer. The SSEM interprets, formats, and sends processed sensor data and other information to the DPU via the communications link. Messages are passed between the FDCU and DPU using the SSEM remote communication protocol.

The FDCU maintenance port connects with the SSEM. The maintenance port is an RS-232 serial interface that allows viewing of sensor data on a terminal emulator. Some sensors can also be commanded to perform self-test or other functions via the maintenance port.

2.4.3 **Power Supply**

The Power Supply circuits convert AC input power to DC power for use by the other FDCU circuits. A line filter and suppressor remove noise and provide protection from voltage spikes and other transients on the AC input. The AC power distribution module also contains mains power failure detection circuitry. It supplies a Power Supply that converts the AC input to DC for distribution to the ZENO[®] 3200 Datalogger, SSEM, Barometers, sensors and communications links.

A 3-amp constant-voltage battery charger maintains charge in a 12 Vdc, 32 amp-hr sealed lead-acid battery. This battery and circuits in the power distribution module form an uninterruptible power supply (UPS) that provides DC power to all essential system components should the main AC power input be interrupted.



2.4.4 **Communications Link**

All sensors are connected to the FDCU.

The FDCUs communicate point-to-point with the DPU via line of sight radio modems. Each radio is tuned to a separate channel in the range of 2.4 Ghz. A radio modem in the FDCU communicates with a radio modem in the DPU via 15 dB Yagi antennas at each end.

2.4.4.1 **Point to Point RF Modem Configuration**

The data transceivers in the FDCU and DPU are Xstream RF modems model PKG-R.



Figure 2-2 – Xstream-PKG-R RF Modem



Figure 2-3 – Pctel MYP 15dB Yagi Antenna



2.5 **Data Processing Unit (DPU)**

The Data Processing Unit runs Coastal Environmental's AVIATION INTERCEPT™ (AI) software. AVIATION INTERCEPT™ is Coastal's COTS software application for fully automated and/or operator-assisted aviation meteorological reporting. It is a complete program for meteorological data processing, display, analysis, reporting, storage, and long-term management. It collects data from the FDCU and processes the data in accordance with approved algorithms. The data is then sent to any external data sources or data feeds and displayed on a graphical user interface (GUI). AVIATION INTERCEPT™ runs on Windows server 2003. It displays both graphical and alphanumeric data.

The DPU has the primary responsibility for processing, formatting, storing, and disseminating the meteorological data received from the FDCU station(s) and RLIM. It is also the command and control center for the system's diagnostic and maintenance activities. The DPU is designed to run continuously and is constructed from components (hardware and software) made for this purpose. The DPU automatically boots after a power outage, but users must launch the AWOS service and log on.

The DPU performs the following functions:

- Data Acquisition from the FDCUs and RLIM
- Data Processing
- Generation of Log files
- Generation of reports

The following functions are accessed through the Graphical User Interface

- Generation of data display
- System setup and configuration
- Security to control access to system setup and displays
- Archival of data and the ability to retrieve archived data

The DPU is equipped with industry standard hardware and software interfaces. At the hardware level, the interfaces include RS-232 ports and Ethernet ports. The Ethernet NIC connects to CAT5 cable. At the software level, the Aviation Intercept™ supports TCP/IP, PPP, and ANSI, among many other protocols. The AI application and the Operating System are used during system installation (or modification) to configure the ports and route information as required. The AI can connect to a variety of communication links and protocols. The physical, data link, and transport layers of the OSI model are integral parts of the AI hardware and software. Data and algorithm values can be viewed remotely in real-time, delayed only by the communications transport media. Data can be asynchronous and synchronous.

2.6 **Software**

The system software consists of firmware running on the FDCU and application software running on the DPU. The DPU software includes a data recorder, database, algorithms, graphical user interface and a communication module for sending messages. Software running on the DPU is divided into two major categories: communications and processing and storage. The communications software can be run on the same CPU as the other applications or can be partitioned off on another CPU if the communications requirements warrant it.



SECTION 3 - MAINTENANCE

3.1 Recommended Preventive Maintenance Schedule

Normal scheduled maintenance intervals are shown in Table 3-1.

NOTE

In certain locations, local conditions may warrant more frequent cleaning and corrosion control.

Table 3-1 - Scheduled Maintenance Intervals Summary (Days)

Equipment	General Cleaning	Corrosion Control	Functional Performance Check
DPU	84		
Wind Sensors	84	84	84
Ceilometer	84	84	84
Present Weather Detector	84	84	84
AT/RH Sensor	84	84	84
Barometers	84	84	84
FDCU	84	84	
Barometer Desiccant	84	84	
FDCU Battery	84	84	84



3.2 **Support Equipment, Tools and Consumable Items**

Table 3-2 – Special Tools and Support Equipment

Item	Application	Type/Model/Part Number
1. Laptop with RS232 serial port and terminal program	Sensor Functional Tests	Dell Inspiron 1501 or comparable model
2. Cable, Serial, DB-9M to DB-9F	Sensor Functional Tests	Radio Shack 26-117B
4. Adapter, Serial to USB	Sensor Functional Tests	TrippLite U209-000-R
7. Sighting compass	Wind Alignment	Suunto KB-14 or equivalent
9. AT/RH field reference	Temperature/Humidity Test	Vaisala HM70 (M170 indicator and HM75b probe) with carry case
10. Barometric pressure field reference	Barometer Test	CES p/n 2910000016
11. Gill WindSonic Packing Box	Wind Test	N/A
12. PWA11 calibration kit	PWD22/PWD20 Calibration	Vaisala PWA11

Table 3-3 – General Purpose Tools

Item	Application	Type/Model/Part #
1. Philips Screwdriver #2	Rain Gauge Test	Any
2. Gloves (skin Protection)	General maintenance	Any
3. Goggles (eye protection)	General maintenance	Any
4. Snips	General maintenance	Any
5. Digital Multimeter	FDCU Troubleshooting	Fluke 187 or equivalent
6. Metric hex wrench set	General maintenance	Any
7. Standard Screwdriver	General maintenance	Any

Table 3-4 – Consumable Items

Item	Type/Model/Part Number
1. Cloth, cotton, lint free	Any
2. Alcohol, Isopropyl	Any
3. Detergent, mild	Any
4. Water	Any
5. Bag, Desiccant (minimum 1 1/3 oz.)	ULINE p/n S-5163
6. Desiccant, Granule, Indicating	IMPAK p/n 640AG05
7. Cable Ties, 14 in., UV Res.	TY527MX

3.3 Sensor Functional Performance Checks

Sensor functional checks require viewing sensor data on a laptop computer. This section describes how to set up a laptop computer for this purpose. The remaining sections describe the sensor functional tests.

3.3.1 Laptop Terminal Emulator Setup

Support Equipment Required:

Cable, DB-9F to DB-9M

Computer, Personal, Laptop with terminal emulation software (such as Hyper-Terminal)

- Connect laptop to FDCU maintenance port inside FDCU using DB-9F to DB-9M cable. With laptop running Windows®, select **Start, Programs, Accessories, Communications, Hyper-Terminal**. The **Connection Description** dialog box appears. (If not, select **Call, Disconnect, Connect** and the **Connection Description** dialog box for a new Connection to appear).
- Type *FDCU* as the connection name, select any icon, and select **OK**.
- The **Connect To** dialog box appears. In Connect Using the pull-down list, select **Com 1, Com 2, Com 3** or **Com 4** (as appropriate) and Select **OK**.
- The **COM Properties** dialog opens. Set port settings to **115200** bits per second, **8** data bits, **No Parity**, **1 Stop** bit, **No Flow Control**, and Select **OK**.
- Press **<enter>**.
- At the password prompt, type *awos* **<enter>**.



g. Type *sum l* <enter>. A summary similar to Figure 3-1 will appear and continually update the data. As an alternative, you can type *sum h* <enter> and a summary similar to Figure 3-2 will appear. This summary does not update the data, but it supplies labels for each of the data elements.

JAKN-0001		Net 1/0 */*		5/23:18 12/09/2009 20:02:35				
FDCU	ok:100	16	14.2V	23C	115 0.4%	3860	7372	
ZENM	idle	5/23:18						
ZENO	ok:100	1	19.4C	21%	0.00mm	0.00mm	15	
			0.2	0.2	245	1025.7	0	
WX500	ok:100	1	0					PAGE
CL31	ok:100	0	0	0	0	0:000000008020		
PWD20	ok:100	1	5757	5290	27			
PWD22	ok:100	1	3400	236	////	HZ		
LINK	ok:75	2	248976	3402				

Figure 3-1 – *Sum l* Summary Screen

5> sum h		SysId-Sernum		Cmd/Data Ser Rx/Tx		RunTime		Date (UTC) Time	
FDCU				BatV	Temp	IRQ CPU	UsedMem	FreeMem	
ZENM	Zeno Maintenance Port								
ZENO				AT	RH	24hrRain	30sRain	Solar	
				Wspeed	Wgust	Wdir	BP1	Bits	
WX500				Strikes	dist:dir	dist:dir	dist:dir	RawStat	
CL31				CloudB1	CloudB2	VertVis		RawStat	
PWD20				Vis1m	Vis10m	BGlum			
PWD22				Vis1m	Vis10m	BGlum	Instant	Recent	
LINK				TotalPkts	BPS				
JAKN-0001		Net 1/0 */*		5/23:18 12/09/2009 20:02:35					
FDCU	ok:100	16	14.2V	23C	115 0.4%	3860	7372		
ZENM	idle	5/23:18							
ZENO	ok:100	1	19.4C	21%	0.00mm	0.00mm	15		
			0.2	0.2	245	1025.7	0		
WX500	ok:100	1	0					PAGE	
CL31	ok:100	0	0	0	0	0:000000008020			
PWD20	ok:100	1	5757	5290	27				
PWD22	ok:100	1	3400	236	////	HZ			
LINK	ok:75	2	248976	3402					

Figure 3-2 – *Sum h* Summary Screen



3.3.2 **Ceilometer**

Support Equipment Required:

Cable, DB-9F to DB-9M

Computer, Personal, Laptop

Standard Screwdriver

- a. Open ceilometer access cover and electronics housing door (requires supplied key). Verify Main power switch, Ceilometer Heater, and Ceilometer Battery switches are all in the ON position.
- b. Connect laptop to FDCU maintenance port and at the prompt type **chat cl31** <enter>.
- c. Type **OPEN** to access the CL31 command prompt, which will be "CEILO".
- d. Type **GET FAILURE STATUS** at the CEILO > prompt (double-echoed characters should appear).
- e. Verify all Alarms, Warnings, and System fields read "OK", and suspect module field equals "None"
- f. Type **CLOSE** to exit out of the CEILO > command prompt.
- g. Key <ctrl-a> **q** <enter> to exit out of sensor chat. At the prompt, type **sum h** <enter>.
- h. Note values from CloudB1, CloudB2, and VertVis fields from the SSEM summary screen.
- i. Wait 2-4 minutes, type **sum l** <enter>, and the values should change if clouds are being detected.
- j. Turn off the ceilometer battery power switch, wait two minutes and verify the ceilometer battery failure message is present in the summary screen.
- k. Turn on the ceilometer battery power switch, wait two minutes and verify the ceilometer battery failure message is no longer present.
- l. Repeat steps k and i, substituting the Main power switch for the battery power switch.
- m. Key <ctrl-c> to return to the SSEM prompt.
- n. Close ceilometer electronics housing door, close ceilometer front access door.

3.3.3 **Present Weather Detector**

Support Equipment Required:

Cable, DB-9F to DB-9M

Computer, Personal, Laptop

PWA11 Calibration Kit

Standard Screwdriver

3.3.3.1 **Calibration Overview**

PWD22 has been calibrated at the factory and needs no recalibration if the circuit boards are not changed and there are no warnings or alarms. If any mechanical damage changes or weakens the optical measurement path, the PWD22 must be replaced. If the receiver unit (PWC22) or transmitter unit (PWT11) is replaced, both visibility and contamination measurements need recalibration. The calibration



is checked and adjusted with the PWA11 calibration kit. The kit consists of a blocking plate and two opaque glass plates with known scatter properties. The calibration procedure checks two points; zero scatter signal and a very high scatter signal. The zero signal is obtained using a blocking plate and the high signal using opaque glass plates. When visibility measurement is calibrated, visibility should be better than 500 meters. Calibration is not recommended to be carried out in heavy rain or in bright sunshine. However, light rain does not matter.

3.3.3.2 **PWD Functional Check/Calibration**

Clean the lenses according to paragraph 3.4.4.1. Also clean the opaque glass plates if necessary.

- a. Connect laptop to FDCU maintenance port per laptop terminal emulator procedures and at the prompt, type **chat visi** <enter>.
- b. Place the blocking plate (with foam) in the receiver hood and wait for 30 seconds.
- c. Type **open ***<enter>.

NOTE

After typing the open * command, a prompt (>) appears. If there is no activity for 90 seconds, the prompt (>) will disappear. If this happens, the open * command must be typed again.

- d. Type **ZERO**<enter>. PWD22 should answer as follows: ZERO SIGNAL: OK>
- e. Remove the blocking plate.
- f. Note signal value printed on glass calibrator plates.
- g. Install the calibrator plates to the lens hoods making sure transmitter plate mounts to transmitter lens and receiver plate mounts on receiver lens. Refer to Figure 3-2 below.

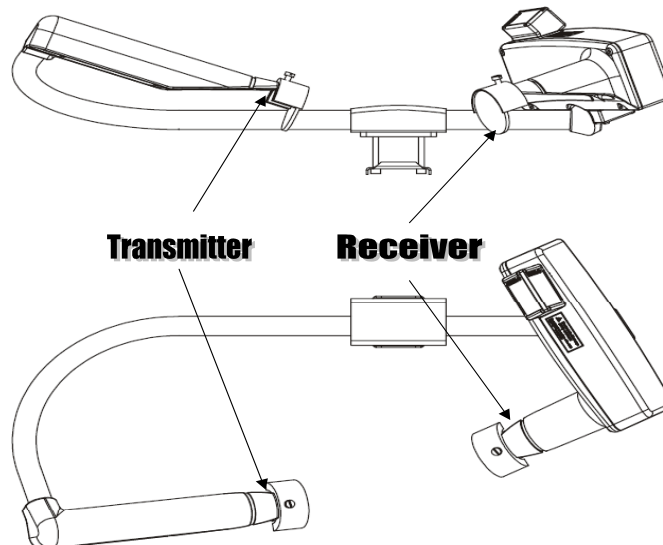


Figure 3-3 - Assembling the Opaque Glass Plates



- h. Move away from the optical path and wait for 30 seconds.
 - i. Type **open** **<enter>* .
 - j. Type **CHEC** *<enter>* .
 - k. After one minute, read the displayed signal.
 - l. If the difference is less than 5 % from the values on the calibrator plates, calibration is correct. Hit the ESC key to terminate, followed by *<ctrl> a* (both keys pressed simultaneously), then *q <enter>* to exit chat mode. If the value is not within 5%, proceed to the next step.
 - m. Type **open** **<enter>* .
 - n. Type **CAL** *calibrator signal value (from value on glass plates) <enter>*.
- For example: CAL 485
- PWD22 calculates a new scaling factor and stores it in the non-volatile memory (EEPROM).
- o. Type **open** * *<enter>*.
 - p. Type **CHEC** *<enter>* to verify that the new scaling factor is in use. The displayed signal value should be equal to the calibrator signal value. If the difference between the new scaling factor and the factory calibrated one is more than 20 %, the **CAL** command will be ignored. Check PWD22 and the calibrator for hardware or mechanical errors. Also consult Vaisala.
 - q. Terminate the **CHEC** command by pressing the ESC key.
 - r. Type *<ctrl> a* (both keys pressed simultaneously), then *q <enter>* to exit chat mode.

3.3.4 AT/RH Sensor

Support Equipment Required:

Cable, DB-9F to DB-9M
Computer, Personal,
Meter, Temperature/Humidity
Standard Screwdriver

- a. Connect laptop to FDCU maintenance port, and at the prompt, type *sum l <enter>*.
- b. Note **air temperature** field reading on laptop.
- c. Set Temperature/Humidity Meter to read temperature.
- d. Position Temperature/Humidity Meter at mouth of AT/RH Sensor shield assembly such that air drawn into aspirated shield is drawn across Temperature/Humidity Meter
- e. Wait several minutes for Temperature/Humidity Meter to stabilize.
- f. Record Temperature/Humidity Meter and laptop **air temperature** field readings.



- g. Wait 2 minutes and repeat step f noting each reading. For inclement weather, wait 15 minutes.
- h. Wait another 2 minutes and repeat step f noting each reading. For inclement weather wait 15 minutes.
- i. Average the three Temperature/Humidity Meter readings. Separately, average the three laptop **air temperature** field readings.
- j. Compare average Temperature/Humidity Meter reading to the average laptop **air temperature** field reading. Difference should be less than 1.5° C.
- k. Note **relative humidity** field reading on laptop.
- l. Set Temperature/Humidity Meter to read **humidity**.
- m. Record Temperature/Humidity Meter and laptop **relative humidity** field readings.
- n. Wait 2 minutes and repeat step m. For inclement weather wait 15 minutes.
- o. Wait 2 more minutes and repeat step m. For inclement weather wait 15 minutes.
- p. Average the three Temperature/Humidity Meter readings and laptop **relative humidity** field readings.
- q. Compare average Temperature/Humidity Meter reading to average laptop **relative humidity** field reading. Difference should be less than $\pm 5\%$.

NOTE

In cold weather, it may take longer for the hand-held meter to stabilize. It might be beneficial to take a large rubber band or tape, and attach the hand-held meter to the sensor. Perform other tests and return to the AT/RH readings at a later time (more than 15 minutes).

3.3.5 Wind Sensor

Support Equipment Required:

- Cable, DB-9F to DB-9M
- Computer, Personal, Laptop
- Standard Screwdriver
- Gill WindSonic Packing Box

- a. Connect laptop to FDCU maintenance port, and at the prompt, type *sum l <enter>*.
- b. Put the Gill WindSonic Packing Box over the wind sensor.
- c. Wait 30 seconds before performing the test to ensure that the wind speed average has stabilized.
- d. Ensure that the resultant wind speed output is zero.



3.3.6 **Barometer**

Support Equipment Required:

Cable, DB-9F to DB-9M

Computer, Personal, Laptop

Barometer, Reference

- a. Connect laptop to FDCU maintenance port and type *sum l <enter>*.
- b. Turn Digital Barometer on and wait 5 minutes for Digital Barometer to stabilize.
- c. Note barometric pressure indicated on Digital Barometer.
- a. Note pressure indicated in barometric pressure field on laptop. The **barometric pressure** reading should be within **0.67 hPa** of Digital Barometer reading.

3.4 **Preventive Maintenance Procedures**

3.4.1 **Obstruction/Debris Inspection**

Visually check all outdoor equipment for the following and correct as required.

- a. Tree obstruction.
- b. Blown twigs, grass, or plastic objects caught in the sensors.
- c. Spider webs, insect nests, bird nests, etc.

3.4.2 **Physical Check**

Physically check all outdoor equipment for the following and correct as required.

- a. Lightning damage (scorch marks).
- b. Corrosion and chemical deposits.
- c. Loose connections, tie wraps, grounding cable, or loose mountings.
- d. Look for physical damage, abraded or frayed cable.

3.4.3 **Ceilometer**

Material Required

Cloth, Cotton, Lint-free

Mild detergent w/ water



3.4.3.1 **Window Cleaning Procedures**

Data messages include a warning that informs when the window is contaminated. After the system has detected contamination on the window, it will start the blower, which is designed to remove light contaminants and dry off raindrops. If the contamination cannot be removed, CL31 will issue a **Window Contaminated** warning, which indicates that the window must be cleaned as follows:

1. Flush the window with clean water to remove coarse grains (keep the enclosure door closed).
2. Clean the window with a soft, lint-free cloth moistened with a mild detergent. Be careful not to scratch the window surface. While cleaning the window, you can also check the operation of the window blower. Unless it is already running, the blower should start when you block the laser beam with the cleaning cloth for some 5 seconds or more. This will verify that the blower is functional. If there are no low clouds, precipitation, or fog present, the blower should stop after the window is cleaned. In case of a malfunction, the window blower has to be replaced.

3.4.3.2 **Checking the Door Gasket**

The door of the measurement unit utilizes an electrically conductive rubber gasket to suppress electromagnetic radiation. When the door is opened, check that the gasket and the opposite contact surface is clean. Use a wet cloth for cleaning if necessary.

3.4.3.3 **Battery Check**

Check the battery condition annually. If any signs of aging such as a bulging battery case, white powder or residue near the battery vent, leaking electrolyte, or corroded terminals is observed replace the battery. Lead acid batteries may age in 3 to 5 years time and result in a rupture and loss of electrolyte.

CAUTION

In freezing temperatures there is a danger of battery rupture if the battery is completely discharged. Do not store empty batteries in freezing temperatures. Replace the battery if signs of mechanical rupture are observed.

NOTE

When disposing of old batteries, be sure to follow local environmental regulations.



3.4.4 **Present Weather Detector**

Support Equipment Required:

Cable, DB-9F to DB-9M

Computer, Personal, Laptop

Standard Screwdriver

Material Required

Cloth, Cotton, Lint-free

Isopropyl alcohol

3.4.4.1 **Window Cleaning Procedures**

1. Moisten a soft, lint-free cloth with isopropyl alcohol and wipe the lenses. Be careful not to scratch the lens surfaces. Lenses should dry indicating that the lens heating is functioning.
2. Check that the hoods and lenses are free of condensed water, or ice and snow deposits.
3. Wipe the dust from the inner and outer surfaces of the hoods.
4. After the optical surfaces are properly cleaned, give the **CLEAN** command.

3.4.4.2 **RAINCAP® Cleaning Procedures**

Material Required

Cloth, Cotton, Lint-free

Mild detergent w/ water

CAUTION

To ensure proper ESD protection of the RAINCAP® electronics, ground your hand first by touching grounded metallic parts of the installation to remove static charges from your body.

- a. Check that the RAINCAP® is free of ice and snow deposits.
- b. Clean the RAINCAP® with a soft, lint-free cloth moistened with mild detergent, being careful not to scratch the surface.



3.4.4.3 **Window Cleaning Procedures**

1. Moisten a soft, lint-free cloth with isopropyl alcohol and wipe the lenses. Be careful not to scratch the lens surfaces. Lenses should dry indicating that the lens heating is functioning.
2. Check that the hoods and lenses are free of condensed water, or ice and snow deposits.
3. Wipe the dust from the inner and outer surfaces of the hoods.
4. After the optical surfaces are properly cleaned, give the **CLEAN** command.

3.4.5 **AT/RH Sensor**

Material Required

Cloth, Cotton, Lint-free
Detergent, Mild

- a. If the radiation shield is coated with dirt film, wash it thoroughly inside and out with solution of warm water and mild detergent. If radiation shield is coated with oil film, clean it using Isopropyl alcohol.
- b. Position radiation shield and probe cover on AT/RH Sensor, and screw probe cover onto sensor.
- c. Check shield mounting bolts for possible loosening from tower vibration. Tighten bolts if necessary.

3.4.6 **Wind Sensor**

Material Required

Cloth, Cotton, Lint-free
Mild detergent w/ water

- a. Inspect and clean wind Sensor as necessary.
- b. Check alignment of wind sensor. If alignment is necessary, perform alignment procedure.

3.4.6.1 **Window Cleaning Procedures**

1. Moisten a soft, lint-free cloth with isopropyl alcohol and wipe the lenses. Be careful not to scratch the lens surfaces. Lenses should dry indicating that the lens heating is functioning.
2. Check that the hoods and lenses are free of condensed water, or ice and snow deposits.
3. Wipe the dust from the inner and outer surfaces of the hoods.
4. After the optical surfaces are properly cleaned, give the **CLEAN** command.



3.4.7 FDCU

Material Required

Bag, Desiccant (minimum of 1.33 oz)
Screw driver - flathead
Desiccant, Granule, Indicating
Tubing

- a. Loosen FDCU enclosure cover latches and open cover.

NOTE

Be sure to disconnect FDCU battery leads before opening FDCU AC Power switch. This prevents the battery from supplying power to circuits and prolongs battery life.

- b. Disconnect battery leads.
- c. Turn off FDCU AC Power switch.
- d. Open FDCU circuit breaker.
- e. At the bottom of the FDCU cabinet, inspect the pressure port assembly to ensure there is no foreign object or excessive moisture blocking the port opening.

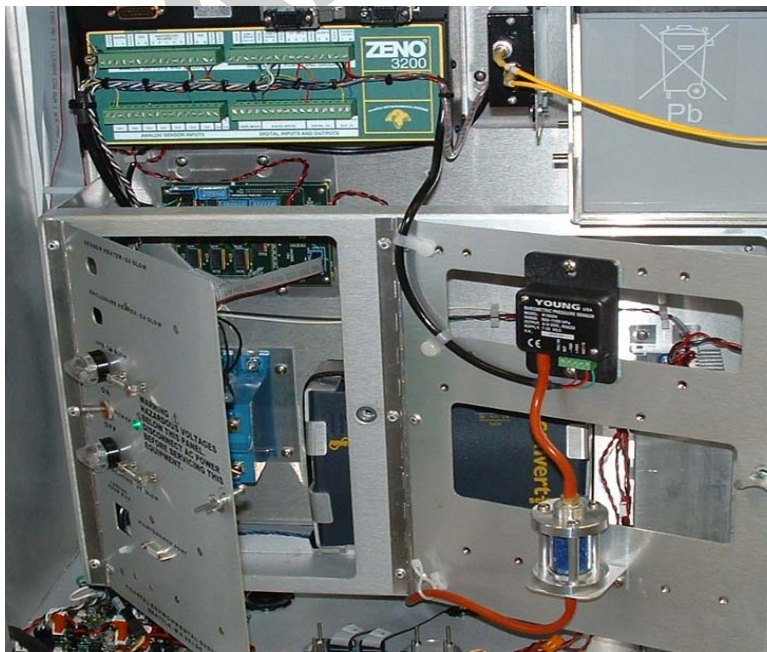


Figure 3-4 - FDCU - Barometer and Desiccant Trap



- f. Check color of desiccant in desiccant trap. If blue, desiccant is ok. If **BRIGHT** pink, replace.
- g. Inspect condition of tubing from desiccant trap to pressure port. If brittle or cracked, replace with new tubing cut to proper length.
- h. Check condition of the gasket around the FDCU door opening. If worn or brittle, replace gasket.
- i. Reconnect battery leads.
- j. Within a few seconds, close FDCU circuit breaker and switch on FDCU AC Power.
- k. Remove used desiccant bags from FDCU enclosures.
- l. Place fresh desiccant bags in FDCU enclosure and date bags.
- m. Close FDCU enclosure cover and secure latches.

3.4.8 DPU

3.4.8.1 General Cleaning

- a. Clean server front panel.
- b. Perform routine cleaning and corrosion control.
- c. Inspect cable connections, check for signs of wear. Repair or replace as needed.
- d. Check ground connection.

3.4.8.2 Purging Log Files

- a. Go to Start > My Computer > D:\ > Coastal Environmental Systems > AWOS 1.x.x (the current software version) > logs > data. The file folders inside are arranged by year, month, and day.
- b. Delete all files that are older than one year.



SECTION 4 - COMPONENT REMOVAL AND INSTALLATION PROCEDURES

4.1 Introduction

This section describes the removal and replacement (installation) procedures for AWOS primary components.

4.2 Wind Sensor

4.2.1 Removal

- a. Loosen screws securing Wind Sensor to coupler.
- b. Remove Wind Sensor and disconnect cable from bottom of sensor.

4.2.2 Installation

- a. Route the Wind Sensor signal cable through the Wind Sensor adapter.
- b. Mount adapter to tower.
- c. Plug Wind Sensor signal cable into the bottom of the Wind Sensor.
- d. Mount Wind Sensor to Wind Sensor adapter and secure using screws.
- e. Align Wind Sensor to north (see alignment procedure).
- f. Perform functional test.

4.2.3 Wind Sensor Alignment Procedure

- a. Loosen the mounting screws on the wind sensor.
- b. Using a compass, align the north markings on the wind sensor with north.
- c. Tighten the mounting screws.

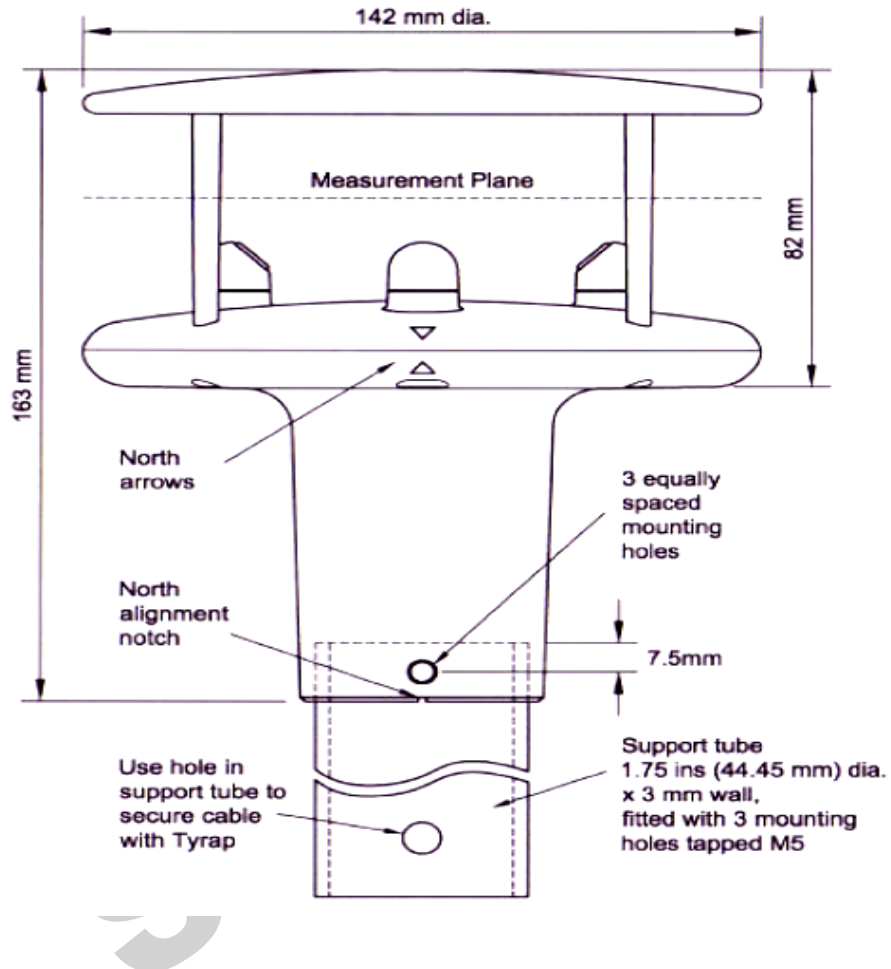


Figure 4-1 - North Markings on Wind Sensor

4.3 **Ambient Temperature/Relative Humidity (AT/RH) Sensor**

4.3.1 **Removal**

- Disconnect AT/RH sensor cable from FDCU.
- Remove U bolts securing AT/RH Sensor to stand and remove AT/RH Sensor.



4.3.2 **Installation**

- a. Position AT/RH Sensor on H stand such that the holes on the motor housing face down.
- b. Secure sensor to stand using U bolts.
- c. Connect sensor cable to FDCU.
- d. Perform functional test.

4.4 **Present Weather Detector**

4.4.1 **Removal**

- a. Disconnect Present Weather Detector cable from sensor.
- b. Remove four bolts securing sensor mounting bracket and remove sensor.

4.4.2 **Installation**

- a. Position Present Weather Detector with receive lens facing north.
- b. Secure sensor using mounting bracket and four bolts.
- c. Connect signal cable to sensor.
- d. Perform functional test.

4.5 **Ceilometer**

4.5.1 **Removal**

- a. Turn battery switch inside the ceilometer to the off position.
- b. Open circuit breaker to remove AC power from Ceilometer.
- c. Disconnect Ceilometer signal cable from signal junction box on pedestal and pull cable out through port on junction box.



- d. Disconnect Ceilometer AC power cable from AC power junction box on pedestal and pull AC power cable out through port on junction box.
- e. Remove ground strap from pedestal.

WARNING

EXERCISE CAUTION WHEN HANDLING THE CEILOMETER. IT WEIGHS OVER 60 POUNDS. TWO PEOPLE MAY BE REQUIRED.

- f. Remove four bolts securing Ceilometer to pedestal.

4.5.2 **Installation**

WARNING

EXERCISE CAUTION WHEN HANDLING THE CEILOMETER. IT WEIGHS OVER 60 POUNDS. TWO PEOPLE MAY BE REQUIRED.

- a. Position Ceilometer on pedestal and secure using 4 bolts.
- b. Connect ground strap to pedestal.
- c. Route AC power cable through port on AC power junction box and connect AC power cable to terminal strip in junction box.
- d. Route signal cable through port on signal junction box and connect to terminal strip.
- e. Close breaker to apply AC power to Ceilometer.
- f. Turn battery switch inside the ceilometer to the on position.
- g. Perform functional test.

4.6 **Barometer**

4.6.1 **Removal**

- a. Loosen FDCU enclosure latches and open FDCU door.



NOTE

Be sure to disconnect FDCU battery leads before opening FDCU AC Power switch. This process prevents FDCU battery from supplying power to FDCU circuits when main AC power is removed.

- b. Disconnect FDCU battery leads.
- c. Turn off AC Power to the FDCU at the power panel (open the breaker).
- d. Remove signal cable from barometer.
- e. Disconnect air tubing from Barometer.
- f. Remove screws securing Barometer to right door.

4.6.2 **Installation**

- a. Inspect condition of tubing. If brittle or cracked, replace with new tubing cut to proper length.
- b. Position Barometer against FDCU right door and secure using 2 screws.
- c. Connect tubing to Barometer.
- d. Connect signal cable to Barometer.
- a. Reconnect FDCU battery leads.
- b. Turn on AC Power.
- c. Close FDCU door and secure latches.
- d. Perform functional test.

4.7 **FDCU**

4.7.1 **Removal**

- a. Loosen FDCU enclosure cover latches and open cover.

NOTE

Be sure to disconnect FDCU battery leads before opening FDCU AC Power switch. This process prevents FDCU battery from supplying power to FDCU circuits when main AC power is removed.



- b. Disconnect battery leads.
- c. Turn off FDCU AC Power switch.
- d. Open FDCU circuit breaker.
- e. Remove battery from FDCU.
- f. Tag and disconnect all external cables connected to FDCU connectors.
- g. Loosen ground lug, and remove ground strap from FDCU.

WARNING

EXERCISE CAUTION WHEN HANDLING THE FDCU. IT WEIGHS APPROXIMATELY 60 POUNDS. TWO PEOPLE MAY BE REQUIRED.

- h. Remove four bolts, nuts and washers securing FDCU to stand and remove FDCU.

4.7.2 **Installation**

WARNING

EXERCISE CAUTION WHEN HANDLING THE FDCU. IT WEIGHS APPROXIMATELY 60 POUNDS. TWO PEOPLE MAY BE REQUIRED.

- a. Position FDCU enclosure on cross members on stand.
- b. Secure FDCU enclosure to rails using four bolts, nuts and washers.
- c. Attach ground strap to FDCU ground lug, and tighten screw.
- d. Connect external cables to FDCU connectors.
- e. Loosen FDCU enclosure cover latches and open cover.
- f. If FDCU was replaced, connect communication links and cables retained during FDCU removal.
- g. Position battery in battery tray and reconnect FDCU battery leads.
- h. Close FDCU circuit breaker and turn on FDCU AC power switch.
- i. Remove used desiccant bag from FDCU enclosure.
- j. Place fresh desiccant bag in FDCU enclosure and date bag.
- k. Close FDCU enclosure cover and secure latches.
- l. Perform Barometer functional test (if changing an FDCU with barometers) and ensure all sensors are reporting.



4.8 **FDCU Battery**

4.8.1 **Removal**

- a. Loosen FDCU enclosure cover latches and open cover.
- b. Disconnect FDCU battery leads.
- c. Turn off FDCU AC Power switch.
- d. Open FDCU circuit breaker.

NOTE

Dispose of battery in accordance with applicable regulations

- e. Remove battery from tray taking care that exposed battery terminals do not contact cabinet.

4.8.2 **Installation**

- a. Position battery on FDCU battery tray in enclosure.
- b. Connect FDCU battery leads.
- c. Close FDCU circuit breaker.
- d. Turn on FDCU AC Power switch.
- e. Close FDCU enclosure cover and secure latches.

4.9 **FDCU ZENO[®] 3200 Datalogger**

4.9.1 **Removal**

- a. Loosen FDCU enclosure cover latches and open cover.

NOTE

Be sure to disconnect FDCU battery leads before opening FDCU AC Power switch. This process prevents FDCU battery from supplying power to FDCU circuits when main AC power is removed.

- b. Disconnect FDCU battery leads.



- c. Turn off FDCU AC power switch.
- d. Open FDCU circuit breaker.
- e. Cut cable ties securing cables to ZENO[®]3200 Datalogger ears.
- f. Loosen ground screw at left edge of ZENO[®]3200 Datalogger, and remove braided ground cable.
- g. Loosen two captive screws on each of two ribbon cable connectors at top of ZENO[®]3200 Datalogger.
- h. Tag and disconnect two ribbon cable connectors from ZENO[®]3200 Datalogger.
- i. Tag and disconnect four header connectors from ZENO[®]3200 Datalogger.
- j. Loosen four screws securing ZENO[®]3200 Datalogger to FDCU chassis.
- k. Lift ZENO[®]3200 Datalogger such that keyholes in mounting ears clear screw heads, and remove ZENO[®]3200 Datalogger.

4.9.2 **Installation**

- a. Position ZENO[®]3200 Datalogger on FDCU chassis such that keyholes and notches in ZENO[®]3200 Datalogger mounting ears are positioned over four screws in FDCU chassis.
- b. Tighten four screws to secure ZENO[®]3200 Datalogger.
- c. Connect four header connectors to ZENO[®]3200 Datalogger.
- d. Connect two ribbon cable connectors to ZENO[®]3200 Datalogger connectors and secure using two captive screws each.
- e. Secure braided ground cable to ground connection at left edge of ZENO[®]3200 Datalogger, and tighten ground screw.
- f. Secure cables to ZENO[®]3200 Datalogger ears using cable ties.
- g. Reconnect FDCU battery leads.
- h. Close FDCU circuit breaker.
- i. Turn on FDCU AC Power switch.
- j. Remove used desiccant bag from FDCU enclosure.
- k. Place fresh desiccant bag in FDCU enclosure.
- l. Close FDCU enclosure cover and secure latches.



4.10 **FDCU SSEM**

4.10.1 **Removal**

- a. Loosen FDCU enclosure cover latches and open cover.

NOTE

Be sure to disconnect FDCU battery leads before opening FDCU AC Power switch. This prevents FDCU battery from supplying power to FDCU circuits when main AC power is removed, and so prolongs battery life.

- b. Disconnect FDCU battery leads.
- c. Turn off FDCU AC Power switch.
- d. Open FDCU circuit breaker.
- e. Rotate latch 1/4 turn and open FDCU left door.

CAUTION

SSEM consists of two individual circuit boards attached to a bracket. Boards are electrostatic discharge (ESD) sensitive.

- f. Disconnect communication link cable connector from SSEM.
- g. Tag and disconnect all cable connectors from SSEM.
- h. Remove four screws securing SSEM bracket to FDCU chassis, and remove SSEM.

4.10.2 **Installation**

- a. Ensure ribbon cable that connects to right side of SSEM is properly positioned under SSEM bracket channel, position SSEM on FDCU chassis, and secure using four screws.
- b. Connect all cable connectors to SSEM.
- c. Connect communication link cable connector to SSEM.
- d. Close FDCU left door, and rotate latch 1/4 turn to secure.



- e. Reconnect FDCU battery leads.
- f. Close FDCU circuit breaker.
- g. Turn on FDCU AC power switch.
- h. Remove used desiccant bag from FDCU enclosure.
- i. Place fresh desiccant bag in FDCU enclosure and date bags.
- j. Close FDCU enclosure cover and secure latches.

4.11 **FDCU Power Supply PS1**

4.11.1 **Removal**

- a. Loosen FDCU enclosure cover latches and open cover.

NOTE

Be sure to disconnect FDCU battery leads before opening FDCU AC Power switch. This prevents FDCU battery from supplying power to FDCU circuits when main AC power is removed, and so prolongs battery life.

- b. Disconnect FDCU battery leads.
- c. Turn off FDCU AC Power switch.
- d. Open FDCU circuit breaker.
- e. Rotate latch 1/4 turn and open FDCU left door.
- f. Rotate latch 1/4 turn and open FDCU right door.
- g. Loosen one screw in each of two Power Supply (PS1) end stops.
- h. Reach under PS1 and pull down release latch securing PS1 to mounting rail.
- i. Tag and disconnect wires from PS terminals (Terminals are spring tension type. There are no screws. To loosen wire connection, insert screwdriver in slot above wire and gently push handle forward.)
- j. Remove PS1.



4.11.2 **Installation**

- a. Position Power Supply (PS1) in FDCU enclosure.
- b. Connect wires to power supply terminals.
- c. Snap latch to secure PS1 to mounting rail.
- d. Reinstall both end stops snugly against PS, and tighten one screw in each.
- e. Close FDCU left door, and rotate latch 1/4 turn to secure.
- f. Close FDCU right door, and rotate latch 1/4 turn to secure.
- g. Reconnect FDCU battery leads.
- h. Close FDCU circuit breaker.
- i. Turn on FDCU AC Power switch.
- j. Remove used desiccant bag from FDCU enclosure.
- k. Place fresh desiccant bag in FDCU enclosure and date bags.
- l. Close FDCU enclosure cover and secure latches.

4.12 **FDCU Battery Charger PS2**

4.12.1 **Removal**

- a. Loosen FDCU enclosure cover latches and open cover.

NOTE

Be sure to disconnect FDCU battery leads before opening FDCU AC Power switch. This prevents FDCU battery from supplying power to FDCU circuits when main AC power is removed.

- b. Disconnect FDCU battery leads.
- c. Turn off FDCU AC Power switch.
- d. Open FDCU circuit breaker.
- e. Rotate latch 1/4 turn and open FDCU right door.
- f. Tag and disconnect wires from battery charger terminals.



- g. Remove four screws securing battery charger to FDCU enclosure, and remove battery charger.

4.12.2 **Installation**

- a. Position battery charger in FDCU enclosure and secure using four screws.
- b. Connect wires to battery charger terminals.
- c. Close FDCU right door, and rotate latch 1/4 turn to secure.
- d. Reconnect FDCU battery leads.
- e. Close FDCU circuit breaker.
- f. Turn on FDCU AC Power switch.
- g. Remove used desiccant bag from FDCU enclosure.
- h. Place fresh desiccant bag in FDCU enclosure and date bags.
- i. Close FDCU enclosure cover and secure latches.

4.13 **FDCU Fuses**

4.13.1 **Removal**

- a. Loosen FDCU enclosure cover latches and open cover.
- b. Visually check for blown fuse (indicated by lit fuse holder cap).

NOTE

Be sure to disconnect FDCU battery leads before opening FDCU AC Power switch. This process prevents FDCU battery from supplying power to FDCU circuits when main AC power is removed.

- c. Disconnect FDCU battery leads.
- d. Turn off AC Power switch.
- e. Open FDCU circuit breaker.
- f. Turn fuse holder cap 1/4 turn counterclockwise, and pull cap with fuse away from FDCU holder door.
- g. Pull fuse from fuse holder cap.



4.13.2 **Installation**

- a. Place fuse in fuse holder cap.
- b. Insert fuse holder cap into fuse holder, and turn 1/4 turn clockwise.
- c. Reconnect FDCU battery leads.
- d. Close FDCU circuit breaker.
- e. Turn on AC Power switch.
- f. Remove used desiccant bag from FDCU enclosure.
- g. Place fresh desiccant bag in FDCU enclosure and date bag.
- h. Close FDCU enclosure cover and secure latches.

4.14 **FDCU Sight Glass and Desiccant**

4.14.1 **Removal**

- a. Loosen FDCU enclosure cover latches and open cover.

NOTE

Be sure to disconnect FDCU battery leads before opening FDCU AC Power switch. This prevents FDCU battery from supplying power to FDCU circuits when main AC power is removed.

- b. Disconnect FDCU battery leads.
- c. Turn off AC Power switch.
- d. Disconnect tubing from desiccant sight glass fittings.
- e. Remove two screws securing sight glass bracket to FDCU right door, and remove sight glass.
- f. Remove three screws from top of sight glass, and remove sight glass top cover.
- g. Empty desiccant from sight glass, ensuring all desiccant debris is removed.



NOTE

Do not lose mesh screen gaskets.

- h. Dispose of desiccant per local regulations.
- i. If necessary, clean corrosion from sight glass and fittings.

4.14.2 Installation

- a. Position mesh screen gasket in *bottom* of sight glass.
- b. Fill sight glass with fresh desiccant.
- c. Position mesh screen gasket and cover on top of sight glass and secure using three screws.
- d. Position sight glass on FDCU right door and secure using two screws.
- e. Reconnect tubing onto desiccant sight glass fittings.
- f. Reconnect FDCU battery leads.
- g. Turn on AC Power.
- h. Remove used desiccant bag from FDCU enclosure.
- i. Place fresh desiccant bag in FDCU enclosure and date bag.
- j. Close FDCU enclosure cover and secure latches.

4.15 FDCU Pressure Port

4.15.1 Removal

- a. Loosen FDCU enclosure cover latches and open cover.

NOTE

Be sure to disconnect FDCU battery leads before opening FDCU AC Power switch. This prevents FDCU battery from supplying power to FDCU circuits when main AC power is removed.

- b. Disconnect FDCU battery leads.



- c. Turn off FDCU AC Power switch.
- d. Open FDCU circuit breaker.
- e. Disconnect tubing from pressure port fitting.
- f. Loosen bottom feed-through fitting securing pressure port on plug, and remove pressure port.
- g. Loosen top feed-through fitting, and remove plug and fitting from FDCU.

4.15.2 **Installation**

- a. Ensure pressure port is not blocked with dirt or debris and clean using water, if necessary.
- b. Position plug and top feed-through fitting in FDCU, and tighten fitting to secure.
- c. Position bottom feed-through fitting and pressure port on plug, and tighten fitting to secure.
- d. Inspect condition of tubing. If brittle or cracked, replace with new tubing cut to proper length.
- e. Connect tubing to pressure port.
- f. Reconnect FDCU battery leads.
- g. Close FDCU circuit breaker.
- h. Turn on FDCU AC Power switch.
- i. Remove used desiccant bag from FDCU enclosure.
- j. Place fresh desiccant bag in FDCU enclosure and date bag.
- k. Close FDCU enclosure cover and secure latches.

4.16 **DPU Server**

4.16.1 **Removal**

- a. Close all open applications on the server.
- b. Click “Start” in the lower left corner of the screen.
- c. Click “Shutdown” when options appear.
- d. When pop-up appears, add comment then select “OK”.
- e. Tag and disconnect cables from server rear panel.



4.16.2 **Installation**

WARNING

EXERCISE CAUTION WHEN HANDLING THE SERVER. TWO PEOPLE MAY BE REQUIRED.

- a. Connect cables to server rear-panel connectors.
- b. Server should power up automatically. If not, press power button on front of server.

SAMPLE



SECTION 5 - RLIM

5.1 Main Components

The RLIM is housed in a metal enclosure and has the following main components:

Power Supply

Microprocessor Board

Serial Programming Interface Port

Serial Communication Port

Current Clamp

Sensor Inputs

ARS Input

5.1.1 Power Supply

This converts the input of 100V to 240VAC 50/60Hz to 15VDC. Other supplies on the board convert this into 12vdc, 10vdc and 5vdc. All are needed to power the microprocessor board. Typical current draw is less than 0.5 amperes.



Figure 5-1 – Power Supply



5.1.2 Microprocessor Board

Microchip PIC 18F8720 or equivalent, industrial embedded control board. This board incorporates many of the components of the RLIM system.

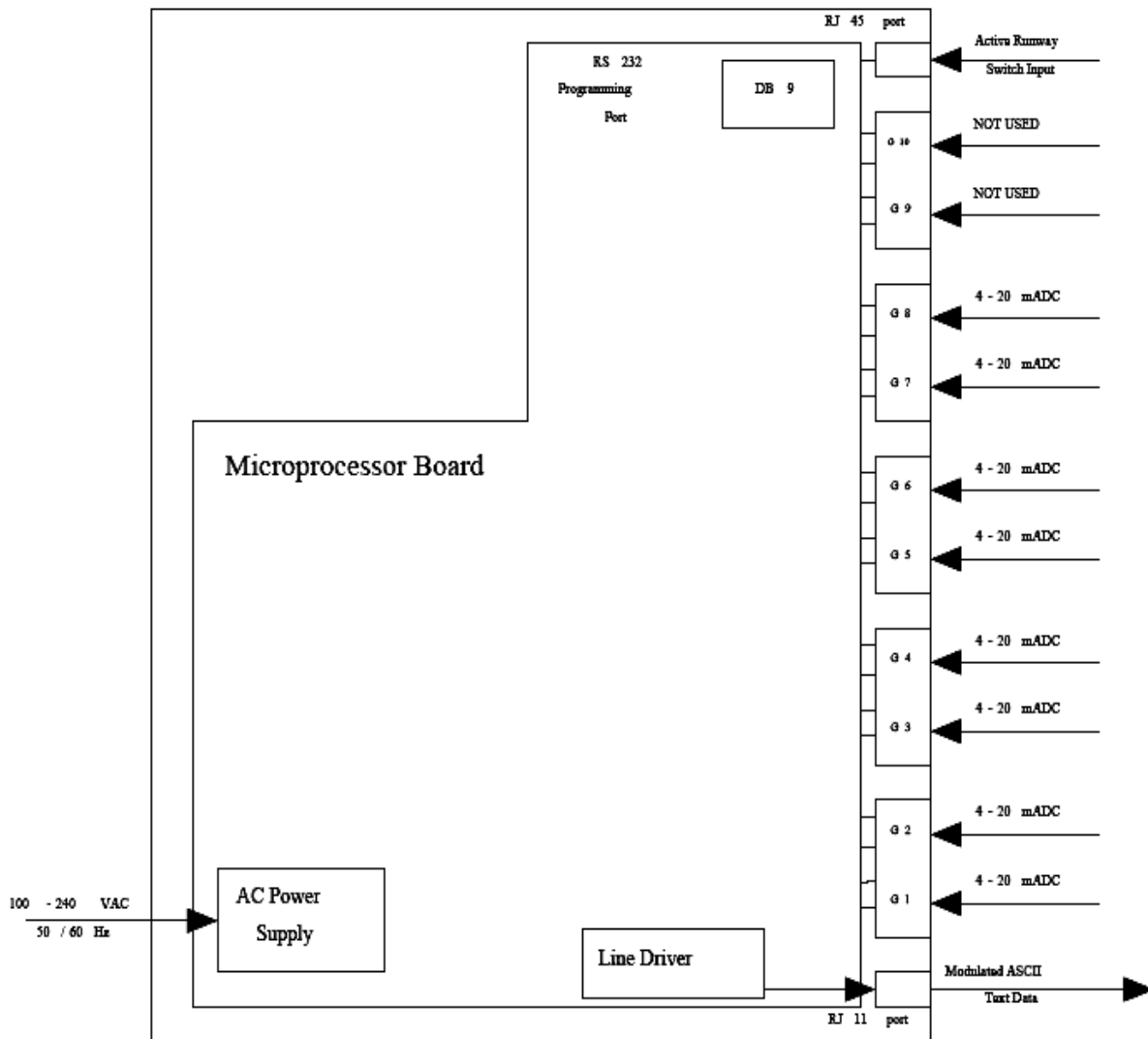


Figure 5-2 – Microprocessor Board



5.1.3 **Serial Programming Interface Port**

This standard RS232 interface is used to initially program the specific message output that the RLIM will generate in response to the input signals. This port is not used during normal operations as programming occurs during initial installation and generally does not need to be configured again. This port is provided on the Microprocessor board as a standard serial interface to any PC, laptop or RS232 terminal device. A common connection is established using a windows based laptop and windows® HyperTerminal® software configured to 9600 baud,8N1. A standard Serial DB9 (male to female) cable is required to communicate with the port.

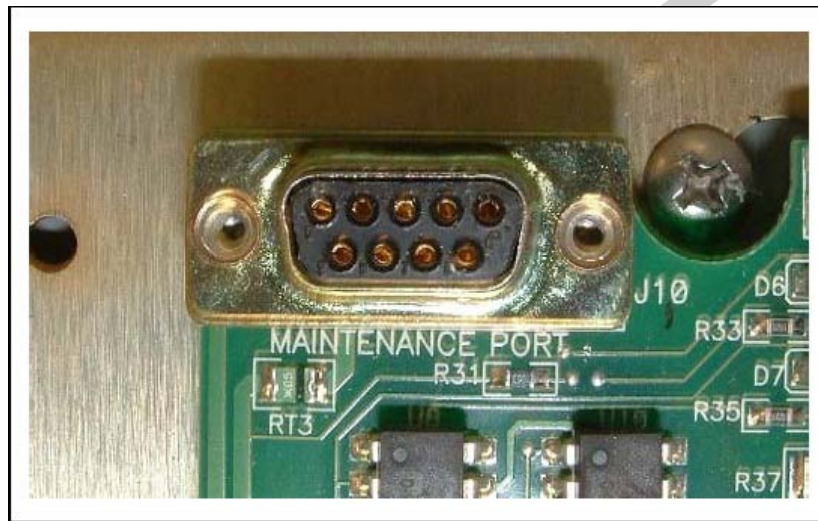


Figure 5-3 – Serial Programming Interface Port

5.1.4 **Serial Communication Port**

This port provides a serial interface with a Modem. Either twisted wire pairs or fiber optic cable carries messages related to the detected runway lighting levels and Active Runway Heading to the server for system processing.

5.1.5 Current Clamps

The PCS series of current clamps are AC only current sensors that measure the RMS level of the current passing through the aperture. These sensors provide electrical isolation between the light loop circuit being measured and the output. These sensors are clamped around the out going supply cables that run directly to the airfield lights being monitored. They detect the amount of current flowing though the cable and output a DC current, 4-20mA, proportional to the sensed current.



Figure 5-4 – Current Clamp



5.1.6 Input/Output

The Current Clamp inputs are channels 1-8. *Channel 9 & 10 are not used.* They are configured to receive a 4-20mA DC signal. These inputs are programmed during installation, the procedure is found in section 7, later in this manual.

The Active Runway Switch input is a RJ45 jack and is monitoring pins 1&2 for runway 1 and 7&8 for runway 2. The input detects a voltage polarity across the pins.

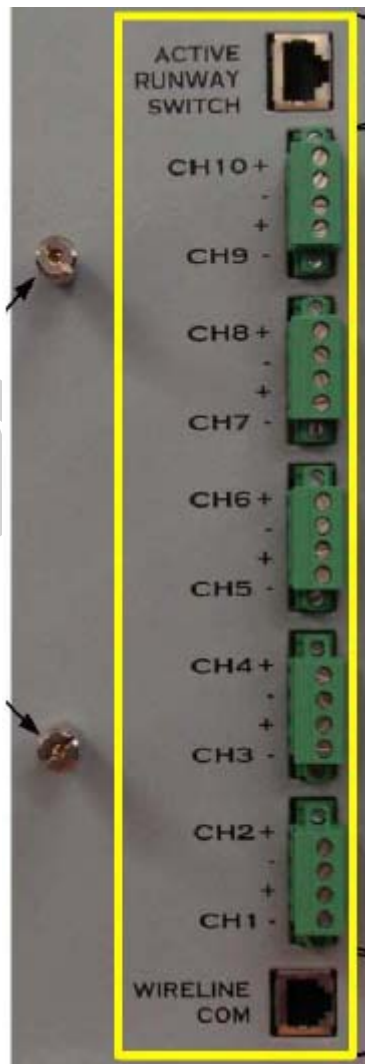


Figure 5-5 – Input/Output Terminals



5.1.7 Active Runway Switch

The “Active Runway Switch” or ARS interface is used when the active runway cannot be automatically detected. The input is from a switch mounted in the ATCT and is physically switched by the tower personnel. The switch inverts the polarity of the +12 VDC signal depending on the position it is in. It is connected to the RLIM via one unconditioned twisted copper telephone pair. The polarity of the voltage is detected by the RLIM electronics. The RLIM then transmits its data to the Server via the modem port.

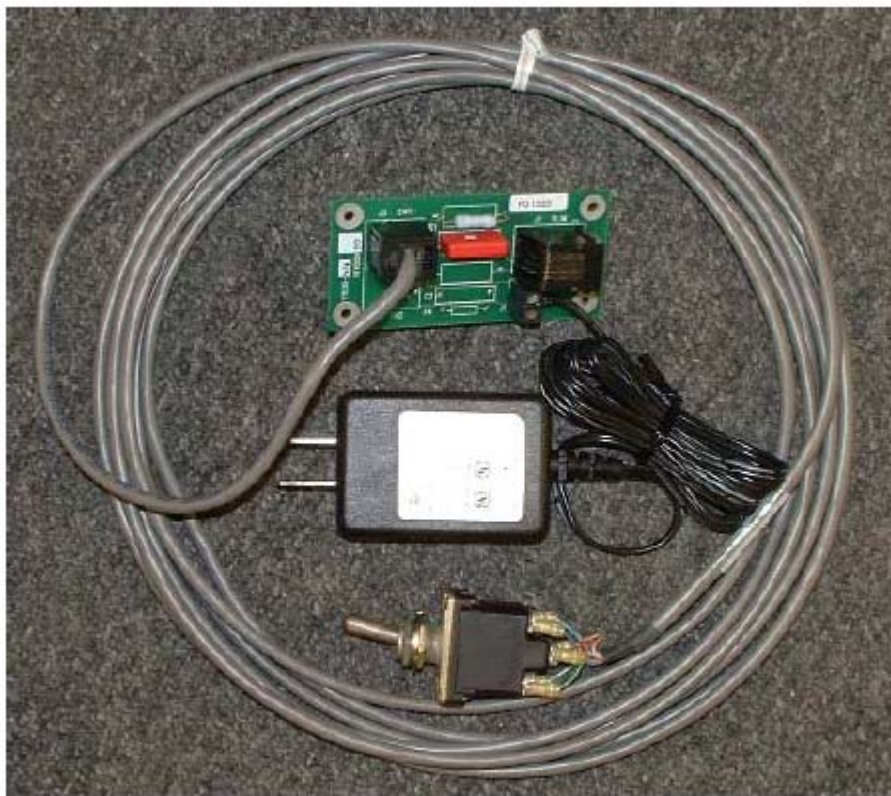


Figure 5-6 – Active Runway Switch



5.2 **Block Diagrams**

5.2.1 **Signal Path, Passive RLIM with edge/center lights and ARS (Single Runway)**

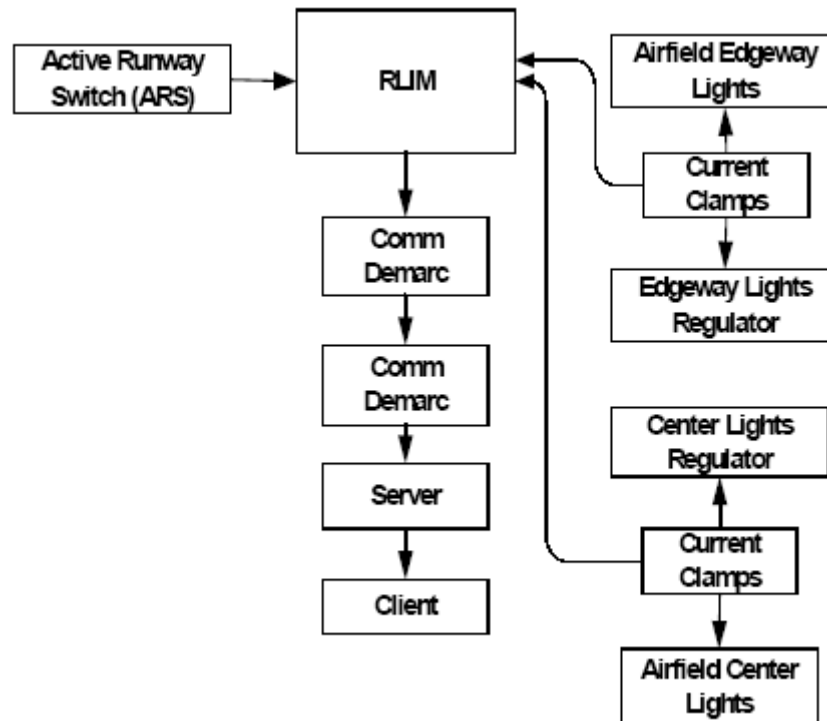


Figure 5-7 – Signal Path with ARS

There are two inputs into the RLIM. The ARS switch will receive a 12VDC signal, and Channels 1-8 are waiting for a 4-20mADC signal.

The RLIM outputs an ASCII text string that is modulated by the Line driver (modem) then transmitted over one unconditioned twisted copper telephone pair or fiber optic cable. The data is demodulated and processed at the server



5.2.2 Signal Path, Passive RLIM with edge/center lights and PAPI lights (Single Runway)

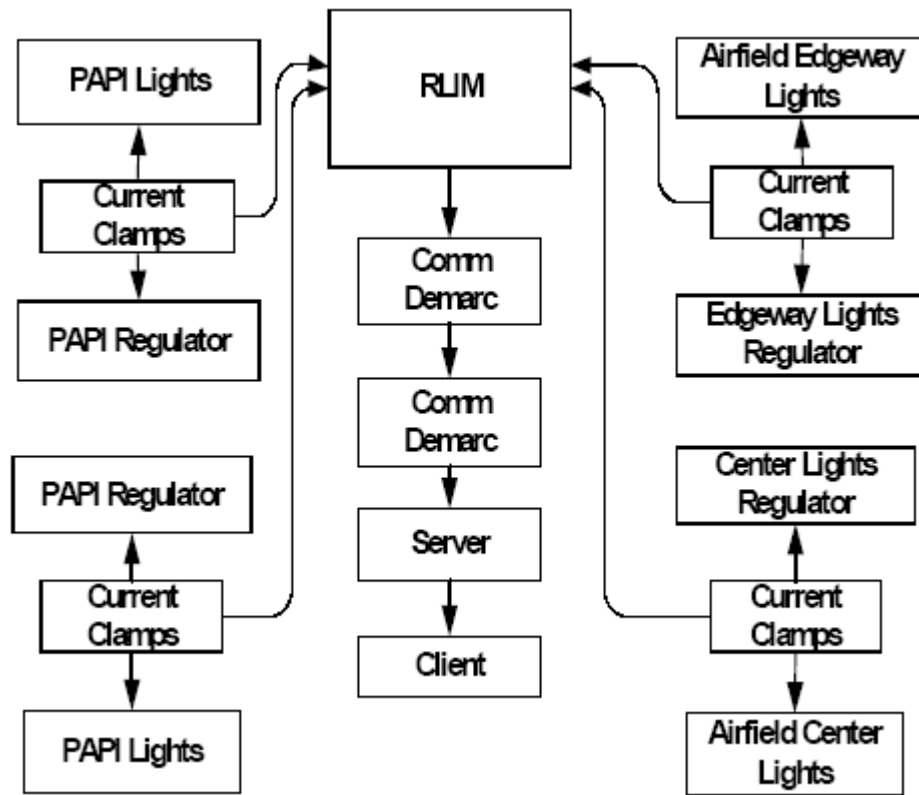


Figure 5-8 – Signal Path with PAPI Lights

There are 4 inputs into the RLIM. They are all current clamps and are a 4-20mADC signal.



5.3 **Operating Specifications**

The RLIM is powered by means of a 100-240V 50/60Hz single-phase fused AC mains source provided by the host facility. Maximum current consumption is less than 0.5 amperes. The unit has no power switch so it cannot be accidentally turned off. Switch off the AC power source at the breaker panel to de-energize the RLIM.

Power input:	100-240 VAC 50/60Hz
Current input:	< 0.5 Amperes max.
Programming port baud rate:	9600 baud, 8 N 1
Message port baud rate:	9600 baud, 8 N 1
Channels 1-8 (current clamp):	4-20 mADC
Active Runway Switch (ARS):	+12 VDC

5.4 **Menu Structure**

The RLIM is configured using a menu structure, which is accessible via the RS232 maintenance port on the processor CPU board. Any ASCII terminal can be used to configure the RLIM.

5.5 **Main Menu**

The Main Menu provides access to the other menus. All menu items can be activated from any submenus. Therefore, once the menu items have been memorized there is no need to use the submenus.

Main Menu	
(S) System Menu	(E) Save Parameters to EEPROM
(L) Control Loops Menu	(D) Diagnostic Menu
(V) Program Version	(Q) Quit

Figure 5-9 – Main Menu



5.5.1 **System Menu**

The (S) System Menu is where system wide configurations are entered. You access this menu by typing “ S “ from the main menu

System Menu

(Cn /m) Change Item n to Value m

(M) Main Menu

(L) Loops Control Menu

(I) Input Configuration

(Gn) Set Levels for Sensor n

(Q) Quit

(E) Save Parameters to EEPROM

(D) Diagnostic Menu

(O) Output Configuration

(1) RLIM / ARS identifier : RLIM

(2) Loop Sensor Type (R,C): C

(3) Runway 1 name : RLIM

(4) Number of Sensors : 1

(5) First Position runway heading : 18

(6) Second Position runway heading : 36

(7) Runway 2 name :

(8) Number of Sensors : 0

(9) First Position runway heading :

(10) Second Position runway heading :

Figure 5-10 – System Menu



5.5.2 Control Loops Menu

The (L)Control Loops Menu is where the configuration for the individual current sensors is entered and maintained. It is used to configure each sensor for the type of light it is monitoring. Each sensor is tied to a loop of lights, Edge, Center or Active Heading.

The setup below shows Edge lights configured for Sensor 1 input, Center lights configured for Sensor 2 and Active Heading configured for Sensors 3 and 4.

Control Loops Menu	
(Cn/m)Change Item n to Value m	(O)Quit
(M)Main Menu	(E)Save Parameters to EEPROM
(S)System Menu	(D)Diagnostics Menu
(1)Sensor 1 location (E, C, A, N): E	
(2)Sensor 2 location (E, C, A, N): C	
(3)Sensor 3 location (E, C, A, N): A	
(4)Sensor 4 location (E, C, A, N): A	
(5)Sensor 5 location (E, C, A, N): N	
(6)Sensor 6 location (E, C, A, N): N	
(7)Sensor 7 location (E, C, A, N): N	
(8)Sensor 8 location (E, C, A, N): N	

Figure 5-11 – Control Loops Menu

5.5.3 Version Menu

(V)Version Menu will display the version of the firmware currently installed & running.

Runway Light Intensity Monitor	
Firmware Version	2.1 @ CES
Press ENTER to continue	

Figure 5-12 – Version Menu



5.5.4 **Save Parameters to EEPROM**

(E)Save Parameters to EEPROM will save the current configuration into non-volatile memory. You must save the changes into the EEPROM every time you affect a change. If you do not save the changes and power to the RLIM is removed, your configuration will revert back to the last EEPROM save.

5.5.5 **Quit**

(Q)Quit exits out of the main menu.

5.5.6 **Diagnostic Menu**

(D)Diagnostic Menu is for assisting with the installation, testing and troubleshooting the RLIM and its sensors.

5.5.7 **DPU Comm Test**

(P)DPU Comm Test is for Factory testing.

5.5.8 **Sensor Value**

(A) Sensor Values displays all sensors in a list by sensor number, sensor name, type of light, raw A/D value and light step. This is the display for Current sensor setup.

Figure 5-13 shows Sensor 1 edge lights at level 3 and Sensor 3 Active approach at level 1.

Sensor 1	RLIM	E	570	3
Sensor 2	RLIM	N	0	0
Sensor 3	RLIM	A	443	1
Sensor 4	RLIM	A	0	0
Sensor 5	RLIM	N	0	0
Sensor 6	RLIM	N	0	0
Sensor 7	RLIM	N	0	0
Sensor 8	RLIM	N	0	0

Press ENTER to continue

Figure 5-13 – Sensor Value



5.5.9 **Raw A/D Values**

(R)Raw A/D Values are the A/D values that the RLIM uses to compute light settings and are for factory use only.

5.5.10 **Bit Messages**

(B) Bit Messages Returns all active bite messages to the terminal display. If there are no active bit messages the message “No BIT Message” is returned.

Some of the bit messages that can be generated are listed below:

Low AC Voltage

ARS Err Both high

ARS Err Both low

ARL Err Both off

ARL Err Both on

5.5.11 **Display Relay and ARS Bits**

(Y)Display Relay and ARS Bits menu is not used.

5.5.12 **Reset to factory Defaults**

(F)Reset to factory Defaults sets the RLIM back to a known default state. This is used when the RLIM configuration is corrupted or needs to be reprogrammed and a known state must be verified.



5.6 **Programming**

Programming the RLIM is essential for correct data flow to the server. The serial RS232 connection using the maintenance port is setup by selecting 9600 baud, 8, N, 1, no flow control. The DB9 female connector of the RLIM maintenance port will connect with a PC serial port using a straight serial DB9F to DB9M extension cable.

(Cn/m) Change Item n to Value m command. This is the command line syntax to make changes in this software.

C = this tells the RLIM that you are going to make a change

n = this represents a number... all possible user changes will be identified with a number inside of parenthesis. ie: (1) or (6)

/ = separates item to be changed and item to change to

m = this represent a value, it can be alpha or numeric and is what your changing the "n" to

Example:

To change (3)Runway 1 name: RLIM to RL18 in the System menu:

Type C3/RL18 <enter>

When multiple runways are to be monitored, attention must be given to which sensors are assigned to each runway by the RLIM using the <A>Sensor Values menu.

Example Configuration

<S>System menu is used to setup the RLIM to match the Runway configuration.

-> S

System Menu

(Cn/m)Change Item n to Value m (Q)Quit

(M)Main Menu

(E)Save Parameters to EEPROM



(L)Control Loops Menu (D)Diagnostic Menu
(I)Input configuration (O)Output configuration
(Gn) Set Levels for Sensor n

- (1)RLIM/ARS identifier: RLIM
- (2)Loop Sensor Type (R, C): C
- (3)Runway 1 name: RL18
- (4) Number of sensors: 1
- (5) First position runway heading: 18
- (6) Second position runway heading: 36
- (7)Runway 2 name: RL12
- (8) Number of sensors: 1
- (9) First position runway heading: 12
- (10) Second position runway heading: 30

Item (1) RLIM/ARS identifier: RLIM (Typical)

Item (2) Set to "C" Current Clamps

Item (3) Match the "Runway Heading" eg. RL18

Item (4) This will be set to 1 if monitoring Edge **OR** Center or set to 2 if monitoring Edge **AND** Center.

Item (5) Set to Primary runway heading

Item (6) set to Runway rollout Heading

(For 2 runway monitoring, set 7 - 10, else leave blank.)

Item (7) Match the "Runway Heading" eg. RL12

Item (8) This will be set to 1 if monitoring Edge **OR** Center or set to 2 if monitoring Edge **AND** Center.

Item (9) Set to Runway 2 Primary heading

Item (10) Set to Runway 2 Rollout heading



Using the <A>Sensor Values command, the RLIM will show which sensor it has assigned to each runway.

-> A

Sensor 1	RL18	E	796	5
Sensor 2	RL12	E	0	0
Sensor 3	FREE	N	0	0
Sensor 4	FREE	N	0	0
Sensor 5	FREE	N	0	0
Sensor 6	FREE	N	0	0
Sensor 7	FREE	N	0	0
Sensor 8	FREE	N	0	0

Press ENTER to continue

Using the <L>Control Loops menu command, setup the sensors to the appropriate type.

E = Edge

C = Center

A = Active Heading

N = None

If PAPI lights are being monitored they require 2 sensors, 1 for each heading

-> L

Control Loops Menu

(Cn/m)Change Item n to Value m (Q)Quit

(M)Main Menu

(E)Save Parameters to EEPROM

(S)System Menu

(D)Diagnostic Menu

(1)Sensor 1 Location (E, C, A, N): E

(2)Sensor 2 Location (E, C, A, N): N

(3)Sensor 3 Location (E, C, A, N): N

(4)Sensor 4 Location (E, C, A, N): N



- (5)Sensor 5 Location (E, C, A, N): N
- (6)Sensor 6 Location (E, C, A, N): N
- (7)Sensor 7 Location (E, C, A, N): N
- (8)Sensor 8 Location (E, C, A, N): N

After setup...

-> L

Control Loops Menu

(Cn/m)Change Item n to Value m (Q)Quit

(M)Main Menu

(E)Save Parameters to EEPROM

(S)System Menu

(D)Diagnostic Menu

- (1)Sensor 1 Location (E, C, A, N): E
- (2)Sensor 2 Location (E, C, A, N): E
- (3)Sensor 3 Location (E, C, A, N): A
- (4)Sensor 4 Location (E, C, A, N): A
- (5)Sensor 5 Location (E, C, A, N): A
- (6)Sensor 6 Location (E, C, A, N): A
- (7)Sensor 7 Location (E, C, A, N): N
- (8)Sensor 8 Location (E, C, A, N): N

-> A

Sensor 1	RL18	E	796	5
Sensor 2	RL12	E	0	0
Sensor 3	RL18	A	0	0
Sensor 4	RL18	A	0	0
Sensor 5	RL12	A	0	0
Sensor 6	RL12	A	0	0
Sensor 7	FREE	N	0	0
Sensor 8	FREE	N	0	0

Press ENTER to continue



5.7 **Calibration**

(Gn)Set Levels for Sensor n

This menu is where the RLIM is calibrated to the light levels used. Every lighting system is unique and this provides a method of configuring the RLIM to the needs of the location.

Calibration is achieved by querying the sensor at each light intensity level. Recording the value received in the corresponding field. The threshold values must be calculated and inserted by hand for each queried light intensity level.

Place the lighting system in the OFF position. Query the sensor with the “g1” command. This value will be inserted into “Level 0” with the “c1/value” command. Continue by incrementing the lighting intensity levels and querying the sensor then writing the value to the corresponding level.

After all of the levels have been written, the thresholds must be calculated and entered. The calculation is as follows: $((\text{Level 1}) - (\text{Level 0}))/2 + (\text{Level 0})$. This will set the threshold near the middle of the range between the two levels.

Example: $((272)-(164))/2 + (164) = 218$

This process is required for each sensor in the system.

Typing “g1” will query sensor 1, “g2” will query sensor 2 and so on.

When the current clamps sense no current, they produce 4mADC. This will produce a value of ~164, which can drift slightly but should never trigger the RLIM to produce a faulty reading when the threshold values are set properly.



```
g1
Level Menu Channel      1 164
( 1)Level 0: 164
( 2)  Threshold  : 303
( 3)Level 1: 443
( 4)  Threshold  : 472
( 5)Level 2: 502
( 6)  Threshold  : 536
( 7)Level 3: 570
( 8)  Threshold  : 626
( 9)Level 4: 682
(10)  Threshold  : 747
(11)Level 5: 812
```

Figure 5-14 – Light Levels

5.8 **Output Messages**

The RLIM will output a formatted message for one or more configured runways. An example is shown below. This is the message that is sent to the server via the modem port.

```
± KTDAURLIMmetml±mÖRLIM.active_heading 18
      RL18.edge_lights_level 1
      RL18.center_lights_level 0
```



5.9 Active Runway Switch

The active runway switch is a module that incorporates a 12VDC power supply, circuit card with connectors for power input, output and switch connections. One or two DPST switches are connected depending on the number of runways that are configured. +12 VDC is applied to pins 3 & 4 and GND applied to pins 1 & 6 of J3 and J4 (switch connectors). This allows the switch to reverse the polarity on the output of J2, pins 1/2 and 7/8 when two switches are used. This output is connected to the RLIM Active Runway Switch input.

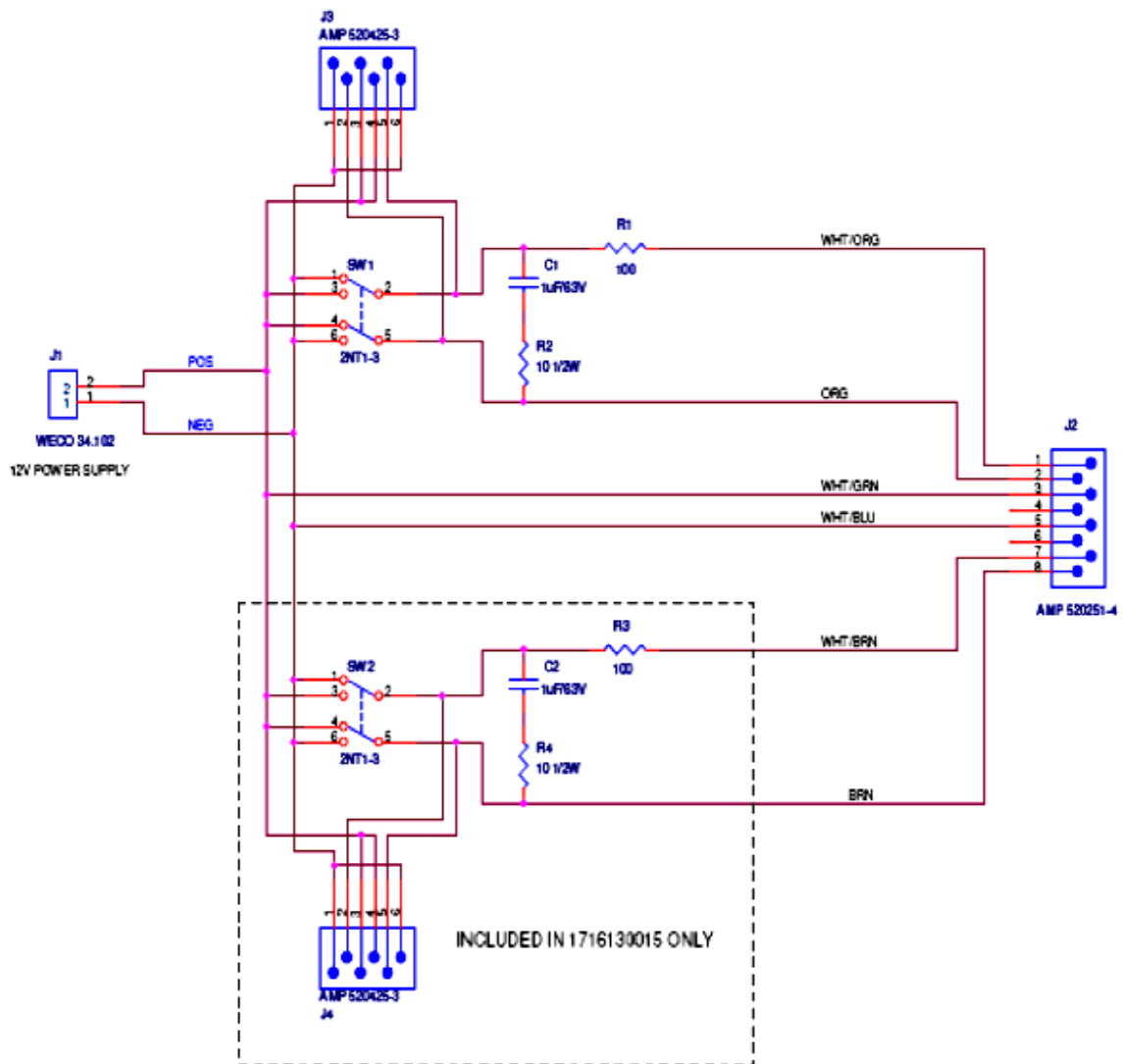


Figure 5-15 – Active Runway Switch



SECTION 6 - PARTS LIST

6.1 Introduction

The parts list is provided to assist supply and maintenance personnel in the identification, requisition, and stocking of replaceable parts. Maintenance should be performed by authorized personnel using the appropriate maintenance procedures in this manual.

6.2 MAINTENANCE PARTS LIST

The maintenance parts list consists of a top-down breakdown of maintenance-related parts for the assembly. The parts lists contain all parts coded for replacement at the applicable maintenance level, all parts that must be removed, disconnected, or handled to gain access to replaceable parts, and all assembly part numbers required to show relationship (indenture) to their next higher assemblies.

6.2.1 Part Number Column

This column lists the Coastal part numbers for each part.

6.2.2 Description Column

This column lists the item names and modifiers required to adequately identify the parts.



6.3 **Parts List**

Table 6-1 – DPU Parts List

Item	Part Number	Description
1	2025-000-075	COMPUTER, SERVER, DELL, T-105
2	1201-130-033	UNINTERRUPTIBLE POWER SUPPLY
3	2025-000-076	MONITOR, COMPUTER, 22INCH
4	6016-000-030	CORD, POWER, 220VAC, W/C13 CONN, UK
5	2070-000-130	CARD, PCI-E, SERIAL, 4 PORT RS-232, DE-9
6	2070-000-130	CARD, PCI-E, SERIAL, 4 PORT RS-232, DE-9
7	2150-000-043	MODEM, FO, SM, 1310NM, TERM, RS232, 115V
8	4050-000-087	POWER SUPPLY, 100-240VAC, 12VDC, 30W

Table 6-2 – Present Weather Sensor Parts List

Item	Part Number	Description
9	2930-000-312	SENSOR, PRESENT WEATHER, PWD-22,
10	6003-153-002	CABLE, SENSOR, FDCU TO VISIBILITY/ALS
11	2109-000-139	CONN, 26482, PLUG, STRT, 12POS, 14, PW

Table 6-3 – Ceilometer Parts List

Item	Part Number	Description
12	2930-000-460	SENSOR, CEILOMETER, CL-31, 230VAC
13	6003-144-020	CABLE, AWOS, FDCU TO JBOX, CLOUD SIG
14	2150-000-043	MODEM, FO, SM, 1310NM, TERM, RS232, 115V

Table 6-4 – AT/RH Sensor Parts List

Item	Part Number	Description
15	1220-153-005	SENSOR, AT/RH, ASPIRATED, NO SW



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Table 6-5 – Rain Gauge Parts List

Item	Part Number	Description
16	2930-000-438	SENSOR, PRECIP, TIPPING BUCKET, 200MM
17	2109-000-163	CONN, 26482, PLUG, STRT, 5POS, 14, P, SR

Table 6-6 – Lightning Sensor Parts List

Item	Part Number	Description
18	1220-153-006	ASSY, SENSOR, LIGHTNING DET, L3, WX-500
19	6003-150-002	CABLE ASSY, LMOS, LIGHTNING SENSOR
20	2109-000-831	CONN, 26482, PLUG, STRT, 5POS, 14, SW

Table 6-7 – Visibility Sensor Parts List

Item	Part Number	Description
21	2930-000-444	SENSOR, VISIBILITY, PWD-20, W/ AMB LIGHT
22	6003-153-002	CABLE, SENSOR, FDCU TO VISIBILITY/ALS
23	2109-000-139	CONN, 26482, PLUG, STRT, 12POS, 14, PW

Table 6-8 – Solar Radiation Sensor Parts List

Item	Part Number	Description
24	2930-000-053	SENSOR, SOLAR RAD PYRANOMETER
25	2109-000-163	CONN, 26482, PLUG, STRT, 5POS, 14, P, SR

Table 6-9 – Wind Sensor Parts List

Item	Part Number	Description
26	2930-000-321	SENSOR, WIND, S&D, ULTRASONIC, H, OPT 3
27	6003-153-001	CABLE, WIND SONIC TO FDCU, ANA/SER
28	2109-000-108	CONN, 26482, PLUG, STRT, 12POS, 14, P



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Table 6-10 – RLIM Parts List

Item	Part Number	Description
29	1201-130-073	FASSY, RLIM, CURRENT SENSOR
30	2150-000-043	MODEM, FO, SM, 1310NM, TERM, RS232, 115V
31	4050-000-104	POWER SUPPLY, SW, 30W, 85-265IN, 15V@2A

Table 6-11 – FDCU Parts List

Item	Part Number	Description
32	2930-000-464	SENSOR,BARO,RMY, 0-5, 500-1100, 0.3MB
33	2531-000-031	PRESSURE PORT
34	2531-130-002	ASSY, DESICCANT AND FIXTURES
35	1220-000-002	SASSY, SIGHT GLASS (DESICCANT TRAP)
36	1602-000-011	SILICA GEL, INDICATING, GRANULES
37	3315-000-030	TUBING, SILICONE, 1/8ID, 1/4OD, 50D, RED
38	6003-153-006	CABLE, AWOS, AC POWER, FDCU, 220VAC
39	2150-000-043	MODEM, FO, SM, 1310NM, TERM, RS232, 115V
40	4302-000-006	FUSE, SLOW, 1 ¼ X ¼, 250V, 5AMP, 3AG
41	4302-000-109	FUSE, SLOW, 1 ¼ X ¼, 250V, 2.5AMP, 3AG
42	4301-000-201	FUSE, SLOW, 1 ¼ X ¼, 250V, 1AMP, 3AG
43	1602-000-033	DESICCANT, 1/6 UNIT, SILICA GEL
44	3903-000-035	BATT, LEAD ACID, 34AH, DEEP CYCLE, SEALED
45	1220-144-001	ASSY, AWOS, ZENO 3200A
46	1220-144-002	ASSY, AWOS, SSEM
47	1201-116-177	FASSY, Z3200, 4/20A CHARGER, 14-20VIN
48	4050-000-066	POWER SUPPLY, SW, 14.5V, 20A OUT, -40C