

Model 6490 Present Weather Sensor



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User's
Manual

Rev. E



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Latest Manual Version

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Revision History

Revision	Date	Summary of Changes
E	2011 Oct 31	Removed references to OEM part numbers, replaced installation drawing with diagrams in the Installation chapter, and better explained options and wiring details

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1. OVERVIEW

The Model 6490 Present Weather Sensor optically measures precipitation-induced scintillation and applies algorithms to determine the precipitation occurrence, type, and rate automatically. The sensor is superior to more traditional sensors and offers reliability and proven performance.

The Model 6490 Present Weather Sensor measures precipitation by detecting the optical irregularities — known as scintillations — induced by particles falling through a beam of partially coherent infrared light in the sample volume. The induced scintillations are related to the characteristics to the precipitation, and the precipitation rate is determined based on the intensity of these scintillations. In turn, the precipitation rate can be used to determine precipitation accumulation. The frequency spectrum of the induced scintillation is analyzed to determine the type of precipitation.

The Model 6490 Present Weather Sensor provides accurate precipitation measurements in all weather conditions. Designed for rugged, unattended operation, these sensors have been field-proven in adverse environments around the world in locations such as Antarctica, Europe, the Far East, and North America.

Precipitation types:

- Drizzle
- Rain
- Snow
- Precipitation
- Freezing Rain
- Freezing Drizzle

1.1 MODELS

Three 6490 models are available.

Model	Description
6490 (standard for North America)	115 V/230 V AC
6490-A (with heater for AWSS installations)	115 V AC
6490-I (standard for outside North America)	115 V/230 V AC

The Model 6490-I Present Weather Sensor is described in detail in the *Model 6490-I Present Weather Sensor User's Manual*.

1.2 ACCESSORIES

The following accessories and replacement parts are available for the Model 6490 Present Weather Sensor.

Part Number	Description
M488173-01	Present Weather Sensor Standalone Mounting Kit
M488176-01	Present Weather Sensor Tandem Mounting Kit (to mount Present Weather Sensor on same mast as Model 1190 Data Collection Platform)
M488181	Optional Heater Kit (already included with Model 6490-A)
M404806	Serial Sensor Interface Board
M442071	10 A 250 V, 5x20 mm slow blow fuse (F1—AC Interface Board)
M442070	5 A 250 V, 5x20 mm slow blow fuse (F2—AC Interface Board — used with 230 V setting)

An optional rechargeable backup battery kit (AWI part number 11903, housed in the nearby Model 1190 Data Collection Platform) is available to power the Model 6490 Present Weather Sensor and the Model 1190 Data Collection Platform in the event of an AC power failure.

2. SYSTEM DESCRIPTION

2.1 MAJOR COMPONENTS

2.1.1 Sensor Head

The 6490 sensor head uses a compact optical system to measure precipitation.

The sensor head frame is an all-aluminum, welded design. The small box (TX) is the transmitter unit and contains an IRED diode and lens with dual heaters. The large box (RX) contains a receiver assembly consisting of a photo diode, lens with dual heaters, and preamplifier electronics.

The dual lens heaters prevent dew, frost, and snow from building up on the lenses, and are self-regulating devices. They are “on” continuously, drawing more current when the outside temperature is cold and less current when the temperature is warm. All wiring between the transmit and the receive heads is within the welded head frame. The sensor head is completely sealed from water intrusion at the factory. Exercise care should to avoid drilling or otherwise puncturing the frame.

Two integral cables with a length of 5 m are supplied as part of the sensor head frame — a transmit cable, P5, and an in-beam receive cable, P4. A green ground cable is provided to electrically ground the sensor head to the electronics enclosure.

A mounting plate, an integral part of the sensor head cross arm, is provided to install the head to a user-supplied mast. Two sets of holes in the mounting plate allow the U-bolts supplied with the head to clamp the head to either a vertical or horizontal pipe up to 50 mm in diameter.

Note:

The sensor head frame contains no user serviceable parts - opening the head will void the warranty!

2.1.2 Electronics Enclosure

The electronics enclosure contains the processing electronics, power supplies, and surge protection circuits.

The electronics enclosure is a fiberglass or stainless steel NEMA-4X type box with a hinged access door. Two power supplies, a controller card cage with five printed circuit boards, and AC and RS-485 interface modules with surge protection are mounted to the base plate of the enclosure. Figure 8 shows the locations of these components inside the enclosure.

All of the units in the enclosure are field-replaceable.

The electronics enclosure is mounted with the supplied fastener hardware using the four (4) mounting tabs on the enclosure.

Note:
Exercise care to avoid drilling or otherwise puncturing the electronics enclosure.

2.1.3 AC Interface Board

Two fuses are located on the AC Interface Board (see Figure 1). Though installed, fuse F2 is only used for the 6490-I. Replace the fuses only with fuses of the same rating, as shown below.

- F1 10 A 250 V, 5×20 mm slow blow
- F2 5 A 250 V, 5×20 mm slow blow (needed only for 230 V operation)

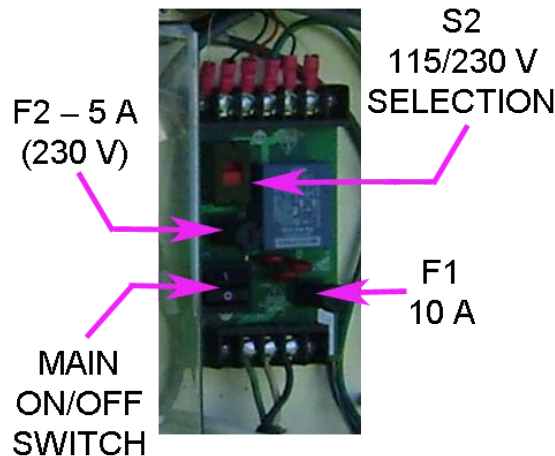


Figure 1. AC Interface Board

Note that there is a plastic safety shield over the AC Interface Board. This shield must be removed to access the fuses for replacement, and should be reinstalled once the fuse has been replaced.

3. THEORY OF OPERATION

3.1 SENSOR HEAD

The sensor head is a self-contained unit consisting of electro-optical components, heaters, and integral cabling to connect with the electronics enclosure.

The sensor measures precipitation by detecting the optical irregularities induced by particles falling through a beam of partially coherent infrared light (in the sample volume). These irregularities are known as scintillation. The twinkling of stars is a familiar example of scintillation. By detecting the intensity of the scintillations which are characteristic of precipitation, the precipitation rate is determined. By analyzing the frequency spectrum of the induced scintillation, the precipitation type (rain, snow, etc.) is determined. Precipitation is measured using the sensor head “in-beam” optics.

These components make up the sensor head.

- Transmitter
 - Infrared LED
 - Heated transmitter optical lens assembly
- Receiver
 - Heated receiver optical lens assembly
 - Photo detector and preamplifier assembly
- Integral Cables
 - 2 external cables for connection to electronics enclosure
 - Ground lug for electrical grounding

The transmitter portion of the sensor head uses an infrared LED as a light source that is modulated to eliminate interference in the system caused by background light. The LED has a very long life time, has a relatively low power draw, is invisible to the eye, and presents no radiation hazard to the user.

The LED is housed in the smaller of the sensor head boxes. A lens is used to collimate the LED's carrier-wave modulated light into a slightly diverged beam. The transmit and receive lenses are heated by dual self-regulating positive temperature coefficient thermistors to a temperature just above the ambient temperature to reduce dew, frost, and snow on the lenses.

The larger sensor head rectangular box houses the in-beam receive optics for present weather sensing and associated photodiode and preamplifier electronics. The in-beam light passes through a horizontal line aperture to increase the precipitation detection sensitivity to particles falling vertically.

Signals from the sensor head are carried in two separate cables to the electronics enclosure.

3.2 CONTROLLER

The Present Weather Sensor controller contains several components for power distribution, analog signal processing, and digital processing.

3.2.1 Controller Subassemblies

AGC Card

Automatically adjusts the signal level received from the sensor head and demodulates the precipitation-induced modulation signal from the carrier frequency.

SP1

Contains two elements, the carrier channel and the low channel. The carrier channel is used to diagnose the carrier signal strength. The low channel detects precipitation-induced frequencies in the range of 25 to 250 Hz, which are associated with snow.

SP2

Contains two elements, the particle-counting channel and the high channel. The particle channel detects the occurrence of falling precipitation. The high channel detects precipitation-induced frequencies in the range of 1 to 4 kHz, which are associated with rain.

TXM Card

Contains the voltage-controlled oscillator, which is amplified to drive the LED in the sensor head.

Microprocessor Card

Contains the A/D converter, sample and hold, and microprocessor control logic to sample the outputs of the signal processing cards. Determines the precipitation type and precipitation intensity using proprietary algorithms. The microprocessor also performs real-time self-tests to detect faults in the sensor on an ongoing basis and contains an RS-232 communication port.

Ancillary Subassemblies

There are two power supplies, a 12 V DC power supply and a DC/DC converter that provides regulated +5, +12, and -12 V DC to the analog and digital electronics. The lens heaters in the sensor head use 12 V DC from the DC/DC converter.

The AC input and RS-485 signal lines are fully protected from the lightning surges by surge suppression circuits. Surge suppression is also used at the termination points for the user AC and RS-485 connections.

A precision thermistor type temperature probe is attached to the bottom of the enclosure. It is used for automatic temperature compensation in the algorithm. The temperature measured by the probe is not meant for meteorological reporting.

4. INSTALLATION

4.1 SITING AND INSTALLATION GUIDELINES

The Model 6490 Present Weather Sensor may be installed almost anywhere outdoors. An area free and clear of obstructions and contamination sources will help insure good sensor performance.

In general, the sensor should be located on level or slightly sloping ground where the sensor site will be exposed to the same environment as the area around it. Ideally, the area around the site should be free of buildings, trees, and other obstructions.

All Weather, Inc. recommends that the siting and installation follow the general guidelines established by the Office of the Federal Coordinator for Meteorology (OFCM). The *Federal Standard for Siting Meteorological Sensors at Airports*, OFCM document # FSM-S4-1987, makes the following recommendations.

1. Distance from Obstructions — The distance between the sensor and obstructions such as trees or buildings should be at least 2 times the height of the obstruction on all sides. For example, if a tree 20 m high is located alongside the sensor, the sensor should be at least 40 m away from the tree. This restriction reduces the effects of wind turbulence created by the nearby obstruction and makes the precipitation measurement more representative. Do not locate the sensor where tree branches or wires will hang over the sensor!
2. Separation from Turbulence and Contamination Sources — Do not mount the sensor near building exhaust vents, strobe lights, or sources of smoke or steam. Where possible, locate the unit as far away from runways and roads as possible to reduce optics fouling from wind-blown road dirt. An ideal minimum distance is at least 30 m.
3. Sensor Height, Rigidity, Verticality, and Orientation — The OFCM recommends that the Present Weather Sensor be mounted at a height of 10 ft (3 m). This height is not always possible because of constraints imposed by the site. Mounting the sensor head lower than 2 m or higher than 5 m is not generally recommended. When installing on the Model 8518-A Foldover Tower, mount the Present Weather Sensor to the hinged side of the tower.

For AWOS installations, All Weather, Inc. recommends that the sensor head be mounted on the sensor tower at a height of 10 ft above the tower base. Install the controller box on the tower close to the AWOS Data Collection Processor box.

The installation must be rigid so that wind-induced vibration does not cause false alarms. This can be accomplished by mounting the sensor to a thick wall pipe such as “Schedule 40” type or to a rigid boom arm 1 m in length or shorter. The Present Weather Sensor may be mounted on the top of a building is acceptable if it located near the center of the building away from the wind turbulence that may occur near the edges.

The sensor head must be mounted vertical within ± 2 degrees so that the line aperture on the in-beam lens is horizontal.

4. The sensor head is generally oriented with the transmitter head on the north side (in the Northern hemisphere) so that the receiver optics face north. Align the sensor head so that the receive lens faces north. If the orientation can be altered to either side of north to obtain a “view” with fewer or more distant obstructions, it is generally acceptable to alter the orientation up to ± 30 degrees from north.

4.2 MECHANICAL INSTALLATION

4.2.1 Preparation

The sensor and site should be readied prior to beginning the installation.

SITING GUIDELINES

- ✓ Sensor head mounted 2–5 m above ground
- ✓ Rigid mounting pole
- ✓ In-beam lens aperture horizontal to ± 2 degrees
- ✓ No overhanging trees, wires, or roof lines
- ✓ Distance between sensor and closest obstruction at least 2 times obstruction height
- ✓ As far from road, runway, and contamination sources as possible

The 6490 Present Weather Sensor is packed in two heavy-walled corrugated cartons. One carton contains the electronics enclosure and the larger, narrow carton contains the sensor head and cables. Also packed in this carton are the sensor head U-bolt mounting hardware, and electronics enclosure mounting hardware. When opening the cartons, be careful to avoid spilling the contents.

CAUTION!

Exercise care when removing the electronics enclosure from its packing carton. The temperature probe at the bottom of the enclosure extends out a short distance and can break easily.

Report any shortages or shipping damage to All Weather Inc. within 3 days.

CAUTION!

Do NOT drill holes in any portion of the sensor head or electronics enclosure! Doing so will void the warranty and may allow water to enter the enclosure!

Site Preparation

1. Choose the site using the guidelines in Section 4.2.1.
2. Following applicable electrical and building codes, install a concrete mounting base, mast or tower, AC power cable, RS-485 signal cable, and ground rod.

4.2.2 Mount the Sensor Head

The sensor must be securely installed and correctly oriented to work properly.

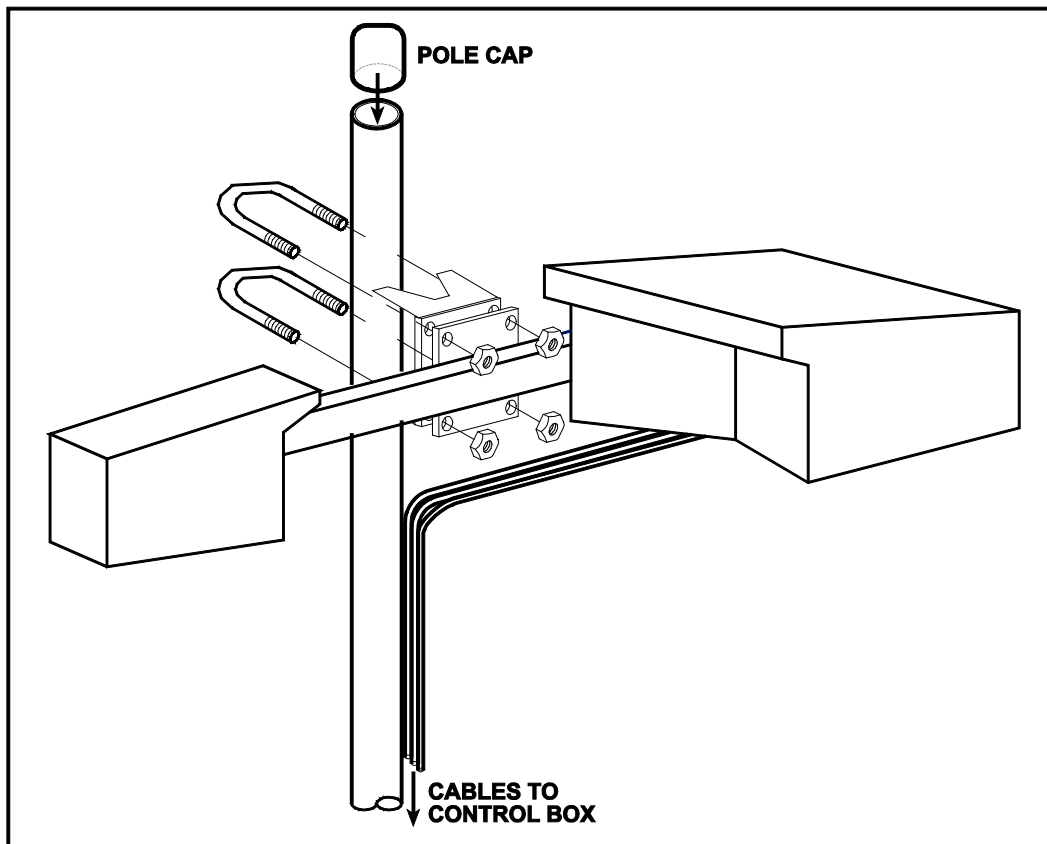


Figure 2. Mounting Present Weather Sensor Head

1. Attach the sensor head using the two U-bolts to connect the mounting plate on the sensor head and the mounting bracket with the 1/4-20 hex locking nuts as shown in Figure 2. To mount the head to a vertical mast or tower section, install the U-bolts and mounting bracket horizontally. To mount to a horizontal tower section or boom arm, install them vertically using the same holes.

Note that the metallurgy of the stainless U-bolts will cause the nuts to seize to the U-bolts and twist them off. Lubricate the threads with anti-seize compound before assembling.

Do not tighten the nuts completely until the sensor head is installed on the mast or tower and is oriented on the north-south axis as shown in Figure 3.

2. Rotate the sensor head until the receive lens is facing north.

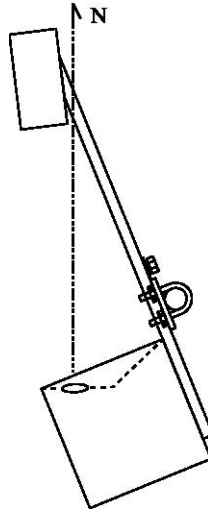


Figure 3. Sensor Head Orientation

When mounting the sensor head on a tower, choose the tower leg that gives the larger head an unobstructed view to the North without rotating the head assembly into the tower. The head assembly should be completely outside the tower as much as possible.

3. Tighten the U-bolt nuts when the orientation is correct. (Do not overtighten such that the mounting plate is bent).
4. Route the cables along the mast or tower to the electronics enclosure and secure them to the mast or tower every meter using tie-wraps or other straps.

4.2.3 Install the Electronics Enclosure

Two mounting kit options are available to mount the electronics enclosure.

- Standalone Mounting Kit (AWI part number M488173-01)
- Tandem Mounting Kit to mount Present Weather Sensor on same mast/tower location as the Data Collection Platform (AWI part number M488176-01)

Attach the electronics enclosure to the Unistrut brackets using the hardware supplied with the sensor. Figure 4 and Figure 5 show the mounting arrangements for the two mounting options.

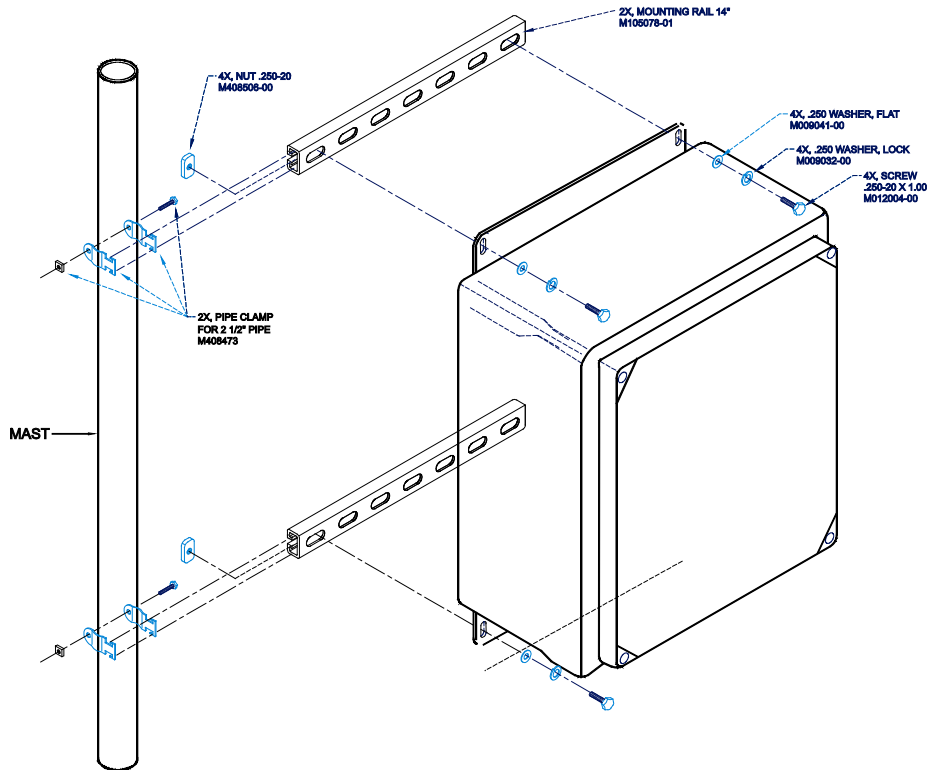


Figure 4. Standalone Enclosure Mounting

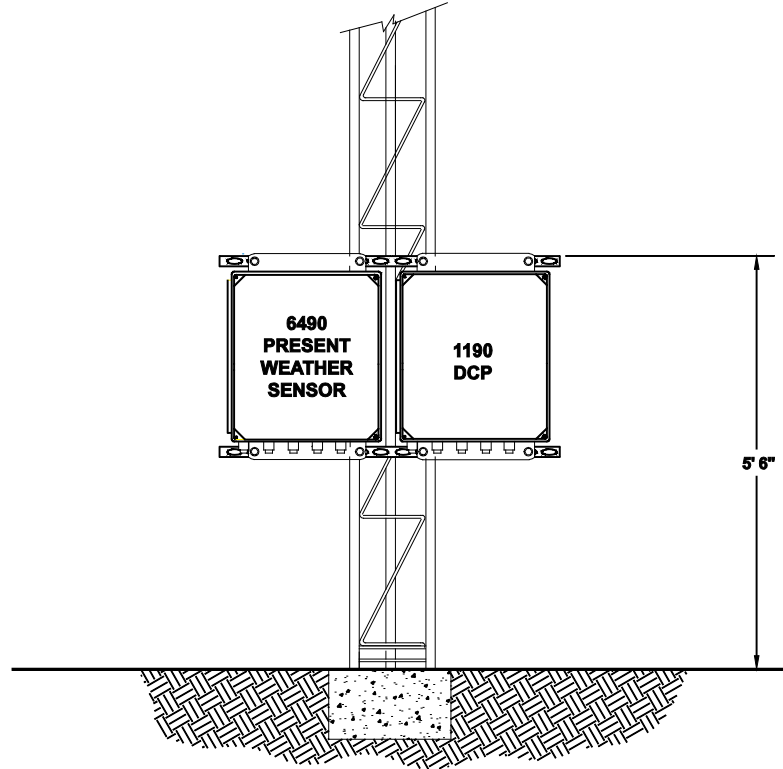


Figure 5. Tandem Present Weather Sensor and DCP Enclosure Mounting

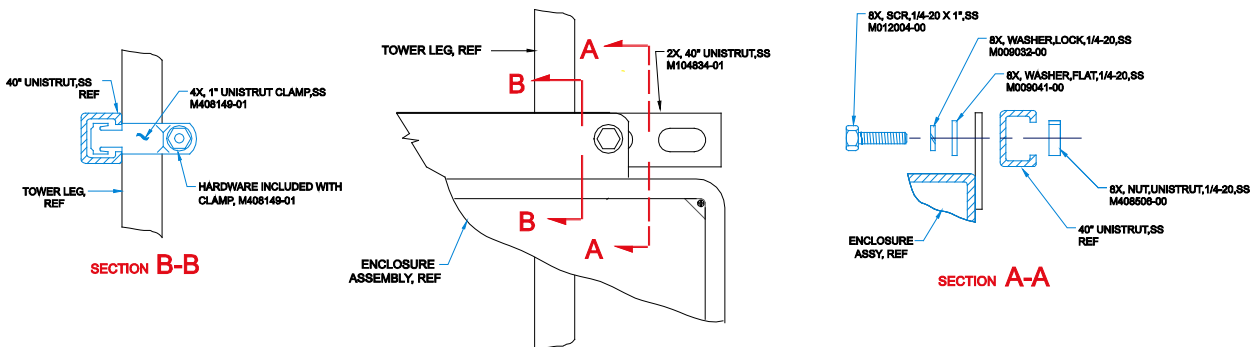


Figure 6. Mounting Hardware Details

Figure 6 shows the details of securing the mounting hardware.

These additional steps will help keep the mounting secure and corrosion-resistant.

- Apply anti-seize compound to all external threaded connections.
- Once the installation of the enclosure has been completed, apply a light spray of corrosion block to all metallic connectors and threaded fasteners.

4.3 ELECTRICAL CONNECTIONS

Figure 7 shows the external connections at the bottom of the enclosure.

- AC power conduit.
- Battery backup cable (optional).
- Signal cables from sensor head.
- A ground lug.

A user supplied ground wire should also be connected to the ground lug to ground the Model 6490 Present Weather Sensor to earth potential per local electrical codes.

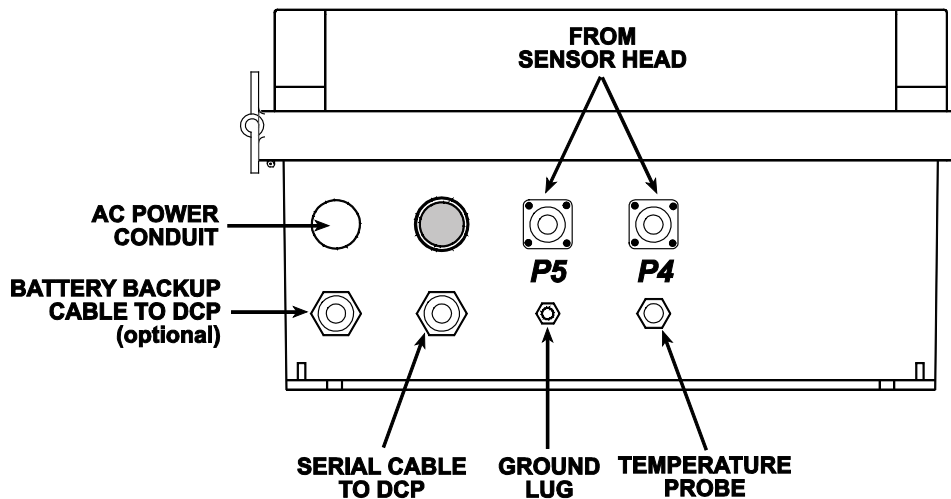


Figure 7. External Connections at Enclosure Bottom

Note that the enclosure bottom layout for the Model 6490-A enclosure is slightly different.

Finish routing the cables from the sensor head to the bottom of the electronics enclosure. Secure any loose cables to the mast or tower pole using tie-wraps or other straps.

1. Connect the sensor head cables labeled P4 and P5 to the electronics enclosure connectors shown in Figure 7. The connectors are keyed so they can only plug into the correct receptacle. P4 connects the receiver and P5 connects the transmitter.
2. Connect the sensor head green wire to the ground lug on the bottom of the enclosure.

Figure 8 shows the layout of the various electronics subassemblies inside the electronics enclosure.

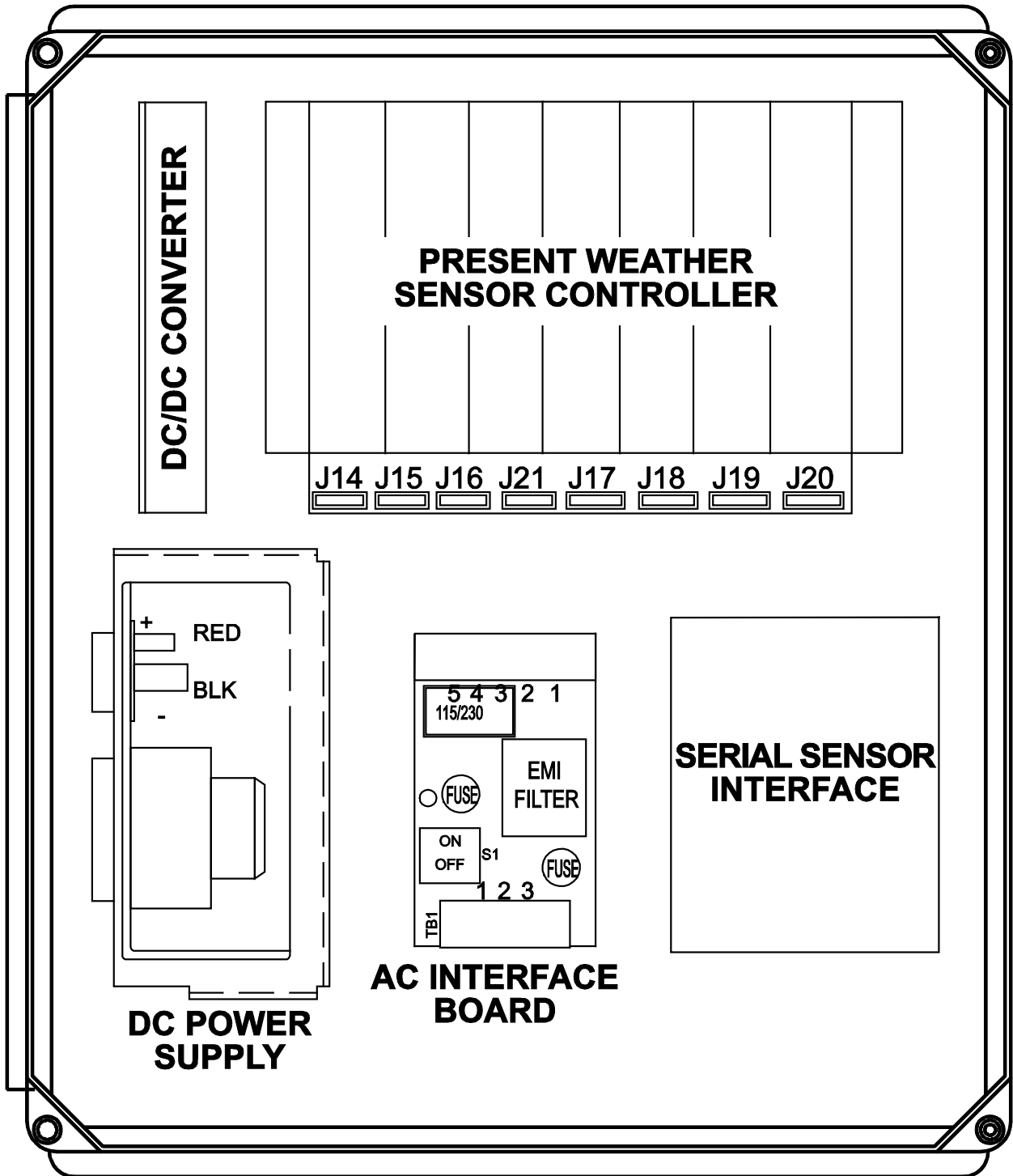


Figure 8. Present Weather Sensor Controller Subassemblies Inside Enclosure

Figure 9 summarizes all the signal and power wiring for the model 6490 Present Weather Sensor.

Sensor Interface Board TB1 Pin	Function	Color	DCP TB4 Pin
4	RS-485 (+)	WHITE	1
5	RS-485 (-)	BLACK	2
6	GROUND	RED	7

AC Interface Board TB1 Pin	Function	Color
1	HOT	BLACK
2	NEUTRAL	WHITE
3	GROUND	GREEN

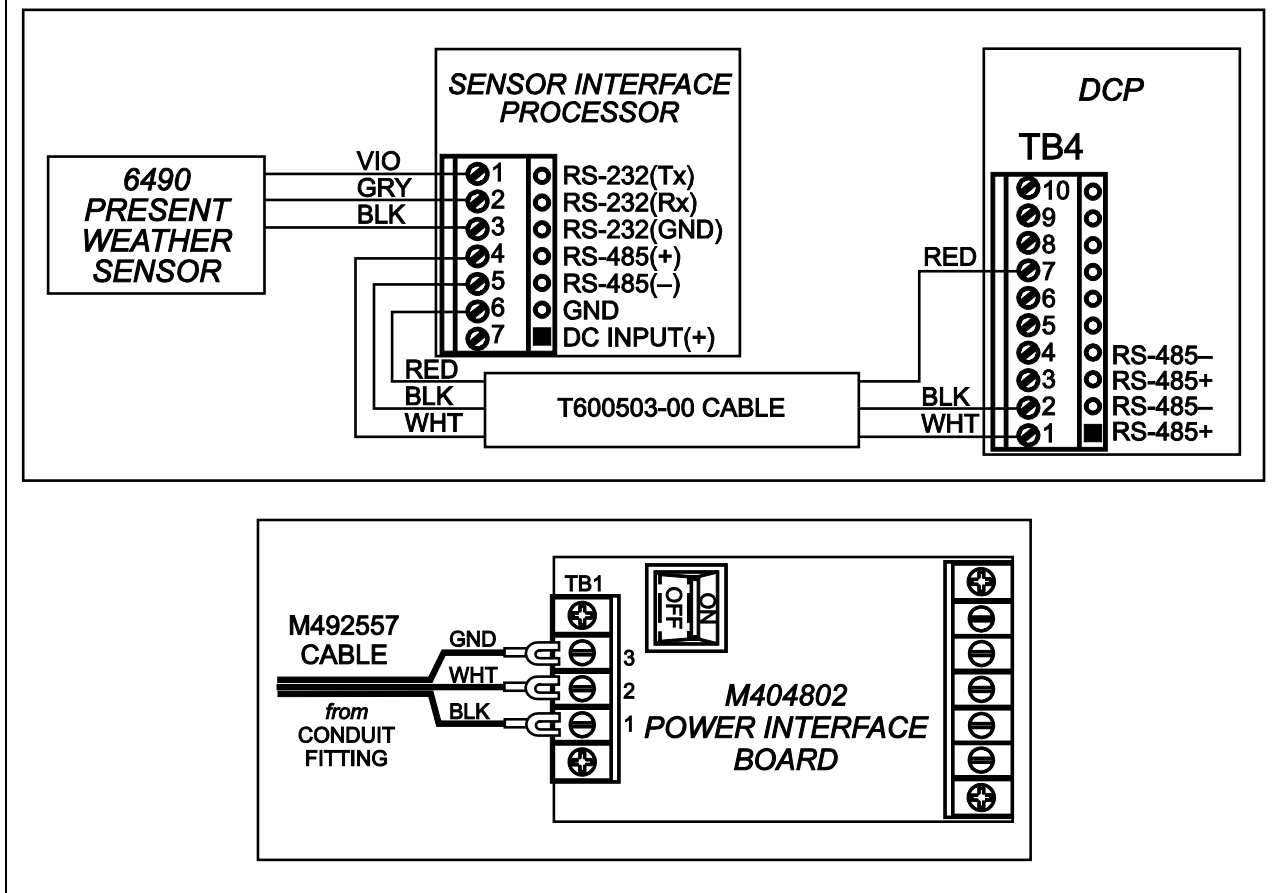


Figure 9. Present Weather Sensor Signal and Power Wiring

4.3.1 RS-485 Connections to the AWOS Data Collection Platform

RS-485 connections are made to the Serial Sensor Interface located in the lower right side of the electronics enclosure. A 3-wire connection to the AWOS Data Collection Platform (DCP) is required. Before proceeding, verify that the 6490 electrical power is turned “OFF.”

1. If the RS-485 cable is not already connected to the Serial Interface Processor, connect the WHITE RS-485(+) signal cable to pin 4, connect the BLACK RS-485(-) signal cable to pin 5, and connect the RED GND cable to pin 6 of the Serial Interface Processor's terminal block.
2. Feed the free end of the three-conductor RS-485 cable through the serial cable gland shown in Figure 7.
3. Strip and tin the ends of the wires.
4. Route the cable through a cable gland on the DCP and connect the three wires inside the DCP to TB4 pins 1 (RS-485+), 2 (RS-485-), and 7 (GND).
5. Ensure that none of the wires are stressed, then hand tighten the gland seals on the DCP enclosure and on the Model 6490 Present Weather Sensor enclosure.

4.3.2 Connecting the Sensor to the AC Power Line

Connections are made to the AC surge protection module inside the electronics enclosure

AC power connections are made to the AC Interface Board located in the lower center of the electronics enclosure. A 3-wire, single-phase AC source is required consisting of hot, neutral, and earth ground connections. Before proceeding, verify that the unit you are installing is configured for the same voltage available at the site. Refer to the voltage selection switch on the AC Interface Board.

WARNING

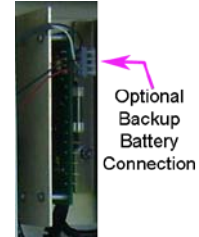
Turn off electrical power at the source before making the electrical connections to the sensor!

1. Feed the power cable through the conduit fitting shown in Figure 7. A 3-wire 16 to 18 AWG cable is recommended.
2. Crimp fork type terminals to the ends of the wires.
3. Connect the three power cable wires to the AC Interface Board terminal block TB1 pins 1 (LINE), 2 (NEUTRAL), and 3 (GND).

4.3.3 Optional Backup Battery Connections

An optional rechargeable backup battery kit (housed in the nearby Model 1190 Data Collection Platform) is available to power the Model 6490 Present Weather Sensor and the Model 1190 Data Collection Platform in the event of an AC power failure.

1. The backup battery cable (AWI part number M491561) is already connected to the terminal block on the DC/DC converter inside the Present Weather sensor enclosure. The remaining cable is looped and stored inside the enclosure.
2. Feed the free end of the backup battery cable through the serial cable gland shown in Figure 7.
3. Route the cable through a cable gland on the DCP and connect the two wires inside the DCP to TB1 pins 1 (WHT +) and 2 (BLK -).
4. Ensure that none of the wires are stressed, then hand tighten the gland seals on the DCP enclosure and on the Model 6490 Present Weather Sensor enclosure.



4.3.4 Heater Kit

The Model 6490-A Present Weather Sensor comes with a built-in heater installed on the inside of the enclosure door. There is a knob that can be used to adjust the temperature. The heater is a factory-installed option for other models. Figure 10 shows the electrical connections for reference.

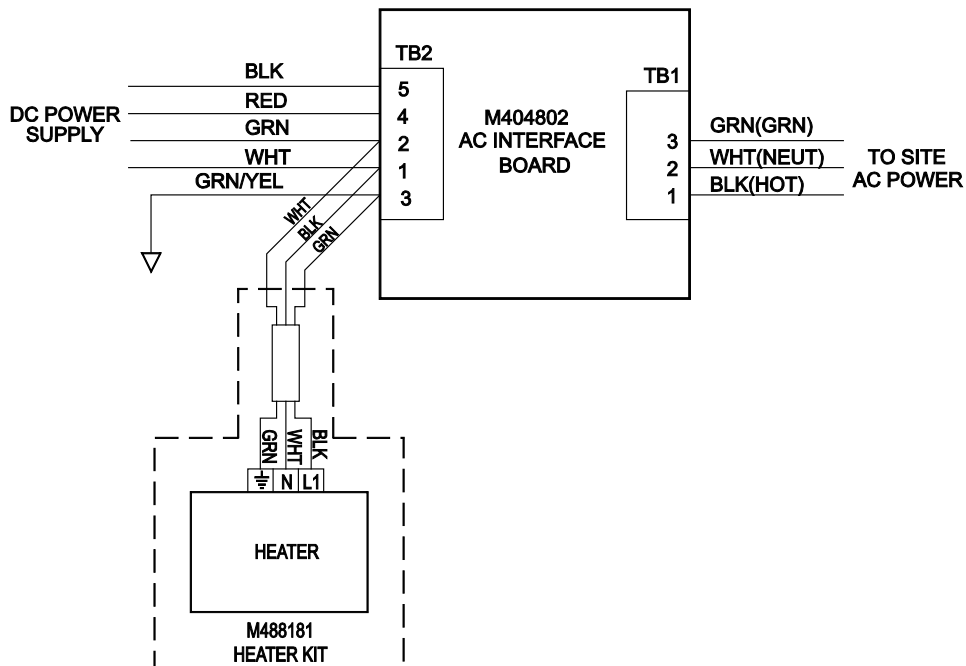


Figure 10. Heater Electrical Connections

5. OPERATION WITH AN AWOS DATA COLLECTION PLATFORM

5.1 SENSOR INTERFACE

5.1.1 Physical Level

The serial signal consists of a three-wire RS-485 connection.

5.1.2 Link Level

Data transfer across the interface is implemented via a serial, ASCII encoded, half duplex, 4800 bps, asynchronous transfer link. Data transfer in the DCP-to-sensor direction is limited to a seven-character poll, "PRWX00 <CR>". Data transfers in the sensor-to-DCP direction are fixed-format ASCII strings, starting with an equals sign (=) and terminated with a carriage return (<CR>).

5.1.3 Frame Format

The standard output frame format is shown below. Details of the data fields are presented in a later section. Each of the transmitted characters are eight (8) bit (msb - bit 7 - always 0), no parity ASCII (decimal codes 0 to 127), with 1 stop bit. The status code and other information, is formatted in this way as printable ASCII characters to aid in system debugging and field maintenance.

The output message from the interface computer in response to the poll consists of the following string of characters.

Position	Contents	Description
1	<blank><blank><equals sign>	start of message string
4	WxxPppppSssss	W plus weather code (see Section 5.3.1) P plus rain rate in 0.001 inches per hour S plus four-digit status code (see Section 5.3.2)
17	<blank>	
18	XnnnLnnnKnnnHnnnTnnn	engineering data (see Section 5.2)
38	<blank>	
39	sensor crc error counter <blank> sensor input msg counter	engineering data (see Section 5.2)
	<blank> 4-character CRC<cr><lf>	crc from position 4 up to but not including the crc itself

5.1.4 Protocol

In order to keep the interface design effective and simple, the protocol does not support unsolicited messages to the DCP. In other words, the only time the sensor is allowed to transmit a message to the DCP via this link is in direct response to a poll transmission from the DCP, which requires the return of the standard data reply string.

Note that the sensor is sampling data continually (every 5 seconds) and processing the precipitation algorithm (once a minute typical). In most cases, the DCP's response time to a poll will begin within 100 ms after receiving the poll. Requesting data from the sensor more than once per minute will result in identical data transmittals being sent within the one-minute period.

5.2 DATA FORMAT

The raw weather information from the sensor head is encoded in the reply message as follows. Section 5.3 provides the processed data that are provided to the DCP by the Present Weather Sensor.

<u>Byte</u>	<u>Description</u>	<u>Value</u>
1	Start of transmission	=
2	Weather type marker	W
3-4	Present weather field	ww
5	Precipitation rate marker	P
6-9	Precipitation rate field	pppp
10	Status field marker	S
11-14	Status field	ssss
15	Blank	0x20
16	Carrier raw data field marker	X
17-19	Carrier 1 min average raw data	nnn
20	Low raw data field marker	L
21-23	Low 1 min average raw data	nnn
24	Particle raw data field marker	K
25-27	Particle 1 min average raw data	nnn
28	High raw data field marker	H
29-31	High 1 min average raw data	nnn
32	Temperature field marker	T
33-35	Temperature field	ttt
36	Blank	0x20

This section describes the format of the various fixed fields as they are used in the poll response above.

1. The capital letters “W”, “P”, “S”, “X”, “L”, “K”, “H”, and “T” above serve as place markers for the Weather, Precipitation, Status, Carrier, Low, Particle, High, and Temperature data fields to follow. These markers are fixed in position and coding. They are included within the format to simplify manual interpretation of the sensor output.
2. ww is a two-byte field indicating present weather. The weather codes contained in this field are described in Section 5.3.1.
3. pppp is a four-byte field indicating the precipitation rate. Zero is formatted as four zeros (“0000”). The number is a floating point format, varying from 0.001 to 9999. The units are inches/hour (millimeters/hour) rain rate, averaged over a one minute period.
4. ssss is a four-character field containing ASCII encoded hex value reserved for error and status codes. Each character represents a four bit field of binary information. The four-bit field contains status information of the field-replaceable units (FRUs). The status codes in this field are described in Section 5.3.2.
5. nnn is a three-byte ASCII numeric field indicating the corresponding one-minute averaged raw data in tens of millivolts. Leading/unused positions are filled with zeros. Valid values are -99 to 999. Overflows and underflows are represented as 999 and -99, respectively.

6. ttt is a three-byte ASCII numeric field indicating the temperature indicated by the probe on the bottom of the enclosure. It is for diagnostic purposes and should not be used as a true meteorological temperature. The valid values are -99 to 999 in units of degrees Fahrenheit. Note that a value of -99 indicates a defective or missing temperature probe.

5.3 DATA INTERPRETATION

5.3.1 Weather Codes

The poll response contains weather codes formatted in NWS type format. The latest one-minute weather code (ww) is found in bytes 3 and 4 immediately following the “W” place marker.

<u>WX Code</u>	<u>NWS WX Code Description</u>	<u>WX Code</u>	<u>NWS WX Code Description</u>
L-	Light Drizzle	I-	Light Ice Pellet
L_	Moderate Drizzle	I_	Moderate Ice Pellet
L+	Heavy Drizzle	I+	Heavy Ice Pellet
R-	Light Rain	A-	Light Hail
R_	Moderate Rain	A_	Moderate Hail
R+	Heavy Rain	A+	Heavy Hail
P-	Light Precipitation	—	No Precipitation
P_	Moderate Precipitation	--	Start-up code
P+	Heavy Precipitation	ER	Error Condition
S-	Light Snow	CL	Lenses need to be cleaned (only reported when no precip.)
S_	Moderate Snow		
S+	Heavy Snow		
ZL	Freezing Drizzle		
ZR	Freezing Rain		

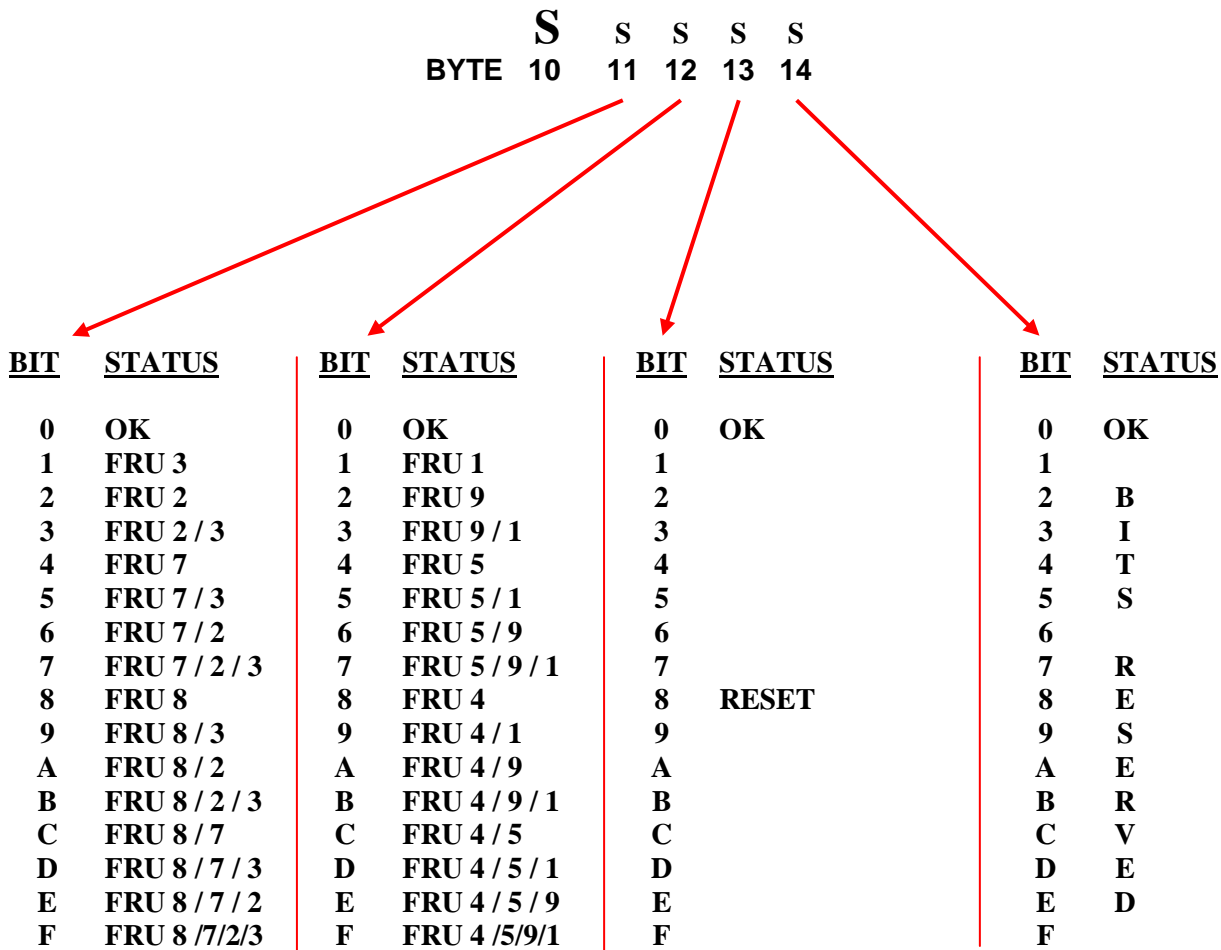
The “_” (underline) character above represents an ASCII underline character. The “--” code will be output in this and other data fields during the first 60 seconds or so after reset or power-up of the sensor.

Note: AWOS installations with a Present Weather Sensor will also report fog, freezing fog, haze, and mist. This information does not originate with the 6490 sensor, but is derived from inputs from other sensors.

5.3.2 Status Codes

The status codes are a convenient way for the sensor to report sensor condition and identify faulty subassemblies.

The status field, denoted by s s s s (four bytes) in the data output format, is a four-byte field of sensor status bytes. The codes can be interpreted as shown in the table below.



A status code of 0 in bytes 11, 12, 13 or 14 indicates “no problem,” while a number or letter other than 0 indicates one or more FRUs may be defective. For instance, if byte 11 read “9”, then both FRU 8 & FRU 3 should be checked.

Example

Status codes read S0180. Interpret this code as follows.

- Byte 11 = 0 OK
- Byte 12 = 1 FRU 1 probably bad
- Byte 13 = 8 MPU was reset in past 5 minutes
- Byte 14 = 0 OK

Solution

Wait for 5 minutes to verify that the reset bit turns off. The status code will now read S0100, indicating that there may be a problem with FRU 1. Replace FRU 1 (Sensor Head) and recheck the status code. After 5 minutes (when reset bit turns off again) status codes should be S0000.

In normal operation (excluding the first five minutes after reset or power-up), the status bytes will be all low (0000). A non-zero character in any of the four positions indicates the suspected failure of an FRU. The host system should take action to alert maintenance personnel of a possible problem. In addition, data from the OWI should be disregarded and a “missing” report issued. (Note that the sensor does not necessarily stop outputting data when a status bit flags an error condition.) The table below summarizes the active status bits and the corresponding FRUs and assembly numbers.

<u>FRU #</u>	<u>Item Description</u>	<u>All Weather Inc. P/N</u>
FRU1	Sensor Head Assembly	M482105
FRU2	Transmit Modulator (TXM) Card	M406053
FRU3	Automatic Gain Control (AGC) Card	M406054
FRU4	Signal Processor 1 (SP1) Card	M406055
FRU5	Signal Processor 2 (SP2) Card	M406056
FRU6	Microprocessor (MPU) Card	M406057
FRU7	Electronics Power Supply	M438150
FRU8	n/a	
FRU9	Heater Power Supply	M438151
FRU10	PCB Sensor Interface	M404806
FRU11	Present Weather Firmware EPROM	M469053

The FRUs are available for maintenance and repair of the sensor in the field or depot. The sensor head contains no user replaceable parts and can not be repaired except at the factory.

5.3.3 Check Sum Calculation

The CRC is calculated using a standard crc-16 formula. The algorithm is as follows.

```

/* CRC routine used with AWOS remote sensors

USE:  crc = crc16(buffer, length, initial_value)

      where:  crc is the returned value,
              buffer is the data buffer to compute a crc
              length is the number of bytes in buffer to process
              initial_value is the results of previous crc calculations
                  that will allow the buffer crc to be computed in
                  stages if necessary. If this is not necessary,
                  then set initial_value to 0.

*/

unsigned int crc16(char *string, unsigned int length, unsigned int ival)

/*  buffer address to compute a crc */
/*  number of characters to process */
/*  initial value of crc          */
{

    static unsigned int crc;

/*   CRC values for crc16 routine                                     */

    static unsigned int crc_vals[] =
    {
        0x0000,0xc0c1,0xc181,0x0140,0xc301,0x03c0,0x0280,0xc241,
        0xc601,0x06c0,0x0780,0xc741,0x0500,0xc5c1,0xc481,0x0440,
        0xcc01,0x0cc0,0x0d80,0xcd41,0x0f00,0xcf41,0xce81,0x0e40,
        0x0a00,0xcac1,0xcb81,0x0b40,0xc901,0x09c0,0x0880,0xc841,
        0xd801,0x18c0,0x1980,0xd941,0x1b00,0xdb41,0xda81,0x1a40,
        0x1e00,0xdec1,0xdf81,0x1f40,0xdd01,0x1dc0,0x1c80,0xdc41,
        0x1400,0xd4c1,0xd581,0x1540,0xd701,0x17c0,0x1680,0xd641,
        0xd201,0x12c0,0x1380,0xd341,0x1100,0xd1c1,0xd081,0x1040,
        0xf001,0x30c0,0x3180,0xf141,0x3300,0xf3c1,0xf281,0x3240,
        0x3600,0xf6c1,0xf781,0x3740,0xf501,0x35c0,0x3480,0xf441,
        0x3c00,0xfcc1,0xfd81,0x3d40,0xff01,0x3fc0,0x3e80,0xfe41,
        0xfa01,0x3ac0,0x3b80,0xfb41,0x3900,0xf9c1,0xf881,0x3840,
        0x2800,0xe8c1,0xe981,0x2940,0xeb01,0x2bc0,0x2a80,0xea41,
        0xee01,0x2ec0,0x2f80,0xef41,0x2d00,0xedc1,0xec81,0x2c40,
        0xe401,0x24c0,0x2580,0xe541,0x2700,0xe7c1,0xe681,0x2640,
        0x2200,0xe2c1,0xe381,0x2340,0xe101,0x21c0,0x2080,0xe041,
        0xa001,0x60c0,0x6180,0xa141,0x6300,0xa3c1,0xa281,0x6240,
        0x6600,0xa6c1,0xa781,0x6740,0xa501,0xa5c0,0xa480,0xa441,
        0x6c00,0xacc1,0xad81,0x6d40,0xaf01,0x6fc0,0x6e80,0xae41,
        0xaa01,0x6ac0,0x6b80,0xab41,0x6900,0xa9c1,0xa881,0x6840,
        0x7800,0xb8c1,0xb981,0x7940,0xbb01,0x7bc0,0x7a80,0xba41,
        0xbe01,0x7ec0,0x7f80,0xbf41,0x7d00,0xbdc1,0xbc81,0x7c40,
        0xb401,0x74c0,0x7580,0xb541,0x7700,0xb7c1,0xb681,0x7640,
    }

```



```
0x7200,0xb2c1,0xb381,0x7340,0xb101,0x71c0,0x7080,0xb041,  
0x5000,0x90c1,0x9181,0x5140,0x9301,0x53c0,0x5280,0x9241,  
0x9601,0x56c0,0x5780,0x9741,0x5500,0x95c1,0x9481,0x5440,  
0x9c01,0x5cc0,0x5d80,0x9d41,0x5f00,0x9fc1,0x9e81,0x5e40,  
0x5a00,0x9ac1,0x9b81,0x5b40,0x9901,0x59c0,0x5880,0x9841,  
0x8801,0x48c0,0x4980,0x8941,0x4b00,0x8bc1,0x8a81,0x4a40,  
0x4e00,0x8ec1,0x8f81,0x4f40,0x8d01,0x4dc0,0x4c80,0x8c41,  
0x4400,0x84c1,0x8581,0x4540,0x8701,0x47c0,0x4680,0x8641,  
0x8201,0x42c0,0x4380,0x8341,0x4100,0x81c1,0x8081,0x4040};  
  
crc = ival;  
while(length--)  
    crc = crc_vals[*string++ ^ crc] ^ ((crc >> 8) & 0xff);  
return crc;  
}  
  
/* end crc16 routine */
```

6. MAINTENANCE & TROUBLESHOOTING

Equipment Required

- Clean Cotton Cloth or Lens Tissue
- Common Household Glass Cleaner

6.1 MONTHLY MAINTENANCE

1. Check Lens Heaters

With a clean finger, touch the lenses in front of the disc-shaped heaters, which are bonded to the upper and lower inside surface of lenses. The lens surfaces should be slightly warmer to the touch than the ambient temperature.

2. Clean Lenses

Cleaning the lenses should be done with lint-free cloth and cleaning solution. Clean the lenses by first spraying the lens cleaner on the lens and then wipe gently to prevent scratching the glass optics. In actual practice, moderate dust buildup and scratches on the lenses will not have any discernible effect on the instrument.

6.2 TRIANNUAL MAINTENANCE

Check the strength of the carrier signal by displaying the present weather status display on the DCP's LCD display screen. Press the * or # keys until the screen is displayed. The carrier raw data field (Xnnn) should be in the range of 405–420. If it needs to be adjusted, go to Section 6.3. The data fields in bold shown below are the channels of interest.

XnnnLnnnKnnnHnnnTnnn

1. Quick Check on Data Fields

The following checks are general in nature and should be used as a general indication that the sensor is working properly. This test should be performed when there is no precipitation and after the sensor has stabilized for at least 30 minutes. Display the present weather data screen on the DCP's LCD display screen using the * and # keys.

Present
Weather Data
W__P0000**S0000**

W__ The present weather field should not contain any data (two underscores) if there is no precipitation falling.

SO000 The status fields should all read zero if the OWI has been operating (and not reset by a power interruption) for at least 5 minutes. If the status fields are not all zeros, refer to Section 4.3.2 for an interpretation of the possible problem.

Present
Weather Stat
XnnnLnnnKnnnH
nnnTnnn

Display the Present Weather Status display on the LCD display and verify the following.

- Lnnn** The one-minute low channel reading will generally read in the range of -30 to 50.
- Knnn** The one-minute particle channel reading will generally read in the range of 0 to 150.
- Hnnn** The one-minute high channel reading will generally read in the range of 40 to 120.
- Tnnn** Temperature should be representative of the ambient temperature, ± 5 degrees. The temperature probe is connected thermally to the electronics enclosure, so it generally reads warmer than the ambient temperature because of internal heating of the enclosure.

Hint — If the “Quick Check” values do not appear to be correct, record at least 10 minutes of the complete status string and fax them to the All Weather Inc. Customer Service department (916-928-1165) for evaluation. Include the weather conditions at the site during the period in question (air temperature, wind speed, type of precipitation if any, etc.)

6.3 CALIBRATION — CARRIER LEVEL

The carrier level can be easily adjusted without special test equipment.
DO NOT PERFORM IN PRECIPITATION, FOG, FREEZING FOG, OR MIST!

Thoroughly clean both lenses with glass cleaner and a soft cloth before proceeding! Clean the lenses by first spraying the lens cleaner on the lens and then wipe gently to prevent scratching the glass optics.

Procedure

1. Turn power to the Sensor ON, and allow 10 minutes before taking a reading of the data string.
2. Display the present weather status display on the LCD screen. The Carrier raw data field should contain:

Channel	Data Value	Tolerance
Carrier	"X405 to 420	Anywhere in range

The Carrier raw data field should be in the range of 405–420. If it needs to be adjusted, go to Step 3. Keep the electronics enclosure door closed during the calibration process. The data fields in **Bold** shown below are the channels of interest.

3. Carrier Channel Adjustment

<p>SP1</p> <p>L O</p> <p>C O ← Increase</p>	<p>CW</p>	<p>Locate SP1 card in enclosure</p> <p>Adjust “C” post as shown at left to increase or decrease data value</p> <p>Wait 2–3 minutes</p> <p>Verify Carrier channel is “405 to 420” per data fields shown below</p> <p>Readjust as necessary to reach correct value</p>
--	------------------	--

The carrier adjustment by the pot labeled “C” is read in the data string at the “X” position.

HINT — A ¼ turn of the pot will typically be enough to adjust the carrier 10–15 counts. Wait for 2–3 minutes to see if the adjustment is sufficient before adjusting again.

7. SPECIFICATIONS

Parameter	Specification		
	6490	6490-A	6490-I
Present Weather Codes Reported	>50 NWS and WMO codes		
Rain Dynamic Range	0.1–3000 mm/h		
Rain Accumulation	0.1–999,999 mm		
Rain Accumulation Resolution	0.001 mm		
Rain Accumulation Accuracy	5%		
Snow Dynamic Range	0.01–300 mm/h water equivalent		
Snow Accumulation	0.001–999,999 mm water equivalent		
Snow Accumulation Resolution	0.001 mm		
Snow Accumulation Accuracy	10%		
Data Update Rate	Once per minute		
Serial Output	RS-485		
Output Format	ASCII characters		
Baud Rate	4800 bps		
Serial Port Parameter Setting	8-N-1 (8 data bits, no parity, 1 stop bit)		
<i>Power Requirements</i>			
Supply Voltage	115/230 V AC, 50/60 Hz, 50 V•A	115 V AC, 50/60 Hz, 50 V•A	115/230 V AC, 50/60 Hz, 50 V•A
Transient Protection	AC power and RS-485 signal lines fully protected		
<i>Environmental</i>			
Operating Temperature	-40 to +50°C (-40 to +122°F)		
Storage Temperature	-50 to +60°C (-58 to +140°F)		
Relative Humidity	0–100%, noncondensing		

Parameter		Specification		
		6490	6490-A	6490-I
<i>Mechanical</i>				
Controller Assembly Enclosure		NEMA 4X fiberglass	NEMA 4X electro-polished 304 stainless steel	NEMA 4X fiberglass
Mounting	Sensor Assembly	2.5" (6.35 cm) dia. mast		
	Controller Assembly	Unistrut mounted		
Dimensions	Sensor Assembly	11.5 cm H × 23.0 cm W × 73.0 cm D (4.5" H × 9.1" W × 28.75"D)		
	Controller Assembly	36 cm W × 41 cm H × 20 cm D (14" W × 16" H × 8" D)	41 cm W × 51 cm H × 24 cm D (16" W × 20" H × 9.25" D)	36 cm W × 41 cm H × 20 cm D (14" W × 16" H × 8" D)
Weight	Sensor Assembly	4 kg (8.8 lb)	4 kg (8.8 lb)	4 kg (8.8 lb)
	Controller Assembly	10 kg (22 lb)	12 kg (27 lb)	10 kg (22 lb)
Shipping Weight (2 boxes)		16 kg (35 lb)	18 kg (40 lb)	16 kg (35 lb)

8. WARRANTY

This equipment has been manufactured and will perform in accordance with requirements of FAA Advisory Circular 150/5220-16B. Any defect in design, materials, or workmanship which may occur during proper and normal use during a period of 1 year from date of installation or a maximum of 2 years from shipment will be corrected by repair or replacement by All Weather Inc.



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