Model 6490
Present Weather Sensor

User's Manual

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1. INTRODUCTION

1.1 The Model 6490 Sensor Improves Your Ability to Measure Present Weather

The Model 6490 optically measures precipitation induced scintillation and applies algorithms to automatically determine the precipitation occurrence, type, rate. The sensor is vastly superior to traditional type sensors and offers the reliability and proven performance you need.

All Weather Inc.'s Model 6490 precipitation sensor provides accurate measurement of precipitation 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.

The 6490 offers many features and options including:

- ✓ NWS or WMO weather code formats
- ✓ English or metric units of measure
- ✓ Past data (15 min and 60 min)
- ✓ Automated calibration
- ✓ HIPS Hail and ice pellet detection (option)
- ✓ 12 VDC power (option)

1.2 Performance Specifications for the Model 6490

The 6490 was designed to measure precipitation in all weather conditions. The general specifications of the sensor are provided in the table below. The exact specifications may vary depending on the firmware and options provided with the unit.

Performance Specification	
PRESENT WEATHER	
PW Codes Reported	More than 50 NWS & WMO codes
Rain Dynamic Range	0.1 to 3000 mm/hr
Rain Accumulation	0.1 to 999.999 mm
Rain Accuracy	5% Accumulation
Rain Resolution	0.001 mm
Snow Dynamic Range	0.01 to 300 mm/hr water eq.
Snow Accuracy	10% Accumulation
Snow Resolution	0.001 mm
Hail & Ice Pellet Accuracy	Correctly report 90% of the time
Data Update Rate	Once per minute

N o t e: The Hail & Ice Pellet Sensors (HIPS) is optional - ignore references to hail and ice pellets unless the option was ordered!

Electrical Specifications	
Power Requirements	Factory selectable 110/220 VAC, 50/60 Hz @ 50 VA (12 VDC @ 3 A power supply optional)
Fusing	User supplied - See Section 2.3.2 for fuse size
Signal Output	RS-485 ASCII 4800 baud, 8 data bits, no parity, 1 stop bit
Transient Protection	AC power and RS-485 signal lines fully protected

Environmental Specifications	
Temperature	-40 to 55° C (-40 to 131° F)
Humidity	0-100%
Precipitation/Dust	NEMA-4X type protection

Physical Specification		
Size -	Sensor Head	730 mm W x 115 mm H x 230 mm D
	Electronics Enclosure	305 mm W x 465 mm H x 210 mm D
	Hail & Ice Pellet Head	865 mm W x 90 mm H x 216 mm D
Weight	Sensor Head	4 kg including cables
	Electronics Enclosure	10 kg
	Hail & Ice Pellet Head	2.3 kg including cables
Cable Lengths -		
	Sensor Head	5 meter (up to 10 m optional)
	Hail & Ice Pellet Head	1.5 meter

1.3 Major Components of Model 6490 Present Weather Sensor

1.3.1 Sensor Head, P/N 1405-101

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 which prevent dew, frost, and snow from building up on the lenses are self-regulating devices. They are "on" continuously but draw more current when the outside temperature is cold and less current when the temperature is warm. All wiring between the transmit and receive heads is within the welded head frame. The sensor head is completely sealed from water intrusion at the factory. Care should be taken to avoid drilling or otherwise puncturing the frame.

Two (2) integral 5-m long cables are supplied as part of the sensor head frame, a transmit cable P5 and an in-beam receive cable P4. A green ground cable, P/N 1203-153, 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 structure. 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.

N o t e:
The sensor head frame contains no user serviceable parts - opening the head will void the warranty!

1.3.2 Electronics Enclosure, P/N 1203-102

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

The electronics enclosure is a fiberglass NEMA-4X type box with hinged access door. Mounted to the base plate of the enclosure are 2 power supplies, a card cage with 5 printed circuit boards, and AC and RS-485 interface module with surge protection. All of the units in the enclosure are field replaceable.

The bottom of the enclosure contains two 1/2 inch conduit holes (nominal 0.66 inch) for the user connections, 3 or 4 connectors for the cables from the sensor head frame, and a ground stud. The welded ground stud is provided to connect the green ground cable, P/N 1203-153, supplied with the unit to the ground stud on the sensor head. A user supplied ground wire should also be connected to the stud to ground the WI to earth potential per local electrical codes.

If the Hail and Ice Pellet option was ordered, an additional connector, J6, will be installed on the bottom of the electronics enclosure and a circuit card, SPB, will be plugged into the card cage in slot 4.

The connectors on the bottom of the electronics enclosure are defined as follows:

J3	Off-axis receiver (not used)
J4	In-beam receiver
J5	Transmitter
J6	HIPS (option)

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

> N o t e:
> Care should be taken to avoid drilling or otherwise puncturing the electronics enclosure.

2. INSTALLATION OF THE MODEL 6490 SENSOR

2.1 Siting and Installation Guidelines

> The sensor may be installed almost anywhere outdoors but 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 20 meter high tree is located alongside the sensor, the sensor should be at least 40 meters away from the tree. This restriction reduces the affects 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 & 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 meters.

3. Sensor Height, Rigidity, Verticality, and Orientation - The OFCM recommends that the present weather sensor be mounted at a height of 10 feet (e m). This height is not always possible due to 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 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 ten feet above the tower base. Install the junction box on the tower near the AWOS Data Collection Processor junction 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 of 1 meter length or less. Mounting the sensor 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.

- ✓ The head is generally oriented with the TX head on the north side (in 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.

2.2 Mechanical Installation

2.2.1 Preparation

Prior to beginning the installation, the sensor and site should be readied.

The 6490 is packed in two (2) heavy walled corrugated cartons. One carton contains the electronics enclosure and the smaller carton contains the sensor head and cables. Also packed in this carton are the User's Guide. Configuration List, light block kit, sensor head U-bolt mounting hardware, and electronics enclosure mounting hardware. The long, narrow carton contains the sensor head with integral cables. When opening the cartons be careful to avoid spilling the contents.

SITTING GUIDELINES TO REMEMBER

- ✓ Sensor head mounted 2-5 meters high
- ✓ 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

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

User Supplied Items Required:

✓ Two (2) 1/2 inch conduit size weather-tight fittings for the holes in the bottom of the electronics enclosure for power and signal cable entry.

✓ AC and RS-485 cables, stripped and tinned, are needed for power and signal connections inside the electronics enclosure.

✓ A copper-clad ground rod and large diameter copper wire are needed to properly ground the sensor per local electrical codes.

✓ Mounting pole or tower to install sensor head and electronics enclosure.

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!

Prepare the Site

1. Carefully choose the site using the guidelines in Section 2.1.

2. Following applicable electrical and building codes, install a concrete mounting base, mounting pole or tower, AC power cable, RS-485 signal cable, and ground rod.

Prepare the Sensor Head

1. Attach the 2 U-bolts to the mounting plate with the 1/4-20 hex locking nuts. To mount the head to a vertical pipe, install the U-bolts horizontally. To mount to a horizontal pipe or boom arm, install them vertically using the same holes. Do not tighten the nuts completely until the sensor head is installed on the pole.

Prepare the Electronics Enclosure

1. Install the waterproof cable glands or conduit fittings in two (2) holes in the bottom of the electronics enclosure for the AC and RS-485 cables.

2. On the mounting pole or tower, prepare cross arm supports or brackets to mount the enclosure using the dimensions shown in Figure 2.2.1-2.

2.2.2 Mounting the Sensor

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

Because there are so many different ways to install the sensor, the installation procedure described in this section should be considered "typical".

Install the Sensor Head

1. Attach the sensor head to the mounting pole using the two (2) U-bolts. Do not lighten the U-bolt nuts completely until the head is oriented.

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

3. Tighten the U-bolt nuts when the orientation is correct. (Do not over tighten such that the mounting plate is bent).

4. Secure the head cables to the pole every 1-meter using tie-wraps or other straps.

Install the Electronics Enclosure

1. Attach the electronics enclosure to the mounting pole brackets using the hardware supplied with the sensor.

2. Connect the 2 sensor head cables labeled P4 and P5 to the electronics enclosure connectors labeled J4 and J5 respectively. The connectors are keyed so they can only plug into the correct receptacle.

3. Connect the sensor head green wire and the user supplied ground rod wire to the 1/4-02 stud on the bottom of the enclosure using the hardware supplied with the unit.

4. Secure any loose cable to the mounting pole using tie wraps or other straps.

2.3 Electrical Installation

2.3.1 Connecting the Sensor to the AWOS Data Collection Processor

Connections are made to the RS-485 surge protection module inside the electronics enclosure

RS-485 Connections

RS-485 connections are made to the RS-485 Interface Processor 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. Connect the signal cable to the RS485+, RS485-, and GND positions of the Interface Processor's terminal block.
2. Feed the free end of the user supplied RS-485 cable through the right most cable gland. An 18-24 AWG cable is recommended.
3. Strip and tin the ends of the wires.
4. Connect the 3 wires inside the DCP to TB4 pins 1 (+), 2 (-), and 7 (GND).
5. Ensure that none of the wires are stressed, then hand tighten the gland seal.

2.3.2 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 Surge Protection Module 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 power interface board located in the lower right corner of the enclosure.

Electrical Power Connections

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

1. Feed the power cable through the left cable gland or conduit fitting. A 3-wire 16 to 18 AWG cable is recommended.

2. Crimp ring type terminals to the ends of the wires.

3. Connect the 3 power cable wires to the AC Interface Board, TB1, pins 1 (LINE), 2 (NEUTRAL), and 3 (GND).

3. THEORY OF OPERATION

3.1 Sensor Head Theory

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 (i.e.: rain, snow, etc.) is determined. Precipitation is measured using the sensor head "in-beam" optics.

The sensor head consists of:

✓ TX Portion
- IR Light Emitting Diode
- Heated transmitter optical lens assembly

✓ RX Portion
- Heated receiver optical lens assembly
- Photo detector and preamplified assembly

✓ Integral Cabling
- 2 external cables for connection to electronics enclosure
- Ground stud for electrical grounding

The TX portion of the sensor head uses an infrared light emitting diode (IRED) as a light source that is modulated to eliminate interference in the system caused by background light. The IRED has a very long lifetime, is relatively low power, invisible to the eye, and presents no radiation hazard to the user.

The IRED is housed in the smaller of the sensor head boxes. A lens is used to collimate the IRED's CW modulated light into a slightly diverged beam. The transmit and receive lenses are heated by dual self-regulating positive temperature coefficient (PTC) thermistor disks, to a point above 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 photo diode 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 to the electronics enclosure are carried in two (2) separate cables. The LED modulation signal is carried in cable P/N 1203-151 (P5) and the in-beam (precipitation) signal is carried in cable P/N 1203-152 (P4).

3.2 Electronics Enclosure Theory

The electronics enclosure contains several elements including power distribution, analog signal processing, and digital processing.

Electronics Subassemblies

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

SP1 - Contains two (2) elements, the carrier (X) channel and the low (L) 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 (2) elements, the particle counting (K) channel and the high (H) 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.

SPB - Contains the acoustic processing channel for the HIPS sensor.

TXM Card - Contains the voltage controlled oscillator and amplified to drive the LED in the sensor head.

MPU Card - Contains the A/D, sample and hold, and microprocessor control log is to sample the outputs of the signal processing cards. Determines the precipitation type and precipitation intensity using ScTi algorithms. The MPU also performs real time self-tests to continually detect faults in the sensor and contains an RS-232 communications port.

Ancillary Subassemblies

There are two (2) power supplies with an AC powered unit, one for the electronics circuitry, and the other for the heaters. The electronics power supply provides regulated +5, +12, and -12 VDC to the analog and digital electronics. The heater power supply provides +12 VDC to the lens heaters in the sensor head.

The AC input and RS-485 signal lines are fully protected from the lightning surges by separate modules. The surge protection modules also are used as 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 purposes.

4. OPERATION WITH AN AWOS DATA COLLECTION PROCESSOR

4.1 Sensor Interface

✓ Physical Level

The Serial input/output (SIO) signal interface consists of a 2-wire RS-485 connection.

✓ Link Level

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

✓ 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 below), P plus rain rate in .001 inches per hr S plus four digit status code (see below)
17	<blank>	
18	XnnnLnnnKnnnHnnnTnnn	engineering data (see below)
38	<blank>	
39	sensor crc error counter <blank> sensor input msg counter	engineering data (see below)
	<blank> 4-character CRC<cr><lf>	crc from position 4 up to but not including the crc itself

✓ Protocol

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

Note that the sensor is continually sampling data (every 5 seconds) and processing the precipitation algorithm (once a minute typical). In most cases, the interface computer's response time to a poll will begin within 100ms 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.

4.2 Data Format

The weather information is encoded in the reply message as follows:

Byte	Description		Value
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 (2) byte field indicating present weather. The weather codes contained in this field are described in Section 4.3.1.

(3) pppp is a four (4) 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 (millimeter/hour) rain rate, averaged over a one minute period.

(4) ssss is a four (4) 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 FRUs. The status codes in this field are described in Section 4.3.2.

(5) nnn is a three(3) 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 (3) 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 F. Note, a value of -99 indicates a defective or missing temperature probe.

4.3 Data Interpretation

4.3.1 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.

WX Code	NWS WX Code Description	WX Code	NWS WX Code Description
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.

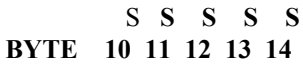
☞ Ice pellet and hail codes are only available with the optional HIPS sensor.

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.

4.3.2 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 (4 bytes) in the data output format, is a 4 byte field of sensor status bytes. The codes can be interpreted as shown in the table below.



BIT	STATUS	BIT	STATUS	BIT	STATUS	BIT	STATUS
0	OK	0	OK	0	OK	0	OK
1	FRU 3	1	FRU 1	1		1	
2	FRU 2	2	FRU 9	2		2	B
3	FRU 2 / 3	3	FRU 9 / 1	3		3	I
4	FRU 7	4	FRU 5	4		4	T
5	FRU 7 / 3	5	FRU 5 / 1	5		5	S
6	FRU 7 / 2	6	FRU 5 / 9	6		6	
7	FRU 7 / 2 / 3	7	FRU 5 / 9 / 1	7		7	R
8	FRU 8	8	FRU 4	8	RESET	8	E
9	FRU 8 / 3	9	FRU 4 / 1	9		9	S
A	FRU 8 / 2	A	FRU 4 / 9	A		A	E
B	FRU 8 / 2 / 3	B	FRU 4 / 9 / 1	B		B	R
C	FRU 8 / 7	C	FRU 4 / 5	C		C	V
D	FRU 8 / 7 / 3	D	FRU 4 / 5 / 1	D		D	E
E	FRU 8 / 7 / 2	E	FRU 4 / 5 / 9	E		E	D
F	FRU 8 /7/2/3	F	FRU 4 /5/9/1	F		F	

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.

ExampleStatus 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. Status code will now read S0100 indicating that there may be a problem with FRU 1. Replace FRU 1 (Sensor Head) and check 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.) A summary of the active status bits and the corresponding FRU's and assembly numbers are given below:

FRU # P/N	Item Description	All Weather Inc.
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

4.3.3 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,
              0xcc01,0x0cc0,0x0d80,0xcd41,0x0f00,0xcfc1,0xce81,0x0e40,
              0x0a00,0xcac1,0xcb81,0x0b40,0xc901,0x09c0,0x0880,0xc841,
              0xd801,0x18c0,0x1980,0xd941,0x1b00,0xdbc1,0xda81,0x1a40,
              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,
              0x6600,0xa6c1,0xa781,0x6740,0xa501,0x65c0,0x6480,0xa441,
              0x6c00,0xacc1,0xad81,0x6d40,0xaf01,0x6fc0,0x6e80,0xae41,
              0xaa01,0x6ac0,0x6b80,0xab41,0x6900,0xa9c1,0xa881,0x6840,
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              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) & 0xff] ^ ((crc >> 8) & 0xff);
return crc;
}

/ * end crc16 routine * /
```

5. AWOS MAINTENANCE & TROUBLESHOOTING

5.1 Monthly Maintenance Checks

Equipment Required

1. Clean Cotton Cloth or Lens Tissue
2. Common Household Glass Cleaner

✓ 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.

✓ 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.

5.2 Quarterly Maintenance Checks

Check the strength of the carrier signal by displaying the present weather status display on the AWOS Data Collection Processor'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 5.3. The data fields in Bold shown below are the channels of interest.

XnnnLnnnKnnnHnnnTnnn

✓ 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 Data Collection Processor's LCD display screen using the * and # keys.

Present Weather Data W__POOOO**SOOOO**

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

SOOOO - 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
XnnnLnnnKnnnHn nnTnnn

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

Lnnn - The one-minute low channel reading will generally ready 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 thermally connected to the electronics enclosure so it generally reads warmer than the ambient temperature due to 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.)

5.3 Calibration - Carrier Level

The carrier level can be easily adjusted without special test equipment.

DO NOT PERFORM IN PRECIPITATION, FOG, FREEZING FOG, OR MIST!

Equipment Required:

1. Clean Cloth or Lens Tissue
2. Common Household Glass Cleaner

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

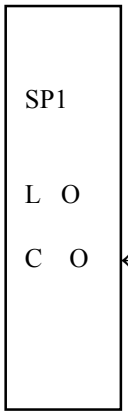
Step 1. Turn power to the Sensor ON, and allow 10 minutes before making a reading of the data string.

Step 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.

Step 3. Carrier Channel Adjustment



CW

← Increase

Locate: Signal Processing 1 (SP1) card in enclosure

Adjust: "C" post as shown at left to increase or decrease data value

Wait: 2-3 minutes

Verify: Carrier channel is "405 to 420" per data fields shown below

Readjust: As necessary to reach correct value

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

HINT - A 1/4 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.

6. 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.

GLOSSARY

ACG	Automatic Gain Control
AWG	American Wire Gauge
ASCII	American Standard Code for Information Exchange
ASOS	Automated Surface Observing System
CR	Carriage Return
CW	Continuous Wave
DC	Direct Current
FAA	Federal Aviation Administration
FRU	Field Replaceable Unit
IRED	Infrared light Emitting Diode
LDM	Limited Distance Modem
LED	Light Emitting Diode
HIPS	Hail & Ice Pellet Sensor
IR	Infrared
NEMA	National Electrical Manufacturer's Association
NWS	National Weather Service
PC	Personal Computer
PTC	Positive Temperature Coefficient Thermistor
RX	Receive or Receiver
ScTi	Scientific Technology, Inc.
TX	Transmit or Transmitter
V AC	Voltage - Alternating Current
VDC	Voltage - Direct Current
OWI	Optical Weather Identifier
WIVIS	Weather Identifier & Visibility Sensor
WMO	World Meteorological Organization

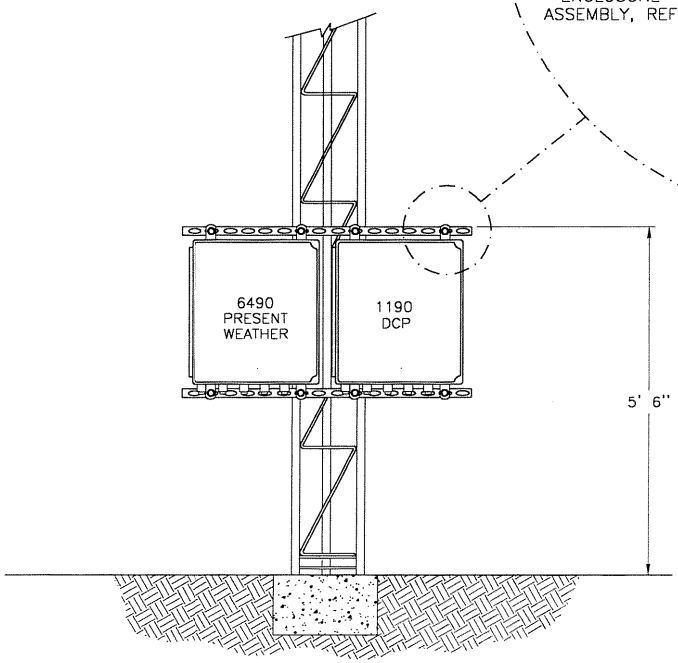
ENGLISH/METRIC CONVERSION FACTORS

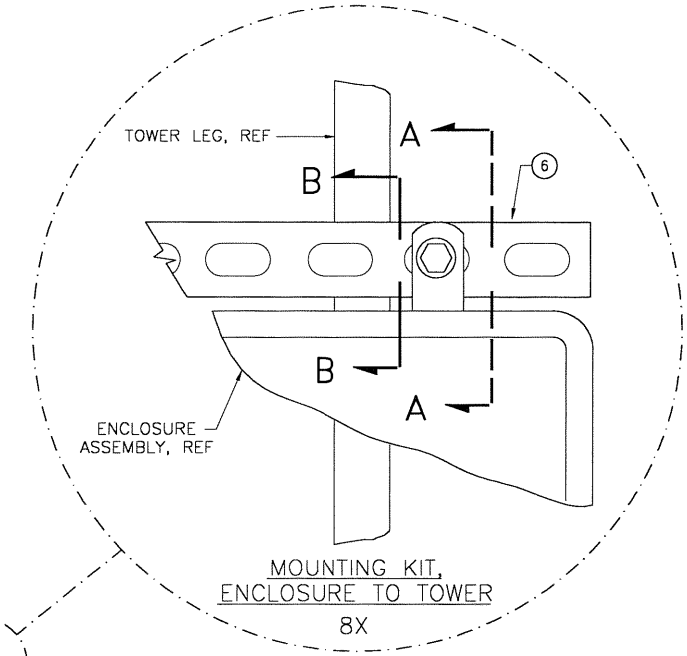
1 inch = 25.4 mm	1 mm = 0.039 in
1 mile = 1.609 km	1 kilometer = 0.614 mi
1 pound = 0.454 kg	1 kilogram = 2.2 lbs
F = 9/5 C + 32	C = 5/9(F - 32)

REVISIONS			DWG NO. M488176-007	
REV	ECN	DESCRIPTION	DATE	APPROVED
A	4811	INITIAL RELEASE	3/30/99	CSP
B	4981	ADD NOTE FOR FOLD OVER TOWER MOUNTING		

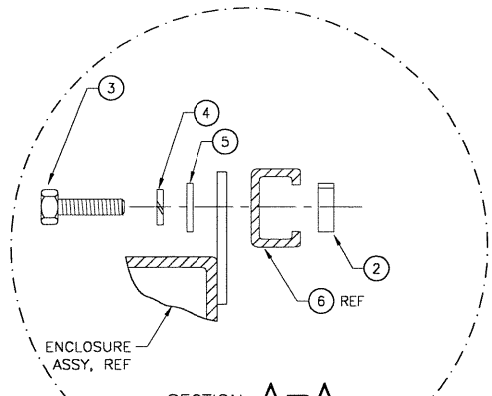
NOTES: UNLESS OTHERWISE SPECIFIED;

1. WHEN USING MODEL 8518-A FOLDOVER TOWER, MOUNT TO HINGED SIDE OF TOWER.

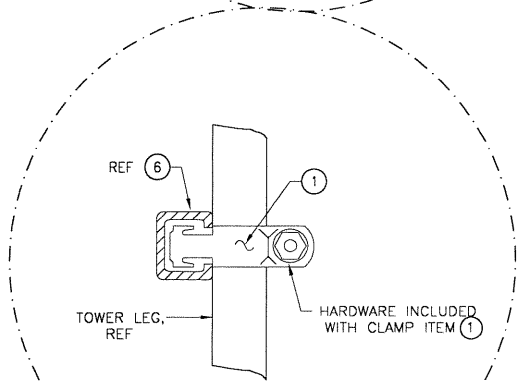




MOUNTING KIT,
ENCLOSURE TO TOWER
8X



SECTION A-A



SECTION B-B

APPEND THE FOLLOWING DOCUMENTS WHEN CHANGING THIS DOCUMENT:	UNLESS OTHERWISE SPECIFIED: DIMENSIONS ARE IN INCHES. TOLERANCES: XX=±.010 ANGLES ±1/2° XXX=±.005 CONCENTRICITY: .003 TIR. DO NOT SCALE DRAWING.	DRAWN BY: P. Kooyman	13JAN99	TITLE: INSTALLATION DRAWING, KIT, PRESENT WEATHER/DCP	allweatherinc
	MATL: SEE BILL OF MATERIALS	REVISED BY: P. Kooyman	24SEP03		
	FINISH: AS ISSUED	CHECKED BY:		SIZE: D	DWG NO. M488176-007
	TREATMENT	DESIGN ENGINEER:			
		PROJECT MANAGER:			
		APPROVALS	DATE	SCALE: NONE	RELEASE DATE: SHEET 1 OF 1

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6490-001
ECO 1541
Revision C
June, 2008