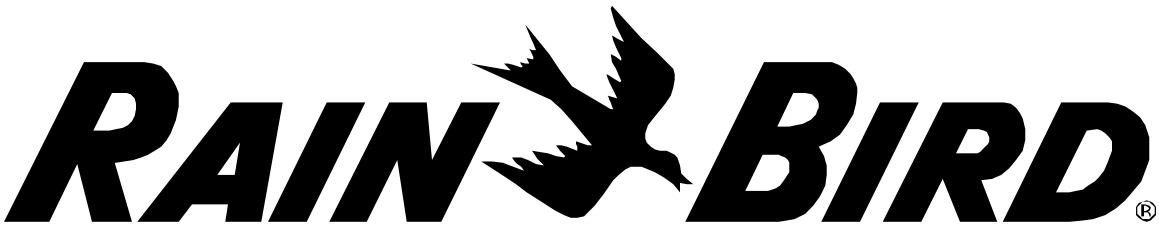


WS-PRO2 Weather Station

Installation, Operation,
Maintenance, and Troubleshooting
Manual

GTB 27176
July, 2007

Table of Contents

WS-PRO2 Weather Station

1.0 General Information

The Rain Bird WS-PRO2 Weather Station, when used in conjunction with the Rain Bird Cirrus, Nimbus II, or Stratus II Central Control system, provides the irrigation professional with a powerful tool to aid in the growing of lush, healthy, green turf grass, while conserving important resources, such as water and power.

Rain Bird Smart Weather software interrogates the WS-PRO2 weather station to retrieve information that has been gathered on a daily basis of the climatic conditions that affect the irrigation application for the area.

The Smart Weather software subjects the climatic information that it gathers to a version of the modified Penman Equation. The Penman Equation has been proven through over 35 years of university research, to be one of the most reliable predictors of turf grass water use requirements.

The Weather Station monitors the following climatic conditions:

- Rainfall
- Wind Speed & Direction
- Air Temperature
- Relative Humidity
- Solar Radiation

The standard WS-PRO2 configuration includes sensors to monitor these conditions, a data logger to capture this data, a modem to communicate the information to the Smart Weather software located on the central control computer and a power supply.

The Rain Bird Model “PRO 2” Weather Station is available in four (4) basic configurations:

Model WSPRO2SH - A direct wire system intended for use when the weather station is within 20,000 feet of the Central Control Computer and communication is via a wire path between the weather station and the computer. A separate power source is required for this weather station.

Model WSPRO2PH - A phone modem system for use when the weather station is further than 20,000 feet from the Central Control Computer or when they cannot be connected by a communication wire path. The system communicates utilizing a standard, dedicated phone service. A separate power source is required for this weather station.

Model WSPRO2SHS – A direct wire system intended for use when the weather station is within 20,000 feet of the Central Control Computer and communication is via a wire path between the weather station and the computer. This weather station utilized solar power instead of a local power source.

Model WSPRO2PHS - A phone modem system for use when the weather station is further than 20,000 feet from the Central Control Computer or when they cannot be connected by a communication wire path. The system communicates utilizing a standard, dedicated phone service. This weather station utilized solar power instead of a local power source.

2.0 Installation Tasks

2.0.1 Tools Required

The tools required for weather station installation are listed below.

2.0.1.1 Tools Required for Tower Installation

WS-PRO2 Tower
Shovel
Rake
Open end wrenches: 3/8", 7/16", ½", (2) 9/16"
Magnetic compass
6' Step ladder
Tape measure (12’ to 20’)
Claw hammer
Level (24” to 36”)
Hand saw
Materials for concrete form:
- (4) 1" x 2" x 12" stakes
- (2) 2" x 4" x 96" lumber
- (12) 8p double-head nails
- (8) 16p double-head nails
- 20 ft form wire
- ½ Yard concrete
- Concrete trowel, edger
- Electrical Fish tape or 20 feet of small diameter rope
- Wheelbarrow

2.0.1.2 Tools for Instrumentation and Maintenance

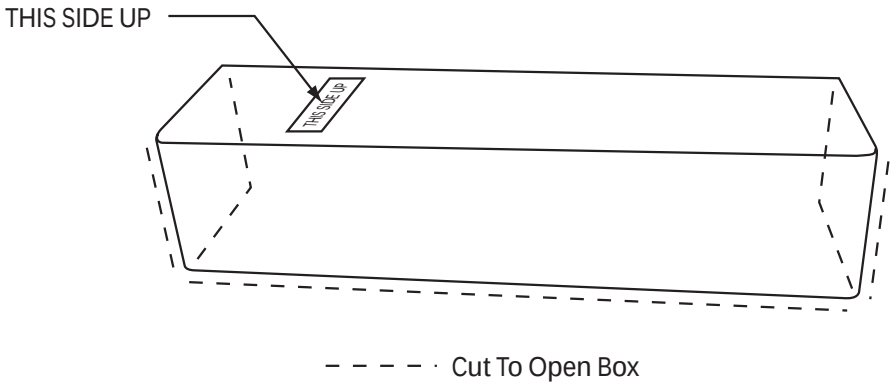
WS-PRO2 Tower
Lock and key for enclosure
Magnetic declination angle (Section 4)
Magnetic compass
Straight bit screwdrivers (small, medium, large)
Phillips-head screwdrivers (small, medium)
Small diagonal side-cutters
Needle-nose pliers
Wire strippers
Pocket knife
Calculator
Volt / Ohm Meter

Electrical Tape
Step ladder (6')
Station manuals
Station log and pen
Open end wrenches: 3/8", 7/16", ½", (2) 9/16"
Socket wrench and 7/16" deep well socket
Adjustable wrench
Pliers
Conduit and associated tools (as required)
Felt-tipped marking pen
Claw hammer
Pipe wrench (12")

2.0.2 Preparation

Immediately upon receipt of your weather station

- Open shipping carton(s).
- Check contents against invoice and shipping checklist. Contact Rain Bird immediately about any shortages.
- Weather station is packed in the shipping box in layers (Figure1, Figure 2, and Figure 3).



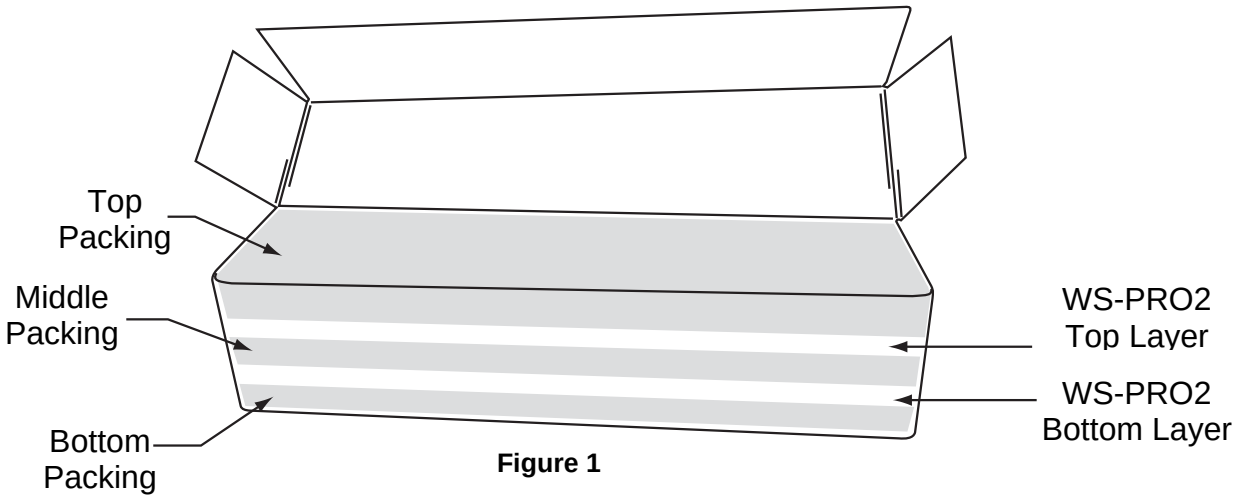


Figure 1

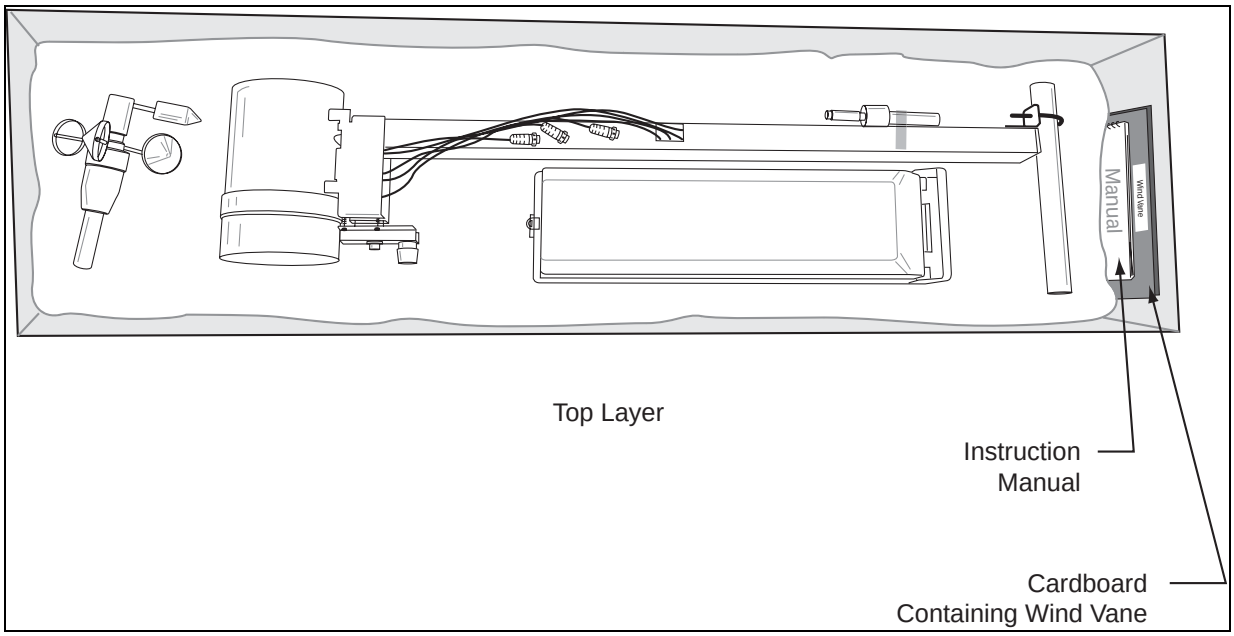
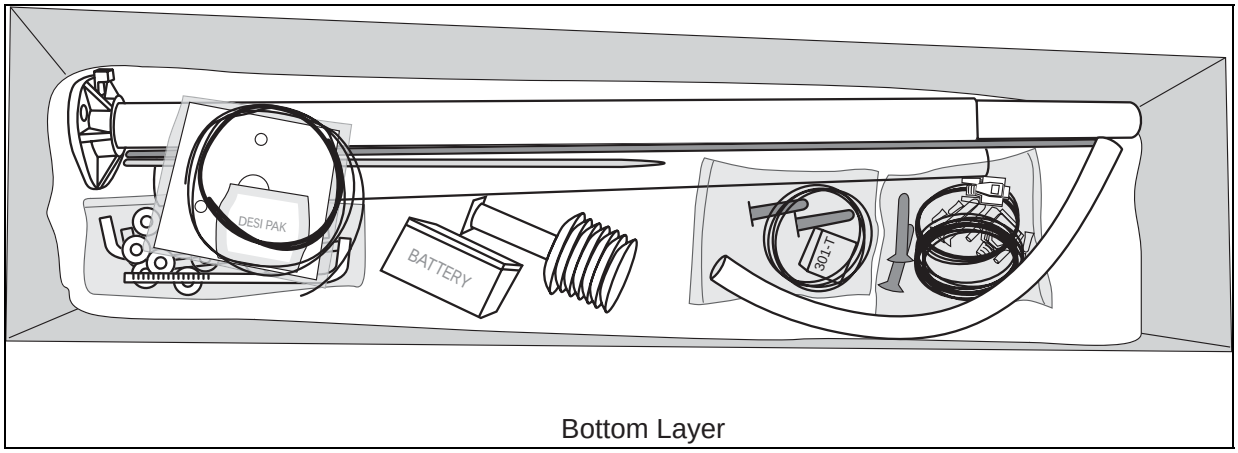


Figure 2



Bottom Layer

Figure 3

2.1 Site Selection

Selecting an appropriate site for the weather station is critical in order to obtain accurate meteorological data. In general, the site should be representative of the general area of interest, and away from the influence of obstructions such as buildings and trees.

The weather station should not be located where sprinkler irrigation water will strike sensors or instrument enclosure.

Some general guidelines for site selection are listed below, which were condensed from EPA (1988)1, WMO (1983)2, and AASC (1985)3 publications.

2.1.1 Wind Speed and Direction

Wind sensors should be located over open level terrain, and at a distance of at least ten times (EPA) the height of any nearby building, tree or other obstruction, as illustrated in Figure 4.

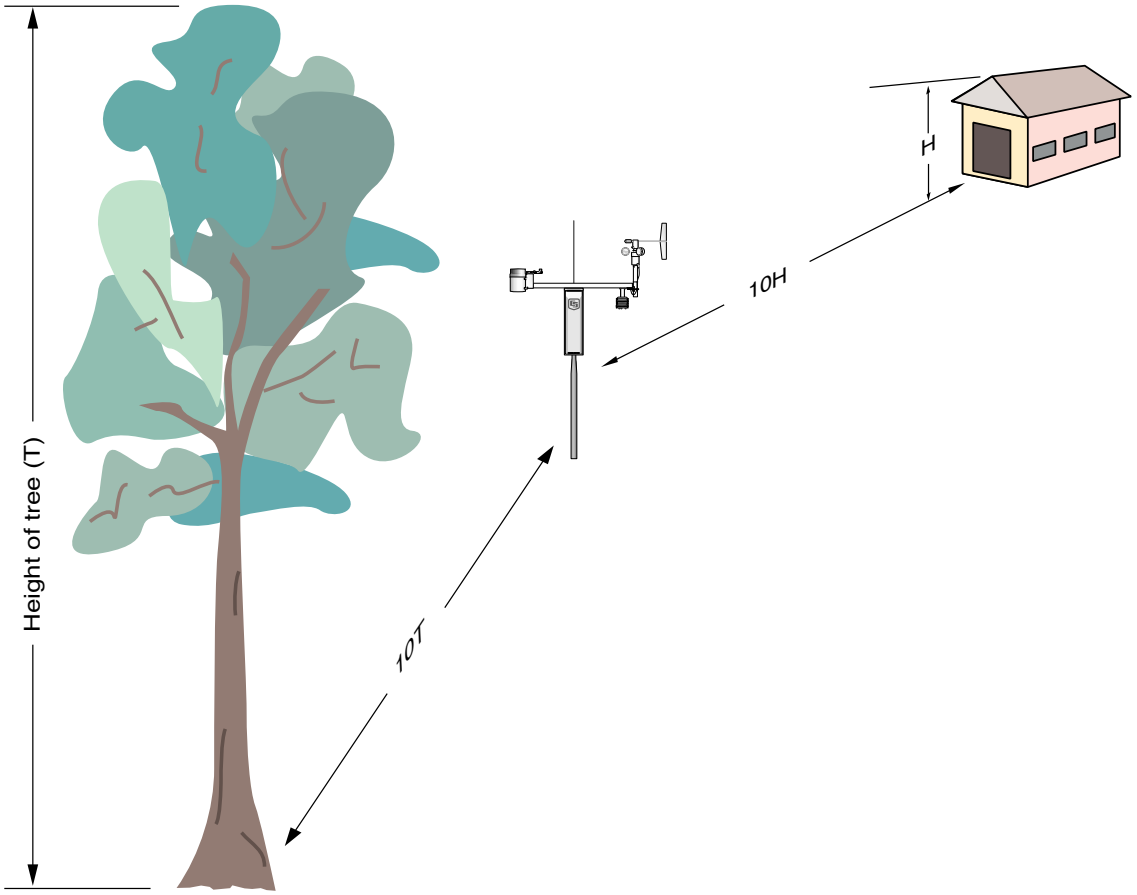


Figure 4

2.1.2 Temperature and Relative Humidity

Sensors should be located over an open level area at least 9 m (EPA) in diameter. The surface should be covered by short grass, or where grass does not grow, the natural earth surface. Sensors should be located at a distance of at least four times the height of any nearby obstruction and at least 30 m (EPA) from large paved areas. Sensors should be protected from thermal radiation, and adequately ventilated.

Situations to avoid include:

- Large industrial heat sources
- Rooftops
- Steep slopes
- Sheltered hollows
- High vegetation

- Shaded areas
- Swamps
- Areas where snow drifts occur
- Low places holding standing water after rains

2.1.3 Precipitation

A rain gage should be sited on level ground that is covered with short grass or gravel. In open areas, the distance to obstructions should be two to four times (EPA, AASC) the height of the obstruction.

2.1.4 Solar Radiation

Pyranometers should be located to avoid shadows on the sensor at any time. Mounting it on the southern most (northern hemisphere) portion of the weather station will minimize the chance of shading from other weather station structures. Reflective surfaces and sources of artificial radiation should be avoided.

2.1.5 Soil Temperature

The measurement site for soil temperature should be at least 1 square meter and typical of the surface of interest. The ground surface should be level with respect to the immediate area (10 m radius).

Standard measurement depths:
10.0 cm ± 1.0 cm (AASC)
5.0 cm, 10.0 cm, 50.0 cm, 100.0 cm (WMO)

2.1.6 Determining True North for Wind Vane Orientation

Magnetic declination, or other methods to find True North, should be determined prior to installing the weather station. True North is usually found by reading a magnetic compass and applying the correction for magnetic declination*; where magnetic declination is the number of degrees between True North and Magnetic North. Magnetic declination for a specific site can be obtained from a USFA map, local airport, or through an internet service called NSSDC CGM (Section 2.1.7). A general map showing magnetic declination for the contiguous United States is shown in Figure 5.

Declination angles east of True North are considered negative, and are subtracted from 0 degrees to get True North as shown Figure 8. Declination angles west of True North are considered positive, and are added to 0 degrees to get True North as shown in Figure 9. For example,

the declination for Logan, Utah is 13.80° East. True North is 360°- 13.80° or 346.2° as read on a compass.

Note: Other methods employ observations using the North Star or the sun, and are discussed in the Quality Assurance Handbook for Air Pollution Measurement Systems, Volume IV - Meteorological Measurements4.

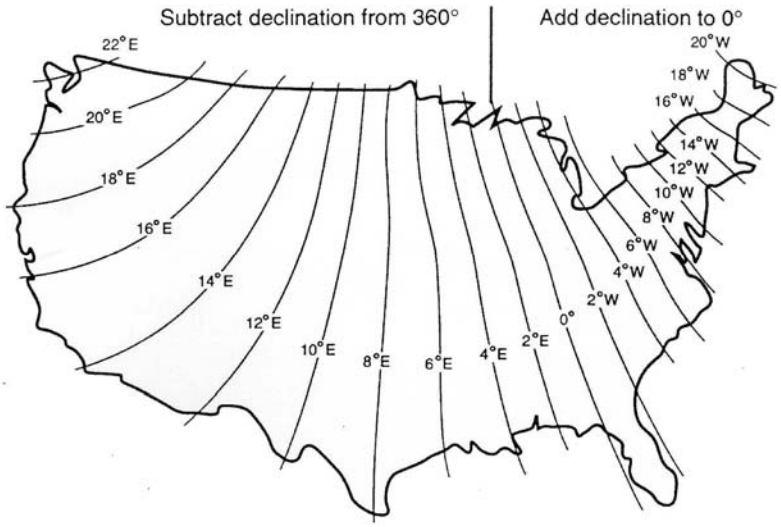


Figure 5

2.1.7 NSSDC CGM Service

The NSSDC CGM (Corrected Geomagnetic) Service provides an easy way of determining magnetic declination of a specific site. Since magnetic declination fluctuates with time, it should be determined each time the wind vane orientation is adjusted. It can be accessed on the internet at:

http://nssdc.gsfc.nasa.gov/space/cgm/cgm.html

If you know the latitude and longitude of your site, fill out Form 1 for an accurate magnetic declination. Below is an example for Logan, Utah U.S.A (Figure 6). If you do not know the latitude and longitude of your site, fill out Form 2 for estimate of magnetic declination. Note that longitude is expressed in 0 to 360 degrees east of the Greenwich prime meridian, and that north latitudes are positive.

A table containing similar information to the following will be returned later submitting Forms 1 or 2.

Query Form 1: Latitude/Longitude

Latitude/Longitude below specified in: Geocentric / CGM

Year (from 1945 to 2005): 2003

Altitude above the 1-Re surface (km) [from 0. to 40000.]: 0

Latitude (degrees) [from -90. to -20. or from 20. to 90.]: 41.78

Longitude (degrees) [from 0. to 360.]: 248.15

Submit Query | Clear Form

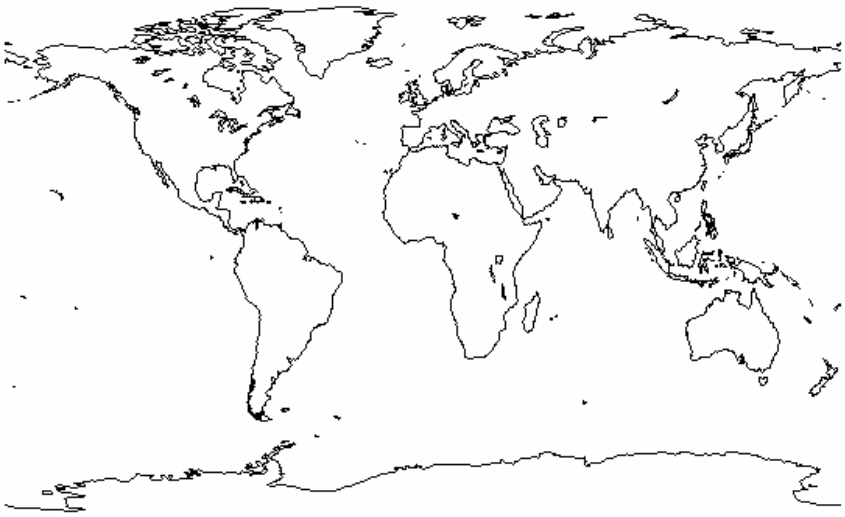
Figure 6

Query Form 2: Image Map (only GEO ==> CGM)

Year (from 1945 to 2005): 2003

Altitude above the 1-Re surface (km) [0. - 40000.]: 0

Click on the map to specify location and submit query:



Clear Form

Figure 7

Transformation between CGM and GEO coordinates and modeling of the geomagnetic field parameters is required.

Results of GEO-CGM calculations:

Geocentric		CGM		L-value	IGRF Magnetic Field			Oval & Azimuth		MLTMN
Lat.	Long.	Lat.	Long.	Re	H,Nt	D,deg	Z,nT	angles	N/S:+E/W	in UT
Starting point at 0.0 km:										
41.78	248.15	49.37	311.42	2.36	20676	**13.8**	49806	15.01	5.97	7:53

Magnetic declination is bold in this example to show its location in the table. A positive declination is east, while a negative declination is west.

The declination in this example is 13.80 degrees. As shown in Figure 5, the declination for Logan, UT is east, so True North for this site is 360 – 13.80, or 346.2 degrees.

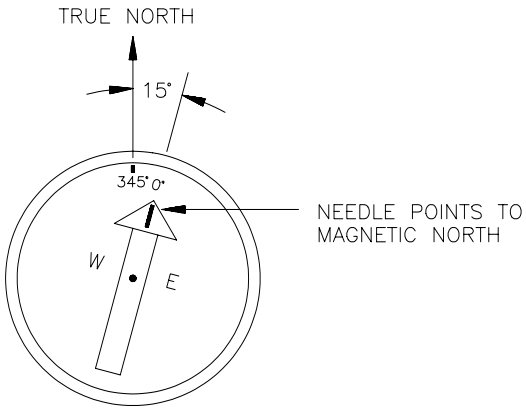


Figure 8

Declination Angles East of True North Are Subtracted From 0 to Get True North.

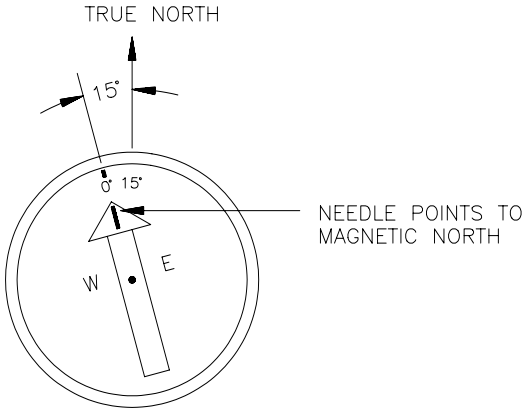


Figure 9

Declination Angles West of True North Are Added to 0 to Get True North

3.0 Base Tower Installation

CAUTION: Do not fit the WS-PRO2 Tower sections together until the appropriate time. Once attached, they cannot be detached.

The WS-PRO2 Tower provides a support structure for mounting the WS-PRO2 weather station components. Figure 10 shows a typical Tower installation option. The tower is designed to withstand winds of 100 mph. The lightning rod assembly is attached after the instrumentation enclosure is installed.

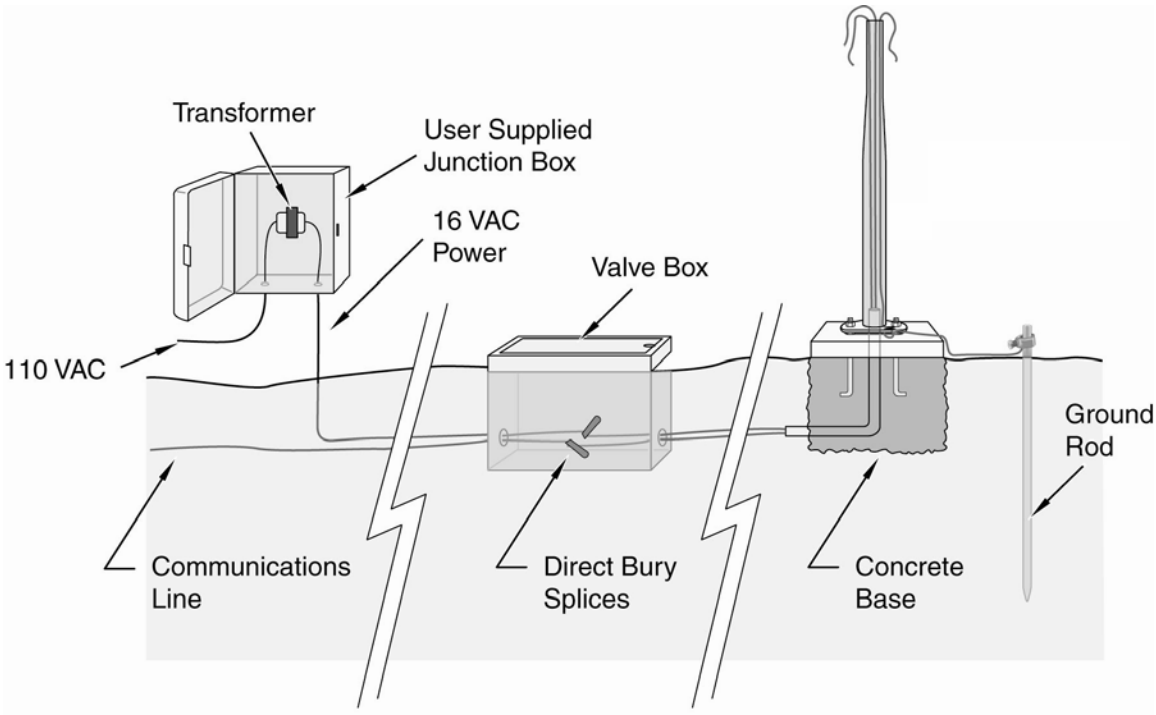


Figure 10
(Note: Figure 10 does not demonstrate the surge protection and grounding requirements for the system)

3.0.1 Base Installation

3.0.1.1 Supplied Components

(3) ½ inch L-Bolts
(9) ½ inch Nuts
(1) Anchor Template
Refer to Section 2 for components supplied by installer.

3.0.2 Installation of Concrete Base

1. The ET Tower attaches to a user supplied concrete foundation constructed as shown in Figure 11.
2. Construct the concrete form with 2" x 4" lumber and 16p nails.
3. Assemble the template and anchor bolts. There should be two nuts below and one nut above the template on each bolt.
4. Clear an area large enough to set the form at the desired elevation.
5. Dig a hole 2 feet x 2 feet x 2 feet. Lighter soils may require a deeper hole. About 20 inches below the top of the hole, gouge a small cavity in one wall of the hole. The cavity should be about 4 inches deep and just large enough in diameter to insert one end of the conduit. Make certain the cavity "points" in the direction from which power and communications cables will come. For example the cavity will “point” towards a valve box if one is being used.
6. Center the form over the hole. Adjacent to the form, drive four stakes into the soil. Secure the leveled form to the stakes with the 8p nails.
7. Cap the ends of the conduit with duct tape. Position the conduit and wire into place by securing the wire to nails in the form.
8. Fill the hole and form with approximately ½ yard of concrete. Screed the concrete level with the top of the form. Center the template assembly over the conduit and press into the concrete. Put 2 x 4 spacers between the template and the top of the form. The bottom of the bolt threads should be about ½ inch above the concrete. The template must be level in two dimensions. Use a trowel and edger to finish.
9. Wait 24 hours before removing the concrete form. Wait 7 days before mounting the WS-PRO2 Tower.

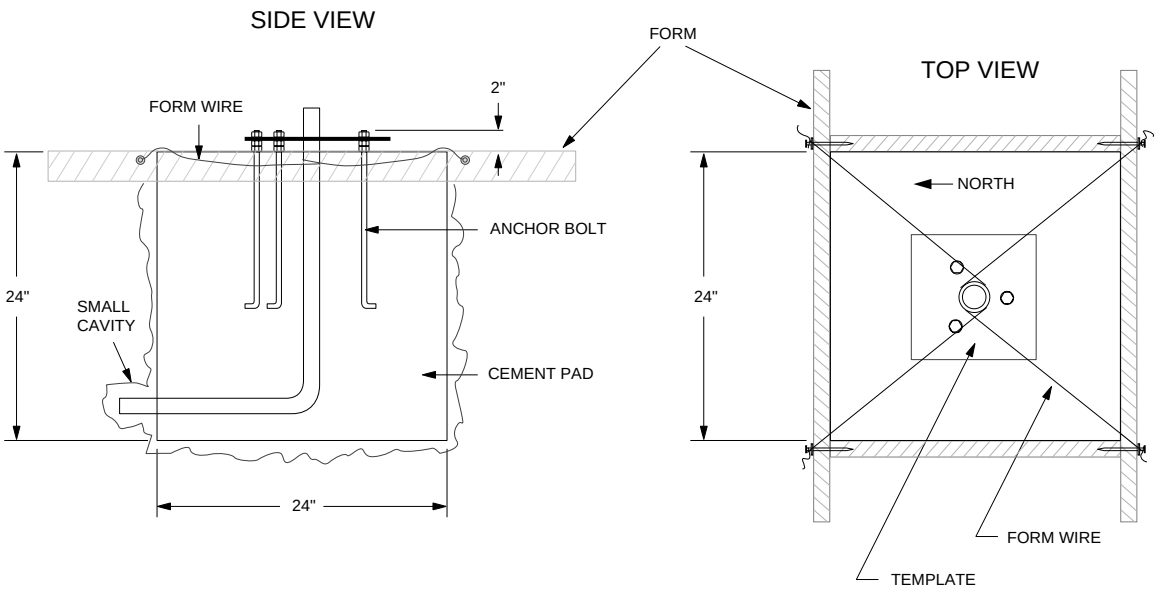


Figure 11

3.1.0 Base Tower Components

3.1.0.1 Supplied Components

(1) Upper Tower Section (Tapered)
(1) Lower Tower Section
(6) ½ inch Washers
(1) 12 foot 10 AWG Ground Cable
(1) Tower Cap
(1) 20' communications cable
(1) 20' power cable

Refer to Section 2 for components supplied by installer.

3.1.1 Tower Installation

Attach the tower to the base as shown in Figure 12.

1. Dig a hole close to the concrete base to access the lower conduit opening. From the hole, trench to the power and communications sources. Remove the duct tape from both ends of the conduit.
2. Remove the template. Attach the two pieces of the tower. This is a permanent connection and cannot be undone. Lay the tower on the ground with the base next to the concrete foundation.
3. Thread communications and power cables through the tower and conduit. Electrical tape will help.

4. Cut and save a 9 inch piece of 12 AWG ground wire from the 12 foot length provided. Thread the remaining 11 foot ground wire through the tower. Secure all wiring so it does not slip back into the tower or conduit.
5. Place the tower cap over the tower end.
6. Raise the tower on a still day. Place a washer on top of the two nuts on each foundation bolt. Taking great care not to damage cables between the tower and conduit, raise the tower and lower it onto the conduit and mounting bolts. Install a washer and nut on each bolt and hand tighten. Check plumb of the tower by placing a level on the north and east sides of the lower tower section. Adjust the topmost of the two lower nuts (leveling nut) on each bolt as necessary. When plumb is established, lock the leveling nut in place by tightening the lowest nut against it. Tighten the three top nuts with the wrench.

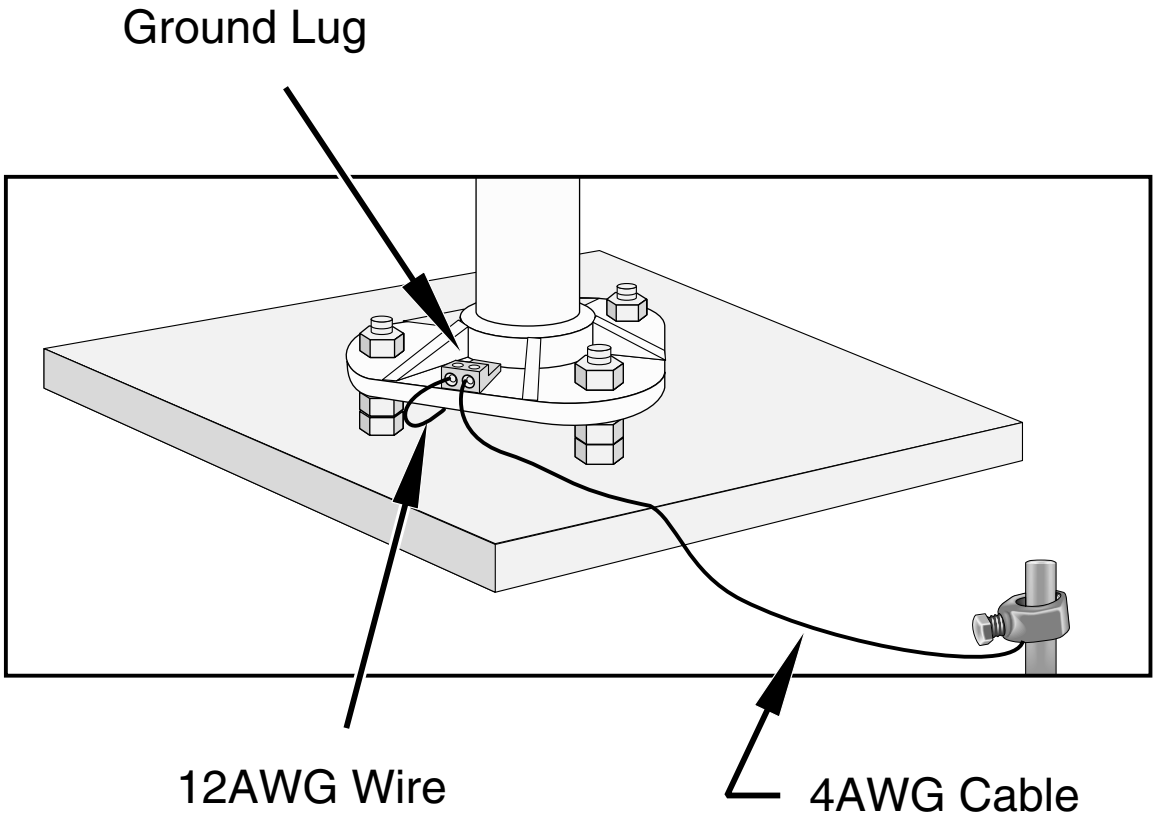


Figure 12

3.1.2 Weather Station Grounding

3.1.2.1 Supplied Components

(1) 5 foot 4 AWG Ground Cable
(1) Copper Ground Lug, Bolt
(1) Ground Rod, Clamp
Refer to Section 2 for components supplied by installer.

3.1.3 Tower Grounding Procedure

Ground the tower as shown in Figure 12.

1. Place the ground rod clamp on the ground rod which is a part of the three rod grounding grid. Secure it about 3 inches from the top. Do this before the rod is driven into the ground. Be careful not to damage the clamp with the hammer
2. Taking care not to damage power or communications lines, drive the ground rod using a fence post driver or sledge hammer.
3. Strip 1 inch of insulation from both ends of the 4 AWG ground cable. Strip 1 inch of insulation from the lower end of the 12 AWG ground wire. Install the tower grounding lug to the tower base with the 7/16 bolt provided (Figure 12). Loosen the lug's set screw and insert the 4 AWG and 12 AWG wire. Tighten the set screw.
4. Loosen the ground rod clamp. Insert the 4 AWG wire. Tighten the clamp (Figure 12).

3.2.0 Wiring Valve Access Box

At the base of the Weather Station and as near to the base as feasibly possible, dig a hole large enough to install a standard 18” x 24” rectangular valve box and cover. The valve box shall accommodate all wiring connections, one rod of a 3-rod grounding grid, MGP-1 grounding plate assemblies and MSP-1 surge arrestors.

3.3.0 Weather Station Power Wiring

Furnished as part of the Weather Station, is a 120VAC to 16VAC power transformer. This transformer can be located in the pedestal of a field satellite controller that is in the near proximity of the weather station or some other convenient weather proof location.

Install the transformer in a 4”x 4” metal electrical box with cover. Connect the 120VAC power wires of the transformer to a source of 120VAC power

that is not easily turned off. To the output of the transformer, connect a pair of UF wires, of proper size, using “crimp-on” open spade connectors. The power wires shall be direct buried and run over to the weather station. Connect the 16VAC power wires to the “LINE” side of an MSP-1 surge arrestor, which shall be mounted in an MGP-1 grounding plate assembly. The MGP-1 grounding plate assembly shall be securely mounted on a 5/8” diameter copper-clad, ground rod - one of a 3-rod grounding grid.

NOTE - The minimum voltage to the transformer shall be not less than 112 volts.

Wire sizing shall be in accordance with the chart given below.

Wire shall be Type “UF” (underground feeder cable) with PVC insulation. The 16VAC power is used to provide constant charging of the battery within the weather station, through the battery charging circuit.

The “EQUIPMENT’ side of this MSP-1 surge arrestor shall be connected to “red” and “black” wires of the 20’power wire cable, which is furnished as part of the weather station. This cable shall be routed through the 1 ½” dia. long sweep elbow to the base of the weather station. All wire connections and splices in the power wiring shall be made using 3-M DBY direct burial connectors. DO NOT apply power to transformer at this time.

POWER WIRE SIZING CHART	
WIRE SIZE	Distance (feet*)
18	500
16	800
14	1275
12	2000
10	3250
8	5100
* Transformer to Weather Station	

3.4.0 Communication Wiring

3.4.1 Direct Connect – Short Haul Modems

Coming from the Central location, furnish and install a Belden #9883, Direct Burial Type, communication cable over to the weather station location. The Belden cable shall consist of three (3) twisted pair of wires (20 Gauge), a bare copper drain wire and an aluminum shield. The three (3) twisted pair shall be color

coded as follows; 1 pair “black” and “white”, 1 pair “black” and “green” and 1 pair “black” and “red”.

The BLACK (-XMT) & GREEN (+XMT) pair shall be connected to the BLACK & RED wires respectively, at the “LINE” end of one of the MSP-1 surge arrestors. The BLACK (-XMT) and the RED (+XMT) wires from the “EQUIPMENT” end of this MSP-1 surge arrestor shall be connected to the WHITE (-XMT) and the GREEN (+XMT) wires of the communication cable furnished with the weather station.

The RED (+RCV) & BLACK (-RCV) pair shall be connected to the RED & BLACK wires respectively, at the “LINE” end of the other MSP-1 surge arrestor. The RED (+RCV) and the BLACK (-RCV) wires from the “EQUIPMENT” end of this MSP-1 surge arrestor shall be connected to the RED (+RCV) and the BLACK (-RCV) wires of the communication cable furnished with the weather station.

This communication cable shall be routed through the 1 ½” diameter long sweep elbow to the base of the weather station. All wire connections and splices in the communication wiring shall be made using 3-M DBY direct burial connectors. DO NOT attempt to use any other type connectors as communication signal may be impaired and poor communication resulting.

3.4.2 Grounding Communication Cable

The bare copper drain wire of the Belden cable shall be grounded to the grounding rod, using a brass ground wire clamp.

IMPORTANT - DO NOT ground the drain wire at the Central end of the cable - just leave the drain wire un-used.

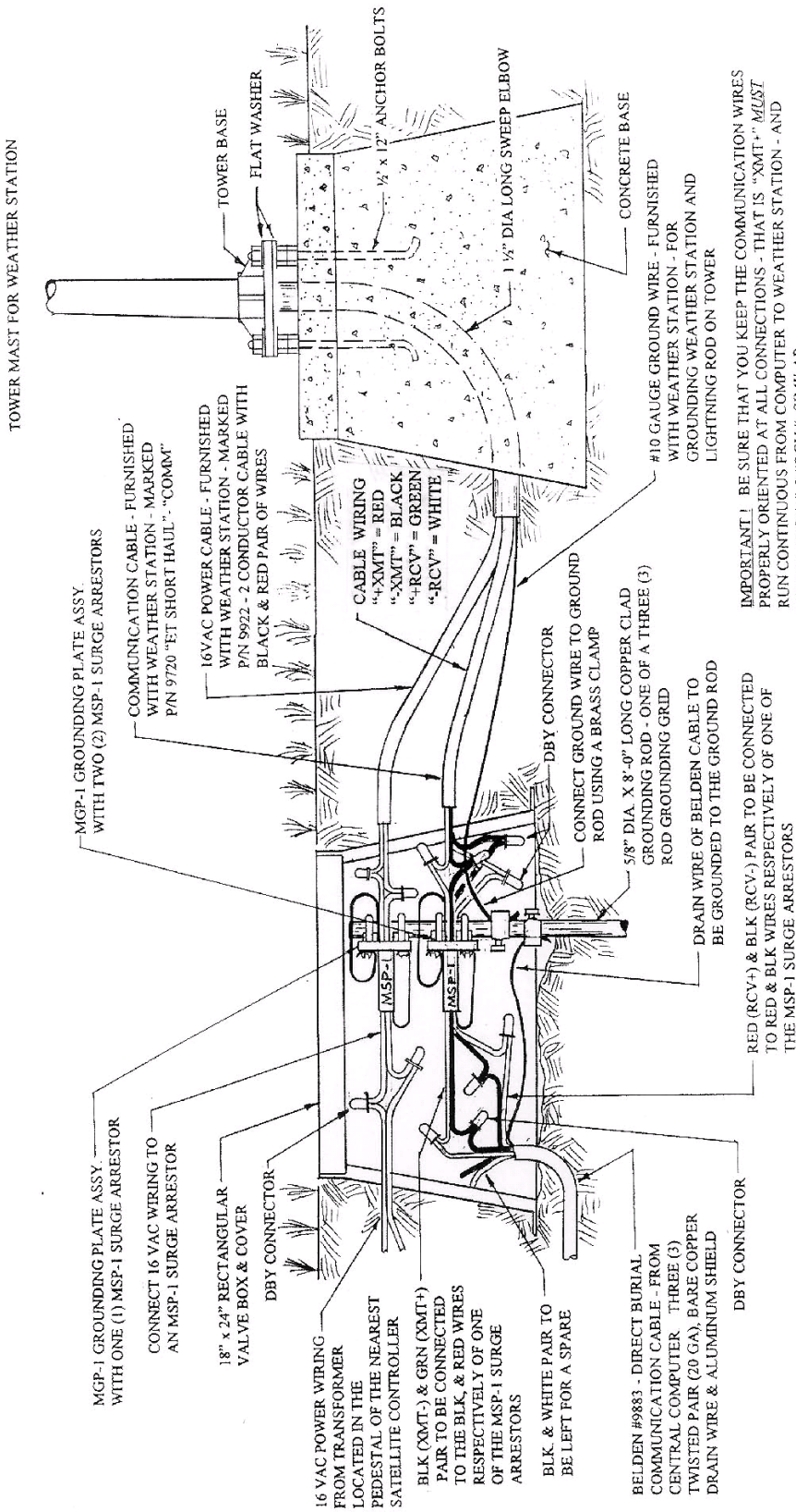

TOWER MAST FOR WEATHER STATION
TOWER BASE
FLAT WASHER
½" x 12" ANCHOR BOLTS
1 ½" DIA LONG SWEEP ELBOW
CONCRETE BASE
MGP-1 GROUNDING PLATE ASSY.
WITH TWO (2) MSP-1 SURGE ARRESTORS
COMMUNICATION CABLE - FURNISHED
WITH WEATHER STATION - MARKED
P/N 9720 "ET SHORT HAUL" - "COMM"
16VAC POWER CABLE - FURNISHED
WITH WEATHER STATION - MARKED
P/N 9922 - 2 CONDUCTOR CABLE WITH
BLACK & RED PAIR OF WIRES
CABLE WIRING
"+XMT" = RED
"-XMT" = BLACK
"+RCV" = GREEN
"-RCV" = WHITE
#10 GAUGE GROUND WIRE - FURNISHED
WITH WEATHER STATION - FOR
GROUNDING WEATHER STATION AND
LIGHTNING ROD ON TOWER
IMPORTANT ! BE SURE THAT YOU KEEP THE COMMUNICATION WIRES
PROPERLY ORIENTED AT ALL CONNECTIONS - THAT IS "XMT+" MUST
RUN CONTINUOUS FROM COMPUTER TO WEATHER STATION - AND
"XMT-", "RCV+" & "RCV-" SIMILAR
DBY CONNECTOR
CONNECT GROUND WIRE TO GROUND
ROD USING A BRASS CLAMP
5/8" DIA. X 8'-0" LONG COPPER CLAD
GROUNDING ROD - ONE OF A THREE (3)
ROD GROUNDING GRID
DRAIN WIRE OF BELDEN CABLE TO
BE GROUNDED TO THE GROUND ROD
RED (RCV+) & BLK (RCV-) PAIR TO BE CONNECTED
TO RED & BLK WIRES RESPECTIVELY OF ONE OF
THE MSP-1 SURGE ARRESTORS
MSP-1
MSP-1
MGP-1 GROUNDING PLATE ASSY.
WITH ONE (1) MSP-1 SURGE ARRESTOR
CONNECT 16 VAC WIRING TO
AN MSP-1 SURGE ARRESTOR
18" x 24" RECTANGULAR
VALVE BOX & COVER
DBY CONNECTOR
16 VAC POWER WIRING
FROM TRANSFORMER
LOCATED IN THE
PEDESTAL OF THE NEAREST
SATELLITE CONTROLLER
BLK (XMT-) & GRN (XMT+)
PAIR TO BE CONNECTED
TO THE BLK. & RED WIRES
RESPECTIVELY OF ONE
OF THE MSP-1 SURGE
ARRESTORS
BLK. & WHITE PAIR TO
BE LEFT FOR A SPARE
BELDEN #9883 - DIRECT BURIAL
COMMUNICATION CABLE - FROM
CENTRAL COMPUTER THREE (3)
TWISTED PAIR (20 GA), BARE COPPER
DRAIN WIRE & ALUMINUM SHIELD
DBY CONNECTOR

Figure 13

3.4.3 Telephone Connected Using Telephone Company Lines

The Telephone Company needs to run a direct burial telephone cable to the weather station and terminate it near the base of the weather station. This needs to be a modem quality type telephone line with a separate call number.

The “TIP” line of the telephone cable shall be connected to the WHITE (“TIP”) wire of a 20’telephone patch cable, furnished as part of the weather station, marked - 2 conductor cable with WHITE (“TIP”) and BLACK (“RING”) pair of wires. The “RING” line of the telephone cable shall be connected to the BLACK (“RING”) wire of the telephone patch cable. Splices shall be made using 3-M DBY Direct Burial connectors. The splices for the phone line shall be made in the valve box, where the power wiring splices are made and where the MGP-1 grounding plate assembly with an MSP-1 surge arrestor mounted in it, is attached to one rod of a 3-rod grounding grid. Refer to FIGURE 14 below.

This telephone patch cable shall be routed through the 1 ½” diameter long sweep elbow to the base of the weather station.

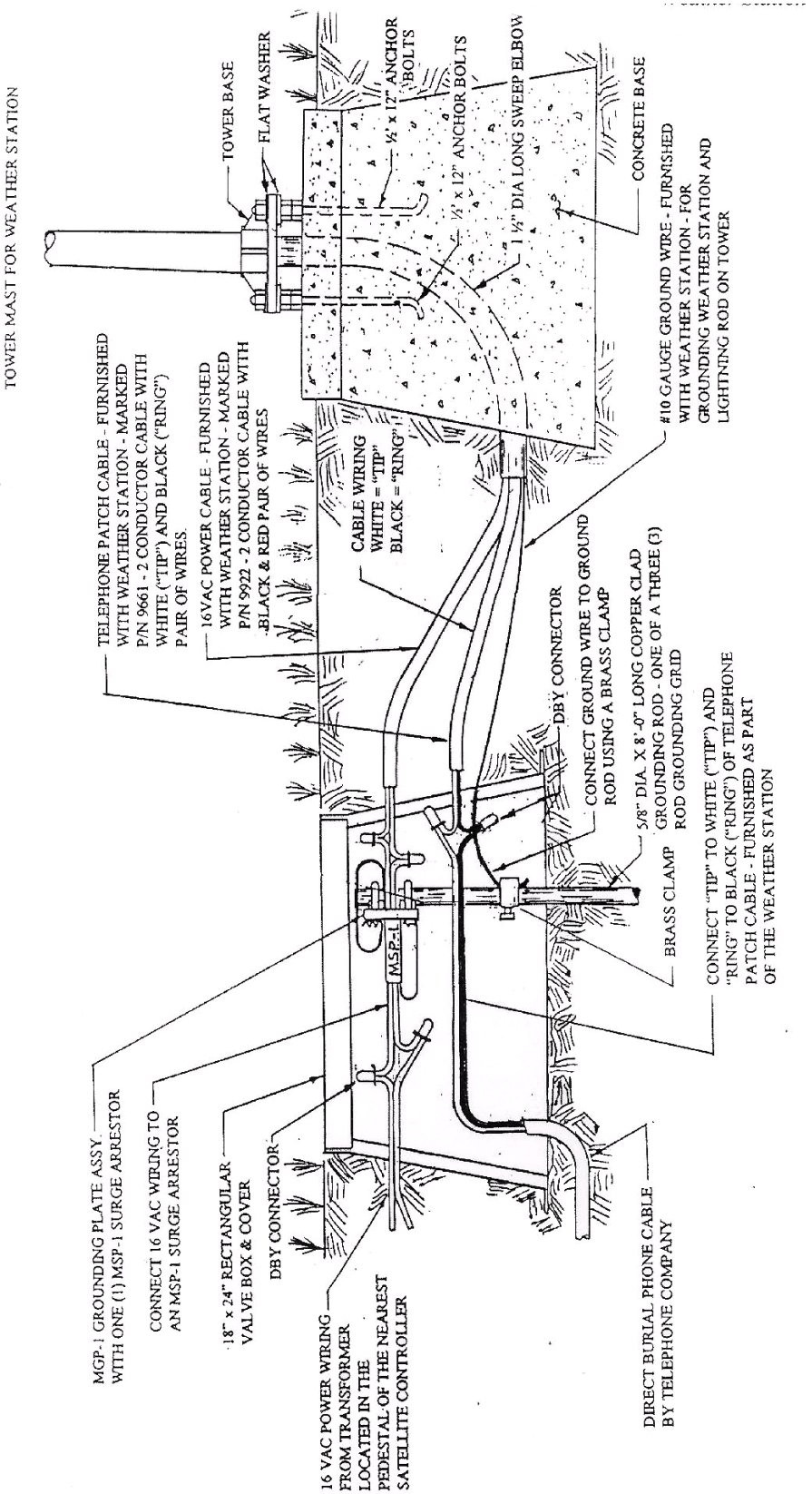

TOWER MAST FOR WEATHER STATION
TOWER BASE
FLAT WASHER
½" x 12" ANCHOR BOLTS
½" x 12" ANCHOR BOLTS
1 ½" DIA LONG SWEEP ELBOW
CONCRETE BASE
#10 GAUGE GROUND WIRE - FURNISHED WITH WEATHER STATION - FOR GROUNDING WEATHER STATION AND LIGHTNING ROD ON TOWER
TELEPHONE PATCH CABLE - FURNISHED WITH WEATHER STATION - MARKED P/N 9661 - 2 CONDUCTOR CABLE WITH WHITE ("TIP") AND BLACK ("RING") PAIR OF WIRES
16VAC POWER CABLE - FURNISHED WITH WEATHER STATION - MARKED P/N 9922 - 2 CONDUCTOR CABLE WITH BLACK & RED PAIR OF WIRES
CABLE WIRING
WHITE = "TIP"
BLACK = "RING"
DBY CONNECTOR
CONNECT GROUND WIRE TO GROUND ROD USING A BRASS CLAMP
5/8" DIA. X 8'-0" LONG COPPER CLAD GROUNDING ROD - ONE OF A THREE (3) ROD GROUNDING GRID
BRASS CLAMP
CONNECT "TIP" TO WHITE ("TIP") AND "RING" TO BLACK ("RING") OF TELEPHONE PATCH CABLE - FURNISHED AS PART OF THE WEATHER STATION
MGP-1 GROUNDING PLATE ASSY WITH ONE (1) MSP-1 SURGE ARRESTOR
CONNECT 16 VAC WIRING TO AN MSP-1 SURGE ARRESTOR
18" x 24" RECTANGULAR VALVE BOX & COVER
DBY CONNECTOR
16 VAC POWER WIRING FROM TRANSFORMER LOCATED IN THE PEDESTAL OF THE NEAREST SATELLITE CONTROLLER
DIRECT BURIAL PHONE CABLE BY TELEPHONE COMPANY
MSP-1

Figure 14

4.0 Instrumentation Installation

The weather station datalogger, power supply, sensor connection panel, communications devices, and data retrieval peripherals are mounted in the enclosure at the locations shown in Figure 15. Components include:

(1) WS-PRO2 Enclosure
(2) 4 unit Desiccant Pack
(1) Flat Point Screw Driver
(1) Power Supply Option
(1) Telecommunications Option
(1) 9-inch piece of 12 AWG ground wire
(1) Lightning rod and clamp

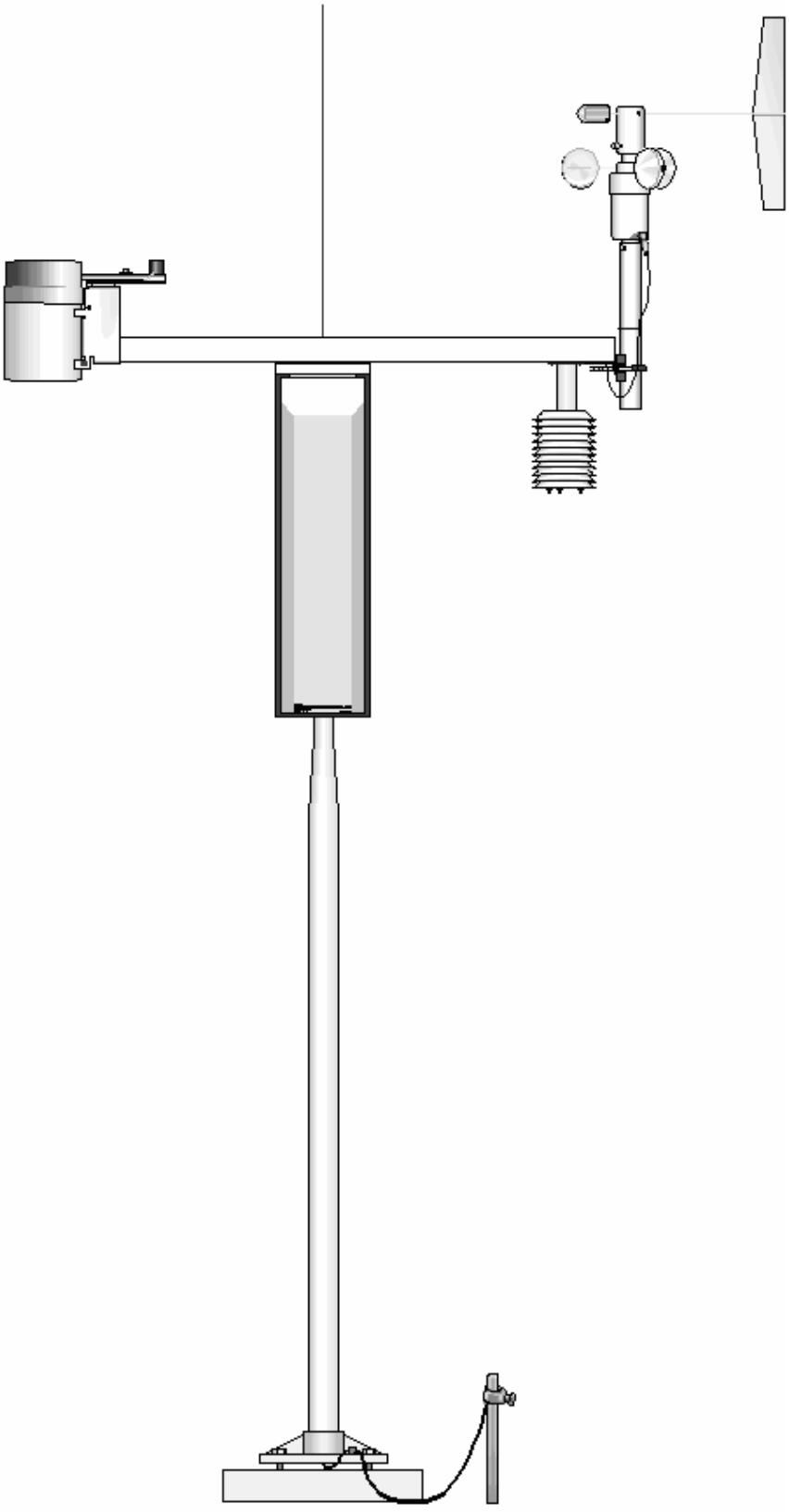


Figure 15

4.1.0 Enclosure, Datalogger, Power Supply

4.1.1 Battery Installation

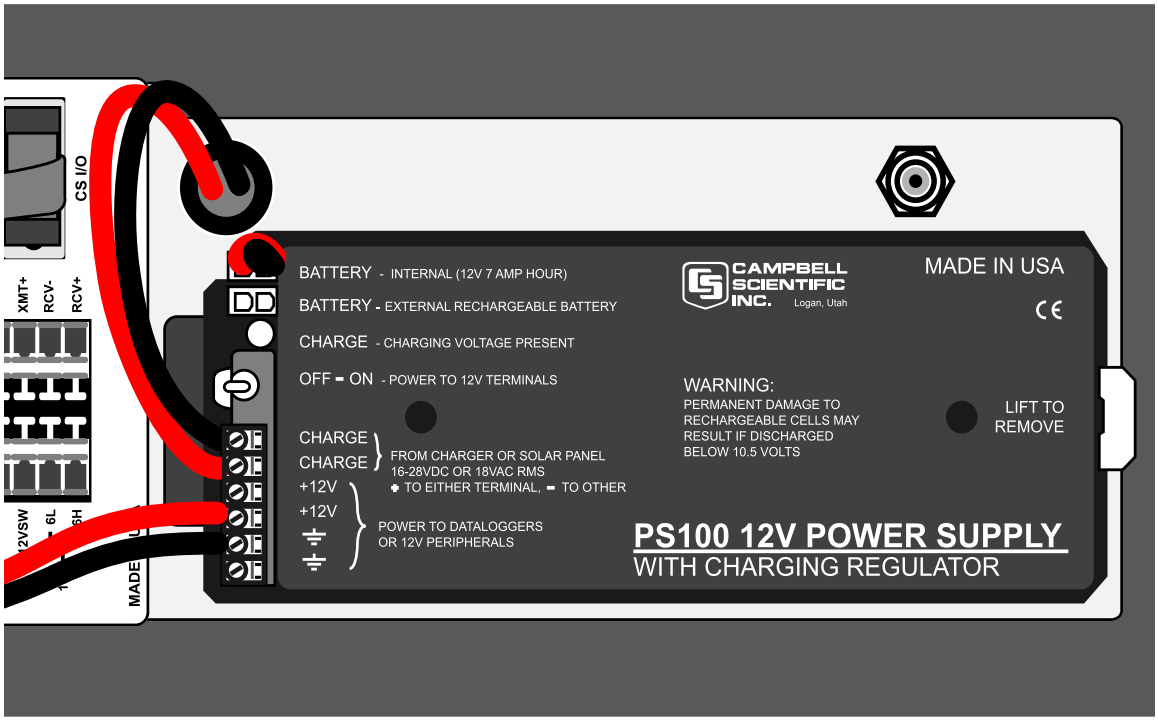


Figure 16

The PS100 power switch should be in the “OFF” position. To install the battery, remove the cover from the PS100 by sliding the latch up at one end of the cover and sliding the cover down and out. Install the battery as shown in Figure 16. Plug the battery lead into the connector labeled “BATTERY – Internal 12V 7 Amp-Hour”. Put the cover back on the PS100 and latch it in place.

NOTE: Do not switch the power supply to “on” until AC or solar power has been connected to the back of the enclosure.

The red charge light on the PS100 will glow when charging voltage is present. The charge light is not affected by the switch. Switching on the power supply without a charging voltage will run the battery down.

Figure 17 shows factory wiring between the PS100 and the enclosure.

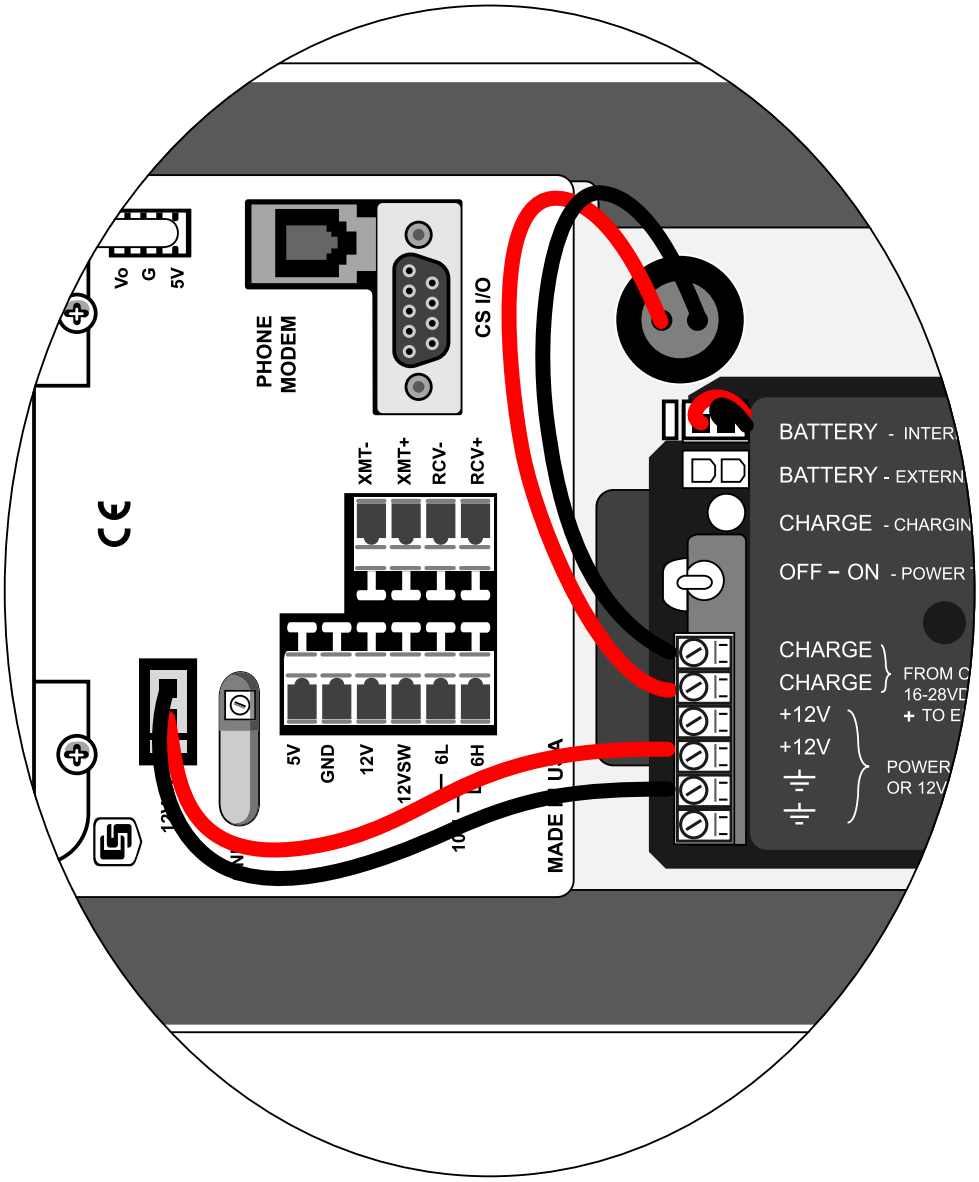

Vo
G
5V
PHONE
MODEM
CS I/O
XMT-
XMT+
RCV-
RCV+
5V
GND
12V
12VSW
6L
6H
BATTERY - INTER
BATTERY - EXTERN
CHARGE - CHARGIN
OFF – ON - POWER
CHARGE
CHARGE
FROM C
16-28VD
+ TO E
+12V
+12V
POWER
OR 12V
MADE

Figure 17

4.1.2 Solar Panel Installation

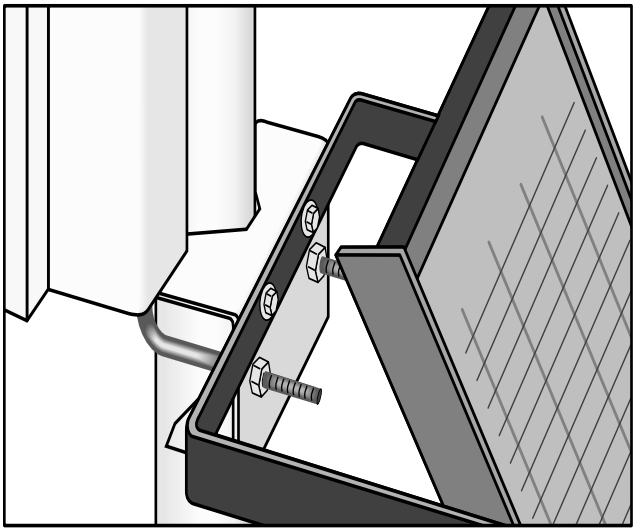


Figure 18

Mount the solar panel to the tower using the mounting brackets as shown in Figure 18. Mount the solar panel to the tower so it faces south (northern hemisphere). Position it as high off the ground as practical; ensuring it cannot interfere with air flow or sunlight around the sensors. The solar panel should be oriented to receive maximum insolation over the course of the year. Suggested tilt angles (referenced to the horizontal plane) are listed below:

Site Latitude	Tilt Angle
0 to 10 degrees	10 degrees
11 to 20	Latitude + 5 degrees
21 to 45	Latitude + 10 degrees
46 to 65	Latitude + 15 degrees
>65+	80 degrees

After determining the tilt angle, loosen the two bolts that attach the mounting bracket to the panel. Adjust the angle, and then tighten the bolts. Secure the lead wire to the mast using wire ties as show in Figure 19. Connect the plug at the end of the solar panel cable to the connector marked “Power”. Make sure the plug is fully seated and the locking ring turned clockwise until it stops.

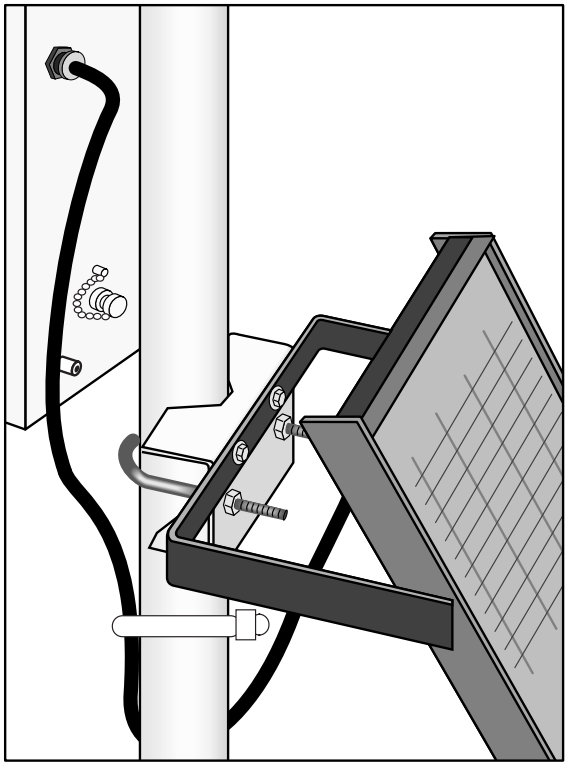


Figure 19

4.1.2 AC Power Installation

1. The AC power option includes a 120 VAC to 16 VAC step down transformer. The transformer should be mounted inside a user-supplied junction box according to local electrical codes. Dangerous electrical accidents may be avoided by locating the transformer remotely and burying a low voltage line to the station. The low voltage will carry up to 500 feet on an 18 AWG power cable.
2. Shut off 110 VAC power at the main breaker. Connect the primary leads of the transformer to 110 VAC following instructions provided with the transformer. Connect a two-conductor cable to the secondary terminals of the transformer. Route the cable from the transformer to the ET Enclosure according to local electrical codes.
3. Splice the incoming two-conductor cable to the power cable provided with the station. Use the direct burial splice kit when splices are in a valve box or buried.
4. Connect the power plug to the connector marked “Power” on the back of the enclosure.

NOTE - The splice and wire nut must be completely immersed into the silicon gel inside the splice tube to be waterproof.

4.1.3 Enclosure Installation

1. Mount and ground the enclosure on the Tower as shown in Figure 18.
2. Remove the front lid. Remove the connector cover from the back of the ET enclosure by loosening the Phillips screw at the bottom of the cover.
3. Loosen the mounting bracket bolts on the back of the enclosure wide enough to slide over the pole. Slide the enclosure over the pole. Position the enclosure so it faces east for northern latitudes or west for southern latitudes. The top of the enclosure should be 3/4" to 1" (2 – 2.5 cm) above the top of the pole (see Figure 19).
4. Carefully mount the lightning rod clamp to the top of the pole (see Figure 20). Position the clamp so it won't interfere with the connector cover.
5. Insert the lightning rod into the clamp opening closest to the enclosure. The milled flat side of the lightning rod should face the clamping screw. Tighten the screw to hold the rod firmly in place.
6. Strip 1" (2.54 cm) from the top of the main green 10 AWG tower ground wire. Insert the exposed wire into the empty clamp opening. Do not tighten the screw at this time (see Figure 21)
7. Strip 1" (2.54 cm) from both ends of the 9" (23 cm) piece of 10 AWG green ground wire. Insert one end into the brass ground lug located at the top back of the enclosure. Put the other end in the same clamp opening as the main grounding wire and tighten down the screw (see Figure 22).

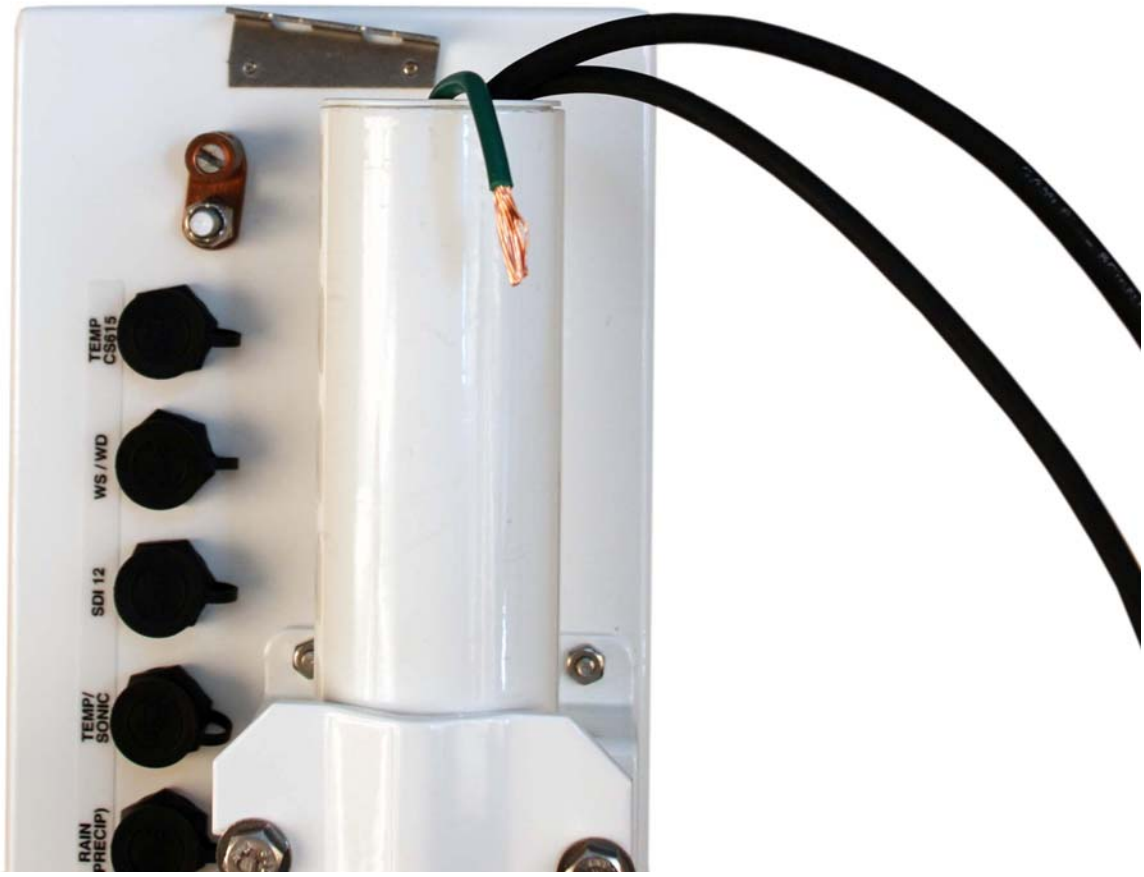


Figure 20

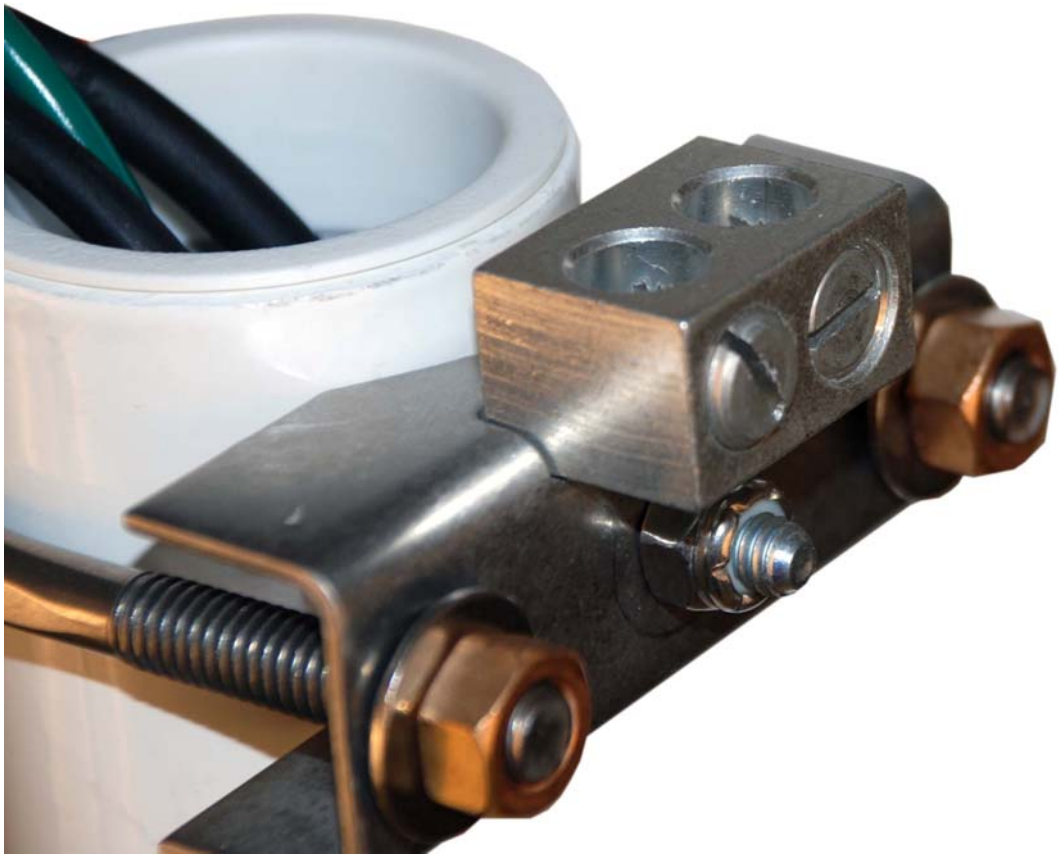


Figure 21

Figure 22

4.1.3 Sensor Connection

Install the sensor set as described in Section 4.
Each sensor cable plug attaches to a unique bulkhead connector as shown in Figure 23. The sensor cables are individually marked to match up with the sensor labeling on the back of the enclosure.

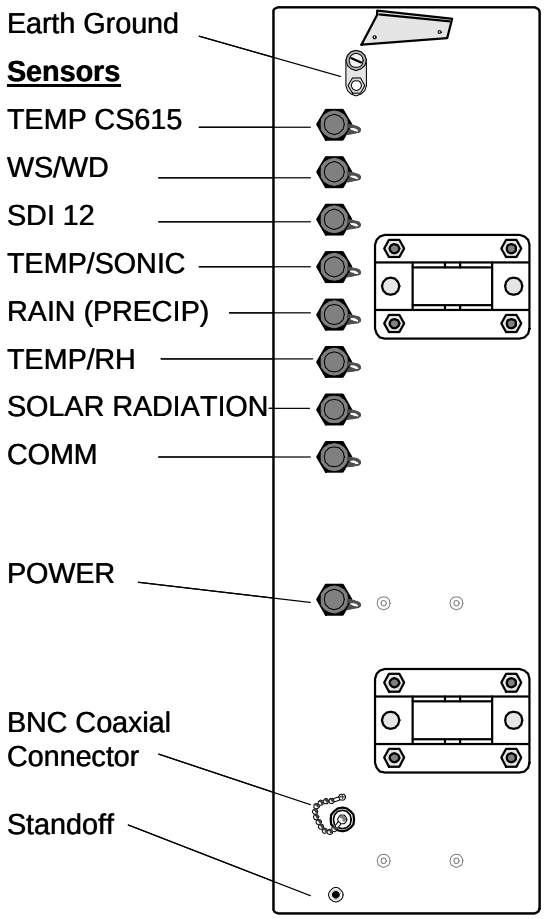


Figure 23

Connect the power and communication cables

NOTE It's very important that each plug is completely seated on to the connector and the locking ring turned ¼ revolutions clockwise. Failure to seat the plug completely could cause corrosion and water damage to both the enclosure and the sensor cable.

.

Figure 24

Loosely wire tie power, communication, and grounding cable to the wire tie harness at the top of the back of the station. Do NOT clip back the wire tie at this time. See Figure 22.

Figure 25

Replace the connector cover. The tab at the top of the connector cover slides into the opening on the back of the cross arm. Ensure that all cables and connector caps are under the cover before tightening the Phillips screw at the bottom of the cover. Make sure that all cables coming out of the top right of the connector cover are not being pinched. See Figure 25.

Tighten down the wire ties holding cabling to the wire tie harness and clip off any excess.

4.2 Communication and Data Storage Peripherals

Only one communication kit can be mounted inside the ET enclosure. Communication kits ordered with the ET Enclosure are pre-mounted and pre-wired; no further connections inside the enclosure are necessary. Follow the "External Installation" procedures in later sections to make the external connections.

4.2.1 Phone Modems

If you received a telecommunication kit separate from the ET Enclosure, follow the "Internal Installation" procedures outlined in later sections.

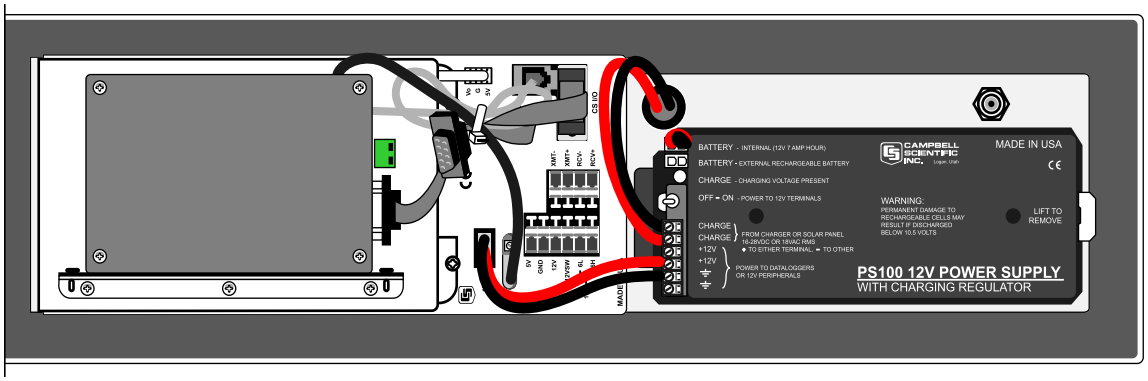


Figure 26

4.2.1.0 Internal Installation

For installation inside the WS-PRO2 Enclosure, the following components are provided in the phone modem kit:

(1) COM220 Phone Modem
(1) 12 inch RJ-11 Patch Cord
(1) Mounting Bracket
(4) Screws
(1) 12 inch 14 AWG Ground Wire
Install the phone modem as shown in Figure 26.

1. Attach the modem to the modem bracket with the 2 screws provided. Mount the modem and bracket into the WS-PRO2 Enclosure with the 3 pre-threaded screws on the mounting plate.
2. Connect the modem 9-pin port to the WS-PRO2 Enclosure port with the P/N 10588 ribbon cable supplied with the ET Enclosure.
3. Connect the modem RJ-ll jack to the WS-PRO2 Enclosure RJ-11 jack with the RJ-ll patch cord.
4. Connect the modem ground port to the WS-PRO2 Enclosure ground with the 14 AWG ground wire.

4.2.1.1 External Installation

The following modem kit components are used to make the external connections:

(1) Direct Burial Splice Kit
(1) 20 foot Telephone Patch Cord with Connector

1. Connect the 20 foot patch cord to connector marked COM on the external back panel, under the protective cover.
2. Splice the labeled "Tip" and "Ring" lines of the patch cord to the telephone service line. Use the direct burial splice kit when splices are in a valve box or buried.

NOTE - The splice and wire nut must be completely immersed into the silicon gel inside the splice tube to be waterproof.

4.2.2 Short Haul Modems

Short-haul modems enable communication between a datalogger and computer over two twisted pairs of wires. The maximum distance between modems is determined by baud rate and wire gauge. At 9600 baud, the approximate maximum cable length is 6.0 miles using 19 AWG cable. DCE / DTE switches on the modems are set to DCE.

NOTE - It's critical to use at least a two twisted-pair cable with a shield wire. Shield wire(s) and/or any additional unused conductors must connect to an earth ground at one end or the other of the cable run.

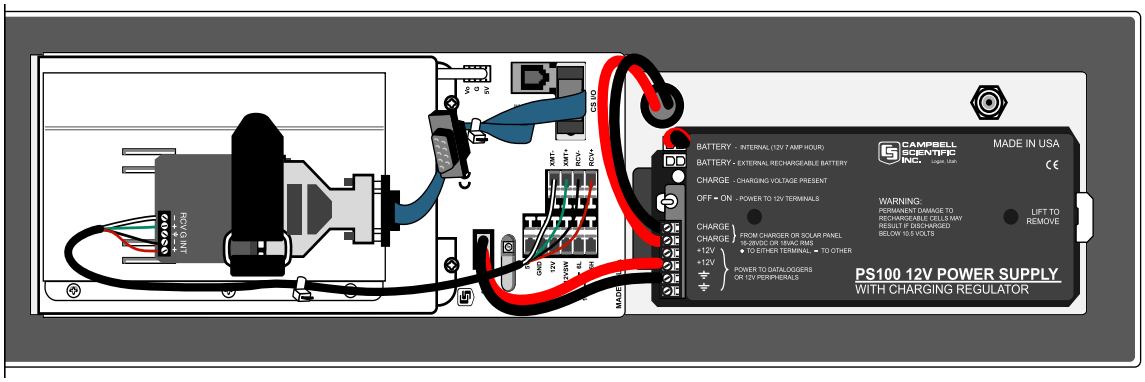


Figure 27

4.2.2.0 Internal Installation

For installation inside the WS-PRO2 Enclosure, the following components are provided in the short-haul modem kit:

(1) Item #10596 (SC932C) 9-pin to RS-232 DCE Interface
(1) Rad Modem
(1) Rad/SC932C Mounting Bracket
(1) 12 inch 4-wire patch cable

Install the short-haul modems as shown in Figure 27 and 28.

1. Mount the Rad / SC932C mounting bracket into the WS-PRO2 Enclosure with the 3 pre-threaded screws provided.
2. Connect the Rad Modem and SC932C. Strap them into the mounting bracket under the Velcro strap.
3. Connect the SC932C 9-pin port to the internal WS-PRO2 Enclosure 9-pin port with the blue ribbon cable provided.
4. Wire the Rad Modem to the WS-PRO2 Enclosure with the 12-inch patch cord. Match wire labels to wiring panel labels on both the WS-PRO2 Enclosure and the Rad Modem (+XMT to +XMT, etc.). A small screwdriver is provided with the WS-PRO2 Enclosure to access the Rad Modem connections.

4.2.2.1 External Installation

The following short-haul kit components are used to make the external connections:

At the WS-PRO2 Enclosure:

(1) 20 foot 4-Wire Patch Cable
(2) 2 Direct Burial Splice Kits
(1) Length of User Supplied Wire

At the PC:

(1) Rad Modem
(1) 5 foot 4-wire Patch Cable
(1) 10 foot 14 AWG Ground Wire
(1) Surge Protector and Case

1. Connect the 20-foot patch cable to the connector marked COM on the back side of the WS-PRO2 Enclosure. Splice the patch cable to the user supplied cable, using the direct burial splice kits.
2. Mount the surge protector to a flat surface within 10 inches of the PC's serial port. Ground the center terminal to an earth (or building) ground using the 14 AWG wire.
3. Connect the 5-foot patch cord to the Rad Modem. Fasten the cable to the strain relief tab with a cable tie. Connect the Rad to the PC's serial port either directly (25 pin port) or through a 9 to 25 pin serial converter.

4. Route the user-supplied cable from the remote splice to the surge protector. Connect it and the 5-foot patch cord to the surge protector.

NOTE - The splice and wire nut must be completely immersed into the silicon gel inside the splice tube to be waterproof.

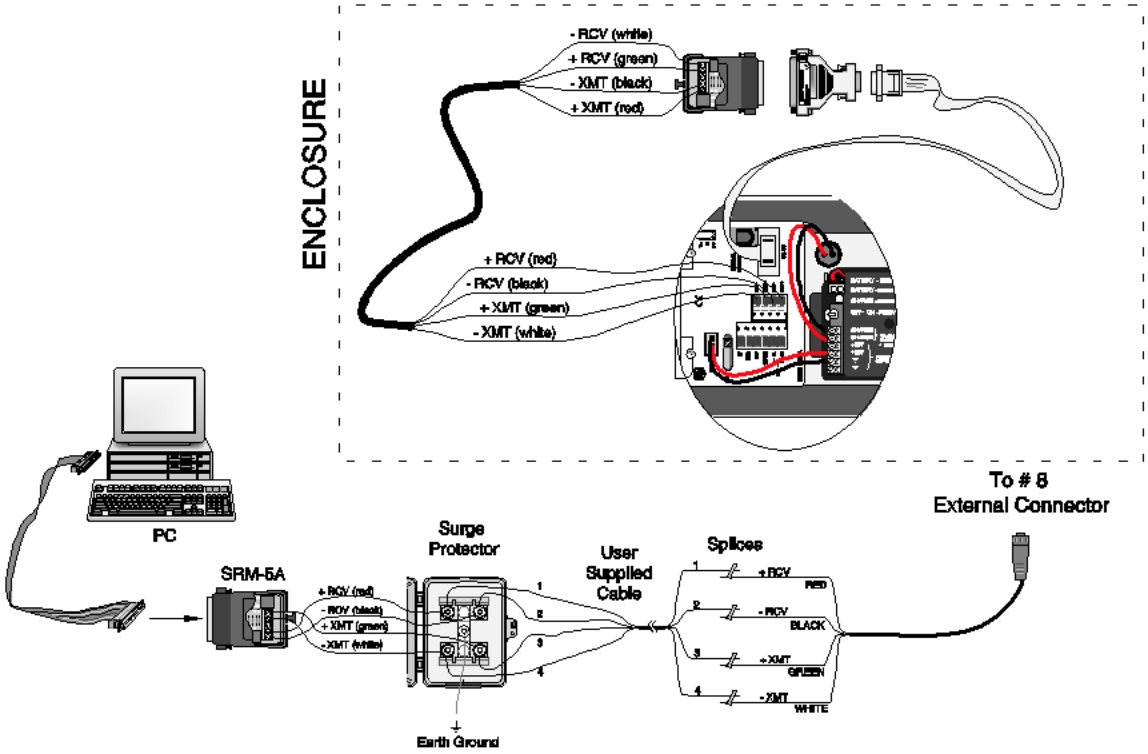


Figure 28
(Note – for illustration purposes only – does not show proper use of MSP-1)

4.2.3 Sealing and Desiccating the Enclosure

The WS-PRO2 Enclosure is supplied with two desiccant packs. The desiccant maintains a low humidity in the enclosure to minimize the chance of condensation on the instrumentation. Desiccant should be changed when the internal WS-PRO2 Enclosure humidity sensor measures 50% or higher. Install the desiccant as shown in Figure 29. Keep unused desiccant tightly sealed in an airtight container.

1. Take the desiccant packs out of the plastic bag. Slide the packs into the desiccant holder inside the lid of the enclosure.
2. Be sure to close the enclosure hasp securely. A padlock may be used on the latch for extra security.

NOTE - Putting desiccant into the station should be the very last thing that is done after all other weather station installation steps have been completed.

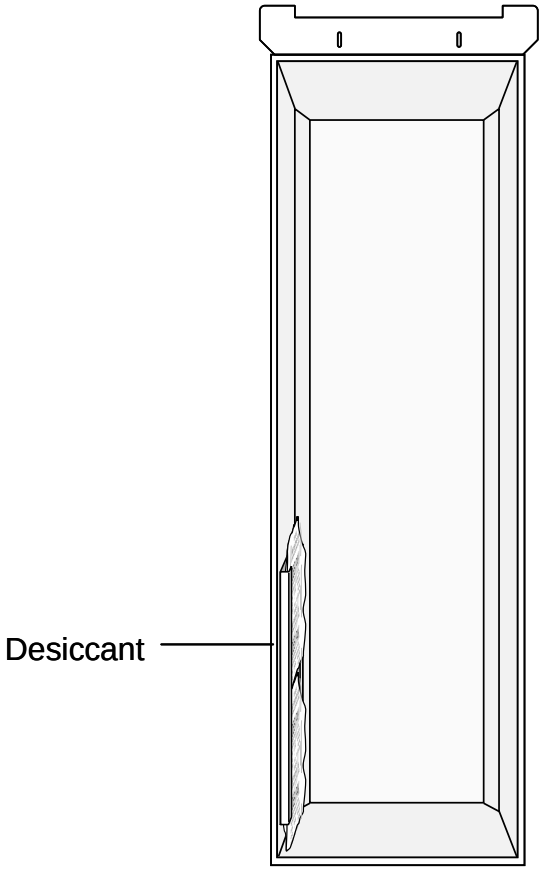


Figure 29

5.0 Installation of Sensor Arm

5.1.0 Components

(1) WS-PRO2 Crossarm with Sensors
(1) Met One 034B Wind Sensor
(1) White Mounting Shaft for 034B
(1) Gill Radiation Shield

5.2.0 Installation

Install the WS-PRO2 Sensor Arm after the WS-PRO2 Enclosure is mounted on the Tower. You may need to temporarily remove the communications option. Mount the sensor arm as shown in Figure 30 without the wind sensor attached. Adjust the bolts at the base of the pole to vertically level the top section of the mounting pole.

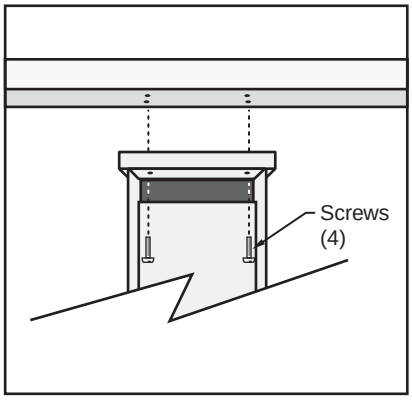


Figure 30

1. Remove the front lid and the protective connector cover from the back of the WS-PRO2 enclosure by loosening the one Phillips screw at the bottom of the cover.
2. Place the sensor arm on top of the enclosure, lining up the four threaded holes on the under side of the arm with the four holes in the top of the enclosure. Attach the arm to the enclosure by inserting and tightening four Phillips head screws. Adjust the position of the WS-PRO2 Enclosure so that the crossarm is oriented along a due north to due south axis with the rain gage and solar radiation sensor (pyranometer) on the south side for northern latitudes and the reverse for southern latitudes.

5.3.0 Sensor Connection

Refer to Section 4 for sensor connection details.

5.4.0 RH and Temperature Radiation Shield

1. Remove the two Phillips screws taped underneath the cross arm. See Figure 31.

2. Remove the yellow shipping cap from off the end of the temperature/relative humidity sensor. See Figures 31 and 32.
3. Insert the temperature/relative humidity into the gill radiation shield until it stops or a “click” is heard.
4. Attach the gill radiation shield to the underside of the cross-arm using the two Phillips screws from step 1.

Figure 31

Figure 32

6.0 Sensor Installation

6.1.0 Wind Sensor

Install the Wind Sensor as shown in Figure 33 and 34 after the sensor arm is securely installed.

WARNING
Plugging this sensor into the connector marked "SDI 12" can result in damaging this sensor, the main enclosure connector board, or both.

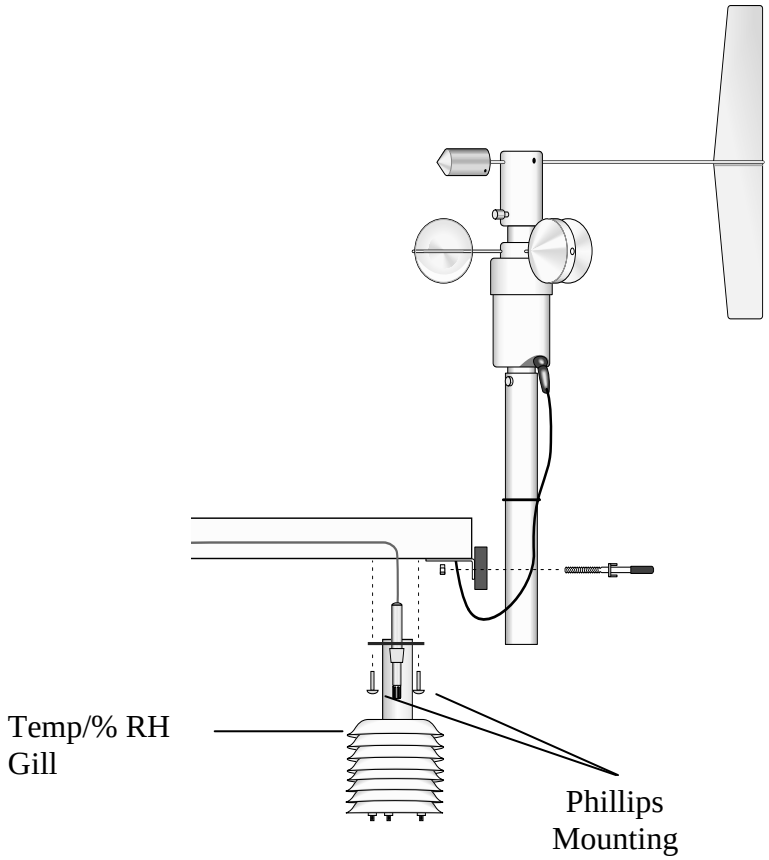


Figure 33

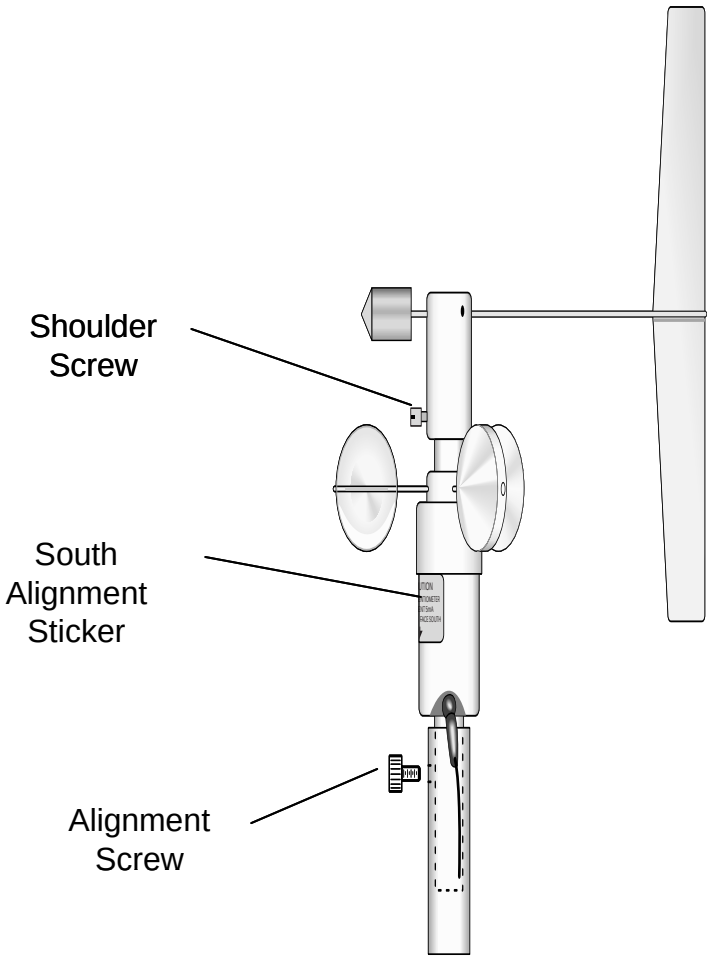


Figure 34

WARNING
The wind vane can be easily damaged if dropped or bent. Leave the wind vane in the protective cardboard sleeve until it's ready to be installed.

1. Remove the alignment screw at the base of the Wind Sensor (Figure 34). Insert the Wind Sensor into the Mounting Shaft. Align the hole in the shaft with that in the base and replace the screw. Do not over tighten the alignment screw. Do not remove the shoulder screw at this time.
2. Insert the mounting shaft through the U-Bolt on the sensor arm. Adjust the mounting shaft so that the cable and connector coming out the end of the sensor arm can plug easily into the mating connector on the wind sensor. Lightly tighten up the U-bolt clamp nuts. See Figure 33.
3. See Figure 34 for the alignment sticker on the wind sensor. Align the arrow on this sticker with True South. The counterweight will also be pointing due south. Make sure the sensor cable is not being pinched by

the U-bolt. Tighten up the U-bolt to hold the sensor firmly. Plug the cable into the mating connector on the sensor. Plug must be fully seated and locking ring turned fully clockwise.

4. Install the wind vane using the Allen wrench supplied with the vane. Wind vane should be perpendicular to the cross-arm. Put the sticker over the wind vane Allen screw opening.

5. Remove and keep the shoulder screw. The shoulder screw will be needed for replacing bearings and/or potentiometer. The wind vane and cups should turn freely.

6.2.0 Rain Gauge Installation

Pull the gold funnel up and off of the top of the rain gage. Remove the rubber band holding the tipping mechanism in place. The rain gage bubble level mounted on the tipping mechanism is dependant on how vertical the pole was installed. Adjust the bolts at the bottom of the pole if necessary. Put the gold funnel back on the top of the rain gage as in figure 35.

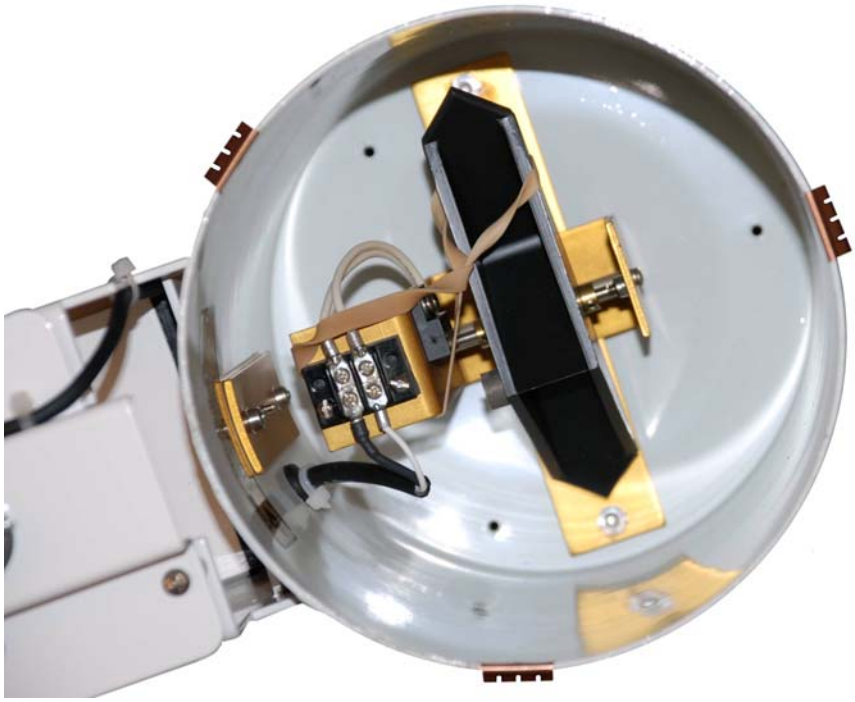


Figure 35

6.3.0 Pyranometer

Level the pyranometer as indicated in Figure 36. Adjust the three leveling screws until the bubble level indicates plumb. **Remove the red or green shipping cap from the pyranometer**. See Figure 37.

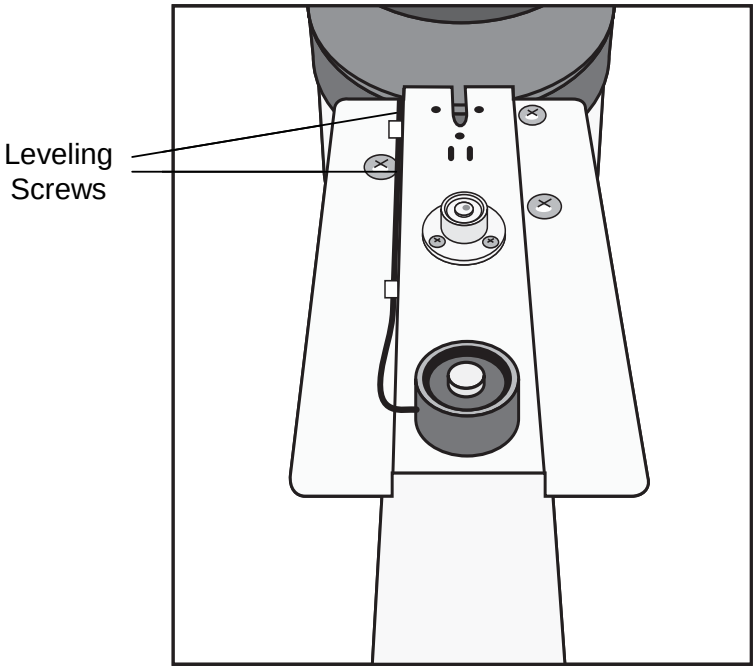


Figure 36

Figure 37

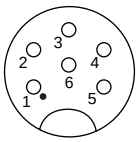
6.4.0 Soil Temperature Sensor (Optional)

Soil temperature sensors do NOT have an armored outer jacket. The jacket is waterproof but NOT cut proof. The recommended method is to bury conduit from the weather station to the soil temperature site and route the sensor cable through the conduit. Bury the end of the sensor so it is in contact with the soil surface to be measured. See manual for complete instructions.
This sensor could be plugged into one of three possible connectors on the back of the WS-PRO2 station. Check with the Rain Bird GSP group or Campbell Scientific for correct station connection.

NOTE - The cable used with the soil temperature sensor is waterproof but not armored. Route cable through conduit if rocky soils or rodents are present.

6.5.0 Sensor Schematics

Schematics of WS-PRO2 sensors and associated connectors are provided in Figures 38, 39, 40 and 41 for help in troubleshooting. Knowledge of the schematics is not necessary for routine installation and maintenance. Each connector has a small molded dot by pin 1. The figures in this section show the pinned connectors on the sensor cables. Socketed connectors on the back of the enclosure are the mirror image of these figures.



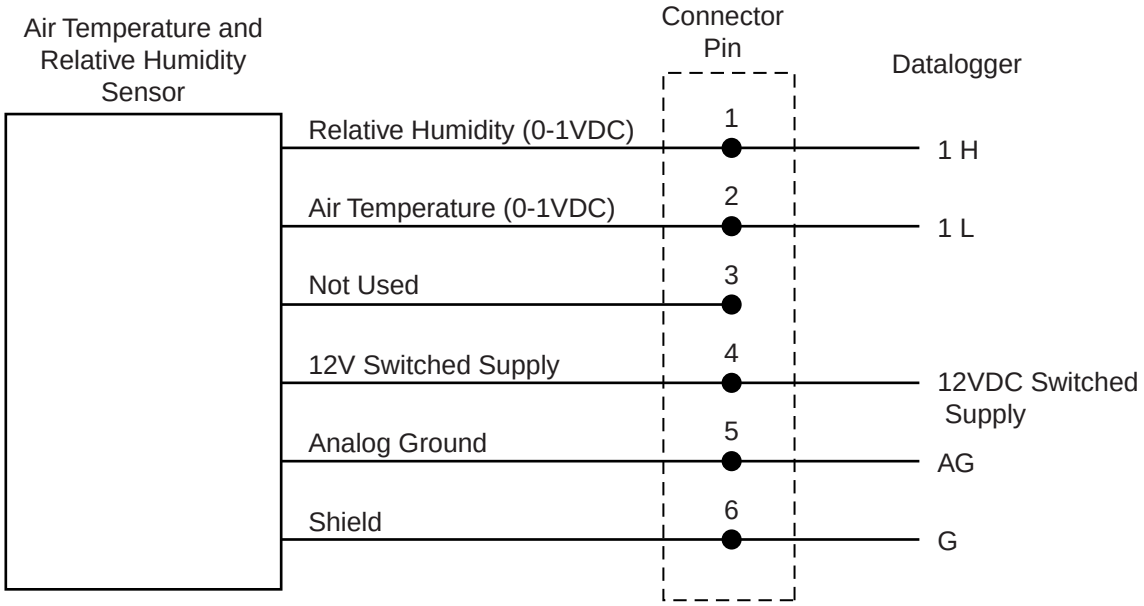


Figure 38

Schematic of RH and Temperature Probe and Connector Temp/RH

Wind Speed and Wind Direction

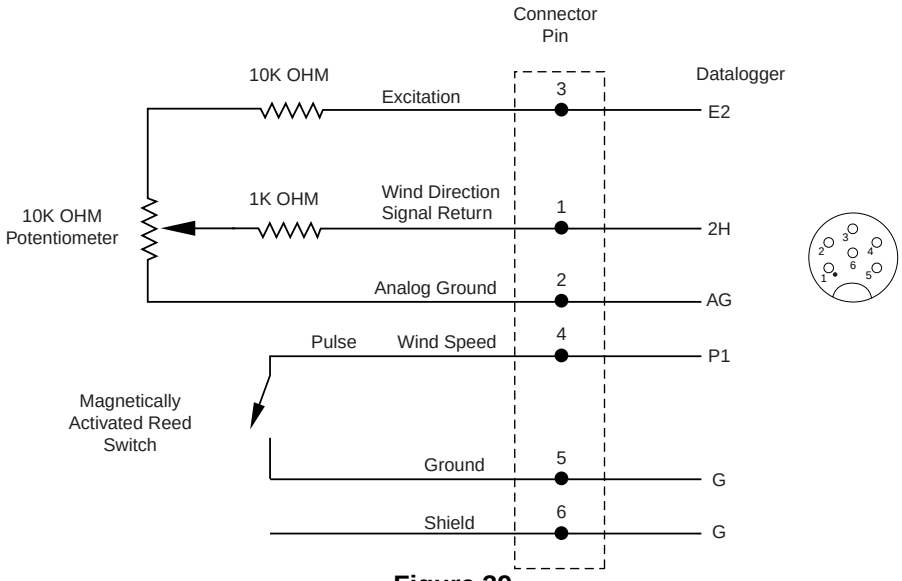


Figure 39

Schematic of Wind Speed and Direction Probe and Connector WS/WD

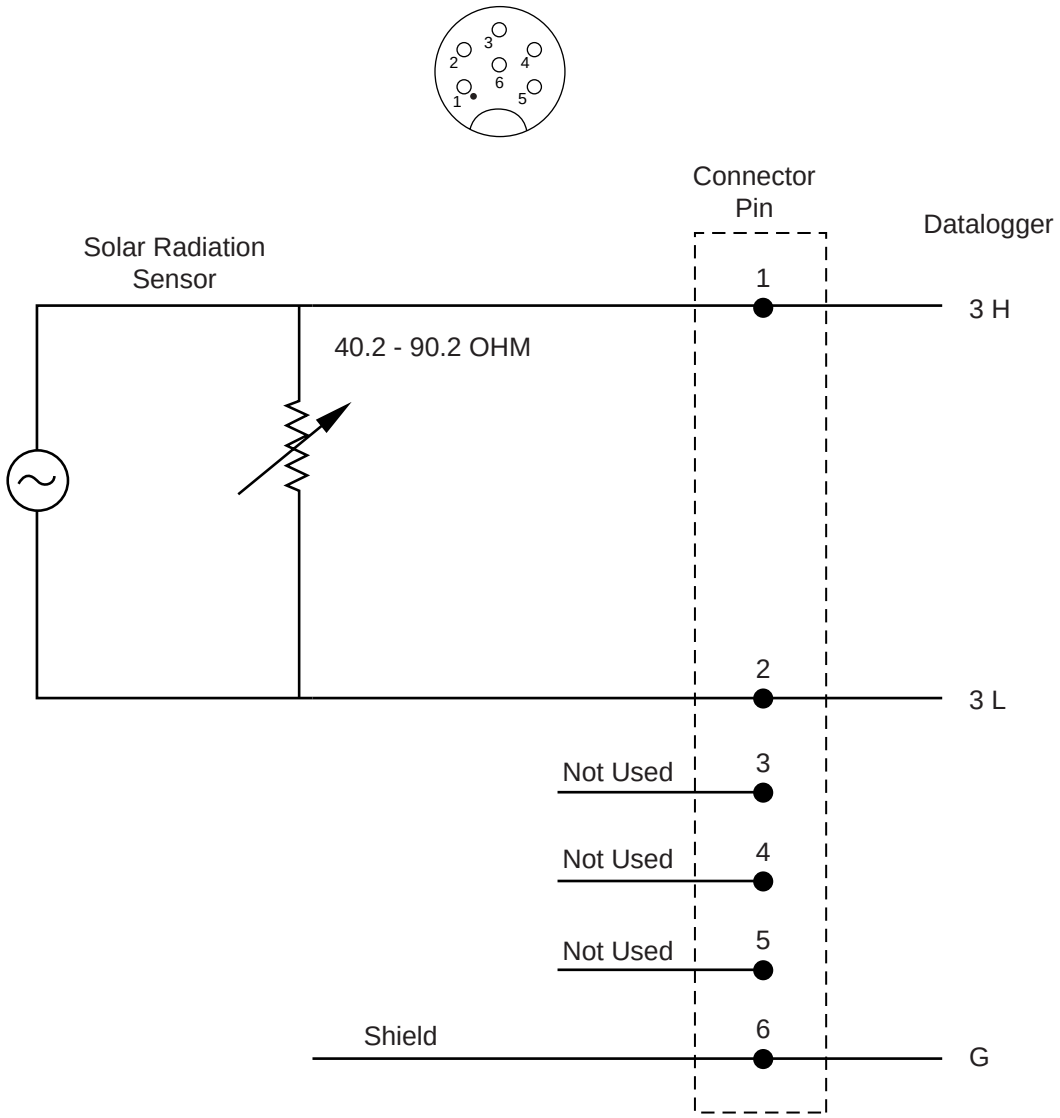


Figure 40

Schematic of Solar Radiation Sensor and Connector Solar Radiation

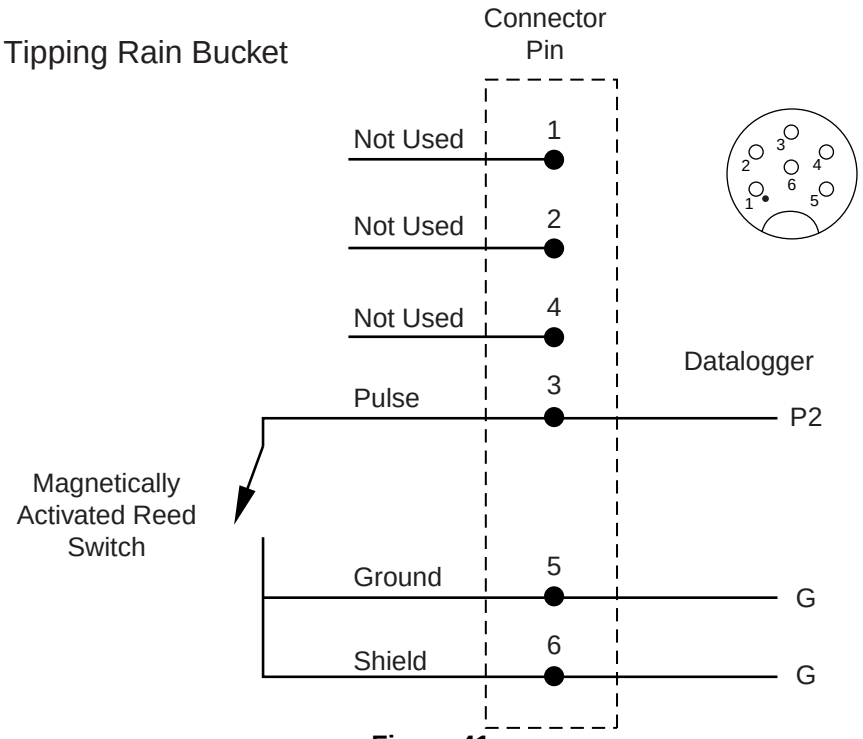


Figure 41

Schematic of Rain Sensor and Connector Rain (Precip)

7.0 Maintenance and Troubleshooting

7.1.0 Maintenance

Proper maintenance of weather station components is essential to obtain accurate data. Equipment must be in good operating condition, which requires a program of regular inspection and maintenance. Routine and simple maintenance can be accomplished by the person in charge of the weather station. More difficult maintenance such as sensor calibration, sensor performance testing (i.e., bearing torque), and sensor component replacement, generally requires a skilled technician, or that the instrument be sent to Campbell Scientific or the manufacturer.

A station log should be maintained for each weather station that includes serial numbers, dates that the site was visited, and maintenance that was performed.

7.1.1 Instrumentation Maintenance

The instrumentation requires a minimum of routine maintenance. A few preventative maintenance steps will optimize battery life and decrease the chances of datalogger failure.

7.1.2 Batteries

Rechargeable power supplies should be connected to an AC transformer or unregulated solar panel at all times. The charge indicating diode should be "ON" when voltage to the charging circuitry is present. Be aware of battery voltage that consistently decreases over time, which indicates a failure in the charging circuitry. Smart Weather automatically programs the weather station to measure battery voltage.

7.1.3 Desiccant

Enclosure humidity is monitored in the WS-PRO2 Enclosure system by a RH sensor incorporate inside the enclosure. Change the desiccant packs when the enclosure RH exceeds 50%. The enclosure RH sensor should be changed every 5+ years.

7.1.4 Sensor Maintenance

Sensor maintenance should be performed at regular intervals, depending on the desired accuracy and the conditions of use. A suggested maintenance schedule is outlined below. Log file is for one year of station use.

1 week

- Check the rain gage screen and funnel for debris and level.

1 month

- Check the solar radiation sensor (pyranometer) for level and contamination. Gently clean with blast of dry hair, soft camel hair brush, or clean water if needed.
- Do a visual/audio inspection of the anemometer at low wind speeds. Worn bearings can cause the wind cups to spin in an uneven manner and/or make a grinding sound.

3 months

- Clean the Gill Radiation Shield by removing the two Phillips screws holding it to the sensor arm. Gently pull the sensor out of the shield. Clean the gill shield using warm mildly soapy water. Rinse with clean water and allow the shield to dry before putting it back on the sensor arm.
- If necessary clean the white filter element on the end of the temp/RH sensor. To clean the filter, unscrew it from off the end of the sensor and put it in a cup of CLEAN DISTILLED WATER. Use no soap. Agitate the filter in the cup of water. Remove the filter and allow to air dry before putting it back on the end of the sensor.

1 year

- Replace wind speed (anemometer) bearings. To send the sensor to Campbell Scientific for bearing replacement call for Return Material Authorization number or contact Campbell Scientific for bearing cost to replace bearings in the field.
- Replace wind speed (anemometer) reed switch if needed. To send the sensor to Campbell Scientific for reed switch replacement call for Return Material Authorization number or contact Campbell Scientific for reed switch cost to replace reed switch in the field.
- Check calibration of the CS500 temp/RH probe. Sensor will tend to drift up over time giving readings higher then 100%. Replace RH chip (item# 9598) if necessary.
- Replace desiccant in enclosure housing as needed.

2 years

- Send the solar radiation sensor (pyranometer) to Campbell Scientific for calibration. Call Campbell Scientific for Return Material Authorization number. Sensor cannot be calibrated in the field. (Some users recommend calibrating this sensor on a yearly basis.)

- Note: Sensor could be away for as long as a month and a half to be calibrated. Best to send sensor in during an off part of the growing season or when solar radiation is not vital.
- Replace wind direction potentiometer if needed. To send the sensor to Campbell Scientific for potentiometer replacement call for Return Material Authorization number or contact Campbell Scientific for potentiometer cost to replace potentiometer in the field.
- Replace enclosure gasket if necessary. Enclosure can be sent in to Campbell Scientific for gasket replacement – call for Return

Material Authorization number or contact Campbell Scientific for gasket cost to replace gasket in the field.

4-5 years

- Check all cabling for sensors, communication, and power. Replace as required.
- Check enclosure relative humidity sensor (item# 10070). To check this sensor take the lid off the enclosure during routine desiccant replacement and leave it off for 5 – 10 minutes before putting in new desiccant. While the lid is off the enclosure compare the internal enclosure humidity to the air humidity. Replace if > 10% off.
- General Maintenance
- An occasional cleaning of the glass on the solar panel will imrove its efficiency. Use warm mildly soapy water and a clean cloth. Rinse with clean water.
- Check sensor leads and cable for cracking, deterioration, proper routing, and strain relief.
- Check the tower for structural damage, proper alignment, and for level/plumb.

7.2.0 Troubleshooting

7.2.1 No Response Using the CR10KD Keypad

Check keypad response after each of the following steps.

- Make sure the battery has been installed and the power switch set to “ON” (section 3.1.1 – 3.1.3).
- Use a voltmeter to measure the voltage on the 12 V and G terminals (see Figure 17); the voltage must be between 9.6 and 16 VDC.
- Use a voltmeter to measure the voltage on the 5V and G terminals (see Figure 17); the voltage must be between 4.9 – 5.1 VDC.
- Disconnect the temp/RH sensor from the back of the enclosure.
- Disconnect the 9-pin ribbon cable from any communication option used with the station so that only the keypad is attached to the 9-pin plug in the lower right hand corner of the enclosure.
- Cycle the power to the datalogger by switching the power supply to “OFF”, then to “ON” or disconnecting and

reconnecting the battery plug. Keypad should power up and the message “HELLO” seen on the display.

- Call Campbell Scientific if still no response.
- No Response from Datalogger through SC32A or Modem Peripheral

At the datalogger:

- Make sure the battery has been installed and the power switch set to “ON” (section 4.1.1 – 4.1.3).
- Use a voltmeter to measure the voltage on the 12V and G terminals (see Figure 17); the voltage must be between 9.6 and 16 VDC.
- Use a voltmeter to measure the voltage on the 5V and G terminals (see Figure 17); the voltage must be between 4.9 – 5.1 VDC.
- Make sure the datalogger is connected to the communication peripheral, and the communication peripheral properly installed and configured (section 3.3).
- At the computer:
- Make sure calling software is properly configured (PC200W, VisualWeather, or LoggerNet).
- Check the cable(s) between the serial port and the modem. If cables have not been purchased through Campbell Scientific, check for the following configuration using an ohm meter:
- 25-pin serial port:

computer end	modem end
2	2
3	3
7	7
20	20

9-pin serial port:

computer end	modem end
2	3
3	2
4	20
5	7

- Make sure the communication device at the computer is properly configured and cabled (section 3.3).
- Call Campbell Scientific if still no response.

-99999 Displayed in an Input Location

- Make sure the battery voltage is between 9.6 and 16 VDC.
- Verify sensors are plugged into the correct bulkhead connector and locking ring is securely in place (see Figure 17). Check connectors for any corrosion on pins.
- If Smart Weather is used to create the station program double check the wiring diagram to see if it matches the physical wiring on the bulkhead connectors on the back of the enclosure.

Unreasonable Results Displayed in an Input Location

- Inspect the sensor for damage and/or contamination.
- Make sure the sensor is plugged into the correct bulkhead connector on the back of the enclosure.

6999 or 99999 Stored in Final Storage (or Storage Module)

- Something is wrong with the datalogger and/or sensor(s).