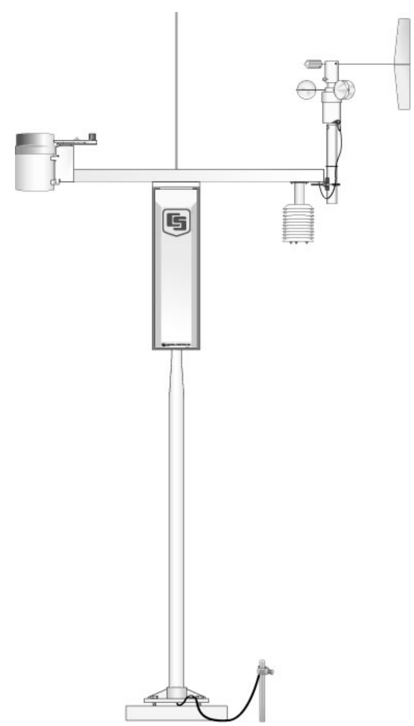
INSTRUCTION MANUAL

T107 Weather Station

Revision: 5/12



Warranty

"PRODUCTS MANUFACTURED BY CAMPBELL SCIENTIFIC, INC. are warranted by Campbell Scientific, Inc. ("Campbell") to be free from defects in materials and workmanship under normal use and service for twelve (12) months from date of shipment unless otherwise specified in the corresponding Campbell pricelist or product manual. Products not manufactured, but that are re-sold by Campbell, are warranted only to the limits extended by the original manufacturer. Batteries, fine-wire thermocouples, desiccant, and other consumables have no warranty. Campbell's obligation under this warranty is limited to repairing or replacing (at Campbell's option) defective products, which shall be the sole and exclusive remedy under this warranty. The customer shall assume all costs of removing, reinstalling, and shipping defective products to Campbell. Campbell will return such products by surface carrier prepaid within the continental United States of America. To all other locations, Campbell will return such products best way CIP (Port of Entry) INCOTERM® 2010, prepaid. This warranty shall not apply to any products which have been subjected to modification, misuse, neglect, improper service, accidents of nature, or shipping damage. This warranty is in lieu of all other warranties, expressed or implied. The warranty for installation services performed by Campbell such as programming to customer specifications, electrical connections to products manufactured by Campbell, and product specific training, is part of Campbell's product warranty. CAMPBELL EXPRESSLY DISCLAIMS AND EXCLUDES ANY IMPLIED WARRANTIES OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE. Campbell is not liable for any special, indirect, incidental, and/or consequential damages."

Assistance

Products may not be returned without prior authorization. The following contact information is for US and international customers residing in countries served by Campbell Scientific, Inc. directly. Affiliate companies handle repairs for customers within their territories. Please visit *www.campbellsci.com* to determine which Campbell Scientific company serves your country.

To obtain a Returned Materials Authorization (RMA), contact CAMPBELL SCIENTIFIC, INC., phone (435) 227-9000. After an applications engineer determines the nature of the problem, an RMA number will be issued. Please write this number clearly on the outside of the shipping container. Campbell Scientific's shipping address is:

CAMPBELL SCIENTIFIC, INC.
RMA#_____
815 West 1800 North
Logan, Utah 84321-1784

For all returns, the customer must fill out a "Statement of Product Cleanliness and Decontamination" form and comply with the requirements specified in it. The form is available from our web site at *www.campbellsci.com/repair*. A completed form must be either emailed to *repair@campbellsci.com* or faxed to (435) 227-9106. Campbell Scientific is unable to process any returns until we receive this form. If the form is not received within three days of product receipt or is incomplete, the product will be returned to the customer at the customer's expense. Campbell Scientific reserves the right to refuse service on products that were exposed to contaminants that may cause health or safety concerns for our employees.

T107 Weather Station Table of Contents

PDF viewers: These page numbers refer to the printed version of this document. Use the PDF reader bookmarks tab for links to specific sections.

Appendices

Figures

Tables

Section 1. Preparation and Siting

1.1 Siting and Exposure

CAUTION If any part of the weather station comes in contact with power lines, you could be killed. Contact local utilities for the location of buried utility lines before digging or driving ground rods.

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.

1.1.1 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 1.1-1.

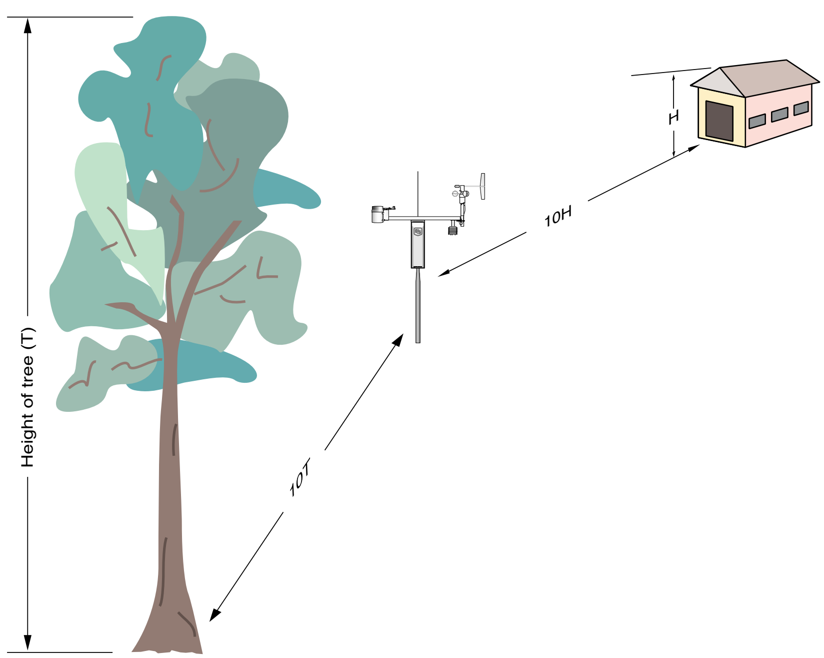


FIGURE 1.1-1. Effect of Structure on Wind Flow

1.1.2 Temperature and Relative Humidity

Sensors should be located over an open level area at least 9 m (29.5 ft) (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 (98.43 ft) (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

1.1.3 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.

1.2 Installation Tasks

1.2.1 Indoors

- Immediately upon receipt of your shipment…

  ⇒ Weather station is packed in the shipping box in layers. See Figures 1.2-1A, 1.2-1B, 1.2-2, and 1.2-3.

  ⇒ Immediately upon receipt of your shipment…
  Open shipping carton(s).
  Set the large weather station carton down lengthwise on a floor or table top. Position the box as shown in Figure 1.2-1A.
  Cut the tape along the edge of the lower flap first. See Figure 1.2-1A.
  Cut the tape around the remaining flaps BUT only cut one layer deep.
  Lift up the cardboard flaps exposing the top layer of foam as shown in Figure 1.2-1B.

  ⇒ Check contents against invoice and shipping checklist. Contact Campbell Scientific immediately about any shortages.

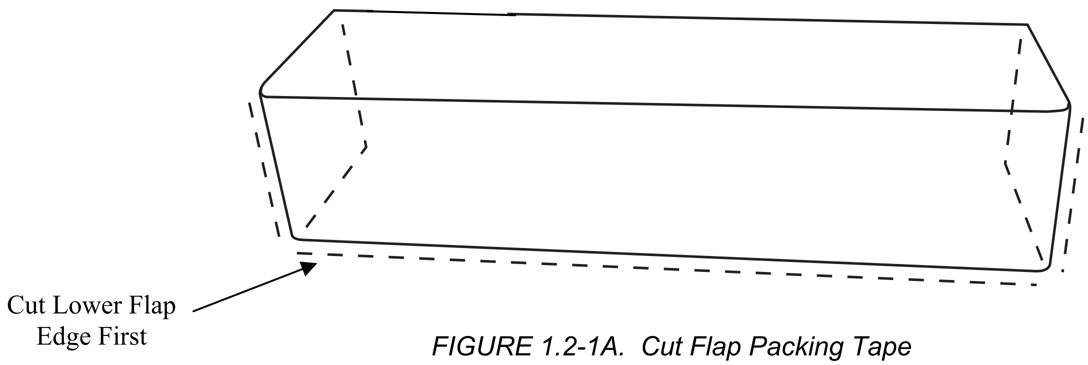


FIGURE 1.2-1A. Cut Flap Packing Tape

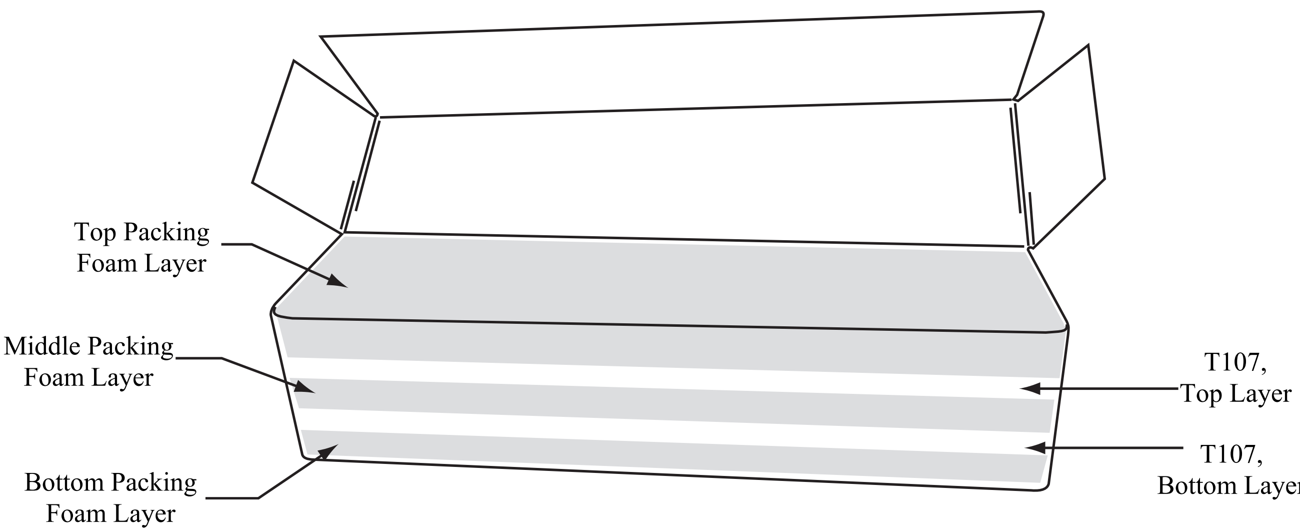


FIGURE 1.2-1B. Shipping Box Packaging

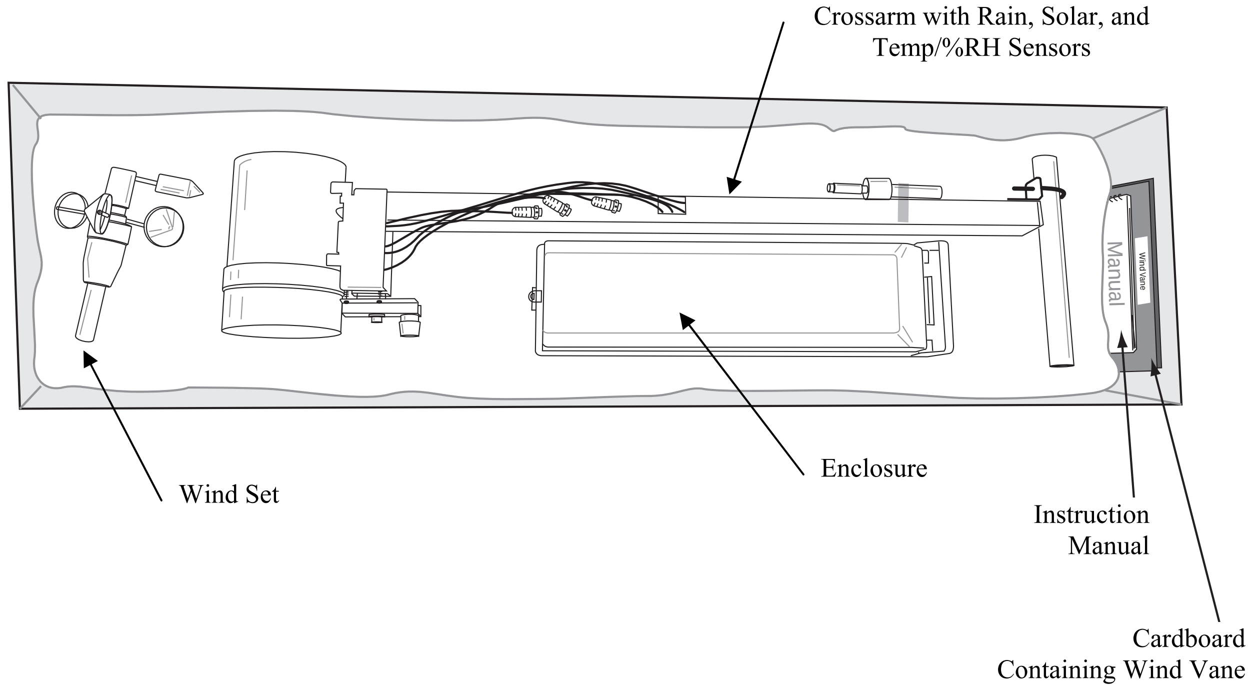


FIGURE 1.2-2. T107 with the Met One 034B-ETM Wind Sensor, Top Layer

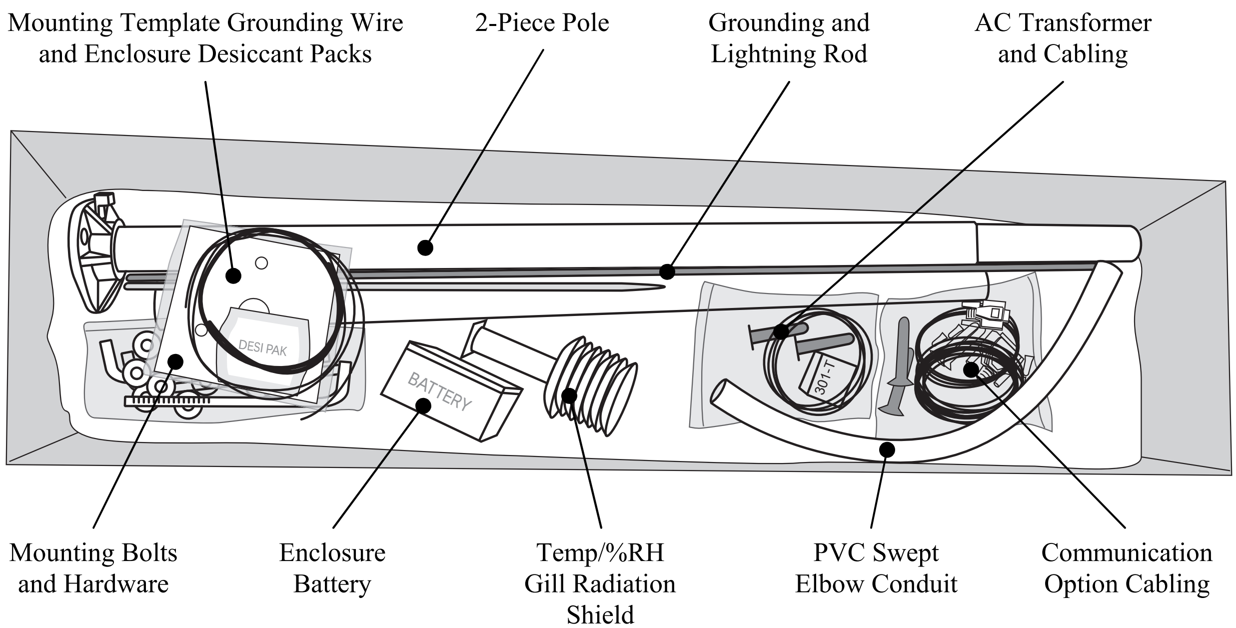


FIGURE 1.2-3. T107, Bottom Layer

⇒ Securely tape box shut if transporting entire station to another site. If at the main site, remove any communication components that are installed at the calling computer. Repackage remaining components for transport to field site.

Solar panel and RF items (if any) will be packed in a separate box.

- Several days prior to the planned installation date…

⇒ Collect tools and site information (Section 1)

⇒ Install datalogger support software (Section 3)

1.2.2 Outdoors

- Locate suitable site (Section 1)
- Prepare concrete base (Section 2)
- T107 Installation:

⇒ Place instrumentation enclosure on the ET pole. Slide enclosure to the top of the pole and secure with correct orientation (Section 2.3).

1.3 Tools Required

Tools required to install and maintain a weather station are listed below.

1.3.1 Tools for Pole Installation

ET Pole
Shovel
Rake
Open end wrenches: 3/8", 7/16", 1/2", (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

1.3.2 Tools for Instrumentation and Maintenance

ET Pole
Lock and key for enclosure
Magnetic declination angle
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", 1/2", 9/16", 15/16"
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")

1.4 Supplies for Power and Communications Options

AC Power
Wire, conduit, and junction boxes as needed (see Figure 2.1-1).

NOTE User supplies valve box at base of station and weatherproof enclosure for transformer. See Figure 2.1-1.

Phone Modem
Phone modem at the central computer.
Dedicated single twisted pair with shield phone line to the weather station valve/junction box (see Figure 2.1-1).

Short-Haul Modem
Direct burial cable with a minimum of 2-twisted pairs with shield (minimum 5 conductors total) to travel from the weather station to the central computer junction box. Direct burial armored cable may be required for rocky soils or rodents (Anixter p/n F-02P22BPN (phone 847.677.2600)) or equivalent type cable (see Figure 2.1-1).

RF450
Antenna for the T107 station (14205 Yagi antenna recommended). PS24 Power Supply and #18520 Hanger Kit if not using ac power (see Appendix B).

1.5 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 a NOAA website (Section 1.5.1). A general map showing magnetic declination for the contiguous United States is shown in Figure 1.5-1.

Declination angles east of True North are considered negative, and are subtracted from 0 degrees to get True North as shown Figure 1.5-2. Declination angles west of True North are considered positive, and are added to 0 degrees to get True North as shown in Figure 1.5-3. For example, the declination for Logan, Utah is 12.4° East. True North is 360° - 12.4° = 347.6° as read on a compass.

* 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 Measurements[4].

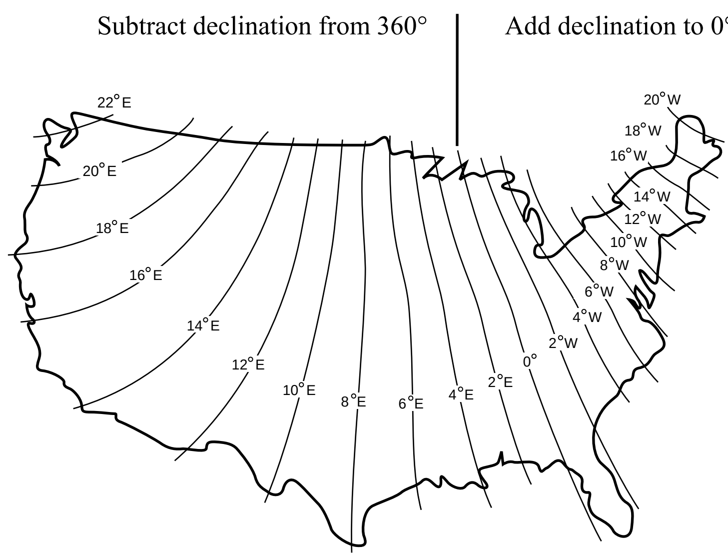


FIGURE 1.5-1. Magnetic Declination for the Contiguous United States

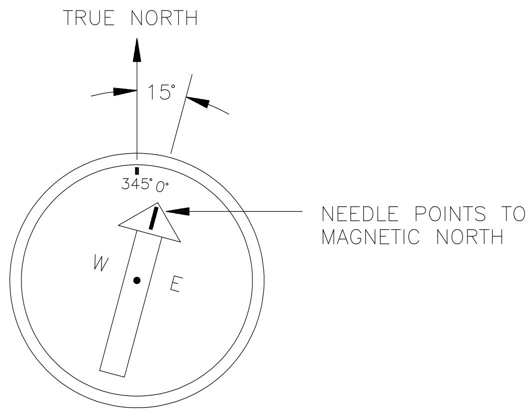


FIGURE 1.5-2. Declination Angles East of True North Are Subtracted From 0 to Get True North

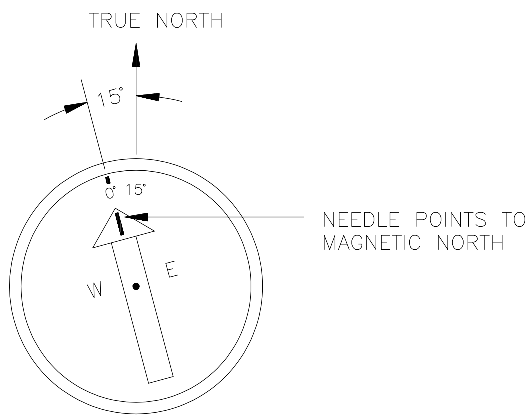


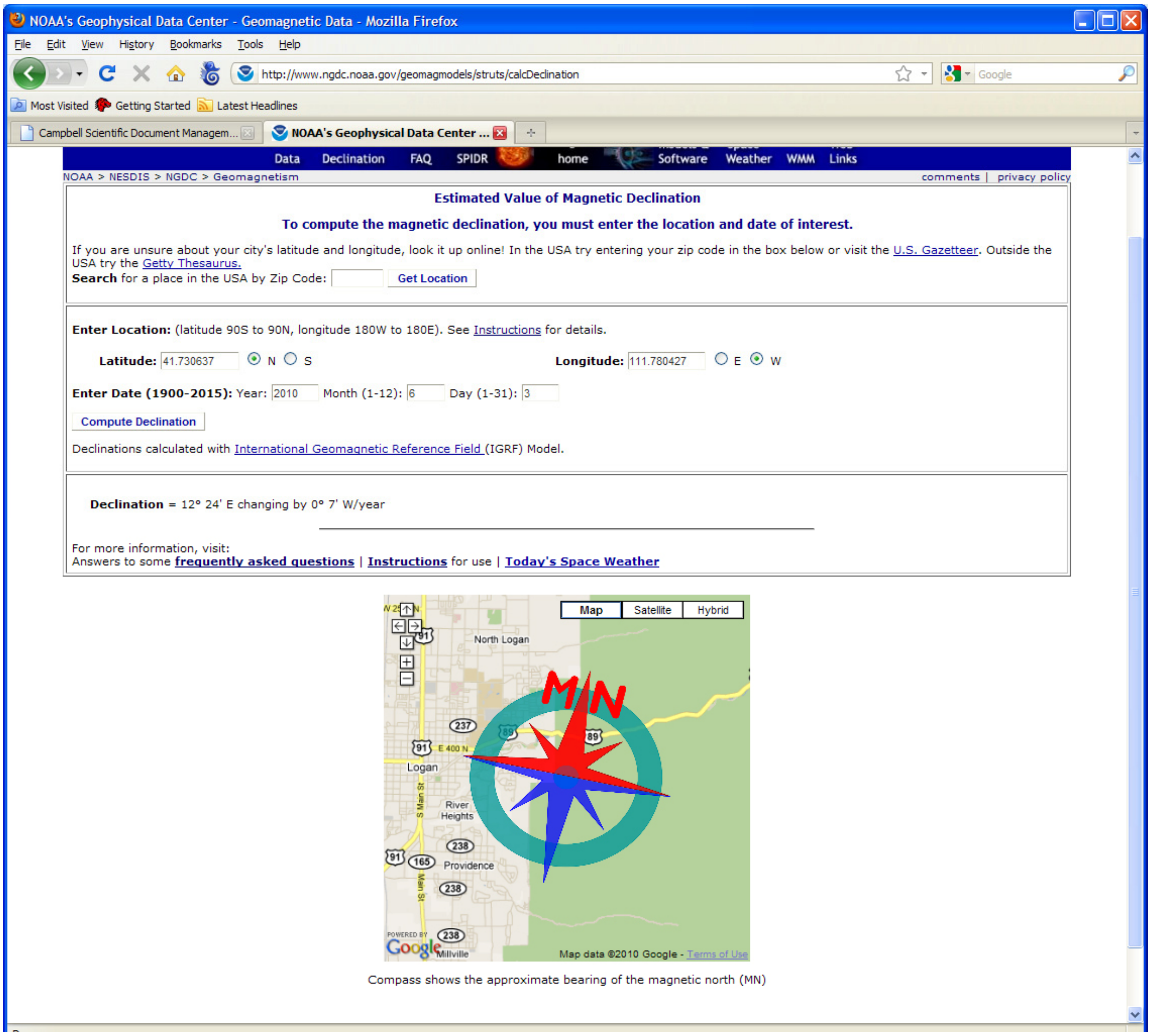
FIGURE 1.5-3. Declination Angles West of True North Are Added to 0 to Get True North

1.5.1 Web Calculator

Since magnetic declination fluctuates with time, it should be determined each time the wind sensor orientation is adjusted. It can be accessed at

www.ngdc.noaa.gov/geomagmodels/Declination.jsp

Below is an example for Logan, UT.



A positive declination is east, while a negative declination is west. The declination in this example is 12º 24′ or 12.4º. As shown in Figure 1.5-1, the declination for Logan, UT is east, so True North for this site is 360 – 12.4, or 347.6 degrees.

References

[1] EPA, (1987). On-Site Meteorological Program Guidance for Regulatory Modeling Applications, EPA-450/4-87-013. Office of Air Quality Planning and Standards, Research Triangle Park, North Carolina 27711.

[2] WMO, (1983). Guide to Meteorological Instruments and Methods of Observation. World Meteorological Organization No. 8, 5th edition, Geneva, Switzerland.

[3] The State Climatologist, (1985) Publication of the American Association of State Climatologists: Height and Exposure Standards for Sensors on Automated Weather Stations, v. 9, No. 4 October, 1985.

[4] EPA, (1989). Quality Assurance Handbook for Air Pollution Measurement Systems, EPA Office of Research and Development, Research Triangle Park, North Carolina 27711.

Section 2. Hardware Installation

DANGER: *Do not install near power lines. If any part of the tower comes in contact with power lines you could be KILLED. Contact local utilities for the location of buried utility lines before digging or driving grounding rods.*

CAUTION: *Do not fit the 3 meter ET Tower sections together until the appropriate time. Once attached, they cannot be detached.*

The ET Tower provides a support structure for mounting the T107 weather station components. Figure 2.1-1 shows a typical ET 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.

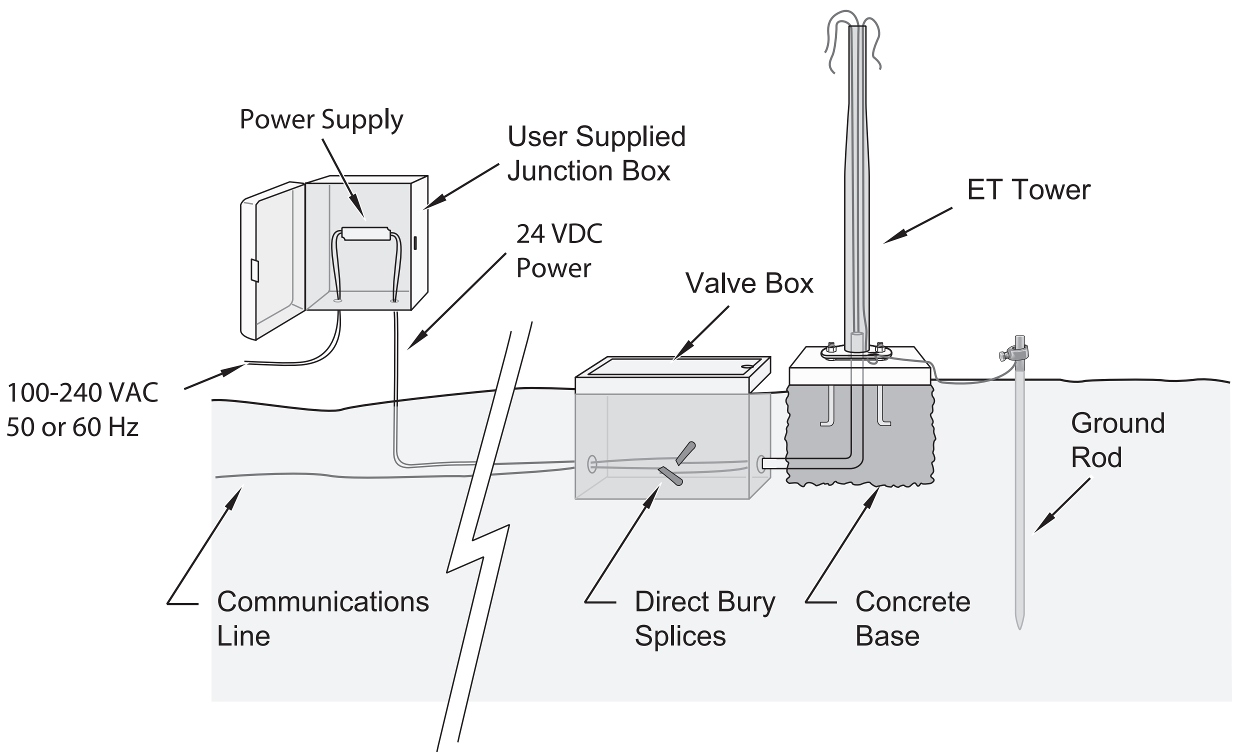


FIGURE 2.1-1. ET tower installation with currently-available AC power option

NOTE User supplies valve box at base of station and weatherproof enclosure for transformer. See Figure 2.1-1.

NOTE The AC power supply option at one time included a step-down transformer instead of the power supply. Appendix E provides information about using the step-down transformer.

2.1 Base Foundation

2.1.1 Supplied Components

(3) 5/8 inch Anchor L-Bolts
(9) 5/8 inch Nuts
(1) Anchor Template

Refer to Section 1 for components supplied by installer and bring components.

2.1.2 Installation

1. The ET Tower attaches to a user supplied concrete foundation constructed as shown in Figure 2.1-2.

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 ET Tower.

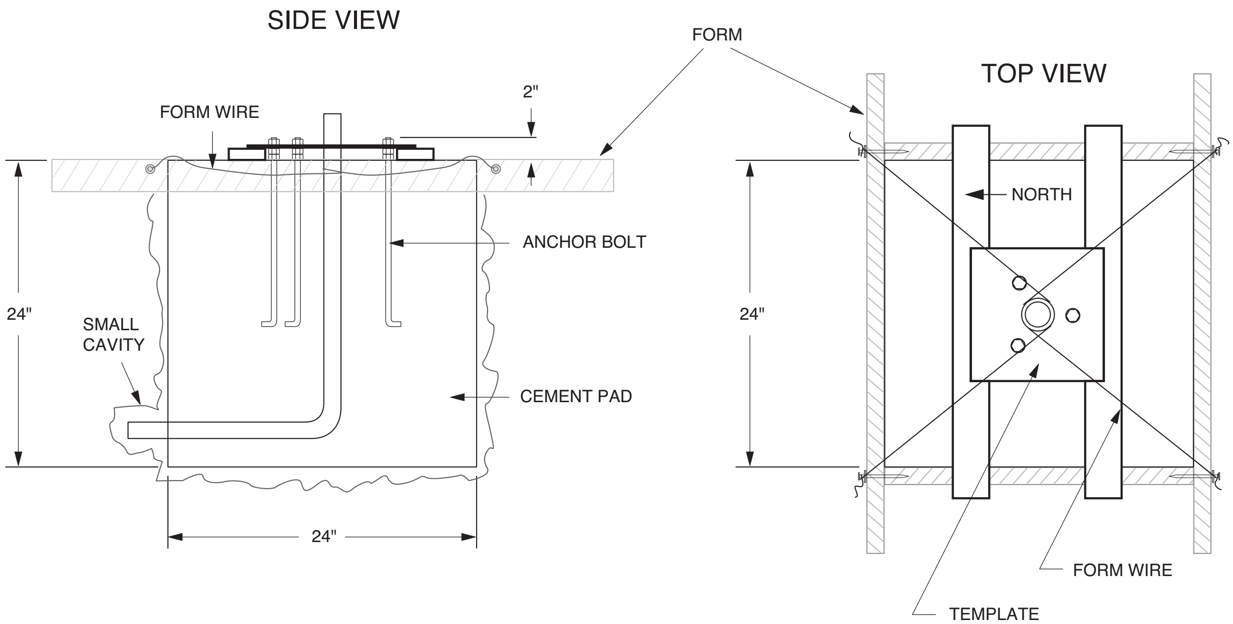


FIGURE 2.1-2. ET Tower Base Installation

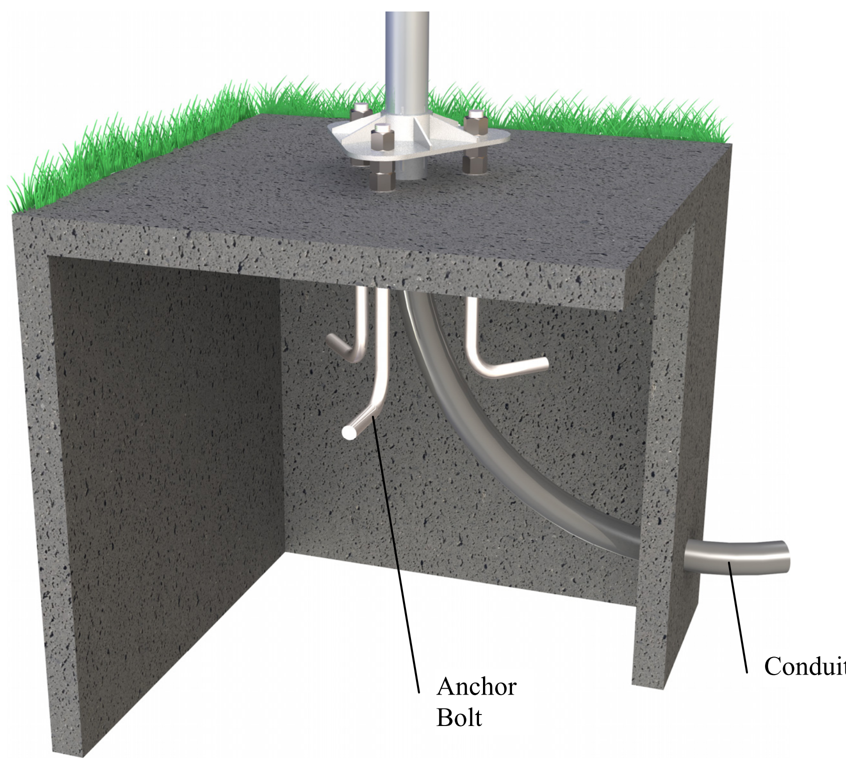


FIGURE 2.1-3. Cut-Away View Shows Anchor Bolt and Conduit Placement in Cement Pad

2.1.3 AC Power Installation

a) The currently-available AC power option includes a 100 to 240 VAC to 24 VDC power supply (see note below). The power supply 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.

b) Shut off 110 VAC power at the main breaker. Connect the primary leads of the power supply to the 100 to 240 VAC power source. Connect a two-conductor cable to the secondary terminals of the power supply. Route the cable from the power supply to the ET Enclosure according to local electrical codes.

c) 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.

d) Connect the power plug to the connector marked "Power" on the back of the enclosure. See Figure 2.4-17.

NOTE The AC power supply option for older T107 stations included a 120 VAC to 16 VAC step-down transformer instead of the 100 to 240 VAC to 24 VDC power supply. Appendix E provides information for installing an AC power system that includes the step-down transformer.

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

2.2 Tower/Pole

2.2.1 Supplied Components

(1) Upper Tower Section (Tapered)
(1) Lower Tower Section
(6) 5/8 inch Washers
(1) 12 foot 10 AWG Ground Cable
(1) White Tower Cap
(1) 20' communications cable (phone or short haul modem)
(1) 20' power cable (for AC option only)

2.2.2 Installation

Attach the tower to the base as shown in Figure 2.2-1.

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. Slide the bottom and top half of the pole pieces together. This is a permanent connection and cannot be taken apart once

they are put together. If a little more force is necessary to put the two halves together, then get a small block of scrap wood and a hammer. Set the pole upright on a grassy area or have someone hold the pole horizontally. Place a piece of scrap wood over the very end of the top section of the pole and gently hammer on the scrap wood to fit the two halves together. A 1.27 cm (1/2 inch) gap between the top and bottom pole sections is acceptable. Lay the assembled pole on the ground next to the concrete foundation.

3. Cut and save a 9 inch piece of 12 AWG ground wire from the 12 foot length provided. This will be used later to attach the enclosure ground to the lightning rod assembly (reference Figure 2.3-1).

4. Thread communication cable, power cable with connector ends of cable out the top of tower, and grounding wire through the tower and conduit. Electrical fish tape will help. Leave approximately two feet of the supplied power and communication cable hanging out of the top of the pole. Secure all wiring so it doesn't slip back down through the pole.

NOTE Solar panel and RF options will not have power or communication cables.

5. Place the white 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.

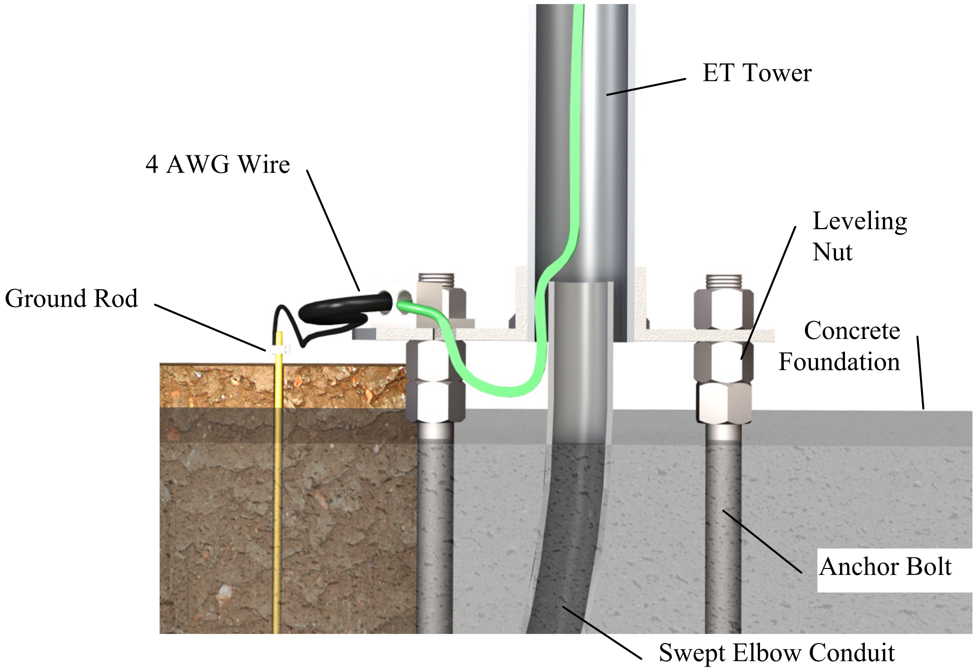


FIGURE 2.2-1. Transparent View Shows Raising and Grounding the ET Tower

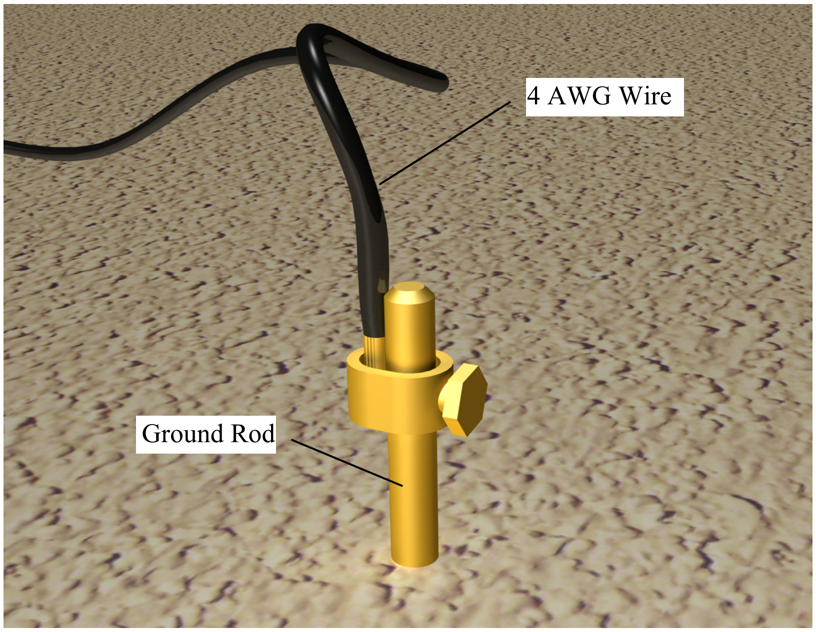


FIGURE 2.2-2. Close up of Ground Rod and 4 AWG Cable

2.2.3 Tower Grounding

2.2.3.1 Supplied Components

(1) 5 foot 4 AWG Ground Cable
(1) Copper Ground Lug, Bolt
(1) Ground Rod, Clamp

2.2.3.2 Grounding Procedure

Ground the tower as shown in Figures 2.2-1 and 2.2-2.

1. Place the ground rod clamp on the ground rod. 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 close to the foundation using a fence post driver or sledge hammer. Drive the rod at an angle if an impenetrable hardpan layer exists. Soften hard clay soils with water if necessary.

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. Loosen the lug's set screw and insert the 4 AWG and 12 AWG wire. Tighten the set screw (Figure 2.2-2).

4. Loosen the ground rod clamp. Insert the 4 AWG wire. Tighten the clamp (Figure 2.2-2).

2.3 Enclosure

The weather station datalogger, power supply, sensor connection panel, communications devices, and data retrieval peripherals are mounted in the ET enclosure. Refer to Appendix C.1 for a labeled, exploded view of the enclosure.

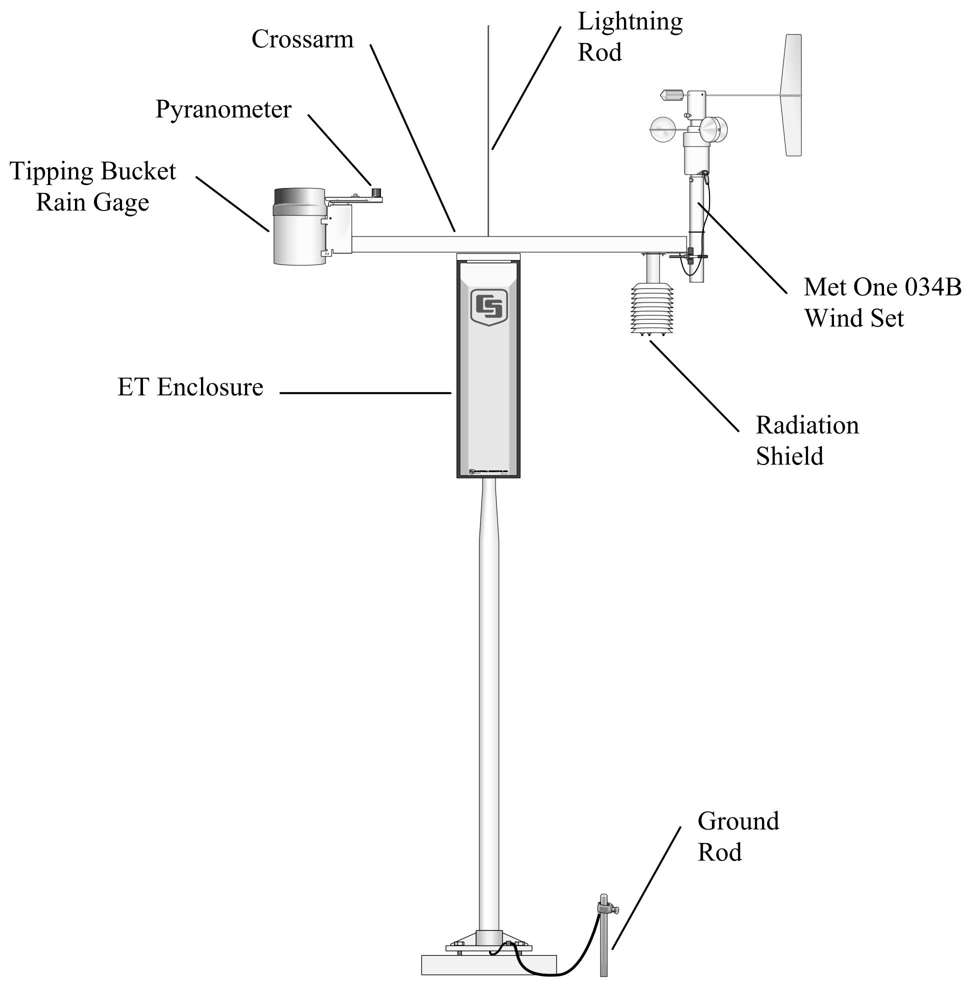


FIGURE 2.3-1. T107 Instrumentation Mounted on the ET Tower

2.3.1 Enclosure Installation

1. Mount the ET enclosure on the ET Tower as shown in Figure 2.3-2.

    a. 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.

b. 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 2 – 2.5 cm (3/4" to 1") above the top of the pole (see Figure 2.3-2).

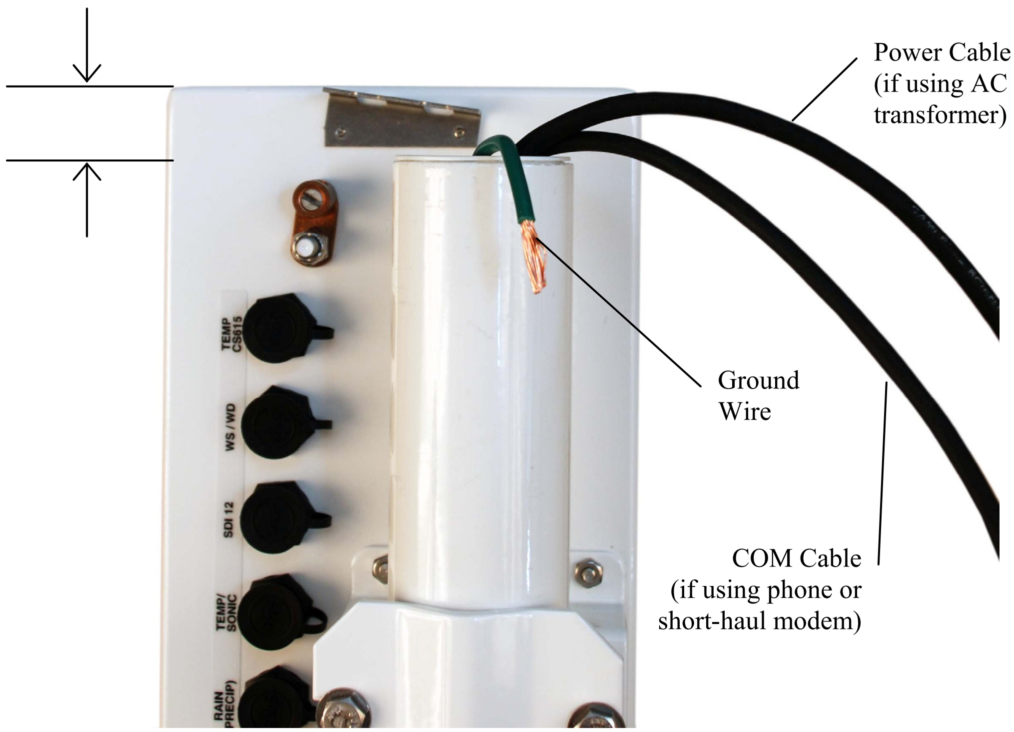


FIGURE 2.3-2. Enclosure Spacing Above Pole

2.4 Crossarm and Sensor Installation

Refer to Appendix C.2 for a labeled, exploded view of the crossarm.

2.4.1 Components

(1) T107 Crossarm with Sensors (see Figure 2.3-1)
(1) Met One 034B or Gill WindSonic Wind Sensor
(1) White Mounting Shaft for 034B or Gill WindSonic
(1) Gill Radiation Shield

2.4.2 Crossarm Installation

Adjust the bolts at the base of the pole to vertically level the top section of the mounting pole. Install the T107 Sensor Arm after the ET Enclosure is mounted on the ET Tower. You may need to temporarily remove the communications option. Mount the sensor arm as shown in Figure 2.4-1 without the wind sensor attached.

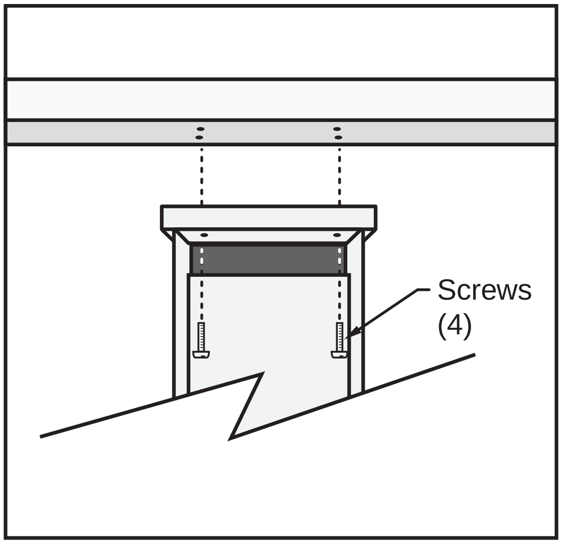


FIGURE 2.4-1. T107 Sensor Arm Mounting

1) Remove the front lid and the protective connector cover from the back of the ET 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 ET 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.

2.4.3 RH and Temperature Radiation Shield

1. Remove the two Phillips screws taped underneath the crossarm.

2. Remove the yellow shipping cap from off the end of the temperature/relative humidity sensor. See Figures 2.4-2 and 2.4-3.

FIGURE 2.4-2. Temperature/Relative Humidity Sensor with Yellow Protective Cap

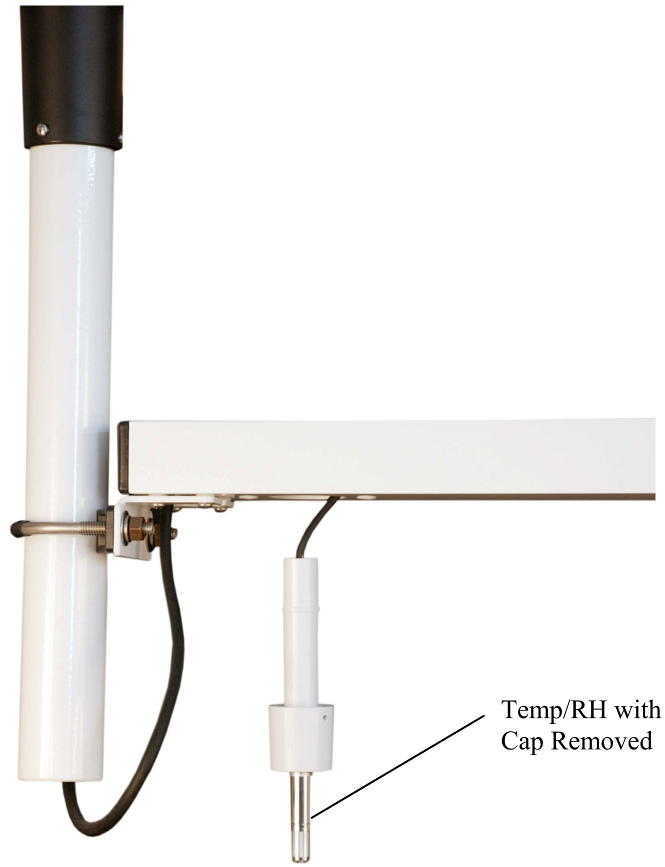


FIGURE 2.4-3. Temperature/Relative Humidity Sensor without Yellow Protective Cap

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 crossarm using the two Phillips screws from step 1.

2.4.4 034B Wind Sensor (Wind Sensor Option –MW)

1. Install the 034B Wind Sensor as shown in Figure 2.4-4 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.**

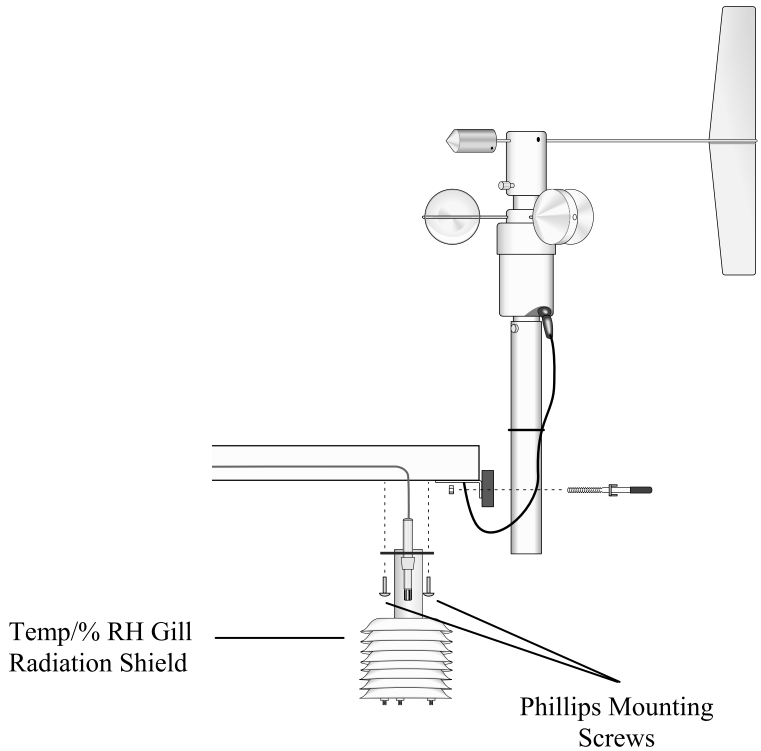


FIGURE 2.4-4. Wind and RH/Temperature Sensor Installation

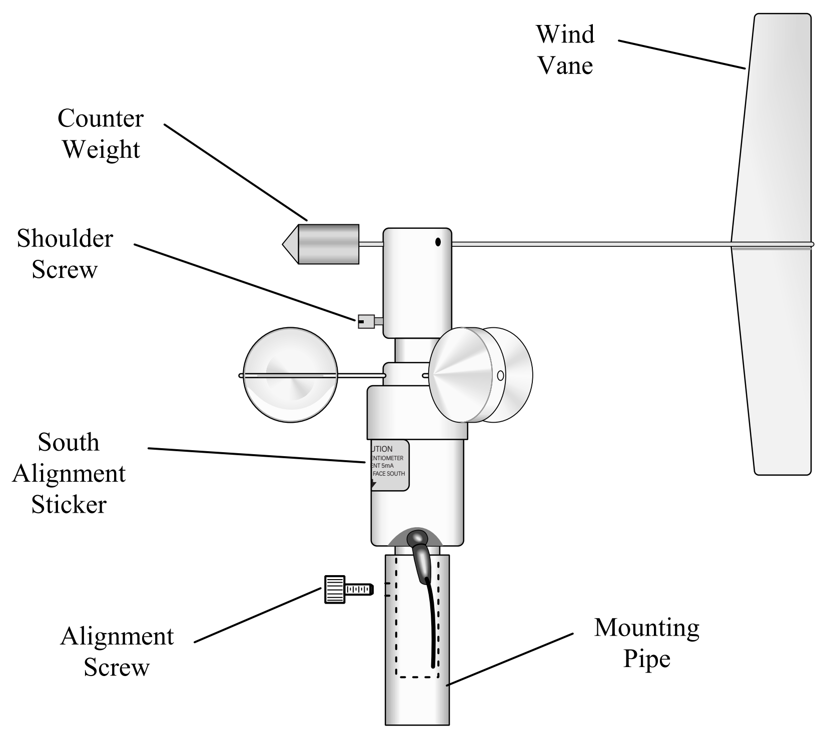


FIGURE 2.4-5. 034B Mounting to Pipe

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.**

2. Remove the alignment screw at the base of the 034B-ET (Figure 2.4-5). Insert the 034B into the 034B Mounting Shaft. Align the hole in the shaft with that in the 034B base and replace the screw. Do not overtighten the alignment screw. Do not remove the shoulder screw at this time.

3. 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 034B. Lightly tighten up the U-bolt clamp nuts. See Figure 2.4-4.

4. See Figure 2.4-5 for the alignment sticker on the 034B. 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.

5. Install the wind vane using the Allen wrench supplied with the vane. Wind vane should be perpendicular to the crossarm. Put the MetOne sticker over the wind vane Allen screw opening.

6. 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.

2.4.5 Gill WindSonic 2-D Ultrasonic Wind Sensor (Wind Sensor Option –GW)

2.4.5.1 Changing the Jumper

NOTE Jumper is set at the factory if Gill WindSonic is ordered with the station.

When the WindSonic1-ET is added to the T107, a jumper setting must be changed. The procedure to change the jumper follows:

1. Remove the cover of the enclosure.

2. Disconnect the 10588 ribbon cable from the CS I/O port.

3. Use a Philips screwdriver to loosen the four screws shown in Figure 2.4-6.

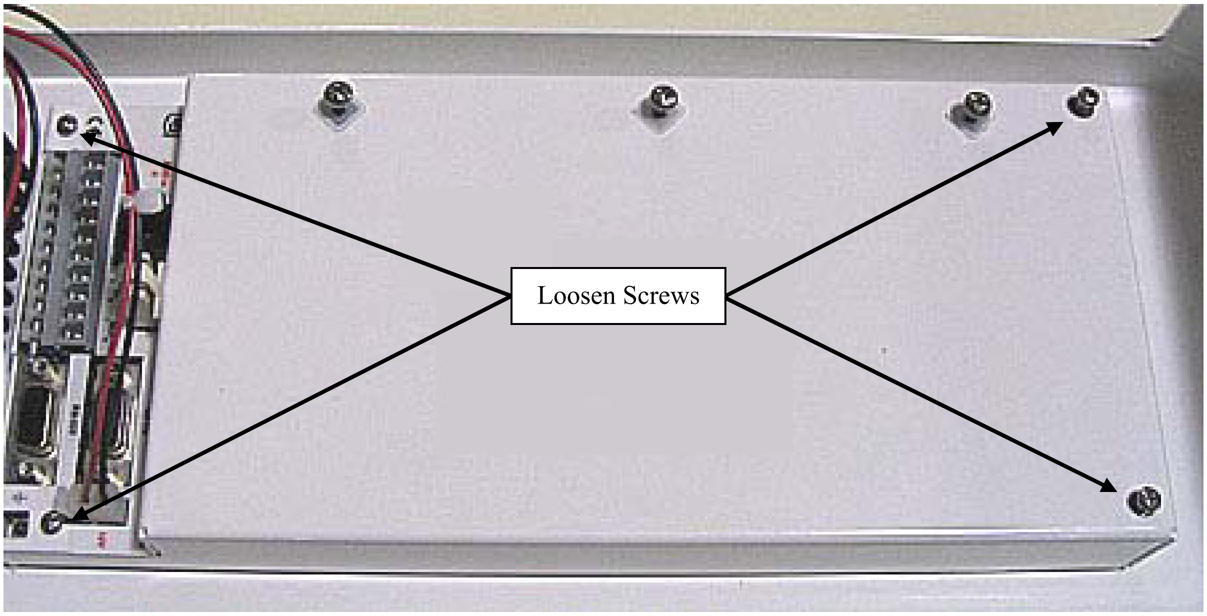
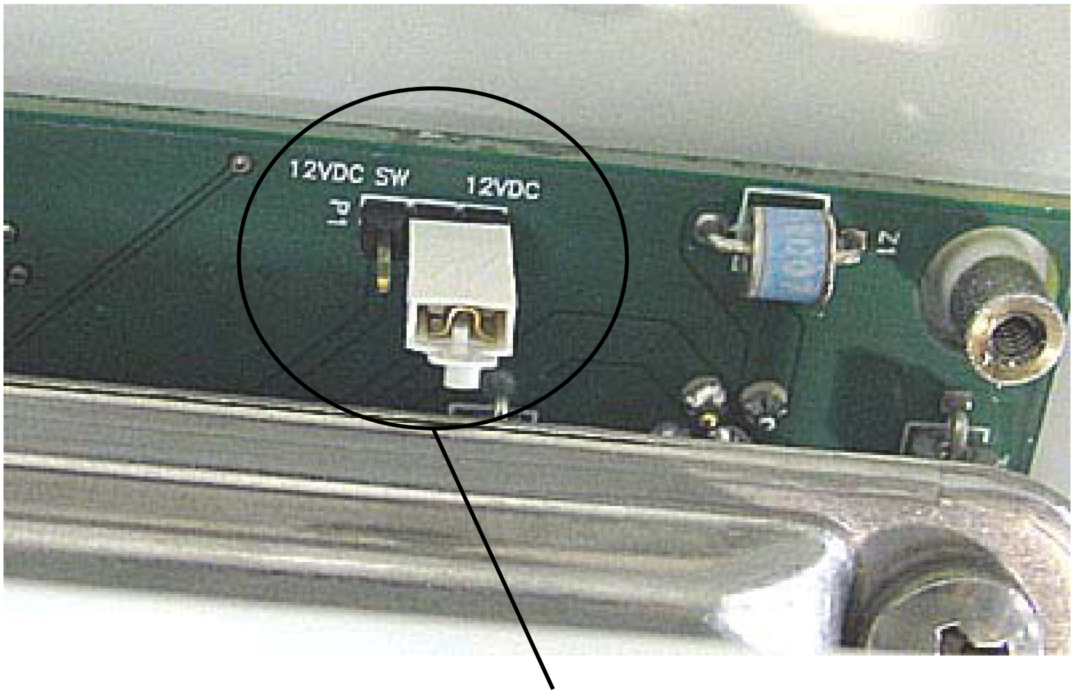


FIGURE 2.4-6. Screws that Secure the Electronics Cover

4. Remove the electronics cover to expose the PCB (see Figure 2.4-7).

FIGURE 2.4-7. Removal of the Electronics Cover

5. Move the jumper at the top of connector PC board so that it is placed over the center and right pins (see Figure 2.4-8).



New Jumper Position

FIGURE 2.4-8. Jumper Set for WindSonic1

6. Replace electronics cover.

7. Tighten screws.

8. Reattach 10588 ribbon cable to the CS I/O port.

9. Replace enclosure cover.

2.4.5.2 Attachment to Sensor Arm

1. Remove the three Phillips screws from the end of the white mounting shaft. Remove the protective cap covering the Gill WindSonic sensor cable plug.

2. Loosen the U-bolt holding the mounting shaft to the crossarm. Pull the shaft up and out of the U-bolt as shown in Figure 2.4-9.

FIGURE 2.4-9. Gill WindSonic Mounting Shaft

3. Slide the connector and cable up through the center of the mounting shaft. Plug the cable into the Gill WindSonic sensor. The connector has a key and needs to be pushed in then rotated clockwise to lock it in place. See Figure 2.4-10.

FIGURE 2.4-10. Gill WindSonic Connected to Cable

4. Center the Gill WindSonic over the three threaded screw holes on the mounting shaft and screw it in place using the three Phillips screws taken off the shaft in step 1.

5. Slide the shaft and sensor back through the U-bolt. Align the sensor with north by pointing the small colored dot on outer edge of the bottom of the sensor so it faces true north. Space the sensor about 25.4 cm (10 inches) above the crossarm and tighten down the U-bolt.

2.4.6 Rain Gage

For accurate measurements, the rain gage needs to be installed so it is horizontally level. A bubble level is situated on the bottom of the inside of the rain gage. To see the bubble level, 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 shows how vertical the pole was installed. Adjust the bolts at the bottom of the pole as needed to get the bubble level centered. Put the gold funnel back on the top of the rain gage after leveling has been completed.

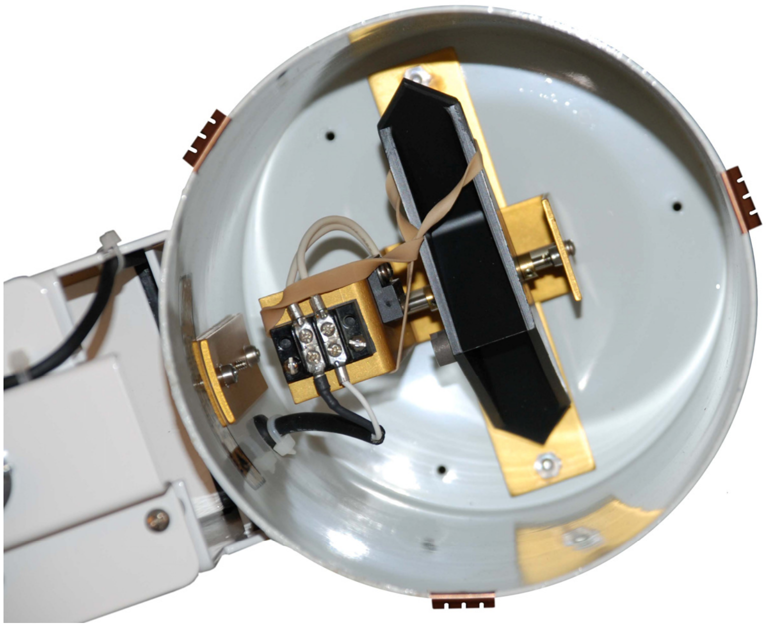


FIGURE 2.4-11. Remove Rubber Band from Tipping Mechanism

2.4.7 Pyranometer

Level the pyranometer as indicated in Figure 2.4-12. Adjust the three leveling screws until the bubble level indicates plumb. Remove the red or green shipping cap from the pyranometer. See Figure 2.4-13.

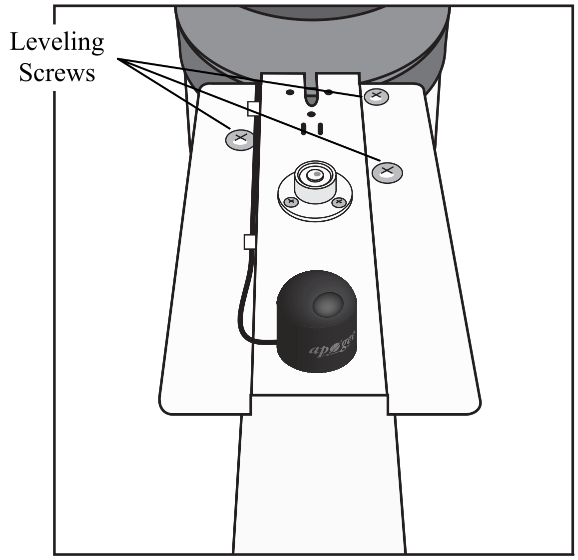


FIGURE 2.4-12. Pyranometer Leveling

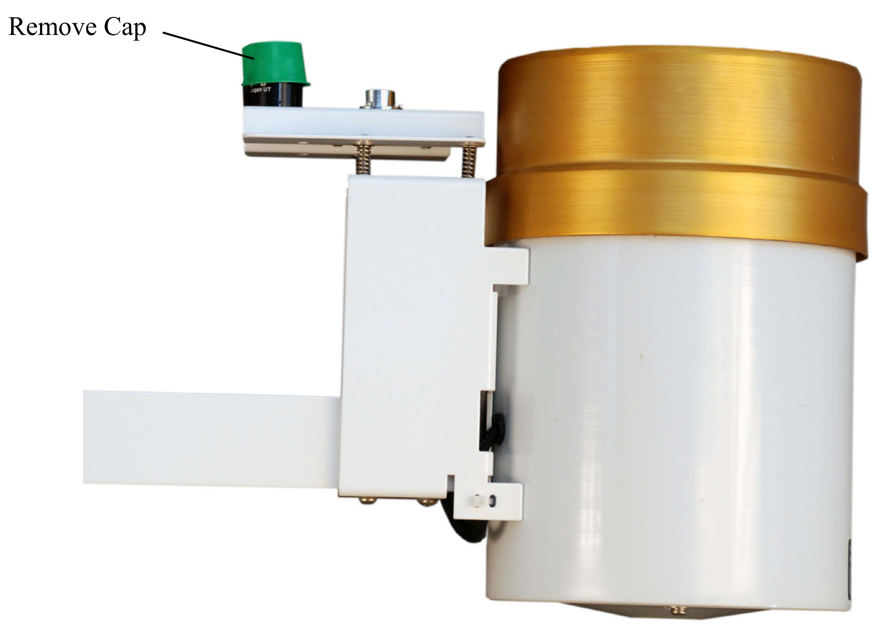


FIGURE 2.4-13. Remove Red or Green Pyranometer Cap

2.4.8 Sensor Connections

Sensor schematics are provided in Section 4.3.1.

1. Each sensor cable plug attaches to a unique bulkhead connector as shown in Figure 2.4-14. The sensor cables are individually marked to match up with the sensor labeling on the back of the enclosure.

WARNING **The 034B Wind Sensor plugs into the connector labeled WS/WD. Plugging this sensor in the connector labeled SDI-12 may damage the sensor and/or the main enclosure connector board.**

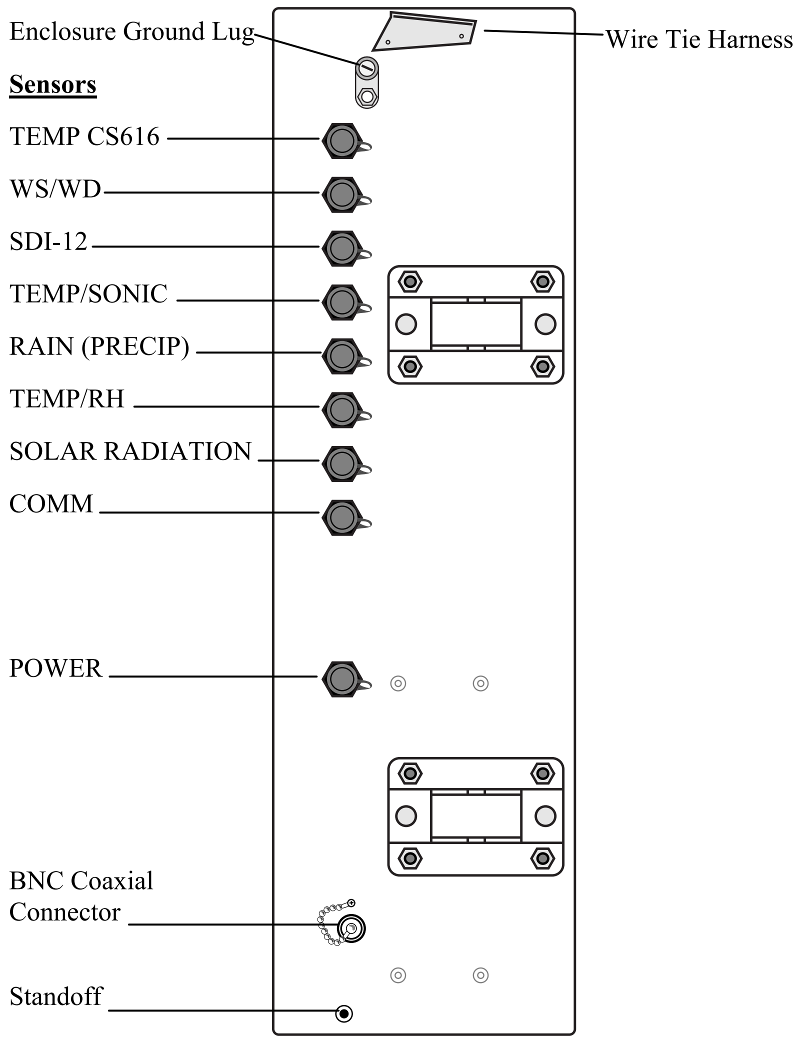


FIGURE 2.4-14. Position of Sensor Bulkhead Connectors

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

NOTE Notice how the sensor caps are slid between the connector and the one above in Figure 2.4-15. This will keep the caps out of the way of the connector cover.

FIGURE 2.4-15. Connecting Sensor Cabling to Enclosure

2.4.9 Sensor Verification and Clock Set

NOTE The T107 comes with a default program (see Appendix D).

NOTE Use standard time in the station if calculating evapotranspiration (ETsz). Do not use daylight savings time.

Additional Station Communication Options:

a) The station can be accessed directly using a CR1000KD keypad display at the weather station. Plug the keypad into the extra plug coming off the 9-pin connector marked "CS I/O".

b) A laptop can be used to connect directly to the RS-232 port at the station using a standard 9-pin serial cable. Do NOT use a null modem cable.

c) The station can be connected directly to using a Palm with Campbell Scientific PConnect software and connector/cable or PConnect CE if using a Windows CE based handheld with connector/cable.

2.5 Communication 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.

If you received a telecommunication kit separate from the ET Enclosure, follow the "Internal Installation" procedures outlined in later sections. Schematics for the phone and short haul modems are in Section 4.3.3.

Default settings for the CR1000 in the T107 station.

- PakBus address 1
- RS-232 Port: Autobaud (300 – 115,200 Baud)
- ME: Autobaud
- SDC7 or SDC8: 115,200 Baud

2.5.1 Direct Connect to T107 Station

The T107 station does not require an interface device for direct RS-232 communication. The inside of the enclosure has a RS-232 and CS I/O port available for communication (see Figure 2.5-1). Most standard communication options use the CS I/O port leaving the RS-232 port free for direct communication with a laptop or desktop computer using a standard RS-232 serial cable. The CR1000 datalogger used in the T107 station can speak with more than one device at a time allowing troubleshooting to be done in the field with a laptop while remote communication devices are accessing the station.

NOTE It's best to use Device Configuration Utility (DevConfig) and connect directly to the station to change the CR1000 configuration. DevConfig is included with LoggerNet and can be obtained, at no charge, from our website.

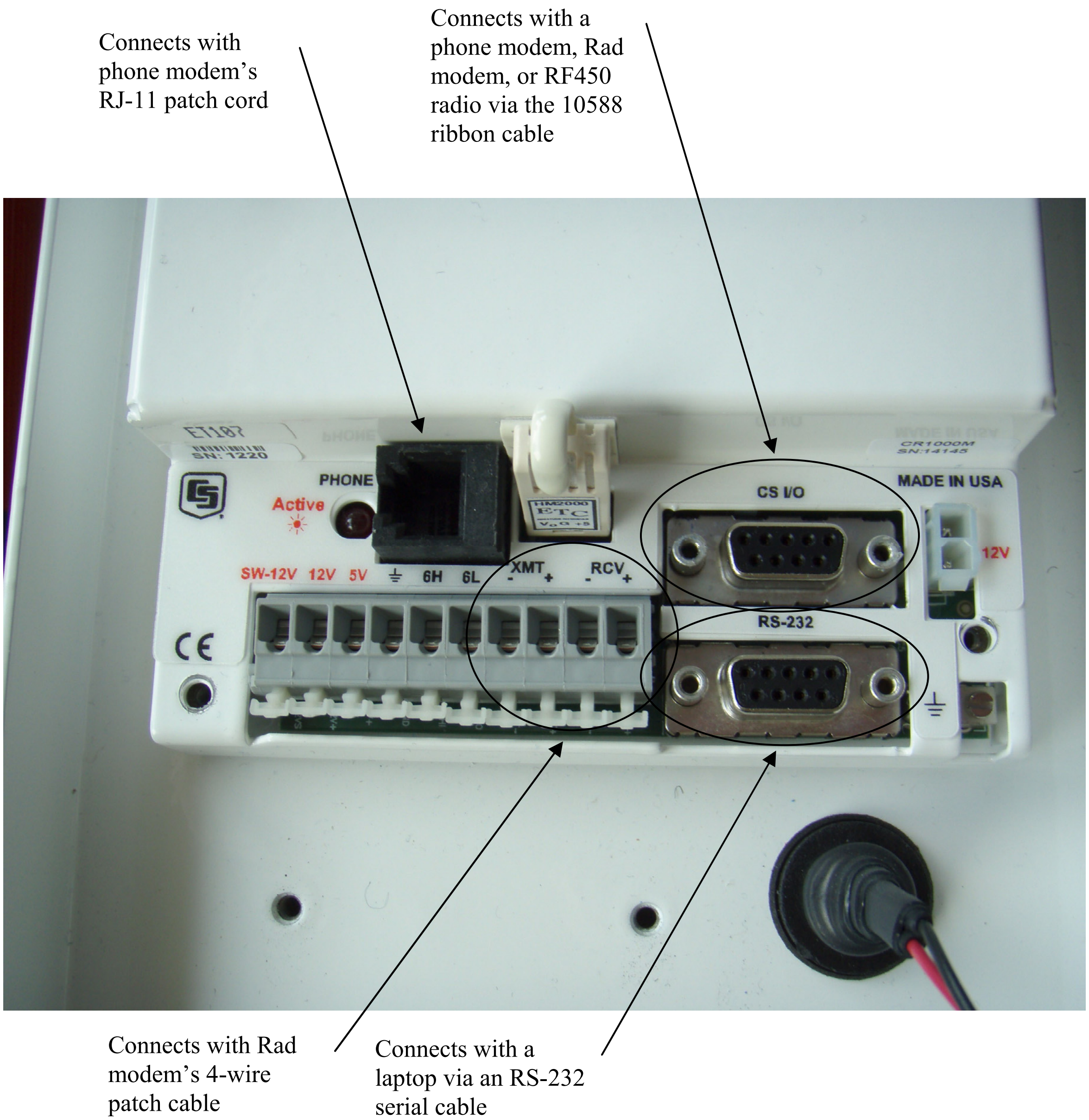


FIGURE 2.5-1. Close-up of the terminals and 9-pin ports in the T107 (battery not shown).

2.5.2 Phone Modem

Phone modems enable communications between the ET Enclosure and a Hayes compatible modem at your PC over a dedicated phone line. Phone line surge protection is built into the ET Enclosure. By default, the COM220 phone modem is configured for SDC7.

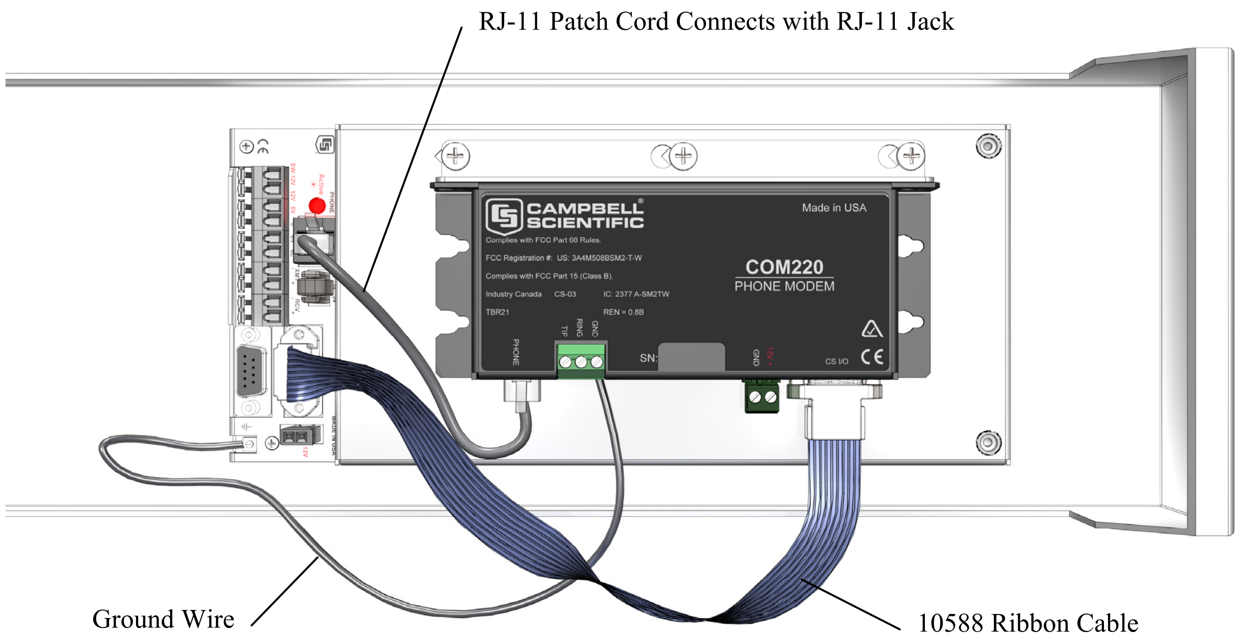


FIGURE 2.5-2. Phone Modem Mounting and Connections (battery not shown)

2.5.2.1 Internal Installation

NOTE If the phone modem was ordered with the T107, you can skip this section and go directly to the External Installation section.

For installation inside the ET 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 2.5-2.

1. Attach the modem to the modem bracket with the 2 screws provided. Mount the modem and bracket into the ET Enclosure with the 3 pre-threaded screws on the mounting plate.

2. Connect the modem 9-pin port to the ET Enclosure CS I/O port with the P/N 10588 ribbon cable supplied with the ET Enclosure (see Figure 2.5-1 and 2.5-2).

3. Connect the modem RJ-ll jack to the ET Enclosure RJ-11 jack with the RJ-ll patch cord (see Figure 2.5-2).

4. Connect the modem ground terminal block (GND) to the ET Enclosure ground with the 14 AWG ground wire.

2.5.2.2 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.

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

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.

2.5.3 Short-Haul Modem

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.

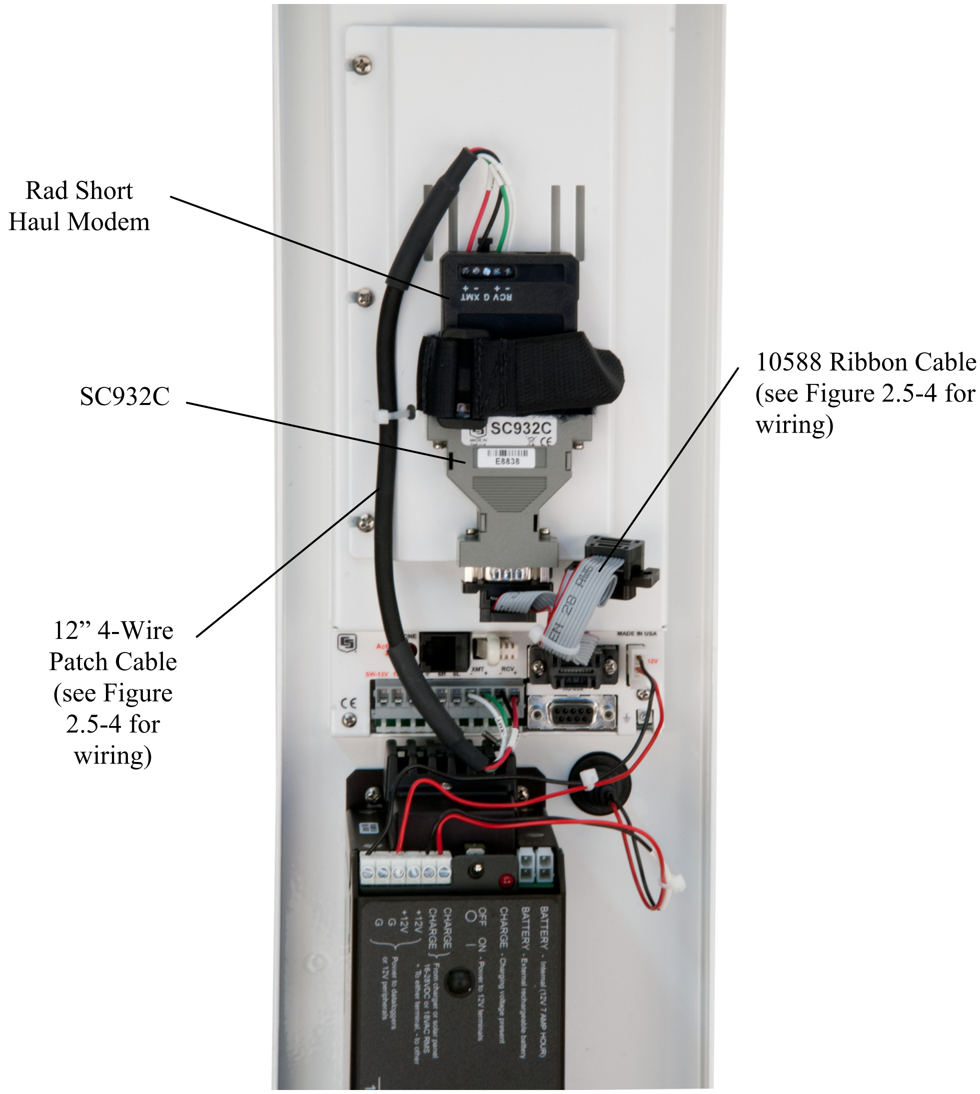


FIGURE 2.5-3. Short-haul modem mounting and connection

2.5.3.1 Internal Installation

NOTE If the short haul modem was ordered with the T107, you can skip this section and go directly to the External Installation section.

For installation inside the ET 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 2.5-3 and 2.5-4.

1. Mount the Rad / SC932C mounting bracket into the ET Enclosure with the three 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 ET Enclosure CS I/O port with the P/N 10588 Ribbon Cable supplied with the ET Enclosure (see Figure 3.3-1).

4. Wire the Rad Modem to the ET Enclosure with the 12-inch patch cable. Match wire labels to wiring panel labels on both the ET Enclosure and the Rad Modem (+XMT to +XMT, etc.). A small screwdriver is provided with the ET Enclosure to access the Rad Modem connections. Use the screwdriver to press down on the lever arm.

WARNING **Pressing too hard on the lever arm can cause it to break!**

2.5.3.2 External Installation

The following short-haul kit components (see Figure 2.5-1) are used to make the external connections:

At the ET Enclosure:

(1) 20 foot 4-Wire Patch Cable
(2) 2 Direct Burial Splice Kits
(1) Length of User Supplied Wire (Supplier: Anixter, p/n F-02P22BPN, Phone 847-677-2600)

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) 9-25 Pin RS-232 Serial Cable

1) Connect the 20-foot patch cable to the connector marked COM on the back side of the ET Enclosure. Splice the patch cable to the user supplied cable, using the direct burial splice kits.

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

NOTE

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

2) Mount the surge protector box to a flat surface within 5 feet 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 cable from the surge box 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 with the 9-to-25 pin serial cable.

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

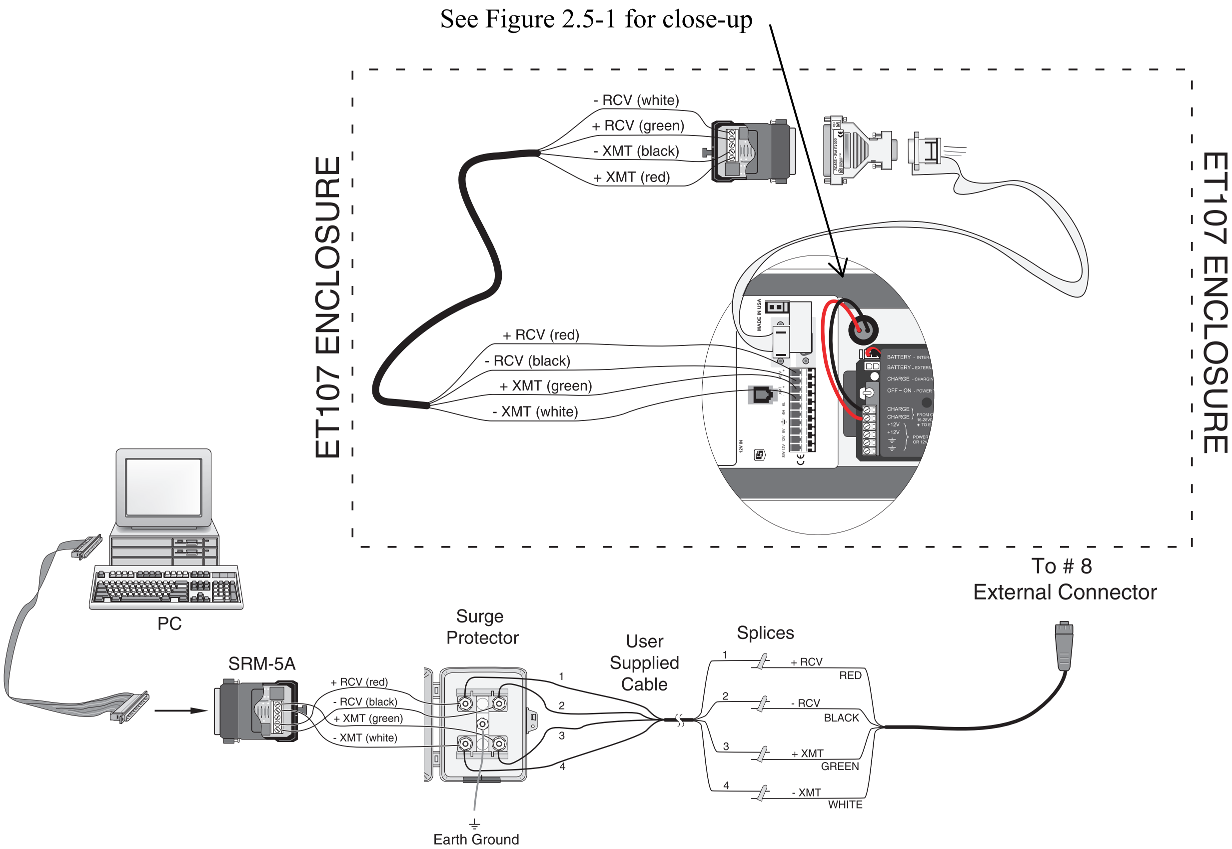


FIGURE 2.5-4. Short-Haul Modem Wiring Diagram

2.5.4 RF450 900 MHz, 1 Watt Spread Spectrum Radio

The RF450 is a license free 1 watt spread spectrum radio. Communication is strictly line-of-sight. Communication distance is dependant on antennas, cabling, and terrain (please note that line-of-sight obstructions and RF interference will affect transmission distance).

2.5.4.1 Power Considerations

AC power is recommended when using RF450 radios with the station. A 10 watt solar panel can be used but days without sunlight and winter months with little sunlight should be considered. The T107 station comes with a 7 amp-hour battery that is NOT designed to handle deep discharge. Discharging the battery below 11 Vdc may require battery replacement. Below are some examples of power calculations. Battery current consumption is based on discharging the 7 amp-hour battery to 80% capacity (5.6 amp-hours). Discharging the battery past this value could result in damaging the battery.

Polling the station once every 10 minutes and staying on line with the station for one minute consumes approximately 1.276 amps over a 24 hour period. If the station were to lose power it could run for around 4.3 days (105 hours) before damaging the battery. A station with a 10 watt panel would need at least 3 hours of sunlight every day to keep the battery charged. Recommendation here would be to decrease the power output of the radios or add a PS24 power supply and enclosure with a 24 amp-hour battery below the main enclosure. See Appendix B for mounting options and information on the PS24.

Polling the station once an hour and staying on line with the station for one minute consumes approximately 0.388 amps over a 24 hour period. If the station were to lose power it could run for around 14 days (346 hours) before damaging the battery. A station with a 10 watt panel would need at least 1 hour of sunlight every day to keep the battery charged.

2.5.4.2 Default Configuration

By default the radios are configured as follows.

Base Radio At Computer

- Multi-Point Master
- RS-232 @ 9600 Baud
- Network ID: 1234
- Frequency Key: 5
- 1 Watt Output (Transmit Power: 10)

Weather Station Radio

- Multi-Point Slave
- Communication With Datalogger via CS I/O SDC7
- Network ID: 1234
- Frequency Key: 5
- 1 Watt Output (Transmit Power: 10)
- Low Power Mode: 2

See the RF450 manual for changing radio settings.

2.5.4.3 Internal Installation

NOTE If the RF450 radio was ordered with the T107, you can skip this section and go directly to the External Installation section.

The following components are provided in the RF450 radio kit for installation inside the ET enclosure:

(1) 18327 RF450 900MHz 1 W Spread Spectrum Radio
(1) 20584 RF450 ET Enclosure Antenna Cable
(1) 20585 RF450 ET Enclosure Mounting Bracket

The radio comes mounted to the ET bracket. Install the assembly as follows.

NOTE Power the station down by flipping the PS100 power switch to "Off" before installing any communication option. Remember to flip the switch back to "On" after enclosure installation is completed.

1. Mount the RF450 bracket and radio into the ET enclosure using the three existing screws. See Figure 2.5-5.

2. Thread the smaller SMA connector end of the enclosure antenna cable underneath the battery cables and screw it to the RF antenna connector on the RF450 radio. Attach the other end of the cable to the BNC RF bulkhead connector in the lower right hand corner of the enclosure. Make sure all connections are tight. See Figure 2.5-5.

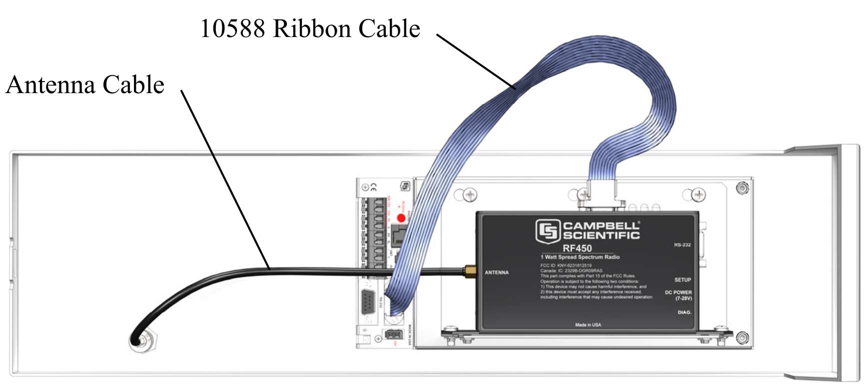


FIGURE 2.5-5. RF450 in T107 (battery not shown)

3. Connect the long 9-pin female end of the 10588 ribbon cable to the CS I/O port on the RF450 radio. Screw the connector to the radio using the provided two screws. See Figures 2.5-6.

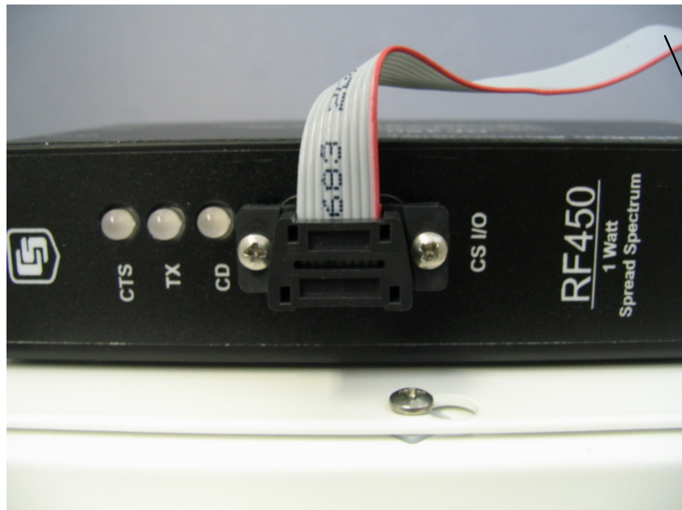


FIGURE 2.5-6. Attach Ribbon Cable to RF450 CS I/O Port

2.5.4.4 External Installation

The following components are provided with the RF450 radio kit for antenna installation on the ET pole:

(1) 14241 Antenna Cable – 59 inch
(1) 18290 ET Antenna Adjustable Angle Mounting Bracket
(1) 17492 5/16-18 X 2.125 Stainless Steel U-bolt
(1) 17851 CM230 Saddle Bracket
(4) Silicon Bronze 5/16-18 Nuts
(4) 4365 5/16 Stainless Steel Washers
(4) 4366 5/16 Stainless Steel Lock Washers
(4) 17592 14.5 Inch Black UV Resistant Wire Ties

The 14221 3 dBd Omni or the 14205 6 dBd Yagi Directional Antenna with Type N Female Connector should have been ordered with the kit.

1. Remove the sensor cable cover off of the back of the enclosure by loosening the thumb screw at the bottom of the cover and swinging the cover back and down. The top of the cover has a tab that fits in to the rectangular hole on the back of the sensor cross arm.

2. Remove the cap off of the BNC bulkhead connector located on the lower left hand corner of the enclosure back. Attach the antenna cable to the BNC connector. Gently bring the cable up alongside the pole and loosely wire tie it to the wire tie block at the top of the enclosure. Drape the antenna cable between the pole and the enclosure. See Figures 2.5-7 and 2.5-8.

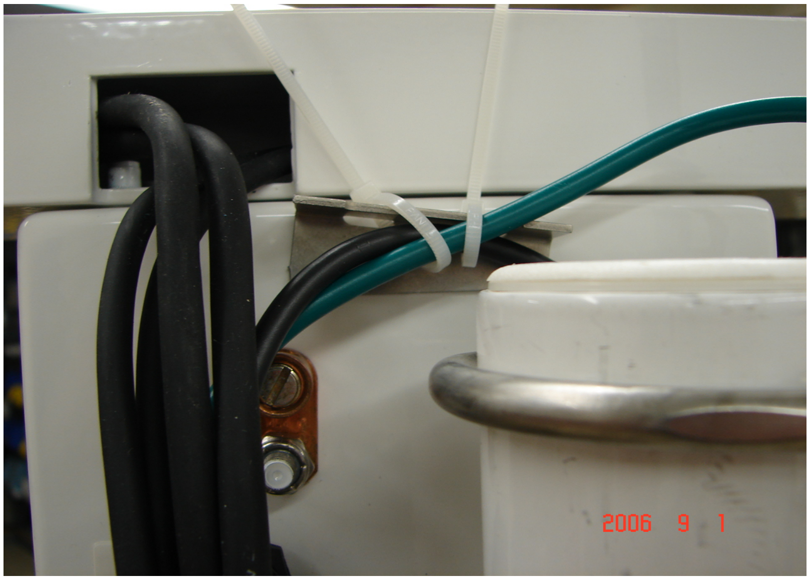


FIGURE 2.5-7. Loosely Wire Tie Antenna Cable

FIGURE 2.5-8. Loosely Drape Antenna Cable over Back of Enclosure

3. Use the 2.125 stainless steel U-bolt to attach the adjustable angle mounting bracket to the pole. Depending on the size of the antenna position the bracket directly below, or above, the enclosure top mounting bracket. The top of an omni directional antenna should not be higher than the top of the lightning rod.

   Slide the U-bolt behind the pole and through the oval notches on the adjustable angle mounting bracket (see Figure 2.5-9). Put a flat washer, lock washer, and a silicon bronze nut, in that order, on the ends of the U-bolt. Tighten the nuts finger tight to allow the angle bracket to rotate around the pole.

FIGURE 2.5-9. Slide Antenna Bracket U-Bolt around Back of the Pole

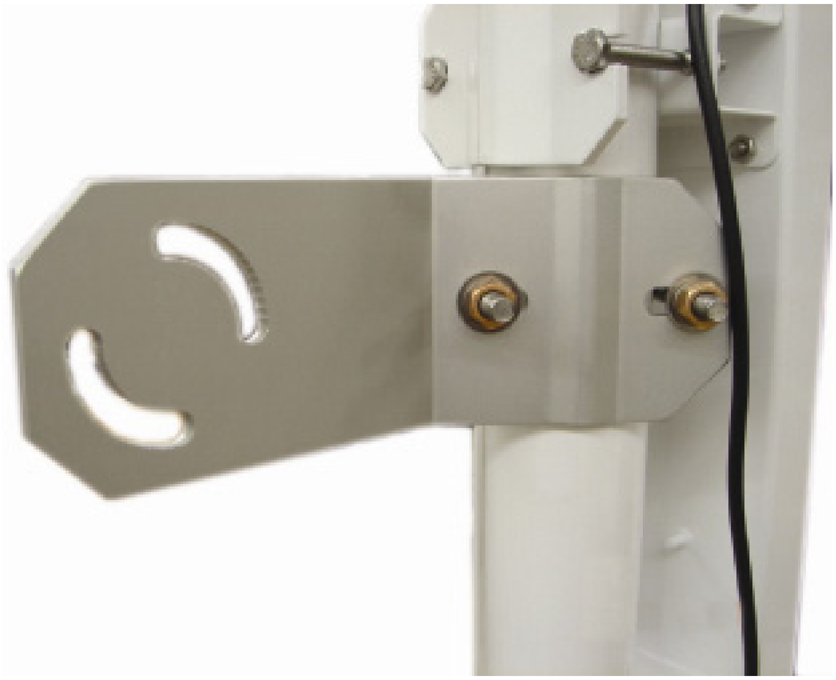


FIGURE 2.5-10. Antenna Bracket Mounted to Pole

4. Mount the saddle bracket to the adjustable angle mount bracket by inserting the ends of the bracket through the quarter circle notches. Put a flat washer, lock washer, and a silicon bronze nut, in that order, on the ends of the saddle bracket. Do NOT tighten down the nuts at this time.

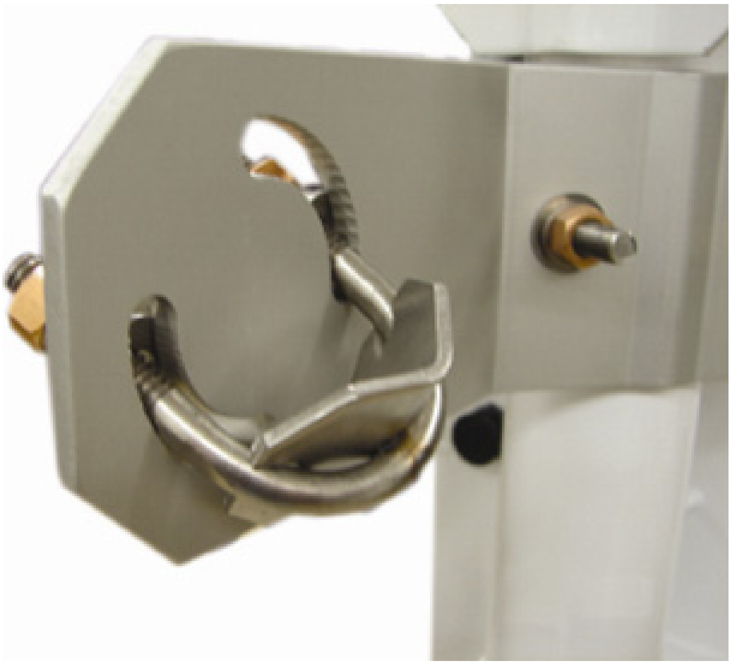


FIGURE 2.5-11. Mount Antenna Saddle Bracket

NOTE Only rotate enclosure if needed to allow aiming of the Yagi antenna to the base antenna. Keep solar radiation sensor towards the South as much as possible. Rotate wind sensor to realign as needed.

5. Use the following procedure to install the 14205 Yagi antenna for the RF450. Installation of the 14221 Omni antenna is similar. See Figure 2.5-14.

NOTE Mounting hardware that comes in the box with the Yagi antenna will not be used.

i. Slide the back of the Yagi antenna into the saddle bracket. If the Yagi antenna at the station is communicating with an omnidirectional antenna at the base then align the tines on the Yagi antenna so they are vertical. See Figure 2.5-12.

   If two Yagi antennas are used at both ends of communication then align the tines the same. If interference is a concern then align the tines on the two Yagi antennas horizontally instead of vertically. This will put the signal out of phase with other antennas that are aligned vertically.

   Tighten the nuts on saddle bracket to hold the antenna firmly in place. Do NOT over tighten the nuts on the saddle bracket or damage to the antenna may occur.

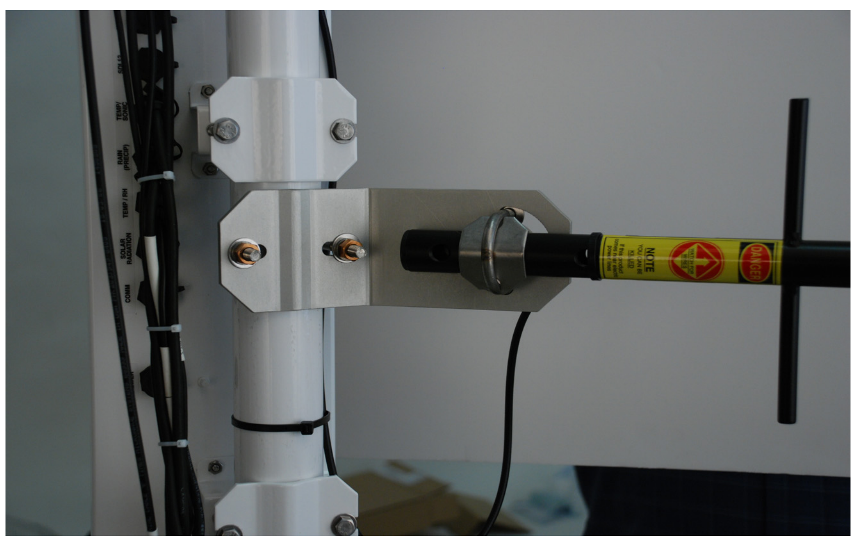


FIGURE 2.5-12. Yagi Antenna Mounted to Saddle Bracket

ii. Orient the Yagi antenna so it's aimed at the base antenna. You may have to flip the adjustable angle bracket over to get the antenna and saddle bracket to point correctly in the vertical direction.

iii. Adjust the antenna cable at the BNC connector so the cable cover fits over all the sensor cables as well as the antenna cable. You may have to gently bend the antenna cable to put a 90° bend by the BNC connector end of the cable. Take the cover off when you're done.

iv. Use one of the black wire ties to strap the antenna cable to the bundle of sensor cables.

v. Tighten up the wire ties holding the antenna cable to the wire tie mount at the top of the enclosure.

vi. Take one black wire tie and strap the antenna cable to the antenna as shown in Figure 2.5-13. Leave a little slack on the cable between the wire tie and the antenna connector so as not to stress the connector/cable connection.

vii. Make sure there is a loop of antenna cable directly under the Yagi antenna. This will act as a drip loop and allow moisture to run off the antenna and cable. See Figure 2.5-13.

viii. Wire tie the antenna cable to the pole. Clean up the wire ties and put the cable cover back on.

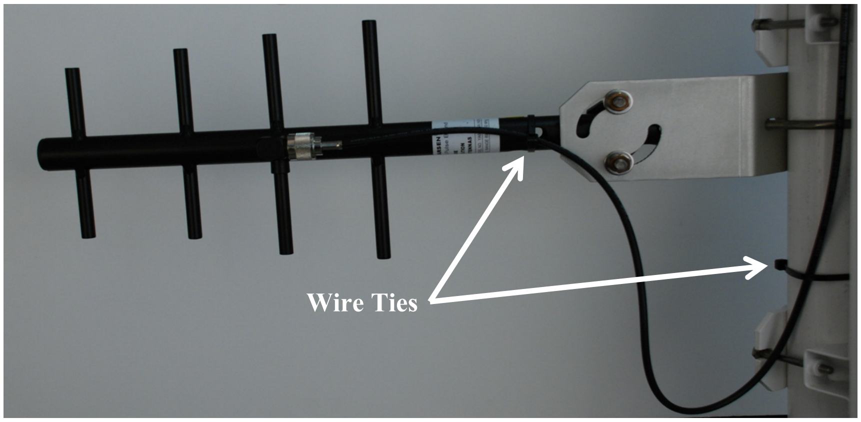


FIGURE 2.5-13. Wire Tie Antenna Cable to Yagi Antenna and to Pole

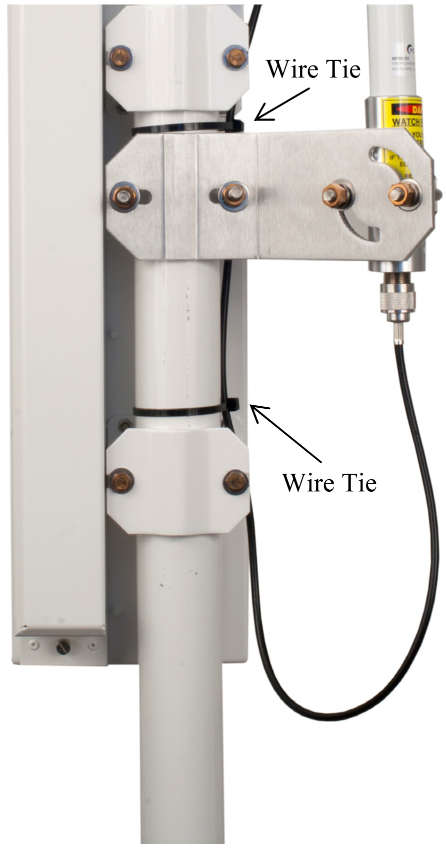


FIGURE 2.5-14. Wire Tie Locations for Omni Antenna Installation

2.5.4.5 Base Radio Installation

The base radio kit comes with the following items.

(1) 10873 RS-232 Serial Data Cable with 6 feet of cable
(1) 15966 Wall Adapter: 100 to 240 Vac, 50-60 Hz Input to 12 Vdc 80 0mA Output with 6 feet of cable.
(1) 18327 RF450 900 MHz, 1 W Spread Spectrum Radio
(1) 20617 900 MHz 0 dBd Omnidirectional Window Mount Antenna with 79 inches (6.58 feet) of Cable

The RF450 radio will need to be connected to a RS-232 serial port on the calling computer and powered by the wall adapter. The antenna is designed to stick to a window facing the weather station (see Figure 2.5-15 and Figure 2.5-16).

CAUTION In order to comply with the FCC RF exposure requirements, the RF450 series may be used only with **approved antennas** that have been tested with this radio and a minimum separation distance of 8 inches (20 cm) must be maintained from the antenna to any nearby persons.

Attach the SMA connector on the antenna to the RF450 radio. Remove the strip covering the adhesive on the antenna and stick it vertically to a window. Attach the serial cable from the calling computer's serial port to the port marked "RS-232" on the RF450. Plug the wall adapter into a wall outlet and plug the barrel connector into the RF450 connector marked "DC POWER 7-28V". You should see the lights on the radio come on.

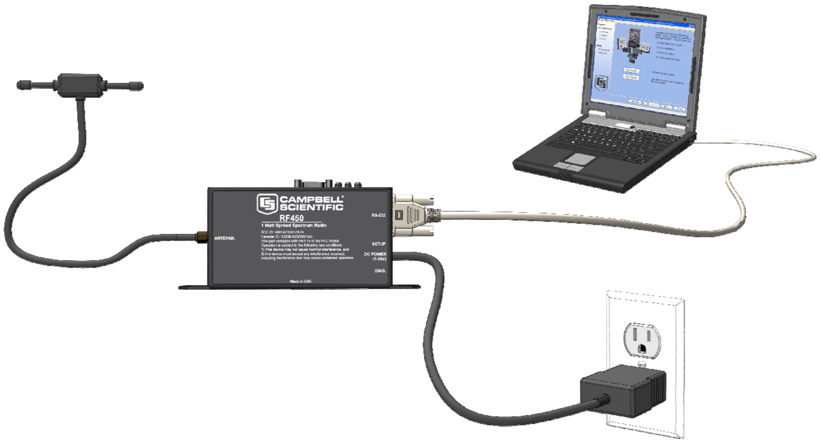


FIGURE 2.5-15. Base RF450 Installation

FIGURE 2.5-16. A Base Radio Installed in an Office

2.6 Lightning Rod Installation

Install lightning rod as shown in Figure 2.6-1 and 2.6-2.

1. Carefully mount the lightning rod clamp to the top of the pole (see Figure 2.6-1). Position the clamp so it won't interfere with the connector cover.

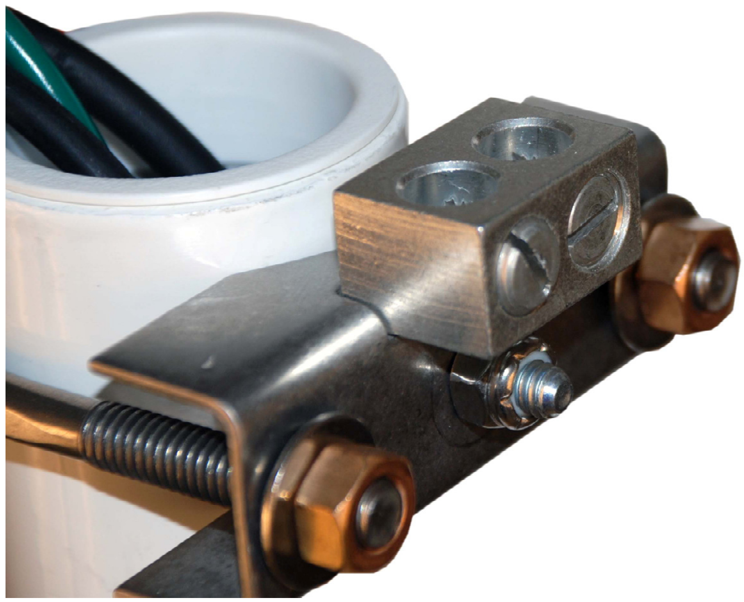


FIGURE 2.6-1. Lightning Rod Bracket Installation

2. Strip 2.54 cm (1") 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 2.6-2).

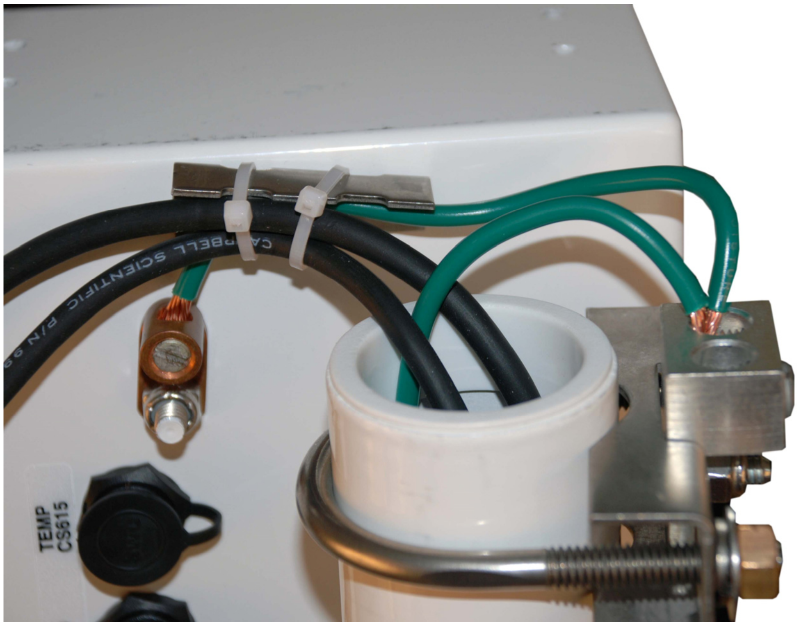


FIGURE 2.6-2. Grounding to Lightning Rod Clamp

3. Strip 2.54 cm (1”) from both ends of the 9” (23 cm) piece of 10 AWG green ground wire. Insert one end into the enclosure 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 2.6-2).

4. Insert the lightning rod into the empty clamp opening. The milled flat side of the lightning rod should face the clamping screw. Tighten the screw to hold the rod firmly in place.

2.7 Solar Panel Installation

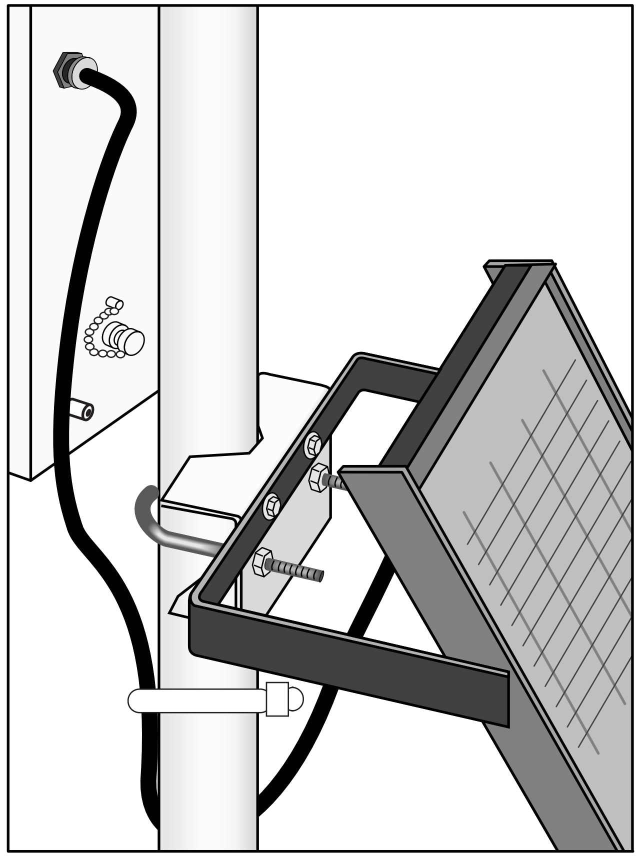


FIGURE 2.7-1. Solar Panel Mounting and Cabling

a) Mount the solar panel to the tower using the mounting brackets as shown in Figure 2.7-1. 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 (α)
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

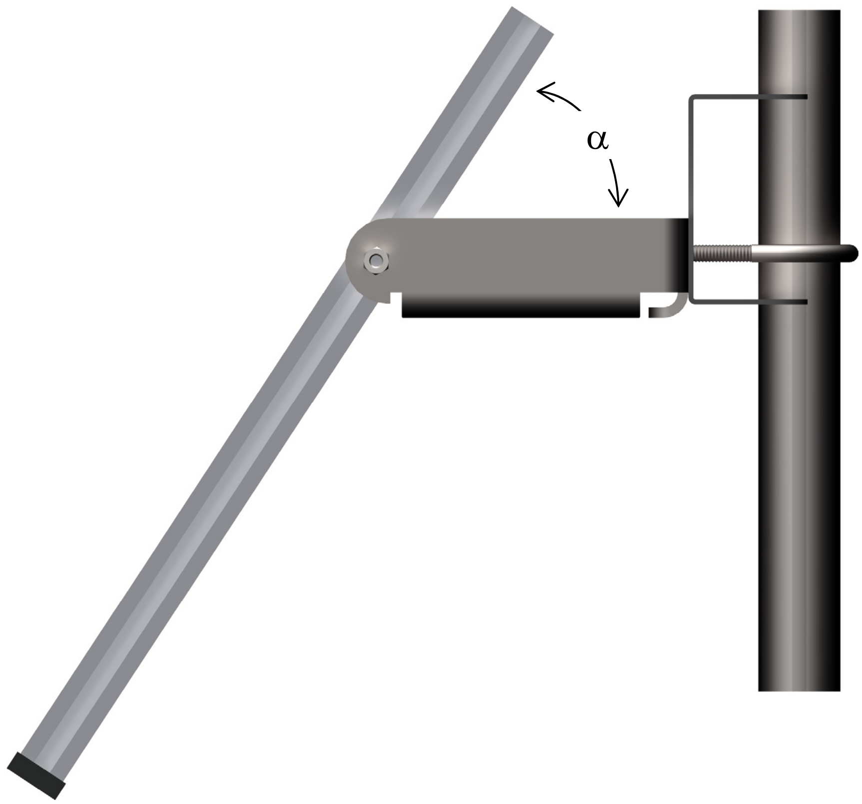


FIGURE 2.7-2. Side View of Solar Panel Shows Tilt Angle

b) After determining the tilt angle, loosen the two bolts that attach the mounting bracket to the panel. Adjust the angle, then tighten the bolts. Secure the lead wire to the mast using wire ties as show in Figure 2.7-2. 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.

NOTE Schematics for the solar panel cable are in Section 4.3.2.

2.8 Battery Installation

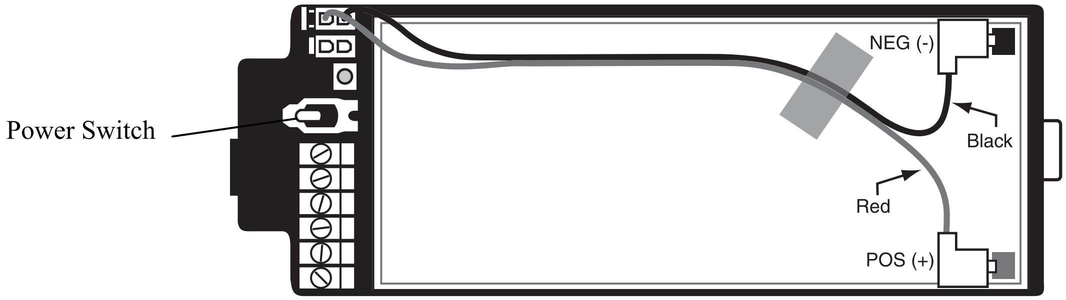


FIGURE 2.8-1. PS100 Battery Installation

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 2.8-1. 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 effected by the switch. Switching on the power supply without a charging voltage will run the battery down.

Figure 2.8-2 shows factory wiring between the PS100 and the enclosure.

FIGURE 2.8-2. PS100 to T107 Enclosure Wiring

2.9 Restraining Cables and Sealing/Desiccating Enclosure

2.9.1 Restraining Cables

1. 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 2.9-1.

Wire Tie Harness

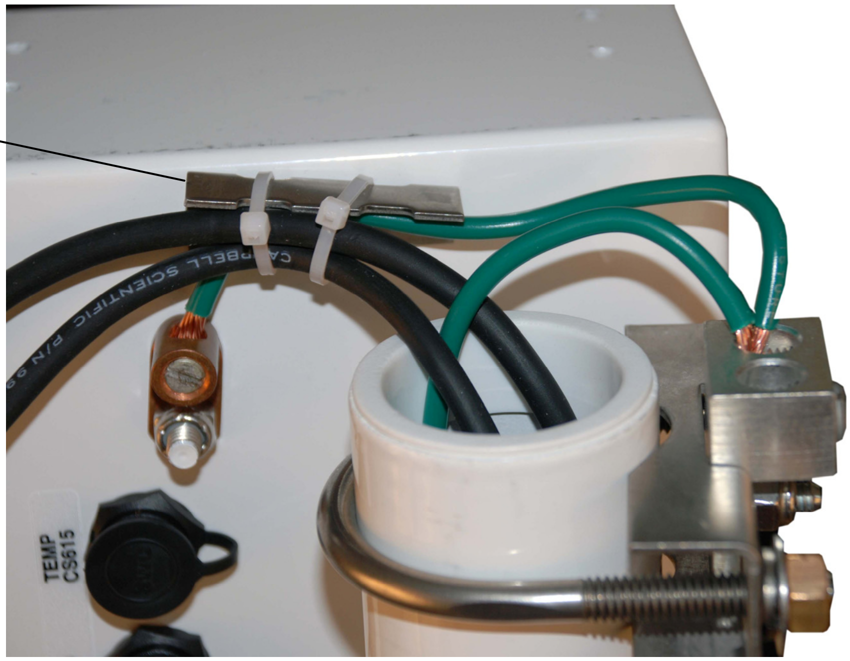


FIGURE 2.9-1. Cabling Strapped to Wire Tie Harness

2. 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.

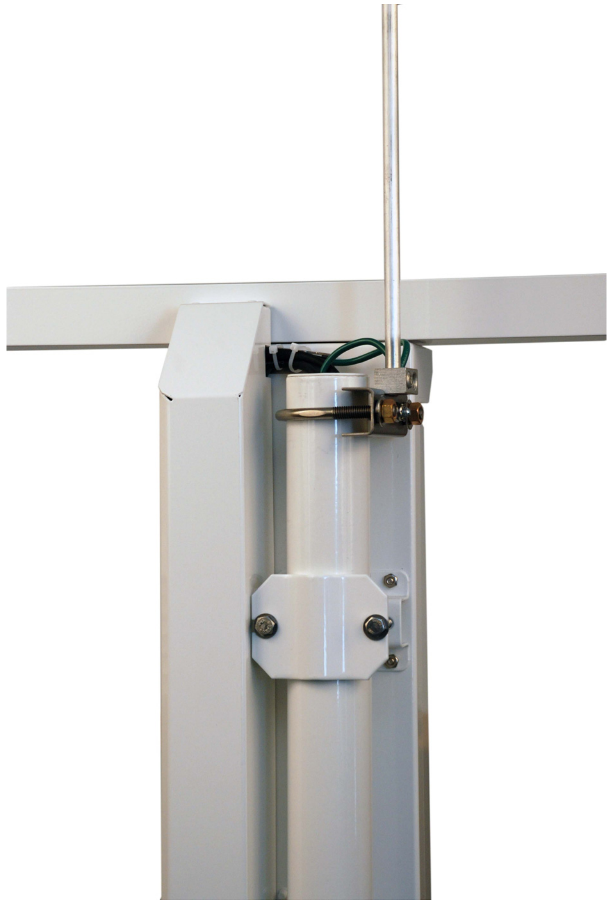


FIGURE 2.9-2. Connector Cover in Place

6. Tighten down the wire ties holding cabling to the wire tie harness and clip off any excess. See Figure 2.9-2.

2.9.2 Sealing and Desiccating the Enclosure

The ET 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 ET Enclosure humidity sensor measures 50% or higher. Install the desiccant as shown in Figure 2.9-3. Keep unused desiccant tightly sealed in an airtight container.

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.

1) Take the desiccant packs out of the plastic bag. Strap the packs into the desiccant holder inside the lid of the enclosure using the two Velcro straps.

2) Be sure to close the enclosure hasp securely. A padlock may be used on the latch for extra security.

FIGURE 2.9-3. Desiccant Installation

Section 3. ET Software

> **NOTE** The T107 comes with a default program, and typically does not require additional programming (see Appendix D).

A variety of different software packages are available to work with the T107 station. This section introduces software packages that can be used with the T107 station. It is not the goal to fully explain capabilities of each package. All software packages mentioned below come with extensive help files. Contact Campbell Scientific with questions and support. All software includes installation instructions.

For Toro T.Weather 3.0 or higher, contact Toro NSN for support at 800-275-8676.

PC200W is free software which is used to communicate with a direct connect or short-haul modem station and collect data. PC200W software cannot be used to communicate with stations on a phone modem. This software can be downloaded from Campbell Scientific's website www.campbellsci.com.

VisualWeather version 3.0 or higher is designed to work with the T107 station and can be used to create programs, monitor present conditions, collect data, and create reports and graphs. VisualWeather is designed to be a very user friendly program. No datalogger experience is needed to use it. VisualWeather will communicate with a direct connect, short-haul modem, RF radio, or phone modem station. Call Campbell Scientific for pricing.

LoggerNet is a very powerful versatile package that requires some experience with datalogger programming. LoggerNet is used to create custom programming for the station as well as handling large networks of stations. LoggerNet is not as easy to use as VisualWeather. Call Campbell Scientific for pricing.

> **NOTE** At default settings, the Campbell Scientific software packages will not work alongside of Toro T.Weather. Contact Campbell Scientific.

Section 4. Maintenance, Troubleshooting, and Schematics

4.1 Maintenance

Proper maintenance of the T107's 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.

4.1.1 Pole

Periodically check the tower for structural damage, proper alignment, and for level/plumb.

4.1.2 Power Supply

4.1.2.1 Batteries

Rechargeable power supplies should be connected to an AC transformer or unregulated solar panel at all times. The PS100 charge indicating light should be "ON" when voltage to the charging circuitry is present. The charge indicating light runs independent of the power switch. Be aware of battery voltage that consistently decreases over time, which indicates a failure in the charging circuitry. Toro T.Weather software displays the battery voltage.

4.1.2.2 Solar Panel

An occasional cleaning of the glass on the solar panel will improve its efficiency. Use warm mildly soapy water and a clean cloth. Rinse with clean water.

4.1.3 Desiccant

Humidity is monitored inside the T107's enclosure using the Elan HM2000 (item # 10070) RH sensor that is incorporated in the enclosure. Change the desiccant packs when the enclosure RH exceeds 50%. The enclosure RH sensor should be changed every 5+ years. The enclosure RH is displayed in Toro T.Weather software.

Desiccant packs may be ordered in quantity of 20 individually sealed packs at a time (item# 6714) or by the individual pack (item# 4905). Campbell Scientific does have a $50.00 minimum charge. Any orders under $50.00 require a $15.00 handling fee. Call Campbell Scientific or your local Toro distributor for pricing.

4.1.4 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. See Appendix A for an example of a maintenance log file. 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 air, soft camel hair brush, or clean water if needed.

CAUTION Handle the pyranometer carefully when cleaning. Be careful not to scratch the surface of the sensor.

- Do a visual/audio inspection of the 034B-ET's anemometer at low wind speeds. Worn bearings can cause the wind cups to spin in an uneven manner and/or make a grinding sound.

- Check the WindSonic1-ET for contamination. If needed, gently clean the WindSonic1 with a cloth and mild detergent.

CAUTION When cleaning the WindSonic1, do not use solvents and avoid scratching the sensor.

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.

6 months

- Replace 034B-ET's anemometer bearings and reed switch if operating under harsh conditions, such as constant high winds, blowing dust, and/or salt spray contamination.

1 year

- Replace 034B-ET wind speed (anemometer) bearings (item #3648). Contact your local Toro distributor for service.

- Replace 034B-ET wind speed (anemometer) reed switch (item #13764) if needed. Contact your local Toro distributor for service.

- Check calibration of the HMP60-ET temp/RH probe. Sensor will tend to drift up over time giving readings higher then 100%. Replace RH chip (item# 9598) if necessary (see Figure 4.1-1 and Section 4.1.4.1).

- Replace desiccant in enclosure housing as needed.

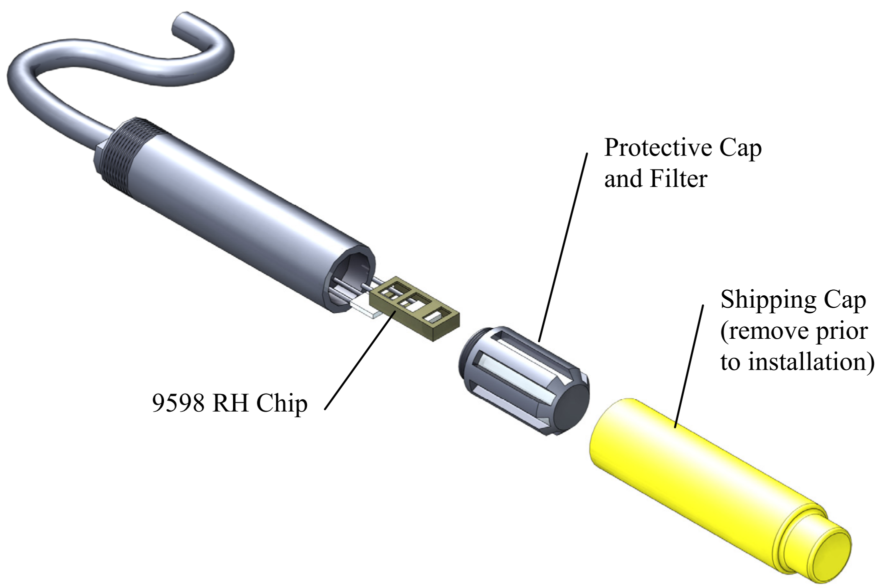


FIGURE 4.1-1. Exploded View of HMP60-ET (as shipped)

2 years

- Replace 034B-ET's vane potentiometer if needed (call for part number and price). Contact your local Toro distributor.

- Replace enclosure gasket if necessary. Contact your local Toro distributor.

3 years

- Send the solar radiation sensor (pyranometer) for calibration. Contact your local Toro distributor. Sensor cannot be calibrated in the field. (Some users recommend calibrating this sensor on a yearly basis.)

4-5 years

- Check sensor cables (as well as all other cables) for cracking, deterioration, proper routing, and strain relief. 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 to 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.

4.1.4.1 Procedure for Removing RH Chip

1. Unscrew the protective cap (see Figure 4.1-1).

2. Hold the plastic sides of the RH chip and unplug it.

CAUTION To prevent scratching, avoid touching the silver chip, and handle the RH chip with care.

3. Rinse off the RH chip with distilled water or dispose of the old RH chip.

4. Hold the sides of the rinsed or new chip and plug it in.

5. Screw on the protective cap.

4.1.5 CR1000M Module

The CR1000M Module contains a lithium battery that operates the clock and SRAM when the module is not powered. The CR1000M does not draw power from the lithium battery while it is powered by a 12 VDC supply. In an T107 stored at room temperature, the lithium battery should last approximately 10 years (less at temperature extremes). Where the T107 is powered most or all of the time, the lithium cell should last much longer.

While powered from an external source, the module measures the voltage of the lithium battery daily. This voltage is displayed in the status table. A new battery will have approximately 3.6 volts. The CR1000 Status Table has a "Lithium Battery" field. This field shows lithium battery voltage.

Replace the battery when voltage is approximately 2.7 V. If the lithium cell is removed or allowed to discharge below the safe level, the T107 will still operate correctly while powered. Without the lithium battery, the clock will reset and data will be lost when power is removed. Contact your local Toro distributor.

CAUTION Toro recommends factory replacement of the lithium battery. Misuse of the lithium battery or installing it improperly can cause severe injury. It is a fire, explosion, and severe burn hazard! Do not recharge, disassemble, heat above 100°C (212°F), solder directly to the cell, incinerate, nor expose contents to water. Lithium batteries need to be disposed of properly.

The lithium battery contained inside of the T107's canister is Campbell Scientific part number 13519. Table 4.1-1 lists the specifications of the battery.

TABLE 4.1-1. CR1000 Lithium Battery Specifications

Manufacturer	Tadiran
Model	TL-59025 (3.6 V)
Capacity	1.2 Ah
Self-discharge rate	1%/year @ 20°C
Operating temperature range	-55°C to 85°C

4.2 Troubleshooting

4.2.1 No Response Using the CR1000KD Keypad

Check keypad response after each of the following steps.

A. Make sure the battery has been installed and the PS100 power switch is set to “ON” (Section 2.8).

B. Use a voltmeter to measure the voltage on the 12 V and G terminals (see Figure 2.8-2); 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 2.8-2); the voltage must be between 4.9 – 5.1 VDC.

C. Disconnect the Temp/RH sensor from the back of the enclosure.

D. 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.

E. Cycle the power to the datalogger by switching the PS100 power supply to “OFF”, then to “ON” or disconnecting and reconnecting the battery plug. Keypad should power up and the Campbell Scientific logo and text appears on the display.

4.2.2 No Response from Datalogger through SC32B, RAD Modem, or Phone Modem

At the datalogger:

A. Make sure the battery has been installed and the power switch set to “ON” (Section 2.8).

B. Use a voltmeter to measure the voltage on the 12V and G terminals (see Figure 2.8-2); 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 2.8-2); the voltage must be between 4.9 – 5.1 VDC.

C. Make sure the datalogger is connected to the communication peripheral, and the communication peripheral properly installed and configured (Section 2.5).

At the computer:

D. Make sure calling software is properly configured (PC200W, VisualWeather, or LoggerNet).

E. Check the cable(s) between the serial port and the modem. If cables have not been purchased through Toro, 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

F. Make sure the communication device at the computer is properly configured and cabled (Section 2.5).

G. Call your local Toro distributor if still no response.

4.2.3 NAN or ±INF Displayed in a Variable

A. Make sure the battery voltage is between 9.6 and 16 VDC.

B. Verify sensors are plugged into the correct sensor connector and the locking ring is securely in place (see Figure 2.4-18). Check connectors for any corrosion on pins.

C. If Short Cut or VisualWeather is used to create the station program double check the wiring diagram to see if it matches the physical wiring on the sensor connectors on the back of the enclosure.

If CRBasic is used to create the station program verify channel assignments and multipliers.

4.2.4 Unreasonable Results Displayed in a Variable

A. Inspect the sensor for damage and/or contamination.

B. Make sure the sensor is plugged into the correct sensor connector on the back of the enclosure.

C. If Short Cut or VisualWeather is used to create the station program double check the wiring diagram to see if it matches the physical wiring on the sensor connectors on the back of the enclosure.

If CRBasic is used to create the station program verify channel assignments and multipliers. Datalogger program may need to be changed.

4.2.5 NAN or ±INF Stored in a Data Table

A. Something is wrong with the datalogger and/or sensor(s) if Short Cut or VisualWeather was used to create the station program. Make sure the sensor is plugged into the correct bulkhead connector.

   If CRBasic is used to create the station program verify channel assignments and multipliers. Datalogger program may need to be changed.

4.2.6 Communication Problems when using an RF450 Radio

LED Status

The RF450 has three red/green LED status indicator lights. Table 4.2-1 shows the status of each light when the RF450 is in various states of communication.

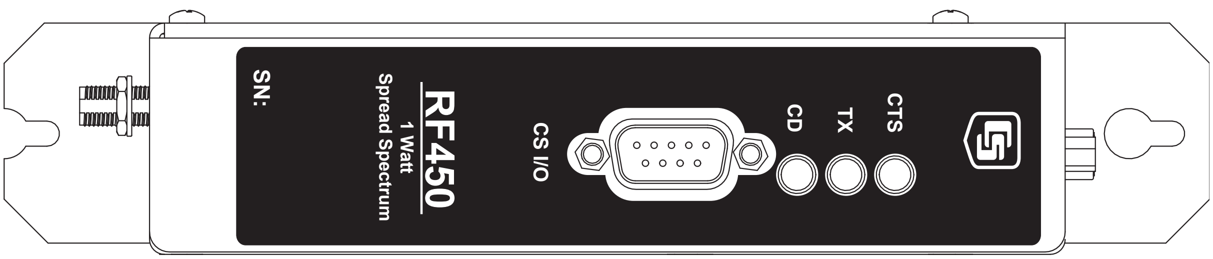


FIGURE 4.2-1. RF450 Front Side View

TABLE 4.2-1. Multi-Point Network LED Status

	Master			Slave			Repeater		
Condition	Carrier Detect (CD)	Transmit (TX)	Clear to Send (CTS)	Carrier Detect (CD)	Transmit (TX)	Clear to Send (CTS)	Carrier Detect (CD)	Transmit (TX)	Clear to Send (CTS)
Powered, not linked	Solid bright red	Solid dim red	Off	Solid bright red	Off	Blinkin g red	Solid bright red	Off	Blinkin g red (a)
Repeater and Slave linked to Master, no data	Solid bright red	Solid dim red	Off	Solid green	Off	Solid bright red (a)	Solid green	Solid dim red	Solid bright red (a)
Repeater and Slave linked to Master, Master sending data to Slave	Solid bright red	Solid dim red	Off	Solid green	Off	Solid bright red (a)	Solid green	Solid dim red	Solid bright red (a)
	Master			**Slave**			**Repeater**		
Repeater and Slave linked to Master, Slave sending data to Master	Solid bright red OR Solid green RCV data	Solid dim red	Intermittent flashing red	Solid green	Intermittent flashing red	Solid bright red (a)	Solid green	Solid bright red	Solid bright red (a)
Master with diagnostics program running	Solid bright red	Solid dim red	Intermittent flashing red	Solid green	Intermittent flashing red	Solid bright red (a)	Solid green	Solid bright red	Solid bright red (a)
(a) Clear to Send will be solid red with a solid link, as the link weakens the CTS on the Repeater and Slave will begin to flash.									

If DevConfig is unable to establish a connection with the RF450:

1. Check that LoggerNet/PC400 is closed.

2. Check power to the radio. The Carrier Detect (CD) light should be flashing red.

3. Check serial cable connections.

4. Check serial port assignment for DevConfig.

5. Press green Setup button on the RF450 and wait several seconds. CD and Clear to Send (CTS) lights should be solid green.

Radios not networked together, not communicating:

1. Check the baud rate of all RF450s; they should be the same.

2. Check Network IDs of all RF450s; they should be the same.

3. Check Frequency Key Number of all RF450s; they should be the same unless two branches of the network are operating in a parallel manner.

4. Check the “Repeaters Used” box for all RF450s.

5. Check the PakBus address of dataloggers connected to RF450s and in LoggerNet.

6. Check that antenna and antenna cables are SMA (SubMiniature version A). They will have a yellow heat shrink label to distinguish them from RPSMA (Reverse Polarity SubMiniature version A) devices. RPSMA antennas and cables are not compatible with the RF450.

LEDs flash when LoggerNet command transmitted but no response from datalogger:

1. Check SC12 cable on the datalogger's CS I/O port.

2. Check SDC address in RF450.

3. Check SDC address in datalogger.

4. Check the baud rate of all RF450s; they should be the same.

5. Check the baud rate of LoggerNet; it should match the baud rate of the RF450s.

Using the diagnostics port.

A special FreeWave Diagnostics cable and software (CSI part number 20625) can be useful in troubleshooting radio problems. Contact FreeWave Inc. for more information on using the Diagnostics cable.

4.2.7 Gill WindSonic1-ET Diagnostic Diagnostic Codes

The WindSonic outputs a diagnostic (Table 4.2-2) along with each wind direction and speed measurement. A datalogger program can be written that filters out all data when the diagnostic is not 0. The programs can also report the number of good samples that were used in computing the on-line statistics. If the total number of good samples is less than 98% of the expected samples, the WindSonic may be in need of repair.

TABLE 4.2-2. Gill WindSonic Diagnostic Codes

Diagnostic	Status	Comment
0	Okay	All okay
1	Axis 1 Failed	Insufficient samples, possible path obstruction
2	Axis 2 Failed	Insufficient samples, possible path obstruction
4	Both Axis Failed	Insufficient samples, possible path obstruction
8	NVM error	Nonvolatile Memory checksum failed
9	ROM error	Read Only Memory checksum failed
10	Maximum Gain	Questionable wind measurements

4.3 Schematics of Connectors

Knowledge of schematics is not necessary for routine installation and maintenance. Each connector has a small molded dot by pin 1. All of the schematics show the pinned connectors on the cables. Socketed connectors on the back of the enclosure are the mirror images of what's shown.

4.3.1 Sensor Schematics

Schematics of T107 sensors and associated connectors are provided in Figures 4.3-1 through 4.3-7 for help in troubleshooting.

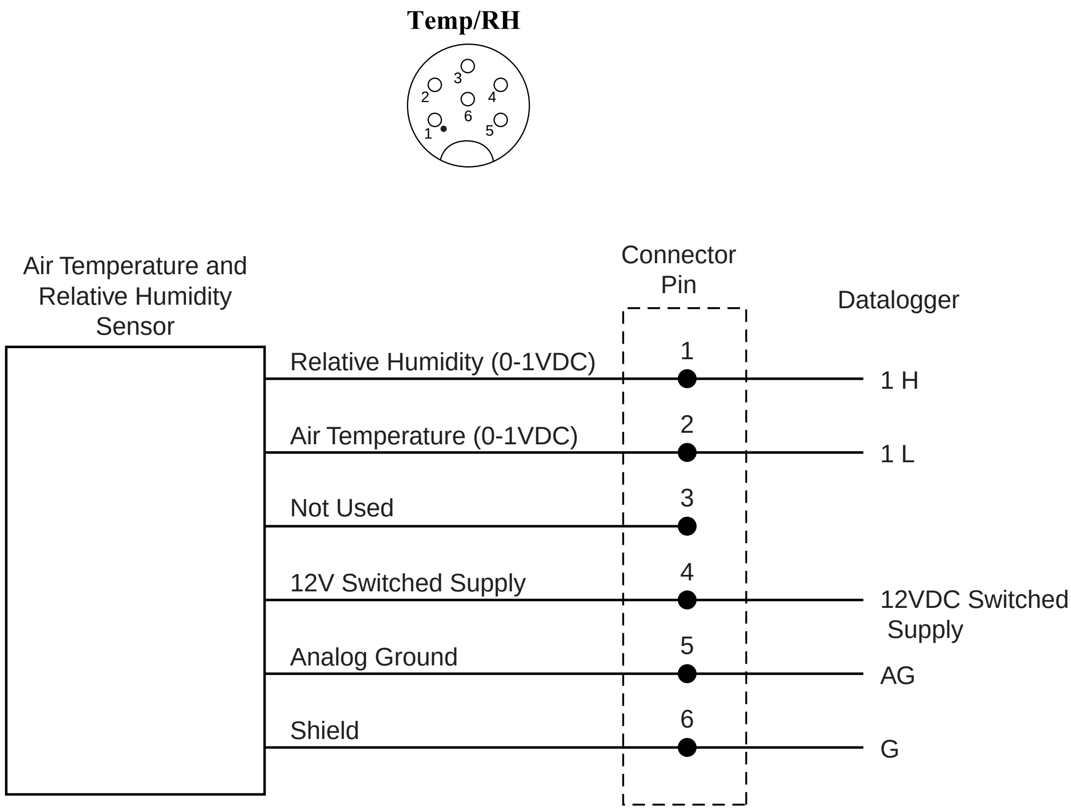


FIGURE 4.3-1. Schematic of HMP60-ET RH and Temperature Probe and Connector Temp/RH

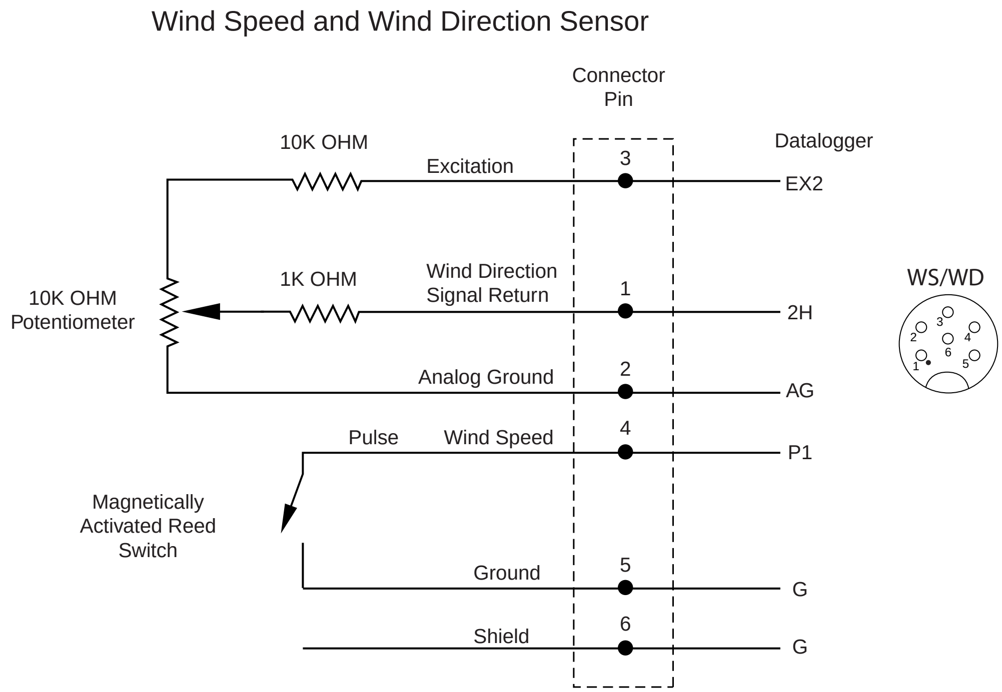


FIGURE 4.3-2. Schematic of 034B-LC Wind Speed and Direction Probe and Connector WS/WD

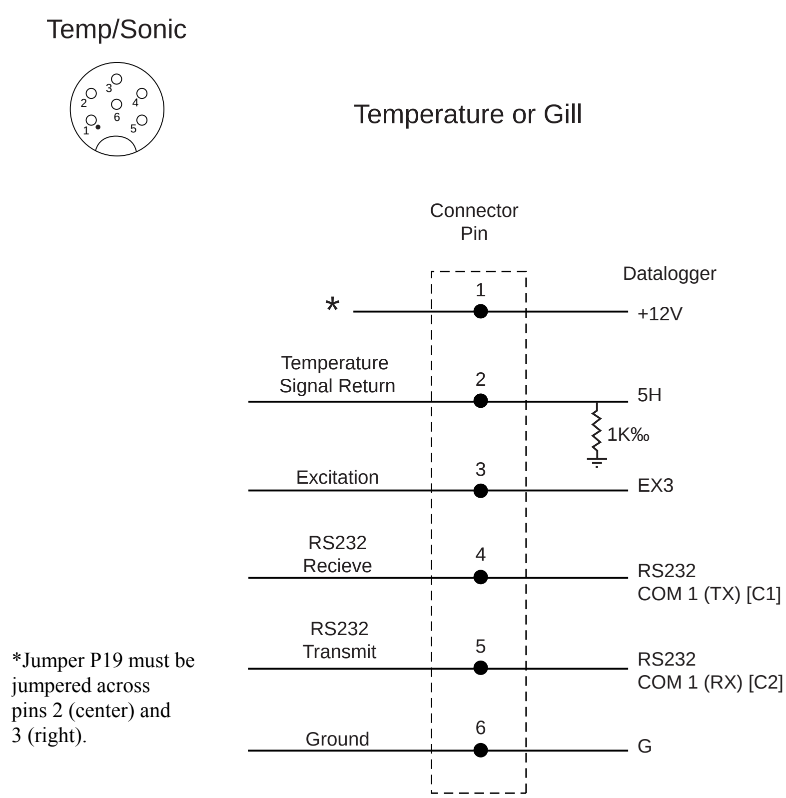


FIGURE 4.3-3. Schematic of Gill WindSonic1-ET Wind Sensor, Soil Temperature Sensor (107-LC or 108-LC), and Connector Temp/Sonic

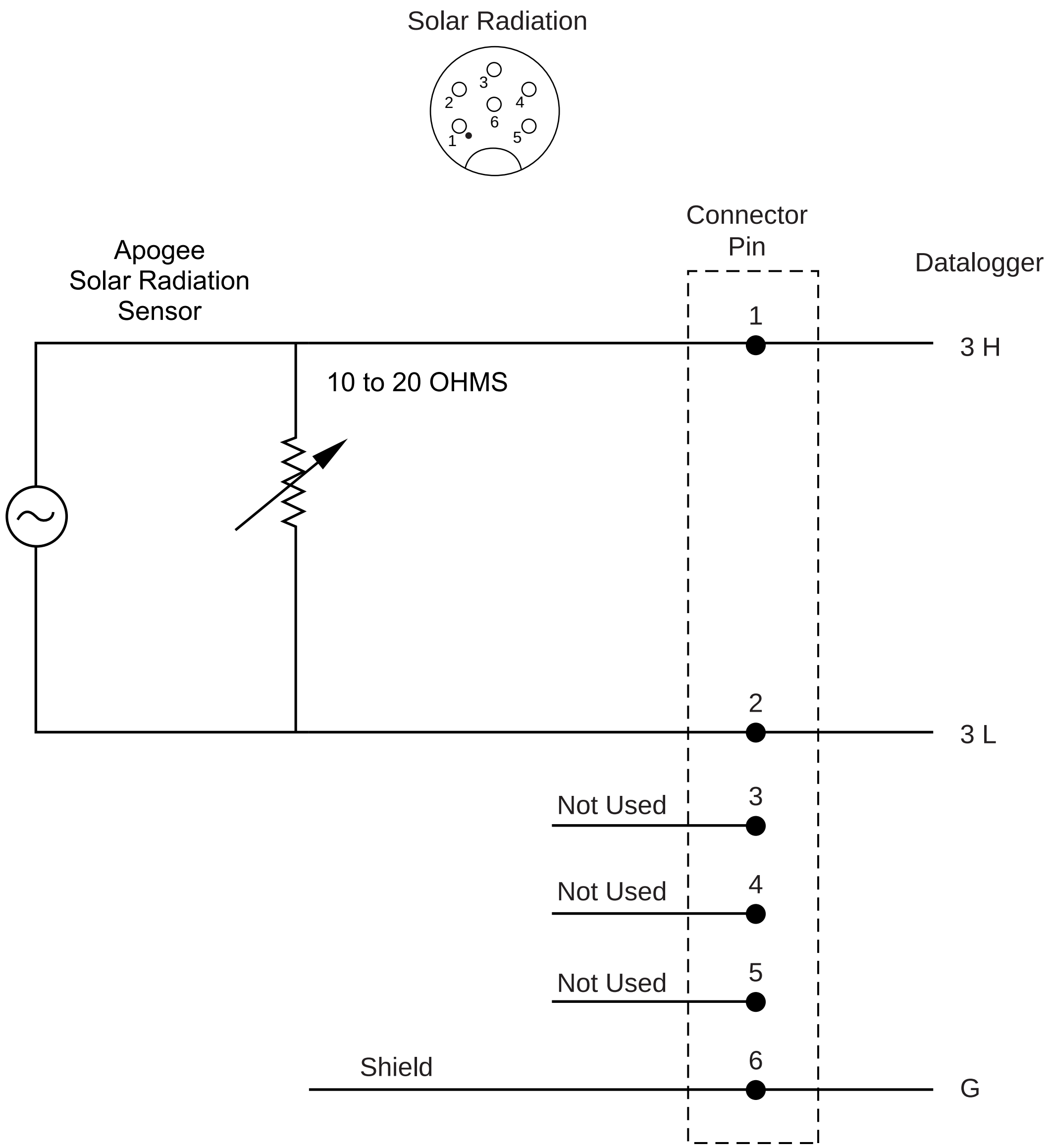


FIGURE 4.3-4. Schematic of CS305-ET Solar Radiation Sensor and Connector Solar Radiation

NOTE The T106 used a Licor LI200X-ET Solar Radiation Sensor with OHM readings of 450 to 650.

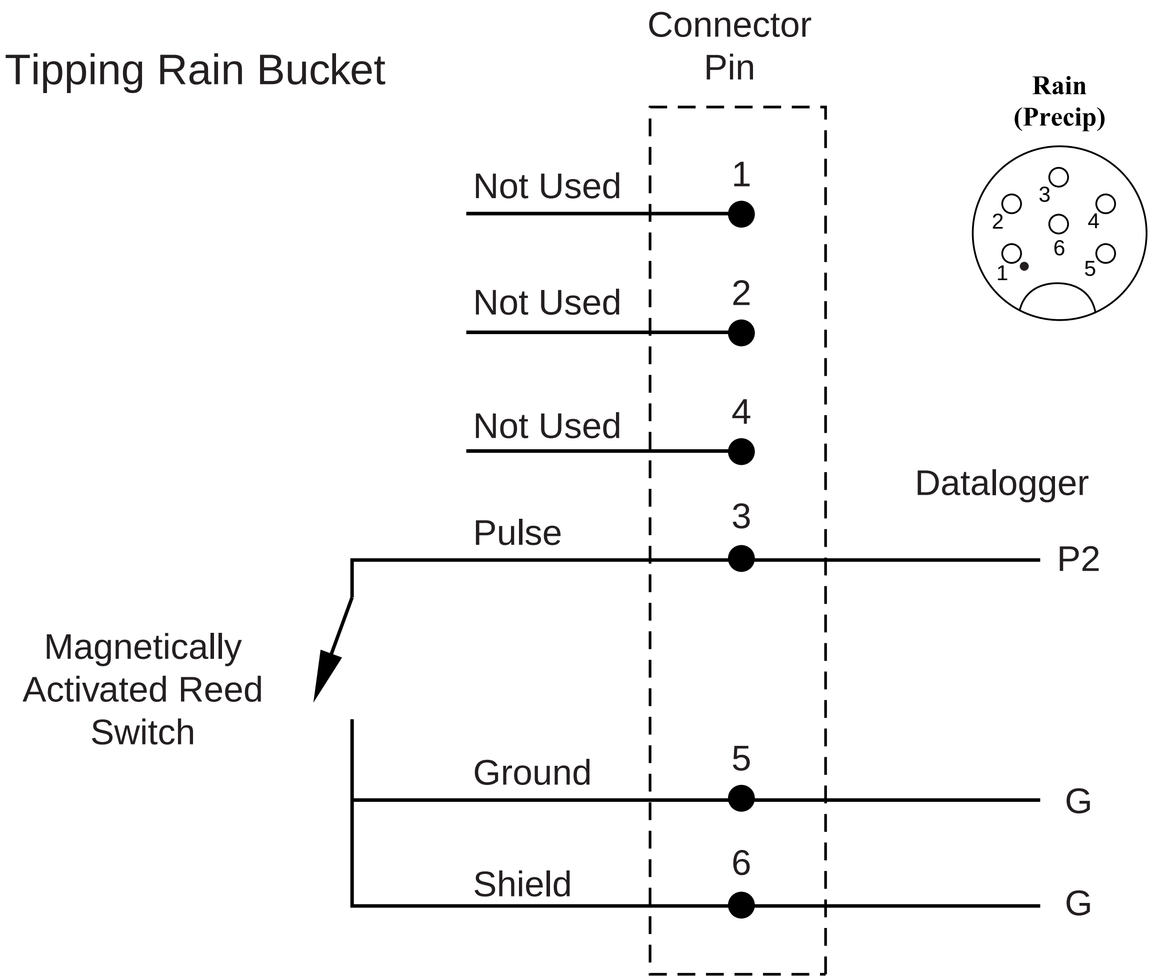


FIGURE 4.3-5. Schematic of TE525-ET Rain Sensor and Connector Rain (Precip)

Temperature or Soil Volumetric Water Content

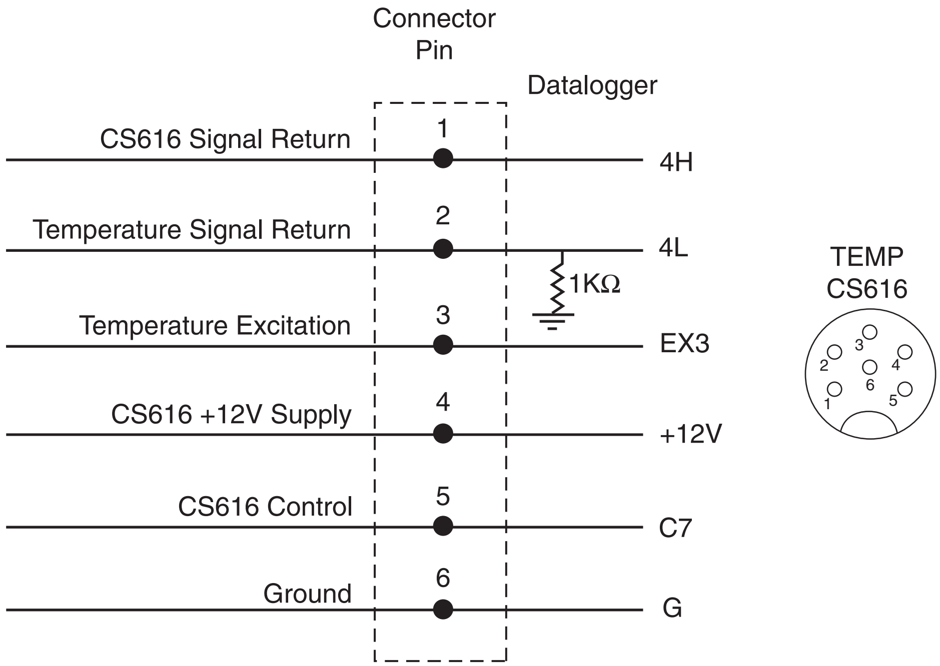


FIGURE 4.3-6. Schematic of 107-LC or 108-LC Temperature Probe or CS616-LC Soil Volumetric Water Content Sensor and Connector Temp/CS616

SDI-12 or Temperature

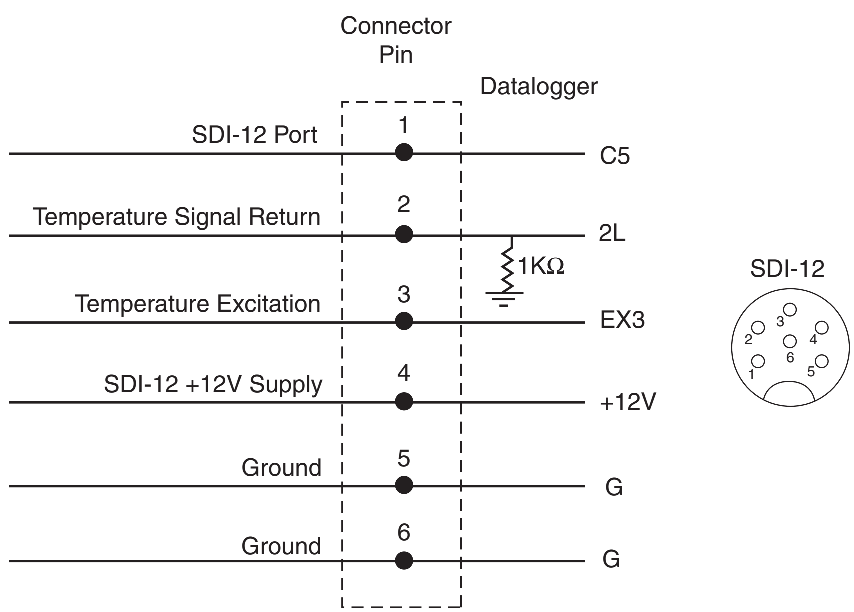
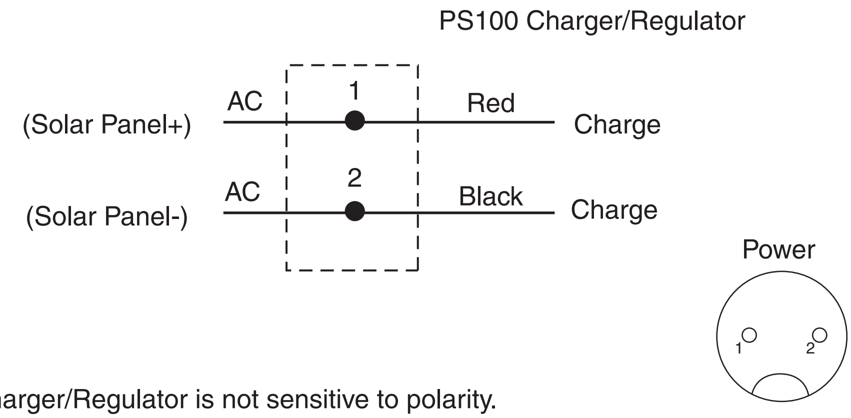


FIGURE 4.3-7. Schematic of Connector SDI-12

4.3.2 Power Schematics

16-19 VAC or 16-24 VDC Solar Panel Power

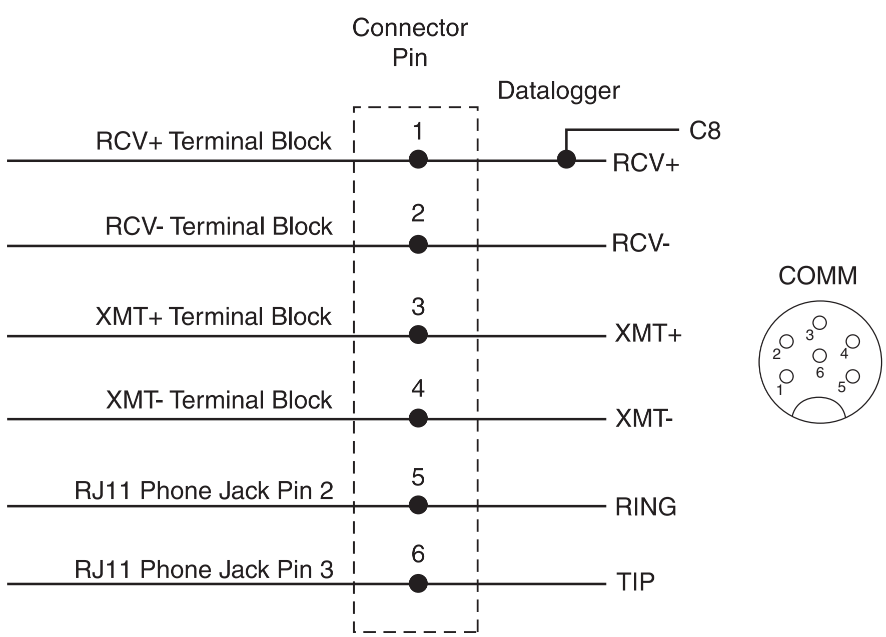


Note: PS100 Charger/Regulator is not sensitive to polarity.

FIGURE 4.3-8. Schematic of Solar Panel and Connector Power

4.3.3 Communication Modems Schematics

Short-Haul or Phone Modem



All Connections are surge protected using spark gaps

FIGURE 4.3-9. Schematic of Short Haul or Phone Modem and Connector COMM

Appendix A. T107 Maintenance Log

Station Installation Date: ___________________

CLEAN/INSPECT RAIN GAGE SENSOR (Recommended - Weekly)	
Date	**OK/Comments**

CLEAN/INSPECT RAIN GAGE SENSOR (Recommended - Weekly)	
Date	**OK/Comments**

CLEAN/INSPECT SOLAR RADIATION SENSOR (Recommended - Monthly)	
Date	**OK/Comments**

CLEAN/INSPECT TEMP/% RH SENSOR & GILL RADIATION SHIELD (Recommended - Quarterly)	
Date	**OK/Comments**

REPLACE WIND SPEED BEARINGS AND REED SWITCH (Recommended - Yearly)	
Date	**OK/Comments**

REPLACE RH CHIP (P/N 9598) IN THE HMP60-ET TEMP/% RH SENSOR (Recommended - Yearly)	
Date	**OK/Comments**

REPLACE DESICCANT BAGS (QTY - 2 OF P/N 4905) INSIDE ENCLOSURE (Recommended - Yearly)	
Date	**OK/Comments**

CALIBRATE SOLAR RADIATION SENSOR (CS305-ET) (Recommended - Every 3 Years)	
Date	**OK/Comments**

Appendix B. PS24 24 Ahr Power Supply and 10 x 12 inch Enclosure

The PS24 Power Supply is typically used when the T107 transmits data via RF450 Spread Spectrum Radios. However, the PS24 can be used for any situation where a larger capacity battery is desirable.

B.1 PS24 Components

The PS24 consists of a 24 Ahr rechargeable battery, CH100 regulator, and a 10” x 12” environmental enclosure (see Figures B.1-1 through B.1-3). The battery should be recharged via ac power or solar power. An SP10 10-W solar panel, SP20 20-W solar panel, or 14014 Wall Charger is typically used to recharge the battery. The environmental enclosure is mounted to the T107’s pole using the #18520 hanger kit.

FIGURE B.1-1. Environmental Enclosure with CH100, Power Cable, and Battery Bracket

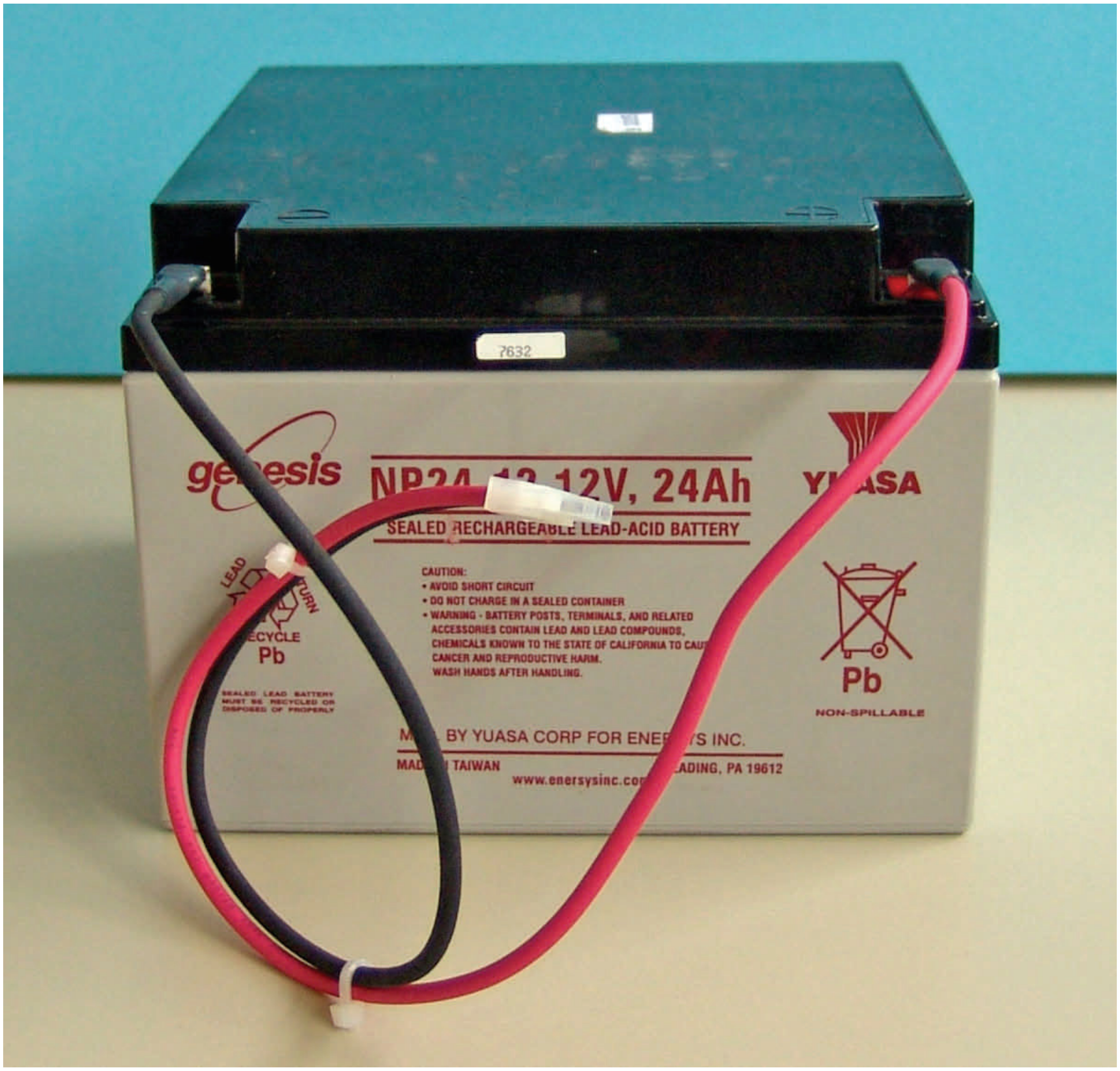


FIGURE B.1-2. 24 Ahr Battery and Battery Cable

FIGURE B.1-3. Enclosure Supply Kit

B.2 Installation

CAUTION The PS24 is purposely shipped without the battery mounted in its bracket. Do not install the battery until instructed to do so.

1. Place the top enclosure bracket on the pole at approximately 40 inches above the bottom of the pole. The bracket should be installed with the hook side up, and facing north.

2. Slide the strut clamps into the bracket as shown in Figure B.2-1. Tighten the clamp so that it doesn't move.

CAUTION Do not over tighten the clamp!

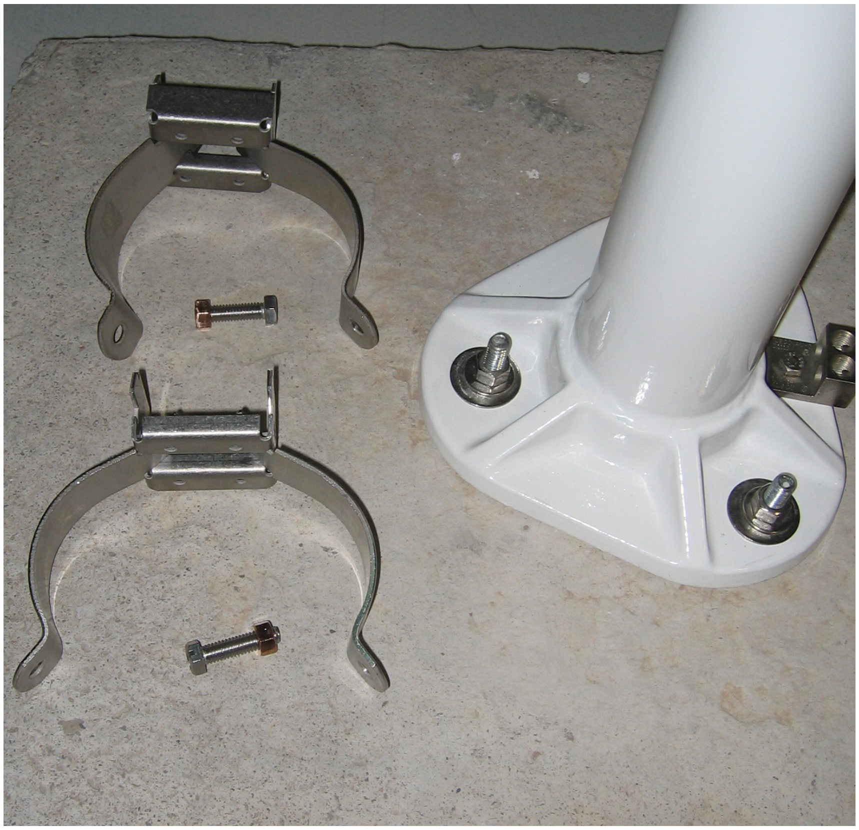


FIGURE B.2-1. Strut Clamps in Brackets

3. Place the bottom strut clamp and bracket approximately 12 inches below the top clamp. This clamp is installed with the hook side down. The bracket might have to be moved a little to accept the enclosure bracketing, so don't tighten the bracket yet. Figure B.2-2 shows the top and bottom brackets correctly positioned on the T107 pole.

FIGURE B.2-2. Both Strut Clamps and Brackets on T107 Pole

4. Hook the enclosure on the top bracket as shown in Figure B.2-3.

FIGURE B.2-3. Top Clamp Hook Side Up

5. The bottom enclosure bracket should slide between the top lip of the bottom strut mount bracket and the notch directly below. Move the bottom bracket if necessary, then bolt the bottom bracket down (see Figure B.2-4).

CAUTION Do NOT over tighten the bottom bracket.

FIGURE B.2-4. Enclosure Mounted on T107 Pole

6. The bottom enclosure bracket has a small metal locking mechanism. Push up on the small Phillips screw underneath the mechanism and slide it to the left. Once in place, put a small wire tie in the hole to the right of the locking mechanism (see Figure B.2-5).

NOTE To remove the enclosure from the bracketing, cut off the wire tie, slide the lock to the right, and lift the entire enclosure off the bracketing.

FIGURE B.2-5. Enclosure Locking Mechanism

7. Install the solar panel above the 10 x 12 enclosure, and face the solar panel south. See Figure B.2-6 for fully mounted solar.

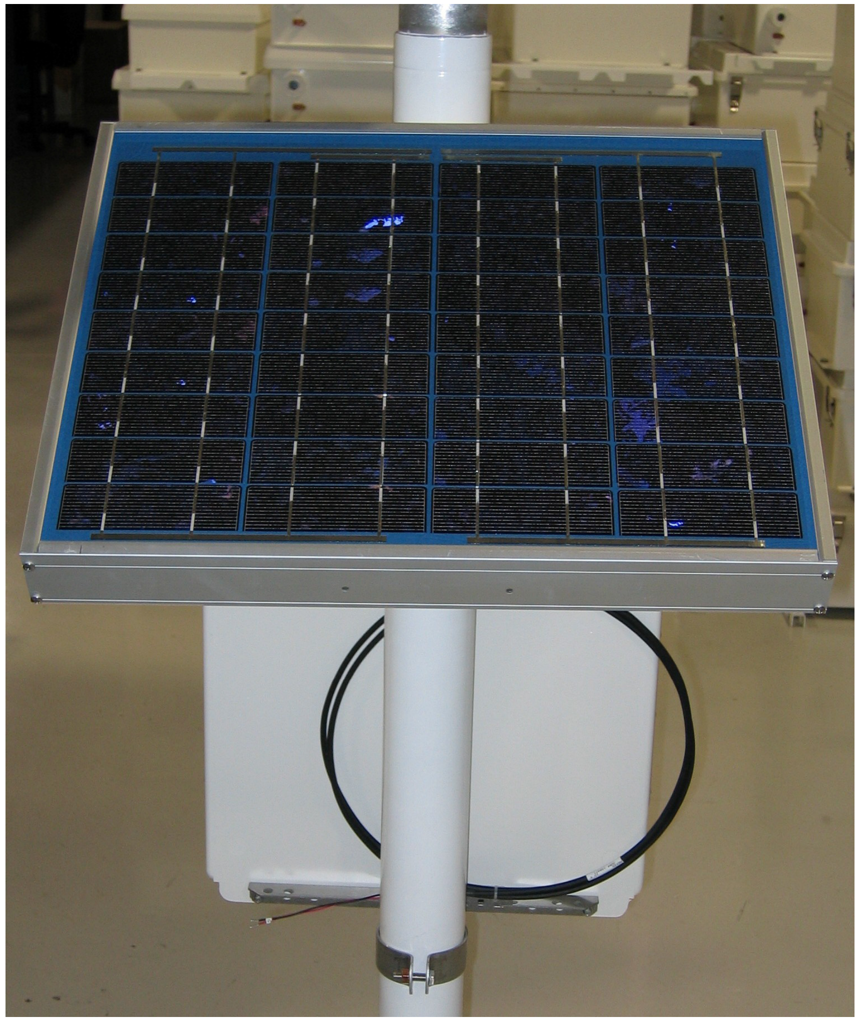


FIGURE B.2-6. Mounted Solar Panel

8. Throw a blanket or box over the solar panel to prevent any voltage output.

9. Route the solar panel cable and power cable coming from the main T107 enclosure into the conduit at the bottom of the 10 x 12 enclosure.

IMPORTANT Leave a loop of all cables under the 10 x 12 enclosure to act as a drip line. Cut both cables to whatever length you need. It doesn't hurt to leave a loop of cable inside the enclosure.

10. Wire the solar panel to the CH100 terminal blocks as follows.

    Solar Panel to CH100
    Red: CHG
    Black: CHG

NOTE Polarity makes no difference. Connect one wire per CHG terminal block.

---

11. Remove the blanket or box from the solar panel once it's wired in place.

12. Wire the power cable coming from the T107 station as follows.

    Power Cable from T107 to CH100
    Red: +12
    Black: ⏚

NOTE The red charging LED indicates that the solar panel is charging the battery. The battery will be charged regardless of the switch position. The switch controls the voltage going to the terminal blocks marked "+12.

---

13. Follow the Installation of Battery procedure provided in Figure B.2-7. Plug the battery into the connector on the CH100 marked “INT”.

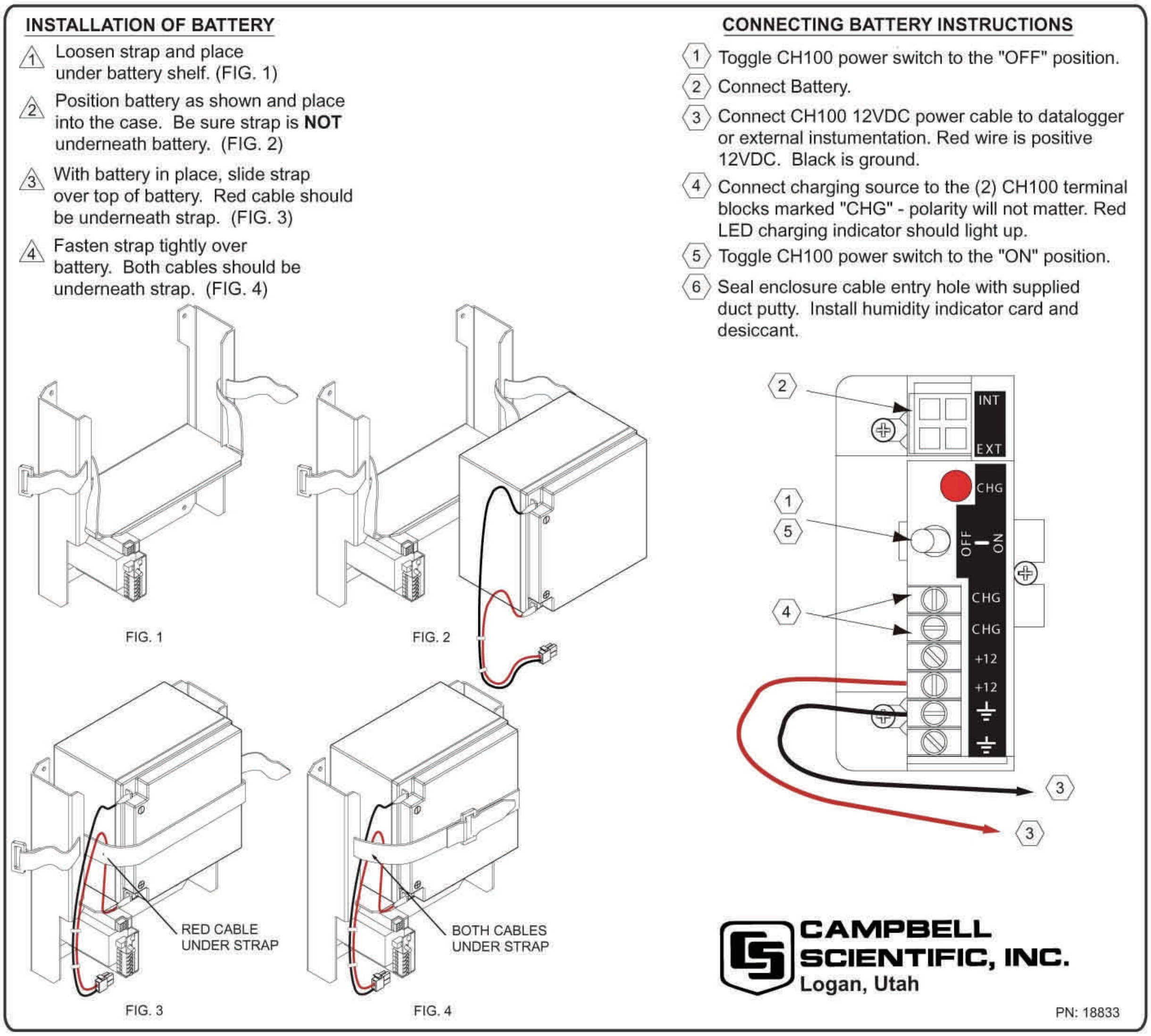


FIGURE B.2-7. Procedure for installing and connecting battery

14. An extra loop of ground wire was sent with the station. Use it to ground the enclosure to the grounding rod system. The external ground lug is mounted on the bottom left hand corner of the 10 x 12 enclosure.

15. Flip the switch to “ON”, and test drive the station.

16. After everything checks out, find the gray duct putty that was included in the enclosure supply kit. Seal the cable-entry conduit by placing putty on the inside and outside of it. Push the putty down into the cable entries.

CAUTION The enclosure needs to be sealed up tight so don't be stingy with the putty.

17. Put both bags of desiccant inside of the enclosure.

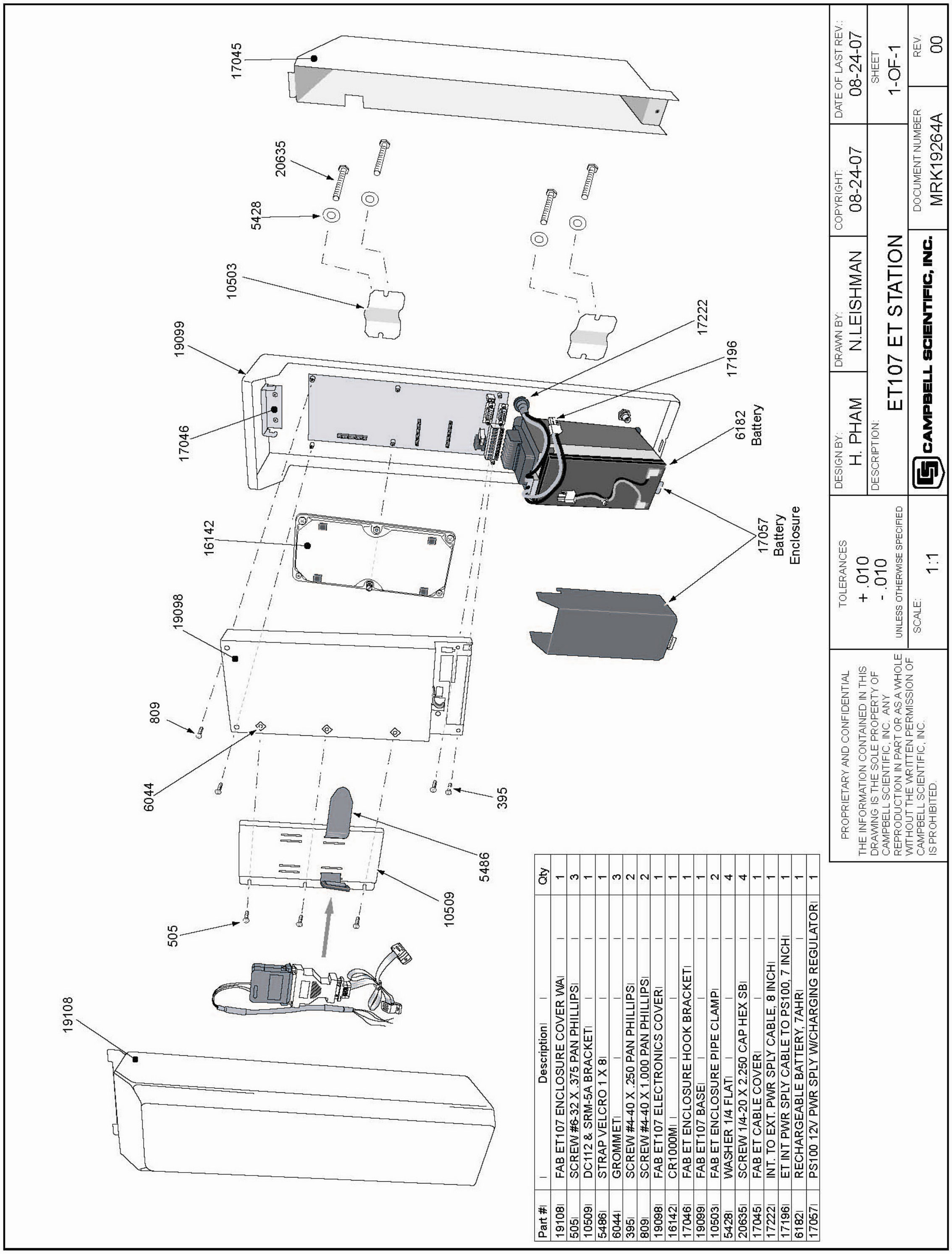
18. Stick the humidity indicator card on a wall inside of the enclosure.

CAUTION Pink on the humidity indicator card means it's time to change the desiccant. Change the desiccant at least every year. However, it's often wise to change the desiccant every six months.

19. Close the enclosure lid.

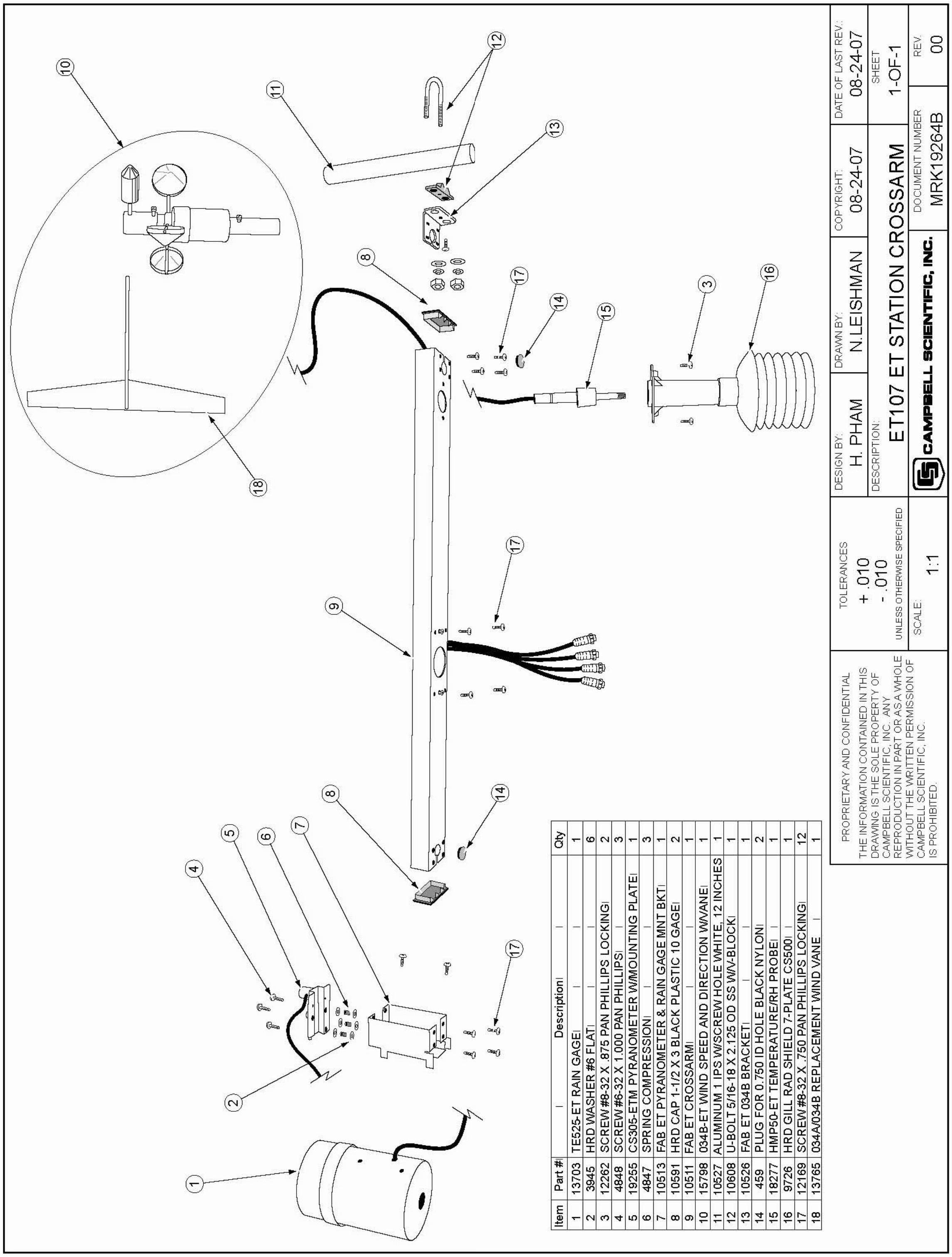
Appendix C. Exploded Views

C.1 Enclosure



Part #	Description	Qty
19108	FAB ET107 ENCLOSURE COVER WA	1
505	SCREW #6-32 X .375 PAN PHILLIPS	3
10509	DC112 & SRM-5A BRACKET	1
5486	STRAP VELCRO 1 X 8	1
6044	GROMMET	3
395	SCREW #4-40 X .250 PAN PHILLIPS	2
809	SCREW #4-40 X 1.000 PAN PHILLIPS	2
19098	FAB ET107 ELECTRONICS COVER	1
16142	CR1000M	1
17046	FAB ET ENCLOSURE HOOK BRACKET	1
19099	FAB ET107 BASE	1
10503	FAB ET ENCLOSURE PIPE CLAMP	2
5428	WASHER 1/4 FLAT	4
20635	SCREW 1/4-20 X 2.250 CAP HEX SB	4
17045	FAB ET CABLE COVER	1
17222	INT. TO EXT. PWR SPLY CABLE, 8 INCH	1
17196	ET INT PWR SPLY CABLE TO PS100, 7 INCH	1
6182	RECHARGEABLE BATTERY, 7AHR	1
17057	PS100 12V PWR SPLY W/CHARGING REGULATOR	1

C.2 Crossarm



Item	Part #	Description	Qty
1	13703	TE525-ET RAIN GAGE	1
2	3945	HRD WASHER #6 FLAT	6
3	12262	SCREW #8-32 X .875 PAN PHILLIPS LOCKING	2
4	4848	SCREW #6-32 X 1.000 PAN PHILLIPS	3
5	19255	CS305-ETM PYRANOMETER W/MOUNTING PLATE	1
6	4847	SPRING COMPRESSION	3
7	10513	FAB ET PYRANOMETER & RAIN GAGE MNT BKT	1
8	10591	HRD CAP 1-1/2 X 3 BLACK PLASTIC 10 GAGE	2
9	10511	FAB ET CROSSARM	1
10	15798	034B-ET WIND SPEED AND DIRECTION W/VANE	1
11	10527	ALUMINUM 1 IPS W/SCREW HOLE WHITE, 12 INCHES	1
12	10608	U-BOLT 5/16-18 X 2.125 OD SS W/V-BLOCK	1
13	10526	FAB ET 034B BRACKET	1
14	459	PLUG FOR 0.750 ID HOLE BLACK NYLON	2
15	18277	HMP50-ET TEMPERATURE/RH PROBE	1
16	9726	HRD GILL RAD SHIELD 7-PLATE CS500	1
17	12169	SCREW #8-32 X .750 PAN PHILLIPS LOCKING	12
18	13765	034A/034B REPLACEMENT WIND VANE	1

Appendix D. Default Programs

D.1 Program for T107 with 034B

```
'Program name: C:\TORO\T107_034B.CR1
'Programmer: Bart Nef - CSI
'Date: 4.Nov.2010
'Ver: C
'Notes: Toro T107_034B program to work with both the Toro software and Eicon.
'Changes from A (22.Jan.2007) to B: Corrected multiplier to convert wind speed in m/s to mph.
'Changes from B (25.Jan.2008) to C: Put in changes to handle an HMP60-ET

StationName (T107_034B_VC)

Public SaveSite           'Setting value to 1 moves site information to non-volatile memory.
Public Latitude           'Latitude in decimal degrees. Must be negative for southern latitudes.
Public Longitude          'Longitude in decimal degrees. Longitude runs 0 - 360 degrees from west to east.
Public Altitude_m         'Altitude of site in meters.
Public BPoffset_KPa       'Offset for barometric pressure. Not used with T107.

'Datalogger status and binary control flags.
Public WatchDog                'Number of watchdog errors. Should always be zero.
Public Overruns                'Number of table overrun errors. Should always be zero.
Public LowVolts                'Number of low voltage errors. Should always be zero.
Public FirstPass As Boolean    'Checks to see if this is the first time program has been run.

'Measured inputs
Public Meas(18)
Alias Meas(1) = BattVolt       'Meas(1) = Battery Voltage - VDC
Alias Meas(2) = SlrRad_W       'Meas(2) = Solar Radiation - Watts/meter^2
Alias Meas(3) = AirTempC       'Meas(3) = Air Temperature - Celsius
Alias Meas(4) = RelHum         'Meas(4) = Relative Humidity - %
Alias Meas(5) = Baro_Kpa       'Meas(5) = Barometric Pressure - Kilopascals. Not used in T107.
Alias Meas(6) = WindSpd_ms     'Meas(6) = Wind Speed - meters/second
Alias Meas(7) = WindDir        'Meas(7) = Wind Direction - degrees
Alias Meas(8) = Rain_mm        'Meas(8) = Past 10-Second Rain Fall - millimeters
Alias Meas(9) = Rain_Hr        'Meas(9) = Rain fall for this hour. Resets at the top of the hour.
Alias Meas(10) = RainRun       'Meas(10) = Rain Fall Since Midnight 'till Now - millimeters
Alias Meas(11) = Rain24        'Meas(11) = Yesterdays Midnight to Midnight Rain Fall - millimeters
Alias Meas(12) = ETos_mm       'Meas(12) = Hour ETo Value - millimeters
Alias Meas(13) = ETos_Run      'Meas(13) = ETo Since Midnight - millimeters
Alias Meas(14) = ETos24        'Meas(14) = Yesterdays Midnight to Midnight ETo - millimeters
Alias Meas(15) = MaxAirC       'Meas(15) = High Air Temp Since Midnight - Celsius
Alias Meas(16) = MinAirC       'Meas(16) = Low Air Temp Since Midnight - Celsius
Alias Meas(17) = Max24Air      'Meas(17) = Yesterdays Midnight to Midnight High Air Temp - Celsius
Alias Meas(18) = Min24Air      'Meas(18) = Yesterdays Midnight to Midnight Low Air Temp - Celsius
Public LogrTmpC                'CR1000 Temperature - Celsius
Public Encl_RH                 'Enclosure Humidity - %
Public LiBattV                 'Lithium Battery Voltage - VDC
```

```
'Unit conversions.
Public AirTempF               'Air Temperature - Fahrenheit
Public WindSpd_mph            'Wind Speed - miles/hour
Public TotalWSmph             'Totalized Wind Speed - miles/hour
Public SlrRad_KW              'Solar radiation - Kilowatts/meter^2
Public SlrRad_MJ              'Solar radiation - Megajoules/meter^2
Public Rain_inch              'Rain - inches
Dim Scratch                   'Scratch pad variable for calculations.

'Define Data Tables
DataTable (SiteVal,True,5)
    Sample (1,Altitude_m,IEEE4)
    Sample (1,Latitude,IEEE4)
    Sample (1,Longitude,IEEE4)
EndTable

DataTable (ToroHourly,1,-1)
    DataInterval (0,60,Min,5)
    Average (1,SlrRad_KW,FP2,False)
    Average (1,AirTempC,FP2,False)
    Average (1,RelHum,FP2,False)
    Sample (1,TotalWSmph,FP2)
    Totalize (1,Rain_inch,FP2,False)
    Maximum (1,SlrRad_KW,FP2,False,False)
    Maximum (1,AirTempC,FP2,False,False)
    Maximum (1,RelHum,FP2,False,False)
    Maximum (1,WindSpd_mph,FP2,False,False)
    Minimum (1,SlrRad_KW,FP2,False,False)
    Minimum (1,AirTempC,FP2,False,False)
    Minimum (1,RelHum,FP2,False,False)
    Minimum (1,WindSpd_mph,FP2,False,False)
    WindVector (1,WindSpd_mph,WindDir,FP2,False,0,0,1)
    FieldNames ("AvgWSmph,AvgWindDir")
    ETsz (AirTempC,RelHum,WindSpd_ms,SlrRad_MJ,Longitude,Latitude,Altitude_m,3,0,FP2,False)
    FieldNames ("ETos_mm,Rso_MJ")
EndTable

DataTable (ToroStatus,1,-1)
    DataInterval (0,1440,Min,5)
    Maximum (1,BattVolt,FP2,False,False)
    Minimum (1,BattVolt,FP2,False,False)
    Maximum (1,LogrTmpC,FP2,False,False)
    Minimum (1,LogrTmpC,FP2,False,False)
    Maximum (1,Encl_RH,FP2,False,False)
    Minimum (1,Encl_RH,FP2,False,False)
    Sample (1,WatchDog,FP2)
    Sample (1,Overruns,FP2)
    Sample (1,LowVolts,FP2)
EndTable
```

```
'Main Program
BeginProg
    'Initialize Values (unitialized values are zero)
    Latitude=0.00001
    Longitude=latitude
    Altitude_m=latitude
    FirstPass = False
    Baro_Kpa = 0

    Scan(5,Sec, 3, 0)
        PortSet(9,1)
        'Battery voltage
        Battery (BattVolt)
        'Micrologger temperature
        PanelTemp (LogrTmpC,250)

        'Save Site Values
        If SaveSite = 1 then
            CallTable SiteVal
            SaveSite=0
        Endif

        'Query Site Values from data table and use if needed.
        If Latitude = 0.00001 and SiteVal.Latitude(1,1)<> NAN then
            Latitude=SiteVal.Latitude(1,1)
            Longitude=SiteVal.Longitude(1,1)
            Altitude_m=SiteVal.Altitude_m(1,1)
        Endif

        'Enclosure humidity
        VoltSE(Encl_RH, 1, mV2500, 10, False, 0, _60Hz, 0.1, 0)
        If Encl_RH > 100 Then Encl_RH = 100

        'CONNECTOR WS/WD
        '034B-ET wind speed/direction sensor
        PulseCount(WindSpd_ms, 1, 1, 2, 1, 0.799, 0.2811)
        If (WindSpd_ms < 0.29) Then WindSpd_ms = 0.001
        WindSpd_mph = WindSpd_ms / 0.44707

        BrHalf(WindDir, 1, mV2500, 3, VX2, 1, 2500,True, 0,_60Hz, 720, 0)
        If (WindDir >= 360 OR WindDir < 0) Then WindDir = 0
        If WindDir = NAN Then WindDir = -6999
        TotalWSmph = TotalWSmph + WindSpd_mph*0.0833

        'CONNECTOR TEMP/RH
        'HMP60-ET or HMP45C-ET temperature/humidity sensor
        VoltSe(AirTempC, 1, mV2500, 2, False, 0, _60Hz, 0.1, -40)
        If (AirTempC = NAN) Then AirTempC = -6999
        VoltSe(RelHum, 1, mV2500, 1, False, 0, _60Hz, 0.1, 0)
        If (RelHum = NAN) Then RelHum = -6999
        If (RelHum >= 100) AND (RelHum < 108) Then RelHum = 100
        PortSet(9, 0)
        AirTempF = AirTempC * 1.8 + 32
```

```
If FirstPass = False Then
    MaxAirC = AirTempC
    MinAirC = AirTempC
    FirstPass = True
Else
    If (AirTempC > MaxAirC) Then MaxAirC = AirTempC
    If (AirTempC < MinAirC) Then MinAirC = AirTempC
Endif

'CONNECTOR SOLAR RADIATION
'CS305-ET or LI200X-ET Pyranometer
VoltDiff(SlrRad_W, 1, mV7_5, 3, true, 0, _60Hz, 200, 0)
If (SlrRad_W < 0) Then SlrRad_W = 0
If (SlrRad_W = NAN) Then
    SlrRad_W = -6999
    SlrRad_KW = -6999
    SlrRad_MJ = -6999
Else
    SlrRad_KW = SlrRad_W*0.001
    SlrRad_MJ = SlrRad_W*0.000005
Endif

'CONNECTOR RAIN (PRECIP)
'TE525-ET, TE525WS-LC, CS700-LC, or TB4-LC tipping rain bucket
PulseCount(Rain_mm, 1, 2, 2, 0, 0.254, 0)
Rain_inch = Rain_mm * 0.03937
Rain_Hr = Rain_mm + Rain_Hr
RainRun = RainRun + Rain_mm

CallTable ToroHourly
If (ToroHourly.Output(1,1)) Then
    ETos_mm = ToroHourly.ETos_mm(1,1)
    ETos_Run = ETos_Run + ETos_mm
    Rain_Hr = 0
    TotalWSmph = 0
Endif

CallTable ToroStatus
If (ToroStatus.Output(1,1)) Then
    Rain24 = RainRun
    RainRun = 0
    ETos24 = ETos_Run
    ETos_Run = 0
    Max24Air = MaxAirC
    Min24Air = MinAirC
    MaxAirC = AirTempC
    MinAirC = AirTempC
    'Watchdog counts
    WatchDog = Status.WatchdogErrors(1,1)
    'Skipped scan counts
    Overruns = Status.SkippedScan(1,1)
    'Low voltage counts
    LowVolts = Status.Low12VCount(1,1)
    'Lithium battery voltage
    LiBattV = Status.LithiumBattery(1,1)
```

```
            Endif

      NextScan
EndProg
```

D.2 Program for T107 with Gill WindSonic

```
'Program name: C:\TORO\T107_GILL.CR1
'Programmer: Bart Nef - CSI
'Date: 7.April.2011
'Ver: D
'Notes: Toro T107_GILL program To work with both the Toro software AND Eicon.
'Changes from version A to B: Corrected the method used to read the Gill wind sonic.
'Customer must have version 13 OS in their CR1000 to use this program!
'Changes from version B to C: Updated the method used to read the Gill wind sonic.
'Customer must have version 14 OS in their CR1000 to use this program!
'Changes from C to D: Put in changes to handle a HMP60-ET.

StationName (T107_GILL_VD)

Public SaveSite            'Setting value to 1 moves site information to non-volatile memory.
Public Latitude            'Latitude in decimal degrees. Must be negative for southern latitudes.
Public Longitude           'Longitude in decimal degrees. Longitude runs 0 - 360 degrees from west to east.
Public Altitude_m          'Altitude of site in meters.
Public BPoffset_KPa        'Offset for barometric pressure. Not used with T107.

'Datalogger status and binary control flags.
Public WatchDog                 'Number of watchdog errors. Should always be zero.
Public Overruns                 'Number of table overrun errors. Should always be zero.
Public LowVolts                 'Number of low voltage errors. Should always be zero.
Public FirstPass As Boolean     'Checks to see if this is the first time program has been run.

'Measured inputs
Public Meas(18)
Alias Meas(1) = BattVolt        'Meas(1) = Battery Voltage - VDC
Alias Meas(2) = SlrRad_W        'Meas(2) = Solar Radiation - Watts/meter^2
Alias Meas(3) = AirTempC        'Meas(3) = Air Temperature - Celsius
Alias Meas(4) = RelHum          'Meas(4) = Relative Humidity - %
Alias Meas(5) = Baro_Kpa        'Meas(5) = Barometric Pressure - Kilopascals. Not used in T107.
Alias Meas(6) = WindSpd_ms      'Meas(6) = Wind Speed - meters/second
Alias Meas(7) = WindDir         'Meas(7) = Wind Direction - degrees
Alias Meas(8) = Rain_mm         'Meas(8) = Past 10-Second Rain Fall - millimeters
Alias Meas(9) = Rain_Hr         'Meas(9) = Rain fall for this hour. Resets at the top of the hour.
Alias Meas(10) = RainRun        'Meas(10) = Rain Fall Since Midnight 'till Now - millimeters
Alias Meas(11) = Rain24         'Meas(11) = Yesterdays Midnight to Midnight Rain Fall - millimeters
Alias Meas(12) = ETos_mm        'Meas(12) = Hour ETo Value - millimeters
Alias Meas(13) = ETos_Run       'Meas(13) = ETo Since Midnight - millimeters
Alias Meas(14) = ETos24         'Meas(14) = Yesterdays Midnight to Midnight ETo - millimeters
Alias Meas(15) = MaxAirC        'Meas(15) = High Air Temp Since Midnight - Celsius
Alias Meas(16) = MinAirC        'Meas(16) = Low Air Temp Since Midnight - Celsius
Alias Meas(17) = Max24Air       'Meas(17) = Yesterdays Midnight to Midnight High Air Temp - Celsius
Alias Meas(18) = Min24Air       'Meas(18) = Yesterdays Midnight to Midnight Low Air Temp - Celsius
Public LogrTmpC                 'CR1000 Temperature - Celsius
```

```
Public Encl_RH                  'Enclosure Humidity - %
Public LiBattV                  'Lithium Battery Voltage - VDC

'Unit conversions.
Public AirTempF                 'Air Temperature - Fahrenheit
Public WindSpd_mph              'Wind Speed - miles/hour
Public TotalWSmph               'Totalized Wind Speed - miles/hour
Public SlrRad_KW                'Solar radiation - Kilowatts/meter^2
Public SlrRad_MJ                'Solar radiation - Megajoules/meter^2
Public Rain_inch                'Rain - inches
Dim Scratch                     'Scratch pad variable for calculations.

'Gill Sonic variables
Dim in_bytes_str As String * 21
Dim checksum_flg As Boolean
Dim nmbr_bytes_rtrnd
Dim disable_flag As Boolean
Dim one
Units one = samples
Public diag
Units diag = unitless

'Define Data Tables
DataTable (SiteVal,True,5)
    Sample (1,Altitude_m,FP2)
    Sample (1,Latitude,IEEE4)
    Sample (1,Longitude,IEEE4)
EndTable

DataTable (ToroHourly,1,-1)
    DataInterval (0,60,Min,5)
    Average (1,SlrRad_KW,FP2,False)
    Average (1,AirTempC,FP2,False)
    Average (1,RelHum,FP2,False)
    Sample (1,TotalWSmph,FP2)
    Totalize (1,Rain_inch,FP2,False)
    Maximum (1,SlrRad_KW,FP2,False,False)
    Maximum (1,AirTempC,FP2,False,False)
    Maximum (1,RelHum,FP2,False,False)
    Maximum (1,WindSpd_mph,IEEE4,disable_flag,False)
    Minimum (1,SlrRad_KW,FP2,False,False)
    Minimum (1,AirTempC,FP2,False,False)
    Minimum (1,RelHum,FP2,False,False)
    Minimum (1,WindSpd_mph,FP2,False,False)
    WindVector (1,WindSpd_mph,WindDir,IEEE4,disable_flag,0,0,1)
    FieldNames ("AvgWSmph,AvgWindDir")
    ETsz (AirTempC,RelHum,WindSpd_ms,SlrRad_MJ,Longitude,Latitude,Altitude_m,3,0,FP2,disable_flag)
    FieldNames ("ETos_mm,Rso_MJ")
EndTable
```

```
DataTable (ToroStatus,1,-1)
      DataInterval (0,1440,Min,5)
      Maximum (1,BattVolt,FP2,False,False)
      Minimum (1,BattVolt,FP2,False,False)
      Maximum (1,LogrTmpC,FP2,False,False)
      Minimum (1,LogrTmpC,FP2,False,False)
      Maximum (1,Encl_RH,FP2,False,False)
      Minimum (1,Encl_RH,FP2,False,False)
      Sample (1,WatchDog,FP2)
      Sample (1,Overruns,FP2)
      Sample (1,LowVolts,FP2)
EndTable

DataTable (STATS,TRUE,168)
      DataInterval (0,60,Min,10)
      Totalize (1,one,IEEE4,disable_flag)
      FieldNames ("n_TOT")
      Totalize (1,one,IEEE4,diag<>1)
      FieldNames ("diag_1_TOT")
      Totalize (1,one,IEEE4,diag<>2)
      FieldNames ("diag_2_TOT")
      Totalize (1,one,IEEE4,diag<>4)
      FieldNames ("diag_4_TOT")
      Totalize (1,one,IEEE4,diag<>8)
      FieldNames ("diag_8_TOT")
      Totalize (1,one,IEEE4,diag<>9)
      FieldNames ("diag_9_TOT")
      Totalize (1,one,IEEE4,diag<>10)
      FieldNames ("diag_10_TOT")
      Totalize (1,one,IEEE4,diag<>NaN)
      FieldNames ("no_data_TOT")
EndTable

'Main Program
BeginProg
      'Initialize Values (unitialized values are zero)
      Latitude=0.00001
      Longitude=latitude
      Altitude_m=latitude
      FirstPass = False
      Baro_Kpa = 0
      'The Gill Sonic is left on all the time!
      one = 1
      SerialOpen (Com1,38400,3,0,432)      'SerialOpen buffer to handle 3 seconds of 1/4 second Gill data.
      'Watchdog counts
      WatchDog = Status.WatchdogErrors(1,1)
      'Skipped scan counts
      Overruns = Status.SkippedScan(1,1)
      'Low voltage counts
      LowVolts = Status.Low12VCount(1,1)
      'Lithium battery voltage
      LiBattV = Status.LithiumBattery(1,1)

      Scan(3,Sec, 3, 0)
            PortSet (9,1)
```

```
'Battery voltage
Battery (BattVolt)
'Micrologger temperature
PanelTemp (LgrTmpC,250)
'Save Site Values
If SaveSite = 1 Then
      CallTable SiteVal
      SaveSite=0
EndIf

'Query Site Values from data table and use if needed.
If Latitude = 0.00001 AND SiteVal.Latitude(1,1)<> NAN Then
      Latitude=SiteVal.Latitude(1,1)
      Longitude=SiteVal.Longitude(1,1)
      Altitude_m=SiteVal.Altitude_m(1,1)
EndIf

'Enclosure humidity
VoltSe(Encl_RH, 1, mV2500, 10, False, 0, _60Hz, 0.1, 0)
If Encl_RH > 100 Then Encl_RH = 100

'CONNECTOR TEMP/RH
'HMP50-ET & HMP60-ET or HMP45C-ET temperature/humidity sensor
VoltSe(AirTempC, 1, mV2500, 2, False, 0, _60Hz, 0.1, -40)
If (AirTempC = NAN) Then AirTempC = -6999
VoltSe(RelHum, 1, mV2500, 1, False, 0, _60Hz, 0.1, 0)
If (RelHum = NAN) Then RelHum = -6999
If (RelHum >= 100) AND (RelHum < 108) Then RelHum = 100
AirTempF = AirTempC * 1.8 + 32

If FirstPass = False Then
      MaxAirC = AirTempC
      MinAirC = AirTempC
      FirstPass = True
Else
      If (AirTempC > MaxAirC) Then MaxAirC = AirTempC
      If (AirTempC < MinAirC) Then MinAirC = AirTempC
EndIf

'CONNECTOR SOLAR RADIATION
'CS305-ET or LI200X-ET Pyranometer
VoltDiff(SlrRad_W, 1, mV7_5, 3, true, 0, _60Hz, 200, 0)
If (SlrRad_W < 0) Then SlrRad_W = 0
If (SlrRad_W = NAN) Then
      SlrRad_W = -6999
      SlrRad_KW = -6999
      SlrRad_MJ = -6999
Else
      SlrRad_KW = SlrRad_W*0.001
      SlrRad_MJ = SlrRad_W*0.000005
EndIf
```

```
        'CONNECTOR TEMP/SONIC
        'Get RS232 data from WindSonic connected to TEMP/SONIC (COM1).
        SerialInRecord (Com1,in_bytes_str,&h02,0,&h0D&h0A,nmbr_bytes_rtrnd,01)
        WindDir = Mid (in_bytes_str,3,3)
        WindSpd_ms = Mid (in_bytes_str,7,6)
        diag = Mid (in_bytes_str,16,2)
        checksum_flg = ( (HexToDec (Mid (in_bytes_str,20,2))) EQV (CheckSum (in_bytes_str,9,18)) )
        disable_flag = (NOT (checksum_flg) OR (nmbr_bytes_rtrnd=0) OR (diag<>0))
        WindSpd_mph = WindSpd_ms * 2.236936
        TotalWSmph = TotalWSmph + WindSpd_mph*0.05

        'CONNECTOR RAIN (PRECIP)
        'TE525-ET, TE525WS-LC, CS700-LC, or TB4-LC tipping rain bucket
        PulseCount(Rain_mm, 1, 2, 2, 0, 0.254, 0)
        Rain_inch = Rain_mm * 0.03937
        Rain_Hr = Rain_mm + Rain_Hr
        RainRun = RainRun + Rain_mm

        CallTable ToroHourly
        If (ToroHourly.Output(1,1)) Then
            ETos_mm = ToroHourly.ETos_mm(1,1)
            ETos_Run = ETos_Run + ETos_mm
            Rain_Hr = 0
            TotalWSmph = 0
        EndIf

        CallTable ToroStatus
        If (ToroStatus.Output(1,1)) Then
            Rain24 = RainRun
            RainRun = 0
            ETos24 = ETos_Run
            ETos_Run = 0
            Max24Air = MaxAirC
            Min24Air = MinAirC
            MaxAirC = AirTempC
            MinAirC = AirTempC
            'Watchdog counts
            WatchDog = Status.WatchdogErrors(1,1)
            'Skipped scan counts
            Overruns = Status.SkippedScan(1,1)
            'Low voltage counts
            LowVolts = Status.Low12VCount(1,1)
            'Lithium battery voltage
            LiBattV = Status.LithiumBattery(1,1)
        EndIf

        CallTable STATS
    NextScan
EndProg
```

Appendix E. Step-down Transformer Installation

This appendix is for users who have a step-down transformer instead of the 100 to 240 VAC to 24 VDC power supply.

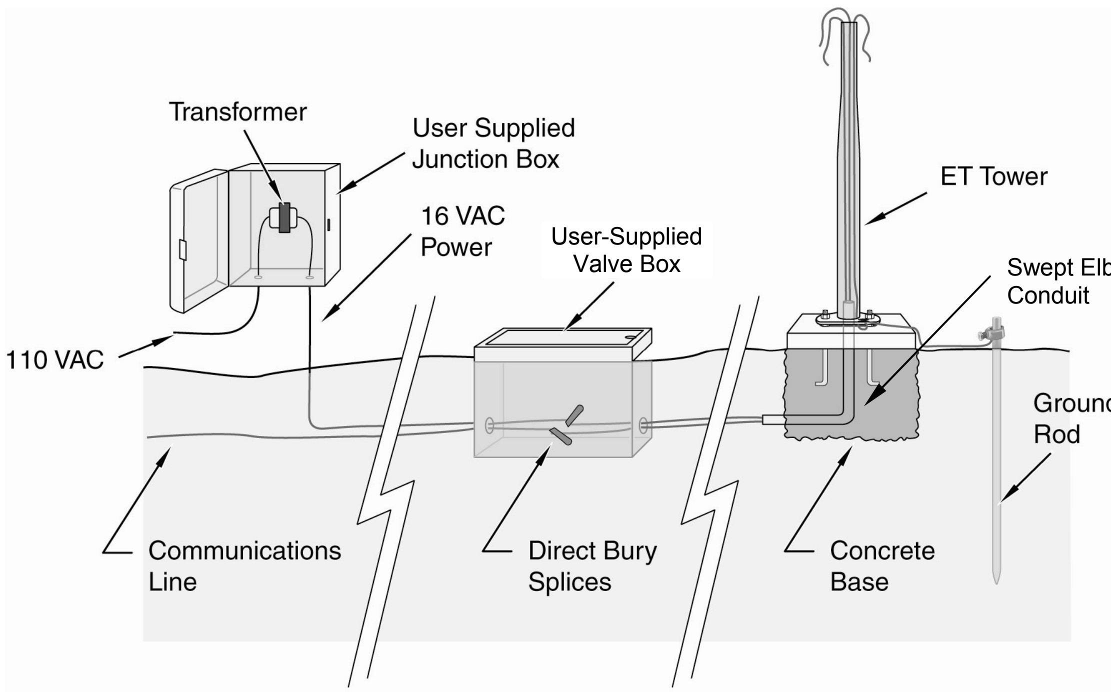


FIGURE E-1. ET tower installation with step-down transformer

NOTE User supplies valve box at base of station and weatherproof enclosure for transformer. See Figure E-1.

1. The AC power option at one time included 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. See Figure 2.4-17.

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

Campbell Scientific Companies

Campbell Scientific, Inc. (CSI)
815 West 1800 North
Logan, Utah 84321
UNITED STATES
www.campbellsci.com • info@campbellsci.com

Campbell Scientific Africa Pty. Ltd. (CSAf)
PO Box 2450
Somerset West 7129
SOUTH AFRICA
www.csafrica.co.za • cleroux@csafrica.co.za

Campbell Scientific Australia Pty. Ltd. (CSA)
PO Box 8108
Garbutt Post Shop QLD 4814
AUSTRALIA
www.campbellsci.com.au • info@campbellsci.com.au

Campbell Scientific do Brazil Ltda. (CSB)
Rua Luisa Crapsi Orsi, 15 Butantã
CEP: 005543-000 São Paulo SP BRAZIL
www.campbellsci.com.br • suporte@campbellsci.com.br

Campbell Scientific Canada Corp. (CSC)
11564 - 149th Street NW
Edmonton, Alberta T5M 1W7
CANADA
www.campbellsci.ca • dataloggers@campbellsci.ca

Campbell Scientific Centro Caribe S.A. (CSCC)
300 N Cementerio, Edificio Breller
Santo Domingo, Heredia 40305
COSTA RICA
www.campbellsci.cc • info@campbellsci.cc

Campbell Scientific Ltd. (CSL)
Campbell Park
80 Hathern Road
Shepshed, Loughborough LE12 9GX
UNITED KINGDOM
www.campbellsci.co.uk • sales@campbellsci.co.uk

Campbell Scientific Ltd. (France)
3 Avenue de la Division Leclerc
92160 ANTONY
FRANCE
www.campbellsci.fr • info@campbellsci.fr

Campbell Scientific Spain, S. L.
Avda. Pompeu Fabra 7-9, local 1
08024 Barcelona
SPAIN
www.campbellsci.es • info@campbellsci.es

Please visit www.campbellsci.com to obtain contact information for your local US or International representative.