INSTRUCTION MANUAL

RAWS-P Remote Automated Weather Station

Revision: 4/12

Warranty

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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.

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RAWS-P Remote Automated Weather Station

1. Introduction

The RAWS environmental enclosure can be used for configuring a custom Remote Automated Weather Station (RAWS) that matches the requirements of your application. The aluminum environmental enclosure houses a 12 V rechargeable battery and a CR1000 datalogger. The outside of the enclosure has color-coded, keyed connectors (Figure 1-1) for attaching the sensors. Besides the connectors, a wiring panel is included that allows the measurement of additional sensors. Communication options include satellite transmitter and voice radio interface module. Additional communication equipment (telephone, cellular phone, radio) can be added to the station. The RAWS data collection platform is ideal for configuring a custom remote automated weather station.

FIGURE 1-1. Color coded, keyed connector panel

NOTE The RAWS-P comes with a generic program. Modifications to this generic program will require datalogger support software (LoggerNet or PC400) purchased from Campbell Scientific, Inc. Please contact a Campbell Scientific Application Engineer for programming assistance. Campbell Scientific company contact information is listed on the last page of this manual.

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2. Getting Started

NOTE Set up and test your station before field deployment.

NOTE **Keep this manual and the CR1000KD Keyboard Display with the RAWS.** Review the station siting and orientation section before field deployment. If a problem is encountered, review the equipment wiring and troubleshooting sections in this manual.

NOTE After siting and leveling the RAWS station, open the enclosure and (1) connect the battery cable and (2) verify the CH100 switch is in the 'on' position. **When this equipment is not in use (i.e., transport or storage), disconnect battery cable to the CH100.**

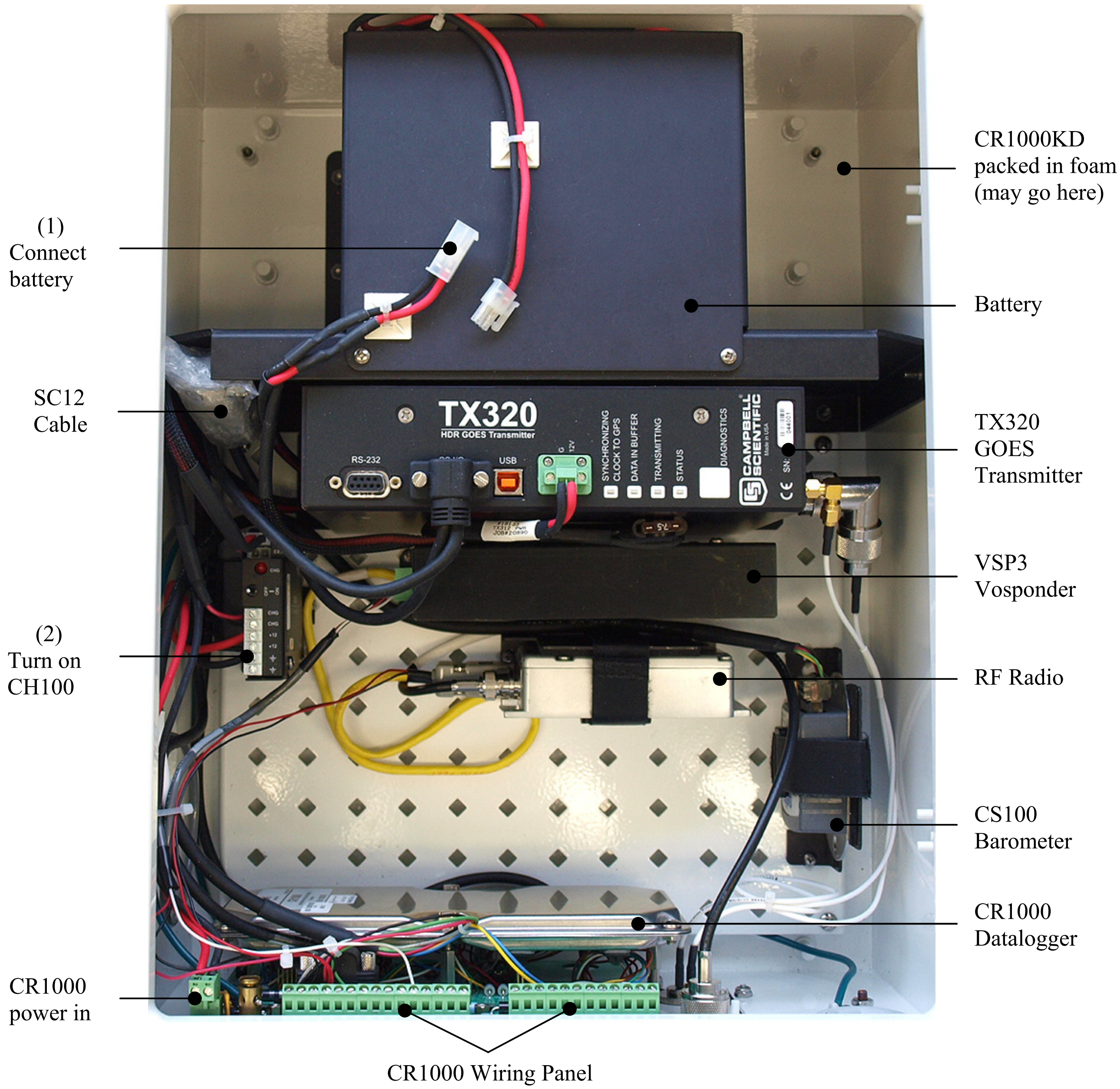

FIGURE 2-1. Inside environmental enclosure (optional equipment shown)

NOTE The RAWS-P comes with a generic program. Modifications to this generic program will require datalogger support software (LoggerNet or PC400) purchased from Campbell Scientific, Inc. Please contact a Campbell Scientific Application Engineer for programming assistance. Campbell Scientific company contact information is listed on the last page of this manual.

NOTE Use the CR1000KD Keyboard Display to see the "Public Variables" shown in Table 2-1.

- Connect the CR1000KD Keyboard Display to the CS I/O connector (Figure 5.7-2) or SC12 Cable (Figure 2-1)
- Press any key for the CR1000KD Power up Screen
- Press Enter to move down a menu (Press Esc to move up a menu)
- (Press up/down arrow to select item)
- Select Data, press Enter
- Select Real Time Tables, press Enter
- Select Public, press Enter
- Press up/down arrow to see the Public Variables listed in Table 2-1

Press any key for Power up Screen
Press ^ to turn on/off backlight
Press <> to adjust contrast

TABLE 2-1. Public Variables

Number	Name	Function
	Sensor Variables	
1	Batt_Volt	System power supply voltage
2	AirTempF	HC2S3 Air Temperature in Degrees F
3	RH	HC2S3 Relative Humidity in Percent
4	TdewF	Dew point in Deg F, calculated from HC2S3 data
5	SlrW	Solar Radiation in Watts, pyranometer
6	Rain_in	Temporary rain, cleared every scan
7	RainTot	TE525 Cumulative rain fall in inches
8	WS_mph	Wind Speed in MPH
9	WindDir	Wind Direction
10	WSDiag	Only for Wind Sonic data, zero otherwise
11	MaxWS	MaxWS, reset 2 minutes before transmit
12	MaxWD	Direction of wind during Max wind speed
13	SlrMJ	Solar Radiation in MJoules
14	BP_inHg	Hourly - Barometric pressure, inHg
15	BPelev_ft	Elevation, to correct Barometric pressure
16	FuelT_F	Hourly - Fuel temperature in degrees F
17	FuelM	Hourly - Fuel Moisture, % moisture by weight
	GOES Variables	
18	CountDwn	True or False: True indicates GPS fix good and program is collection data. False until GPS fix
19	Clockgood	True or False: True after GPS fix and CR1000 clock has been set to match TX320 clock
20	TimeToXmit	Seconds until transmit time. Indicates CR1000 and TX320 are properly setup and running
21	SWR	Standing Wave Ratio (SWR), only after a transmission. Indicates condition of antenna and cable. SWR should be less than 2.0
22	FwdPower	Forward Power in dBm, should be about 37
23	RefPower	Reflected power in dBm, should be about 25 or less
24	RC_Data	Only valid after first transmission. Anything other than zero is a problem
25	Setup_RC	Indicates if CR1000 could setup TX320. Zero is success or has not run

3. Station Siting and Orientation

3.1 General Description

Selecting an appropriate site for the RAWS 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.

NOTE See Section 8 for siting references.

WARNING **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.**

3.2 Air Temperature and Relative Humidity

A temperature and relative humidity sensor should be located over an open level area at least 9 m in diameter (EPA). The surface should be covered by short grass, or where grass does not grow, the natural earth surface. The sensor must be housed inside a radiation shield and adequately ventilated.

Situations to avoid include: 1) large industrial heat sources, 2) rooftops, 3) steep slopes, 4) sheltered hollow, 5) high vegetation, 6) shaded areas, 7) swamps, 8) areas where snow drifts occur, and 9) low places holding standing water after rains.

3.3 Precipitation

A rain gauge should be located over an open level area covered by short grass, or where grass does not grow, the natural earth surface. Level the rain gage.

NOTE Take off the funnel and remove the rubber band securing the tipping bucket mechanism during transport.

3.4 Solar Radiation

A solar radiation sensor should be located to avoid shadows on the sensor at any time. Orient the solar radiation sensor where the solar radiation sensor faces south (northern hemisphere) minimizing the chance of shading from other weather station structures. Reflective surfaces and sources of artificial radiation should be avoided. Level the solar radiation sensor.

3.5 Wind Speed and Direction

A wind sensor 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.

3.6 Barometric Pressure

The barometric pressure sensor is mounted to the back plate inside the RAWS environmental enclosure.

3.7 Fuel Moisture and Fuel Temperature

The fuel moisture and fuel temperature sensor should be left outside at the field site continually exposed to the same conditions as forest fuels. The fuel moisture and fuel temperature dowel rods absorb and desorb moisture from its surroundings. Install the probes horizontally on the mounting stake and face the sensors south (northern hemisphere) above a representative forest floor duff layer. Place the sensor away from foot traffic areas.

4. Sensor Wiring and Troubleshooting

4.1 Air Temperature and Relative Humidity

4.1.1 General Description, Air Temperature and Relative Humidity (part #HC2S3-L-RQ)

The HC2S3 Rotronic's HydroClip2 Air Temperature and Relative Humidity Probe has a -RQ cable termination option that allows it to connect to the RAWS-P. This probe contains a Platinum Resistance Thermometer (PRT) and a Rontronic's IN1 capacitive relative humidity sensor. Voltage is output for each of the probe's sensors.

4.1.2 Wiring, Air Temperature and Relative Humidity (part #HC2S3-L-RQ)

The temp/RH sensor is connected to the RAWS connector panel "TEMP/RH" connector COLOR CODED ORANGE. This sensor is internally wired from the RAWS connector panel to the CR1000 datalogger.

Connector Panel "TEMP/RH" connector COLOR CODED ORANGE

Connector Pin A	Temp Hi	to CR1000	1L
Connector Pin B	Sensor excitation	to CR1000	EX1
Connector Pin C	Sensor signal Lo/AG	to CR1000	AG
Connector Pin D	Power ground	to CR1000	Ground
Connector Pin E	RH signal	to CR1000	1H
Connector Pin F	SW_12V	to CR1000	SW_12V

4.1.3 Troubleshooting, Air Temperature and Relative Humidity (part #HC2S3-L-RQ)

Check the sensor cable. Disconnect the connector and look for damaged pins. Verify that the sensor body is connected to the sensor head. Under the filter assembly, verify the sensors are connected but not touching. Try connecting a substitute sensor. Obtain a Return Material Authorization (RMA) number before returning this sensor to Campbell Scientific for repair.

NOTE Consult the HC2S3-L manual for more information.

4.2 Rain Gage

4.2.1 General Description, Rain Gage (part #TE525-LQ)

The Texas Electronics Rain Gage (part #TE525-LQ) is an adaptation of a Weather Bureau tipping bucket rain gage. The rain gage has a 6 inch collector. The rain gage sensor output has a switch closure for each bucket tip. Level the rain gage.

4.2.2 Wiring, Rain Gage (part #TE525-LQ)

The rain gage is connected to the RAWS connector panel "PRECIP" connector COLOR CODED BLUE. This sensor is internally wired from the RAWS connector panel to the CR1000 datalogger.

Connector Panel "PRECIP" connector COLOR CODED BLUE

Connector Pin A	Tipping Bucket	to CR1000	C6
Connector Pin B	5V	to CR1000	5V
Connector Pin C	Ground	to CR1000	Ground

4.2.3 Troubleshooting, Rain Gage (part #TE525-LQ)

Check the sensor cable. Disconnect the connector and use a DVM to check the resistance between Pin A (sensor signal) and Pin C (sensor ground). The resistance should read as an open circuit until you move the rain gage tipping mechanism where the magnet swings past the reed relay. Try connecting a substitute sensor. Obtain a Return Material Authorization (RMA) number before returning this sensor to Campbell Scientific for repair.

NOTE Consult the TE525-L manual for more information.

4.3 Solar Radiation

4.3.1 General Description, Pyranometer (part #CS300-LQ)

The Apogee Pyranometer (part #CS300-LQ) measures incoming solar radiation with a silicon photovoltaic detector mounted in a cosine-corrected head. The detector outputs current; a shunt resistor in the sensor converts the signal from current to voltage. During the night the CS300-LQ may read slightly negative incoming solar radiation. The negative signal is caused by RF noise.

4.3.2 Wiring, Pyranometer (part #CS300-LQ)

The pyranometer sensor is connected to the RAWS connector panel "SOLAR RAD SDI-12" connector COLOR CODED GREEN. The pyranometer sensor is internally wired from the RAWS connector panel to the CR1000 datalogger.

Connector Panel "SOLAR RAD SDI-12" connector COLOR CODED GREEN

Connector Pin A	Solar Sensor +	to CR1000	3H
Connector Pin B	Solar Sensor -	to CR1000	3L/AG (3L shorted to AG)
Connector Pin C	Solar Sensor Gnd	to CR1000	AG
Connector Pin D	SDI-12 Ground	to CR1000	Ground*
Connector Pin E	SDI-12 Signal	to CR1000	C5* (*Note: 2nd SDI-12 sensor)
Connector Pin F	SDI-12 12V	to CR1000	12V*

4.3.3 Troubleshooting, Pyranometer (part #CS300-LQ)

Check the sensor cable. Disconnect the connector and use a DVM to check the voltage between Pin A Solar Sensor (+) and Pin B Solar Sensor (-). The voltage should be 0 to 200 mV for 0 to 1000 Wm^{-2} radiation. No voltage indicates a problem with either the photodiode or the shunt resistor, both of which are potted in the sensor head and cannot be serviced. Try connecting a substitute sensor. Obtain a Return Material Authorization (RMA) number before returning this sensor to Campbell Scientific for repair.

NOTE Consult the CS300-L manual for more information.

4.4 Wind Speed and Direction

4.4.1 Windset (part #034B-LQ)

4.4.1.1 General Description, Windset (part #034B-LQ)

The Met One Windset (part #034B-LQ) is an integrated cup anemometer and wind vane. The anemometer consists of three cups that sense the wind speed. These cups rotate on a vertical shaft that magnetically activates a sealed reed switch. The reed switch opens and closes at a rate proportional to wind speed. The wind direction is sensed by a vane. The vane drives a 10 K Ohm potentiometer. The wind speed sensor outputs a pulse. The wind direction sensor outputs a voltage.

4.4.1.2 Wiring, Windset (part #034B-LQ)

The windset sensor is connected to the RAWS connector panel “WS/WD” connector COLOR CODED RED. The wind speed probe is internally wired from the RAWS connector panel to the CR1000 datalogger.

Connector Panel “WS/WD” connector COLOR CODED RED

Connector Pin A	Sensor ground	to CR1000	AG
Connector Pin B	Wind dir. Excitation	to CR1000	Ex2
Connector Pin C	Wind dir. Signal	to CR1000	2H
Connector Pin D	Power ground	to CR1000	Ground
Connector Pin E	+12V power	to CR1000	+12V
Connector Pin F	Wind speed signal	to CR1000	P1

4.4.1.3 Troubleshooting, Windset (part #034B-LQ)

Check the sensor cable. Disconnect the connector and look for damaged pins. Verify free movement of the cup anemometer and wind vane. Try connecting a substitute sensor. Obtain a Return Material Authorization (RMA) number before returning this sensor to Campbell Scientific for repair.

NOTE Consult the 034B-L manual for more information.

4.4.2 2-D WindSonic

4.4.2.1 General Description, 2-D WindSonic (part #WindSonic-LQ)

The Gill Instruments 2-D Sonic Wind Sensor (part #WindSonic-LQ) is an ultrasonic anemometer for measuring wind direction and wind speed. It uses two pairs of orthogonally oriented transducers to sense the horizontal wind. The transducers bounce the ultrasonic signal from a hood, thus minimizing the effects of transducer shadowing and flow distortion. The 2-D Sonic Wind Sensor makes wind measurements at a frequency of 1 Hz and outputs a SDI-12 signal to the datalogger.

4.4.2.2 Wiring, 2-D WindSonic (part #WindSonic-LQ)

The 2-D Sonic Wind Sensor is connected to the RAWS connector panel "SDI-12" connector COLOR CODED YELLOW. The wind sensor is internally wired from the RAWS connector panel to the CR1000 datalogger.

Connector Panel "SDI-12" connector COLOR CODED YELLOW

Connector Pin A	Signal +	to CR1000	C7
Connector Pin B	12V	to CR1000	12V
Connector Pin C	Power ground	to CR1000	Ground
Connector Pin D	Open	to CR1000	

4.4.2.3 Troubleshooting, 2-D WindSonic (part #WindSonic-LQ)

Check the sensor cable. Disconnect the connector and look for damaged pins. Try connecting a substitute sensor. Should the 2-D sonic sensor be damaged, fails to output data, or sends a nonzero diagnostic, obtain a Return Material Authorization (RMA) number before returning this sensor to Campbell Scientific for repair.

NOTE Consult the WINDSONIC4-L manual for more information.

4.5 Barometric Pressure

4.5.1 General Description, Barometric Pressure (part #CS100-QD)

The Setra Barometric Pressure Sensor (part #CS100-QD) is a capacitive pressure transducer that uses Setra's electrical capacitor technology for barometric pressure measurements over the 600 to 1100 milibar range. The CS100 is supplied in the triggered mode, in which the datalogger switches 12 VDC power to the barometer before the measurement. The datalogger then powers down the barometer after the measurement to conserve power.

4.5.2 Wiring, Barometric Pressure (part #CS100)

The barometric pressure sensor (part #CS100-QD) is mounted inside the RAWS environmental enclosure and the sensor wires are attached to the CR1000 printed circuit board wiring panel.

CS100 Barometric Pressure Sensor wires attached to CR1000 Wiring Panel

CS100 Blue wire	to CR1000 wiring panel	5H
CS100 Yellow wire	to CR1000 wiring panel	AG
CS100 Red wire	to CR1000 wiring panel	12V
CS100 Clear wire	to CR1000 wiring panel	Ground
CS100 Black wire	to CR1000 wiring panel	Ground
CS100 Green wire	to CR1000 wiring panel	C4

CAUTION The CS100 is sensitive to static when the back plate is removed. To avoid damage, take adequate anti-static measures when handling this sensor.

4.5.3 Troubleshooting, Barometric Pressure (part #CS100)

Verify the sensor wires are securely fastened to the CS100 Barometric Pressure Sensor connector and the CR1000 printed circuit board wiring panel. Use a DVM to check the sensor output voltage on the CR1000 printed circuit board wiring panel (0 to 2.5 VDC) between terminals 5H and AG.

NOTE For the DVM test, "temporarily" move the green wire from "C4" to "5V" terminal. No voltage indicates a problem with the sensor or a bad sensor cable connection. Try connecting a substitute sensor.

Obtain a Return Material Authorization (RMA) number before returning this sensor to Campbell Scientific for repair.

NOTE Consult the CS100 manual for more information.

4.6 Fuel Moisture and Fuel Temperature

4.6.1 General Description, Fuel Moisture/Fuel Temperature (part #CS516-LQ)

The Campbell Scientific Fuel Moisture/Fuel Temperature Sensor (part #CS516-LQ) consists of a CS506 Fuel Moisture Probe, 26601 Fuel Moisture Stick, CS205 Fuel Temperature Stick, and 107-LQ thermistor mounted on a 10974 fuel moisture/temperature mounting stake. The fuel moisture probe provides the moisture content of a standard 10-hour fuel moisture dowel. This moisture represents the moisture content of small-diameter (10-hour time lag) forest fuels. The fuel temperature probe consists of a Ponderosa pine dowel with a bored hole and a Model 107 Temperature Probe inserted into the dowel. The CS205 mounts on the mounting stake with the CS506.

4.6.2 Wiring, Fuel Moisture/Fuel Temperature (part #CS516-LQ)

The Campbell Scientific CS506 and CS205 sensors are combined into one connector (part#CS516-LQ). This sensor is internally wired from the RAWS connector panel to the CR1000 datalogger. This sensor is connected to the RAWS connector panel "FM/FT" connector COLOR CODED BROWN.

<u>Connector Panel “FM/FT” connector COLOR CODED BROWN</u>

Connector Pin A	107-LQ Temp. Signal	to CR1000	4L
Connector Pin B	Sensor Ground	to CR1000	Ground
Connector Pin C	107-LQ Temp. Excitation	to CR1000	EX1
Connector Pin D	CS506 FM Enable	to CR1000	C8
Connector Pin E	CS506 FM Signal	to CR1000	4H
Connector Pin F	CS506 FM +12V power	to CR1000	+12V

4.6.3 Troubleshooting, Fuel Moisture/Fuel Temperature (part #CS516-LQ)

Check the sensor cable. Disconnect the connector and look for damaged pins. Verify the CS506 sensor element is securely fastened. Try connecting a substitute sensor. Obtain a Return Material Authorization (RMA) number before returning the CS516-LQ sensor to Campbell Scientific for repair.

NOTE Consult the CS506-L, CS205 and 107-L manuals for more information.

5. Equipment Wiring and Troubleshooting

5.1 Solar Panels

5.1.1 General Description, Solar Panel (part #SP10/20-LQ)

The RAWS Solar Panel is a photovoltaic power source used for charging lead acid batteries. The SP20-LQ 20 watt solar panel is used for system configurations that have higher-than-average power requirements. It is also recommended for use at higher elevations and latitudes. The solar panel should be mounted facing south if located in the northern hemisphere, or facing north in the southern hemisphere.

The SP10-LQ 10 watt solar panel is recommended for a RAWS where NO communication equipment is used. The SP20-LQ 20 watt solar panel is recommended for a RAWS where communication equipment is used (i.e., GOES, voice, cell phone, or radio).

NOTE The solar panel selected for the RAWS depends on the station power requirements, specifically the communication equipment selected for the station.

The SP10-LQ solar panel outputs 0.59 Amps, 8.9 Watts typical peak power.

The SP20-LQ solar panel outputs 1.17 Amps, 18 Watts typical peak power.

5.1.2 Wiring, Solar Panel (part #SP10/20-LQ)

The RAWS-Solar Panel (part # SP20-LQ or SP10-LQ) attaches to the connector panel labeled “BATT CHARGER/SOLAR PANEL”. Inside the RAWS environmental enclosure the “BATT CHARGER/SOLAR PANEL” connector pin A and pin B are wired to the CH100 charger/regulator “CHG” and “CHG” ports. Polarity does not matter; either lead can be connected to either terminal. The CH100 charger/regulator has two functions: 1) blocks any current flow from the battery to the solar panel, and 2) limits the source current to the battery.

5.1.3 Troubleshooting, Solar Panel (part #SP10/20-LQ)

If a problem with the solar panel is suspected, the solar panel may be checked by measuring the voltage output from the solar panel. Check the voltage with a voltmeter connected between the two leads going to the CH100 charger/regulator “CHG” “CHG” terminals located inside the environmental enclosure (15 VDC to 28 VDC). There must be solar radiation incident on the panel and there must be a load connected to the solar panel. The load can be the datalogger, other equipment, or a 75 ohm resistor capable of dissipating solar panel power between the two leads. No voltage output implies a bad solar panel, regulator, or cable. The magnitude of the voltage output depends on the incident solar radiation. Check the sensor cable. Disconnect the connector and look for damaged pins. Try connecting a substitute panel. Obtain a Return Material Authorization (RMA) number before returning the SP10/20-LQ to Campbell Scientific for repair.

NOTE Consult the SP10_SP20 Solar Panels manual for more information.

5.2 Charger/Regulator

5.2.1 General Description, 12 V Charger/Regulator (part #CH100)

The 12 volt charger/regulator (part #CH100) is a charging regulator for 12 V rechargeable batteries. The CH100 is connected to an external charging source such as an unregulated solar panel (part # SP20-LQ or SP10-LQ) or a wall charger (part #9591-QD). The CH100 charger/regulator has two functions: 1) blocks any current flow from the battery to the solar panel, and 2) limits the source current to the battery.

FIGURE 5.2-1. 12 volt charger/regulator

5.2.2 Wiring, 12 V Charger/Regulator (part #CH100)

The leads from the RAWS connector panel "BATT CHARGER/SOLAR PANEL" connector COLOR CODED PURPLE are wired to the CH100 "CHG" terminals. Polarity does not matter; either lead can be connected to either terminal. The charge indicating diode should be "ON" when voltage to the charging circuitry (CHG Terminals) is present.

An internal and/or external battery can be connected to the CH100 Charger/Regulator by means of the INT (Internal) or EXT (External) connectors. The battery red lead connects to the positive battery terminal and the black lead connects to the negative terminal.

NOTE An "external battery cable" (part #6186) ships with the RAWS Quick Deployment Weather Station.

Connect 12 V power to the datalogger and/or peripherals using the "+12 and Ground" terminals. The ON-OFF switch applies power to these 12 V terminals.

WARNING **Reversal of battery polarity will damage the CH100 or battery.**

CAUTION A battery must be attached for the CH100 to function correctly as a power supply.

CAUTION It is possible to leave two batteries connected. The battery connections are diode isolated; however, if one of the batteries fails, it could draw all the charging current and the other battery will be discharged.

5.2.3 Troubleshooting, 12 V Charger/Regulator (part #CH100)

If a problem with the charger/regulator (part #CH100) is suspected, the CH100 may be checked by measuring: 1) input voltage (CHG terminals) from the solar panel (15 VDC to 28 VDC) or input voltage from the AC adapter (part #9591-QD) about 18 VAC RMS, 2) charging output voltage (BATT INT or EXT terminal) with battery disconnected about 13.5 VDC to 14 VDC, and 3) power out (+12 terminals) about 11 VDC to 14 VDC. No voltage output implies a bad solar panel, regulator, or battery. Power out (+12 terminals) is controlled by the CH100 ON-OFF switch position. If problems persist, try a substitute. Obtain a Return Material Authorization (RMA) number before returning this equipment to Campbell Scientific for repair.

NOTE Power out (+12 terminals) is controlled by the CH100 ON-OFF switch position.

NOTE Consult the CH100 manual for more information.

5.3 Battery

5.3.1 General Description, Battery

The RAWS battery is a rechargeable 12 volt battery. The battery requires a regulated charging source provided by the RAWS Charger/Regulator (part #CH100) connected to an unregulated solar panel or a wall charger.

WARNING **RAWS rechargeable batteries are designed to be float charged. Permanent damage occurs and battery life is shortened if the battery is allowed to discharge below 10.5 volts.**

5.3.2 Wiring, Battery

The RAWS rechargeable battery should be connected to the CH100 charger/regulator INT (Internal) connector. The battery red lead connects to the positive battery terminal and the black lead connects to the negative terminal. If desired, an external battery can be connected to the CH100 charger/regulator EXT (External) connector. It is possible to leave two batteries connected. The battery connections are diode isolated; however, if one of the batteries fails, it could draw all the charging current and the other battery will be discharged. An "external battery cable" (part #6186) ships with the RAWS.

WARNING **Reversal of battery polarity will damage the CH100 or battery.**

CAUTION It is possible to leave two batteries connected. The battery connections are diode isolated; however, if one of the batteries fails, it could draw all the charging current and the other battery will be discharged.

5.3.3 Troubleshooting, Battery

Measure the +12 V and Ground terminal on the CR1000 printed circuit board wiring panel. Acceptable readings are +11 VDC to +14 VDC. Use PC200W software to collect the 1-HR data table from the CR1000 datalogger and review the historical record of battery voltage.

5.4 GOES Transmitter

5.4.1 General Description, GOES Transmitter (part #TX320)

The High Data Rate GOES transmitter (part #TX320) shown in Figure 5.4-1 supports one-way communication, via satellite, from a Campbell Scientific datalogger to a ground receiving station. Satellite telemetry offers a convenient communication alternative for field stations where phone systems or RF systems are impractical or rendered unreliable after a tragedy to the local infrastructure. Data transmission rates of 100, 300, and 1200 bps are supported. Because clock accuracy is critically important for GOES satellite telemetry, the TX320 includes a robust, TCXO-based real-time clock and a GPS receiver.

The TX320 transmitter has two siting requirements for proper operation. The GOES antenna must have a clear view of the spacecraft. The GOES antenna is directional and should be aimed at the spacecraft. Both elevation and azimuth are unique to the location of the planet and must be set. A poorly aimed antenna will cause a drop in signal strength or possibly prevent successful transmission.

For more information on the GOES transmitter (part #TX320) and antenna siting, go to our website at www.campbellsci.com, enter the "TX320" in the "Search" box on the website mentioned above, and go the equipment manual. The GOES transmitter (part #TX320) manual is also provided on the ResourceDVD which ships with the RAWS Quick Deployment Weather Station.

NOTE The spacecraft specific DCP-Setup parameters for the GOES transmitter must be entered in the CR1000KD menus for the GOES transmitter TX320 to work properly. If the RAWS Quick Deployment Weather Station does NOT have a GOES transmitter disregard the DCP-Setup parameters.

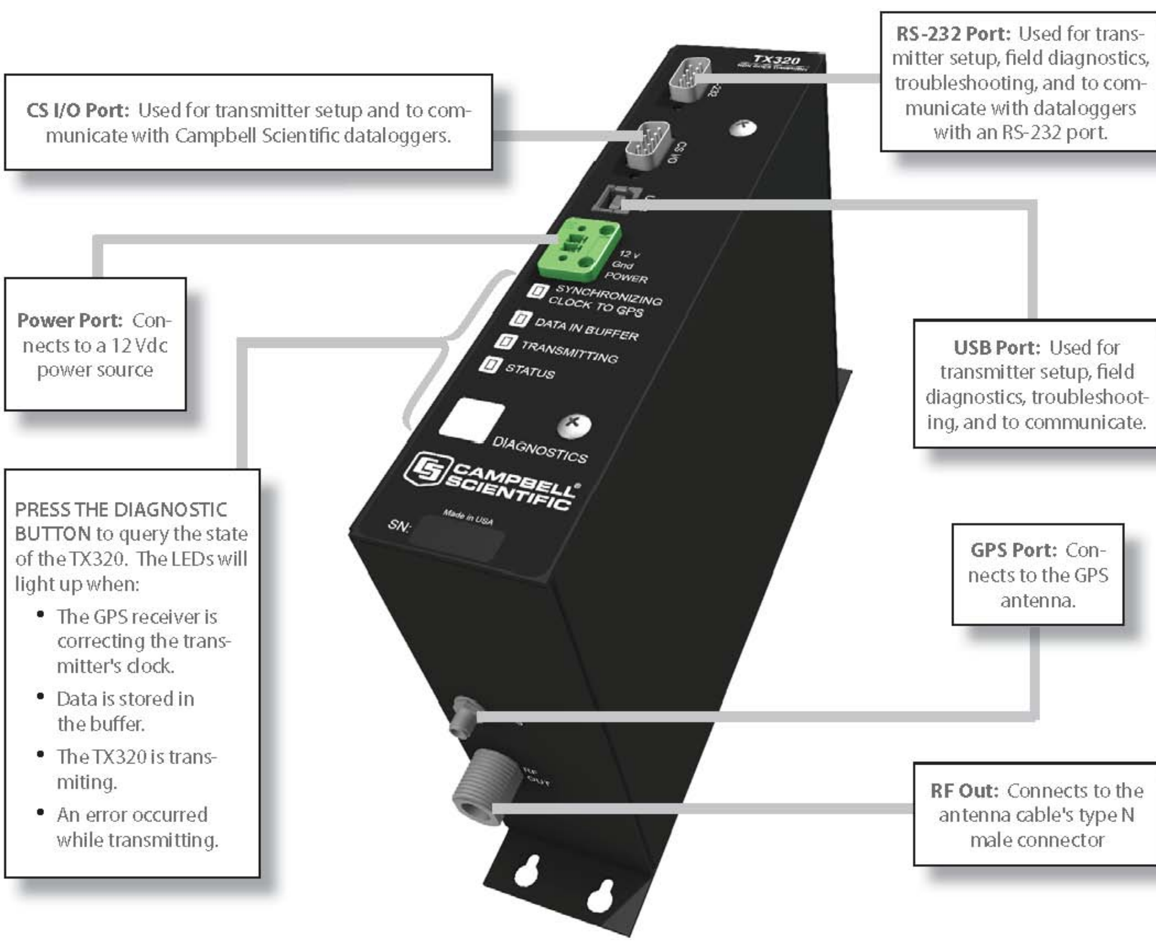

FIGURE 5.4-1. GOES transmitter

5.4.2 Wiring, GOES Transmitter (part #TX320)

The GOES transmitter (part #TX320) is mounted inside the RAWS environmental enclosure and the transmitter connections are described below;

GOES Transmitter TX320 Connection inside the RAWS environmental enclosure

GOES	TX320 “CSI/O” Port	--to-- CR1000 PC Board “CSI/O” Port using an *SC12 Cable
GOES	TX320 “GPS Port”	--to-- GPS Antenna Cable
GOES	TX320 “RF Out”	--to-- GOES Antenna Cable
GOES	TX320 “Power Port”	--to-- Battery Cable Junction Connector

*Note: The SC12 Cable ships with the RAWS Quick Deployment Weather Station.

5.4.3 Troubleshooting, GOES Transmitter (part #TX320)

If a problem with the GOES transmitter (part #TX320) is suspected, the TX320 may be checked by measuring the +12 V and Ground terminal on the CR1000 PC-board wiring panel. Acceptable readings are +11 VDC to +14 VDC. Check the SC12 cable connection between the CR1000 wiring panel and the TX320. Press the TX320 diagnostic button to query the state of the transmitter. If problems persist, try a substitute. Obtain a Return Material Authorization (RMA) number before returning this equipment to Campbell Scientific for repair.

NOTE Consult the TX320 manual for more information.

5.5 Voice Radio Interface

5.5.1 General Description, Voice Radio Interface (part #VSP3)

The DACOM Voice Radio Interface (part #VSP3) shown in Figure 5.5-1 is mounted inside the RAWS environmental enclosure. The VSP3 converts data into voice messages that can be transmitted via UHF or VHF transceiver. The VSP3 Vosponder uses phonetic native text string to speech conversion, which provides for an unlimited vocabulary. The Vosponder communicates with a datalogger using the SDI-12 protocol. The VSP3 Vosponder can be integrated into an existing UHF/VHF radio network. A minimum of two radios with matching frequencies is required. The VSP3 ships preprogrammed with a voice image file for the fire weather market.

NOTE A minimum of two radios with matching frequencies is required to transmit voice messages. To activate the voice file, hold down the radio microphone button and press 9 on the radio keypad. Radios can be purchased from Campbell Scientific.

FIGURE 5.5-1. Voice radio interface

5.5.2 Wiring, Voice Radio Interface (part #VSP3)

The Voice Radio Interface (part #VSP3) is mounted inside the RAWS environmental enclosure and the VSP3 connections are described below.

Voice Radio Interface (part #VSP3) inside the RAWS environmental enclosure

VSP3 "Ground" terminal contact	--to--	CR1000 PC Board "G"
VSP3 "+12V" terminal contact	--to--	CR1000 PC Board "+12V"
VSP3 "DATA" terminal contact	--to--	CR1000 PC Board "C1"
VSP3 "RADIO" RJ45 Connector	--to--	UHF/VHF Radio*

*Note: Maxon and Bendix King Radio cables are available from Campbell Scientific.

5.5.3 Troubleshooting, Voice Radio Interface (part #VSP3)

If a problem with the voice radio interface (part #VSP3) is suspected, the VSP3 may be checked by measuring the +12 V and Ground terminal on the VSP3. Acceptable readings are +11 VDC to +14 VDC. Verify the sensor wires are securely fastened to the VSP3 connector and the CR1000 printed circuit board wiring panel. If problems persist, try a substitute. Obtain a Return Material Authorization (RMA) number before returning this equipment to Campbell Scientific for repair.

NOTE Consult the VSP3 manual for more information.

5.6 CR1000 Keyboard/Display

5.6.1 General Description, CR1000 Keyboard/Display (part #CR1000KD)

The CR1000 Keyboard/Display (part #CR1000KD) shown in Figure 5.6-1 is used to check datalogger status, display or plot sensor readings and stored values, and to enter numeric data or change port/flag state. The CR1000KD is powered from the CR1000 printed circuit board "CS I/O" connector via a standard 9-pin serial cable (part #10873) that ships with the RAWS station.

NOTE Use the CR1000KD menus to enter GOES DCP-Setup Parameters and to select the wind speed/direction sensor on the RAWS station. If the RAWS does NOT have a GOES transmitter, disregard the DCP-Setup parameters.

FIGURE 5.6-1. CR1000 Keyboard/Display

5.6.2 Wiring, CR1000 Keyboard/Display (part #CR1000KD)

The CR1000 Keyboard/Display (part #CR1000KD) connects to the CR1000 PC board "CSI/O" 9-Pin connector using a standard serial cable (part #10873) that ships with the RAWS station.

5.6.3 Troubleshooting, CR1000 Keyboard/Display (part #CR1000KD)

If a problem with the CR1000 Keyboard/Display is suspected, the CR1000KD may be checked by connecting the CR1000KD to the CR1000 PC board 9-Pin "CS I/O" connector using our 9-pin serial cable (part #10873). The CR1000KD display should be visible. Check the CH100 on/off switch. If the display is not visible, check the CR1000 wiring panel for 12 volt power. If the CR1000 is unresponsive to CR1000KD key strokes, then there might be a problem with the CR1000 datalogger. If problems persist, try a substitute. Obtain a Return Material Authorization (RMA) number before returning this equipment to Campbell Scientific for repair.

NOTE Consult the CR1000 manual for more information.

5.7 CR1000 Datalogger (part #CR1000)

5.7.1 General Description, CR1000 Datalogger (part #CR1000)

The CR1000 shown in Figure 5.7-1 provides sensor measurement, timekeeping, data reduction, data/program storage and control functions. The RAWS CR1000 datalogger includes 2 Mbytes of memory for data and program storage. A lithium battery backs up the RAM and real-time clock. The CR1000 also suspends execution when primary power drops below 9.6 V, reducing the possibility of inaccurate measurements.

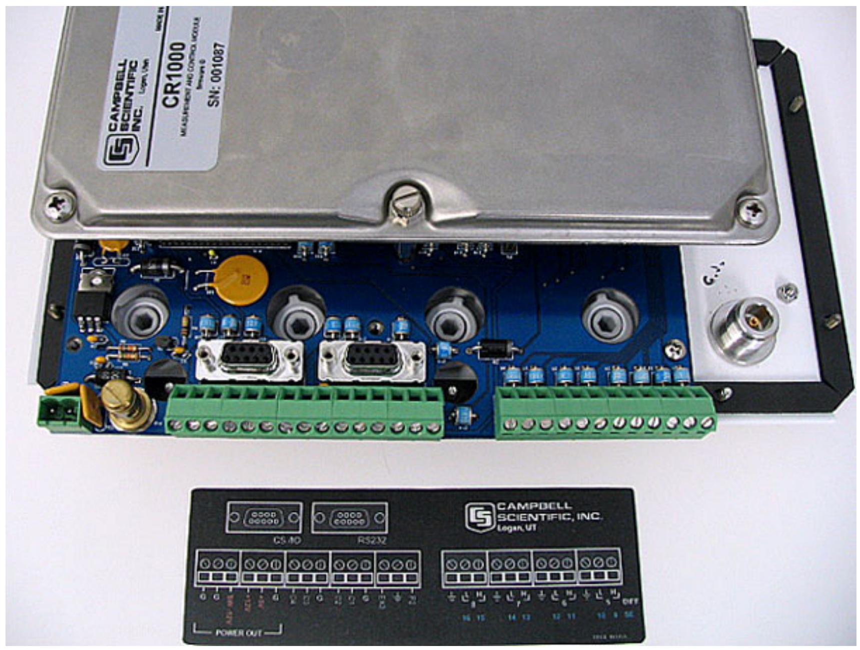

FIGURE 5.7-1. CR1000 and printed circuit wiring panel

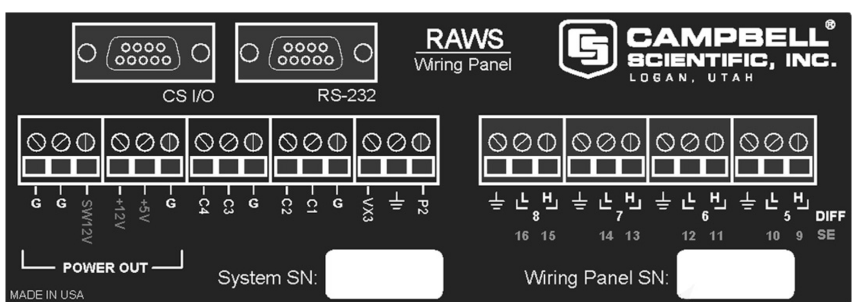

FIGURE 5.7-2. Printed circuit board wiring panel connector ID

5.7.2 Wiring, CR1000 Datalogger (part #CR1000)

The CR1000 datalogger is mounted inside the RAWS environmental enclosure and fastened to the CR1000 printed circuit board wiring panel. Connect 12 V power to the CR1000 printed circuit board wiring panel green power connector. The CH100 ON-OFF switch applies power to the 12 V terminals.

5.7.3 Troubleshooting, CR1000 Datalogger (part #CR1000)

If a problem with the CR1000 datalogger is suspected, the CR1000 may be checked by connecting the CR1000KD to the CR1000 printed circuit board 9-Pin “CSI/O” connector using our 9-pin serial cable (part #10873). The CR1000KD display should be visible. If the display is not visible, check the CR1000 printed circuit board for 12 volt power. If the CR1000 is unresponsive to CR1000KD key strokes, then there might be a problem with the CR1000 datalogger. If problems persist, try a substitute. Contact a Campbell Scientific applications engineer for assistance. Obtain a Return Material Authorization (RMA) number before returning this equipment to Campbell Scientific for repair.

NOTE Consult the CR1000 manual for more information.

6. Desiccant

6.1 When to Replace Desiccant

A humidity indicator card and desiccant packs are provided with the weather station. Place the humidity indicator card and 2 ea. desiccant packs inside the enclosure. Desiccant packets inside the enclosure should be replaced with fresh packets when the upper dot on the indicator begins to turn pink. The indicator tab does not need to be replaced unless the colored circles overrun. A humidity indicator card (part #6571) and desiccant pack (part # 4905) may be ordered through Campbell Scientific. Desiccant packs inside of the datalogger do not require replacement under normal conditions.

6.2 Reusing Desiccant

Customers can reactivate saturated desiccant packets. Care must be taken. If the heating process is too rapid, water vapor is released too quickly causing too much pressure to build up inside the packets so that the packets burst.

Standard Oven Method:

1. Bake at an oven temperature of 125ºF for 2 hours.
2. Increase the oven temperature to 175ºF and bake for 2 hours.
3. Increase the oven temperature from 245ºF to 250ºF and bake for 12 hours.

The optimum situation for reactivation is to use a recalculating oven that has a ramping temperature. The desiccant should bake for 16 hours, and the final temperature should be 245ºF to 250ºF.

7. Sensor and Equipment Maintenance

7.1 Sensor and Equipment Maintenance

Proper maintenance of weather station components is essential to obtain accurate data. Equipment must be in good operating condition, which requires a program of regular inspection and maintenance. Routine and simple maintenance can be accomplished by the person in charge of the weather station. More difficult maintenance, such as sensor calibration, sensor performance testing (i.e., bearing torque), and sensor component replacement, generally requires a skilled technician, or send the instrument to Campbell Scientific. A station log should be maintained for each weather station that includes equipment model and serial numbers and maintenance that was performed.

NOTE Consult the equipment manual for routine maintenance procedures.

NOTE Contact Campbell Scientific, Inc., phone (435) 227-9000, for a RMA number before returning sensor or equipment for service.

8. References

8.1 Specifications, Equipment and Sensor

Specifications are available from our web site at http://www.campbellsci.com/index.cfm.

For "sensors specifications," click on "Products", select "Sensors" and go to the sensor manual for specifications. For "equipment specifications", enter the part # in the "Search" box on the website mentioned above and go to the equipment manual for specifications.

NOTE Equipment and sensor specifications are provided on the ResourceDVD which ships with the RAWS

8.2 Siting References

General guidelines for site selection are listed below.

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, NC, 27711.

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

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

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

8.3 RAWS Orientation

8.3.1 Determining True North and Sensor Orientation

Orientation of the wind direction sensor is done after the datalogger has been programmed and the location of True North has been determined. True North is usually found by reading a magnetic compass and applying the site-specific correction for magnetic declination; where the magnetic declination is the number of degrees between True North and Magnetic North. Magnetic declination for a specific site can be obtained from a USGS map, local airport, or through the web calculator offered by the USGS (Section 8.3.2). A general map showing magnetic declination for the contiguous United States is shown in Figure 8.3-1.

Declination angles are always subtracted from the compass reading to find True North. A declination angle East of True North is reported as positive a value and is subtracted from 360 (0) degrees to find True North as shown Figure 8.3-2. A declination angle West of True North is reported as a negative value and is also subtracted from 0 (360) degrees to find True North as shown in Figure 8.3-3. Note that when a negative number is subtracted from a positive number, the resulting arithmetic operation is addition.

For example, the declination for Longmont, CO is 10.1°, thus True North is 360° - 10.1°, or 349.9° as read on a compass. Likewise, the declination for Mc Henry, IL is -2.6°, and True North is 0° - (-2.6°), or 2.6° as read on a compass.

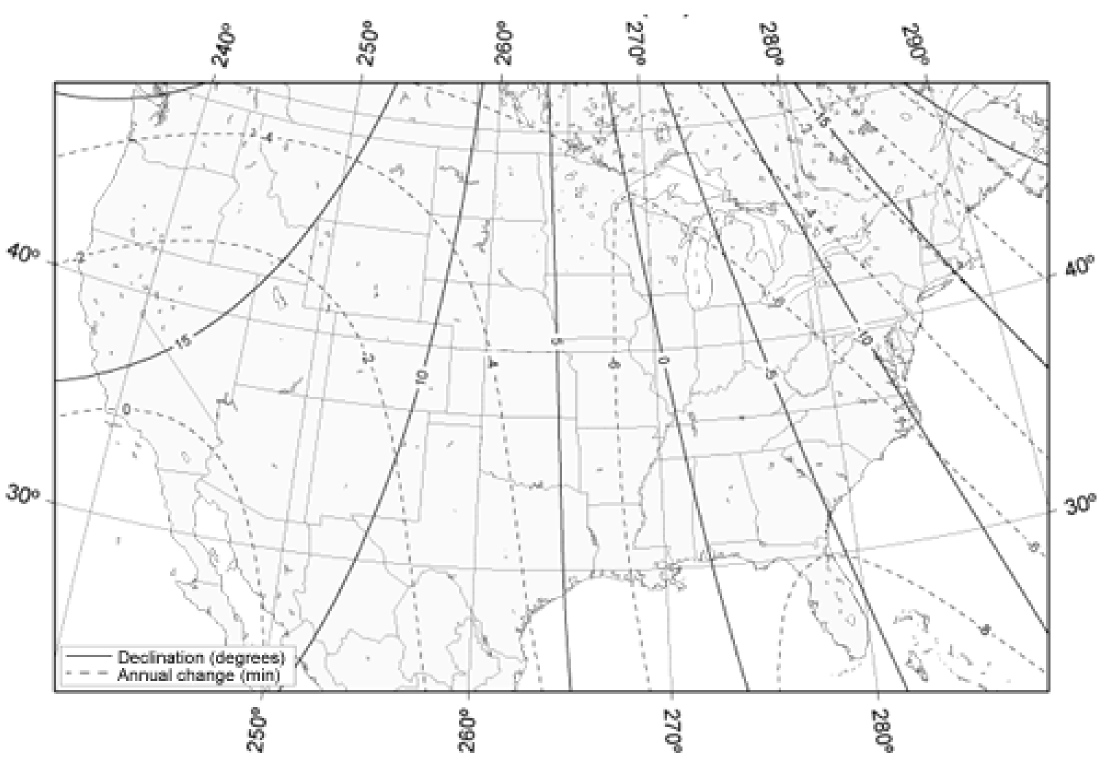

FIGURE 8.3-1. Magnetic declination for the contiguous United States

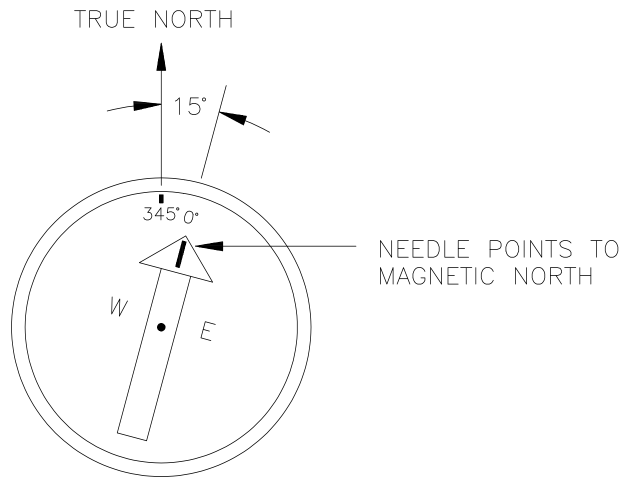

FIGURE 8.3-2. A declination angle East of True North (positive) is subtracted from 360 (0) degrees to find True North

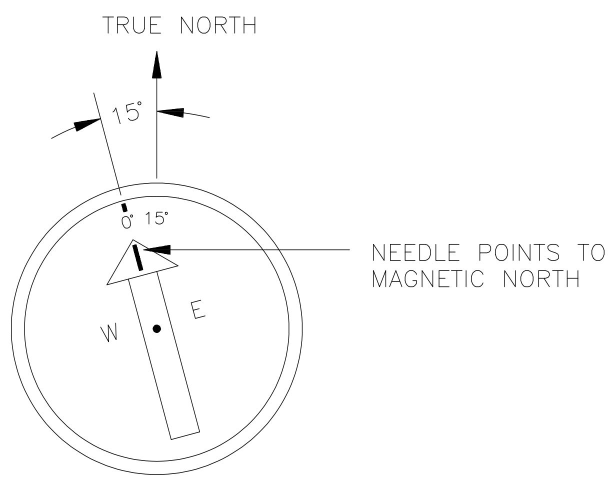

FIGURE 8.3-3. A declination angle West of True North (negative) is subtracted from 0 (360) degrees to find True North

8.3.2 USGS Web Calculator

The USGS provides an easy way of determining declination of a specific site. Since magnetic declination fluctuates with time, it should be adjusted each time the wind sensor orientation is adjusted. The calculator can be accessed at: www.ngdc.noaa.gov/geomagmodels/Declination.jsp. Figure 8.3-4 shows an example for Logan, UT.

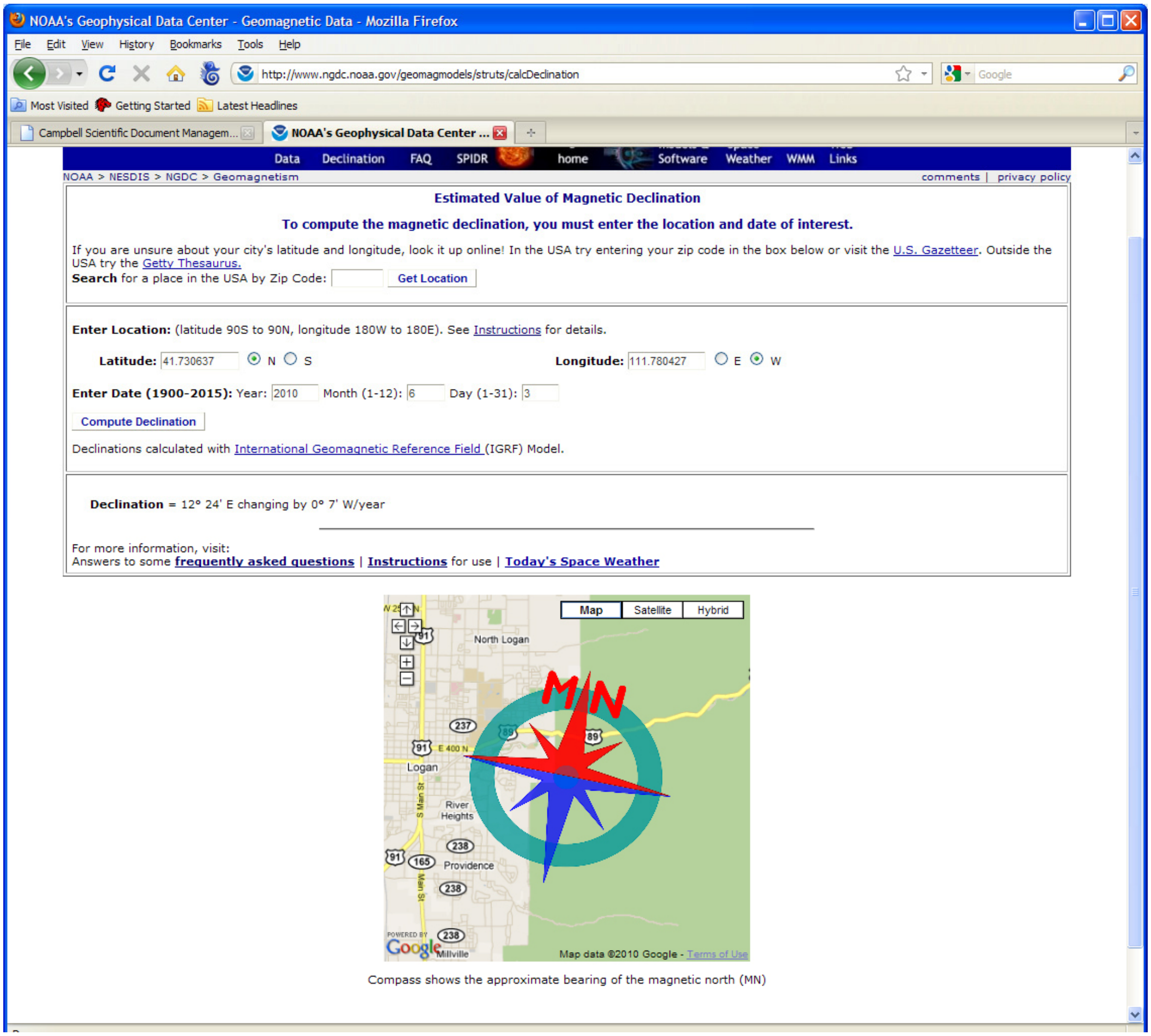

FIGURE 8.3-4. USGS Web Calculator

In the example above the declination for Logan, UT is 12º 24′ or 12.4º. As shown in Figure 8.3-4, the declination for Utah is East (positive), so True North for this site is 360 – 12.4 = 347.6 degrees. The annual change is 7 minutes West per year or -7 minutes/year.

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