

INSTALLATION MANUAL



Basic Weather Station BWS-200 (including ETo Variant)



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PLEASE READ FIRST

About this manual

Some useful conversion factors:

Area: 1 in² (square inch) = 645 mm²

Length: 1 in. (inch) = 25.4 mm
1 ft (foot) = 304.8 mm
1 yard = 0.914 m
1 mile = 1.609 km

Mass: 1 oz. (ounce) = 28.35 g
1 lb (pound weight) = 0.454 kg

Pressure: 1 psi (lb/in²) = 68.95 mb

Volume: 1 UK pint = 568.3 ml
1 UK gallon = 4.546 litres
1 US gallon = 3.785 litres

Recycling information



At the end of this product's life it should not be put in commercial or domestic refuse but sent for recycling. Any batteries contained within the product or used during the products life should be removed from the product and also be sent to an appropriate recycling facility.

Campbell Scientific Ltd can advise on the recycling of the equipment and in some cases arrange collection and the correct disposal of it, although charges may apply for some items or territories.

For further advice or support, please contact Campbell Scientific Ltd, or your local agent.



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Basic Weather Station BWS-200



1. Introduction

Thank you for buying a Campbell Scientific Basic Weather Station. We recommend that you begin by reading this Installation Manual carefully before attempting to assemble, set-up and use the weather station, as it contains important information about siting, assembly and maintenance.

This manual also explains how to set up and connect both the standard and optional components of the Basic Weather Station. Most components are supplied as separate units for you to mount in any appropriate location. A simple low-cost mast, designed to be mounted into a concrete filled hole, is available as an optional extra.

The manual also includes introductory information about setting up communications with your weather station. Using this information you should be able to start making measurements straight away.

Separate manuals are provided for the datalogger, sensors and any optional peripherals which give additional technical information on these devices.

1.1 Documentation

The documentation supplied with your BWS200 consists of the following:

- Manual for the BWS200 (this document)
- Manual for the CS215 Temperature and Relative Humidity Sensor which is fitted as standard in the BWS200

- Manual for the Wind Sentry Wind and Direction Sensor which is fitted as standard
- Manual for the optional ARG100 Raingauge if ordered with your BWS200
- manual for the optional CS300 Solar Radiation sensor if ordered with your BWS200
- Manual for the CS100 Barometric Pressure sensor if ordered with your BWS200
- Disk containing a full version of PC200W software
- Disk containing a copy of the program running in your BWS200

1.2 Component Parts

Carefully unpack your equipment and check you have the following:

03002-5 Wind Sentry C/W junction box
Adapter $\frac{3}{4}$ pipe for 03002-5 Wind Sentry
Clamp M6 'V' bolt
Clamp V bracket
Desiccant Desipack 4 units
BWS200 Support Software (CD)
PC200W Starter Software for Windows (CD-Rom)
BWS200 Enclosure with logger and power supply

Are any components missing or damaged?

Do you have all the necessary tools for assembly?

Refer to Sections 4.1 and 4.2.

2. Choosing the Location

For optimum results, the siting of the Basic Weather Station is crucial. This section briefly describes several factors which can affect the results obtained. Please read through this information before deciding where to locate your weather station, and try to minimise as many factors as possible that may adversely affect your data.

The objective of any data collection exercise is to obtain data that is accurate, reliable and representative. Accuracy and reliability depend mostly on the correct selection and use of sensors. Data representativeness refers to the extent to which the values recorded are typical of the site or location in which the sensors are placed.

Weather stations are often used to provide local meteorological measurements that otherwise could only be obtained from a 'standard' meteorological site, perhaps some inconvenient distance away. In this case the weather station should be exposed in a similar way to the instruments on the standard site, i.e. over a short grass surface that is level and not shielded by trees or buildings. The standard site is designed to allow representative measurements of local weather and not of a specific microclimate.

In other cases, a weather station is required to measure the true conditions at a site — possibly to determine how much these differ from the standard conditions measured over a regional network of meteorological stations. Here, the weather station should be exposed over a relatively uniform area of terrain. Some care is required in interpreting the measurements obtained, however, because gradients of air temperature, humidity and wind speed increase as the distance from the surface decreases.

As an example, consider a weather station sited in a crop of newly planted corn with the anemometer 2m above the ground. The measured wind speed will decrease markedly as the crop grows because the distance between the instrument and the surface is continually reducing. At harvest the anemometer may be only 20 or 30cm above the upper foliage and the measured wind speed will be slow. This is a true representation of conditions at the height of the anemometer; it is effectively a microclimatic measurement that is not representative of the general conditions in the region.

2.1 The Effects of Varying Environmental Conditions

This section describes three ways in which local conditions such as moisture or the presence of vegetation can affect the measurements taken by a weather station. These effects are well documented and further details can be found in the meteorological literature.

2.1.1 The Clothesline Effect

The 'clothesline effect' in its simplest form describes the effect of air passing from dry, un-vegetated surfaces to moist, vegetated surfaces and the consequent effect on vapour gradients and heat transfer. This should be carefully considered when siting a weather station in crops or near trees when the wind direction is mostly towards the vegetation.

2.1.2 The Leading Edge Effect

This effect occurs when air moves over a surface that differs in temperature, moisture content, roughness or some other characteristic from an adjacent surface. The line of discontinuity is known as the leading edge. As air passes over the leading edge its characteristics gradually adjust to the new surface. This internal boundary layer varies in vertical extent with distance from the leading edge. A transitional zone exists where the air is modified but not adjusted to the new surface. These effects become most pronounced when advection (horizontal air flow) is strongest. There are no universally accepted figures for the height of this internal boundary layer as it is influenced by the nature of the surface and the extent of any advection.

2.1.3 The Oasis Effect

The 'oasis effect' occurs when an isolated moisture source is surrounded by an otherwise arid region. If the wind direction is such that moist air is drawn from the surface of the water body (or other water source such as a glacier or area of vegetation), then the relative humidity measurements do not represent the general conditions in the region.

2.2 Obstructions

Whenever possible, the weather station should be located away from windbreaks or shelterbelts. Several zones have been identified upwind and downwind of a windbreak in which the airflow is unrepresentative of the general speed and direction. Eddies are generated in the lee of the windbreak and air is displaced upwind of it. The height and depth of these affected zones varies with the height and to some extent the density of the obstacle.

Generally, a structure disturbs the airflow in an upwind direction for a distance of about twice the height of the structure, and in a downwind direction for a distance of about six times the height. The airflow is also affected to a vertical distance of

about twice the height of the structure. Ideally, therefore, the weather station should be located outside this zone of influence in order to obtain representative values for the region (see Figure 1).

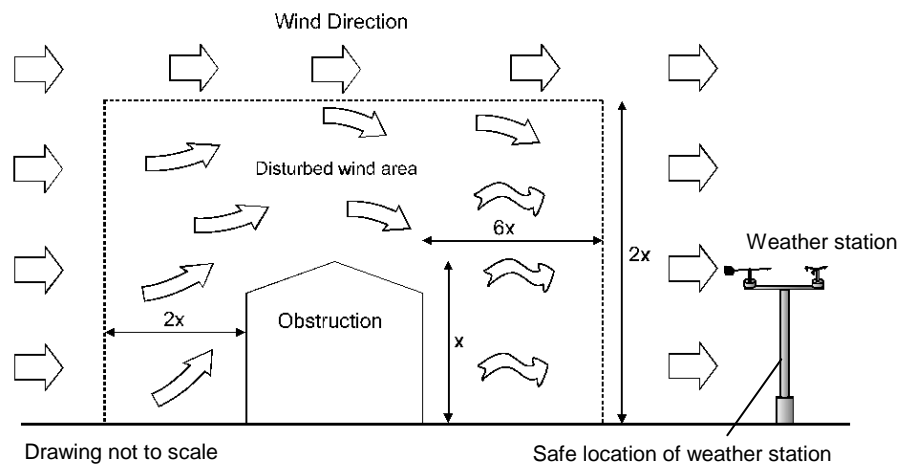


Figure 1 Effect of Structure on Air Flow

2.3 Siting on Roofs

Weather stations are commonly located on roof surfaces and interrogated from a room below. There are several inherent problems with this. The urban environment can generate its own climate and even smaller scale microclimates are possible, depending on the building materials and design. High air temperatures caused by heat convected or conducted from the surface of the building are the most obvious source of error. Also, the physical and radiative properties of the building fabric are important, for example, in determining heat loading.

2.4 The Effects of an Urban Environment

The impervious nature of an urban surface compared to surrounding rural areas, together with the efficient channelling of water as surface run-off, leads to a generally drier environment. However, the ponding of water that occurs, for example, on flat roofs, can also lead to local areas of high relative humidity.

Wind speeds are generally lower in urban areas compared to more exposed rural locations. However, aspects of city design and building geometry can combine to create areas of high or low wind speeds because of the funnelling of air.

3. What You Get with Your Basic Weather Station

3.1 Standard Equipment

- Fibreglass Enclosure with integral, rechargeable, lead-acid battery power supply unit (to supply power to the datalogger).
- SOP5 Solar Panel, mounted on the door of the enclosure, for charging the battery.
- CR200X Series Datalogger.
- Wind Speed and Direction Sensors (R M Young's Wind Sentry Anemometer and Vane) complete with junction box.

- CS215 Temperature and Relative Humidity Probe, T351-RS Solar radiation Shield, mounted on the underside of the enclosure
- Manuals for the datalogger and sensors.
- CD containing the datalogger program plus the PC200W Datalogger Support Software package.

3.2 Optional Equipment

- SPM2 Simple Pole Mast (designed to effectively mount all the above equipment).
- CM10/2 instrument tripod (2 metres)
- ARG100 Tipping Bucket Rain Gauge.
- CS300 Radiation sensor (required for Evapotranspiration calculations)
- The CS100 Barometric pressure sensor.

The Basic Weather Station comes ready programmed for immediate use. For more details of the program, giving information on measurements and data storage, please see Appendix A. A backup copy of the program is supplied on CD.

Our datalogger software support package PC200W will allow you to re-program the datalogger using 'Short Cut', a point-and-click program generator, but we recommend that you do not attempt any form of reprogramming until you are thoroughly familiar with both the operation of your weather station as a whole, the CR200X Series Datalogger and the PC200W package in particular.

4. Installation

The Basic Weather Station components can be fitted to any suitable mounting, bearing in mind the effects of the environmental conditions as described in Section 1 of this manual.

Campbell Scientific can supply a suitable low-cost mounting pole, as shown in Figure 2.

Under normal conditions, assembly should take one person less than two hours (not including the cure time for concrete in the mast foundations). However setting the windvane to true north might be easier with two people.

4.1 Installing a Mounting Mast

If you will be mounting your Basic Weather Station on a pole type mast, it is recommended that it is mounted into a concrete filled hole, to provide stability, as shown in Figure 2 for the Campbell Scientific SPM2 mast.

The Campbell Scientific SPM2 Mast as it is specially designed for the Basic Weather Station and comes complete with a stabilisation bar which is concreted into the foundations. The main mast diameter is 42.9mm (1½" nominal bore pipe) reducing to a top mast diameter of 26.9mm (¾" nominal bore pipe).

If you are using your own mounting mast or pole, the dimensions should closely match those given above, so that the enclosure can be mounted on the main section, and the Wind Sentry bracket can be mounted on the reduced top portion as shown in Figure 2.

To install the mast securely into the ground you will need:

- A spade and/or shovel
- A pickaxe
- A concrete trowel
- Sufficient concrete mix for a 300mm square x 600mm deep hole (including water supply etc. if mixing concrete on site)
- A spirit level

Install the mast as follows:

1. Locate a suitable position for the weather station. Ensure that the ground consistency is not too loose, and will be able to support the mast and concrete foundation.
2. Dig a hole at least 300mm square by 600mm deep (see Figure 2).
3. Fit the 'anti-spin' bar into the hole towards the lower end of the mast, and secure in place with the two nuts supplied.
4. Set the SPM2 Mast into the centre of the hole and temporarily pack it with suitable material so that it is vertical.
5. Mix the concrete and pour into the hole removing any temporary packing. It is very important to ensure that the mast is vertical – periodically *check with a spirit level* and make adjustments as necessary. Double check that the mast is vertical before the concrete starts to cure.
6. Allow at least 24 hours for the concrete to cure properly before attempting to fit the instrumentation.

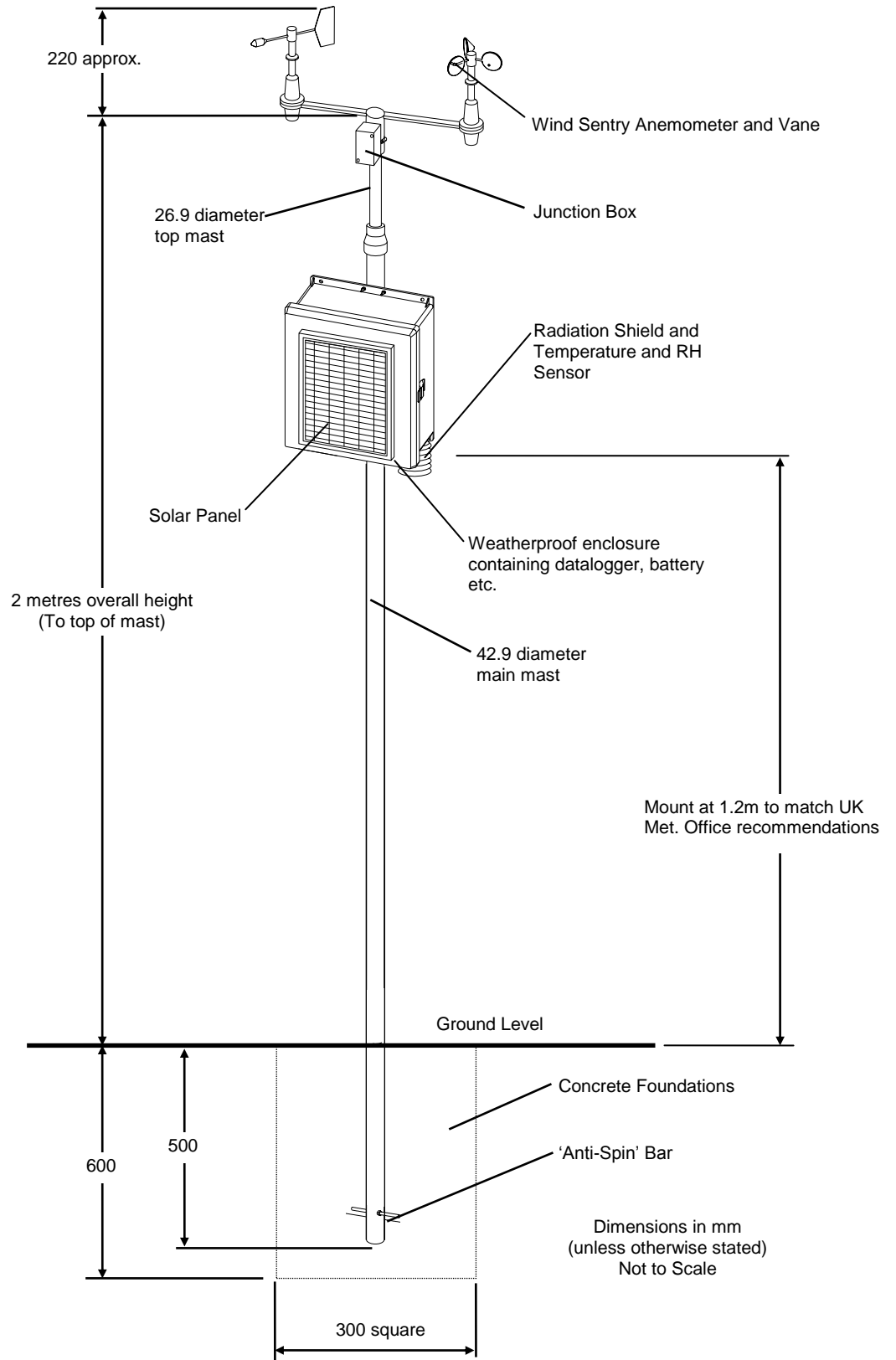


Figure 2 Basic Weather Station Mounted on Optional SPM2 Mast

4.2 Installing the Enclosure and Sensors

To install the enclosure and sensors you will need:

- A spirit level
- A tape measure
- An adjustable spanner
- A range of standard and Phillips screwdrivers
- A compass (for wind direction orientation)
- Cable ties
- A set of Allen hex keys (at least a 3/16")

4.2.1 Mounting the Enclosure

Mount the enclosure onto the mast at a suitable height using the notched brackets and 'V' bolts as shown in Figure 3, below. Adjust the position of the enclosure to achieve the best exposure of the solar panel. When installing in latitudes greater than 30 degrees from the equator, point the solar panel towards the equator, e.g. facing due South in the Northern hemisphere. If the installation is within 30 degrees of the equator, the panel should be pointed towards the East to capture energy from the sun during the morning (rather than mid-day when the sun is overhead). It is important to ensure that no shadows fall on the panel from other structures or vegetation.

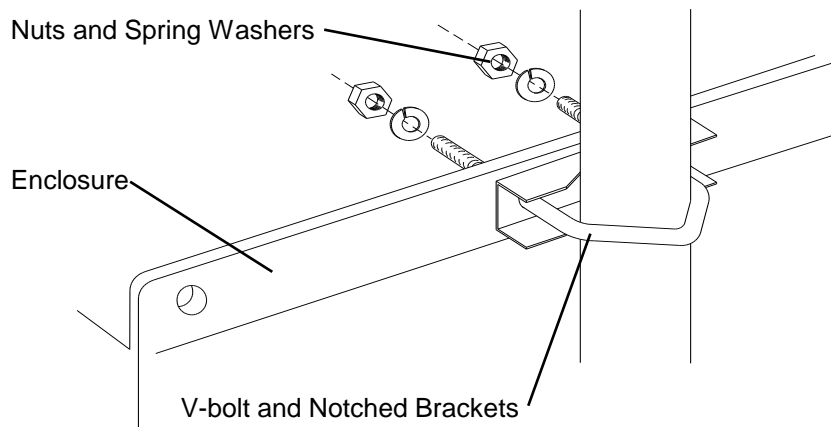


Figure 3 Mounting the Enclosure

4.2.2 Installing the Standard Sensors

Install all the sensors, carefully following the instructions and wiring diagrams given below. If you need further advice on the installation and operation of specific sensors, please read the installation manual provided for that sensor. Handle all sensors and wiring with care. Rough handling can damage both the mechanical and electrical integrity of the sensors.

CS215 Temperature/Relative Humidity Probe

The CS215 is fully integrated into the T351-RS Radiation Shield on the underside of the enclosure and wired into the datalogger before despatch.

The sensor can be removed for periodic inspection/maintenance from inside the enclosure. Loosen the large gland nut retaining the CS215 and gently pull upwards on the threaded part of the sensor until it is completely removed. Do NOT pull the sensor up by the cable, as you may damage it. Replace the sensor by re-inserting it into the radiation shield through the gland until the threaded portion of the sensor is about 3mm above the main gland body. Re-tighten the gland nut.

Wind Sentry Wind Speed and Direction Sensors

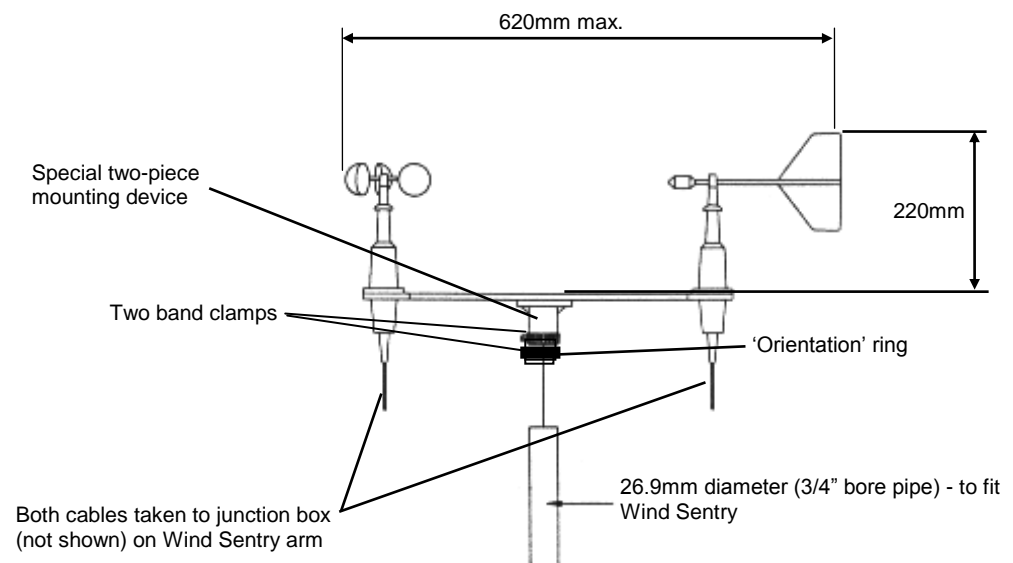


Figure 4 Wind Sentry Mounting

The 03002-5 Wind Sentry is provided with a mounting bracket which fits directly to a 26.9mm outside diameter (3/4" nominal bore) pipe. The mounting device consists of a two-piece male/female spigot, and is fitted with two band clamps. The lower 'orientation' clamp secures the equipment to the mast. By loosening the upper clamp, the complete bracket and sensors can be removed for maintenance, and, by means of the spigot, replaced in exactly the same orientation, saving the time and effort required in re-aligning the wind sensor to true north (see below).

Mount and align the Wind Sentry as follows (refer to Figure 4, above):

1. Ensure that the upper band clamp is fully tightened.
2. Open the lower 'orientation' clamp sufficiently so that the complete assembly will easily slide onto the top of the mast.
3. Mount the complete Wind Sentry onto the top of the mast; only lightly tighten the lower band clamp so that the assembly can be easily rotated.

4. Determine the position of *true* north and align the Wind Direction sensor to this bearing, carefully following the instructions given in Appendix B.
5. After the sensor is correctly aligned, fully tighten the lower clamp so that the Wind sentry is secure. Double check that the direction sensor is still pointing to true north.

You will need to connect the Wind Sentry into the datalogger. The Wind Sentry is supplied with a 3 metre length of cable, pre-wired into its junction box and ready for connection to the datalogger. Take the cable through one of the smaller cable entry glands on the lower face of the enclosure, and wire into the datalogger terminals as indicated below.

Other lengths of cable for your specific installation can be supplied to order by Campbell Scientific. If you are using your own cable it must match the specifications set out in the Wind Sentry manual. Remove the existing cable from the Wind sentry junction box, carefully noting the wire colours/connection position, and wire up the replacement cable using the old cable as a template.

CAUTION

Never connect an additional piece of cable to existing cable, as this may cause errors and sealing problems.

Table 1 Wind Sentry - Datalogger Connections	
Wire colour	Datalogger connection
Clear	G
Black	G
White	Ground
Green	SE1
Red	P_LL
Blue	EX1

4.3 Optional Sensor Connections

4.3.1 Installing the Optional Raingauge

In addition to the standard sensors provided with the Basic Weather Station, you may wish to fit the ARG100 Tipping Bucket Raingauge. Wiring and program details for the ARG100 raingauge are discussed in Appendix A.

See the separate ARG100 manual for full installation, operational details and specifications.

4.3.2 Installing the Optional Radiation Sensor

In addition to the standard sensors provided with the Basic Weather Station, you may wish to fit the CS300 Radiation Sensor. This sensor is required to obtain meaningful Evapotransporation data. Wiring and program details for the CS300 Radiation Sensor are discussed in Appendix A. A suitable cross arm to support the sensor can be obtained from Campbell Scientific.

See the separate CS300 manual for full installation, operational details and specifications.

4.3.3 Installing the Optional Barometric Pressure Sensor

In addition to the standard sensors provided with the Basic Weather Station, you may wish to fit the CS100 barometric Pressure sensor. Wiring and program details for the CS100 sensor are discussed in Appendix A. The CS100 Barometric Pressure sensor is normally fitted inside the enclosure alongside the battery, datalogger and CS215 Temp and RH sensor. A breathable ceramic plug is fitted to the underside of the enclosure in one of the cable glands to ensure internal pressure is balanced with atmospheric pressure.

See the separate CS100 manual for full installation, operational details and specifications.

4.3.4 Installing the Other Sensors

The CR200X datalogger which lies at the heart of the BWS200 weather station is a powerful and versatile measurement tool that can connect to a wide variety of sensors. If you would like to use it to collect other parameters please contact Campbell Scientific.

4.4 Installing Grounding and Lightning Protection

Your weather station must be properly grounded by taking a ground wire from the brass grounding lug in the lower face of the enclosure to an adequate grounding point. The mast and foundations of a mast mounted installation will provide some basic lightning protection. An optional full grounding system is available for high risk applications if required. See 'Warning', below.

WARNING

The grounding system supplied with the weather station is designed to give the system protection against induced transients and secondary lightning discharges. While the system does offer some protection against lightning damage, if the weather station is installed at a site where frequent direct lightning strikes are likely, Campbell Scientific recommends that you seek the advice of a specialist lightning protection company.

4.4.1 Installation Using the SPM2 Mast

If you have purchased the optional SPM2 Mast, you will receive a grounding clamp (see Figure 5) and a length of suitable cable. The foundations of the mast will provide a good ground. Connect one end of the cable to the grounding lug on the enclosure, and the other end to the mast, using the grounding clamp. Ensure good electrical contact throughout.

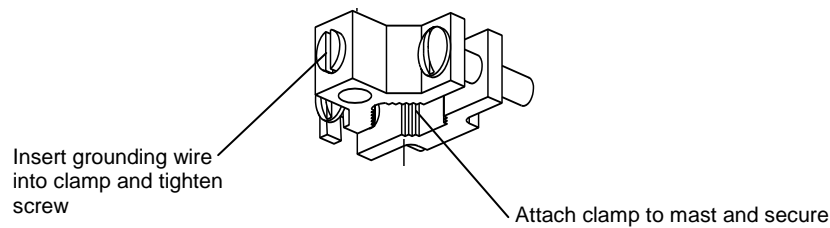


Figure 5 Grounding Clamp

4.4.2 Other Installations

For installations other than those with the SPM2 Mast, you must ensure adequate grounding facilities. If you are mounting the weather station at a high level (on a roof etc.) you must run a grounding wire to a good ground point. A full grounding system, including clamps and ground spikes, can be provided if required. Please contact Campbell Scientific for price and further details.

5. Installing a Communications Link

There are several ways to communicate with the datalogger in your Basic Weather Station in order to retrieve data. The most common, and recommended, method is to use a direct link to a computer, either a laptop on site, or connected to a desktop PC at any convenient location using an appropriate interface package. As a further option, communication can be carried out by using a remote communications package with a modem to transmit data, either via the public telephone network or by one of the cellular networks.

Please contact Campbell Scientific if you require assistance in selecting an appropriate interface.

5.1 Communication Directly to the PC

For computer/weather station distances of up to 15 metres the simplest method is direct connection from the PC Serial Port to the RS232 Port on the CR200X Series datalogger.

NOTE

Many customers have successfully used this type of set up for distances of up to 75 metres, but success will depend on a number of factors, including cable type and size. Campbell Scientific cannot, therefore, guarantee effective communication quality at distances more than 15 metres. A long connection is also more vulnerable to lightning damage and so you would need to consider extra lightning protection measures.

For distances over 15 metres consider using a communications link using either MD485 Multidrop Interfaces or the CR216X radio datalogger. See following page.

5.2 Other Communication Options

If you have ordered your BWS200 with an alternative communications option then please refer to the manual for that option for further information on setting up the communication link. If you have bought the basic BWS200 then communication

options which you can add to your BWS200 are outlined below. Note that all will require additional software running in both the logger and the PC.

5.2.1 Short Haul Modem

Campbell Scientific is able to provide a Short Haul point to point communications package with modems for either end of a fixed line cable to be supplied by the customer. Distances up to 25km are possible via this method. This popular option can be bought as a complete package and installed by the user.

5.2.2 Multidrop Communications

As the name implies Multidrop communications allows a number of weather stations to sit on the same data bus. For example a number of weather stations located around a farm might all be connected together in a ring, star or line formation onto the same cable. Campbell Scientific's MD485 interfaces will direct the communications to the appropriate station.

5.2.3 Radio Communications

Short range radio communications are also possible but would require an alternative logger and so must be specified before ordering or will require your unit to be returned for upgrade.

Note that all of the above options will require additional software either in the logger and/or in the PC. The cordless methods in particular will also have a major impact on the power budget of the unit and steps will need to be taken to minimise power loss. Please contact Campbell Scientific for more details and advice.

The following communications connections require either PC400 or LoggerNet software:

5.2.4 PSTN Telephone Connection

Where your weather station has access to a fixed line telephone connection you can add a COM200E telephone modem and dial the logger up from your PC.

5.2.5 GSM/GPRS Modem

To connect via the GSM mobile network you will need a CS-GSM/GPRS kit including a GSM modem, antenna and connection leads. A Data SIM card should be obtained from your local authorised reseller. Refer to the manual.

5.2.6 Internet Access

To access your data via an Ethernet connection kit you will need a configured NL201 network module.

6. Final Installation Details

1. Secure all grounding wire and sensor cables to the mast (if used) or other suitable place.

CAUTION

It is essential to secure any excess sensor cables to the mast, or other suitable point. Unsecured cable can blow around in the wind, and may cause the wires inside to break, often without any external signs of damage.

2. Ensure that all cable entries are properly sealed by tightening the cable gland firmly. Ensure that all unused cable glands on the enclosure are sealed with the aluminium plugs provided.

7. Power-Up the Datalogger

When all the sensor wiring is complete, including adequate grounding, and your chosen communications link is in place, power up the datalogger (inside the enclosure) prior to establishing communications.

Power-up your datalogger as follows:

- a) Open the enclosure and identify the power connections for the battery. There are two spade terminals on the battery.
- b) Attach the spade connectors to the battery, observing the correct polarity – the connector with the red wires is positive, the connector with the black wires is negative. Push the connectors onto the appropriately marked battery terminals. The CR200X Series Datalogger will then turn on.
- c) After connecting power to the datalogger, leave it for at least one minute to complete its self power-up tests.

8. Establish Active Communications

Your Basic Weather Station comes ready programmed for standard and optional sensors. It is programmed using Short Cut, an easy to use program builder, which is part of Campbell Scientific's Datalogger Support Starter Software Package, PC200W. Short Cut determines the correct wiring and produces appropriate wiring diagrams (as described in Appendix A).

CAUTION

Always wire the sensors to the datalogger as described in Appendix A. Failure to do this will produce incorrect readings and may possibly damage the sensors.

8.1 Using a Personal Computer Running PC200W

As part of your Basic Weather Station system, you will be provided with a copy of PC200W Datalogger Support Software package. This Windows program will allow you to view the data, communicate with the weather station and to re-program the datalogger if required, using the built-in program generator, Short Cut.

Install PC200W onto your computer by following the instructions on screen. After installation, use the datalogger program as follows:

1. Ensure that you have connected your computer and weather station as detailed in Section 5.

If you intend to use a different interface consult the instruction manuals for the appropriate device.

2. After powering up the datalogger as described in Section 7, above, use the setup/connect tab in PC200W. Click on "Add" and follow the EZSetup instructions.

PC200W EZSetup Settings for BWS200

Communication Setup

Choose the CR200X Series logger from the scrolling list.

Datalogger name: Enter a name up to 12 digits (CR200X Series is default)

CLICK NEXT >>

COM Port: COM1

COM Port Communication Delay: 00 Seconds

CLICK NEXT >>

DataloggerSettings

Baud Rate: 9600

Security Code:

Extra Response Time: 00 Seconds

CLICK NEXT >>

Setup Summary

CLICK NEXT >>

Communication Test

Check Yes

CLICK NEXT >>

If communication is unsuccessful then

- a) ensure power is switched on (see section 7)
- b) use standard RS232 lead provided and connect direct to station
- c) contact Campbell Scientific

Datalogger Clock

Check the dataloggers clock and reset if required.

CLICK NEXT >>

Send Program

Do not send a program. Your BWS comes pre loaded with one.

CLICK NEXT >>

Wizard Complete

CLICK NEXT >>

NOTE

If you have more than one Basic Weather Station, you will have to set up a different datalogger (with a different, unique, name) for each station to ensure that data from each station is collected properly.

3. The first thing to do when communications are established is to set the datalogger clock using PC200W.

9. Checking the Datalogger Clock (Date/Time) Setting

The CR200X Series Datalogger used in the Basic Weather Station contains the program in non-volatile flash memory, and this will be retained even when the main battery power supply is removed. The clock (date and time) settings are also battery-backed, and will be retained when the datalogger is powered down. Although your datalogger will have the date and time set before despatch, you should check the current settings to ensure that they conform to your specific requirements, as detailed below.

9.1 Using a Personal Computer Running PC200W

You can synchronise the datalogger clock with the computer clock by pressing the 'Set Clock' button on the PC200W main screen. PC200W will communicate with the CR200X Series Datalogger and set its clock time to match your computer time. Of course, if your computer time is incorrect, the datalogger time will also be incorrect!

The datalogger clock can be offset from the computer clock in one hour increments, up to plus or minus 24 hours. Use the up arrow or down arrow to select an offset (or type in a new value over the old), then press 'Set Now' to implement the change.

10. Running the Datalogger Program and Viewing Measurements

Now that you have established communications and set the datalogger clock, you will probably be anxious to view the measurements being obtained by your weather station. Measurements can be viewed on the computer using PC200W. Measurements from the sensors are stored as Publicly accessible variables on the datalogger. These locations each have their own label (name) for easy identification. See Appendix A for details of the programs supplied with your Basic Weather Station.

10.1 The Datalogger Program

The datalogger program supplied with your Basic Weather Station has been carefully designed to suit most applications. Program details are discussed further in Appendix A.

This program includes information for the optional sensors. If you do not have the optional sensors fitted please disregard the values returned. Details of which values are generated from which sensor input can be found in Appendix A.

The datalogger can be re-programmed using 'Short Cut' to suit more specific requirements. Before attempting to construct a new program, or modify the existing program, please ensure that you are fully conversant with the operation of the weather station, the datalogger and the PC200W software. Please consult Appendix A for more information.

10.2 Viewing/Monitoring Incoming Measurements

You can monitor the measurements in real time by in the following way:

1. Connect your PC to the datalogger
2. Open up PC200W
3. Click on “Setup/Connect” tab on the main PC200W screen.
4. Click on the “Connect” button to initiate communication with the datalogger.
5. Click on the “Monitor Values” tab on the main PC200W screen.
6. Click on the “Add”
7. A list of all the items that can be monitored will then show up. The public variables are listed under “Public” and can all be selected together by clicking on the first one, pressing shift and clicking on the last. Then click on paste and all the variables along with their real time current values should appear in the main screen of PC200W.
8. You can observe them changing every 10 seconds as the sensor outputs change.

A typical screen shot for the Basic Weather Station running the standard program is shown in Figure 6, below. Please see Appendix A for details of each measurement.

RecNum	2.00					
TimeStamp	17:40:35					
Batt_Volt	13.12					
AirTC	23.90					
RH	63.00					
WS_ms	2.10					
WindDir	236.50					
Rain_mm	0.20					
Solar_W	540.00					
Solar_kJ	5.40					
WindRun_m	21.00					
TdC	16.45					
BP_mBar	1,024.00					

Connection Time 0:15:31

Figure 6 Monitor Values Screen showing measured values

10.3 Collecting and Viewing Recorded Data

Initiate data collection by clicking on the ‘Data Collection’ button on PC200W’s Main Screen. On the Data Collection Screen you will be given the option to collect data from the datalogger by clicking the ‘Collect Now’ button. You choose *what data to collect* and where to *collect it to*.

You should choose to collect data from the Datalogger Tables by checking the checkbox against Table1 and Table2 (see Figure 7).

You can choose to:

- append just *new* data (since the last data collection) to an existing data file – (this is the normal mode of operation), or
- overwrite *all* data from the datalogger to an existing file, or
- write data to a new data file.

The file selection box allows you to specify the appropriate file name and location.

Data is normally collected in a table format for easy use in data manipulation packages and spreadsheets.

The Final Storage area can hold a considerable amount of data in memory. When it becomes full, the earliest data is overwritten in a continuous cycle. The Basic Weather Station will store approximately three months of data if using the standard program,

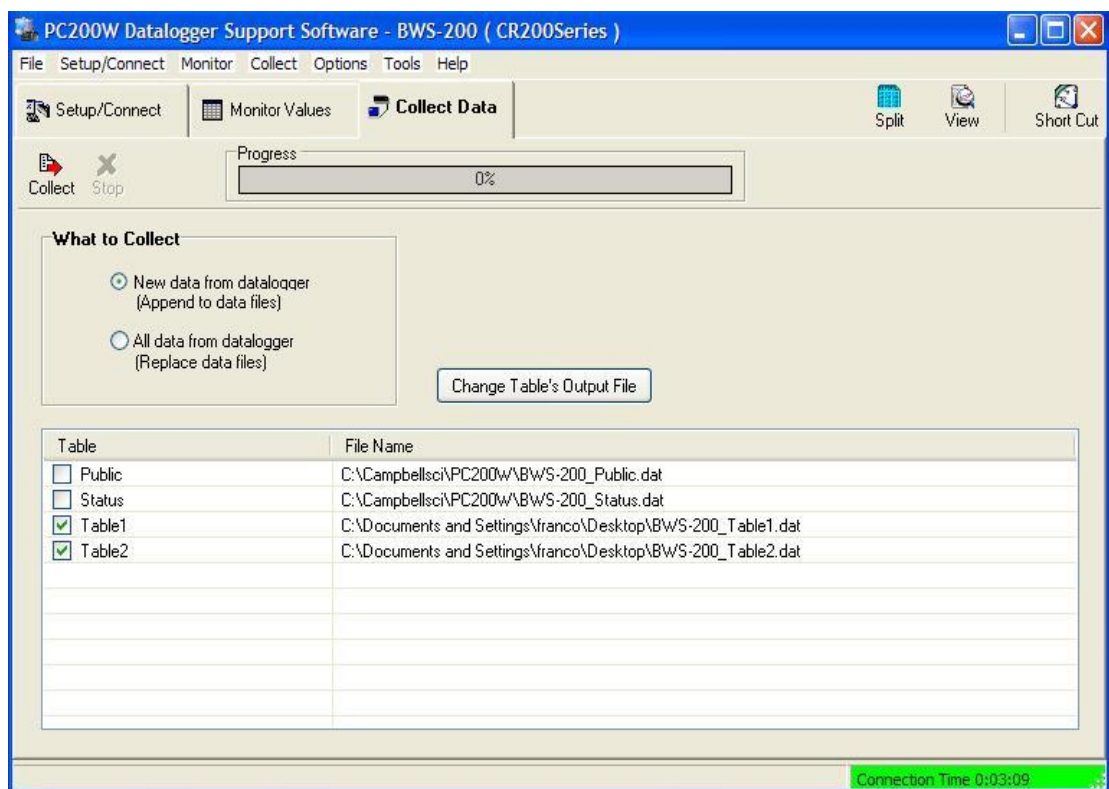


Figure 7 Data Collection Screen

11. Maintenance

The whole Basic Weather Station is designed for prolonged use in field conditions, and so requires minimal maintenance. However, some recommendations for specific items of equipment are given below. If your weather station site is subject to particularly severe environmental conditions, you may wish to devise your own maintenance schedule based on these conditions.

11.1 Enclosure

The enclosure is made from fibreglass and is completely weatherproof. There is minimal maintenance required, but particular care should be taken to the points listed below.

11.1.1 Cable Entries

Care should be taken that all cable entries on the enclosure are properly sealed. Ensure that the cable gland grips the cable tightly to ensure a proper seal. This is particularly true of the gland on the top surface of the enclosure. Any unused glands are blanked with the blanking plugs provided, which provide a good seal.

11.1.2 Desiccant

The enclosure contains packages of desiccant, which helps to reduce water vapour, and should be regularly replaced. The frequency of replacement will depend on how often, and for how long, the enclosure door is opened. In general the desiccant will last for about 4-6 months if the enclosure door is opened for a few minutes each week. More frequent changes of desiccant may be required in very wet or humid conditions.

Some desiccant packs have an indicator which is blue when the desiccant is dry, but which will turn pink as moisture is absorbed. When the desiccant fully changes colour it should be replaced.

Used desiccant packs may be re-used if dried by placing in an oven at 120°C for 16 hours.

Ensuring all cable entry ports are properly sealed, as described above, will help prolong desiccant life.

11.2 Regular Inspection

The Basic Weather Station is designed to operate remotely, without attention, for long periods of time. However, regular preventative maintenance will pay dividends, and so the station should be visited at regular intervals depending on environmental conditions, its usage and the accuracy of measurements required from the station.

Suggested schedules are given below, but these can be modified to suit your own circumstances.

11.2.1 General

Every six months or so (and at least once a year) check all parts for misalignment and damage. Check for any corrosion and apply suitable rust inhibitors, and check and /or change the desiccant pack in the enclosure as detailed above. More regular inspections are advised in very wet or humid conditions, or after severe storms.

CAUTION

Do not allow any contact between rust proofing compounds and the datalogger or sensors. In particular, avoid spraying such compounds close to the humidity sensor.

11.2.2 Sensors

Inspect and carry out routine maintenance and calibration of sensors at regular intervals. This frequency will depend on environmental conditions and the accuracy you wish to achieve from your particular installation.

Individual sensor manuals will give further advice on maintenance and calibration etc.

Weekly

- Visually inspect the wind sensors and the radiation shield.

Monthly

- Do a more thorough visual inspection of the wind sensors, and listen to the anemometer bearings at low wind speeds for audible signs of bearing wear.
- Check, and clean if necessary, the CS215 sensor and its radiation shield.
- Check the (optional) rain gauge funnel for debris and ensure the gauge is level and operating correctly.

Six-Monthly

- Clean the CS215 sensor.
- Clean the radiation shield.

Yearly

- Thoroughly check anemometer bearings and replace if any signs of wear.
- Calibrate the (optional) ARG100 Raingauge.

Every Two Years

- Thoroughly check the wind vane potentiometer and bearings, and replace as necessary.
- Consider replacing the CS215 humidity chip. This should be replaced at a maximum of 3 years.

Every Four to Five Years

Thoroughly check all sensor cables for abrasion or other damage and replace as necessary.

Should it be necessary to remove the CS215 sensor for replacement the four wires of the CS215 will need to be disconnected as follows:-

1. *Red - Battery +
2. *Black - Battery -
3. Green - C1/SDI-12
4. White - G
5. Screen - G

*It is essential to ensure that these wires are re-connected in the same configuration in order to maintain the correct polarity.

11.2.3 Power Supply

At every site visit check the solar panel for dirt and debris such as bird droppings and clean. Frequency of visits may be site dependent – for instance, in the autumn leaves may blow onto (and possibly stick to) the panel.

Keep an eye on the battery voltage (the daily minimums are stored by default in Table2) to ensure that the voltage available continues to look healthy.

If the voltage drops below 11.5V then please consult the troubleshooting section (Appendix C) for possible remedial action. Please note that a weather station performing well in the height of summer may not be able to sustain its charge during the middle of winter.

Whilst the Solar panel is sufficient for most operations, the addition of some sensors or an increase in the periods of direct communication can affect the power consumption over time.

12. And Finally

We hope that your Basic Weather Station will give you many years of accurate data and trouble free use. If you have any problems with the weather station, remember to first check out the troubleshooting guide in Appendix C. Further help and advice is available from Campbell Scientific as shown below:

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Fax: +44 (0) 1509 601091

Email: support@campbellsci.co.uk
World wide web: <http://www.campbellsci.co.uk>

Appendix A. Basic Weather Station Program

The CR200X Series Datalogger, which is part of your Basic Weather Station, is pre-loaded with an appropriate program, ready for immediate use. A backup copy of this program is supplied on CD.

This Appendix gives details of the 'standard' program, along with guidance on how to modify it to suit an alternative set of sensors or measurements.

A.1 Standard Program

The basic program supplied with the Basic Weather Station covers the standard sensors – the 03002-5 Wind Sentry measuring Wind Direction and Wind Speed, and the CS215 measuring Temperature and Relative Humidity.

The program also includes instructions for the optional ARG100 Raingauge, CS100 Barometric Pressure Sensor, and CS300. If those sensors are not fitted then the values should be disregarded.

The CS300 is required for ETo calculations.

The program executes and takes measurements every 10 seconds, calculating statistics based on that sample rate.

A.2 Wiring of Sensors

The program within the logger relies on the sensors being wired to the correct locations. If the program is modified in any way then the program generator will output a new wiring diagram. The program that the BWS-200 is pre-loaded with requires the following wiring:

CS215 Temperature & Relative Humidity Sensor

Battery +: Red
C1/SDI-12: Green
G: White
G: Black
G: Clear

03002-5 "Wind Sentry" Wind Speed & Direction Sensor

EX1: Blue
G: Screen
G: Black
P_LL: Red
SE1: Green
Ground: White

ARG100 Rain Gauge (Optional)

G: Clear
P_SW: Black

CS300 Pyranometer (Optional - required for ETo Calculations)

G: Clear
 Ground: Black
 SE2: Red

CS100 Barometric Pressure Sensor (Optional)

Battery +: Red
 G: Black
 C2: Green
 G: Clear
 Ground: Yellow
 SE3: Blue

A.3 Measurements

Each time a sensor is scanned, the result is stored as a *Public* variable. With each scan, the value of each *Public* variable is processed then overwritten with the next measurement result.

Public Variables		
Variable Name	Typical Value	Explanation
The program measures the following raw signals:		
Batt_Volt	12.794	Battery Voltage (Volts)
Air_TC	24.232	Air Temperature (Degrees Celsius)
RH	49.771	Relative Humidity (percent)
WS_ms	2.525	Wind Speed (ms ⁻¹)
Wind Dir	205.501	Wind Direction (Degrees clockwise from True North)
Rain_mm	0.00	Precipitation (mm) *
Solar_W	10.8	Solar Radiation (Watts) **
BP_mBar	1014	Barometric Pressure (Millibars) ***
It then calculates in real time the following derived values:		
Solar_kJ	5	Total Solar Radiation (KiloJoules) **
WindRun_m	25.250	Run of wind passing sensor during scan period (metres)
TdC	13.101	Dew point (degrees Celsius)

* Must have ARG100 Tipping bucket rain gauge connected for valid reading

** Must have CS300 Solar radiation Sensor connected for valid reading

*** Must have CS100 Setra Barometric pressure Sensor connected for valid reading

A.4 Recorded Data

The Standard Program saves the data under two tables.

Table1 is an hourly summary of recorded data. Table1 is recorded every 60 minutes on the hour.

Derived Data Recorded in Table1	
Variable Name	Explanation
RH	Relative Humidity (%)
TdC_AVG	Average Dewpoint (Celcius)
WS_ms_S_WVT	Average Wind Speed (Meters per Second)
WindDir_D1_WVT	Unit vector Wind Direction (Degrees)
WindDir_SD1_WVT	Standard Deviation of Wind Direction
WS_ms_MAX	Maximum Wind Speed (Meters per Second)
Rain_mm_TOT	Total Rainfall (millimetres) *
WindRun_m_TOT	Total Wind Run (Metres)
AirTC_Avg	Average Air Temp (Celcius)
RH_Avg	Average Relative Humidity (%)
WS_ms_Avg	Average Wind Speed (Meters per Second)
Solar_W_Avg	Average Solar Radiation (Watts) **
ETo	Calculated Evapotranspiration for the period (millimeters) **
BP_mBar_AVG	Average Barometric pressure (Millibars) ***

Table2 is a daily summary of maxima and minima. Table2 is recorded every 24 hrs at midnight

Derived Data Recorded in Table2	
Variable Name	Explanation
Batt_Volt_MIN	Minimum Battery Voltage (Volts)
AirTC_MAX	Maximum Air temperature (Celcius)
AirTC_MIN	Minimum Air temperature (Celcius)
TdC_AVG	Average Dew point Temperature (Celcius)
TdC_MAX	Maximum Dew point Temperature (Celcius)
TdC_MIN	Minimum Dew point Temperature (Celcius)
WS_ms_MAX	Maximum Wind Speed (Meters per Second)
WindRun_m_TOT	Total Wind Run (Metres)
Rain_mm_TOT	Total Rainfall (millimetres) *
Solar_kJ_TOT	Total Solar Radiation (KiloJoules) **
AirTC_Avg	Average Air Temperature (Celcius)
RH_Avg	Average Relative Humidity (%)
WS_ms_Avg	Average Wind Speed (Meters per Second)
Solar_W_Avg	Average Solar Radiation (Watts) **
AirTC_Avg	Average Air Temperature (Celcius)
ETo	Calculated Evapotranspiration for the period (millimeters) **
BP_mBar_AVG	Average Barometric pressure (Millibars) ***

* Must have ARG100 Tipping bucket rain gauge connected for valid reading

** Must have CS300 Solar radiation Sensor connected for valid reading

*** Must have CS100 Setra Barometric pressure Sensor Connected for valid reading

A.5 Modifying the Program

A copy of the standard program (BWS200.scw) is supplied to you on disk with your BWS-200 for your convenience. It has been written using a program called SCWIN (ShortCut for Windows) which is a module of the PC200W accessible from the “Short cut” button in the top right hand corner of your PC200W screen.

To edit it please copy the BWS200.scw file to C:\Campbellsci\PC200W on your hard drive, open PC200W, click on the “Short Cut” Editor button and open the file from there. A separate file with a .CR2 ending will be generated. This should be loaded onto the datalogger. Please note that programs cannot be retrieved from the datalogger so a copy should be kept secure at all times.

NOTE

Short Cut automatically allocates the wiring on a first come first served basis. Since your datalogger has come pre-wired it is important that, if you generate a new program from scratch, or edit the standard program, that you add the sensors in a consistent manner with a view to maintaining the original wiring associated with the Standard program. The order in which the sensors have been added is as follows:

CS215
03002-5 (CSL)
ARG100 (CSL)
CS300
CS100

A.6 Calculating ETo

To calculate Evapotranspiration The Penman-Monteith calculation method is used. ETo is calculated on an hourly and daily basis. The daily ETo is reset at 0100 hours each day.

Because the calculation relies on meteorological data, the sensors for air temperature, relative humidity, wind speed and solar radiation must all be present and recorded before ETo can be calculated. Solar radiation, measured with the CS300 is an optional extra sensor.

The ETo Calculation additionally relies on the following site specific data:

Site Latitude
Site Longitude
Site Elevation

By default your Weather Station is programmed to assume a mid European latitude of 50 degrees north on the Greenwich Meridian (ie Longitude 0 degrees E) at sea level. For most purposes this assumption is perfectly adequate. However you can customise these values should you wish to.

To do so open the program in ShortCut. Click on the Outputs menu item on the left hand side, click on the “ETo” field in the “Processing” column on the left hand window of the screen and click on the “Edit” button at the bottom. A dialogue box will open up and the values can be altered to suit, saved as a new program and downloaded to the logger.

Appendix B. Wind Direction Sensor Orientation

B.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 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 USGS map, local airport, or through a computer service offered by the USGS at www.ngdc.noaa.gov/geomag. A general map showing magnetic declination for the contiguous United States is shown in Figure B-1.

Declination angles east of True North are considered negative, and are subtracted from 0 degrees to get True North as shown Figure B-2. Declination angles west of True North are considered positive, and are added to 0 degrees to get True North as shown in Figure B-3. For example, the declination for Logan, Utah is 14° East. True North is $360^{\circ} - 14^{\circ}$, or 346° as read on a compass.

Orientation is most easily done with two people, one to aim and adjust the sensor, while the other observes the wind direction displayed by the datalogger.

1. Establish a reference point on the horizon for True North.
2. Sighting down the instrument centre line, aim the nose cone, or counterweight at True North. Display the input location or variable for wind direction using a hand-held keyboard display, PC, or palm.
3. Loosen the u-bolt on the CM220 or the set screws on the Nu-Rail that secure the base of the sensor to the crossarm. While holding the vane position, slowly rotate the sensor base until the datalogger indicates 0 degrees. Tighten the set screws.

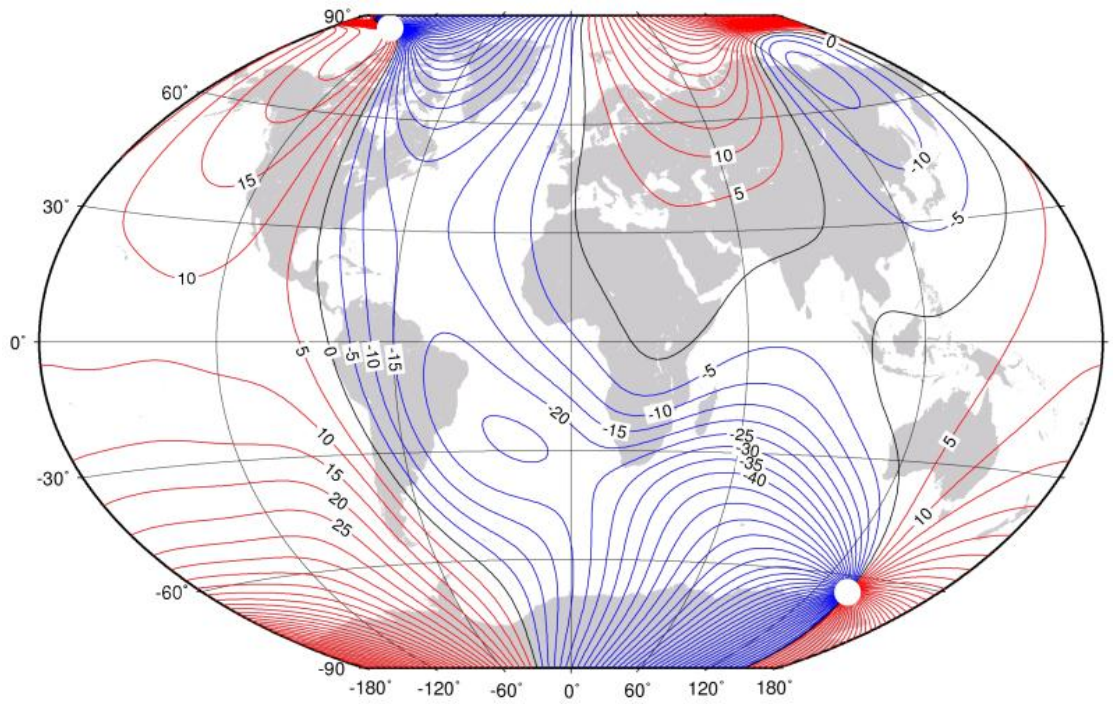


Figure B-1. Magnetic Declination at 2012.5 (degrees relative to true north, positive is east)

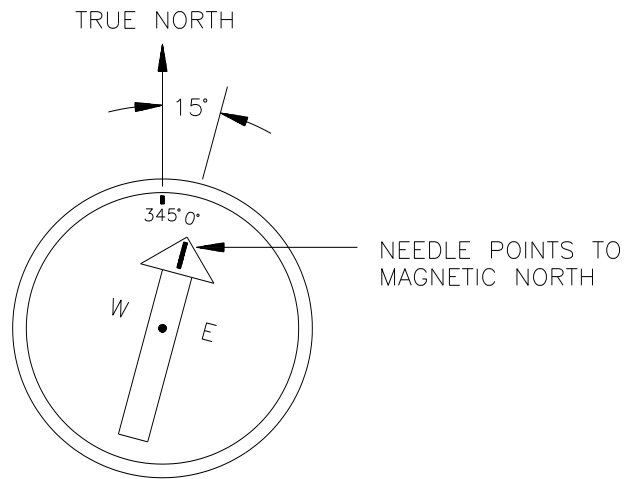


Figure B-2. Declination Angles East of True North Are Subtracted From 0 to Get True North

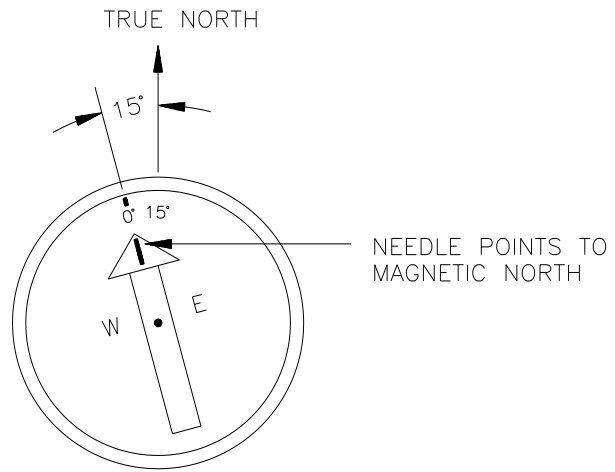


Figure B-3. Declination Angles West of True North Are Added to 0 to Get True North

Appendix C. Troubleshooting

If your Basic Weather Station seems to be operating incorrectly, there are a number of checks you can make to help isolate the problem. These checks may enable you to solve the problem, but, in any case, will give you some basic facts to pass on to an engineer if you need to contact Campbell Scientific.

C.1 Loss of Battery Power

If you are operating the station in conditions of low solar irradiance (far North/South for instance) the power consumption may not be balanced by charge from the solar panel. To prevent the battery discharging, carefully monitor the battery voltage in Table 2. If it is seen to decline continuously over a period of several days steps should be taken to redress the balance. These may include reducing the scan rate to, say, once every sixty seconds, which will reduce the average power consumption of the system to meet the available charge.

This will of course mean that real-time values are not updated so often and reported peak wind speed measurements may be lower due to the longer averaging period. If making this change, please take note of the comment above about amending the wind-run calculation.

C.2 No Response from the Datalogger

Do the following steps:

1. Make sure that the main power supply battery has been installed and connected properly. Ensure that the spade connectors are attached to the correct battery terminals and that the green connector is fully inserted into the power connector point on the datalogger – see Section 7.
2. Use a voltmeter to measure the voltage between the terminals on the Battery. The voltage must be greater than 11.5V lower than this means that the battery is either faulty or not getting enough charge. The logger will operate between 7V and 16V DC.
3. Make sure that the correct interface and cables are used and securely connected to the RS232 port on the datalogger and to the RS232 port of the computer – see Section 5.
4. Make sure that the PC200W software is correctly installed and the station file is configured on the computer. See the **PC200W Manual**.

If you still cannot communicate with the datalogger, please contact Campbell Scientific. See Section 12.

C.3 Unreasonable or Unexpected Results are Displayed by the Datalogger

This indicates an incorrect response from one of the sensors. Note this may be the case where an optional sensor has not been ordered and the input channel remains unused.

Check the following:

1. Ensure that the value is one that should be returned by the attached sensors.
2. Ensure that the battery voltage is between greater than 11.5V DC. The logger will operate between 7V and 16V DC.
3. Check that the Wind Sentry, CS215 (and the ARG100 raingauge, if fitted) is wired to the correct datalogger channel as shown in the sensor wiring table.
See Appendix A of this manual.
4. If you have modified the original datalogger program in any way, ensure that the correct range code parameters have been used – **see the Sensor and Datalogger manuals for details.**
5. Check the appropriate sensor for damage and/or contamination.

NOTE

If you have modified the original datalogger program you should connect the sensors as described in Appendix A and download the original program to eliminate program errors etc. before seeking advice.

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