Capricorn 2000EX™ Weather Station

User Manual

Version 1.08

Serial Number: _____

Date Purchased: _____

Printed in U. S. A.

Welcome!

Congratulations on your purchase of the Capricorn 2000EX Weather Station.

The Capricorn 2000EX is a precision instrument that requires proper installation and a certain amount of regular maintenance.

Please read this manual completely prior to installation.

Important Notice: Shipping Damage

BEFORE YOU READ ANY FURTHER, please inspect all system components for obvious shipping damage. The Capricorn 2000EX is a high precision instrument and can be damaged by rough handling. Your unit was packaged to minimize the possibility of damage in transit. Therefore, we recommend that you save the shipping container for any future shipment of your Capricorn unit.

In the event your order arrives in damaged condition, it is important that the following steps be taken immediately. The title transfers automatically to you, the customer, once the material is entrusted to the transport company.

NOTE: DO NOT RETURN THE INSTRUMENT TO COLUMBIA WEATHER SYSTEMS until the following steps are completed. Failure to follow this request will jeopardize your claim.

1. Open the container and inspect the contents. Do not throw away the container or any damaged parts. Try to keep items in the same condition as originally received.
2. Notify the transport company immediately in writing, preferably by facsimile, about the shipping damage.
3. Wait for the transport company's representative to inspect the shipment personally.
4. After inspection, request permission from Columbia Weather Systems for return of the damaged instrument by calling the Capricorn Service Department, (503) 629-0887.
5. Return approved items to us at the following address:

   Columbia Weather Systems, Inc.

   2240 NE Griffin Oaks Street, Suite 100

   Hillsboro, OR 97124

6. After return authorization is issued and we receive the instrument, an estimate of the cost of repair will be sent to you for submittal to the transport company as a claim.

Table of Contents

SECTION 1: INTRODUCTION

The Capricorn 2000EX System

The Capricorn 2000EX is a modular-design weather station providing commercial-level data capture, storage, and transfer. The system is designed around the Control Module which is housed in a compact utility-grade enclosure powered by a wall mount transformer. The module accepts signal inputs from a wide range of meteorological sensors. User interface is via RS-232 ports. The Capricorn 2000E has the capacity for handling additional sensors.

Specifications

Temperature

The temperature port on the Capricorn 2000EX can accept up to four temperature probes.

Type: digital semiconductor

Range: -67° to 257°F

Accuracy: ± 0.9°F from +14° to 185°F (±0.5°C from -10° to 85°C)
± 3.6°F from -67° to 257°F (±2.0°C from -55° to 125°C)

Resolution: 0.01°F

Units: Fahrenheit

Cable Length: maximum 400 ft. combined length for all four sensors

Barometric Pressure

The barometric pressure sensor is located inside the Control Module and is part of the weather station circuit board.

Type: silicon shear stress strain gauge; temperature compensated and calibrated

Range: 27 to 33.96 in. Hg

Accuracy: ±0.03 in. Hg over range (at sea level, with temperature between 32° and 182°F)

Resolution: 0.01 in. Hg

Units: in. Hg

Wind Speed

Type: Sealed reed switch

Accuracy: ± 0.25 mph from 0 to 23 mph, ± 1% from 24 to 160 mph

Range: 0 to 160 mph (139 knots)

Resolution: 1 mph

Starting Threshold: 0.9 mph

Wind Direction (channel X2)

Type: Precision Potentiometer

Resolution: 2 degrees

Mechanical Range: 0 to 360 degrees

Electrical Range: 0 to 356 degrees

Accuracy: ± 4 degrees

Relative Humidity

Type: Capacitance

Range: 0 to 100%

Accuracy: ±3% (or better) from 10 to 90% RH at 68° F

Temperature Effect: <±1.5% RH from 14° F to 140° F

Stability: ±2% RH over 2 years

Resolution: 1% RH

Rainfall

Type: tipping bucket

Accuracy: ±1% at 2 in/hr or less

Resolution: 0.01 inch

Leaf Wetness

Type: capacitance grid (measures percentage of wetness where 0.50 volts corresponds to dry and 4.40 volts corresponds to dripping)

Accuracy: ±5%

Resolution: 0.01 volts

Solar Radiation (Pyranometer) (Channel X1)

Type: high performance silicon photodiode

Cosine Response: 45° zenith angle ± 1%, 75° zenith angle ± 5%

Absolute Accuracy: ± 5%

Uniformity: ± 3%

Repeatability: ± 1%

Sensitivity: Custom calibrated to exactly 5.00 W m-2 per mV

Operating Environment: -40 to 55°C, 0 to 100% relative humidity

Input Voltage

Powered by a wall mount transformer

Input: 120 VAC, 60 HZ, 16 W

Output: 12 VDC, 800 mA

Control Module

Dimensions: 10" L x 7.5" W x 2.8" H

Weight: 3 lbs/1.3 kg.

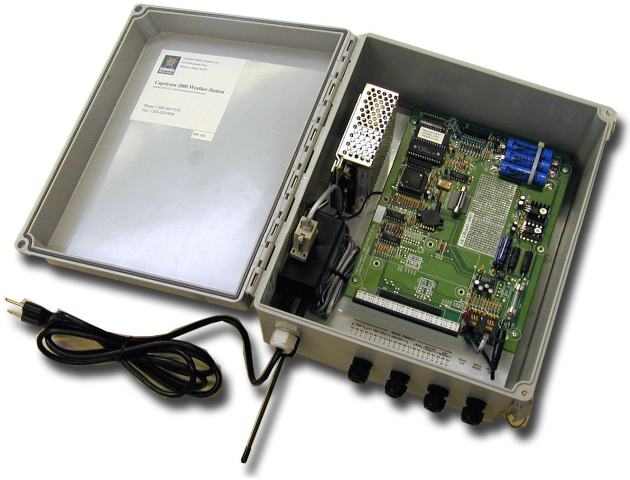
SECTION 2: PHYSICAL DESCRIPTION

Control Module

The Control Module consists of the System board housed in a utility-grade enclosure with access to the sensor connections (terminal block), RS-232 ports and power connection through the back panel.

The System board has an on-board barometric pressure sensor and a system fuse (including a spare fuse). The System board also has in-line rechargeable lithium batteries to preserve the datalog and system configuration when power is absent.

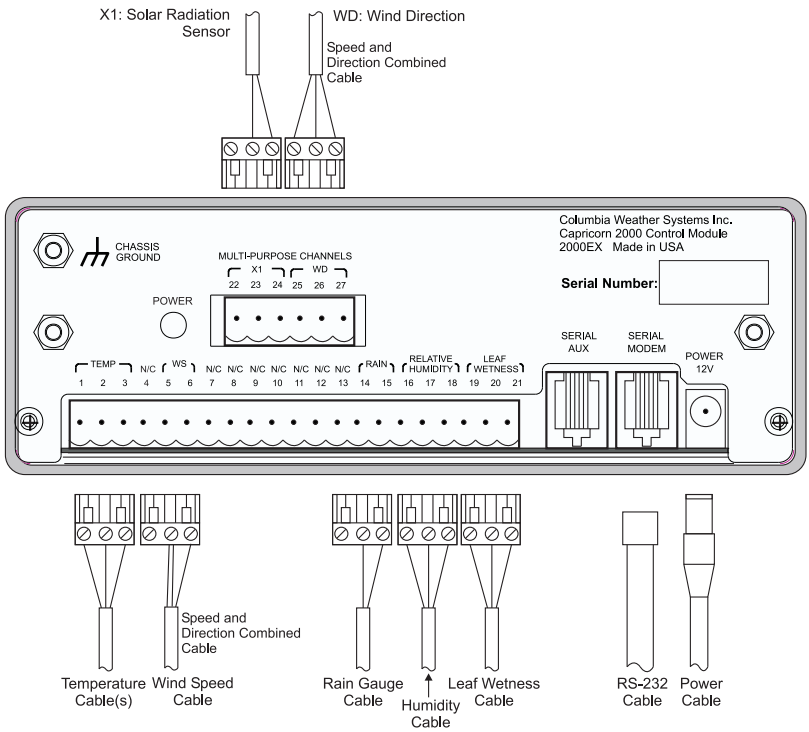
The Control Module dimensions are: 10" L x 7.5" W x 2.8" H and weighs: 3 lbs/1.3 kg.



The Control Module can also come in an optional weatherproof enclosure.

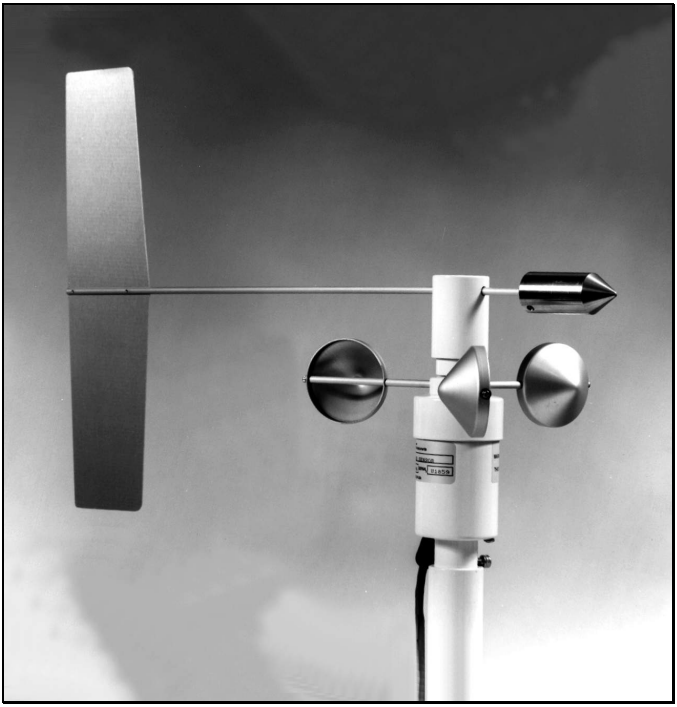
Dimensions: 12.5” L x 10.5” W x 6.25” H

Back Panel



All connections are made at the back panel of the Control Module.

Wind sensor



Note: Please refer to the Met One 034B wind sensor user manual for detailed installation, calibration and maintenance information

The Model 034B Wind Sensor combines wind speed and direction measurements into a single sensing unit.
The 034B Wind Sensor installs in minutes and will provide accurate, long term, continuous monitoring in hostile environments.

Features

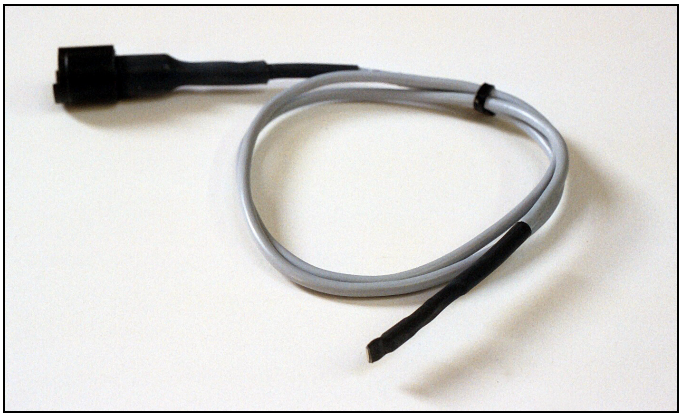
- Wind speed and direction in a single sensor
- Long field life
- Durable aluminum and stainless steel construction
- Low starting threshold
- Stainless steel bearings
- Ultra low power operation
- Easy maintenance

Wind sensor components

The wind sensor consists of four parts:

1. Sensor body
2. Vane
3. Alignment adapter
4. 50 feet of Cable with quick disconnect

Temperature sensor



The Capricorn 2000EX includes one temperature sensor with 50 feet of cable and a quick disconnect connector set. Up to four temperature sensors can be connected with a maximum of 400 feet combined cable length. These digital, semiconductor-type probes all connect to a single port, reducing susceptibility to noise interference, reducing cost, and increasing accuracy. The sensors are calibrated at the factory to a superior grade ASTM mercury thermometer.

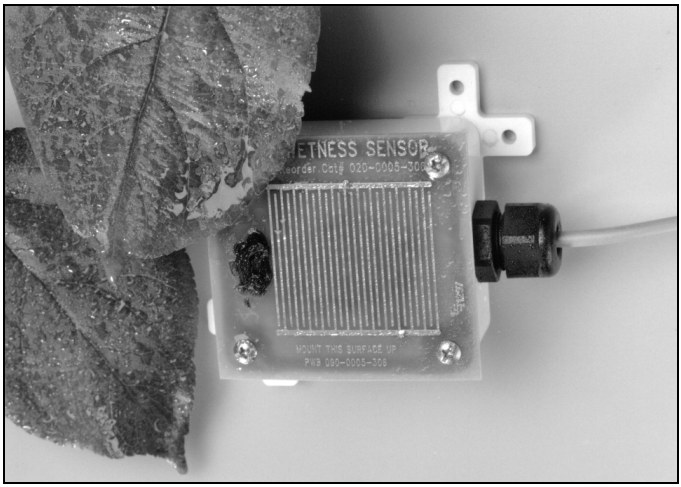
Relative Humidity sensor

This optional capacitive relative humidity sensor is compact and easy to use. It can be easily installed in a self-aspirating radiation shield for protection from the sun and rain. This sensor offers long-term stability with minimal drift. Because the sensor is a capacitive device, it will not be affected by surface contamination in unclean environments. Since the sensor element is socketed and laser trimmed it can be easily replaced in the field without any additional calibration. The relative humidity sensor comes with a standard 50-foot cable and a quick disconnect connector.

Rain gauge (optional)

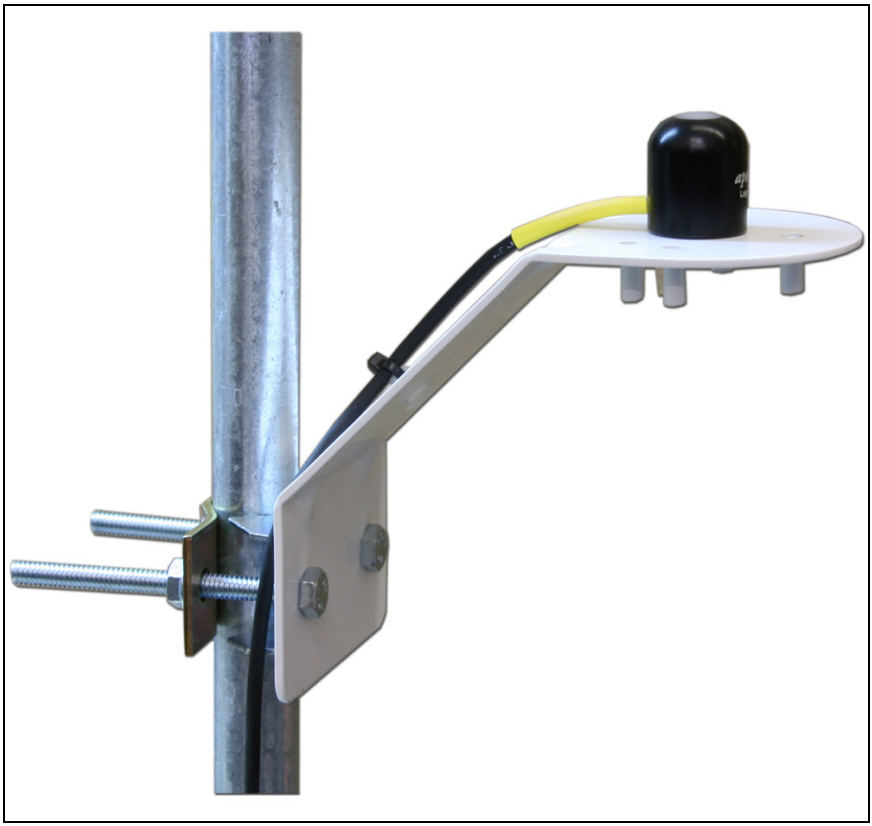
This optional tipping bucket rain gauge is composed of a complex spun collector funnel with a knife-edge that diverts the water to a tipping bucket mechanism. For each tip, a magnet causes an electronic pulse to be generated and is recorded by the Control Module. The rainfall sensor is completely automatic - spent water drains out of the bottom of the housing, hence, the instrument requires no servicing. The rain gauge comes with a standard 50-foot cable.

Leaf wetness sensor (optional)



Measured with a capacitance grid, this leaf wetness sensor is manufactured by Columbia Weather Systems to provide a precise, high resolution scale - not just wet or dry. It is useful to determine the wetness condition of surfaces such as foliage, for example, in preparation for spraying pesticides. The leaf wetness sensor measures the percentage of wetness where 0.5 volts corresponds to wet and 4.4 volts corresponds to dry. The leaf wetness sensor comes with a standard 50-foot cable.

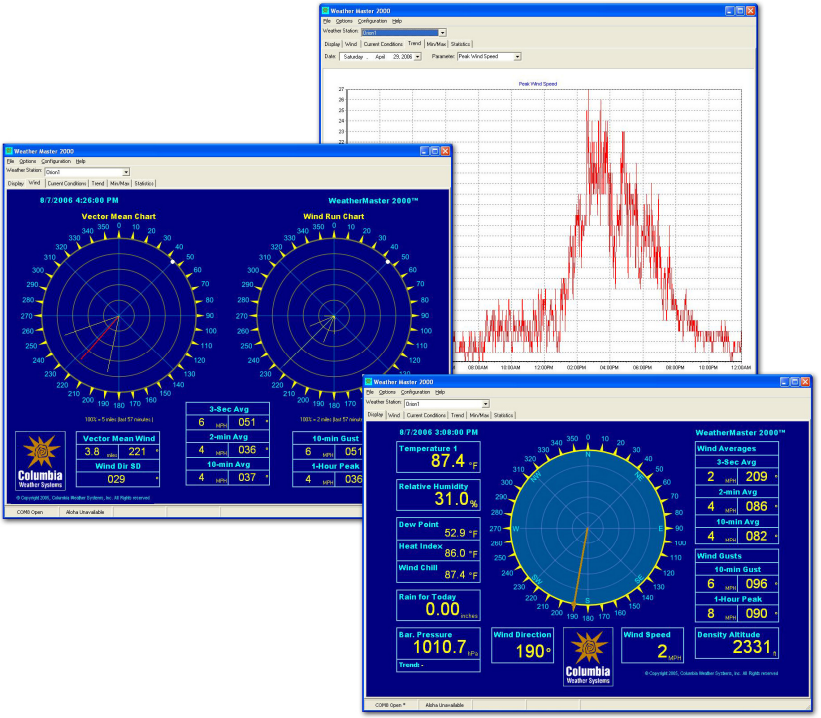
Solar Radiation Sensor –Pyranometer (Optional)



This sensor is designed for routine measurement of global hemispherical solar radiation under all weather conditions. The sensor has a rugged uni-body design, which houses a high performance silicon photodiode detector mounted beneath a conical shaped (self-cleaning) diffuser. Due to the unique diffuser design, the sensitivity of this sensor is proportional to the cosine of incidence of the incoming solar irradiance, allowing for accurate and consistent measurement.

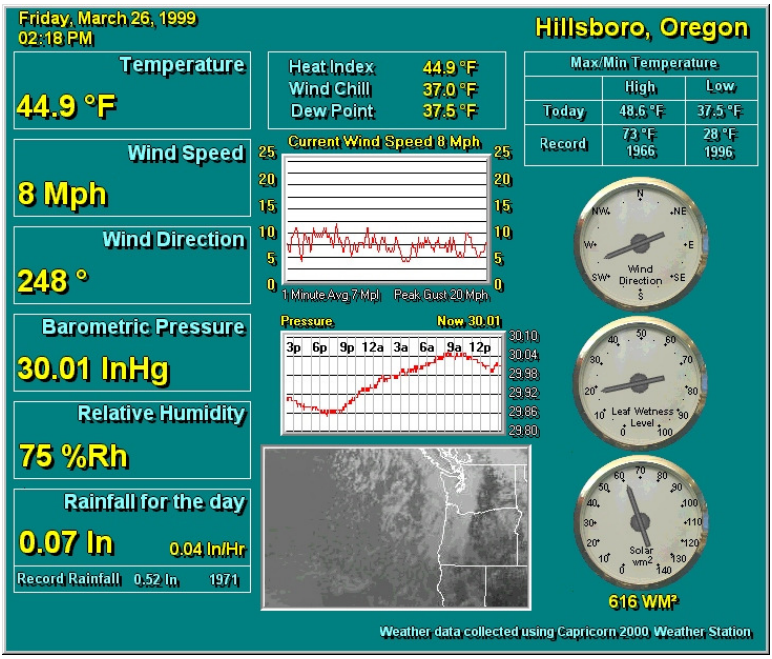
An optional leveling plate is available for most accurate measurements.

WeatherMaster™ Software



WeatherMaster is a professional grade weather monitoring software. This software package is designed for specialized markets that require robust weather calculations, interoperability with computer models, and data interfaces to other industrial systems. WeatherMaster utilizes Microsoft Access database for easy data access and manipulation.

Weather View 32™ Software



Operating in Windows graphic environment, Weather View 32 monitors, records, and stores local weather data for current or future analysis.

Weather View 32 offers:

- User-defined real time monitoring display
- Internet and email interface
- Calculated parameters including wind chill, dew point, heat index and degree days
- Monthly calculations for degree days heating and cooling
- Full-featured graphing and printing capabilities
- Six separate alarms functions
- A Climatological database that covers the U.S. and Canada
- Modem access for remote weather stations

Weather Display Console (Optional)

Displays weather information • Designed to be viewed clearly from a distance • Industrial grade WVGA touchscreen

Seven-inch, TFT color LCD panel with 800 x 480 pixel resolution.

Performs computations for wind chill, heat index and other calculated parameters • 200MHz ARM9 CPU

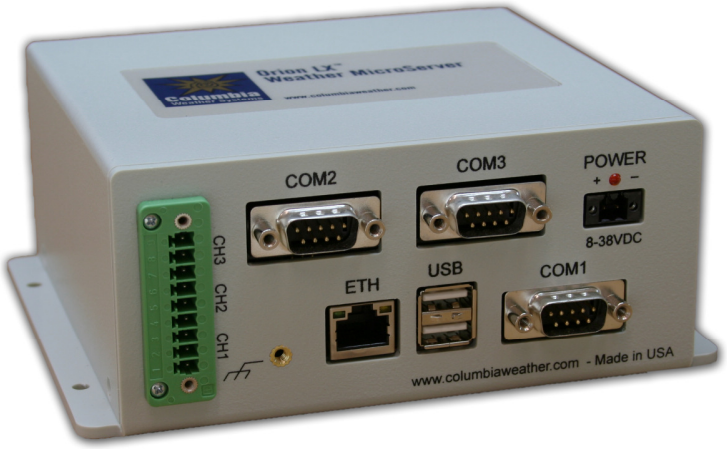
Serial or Ethernet connection: Connects directly to weather station with serial port or connect to a Weather MicroServer over a network utilizing an existing Ethernet infrastructure -- no extra wiring. The MicroServer configuration also allows for data from one weather station to be monitored from multiple display consoles at various locations

Compatible with all CWS weather stations.

Screens can be factory-customized to meet specialized market and industry requirements.

The Weather Display is also available in a 19” rack-mount and panel mount chassis.

Weather MicroServer



No longer does weather station connectivity require a dedicated computer with its requisite maintenance, virus-protection and operating system upgrades. The Weather MicroServer is a self-contained, proprietary system utilizing the Linux operating system.

The Weather MicroServer creates an “Internet-ready” weather monitoring system by automatically providing FTP output, XML web service, and Internet browser user interface. FTP output includes XML, CSV, and CSV append formats.

SNMP and Modbus/OPC communication protocols are standard for Industrial Management applications.

The Weather MicroServer has data logging capability. It connects to your network with an included Ethernet cable. Two serial ports offer interface to both the Weather Display Console and additional peripheral devices or sensors.

The Weather MicroServer can provide real-time weather data to WeatherMaster Software over the network. This allows users to simultaneously monitor the weather using WeatherMaster on any computer connected to the network.

SECTION 3: INSTALLATION

Wiring and Color Code

Terminal #	Wire Color	Description
Temperature		
1	RED	+5V
2	BARE	Ground
3	BLACK	Temperature Signal
Wind Speed		
4	N/C	No Connection
5	BLACK	Ground
6	RED	Wind Speed Signal
7	N/C	No Connection
8	N/C	No Connection
9	N/C	No Connection
10	N/C	No Connection
11	N/C	No Connection
12	N/C	No Connection
Rainfall		
13	N/C	No Connection
14	RED	Rain Signal
15	BLACK	Ground
Relative Humidity		
16	RED	+12V
17	BARE	Ground
18	BLACK	Humidity Signal
Leaf Wetness		
19	RED	+5V
20	BARE	Ground
21	BLACK	Wetness Signal
Solar Radiation (X1)		
22	N/C	No Connection
23	RED & BARE	Ground
24	BLACK	Solar Signal
Wind Direction (same cable as wind speed)		
25	WHITE	Reference Voltage
26	GREEN	Ground
27	BROWN	Wind Direction Signal

Installation Overview

Unpacking the Unit

Installing the Control Module

Installing the Barometric Pressure Sensor

Installing the Temperature Sensors

Temperature Sensor Initialization

Installing optional Self-Aspirating Radiation Shield

Installing the Optional Humidity Sensor

Installing Wind Sensor

Installing the Optional Rain Gauge Sensor

Installing the Optional Leaf Wetness Sensor

Installing the Optional Solar Radiation Sensor

Tools Needed

7/64 Allen wrench (provided with wind sensor)

7/32 Allen wrench (provided with wind sensor)

#3 (med.) Phillips Screwdriver

#2 (small) Phillips Screwdriver

Small straight blade (1/8") Screwdriver

Power Drill and 3/8" or 1/2" Bit

(1/2" bit needed to thread temperature and wind sensor cables through same hole.)

3/8" or Adjustable Wrench

Wire Cutter

Compass

Pencil

Materials Needed

(See also Section 4: Optional Sensor Mounting Hardware.)

Black PVC Electrical Tape

(2-4) Plastic Wall Bushings

Mast: Height above structure: Minimum 5 ft., recommended 10 ft.

For Roof Mount

“Cold Patch” Roofing Tar

50' Guy Wire

Roof Anchor Mount

Guy Ring & Collar

(3-4) Eye Bolt Screws

For Wall Mount

(2) 4" Wall Mount Bracket Assembly.

(4) Bracket Mounting Screws

Optional Items

Surge Suppressor

Unpacking the Unit

Unpack the Capricorn 2000EX weather station and verify that all parts are included.

Inspect all system components for obvious shipping damage (Refer to page 5 in case of damage).

Save the shipping carton and packing material in case the unit needs to be returned to the factory. Note: If items are missing or if there is damage, see page 5. If the system does not operate or calibrate properly, see Section 7: Maintenance and Section 8: Troubleshooting, for further instructions.

Installing the Control Module

Place the Capricorn 2000EX Control Module in a clean, dry location, close to a grounded power outlet (and phone line, if a modem connection is required).

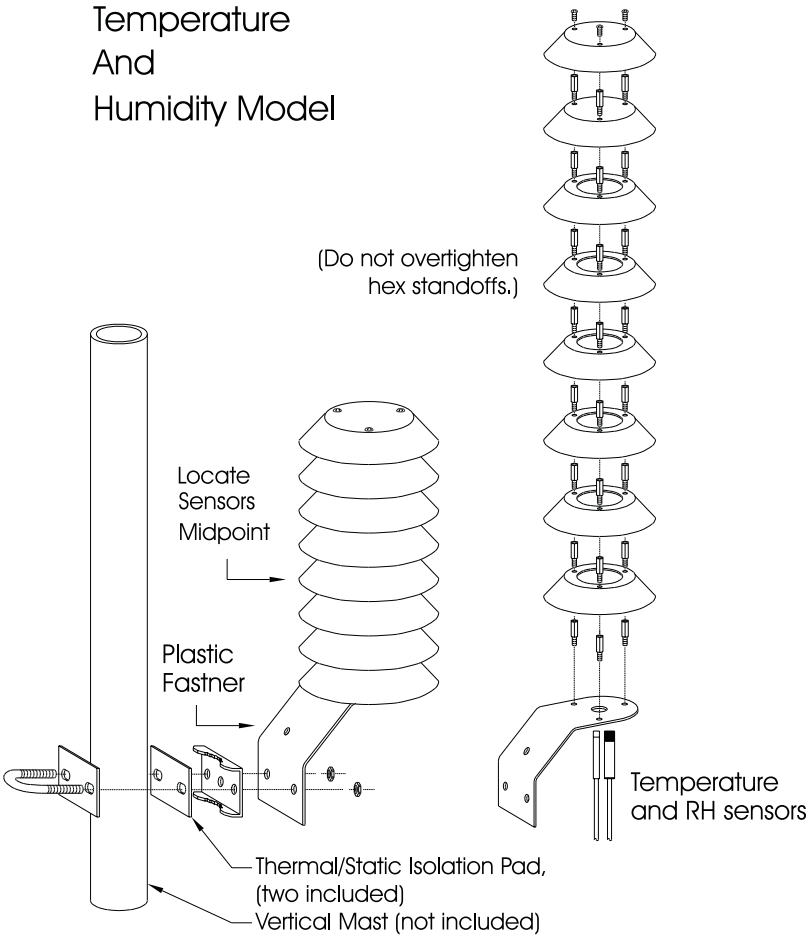
Plug the power cord into a convenient grounded outlet. Connect the Chassis Ground terminal to a good earth ground.

Note: It is strongly recommended that you protect your unit from power line spikes (caused by lightning or electrical discharge) by installing a good quality spike-surge suppression device between the Control Module and the power source.

Installing the Barometric Pressure Sensor

The barometric pressure sensor is located inside the Control Module; no user installation is required. The sensor does need to be calibrated for altitude, however. Please refer to Section 6: Calibration for the procedure of setting the altitude.

Installing the Temperature and Humidity Sensors



The temperature and relative humidity sensors should be mounted in a sheltered area, preferably on the north side of a building.

Insert both humidity and temperature sensors in the radiation shield to the midway point and secure both cables to the plastic fastener on the mounting bracket using the provided tiewrap.

Both sensors are supplied with a standard 50-foot cable. The cable provided is a 22 gauge, 2 conductor shielded cable with a ground drain lead.

Once the sensors have been placed, route the cables back to the Control Module.

Using a small straight screw driver, attach the temperature cable to the back of the Control Module as follows:

Red Wire - Terminal #1

Bare Wire - Terminal #2

Black Wire - Terminal #3

Using a small straight screw driver, attach the humidity cable to the back of the Control Module as follows:

Red Wire - Terminal #16

Bare Wire - Terminal #17

Black Wire - Terminal #18

Installing additional Temperature Sensors

The Capricorn 2000EX can accept up to four temperature sensors. The standard model is supplied with only one temperature sensor. Additional sensors can be added at any time (Cat. No.82100).

Temperature Sensor Initialization

Power the Control Module initially without any temperature sensor installed.

Using a small Straight Slot screwdriver, attach the wires from the end of the first temperature sensor cable to the Temperature terminal block screws as follows:

Red Wire Terminal #1

Bare Wire Terminal #2

Black Wire Terminal #3

Apply power to the Control Module for 10 seconds to identify the probe and then remove power. This probe is now identified as T1 by the Control Module.

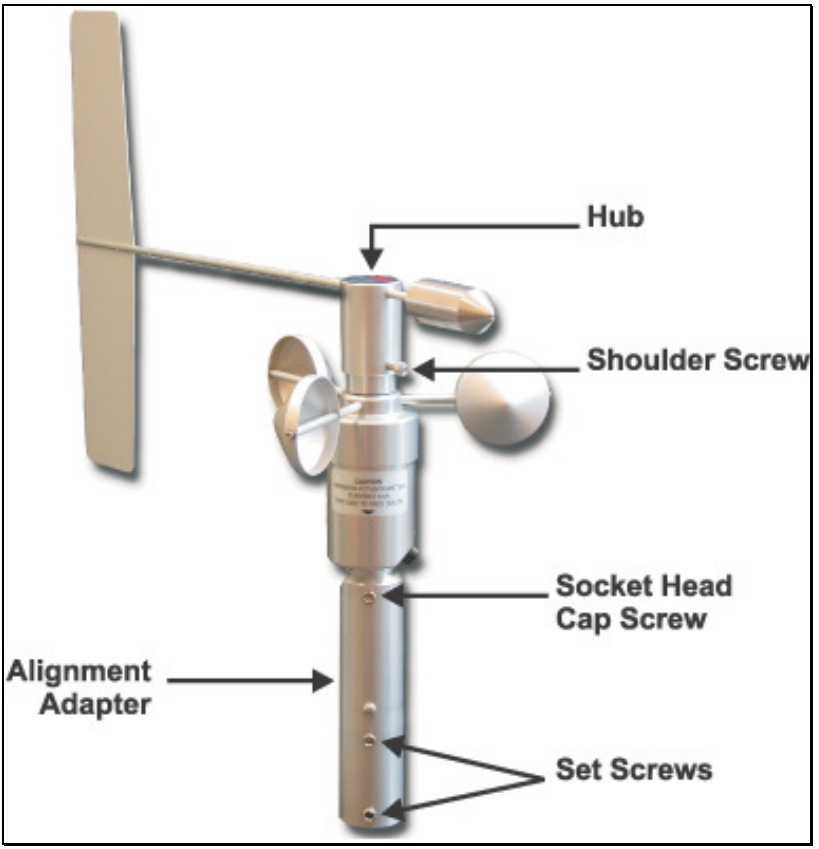
If more than one Temperature Probe is to be installed, they must all be identified by the Control Module. Remove power from the Control Module, connect the next temperature sensor cable to the same temperature terminal block, and apply power for 10 seconds to identify the probe and then remove power. The second probe is now identified as T2. Repeat these steps for each additional temperature sensor, T3 and T4 (up to 4 total).

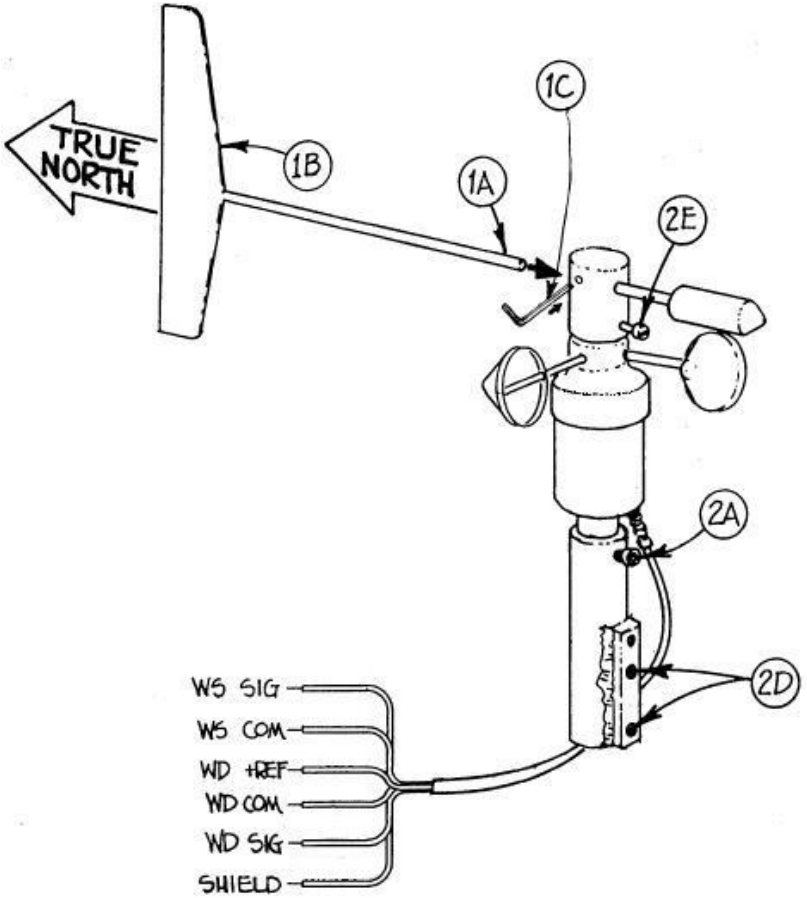
Note: **Do Not** remove the first set of wires from the Terminals.

Installing the Wind Sensor

Assembling the Wind Speed Sensor

Note: Please refer to the Met One 034B wind sensor user manual for detailed installation, calibration and maintenance information





1. Install Vane
   A. Fully insert vane arm into hub
   B. Align vane with center axis of sensor
   C. Using 7/64” Allen wrench, tighten set screw thru top of hub
2. Sensor Installation
   A. Install alignment adapter onto sensor base with socket head cap screw
   B. Place sensor with adapter on tip of mast
   C. Rotate entire sensor until vane tail points to “true North”
   D. Tighten both set screws clamping adapter to mast, using 7/32 Allen wrench
   E. Remove shoulder screw from hub and save
      Connect sensor cable

Installing the Mast

The Capricorn 2000EX will measure wind speeds of up to 160 mph (257 km/h). However, unless the Wind Sensor Assembly is properly mounted to withstand such high winds, this capability is useless. Please read these instructions carefully to insure a safe and reliable installation.

There are three acceptable methods for mounting the mast to a roof or building structure: Sloped roof mounting, flat roof mounting or wall mounting. See Section 4: Optional Sensor Mounting Hardware for more information.

Location

Do not attach the Wind Sensor Assembly to a chimney or any other transmitting mast or tower.

Select a mounting location that will allow the Wind Sensor Assembly cables to be routed away from any other data cables to avoid interference.

Do not mount sensors close to power lines or in tall trees.

Mounting Method

Choose the appropriate mounting method for the installation and obtain the necessary mounting hardware. Refer to Section 4 for information on optional sensor mounting hardware and accessories which are available from the factory.

If the mounting hardware is not obtained from the factory, be certain to use metal parts which are plated or galvanized to assure maximum longevity.

In marine locations (or other areas) which experience severe corrosion problems, a watertight, rubberized spray coating is recommended. This can be sprayed on all metal parts from the cross arm support down (not the wind sensors) after the installation is completed.

Secure the mast to the roof, using guy wires with sufficient tensile strength. The Wall Mounting Method should utilize a mast of no more than 5 ft. maximum height, unless it can be secured with guy wires.

Routing Cable

Use plastic tie wraps secure the cable to mast. Be sure that one is used at the mast base. Tighten the tie wraps securely and clip off any excess length with a wire cutter tool.

Route the cable back to the Control Module. If mounting on a roof, route the sensors through a vent or other opening into an attic or crawl space.

Avoid routing the cable near metal windows, metal door frames, metal gutters, or on a metal tower.

Any mast or tower should always be properly earth grounded to minimize electrical storm damage. Use insulated standoffs (user supplied, see Section 4) when routing cable to help avoid electrical storm damage.

CAUTION - There may be electric wires in the wall. We recommend that you shut off the electricity in the room(s) where you are drilling.

For best results when routing the cable through the exterior wall adjacent to the console:

a. drill a 3/8" hole though the wall (1/2" if combined with the temperature sensor cable);

b. insert a pair of small plastic wall bushings (available as an option; see Section 4) on either side of the wall (or, insert a wall feed-through tube, also optionally available); and

c. thread the cable through the bushings or tube.

Make sure that the exposed portion of the sensor cable that is beyond the mast will not be blown about by the wind. Use insulated eye bolt standoffs or other fasteners if necessary. (See Section 4.)

Once the Wind Sensor has been placed, route the cable back to the Control Module.

Using a #1 Straight Slot screwdriver, attach the wires from the end of the Wind Sensor cable to the Wind Sensor terminal block screws at the back of the Control Module as follows:

Black	- Terminal #5
Red Wire	- Terminal #6
White Wire	- Terminal #25
Green Wire	- Terminal #26
Brown Wire	- Terminal #27

Connect the ground lug to the chassis ground terminal on the back panel of the Control Module.

Installing the Rain Gauge Sensor

Safety Note: The top rim of the rain gauge sensor is EXTREMELY sharp. Handle the rim with great care.

Evaluate the proposed sensor location as compared to the cable length supplied. The rain gauge is supplied with a standard 50-foot cable. The cable provided is a 22 gauge, 2 conductor shielded cable with a ground drain lead. If additional cable is required, a good splice and waterproof insulation are essential; merely twisting the respective wires together is not adequate.

To obtain an accurate reading, mount the Rain Gauge Sensor in a clear and open area. The Rain Gauge can be either surface mounted or mast mounted. Surface mounting is recommended where possible. The Rain Gauge must be mounted in a LEVEL position and in a location free from vibration.

If using a mast mounting, make sure that the mast is properly guyed so that vibration in a high wind situation is kept to a minimum. When mounting with other sensors on a mast, position the Rain Gauge so that it is the lowest sensor in the vertical stack. This will prevent the Rain Gauge from draining water on the other sensors. Make sure any sensors above the Rain Gauge are rotated on the mast to provide an unobstructed rain path to the Rain Gauge.

Once the Rain Gauge Sensor is securely mounted, grasp the top gold funnel portion of the Rain Gauge Sensor firmly and lift up. Do Not place any part of your hand on the rim of the Rain Gauge Sensor due to the sharpness of the Knife edge. Verify that the black tipping bucket is not in a center position and that one end of the bucket is down against the stop. Replace the top gold funnel portion of the Rain Gauge Sensor.

Once the Rain Gauge Sensor has been placed, route the cable back to the Control Module

Using a small straight screwdriver, attach the wires from the end of the cable to the Rain terminal posts screws as follows:

Black Wire - Terminal #14

White Wire - Terminal #15

Installing the Leaf Wetness Sensor

Evaluate the proposed sensor location as compared to the cable length supplied. In order to obtain an accurate reading, mount the Leaf Wetness Sensor in an exposed area.

Once the Leaf Wetness Sensor has been mounted, route the cable back to the Control Module. The leaf wetness sensor is supplied with a standard 50-foot cable. The cable provided is a 22 gauge, 2 conductor shielded cable with a ground drain lead. If additional cable is required, a good splice and waterproof insulation are essential; merely twisting the respective wires together is not adequate.

Once the Leaf Wetness Sensor has been placed, route the cable back to the Control Module.

Using a small Straight Slot screwdriver, attach the wires from the end of the cable to the Leaf Wetness terminal posts screws as follows:

Red Wire - Terminal #19

Bare Wire - Terminal #20

Black Wire - Terminal #21

Installing the Solar Radiation Sensor

Evaluate the proposed sensor location as compared to the cable length supplied. The solar radiation sensor should be installed in an area that receives full sunlight away from any object that can create a shadow over the sensor. Please be aware that the sun position changes from season to season.

The sensor should be mounted on a leveled surface for accurate readings.

Once the solar radiation sensor is mounted, route the cable to the Control Module. It may be convenient to combine this step with routing of other sensors.

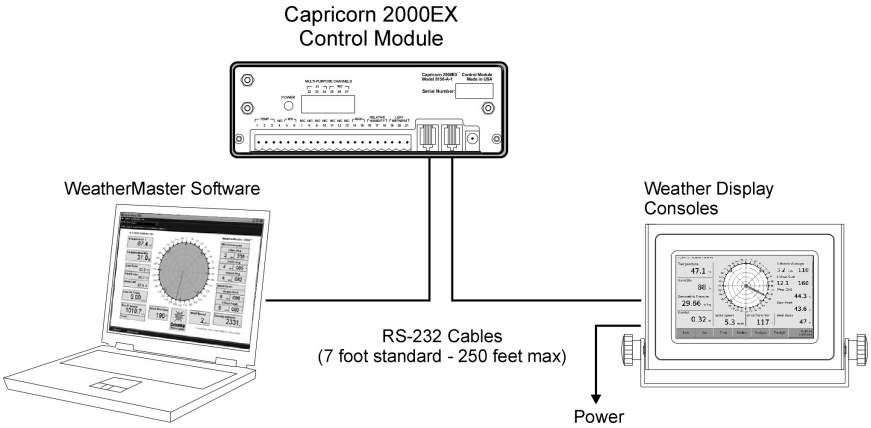
Using a small straight screwdriver, attach the wires from the end of the cable to Channel X1 terminal block in the Multi-Purpose Channels area as follows:

No Connection - Terminal #22

Bare and Red Wire - Terminal #23

Black Wire - Terminal #24

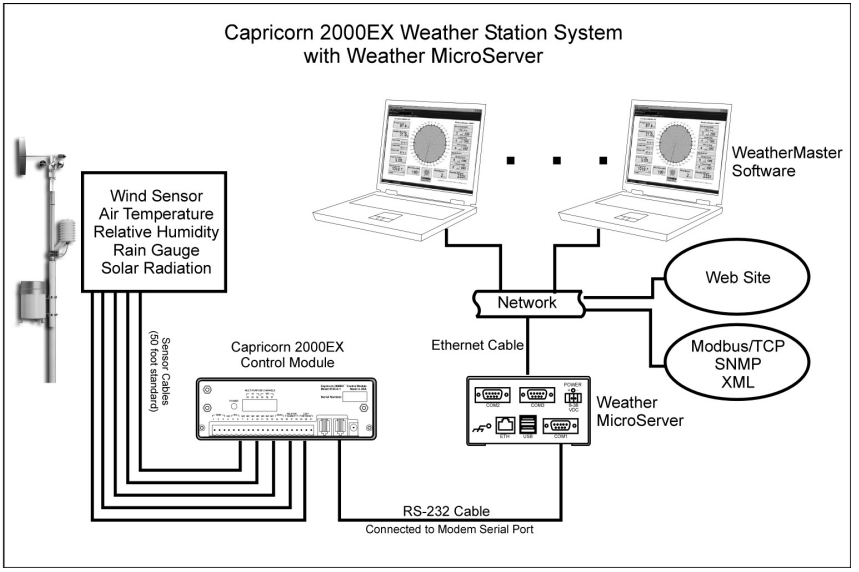
Connecting the Control Module to a Computer



Connect the computer RS-232 port to the Serial Aux port on the Control Module using an RS-232 Computer Cable (Cat. No. 8239).

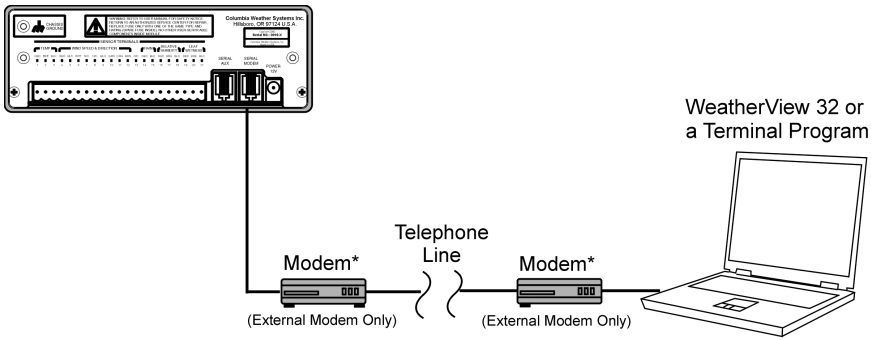
Connect the Weather Display Console to the Modem port on the Control Module using an RJ-11 cable (Cat. No. 8238).

Connecting the Control Module to the Weather MicroServer



Connect COM1 on the MicroServer to the Serial Modem port. The Serial Modem port should be configured to output 1 XFER data on power up. This configuration is normally performed at the factory.

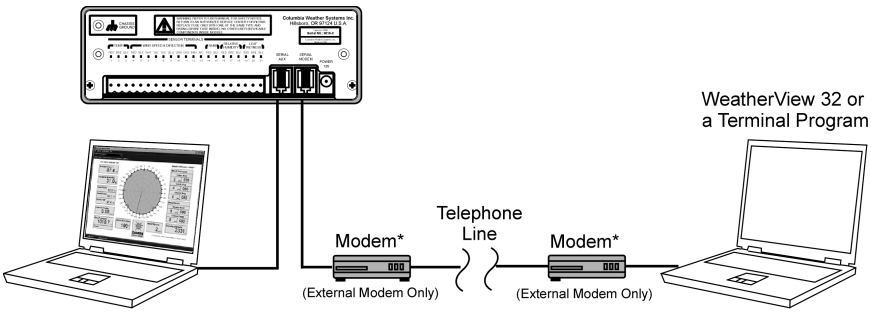
Connecting the Control Module to a Modem



* Recommend 33.6 US Robotics Sportster External Modem

Connect a modem to the Modem Port of the Control Module using an RS-232 Modem Cable (Cat. No. 8237).

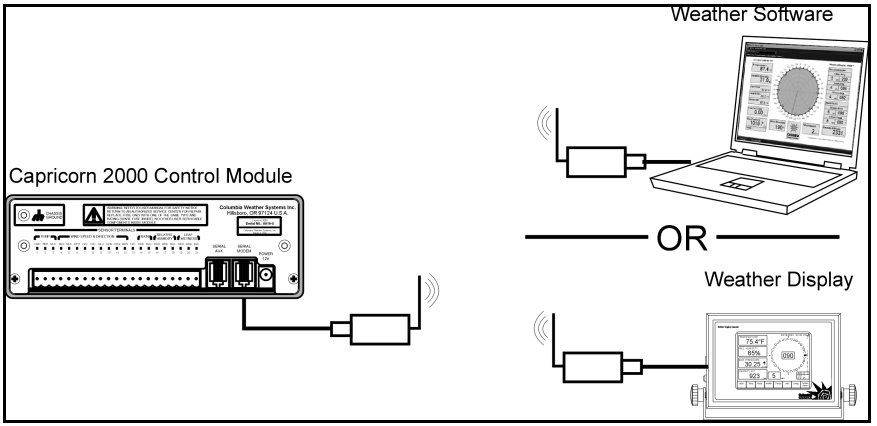
Connecting the Control Module to Computer and Modem

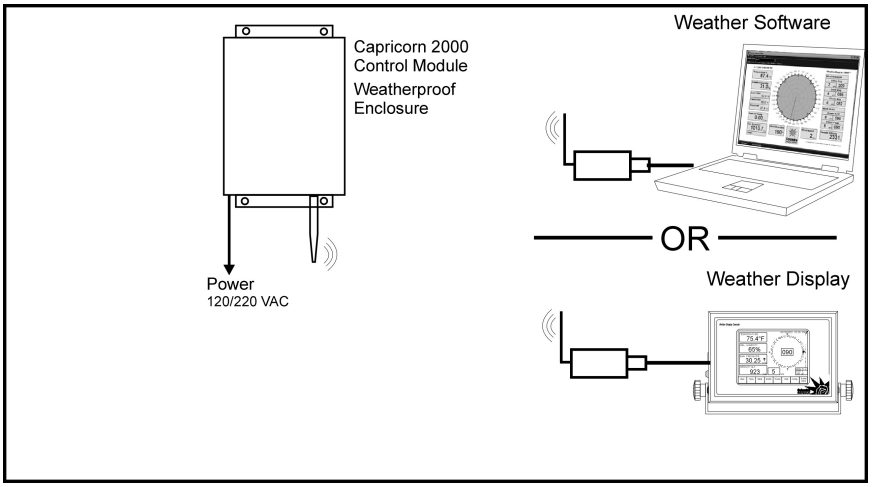


* Recommend 33.6 US Robotics Sportster External Modem

If both a computer and a modem are to be connected to the Control Module, connect the modem to the Modem Port using an RS-232 Modem Cable (Cat. No. 8237) and connect the computer RS-232 port to the Aux Port on the Control Module using an RS-232 Computer Cable (Cat. No. 8239).

Using Wireless Transceivers





The Capricorn 2000EX Control Module can be connected to a wireless transceiver to communicate with a computer or a Weather Display.

The standard wireless transceiver is a 2.4 GHz radio with a 2-mile line-of-site range.

Connect the transceiver to the Modem Port (or the Aux. port) of the Control Module using an RS-232 Cable.

Connect the second transceiver to a computer using the transceiver built-in cable or to a Weather Display console using an RS-232.

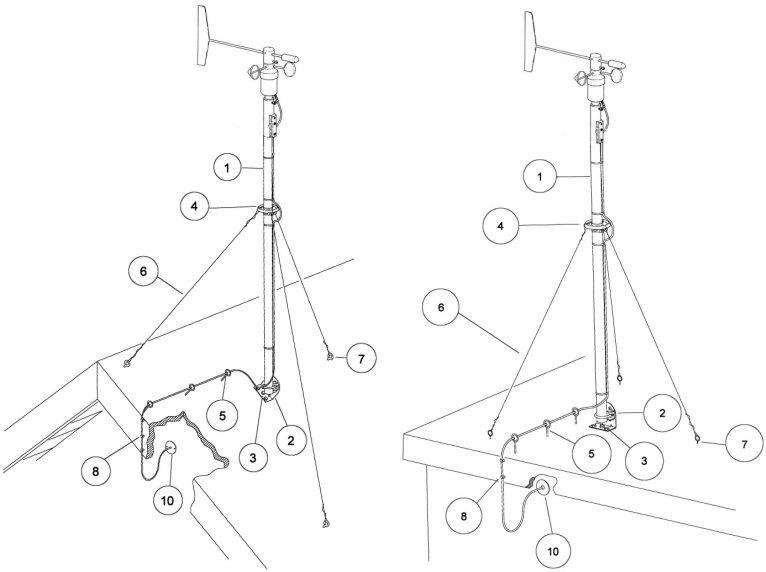
SECTION 4: OPTIONAL SENSOR MOUNTING HARDWARE

Fiberglass and steel 10-foot masts are available for use with either Roof Mounting Hardware Kit (Cat. No. 88002) or Wall Mounting Kit (Cat. No. 88003).

A 10-foot free standing tripod is also available.

Roof Mounting

The Roof Mounting Kit (Cat. No. 88002) is suitable for both a slanted and flat roof installation. The figure and table below illustrates and describes the individual parts. Items included in the kit are marked with an asterisk (*). Individual parts are also available.

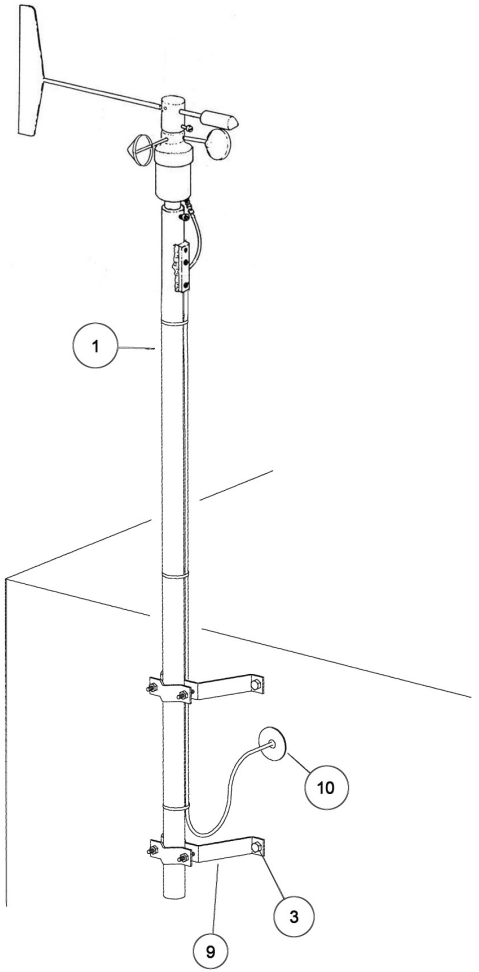


Description	Pkg.	Ref	Catalog No.
Mast, 10 ft. (steel or fiberglass)	1	1	88005 / 88004
*Universal Mast Mount	1	2	88010
Lag Screw, Roof Mast Mount	3	3	88020

1/4" x 4" (for shake roofs			
*Lag Screw, Roof Mast Mount	4	3	88030
1/4" x 2 1/4" (for comp. roofs)			
*Guy Ring and Collar	1	4	88040
*Cable Standoffs, Wood Screw	4	5	88050
Cable Standoffs, Nail-In (for masonry application)	2	5	88060
Guy Wire Clamps, 1/8"	3	(not shown)	88070
*Steel Guy Wire, Galvanized	50 ft.	6	88080
*Eye Bolt Wood Screws, 1/4" x 3"	4	7	88090
Turnbuckles, 6" open x 4" closed	2	(not shown)	88100
*Cable Nail Clips	20	8	88110
Wall Feed Through Tube	1	10	88130
*Cable Feed Through Bushings	4	10	88140
Watertight Rubberized Coating	17oz	(not shown)	83500

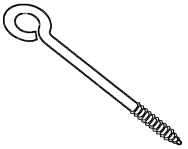
Wall Mounting

The figure and table below illustrates and describes the individual parts in the Wall Mounting Kit (Cat. No.88003). Items included in the kit are marked with an asterisk (*). Individual parts are also available.

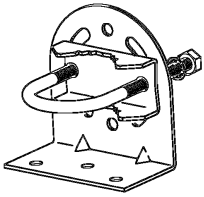


Description	Pkg.	Ref	Catalog No.
Mast, 10 ft. (steel or fiberglass)	1	1	88005 / 88004
*4" Wall Mount	2	9	88120
Lag Screw, 1/4" x 2 1/4"	4	3	88030
*Cable Nail Clips	20	8	88110

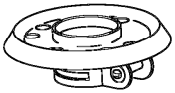
Wall Feed Through Tube	1	10	88130
*Cable Feed Through Bushings	4	10	88140



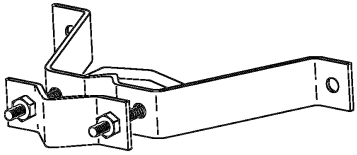
EYE BOLT SCREW



UNIVERSAL MAST MOUNT

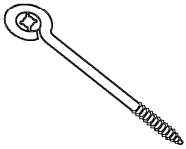


GUY RING & COLLAR



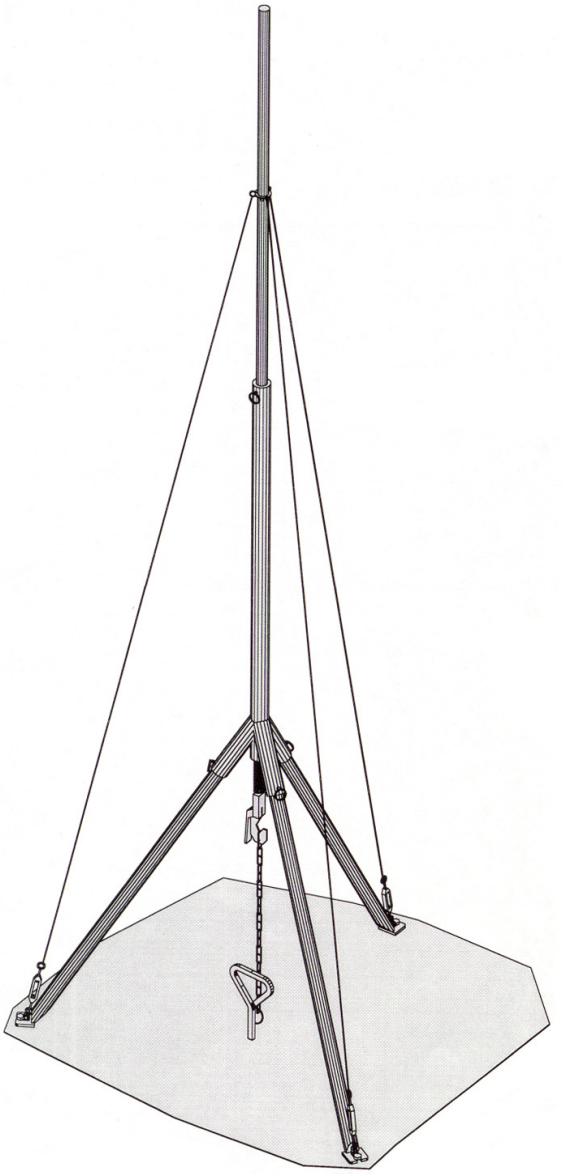
4" WALL MOUNT

CABLE NAIL CLIP



CABLE STANDOFF

Tripod



The tripod is designed to provide up to 10 feet of stable, secure support for your meteorological sensors.

The tripod is constructed from welded aluminum and is anodized for appearance and longevity. The 15-pound tripod can easily support up to

60 pounds of equipment. An optional tie-down kit allows for additional security in high-wind areas.

Set up takes less than five minutes. Simply insert the legs into the main body and install the stainless steel retainer pins. Extend the mast to the desired height and insert another retainer pin. Install the guy wires and you're ready to go!

Specifications

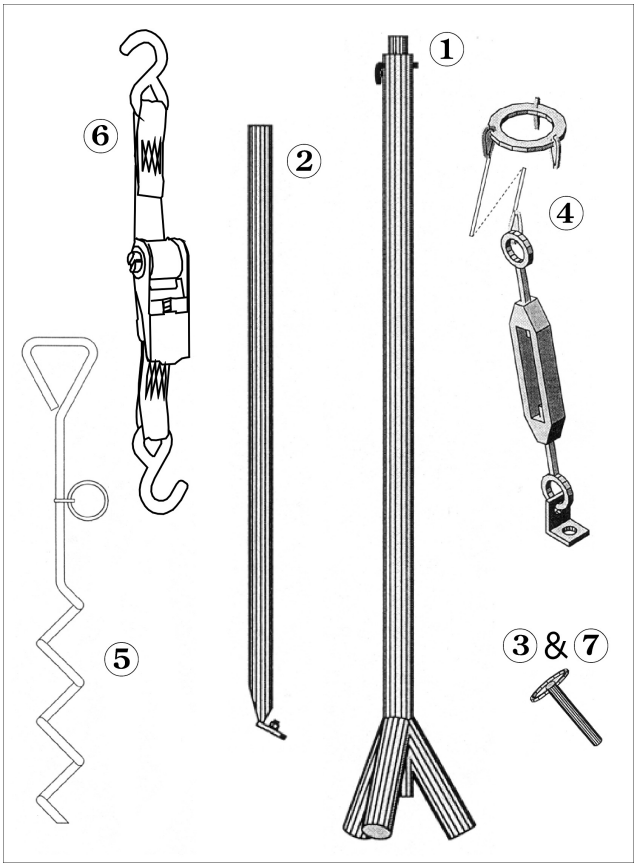
Capacity: Supports up to 60 lbs.

Shipping Weight: 17lbs

Shipping Box Dimensions: 70" x 8" x 8"

Tripod and Tiedown Kit, Catalog Number: 88019

Tripod, 10 foot (Catalog No. 88019) Parts List:



Item #	Description	Qty
1	Body/Mast Assembly	1
2	Legs	3
3	Retainer Pins	4
4	Guy Wire Ring with 3 Wires and Turnbuckles	1

Tiedown Kit Parts List:

Item #	Description	Qty
5	Anchor Screw with Chain	1
6	Clamp with Strap	1
7	Retainer Pin	1

Section 5: Operation

The Capricorn 2000EX communicates with a computer via an RS-232 interface. The weather station has two ports available on the back panel (RJ-12 Jacks). All of the following commands are accessible through either port. The two ports are independent from one another and are controlled by a multitasking processor.

RS-232 Modem serial port

This is the main serial port in the system. It is usually used for communication via modem or directly to a computer if a modem is not used.

RS-232 Aux serial port

This is a secondary serial port. It is usually used for direct communication with a computer if the Modem serial port is used.

Communication Settings

The protocol for both serial ports is the following:

Bits per Second (baud rate): 9600

Data bits: 8

Parity: None

Stop bits: 1

Flow control: None

Operating software

Once an RS-232 connection is made between the computer and the weather station, commands can be issued to the weather station using a "Terminal" software such as Hyper Terminal (available with Windows operating system), or by using such as Weather View 32™, WeatherMaster™.

The protocol is 8-bit, no parity, 1 stop bit and 9600 baud. All commands must be entered using upper case letters and followed by a carriage return.

The weather station will return "ok" after the results of each command. If the command is incorrect, the weather station will return "?".

Setting date and time

SET-DATE: This command is used to set the internal calendar to the appropriate date. It uses space delimiters between the month field, the day field, the year field, and the command field.

Example: 12 25 07 SET-DATE sets the date to 12/25/2007

SET-TIME: This command is used to set the internal clock to the appropriate military time (24 hours clock). It uses space delimiters between the hours field, minutes fields and the command field.

Example: 13 46 SET-TIME sets the time to 1:46 PM

Displaying date and time

DATE-TIME: This command is used to display the system date and time. When used the weather station will return the date followed by the time, comma delimited.

Example: 02/11/2007,13:20ok

Displaying current sensor readings

There are three ways to display current sensor readings:

The POLL command

POLL: This command is used to display the current sensor readings in a report format. When a POLL command is issued, the weather station will interrogate all the sensors and will display the information

Example:

11:00		Time
02/11/2007		Date
50.14	Degrees F	Temperature 1
70.89	Degrees F	Temperature 2
68.33	Degrees F	Temperature 3
64.46	Degrees F	Temperature 4
29.88	Inches Hg	Barometric Pressure
006	MPH	Wind Speed
SE		Wind Direction
073	Percent	Relative Humidity
00.06	Inches	Rain (Today)
04.43	Volts	Leaf Wetness
01.30	Volt	X1
04.58	Volts	X2

ok

The SAMPLE command

SAMPLE: This command is used to display the current sensor readings in a one line record format (the same format as the datalog). The record starts with the letter S followed by the date and time of the sample, followed by the sensor values and ends with a check sum value. All of these fields are comma delimited.

Example:

S,02/11/98,11:09,36WD,003WS,00.06R,072RH,29.88P1,+050.59T1,+070.77T2,+068.23T3,+064.60T4,04.43LW,0.00X1,0.00X2,6007ok

Where, WD is wind direction, WS is wind speed in MPH, R is rain fall in inches, RH is relative humidity percentage, P1 is barometric pressure in Inches-Hg, T1 through T4 are the four temperature sensors in degrees F, LW is leaf wetness in volts, X1 is typically solar radiation (5.00 volts equals 2000 Weather Master 2000-2) and X2 is used for additional sensors (X1 and X2 are available only in the Capricorn 2000MP).

Temperature sensors that are not defined or connected will have a +255.00 reading.

Wind direction is displayed in a 64 degree compass (1 = 5.625 degrees). For example:

		Degrees
0	N	0
4	NNE	22.5
8	NE	45
12	ENE	67.5
16	E	90
20	ESE	112.5
24	SE	135

28	SSE	157.5
32	S	180
36	SSW	202.5
40	SW	225
44	WSW	247.5
48	W	270
52	WNW	292.5
56	NW	315
60	NNW	337.5

The Short commands

WD: will display wind direction in 64 compass points (5.625 deg resolution).

WS: will display wind speed in MPH

R1: will display the rain fall for the day in inches

RH: will display relative humidity percentage

P1: will display the barometric pressure in inches-Hg

T1: will display the temperature for the first temperature probe in degrees F

T2: will display the temperature for the second temperature probe in degrees F

T3: will display the temperature for the third temperature probe in degrees F

T4: will display the temperature for the fourth temperature probe in degrees F

LW: will display leaf wetness in volts. The range may vary per sensor. Typically, 0.5 volts indicates saturated condition and 4.5 volts indicates dry conditions.

X1: will display solar radiation (typically). 5.00 volts equals 2000 Wm-2.

X2: will display the value of the wind direction in 0 to 5 volts.

Datalog

The Capricorn 2000EX weather station has a built in circular datalogger. The datalog holds records of sensor readings (Samples) and High/Low information. Both types of records (Samples and High/Low) are recorded at user defined intervals.

The datalog can hold up to 511 records. A Sample occupies on record and High/Low information occupies four records.

Setting datalog intervals

The interval for the Sample records in the datalog is user selectable. The interval duration is restricted to the following: 1, 2, 3, 4, 5, 6, 10, 15, 20, 30, and 60 minutes.

n MEAS-INT: This command sets the Sample interval in the datalog. n is the interval duration in minutes.

Example: 15 MEAS-INT will cause the weather station to save a Sample record every 15 minutes.

Setting Hi/Lo intervals

The interval for the High/Low records in the datalog is user selectable. The interval duration is restricted to the following: 1, 2, 3, 4, 6, 8, 12 and 24 hours.

n HI/LO-INT: This command sets the High/Low interval in the datalog. n is the interval duration in hours.

Example: 12 HI/LO-INT will cause the weather station to save High/Low records (total of four records) every 12 hours.

Displaying the datalog

ALL: This command will display the complete datalog (511 maximum records)

Example: In this example the Sample interval is set at one minute and the High/Low interval is set at one hour and the datalog has 13 records (9 Sample records and 4 High/Low records).

13 records

S,02/11/98,13:56,32WD,007WS,00.07R,074RH,29.85P1,+052.31T1,+071.62T2,+069.17T3,+065.57T4,01.88LW,0.00X1,0.00X2,6015

S,02/11/98,13:57,32WD,005WS,00.07R,074RH,29.86P1,+052.74T1,+071.83T2,+069.26T3,+065.69T4,01.70LW,0.00X1,0.00X2,6019

S,02/11/98,13:58,32WD,006WS,00.07R,072RH,29.85P1,+052.76T1,+071.64T2,+069.35T3,+065.75T4,01.74LW,0.00X1,0.00X2,6020

S,02/11/98,13:59,32WD,006WS,00.07R,071RH,29.85P1,+052.94T1,+071.86T2,+069.36T3,+065.81T4,01.74LW,0.00X1,0.00X2,6022

H,02/11/98,14:00,013,13:25WS,081,13:40RH,29.86,13:27P1,+053.23,14:00T1,+072.27,13:52T2,+069.59,13:31T3,+065.88, 14:00T4,01.70,13:57LW,0.00,14:00X1,0.00,14:00X2,8351

L,02/11/98,14:00,013,13:25WS,067,13:25RH,29.84,13:25P1,+050.17,13:39T1,+071.29,13:26T2,+068.33,13:42T3,+065.34, 13:25T4,04.41,13:27LW,0.00,00:00X1,0.00,00:00X2,8349

S,02/11/98,14:00,28WD,000WS,00.07R,071RH,29.85P1,+053.23T1,+072.02T2,+069.26T3,+065.88T4,01.76LW,0.00X1,0.00X2,5998

S,02/11/98,14:01,28WD,003WS,00.07R,071RH,29.85P1,+053.67T1,+072.52T2,+068.91T3,+065.88T4,01.78LW,0.00X1,0.00X2,6018

S,02/11/98,14:02,32WD,006WS,00.07R,069RH,29.85P1,+053.70T1,+072.86T2,+068.89T3,+065.86T4,01.84LW,0.00X1,0.00X2,6027

S,02/11/98,14:03,32WD,003WS,00.07R,068RH,29.85P1,+053.73T1,+073.13T2,+069.21T3,+065.86T4,01.88LW,0.00X1,0.00X2,6009
S,02/11/98,14:04,28WD,005WS,00.07R,067RH,29.85P1,+053.41T1,+072.48T2,+069.36T3,+065.86T4,01.94LW,0.00X1,0.00X2,6021ok

Note that the Sample records start with the letter S and the High/Low records start with the letter H and L respectively.

NOW: This command will display the last record in the datalog

n GET: This command will display a user defined number of records in the datalog, where n is the number of records.

Example: 10 GET will display the last ten records in the datalog.

Resetting Hi/Lo

RESET-HI/LO: This command will erase the high/low values from memory for the current high/low interval.

Resetting the datalog

RESET-DATA: This command will erase the datalog and will insert one current Sample record.

Displaying current Hi/Lo

HIGH: This command will display the current high record. The High record starts with the letter H followed by the date and time the record was requested followed by the high values and the time for wind speed, relative humidity, pressure, temperatures, leaf wetness and two undefined sensors (X1 and X2). The high value of wind speed is the wind gust.

Example:

H,02/11/98,14:00,013,13:25WS,081,13:40RH,29.86,13:27P1,+053.23,14:00T1,+072.27,13:52T2,+069.59,13:31T3,+065.88, 14:00T4,01.70,13:57LW,0.00,14:00X1,0.00,14:00X2,8351

LOW: This command will display the current low record. The Low record starts with the letter L followed by the date and time the record was requested followed by the low values and the time for wind speed, relative humidity, pressure, temperatures, leaf wetness and two

undefined sensors (X1 and X2). The low value of wind speed is the high 4 second sustained wind average.

Setting temperature offsets

Temperature offsets are used to calibrate the temperature probes.

n TCAL#: This command is used to enter an offset for a temperature probe. Where n is the offset in 1/100 of a degree F and # is the temperature probe number.

Example: 231 TCAL2 adds 2.31 degree F to the temperature reading from temperature probe two and -231 TCAL2 subtracts 2.31 degrees F from the reading.

Please refer to the Temperature Calibration section for more information.

Setting barometric pressure altitude and offset

n ALT: This command sets the altitude of the weather station, where n is the altitude in feet.

Example: 225 ALT sets the altitude to 225 feet above sea level.

n BAR-OFFSET: This command is used to enter an offset to the barometric pressure reading, where n is the offset in 1/100 of In.Hg.

Example: 34 BAR-OFFSET adds 0.34 in.Hg to the barometric pressure reading and -34 BAR-OFFSET subtract 0.34 in.Hg from the reading.

Please refer to Barometric Pressure Calibration for more information.

Display current settings

PARAMETERS: This command displays the current weather station settings and the number of records in the datalog.

Example:

Date & Time	02/11/2007,17:31
Measurement interval	1 minute
Hi/Lo interval	1 hours
Records in memory	262
Pressure offset	38
Altitude	225
Temperature 1 offset	255
Temperature 2 offset	-25
Temperature 3 offset	55
Temperature 4 offset	155 ok

Continuous display of direction

NORTH: This command continuously displays the wind direction. This command is used for locating the north direction on the wind sensor. An <Esc> followed by a carriage return terminates this command.

Continuous display of weather information

1 XFER: This command continuously displays a Sample record every 15 seconds and wind speed and direction every one second. The wind speed and direction record starts with the letter W followed by three digits for wind speed in MPH followed by two digits for wind direction.

Example:

W00124

S,02/11/07,17:44,24WD,001WS,00.08R,085RH,29.82P1,+048.56T1,+070.85T2,+067.24T3,+065.0

8T4,01.74LW,0.00X1,0.00X2,6014

W00224

W00224

W00124

W00124

W00124

W00120okok

An <Esc> followed by a carriage return terminates this command.

XSET: This command defines the frequency the Sample record is displayed in the XFER output. The default frequency of the Sample record in the XFER output is 15 seconds. This frequency can be changed using the XSET command. For example, 60 XSET will cause the Sample record to be issued every 60 seconds. XSET will change the frequency of the XFER output on both serial ports.

CONT: This command will continuously output the Sample record at a specified interval. For example, 5 CONT will output a Sample record every 5 seconds. The time interval is limited to a range of 1 to 16 seconds.

S,05/01/99,09:44,40WD,000WS,00.00R,022RH,29.10P1,+070.70T1,+255.00T2,04.80LW,5.00X1,0

.10X2,4923

S,05/01/99,09:44,40WD,000WS,00.00R,023RH,29.09P1,+070.70T1,+255.00T2,04.80LW,5.00X1,0

.10X2,4932

S,05/01/99,09:44,40WD,000WS,00.00R,023RH,29.09P1,+070.70T1,+255.00T2,04.80LW,5.00X1,0
.10X2,4932
S,05/01/99,09:44,40WD,000WS,00.00R,023RH,29.10P1,+070.70T1,+255.00T2,04.80LW,5.00X1,0
.10X2,4924
S,05/01/99,09:45,40WD,000WS,00.00R,023RH,29.10P1,+070.70T1,+255.00T2,04.80LW,5.00X1,0
.10X2,4925
S,05/01/99,09:45,40WD,000WS,00.00R,023RH,29.10P1,+070.70T1,+255.00T2,04.80LW,5.00X1,0
.10X2,4925
S,05/01/99,09:45,40WD,000WS,00.00R,023RH,29.10P1,+070.70T1,+255.00T2,04.80LW,5.00X1,0
.10X2,4925
S,05/01/99,09:45,40WD,000WS,00.00R,023RH,29.10P1,+070.70T1,+255.00T2,04.80LW,5.00X1,0
.10X2,4925
S,05/01/99,09:46,40WD,000WS,00.00R,023RH,29.10P1,+070.72T1,+255.00T2,04.80LW,5.00X1,0
.10X2,4928
S,05/01/99,09:46,40WD,000WS,00.00R,023RH,29.10P1,+070.72T1,+255.00T2,04.80LW,5.00X1,0
.10X2,4928okok

An <Esc> followed by a carriage return terminates this command. The output will stop after one more Sample record is issued. For example, if CONT is set to repeat the Sample record every 15 seconds (15 CONT) and an <ESC><RETURN> was entered, one more Sample record will be issued before the double ok is displayed indicating that the command is terminated.

SECTION 6: CALIBRATION

Calibrating the Barometric Pressure Sensor

The barometric pressure sensor is calibrated at the factory to a highly accurate digital pressure gauge (±0.02% of full range) and, therefore, requires no further calibration.

Altitude Setting

After calibration at the factory, the altitude is set to zero. To get an accurate barometric pressure reading, the local altitude needs to be set in the weather station.

To set the altitude, use the ALT command and enter the altitude in feet. Please refer to Section 4: Operation for more information. The altitude can also be set using weather software or display console. Please refer to the product user manual.

Note: The electronic transducer used to measure air pressure is sensitive to changes in elevation of as little as 10 ft. (3 m).

Note: For systems with a MicroServer, the altitude setting should be entered in the MicroServer/Parameter Settings

Optional Calibration Procedure

Even though the barometric pressure sensor is calibrated at the factory, the sensor can be calibrated on-site. This might be required if the original barometric pressure offset has been erased from memory, or if weather station needs to match a local source.

To calibrate the barometric pressure on-site:

Using a terminal program set the barometric pressure offset to zero by entering: 0 BAR-OFFSET

Wait approximately 5 seconds, then take a pressure reading using SAMPLE, POLL or P1

Record the barometric pressure from a local reliable source at the same elevation as the Capricorn 2000EX.

Calculate the barometric pressure offset as follows:

Barometric Pressure Offset = Source Reading - Capricorn 2000EX Reading.

Enter the barometric pressure offset in 1/100 of in.Hg using the BAR-OFFSET command.

Calibrating the Wind Sensor

General Maintenance schedule:

6-12 month intervals:

A. Inspect the sensor for proper operation per Section 3.0 of user manual
B. Replacement of wind speed sensor bearing in extremely adverse environments

12-24 month intervals:

A. Replacement of wind speed sensor bearings

24-36 month intervals:

A. Recommended complete factory overhaul of sensor

Note: Please refer to the Met One 034B wind sensor user manual for detailed installation, calibration and maintenance information

Calibrating the Temperature Sensors

All Temperature sensors are calibrated at the factory to a superior grade ASTM mercury thermometer. The calibration offset is recorded on the temperature sensor and on the end of the cable.

After initializing all the temperature sensors, enter the temperature offsets using the TCAL command. Please refer to Section 5: Operation for more information.

To calibrate the temperature sensors on-site, perform the following steps:

Prepare an ice bath by mixing two cups of crushed ice in two cups of water. Use an insulated container for best results. Allow the temperature throughout the ice bath to stabilize by waiting for about twenty minutes.

Stir the ice bath to mix the ice and water, wait for the ice to separate from the water, place the temperature sensor in the ice bath. Make sure that the sensor is not in direct contact with ice.

Take a temperature reading from the Capricorn 2000EX using SAMPLE or POLL.

Calculate the temperature offset as follows:

Temperature offset = (32 - Capricorn 2000EX reading) * 100

Enter the temperature offset using the TCAL command. Please refer to Section 4: Operation for more information.

Record the temperature offset on a label attached to the sensor.

Repeat the process for any other temperature sensor.

Calibrating the Humidity Sensor

The humidity sensor is calibrated at the factory. No field calibration is required.

The humidity sensor has a ±2% stability over 2 years. Therefore we recommend replacing the sensing element every 2 to 4 years.

Calibrating the Rain Gauge Sensor

The rain gauge is calibrated at the factory and does not require any initial field calibration.

The tipping bucket mechanism is a simple and highly reliable device. The transmitter must be located in a clear area, away from trees, buildings, etc. It must also be mounted level. Accurate readings will not be obtained unless the transmitter is mounted in a level position. The mechanism must be clean. Any accumulation of foreign material, dust, etc. will alter the calibration of this unit.

Absolutely accurate calibration can be obtained only with laboratory equipment, but an approximate field check can be easily made.

For field calibration, a calibration kit is available from the factory.

Calibrating the Leaf Wetness Sensor

The leaf wetness sensor is calibrated at the factory. No field calibration is required.

Calibrating the Solar Radiation Sensor

The solar radiation sensor is calibrated at the factory. No field calibration is required.

SECTION 7: MAINTENANCE

In normal use, the Capricorn 2000EX should require very little maintenance. In the event of any problems, follow the procedures contained in Section 8: Troubleshooting, to determine whether the unit is defective. If it is defective and the unit needs to be returned to the factory for repair, refer to the Return For Repair Procedure in Section 9: User Support Information.

Console Maintenance

The Control Module contains sensitive electronics components and should not be serviced by the user. If the LED on the back (inside) of the unit is not on, check for proper installation of the wall mount power supply and then check to see if the fuse on the Control Module board needs to be replaced. If necessary, replace it with a 1.0 amp 250V fast acting fuse.

Barometric Pressure Sensor Maintenance

The barometric pressure sensor is located inside the cabinet and should not be serviced by the user.

Temperature Sensor Maintenance

Check the temperature sensor cables during installation and periodically thereafter to make sure they contain no cuts, kinks or other abnormalities, and that any splices are properly connected and insulated.

Wind Sensor Maintenance

Note: Please refer to the Met One 034B wind sensor user manual for detailed installation, calibration and maintenance information

Relative Humidity Sensor Maintenance

The Relative Humidity sensor does not require any field maintenance.

Rain Gauge Maintenance

Periodically clean the Rain Gauge of any debris that might be clogging the funnel or accumulating in the tipping bucket.

Leaf Wetness Sensor Maintenance

Periodically clean the Leaf Wetness sensor grid surface of any dirt or debris accumulation.

Solar Radiation Sensor Maintenance

Periodically clean the solar radiation sensor lens from any dirt or debris accumulation.

Section 8: Troubleshooting

Wind Sensor Tests

In the event the wind speed is reporting zero constantly regardless of wind conditions, is inexplicably erratic and/or the wind direction is reporting North constantly regardless of wind conditions, or is reporting incorrect direction, either the Control Module or the sensors (or both) may be defective. The following tests are appropriate to help locate the source of the problem.

Tools required:

(1) Small Phillips screwdriver

(1) 6" (15 cm) jumper wire, 22 gauge

Multi meter or volt meter

Wind Speed Test

1. Unplug the power supply cord from the Control Module.
2. Remove the seven wind sensor wires from their terminals at the back of the Control Module.
3. Power up the Control Module.
4. With one end of the jumper wire connected to terminal #6, tap the other end on terminal #5; the wind speed reading should change from zero. The faster you tap, the higher the wind speed value.
5. If the wind speed value does not change from zero, then the wind speed channel in the Control Module is defective and the Control Module should be returned to the factory for repair.
6. If the wind speed value changes from zero, the problem is in the wind sensor or cable. Check the cable for damage and inspect any cable splices. Make sure the cable connector is plugged in the wind sensor correctly.
7. If you cannot find any problems with the cable, disconnect the wind sensor and return it to the factory for repair.

Note: Please follow the procedure on page 76 for returning any defective items to the factory.

Wind Direction Test

1. Set the multi meter set to volts DC.
2. Measure the voltage between terminal #25 and #26. Place the black probe on terminal #26 and the red probe on terminal #25. The voltage should be 5.0 volts DC. If the voltage is different, the wind direction channel is defective and the Control Module should be returned to the factory for repair.
3. With the Control Module powered On and the wind sensor connected, place the back probe on terminal #26 and the red probe on terminal #27.
4. As the wind vane rotates, the voltage reading will vary from 0 to 5 volts DC. If the vane is pointing south, the voltage reading should be 2.5 volts.
5. If the voltage reading is not changing when the vane is rotating or if the value is out of the normal range (0 to 5.0 volts DC) the wind sensor is defective and should be returned to the factory for repair.

Note: Please follow the procedure on page 76 for returning any defective items to the factory.

Temperature Sensor Troubleshooting

If the Temperature sensor is reading a few degrees off when compared to a standard, the Temperature sensor may require re-calibration. Please refer to calibration procedure in Section 6: Calibrating the Temperature Sensor.

If the Temperature sensor is reading 255°F, the Temperature sensor may be disconnected from the Control Module, may not be initialized, or may be defective.

Check the cable from the sensor to the Control Module for any cuts or kinks. Check any splices to ensure good connection. Check the cable connection to the Control Module.

The initialization procedure should be performed when replacing or adding a sensor or when a sensor has lost its initialization to the Control Module and is reading 255°F.

To initialize a temperature sensor to the Control Module, perform the following procedure:

1. Disconnect all temperature sensors from the Control Module.
2. Disconnect the power from the Control Module. Wait for 10 seconds and then connect the power to the Control Module.
3. Connect the temperature sensor to the Control Module
4. Disconnect the power from the Control Module. Wait for 10 seconds and then connect the power to the Control Module.
5. If installing more than one temperature sensor, repeat steps 3 and 4 for each sensor added.

This procedure will initialize the temperature sensor(s) to the Control Module. The Control Module identifies each temperature sensor connected and initialized by an internal serial number. The Control Module will define the sensors by the numbers 1 through 4 based on the order in which they are initialized. Be sure to initialize the main outdoor sensor first, so that it will be defined as T1. Wind chill, heat index and dew point are all calculated based on the value of T1.

SECTION 9: USER SUPPORT INFORMATION

This section consists of the following items:

1. Two-Year Limited Warranty: Please read this document carefully.
2. Return for Repair Procedure: This procedure is for your convenience in the event you mut return your Capricorn 2000EX for repair or replacement. Follow the packing instructions carefully to protect your instrument in transit.

Limited Warranty

Columbia Weather Systems, Inc. (CWS) warrants the Capricorn 2000EX Weather Station to be free from defects in materials and/or workmanship when operated in accordance with the manufacturer's operating instructions, for two (2) years from date of purchase, subject to the provisions contained herein. CWS warranty shall extend to the original purchaser only and shall be limited to factory repair or replacement of defective parts.

EXCLUSIONS

Certain parts are not manufactured by CWS (i.e., certain purchased options, etc.) and are therefore not covered by this warranty. These parts may be covered by warranties issued by their respective manufacturers and although CWS will not warrant these parts, CWS will act as agent for the administration of any such independent warranties during the term of this warranty. This warranty does not cover normal maintenance, damage resulting from improper use or repair, or abuse by the operator. Damage caused by lightning or other electrical discharge is specifically excluded. This warranty extends only to repair or replacement, and shall in no event extend to consequential damages. In the event of operator repair or replacement, this warranty shall cover neither the advisability of the repair undertaken, nor the sufficiency of the repair itself.

THIS DOCUMENT REFLECTS THE ENTIRE AND EXCLUSIVE UNDERSTANDING OF THE PARTIES, AND EXCEPT AS OTHERWISE PROVIDED HEREIN, ALL OTHER WARRANTIES, EXPRESS OR IMPLIED, PARTICULARLY THE WARRANTIES OF MERCHANT

ABILITY AND/OR FITNESS FOR A PARTICULAR PURPOSE ARE EXCLUDED.

This warranty gives you specific legal rights, and you may also have other rights which vary from state to state.

Return for Repair Procedure

1. In the event of defects or damage to your unit, first call the factory Capricorn Service Department Monday through Friday, 8:30 am to 4:00 pm PST, (503) 629-0887 to determine the advisability of factory repair. The Service Department will issue an RMA number (Return Merchandise Authorization) to help us identify the package when received. Please place that number on the outside of the box.
2. In the event factory service is required, return your Capricorn 2000EX as follows:

   A. Packing

   - Wrap Control Module in plastic bag first.
   - Pack in original shipping carton or a sturdy oversized carton.
   - Use plenty of packing material.

   B. Include:

   - A brief description of the problem with all known symptoms.
   - Your phone number.
   - Your return street shipping address (UPS will not deliver to a P.O. box).
   - Write the RMA number on the outside of the box.

   C. Shipping

   - Send freight prepaid (UPS recommended).
   - Insurance is recommended. (The factory can provide the current replacement value of the item being shipped for insurance purposes.)

D. Send to:

Columbia Weather Systems, Inc.
2240 NE Griffin Oaks Street, Suite 100
Hillsboro, Oregon 97124

E. C.O.D. shipments will not be accepted.

3. If your unit is under warranty, after repair or replacement has been completed, it will be returned by a carrier and method chosen by Columbia Weather, Inc. to any destination within the continental U.S.A. If you desire some other specific form of conveyance or if you are located beyond these borders, then you must bear the additional cost of return shipment.

4. If your unit is not under warranty, we will call you with an estimate of the charges. If approved, your repaired unit will be returned after all charges, including parts, labor and return shipping and handling, have been paid. If not approved, your unit will be returned as is via UPS COD for the amount of the UPS COD freight charges.

Reference

Glossary

Aspirating Radiation Shield

A device used to shield a sensor such as a temperature probe from direct and indirect radiation and rain while providing access for ventilation.

Barometric Pressure

The pressure exerted by the atmosphere as a consequence of gravitational attraction exerted upon the “column” of air lying directly above the point in question.

Celsius Temperature Scale

A temperature scale with the ice point at 0 degrees and the boiling point of water at 100 degrees.

Dew Point

The temperature to which a given parcel of air must be cooled at constant pressure and constant water-vapor content in order for saturation to occur. When this temperature is below 0°C, it is sometimes called the frost point.

Fahrenheit Temperature Scale

A temperature scale with the ice point at 32 degrees and the boiling point of water at 212 degrees.

Global Radiation

The total of direct solar radiation and diffused sky radiation received by a unit horizontal surface. Global radiation is measured by a Pyranometer.

Heat Index

The heat index or apparent temperature is a measure of discomfort due to the combination of heat and high humidity. It was developed in 1979 and is based on studies of evaporative skin cooling for combinations of temperature and humidity.

Pyranometer

It measures the combined intensity of incoming direct solar radiation and diffused sky radiation. The Pyranometer consists of a radiation-sensing element, which is mounted so that it views the entire sky.

Relative Humidity

Popularly called humidity. The ratio of the actual vapor pressure of the air to the saturation vapor pressure.

Sea Level Pressure

The atmospheric pressure at mean sea level, either directly measured or, most commonly, empirically determined from the observed station pressure.

In regions where the earth's surface pressure is above sea level, it is standard observational practice to reduce the observed surface pressure to the value that would exist at a point at sea level directly below.

Soil Moisture

Moisture in the soil within the zone of aeration present in the soil pores. In some cases this refers strictly to moisture within the root zone of plants.

Solar Radiation

The total electromagnetic radiation emitted by the sun. 99% of the suns energy output falls within the wavelength interval from 0.15 microns to 4.0 microns, with peak intensity near 0.47 microns. About one-half of the total energy in the solar beam is contained within the visible spectrum from 0.4 to 0.7 microns, and most of the other half lies near infrared, a small additional portion lying in the ultraviolet.

Wind Chill

That part of the total cooling of a body caused by air motion.

Unit Conversion

Speed

Kilometers per hour = 1.610 x miles per hour

Knots = 0.869 x miles per hour

Meters per second = 0.448 x miles per hour

Feet per second = 1.467 x miles per hour

Temperature

Temperature in °C = 5/9 (temperature in °F - 32)

Temperature in °F = (1.8 x temperature in °C) + 32

Distance

Millimeters = 25.4 x inches

Pressure

Millibars = 33.86 x inches of mercury

Kilopascals = 3.386 x inches of mercury

Pounds per square inch = 0.49 x inches of mercury

Standard atmospheres = 0.0334 x inches of mercury

Solar Radiation

BTU/foot^2 minutes = 0.00529 x watts/meter^2

Joules/centimeter^2 minutes = 0.006 x watts/meter^2

Mega joules/meter^2 day = 11.574 x watts/meter^2

Langleys/minutes = 0.00143 x watts/meter^2

Tables and Formulas

Wind Chill Chart

In 2001, NWS implemented an updated Wind chill Temperature (WCT) index. The change improves upon the former WCT Index used by the NWS and the Meteorological Services of Canada, which was based on the 1945 Siple and Passel Index.

In the fall of 2000, the Office of the Federal Coordinator for Meteorological Services and Supporting Research (OFCM) formed a group consisting of several Federal agencies, MSC, the academic community (Indiana University-Purdue University in Indianapolis (IUPUI), University of Delaware and University of Missouri), and the International Society of Biometeorology to evaluate and improve the windchill formula. The group, chaired by the NWS, is called the Joint Action Group for temperature Indices (JAG/TI). JAG/TI's goal is to upgrade and standardize the index for temperature extremes internationally (e.g. Wind chill Index).

The current formula uses advances in science, technology, and computer modeling to provide a more accurate, understandable, and useful formula for calculating the dangers from winter winds and freezing temperatures.

Temperature (°F)

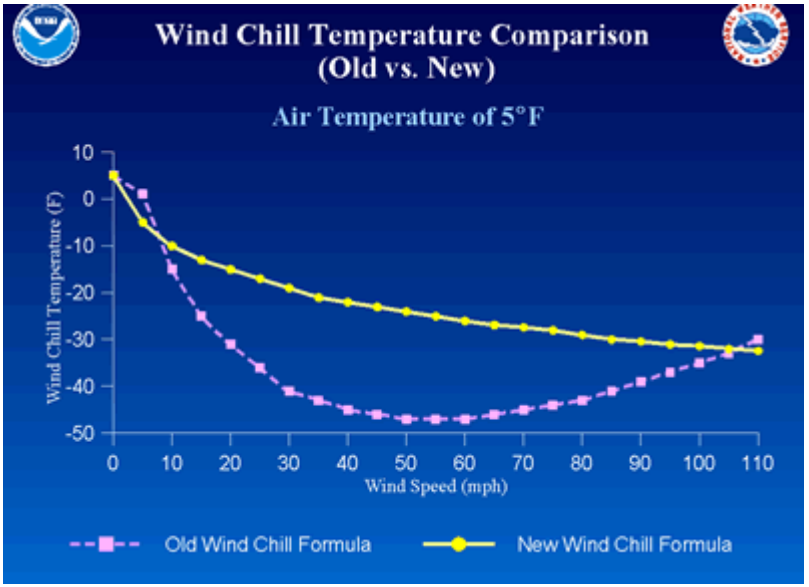
Wind (mph)	Calm	40	35	30	25	20	15	10	5	0	-5	-10	-15	-20	-25	-30	-35	-40	-45
	5	36	31	25	19	13	7	1	-5	-11	-16	-22	-28	-34	-40	-46	-52	-57	-63
	10	34	27	21	15	9	3	-4	-10	-16	-22	-28	-35	-41	-47	-53	-59	-66	-72
	15	32	25	19	13	6	0	-7	-13	-19	-26	-32	-39	-45	-51	-58	-64	-71	-77
	20	30	24	17	11	4	-2	-9	-15	-22	-29	-35	-42	-48	-55	-61	-68	-74	-81
	25	29	23	16	9	3	-4	-11	-17	-24	-31	-37	-44	-51	-58	-64	-71	-78	-84
	30	28	22	15	8	1	-5	-12	-19	-26	-33	-39	-46	-53	-60	-67	-73	-80	-87
	35	28	21	14	7	0	-7	-14	-21	-27	-34	-41	-48	-55	-62	-69	-76	-82	-89
	40	27	20	13	6	-1	-8	-15	-22	-29	-36	-43	-50	-57	-64	-71	-78	-84	-91
	45	26	19	12	5	-2	-9	-16	-23	-30	-37	-44	-51	-58	-65	-72	-79	-86	-93
	50	26	19	12	4	-3	-10	-17	-24	-31	-38	-45	-52	-60	-67	-74	-81	-88	-95
	55	25	18	11	4	-3	-11	-18	-25	-32	-39	-46	-54	-61	-68	-75	-82	-89	-97
	60	25	17	10	3	-4	-11	-19	-26	-33	-40	-48	-55	-62	-69	-76	-84	-91	-98

Frostbite Times: 30 minutes | 10 minutes | 5 minutes

$$\text{Wind Chill (°F)} = 35.74 + 0.6215T - 35.75(V^{0.16}) + 0.4275T(V^{0.16})$$

Where, T= Air Temperature (°F) V= Wind Speed (mph)

Effective 11/01/01



Wind Chill Equation

$WC = 35.74 + 0.6215\ T - 35.75(V^{0.16}) + 0.4275\ T(V^{0.16})$

Where:

WC = wind chill temperature in °F

V = wind velocity in mph

T = air temperature in °F

Note: *Wind chill Temperature is only defined for temperatures at or below 50 degrees F and wind speeds above 3 mph.*

Heat Index

	Temperature in °F													
RH	70	75	80	85	90	95	100	105	110	115	120	125	130	135
0	64	66	73	78	83	87	91	95	99	103	107	111	117	120
5	64	69	74	79	84	88	93	97	102	107	111	116	122	126
10	65	70	75	80	85	90	95	100	105	111	116	123	131	
15	65	71	76	81	86	91	97	102	108	115	123	131		
20	66	72	77	82	87	93	99	105	112	120	130	141		
25	66	72	77	83	88	94	101	109	117	127	139			
30	67	73	78	84	90	96	104	113	123	135	148			
35	67	73	79	85	91	98	107	118	130	143				
40	68	74	79	86	93	101	110	123	137	151				
45	68	74	80	87	95	104	115	129	143					
50	69	75	81	88	96	107	120	135	150					
55	69	75	81	89	98	110	126	142						
60	70	76	82	90	100	114	132	149						
65	70	76	83	91	102	119	138							
70	70	77	84	93	106	124	144							
75	70	77	85	95	109	130	150							
80	71	78	86	97	113	136								
85	71	78	87	99	117	140								
90	71	79	88	102	122	150								
95	71	79	89	105	126									
100	72	80	90	108	131									

Dew Point

B = (ln (RH/100) + ((17.2694*T) / (238.3+T))) / 17.2694

Dew Point in ℃ = (238.3 * B) / (1-B)

Where:

RH = Relative Humidity

T = Temperature in ℃

Ln = Natural logarithm

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