CAPRICORN II PLUS™ WEATHER STATION

USER MANUAL

Version 3.0

Cat. No. 81621

All specifications subject to change without notice.

Printed in U.S.A.

WELCOME!

Welcome to the Capricorn family of users and congratulations on your purchase of the Capricorn II Plus Digital Weather Station.

Please be sure to fill in and return the Capricorn Product Registration Card located in the front of the manual. The Capricorn II Plus has been in use since 1982, during which time it has earned a reputation as a rugged, reliable product. It is a precision instrument, however, and requires proper installation and a certain amount of regular maintenance.

The Capricorn II Plus is quite easy to install and you may be tempted to skip the installation procedure or other portions of this manual. We recommend that you resist that urge. A thorough knowledge of these installation and calibration procedures will greatly increase the usefulness and the accuracy of your instrument. In particular, a proper installation will help prevent problems with both operation and 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 II Plus is a 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 specially designed 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 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.

4. After inspection, request permission and a Return Materials Authorization (RMA) number from Columbia Weather for return of the damaged instrument by calling (503) 629-0887.

5. Return approved items to the following address:

   > Columbia Weather Systems, Inc.
   > 2240 NE Griffin Oaks Steet, Suite 100
   > Hillsboro, OR 97124

6. After return permission is given 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.

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SECTION 1: INTRODUCTION

A. THE CAPRICORN II PLUS SYSTEM

The Capricorn II Plus weather station provides at-a-glance display of temperature, wind chill temperature, relative humidity, barometric pressure, wind speed and wind direction. Temperature may be displayed in Fahrenheit or Celsius. Barometric pressure may be displayed in inches of mercury (in. Hg) or in millibars, at 0.01 in. Hg (1 millibar) resolution. Wind speed may be displayed in miles per hour (mph), kilometers per hour (km/h) or knots. Wind direction is displayed on a 16 point compass.

User calibration is required for only wind direction and barometric pressure at the time of installation. No other calibrations are required. The temperature sensor and humidity sensor have been factory calibrated.

A memory feature keeps track of the highest and lowest temperatures and barometric pressures, and the highest wind speeds. A battery backup feature assures that these readings will not be forgotten if power is either interrupted or cut off entirely. An alarm feature provides an audible and visible alert when temperatures reach predetermined highs or lows, or when the wind speed reaches limits set by the user. The alarm can be coupled with an external relay to control remote electrical devices such as pumps, motors and fans.

For those who need to record or transmit their weather data, the Capricorn II RS232C Interface/Data Formatter option provides an easy connection to printers, terminals, computers and modems. This option may be added at any time, and can be easily installed by the user.

For those who want greater flexibility in the management and manipulation of their weather data, WeatherView 32™ software (for IBM and compatible personal computers) provides user-selectable data in a variety of formats. The flow of weather data can be customized to fit the needs of each user. It can be printed, stored or integrated into other databases to provide local forecasts.

B. SPECIFICATIONS

Temperature

Display: Either Fahrenheit or Celsius via a slide switch on the front panel for three Function Modes; indoor only, outdoor only, or four-second alternating.

Sample Rate: "Indoor" and "outdoor" temperatures are sampled for 0.5 seconds every 1.5 seconds, followed by a comparison of two sequential readings. If they differ, a third reading is taken. In all, eight 0.5-second samples are taken, averaged and output to the display. In the Operating Mode, the display is updated every 12 seconds. The Calibrate Mode does not average, so the display is updated every 1.5 seconds.

Display Resolution: 1° F or C; 0.2° F (0.1° C) Calibrate Mode.

Range: -67° to 140° F (-55° to 60° C).

Accuracy: +/- 1.0° F (0.5° C) or better from 20° to 105° F (-7° to 41° C); calibrated at 32.0° F.

+/- 2.0° F (1.0° C) or better from -67° to 140° F (-55° to 60° C).

Chill Factor Temperature

Definition: The still-air temperature that would have the same cooling effect on exposed skin as a given combination of wind and temperature. Please refer to Addendum: Wind Chill Algorithm.

Display: Replaces normal temperature display via a front panel slide switch.

Range: -99° F to 91° F (-99° C to 33° C).

Relative Humidity

Display: Unit-less percentage

Sample Rate: Relative Humidity is sampled for 0.5 seconds every 1.5 seconds, followed by a comparison of two sequential readings. If they differ, a third reading is taken. In all, eight 0.5-second samples are taken, averaged, and output to the display. In the Operate Mode, the display is updated every 12 seconds. The Calibrate Mode does not average, so the display is updated every 1.5 seconds.

Accuracy: +/-5% or better at 25° C for a range of 20% to 95% RH

Display Resolution: 1% RH, 0.1% RH is Calibration Mode Range: 0 to 99% RH in a non-condensing -40° to +130° F temperature range.

Barometric Pressure

Display: Either millibars or inches of mercury (in. Hg), via a slide-switch on the back panel.

Sample Rate: One 0.5-second sample is taken every 1.5 seconds, followed by a comparison of two sequential readings. If they differ, a third reading is taken. In all, eight 0.5 second samples are taken, averaged and output to the display.

In the Operate Mode the display is updated every 12 seconds. The Calibrate Mode does not average, so the display is updated every 1.5 seconds.

Display Resolution: 0.01 in. Hg; 1 mbar.

Range: Sea Level   Total Range

	Sea Level	Total Range
Inches of Mercury (In. Hg)	27 - 32	8.9 - 35.5
Millibars (mbar)	914 - 1084	300 - 1200

Accuracy: +/- 0.15% (or better) from 29 to 31 in. Hg (982 to 1050 mbar) at sea level for an ambient temperature of 64° to 82° F (18° to 28° C).

Altitude Correction: Altitude correction permits use within the range of -1000 ft. to 25,000 ft. altitude.

Wind Speed

Display: Either knots, mph, or km/h via a slide switch on the front panel.

Sample Rate: Computed over a 0.5-second period and output to the display every 0.5 second.

Electronic Display Resolution: 1 mph

Mechanical Threshold Speed: Responds to winds of 0.5 mph

Memory Mode: Two wind speed values are retained in memory for subsequent display (see "Memory Feature" below)

Peak Wind Gust – highest 0.5-second reading since reset.

Highest Average Wind Speed – highest four-second average since reset.

Range: 0 to 125 mph/200 km/h /108 knots (sustained); higher gusts may be recorded.

Accuracy: +/- 5% of reading (or better) from 20 to 125 mph; +/- 1 mph from 5 to 20 mph.

Wind Direction

Display: 16 compass points indicated by LEDs

Sensor Range: 360 degrees

Alarm Feature

Functions: "Outdoor" temperature (rising or falling) and wind speed (rising).

Modes: Visual ("alarm" light), audible (2" internal speaker defeatable by a front panel switch) and a relay contact closure.

Memory Feature

The following values may be displayed (and output via the Capricorn RS232C Interface Option) on command:

Highest outdoor temperature	Lowest outdoor temperature
Highest barometric pressure	Lowest barometric pressure
Peak wind gust	Highest average wind speed (four-second average)

Each value is displayed for four seconds and continues until the springloaded slide switch is reset to either a) clear the memory or b) return to current condition display.

Alarm-Controlled Output Feature

The maximum control signal that may be switched by the Capricorn II's contact closure (see "Alarm Feature" above) is 12 volts DC, 100 milliamps.

Input Voltage

115 volts AC +/- 10%, 50/60 Hz (Domestic)

230 volts AC +/- 10%, 50/60 Hz (Foreign)

9 volt DC, for Memory Backup

Console Dimensions

15.25" L x 7.5" W x 6.5" H (39 cm x 19 cm x 16.5 cm)

Weight

Net (console only)	17 lbs/7.7 kg
Shipping	20 lbs/10 kg

SECTION 2: PHYSICAL DESCRIPTION

A. CONSOLE

The Capricorn II Plus Console is designed to display all it's weather parameters on individual displays in a finely crafted wooden cabinet so that all readings can be seen at a glance.

Cabinet

The hardwood cabinet comes in light oak or dark walnut. Section 7: Maintenance includes instructions on how to keep the cabinet looking new.

Front Panel
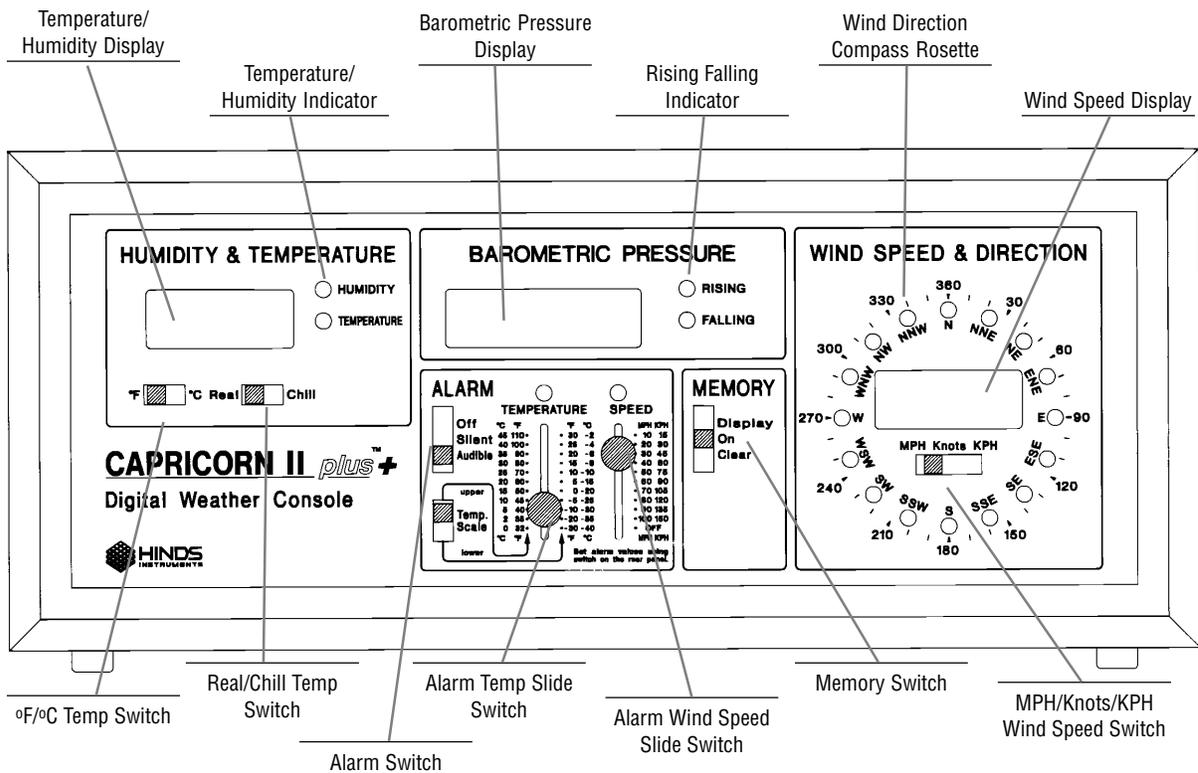
Figure 1: Front Panel, Capricorn II Plus Console

Back Panel
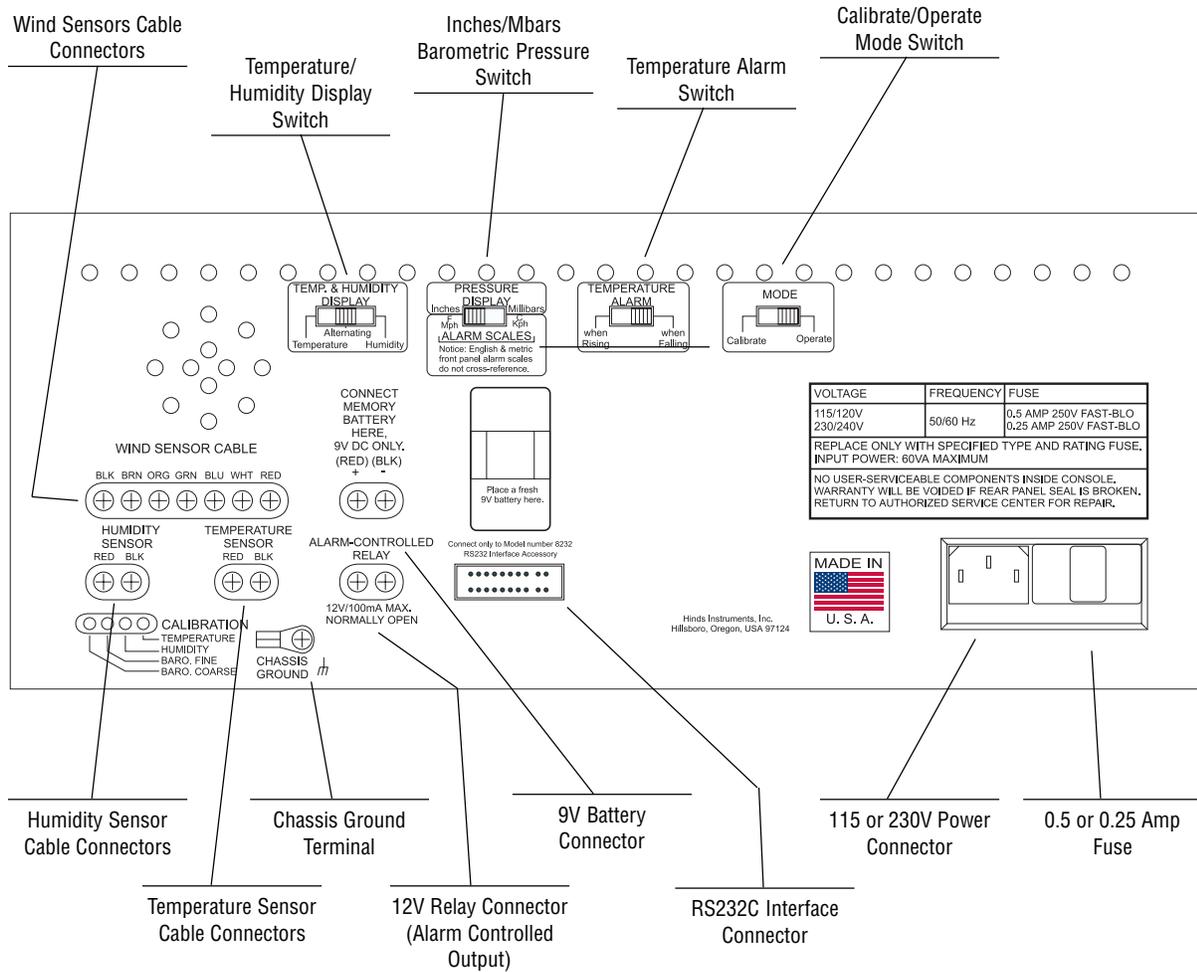
Figure 2: Capricorn II Plus, Back Panel

B. LIST OF PARTS

Figure 3: Wind Sensor Assembly
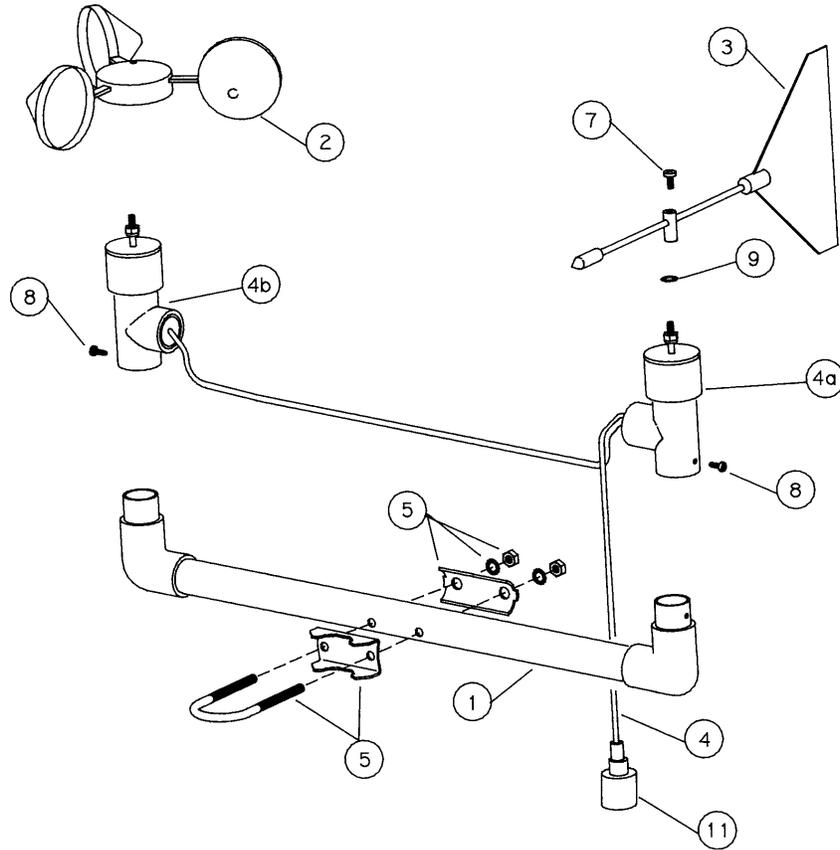
Figure 4: Hardware Assembly Kit

8 — SHEET METAL SCREW
FOR CROSS-ARM SUPPORT,
STAINLESS STEEL (QTY 2)

7 — TOP SCREW
FOR DIRECTION VANE,
STAINLESS STEEL

10 — TOP LOCK NUT
FOR WIND SPEED SENSOR,
STAINLESS STEEL

9 — INTERNAL STAR WASHER
FOR WIND DIRECTION SENSOR,
STAINLESS STEEL

5 — U-BOLT
ASSEMBLY
PLATED STEEL

6 — BLACK PLASTIC TIE-WRAPS (QTY 6)
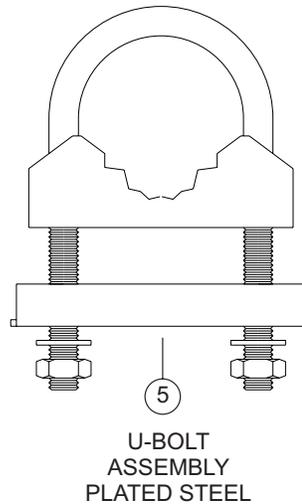
Refer to Figures 3 & 4 for key references. The following parts should be included in the shipping carton:

Ref. Qty   Description

 -    (1)   User Manual

 1   (1)   Cross Arm Support

 2   (1)   Wind Cup Hub Assembly (with spare top lock nut)

 3   (1)   Wind Direction Vane (with spare top screw)

 -    (1)   Console

 -    (1)   25-foot cables attached to temperature sensors for console display

 -    (1)   25-foot cable attached to humidity sensor assembly for console display

 4   (1)   3-foot cable coil with connector half molded to a wind direction sensor body (4a) (white, T-shaped, PVC fitting with two cables protruding) which in turn is connected by a single cable to a wind speed sensor body (4b) (white, T-shaped, PVC fitting).

 -    (1)   50-foot wind sensor cable coil with connector half.

 -    (1)   Hardware Assembly Kit (see Fig. 4) consisting of:

 5   (1)   U-Bolt

 5   (2)   U-bolt nuts

 5   (2)   Locking washers

 5   (2)   U-bolt plates, one serrated, one rounded

 6   (6)   Black plastic tie wraps (UV-resistant)

 7   (1)   Top screw (for clamping the direction vane shaft to the vane holder)

 8   (2)   Stainless steel sheet metal screws (for mounting wind sensors to Cross Arm Support)

 9   (1)   Internal locking star washer (for threaded shaft of wind direction sensor

 10   (1)   Top lock nut (to be placed on threaded shaft of wind speed sensor, above wind cup assembly)

 -    (1)   Console power cord

 11   (1)   Wind Sensor Cable Connector

SECTION 3: INSTALLATION

Tools Needed

#3 (med.) Phillips Screwdriver

#2 (small) Phillips 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. (Taller may be preferred)

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 Assy.

(4) Bracket Mounting Screws

Optional Items:

9 Volt Battery (Memory Backup)

Surge Suppressor (highly recommended; see Cat. No. 8351 or 8350)

A. UNPACKING THE UNIT

Unpack the Capricorn II Plus console and verify that all parts are included. (See page 16 for a complete parts list.)

Inspect all system components for obvious shipping damage. The Capricorn II Plus is a precision instrument and can be damaged by rough handling. (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: Trouble-shooting, for further instructions.

B. INSTALLING THE CONSOLE

The Capricorn II Plus will operate on 98 VAC to 130 VAC or 196 VAC to 250 VAC at 50 or 60 Hz. Many international standard power outlets can be accommodated with available power cords that are compatible with the IEC 320 standard power receptacle on the rear of the console.

Before connecting the Capricorn II Plus to the power line, verify the line voltage selection by looking into the fuse compartment adjacent to the power connector. The nominal value of the selected range is shown by etched markings on a small circuit board (120 or 240). If the incorrect range is selected, open the fuse cover and firmly pull the circuit board out of the fuse compartment. Reinsert the board with the desired line voltage range as indicated on the back panel. Close the fuse cover and insert the power cord in the receptacle.

If a different male end of the supplied power cord needs to be attached rather than the male connector supplied; the installed should be aware that the GREEN conductor is GROUND. Only use connectors which can be grounded.

Place the Capricorn II Plus Console in a clean, dry location at room temperature, close to a grounded power outlet. Avoid areas subject to extreme or rapid changes in temperature, such as locations near furnace vents, heaters, stoves, televisions or other heat generating appliances. Also avoid placing the console in the path of constant direct sunlight to prevent bleaching of the wood cabinet. **Do not plug the power cord in at this time.**

With the uninstalled temperature, humidity and wind sensors just out of the shipping carton, connect all of the wires from the wind sensors (7), the temperature probe (3), and the humidity sensor (3) to the back panel of the console. The "bare" wires from temperature and humidity sensors should be connected to the chassis ground terminal. For wind sensors which have the shielded cable option, the "bare" wire should be connected to the chassis ground terminal. To avoid confusion and simplify troubleshooting, hook up all wires at this time, even if you do not intend to use a particular display.

Plug the power cord into a convenient grounded outlet. (Foreign users may need to remove the standard plug and replace it with one compatible with local requirements.)

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 Capricorn II Plus and the power source. This becomes critical if the installation occurs in areas which tend to experience frequent electrical storms, such as the southeastern United States. More than 80% of repairs performed on Capricorn II Plus units are caused by electrical storms.

Theoretically, there is no way to avoid the risk of damage entirely, but there has never been a reported case of electrical damage by power line transients to a Capricorn II Plus console that was protected by a good quality spike-surge suppressor. A good spike-surge suppression device is relatively inexpensive damage insurance and may be purchased from finer computer and electronics outlets, or from the factory. If ordering from Columbia Wather Systems, Inc., specify Cat. No. 8350 (six outlets) or 8351 (single outlet).

After waiting 30 seconds to give the microcomputer time to achieve normal operating condition, check to see that all displays light properly. When power is first applied, the display digits may not come on, or the values may be incorrect. This is normal. If the display does not light up within 30 seconds unplug the unit, wait 15 seconds and plug it in again. The Capricorn II Plus should warm up at least one hour to achieve the specified sensor and display accuracies. The temperatures displayed should be around room temperature.

Disconnect the temperature wires from the console back panel (in preparation for installing the temperature sensors). Do not disconnect the wind sensor wires at this time.

After the computer has been operating for some time, the back panel will be warm to the touch. This is normal and is an indication that Capricorn II Plus is operating correctly. The instrument is designed so that heat will be released through the back panel. *Insure that sufficient air circulation is available all around the console.*

Backup battery

Attach an alkaline 9-volt battery (user supplied) to the "Keep-Alive" battery clip on the back panel to insure continuous memory protection. See the Memory Protection Feature section on page 40 for further details on this feature

Alarm Controlled Output

If Alarm Controlled Output is desired, a security-alarm contractor, a local electrician or an electrical supplier should be contacted to supply an external 12-volt (or less) relay. A qualified contractor should assist in connecting the relay to the control system. (The alarm output relay contact is rated 100 mA maximum DC current, 12 volts.) See Figure 5.
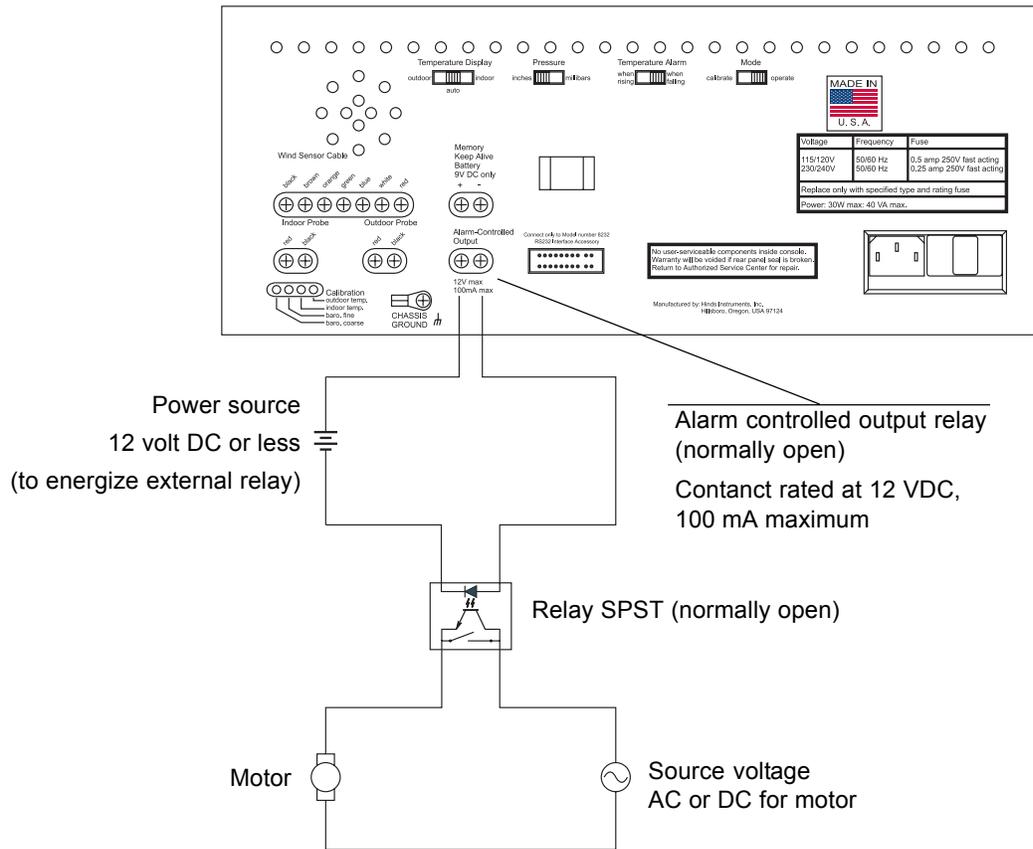
Figure 5: Typical Wiring Diagram for Alarm Controlled Output

C. INSTALLING THE BAROMETRIC PRESSURE SENSOR

The barometric pressure sensor is located inside the console; no user installation is required. The sensor does need to be calibrated, however. Allow a one-hour warm-up period before carrying out the barometric pressure calibration steps listed in Section 5: Calibration.

D. INSTALLING THE TEMPERATURE SENSORS

The temperature sensor is wound into 25 ft. coils.

If the temperature cable provided is not long enough, it may be extended by splicing on the extra length of 22 gauge, stranded, 2 conductor shielded cable with a ground drain wire. When cutting and splicing, insure good contacts, proper color coding of the terminal leads, and a good seal. (A good solder splice and waterproof insulation are essential; merely twisting the respective wires together is not adequate.) Additional cable (Cat. No. 81560) and a water tight splice kit (Cat. No. 81580) are available from the factory. The maximum length of the cable (original cable plus spliced section) should not exceed approximately 1500 ft. (457 m).

As a general precaution, avoid placing or routing the temperature sensors or cable near cables from other systems in order to decrease the possibility of picking up disruptive signals and of interfering with other systems. Also, avoid placing and routing sensors on or near metal gutters, metal windows, metal door frames, or directly on a metal tower. These items may attract an electrostatic discharge (possibly lightning) which could jump to the grounded cables and cause damage to the sensors and/or console.

Note: Sensors and cables mounted to properly earth grounded metal masts and towers may receive some protection from electrostatic discharge.

Using insulated standoffs (user supplied, or see Section 4) when routing cable helps avoid these problems.

Mount the temperature sensor. It may be located anywhere, but in order to obtain an accurate wind chill reading, it must be located outdoors. It should be mounted in a location shielded from direct or reflected sunlight. Mounting the sensor under roof eaves is appropriate in most applications. Avoid locations where ice and snow will accumulate, or near heat radiating objects such as patios, sidewalks, reflective siding, attic vents, etc.

Note: If desired, radiation shields (reflector type or aspirated) that will house the temperature sensor are available from various sources. Contact Columbia Weather Systems for more information if interested.

Once the temperature sensor has been placed, route the cable back to the console.

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:

a.   drill a 3/8" hole though the wall

b.   insert small plastic wall bushings (user supplied, or see Section 4) on either side of the wall; and

c.   thread the cable through the bushings. (It may be convenient to combine this step with routing of the wind sensor cable. See "Mounting the Wind Sensor Assembly," page 27.)

Using a Phillips screwdriver, attach the three wires from the cable to the "Temperature" terminal post screws labeled "red," "black," and "bare" on the back panel.

E. INSTALLING THE HUMIDITY SENSOR
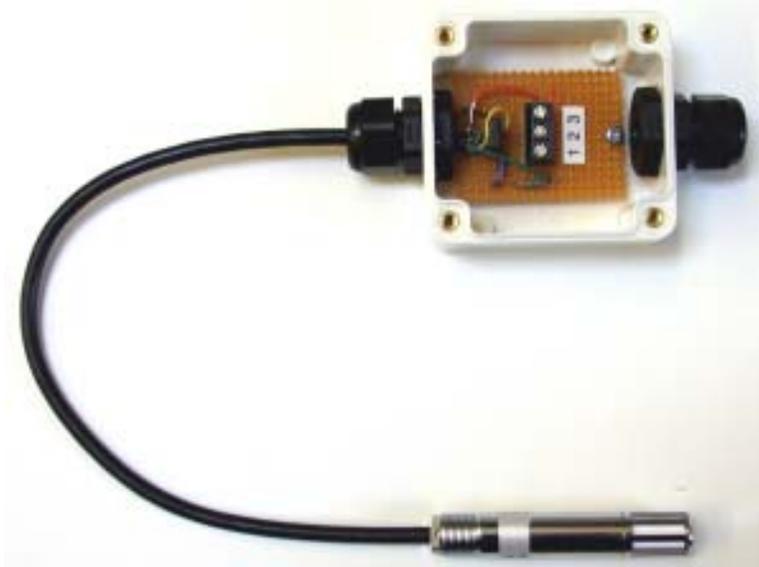
Figure 6: Humidity Sensor Mounting

The Relative Humidity sensor should be mounted in a sheltered area, preferably on the north side of a building under the eaves to prevent sun-heated air from rising up the side of the building and affecting the relative humidity at the sensor. If a sheltered area is not available the sensor can be mounted in a self-aspirating radiation shield.

Wiring should be through 1/2" conduit or alternatively through the rubber grommet provided in the 1/2" EMT elbow conduit.

The relative humidity sensor is supplied with a standard 25-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 sensor has been placed, route the cable back to the console. It may be convenient to combine this step with routing of the wind sensor cable.

Using a Phillips screw driver, attach the humidity cable to the back of the console. The black and red wire should be attached to the appropriately labeled section on the back panel. Attach the "bare" wire to the chassis ground terminal.

E. INSTALLING THE WIND SENSORS

Assembling the Wind Speed Sensor

TOP LOCK NUT,
STAINLESS STEEL

SENSOR SHAFT,
STAINLESS STEEL

WIND CUP/HUB
ASSEMBLY,
LIGHTWEIGHT PLASTIC

RAIN CAP,
PLASTIC

SHEET METAL SCREW,
STAINLESS STEEL

CABLE, MOLDED
TO SENSOR BODY

WIND SPEED
SENSOR BODY,
PLASTIC

ROUTED TO
WIND DIRECTION
SENSOR
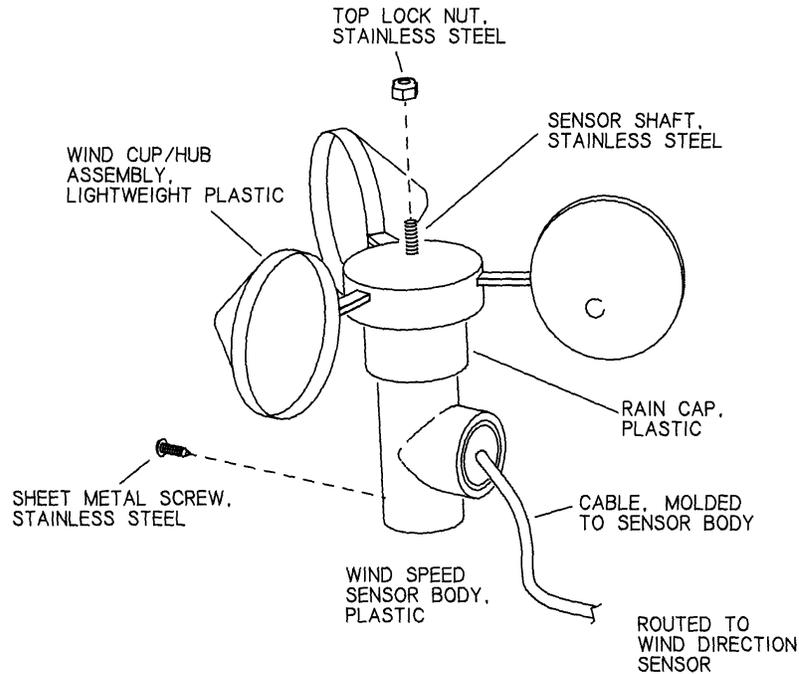
Figure 7: Wind Speed Sensor

Locate the wind speed sensor body. (It has one cable attached.)

Remove and discard the red vinyl shipping bumper from the threaded shaft. (The purpose of this shaft bumper is to protect the precision internal bearings from any damage during shipment and pre-installation handling that might be caused by accidental shock to the shaft.)

Place the wind cup/hub assembly on the threaded shaft of the wind speed sensor so that the cup assembly rests on and mates to the inverted shaft nut which has been installed at the factory.

Thread the lock nut (from the Hardware Kit) onto the shaft above the wind cup assembly.

While holding the wind cup/hub assembly with one hand, use a 3/8" wrench to screw the lock nut down onto the cup assembly. **DO NOT OVER TIGHTEN.**

Spin the wind cup/hub assembly to make sure the wind speed display is functional. The number displayed on the front panel should be greater than zero.

Assembling the Wind Direction Sensor
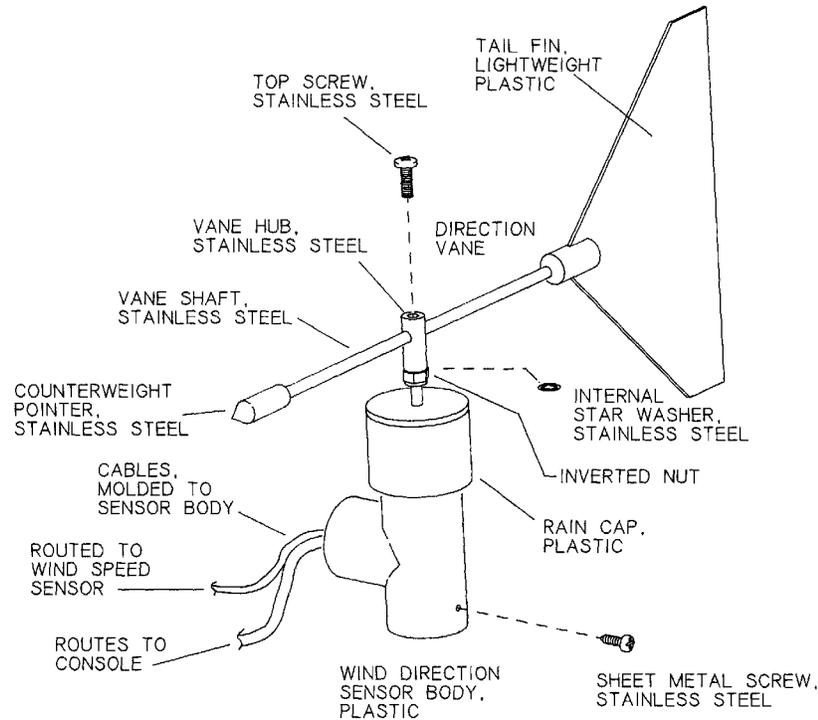
Figure 8: Wind Direction Sensor

Remove and discard the red vinyl shipping bumper from the threaded direction shaft.

Place the internal star washer from the Hardware Kit onto the shaft of the wind direction sensor body so that the washer sits on the inverted nut. (Note: The wind direction sensor body has two cables attached to it.)

Place a 3/8" wrench on the inverted nut. Holding the direction vane assembly with one hand, firmly tighten the vane hub onto the nut.

Gently spin the wind direction vane to make sure the wind direction display is functional. The LEDs should light up in sequence around the rosette on the front panel.

Attaching the Wind Sensors to the Cross Arm Support

Refer to Figure 3 as the individual wind sensors are assembled to the cross arm support.

Set the wind speed and direction sensor bodies onto their respective ends of the cross arm support. Each sensor body is marked with either an "I" or "II" and should be matched to the same mark on either end of the cross arm support.

Line up the marked hole in each sensor body with the correspondingly marked holes (1/8" diameter) at either end of the cross arm support.

Using a Phillips screwdriver, screw the stainless steel sheet metal screws from the Hardware Kit through the predrilled holes and directly into the pilot holes in the cross arm support.

Assemble the U-bolt Assembly onto the Cross Arm Support. Refer to Figure 3 for the proper order of assembly. Thread the two nuts onto the ends of the U-bolt arms so that the ends of the arms are flush with the outside faces of the nuts. (The nuts will be tightened later after the mast is inserted through the U-bolt assembly.)

Pre-Calibrating the Wind Direction Sensor
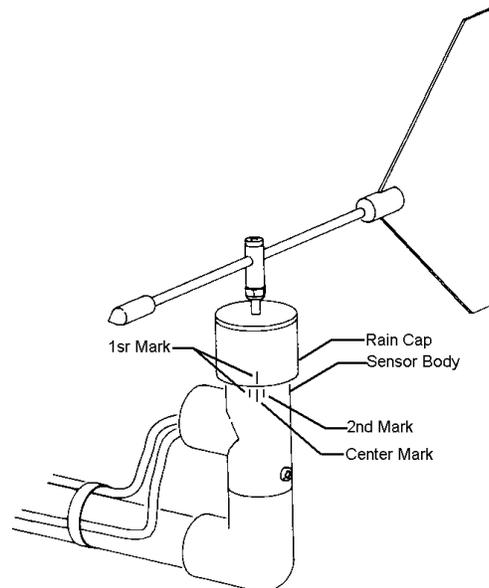
Figure 9: Marking the Wind Direction Sensor

With the wind sensor cable still connected to the console back panel, hold the sensor body vertical so the vane rotates in a horizontal plane. Then rotate the vane and the rain cap on the wind direction assembly clockwise (when viewed from above); stop as soon as the NNE light on the front panel is illuminated. Mark the position of the rain cap to the sensor body with a pencil by marking a vertical line that extends from the rain cap down onto the sensor body.

Rotate the vane and rain cap counterclockwise; stop as soon as the NNW light is illuminated. Make a second pencil mark on the sensor body which is directly below the pencil mark on the rain cap (that was made in the previous step).

Divide the distance between the two marks on the sensor body, and mark that point with a pencil. This center mark indicates north in relation to the console display.

Rotate the rain cap so that its mark aligns with the middle mark on the sensor body. Secure the rain cap to the sensor body with a piece of tape so that the rain cap cannot rotate around the sensor body.

Disconnect the wind sensor wires from the console back panel and prepare to take the Wind Sensor Assembly to the roof for the final installation procedure.

Installing the Mast

The Capricorn II Plus will measure wind speeds of up to 125 mph (200 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. Mounting the mast and the wind speed and direction sensors should be comparable in scope to installing a TV antenna.

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 a TV or radio transmitting mast or tower.

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

Do not mount sensors close to power lines or telephone lines. For normal roof mounting, the recommended minimum distance from power or telephone lines is 25 ft. (8 m). Use extreme caution when working close to power lines

Never route sensor cables 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. Refer to Columbia Weather Systems Cat. No. 83500 as noted in

Section 4.

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

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. The use of a properly grounded metal mast or tower, however, does not insure protection from electrostatic discharge. These items could become electrically charged resulting in damage to the sensors and/or console. This could damage the system in the event of an electrical storm. Use insulated standoffs (user supplied, see Section 4) when routing cable to help avoid this problem.

Mounting the Wind Sensor Assembly

Note: At this point, you will need to take the assembled and pre-calibrated Wind Sensor Assembly and tools (including wrench and compass) to the roof mounting location.

Attach the Wind Sensor Assembly to the mast. The mast should be inserted between the rounded section of the U-bolt assembly and the serrated edge of the U-bolt clamp.

Tighten the two nuts on the U-bolt assembly so that the Wind Sensor Assembly is lightly fastened to the mast. Final adjustment and tightening are described below.

With the direction vane/rain cap still secured with tape to the sensor body, rotate the entire cross arm support/sensor assembly around the mast until the pointer on the secured direction vane is pointing toward true north. Use a compass to help align the pointer to the north. Once north has been located, tighten the cross arm support U-clamp nuts securely with a wrench. Remove the tape from the rain cap/sensor body. It should now rotate freely.

Use six plastic tie wraps to secure the cables to the cross arm support and mast. Use one tie wrap for the wind speed cable and one for the wind direction cables. The other four tie wraps can be placed on the 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 Capricorn II Plus Console. If mounting on a roof, route the sensors through a vent or other opening into an attic or crawl space.

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.)

Note: If the standard 50 ft. cable provided with the wind sensor assembly is not long enough, it may be extended by splicing on an appropriate length of 22 gauge, stranded, seven conductor cable with the same color code. When cutting and splicing, insure good contacts, proper color coding of the terminal leads, and a good seal. (A good solder splice and water proof insulation are essential; merely twisting the respective wires together is not adequate.) Additional cable (Cat. No. 81540) and a water tight splice kit (Cat. No. 81580) are available from the factory. The maximum length of the cable (original cable plus spliced section) should not exceed 1000 ft. (305 m).

Using a Phillips screwdriver, attach the seven colored wires from the end of the wind sensor cable to the matching terminal post screws protruding from the back panel of the console below the label, "Wind Sensor Cable." The screws are labeled to match the corresponding wire colors. See Figure 2.

F. LIGHTNING EARTH GROUND

Customers who desire to provide a lightning earth ground for the Capricorn II Plus console are encouraged to do so.

Drive a 5/8" x 8 foot solid copper ground into the earth. Use a suitable ground rod wire clamp and connect a #12 AWG. solid copper wire from the ground rod to the chassis ground terminal on the Capricorn II Plus rear panel. A solderless crimp terminal is provided for this purpose on the back panel of the console.

SECTION 4: OPTIONAL SENSOR MOUNTING HARDWARE

A complete Wind Sensor Mounting Hardware Kit is available for roof mounting (Cat. No. 88002) or wall mounting (Cat. No. 88003).

A. 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.
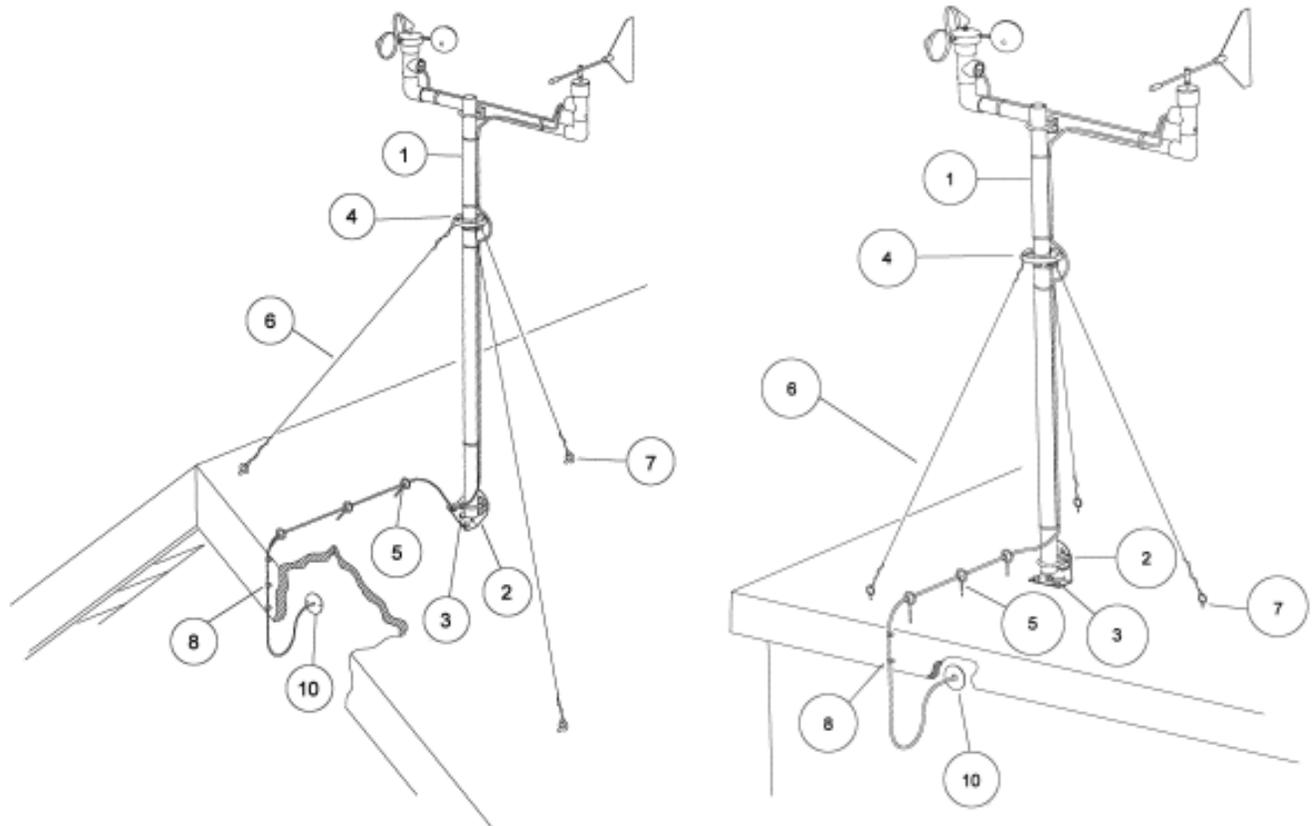
Figure 11: Flat Roof Mounting Method

Description	Per Pkg	Ref	Catalog No
*Mast, 10 ft. (two 5 ft. sections)	1	1	88005
*Universal Mast Mount	1	2	88010
Lag Screw, Roof Mast Mount[1] 1/4" x 4" (for shake roofs)	3	3	88020
*Lag Screw, Roof Mast Mount[1] 1/4" x 2 1/4" (for comp. roofs)	4	3	88030

*Guy Ring and Collar	1	4	88040
*Cable Standoffs, Wood Screw[1]	4	5	88050
Cable Standoffs, Nail-In[1] (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]	1	10	88130
*Cable Feed Through Bushings[1]	4	10	88140
Watertight Rubberized Spray	17.75oz	(not shown)	83500

[1] Select one type

B. 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.
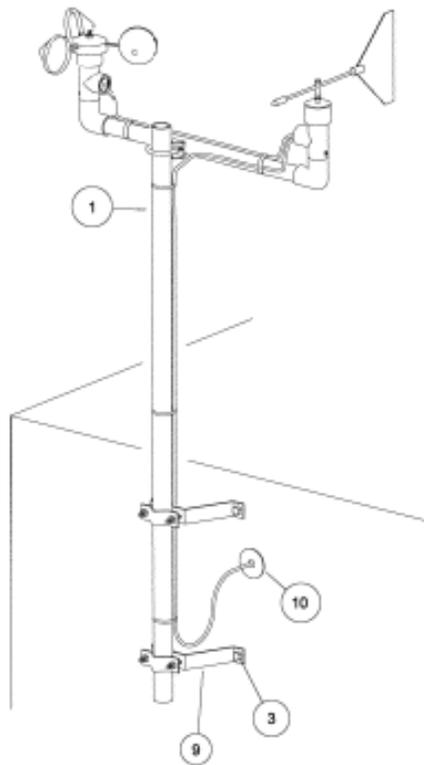
Figure 12: Wall Mounting Method

Description	Per Pkg	Ref	Catalog No.
*Mast, 10 ft. (two 5 ft. sections)	1	1	88005
*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]	1	10	88130
*Cable Feed Through Bushings[1]	4	10	88140
Watertight Rubberized Spray Coating 17.75oz	(not shown)		83500

[1] Select one type

EYE BOLT SCREW   UNIVERSAL MAST MOUNT
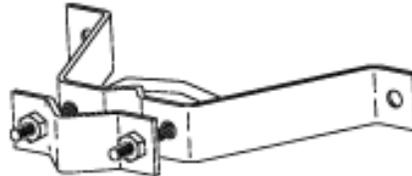
GUY RING & COLLAR   4" WALL MOUNT

CABLE NAIL CLIP   CABLE STANDOFF

Figure 13: Optional Sensor Mounting Hardware

SECTION 5: CALIBRATION

Tools Needed:

Small Slotted Screwdriver

Insulated, Watertight Container

Materials Needed:

Crushed Ice

Water

A. CALIBRATING THE TEMPERATURE SENSORS

The Capricorn II Plus temperature probe is carefully calibrated at the factory and should not require any re-calibration for sometime. In any event, the probe should not be calibrated until the unit has had a sufficient warm-up time, at least one hour.

To re-calibrate, perform the following steps:

1. Move the Mode switch on the back panel of the console from "operate" to "calibrate."

2. Move the Temperature Display switch on the back panel of the console to the "Temperaturer" position.

3. Move the °F/°C switch on the front panel to °C.

4. Create an ice bath by mixing two cups of crushed ice in one cup of water. Use an insulated container for best results. A Thermos-type container is preferable. Allow the temperature throughout the ice bath to stabilize by waiting five minutes before proceeding.

5. Place the temperature probe in the ice bath. Stir the ice bath with the probe. Keeping the probe tip from touching the sides or bottom of the container, continue stirring during step 6.

6.   Use a small flat head screwdriver to turn the "Calibration; Temperature." screw on the back panel of the console. Turn it clockwise to decrease the value of the display, counterclockwise to increase the value of the display. Adjust the screw until the Temperature Display reads 0.0° C.

8. When finished with re-calibration, move the Mode switch back to the "operate" position.

B. CALIBRATING THE HUMIDITY SENSOR

The relative humidity sensor is pre-calibrated at the factory. The entire console and humidity sensor must be returned to the factory to maintain factory specifications. Call the factory regarding information on this procedure.

C. CALIBRATING THE BAROMETRIC PRESSURE SENSOR

The electronic transducer used to measure air pressure is sensitive to changes in elevation of as little as 10 ft. (3 m),* and the user will need to calibrate the barometric pressure display for each installation to compensate for local conditions. In addition to elevation, several other factors affect the overall accuracy of the barometric pressure display when calibrated for local conditions. These include:

•   The accuracy of the reference barometer (mercury column, aneroid, etc.) used to calibrate the Capricorn II Plus on-site.

•   The accuracy with which the reading is taken from the reference barometer and how recently the reading was taken.

•   The difference in the barometric pressure between the reference barometer location and the Capricorn II Plus location.

•   The variations in the immediate environment around the console due, for example, to window fans, air conditioners, opening and closing of doors and windows. Minor effects such as these can be reflected in the last digit of the display.

•   Subsequent relocation of the Capricorn II Plus after calibration

•   Stability of actual barometric pressure conditions during calibration. The best time to perform the calibration is during stable and steady barometric pressure conditions.

*(10 feet in height equals 0.01 in. Hg; 3 meters in height equals approximately 0.33 mbar).

With these considerations in mind, calibrate the barometric pressure display for each installation by performing the following steps:

1.   Allow a one-hour warmup period before performing a calibration.

2.   Locate the nearest, most accurate barometric pressure at an elevation closest to the elevation of the Capricorn II Plus site.

The most accurate calibration would involve a precise determination of the elevation of the Capricorn II Plus installation by consulting the original building/ site construction plans (or, alternatively, by consulting a civil engineer), followed by determination of the actual barometric pressure at the site under stable conditions with an accurate mercury column or aneroid barometer.

However, since this usually involves more time and expense than most installations require, there are other means of obtaining a reasonably precise barometric pressure reading for your installation. Call a nearby National Weather Service office, airport, radio station, or television station, etc., and ask for the barometric pressure at that location. This will probably be an "adjusted-to-mean-sea-level" reading, as is usually reported by NWS offices. This is your calibrate value. Because of FAA requirements, an airport Flight Service Station (FSS) is usually best for this purpose. Be sure to ask when the last reading

was taken, and use the most current information you can obtain.

If you do not have a local barometric pressure reference (within 10 miles), but know your elevation (mean sea level), you can use the factory calibration and correct for your elevation. Every ten feet of elevation is equal to approximately 0.01 in. Hg, so divide your elevation in feet by ten and multiply by 0.01. This is the correction factor to be subtracted (elevations above sea level) from the reading (using "Calibration; baro. fine" screw) if units are in in. Hg.

3.   Move the Mode switch on the back panel of the console to the "calibrate" position.

4.   Use a small flat head screwdriver to turn the "Calibration; baro. coarse" screw clockwise until lowest value is displayed. Then slowly turn the screw counter-clockwise until the display is near the calibrate value (see Step 2). Make the final adjustment by turning the "Calibration; baro. fine" screw until the display reads the same as the calibrate value within the nearest hundredth of an inch (or nearest Millibar, as appropriate).

5.   When finished with calibration, move the Mode switch back to the "operate" position. The first update of the display will occur within 12 seconds. It will take from one to two update readings to reach the correct average pressure reading.

D. CALIBRATING THE WIND SENSORS

The wind speed sensor contains no components that can be calibrated by the user. Refer to Section 7: Maintenance and Section 8: Troubleshooting if there appears to be a problem. The wind direction sensor is calibrated during installation. Refer to Section 3: Installation.

SECTION 6: OPERATION

A. TEMPERATURE

Actual temperature is displayed in the range -67° F to 140° F or -55° C to 60° C. The Capricorn II Plus continuously averages the temperature detected by the probes and updates the display approximately every 12 seconds.

1. Temperature Display: For a continuous display of temperature move the Temperature/Humidity Display switch on the back panel of the console to the "temperature" position.

3. Alternating Display: By moving the Temperature/Humidity Display switch to the "alternating" position, the display will alternate between the temperature and humidity every four seconds.

4. Sensor Indicator Display: Two LED lights to the right of the Temperature/ Humidity display on the front panel indicate which reading ("temperature" or "humidity") is being displayed.

5. Units of Measure: Temperature may be displayed in either units Fahrenheit (F) or Celsius (C), as determined by the position of the F/C switch below the Temperature/Humidity display on the front panel.

6. Display Resolution: To display temperature with 0.2° F (0.1° C) resolution, move the Mode switch on the back panel to the "calibrate" position.

    Note: When the unit is in the "calibrate" mode, the averaging will not be performed and the memory will not be updated with high/low temperature values. The temperature display may appear unstable as a result of the lack of averaging.

7. Wind Chill Display: The "wind chill" temperature is displayed when the Real/ Chill switch on the front panel is in the "chill" position. It is a computed value based on the actual temperature and the average wind speed. (Please refer to Addendum: Wind Chill Algorithm.) The microcomputer does not calculate the "wind chill" temperature when the temperature exceeds approximately 91° F or 33° C. Above this point the temperature displayed will be the same whether or not the switch is in the "real" or "chill" position. The lowest temperature that can be displayed for the wind chill temperature in the Celsius position is 99° C (-146° F). In the Fahrenheit position, -99° F (-73° C) is the lowest temperature.

B. RELATIVE HUMIDTY

Relative Humidity is displayed in the range 0 to 99% RH in a non condensing -40° to 130° F or -40° to 55° C temperature range. The Capricorn II Plus averages the continuous relative humidity readings from the sensor and updates the display approximately every 12 seconds.

1. Humidity Display: For a continuous display of the relative humidity, move the Temperature/Humidity Display switch to the "humidity" position.

2.   Alternating Display: By moving the Temperature/Humidity Display switch to the "alternating" position, the displaywill alternate between the temperature and humidity every four seconds.

3.   Sensor Indicator Display: Two LED lights to the right of the Temperature display on the front panel indicate which reading ("temperature" or "humidity") is being displayed.

4.   Units of Measure: Relative Humidity is displayed as a unit-less percentage, % RH.

5.   Display Resolution: Normal operating resolution is 1% RH. To display relative humidity with 0.1% RH resolution, move the Mode switch on the back panel to the "calibrate" position.

Note: When the unit is in the "calibrate" mode, the averaging will not be performed. The humidity display may appear unstable as a result of the lack of averaging.

C. BAROMETRIC PRESSURE

The barometric pressure measuring range is from at least 27.00 inches of mercury (Hg) to 32.00 inches in 0.01 increments. The range in Millibars is 914 to 1084 in 1 mbar steps. The accuracy is 0.15% or better from 29 to 31 in. Hg (982 to 1050 mbar) at an ambient temperature of between 64° and 82° F (18° and 28° C.)

Each digit in the Barometric Pressure display has varying levels of importance. For example, 29.96 in. Hg. would read:

Digit Number	1	2	3	4
Sample Reading	2	9	9	6

Digit 1 is significant, but relatively unchanging in the measurement of barometric pressure. This digit will display a reading of either 2 or 3. Digits 2 and 3 are the most meaningful in indicating weather activity. A change in either of these digits indicates that a "high" or a "low" pressure weather system may be passing through the area with a resulting effect on local weather conditions. Digit 4 is more interesting than important. It can change due to slight variations in pressure caused by the opening and closing of doors or windows, or the operation of fans and air conditioners. Frequent changes in the fourth digit are usually related to changes in the immediate environment. Slow changes are usually a true indicator of barometric pressure variations.

Note that the rate and direction of change are normally more significant than the actual barometric pressure level itself.

During each measuring cycle, the Capricorn II Plus will read the barometric pressure eight times, compute the average, and update the Barometric Pressure display. The display update will occur approximately every 12 seconds.

1.   Inches of Hg Display: For a continuous display of barometric pressure in

inches of mercury (in. Hg.) move the Pressure switch on the back panel of the console to the "inches" position.

2.   Millibars Display: For a continuous display of barometric pressure in Millibars, move the Pressure switch on the back panel of the console to the "millibars" position.

3.   Pressure Trend Indicators: Two LED lights to the right of the barometric pressure display indicate when the pressure is rising or falling.

If there has been no change over a three-hour period (i.e., the pressure conditions are steady), neither light will be illuminated. The Capricorn II Plus takes a sample approximately every hour to see if there has been a significant change in barometric pressure from the reading taken three hours previously. If there has been a change in the averaged barometric pressure of 0.06 in. Hg (2 mbar) or more over the last three hours, the Rising or Falling light will illuminate, as appropriate. During the first three hours of operation, the barometric pressure readings will be compared every hour with the reading taken at the start.

Since the barometric pressure readings broadcast on radio and television are frequently several hours old, it is likely that the Capricorn II Plus will not agree with the broadcast readings during changing weather conditions. Additionally, the Capricorn II Plus will differ from broadcast readings if it is not located in the immediate vicinity or elevation of the broadcast pressure site.

The United States Weather Service measures barometric pressure in Millibars and converts the readings into inches of mercury (Hg). Use the following chart for conversion of values:

One inch Hg (mercury)	= 33.8639 Millibars
One millimeter Hg	= 1.3333 Millibar
One Millibar	= 0.02953 inches Hg
One Millibar	= 0.750 millimeter Hg
One atmosphere	= 760 millimeters Hg
One atmosphere	= 1013.3 Millibars
One atmosphere	= 29.921 inches Hg

D. WIND SPEED

The Capricorn II Plus measures wind speed by using a precision wind cup anemometer which turns an infrared optical chopper. The unique design of the wind speed sensor assembly virtually eliminates the effect of friction on the sensor hub. The mechanical threshold wind speed at which the anemometer starts to turn is 0.5 mph.

Measurable wind speeds range from 0 to 125 mph (0 to 200 km/h or 0 to 108 knots). Accuracy is +/- 5% (or better) of the wind (gust) speed reading. The displayed wind speed is the 0.5-second average. A measurement is taken and displayed every 0.5 second.

The Capricorn II Plus also records (but does not display) the average wind speed. The average wind speed is determined by averaging wind gusts over a four-second period. Average wind speed has three purposes. It is used to calculate the wind chill factor. It is also used to trigger the wind speed alarm. Finally, the highest average wind speed is also kept in memory and displayed during operation of the Memory function.

The flashing LED light located in the bottom right-hand corner of the Wind Speed display indicates that the microcomputer is active. A steady light indicates an "inactive" condition. If this occurs, unplug the power cord, wait 15 seconds and reconnect the power cord.

Units of Measure – Move the MPH/Knots/KPH switch on the front panel of the console to display wind speed in either miles per hour, knots or kilometers per hour, respectively.

> 1 knot =   1.15078 mph
>
> 1 km/h =   0.62137 mph

E. WIND DIRECTION

Wind direction is displayed in a rosette of 16 LED compass points, 22.5° apart. If the wind direction sensor is installed as described in Section 3: Installation, the sensor should be accurate to within +/- 11.25° (or better). The illuminated compass point indicates the direction the wind is coming from. For example, when the unlabeled light between "N" and "NE" is illuminated, the wind is blowing from (or "out of") the "NNE."

The Wind Direction display will always record the direction of the wind vane, even when there is no detectable wind. As a result, when the wind speed display reads "0", the compass point indicating the direction of the last detectable wind activity will remain illuminated.

E. ALARM FEATURE

The alarm feature allows the user to be warned of temperature and/or wind speed alarm conditions by providing visual, audible, and output contact closure response. Once set, the Capricorn II Plus simultaneously evaluates both wind speed and outdoor temperature for alarm conditions.

Activating the Alarm

The purpose of the alarm feature is to draw the user's attention to the alarm condition. The purposes of the LEDs in the "Alarm" box on the front panel are 1) to provide a visual indication of an alarm condition and 2) to indicate whether the alarm condition relates to temperature or wind speed. A speaker mounted inside the back panel provides an audible indication of an alarm condition, if desired.

To activate the alarm, move the Alarm switch on the front panel of the console from the "Off" position to either the "Silent" or "Audible" position.

1.	In the "Silent" mode, only the LED light(s) corresponding to the sensor that is set, either "Temperature" or "Speed" or both, will illuminate upon detection of the set condition. The LEDs will remain lit until the condition ceases or the Alarm switch is moved to the "Off" position.

2.	In the "Audible" mode, in addition to the visible LED alarm, a speaker mounted inside the back panel will sound an audible alarm upon detection of a set condition. The audible alarm may be disabled by moving the Alarm switch to the "Off" position. Simply moving the switch to the "Silent" position will not disable the audible alarm unless the alarm condition has ceased to exist (LED is no longer lit).

3.	A sudden power interruption (drop, loss or surge) may also cause the alarm to activate. If this occurs, the audible alarm can be disabled by moving the alarm switch to the "Off" position. (It is also possible that the system microprocessor has not been properly reset. To insure proper reset, unplug and then replug the console power cord from the wall receptacle.)

Setting The Temperature Alarm

Two temperature scales are available to set the temperature alarm. The scale on the right is for setting the alarm to be activated when detecting temperatures below the freezing point of water, and the one on the left is for temperatures at or above the freezing point. The scale selector switch, below the Alarm switch and to the left of the Temperature scales, is used to select the desired scale.

Note: Only when a sensor is attached to the temperature terminals on the back panel will activate the alarm feature.

1.	First, move the Alarm switch on the front panel of the console to the "Off" (reset) position to reset the feature.

2.	After the temperature/wind alarm values are set, move the switch to either the "Silent" or "Audible" position, as desired, to set the alarm.

3.	To set the alarm to activate when the temperature rises above a certain point, move the Temperature Alarm switch on the back panel of the console to "when rising."

4.	To activate the alarm when the temperature drops below a certain point, move the Temperature Alarm switch to "when falling."

	For example, if you wanted the alarm to activate when the outdoor temperature falls to 32° F, you would:

	a.	move the Alarm switch on the front panel to the "Off" position;

	b.	move the Temperature scale selector switch to the up position;

	c.	move the Temperature slide switch to the bottom setting (32° F);

	d.	move the Temperature Alarm switch on the back panel to the "when falling" position; and

e.   move the Alarm switch on the front panel to the "Silent" or "Audible"   position, as desired.

5.   To set alarm conditions equal to or greater than 32° F (0° C), move the scale selector switch to the up position. To set alarm conditions of less than 32° F (0° C), move the switch to the down position.

Setting the Wind Speed Alarm

1.   First, move the Alarm switch on the front panel of the console to the "Off" (reset) position to reset the feature.

2.   Move the "Speed" slide switch on the front panel to the wind speed at which an alarm is desired, to set the alarm.

3.   Move the Alarm switch on the front panel to either the "Silent" or "Audible" position, as desired, to activate the alarm.

4.   To be warned of a wind speed alarm condition independent of temperature conditions, set the desired wind speed alarm as described above, move the temperature scale switch (below the alarm switch) to the "down" position, move the Temperature slide switch down to -30° F, and move the Temperature Alarm switch on the back panel of the console to "when falling." In this configuration the temperature alarm will not activate unless the actual temperature reaches -30° F.

When the average wind speed (see pages 39) reaches or exceeds the alarm condition, the LED light above the word "Speed" on the front panel will illuminate, the alarm will sound (if the Alarm switch is in the "Audible" position), and the Alarm Controlled Output relay contact will close (12V/100mA maximum contact rating).

The scale reads in mph units of measure (km/h for optional foreign front panels), but the alarm is designed to trigger at the actual wind speed regardless of the unit of measure being displayed. Therefore, if the alarm is set at 10 mph the alarm will trigger when the display reads 16 km/h (10 mph = 16 km/h) if the Wind Speed

switch is set on "KPH."

Alarm Controlled Output

The Alarm Controlled Output terminal on the rear panel makes it possible to attach a relay device rated 12V (or less) to the Capricorn II Plus so that independent electrical equipment such as external speakers, fans, heaters and pumps can be controlled by the alarm output.

When one or more alarm conditions are reached, a contact closure will be present at the Alarm Controlled Output terminals until the alarm condition(s) cease(s), the temperature and/or wind settings are changed, or the Alarm switch is moved to the "Off" position.

The Alarm Controlled Output contact has ratings of 12V and 100mA maximum. If inductive loads are switched, appropriate capacitor and resistor contact protection needs to be added. Contact an electrical supply store for this.

Alarm Function Table

The following table shows the status of the alarm functions under different conditions.

Switch Settings	LED Indicator Lights	LED Display Digits	Speaker	Relay contact
Off	Off	Displays sensor readigns as normal	Off	Relay off (Contact open)
Silent	On while condition exists, off once condition ceases to exist	Displays sensor readings as normal	Off	Closed (on) while condition exists, open once condition ceases to exist
Audible	On while condition exists, off once condition ceases to exist	Displays sensor readings as normal	Tone on when alarm condition exists; continues until Alarm switch moved to "Off"	Closed (on) while condition exists open once condition ceases to exist

G. MEMORY FEATURE

The Memory Feature permits immediate display of high and low temperature, high and low barometric pressure, peak wind gust and high average wind speed.

Note: When the unit is in the "calibrate" mode, the averaging will not be performed and the memory will not be updated with high/low values.

1.   Memory Display: To activate the Memory feature, move the Memory switch on the front panel up to the "Display" position. The Capricorn II Plus will then display for four seconds each the highest temperature, the highest barometric pressure reading, and the highest wind gust. Then the lowest outdoor temperature, the lowest barometric pressure reading, and the highest average wind speed (four-second average) will be displayed for four seconds. A complete rotation of high and low memory values will take approximately eight seconds. **Move the switch back to the "On" position to return the unit to normal operation.**

2.   Memory Clear: To clear the Memory, move the Memory switch to the "Erase" position. The Capricorn II Plus will immediately purge the previously stored high/low readings and begin storing new information.

3.   Current Display: Move the switch to the "On" position to return the unit to normal operation.

H. MEMORY PROTECTION FEATURE

In order to retain stored Memory values in the event of a power failure or interruption, a 9-volt battery (user supplied) may be attached to the Capricorn II. Plus With the battery properly attached, Memory values will be retained in the event of a power loss.

Attach a high quality, alkaline 9 volt battery to the "Memory Keep Alive Battery" terminals on the back panel. Be sure to match the positive and negative terminals with the red (positive) and black (negative) wires of the supplied battery clip. If they are reversed, memory will not be retained in the event of a power loss.

The Memory Protection feature only provides power to save the values stored in the memory in case of power failure or power interruption. The battery does not provide power for the instrument to continue operating during power failure.

The console will display erratic values when the 9V battery wears out and the memory is displayed.

SECTION 7: MAINTENANCE

In normal use, the Capricorn II Plus should require very little maintenance, other than normal care of the hardwood cabinet and a periodic check of the sensor calibration. In the event of any problems, follow the procedures contained in Section 8: Trouble, shooting to determine whether the unit is defective. If it is and the unit needs to be returned to the factory for repair, refer to the Return For Repair Procedure on page 58 in Section 10: User Support Information.

A. CONSOLE MAINTENANCE

Keep your cabinet like new by wiping it occasionally with a good quality wood polish or wax. Sparingly spray a soft cloth, then wipe or rub on the cabinet. Avoid getting wax or dusting products on the painted front and rear panels as these will stain the panels. The console contains sensitive and dangerous electrical components and should not be serviced by the user. If none of the displays light at all, check to see if the fuse on the back panel needs to be replaced. If it does, replace it with a 0.5 amp 250V fast acting fuse. (0.25 amp 250V fast acting fuse for the 230V foreign voltage unit.) If the problem persists, or the digits all display "0"s or are otherwise erratic, the console (or any of the sensors) may be defective. Refer to Section 8: Troubleshooting, and call the factory for service as required.

B. BAROMETRIC PRESSURE SENSOR MAINTENANCE

The barometric pressure sensor is located inside the cabinet and should not be serviced by the user. If the barometric pressure display does not light, displays "0" or is otherwise erratic, it may be defective. Refer to Section 8: Troubleshooting, and call the factory for service as required.

C. 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. If the temperature display does not light or is erratic, the console or the temperature sensor, or both the console and the sensor may be defective. A new sensor, which can be installed in the field, may be all that is necessary. In any event, refer to Section 8: Troubleshooting, and call the factory for service as required.

D. HUMIDITY SENSOR MAINTENANCE

Check the humidity sensor assembly cables during installation and periodically thereafter to make sure it has no cuts, kinks, or other abnormalities, and that any splices are properly connected and insulated. If humidity display does not light or is erratic, the console or the humidity, or both the console and the sensor may be defective. If this occurs, refer to Section 8: Troubleshooting, and call the factory for service as required.

E. WIND SENSOR MAINTENANCE

Do not attempt to oil, grease or otherwise lubricate the wind sensors. The wind speed and direction bearings are permanently sealed and should not be tampered with. If it appears that the displayed wind speed values are substantially less than existing conditions, or that the wind direction display is sluggish in responding to changes in wind direction, it may be that the bearings need service. This can be tested by spinning the sensors. They should spin freely. If they do not, call the factory for service. All or part of the wind sensors may need to be replaced. Since the circuit is molded into the wind sensor housing, an electronic defect requires replacement of the sensor. The wind sensors are not designed for field repair.

In the event the wind speed or wind direction displays do not light, display "0" constantly regardless of wind conditions, or are erratic, either the console or the sensors (or both) may be defective. Refer to Section 8: Troubleshooting for recommended tests that will help locate the source of the problem.

SECTION 8: TROUBLESHOOTING

A. CONSOLE OPERATION PROBLEMS

Symptom	Probable Cause	Correction
No illumination of lights. No power.	Instrument not plugged in. Or;	Plug power cord into 120 VAC, 60 Hz source (or 240 VAC, 50 Hz for applicable models.
	Fuse blown.	Check and replace fuse.
Display never changes.	Microcomputer is not running and needs to be reset.	Unplug unit, wait 15 seconds, plug in again. Flashing dot by wind speed display indicates that the microprocessor is running. Flashing will stop when the microprocessor is inactive.
Erratic console dispaly.	Unit just turned on: microprocessor needs time to calculate averages and change display. Or;	Allow several seconds for warm-up.
	In calibrate mode	Move mode switch to operate.
Erratic front panel display when accessing memory.	Memory backup battery is low or drained and a brown out or power failure occurred.	Replace 9V battery with a fresh one and erase the memory.

B. ALARM DISPLAY PROBLEMS

Symptom	Probable Cause	Correction
Temperature alarm light connont be turned off by moving the scale and toggle switches.	Temperature alarm switch on back panel is incorrectly positioned.	Properly set the temperature alarm switch on back panel. (See Section 6: Operation).

C. TEMPERATURE DISPLAY PROBLEMS

Symptom	Probable Cause	Correction
195°F/273°C displayed constantly for indoor and/or outdoor temperature.	Sensor wire broken or disconnected. Or;	Repair broken wires and/or reconnect.
	Temperature circuit in console may be defective. Or;	Indoor and outdoor sensors can be interchanged to see if the problem follows the sensor in question.
	Red and black sensor wires installed backward. Or;	Proberly connect probe wires to console.
	Temperature sensor defective.	Replace sensor assembly.
Display is blank.	Microcomputer inactive (power interruption).	Umplug power cord and replug after 15 seconds.
Temperature changes when wind blows.	Real/Chill switch in "Chill" position.	Move Real/Chill switch to "Real" position.

D. HUMIDITY DISPLAY PROBLEMS

Symptom	Probable Cause	Correction
-25 displayed Constantly.	Wires not connected. Or;	Reconnect wires.
	Wires broken.	Call factory to replace.
Display is blank.	Microcomputer inactive (power interruption).	Unplug power cord and replug after 15 seconds.

E. BAROMETRIC PRESSURE DISPLAY PROBLEMS

Symptom	Probable Cause	Correction
Display never changes.	Microcomputer stopped running and needs to be reset.	Unplug the power cord and replug after 15 seconds.
Rising and falling lights do not agree with broadcast readings.	Capricorn II determines trend every three hours; therefore it might not agree with broadcast.	No corrective action required.
Pressure display reading floats abnormally.	Console not grounded.	Supply an adequate electrical ground for the power cord. (See Sect 3: Lightning Earth Ground).

F. WIND SPEED DISPLAY PROBLEMS

Symptom	Probable Cause	Correction
No apparent wind but number higher than 0 occasionally flashed on the display.	Electrical interference picked up via the wind sensor cable.	This is not critical to Capricorn II operation. To eliminate this inconvenience, determine the source of interference, and re-route the cable. (Shielded cable is available from the factory as an optional solution.)
Display show 0 constantly	No wind. Or,	No correction necessary.
	Wind cable connector unplugged. Or,	Plug in wind connector.
	Sensor not properly located	Reposition the wind sensor assembly to more accurately monitor prevailing winds.

F. WIND SPEED DISPLAY PROBLEMS (CONTINUED)

Symptom	Probable Cause	Correction
	Sensor cable is broken. Or;	See above. Check sensor cable at roof sensor assembly. Look for cuts or breaks in the cable. Repair the cable or consult manufacturer for a new sensor assembly or wind sensor cable with connector half.
	Sensor has fallen from mount. Or;	Re-install sensor if it is not damaged. Otherwise consult manufacturer or dealer for new sensor assembly.
	Wind cup/hub assembly arm is broken. Or;	Contact factory for a new wind cup/hub assembly.
	Ice on sensor. Or;	Allow to thaw. Do not use a flame source to thaw the sensor.
	Microcomputer stopped running and needs to be reset	Unplug power cord and replug after 15 seconds.
Display is blank or erratic	Console and/or sensors are defective. Or;	Perform test described following.
	Vane assembly and cup/hub set are on the wrong sensor bodies.	Switch location of the vane and cups.

G. WIND DIRECTION DISPLAY PROBLEMS

Symptom	Probable Cause	Correction
"N" (north) light illuminated continuously.	Sensor wires not properly connected to console. Or:	Make certain that no frayed or bare wires are touching, that wires are attached according to the color code, that there are no loose terminal screws and that all wires are attached to a terminal. Peform test described following.
	Wind cable connector unplugged.	Plug in wind cable connector.
Lights do not light sequentially as is rotated	Same as above.	Same as above.
Lights indicate that wind direction is rotating continuously.	Winds vane is not balanced. Or;	Balance wind vane (See Section 3: Installation),
	Winds speed cup assembly is mounted on the direction sensor body.	Switch location of the vane and wind cups.
Display is erratic	Console or sensors (or both) are defective.	Perform test describe below.

H. WIND SENSOR TESTS

In the event the wind speed or wind direction display does not light, displays "0" constantly regardless of wind conditions, or is inexplicably erratic, perform the following tests as appropriate to help locate the source of the problem.

Tools required:

One small Phillips screwdriver

One 6" (15 cm) jumper wire, 22 gauge (approximately the same size as the individual wind sensor conductor wires)

Wind Speed Test:

1. Unplug the power supply cord from the Capricorn II Plus.

2. Remove the seven wind sensor wires from their terminals at the back of the console.

3. Connect one end of the jumper wire to the wind sensor terminal marked "Red" on the back panel of the console.

4. Reconnect the power supply cord to the Capricorn II Plus. If the dot is flashing in the lower right corner of the wind speed display on the front panel, you are ready to proceed with the individual tests for speed and direction.

5. With one end of the jumper wire connected to the "Red" terminal, rapidly tap the loose end of the wire to the "White" terminal for several seconds. A wind speed display of any number (other than "0") should appear as the white terminal is being tapped. If that is the case, the console is functioning properly. Check the entire length of the cable for any cuts, kinks or other abnormalities. If there are none, or if problems persist after adjusting the cable, contact the factory for service. Only the sensors need to be returned for repair. Unplug the wind sensors form the main cable. Do not send the cup/hub assembly or the wind vane as they may be damaged in shipping.

6. If no other numbers appear in the wind speed display, repeat the procedure to confirm the results. If the result is the same, the console is defective (although it is possible that the wind sensor is also defective). The wind sensors are not designed for field repair. Contact the factory for service. Both the console and the sensors need to be returned. Unplug the wind sensors from the main cable. Do not send the cup/hub assembly or the wind vane as they may be damaged in shipping.

Wind Direction Test:

1. With one end of the jumper wire connected to the "Red" terminal, connect the other end to the "Blue" terminal; the NNW light should appear on the wind direction display. Proceed to touch the loose end of the jumper wire to the other terminals listed below and observe the wind direction display to confirm

that the appropriate direction light appears as its respective terminal is touched.

Terminal	Direction
Blue	NNW
Green	SSE
Orange	ENE
Brown	NNE

2. If all the direction lights perform as indicated, the console is functioning properly. Check the entire length of the cable for any cuts, kinks or other abnormalities. If there are none, or of problems persist after adjusting the cable, contact the factory for service. Only the sensors need to be returned for repair. Unplug the wind sensors from the main cable. Do not send the cup/hub assembly or the wind vane as they may be damaged in shipping.

3. If any or all of the direction lights do not light up as indicated, repeat the procedure to confirm the results. If the result is the same, the console is defective (although it is possible that the wind sensor assembly is also defective). The wind sensors are not designed for field repair. Contact the factory for service. Both the console and the sensors need to be returned for repair. Unplug the wind sensors from the main cable. Do not send the cup/hub assembly of the wind vane as they may be damaged in shipping.

SECTION 9: REPLACEMENT PARTS

Refer to Figure 14. Consult factory for price and availability.

Description	Ref.	Catalog No.
Complete Wind Sensor Assembly	1	81500
Partial Wind Sensor Assembly Includes Speed and Direction Sensor bodies and connector only.	2	81440
Wind Speed Cup/Hub Assembly, with top nut.	3	81400
Wind Direction Vane Assembly with top screw.	4	81420
Temperature Probe Assembly Includes one complete sensor Assembly with 25 ft. cable.	-	81520
Humidity Proble Assembly Includes one complete sensor with 25 ft. calbe	-	81525
Hardware Assembly Kit	5	81480
User Manual	-	81620
Cross-Arm Support	6	81460
Power Cord	-	81610
Extra Length Temperature Sensor Cable for lengths over 25 ft.	-	81560
50 ft. Wind Sensor Cable with connector half.	-	81538
100 ft. Wind Sensor Cable with connector half.	-	81539
Extra Length Wind Sensor Cable for lengths over 100 ft.	-	81540
Cable Splice Kit for user installation/repair of cable.	-	81580

Sensor Cable Connector Option   -   81585
Allows quick disconnect of cables
from temperature sensor;
watertight. Factory installed.

Sensor Cable Connector Option   -   81590
Allows quick disconnect of cables
from humidity sensor;
watertight. Factory installed.

Figure 14: Wind Sensor Assembly Parts
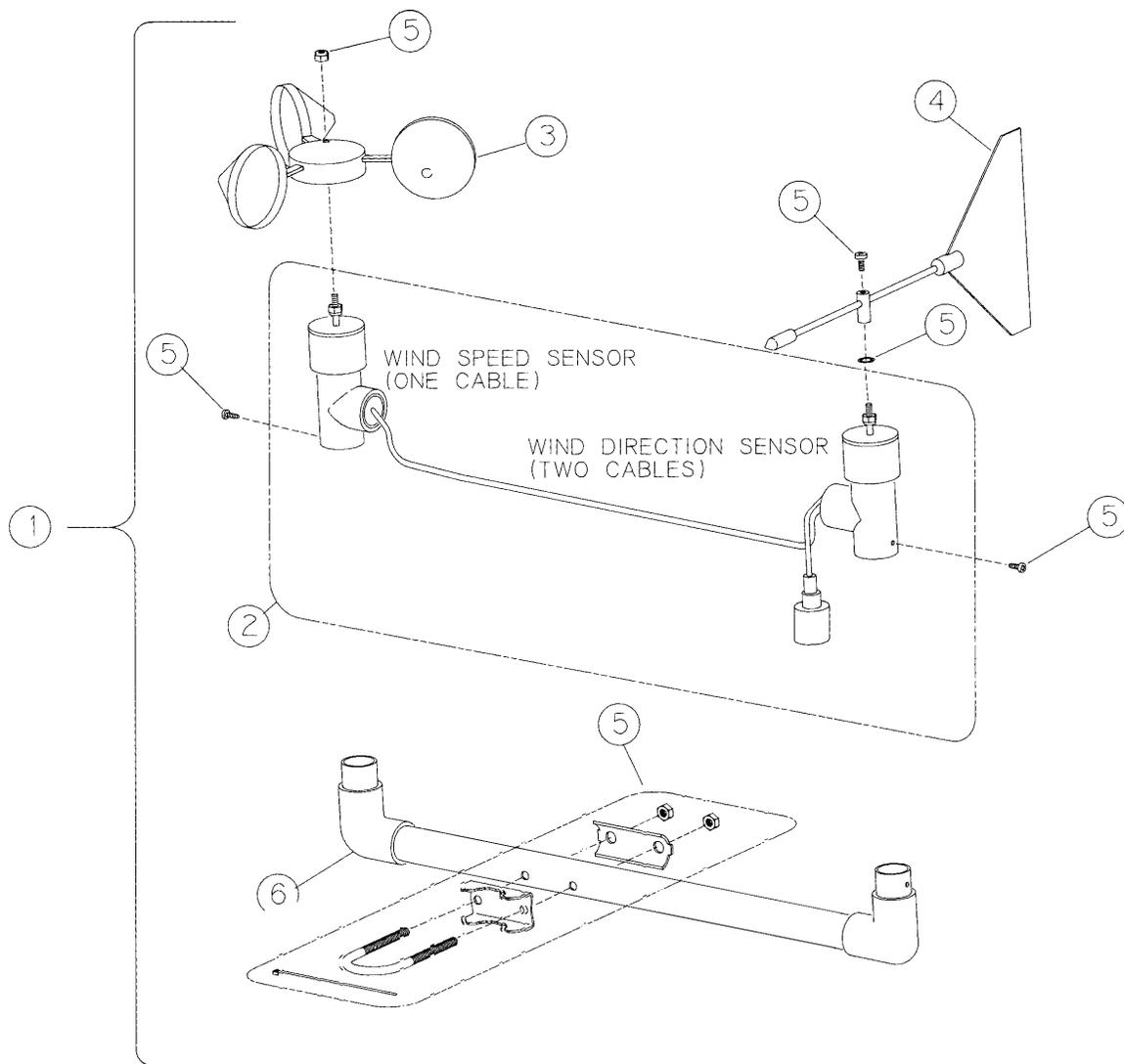
SECTION 10: USER SUPPORT INFORMATION

Please fill out and return the Capricorn Product Registration Card immediately. If the card is missing from the front of this manual, please call the Capricorn Service Department to obtain one.

Columbia Weather Systems, Inc. makes every attempt to ensure that the Capricorn II Plus Digital Weather Station is a product of superior quality and workmanship. Our documentation is detailed to provide you with the maximum product support for the operation of your instrument. Additionally, our Capricorn Service personnel are available to assist you from 8:00 a.m. to 4:30 p.m. PST.

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 must return your Capricorn II Plus for repair or replacement. Follow the packing instructions carefully to protect your instrument in transit.

A. LIMITED WARRANTY

Columbia Weather Systems, Inc. (CWS), warrants the Capricorn II Plus Digital 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 Columbia (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 Columbia will not co-warrant these parts, Columbia 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.

B. 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, 8:00 am to 4:30 pm PST, (503) 690-2000 to determine the advisability of factory repair.

2. In the event factory service is required, return your Capricorn II Plus as follows:

   a.   Packing

   - wrap console 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).

   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:

   Capricorn Service Dept.
   Columbia Weather Systems
   2240 NE Griffin Oaks Street, Suite 100
   Hillsboro, Oregon 97124

   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 Systems, 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.

ADDENDUM: WIND CHILL ALGORITHM

To compute the wind chill, first calculate the CORRECTION FACTOR (CF) from the following table and formulas:

Using the wind speed in mph, calculate the wind speed index. (Range is 5 to 50 mph.)

Index = 10 - Integer (Wind Speed/5)

Example: 37 mph/5 = 7 R2, where 7 = integer and 2 = remainder

Index	Table #1	Table #2	Wind Speed (mph)
0	156	0	50
1	151	16	45
2	146	16	40
3	141	16	35
4	133	25	30
5	123	33	25
6	110	41	20
7	87	74	15
8	61	82	10
9	14	152	5
10	0	0	<5

CF = Table #1 + (Table #2 * 1/16 * Remainder (Wind Speed/5)

Then compute the WIND CHILL (WC), use the following formula:

IF temperature (in °C) - 33 (or in °F -91.4) is > 0;
Then WC = (CF* (Temp. in °C - 33 (or Temp. in °F - 91.4))/256) + temperature

IF temperature (in °C) - 33 (or in °F -91.4) is < 0;
Then WC = actual temperate (there is no wind chill)

Examples:

1. Given 25 mph and 20°C:
   Index = 10 - 25/5 = 5
   CF = 123 + (33 * 1/16 * 0) = 123
   WC = (123 * (20 - 33)/256) +20
   WC = -123 (0.05078) + 20 = 13.75° C

2. Given 27 mph and 68° F:
   Index = 10 - Integer(27/5) = 10 -5 = 5, Remainder = 2
   CF = 123 + (33 * 1/16 * 2) = 127.125
   WC = (127.125 * (68 - 91.4)/256) + 68 = 56.38° F