MODEL 50.5
WIND SENSOR

OPERATION MANUAL
Document No. 50.5-9800

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50.5 Sonic Wind Sensor Manual

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MODEL 50.5 WIND SENSOR OPERATION MANUAL

1. GENERAL INFORMATION

The Met One Instruments Model 50.5 Wind Sensor is a solid-state ultrasonic instrument capable of measuring wind speed and wind direction in the U and V axes. Sonic pulses are generated at the transducers and are received by opposing transducers. Mathematics derived for these sonic pulses provide a wind velocity measurement in each of the corresponding axes.

The 50.5 uses a microprocessor-based, digital electronic measurement system to control the sample rate and compute the wind speed and wind direction. The sensor is factory calibrated and requires no field calibration. In the field, the operation of the sensor can be quickly checked using a combination of simple tests. A zero chamber or bag is used to verify the zero reference by covering the entire sensor, or individual outputs are checked by blocking various combinations of sensors.

The 50.5 provides are variety of outputs to suit the connection requirements of the user. Standard outputs are voltage and RS-232. SDI-12 and RS422/485 outputs are configured at the factory.

2. INSTALLATION

2.1 UNPACKING

Carefully remove the sensor from its shipping container and inspect it for damage. Referring to the packing list, check for shortages. Any claims for damages should be filed promptly with the carrier.

The sensor is a precision, electromechanical transducer. Always handle it with care, exercising particular caution to ensure that the instrument is not subjected to side loading, shock or other abuse. After initial inspection, keep the sensor in its shipping container for protection until actual installation.

2.2 PREPARATION

For accurate measurements, the sensor mount must be rigid with little or no movement from the wind. The sensor is designed for installation in a Model 3188 mounting and alignment fixture. This provides a mount for use on a horizontal ¾" IPS pipe (1.05" O.D.) boom. Mounting information and diagrams can be found in Appendix B of this manual.

The 3188 Sensor Mounting Fixture includes a keyed bushing, which will be adjusted for alignment to North orientation. This enables the sensor to be removed and replaced without requiring realignment. Three captive machine screws are used to secure the sensor to the keyed bushing.

If a temperature shield such as the Model 073B is to be used in the configuration, the Model 1539-4 Arm and 1552 Mount is recommended. These parts provide the necessary mounting for a vertical mast of ¾" IPS pipe (1.05" O.D). This same configuration can also be used to mount other sensors as well as providing a way to mount the sensor on a vertical mast. (See Appendix B for Mounting Details)

2.3 SENSOR SITING

The primary objective of instrument siting is to place the instrument in a location where it can make precise measurements that are representative of the general state of the atmosphere in that area. Because most atmospheric properties change dramatically with height and surroundings, certain somewhat arbitrary conventions must be observed so that measurements can be compared.

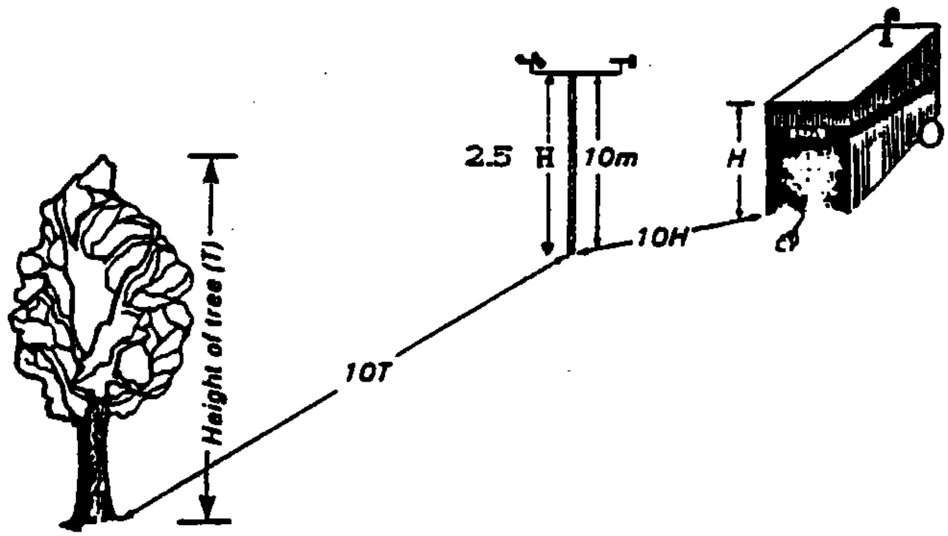


Figure 2-1 Siting Wind Instruments

The standard exposure of wind instruments over level, open terrain is 10 meters above the ground. (WMO 1971), however optimum measurement height may vary according to data needs. Open terrain is defined as an area where the horizontal distance between the wind sensor and any obstruction is at least ten (10) times the height of that obstruction. An obstruction may be man-made (such as a building) or natural (such as a tree) (See Figure 2-1)

The wind instrument should be securely mounted on a mast that will not twist, rotate or sway. If it is necessary to mount the wind instrument on the roof of a building, it should be mounted high enough to be out of the area in which the airflow is disturbed by the building. This is usually 1.5 times the height of the building above the roof so that it is out of the wake of the obstruction. This is not a good practice, however, and should only be resorted to when absolutely necessary.

Wind instruments are best sited when they are used on towers. The tower should be located in an open level area, representative of the area under study. Towers should be of the open grid type of construction, such as is typical of most television and radio broadcast towers. Enclosed towers, stacks, water storage tanks, grain elevators, cooling towers and similar structures should not be used.

Wind instruments should be mounted above the top of the tower on booms projecting horizontally out from the tower. If a boom is used, it should support the sensor at a distance equal to minimum of twice or at best three times the maximum diameter or diagonal of the tower away from the nearest point on the tower. On large towers with large verticals, it may be best to place the sensor at least 5 tower leg diameters from the tower leg. The boom should project into the direction, which provides the least distortion for the most important wind direction. For example, a boom mounted to the east of the tower will provide least distortion for north or south winds.

Weather sensors are sensitive to direct or nearby lightning strikes. A well-grounded metal rod or frame should be placed above the sensor installation. In addition, the shield on the signal cable leading to the translator must be connected to a good earth ground at the translator end and the cable route should not be vulnerable to lightning.

2.4 ORIENTATION WITH FIXTURE

The Orientation Fixture, Model 70.5, is used for very accurate positioning of the 50.5 sensor with respect to a benchmark or other object that can be visually observed. If a compass is used to establish a benchmark, the reading should be taken away from heavy metal objects, which can affect the reading and should be corrected for declination of the magnetic north pole. The benchmark is set to true north of the sensor site. Information on determining true North can be found in Appendix A of this manual.

The fixture contains a telescopic sight with crosshairs and includes a keyed base identical to that on the sensor. The fixture is specifically designed for use with the 3188 Sensor Mounting Fixture. The base of the fixture is keyed so that the object lens of the sight assumes the same position as the north side of the sensor.

Before orienting the sensor, ensure that it is vertical and adjust the cross arm as necessary. Orientation of the sensor is then performed with the fixture installed on the cross arm in place of the sensor. (The three screws in the base of the fixture must be tightened to ensure proper orientation in the cross arm). Loosening the three setscrews on the side of the sensor mount allows free rotation of the keyed bushing and orientation fixture. The ring and fixture are then rotated to position the benchmark in the center of the sight crosshairs. The sight can be tilted as necessary by loosening the slotted screw on the side of the fixture. The set screws are then tightened, the fixture removed, and the sensor installed in its place. The sensor is now oriented for zero (north) wind direction signal output when the wind is from north.

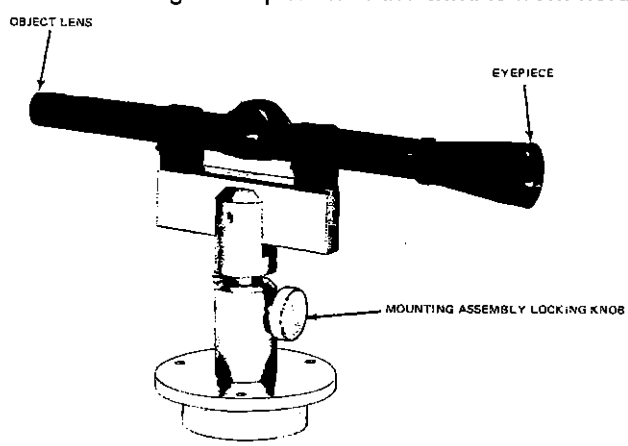


Figure 2-2 Orientation Fixture

The electrical connector on the bottom of the sensor should be properly mated to the cable connector, and the three captive screws on the base of the sensor should be tightened.

When using the orientation fixture, assure that the two-piece mounting assembly is properly aligned. The upper half of the assembly contains a horizontal peg, which must seat in the V-notch located in the lower half. The knurled knob on the lower half is used to secure the two sections and should be tight.

2.5 ORIENTATION WITHOUT FIXTURE (See FIGURE 2-3 and 2-4)

Establish a True North benchmark. See Appendix A for aids to determine True North. This should be a point directly north from the sensor's mounted location. This point should allow easy access so that a person may sight the sensor with a spotting telescope. If a compass is used to establish a benchmark, the reading should be taken away from heavy metal objects, which can affect the reading and should be corrected for declination of the magnetic north pole. The benchmark is set due north of the sensor site.

One person is located at True North benchmark equipped with a spotting scope. A second person is located at the sensor. The sensor alignment may be established as follows.

A. Install the sensor into the alignment bushing and secure with the two setscrews under the 3188 Alignment Fixture. Keep the three setscrews around the ring of the fixture loose so that the ring can be rotated into position.

B. Turn the sensor so that the sensor points to the North benchmark. Tighten the 3 setscrews and recheck alignment.

C. Connect the 9574-cable assembly to the sensor. Secure cable to boom with cable ties or tape to prevent damage.

D. The sensor can be removed without requiring realignment at any time. Simply remove the sensor. The alignment bushing remains properly oriented in the fitting.

2.6 EXTERNAL HEATER

The Optional External Heater provides de-icing for the sensor arms and prevents the accumulation of ice, which might block the sonic sensor elements. The heater consists of a laminated heater material that is custom designed and wrapped around the four sensor arms and sonic sensor element housings. The heater controller requires 15 to 24 VAC/VDC at approximately 4-5 amps at startup. There are jumper connections on the controller board for the selection of power source. The controller is normally provided with the jumpers not installed. This is for 24 volts AC operation of the heaters. Heater power can be supplied from a power transformer or a Met One Instruments supplied power unit in a weatherproof box. The proportional controlled heater uses maximum current at start-up and power requirement goes down as the sensor/heater reaches stability. The heater is activated at 38 degrees F and will keep the arms ice-free at temperatures down to below –20 degrees F. The connection information can be found in Appendix C of this manual.

The temperature controller electronics box should be mounted no more than 5 feet from the sensor using the cable supplied with the heater controller. The power cable should be of minimum 16 AWG wire and cable length should be at a minimum to prevent power loss due to cable resistance at the 4-amp power requirement.

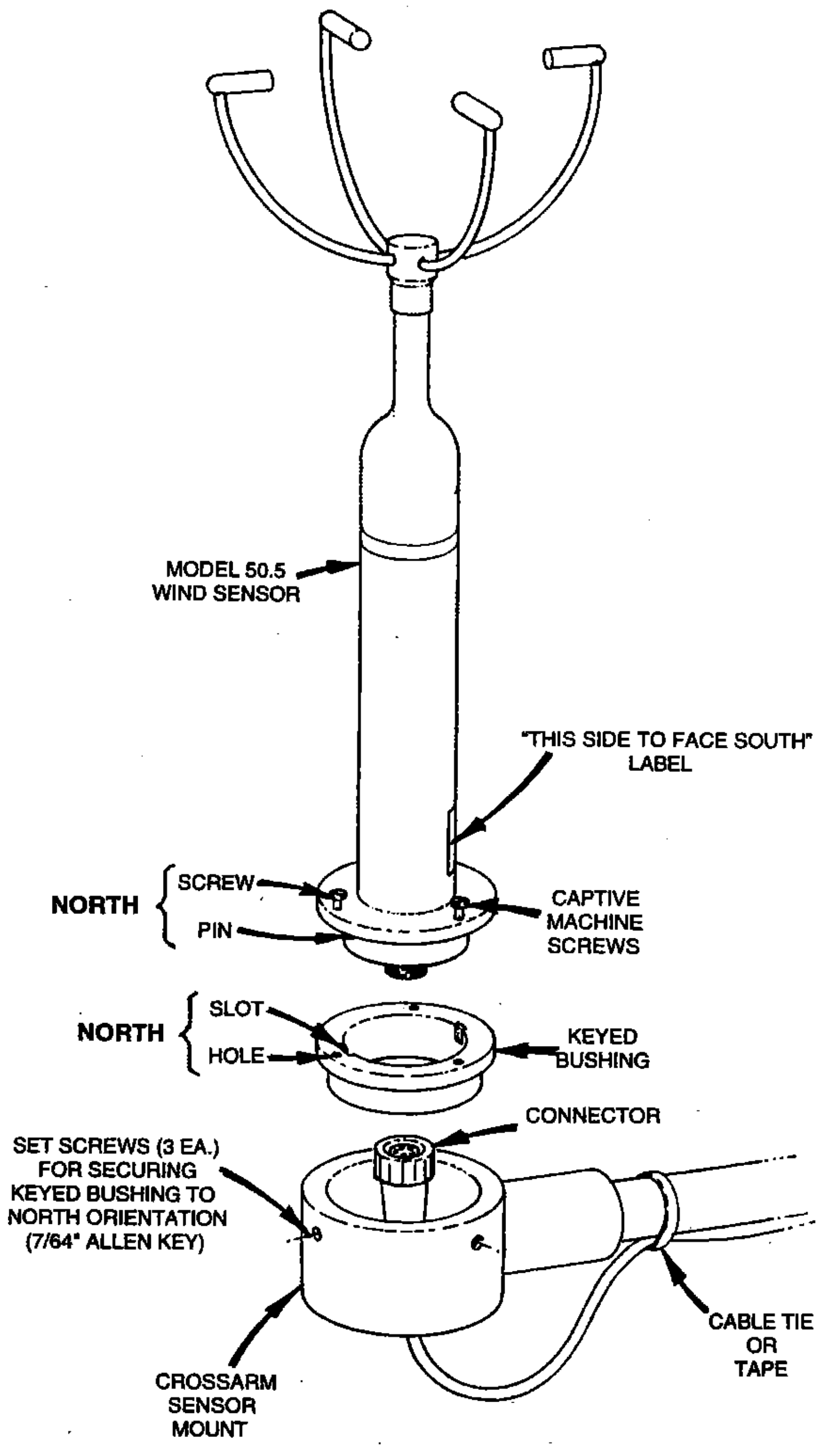


Figure 2-3 50.5 Wind Sensor Components

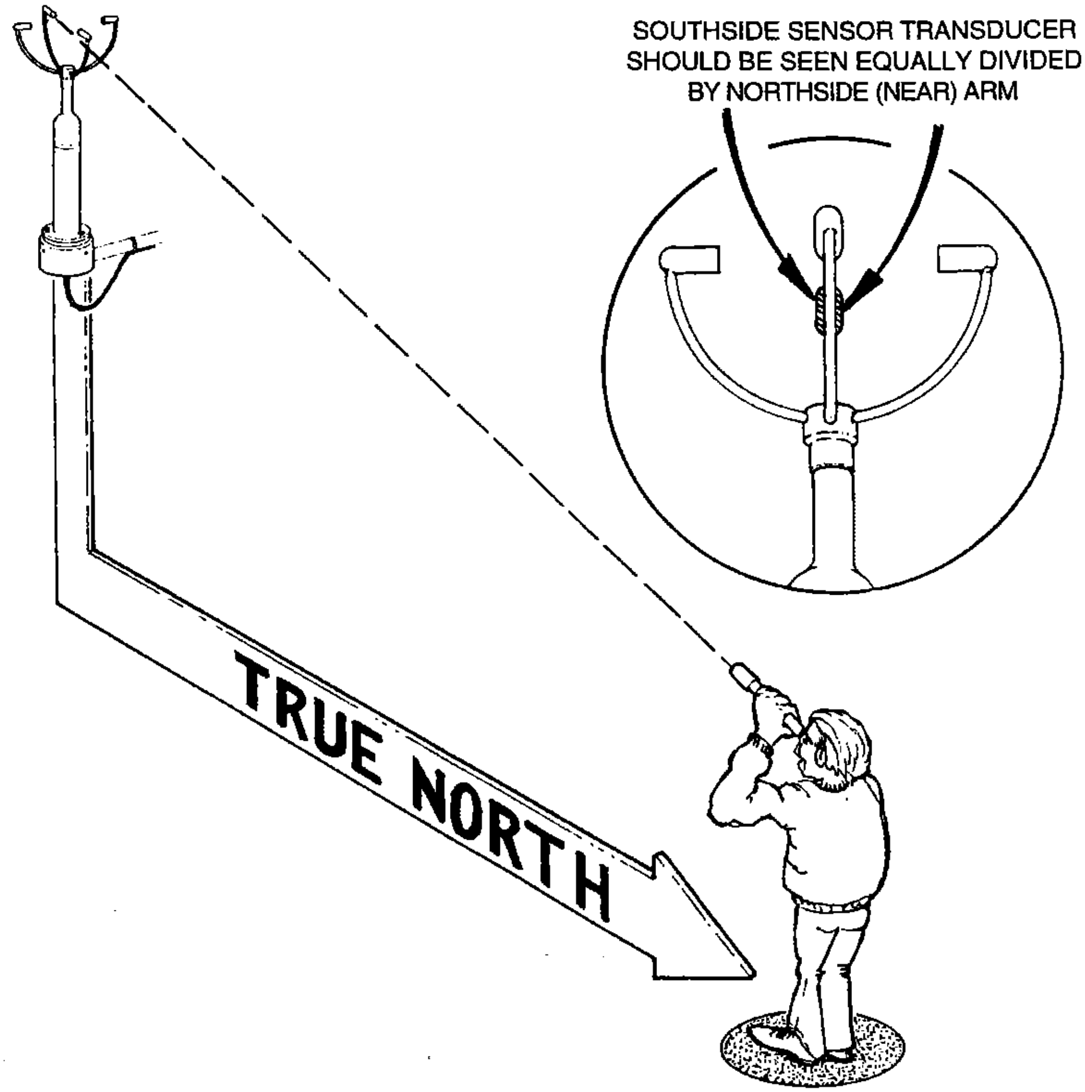
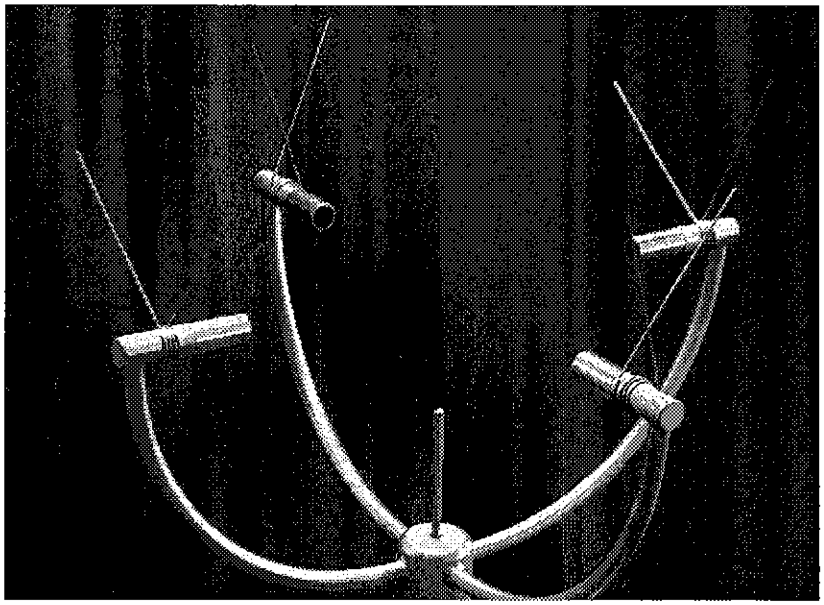


Figure 2-4 Alignment of Sensor to True North

2.7 INSTALLATION OF AVERY DETERRENTS

To prevent birds from entering the pathway between the sensors a vertical stainless steel rod is located in the center of the sensor array. To keep birds from perching on the sensors, stainless steel wire "aviary deterrent" need to be installed on the sensor prior to installation in the fixture.

> ***NOTE: The stainless steel wires used for the aviary deterrents are very sharp. The wire is spring steel and there is the possibility that it could slip off during the installation. Use care when installing the aviary deterrent, and be careful after installation.***
>
> **PROTECTIVE GLASSES SHOULD BE WORN DURING INSTALLATION**



Installed Aviarv Deterrents

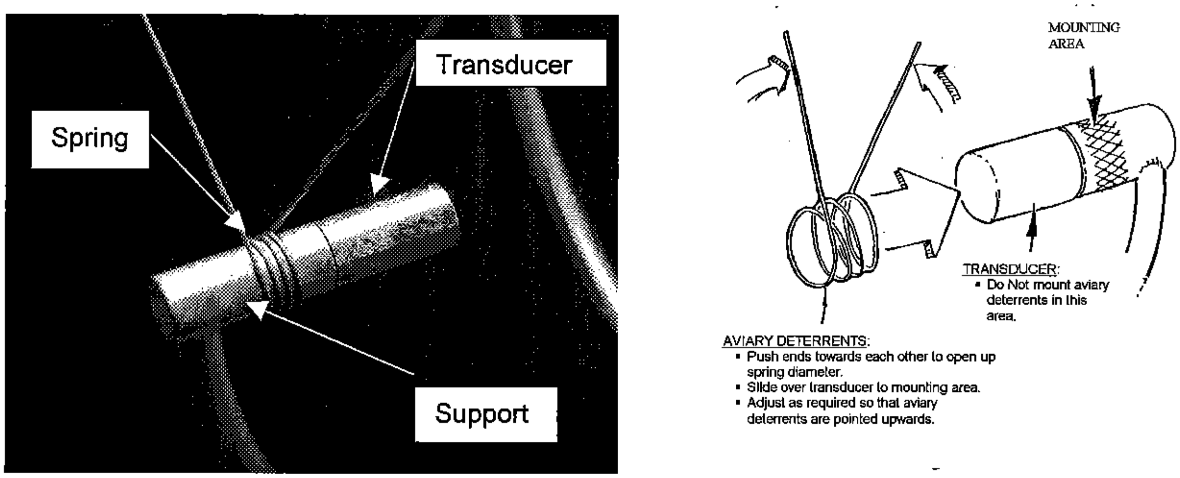


Figure 2-5 Installation of Aviary Deterrents

WARNING: If the aviary deterrents are not properly installed. The sensor may experience signal degradation. Install as shown. DO NOT allow for the spring section of the aviary deterrent to contact the transducer portion of the sensor array.

2.8 CONNECTIONS TO RECORDING ELECTRONICS

Route the cable to the data-recording device. Secure the cable with cable ties or tape. The 9574-cable assembly contains 7 wires and a shield. Typical wiring hookup is shown in the figures below. Actual wiring will depend upon the version of the sensor. To determine which of the three connections drawings apply examine the cable part number at both ends of the cable.

Cable type 9574 includes the 9573 Differential Amplifier; it is located at the end of the cable opposite the sensor connector. The amplifier provides high immunity to any noise that might be picked up the sensor cables. It is recommended that this cable with amplifier be used whenever connected to a single ended input recorder. If necessary to remove the differential amplifier, a wiring diagram has been included in the top of the small amplifier enclosure. A small screwdriver is provided, for use on the small terminal screws on the PC Board of the 9573 Amplifier. Be sure that the connection color codes are followed, so that no wiring error occurs. See below.

Warning: If you are connecting this 50.5 to an older 3155-cable assembly and are using the black wire as signal common, disconnect it because it will short out the RS-232 transmitter. No damage will occur to the circuit but the 50.5 current consumption will increase by 20 mA.

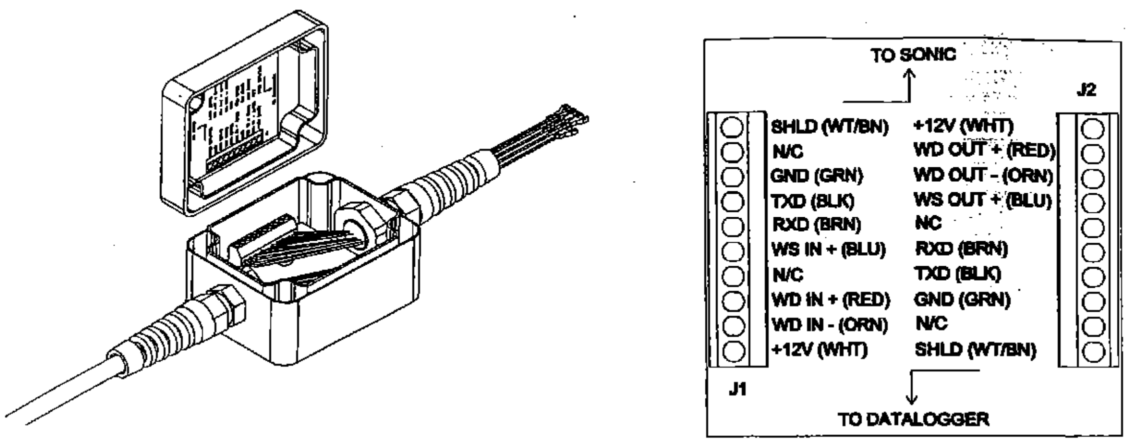


Figure 2-6 Amplifier (9573) attached to Cable (9574) and wiring in box

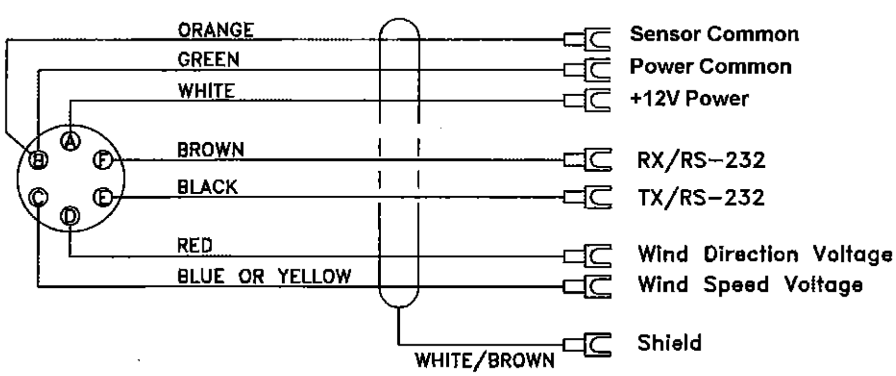


Figure 2-7 Factory Standard Analog & RS-232 Output Connections (Cable 9574 w/ Differential Amplifier 9573)

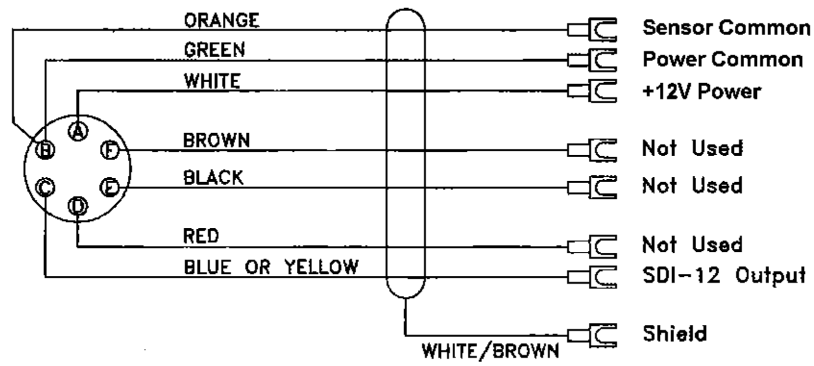


Figure 2-8 Factory Custom SDI-12 Output Connections

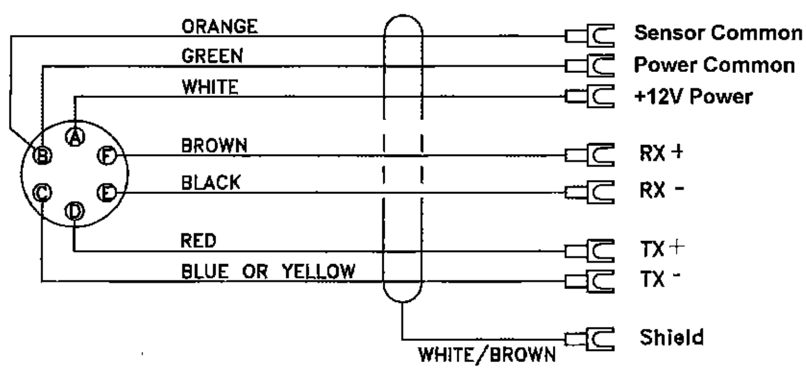


Figure 2-9 Factory Custom RS422/485 Output Connections

2.8 SIGNAL OUTPUTS – Analog, RS-232, and SDI-12

The standard configuration of the sensor provides for a voltage outputs for wind speed and direction as well as RS-232 Data. The default output voltage is 1.0 volts full scale for 50 meters/second and 360 degrees of direction. Alternate full-scale values can be changed by using the RS-232 command set discussed in Appendix D. The RS-232 output occurs every second in the format S sss.s D ddd <cr><lf> where sss.s is the wind speed value up to 999.9 and the direction ddd up to a value of 360. RS-232 output is at 9600 baud 8 data bits, 1 stop bit, and no parity.

As an option, an output of SDI-12 Data from the sensor is available. In this configuration it is the only available output and is in the format +sss.s+ddd <cr><lf>. The same values for sss.s and ddd as the RS-232 format are output. The SDI-12 handshake is per the SDI-12 specifications and format. In this configuration, the RS-232 output or analog output is no longer available from the sensor.

2.9 SIGNAL OUTPUTS – RS422 and RS485

In this configuration. the sensor has no analog outputs (see diagram "Factory Custom RS422/RS485 Output Connections". The correct sensor cable for this configuration is part number 3379.

The default serial trigger (sensor address) is "1". After receiving 1, the sensor will return wind speed and wind direction in the same format as with RS232 (S sss.s D ddd <cr><lf>).

To use the RS232 Command Set defined in Appendix D, the sensor must first be put into Terminal Mode by sending "!!!" (three exclamation points). The serial trigger is not used in this case, and there must be only one sensor connected on the serial buss. The sensor will return "!" when in Terminal Mode, and will then accept RS232 commands. The QU (quit) command will take the sensor out of Terminal Mode and return it to normal operating mode.

3. OPERATIONAL CHECK-OUT AND CALIBRATION

3.1 GENERAL

Operation of the 50.5 is essentially automatic, and no specific sensor calibration is required for normal operation. The sensor has been calibrated in a wind tunnel at the factory prior to shipment.

3.2 RECORDING ELECTRONICS

The sensor may be connected to a variety of data recorders and translators. Standard wind speed range is 0-50 m/s and wind direction range is 0-360 degrees. Standard output voltage is 0-1.0V, with 0-2.5V and 0-5.0V as available options. Refer to the calibration certificate supplied with the sensor to determine the actual output.

To ensure that the recorder is scaled properly, it is recommended that zero and span tests are performed after the sensor is connected and operational.

3.3 ZERO TEST

A zero test requires no air movement across the sensor array, so a means of covering the array is needed. A plastic bag can be placed over the array, using care not to contact the transducers or block the sonic paths between transducers. The bag should be spaced at least 2" above the transducers to avoid sonic reflections, which may affect readings. The bag can be tied at the bottom with a tie wrap or tape to prevent air movement from below. Keep in mind that wind can deflect the bag, causing air movement inside.

The preferred method is to use a box insulated with foam to prevent reflections, and spaced so that the top is at least 2" above the transducers. Again, the bottom should be sealed around the sensor to isolate the array from ambient air movement.

With no air movement across the array, the sensor should indicate 0.0 to 0.1 m/s wind speed. The wind direction output will wander to any value between 0 and 360 degrees.

3.4 SPAN TEST

The sensor is designed to produce known default outputs if an object blocks the sonic signal path between the transducers. This feature is useful for verifying sensor operation and recorder scaling. For testing purposes, the sonic path can be blocked by placing a finger (or any solid object) on the face of one or more transducers.

NOTE: The following table defines the sensor outputs with blocked paths.

Wind Speed

Blocked Axis	*Serial Output*	*Analog Output*	*0-1.0V*	*0-2.5V*	*0-5.0V*
North-South	100 m/s	50 m/s	1.00V	2.50V	5.00V
East-West	100 m/s	50 m/s	1.00V	2.50V	5.00V
Both	100 m/s	50 m/s	1.00V	2.50V	5.00V

Wind Direction

Blocked Axis	*Serial Output*	*Analog Output*	*0-1.0V*	*0-2.5V*	*0-5.0V*
North-South	10 Deg	10 Deg	0.03V	0.07V	0.14V
East-West	160 Deg	160 Deg	0.44V	1.11V	2.22V
Both	170 Deg	170 Deg	0.47V	1.18V	2.36V

4. MAINTENANCE AND TROUBLESHOOTING

The 50.5 sensor is sealed and there are no replaceable parts contained therein. The sensor does not require periodic calibration, and there are no internal adjustments that can be made.

4.1 GENERAL MAINTENANCE SCHEDULE*

12-24 month intervals

The Model 50.5 Wind Sensor should be inspected periodically for physical damage to the sensor array assembly, cable, and cable connections. Inspect all transducers to be sure they are securely fastened.

*Schedule based on average to adverse conditions.

4.2 TROUBLESHOOTING

Symptom	Probable Cause	Action to Repair
Wind Speed output goes to full scale.	Blocked pathway. Failed sensor.	1 – Check path and clear. 2 – If clear, contact factory for Return Authorization to repair sensor.
Wind Speed output high, but not full scale. supply, inputs	Common mode voltage.	1 – Replace cable with part number 9574 (with 9573 differential-to- single-ended converter). 2 – Use 3379 cable and power sensor with isolated power separate from recorder power supply. 3 – Use 3379 cable and connect sensor signals to differential on recorder.

5. THEORY OF OPERATION

5.1 SPEED OF SOUND IN AIR

The speed of sound in still air can be measured accurately between two points a few centimeters apart by two ultrasonic transducers set at that distance. The resulting speed of sound is a known function of the air temperature and composition.

The speed of sound waves in an ideal gas may be written

$$C = \sqrt{\frac{LRT}{M}}$$

where R is the universal gas constant (0831.34 mJ/mol K), T is the temperature in Kelvin, M is the molecular weight (grams/mol) of the gas, and L is the ratio of heat capacities C_p and C_v; C_p and C_v are the specific heats at constant pressure and constant volume of the gas, respectively.

5.2 SPEED OF SOUND PRINCIPLE

The transit time of a sound signal traveling from one end of a sound path to the other, separated by distance d, can be written as follows (Schotland, 1955):

$$t = \left[\frac{\sqrt{C^2 - Vn^2} \pm Vd}{C^2 + V^2} \right] d$$

where V is the total velocity, V_d and V_n are velocity components in the directions parallel and normal to the sound path, and C is the velocity of sound in still air. If two transit times, t_1 and t_2 in opposite directions on the same path are directed, V_d can be obtained independent from V and V_n as follows:

$$Vd = \left[\frac{1}{t_1} - \frac{1}{t_2} \right]$$

It is this principle that is used to compute the velocity of the air in the path between two opposing transducers.

5.3 CALCULATION OF THE WIND VELOCITY

In still air, t_1 and t_2 are equal. For a distance 15 cm at 20° C, the transit time is approximately 450 µs. If a 20 m/s wind is in the direction of the sonic pulse, the transit time t_1 will be approximately 427 µs. If the wind is opposing the sonic pulse, the transit time will be approximately 482 µs. If these two values are used in the previous equation, the resultant velocity from equation will be 20 m/s.

6. SPECIFICATIONS

Sonic Wind Sensor Model 50.5

Wind Speed	
Range:	0 to 50 m/sec
Accuracy:	± 0.2 m/sec ≤ 11.3 m/sec or ± 2% ≥ 11.3 m/sec
Resolution:	0.1 m/sec
Wind Direction	
Range:	0 to 360°
Accuracy:	±3°
Resolution:	1°
Operation	
Sample Rate:	5 per second
Data Output Rate:	1 per second
Sonic frequency:	200 KHz
Output Signals	
Wind speed voltage:	0 – 5.0 VDC (Specified at time of purchase)
Wind direction voltage:	0 – 5.0 VDC (Specified at time of purchase)
RS-232:	1200 to 19.2K Baud
Optional Digital Outputs:	SDI-12, RS-422 or RS-485 (Specified at time of purchase)
Power requirement	
Sensor:	9-18 VDC @ 10 mA @ 12 VDC Average power requires .75 amp pulse for 2msec.
External Heater Option:	15 VDC @ 50 Watts
Environmental	
Maximum Measurement range:	0 to 65 m/s
Operating Temperature:	-40°C to +55°C no ice
Extended Temperature Range:	-50°C to +55°C with external heater
Physical	
Weight:	5.5 lbs (2.5 Kg)
Dimensions:	19.29in (490mm) high, 9.38in (238mm) diameter
Options	
Signal Cable:	PN 9574 – Specify length
Horizontal Mount & Orientation Fixture:	PN 3188
External Heater with Control Box:	50.5H
External Heater Power Source:	50.5PS (100 to 240 VAC 50/60 HZ), 15VDC @ 4 amps
Programming Cable & Power Supply:	TBD

*Heater Options must be specified at time of purchase.
*Specifications Subject to Change without prior Notice.

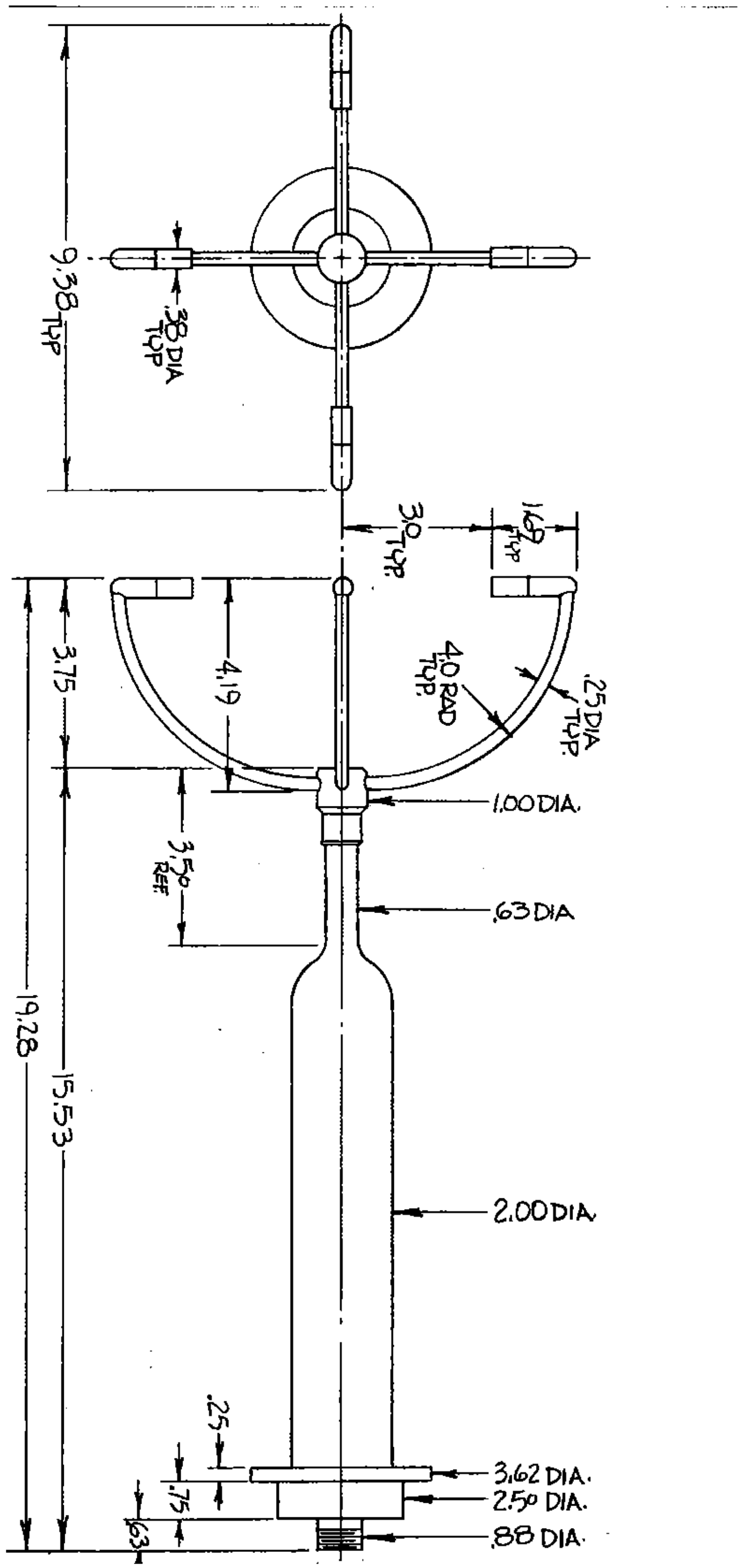


FIGURE 6-1 50.5 Wind Sensor Outline Dimensions

APPENDIX A - WIND DIRECTION SENSOR ORIENTATION

INTRODUCTION:
Determining True North or Magnetic Declination is very important to the proper setup and orientation of the wind direction portion of the sonic wind sensor. The declination value is used to determine the difference between True North and magnetic North. This value varies around the world depending upon your location. The following procedure can be used to either point the sonic wind sensor to True North.

ADJUSTMENT:
Orientation of the wind direction sensor is done after the location of True North has been determined. True North is usually found by reading a magnetic compass and applying the correction for magnetic declination; where magnetic declination is the number of degrees between True North and Magnetic North. Magnetic declination for a specific site can be obtained from a USGS topographic map, pilots maps, local airport, or through a computer service offered by the USGS called GEOMAG.

The following map showing magnetic declination for the contiguous United States is shown in the figure #1, can be used for determination of declination. This will depend upon the accuracy requirement required. Alternately use a more accurate method of determining declination from magnetic North.

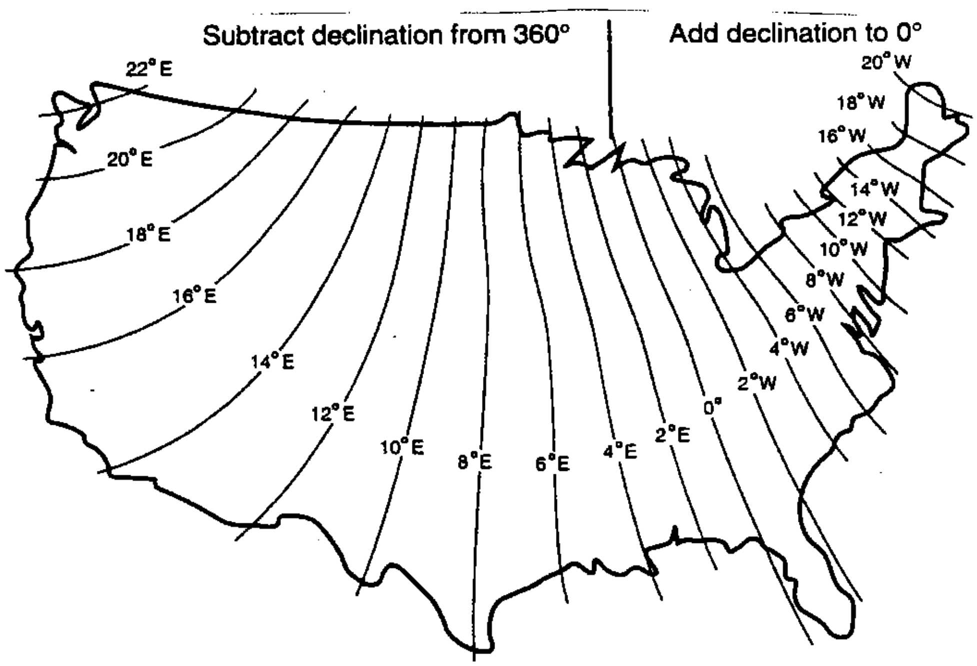


Figure #1 typical declination values in the USA

Declination angles east of True North are considered negative, and are subtracted from 0 or (360) degrees to get True North as shown in figure #2. Declination angles west of True North are considered positive, and are added to 0 degrees to get True North as shown in figure #3. For example, the declination for Grants Pass, Oregon is 17° East. True North is 360° -17°, or 343° as read on a compass.

Alignment to North

Orientation is most easily done with two people, one to aim and adjust the sensor, while the other observes the wind direction display. (Once True North is located, the South reference can be determined)

1. Establish a reference point on the horizon for True North.
   Sighting down the instrument centerline, aim the two arms of the North/South pair at True North with the locking set screw pointed South.

2. Align the sensor adapter or adapter mount.
   Loosen the setscrews that secure the base of the sensor to the cross arm. While viewing the position/rotation of the North/South sensor arms, slowly rotate the sensor base until the two arms point to True North that was determined by earlier measurement using compass.

   Other methods employ observations using the North Star or the sun, and are discussed in the Quality Assurance Handbook for Air Pollution Measurement Systems, Volume IV Meteorological Measurements.

Determining Local Magnetic Declination

Several resources for determining the magnetic declination of any site in the world can be found on the internet or can be accessed by modem using any common terminal program.

GEOMAG is a resource that can be accessed by telephone or the Internet (Telnet) connection. GEOMAG is accessed by calling 1-800-358-2663 with a computer and telephone modem, and communications program such as HyperTerminal. GEOMAG can also be accessed by the internet using the address: telnet://neis.cr.usgs.gov

GEOMAG prompts the caller for site latitude, longitude, and elevation, which it uses to determine the magnetic declination and annual change. The following Menu and prompts are from GEOMAG: Use the username: "QED".

MAIN MENU
Type Q for Quick Epicenter Determinations (QED)
L for Earthquake Lists (EQLIST)
M for Geomagnetic Field Values (GEOMAG)
X to log out

Enter program option: M

Would you like information on how to run GEOMAG (Y/N)? N

Options:
1 = Field Values(D, I, H,X,Z, F)
2 = Magnetic Pole Positions
3 = Dipole Axis and Magnitude
4 = Magnetic Center

Display values twice	[N]: press return
Name of field model	[USCON95]: press return
Date	[Current date]: press return
Latitude	: 42/25 N
Longitude	: 123/20 W
Elevation	: 1000
Units (m/km/ft)	: ft

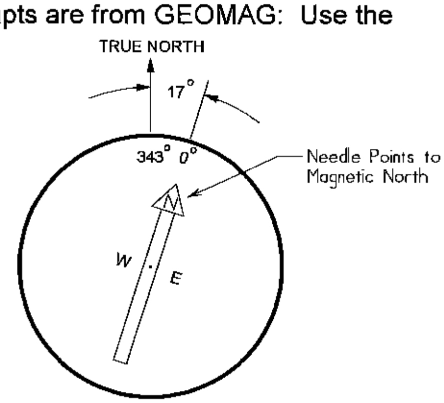


FIGURE 2 Declination Angles East of True North Are Subtracted from 0 to Get True North

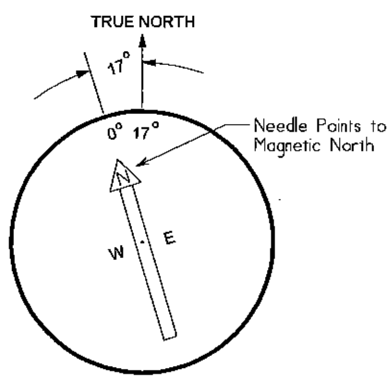


FIGURE 3 Declination Angles West of True North Are Added to 0 to Get True North

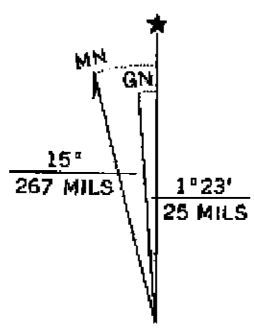
Example of report generated by GEOMAG:

Model: USCON95 Latitude : 42/25 N
Date : 2/13/99 Longitude: 123/20 W Elevation: 1000.000 ft

	D	I	H	X	Y	Z	F
	deg min	deg min	nT	nT	nT	nT	nT
	17 17.5	65 7.3	22056	21059	6555	47560	52425
Annual change:	0 -2.4	0 -1.7	-2.9	1.8	-15.6	-66.2	-61.3

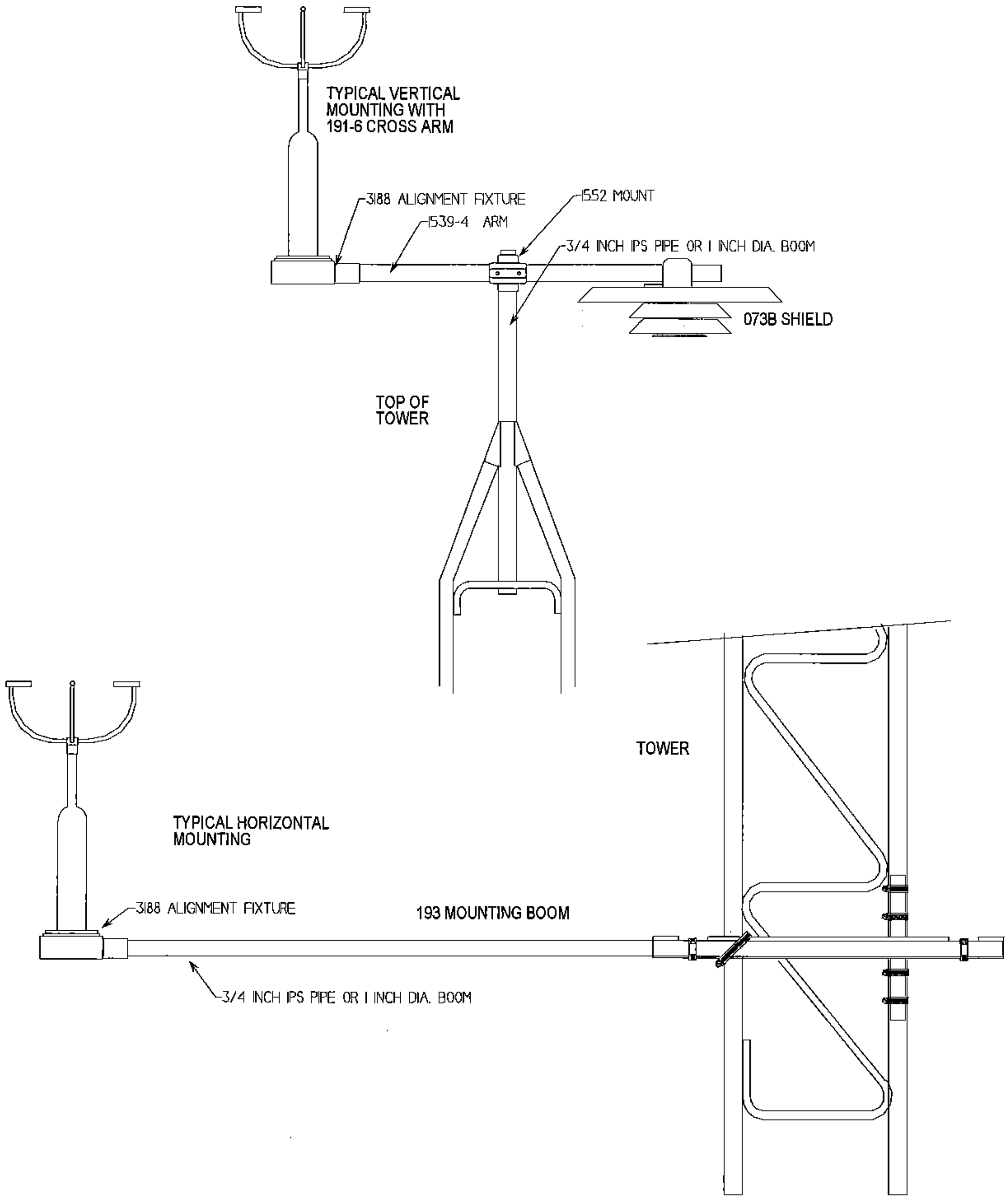
The calculated declination would be 17 degrees and 17.5 minutes for Grants Pass, Oregon.
The declination in the example above is listed as 17 degrees and 17.5 minutes. Expressed in degrees, this would be 17.3 degrees. As shown in Figure #1, the declination for Oregon is east, so True North for this site is 360 – 17.3, or 342.7 degrees. The annual change is –2.4 minutes. In this case a value 343 degrees would probably be sufficient for most measurement accuracy.

An alternative method is to find a USGS map and examine the text at the bottom center of the map. At this point either a written indication is given, or a symbol similar to the one seen below will be found. This would indicate a declination of 15 degrees West-showing MN (magnetic North) to True North (Star). Other sources such as the local airport can be helpful in determining the correct declination.

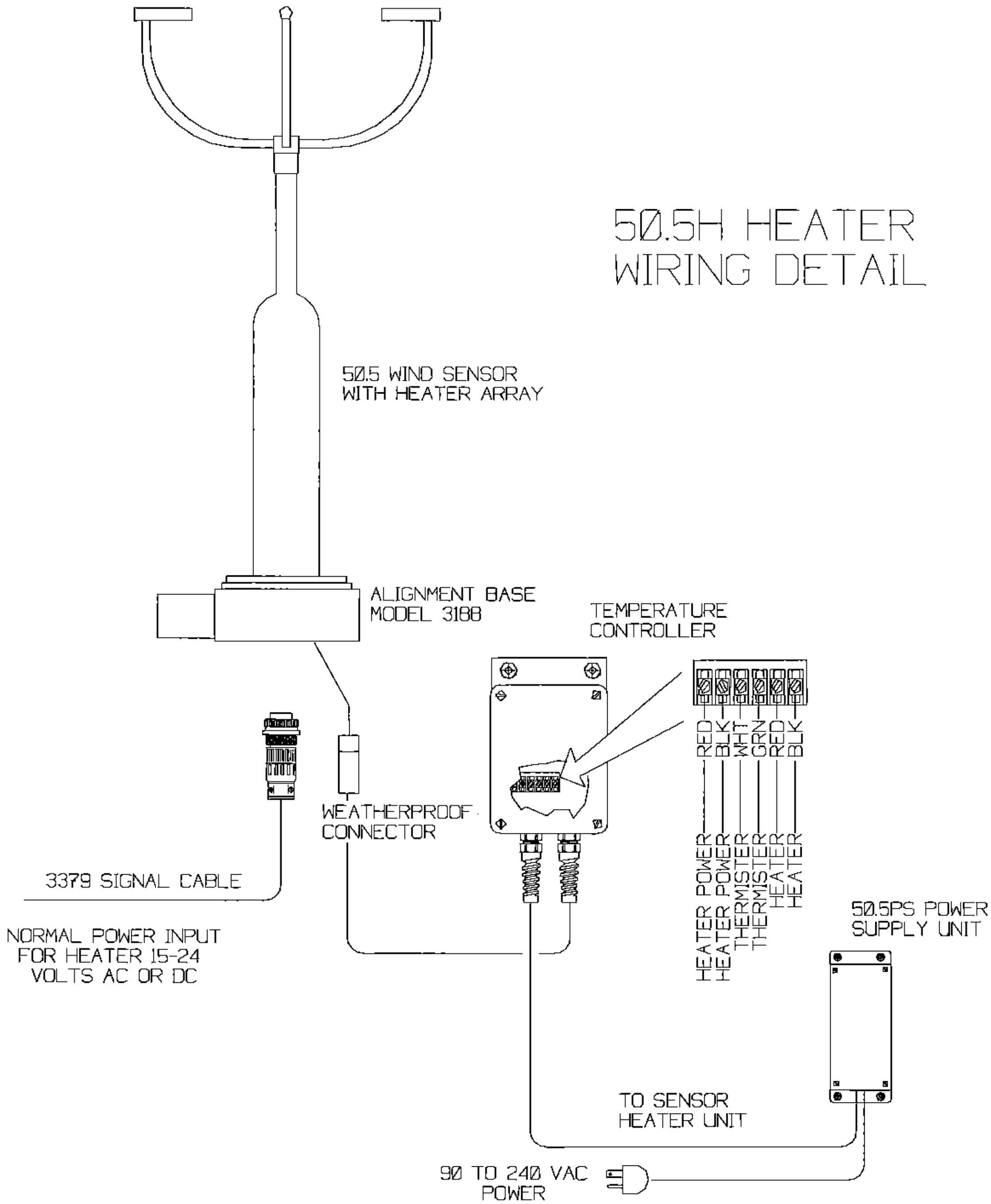


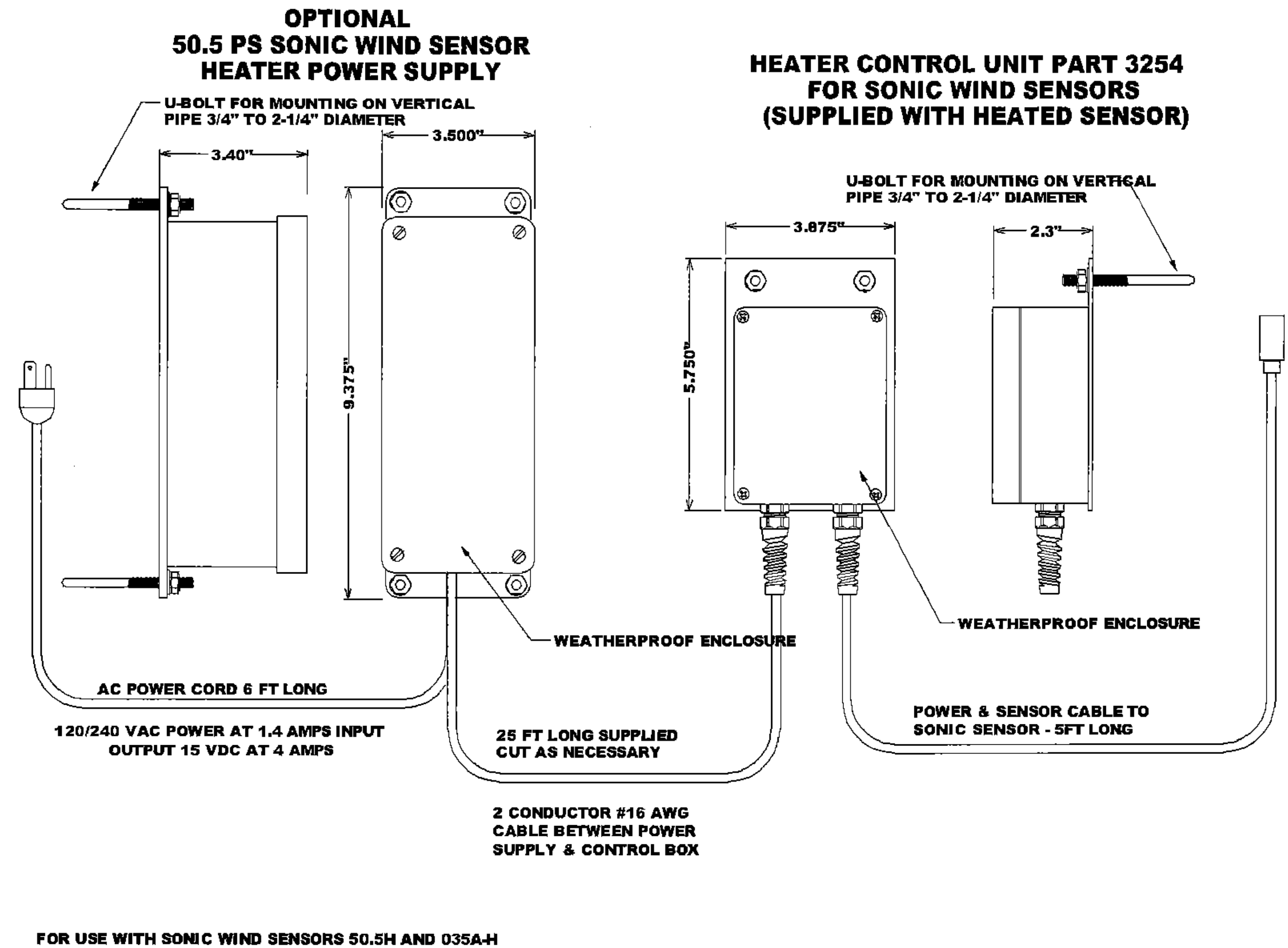
UTM GRID AND 1971 MAGNETIC NORTH
DECLINATION AT CENTER OF SHEET

APPENDIX B - WIND SENSOR MOUNTING OPTIONS



APPENDIX C - HEATER CONFIGURATION AND WIRING




OPTIONAL
50.5 PS SONIC WIND SENSOR
HEATER POWER SUPPLY
U-BOLT FOR MOUNTING ON VERTICAL
PIPE 3/4" TO 2-1/4" DIAMETER
3.40"
3.500"
9.375"
WEATHERPROOF ENCLOSURE
AC POWER CORD 6 FT LONG
120/240 VAC POWER AT 1.4 AMPS INPUT
OUTPUT 15 VDC AT 4 AMPS
25 FT LONG SUPPLIED
CUT AS NECESSARY
2 CONDUCTOR #16 AWG
CABLE BETWEEN POWER
SUPPLY & CONTROL BOX
HEATER CONTROL UNIT PART 3254
FOR SONIC WIND SENSORS
(SUPPLIED WITH HEATED SENSOR)
U-BOLT FOR MOUNTING ON VERTICAL
PIPE 3/4" TO 2-1/4" DIAMETER
3.875"
2.3"
5.750"
WEATHERPROOF ENCLOSURE
POWER & SENSOR CABLE TO
SONIC SENSOR - 5FT LONG
FOR USE WITH SONIC WIND SENSORS 50.5H AND 035A-H

APPENDIX D – RS232 Command Set

General Protocol

The computer interface commands use a simple ASCII packet protocol. Only one command is transferred per packet.

To enter the command mode, send the exclamation point (!) character until the unit returns '!'.

The unit will remain in the command mode until the quit command (QU) is received or a power reset.

Command packets are constructed with a two (2) character command, and if required a data string.

All commands must end with a carriage return (0x0D).

The unit will echo back the command string terminated with a carriage return and line feed (0x0A).

Data string requirements are described with each command.

A command with no argument returns the current setting.

The default RS-232 configuration is 9600, 8, N, 1.

There are two command sets—User and Factory.

1. RS-232 Data Output Protocol

The typical RS-232 data output stream has the following format.

S sss.s D ddd<cr><lf>

Where sss.s is the wind speed value and ddd is the wind direction value.
The range of the direction value is 0 to 359 degrees.

The units of sss.s are determined by the SU (Speed Units) settings.

The data output rate is determined by the TS (Sample Period) settings.

Parameter labels can be suppressed by the LB setting. The output format follows.

sss.s ddd<cr><lf>

The sonic temperature reading can be added to the data output with the TT (Sonic Temperature) setting. The output format follows.

S sss.s D ddd T ttt.t<cr><lf>

The units of ttt.t are in degrees C.

The sonic error code can be added to the data output with the EE (Sonic Error Code) setting. The output form follows.

S sss.s D ddd T ttt.t E eee<cr><lf>

1.1 Error Code

There is a time-of-flight window establish to determine sensor failures. If the receive signal arrives before the window it is considered early. If is arrives after the window it is considered late. There is an early and late error code for each sensor.

The firing order is NWSE so the receive order is SENW.
The error code table follows.

	Early	Late
N	1	2
S	4	8
W	16	32
E	64	128

The error code output is the sum of the sensor failures.
An error code does not mean the speed or direction values are invalid. Here is an example.

```
S  3.4  D  77  E  16<cr><lf>
```

The speed or direction values are invalid when an axis failure has occurred for three (3) consecutive sample periods.

An axis failure is when each sensor of the sensor pair has a failure—early or late. When this condition occurs the speed is set to an equivalent of 100.0 meter-per-second. The actual speed report is determined by the SU setting. The direction is equal to the error code.

For example, if the north-south axis is block and SU is MPS the data output looks like this.

```
S 100.0  D  10  E  10<cr><lf>
```

If the east-west axis is block and SU is MPH the data output looks like this.

```
S 223.7  D 160  E 160<cr><lf>
```

If the north-south and east-west axis is block and SU is KPH the data output looks like this.

```
S 360.0  D 170  E 170<cr><lf>
```

2. User Command Set

Note: <cr> refers to a carriage return

2.1 LB-Verbose Control of RS-232 PARAMETER labels

Display or suppress parameter labels of Wind Speed (S), Wind Direction (D), Sonic Temperature (T), and Error Code (E) at RS-232 output.

COMMAND	RESULT
LB<cr>	Report Present Setting
LB0<cr>	Suppress parameter labels
LB1<cr>	Display parameter labels

2.2 MS-Maximum Full Scale Wind Speed

Set the unit's full-scale Wind Speed output for full-scale analog output. Note that these numbers MUST correspond to units set in "SU" below.

Example:

COMMAND	RESULT
MS<cr>	Report Present Setting
MS50<cr>	50 Meters per second when SU = 0
MS111.85<cr>	111.85 MPH when SU = 1
MS180.0<cr>	180 KPH when SU = 2
MS97.19<cr>	97.19 KNOTS when SU = 4

2.3 SU-Wind Speed Units

Set units for Wind Speed.

COMMAND	RESULT
SU<cr>	Report Present Units selected
SU0<cr>	MPS
SU1<cr>	MPH
SU2<cr>	KPH
SU4<cr>	Knots

These values are mutually exclusive.

2.4 QU-Quit

Exit the command mode and save any changes.

COMMAND: QU<cr>
Note: This command not supported by SDI-12.

2.5 SB-Serial Baud Rate

Read or Set the unit's Baud rate.
Note: This command is not supported by SDI-12.

COMMAND	RESULT
SB<cr>	Report Present Baud Rate
SB1<cr>	Set 1200 BAUD
SB2<cr>	Set 2400 BAUD
SB3<cr>	Set 4800 BAUD
SB4<cr>	Set 9600 BAUD
SB5<cr>	Set 19200 BAUD

Baud rate changes take effect after turning off the power to the sensor and turning it back on again.

2.6 ST-Serial Trigger (RS-485 Only)

Set the string used in RS-485 mode to serve as a trigger for the unit's send data command.

COMMAND: STx<cr> Where x can be any set of one to six alphanumeric characters except three "!" in a row.

2.7 TT-Sonic Temperature

Enable or disable Sonic Temperature RS-232 output.

COMMAND	RESULT
TT<cr>	Report Present Output Status
TT0<cr>	Disable Sonic Temperature Output
TT1<cr>	Enable Sonic Temperature Output

2.8 VN-Version Number

Returns the Firmware version number.

COMMAND: VN<cr> Example Report: 3194-02 R2.60

2.9 VS-Full Scale Analog Output Voltage for Wind Speed and Wind Direction

Set the full-scale analog output voltage for the full-scale wind speed and wind direction.

COMMAND: VSx.x<cr> Where x.x is the full-scale analog output voltage at the full-scale wind speed and wind direction.

The range of x.x is 0.0 to 5.0 volts at the full scale