Wind Speed, Direction and Barometric Pressure Transmitter

A70-SDPX

4 Wire Systems

Instruction Manual

A70-SDP Kit with
Comptus A75-104 and Comptus
A75-302

This Manual covers the following
products:

A70-SLx
A70-DLx
A70-PLx
A70-SDLx
A70-SPLx
A70-DPLx
A70-SDPLx

(Speed, Direction and Pressure are available and must be specified at time of order. "x" in the model number indicates operating power – see Technical Specifications.)

DOCUMENT VERSION: 210426

COMPTUS

Wind Speed, Direction and Barometric Pressure Transmitter

A70-SDPX

INTRODUCTION:

The A70 Series of transmitters converts the signal from the sensors to an output signal which can be connected to a display, data logger or other controller.

The A70-SDPX series of Wind Speed transmitters converts the wind speed signal from the A75-104 anemometer into a 4-20 mA electrical signal for input to a computer, meter or other instrumentation. Input power may be supplied from 12-24 VDC, 24 VAC, 115 VAC, or 230 VAC (specified at time of order).

Monitoring of Wind Direction and/or Barometric Pressure can be added as options (specified at time of order). Each of these would have their own sensor with separate 4-20mA output signal corresponding to the selected output range. Each measured characteristic is independent of all others, so your system may be for wind speed, wind direction, barometric pressure, or any combination of these three.

All A70 series instruments include transmitter board and appropriate sensor(s) with cabling and mounting hardware

as required.

MOUNTING TABLE:

Designator:	*Mount / Enclosure:*
T	Snap Track Mount
N12	NEMA 12 Steel
N4	NEMA 4 Steel
N4XFG	NEMA 4X Fiberglass

MODEL DESIGNATION:

A70-SLx-m/r	Wind Speed
A70-SDLx-m/r	Wind Speed & Wind Direction
A70-SDPLx-m/r	Wind Speed, Wind Direction & Barometric Pressure

where x = operating power (see Technical Specifications)
m = mounting or enclosure option (see Mounting table) r = full scale output range (see Output Range table)

OUTPUT RANGE TABLE:

Item:	*Designator:*	*Full Scale Range:*
Wind Speed	E	0-100 MPH
Wind Speed	M	0-50 m/s
Wind Speed	K	0-160 KPH
Wind Speed	K2	0-100 KPH
Barometric Pressure	E	27-31 inHg
Barometric Pressure	M	900-1100 mbar

**NOTE:*
One designator is used for the combination of measured characteristics in those products with more than one sensor attached, e.g., "E", where speed is MPH and pressure is "Hg, or "M", where speed is M/sec and pressure is mbar.

INPUT SENSORS:

If included

Wind Speed -
A75-104 Anemometer

Wind Direction -
A75-304 Wind Vane

Barometric Pressure -
Integrated 15-psia silicon sensor (board mounted)

A70-xxxL1* A70-xxxL4* A70-xxxL6* A70-xxxL7*

Wind Speed, Direction and Barometric Pressure Transmitter

A70-SDPX

Operating Power: 12-24 VDC 24 VAC** 115 VAC** 230 VAC**

Operating Temperature:

Electronics - 0ºC to 60ºC (-20ºC to 70ºC optional)

Sensors - -55ºC to 60ºC

Accuracy:

SPECIFICATIONS:

Electronics - ±1%

Anemometer - ±1 MPH @ ≤10 MPH

±0.2 MPH @ 11-55 MPH

±5 % of reading @ ≥56 MPH

Wind Vane - ±1º

Pressure Sensor - ±0.05 inHg / ±2 mbar Output

Range:

Speed - 0-100 MPH

0-50 m/s

0-160 KPH

0-100 KPH (Optional)

Direction - 0-359º

Pressure - 27-31 inHg

900-1100 mbar (Optional)

Output Signal: 4-20 mA - corresponding output ranges above Starting

Threshold:

Anemometer - 1.75 MPH (0.75 m/s)

Wind Vane - 2.2 MPH (1 m/s)

Gust Survival Speed:

Anemometer - 232 MPH (104 m/s)

Wind Vane - 134 MPH (60 m/s)

*x represents either “S” Speed, “D” Direction,
“P” Barometric Pressure, or any combination of the three depending on board specified when placing an order

**50/60 Hz

SENSOR DESCRIPTIONS:

Anemometer:

Wind Speed, Direction and Barometric Pressure Transmitter

A70-SDPX

The A75-104 Anemometer is a rugged three-cup device whose accuracy and reliability has been proven in wind tunnel and field tests over many years. The anemometer housing and rotor are fabricated of rugged UV stabilized Lexan. The rotor is supported by a beryllium copper shaft riding in Teflon bearings. Swept diameter is 7.5” (19 cm).

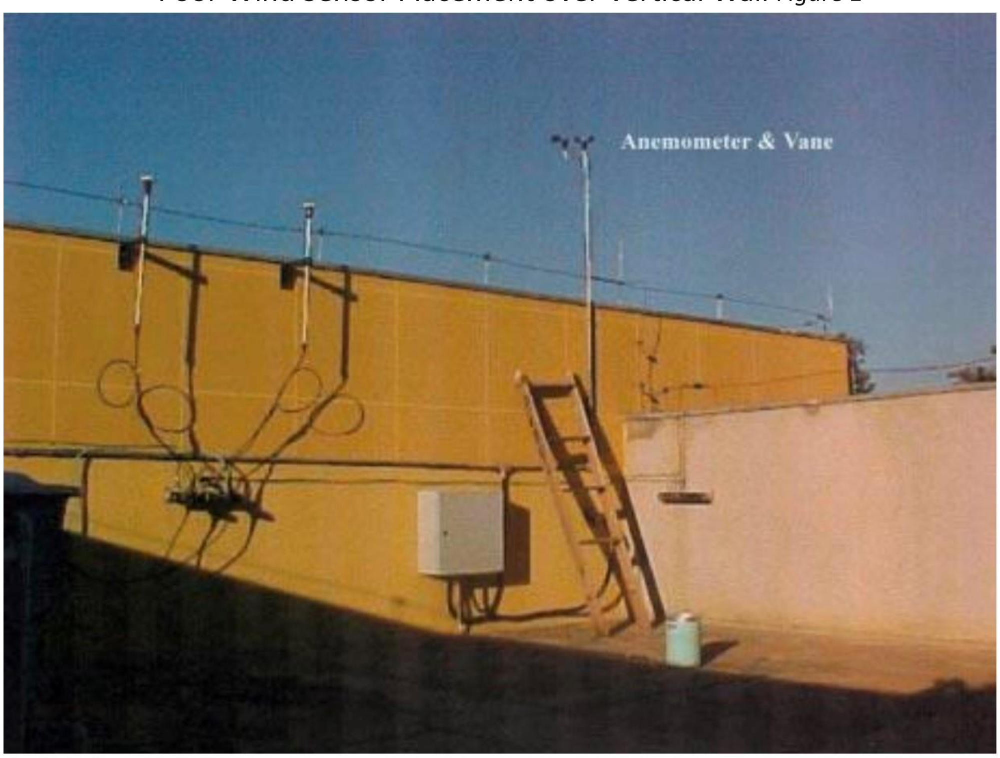
Wind Vane:

The A75-302 Wind Direction Vane is a precision potentiometric device that converts a supplied electrical voltage to an analog voltage that is linearly proportional to the azimuth angle. The wind vane shaft is supported by sealed and shielded stainless steel bearings. The housing and tail are made of black UV stabilized Lexan.
Swept diameter is 10.5” (27 cm).

Barometric Pressure:

The Barometric Pressure sensor has a 3/16” diameter port. Flexible tubing may be attached to this port if it is desired to monitor air pressure at a remote location. If doing so, be sure to avoid getting any kinks in the hose when being assembled and mounted. Hose length will not affect air pressure. The instrument as supplied is calibrated to absolute pressure.

Poor Wind Sensor Placement over Vertical Wall *Figure 1*



INSTALLATION:

Select Location

Choose a suitable protected mounting location for the transmitter board near a source of appropriate operating power. Do not install the transmitter board in the same enclosure with a liquid electrolyte battery unless ventilation is provided. Various gases emitted from the battery will cause both premature and intermittent circuit failure.

Special consideration must be given to installation locations where the sensors or electronics will be exposed to strong radio frequency radiation or strong magnetic fields. Contact the factory for application assistance.

The wind sensor (meaning the anemometer and/or direction vane) should be mounted at the height at which it is desired to sample the wind. Typically, it is located as high as feasible and well clear of obstructions.

Do not mount sensor directly above a vertical wall as this location often has accelerated and/or turbulent airflow. (See Figure 1.)

The sensor may be mounted on an existing structure, on a natural formation, or on a mast or tower. It is desirable to mount it so that the supporting structure will not influence the wind characteristics in its immediate vicinity; if it is mounted above a rooftop or similar building structure, it should be high enough so that the wind deflected off the structure will not affect it, typically 5 to 10 feet or more.

If mounted to the side of a supporting structure the sensor should be mounted at least ten structure diameters away to take the sensor head out of the disturbed air around the structure; it should be mounted toward the prevailing wind; and it should be positioned so that the influence of structural members is minimized.

A preferred mounting that is commonly used is a telescopic tower for installations up to forty or fifty feet high; a tower commonly used for TV antenna support; consisting of concentric pieces of tubing approximately ten feet long, guyed at each section, is suitable. Above this height self-supporting or guyed lightweight structural towers can be used.

The sensor base is designed to mount to a ½" outer diameter rod or tube. A 10" length of aluminum tubing is furnished with the anemometer for convenience of mounting. An "S" shaped mast made of the same aluminum tubing is supplied for mounting the wind direction vane. This S mast should be oriented so the horizontal section points due North from the base tower or structure (see figure 2) Make sure a protective boot is slipped over the mast(s) before mounting the sensor.

If the mast is to be mounted on a metallic tower consideration must be given to galvanic corrosion that occurs between dissimilar metals. Attachment to galvanized steel towers using stainless steel hose clamps is acceptable. For other combinations of metals, it is recommended to electrically insulate the mast from the tower with a plastic bushing or sheet. Alternatively, fabricate a mast from the same material as the tower. This consideration is especially important in locations exposed to salt spray or air.

INSTALLATION:

(Continued)

Anemometer Mounting

Note the location of the 1/8" diameter holes in the anemometer base and in the top of the stub mast. Do not press on the anemometer rotor as the bearing may be damaged. Grasp the anemometer about its lower body and press it into the stub mast. Align the 1/8" holes and secure the anemometer to the stub mast by passing the cotter pin through the holes. Tighten down the set screw that is on the side of the base perpendicular to the cotter pin. Attach the stub mast to the tower or other support using the two stainless steel hose clamps. Slide the protective boot over the base of the anemometer after wiring is complete. Tape it to the mast to secure it in place.

Feed the anemometer cable though the small hole in the bottom of the protective boot. It may be easiest to slide the end with the tinned leads through and then pull the length of cable through the boot until you are near the end with the lugs. Connect the sensor cable to the anemometer using the end with the attached lugs. Polarity is not important. There are two brass studs with #4-40 thread that extend from the bottom of the anemometer housing. Attach the senor cable to these studs being careful to tighten only the outer #4 hex nut to 3 inch-pounds torque. If the inner nut is loosened or the nuts are tightened simultaneously the stud may rotate. This may result in a poor electrical connection inside the anemometer. See Figure 3.

Secure the sensor cable to the supporting structure at intervals of four feet or less. If the cable can vibrate in the wind a broken cable may result.

In locations exposed to corrosive atmospheres, such as salt air or smog, cover the wires and studs with a layer of electronic grade silicon rubber. Do not use caulking grade silicon as it emits acetic acid as it cures that will corrode the connection.

Wind Direction Vane Mounting

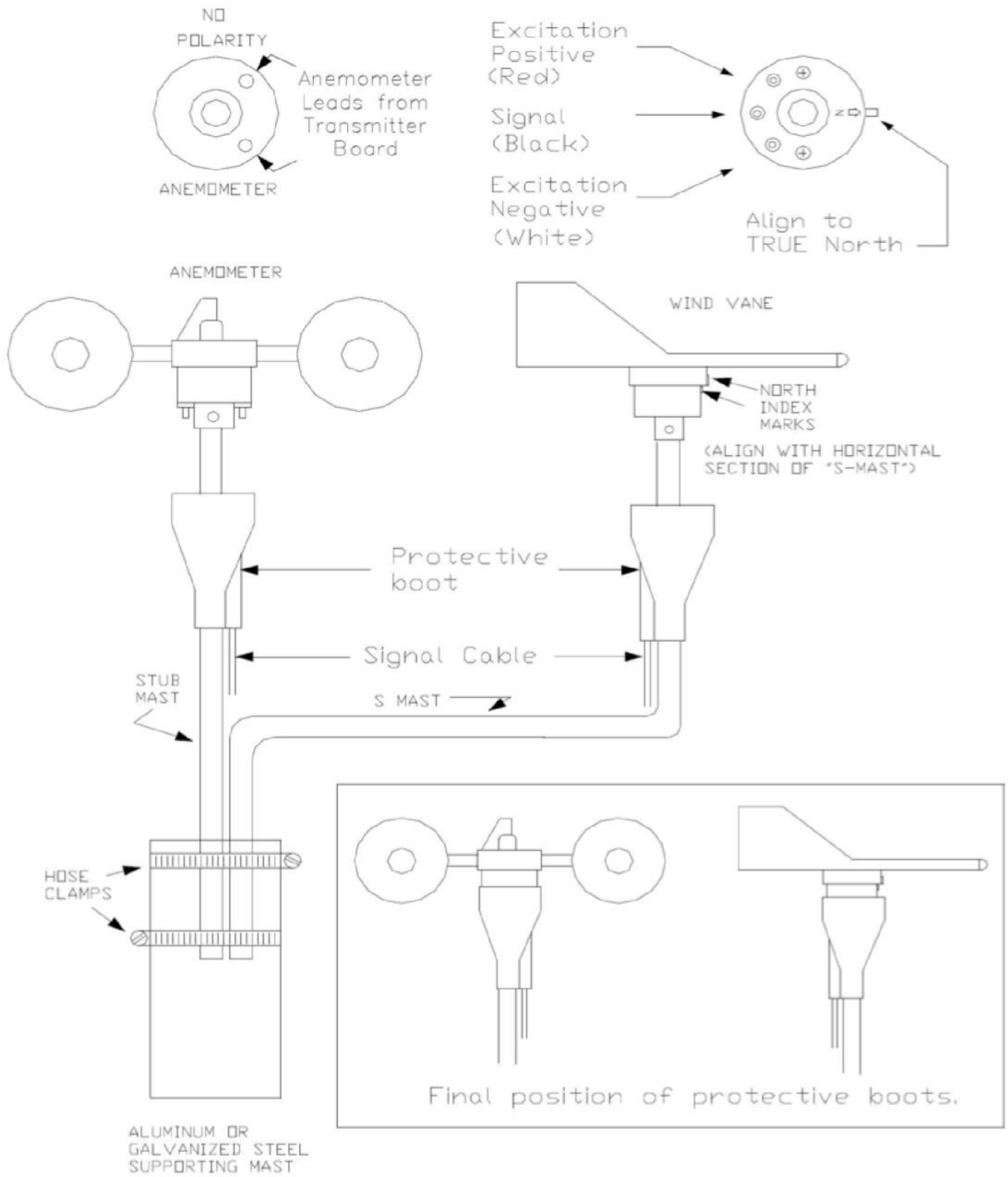
The lower housing of the wind vane has a North alignment mark molded into it. (Refer to Figure 4.) This must be oriented so that it is toward the North as shown in Figure 2. The vane's mounting holes are oriented such that the "S" mast is on a North-South line with respect to the vane. For installation using large, climbable towers, the vane must be oriented by pivoting the "S" mast in the hose clamps. For smaller towers, pivot the entire tower until the "S" mast is properly aligned.

It is usually desirable to relate the wind direction reading to True North. If a magnetic compass is used, the deviation from True North must be determined. A topographical map contains this information. For example, if the deviation is 15 degrees West, a magnetic compass will indicate 15 degrees when pointed at True North. If the deviation is East, then subtract it from 360 to obtain the reading for True North.

Do not press on top of the vane as it may damage the bearings. To install the wind vane, grasp it about its lower body and press it with a twisting motion onto the mast. (Be certain to slide the protective boot down over the "S" mast before installing the vane.) Align the 1/8" holes in the base of the wind vane with the holes in the "S" mast. Secure the vane to the mast by passing the cotter pin through the holes and tightening the set screw. Slide the protective boot over the base of the wind vane after wiring is complete. Tape its base to the mast to secure it in place.

SENSOR MOUNTING:

Figure 2



WIRING TERMINAL

Figure 3

NORTH ALIGNMENT MARK

Figure 4

INSTALLATION:

(Continued)

Wind Vane Wiring

Connect the end of the cable with the spade lugs to the sensor using a #4 nut driver. There are three brass studs with #4-40 thread that extend from the bottom of the wind vane housing. Attach the sensor cable to these studs being careful to tighten only the outer #4 hex nut to 3 inch-pound torque. If the inner nut is loosened, or the nuts are tightened simultaneously, the stud may rotate. This may result in a poor electrical connection inside the wind vane. See Figure 3.

3. Refer to Figure 5. Connect the Red wire of the signal cable to the Direction Vane Positive "+" terminal. Tighten wind vane terminal to approximately 3 inch-pounds.

4. Connect the GREEN (or White) to the DIRECTION VANE NEGATIVE "-" terminal. Tighten wind vane terminal to approximately 3-inch pounds.

5. Connect the Black wire of the signal cable to the Direction Vane Signal center terminal. Tighten wind vane terminal to approximately 3 inch-pounds.

6. Refer to figure 6. Connect the Red wire from the wind vane to terminal` #3 marked "VANE +".

7. Connect the Black lead from the wind vane to the terminal #5 marked "VANE SIG".

8. Connect the GREEN (or White) lead from the wind vane to terminal #4, the remaining wind vane terminal, marked "VANE –".

9. Connect the Wind Direction current loop to terminals 1 & 2 in the DIRECTION section marked 4-20mA. See Figure 6. Observe polarity as marked.

Secure the sensor cable to the supporting structure at intervals of four feet or less. If the cable can vibrate in the wind, a broken cable may result.

Note:
Should additional cable be required, up to 1,000 feet may be carefully spliced into the existing cable. Take care to preserve the color code. AWG#18-#22 stranded copper wire with shield is recommended.

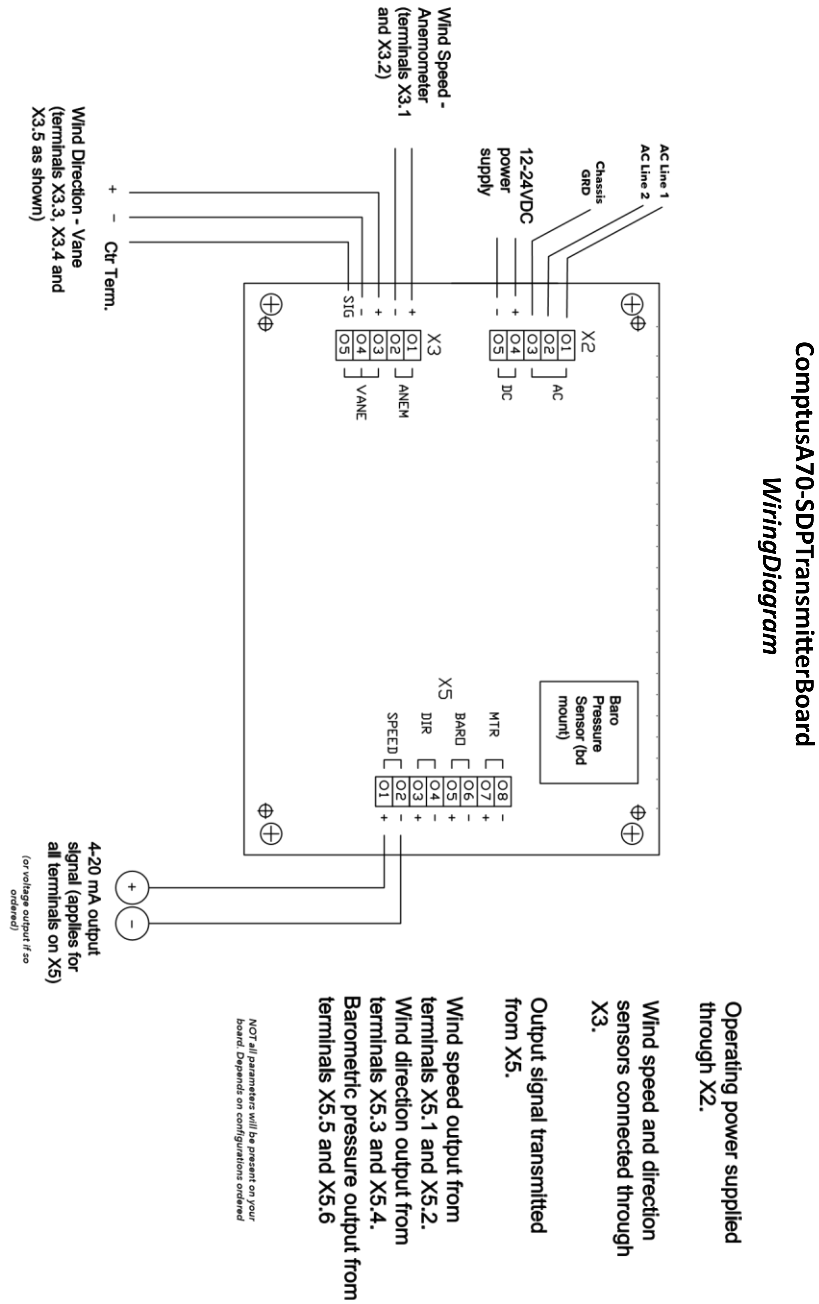
Wiring Considerations

The wire type is noncritical for most applications. If the wiring is in an electrically noisy environment or the sensor signal cable length is greater than 60 feet, then the use of a twisted pair with shield is recommended. Connect the shield to ground the transmitter end only. See Figure 4. The insulation should be sunlight resistant. Polyethylene or polyvinyl chloride insulation is recommended.

Before proceeding, verify the maximum resistance of the current loop including the wiring and sensing element does not exceed the maximum given by Formula 1. If this resistance is exceeded the loop current will not attain full scale.

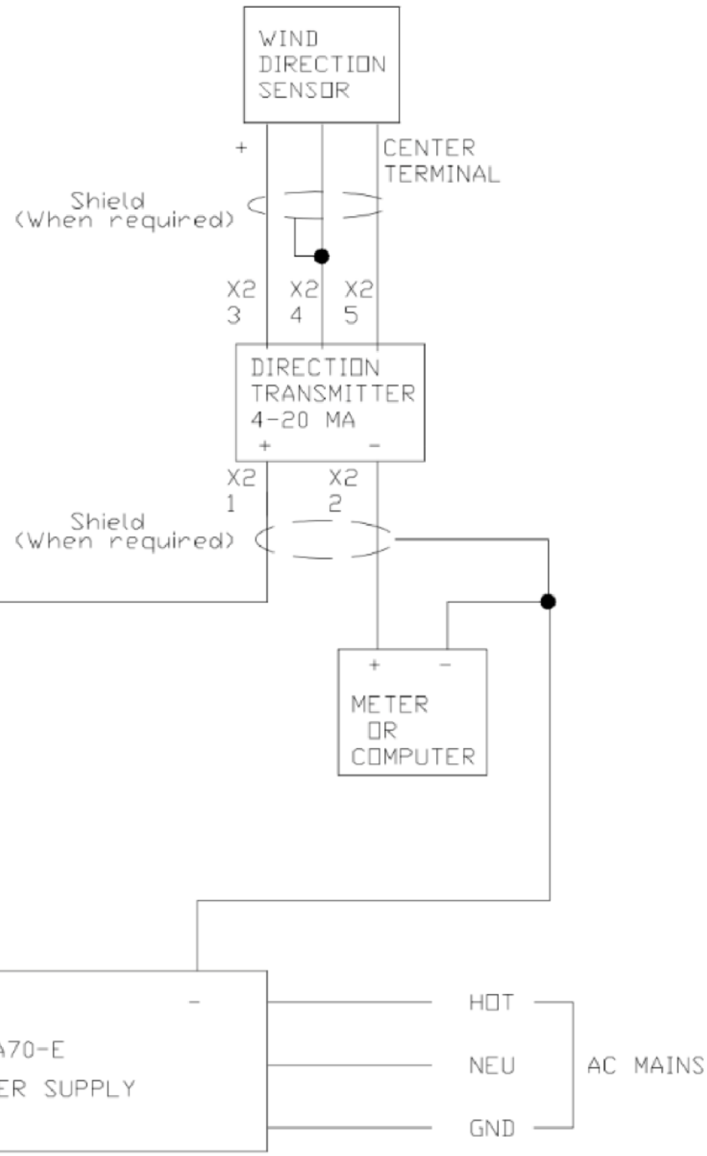
WIRING DIAGRAM

Figure 5



WIRING DIAGRAM

Figure 6



MAXIMUM LOOP RESISTANCE

Formula 1

$$R = (V - 10 \text{ VDC}) \times 50$$

The resistance of various gages of copper wire is given in Table 3.

R: maximum loop resistance in ohms

V : DC excitation voltage

WIRING CONSIDERATIONS:

(Continued)

WIRE GAUGE RESISTANCE

Table 3

AWG	Resistance Ohms / foot
12	.0016
14	.0026
16	.0041
18	.0065
20	.0103
22	.0165
24	.0262

Proper operation of the Transmitter requires the power supply provide a voltage in the range of 12-24 VDC. Voltage ripple must be less than 100 volts per second for proper operation. The Transmitter is designed so that the loop current will not exceed approximately 30mA under any circumstances.

A 12-volt power supply can drive a current loop with a total resistance of 100 ohms. A 16-volt power supply can drive a current loop with a total resistance of 300 ohms.

It is recommended that the system be assembled and tested on the ground before the final installation.

WIRING SUMMARY:

1. Check that the protective boot is slipped over the stub mast as shown in Figure 2. Locate the two-wire, 60-foot anemometer cable and slip the tinned leads end through the hole in the protective boot. Connect the spade lugs to the anemometer. Polarity is not important.

2. See Figure 6. Connect the anemometer signal cable to the anemometer input terminals of the Transmitter. Polarity is not important if only one anemometer is in the loop.

3. See Figure 6. Connect the output signal to the load being sure to observe polarity.

4. Check the nameplate on the inside of the front cover (if supplied in an enclosure) for the proper operating voltage. Connect the operating power to the terminals as shown in Figure 6. Transmitter board wiring diagram here? Or better above as shown?

LIGHTNING PROTECTION:

The Transmitter electronics and A75-104 Anemometer and A75-302 Wind Direction Vane each have integral metal oxide varistors for protection from lightning induced surges, electrostatic discharge, and other atmospheric discharges. Windblown aerosols such as sand and snow can generate electrostatic charges with consequences like lightning discharges. The A96 Series of gas tube surge arrestors can safely dissipate much higher energy discharges than the internal varistors.

A consequence of the rapid rise time of these electrostatic discharges is that the inductance of the grounding system and interconnecting wiring is generally of more concern than resistance. Gas tube surge arrestors should be placed as close as possible to the device they are intended to protect to minimize the inductance in the wiring.

In highly exposed systems the sensors should be protected by gas tube surge arrestors located as close as 12 inches or less. The Transmitter electronics can benefit from another set of gas tube arrestors located where the sensor wiring enters the control building. Gas tube surge arrestors are recommended for any system with underground wiring.

OPERATION:

Operation of the system is fully automatic and commences when electrical power is supplied.

NOTE: Wind speeds greater than 110% of the specified maximum may produce wind speed outputs indicating less than full scale.

Output Characteristics

Note that models may not include each measurement as listed below.

Wind Speed

Wind speed may be determined for various models using the following formulas, where S = wind speed in appropriate units and I = actual output current in mA.

Output range E:	S (MPH) = [(I - 4)/16] * 100 (where 100 = full scale range)
Output range M:	S (M/sec) = [(I-4)/16] * 50 (where 50 = full scale range)
Output range K:	S (KPH) = [(I-4)]/16 * 160 (where 160 = full scale range)

OPERATION:

(Contintuted)

Wind Direction

Wind direction in degrees of azimuth may be determined using the following formula, where D = wind azimuth in degrees and I = actual output current in mA. Note that azimuth angle starts just east of North, with East being 90 degrees, South being 180 degrees, West being 270 degrees and coming back to just west of North being 359 degrees (assuming North orientation is maintained per installation instructions). Note that the wind direction vane has a 4–5-degree dead band that is centered around the North orientation mark. When the sensor is in this dead band, the output signal will be at its minimum value.

Output range all:	D = (I – 4) * 360/16

Barometric Pressure

Barometric pressure may be determined for various models using the following formulas, where P = pressure in appropriate units and I = actual output current in mA.

Output range E:	P (in Hg) = (I + 104)/4
Output range M:	P (mbar) = (I * 12.5) + 850

TROUBLESHOOTING:

Effective trouble shooting requires that problem locations be systematically eliminated until the problem is found. There are four basic questions to answer when trouble shooting (Ref. #1):

1. Did it ever work right?
2. What are the symptoms that tell you it's not working right?
3. When did it start working badly or stop working?
4. What other symptoms showed up just before, just after, or at the same time as the failure?

It is best to write down any clues you may obtain. Be sure to write down anything unusual.

The response to question #3 should probably not be 3:04 P.M.. A useful response might be, "Just after an electrical storm." or, "Just after it fell off the shelf." Double check all the simple solutions to the problem before searching for complex ones. If the problem occurs right after installation, it probably has a simple solution. If an automobile engine cranks, but doesn't start, make sure there is fuel in the tank before replacing the engine. If the electronic equipment doesn't function verify that it has power and is turned on.

Systems containing parts which can be quickly interchanged are easy to trouble shoot. Swap parts until the problem moves. The location has then been narrowed to the part that caused the problem to move. Sometimes there are multiple problems. These reveal themselves in layers much like peeling an onion.

It often helps to explain the problem to another person, even if that person is not knowledgeable about the particular piece of equipment. This does two things. First it requires you to organize the situation so it can be explained to another. Secondly, it may turn out that you are so familiar with the situation that you have overlooked the obvious. Another person unfamiliar with the equipment may be able to help. If you are unable to solve the problem, put it aside until the next day. Some new thoughts will probably occur while working on another project.

References

1. "Troubleshooting is More Effective with the Right Philosophy", Robert A. Pease, Electronic Design News, January 5, 1989.

TROUBLESHOOTING:

(Continued)

TROUBLE SHOOTING

Loop Current: 0 mA

ICING:

Under some conditions, operation of theanemometer and wind Wind Speed vane will be degraded by the presence of ice.

Failure Description:

Current loop polarity reversed

Open circuit in cable

Power supply failure

Transmitter failure

Anemometer input & signal output wiring interchanged

Loop Current: Less than 4mA

Failure Description:

Low power supply voltage

Loop resistance too high

Loop Current: Constant 4mA

Failure Description:

Anemometer cable shorted

Anemometer coil open

Loop Current: Constant 20 -22 mA

Failure Description:

Power line interference

Open anemometer cable

Loop Current: Greater than 25 mA

Failure Description:

Transmitter failure

Loop Current: Does not reach 20mA, otherwise operates properly

Failure Description:

Low power supply voltage

Loop resistance too high

This most often occurs as the result of freezing rain. The condition quickly clears when sunshine heats the wind vane causing the ice to melt. The condition may persist for hours or days in the absence of bright sunshine. No permanent damage is done to the sensors.

MAINTENANCE:

SENSORS

It is recommended that the sensors be checked for wear each year. This can be accomplished by comparison with a similar sensor or by wind tunnel testing.

TRANSMITTER

It is recommended that the Transmitter be checked for calibration each year. Refer to the Calibration section for details.

CALIBRATION

All instruments are fully calibrated at the factory before shipment. Contact the factory should you wish to explore having any calibrations performed.

TROUBLESHOOTING:

(Continued)

Anemometer Testing

The Anemometer at rest should exhibit a resistance of 600-700 ohms. This can be tested from the Transmitter end of the signal cable. Disconnect cable from the Transmitter and use an ohmmeter. A fluctuating resistance will result if the anemometer turns during the test.

A resistance greater than 1000 ohms indicates an open circuit (break in cable). If this occurs after a period of normal operation the cable may have broken in a section where it could vibrate in the wind.

A resistance less than 100 ohms indicates a short circuit. Any splices in the sensor cable should be suspected if an open or short circuit occurs.

If an ohmmeter is unavailable connect the anemometer to the transmitter board with a short length of cable. If the problem is remedied the trouble is in the cable.

Anemometer Simulation

The A75-104 Anemometer produces an AC signal whose frequency and amplitude are proportional to wind speed. The instrument measures the frequency and is relatively insensitive to the signal's amplitude.

The frequency is 0 Hz at 0mph and 60 Hz at 102.5 MPH (45.8M/sec). See Table 2 for other units of wind speed. The amplitude varies from 0 V RMS at 0mph to 3.67 V RMS at 102.5 mph.

The signal may be simulated with a function generator or a transformer connected to the electric utility. A transformer with a 6 V output is sold at most hardware stores for use in home doorbell circuits.