Data Sheet

WS/S, /SD

Wind Speed and Direction Sensors

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Description

The Trend WS/SD provides accurate measurement of wind speed and direction for building applications where the control strategy needs to respond to outside weather conditions. The unit incorporates an anodised aluminium mounting arm suitable for mast or wall-mounting using the clamp supplied.

The wind speed component consists of a low inertia ABS cup assembly for fast response, mounted on a dual ballrace supported stainless steel shaft. A magnet on the rotor operates a long life reed switch producing one pulse per rotation.

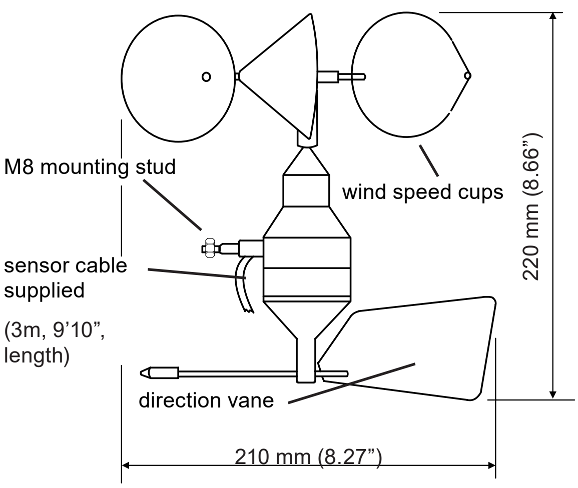
The wind direction component consists of a dynamically balanced wind vane operating a triple ballrace supported shaft and micro-torque 357° potentiometer with a deadband of 3° at North.

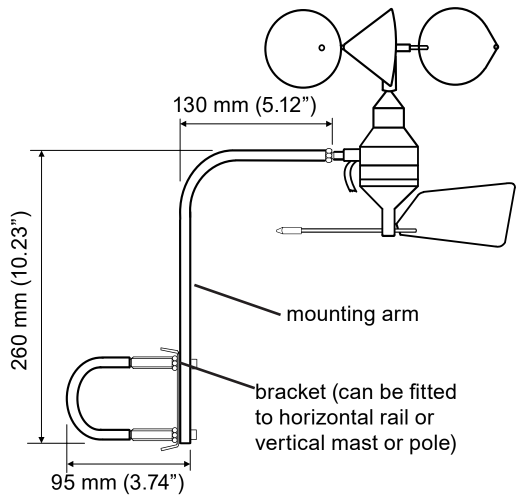
The WS/SD has been wind tunnel tested at the UK Meteorological Office to determine its full wind speed characteristics. A wind speed only version is also available.

Features

- Wind speed ±2 % accuracy
- 360° wind direction indication
- Clear anodised aluminium housing and mount
- Flexible mounting arrangements
- Bounce-free pulse output of wind speed
- 0 to 1 kΩ output of wind direction
- Suitable for naturally ventilated building applications

Physical

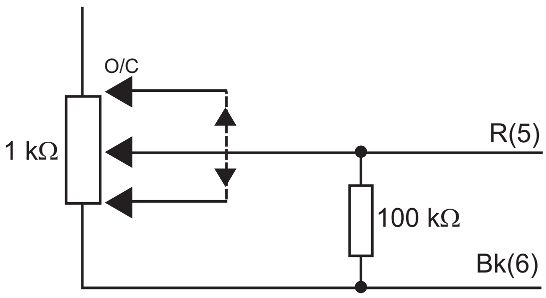




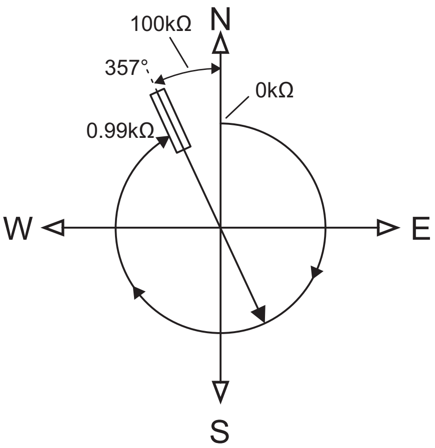
FUNCTIONALITY

The wind speed sensor produces one contact closure per rotation of the head which is equivalent to 1.493 m (4' 9") of travel. This needs to be counted over a time period within the controller to produce a rate of m/s (or feet/s). The optional direction sensor produces a resistance varying between 0 to 1 kΩ as wind direction varies between 0 to 357°. Zero degrees is normally set at North with a dead band of 3° (358° to 360° inclusive). The mounting bracket consists of an anodised aluminium alloy elbow and a bracket plate with two U clamps suitable for fixing to masts or poles.

WIND DIRECTION INPUT



The wind direction potentiometer varies from 0 to 1 kΩ as the direction changes from 0° to 357°. The sensor should be aligned so that 360°/0° is North. When the direction exceeds 357° the potentiometer wiper goes open circuit and the 100 kΩ parallel resistance appears across the connections. Thus for the quoted accuracy, the parallel effect of the 100 kΩ can be ignored over the linear phase and the resistance across the connection R(5) to Bk(6) will read 0 to 1kΩ for 0° to 357°, and then it will read100 kΩ for 358° to 359°.



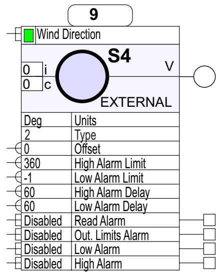
Resistance value with Wind Direction
(sensor viewed from above)

Both the strategies shown below require the input channel to be linked for thermistor (T). The outputs of the strategies below should not be averaged as when the sensor is positioned in the north direction it would average between 357° and 0° (i.e. 178.5°).

Strategy IQ3/4 or IQ2 (v2.1 or greater)

A sensor should be set up to read the channel. For IQ controllers link input channel for thermistor, T and set up the sensor type scaling; the recommended method of setting the sensor type scaling is to use SET.

For all IQ2 series controllers with firmware of version 2.1 or greater, or IQ3/4 series controllers, the WS Wind Speed and Direction Sensor, P02-Wind Direction strategy block can be used. This sets up the sensor and sensor type.



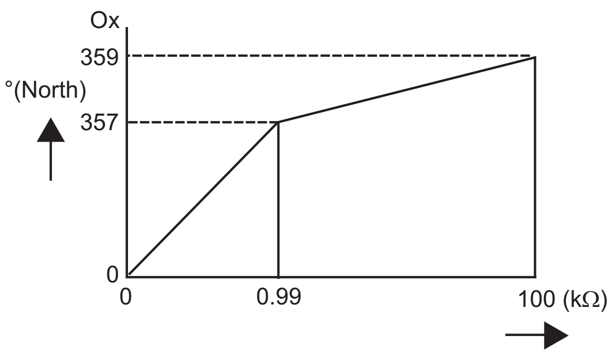
It uses the following SET Unique Sensor Reference:
Wind Direction Therm

Alternatively use sensor scaling mode 5, characterise, and enter the scaling manually as defined in the table shown below. Note that for IQ3/4 the scaling mode and exponent (E) do not need to be set up.

For all other IQ controllers see the Sensor Scaling Reference Card (TB100521A).

Y	input type	3 (thermistor kohms)
E	Exponent	4
U	Upper	380
L	Lower	-1
P	Points	3
x	Ix	Ox
1	0	0
2	0.99	357
3	100	359

This will produce a function as shown in the graph below.



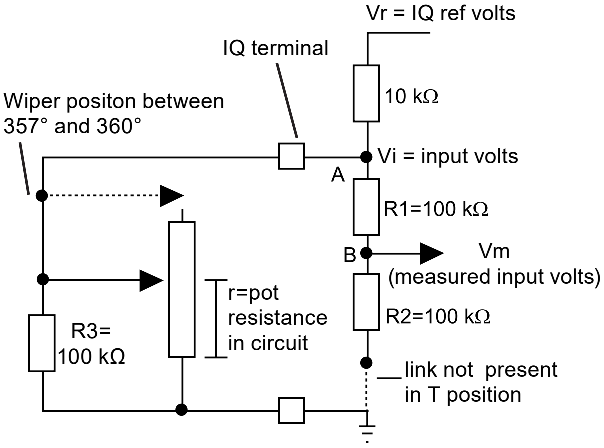
Thus the output will be a linear response of 0° to 357° over the 0 to 0.99 kΩ range and another linear response of 357° to 359° over 0.99 kΩ to 100 kΩ.

Note that if the sensor position is in the north direction it may switch rapidly between 0° and 359°, and a graph of the sensor would show spikes.

Strategy IQ1 and IQ2 (prior to v2.1)

IQ1 and IQ2 (<v2.1) cannot be scaled directly from resistance, so the strategy is designed to measure voltage.

When set for thermistor input the equivalent circuit is shown below.



From the circuit diagram, it can be seen that:

$$R = \frac{100r}{100 + r}\, kohm$$

and $$\frac{Vr - Vi}{10} = \frac{Vi}{R}$$

where resistances are in units of kΩ

(ignoring any current flow along AB)

where R is the effective resistance of the sensor as seen by the controller, r is the resistance of the potentiometer up to the position of the wiper, Vr is the IQ reference voltage, and Vi is the voltage at the input to the controller.

In addition, the equation linking the wind direction, D, and the potentiometer resistance, r, is:

D=357r degrees clockwise from North (where r is in kΩ)

Substituting and rearranging these gives:

$$D = \frac{35700Vi}{10Vr - 11Vi}$$

The relationship between D and Vi is clearly non-linear. However, it is not possible to use a linearisation Type module for the Sensor in the IQ strategy because a Top of range of 357 would be required and the upper limit on the T parameter is only 327 (if exponent is set to 4). Instead, the sensor can be scaled to read the value of input voltage, or of 10Vr - 11Vi.

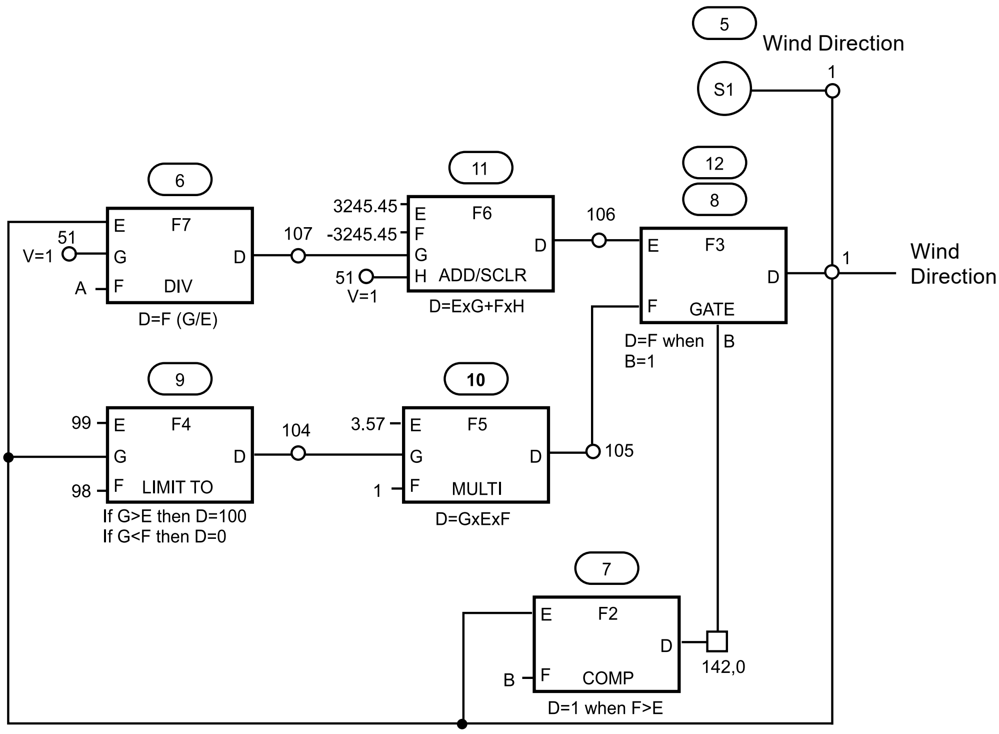
The latter option results in the scaling parameters shown in the table for all controllers with thermistor linking (including all + range controllers) and IQ70s (channels 1 and 2).

Parameter	IQ type A	IQ type B
Scaling type	0	0
Exponent	4	4
T range	-5	45
B range	105	155
Upper limit	360	360
Lower limit	0	0

IQ type A: IQ2xx Series, IQ7x, 9x, 10x, 10x+, 111+, 131+, 9x+, 8xe, 9xe. This can be set up using SET Unique Sensor Reference WS/SD Wind Direction

IQ type B: IQ111, 131, 151, 151+.
There is no SET standard setup for IQ type B

Strategy
The following strategy can easily be engineered in SET by selecting the standard strategy block WS Wind Speed and Direction pre IQ2 2.1, P01 - Wind Direction pre IQ2 v2.1; this will also set up the sensor type. The diagram shows sensor 1 being used, and the strategy should be modified to match the actual input channel used.



The F input to F7 (labelled A) is set as follows for all IQs in the defined range i.e. all IQs with thermistor linking plus IQ70s (channels 1 and 2):

for IQ111, 151, 151+, set to 100
for other IQ's with thermistor linking and IQ70s, set to 50

The input to F2 (labelled B) is set according to the type of IQ as follows:

for IQ type A (IQ2xx Series, IQ7x, 9x, 10x, 10x+, 111+, 131+, 9x+, 8xe, 9xe); set to 45.05
for IQ type B (IQ111, 131, 151, 151+); set to 90.10

Note that the sequencing order is critical and there must be no empty steps. The step used for the sensor must be of the form 4n+1 where n is an integer.

For IQ251, the number of steps between S1 and F3 in the Sequence Table can be increased to 13, so the first service of F3 can be omitted. The usable 'window' is between steps 13n+1 and 13n+13.

Note that when linear scaling is used (as here), the controller assumes that R2 is in circuit and doubles the measured voltage to calculate Vi. Since Vm and Vi are actually the same (as R2 is not in circuit), the value of Vi used to construct the table was half the normal IQ scaling voltage (e.g. for IQ251, Vi=±5).

With S = 10Vr - 11Vi, the equation for the wind direction becomes:

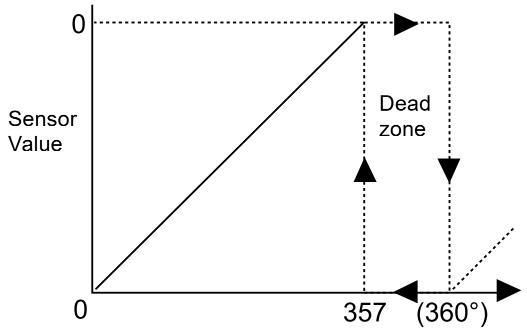
$$D=\frac{35700}{11}x\left(\frac{10Vr}{S}-1\right)$$

This is evaluated by F6 and F7 in the strategy.

Note that the value of Vr is 10 volts for IQ type A controllers, and 5 volts for IQ type B controllers. This means that the value of the F input to F7 is 100 for IQ type A, and 50 for IQ type B.

Although the Sensor module does not actually read the wind direction, it is possible to make it appear to do so by writing the calculated direction back into the sensor node. This is done by F3 in the strategy, and provided that S1, F3 and all the modules between them are serviced between Steps 4n+1 and 4n+4, where n is any integer, supervisors, display panels and other controllers that request the Sensor value will only ever see the direction figure.

When the wind direction moves into the dead zone, the strategy sets its value to 0 if it was previously greater than 0, or to 357 if it was previously less than 357, as shown in the diagram below.



This helps to prevent spikes on Trend plots of the direction when the wind is northerly. The decision whether to set the value to 0 or 357 is made by F4 and F5. F2 detects when the direction is in the dead zone by looking for a value of S that is less than 4V, and if it finds that this is the case it switches the output of F5 through Gate F3, rather than the direction calculated by F6.

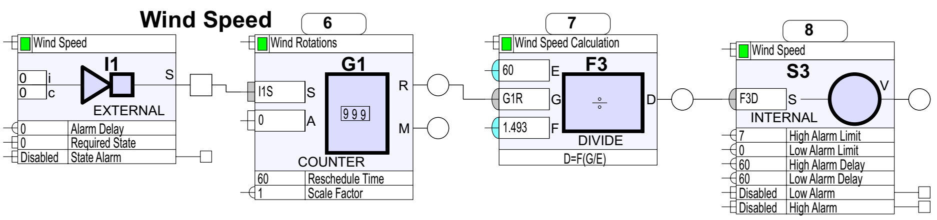
Note that F3 is serviced twice. The first time it writes either the same direction into Node 1 as it did on the last pass through the strategy or, if F2 has detected that the direction is in the dead zone, it writes 0 or 357 into the Node, as called for by F5. This ensures that Node 1 is overwritten within the four step 'window' described above.

The second time F3 is serviced , it selects the same source that it did the first time, but now the direction value, if selected, will be the one derived from the latest sensor reading.

WIND SPEED INPUT

This can easily be engineered in SET by selecting the standard strategy block WS Wind Speed and Direction Sensor, P01 - Wind Speed

Set up the following strategy to deal with the wind speed measurement: The diagram shows digital input 1 being used and the strategy should be changed to match the actual input channel used.



INSTALLATION

CHOOSING A SITE

The site chosen to install the WS/SD sensor head will depend in part on the application to which it is being put and in part on the particular circumstances at the site. If the application is very specific, such as monitoring wind speeds on a bridge, then the siting of the head is largely prescribed by use. However, even then, some precautions need to be taken. These are largely self-evident but often overlooked.

Firstly, a site should be chosen which is as representative as possible of the area to be monitored. Circumstances may limit choice, but extremes should be avoided whenever possible, unless of course, it is desired to measure the weather at these particular, extreme sites. For example, sites on the top of hills, however small, will give increased wind speeds, while in valleys and small hollows the reverse will also be the case. Too close proximity to buildings or trees will also affect readings, due to their shielding properties, while deployment actually on a building (flat roof or wall) is particularly bad due to the obstruction of wind-flow, causing turbulence and eddies. Because the wind speed increases logarithmically with height above the ground for the first 20 metres (22 yds) but less thereafter, exposure on a tall mast will give higher wind speeds. Two metres (6’) is the most usual height adopted, although the UK Meteorological Office standard is 9 metres (30 feet).

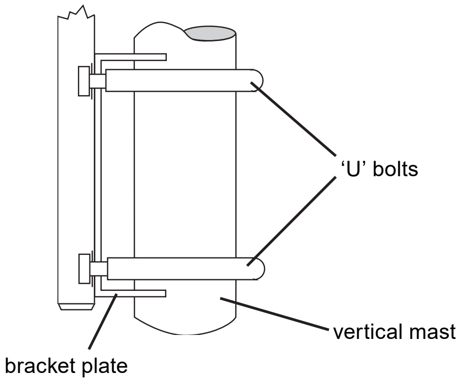
It should also be remembered that all weather characteristics are spatially variable, even over quite short distances. Extrapolating the wind readings to distances well beyond the position of the sensor may not, therefore, be justifiable; however, with the low cost of the WS/SD, and the use of a multi-channel logger, several heads could be installed over an area, giving a better spatial coverage and a more precise estimate of an area’s wind characteristics. Highly precise measurements made at just one point may well be a waste of money due to spatial variability.

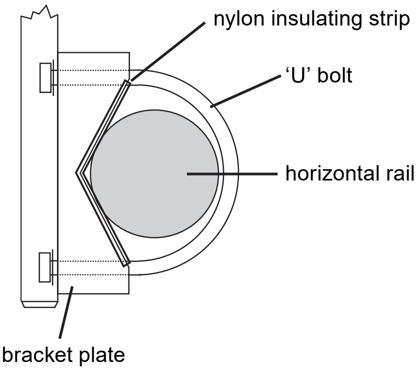
Vandalism can be a problem. However, if a fence is built around the station, it should not be too close and should be of fairly open construction. Due to the compact and lightweight design of the WS/SD head, however, it can easily be installed high enough to be out of reach. This may be sufficient to prevent interference.

Note: In severe weather locations the bearings should be checked for wear within 12 months as the warranty on the bearings is limited to 12 months.

FIXING TO A MAST OR HORIZONTAL RAIL

The bracket plate and U bolts enable the wind sensor to be fixed to either a vertical mast of a horizontal rail.





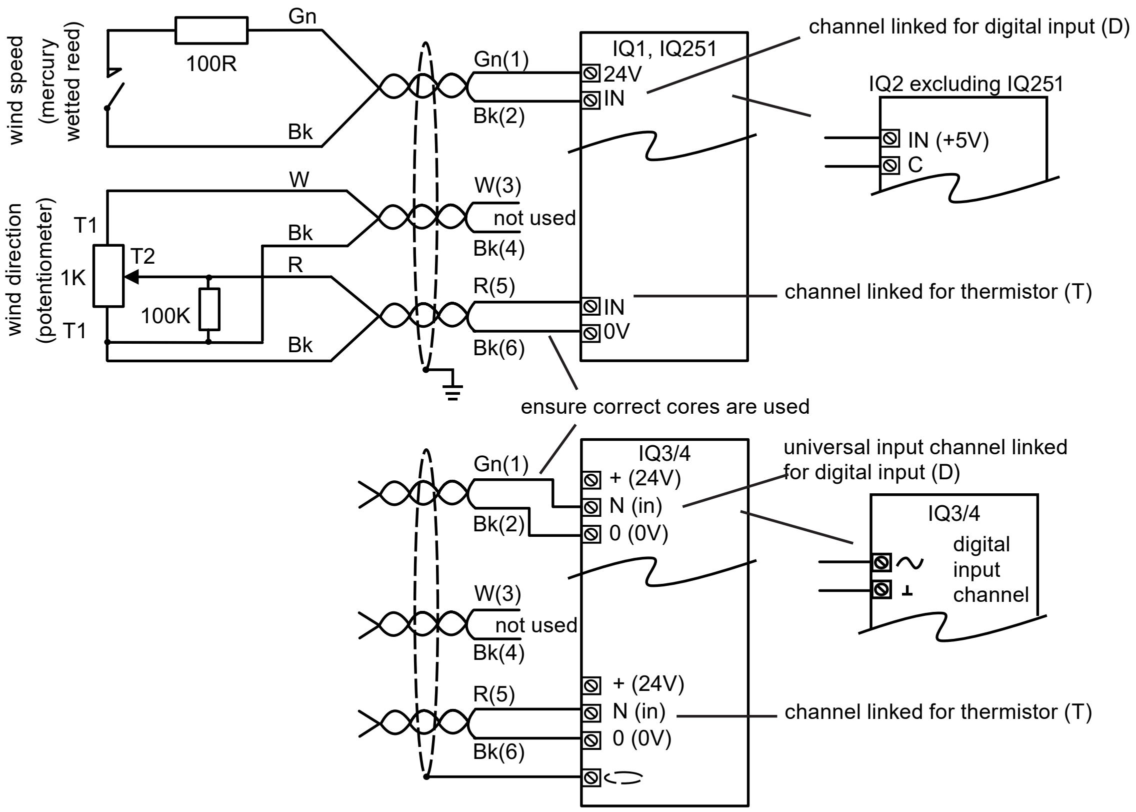
INSTALLATION PROCESS

The installation process involves:

1 Find a suitable location (see above)
2 Fix the mount bracket (see above)
3 Attach sensor head to elbow
4 Align the direction sensor to the north (if fitted)
5 Connect to controller (use correct specification extension cable if necessary - see specific section below)
6 Configure controller (see above)
7 Test and commission

CONNECTIONS

Note that the supplied cable is 3 m (9' 10") long and may be shortened or lengthened, as required. If the cable is lengthened ensure that a good quality environmental connector or suitable waterproof junction box is used. Extension cables should be of a similar specification to that shown in the specification section below but only 2 twisted pairs are required (Belden equivalent 9503).



Full installation details are given in the WS/S, /SD Installation Instructions (TG102613).

ORDER CODES

WS/SD	Wind Speed and Direction Sensor including mounting bracket
WS/S	Wind Speed Sensor including mounting bracket
WS/S BEARING KIT	Kit with 2 off bearings
WS/SD BEARING KIT	Kit with 3 off bearings
WS/SD BEARING KIT + POT	Kit with 3 off bearings and potentiometer
WS & D CUPS (3PKT)	WS/S, WS/SD kit with 3 wind speed cups

MAINTENANCE

It is recommended that the bearings of the wind speed unit and the wind direction unit are checked every 12 months. If either is not rotating smoothly or creates detectable noise, then the bearings must be replaced. In addition (due to normal wear) it may eventually become necessary to renew the direction potentiometer.

Note that the warranty on the bearings is limited to 12 months.

DISPOSAL

WEEE Directive:

At the end of their useful life the packaging, and product , and battery (if fitted) should be disposed of by a suitable recycling centre.

Do not dispose of with normal household waste.
Do not burn.

SPECIFICATIONS

Electrical

Speed sensor

Connections	:3 m (9' 10") flying lead. 3 twisted pairs and overall screen. Screen not connected in sensor. Twisted pair consists of coloured core and black core. Each core is numbered with a heat shrink numbered marker.
Switch	:magnetic operated mercury wetted relay (zero bounce)
Calibration	:1 contact closure/1.493 m (4'9")
Start up	:0.5 m/s typically (19'/s)
Accuracy	:±2 %
Linearity	:±2 %
Contact rating	:50 W (dc resistive); 100 Vdc max, 1 A max. Product of voltage and current must not exceed wattage

Direction sensor

Mechanical travel	:360° (endless)
Electrical travel	:357° ±2°
Calibration	:0 to 1 kΩ potentiometer for 0 to 357° travel
Resistance tolerance	:±3 %
Linearity tolerance	:±0.5 %
Temp coefficient of wire	:±20 ppm/°C (±36 ppm/°F)
Supply voltage	:80 Vdc max, 24 Vdc recommended max

Mechanical

Material	:clear anodized aluminium alloy (HT30)
Dimensions	:280 mm (11") height
Max arc of sensor cups	:120 mm (4.72")
Weight	:500 g (1.1 lb)
Mounting	:Arm and clamp for fixing to masts and poles of up to 2" (50 mm) diameter. Clear anodised aluminium alloy parts
Temperature range	:-20 °C to +70 °C (-4 °F to 158 °F)
Cable length	:3 m (9' 10")
Cable Specification	
Construction	:7/0.2 mm (24 AWG) stranded trimmed copper
Wires	:3 insulated twisted pairs
Screen	:7/0.2 mm (24 AWG) wire with overall foil wrap screen.
Overall cable sheath	:diameter 6.0 mm
Operating temperatures	:-25 °C to 75 °C (-8 °F to 107 °F)
Characteristic impedance	:85 Ω
Capacitance	:108 pF/m

IQ Scaling: The direction sensor channel is linked for thermistor. Use scaling and strategy as described in text above.

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