

Environdata Sensor Guide

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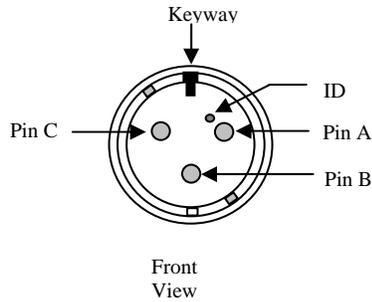
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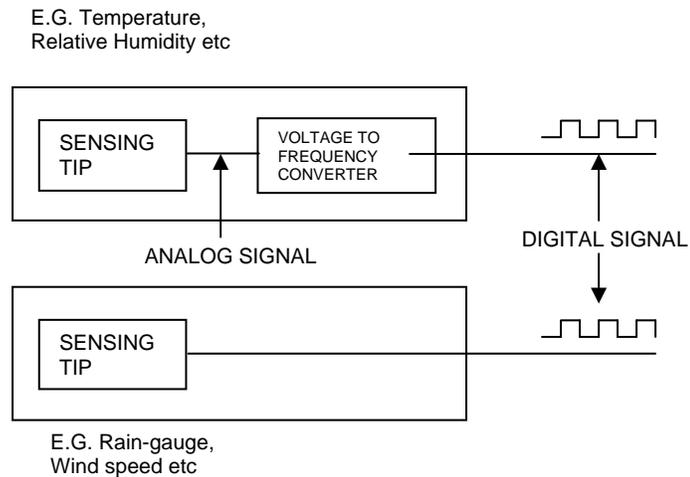
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1. General Sensor Information

1.1. General Sensor Information

Envirodata's 'SENSORS' measure meteorological and environmental parameters and transmit a pulse signal back to a data recorder or control system at a pulse rate proportional to their measurement. Some sensor signals are already in pulse form, while other sensors need signal conversion (from an analogue/continuous form to a digital/pulse form). Pulse signals are very reliable over long distances of cable, thus providing good data integrity.



The Two Sensor Representations

Envirodata manufactures more than a dozen different types of sensors to operate with this system. In addition to these, Envirodata can adapt almost any other sensor with an electrical output to suit the system by adding a suitable electronic converter.

Envirodata sensors use a proprietary technology. This technology ensures reliable readings for environmental sensing with the conversion of low-level sensor signals (analogue signals) into a high-level pulse signal, where the number or rate of pulses is proportional to the input sensor signal. The high level pulse signal is highly resistant to electrical noise and can travel long distances - up to hundreds of metres, quite safely. This ensures a reliable transfer of the sensor signal to the recorder or control system.

A further advantage of this technique is that momentary variations in signal (eg. wind speed) result in an equivalent change in the pulse

signal. Since the recorder can continuously accumulate the pulse count over the sample period (normally 1 minute), the resulting total is a true reflection of the average weather parameter over the whole minute.

Another advantage is that all sensors can have the same connector and create the same signal levels, thus they can be connected to the same input of the recorder. Sensors of the same type, eg. temperature sensors, are fully interchangeable. (Sensors of different weather parameters need different scaling factors. These factors are software defined and are easily modified).

Physically, the electronic converter is either included within the sensor body, or is contained in its own housing. A protective coating or full encapsulation is used to protect the electronics from the environment.

All converters include internal adjustment that can be accessed by an Environdata instrument technician. These minor adjustments allow the sensor to be recalibrated for ageing effects. This is recommended at least every 5 years for all sensors.

Some sensors inherently produce a pulse output and only require minimal matching components, thus usually have no adjustment facilities. Normally their calibration relies on mechanical construction, and will not alter for the life of the product unless they are damaged or have unapproved modifications incorporated.

1.2. Connecting the Sensors

All sensors have the same 3 pin connector with a keyway as shown. Align the keyway to the top of the receptacle connector, insert and turn the locking ring using a quarter turn clockwise until it clicks into the locked position. Turn a quarter turn anti-clockwise to undo.

The connectors are fitted with 'O' ring seals where the two connectors mate and at the cable exit to prevent entry of moisture, provided it is locked in place. In high humidity environments an insulating gel to further exclude moisture from the joint is recommended.

Pin A is positive
Pin B is signal
Pin C is ground

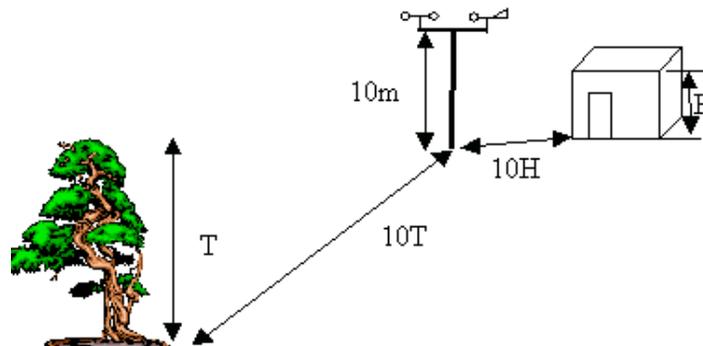


2. Wind Speed Sensor (Anemometer)

Wind can be measured in units of speed (eg. - kilometres per hour), which must be averaged over a period, typically one hour, or one day. Wind can also be measured in units of distance of travel, or "run" (eg. - kilometres) which must be totalled over a period, and the period stated to give the reading full meaning.

2.1. Siting of the Wind Speed Instrument

Envirodata's anemometer utilises spinning cups to measure the wind, it is classed as a 3-cup anemometer. The cups are manufactured from high impact Delron thermo-plastic. The anemometer should be mounted on a rigid metal pole (or instrument stand) in a location unobstructed by turbulence from buildings, trees, steep slopes etc. The following diagram indicates the 'ten times rule' for siting of wind instruments. That is (if possible) they should be sited 10 times the height of the highest nearby object away from that object.



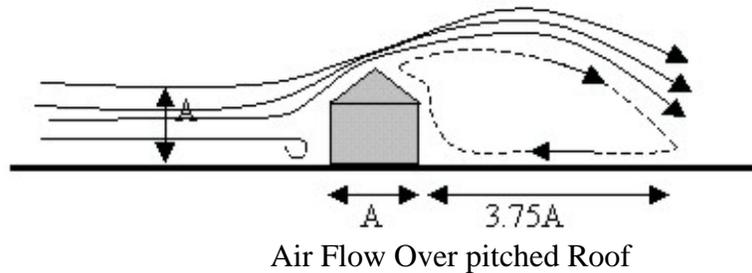
Example of Siting Wind Instruments: A 10m tower located at least 10 times the height of obstructions away from them, (not to scale)

Standard heights for mounting wind instruments are generally either two, three or ten metres above ground level, although a range of heights may be used depending on the objective of the measurement.

The effect of surrounding obstructions is to create a disturbed flow of air both in speed and direction. As circumstances will not always allow for siting to the standard, there may need to be a balance struck between theoretically correct versus practical, particularly in heavily built up areas.



The following diagram provides an example of the effect of wind flow on a building.



If the instrument requires mounting on a building or solid obstruction, it must be high enough above the structure to avoid the increased speed at the upwind side or decreased flow in the wake of the obstruction.

If the wind instrument must be mounted on the side of a tower or pole, it should be at least twice the maximum width of the tower at that height away from the tower.

For more details refer 'Australian Standard 2923 –1987 – Ambient Air – Guide for Measurement of Horizontal Wind for Air Quality Applications' (Standards Association of Australia)

2.2. Mechanism of operation

Wind speed sensors (WS40 series) use a magnetic switch (Hall Effect Detector) to detect the rotation of the cups.

2.3. Routine Maintenance

At a minimum 6 monthly interval check that the cup assembly turns freely, and there are no rattling or grating sounds. The rotating assembly uses a high quality shielded ceramic bearing mechanism designed for long life.

2.4. Calibration

The calibration of the wind speed sensor is a mechanical function which relies on accurate balancing and assembly. No onsite calibration can be performed.



3. Wind Direction Sensor

This sensor uses a rotating wind vane to measure direction of the wind.

3.1. Siting of the Instrument

The sensor is normally mounted on a pole - or on the opposite side of the cross arm on Envirodata's instrument stand - at the same height as the wind speed sensor. The sensor relies on a free flow of air to ensure accurate readings.

For details on siting refer section 2.1 on siting of Wind Speed Instrument, as similar issues apply.

3.2. Alignment of the Wind Direction Sensor

Wind direction sensors require alignment to north during installation. Mount the sensor body to the instrument stand first, but do not place the vane onto the spindle. An Envirodata sensor test box (TB10) should be used together with a compass or a knowledge of **True** North to perform the alignment. Observe the following procedure:

1. Connect the wind direction sensor to the Envirodata sensor test box.
2. Rotate the spindle until the lowest flash rate is achieved. This will indicate a position of 0 degrees, within 2 degrees.
3. **WITHOUT** moving the spindle, place the vane onto the spindle such that the vane arrow points to **True** North.
4. Tighten the grub screw to lock the two parts together. The sensor is now calibrated.

If a sensor test box is not available, take a wind direction reading from your system, and point the arrow of the vane to that direction using your knowledge of **True** North and a compass. Then follow steps three and four as above.

3.3. Mechanism

Wind direction sensors (WD45 series) use a linear magnetic shaft encoder in the main body housing, and a microprocessor which converts this into a digital signal. The number of pulses per second is proportional to the angle away from North in a clockwise direction. This sensor has a maximum reading of approximately 359 degrees and NO gap at North.

3.4. Routine Maintenance

At a minimum 6 monthly interval check that the vane assembly turns freely.

3.5. Calibration

By holding the vane assembly locked in a particular direction and allowing two minutes for collection of a full minute period of signal at this position, the sensor can be checked against a known direction.

4. Temperature Sensors (Air, Water, Soil)



Temperature is normally measured in degrees Celsius. An electronic converter is also supplied as part of the sensor. The housing of these sensors is partially filled with sealant to protect internal components. The temperature sensors are waterproof and can be located on the ground or under the ground as required. Within the housing are two calibration adjustments, which protrude from the sealant to allow final adjustment to be set and for re-calibration later, if required. These adjustments are protected from moisture by sealing compound, which also prevents alteration of the settings through vibration.

4.1. Siting of the Air Temperature Sensor

The air temperature sensor must be housed inside a radiation shield, to prevent the temperature effects of sunlight (solar radiation) and rain. Envirodata's Sensor Shelter, which is a louvered screen, allows a free flow of air and keeps the sensor at the equivalent of the outside shade temperature. Alternatively a larger 'Stevenson Screen' may be used, although this is rare for most modern applications. Standard mounting heights above ground level are generally 1.2, 1.5 or 2 metres but also may be other heights for measuring temperature difference with height.

4.2. Siting of the Water Temperature Sensor

The water temperature sensor is similar to both the air temperature and the soil temperature sensor. The tip can be placed into fluids safely, to provide thermal contact with the fluid.

4.3. Siting of the Soil Temperature Sensor

The soil temperature sensor is normally buried in the soil. The tip can be placed into the ground safely. To give good thermal contact with the soil the sensor is normally placed at a depth of 10cm below the surface, although other depths may be used under special circumstances.

4.4. Routine Maintenance

Check the cables for damage. NOTE: The temperature sensors have no exposed parts that require regular maintenance.

However, if found faulty, they may be returned to Environdata for repair.

4.5. Calibration

The calibration of temperature sensors can be checked by using a Standard thermometer in a container of water. (Variations of up to 1 degree can occur if checked in the air only.) Allow five (5) minutes for the temperatures to stabilise. If you want to perform a test at zero degrees Celsius, (Ice Point) then use clean water packed with pure ice slithers, (otherwise zero degrees will not be attained).



5. Electronic Relative Humidity Sensor

5.1. Mechanism

The electronic humidity tip contains a thin film sensing device which varies its capacitance in accordance with the amount of humidity in the air. This small variation in capacitance is measured and converted into pulses, which can be measured by the data logger.

5.2. Siting the Electronic Humidity Sensor

The relative humidity sensor must be housed inside a radiation shield, to prevent the temperature effects of sunlight (solar radiation) and rain. Envirodata's Sensor Shelter, which is a louvered screen, allows a free flow of air and keeps the sensor at the equivalent of the outside shade conditions. Alternatively a larger 'Stevenson Screen' may be used, although this is rare for most modern applications. Standard mounting heights above ground level are generally 1.2, 1.5 or 2 metres

5.3. Routine Maintenance

As the tip senses moisture in the air on it's tip, trace level pollutants will gradually build up on the sensing element and affect the accuracy of the reading over time. Accordingly it is desirable that the accuracy be checked regularly. The plug-in sensing tip is easily replaced and if continuity of data is essential a spare tip should be kept in a sealed bag.

5.4. Test Equipment

A hand held Kestrel meter is recommended to allow you to measure relative humidity quickly and accurately, and check your electronic relative humidity sensor.

5.5. Calibration

Re-calibration of the sensor or tip is not possible. Replacement of the tip is the required every 2 years.



6. Solar Radiation (Sunlight)

This sensor measures the total energy coming from the sun, and is sometimes called a "Global Solar Radiation Sensor" as it detects all wavelengths (colours) of incoming energy.

Sunlight can be measured in units of energy (Megajoules per metre), which is totaled over a period of typically one hour or one day, or units of power or intensity (Watts per metre²), which are averaged over a period of typically one hour or one day.

6.1. Mechanism

The solar radiation sensor uses a semiconductor cell, similar to a solar panel for charging batteries. The current produced by this cell is converted into a series of pulses easily interpreted by a data logger. A protective cover made of Teflon is used to protect the cell and to provide cosine correction (angle of incidence) of the sensor's response.

6.2. Siting of the Solar Radiation Sensor

The top of the sensor should be level with, or higher than, the highest point in close proximity, so that shadows and reflections do not affect the readings. All surrounding objects should be <10° above the horizontal plane of the instrument and the sensor must be mounted vertically.

It can be fixed onto the instrument stand by means of its base, with the mounting bolt provided. Consideration should be given in mounting height to accessibility for regular cleaning of the sensing surface, which will accumulate dust over time.

6.3. Routine Maintenance

For routine maintenance, it is necessary to clean the top of the solar radiation sensor with a soft cloth to remove dust at a minimum interval of 6 months depending on local conditions.

6.4. Calibration

Unless you have a second sensor on hand, it is not possible to validate the calibration. As a guide, full strength sunlight is approximately 1200W/m² which gives 6 pulses per second from an SR10 sensor and reads 1200W/m².

The SR40 calibration is 10 – 50 Hz for 0 – 2000 W/m².



7. Barometric Pressure Sensor

7.1. Mechanism

This sensor is designed to measure atmospheric pressure in the range 750 to 1050mBars. The sensor uses an integrated circuit sensor element, laser trimmed in a nylon package. The sensor has a Gortex membrane vent that allows air through, but prevents passage of moisture.

7.2. Siting the Barometric Pressure Sensor

Placement should be away from direct breezes and preferably in a protected (but not sealed) environment. A 'static pressure' environment such as a large enclosure with small openings to the ambient air such as the LH35 Lockable housing is ideal.

7.3. Barometric Pressure Values

The sensor has been programmed to give an output that shows the actual barometric pressure (at its height - the station level pressure or QFE). This is NOT the same as the barometric pressure as normally reported on the television etc, which has been corrected back to mean sea level (MSL).

You can adjust your barometric pressure reading by subtracting a correction for the sensor height above sea level (so that it reflects the 'sea level' pressure of your specific location).

Naturally, if the station is moved at any time in the future this will require re-adjustment or the readings will not be correct for another site at a different height above sea-level.

7.4. Routine Maintenance

The only routine maintenance possible is to check that the vent hole in the housing is not blocked

7.5. Calibration

On-Site calibration is not possible without extensive equipment and an independently calibrated standard. If a problem is suspected with the sensor, please call Environdata for recommended action.

8. Rainfall Sensor

8.1. Mechanism



The rain gauge collects the rain in a standard 203 mm diameter funnel. It passes through a syphon and then collects in one of a pair of buckets arranged at each end of a tipping mechanism.

When a precise volume of rain has fallen, the mechanism tips, emptying the full bucket and moving the empty bucket under the spout so that this bucket now fills.

The process then repeats, tipping the mechanism backwards and forwards, with each tip being a measured quantity of rain (normally either 0.2 or 0.5mm per tip).

The weather station logger counts the number of tips and converts this to a rainfall measurement.

A gauze strainer in the funnel and the outlet filter prevents debris and insects from entering the working parts of the instrument.

8.2. Siting the Rain Gauge



There should be clear ground for 2-3 metres around the rain gauge. The rain gauge should be mounted on a flat level surface, or a suitable mounting post with the top of the gauge perfectly horizontal.

The ISRG mounting mast with leveling bracket is the recommended mounting option. Please refer to the ISRG Manual for detailed installation guide.

If not using the ISRG then a concrete pad may be set with bolts captive in the concrete carefully placed to set the base of the RG unit onto.

If using a concrete pad or paver, check that the measured water can escape freely from the bottom of the gauge. In areas where heavy rainfall or flash flooding may occur, it is advisable to raise the base of the rain gauge above the surrounding surface. The standard height of the top of the rain gauge is 340mm above the ground, however 1000mm above ground is acceptable with negligible difference in the readings!

8.3. Routine Maintenance

The filter in the funnel **MUST** be cleaned at a minimum interval of 6 months. Internally, the unit is largely self-cleaning as fine

material should pass through with the measured rainfall. Occasionally, dependant upon the nature of dusts/pollutants, an accumulation may build up. This should be cleaned manually by removing the barrel and cleaning the tipping bucket internally along the syphon which can be unscrewed, and also cleaning the exit filter, if needed.

8.4. Electrical Connections

8.4.1. RG12U Reed Contact Model

The RG12U is supplied with a single Reed contact as a detector. This is a simple two wire connection. A series resistor provides protection against excessive currents.

8.4.2. RG12H Hall Effect Model

The RG12H is supplied with an electronic (Hall Effect) detector. This means an indefinite life and includes standard pulse stretching. There is no 'debouncing' required as there is no 'bounce' effect with the electronic detector. Each tip provides a very clean signal; a single pulse 50ms in duration, square wave, 5V in amplitude.

8.4.3. RG12S Hall Effect Signal Conditioning

The RG12S converts the low voltage sensor output into a higher voltage (PLC or RTU operating voltage typically 24VDC) open collector output. The output signal is an open collector pull down, current limited to 100mA and transient protected to 30V DC. This output is also factory settable to suit almost all PLC inputs, sinking, sourcing, & pulse durations of 50ms or 250ms.

APPENDIX A: SENSOR FAILURE

Incorrect data readings from one sensor only are generally caused by incorrect software set-up or a faulty sensor.

A sensor failure is slightly less critical as the system will still record other sensor parameters correctly. The first basic checks to make are the cable, the connector, and the sensor housing.

Cable

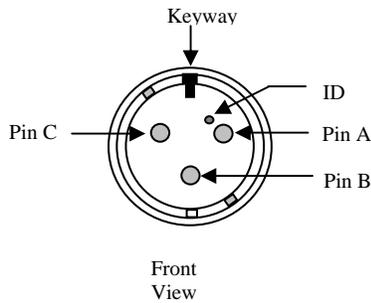
Ensure that all cables associated with the sensor in question are clear of punctures, cuts, or deep abrasions. Also check for breaks in the cable.

Sensor Connector

Examine the connector plug and check that all of the gold plated contacts with slightly recessed openings are present. Ensure that the contacts are clean and clear of water, mud and greases. Also check for physical damage to the connector which may result in internal breakage of the cable. (This is unlikely but still possible)

Sensor Housing

Check the sensor for obvious signs of damage which may result in impaired operation of the sensor.



APPENDIX B: Digital Sensor Connector Specification

GENERAL

The following information defines the physical connector and the electrical connections for sensors manufactured by Envirodata Australia Pty. Ltd.

The output signal is a square wave switching between ground and the positive D.C. voltage with frequencies in the general range of zero to 100 pulses per second (100 Hz). This is a robust signal that can be transmitted distances of up to several hundred metres without loss or accuracy due to noise or cable length. For analogue sensors, such as temperature, this means an electronic converter is required next to the sensor itself.

PHYSICAL CONNECTOR

The connector supplied with each sensor is a Conxall type three pin receptacle with female contact pins :-

Receptacle part 6280-3SG-316 CABLE SOCKET W/#20

Contact Part CRIMP CONTACT SOCKET #20 586-SG

ELECTRICAL CONNECTIONS

PIN A +5.5 to 7 volts D.C. (Note 1) [Red Wire]

PIN B SIGNAL [Blue Wire]

PIN C GROUND (Zero volts D.C.) [Green Wire]

NOTE 1

Most Envirodata manufactured sensors require less than 2.5 mA for operation, although special accuracy sensors sometimes require up to 5mA.

SENSOR TEST BOX INSTRUCTIONS

The Sensor Test Box is used to test sensors and is provided with every complete Envirodata weather station. It is simple to use



and confirms correct operation of any sensor, independently of the logger. Three indicator lights show the sensor output, the rate of digital pulses being sent by the sensor, and any power fault. It also has its own battery tester. This tool is invaluable for system fault-finding and is strongly recommended as part of your test equipment.

Procedure to Test Sensors

1. Test the internal battery of the Sensor Test Box by pressing the 'Battery Test' button. The 'Short Circuit' light should light (red) showing that the short circuit indicator is working and that the battery voltage is correct.
2. Plug in each sensor in turn. The sensors should send pulses (signal light) to the test box. The 'period' light is used to measure the pulse rate where the pulse rate is too fast to see on the 'signal' light. One pulse will be shown on the 'period' light for every 128 pulses on the 'signal' light.
3. Checking power usage. Leave the sensor plugged in. **DO NOT PRESS TEST BUTTON.** If the short circuit light is on, then the power usage is excessive. Please consult Envirodata before returning the sensor for repair.

Should the sensor indeed prove to be faulty, contact Envirodata to arrange repairs.

APPENDIX C: USE OF THE FREQUENCY TO MILLIAMP CONVERTER [MODEL FA12]

Applications

Conversion of a sensor's frequency signal into a current signal output.

Installation

The Frequency to Current Converter should be connected between the output of an Envirodata sensor and your equipment that requires the current signal.

Note: Each FA12 is calibrated for a specific sensor. If you have several different sensors and FA12s, you should ensure that each sensor is connected to the correct FA12 converter.

Mechanism

The Frequency to mA converter measures the frequency of the incoming signal, and then converts this to an output current proportional to incoming frequency.

Limitations

Version 2.0 of the FA12 needs to operate using a three wire system, such that the outgoing signal wire is separate from the power supply wires.

Calibration Verification

The FA12 is calibrated for connection to a specific type of Envirodata sensor only. Connection to a different type of sensor may yield incorrect readings.

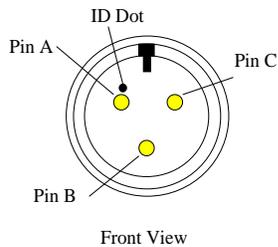
For example, for connection to an Envirodata Solar Radiation sensor SR10, the device is calibrated to provide an output between 4 mA (0 W/m²) and 20 mA (2000 W/m²) for the input range between 0 Hz and 10 Hz.

Sensor Connection

The sensor input connector is a three pin weatherproof male panel mount connector that mates to all Envirodata sensors.

The wiring is as follows:

- A +5 to +7V DC (**Red**)
- B Output Signal (**Blue**)
- C 0V Ground (**Green**)



4-20 mA Connection

The three wire output connection as tinned copper wires is as follows:

- | | | |
|-----------------|-------------------------------|-----------------------|
| Supply | +10 to +40V DC (Red) | - Connect to Positive |
| Return [4-20mA] | Output Signal (Blue) | - Connect to Signal |
| | 0V Ground (Green) | - Connect to Ground |

Note: You might need to connect two wires to your 4-20ma input. If so, consult the manual for your product.

F.A.Q. (Frequently Asked Questions)

Q: Why are there three wires needed?

A: The third wire is used to power the converter, and the converter regulates this voltage to the correct level to power the connected Envirodata sensor.

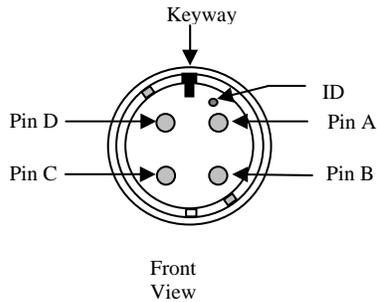
Q: If my FA12 is calibrated for a wind speed sensor for 20ma at 120kph, what happens if the wind speed goes higher than 120 kph?

A: The FA12 output will continue to increase past 20ma. In this situation, please ensure your product can handle higher than 20ma input, or get the FA12 calibrated for a higher wind speed range, (IE: 0-180kph = 4-20ma)

Q: Should the FA12 be mounted near the sensor?

A: There are no specific requirements as to mounting location. Both 4-20ma and our sensors' outputs can be run over long cables. You may mount the FA12 where it is most convenient for your installation.

APPENDIX D: ANALOG SENSOR CONNECTION SPECIFICATION



GENERAL

Analog sensors supplied by Envirodata use the same connector type, but are generally supplied as four pin connectors. This means the sensors cannot be accidentally plugged into the wrong connector.

The following information defines the physical connector, the electrical connections for signals for sensors manufactured by Envirodata Australia Pty. Ltd.

The output signal is typically a 0 – 5 volt signal relative to ground.

PHYSICAL CONNECTOR

The connector supplied with each sensor is a Conxall type four pin receptacle with female contact pins :-

Receptacle part 6280-4SG-316 CABLE SOCKET W/#20

Contact Part CRIMP CONTACT SOCKET #20 586-SG

ELECTRICAL CONNECTIONS

PIN A +5.5 to 7 volts D.C. (Note 1) [Red Wire]

PIN B DIGITAL SIGNAL [Not Used]

PIN C ANALOG SIGNAL [Blue Wire]

PIN D GROUND (Zero volts D.C) [Green Wire]

NOTE 1

Most Envirodata manufactured sensors require less than 2.5 mA for operation, although special accuracy sensors sometimes require up to 5mA.

APPENDIX E: SENSOR DETAILS

Sensor Type	Identification	Operating Range	Accuracy	Resolution	Rountine Maintenance Requirements	Calibration Requirements
Wind Speed	WS45	0 - 75m/s	+/- 0.2 m/s	0.1m/s	Check for low friction rotation every 6 months	Return to Environdata every 5 years
Wind Direction	WD45	0 - 359 degree	+/- 1 degree	1 degree	Check for low friction rotation every 6 months	Return to Environdata every 5 years
Air Temperature	TA40	-20 to 60 deg C	+/- 0.2 deg C	0.025 deg C	Check cables for damage at minimum 6 monthly interval	Return to Environdata every 5 years
Relative Humidity	RH40	0 - 100% RH	±2 % RH (10%-90% RH) ±4 % RH (<10% or >90% RH)	0.1% RH	Replacement of the sensor tip ever 2 years	Return to Environdata every 5 years
Solar Radiation	SR10	-20 - +50 deg C	Max deviation 1% up to 2000w/m2	1 w/m2	Clean top of sensor at minimum 6 monthly interval with a soft tissue to remove dust.	Return to Environdata every 5 years
Barometric Pressure	BP10	750 - 1050hPa	+/- 3hPa	1hPa	Check vent hole in housing for blockages at minimum 6 monthly interval	Return to Environdata every 5 years
Rain Gauge	RG12U/H/S	0 - 450mm/hr	+/- 2% at low rainfall rates 5% at rainfall rates > 300mm/hr	+/- 0.2mm per tip	Funnel filter and vent filter MUST be cleaned at minimum 6 monthly interval or more frequently as dictated by local conditions	Return to Environdata every 5 years