Delta-T Devices

GP2 DeltaLINK 3

Sensor Library

(Installation and programing notes)

Sensors listed in alphabetical order

2K Thermistor probes

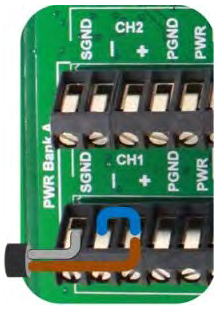
Delta-T Devices
SENSOR

DESCRIPTION

Sensor type: 2K Thermistor

Measures temperature, in the range -40 to +125 deg C, using Fenwall UUA32J2 or BetaCURVE 2K3A1 thermistor types.

WIRING



Click image to toggle it's size.

Colour	Thermistor wiring	GP2 terminal	Notes
-	Resistance HI	CH (+) and CH (-)	Fit wire link
-	Resistance LO	SGND	

Note: The channel numbers are for illustration only. Other channel numbers are also possible.

MEASUREMENT PROPERTIES

Property	*Value*
Settling time (ms) (Advanced property)	The default settling time of 6 ms is suitable for measuring temperatures down to -40 deg C using up to 25 m of cable with 5 nF total cable capacitance. For longer cables or larger cable capacitance see Settling time (ms)
Cable resistance (ohm) (Advanced property)	To correct for resistance of long cable lengths measure the cable resistance with a multimeter and enter the value here. Include the combined series resistance of both (i.e. Signal HI and Signal LO) wires. At 60 deg C the sensitivity of a 2K Thermistor is 18 ohm per deg C, so 1 ohm of cable resistance will cause a small error of 0.056 deg C. At 125 deg C the sensitivity is 1.8 ohm per deg C, so 1 ohm of cable resistance will cause a 0.56 deg C error.
Power channel	The default value 'None' is suitable because 2K Thermistor doesn't require a power supply.

See also:

General (Measurement) properties
Input (Measurement) properties
Resistance (Input) properties
Linearization table (Calculation) properties
Result properties

CHECK SENSOR IS WORKING

1. Connect the sensor to the logger as shown above.
2. Connect the logger to the PC and run DeltaLINK.
3. Make sure the logger is programmed to read a 2K thermistor from the channel it is connected to, and is selected into a suitable Recording.
4. Select the Sensors window and click **Read now**. You should have a reading from the sensor.
5. Put the sensor between your hands and try to warm it up - you should see the temperature reading increase.
6. Hold the sensor in the air and wave it around - you should see the temperature reading decrease.

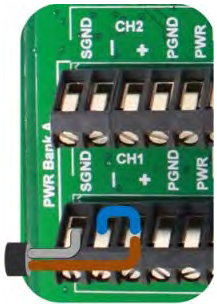
10K Thermistor probe

Delta-T Devices
SENSOR

DESCRIPTION

Sensor type: 10K Thermistor (10K3A1 series)
Measures temperature, in the range -25 to +150 deg C, using 10K3A1 series thermistor

WIRING



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Colour	Thermistor wiring	GP2 terminal	Notes
-	Resistance HI	CH (+) and CH (-)	Fit wire link
-	Resistance LO	SGND	

Note: The channel numbers are for illustration only. Other channel numbers are also possible.

MEASUREMENT PROPERTIES

Property	*Value*
Settling time (ms) (Advanced property)	The default settling time of 12 ms is suitable for measuring temperatures down to -25 deg C using up to 25 m of cable with 5 nF total cable capacitance. For longer cables or larger cable capacitance see Settling time (ms)
Cable resistance (ohm) (Advanced property)	To correct for resistance of long cable lengths measure the cable resistance with a multimeter and enter the value here. Include the combined series resistance of both (i.e. Signal HI and Signal LO) wires. At 60 deg C the sensitivity of a 10K Thermistor is 90 ohm per deg C, so the cable resistance correction will not significantly affect accuracy. At 150 deg C the sensitivity is 4 ohm per deg C, so 1 ohm of cable resistance will cause a 0.25 deg C error.
Power channel	The default value 'None' is suitable because 10K Thermistor doesn't require a power supply.

See also:
General (Measurement) properties
Input (Measurement) properties
Resistance (Input) properties
Linearization table (Calculation) properties
Result properties

CHECK SENSOR IS WORKING

1. Connect the sensor to the logger as shown above.
2. Connect the logger to the PC and run DeltaLINK.
3. Make sure the logger is programmed to read a 10k thermistor from the channel it is connected to, and is selected into a suitable Recording.
4. Select the Sensors window and click **Read now**. You should have a reading from the sensor.
5. Put the sensor between your hands and try to warm it up - you should see the temperature reading increase.
6. Hold the sensor in the air and wave it around - you should see the temperature reading decrease.

AN1 Anemometer

Delta-T Devices
SENSOR

DESCRIPTION

Sensor type: AN1

Measures continuous average windspeed using the Delta-T Anemometer (type AN1).

WIRING

Click image to toggle it's size.

Colour	AN1 wiring	GP2 terminal	Notes
Green	Signal	EV1	
Yellow	Signal	GND	
Braid	Screen	GND	

Note: The channel numbers above are for illustration only. Other channel numbers are also possible.

MEASUREMENT PROPERTIES

Property	*Value*
Power channel	The default value 'None' is suitable because AN1 doesn't require a power supply.

REMARKS:

The AN1 linearization table gives a zero reading below a startup speed of 0.217 m.s-1 and a value of 0.2170 + Hz * 1.2146 above the sensor's startup speed. These figures are based on 'Consensus Figures' derived by Garrad Hassan (GH): slope=1.2146, offset=0.2170'. See http://www.windspeed.co.uk/ws/index.php?option=faq&task=viewfaq&artid=29&Itemid=5

See also:

General (Measurement) properties
Input (Measurement) properties
Frequency (Input) properties
Linearization table (Calculation) properties
Result properties

INSTALLATION NOTES

Mount the anemometer using a 0.25 inch BSW or UNC screw into the base, ensuring that the screw does not project more than 0.3 inches into the instrument. Mount vertically for accurate results.
The cable may be extended up to 100m total length of similar screened cable

Warning: This instrument contains a magnetic reed switch partly filled with mercury. If subject to shock or vibration during transit, the mercury may become distributed in globules which sometimes affect normal operation.
The mercury should therefore be driven down into its reservoir before using the instrument by shaking downwards whilst holding the instrument in an approximately vertical position.

CHECK SENSOR IS WORKING

1. Connect the AN1 to the logger as shown above
2. Connect the logger to the PC and run DeltaLINK.
3. Make sure the logger is programmed to read an AN1 from the channel it is connected to and is selected into a suitable Recording.
4. Select the Sensors window and click **Read now**.
5. Spin the cup rotors around – the reading should increase and decrease depending on how fast or slow the rotor cups are spinning

REFERENCES

- AN1 user manual

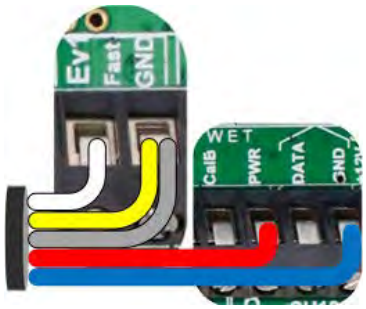
AN3 Anemometer (Pulse)

Delta-T Devices
SENSOR

DESCRIPTION

Sensor type: AN3 (pulse output)
Measures continuous average windspeed using the pulse output of Delta-T High Resolution Anemometer (type AN3).

WIRING



Click image to toggle it's size.

Colour	AN3 (pulse) wiring	GP2 terminal	Notes
White	Digital Signal	EV1	
Yellow	Signal LO	GND	
Braid	Screen	GND	
Red	Power V+	WET (PWR)	*
Blue	Power 0V	WET (GND)	*
Green	An signal HI	Not connected	
Black		Not connected	

Note: The channel numbers above are for illustration only. Other channel numbers are also possible.

***If sample rate is continuous, connect to permanent source of power**

MEASUREMENT PROPERTIES

Property	*Value*
Sample period (ms)	The default sample period of 500 ms gives a resolution of 0.1 m.s-1 and is suitable for most purposes. Shorter sample periods will give reduced resolution. If you select 'Continuous' you must permanently power the sensor, so set Power channel to 'None' and connect the sensor directly to a suitable power supply. Note that you must select 'Continuous' if you want to record Wind gust in a Wind Recording.
Power channel	The wiring diagram shows connection to the preferred Power channel. If a preferred Power channel is not available, select one of the other Power channels and modify the Power V+ wiring accordingly. If you set Sample period to 'Continuous' then select 'None' and connect the sensor to a permanent power supply. See Power channel.

REMARKS:

The AN3 (pulse) linearization table gives a zero reading below a startup speed of 0.217 m.s-1 and a value of 0.24 + Hz * 0.0499 above the sensor's startup speed. These figures are based on 'Consensus Figures' derived by Garrad Hassan (GH): slope=1.2146, offset=0.2170'. See http://www.windspeed.co.uk/ws/index.php?option=faq&task=viewfaq&artid=29&Itemid=5

See also:
General (Measurement) properties
Input (Measurement) properties
Frequency (Input) properties
Linearization table (Calculation) properties
Result properties

INSTALLATION NOTES

Mount the anemometer using a 0.25 inch BSW screw into the base, ensuring that the screw does not project more than 0.38 inches into the instrument.The anemometer also accepts a standard tripod fitting. Mount vertically for accurate results.

CHECK SENSOR IS WORKING

1. Connect the AN3 to the logger as shown above
2. Connect the logger to the PC and run DeltaLINK.
3. Make sure the logger is programmed to read an AN3 from the channel it is connected to and is selected into a suitable Recording.
4. Select the Sensors window and click **Read now**.
5. Spin the cup rotors around – the reading should increase and decrease depending on how fast or slow the rotor cups are spinning

REFERENCES

- AN3 user manual

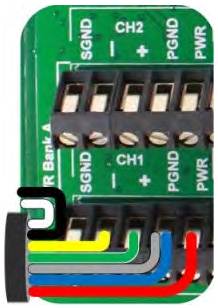
AN3 Anemometer (voltage)

Delta-T Devices
SENSOR

DESCRIPTION

Sensor type: AN3 (Voltage output)
Measures instantaneous windspeed using the analog output of Delta-T High Resolution Anemometer (type AN3).
Note: use the AN3 (pulse) sensor type if you want to record Wind gust in a Wind Recording.

WIRING



Click image to toggle it's size.

Colour	AN3 (voltage) wiring	GP2 terminal	Notes
Red	Power V+	PWR	
Blue	Power 0V	PGND	
Green	An Signal HI	CH (+)	
Yellow	An Signal	CH (-)	
Braid	Screen	PGND	
White	Dig Signal	Not connected	
Black		Not connected	

Note: The channel numbers are for illustration only. Other channel numbers are also possible.

MEASUREMENT PROPERTIES

Property	*Value*
Signal ground terminal (Advanced property)	The default setting is correct for the wiring above. See Signal ground terminal
Minimum power voltage	The default value of 6.6V is suitable for the standard cable length. For extended cable lengths see Minimum power voltage. Note that Minimum power voltage is only available if Power channel (below) is PWR on Bank A or PWR on Bank B.
Power channel	The wiring diagram shows connection to the preferred Power channel. If a preferred Power channel is not available, select one of the other Power channels and modify the Power V+ wiring accordingly. See Power channel
Sensitivity	The sensor type uses nominal calibration values: 0 to 2500mV => 0 to 77m.s-1. A default conversion factor of 32.5 is used. Sensors are supplied with individual calibration data: for improved accuracy use the supplied calibration values (found on the calibration certificate) to create an individual sensor type for each unit. To calculate the sensitivity for your particualr sensor please refer to the AN3 user manual,

See also:
General (Measurement) properties
Input (Measurement) properties
Voltage (Input) properties
Linear scaling (Calculation) properties
Result properties

INSTALLATION NOTES

Mount the anemometer using a 0.25 inch BSW screw into the base, ensuring that the screw does not project more than 0.38 inches into the instrument.The anemometer also accepts a standard tripod fitting. Mount vertically for accurate results.

CHECK SENSOR IS WORKING

1. Connect the AN3 to the logger as shown above
2. Connect the logger to the PC and run DeltaLINK.
3. Make sure the logger is programmed to read an AN3 from the channel it is connected to and is selected into a suitable Recording.
4. Select the Sensors window and click **Read now**.
5. Spin the cup rotors around – the reading should increase and decrease depending on how fast or slow the rotor cups are spinning

REFERENCES

- AN3 user manual

AN4 Anemometer

Delta-T Devices
SENSOR

DESCRIPTION

Sensor type: AN4
Measures continuous average windspeed using the Delta-T Anemometer (type AN4).

WIRING

Click image to toggle it's size.

Colour	AN4 wiring	GP2 terminal	Notes
Brown	Signal	EV1	
White	Signal	GND	

Note: The channel numbers above are for illustration only. Other channel numbers are also possible.

MEASUREMENT PROPERTIES

Property	*Value*
Power channel	The default value 'None' is suitable because the AN4 doesn't require a power supply.

REMARKS:
The AN4 linearization table gives a zero reading below a startup speed of 0.5 m.s-1 and a value of 0.5 to 40 m.s-1 for 0 to 50 Hz input frequency range

See also:
General (Measurement) properties
Input (Measurement) properties
Frequency (Input) properties
Linearization table (Calculation) properties
Result properties

INSTALLATION NOTES

Selecting a site: In general, wind measurement sensors should be positioned to detect the wind conditions of a large area.
For meteorological purposes, measurements are specified ideally at a height of 10 metres on a site with no obstacles.
In practice, it is often not possible to fulfil these conditions, and you must choose a position that, as far as possible, represents the local wind speed and direction. In particular, avoid roof positions which can often introduce biased wind directions and exaggerated wind speeds.
Mounting details: First, slide the Delrin sleeve over the free end of the cable, then insert the sleeve into the sensor body. Tighten the two retaining screws.
Attach the sensor to a mast cross arm, using the ¼ BSW bolt and saddle washers. Any cross arm of about 32 mm diameter, with a 7 mm clearance hole through it would be equally suitable.
When the weather station mast is erected, check that the anemometer axis is vertical by making slight adjustments to the mast and cross arm alignment.

Cable can be extended with similar cable, up to the 100 metre limit, provided the joint is waterproof.

CHECK SENSOR IS WORKING

1. Connect the sensor to the logger as shown above
2. Connect the logger to the PC and run DeltaLINK.
3. Make sure the logger is programmed to read an AN4 from the channel it is connected to and is selected into a suitable Recording.
4. Select the sensors window and click **Read now**.
5. Spin the cup rotors around – the reading should increase and decrease depending on how fast or slow the rotor cups are spinning

REFERENCES

- AN4 user manual

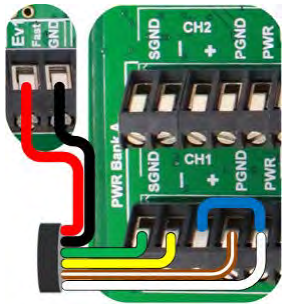
AN-WD2 Wind Sensor

Delta-T Devices
SENSOR

DESCRIPTION

Sensor types: AN-WD2 (direction), AN-WD2 (speed)
Measures wind speed (m.s-1) and direction (deg) using the Delta-T Wind sensor (type AN-WD2)

WIRING



Click image to toggle it's size.

Colour	AN-WD2 wiring	GP2 terminal	Notes
Green	Wind Dir LO	CH (SGND)	
Yellow	Wind Dir HI	CH (-)	
White/Brown	Shield	PGND	
White	Wind Dir V+ REF	PWR and CH (+)	Fit wire link
Red	Wind Speed Signal	EV1	
Black	Wind Speed GND	EV1 (GND)	

Note: The channel numbers are for illustration only. Other channel numbers are also possible.

MEASUREMENT PROPERTIES: AN-WD2 (direction)

Property	*Value*
Power channel	The wiring diagram shows connection to the preferred Power channel. If a preferred Power channel is not available, select one of the other Power channels and modify the Wind Dir V+ REF wiring accordingly. See Power channel

REMARKS:
The AN-WD2 (direction) linearization table gives a reading of 0 to 356 deg over the sensor's electrical range, and 358 degrees in the gap of the potentiometer windings.

MEASUREMENT PROPERTIES: AN-WD2 (speed)

Property	*Value*
Power channel	The default value 'None' is suitable because AN-WD2 (direction) doesn't require a power supply.

REMARKS:
The AN-WD2 (speed) linearization table gives a zero reading below a startup speed of 0.28 m.s-1 and a value of 0.28 + Hz / 1.2517 above the startup speed.

See also:
General (Measurement) properties
Input (Measurement) properties
Potentiometer (Input) properties
Frequency (Input) properties
Linearization table (Calculation) properties
Result properties

INSTALLATION NOTES

Once the wind sensor is properly installed and oriented as instructed, the locking shoulder screw is removed.
Save the shoulder screw, and use it to immobilise the shaft of the wind vane during transport.

Install vane:
1. Insert the vane tail shaft into the hub. Make sure the shaft is fully seated at the bottom of its hole, which will replicate factory balance.
2. Align the vane with the centre axis of the sensor body.
3. Tighten the set screw using the 5/32” allen wrench (provided) to secure the vane tail in the hub.

Sensor installation & orientation
1. Install the sensor into the alignment adapter. The socket head screw will pass through the adapter and will tighten into the sensor housing.
2. Place the sensor with adapter onto tip of the tripod mast or in the fitting on the cross arm.
3. Rotate the entire sensor until the vane points to “TRUE NORTH”. The use of transit/compass will assure accurate alignment, when the magnetic correction to true has been established.
4. When the sensor is properly aligned, tighten the adapter grub screws.
5. Remove and retain the shoulder screw from the vane hub. Check to see that the vane assembly rotates freely.
6. Connect the cable to the sensor. Route the cable to the data recording device. Secure the cable with cable ties or tape. The cable assembly contains 5 wires.

CHECK SENSOR IS WORKING

1. Connect the sensor to the logger as shown above
2. Connect the logger to the PC and run DeltaLINK.
3. Make sure the logger is programmed to read a WD1 from the channel it is connected to and is selected into a suitable Recording.
4. Select the Sensors window and click **Read now**.

Windvane:

5. Spin the wind vane around – you should see a reading ranging between 0 - 360deg

Annemometer:

6. Spin the cup rotors around – the reading should increase and decrease depending on how fast or slow the rotor cups are spinning

REFERENCES

- AN-WD2 user manual

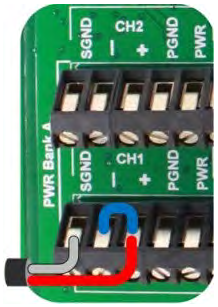
AT2 Air Temperature sensor

Delta-T Devices
SENSOR

DESCRIPTION

Sensor type: AT2
Measures temperature (deg C) using the Delta-T Air Temperature sensor (type AT2)

WIRING



Click image to toggle it's size.

Colour	AT2 wiring	GP2 terminal	Notes
Red	Resistance HI	CH (+), CH (-)	Fit wire link
Braid	Screen	SGND	

Note: The channel numbers are for illustration only. Other channel numbers are also possible.

MEASUREMENT PROPERTIES

Property	*Value*
Settling time (ms) (Advanced property)	The default settling time of 0 ms is suitable for measuring temperatures down to -10 deg C using up to 25 m of cable with 5 nF total cable capacitance. For longer cables or larger cable capacitance see Settling time (ms)
Cable resistance (ohm) (Advanced property)	To correct for resistance of long cable lengths measure the cable resistance with a multimeter and enter the value here. Include the combined series resistance of both (i.e. Signal HI and Signal LO) wires. At 60 deg C the sensitivity of the AT2 is 18 ohm per deg C, so 1 ohm of cable resistance will cause a small error of 0.056 deg C.
Power channel	The default value 'None' is suitable because the AT2 doesn't require a power supply.

See also:
General (Measurement) properties
Input (Measurement) properties
Resistance (Input) properties
Linearization table (Calculation) properties
Result properties

INSTALLATION NOTES

After the shield has been mounted, you can fit the AT2 temperature probe through the sensor gland clamp, from below. A housing sleeve is provided with each sensor to enable you to position the sensor element within the shield at the approximate level shown. You can subsequently remove the sensors easily for inspection without dismantling the shield from the mast.
Up to 100m of cable can be fitted at time of ordering. The Air Temperature thermistor reading may be slightly affected by long cable lengths.

The AT2 sensor output is slightly affected by cable resistance (0.005°C per metre, at 50°C; less at lower temperatures). Generally, this effect can be ignored, but it can be compensated for by a variety of means if required. ***See the settling time help for further details***

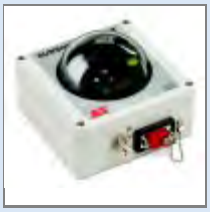
CHECK SENSOR IS WORKING

1. Connect the sensor to the logger as shown above.
2. Connect the logger to the PC and run DeltaLINK.
3. Make sure the logger is programmed to read an AT2 from the channel it is connected to, and is selected into a suitable Recording.
4. Select the sensors window and click **Read now**. You should have a reading from the sensor.
5. Put the sensor between your hands and try to warm it up - you should see the temperature reading increase.
6. Hold the sensor in the air and wave it around - you should see the temperature reading decrease.

REFERENCES

- RHT2 and AT2 User Manual

BF3 Sunshine Sensor

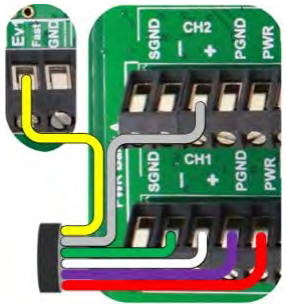


Delta-T Devices
SENSOR

DESCRIPTION

Sensor types: BF3 (energy), BF3 (PAR), BF3 (illuminance) and BF3 (sunshine)
Measures total and diffuse solar radiation and sunshine status using Delta-T Sunshine sensor (type BF3)

WIRING



Click image to toggle it's size.

Colour	BF3 wiring	GP2 terminal	Notes
White	Total Signal HI	CH1 (+)	
Grey	Diffuse Signal HI	CH2 (+)	
Green	Signal LO (shared)	CH1 (-)	
Yellow	Sun State Output	EV1 (Ev)	
Red	Power (V+)	CH1 (PWR)	
Violet	Power 0V	CH1 (PGND)	
Braid	Screen	CH1 (PGND)	

Note: The channel numbers above are for illustration only. Other channel numbers are also possible.

MEASUREMENT PROPERTIES: BF3 (energy), BF3 (illuminance), BF3 (PAR)

Property	*Value*
Signal ground terminal (Advanced property)	The terminal that Signal LO (shared) is connected to. **IMPORTANT:** The BF3 (complete) options initially set this up correctly. If you insert the total and diffuse Measurements individually or change their Channels, you must also set Signal ground terminal correctly for each Measurement. See Signal ground terminal
Minimum power voltage	The default value of 5.1V is suitable for the standard cable length. For extended cable lengths see Minimum power voltage. Note that Minimum power voltage is only available if Power channel (below) is PWR on Bank A or PWR on Bank B.
Power channel	The wiring diagram shows connection to the preferred Power channel. If a preferred Power channel is not available, select one of the other Power channels and modify the Power V+ wiring accordingly. See Power channel

See also:
General (Measurement) properties
Input (Measurement) properties
Voltage (Input) properties
Digital state (Input) properties
No calculation (Calculation) properties
Linear scaling (Calculation) properties
Result properties

INSTALLATION NOTES

You can set up the two radiation outputs (total and diffuse) to give millivolt signals scaled to the radiation units of your choice:
• For PAR, in umol.m-2.s-1
• For Energy, in W.m-2 ,or
• For Illuminance, in klux .

The default output of the BF3 is set to PAR. To change the output setting, connect the BF5 to your PC RS232 serial port, open the 'SunRead' software (supplied on CD with unit) and set the output units, as required (only 1 can be selected).

Make sure the sunshine output mode jumper, inside the BF3, is set to 'contact closure mode' (See BF3 user manual for more information).

The BF3 may be mounted on a camera tripod, or more permanently, via an accessory cross-arm type BF3-M with a mounting bracket suitable for connecting to the Delta-T 2 m Weather Station Mast.
The BF3 is fitted with an 8-way triad connector for the analogue output. This analogue connector provides voltage outputs for Total (global) and Diffuse radiation, plus a digital output for sunshine state. It is suitable for recording by many data loggers via cable 'BFDL-xx'.
Extension cables can be added to this, up to a maximum of 100m.

Warning - Ensure that differential wiring is used (as diagram above) and not single ended.

CHECK SENSOR IS WORKING

1. Connect the BF3 to the logger as shown above
2. Connect the logger to the PC and run DeltaLINK.
3. Make sure the logger is programmed to read a BF3 from the channels it is connected to and is selected into a suitable Recording.
4. Select the Sensors window and click **Read now**. You should have a reading from the BF3.
5. Shade the dome from any light – the reading should drop low
6. Put the dome in direct sunlight – the reading should increase

REFERENCES

- BF3 user manual

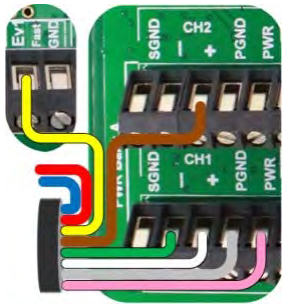
BF5 Sunshine Sensor

Delta-T Devices
SENSOR

DESCRIPTION

Sensor types: BF5 (energy), BF5 (PAR), BF5 (illuminance) and BF5 (sunshine)
Measures total and diffuse solar radiation and sunshine status using Delta-T Sunshine sensor (type BF5)

WIRING



Click image to toggle it's size.

Colour	BF5 wiring	GP2 terminal	Notes
White	Total Signal HI	CH1 (+)	
Brown	Diffuse Signal HI	CH2 (+)	
Green	Signal LO (shared)	CH1 (-)	
Yellow	Sun State Output	EV1	
Pink	Power V+	CH1 (PWR)	
Grey	Power 0V	CH1 (PGND)	
Blue	Heater -	N/C	Connect to separate, isolated power supply 12V DC, 1.5A max
Red	Heater +	N/C	Connect to separate, isolated power supply 12V DC, 1.5A max
Braid	Screen	CH1 (PGND)	

Note: The channel numbers above are for illustration only. Other channel numbers are also possible.

MEASUREMENT PROPERTIES: BF3 (energy), BF3 (illuminance), BF3 (PAR)

Property	*Value*
Signal ground terminal (Advanced property)	The terminal that Signal LO (shared) is connected to. **IMPORTANT:** The BF5 (complete) options initially set this up correctly. If you insert the total and diffuse Measurements individually or change their Channels, you must also set Signal ground terminal correctly for each Measurement. See Signal ground terminal
Minimum power voltage	The default value of 5.1V is suitable for the standard cable length. For extended cable lengths see Minimum power voltage. Note that Minimum power voltage is only available if Power channel (below) is PWR on Bank A or PWR on Bank B.
Power channel	The wiring diagram shows connection to the preferred Power channel. If a preferred Power channel is not available, select one of the other Power channels and modify the Power V+ wiring accordingly. See Power channel

See also:
General (Measurement) properties
Input (Measurement) properties
Voltage (Input) properties
Digital state (Input) properties
No calculation (Calculation) properties
Linear scaling (Calculation) properties
Result properties

INSTALLATION NOTES

You can set up the two radiation outputs (total and diffuse) to give millivolt signals scaled to the radiation units of your choice:
- For PAR, in umol.m-2.s-1
- For Energy, in W.m-2 ,or
- For Illuminance, in klux .

The default output of the BF5 is set to PAR. To change the output setting, connect the BF5 to your PC RS232 serial port, open the 'SunRead' software (supplied on CD with unit) and set the output units, as required (only 1 can be selected).

Cables:
The 8-core analogue cable type SP-BF/w-05 is provided for connecting the sensor to a data logger and to carry power to the internal heater.
It is 5m long with a weatherproof M12 8-pole connector at the sensor end and with bare wire flying leads at the logger end.

Analogue extension cables type EXT/M12-xx, where xx = 5, 10 or 25m are available for extending the cable from the sensor to logger. Extension cables can be added, up to a maximum of 100m.

Important: The sensor cable is too big to fit through the standard GP2 cable glands. Please use the cable gland expansion lid (GP2-G5-LID) as this has larger gland options that allow the cable to fit through them.

The BF5 may be installed at any latitude and at any polar angle i.e. relative to North. Mount the BF5 horizontally; checking the bubble is centred in the bubble level.
The BF5-M (1m x 32mm) cross-arm adaptor may be useful. It includes a Manforotto type 482 camera adaptor and a KeeKlamp type 45-86 connector. This is compatible with the Delta-T M2 weather station mast and with many building scaffolding systems.
Alternatively the BF5 may be mounted using holes (for M4 bolts) located at the four corners at the base of the box. These are accessed by opening the BF5 via the four screws in the lid. You will have to provide something to support and hold the BF5 level.
The BF5 is fitted with an 8-way M8 connector for the analogue output. This analogue connector provides voltage outputs for Total (global) and Diffuse radiation, plus a digital output for sunshine state.

Warning - Ensure that differential wiring is used (as diagram above) and not single ended.

CHECK SENSOR IS WORKING
1. Connect the BF5 to the logger as shown above
2. Connect the logger to the PC and run DeltaLINK.
3. Make sure the logger is programmed to read a BF5 from the channels it is connected to and is selected into a suitable Recording.
4. Select the Sensors window and click **Read now**. You should have a reading from the BF5.
5. Shade the dome from any light – the reading should drop low
6. Put the dome in direct sunlight – the reading should increase

REFERENCES
- BF5 Quick start guide and user manual

BS5 Barometer

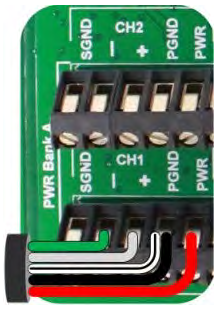
Delta-T Devices
SENSOR

DESCRIPTION

Sensor type: BS5

Measures atmospheric pressure, 900 to 1100hPa using Delta-T Barometric Pressure Sensor (type BS5).

WIRING



Click image to toggle it's size.

Colour	BS5 wiring wiring	GP2 terminal	Notes
Green	Signal LO	CH (-)	
White/Clear	Signal HI	CH (+)	
Black	Power 0V	PGND	
White and Black	Screen	PGND	
Red	Power V+	PWR	

Note: The channel numbers are for illustration only. Other channel numbers are also possible.

MEASUREMENT PROPERTIES

Property	*Value*
Signal ground terminal (Advanced property)	The default setting is correct for the wiring above. See Signal ground terminal
Minimum power voltage	The default value of 7.1V is suitable for the standard cable length. For extended cable lengths see Minimum power voltage. Note that Minimum power voltage is only available if Power channel (below) is PWR on Bank A or PWR on Bank B.
Power channel	The wiring diagram shows connection to the preferred Power channel. If a preferred Power channel is not available, select one of the other Power channels and modify the Power V+ wiring accordingly. See Power channel
Intercept	Refer to the BS4 user manual and set the BS5 DIP switches to the range of pressures that you want to measure and the full scale voltage. Set Intercept to the lower end of the measurment range. For example, if you select the 900 to 1100 hPa range, then set Intercept to 900. Also set Minimum and Maximum Result properties accordingly.
Slope	Calculate Slope from the BS5 measurement range and full scale voltage (i.e. as set up by hte BF5 DIP switches): Slope = (upper range limit - lower range limit) / full scale voltage in mV For example, if measurement range is 900 to 1100hPa, and full scale voltage is 2500mV, then Slope = (1100-900) / 2500 = **0.08**

See also:

General (Measurement) properties
Input (Measurement) properties
Voltage (Input) properties
Slope and intercept (Calculation) properties
Result properties

INSTALLATION NOTES

Please set the DIP switches as described in the BS5 user manual.
Delta-T recommended settings for using the BS5 with the GP2 would be:
Analog output switches set to 2.5V
Pressure range settings 900 to 1100mbar
The default measurement properties are set up assuming this configuration. Please make sure the DIP switch settings reflect this. If you decide to change the DIP switch settings you will need to alter the measurement properties as detailed above.

Mounting for outdoor use:
When designated for outdoor use, the unit is supplied with a solar shield and U-bolts. The sensor is provided attached to the solar shield. Install the solar shield with the Ubolts provided on any vertical pipe up to 2” IPS. For mounting on a flat surface, remove U-

bolts. Install the sensor to face a northerly direction so that the solar shield protects the sensor enclosure from direct sunlight.

Mounting for indoor use:
For indoor mounting to a flat surface without the solar shield, refer to Figure 2.2 for mounting dimensions. Please note the cover must be removed when mounting the pressure sensor in this manner.

CHECK SENSOR IS WORKING
1. Connect the sensor to the logger as shown above
2. Connect the logger to the PC and run DeltaLINK.
3. Make sure the logger is programmed to read a BS5 sensor from the channel it is connected to and is selected into a suitable Recording.
4. Select the Sensors window and click **Read now**. You should have a sensible reading from the sensor ~1000mbar at sea level.

REFERENCES
- BS5 user manual, Climatronics M102663 user manual

BT1 Thermistor probe

Delta-T Devices
SENSOR

DESCRIPTION

Sensor type: BT1
Measures temperature using the Delta-T Sealed Temperature probe (type BT1)

WIRING

Click image to toggle it's size.

Colour	BT1 wiring	GP2 terminal	Notes
Brown	Resistance HI	CH (+), CH (-)	Fit wire link
Black	Resistance LO	SGND	Screen

Note: The channel numbers are for illustration only. Other channel numbers are also possible.

MEASUREMENT PROPERTIES

Property	*Value*
Settling time (ms) (Advanced property)	The default settling time of 1 ms is suitable for measuring temperatures down to -20 deg C using up to 25 m of cable with 5 nF total cable capacitance. For longer cables or larger cable capacitance see Settling time (ms)
Cable resistance (ohm) (Advanced property)	To correct for resistance of long cable lengths measure the cable resistance with a multimeter and enter the value here. Include the combined series resistance of both (i.e. Signal HI and Signal LO) wires. At 60 deg C the sensitivity of the BT1 is 18 ohm per deg C, so 1 ohm of cable resistance will cause a small error of 0.056 deg C.
Power channel	The default value 'None' is suitable because the BT1 doesn't require a power supply.

See also:
General (Measurement) properties
Input (Measurement) properties
Resistance (Input) properties
Linearization table (Calculation) properties
Result properties

INSTALLATION NOTES

The BT1 thermistor probe is designed for long periods of immersion in SALT or FRESH water. The sensor is 150mm. long by 6 mm diameter, and has a 5 metre long, two core cable. The cable is covered in corrosion - resistant pvdf and may also be immersed

CHECK SENSOR IS WORKING

1. Connect the sensor to the logger as shown above.
2. Connect the logger to the PC and run DeltaLINK.
3. Make sure the logger is programmed to read a BT1 from the channel it is connected to, and is selected into a suitable Recording.
4. Select the Sensors window and click **Read now**. You should have a reading from the sensor.
5. Put the sensor between your hands and try to warm it up - you should see the temperature reading increase.
6. Hold the sensor in the air and wave it around - you should see the temperature reading decrease.

REFERENCES

- Temperature Probes User Manual

EQ2 Equitensiometer

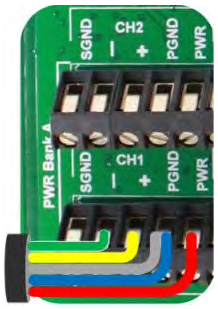
Delta-T Devices SENSOR

DESCRIPTION

Sensor type: EQ2

Measures soil matric potential - that is the negative pressure (or suction) required to extract water from between the matrix of soil particles using the EQ2 Equitensiometer.

WIRING



Click image to toggle it's size.

Colour	EQ2 wiring	GP2 terminal	Notes
Blue	Power 0V	PGND	
Red	Power V+	PWR	
Yellow	Signal HI	CH (+)	
Green	Signal LO	CH (-)	
Screen	Cable shield	PGND	

Note: The channel numbers are for illustration only. Other channel numbers are also possible.

MEASUREMENT PROPERTIES

Property	*Value*
Signal ground terminal (Advanced property)	The default setting is correct for the wiring above. See Signal ground terminal
Minimum power voltage	The default value of 5.1V is suitable for the standard cable length. For extended cable lengths see Minimum power voltage. Note that Minimum power voltage is only available if Power channel (below) is PWR on Bank A or PWR on Bank B.
Power channel	The wiring diagram shows connection to the preferred Power channel. If a preferred Power channel is not available, select one of the other Power channels and modify the Power V+ wiring accordingly. See Power channel
Table	**IMPORTANT:** EQ2 Equitensiometers are supplied with unique linearisation tables which vary widely between units. You will need to create your own sensor linearisation table using the data supplied the Equitensiometer unit. See Creating a linearization table. Note that the Result units of the EQ2x measurement will be the Result units that you enter in the linearization table.

See also:

General (Measurement) properties
Input (Measurement) properties
Voltage (Input) properties
Linearization table (Calculation) properties
Result properties

INSTALLATION NOTES

The Equitensiometer should be thoroughly wetted before use, and installed at a horizontal or slanting angle. Vertical installation may slow the response time, and also lead to incorrect readings because rainfall running down the side of the probe housing may wet the soil around the probe excessively. This is particularly important if the probe is being installed below the soil surface using a probe extension tube. Any gaps between the Equitensiometer and soil should be filled with quartz powder suspension. Small changes to the soil structure surrounding the probe will not affect readings.

It is important to protect the Equitensiometer from strong temperature fluctuations and in particular to avoid exposing the electronics and equilibrium body to different temperatures, e.g. by installing it with the case in strong sunlight. Avoid flexing the cable at low temperatures. It is advisable to protect the cable before burying it in conditions where it may be attacked by soil insects etc.

CHECK SENSOR IS WORKING

1. Connect the sensor to the logger as shown above.
2. Connect the logger to the PC and run DeltaLINK.
3. Make sure the logger is programmed to read an EQ2 from the channel it is connected to, and is selected into a suitable Recording AND you have entered you linearisation table in.
4. Select the Sensors window and click **Read now**. You should have a reading from the sensor.

REFERENCES

- EQ2 User Manual

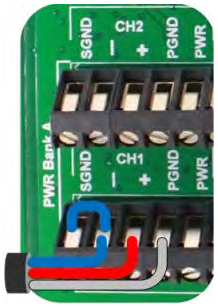
ES2 Energy Sensor

Delta-T Devices
SENSOR

DESCRIPTION

Sensor type: ES2
Measures solar radiation, up to 2kW.m-2, using the Delta-T Energy Sensor (type ES2).

WIRING



Click image to toggle it's size.

Colour	ES2 wiring	GP2 terminal	Notes
Red	Signal HI	CH (+)	
Blue	Signal LO	CH (-) and SGND	Fit wire link
Braid	Screen	PGND	

Note: The channel numbers are for illustration only. Other channel numbers are also possible.

MEASUREMENT PROPERTIES

Property	*Value*
Power channel	The default value 'None' is suitable because the ES2 doesn't require a power supply.

See also:
General (Measurement) properties
Input (Measurement) properties
Voltage (Input) properties
Linear scaling (Calculation) properties
Result properties

INSTALLATION NOTES

Two M4 mounting screws are provided with each sensor.
The sensor is usually mounted horizontally for most solar radiation insolation studies. The readings then give the irradiance (kW.m-2) of a horizontal surface.

The sensor is fitted with 5m of cable with bare wire ends as standard but up to 100m of cable can be fitted at time of ordering.
The ES2 sensor output is not sensitive to the cable length within this limit.
If you need to remove excess cable, simply cut off the excess, but allow for a sufficient length of the cable screen to make the necessary connections.
If you need to extend the cable length, simply add extra cable of similar type with a waterproof joint or junction box.

Two standard fittings are offered, or you can easily make up your own mounting plate.
Levelling Mount type SRLF1
This is a freestanding platform with adjustable legs and bubble level to allow the sensor to be accurately mounted horizontally.

M2 Mast Top Fixture
This is a mast-mounted bracket with an inverted bubble level.
The moveable ball-joint allows the sensor to be mounted horizontally even if the mast is not exactly vertical.

CHECK SENSOR IS WORKING

1. Connect the sensor to the logger as shown above
2. Connect the logger to the PC and run DeltaLINK.
3. Make sure the logger is programmed to read an ES2 from the channel it is connected to and is selected into a suitable Recording.
4. Select the Sensors window and click **Read now**. You should have a reading from the sensor.
5. Shade the sensor from any light – the reading should drop low
6. Put the sensor in direct sunlight – the reading should increase

REFERENCES

- ES2 user manual

ES3 Pyranomemter

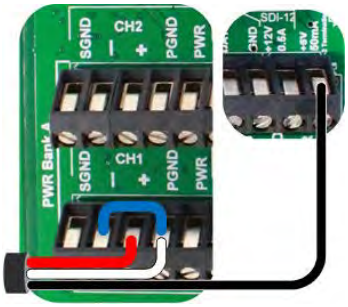
Delta-T Devices
SENSOR

DESCRIPTION

Sensor type: ES3

Measures total shortwave solar radiation, up to 1350W.m-2, using the ES3 pyranometer.

WIRING



Click image to toggle it's size.

Colour	ES3 wiring	GP2 terminal	Notes
Red	Signal HI	CH (+)	
White	Signal LO and Power 0V	PGND and link to CH (-)	
Black	Power V+	+5V 50mA (SDI-12)	

Note: The channel numbers are for illustration only. Other channel numbers are also possible.

MEASUREMENT PROPERTIES

Property	*Value*
Power channel	The wiring diagram shows connection to the preferred Power channel. If a preferred Power channel is not available, select one of the other Power channels and modify the Power V+ wiring accordingly. See Power channel

See also:

General (Measurement) properties
Input (Measurement) properties
Voltage (Input) properties
Linear scaling (Calculation) properties
Result properties

INSTALLATION NOTES

Each sensor is equipped with a mounting bolt. Mount the sensor as level as possible. Small changes in level can cause measurement errors.

The sensor should be mounted with the cable pointing toward the nearest magnetic pole to minimize azimuth error.

CHECK SENSOR IS WORKING

1. Connect the sensor to the logger as shown above.
2. Connect the logger to the PC and run DeltaLINK.
3. Make sure the logger is programmed to read a ES3 from the channel it is connected to, and is selected into a suitable Recording.
4. Select the Sensors window and click **Read now**. You should have a reading from the sensor.
5. Shade the sensor from any light – the reading should drop low
6. Put the sensor in direct sunlight – the reading should increase

REFERENCES

- ES3 Technical Manual

EV2/G Evaporation Gauge

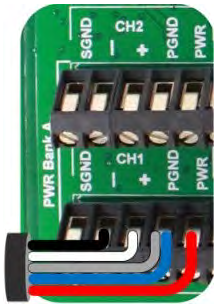
Delta-T Devices
SENSOR

DESCRIPTION

Sensor type: EV2/G

Measures evaporation, up to 300mm, using the Delta-T Evaporation Gauge (type EV2/G).

WIRING



Click image to toggle it's size.

Colour	EV2 wiring	GP2 terminal	Notes
Black	Signal LO	CH (-)	
White	Signal HI	CH (+)	
Blue	Power 0V	PGND	
Braid	Screen	PGND	
Red	Power V+	PWR	

Note: The channel numbers are for illustration only. Other channel numbers are also possible.

MEASUREMENT PROPERTIES

Property	*Value*
Signal ground terminal (Advanced property)	The default setting is correct for the wiring above. See Signal ground terminal
Minimum power voltage	The default value of 7.6V is suitable for the standard cable length. For extended cable lengths see Minimum power voltage. Note that Minimum power voltage is only available if Power channel (below) is PWR on Bank A or PWR on Bank B.
Power channel	The wiring diagram shows connection to the preferred Power channel. If a preferred Power channel is not available, select one of the other Power channels and modify the Power V+ wiring accordingly. See Power channel
Intercept (mm)	The default value is -62.5. Trim the Intercept (offset) value if absolute depth accuracy is required: Use default value to start with, install the sensor and put a known quantity of water over it (measure depth with a ruler). Obtain a GP2 reading (as in CHECK SENSOR IS WORKING below), then adjust the offset to compensate, i.e. trimmed Intercept = original Intercept - error. For example, if the GP2 reads 20 mm and ruler depth is 22 mm, then the error is -2 mm and the trimmed Intercept is -62.5 - (-2) = -62.5 +2 = -60.5.

See also:

General (Measurement) properties
Input (Measurement) properties
Voltage (Input) properties
Slope and intercept (Calculation) properties
Result properties

INSTALLATION NOTES

The pan is manufactured in corrosion resistant aluminium. For siting and location of the pan, please consult the WMO recommendations (publication WMO No.8 'Guide to Meteorological Instruments and Methods of Observation', Sixth edition, 1996). Generally the bottom of the pan should be supported 3-5 cm above the ground on an open frame wooden platform to allow air to circulate under it. The pan should never be placed on a concrete slab or asphalt or a layer of crushed rock.

During the installation of the evaporation sensor it is important to follow these procedures:

1 .The sensor must first be assembled to the base unit. This is achieved by placing the sensor into the hole on the base plate of the same diameter as that of the sensor. Make sure that the sensor body does not protrude through too far as this might impede the free access of water to the measuring surface (see figure). It is best to place the base unit onto a flat surface and to set the sensor body so there is a gap to the flat surface of about 2-3 mm. Using the hexagon key supplied carefully adjust the clamp screw to hold the sensor in the required position.

Note: it is important not to over tighten the clamp screw as this could damage the sensor. Only tighten it enough to secure the sensor.

2. Fill the evaporation pan to approximately 50 mm from the top edge. Note: it is recommended to keep the pan topped up to 50 mm from the top edge for optimum performance. In countries with high ambient radiation from the sun the sensor should be kept submerged as excessive heat could damage the sensor.

3. Place the base plate with the sensor into the water in the evaporation pan. Note: it is important to remove any air bubbles from the underside of the sensor by carefully turning the sensor upside down under water until all the air has escaped from the cavity in the sensor.

4. When the sensor is sitting inside the pan, attach the cable clamp to the top edge of the pan. This should hold the sensor cable securely.
5. Attach the sensor to the logger.
For more information, please refer to the EV2 user manual

Warning:
1. The pressure diaphragm is extremely sensitive and is vulnerable to damage if overloaded. When unpacking the gauge it is important to handle the transmitter with care. The aperture at the end of the sensor is the sensing area and on no account must this surface be touched by sharp objects, or any pressure applied to the face other than the water pressure which is to be measured.
2. Do not attempt to shorten the cable. A high precision 10 ohm resistor is embedded in the free end of the cable. Protect this end of the cable from physical damage.

CHECK SENSOR IS WORKING
1. Connect the sensor to the logger as shown above
2. Connect the logger to the PC and run DeltaLINK.
3. Make sure the logger is programmed to read a EV2 sensor from the channel it is connected to and is selected into a suitable Recording.
4. Hold the sensor in air, Select the Sensors window and click **Read now**. You should have a zero reading from the sensor
5. Drop the sensor into a rather deep container of water - the reading should increase (could be a very slight increase depending on depth of water above the sensor).

REFERENCES
- EV2 user manual

FL10 Flow meter

DESCRIPTION

Sensor type: FL10

Flow meter outputting 1 pulse per 10 litre flow.
Note that this sensor type is provided principally for the purpose of simulating irrigation water flow in the GP2 simulator and is not intended to represent any specific physical device.

See also:

General (Measurement) properties
Input (Measurement) properties
Counter (Input) properties
Linear scaling (Calculation) properties
Result properties

GS1/2 Dome Solarimeter

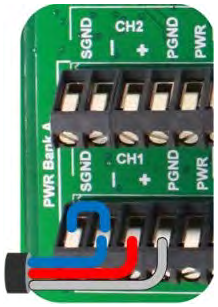
Delta-T Devices
SENSOR

DESCRIPTION

Sensor types: GS1, GS2

Measures net radiation, -0.1 to 1.5KW.m-2, using Delta-T Dome Solarimeters (types GS1, GS2).

WIRING



Click image to toggle it's size.

Colour	GS1/GS2 wiring	GP2 terminal	Notes
Red	Signal HI	CH (+)	
Blue	Signal LO	CH (-) and SGND	Fit wire link
Braid	Screen	PGND	

Note: The channel numbers are for illustration only. Other channel numbers are also possible.

MEASUREMENT PROPERTIES

Property	*Value*
Power channel	The default value 'None' is suitable because the GS1 and GS2 don't require power.
Sensitivity (mV / W.m-2)	**IMPORTANT:** GS1 and GS2 Dome Solarimeters are supplied with unique calibration data which varies widely between units. The default Sensitivity value of '1' is **NOT** suitable and you must convert the value supplied on the sensor's calibration certificate into mV/W.m-1 and enter it here. For example, if the sensitivity is quoted as 19.88 × 10-6 V per W.m-2, then set Sensitivity to 0.01988 mV / W.m-2.

See also:

General (Measurement) properties
Input (Measurement) properties
Voltage (Input) properties
Linear scaling (Calculation) properties
Result properties

INSTALLATION NOTES

The solarimeter should also be located so that no shadows will be cast on it at any time, and far away from light-coloured walls or other objects likely to reflect sunlight on to it. In principle no special orientation of the sensor is required, but the WMO recommend that the emerging leads are pointed to the nearest Pole to minimise heating of the electrical connections.
Accurate measurement of the global radiation requires the proper levelling of the thermopile surface. The bubble level fitted may be used to achieve this in conjunction with the adjustments on the mounting fixture. Note that on the mast mounted version, the mast (not supplied with GS1) must be vertical to achieve this easily.

GS2
Albedo measurements give the fraction of solar radiation reflected by the ground surface. A pair of solarimeters can be used as an albedometer by inverting one of them to receive reflected solar radiation. The GS2 is constructed in this manner, using two GS1s, and much of the detailed information previously for GS1 given is equally relevant to the GS2.

The W.M.O recommends mounting the albedometer 1-2m above the ground surface, which should preferably be grass covered. Special considerations are needed for snow cover and reference should be made to W.M.O No.8.

If the cable has been extended, the joint is weatherproof but not recommended for long periods of immersion and should be protected from such conditions. Additional screened cable of similar cross-section may be added if required without significantly affecting the Delta-T logger accuracy.

CHECK SENSOR IS WORKING

1. Connect the sensor to the logger as shown above
2. Connect the logger to the PC and run DeltaLINK.
3. Make sure the logger is programmed to read a GS1 or GS2 from the channel it is connected to and is selected into a suitable Recording.
4. Select the Sensors window and click **Read now**. You should have a reading from the sensor.
5. Shade the dome from any light – the reading should drop low
6. Put the dome in direct sunlight – the reading should increase

REFERENCES
- GS1/2 user manual

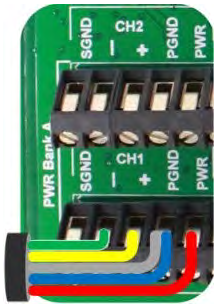
ML2x soil moisture Sensor

Delta-T Devices
SENSOR

DESCRIPTION

Sensor types: ML2x, ML2-Special
Measures volumetric soil moisture (%vol) in mineral soils using the Delta-T ThetaProbe (type ML2).
ML2-Special gives soil moisture values using the **150mS.m-1 calibration**, in line with ML3 calibration (for more information, **see below**).

WIRING



Click image to toggle it's size.

Colour	ML2x wiring	GP2 terminal	Notes
Blue	Power 0V	PGND	
Red	Power V+	PWR	
Yellow	Signal HI	CH (+)	
Green	Signal LO	CH (-)	
Screen	Cable shield	PGND	

Note: The channel numbers are for illustration only. Other channel numbers are also possible.

MEASUREMENT PROPERTIES

Property	*Value*
Signal ground terminal (Advanced property)	The default setting is correct for the wiring above. See Signal ground terminal
Minimum power voltage	The default value of 5.1V is suitable for the standard cable length. For extended cable lengths see Minimum power voltage. Note that Minimum power voltage is only available if Power channel (below) is PWR on Bank A or PWR on Bank B.
Power channel	The wiring diagram shows connection to the preferred Power channel. If a preferred Power channel is not available, select one of the other Power channels and modify the Power V+ wiring accordingly. See Power channel
Result units	Select % or m3.m-3. Note that if you change the Result units, then Minimum, Maximum and Resolution Result properties are automatically adjusted. However, you will need to adjust any Formulae, Conditions or Scripts which use the measurement.
Soil type	Select one of the soil types provided or enter soil-specific a0 and a1 values (below).
a0 and a1	Soil coefficients for the selected Soil type (above). Alternatively, enter soil-specific values for your soil. To perform a soil-specific calibration refer to the ML2x user manual.

See also:
General (Measurement) properties
Input (Measurement) properties
Voltage (Input) properties
Soil moisture from mV (Calculation) properties
Result properties

INSTALLATION NOTES

Essentially installation is very simple - you just push the probe into the soil until the rods are fully covered, connect up the power supply and take readings from the analogue output. Optional extension tubes are available for monitoring a soil layer below the surface.

You will need to consider each of the following factors when setting up a measurement:

Air pockets

The ThetaProbe is sensitive to the water content of the soil sample held within its array of 4 stainless steel rods, but this sensitivity is biased towards the central rod and falls off towards the outside of this cylindrical sampling volume. The presence of air pockets around the rods, particularly around the central rod, will reduce the value of soil moisture content measured. In particular, you need to be very careful when removing and re-inserting the probe into a previous location.

Insertion angle

If the probe is going to be left in situ, and measurements taken during and after rainfall, it is a good idea to insert it at an angle (say 20°), so that any water running down the side of the probe housing tends to be carried away from the rods. This is particularly

important if the probe is being installed below the soil surface using a probe extension tube.

Soil sampling points
The soil water content measured by a ThetaProbe within one small locality can be affected by :
Variations in soil density and composition
Stones close to the rods
Roots (either nearby or pierced by the rods)
Earth worm holes (or even mole holes!)
Subsoil drainage
Small scale variability in transpiration and evaporation losses.
It is important to take the degree of variability of these various parameters into account when deciding on the number of probes to use at any particular location. If the soil is known to be very heterogeneous, it will be necessary to take measurements from at least three closely-spaced locations.

150mS.m-1 Calibration (ML2-Special)
The ML3 was launched with a new sensor calibration in order to further improve its performance. This brings it into line with the PR2, SM300 and SM150 sensors, but at higher water contents (>40%vol) it results in a significant change from the ML2x which it replaces. If you want to achieve full compatibility between future ML3 and ML2x readings (that maybe installed together), we recommend using the '**ML2-Special'** option for the ML2s, instead of th standard ML2 option.

Warning
Do not remove the ThetaProbe from soil by pulling on the cable.
Do not touch the pins. A typical electrostatic discharge from your body can create a temporary -10mV offset in sensor readings lasting an hour.

CHECK SENSOR IS WORKING
1. Connect the sensor to the logger as shown above
2. Connect the logger to the PC and run DeltaLINK.
3. Make sure the logger is programmed to read an ML2 from the channel it is connected to and is selected into a suitable Recording.
4. Select the Sensors window and click **Read now**. You should have a reading from the sensor (unless it is in air, in which case you will get a reading of '-INF' as it is below the measurement range).
5. Put the ML2x in wet, saturated soil - the reading should increase.
6. Put the ML2x in dry soil - the reading should drop down.

REFERENCES
- ML2 Quick start guide and user manual

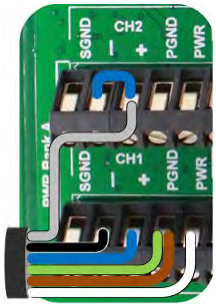
ML3 soil moisture and temperature Sensor

Delta-T Devices
SENSOR

DESCRIPTION

Sensor types: ML3 (soil moisture), ML3 (temperature)
Measure volumetric soil moisture and temperature using the Delta-T Soil Moisture sensor (type ML3).

WIRING



Click image to toggle it's size

Colour	ML3 wiring	GP2 terminal	Notes
Black	Soil Moisture Signal LO	CH1 (-)	
Blue	Soil Moisture Signal HI	CH1 (+)	
Green	Cable Shield	CH1 (PGND)	
Brown	Power 0v/Thermistor LO	CH1 (PGND)	
White	Power V+	CH1 (PWR)	
Grey	Thermistor HI	CH2 (+) and CH2 (-)	Fit wire link

Note: The channel numbers above are for illustration only. Other channel numbers are also possible.

MEASUREMENT PROPERTIES: ML3 (soil moisture)

Property	*Value*
Signal ground terminal (Advanced property)	The default setting is correct for the wiring above. See Signal ground terminal
Minimum power voltage	The default value of 5.1V is suitable for the standard cable length. For extended cable lengths see Minimum power voltage. Note that Minimum power voltage is only available if Power channel (below) is PWR on Bank A or PWR on Bank B.
Power channel	The wiring diagram shows connection to the preferred Power channel. If a preferred Power channel is not available, select one of the other Power channels and modify the Power V+ wiring accordingly. See Power channel
Result units	Select % or m3.m-3. Note that if you change the Result units, then Minimum, Maximum and Resolution Result properties are automatically adjusted. However, you will need to adjust any Formulae, Conditions or Scripts which use the measurement.
Soil type	Select one of the soil types provided or enter soil-specific a0 and a1 values (below).
a0 and a1	Soil coefficients for the selected Soil type (above). Alternatively, enter soil-specific values for your soil. To perform a soil-specific calibration refer to the ML3 user manual.

MEASUREMENT PROPERTIES: ML3 (temperature)

Property	*Value*
Settling time (ms) (Advanced property)	The default settling time of 6 ms is suitable for measuring temperatures down to -20 deg C using up to 25 m of cable with 5 nF total cable capacitance. For longer cables or larger cable capacitance see Settling time (ms)
Cable resistance (ohm) (Advanced property)	The default value of 0 ohm is suitable for most purposes because at 60 deg C the sensitivity of ML3 (temperature) is 95 ohm per deg C and cable resistance of a few ohms will not significantly affect accuracy. If desired, measure the cable resistance with a multimeter and enter the value here. Include the combined series resistance of both (i.e. Signal HI and Signal LO) wires.
Power channel	The default value 'None' is suitable because ML3 (temperature) doesn't require a power supply.

See also:
General (Measurement) properties
Input (Measurement) properties

Voltage (Input) properties
Resistance (Input) properties
Linearization table (Calculation) properties
Soil moisture from mV (Calculation) properties
Result properties

INSTALLATION NOTES

The ML3 is fitted a 5-way connector that should be connected to the GP1 or GP2 using the 'SMSC/sw-05' cable. Extension cables can be added to this, up to a maximum of 100m.

Surface installation

Clear away any stones. Pre-form holes in very hard soils before insertion.

Push the ML3 into the soil until the rods are fully inserted. Ensure good soil contact.

If you feel strong resistance when inserting the ML3, you have probably hit a stone. Stop, and re-insert at a new location.

Installing at depth

Make a 45mm diameter hole, preferably at about 10° to the vertical using the SM-AUG-100 auger.

Connect an extension tube e.g. ML/EX50

Push the ML3 into the soil until rods are fully inserted. Ensure good soil contact.

Alternatively

Dig a trench, and install horizontally.

Warning: Do not touch the pins. A typical electrostatic discharge from your body can create a temporary -10mV offset in sensor readings lasting an hour.

CHECK SENSOR IS WORKING

1. Connect the sensor to the logger as shown above.
2. Connect the logger to the PC and run DeltaLINK.
3. Make sure the logger program is set to read an ML3 from the channel it is connected to and is selected into a suitable Recording.
4. Select the Sensors window and click **Read now**. You should have a reading from the sensor (unless it is in air, in which case you will get a reading of '-INF' as it is below the measurement range).
5. Put the ML3 in wet, saturated soil - the soil moisture reading should increase
6. Put the ML3 in dry soil - the soil moisture reading should drop down.
7. Check the temperature reading is sensible.

REFERENCES

- ML3 Quick start guide and user manual

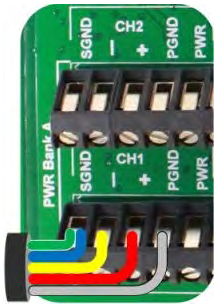
MT2/3 Thermistor Probes

Delta-T Devices
SENSOR

DESCRIPTION

Sensor types: MT2, MT3
Measure temperature (deg C) using the Delta-T Temperature probes (types MT1, MT2)

WIRING



Click image to toggle it's size.

Colour	Thermsitor wiring	GP2 terminal	Notes
Red	Resistance HI	CH (+)	
Yellow	Sense HI	CH (-)	
Blue	Resistance LO	SGND	
Green	Sense LO	SGND	
Braid	Screen	PGND	

Note: The channel numbers are for illustration only. Other channel numbers are also possible.

MEASUREMENT PROPERTIES

Property	*Value*
Settling time (ms) (Advanced property)	The default settling time of 1 ms is suitable for measuring temperatures down to -20 deg C using up to 25 m of cable with 5 nF total cable capacitance. For longer cables or larger cable capacitance see Settling time (ms)
Cable resistance (ohm) (Advanced property)	To correct for resistance of long cable lengths measure the cable resistance with a multimeter and enter the value here. Include the combined series resistance of both (i.e. Signal HI and Signal LO) wires. At 60 deg C the sensitivity of the MT2 is 18 ohm per deg C, so 1 ohm of cable resistance will cause a small error of 0.056 deg C.
Power channel	The default value 'None' is suitable because the MT2 doesn't require a power supply.

See also:
General (Measurement) properties
Input (Measurement) properties
Resistance (Input) properties
Linearization table (Calculation) properties
Result properties

INSTALLATION NOTES

The high precision 2k microchip thermistor is accurate to ±0.1°C over 0-70°C. It is coated with a vinyl dip resulting in a very thin protective skin. The thermistor leads are connected to a four-core extension cable, 5 metres long.

The vinyl dip provides an electrically insulating coating. In view of the possibility of damage to the coating, however, the probe should not be used in water or other electrically conductive liquids.

This sensor has been chosen for its suitability as a high accuracy small temperature sensor for use with the Delta-T Logger, where fast response and small thermal mass is required in situations not requiring hermetic sealing against moisture.

CHECK SENSOR IS WORKING

1. Connect the sensor to the logger as shown above.
2. Connect the logger to the PC and run DeltaLINK.
3. Make sure the logger is programmed to read an MT2/MT3 from the channel it is connected to, and is selected into a suitable Recording.
4. Select the Sensors window and click **Read now**. You should have a reading from the sensor.
5. Put the sensor between your hands and try to warm it up - you should see the temperature reading increase.
6. Hold the sensor in the air and wave it around - you should see the temperature reading decrease.

REFERENCES

- MT2 User Manual

NR2 Net Radiometer

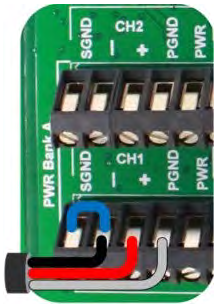
Delta-T Devices
SENSOR

DESCRIPTION

Sensor type: NR2

Measures net radiation, -600 to 1000W.m-2, using the Delta-T Net Radiometer (type NR2).

WIRING



Click image to toggle it's size.

Colour	NR2 wiring	GP2 terminal	Notes
Red	Signal HI	CH (+)	
Black	Signal LO	CH (-) and SGND	Fit wire link
Braid	Screen	PGND	

Note: The channel numbers are for illustration only. Other channel numbers are also possible.

MEASUREMENT PROPERTIES

Property	*Value*
Power channel	The default value 'None' is suitable because the NR2 doesn't require a power supply.
Table	**IMPORTANT:** Each NR2 has 2 different slopes for +ve and -ve sensitivity. You need to construct your own '3 point' linearization table that contains the mV per W.m-2 values obtained from each individual NR2 calibration certifcate. mV W.m-2 -500 -500 x -ve sensitivity (mV per W.m-2) 0 0 1000 1000 x +ve sensitivity (mV per W.m-2) For example, if +ve sensitivity = 0.108 and -ve sensitivity = 0.0856, the linearization table would look like this: mV W.m-2 -500 -42.8 0 0 1000 108 See Creating a linearization table. Note that the Result units of the NR2 measurement will be the Result units that you enter in the linearization table.

See also:
General (Measurement) properties
Input (Measurement) properties
Voltage (Input) properties
Linearization table (Calculation) properties
Result properties

INSTALLATION NOTES

Siting the net radiometer:

Generally, the WMO recommendation is that a height of 2m above short homogeneous vegetation is adopted. Practical considerations may require a compromise height of between 1 and 2 m.

The upward facing surface of the sensor requires a site free from obstructions around the horizon, or at least having no obstruction of angular size greater than 5° in any direction which has a low sun angle at any time during the year.The sensor head must be installed above the surface of interest. The downward facing surface of the sensor is influenced most by the ground directly beneath the sensor, which must of course be as representative as possible of the surrounding terrain. For a sensor mounted 1m above the surface, 90% of all the radiation measured is emitted by a circular surface of diameter of 6m, 95% by one of 9m, and 99% by one of 20m.

The output of a sensor located too close to the surface will show large effects due to its own shadow, and may be affected by other parts of the weather station appearing in the field of view.If the surface close to the mast is not representative, an alternative site for the NR2 must be found in the vicinity, and a separate mast or mounting method must be provided. Extension of the cable may also be required.

Mounting brackets, and support arm extension:

The NR2 is supplied with a tube mounting bracket which fits on to the Delta-T weather station M2 mast. Using this you can position the NR2 sensor head up to 0.85 m horizontally away from the mast. An optional 1m support arm extension tube increases this capability to about 1.75m.

When using the Delta-T support arm extension, you will have to remove the support arm from the extension tube to gain access to the desiccant tube. Leave enough slack in the cable to facilitate this. An additional clamping bracket is provided if you are not using the

standard M2 mast. Always ensure the NR2 is level.

Cable:
If you need to extend the cable, you can join additional similar screened cable to it, up to a total length of about 50 m. The calibration of the NR2 will not be affected, but you must check that noise problems do not occur if the cable is situated in an electrically noisy environment. Make sure the cable joints are weatherproof.

For more information, please refer to the NR2 user manual

CHECK SENSOR IS WORKING
1. Connect the sensor to the logger as shown above
2. Connect the logger to the PC and run DeltaLINK.
3. Make sure the logger is programmed to read an NR2 sensor from the channel it is connected to and is selected into a suitable Recording.
4. Select the Sensors window and click **Read now**. You should have a reading from the sensor.
5. Shade the upward facing dome from any light – the reading should drop low
6. Put the upward facing dome in direct sunlight – the reading should increase

REFERENCES
- NR2 User manual

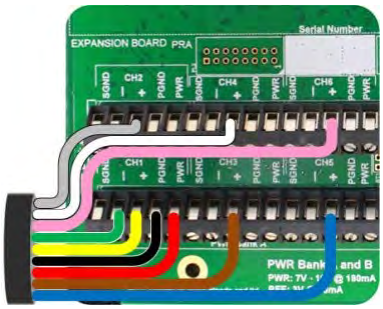
PR2 Profile Probe

Delta-T Devices
SENSOR

DESCRIPTION

Sensor type: PR2
Measures volumetric soil moisture using Delta-T Profile Probes (types PR2/4 and PR2/6)

WIRING



Click image to toggle it's size.

Colour	PR2 wiring	GP2 terminal	Notes
Yellow	Vout1	CH1 (+)	
Grey	Vout2	CH2 (+)	
Brown	Vout3	CH3 (+)	
White	Vout4	CH4 (+)	
Blue	Vout5	CH5 (+)	
Pink	Vout6	CH6 (+)	
Green	Signal LO	CH1 (-)	
Red	Power V+	CH1 (PWR)	
Black	Power 0V	CH1 (GND)	

Note: The channel numbers above are for illustration only. Other channel numbers are also possible.

If you have an extension lid fitted to the GP2 (GP2-P2-LID), you can connect the PR2 directly to the 8way connector, using a PR2 extension cable, thus avoiding any wiring.

MEASUREMENT PROPERTIES

Property	***Value***
Signal ground terminal (Advanced property)	The terminal that Signal LO is connected to. **IMPORTANT:** The PR2 (complete) options initially set this up correctly. If you insert the PR2 Measurements individually or change their Channels, you must also set Signal ground terminal correctly for each Measurement. See Signal ground terminal
Minimum power Voltage	The default value of 5.6V is suitable for the standard cable length. For extended cable lengths see Minimum power voltage. Note that Minimum power voltage is only available if Power channel (below) is PWR on Bank A or PWR on Bank B.
Power channel	The wiring diagram shows connection to the preferred Power channel. If a preferred Power channel is not available, select one of the other Power channels and modify the Power V+ wiring accordingly. See Power channel
Result units	Select % or m3.m-3. Note that if you change the Result units, then Minimum, Maximum and Resolution Result properties are automatically adjusted. However, you will need to adjust any Formulae, Conditions or Scripts which use the measurement.
Soil type	Select one of the soil types provided or enter soil-specific a0 and a1 values (below).
a0 and a1	Soil coefficients for the selected Soil type (above). Alternatively, enter soil-specific values for your soil. To perform a soil-specific calibration refer to the PR2 user manual.

See also:
General (Measurement) properties
Input (Measurement) properties
Voltage (Input) properties
Soil moisture from mV (Calculation) properties
Result properties

INSTALLATION NOTES

Install the access tubes into the ground, please refer to the PR2 augering manual for instructions on this.

Important: The sensor cable is too big to fit through the standard GP2 cable glands. Please use the GP2 expansion lid, with the PR2 connectors fitted (GP2-P2-LID), as this has M12 connectors fitted to it, that allow direct connection from the PR2 cable to the logger, circumventing any wiring. Alternatively, you could use the GP2 expansion lid with the larger gland options (GP2-G5-LID) that allows the cable to fit through them.

Remove the access tube cap and check for damp
If the access tube has been left empty for several weeks, check for condensation by threading paper towel into the slot in the cleaning rod and pushing this to the bottom of the tube. If there is any water present, you will need to dry the tube thoroughly.

Check the centring springs
Remove the PR2 from its protective tube.
The Profile Probe is fitted with centring springs so that the probe is correctly centred within an access tube. They must be fitted and working properly for the probe to take accurate readings. Each centring spring (coiled spring) sits on top of an o-ring.

Insert the Profile Probe
Take care as the first centring spring is pushed into the tube not to pinch the spring unevenly against the side of the tube. A slight twisting motion as the spring goes in will help protect it.

Align the probe
The probe should be aligned consistently each time it is inserted, using the alignment marks on the access tube and the label on probe handle.
If you want to maximise the sampling at each location, we suggest that you take the average of three readings at each location, with the tube rotated through 120° each time – the three small screw heads can be used for this purpose.
Ensure that the Profile Probe is pushed all the way down over the top o-ring.
The PR2 is then fully sealed in its access tube and ready either for immediate reading or for attaching to a logger for extended monitoring.

The Profile Probe is fitted with a screened 8-way connector. When used with a GP2 without a lid extension this should be connected using the PRC/w-05 cable and wired directly into the screw terminals, as shown above. If you have a lid extension then the PR2 can be connected directly to an 8 way connector using an extension cable type 'EXT/8W'. Extension cables can be added as required up to 100m.

Warning:
Keep your PR2 in its protection tube and fit the connector cap when the probe is not in use. The Profile Probe should be stored in a dry environment (definitely non-condensing), and protected from sharp blows.
Do not touch the metal sensor rings, the PR2 is susceptable to damage by electrostatic discharge.
Never use any chemical solvents or cleaners on the probe, or near to it. Avoid strong chemical vapours, especially during probe storage. Polycarbonate can develop stress cracks when exposed to certain chemicals. Such stress cracking greatly weakens the polycarbonate and may lead to brittle fracture of the shaft, even at very low stresses.

CHECK SENSOR IS WORKING
1. Connect the sensor to the logger as shown above and make sure it is pushed into it's protective access tube.
2. Connect the logger to the PC and run DeltaLINK.
3. Make sure the logger is programmed to read a PR2 from the channels it is connected to and is selected into a suitable Recording.
4. Select the Sensors window and click **Read now**. You should see a response from each of the sensor positions. Note: this may be a '-INF' reading as it is below the measurement range.
5. In turn, place your hand around each of the sensor positions and check that the reading increases for the sensor position that you have your hand around. Check that the reading drops when you remove your hand from the sensor.

REFERENCES
- PR2 Quick start guide and user manual
- PR2 augering quick start guide and user manual

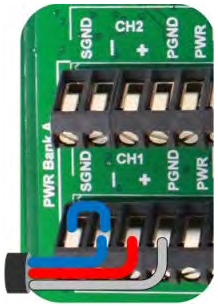
QS2 Energy Sensor

Delta-T Devices
SENSOR

DESCRIPTION

Sensor type: QS2
Measures PAR, up to 2mmol.m-2.s-1 (mmol), using the Delta-T Quantum Sensor, type QS2.

WIRING



Click image to toggle it's size.

Colour	QS2 wiring	GP2 terminal	Notes
Red	Signal HI	CH (+)	
Blue	Signal LO	CH (-) and SGND	Fit wire link
Braid	Screen	PGND	

Note: The channel numbers are for illustration only. Other channel numbers are also possible.

MEASUREMENT PROPERTIES

Property	*Value*
Power channel	The default value 'None' is suitable because the QS2 doesn't require a power supply.

See also:
General (Measurement) properties
Input (Measurement) properties
Voltage (Input) properties
Linear scaling (Calculation) properties
Result properties

INSTALLATION NOTES

Two M4 mounting screws are provided with each sensor.
The sensor must be mounted horizontally.
The sensor is fitted with 5m of cable with bare wire ends as standard but up to 100m of cable can be fitted at time of ordering.
The QS2 sensor output is not sensitive to the cable length within this limit.
If you need to remove excess cable, simply cut off the excess, but allow for a sufficient length of the cable screen to make the necessary connections.
If you need to extend the cable length, simply add extra cable of similar type with a waterproof joint or junction box.

Two standard fittings are offered, or you can easily make up your own mounting plate.

Levelling Mount type SRLF1
This is a freestanding platform with adjustable legs and bubble level to allow the sensor to be accurately mounted horizontally.

M2 Mast Top Fixture
This is a mast-mounted bracket with an inverted bubble level.
The moveable ball-joint allows the sensor to be mounted horizontally even if the mast is not exactly vertical.

CHECK SENSOR IS WORKING

1. Connect the sensor to the logger as shown above
2. Connect the logger to the PC and run DeltaLINK.
3. Make sure the logger is programmed to read a QS2 from the channel it is connected to and is selected into a suitable Recording.
4. Select the Sensors window and click **Read now**. You should have a reading from the sensor.
5. Shade the sensor from any light – the reading should drop low
6. Put the sensor in direct sunlight – the reading should increase

REFERENCES

- QS2 user manual

RG1 Rain Gauge

Delta-T Devices
SENSOR

DESCRIPTION

Sensor type: RG1
Measures accumulated rainfall (mm) using the Delta-T Raingauge (type RG1).

WIRING

Click the above image to toggle it's size

Colour	RG1 wiring	GP2 terminal	Notes
Clear	Switch NO	EV1	
Yellow	Switch common	GND	
Braid	Screen	GND	

Note: The channel numbers are for illustration only. Other channel numbers are also possible.

MEASUREMENT PROPERTIES

Property	*Value*
Sensitivity	Each RG1 has its own individual calibration factor that can range from 0.195 to 0.205 mm per tip, which is provided on the RG1 calibration certificate. To use this individual calibration set Sensitivity = 1 / calibration factor. For eaxample, if calibration factor = 0.198, then set Sensitivity to 5.05 (i.e. 1 / 0.198)

See also:
General (Measurement) properties
Input (Measurement) properties
Counter (Input) properties
Linear scaling (Calculation) properties
Result properties

INSTALLATION NOTES

The gauge should be installed in accordance with the standard rules applicable to any raingauge, such as ensuring that it is not closer to an object by more than twice the object's height. This avoids any shielding effect. The weather station mast has quite a low wind profile, but we provide 5m of cable for mounting the raingauge at a distance from the mast. Research has shown that since a raingauge acts as an obstruction to the flow of wind, the flow of air speeds over the top, causing less rain to be collected by the funnel than would have fallen on the ground if the raingauge had not been there. In most cases this is ignored, but it may be corrected for arithmetically, or overcome physically by placing the gauge in a pit with the tip of its funnel level with the ground. The pit is covered by a grating to simulate the ground aerodynamically while preventing splash-in to the funnel. While excellent, this method may not always be practical. To minimise the effect of wind turbulence around the funnel, the profile of the raingauge has been designed to reduce wind effects so that the catch of the gauge is increased. Such a gauge can therefore, be deployed successfully in more exposed sites. An anodised aluminium base plate is provided for levelling the raingauge and to attach it firmly to the ground. This plate can either be pinned to the ground with the stakes provided, or it can be bolted to a block of concrete or wood. Three threaded studs attached to the base plate are bolted to the plastic base of the raingauge. It can be levelled by adjusting the heights of the nuts on the studs and by observing the built-in spirit level.
It is important to ensure that the raingauge is level. Failure to do this will result in a systematic error. Many users pay only scant attention to this, yet it is one of the simplest means of improving the accuracy of rainfall measurements.

CHECK SENSOR IS WORKING

1. Connect the sensor to the logger as shown above and remove the funnel (3 screws).
2. Connect the logger to the PC and run DeltaLINK.
3. Make sure the logger is programmed to read an RG1 from the channel it is connected to and is selected into a suitable Recording.
4. Select the Sensors window and click **Read now**.
5. Manually tip the tipping collector inside the rain gauge, every time you tip it, the logger should record a ~0.2mm (or whatever your individual calibration factor is) rain event

REFERENCES

- RG1 user manual

RG2 Rain Gauge

Delta-T Devices
SENSOR

DESCRIPTION

Sensor type: RG2
Measures accumulated rainfall (mm) using the Delta-T Rain Gauge (type RG2).

WIRING

Click image to toggle it's size.

Colour	RG2 wiring	GP2 terminal	Notes
Red	Switch NO	EV1	
Blue	Switch Common	GND	

Note: The channel numbers above are for illustration only. Other channel numbers are also possible.

MEASUREMENT PROPERTIES

Property	*Value*
Power channel	The default value 'None' is suitable because the RG2 doesn't require a power supply.

See also:
General (Measurement) properties
Input (Measurement) properties
Counter (Input) properties
Linear scaling (Calculation) properties
Result properties

INSTALLATION NOTES

The RG2 is supplied with aluminium angle brackets to fit the box at the base of the unit. You can use these to mount the raingauge on any suitable horizontal surface.
Four M4 mounting holes at 30 mm x 138 mm rectangular pitch spacing are provided by the angle brackets.
Ground mounting is generally preferred. It is scientifically accepted that a raingauge mounted at 1.5 m above ground will collect about 7% less rain than an identical unit mounted on the ground.
Mount the raingauge with its axis vertical. Small deviations from the vertical will not significantly affect the accuracy of rainfall collection. Use a spirit level across the top of the funnel to verify the alignment, if necessary.
Note that water emerges from the slots in the base during rainfall.

Baseplate type RG2-BP

This is a rectangular Foamex plate of durable plastic, for mounting the raingauge on the ground.
Attach the raingauge to the base plate holes (countersunk underneath), using four countersunk screws and nuts provided.
Secure the baseplate to the ground or soil with four spikes using the corner mounting holes. Finally, make sure the raingauge is vertical.

Mast Mount type RG2-M

This mount can be used on the Delta-T M2 Mast, or S/Pole, using the U-bolts provided. In fact, it can be attached to almost any vertical or horizontal pole with a diameter in the range of 30 to 50 mm.
The raingauge centre line is positioned approximately 250 mm from the centre line of the mast.
Use the small amount of play in the U-bolt fittings to ensure that the raingauge is mounted vertically, even if the support poles are not perfectly aligned.
A typical requirement is to mount the top of the funnel 1.5 m above the ground level. As far as possible, make sure that the raingauge does not shield other sensors on the mast (for example wind sensors), and is not itself shielded from receiving rainfall.

Warning: Do not block the slots in the base of the unit. Take care to prevent blockage by insect or leaf debris.

CHECK SENSOR IS WORKING

1. Connect the sensor to the logger as shown above and remove the funnel (3 screws).
2. Connect the logger to the PC and run DeltaLINK.
3. Make sure the logger is programmed to read an RG2 from the channel it is connected to and is selected into a suitable Recording.
4. Select the Sensors window and click **Read now**.
5. Manually tip the tipping collector inside the rain gauge, every time you tip it, the logger should record a 0.2mm rain event

REFERENCES

- RG2 user manual

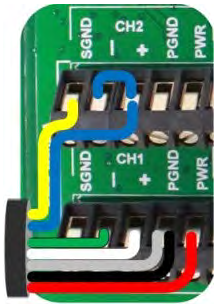
RHT2nl RH and Air Temperature Sensor

Delta-T Devices
SENSOR

DESCRIPTION

Sensor types: RHT2nl (humidity), RHT2nl (temperature)
Measures relative humidity (%) and temperature (deg C) using Delta-T Humidity and Temperature sensor (type RHT2nl)

WIRING



Click image to toggle it's size.

Colour	RHT2nl wiring	GP2 terminal	Notes
Green	RH Signal LO	CH1 (-)	
White	RH Signal HI	CH1 (+)	
Black	Power 0V	CH1 (PGND)	
Braid	Screen	CH1 (PGND)	
Red	Power V+	CH1 (PWR)	
Yellow	Thermistor LO	CH2 (SGND)	
Blue	Thermistor HI	CH2 (+) and CH2 (-)	Fit wire link

Note: The channel numbers are for illustration only. Other channel numbers are also possible.

MEASUREMENT PROPERTIES: RHT2nl (humidity)

Property	*Value*
Signal ground terminal (Advanced property)	The default setting is correct for the wiring above. See Signal ground terminal
Minimum power voltage	The default value of 5.6V is suitable for the standard cable length. For extended cable lengths see Minimum power voltage. Note that Minimum power voltage is only available if Power channel (below) is PWR on Bank A or PWR on Bank B.
Power channel	The wiring diagram shows connection to the preferred Power channel. If a preferred Power channel is not available, select one of the other Power channels and modify the Power V+ wiring accordingly. See Power channel

MEASUREMENT PROPERTIES: RHT2nl (temperature)

Property	*Value*
Settling time (ms) (Advanced property)	The default settling time of 1 ms is suitable for measuring temperatures down to -20 deg C using up to 25 m of cable with 5 nF total cable capacitance. For longer cables or larger cable capacitance see Settling time (ms)
Cable resistance (ohm) (Advanced property)	To correct for resistance of long cable lengths measure the cable resistance with a multimeter and enter the value here. Include the combined series resistance of both (i.e. Signal HI and Signal LO) wires. At 60 deg C the sensitivity of RHT2nl (temperature) is 18 ohm per deg C, so 1 ohm of cable resistance will cause a small error of 0.056 deg C.
Power channel	The default value 'None' is suitable because RHT2nl (temperature) doesn't require a power supply.

See also:
General (Measurement) properties
Input (Measurement) properties
Voltage (Input) properties
Resistance (Input) properties
Linear scaling (Calculation) properties
Linearization table (Calculation) properties
Result properties

INSTALLATION NOTES

If the shield has not been pre-assembled, fix the angle bracket to the shield using the three stud nuts. You can then attach the angle

bracket to a horizontal or vertical pole or mast using the U-bolts provided.
After the shield has been mounted, you can fit either the RHT2 sensor through the sensor gland clamp, from below. A housing sleeve is provided with each sensor to enable you to position the sensor element within the shield.
You can subsequently remove the sensors easily for inspection without dismantling the shield from the mast.

CHECK SENSOR IS WORKING

1. Connect the sensor to the logger as shown above.
2. Connect the logger to the PC and run DeltaLINK.
3. Make sure the logger is programmed to read an RHT2 from the channels it is connected to, and is selected into a suitable Recording.
4. Select the Sensors window and click **Read now**. You should have some readings from the sensor.
5. Blow on to protective cap at the top of the sensor - you should see the humidity and temperature readings increase.
6. Hold the sensor in the air and wave it around - you should see the readings decrease again.

REFERENCES

- RHT2 user manual

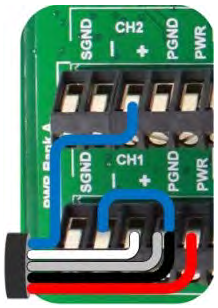
RHT2v RH and Air Temperature Sensor

Delta-T Devices
SENSOR

DESCRIPTION

Sensor types: RHT2v (humidty), RHT2v (temperature)
Measures relative humidity (%) and temperature (deg C) using Delta-T Humidity and Temperature sensor (type RHT2v)

WIRING



Click image to toggle it's size.

Colour	RHT2v wiring	GP2 terminal	Notes
White	RH Signal HI	CH1 (+)	
Black	Common Ground	CH1 (-) and CH1 (PGND)	Link all inputs together
Red	Power V+	CH1 (PWR)	
Blue	Temp Signal HI	CH2 (+)	

Note: The channel numbers are for illustration only. Other channel numbers are also possible.

MEASUREMENT PROPERTIES: RHT2v (humidty)

Property	*Value*
Signal ground terminal (Advanced property)	The terminal that Common Ground is connected to. **IMPORTANT:** The RHT2v (complete) option initially sets this up correctly. If you insert the humidity and temperature Measurements individually or change their Channels, you must also set Signal ground terminal correctly for each Measurement. See Signal ground terminal
Signal ground terminal (Advanced property)	The default setting is correct for the wiring above. See Signal ground terminal
Minimum power voltage	The default value of 5.6V is suitable for the standard cable length. For extended cable lengths see Minimum power voltage. Note that Minimum power voltage is only available if Power channel (below) is PWR on Bank A or PWR on Bank B.
Power channel	The wiring diagram shows connection to the preferred Power channel. If a preferred Power channel is not available, select one of the other Power channels and modify the Power V+ wiring accordingly. See Power channel

MEASUREMENT PROPERTIES: RHT2v (temperature)

Property	*Value*
Signal ground terminal (Advanced property)	As RHT2v (humidty) above
Signal ground terminal (Advanced property)	As RHT2v (humidty) above
Minimum power voltage	As RHT2v (humidty) above
Power channel	As RHT2v (humidty) above

See also:
General (Measurement) properties
Input (Measurement) properties
Voltage (Input) properties
Linear scaling (Calculation) properties
Slope and intercept (Calculation) properties
Result properties

INSTALLATION NOTES

If the shield has not been pre-assembled, fix the angle bracket to the shield using the three stud nuts. Then attach the angle bracket to a horizontal or vertical pole or mast using the U-bolts provided.
After the shield has been mounted, fit the RHT2 sensor through the sensor gland clamp, from below. A housing sleeve is provided with

each sensor to enable you to position the sensor element within the shield.
You can subsequently remove the sensors easily for inspection without dismantling the shield from the mast.

CHECK SENSOR IS WORKING

1. Connect the sensor to the logger as shown above.
2. Connect the logger to the PC and run DeltaLINK.
3. Make sure the logger is programmed to read an RHT2 from the channels it is connected to, and is selected into a suitable Recording.
4. Select the Sensors window and click **Read now**. You should have some readings from the sensor.
5. Blow on to protective cap at the top of the sensor - you should see the humidity and temperature readings increase.
6. Hold the sensor in the air and wave it around - you should see the readings decrease again.

REFERENCES

- RHT2 user manual

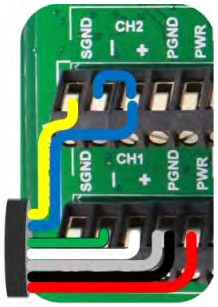
RHT4nl RH and Air Temperature Sensor

Delta-T Devices
SENSOR

DESCRIPTION

Sensor types: RHT4nl (humidity), RHT4nl (temperature)
Measures relative humidity (%) and temperature (deg C) using Delta-T Humidity and Temperature sensor (type RHT4nl)

WIRING



Click image to toggle it's size.

Colour	RHT4 wiring	GP2 terminal	Notes
Green	RH Signal LO	CH1 (-)	
White	RH Signal HI	CH1 (+)	
Black	Power 0V	CH1 (PGND)	
Braid	Screen	CH1 (PGND)	
Red	Power V+	CH1 (PWR)	
Yellow	Thermistor LO	CH2 (SGND)	
Blue	Thermistor HI	CH2 (+) and CH2 (-)	Fit wire link

Note: The channel numbers are for illustration only. Other channel numbers are also possible.

MEASUREMENT PROPERTIES: RHT4nl (humidity)

Property	*Value*
Signal ground terminal (Advanced property)	The default setting is correct for the wiring above. See Signal ground terminal
Minimum power voltage	The default value of 5.6V is suitable for the standard cable length. For extended cable lengths see Minimum power voltage. Note that Minimum power voltage is only available if Power channel (below) is PWR on Bank A or PWR on Bank B.
Power channel	The wiring diagram shows connection to the preferred Power channel. If a preferred Power channel is not available, select one of the other Power channels and modify the Power V+ wiring accordingly. See Power channel

MEASUREMENT PROPERTIES: RHT4nl (temperature)

Property	*Value*
Settling time (ms) (Advanced property)	The default settling time of 9 ms is suitable for measuring temperatures down to -20 deg C using up to 25 m of cable with 5 nF total cable capacitance. For longer cables or larger cable capacitance see Settling time (ms)
Cable resistance (ohm) (Advanced property)	The default value of 0 ohm is suitable for most purposes because at 60 deg C the sensitivity of RHT4nl (temperature) is 90 ohm per deg C and cable resistance of a few ohms will not significantly affect accuracy. If desired, measure the cable resistance with a multimeter and enter the value here. Include the combined series resistance of both (i.e. Signal HI and Signal LO) wires.
Power channel	The default value 'None' is suitable because RHT4nl (temperature) doesn't require a power supply.

See also:
General (Measurement) properties
Input (Measurement) properties
Voltage (Input) properties
Resistance (Input) properties
Linear scaling (Calculation) properties
Linearization table (Calculation) properties
Result properties

INSTALLATION NOTES

The angle bracket can be mounted directly on a wall or vertical surface or alternatively to a vertical or horizontal pole or mast with the

U-bolts provided.
The sensor will be spaced approximately 17cm away from the vertical surface or 20cm from the pole or mast centre-line.
After the shield has been mounted, you can install the RHT4 in it using the sensor clamp nut. Thread the sensor cable through the clamp nut before wiring the sensor to the logger!
You can subsequently remove the sensor for inspection by unscrewing the clamp nut, without dismantling the shield from the bracket.

CHECK SENSOR IS WORKING

1. Connect sensor to the logger as shown above.
2. Connect the logger to the PC and run DeltaLINK.
3. Make sure the logger is programmed to read an RHT4nl from the channels it is connected to, and is selected into a suitable Recording.
4. Select the Sensors window and click **Read now**. You should have some readings from the sensor.
5. Blow on to protective cap at the top of the sensor - you should see the humidity and temperature readings increase.
6. Hold the sensor in the air and wave it around - you should see the readings decrease again.

REFERENCES

- RHT4nl and RHT3nl user manuals

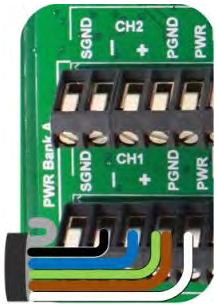
SM150 soil moisture Sensor

Delta-T Devices
SENSOR

DESCRIPTION

Sensor type: SM150
Measures volumetric soil moisture using the Delta-T Soil Moisture sensor (type SM150)

WIRING



Click image to toggle it's size.

Colour	SM150 wiring	GP2 terminal	Notes
Brown	Power 0V	PGND	
White	Power V+	PWR	
Blue	Signal HI	CH (+)	
Black	Signal LO	CH (-)	
Grey	Thermistor+	N/C	
Green	Cable shield	PGND	

Note: The channel numbers are for illustration only. Other channel numbers are also possible.

MEASUREMENT PROPERTIES

Property	*Value*
Signal ground terminal (Advanced property)	The default setting is correct for the wiring above. See Signal ground terminal
Minimum power voltage	Default set to 5.1 for standard cable length. For extended cable lengths, please refer to the DeltaLINK help
Power channel	The wiring diagram shows connection to the preferred Power channel. If a preferred Power channel is not available, select one of the other Power channels and modify the Power V+ wiring accordingly. See Power channel
Result units	Select % or m3.m-3. Note that if you change the Result units, then Minimum, Maximum and Resolution Result properties are automatically adjusted. However, you will need to adjust any Formulae, Conditions or Scripts which use the measurement.
Soil type	Select one of the soil types provided or enter soil-specific a0 and a1 values (below).
a0 and a1	Soil coefficients for the selected Soil type (above). Alternatively, enter soil-specific values for your soil. To perform a soil-specific calibration refer to the SM150 user manual.

See also:
General (Measurement) properties
Input (Measurement) properties
Voltage (Input) properties
Soil moisture from mV (Calculation) properties
Result properties

INSTALLATION NOTES

The SM150 is fitted a 5-way connector that should be connected to the GP1 or GP2 using the 'SMSC/sw-05' cable. Extension cables can be added to this, up to a maximum of 100m.

Surface installation

Clear away any stones. Pre-form holes in very hard soils before insertion.
Push the SM150 into the soil until the rods are fully inserted. Ensure good soil contact.
If you feel strong resistance when inserting the SM150, you have probably hit a stone. Stop, and re-insert at a new location.

Installing at depth

Make a 45mm diameter hole, preferably at about 10° to the vertical using the SM-AUG-100 auger.
Connect an extension tube e.g. ML/EX50
Push the SM150 into the soil until rods are fully inserted. Ensure good soil contact.
Alternatively
Dig a trench, and install horizontally.

Warning:
Do not touch the pins. A typical electrostatic discharge from your body can create a temporary -10mV offset in sensor readings lasting an hour.

CHECK SENSOR IS WORKING
1. Connect the sensor to the logger as shown above
2. Connect the logger to the PC and run DeltaLINK.
3. Make sure the logger is programmed to read an SM150 from the channel it is connected to and is selected into a suitable Recording.
4. Select the Sensors window and click **Read now**. You should have a reading from the sensor (unless it is in air, in which case you will get a reading of '-INF' as it is below the measurement range).
5. Put the SM150 in wet, saturated soil - the reading should increase
6. Put the SM150 in dry soil - the reading should drop down.

REFERENCES
- SM150 Quick start guide and user manual

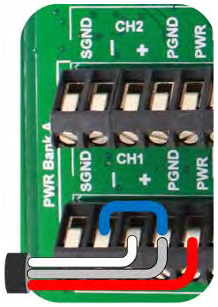
SM200 soil moisture sensor

Delta-T Devices
SENSOR

DESCRIPTION

Sensor type: SM200
Measures volumetric water content using SM200 soil moisture sensor

WIRING



Click image to toggle it's size

Colour	SM200 wiring	GP2 terminal	Notes
Red	Power V+	PWR	
White	Signal HI	CH (+)	
Braid	Ground	CH (-) and PGND	Fit wire link

Note: The channel numbers above are for illustration only. Other channel numbers are also possible.

MEASUREMENT PROPERTIES

Property	*Value*
Signal ground terminal (Advanced property)	The default setting is correct for the wiring above. See Signal ground terminal
Minimum power voltage	Default set to 5.1 for standard cable length. For extended cable lengths, please refer to the DeltaLINK help
Power channel	The wiring diagram shows connection to the preferred Power channel. If a preferred Power channel is not available, select one of the other Power channels and modify the Power V+ wiring accordingly. See Power channel
Result units	Select % or m3.m-3. Note that if you change the Result units, then Minimum, Maximum and Resolution Result properties are automatically adjusted. However, you will need to adjust any Formulae, Conditions or Scripts which use the measurement.
Soil type	Select one of the soil types provided or enter soil-specific a0 and a1 values (below).
a0 and a1	Soil coefficients for the selected Soil type (above). Alternatively, enter soil-specific values for your soil. To perform a soil-specific calibration refer to the SM200 user manual.

See also:
General (Measurement) properties
Input (Measurement) properties
Voltage (Input) properties
Soil moisture from mV (Calculation) properties
Result properties

INSTALLATION NOTES

The SM200 is fitted a 5-way connector that should be connected to the GP1 or GP2 using the 'SM2C/sw-05' cable. Extension cables can be added to this, up to a maximum of 100m.

Surface installation

Clear away any stones. Pre-form holes in very hard soils before insertion.
Push the SM200 into the soil until the rods are fully inserted. Ensure good soil contact.
If you feel strong resistance when inserting the SM200, you have probably hit a stone. Stop, and re-insert at a new location.

Installing at depth

Make a 45mm diameter hole, preferably at about 10° to the vertical using the SM-AUG-100 auger.
Connect an extension tube e.g. ML/EX50
Push the SM200 into the soil until rods are fully inserted. Ensure good soil contact.
Alternatively
Dig a trench, and install horizontally.

Warning:
Do not touch the pins. A typical electrostatic discharge from your body can create a temporary -10mV offset in sensor readings lasting an hour.

CHECK SENSOR IS WORKING
1. Connect the sensor to the logger as shown above
2. Connect the logger to the PC and run DeltaLINK.
3. Make sure the logger is programmed to read an SM200 from the channel it is connected to and is selected into a suitable Recording.
4. Select the Sensors window and click **Read now**. You should have a reading from the sensor (unless it is in air, in which case you will get a reading of '-INF' as it is below the measurement range).
5. Put the SM200 in wet, saturated soil - the reading should increase
6. Put the SM200 in dry soil - the reading should drop down.

REFERENCES
- SM200 Quick start guide and user manual

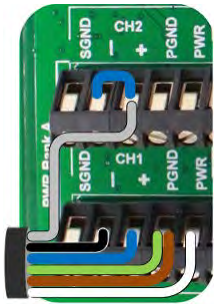
SM300 soil moisture and temperature Sensor

Delta-T Devices
SENSOR

DESCRIPTION

Sensor types: SM300 (soil moisture), SM300 (temperature)
Measure volumetric soil moisture and temperature using the Delta-T Soil Moisture sensor (type SM300)

WIRING



Click image to toggle it's size.

Colour	SM300 wiring	GP2 terminal	Notes
Black	Soil Moisture Signal LO	CH1 (-)	
Blue	Soil Moiture Signal HI	CH1 (+)	
Green	Cable shield	CH1 (PGND)	
Brown	Power 0V/Thermistor LO	CH1 (PGND)	
White	Power V+	CH1 (PWR)	
Grey	Thermistor HI	CH2 (+) and CH2 (-)	Fit wire link

Note: The channel numbers above are for illustration only. Other channel numbers are also possible.

MEASUREMENT PROPERTIES: SM300 (soil moisture)

Property	*Value*
Signal ground terminal (Advanced property)	The default setting is correct for the wiring above. See Signal ground terminal
Minimum power voltage	The default value of 5.1V is suitable for the standard cable length. For extended cable lengths see Minimum power voltage. Note that Minimum power voltage is only available if Power channel (below) is PWR on Bank A or PWR on Bank B.
Power channel	The wiring diagram shows connection to the preferred Power channel. If a preferred Power channel is not available, select one of the other Power channels and modify the Power V+ wiring accordingly. See Power channel
Result units	Select % or m3.m-3. Note that if you change the Result units, then Minimum, Maximum and Resolution Result properties are automatically adjusted. However, you will need to adjust any Formulae, Conditions or Scripts which use the measurement.
Soil type	Select one of the soil types provided or enter soil-specific a0 and a1 values (below).
a0 and a1	Soil coefficients for the selected Soil type (above). Alternatively, enter soil-specific values for your soil. To perform a soil-specific calibration refer to the SM300 user manual.

MEASUREMENT PROPERTIES

Property	*Value*
Settling time (ms) (Advanced property)	The default settling time of 6 ms is suitable for measuring temperatures down to -20 deg C using up to 25 m of cable with 5 nF total cable capacitance. For longer cables or larger cable capacitance see Settling time (ms)
Cable resistance (ohm) (Advanced property)	The default value of 0 ohm is suitable for most purposes because at 60 deg C the sensitivity of SM300 (temperature) is 95 ohm per deg C and cable resistance of a few ohms will not significantly affect accuracy. If desired, measure the cable resistance with a multimeter and enter the value here. Include the combined series resistance of both (i.e. Signal HI and Signal LO) wires.
Power channel	The default value 'None' is suitable because SM300 (temperature) doesn't require a power supply.

See also:
General (Measurement) properties
Input (Measurement) properties

Voltage (Input) properties
Resistance (Input) properties
Linearization table (Calculation) properties
Soil moisture from mV (Calculation) properties
Result properties

INSTALLATION NOTES
The SM300 is fitted a 5-way connector that should be connected to the GP1 or GP2 using the 'SMSC/sw-05' cable. Extension cables can be added to this, up to a maximum of 100m.

Surface installation
Clear away any stones. Pre-form holes in very hard soils before insertion.
Push the SM300 into the soil until the rods are fully inserted. Ensure good soil contact.
If you feel strong resistance when inserting the SM300, you have probably hit a stone. Stop, and re-insert at a new location.

Installing at depth
Make a 45mm diameter hole, preferably at about 10° to the vertical using the SM-AUG-100 auger.
Connect an extension tube e.g. ML/EX50
Push the SM300 into the soil until rods are fully inserted. Ensure good soil contact.
Alternatively, dig a trench, and install horizontally.

Warning: Do not touch the pins. A typical electrostatic discharge from your body can create a temporary -10mV offset in sensor readings lasting an hour.

CHECK SENSOR IS WORKING
1. Connect the sensor to the logger as shown above
2. Connect the logger to the PC and run DeltaLINK.
3. Make sure the logger program is set to read an SM300 from the channel it is connected to and is selected into a suitable Recording.
4. Select the Sensors window and click **Read now**. You should have a reading from the sensor (unless it is in air, in which case you will get a reading of '-INF' as it is below the measurement range).
5. Put the SM300 in wet, saturated soil - the reading should increase
6. Put the SM300 in dry soil - the reading should drop down.

REFERENCES
- SM300 Quick start guide and user manual

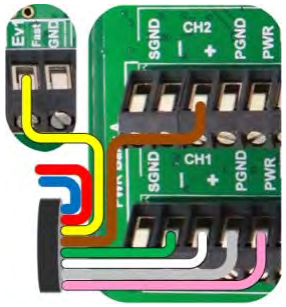
SPN1 Sunshine Pyranometer

Delta-T Devices
SENSOR

DESCRIPTION

Sensor types: SPN1 (energy), SPN1 (sunshine)
Measures total and diffuse solar energy flux up to 2000 W.m-2, and sushine status, using the Delta-T Sunshine Pyranometer (type SPN1).

WIRING



Click image to toggle it's size.

Colour	SPN1 wiring	GP2 terminal	Notes
Green	Signal LO (shared)	CH1 (-)	
White	Total Energy HI	CH1 (+)	
Grey	Logger Power 0V	CH1 (PGND)	
Pink	Logger Power V+	CH1 (PWR)	
Brown	Diffuse Enegy HI	CH2 (+)	
Yellow	Sun Contact	EV1	
Red	Heater V+	N/C	Connect to separate, isolated power supply 12V DC, 1.5A max
Blue	Heater V-	N/C	Connect to separate, isolated power supply 12V DC, 1.5A max
Braid	Screen	CH1 (PGND)	

Note: The channel numbers above are for illustration only. Other channel numbers are also possible.

MEASUREMENT PROPERTIES: SPN1 (energy)

Property	*Value*
Signal ground terminal (Advanced property)	The terminal that Signal LO is connected to. **IMPORTANT:** The SPN1 (complete) option initially sets this up correctly. If you insert the total and diffuse Measurements individually or change their Channels, you must also set Signal ground terminal correctly for each Measurement. See Signal ground terminal
Minimum power voltage	The default value of 5.1V is suitable for the standard cable length. For extended cable lengths see Minimum power voltage. Note that Minimum power voltage is only available if Power channel (below) is PWR on Bank A or PWR on Bank B.
Power channel	The wiring diagram shows connection to the preferred Power channel. If a preferred Power channel is not available, select one of the other Power channels and modify the Logger Power V+ wiring accordingly. See Power channel

MEASUREMENT PROPERTIES: SPN1 (sunshine)

Property	*Value*
Power channel	As SPN1 (energy) above

See also:
General (Measurement) properties
Input (Measurement) properties
Voltage (Input) properties
Digital state (Input) properties
No calculation (Calculation) properties
Result properties

INSTALLATION NOTES

The SPN1 can be mounted either directly onto a horizontal surface or via support arm type SPN1/ARM which includes a ball-joint for levelling and an adapter for connecting to a vertical mast, or on to the adjustable levelling baseplate (type SPN1/BP)

Cables:
The 8-core analogue cable type SP-BF/w-05 is provided for connecting the sensor to a data logger and to carry power to the internal heater.

It is 5m long with a weatherproof M12 8-pole connector at the sensor end and with bare wire flying leads at the logger end.
Analogue extension cables type EXT/M12-xx, where xx = 5, 10 or 25m are available for extending the cable from the sensor to logger. Extension cables can be added, up to a maximum of 100m.

Important: The sensor cable is too big to fit through the standard GP2 cable glands. Please use the cable gland expansion lid (GP2-G5-LID) as this has larger gland options that allow the cable to fit through them.

Warning:
Ensure that differential wiring is used (as diagram above) and not single ended.
There are three different ground connectors in the SPN1 analogue output cable (and another one in the serial cable), so it is possible to create offsets in the readings if these are used without care, especially with long cables. You also need to think about how the data logger ground is connected internally.
Some key principles to remember are:
• Ensure that no return currents flow in the SigGND wire. This should only go to the –ve terminal of a differential voltage input channel.
• Ensure that the current returns for the DL-Pwr wire and the Sun wire are through the DL-Gnd wire.
• Ensure that the current return for the Heater current (Htr+) is through the Htr- wire.
• If you use a logger and a separate power supply, then one of them must be able to float relative to the other, or they must share a common ground connection.

CHECK SENSOR IS WORKING
1. Connect the sensor to the logger as shown above
2. Connect the logger to the PC and run DeltaLINK.
3. Make sure the logger is programmed to read an SPN1 from the channels it is connected to and is selected into a suitable Recording.
4. Select the Sensors window and click **Read now**. You should have a reading from the sensor.
5. Shade the dome from any light – the reading should drop low
6. Put the dome in direct sunlight – the reading should increase

REFERENCES
- SPN1 Quick start guide and user manual

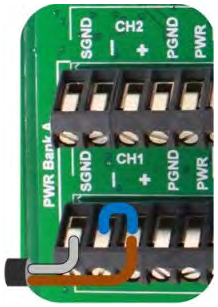
ST1/2 and GT1Thermistor probes

Delta-T Devices
SENSOR

DESCRIPTION

Sensor types: ST1, ST2, GT1
Measures temperature using Delta-T Temperature probes (types ST1, ST2, GT1)

WIRING



Click image to toggle it's size.

Colour	Thermistor wiring	GP2 terminal	Notes
Brown	Resistance HI	CH (+) and CH (-)	Fit wire link
Braid	Resistance LO	SGND	

Note: The channel numbers above are for illustration only. Other channel numbers are also possible.

MEASUREMENT PROPERTIES

Property	*Value*
Settling time (ms) (Advanced property)	The default settling time of 0 ms is suitable for measuring temperatures down to -10 deg C using up to 25 m of cable with 5 nF total cable capacitance. For longer cables or larger cable capacitance see Settling time (ms)
Cable resistance (ohm) (Advanced property)	To correct for resistance of long cable lengths measure the cable resistance with a multimeter and enter the value here. Include the combined series resistance of both (i.e. Signal HI and Signal LO) wires. At 60 deg C the sensitivity of the ST1 is 18 ohm per deg C, so 1 ohm of cable resistance will cause a small error of 0.056 deg C.
Power channel	The default value 'None' is suitable because the sensor doesn't require a power supply.

See also:
General (Measurement) properties
Input (Measurement) properties
Resistance (Input) properties
Linearization table (Calculation) properties
Result properties

INSTALLATION NOTES

The sensor consists of a stainless steel clad thermistor probe with a 5m cable. This can be buried in the soil or used to measure air temperature.

CHECK SENSOR IS WORKING

1. Connect the sensor to the logger as shown above.
2. Connect the logger to the PC and run DeltaLINK.
3. Make sure the logger is programmed to read a thermistor from the channel it is connected to, and is selected into a suitable Recording.
4. Select the Sensors window and click **Read now**. You should have a reading from the sensor.
5. Put the sensor between your hands and try to warm it up - you should see the temperature reading increase.
6. Hold the sensor in the air and wave it around - you should see the temperature reading decrease.

REFERENCES

- ST1 and Temperature probes user manuals

ST3 Thermistor probe

Delta-T Devices
SENSOR

DESCRIPTION

Sensor type: ST3
Measures temperature using Delta-T Temperature probe (type ST3)

WIRING

Click image to toggle it's size.

Colour	ST3 wiring	GP2 terminal	Notes
Brown	Resistance HI	CH (+) and CH (-)	Fit wire link
Black	Resistance LO	SGND	

Note: The channel numbers above are for illustration only. Other channel numbers are also possible.

MEASUREMENT PROPERTIES

Property	*Value*
Settling time (ms) (Advanced property)	The default settling time of 1 ms is suitable for measuring temperatures down to -20 deg C using up to 25 m of cable with 5 nF total cable capacitance. For longer cables or larger cable capacitance see Settling time (ms)
Cable resistance (ohm) (Advanced property)	To correct for resistance of long cable lengths measure the cable resistance with a multimeter and enter the value here. Include the combined series resistance of both (i.e. Signal HI and Signal LO) wires. At 60 deg C the sensitivity of the ST3 is 18 ohm per deg C, so 1 ohm of cable resistance will cause a small error of 0.056 deg C.
Power channel	The default value 'None' is suitable because the ST3 doesn't require a power supply.

See also:
General (Measurement) properties
Input (Measurement) properties
Resistance (Input) properties
Linearization table (Calculation) properties
Result properties

INSTALLATION NOTES

The ST3 is similar to the general purpose ST2, except that it has a sheath-to-cable seal and corrosion-resistant pvdf cable that will improve operational life if immersed for long periods in FRESH water.

CHECK SENSOR IS WORKING

1. Connect the sensor to the logger as shown above.
2. Connect the logger to the PC and run DeltaLINK.
3. Make sure the logger is programmed to read an ST3 from the channel it is connected to, and is selected into a suitable Recording.
4. Select the Sensors window and click **Read now**. You should have a reading from the sensor.
5. Put the sensor between your hands and try to warm it up - you should see the temperature reading increase.
6. Hold the sensor in the air and wave it around - you should see the temperature reading decrease.

REFERENCES

- Temperature Probes user manual

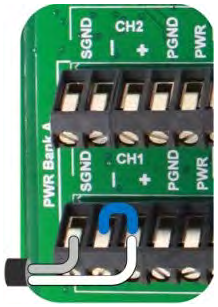
ST4 Thermistor probe

Delta-T Devices
SENSOR

DESCRIPTION

Sensor type: ST4
Measures temperature using Delta-T Temperature probe (type ST4)

WIRING



Click image to toggle it's size.

Colour	ST4 wiring	GP2 terminal	Notes
Clear	Resistance HI	CH (+) and CH (-)	Fit wire link
Braid/Screen	Resistance LO	SGND	

Note: The channel numbers above are for illustration only. Other channel numbers are also possible.

MEASUREMENT PROPERTIES

Property	*Value*
Settling time (ms) (Advanced property)	The default settling time of 9 ms is suitable for measuring temperatures down to -20 deg C using up to 25 m of cable with 5 nF total cable capacitance. For longer cables or larger cable capacitance see Settling time (ms)
Cable resistance (ohm) (Advanced property)	The default value of 0 ohm is suitable for most purposes because at 60 deg C the sensitivity of the ST4 is 90 ohm per deg C and cable resistance of a few ohms will not significantly affect accuracy. If desired, measure the cable resistance with a multimeter and enter the value here. Include the combined series resistance of both (i.e. Signal HI and Signal LO) wires.
Power channel	The default value 'None' is suitable because the ST4 doesn't require a power supply.

See also:
General (Measurement) properties
Input (Measurement) properties
Resistance (Input) properties
Linearization table (Calculation) properties
Result properties

INSTALLATION NOTES

The sensor consists of a stainless steel clad thermistor probe with a 5m or 10m cable. This can be buried in the soil or used to measure air temperature.

CHECK SENSOR IS WORKING

1. Connect the sensor to the logger as shown above.
2. Connect the logger to the PC and run DeltaLINK.
3. Make sure the logger is programmed to read an ST4 from the channel it is connected to, and is selected into a suitable Recording.
4. Select the Sensors window and click **Read now**. You should have a reading from the sensor.
5. Put the sensor between your hands and try to warm it up - you should see the temperature reading increase.
6. Hold the sensor in the air and wave it around - you should see the temperature reading decrease.

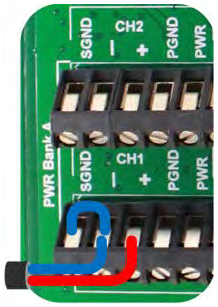
STK1 Thermocouple (type K)

Delta-T Devices
SENSOR

DESCRIPTION

Sensor type: STK1
Measures temperature using Delta-T Temperature probe (types STK1)

WIRING



Click image to toggle it's size.

Colour	thermocouple wiring	GP2 terminal	Notes
Red	Signal HI	CH (+)	
Blue	Signal LO	CH (-) and SGND	Fit wire link

Note: The channel numbers above are for illustration only. Other channel numbers are also possible.

MEASUREMENT PROPERTIES

Property	*Value*
Power channel	The default value 'None' is suitable because the STK1 doesn't require a power supply.

See also:
General (Measurement) properties
Input (Measurement) properties
Voltage (Input) properties
Thermocouple (Calculation) properties
Result properties

INSTALLATION NOTES

The STK1 is a general purpose probe utilising a nickel-chromium (Chromal)/nickel-aluminium (Alumel), K type, thermocouple sensor. This is contained in a stainless steel sheath of 4.8mm nominal outside diameter, 125mm long, which is, in turn, connected to a two core cable, 5m long. This can be buried in the soil or used to measure air temperature.

CHECK SENSOR IS WORKING

1. Connect the sensor to the logger as shown above
2. Connect the logger to the PC and run DeltaLINK.
3. Make sure the logger is programmed to read an STK1 sensor from the channel it is connected to and is selected into a suitable Recording.
4. Select the Sensors window and click **Read now**. You should have a reading from the sensor.
5. Put the sensor between your hands and try to warm it up - you should see the temperature reading increase.
6. Hold the sensor in the air and wave it around - you should see the temperature reading decrease.

REFERENCES

- Temperature Probes user manual

SWS Surface Wetness Sensor

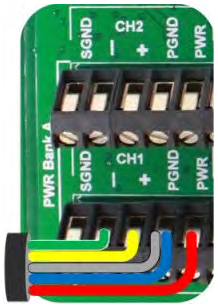
Delta-T Devices
SENSOR

DESCRIPTION

Sensor type: SWS

Measures surface wetness, using the Delta-T Surface Wetness Sensor (type SWS).

WIRING



Click image to toggle it's size.

Colour	SWS wiring	GP2 terminal	Notes
Green	Signal LO	CH (-)	
Yellow	Signal HI	CH (+)	
Blue	Power 0V	PGND	
Braid	Screen	PGND	
Red	Power V+	PWR	

Note: The channel numbers above are for illustration only. Other channel numbers are also possible.

MEASUREMENT PROPERTIES

Property	*Value*
Signal ground terminal (Advanced property)	The default setting is correct for the wiring above. See Signal ground terminal
Minimum power voltage	The default value of 7.1V is suitable for the standard cable length. For extended cable lengths see Minimum power voltage. Note that Minimum power voltage is only available if Power channel (below) is PWR on Bank A or PWR on Bank B.
Power channel	The wiring diagram shows connection to the preferred Power channel. If a preferred Power channel is not available, select one of the other Power channels and modify the Power V+ wiring accordingly. See Power channel

See also:
General (Measurement) properties
Input (Measurement) properties
Voltage (Input) properties
Comparator (Calculation) properties
Result properties

INSTALLATION NOTES

The sensors active surface can be mounted horizontally, and facing upwards, or at any other appropriate angle.

CHECK SENSOR IS WORKING

1. Connect the sensor to the logger as shown above
2. Connect the logger to the PC and run DeltaLINK.
3. Make sure the logger is programmed to read an SWS sensor from the channel it is connected to and is selected into a suitable Recording.
4. Select the Sensors window and click **Read now**. You should have a 'Dry' reading from the sensor
5. Drop some water on the carbon pad - the reading should change to 'Wet'.

REFERENCES

- SWS user manual

SWT 4/5/5x Tensiometer

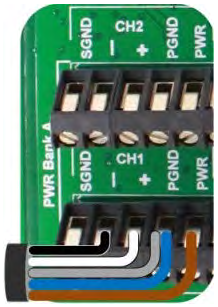
Delta-T Devices
SENSOR

DESCRIPTION

Sensor types: SWT4, SWT5 and SWT5x

Measures the soil matric potential using Delta-T Tensiometers (types SWT4, SWT5 and SWT5x)

WIRING



Click image to toggle it's size.

Colour	Tensiometer wiring	GP2 terminal	Notes
Yellow	Signal HI	CH (-)	
Green	Signal LO	CH (+)	
Brown	Power V-	PGND	
Braid	Screen	PGND	
White	Power V+	PWR	

Note: The channel numbers above are for illustration only. Other channel numbers are also possible.

MEASUREMENT PROPERTIES

Property	*Value*
Power channel	The wiring diagram shows connection to the preferred Power channel. If a preferred Power channel is not available, select one of the other Power channels and modify the Power V+ wiring accordingly. See Power channel
Intercept (kPa)	Default set to **0kPa**. This is the intercept value for a 90 deg insertion angle (to the vertical line). This can be trimmed according to tensiometer insertion angle, for optimum accuracy. These can range from 0.5kPa at a 0 deg angle to 0kPa at a 90 deg angle. Refer to the tensiometer user manual and Slope and intercept (Calculation) properties

See also:
General (Measurement) properties
Input (Measurement) properties
Bridge (Input) properties
Slope and intercept (Calculation) properties
Result properties

INSTALLATION NOTES

This section is only a summary. Please read the complete manual carefully before using the instrument, particularly Chapter 3 and 5!
1. Drill the borehole. Mark the required drilling depth both on auger and on Tensiometer shaft.
For SWT4R: For installation from the soil surface, an installation angle of 25° to 65° from the vertical line is ideal for the optimal removal of air from the cup. For “horizontal” installation from a manhole the borehole should point upwards in an angle of 5°.

2. Slurrying the cup is only reasonable in clayey soils and only if the bore hole is larger than the ceramic cup (24 mm). In coarse sand or pebbly soils, a fine-pored slurry might create a water reservoir which slows down the response.
3. Take off the protective plastic bottle (rubber bulb on the SWT5) from the Tensiometer cup. Tilt and pull the bottle off carefully. If necessary, carefully turn it counter-clockwise only! (as marked on the bottle)
Turn the bottle counter-clockwise only when you remove the bottle but also when you reassemble the bottle (see arrow on bottle label).

4. Insert the tensiometer into the hole to the depth mark with constant gentle pressure and without using force.
In clayey soils a dangerous overpressure might develop. So monitor the Tensiometers pressure with a type SWT-MR (INFIELD7) Manual Readout Unit or a data logger.
Do not exceed 2 bar (200 kPa, 2000 hPa) during insertion (because >300 kPa is fatal!).
Do not turn the Tensiometer after it is inserted into the ground - this might loosen the cup.

Note for SWT4R Tensiometers:
Pay attention to the engraved black spot on the shaft’s top end that marks the position of the exit opening of the external filling inside the cup:
a) Downwards installation: If the position of the cup will be lower than the end of the shaft, the black mark must exactly face up! The optimal installation angle is between 25° and 65°.
b) Upwards installation: If the position of the cup will be higher than the end of the shaft, the black mark must exactly face down! The optimal installation angle is about 5°.
5. Push down the shaft water retaining disk to a position directly on the soil surface.

6. Slide a thermal insulation tube over the capillary filling tubes.
7. If the plug is not connected right away leave the protective cover on the plug. Dirt will influence the impermeability and water tightness is only assured when the plug is kept clean.

8. Connect the Tensiometer signal wires to either a data logger or the SWT-MR/Infield7
The tensiometers are fitted with a 4-pin plug and this must be used in conjunction with a conencting cable type 'SWTCC' in order to connect to the GP2 data logger.

Warning:
-Lightning: Long cables act as antennas and might conduct surge voltage in case of lightning stroke – this might damage sensors and instruments.
-Frost: Tensiometers are filled with water and therefore are sensitive to frost! Protect Tensiometers from frost at any time. Never leave Tensiometers over night inside a cabin or car when freezing temperatures might occur! Tensiometers are not usually damaged when the cup is installed in a frost-free soil horizon.
-Excess pressure: The maximum non destructive pressure is 300 kPa = 3 bar = 3000 hPa. Higher pressures - which might occur, for example, during insertion in wet clayey soils, whilst measuring shear force, or during refilling and reassembly - will destroy the pressure sensor!
-Electronic installation: Any electrical installations must be executed by qualified personnel. Ceramic cup: Do not touch the cup with your fingers. Grease, sweat or soap residues will influence the ceramic's hydrophilic performance.

CHECK SENSOR IS WORKING
1. Connect the sensor to the logger as shown above
2. Connect the logger to the PC and run DeltaLINK.
3. Make sure the logger is programmed to read a tensiometer from the channel it is connected to and is selected into a suitable Recording.
4. Select the Sensors window and click **Read now**. You should have a reading from the sensor.
5. Remove the bottle from the ceramic cup. The reading will decrease.
6. Put the bottle back on (counter clockwise, using the warning instructions, as above). The reading will increase. DO NOT exceed 200kPa

REFERENCES
- SWT4 and SWT5 user manuals

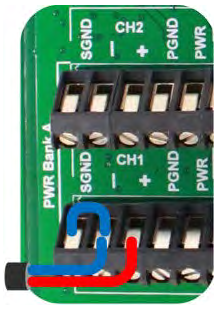
Thermocouple, all types

Delta-T Devices
SENSOR

DESCRIPTION

Sensor types: Thermocouple J-type, Thermocouple K-type, Thermocouple T-type
Measures temperature, in the range -200 to +1150 (J-type), -200 to +1300 deg C (K-type), -200 to +400 (T-type) using generic thermocouples.

WIRING



Click the above image to toggle it's size

Colour	Thermocouple wiring	GP2 terminal	Notes
	Signal HI	CH (+)	
	Signal LO	CH (-) and SGND	Fit wire link

Note: The channel numbers above are for illustration only. Other channel numbers are also possible.

MEASUREMENT PROPERTIES

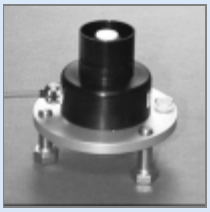
Property	*Value*
Power channel	The default value 'None' is suitable because thermocouples don't require a power supply.

See also:
General (Measurement) properties
Input (Measurement) properties
Voltage (Input) properties
Thermocouple (Calculation) properties
Result properties

CHECK SENSOR IS WORKING

1. Connect the sensor to the logger as shown above
2. Connect the logger to the PC and run DeltaLINK.
3. Make sure the logger is programmed to read a thermocouple from the channel it is connected to and is selected into a suitable Recording.
4. Select the Sensors window and click **Read now**. You should have a reading from the sensor.
5. Put the sensor between your hands and try to warm it up - you should see the temperature reading increase.
6. Hold the sensor in the air and wave it around - you should see the temperature reading decrease.

UV3 Sensor, pre-amplified



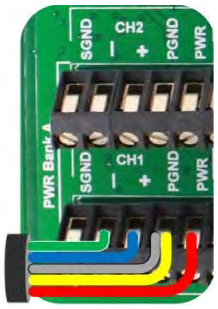
Delta-T Devices
SENSOR

DESCRIPTION

Sensor types: UV3pA, UV3pB, UV3pAB

Measures UV radiation using the Delta-T pre-amplified UV Sensors (types UV3pA, UV3pB, UV3pAB).

WIRING



Click image to toggle it's size.

Colour	UV3 wiring	GP2 terminal	Notes
Green	Signal LO	CH (-)	
Blue	Signal HI	CH (+)	
Yellow	Power 0V	PGND	
Braid	Screen	PGND	
Red	Power V+	PWR	

Note: The channel numbers above are for illustration only. Other channel numbers are also possible.

MEASUREMENT PROPERTIES

Property	*Value*
Signal ground terminal (Advanced property)	The default setting is correct for the wiring above. See Signal ground terminal
Minimum power voltage	The default value of 7.1V is suitable for the standard cable length. For extended cable lengths see Minimum power voltage. Note that Minimum power voltage is only available if Power channel (below) is PWR on Bank A or PWR on Bank B.
Power channel	The wiring diagram shows connection to the preferred Power channel. If a preferred Power channel is not available, select one of the other Power channels and modify the Power V+ wiring accordingly. See Power channel

See also:
General (Measurement) properties
Input (Measurement) properties
Voltage (Input) properties
No calculation (Calculation) properties
Result properties

INSTALLATION NOTES

M4 mounting screws are provided for the two tapped holes in the base of each sensor. The mounting holes are at 43 mm spacing.
Warning! Do not use the central hole for mounting the sensor. It is provided only for factory calibration purposes.

The sensor is usually mounted horizontally for most solar radiation insolation studies. The readings then give the irradiance (W.m-2) of a horizontal surface.
A levelling mount is offered as an option, or you can easily make up your own mounting plate.
If you need to remove excess length of cable at this stage, simply cut off the excess, but allow for a sufficient length of the cable screen.
The sensors are fitted with 5m of 4-core screened cable, with bare wire ends as standard.Up to 100m of cable can be fitted at time of ordering.
The UV signal voltage output is not sensitive to the cable length within this limit.

Levelling Mount type SRLF1
This is a freestanding platform with adjustable legs and bubble level to allow the sensor to be accurately mounted horizontally.

CHECK SENSOR IS WORKING

1. Connect the sensor to the logger as shown above
2. Connect the logger to the PC and run DeltaLINK.
3. Make sure the logger is programmed to read a UV3 sensor from the channel it is connected to and is selected into a suitable Recording.
4. Select the Sensors window and click **Read now**. You should have a reading from the sensor.
5. Shade the sensor from any light – the reading should drop low
6. Put the sensor in direct sunlight – the reading should increase

REFERENCES
- UV3 user manual

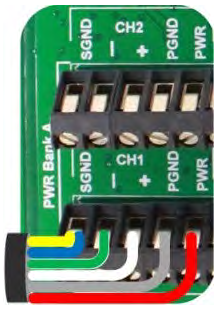
WD1 Windvane

Delta-T Devices
SENSOR

DESCRIPTION

Sensor type: WD1
Measures wind direction (0 to 360 deg) using the Delta-T Windvane (type WD1)

WIRING



Click image to toggle it's size.

Colour	WD1 wiring	GP2 terminal	Notes
Yellow	Sense LO	SGND	
Blue	Track LO	SGND	
Green	Wiper	CH (-)	
White	Sense HI	CH (+)	
Braid	Screen	PGND	
Red	Track HI	PWR	

Note: The channel numbers above are for illustration only. Other channel numbers are also possible.

MEASUREMENT PROPERTIES

Property	*Value*
Power channel	The wiring diagram shows connection to the preferred Power channel. If a preferred Power channel is not available, select one of the other Power channels and modify the Track HI wiring accordingly. See Power channel

REMARKS:

The WD1 linearization table gives a reading of 1.75 to 358.25 deg over the sensor's electrical range, and 360 deg in the gap of the potentiometer windings.

See also:
General (Measurement) properties
Input (Measurement) properties
Potentiometer (Input) properties
Linearization table (Calculation) properties
Result properties

INSTALLATION NOTES

1) Remove the white spindle protection tube and turn the spindle so that the locator indent is in-line with the right hand side of the fin as viewed from above. Lightly push on the fin, with a force of about 1 to 2 Kg, until positive location is obtained. To remove the fin, first invert the instrument, press hub of fin to release the gravity-sensitive catch within the hub, and allow it to slide off. The required force is no more than 1 to 2 Kg. DO NOT USE EXCESSIVE FORCE.
2) The windvane is now ready for attaching to the horizontal cross-bar of the weather station, using a 0.25 inch BSW/UNC stainless steel bolt and two white nylon saddle washers. If you are not using a Delta-T Weather Station to mount this sensor then you will have to provide your own mounting fixtures. Make sure the North marker arrow on the body of the windvane faces north.

In general, wind measurement sensors should be positioned to detect the wind conditions of a large area. For meteorological purposes, measurements are specified ideally at a height of 10 metres on a site with no obstacles.
In practice, it is often not possible to fulfil these conditions, and you must choose a position that as far as possible represents the local wind speed and direction. In particular, avoid roof positions, which can often introduce biased wind directions and exaggerated wind speeds.

CHECK SENSOR IS WORKING

1. Connect the sensor to the logger as shown above
2. Connect the logger to the PC and run DeltaLINK.
3. Make sure the logger is programmed to read a WD1 from the channel it is connected to and is selected into a suitable Recording.
4. Select the Sensors window and click **Read now**.
5. Spin the wind vane around – you should see a reading ranging between 0 - 360deg

REFERENCES

- WD1 user manual

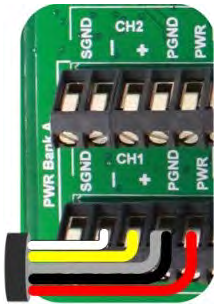
WD4 Windvane

Delta-T Devices
SENSOR

DESCRIPTION

Sensor type: WD4
Measures wind direction using Delta-T Wind Direction sensor (type WD4)

WIRING



Click image to toggle it's size.

Colour	WD4 wiring	GP2 terminal	Notes
White	Signal LO	CH (-)	
Yellow	Signal HI	CH (+)	
Black	Power 0V	PGND	
Braid	Screen	PGND	
Red	Power V+	PWR	

Note: The channel numbers are for illustration only. Other channel numbers are also possible.

MEASUREMENT PROPERTIES

Property	*Value*
Signal ground terminal (Advanced property)	The default setting is correct for the wiring above. See Signal ground terminal
Minimum power voltage	The default value of 6.1V is suitable for the standard cable length. For extended cable lengths see Minimum power voltage. Note that Minimum power voltage is only available if Power channel (below) is PWR on Bank A or PWR on Bank B.
Power channel	The wiring diagram shows connection to the preferred Power channel. If a preferred Power channel is not available, select one of the other Power channels and modify the Power V+ wiring accordingly. See Power channel

See also:
General (Measurement) properties
Input (Measurement) properties
Potentiometer (Input) properties
Linearization table (Calculation) properties
Result properties

INSTALLATION NOTES

In general, wind measurement sensors should be positioned to detect the wind conditions of a large area. For meteorological purposes, measurements are specified ideally at a height of 10 metres on a site with no obstacles.
In practice, it is often not possible to fulfil these conditions, and you must choose a position that as far as possible represents the local wind speed and direction. In particular, avoid roof positions, which can often introduce biased wind directions and exaggerated wind speeds.
Mounting Details
Accessories are provided to attach the WD4 Windvane to the cross arm of the Delta-T M2 mast. This positions the sensor about 2 metres above the ground. Any cross arm of about 32 mm diameter, with a 7 mm clearance hole through it would be equally suitable.
Remove the nut from the stud on the base of the windvane, and screw the mounting bush on to it. Make sure the bush seats firmly against the windvane base.
Pass the ¼ BSW mounting bolt with saddle washers through a vertical hole in the cross arm, and screw the bolt into the base of the mounting bush.
When the weather station mast is erected, you must ensure that the body of the windvane is correctly aligned with North. There is an “N” marker label and two small marks on the base of the windvane to help with this.
Finally, check that the windvane spindle is vertical by making slight adjustments to the mast and cross arm alignment.

Up to 100m of cable can be fitted at time of ordering. The WD4 signal voltage output is not sensitive to the cable length within this limit. A waterproof cable-join about 3 m from the sensor may be present in longer cables.

CHECK SENSOR IS WORKING

1. Connect the sensor to the logger as shown above
2. Connect the logger to the PC and run DeltaLINK.

3. Make sure the logger is programmed to read a WD4 from the channel it is connected to and is selected into a suitable Recording.
4. Select the Sensors window and click **Read now**.
5. Spin the wind vane around – you should see a reading ranging between 0 - 360deg

REFERENCES

- WD4 user manual

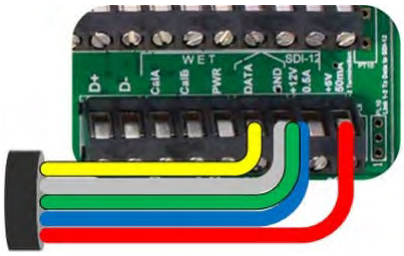
WET-1 Sensor

Delta-T Devices
SENSOR

DESCRIPTION

Sensor types: WET-1 (soil moisture), WET-1 (pore conductivity), WET-1 (temperature), WET-1 (permittivity) and WET-1 (bulk conductivity)
Measures water content, electrical conductivity and temperature, using the Delta-T WET-1 sensor.
IMPORTANT: These sensor types are for WET-1 sensors, i.e. of serial number WET-26/999 and earlier. For later WET-2 sensors use WET-2 sensor types.

WIRING



Colour	WET-1 wiring	GP2 terminal	Notes
Yellow	5V serial data out	WET (DATA)	
Blue	Power 0V	WET (GND)	
Green	Power 0V	WET (GND)	
Braid	Screen	WET (GND)	
Red	Power V+	SD1-12 (+5V 50mA)	

Click image to toggle it's size.

MEASUREMENT PROPERTIES: all WET-1 sensor types

Property	*Value*
File	Click the Browse (**...**) button and select your sensor's calibration file. Calibration files are supplied with the WET sensor, and are named according to the sensor's serial number, for example "WET06278.CAL" (Standard range, 0 to 200 mS.m-1) and "WEX06278.CAL" (Extended range, 0 to 500 mS.m-1) for serial number WET-06/278.
Power channel	WET-1 sensors require a 5V regulated power supply. Select +5V. See Power channel

MEASUREMENT PROPERTIES: WET-1 (soil moisture)

Property	*Value*
Result units	Select % or m3.m-3. Note that if you change the Result units, then Minimum, Maximum and Resolution Result properties are automatically adjusted. However, you will need to adjust any Formulae, Conditions or Scripts which use the measurement.
Soil type	Select one of the soil types or substrates provided or enter soil-specific b0 and b1 values (below). Note that substrate calibrations require a GP2 with WET-GH-1G2 Horticultural or WET-ST-1G2 Stonewool upgrades installed.
b0 and b1	Soil coefficients for the selected Soil type (above). Alternatively, enter soil-specific values for your soil. To perform a soil-specific calibration refer to the WET-1 user manual. Note that substrates don't have b0 and b1 values.

MEASUREMENT PROPERTIES: WET-1 (pore conductivity)

Property	*Value*
Compensate to	Conductivity readings are affected by temperature, and it is common practise to apply a correction so that they are quoted at a standard temperature. Select 20 or 25 deg C, or None if you don't want to apply temperature compensation.
Tempco(%/deg C)	If Compensate to is not None, this is the % rate at which temperature compensation will be applied. The default value of 2.0 is suitable for many soils. Values in the between –1.0% and 4.0% are common, depending on the ionic compostion of pore water.See the Calibration section in the WET user manual for suggested values for different ions.
Result units	Select one of the available options. Note that if you change the Result units, then Minimum, Maximum and Resolution Result properties are automatically adjusted. However, you will need to adjust any Formulae, Conditions or Scripts which use the measurement.
	The 'soil parameter' in the Pore Water Conductivity calculation. The default value is 4.1, but values between 1.0..9.0 can be used. The default value is suitable for a range of both organic and mineral agricultural soils. However if you are taking

e0	measurements in heavy clay or sand, or some other unusual medium, you may want to calculate a value that is specific to that medium. Warning: the soil parameter should be left at the default value of 4.1 unless you have measured it for your soil. Changing it will significantly affect the ECp readings, especially in dry soils. The Calibration section in the WET user manual explains how to measure a value for the soil parameter, and the Technical Reference section describes how the parameter is used in the ECp calculation.

MEASUREMENT PROPERTIES: WET-1 (bulk conductivity)

Property	*Value*
Compensate to	As WET-1 (pore conductivity) above
Tempco(%/deg C)	As WET-1 (pore conductivity) above
Result units	Type the result units you require (for example mS.m-1, mS.cm-1, uS.cm-1) and adjust Sensitivity as below, and also Minimum, Maximum and Resolution Result properties
Sensitivity	The default value of 0.01 is suitable for mS.m-1 Result units. Set Sensitivity to the correct value for the Result units (above). For example: mS.cm-1: Sensitivity = 1 uS.cm-1: Sensitivity = 0.001

See also:
General (Measurement) properties
Input (Measurement) properties
WET sensor (Input) properties
No calculation (Calculation) properties
Soil moisture from e? (Calculation) properties
Pore conductivity (Calculation) properties
Result properties

INSTALLATION NOTES
Push the WET Sensor into the soil or substrate.
The WET Sensor is designed to be robust and trouble-free in normal use, but please observe the following sensible precautions:
• Look after the sensor rods. Don't attempt to push the probe through stones or extremely hard soil (If in doubt, use an insertion tool to make pilot holes before inserting the WET Sensor).
• Do not pull the WET Sensor out of the soil by tugging on its cable or push it into the ground applying any force to the cable (bending it over).
• The WET Sensor is fully sealed and may be safely immersed in water, but the interface connectors are not sealed, and should be kept dry.
• The WET sensor can be buried to a depth of 2 metres.
• Rinse the WET Sensor in tap water and wipe off after use.

Warning: you need to take reasonable precautions to protect the WET Sensor from physical damage to the rods and from static damage. When not in use it is advisable to keep the sensor with the rods inserted into conductive foam, or use the packing materials provided.

CHECK SENSOR IS WORKING
1. Connect the sensor to the logger as shown above
2. Connect the logger to the PC and run DeltaLINK.
3. Make sure the logger is programmed to read a WET sensor from the channels it is connected to and is selected into a suitable Recording.
4. Select the Sensors window and click **Read now**. You should have a reading from the sensor (unless it is in air, in which case you will get a reading of '-INF' as it is below the measurement range).
5. Put the WET sensor in wet, saturated soil - the reading should increase.
6. Put the WET sensor in dry soil - the reading should drop down.
7. To check the temperature put the sensor rods between your hands and try to warm it up - you should see the temperature reading increase, then hold the sensor in the air and wave it around - you should see the temperature reading decrease.

REFERENCES
- WET logging quick start guide and WET sensor user manual

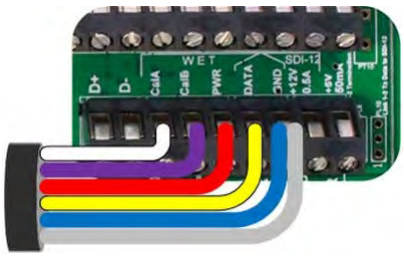
WET-2 Sensor

Delta-T Devices
SENSOR

DESCRIPTION

Sensor types: WET-2 (soil moisture), WET-2 (pore conductivity), WET-2 (temperature), WET-2 (permittivity) and WET-2 (bulk conductivity)
Measures water conent, electrical conductivity and temperature, using the Delta-T WET-2 sensor.
IMPORTANT: These sensor types are for WET-2 sensors, i.e. of serial number WET-27/001 and later. For earlier WET-1 sensors use WET-1 sensor types.

WIRING



Colour	WET-2 wiring	GP2 terminal	Notes
White	EEPROM - clock	WET (CalA)	
Violet	EEPROM - data	WET (CalB)	Wire colour is Turquoise in WET sensors listed below*
Red	Power V+	WET (PWR)	
Yellow	5V serial data out	WET (DATA)	
Blue	Power 0V	WET (GND)	Wire colour is Black in WET sensors listed below*
Braid	Screen	WET (GND)	

Click image to toggle it's size.

*WET-16/001 to WET-26/070

MEASUREMENT PROPERTIES: all WET-2 sensor types

Property	*Value*
Calibration	WET-2 sensors have Standard (0 to 200 mS.m-1) and Extended (0 to 500 mS.m-1) range calibrations stored internally in electronic form. Select Standard (Auto) or Extended (Auto) to use one these calibrations ? unless using a longer cable than 5m, in which case select From file and select a calibration dile (below).
File	If Calibration (above) is 'From file' Click the Browse (**...**) button and select your sensor's calibration file. Calibration files are supplied with the WET sensor, and are named according to the sensor?s serial number, for example "WET06278.CAL" (Standard range) and "WEX06278.CAL" (Extended range) for serial number WET-06/278.
Power channel	The wiring diagram shows connection to the preferred Power channel WET PWR. Alternatively, select one of the other Power channels and modify the Power V+ wiring accordingly. See Power channel

MEASUREMENT PROPERTIES: WET-2 (soil moisture)

Property	*Value*
Result units	Select % or m3.m-3. Note that if you change the Result units, then Minimum, Maximum and Resolution Result properties are automatically adjusted. However, you will need to adjust any Formulae, Conditions or Scripts which use the measurement.
Soil type	Select one of the soil types or substrates provided or enter soil-specific b0 and b1 values (below). Note that substrate calibrations require a GP2 with WET-GH-1G2 Horticultural or WET-ST-1G2 Stonewool upgrades installed.
b0 and b1	Soil coefficients for the selected Soil type (above). Alternatively, enter soil-specific values for your soil. To perform a soil-specific calibration refer to the WET-2 user manual. Note that substrates don't have b0 and b1 values.

MEASUREMENT PROPERTIES: WET-2 (pore conductivity)

Property	*Value*
Compensate to	Conductivity readings are affected by temperature, and it is common practise to apply a correction so that they are quoted at a standard temperature. Select 20 or 25 deg C, or None if you don't want to apply temperature compensation.
Tempco(%/deg C)	If Compensate to is not None, this is the % rate at which temperature compensation will be applied. The default value of 2.0 is suitable for many soils. Values in the between –1.0% and 4.0% are common, depending on the ionic compostion of pore water.See the Calibration section in the WET user manual for suggested values for

	different ions.
Result units	Select one of the available options. Note that if you change the Result units, then Minimum, Maximum and Resolution Result properties are automatically adjusted. However, you will need to adjust any Formulae, Conditions or Scripts which use the measurement.
e0	The 'soil parameter' in the Pore Water Conductivity calculation. The default value is 4.1, but values between 1.0..9.0 can be used. The default value is suitable for a range of both organic and mineral agricultural soils. However if you are taking measurements in heavy clay or sand, or some other unusual medium, you may want to calculate a value that is specific to that medium. Warning: the soil parameter should be left at the default value of 4.1 unless you have measured it for your soil. Changing it will significantly affect the ECp readings, especially in dry soils. The Calibration section in the WET user manual explains how to measure a value for the soil parameter, and the Technical Reference section describes how the parameter is used in the ECp calculation.

MEASUREMENT PROPERTIES: WET-2 (bulk conductivity)

Property	*Value*
Compensate to	As WET-2 (pore conductivity) above
Tempco(%/deg C)	As WET-2 (pore conductivity) above
Result units	Type the result units you require (for example mS.m-1, mS.cm-1, uS.cm-1) and adjust Sensitivity as below, and also Minimum, Maximum and Resolution Result properties
Sensitivity	The default value of 0.01 is suitable for mS.m-1 Result units. Set Sensitivity to the correct value for the Result units (above). For example: mS.cm-1: Sensitivity = 1 uS.cm-1: Sensitivity = 0.001

See also:
General (Measurement) properties
Input (Measurement) properties
WET sensor (Input) properties
No calculation (Calculation) properties
Soil moisture from e? (Calculation) properties
Pore conductivity (Calculation) properties
Result properties

INSTALLATION NOTES
Push the WET Sensor into the soil or substrate.
The WET Sensor is designed to be robust and trouble-free in normal use, but please observe the following sensible precautions:
• Look after the sensor rods. Don't attempt to push the probe through stones or extremely hard soil (If in doubt, use an insertion tool to make pilot holes before inserting the WET Sensor).
• Do not pull the WET Sensor out of the soil by tugging on its cable or push it into the ground applying any force to the cable (bending it over).
• The WET Sensor is fully sealed and may be safely immersed in water, but the interface connectors are not sealed, and should be kept dry.
• The WET sensor can be buried to a depth of 2 metres.
• Rinse the WET Sensor in tap water and wipe off after use.

Warning: you need to take reasonable precautions to protect the WET Sensor from physical damage to the rods and from static damage. When not in use it is advisable to keep the sensor with the rods inserted into conductive foam, or use the packing materials provided.

CHECK SENSOR IS WORKING
1. Connect the sensor to the logger as shown above
2. Connect the logger to the PC and run DeltaLINK.
3. Make sure the logger is programmed to read a WET sensor from the channels it is connected to and is selected into a suitable Recording.
4. Select the Sensors window and click **Read now**. You should have a reading from the sensor (unless it is in air, in which case you will get a reading of '-INF' as it is below the measurement range).
5. Put the WET sensor in wet, saturated soil - the reading should increase.
6. Put the WET sensor in dry soil - the reading should drop down.

7. To check the temperature put the sensor rods between your hands and try to warm it up - you should see the temperature reading increase, then hold the sensor in the air and wave it around - you should see the temperature reading decrease.

REFERENCES

- WET logging quick start guide and WET sensor user manual

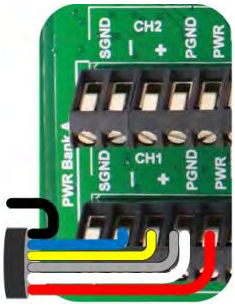
WL1 Water Depth Sensor

Delta-T Devices
SENSOR

DESCRIPTION

Sensor type: WL1
Measures water depth, up to ~7 meters, using the Delta-T Water Depth Sensor (type WL1).

WIRING



Click image to toggle it's size.

Colour	WL1 wiring	GP2 terminal	Notes
Blue	Signal LO	CH (-)	
Yellow	Signal HI	CH (+)	
White	Power V-	PGND	
Braid	Screen	PGND	
Red	Power V+	PWR	

Note: The channel numbers above are for illustration only. Other channel numbers are also possible.

MEASUREMENT PROPERTIES

Property	*Value*
Power channel	The wiring diagram shows connection to the preferred Power channel. If a preferred Power channel is not available, select one of the other Power channels and modify the Power V+ wiring accordingly. See Power channel
Result units	meters (m)
Intercept (m)	Default is 0. For improved accuracy, calculate Intercept from 'ZOS'(zero offset) provided on the WL1 calibration certificate, and Slope (see below): Intercept = - Slope * ZOS
Slope (m/mV/V)	Default is set to 0.7138. For improved accuracy, calculate Slope from 'FRO' (full range output) and 'ZOS'(zero offset) values provided on the WL1 calibration certificate: Slope = 10 x 7.138 / (FRO-ZOS)

See also:
General (Measurement) properties
Input (Measurement) properties
Bridge (Input) properties
Slope and intercept (Calculation) properties
Result properties

INSTALLATION NOTES

The gauge should be mounted at the bottom of the well or body of water. Readings will then correspond to the pressure of the water above the gauge, or more exactly, above the position of the pressure element in the gauge. Pressure readings can be expressed in units of pressure, or as depths of water.
The cable contains the pressure reference tube which must have access to free air. You must not allow the tube to be blocked or constricted, or to be exposed to conditions that might create a spurious reference air pressure.
Because of this, lengthening the cable is not really practical, but the cable could be shortened, with care.

Cable:
Length: As specified on the individual Calibration Data sheet.
Cable resistance (per core): 87 ohm per km
Adjustment for long cables
Very long cables can introduce an error because of the voltage drop in the cable. This amounts to a small percentage of reading error: 0.87% voltage drop in 10 V sensor supply for 100 metres of cable (two cores). The signal output is reduced in the same proportion. This error is consistent, and if considered significant, can be compensated for by reducing the FRO mV value in the above calculations by a percentage appropriate to the cable length.

CHECK SENSOR IS WORKING

1. Connect the sensor to the logger as shown above
2. Connect the logger to the PC and run DeltaLINK.
3. Make sure the logger is programmed to read a WL1 sensor from the channel it is connected to and is selected into a suitable Recording.

4. Hold the sensor in air, Select the Sensors window and click **Read now**. You should have a zero reading from the sensor
5. Drop the sensor into a deep container of water - the reading should increase (could be a very slight increase depending on depth of water above the sensor).

REFERENCES

- WL1 user manual