



## Delta-T Devices

Delta-T Devices designs and manufactures a wide range of research-grade sensors for meteorological, environmental and industrial measurement and monitoring.

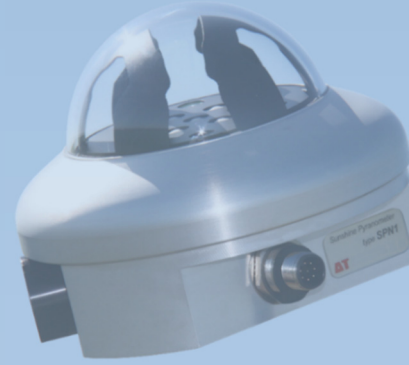
Our systems and weather stations are used all over the world. Whatever the application, we can help you select the best combination of sensors, data loggers and accessories to achieve your goals.

- **Highly accurate premium-grade instruments**
- **Field proven in severe weather conditions**
- **Unattended monitoring at remote sites**
- **Wide choice of sensors and accessories**
- **Cellular modem communications**

## Environmental and Meteorological SENSORS & SYSTEMS

### Sensor Systems

Delta-T Devices can address both simple and complex requirements. If your application requires just a few sensors we can provide a suitable system with or without a mast. Such systems are easily expanded to include additional sensors.



Complex systems can also be created with ease. These often include a wide range of inputs, such as soil moisture sensors, solar radiation sensors and meteorological sensors. These environmental monitoring systems can involve hundreds of sensors across multiple sites.



### Automatic Weather Stations

Our weather stations are based on either the GP2 Advanced Data Logger - powerful, flexible and expandable to meet demanding requirements, or on the GP1 Data Logger - compact and very easy to set up and use.



# Environmental & Meteorological – sensor specifications

## Temperature

Type	Description	Probe Type	Probe accuracy (°C)	Probe range (°C)	Cable type	Number of cores	Cable range (°C)	Logger accuracy			
								DL2e <sup>(a)</sup> (°C)	DL6 <sup>(b)</sup> (°C)	GP1 <sup>(c)</sup> (°C)	GP2 <sup>(d)</sup> (°C)
ST1-05	Soil temperature probe 2k thermistor, stainless steel sheath, 6s response.	2 k	±0.2	-50 to 150	PVC	2	-10 to +105	±0.14	±0.4	±0.4	±0.09
ST2-05	Precision temperature probe, 2k thermistor, stainless steel sheath, 6s response.	2 k	±0.1 <sup>(f)</sup>	-50 to 150	PVC	2	-10 to +105	±0.14	±0.4	±0.4	±0.09
ST3-05	Sealed thermistor Probe, 2k thermistor, with sealed sheath and leads suitable for continuous immersion in fresh water.	2 k	±0.2	-20 to +80	Poly-ethelene	2	-20 to +80	±0.14	±0.4	±0.4	±0.09
ST4-05	Soil temperature probe 10k thermistor, stainless steel sheath, 6s response, IP67.	10 k	±0.2	-10 to +40	PVC	2 <sup>(e)</sup>	-10 to +40	Not available	Not available	±0.14	±0.08
STK1-05	General purpose K type thermocouple probe, stainless steel sheath.	k	±1.5	-50 to 250	PTFE	2	-50 to +250	±1.0	Not available	Not available	±1.0
GT1-05	General purpose temperature probe, 2k thermistor.	2 k	±0.2	-50 to 150	PVC	2	-10 to +105	±0.14	±0.4	±0.4	±0.09
MT2-05	Fast response temperature sensor, 2k, suitable for leaves	2 k	±0.1 <sup>(f)</sup>	-50 to 150	Vy/TEFL <sup>(g)</sup>	4	Not available	±0.14	±0.4	±0.4	±0.09
MT3-05	Flexible mini-thermistor Probe, 2k thermistor.	2 k	±0.1 <sup>(f)</sup>	-50 to 150	Nylon - PVC	2	-10 to +105	±0.14	±0.4	±0.4	±0.09
AT2-05	Air temperature sensor, 2k thermistor.	2 k	±0.1 <sup>(f)</sup>	-50 to 150	PVC	2	-10 to +105	±0.14	±0.4	±0.4	±0.09

### NOTES:

**a:** Additional (worst case) error due to DL2e at +15 to +25 °C.  
**b:** Additional (worst case) error due to DL6 at -10 to +50 °C.  
**c:** Additional (typical) error due to GP1 at 0 to +60 °C.  
**d:** Additional (worst case) error due to GP2 at -20 to +60 °C.  
 see also page 14 of the Temperature Sensors User Manual v2.

**e:** Co-axial single-core with screen acting as signal loop.  
**f:** Over 0-70°C.  
**g:** Teflon lead, vinyl tip.

## Relative Humidity

Type	Description	Units	Measuring range	Accuracy	Sensitivity	Operating temp. range	Power requirement	Cable details
RHT2nl	Combined relative humidity with replaceable sensing element (chip) module and type AT2 air temperature sensor (2 k thermistor) in optional cylindrical louvered solar radiation shielded housing. Requires use of a lookup table to convert resistance to temperature. Suitable for GP2, DL2 and DL6 data loggers.	%RH	0-100% RH	±2% RH <sup>(h)</sup>	10 mV per %RH 0-1 V for 0-100%RH	-30 to +70°C	5-32 VDC 2 mA	2m/6w
		°C	-10 to +105°C	± 0.1°C	2 kΩ at 25°C Non-linear		Negligible	
RHT2v	Replaceable combined relative humidity and air temperature sensor module in optional cylindrical louvered solar radiation shielded housing. The temperature sensor has a linear 0-1 V output derived from a PRT platinum resistance sensor. Suitable for GP2, GP1, DL2 and DL6 data loggers.	%RH	0-100% RH	±2% RH <sup>(h)</sup>	10 mV per %RH 0-1 V for 0-100%RH	-30 to +70°C	5-32 VDC 2 mA	2m/6w
		°C	-20 to +80°C	± 0.5°C	10 mV per °C			
RHT4nl	Combined RH and air temperature transducer (10 k thermistor) housed in probe which fits in a solar radiation shield. The RH transducer requires power and provides a 0-1 V output signal. Requires use of a lookup table to convert resistance to temperature. Suitable for use with GP1 and GP2 loggers.	%RH	0-100% RH	±2%RH over (5-95% RH) <sup>(h)</sup> ±2.5%RH over (0-5% and 95-100%)	10 mV per %RH 0-1 V for 0-100%RH	-20 to +80°C	5.5 to 32 VDC ≤2 mA	0.5m/6w
		°C	-20 to +60°C	± 0.2°C	10 kΩ at 25°C Non-linear		Negligible	

NOTES: h: at 23°C

Radiation shield temperature errors in sunlight

Shield used with	Irradiance W/m2	Wind Speed		
		1 m/s	2 m/s	3 m/s
RHT2	1000	1.4°C	0.65°C	0.4°C
RHT4	500	2.0°C	1.0°C	0.5°C

## Atmospheric Pressure

Type	Description	Measuring range	Accuracy	Output range	Sensitivity	Power requirement	Cable details
BS5	Barometric pressure sensor. For use at low altitude (0-1500 m), in weatherproof housing (IP65).	16 pressure ranges over 600 – 1100 hPa (mbar)	±0.35 hPa (resolution 0.1 hPa)	0-1, 0-2, 0 -2.5 or 0-5 VDC	Depends on ranges selected	10-36 VDC 10mA @12 VDC <sup>(i)</sup>	3m/4w

### NOTES:

**i:** Compatible with GP2 Logger. When used with GP1 or DL2e Logger external power is required to maintain 10-36 VDC. Suitable battery pack and solar power supplies are available - please consult Delta-T Devices.



## Wind Speed and Direction

Type	Description	Sensor	Measuring range	Accuracy and resolution	Output range	Sensitivity	Operating temp. range	Power requirement	Cable details
AN-WD2	Combined wind speed and direction sensor. Three cup anemometer closes magnetic reed switch. Wind vane connected to a 10K potentiometer. Suitable for GP2 and DL2e data loggers.	Speed	0.4 to 75 m.s <sup>-1</sup> (0-167 mph)	±0.1 m.s <sup>-1</sup> if < 10.1 m.s <sup>-1</sup> ±1.1% if > 10.1 m.s <sup>-1</sup> starting threshold 0.4 m.s <sup>-1</sup>	0 to 75 m/s	0.8 Hz per m.s <sup>-1</sup>	-30 to +70°C (minimal icing)	None	
		Direction	0-360° mechanical 0-356° electrical	±4 degrees 0.5° (resolution) starting threshold 0.4 m.s <sup>-1</sup>	0-3V = 0-356 degrees	28 Ω per degree		3V±0.2 VDC *	
AN1	Anemometer, mercury-wetted reed switch type. 3-cup rotor.	Speed	0.2 - 75 m.s <sup>-1</sup> (170 mph)	1% ±0.1 m.s <sup>-1</sup> (0 - 55 m.s <sup>-1</sup> ) 2% (>55 m.s <sup>-1</sup> )	0.2 to 60 Hz	0.8 Hz per m.s <sup>-1</sup>	-30 to +70°C	None	3m/2w
AN3	Anemometer - high resolution, 3-cup rotor. Digital photodiode pulse and analogue outputs.	Speed	0.15 - 75 m.s <sup>-1</sup>	1% ±0.01 m.s <sup>-1</sup> (pulsed)  1% (analogue)	3 to 1500 Hz  0 - 2.5 VDC	20 Hz per m.s <sup>-1</sup>  33 mV per m.s <sup>-1</sup>	-30 to +70°C (minimal icing)	7-28 VDC  2.0 mA max	3m/6w
AN4	Anemometer, reed switch activated by non-contact magnet. 3 cup rotor.	Speed	0.5 - 40 m.s <sup>-1</sup> max 60 m.s <sup>-1</sup>	±5% ±0.5 m.s <sup>-1</sup> (0-40 m.s <sup>-1</sup> )	0.5 to 50 Hz	1.25 Hz per m.s <sup>-1</sup>	25° to +60°C (free of ice)	None	5m/2w
WD1	Wind vane. Sturdy and highly responsive, based on 358° micro-torque potentiometer.	Direction	0 to 358 degrees	0.3 degrees (resolution) ±2° in winds >5 m.s <sup>-1</sup> starting threshold 0.6 m/s, 45° to flow.	0 to 1000 Ω nominal	2.8 Ω per degree	-50 to +70°C	20 V max 20 mA max	3m/6w

\* 3 ±0.2 VDC using the GP2 logger 3V reference. Users of other loggers may choose a different method to read the 10K potentiometer

## Precipitation

Type	Description	Max. rate of rainfall	Operating temp. range	Sensitivity	Funnel dia.	Cable details
RG1	Tipping bucket rain gauge. Used with levelling base-plate type RGB1. (Heated version available for use in snow).	500 mm in 1 hour	0 to +60°C	0.2 mm per tip	254 mm	6m/2w
RG2	Tipping bucket rain gauge with optional accessories for ground or mast fixing. Compact design.	360 mm in 1 hour	0 to 50°C	0.2 mm per tip	160 mm	6m/2w

## Evaporation

Type	Description	Measuring range	Accuracy & resolution	Output range	Sensitivity	Power Requirement	Operating temp. range	Cable details
EV2/G	High precision pressure transducer design with no moving parts. No stilling well requirement.	0-250 mm water depth	±1 mm (typ ±0.5) res. 0.2 mm	40 - 200 mV	0.64 mV per mm	7.5 to 28 VDC up to 22 mA	0 to 50°C	5m/4w vented
EV2/P	Evaporation Pan USA Class A (for use with EV2/G)							

## Solar Radiation

Type	Description range	Measuring	Accuracy	Spectral response	Operating temp. range	Sensitivity	Cable details
ES2	High quality Si photodiode for solar energy measurements in natural, unobstructed daylight. 30mm dia x 48mm.	0 to 2 kW.m <sup>-2</sup>	±15% <sup>(k)</sup>	400-1050 nm	-10 to +60°C	10m V per (kW.m <sup>-2</sup> )	5m/2w
QS5	High stability Si photodiode for solar radiation measurements for crop and plant growth. Gives PAR output. 44mm dia. x 48mm.	0-2000 μmol.m <sup>-2</sup> .s <sup>-1</sup>	±5%	400 - 700 nm	-35 to + 70°C	10.0 mV per mmol.m <sup>-2</sup> .s <sup>-1</sup> of PAR	5m/2w
GS1	Dome solarimeter (pyranometer), based on thermopile, for WMO Class 2 solar energy reference measurements. Dome 36mm dia.	0 to 2 kW.m <sup>-2</sup>	±10% <sup>(l,m)</sup>	305-2800 nm	-40 to +80°C	10-35 mV per (kW.m <sup>-2</sup> )	10m/2w
GS2	Albedometer using 2 GS1s mounted back-to-back. For measuring both incident and reflected radiation.	0 to 2 kW.m <sup>-2</sup>	±10% <sup>(l,m)</sup>	305-2800 nm	-40 to +80°C	10-35 mV per (kW.m <sup>-2</sup> )	10m/2w 2 cables
NR2	Dome net radiometer based on thermopile, for reference measurements of net radiation.	-0.5 to 1 kW.m <sup>-2</sup>	±5% at 20°C <sup>(o)</sup>	0.25-60 μm	-40 to +60°C	100 mV per (kW.m <sup>-2</sup> )	7m/2w

### NOTES:

j: For daily integrals.

k: Can be reduced to ±5% (typical) with on-site calibration with thermopile pyranometer.

l: ±3% under standard lamp.

m: Over -10 to +40°C operating range.

o: Manufacturer's figure.

## UV Radiation

Type	Description	Measuring range	Peak wavelength	Band- width	Sensitivity (per W m <sup>-2</sup> )	Power requirement	Size	Cable details
UV3pA	A range of 3 UV sensors fitted with a photodiode detector and transimpedance amplifier. Accuracy for all models is ±7.5% at 20°C.	0-150 W m <sup>-2</sup>	373 ± 2 nm	31 ± 2 nm	1 mV	7-15 VDC 2mA	50 mm dia x 48 mm	5m/4w
UV3pB		0-150 W m <sup>-2</sup>	313 ± 2 nm	26 ± 2 nm				
UV3pAB		0-200 W m <sup>-2</sup>	360 ± 5 nm	72 ± 5 nm				

## Sunshine Duration and Solar Irradiance

(See individual BF5 and SPN1 datasheets for full info and specs)

### BF5 Sunshine Sensor

For simultaneous outputs of total radiation, diffuse radiation and sunshine status. Output can be pre-set to PAR, Energy or Lux units

	Output setting		
	PAR	Energy	Illuminance
Units	$\mu\text{mol.m}^{-2}.\text{s}^{-1}$	$\text{W.m}^{-2}$	klux
Overall accuracy: Total	$\pm 10 \mu\text{mol.m}^{-2}.\text{s}^{-1}$ $\pm 12\%$	$\pm 5 \text{ W.m}^{-2}$ $\pm 12\%$	$\pm 0.600 \text{ klux}$ $\pm 12\%$
Overall accuracy: Diffuse	$\pm 10 \mu\text{mol.m}^{-2}.\text{s}^{-1}$ $\pm 15\%$	$\pm 20 \text{ W.m}^{-2}$ $\pm 15\%$	$\pm 0.600 \text{ klux}$ $\pm 15\%$
Resolution	$0.6 \mu\text{mol.m}^{-2}.\text{s}^{-1}$	$0.3 \text{ W.m}^{-2}$	$0.060 \text{ klux}$
Range	$0\text{-}2500 \mu\text{mol.m}^{-2}.\text{s}^{-1}$	$0\text{-}1250 \text{ W.m}^{-2}$	$0\text{-}200 \text{ klux}$
Analogue output sensitivity	$1 \text{ mV} = 1 \mu\text{mol.m}^{-2}.\text{s}^{-1}$	$1 \text{ mV} = 0.5 \text{ W.m}^{-2}$	$1 \text{ mV} = 0.100 \text{ klux}$
Analogue output range	$0\text{-}2500 \text{ mV}$	$0\text{-}2500 \text{ mV}$	$0\text{-}2000 \text{ mV}$

Accuracy : Sunshine hours	$\pm 10\%$ compared to the WMO definition
Accuracy : Cosine correction	$\pm 10\%$ of incoming radiation over $0\text{-}90^\circ$ Zenith angle
Accuracy : Azimuth angle	$\pm 5\%$ over $360^\circ$ rotation
Temperature coefficient	$\pm 0.15\%$ / $^\circ\text{C}$ (typical)
Temperature range	$-20$ to $+50^\circ\text{C}$ with Alkaline batteries $-20$ to $+70^\circ\text{C}$ with Lithium batteries
Stability	Recalibration recommended every 2 years.
Response time	$< 250 \text{ ms}$
Spectral response	$400\text{-}700 \text{ nm}$
Latitude capability	$-90^\circ$ to $+90^\circ$
Environmental : Sealing	IP65 ( shower and dust proof)
Sunshine status : contact closure	No sun = open circuit Sun = short circuit to ground
Internal battery	$2 \times 1.5 \text{ V AA}$ alkaline batteries
Power requirement	$2 \text{ mA}$ (awake ), $<30 \mu\text{A}$ (asleep)
Heater power	$12 \text{ V} - 15 \text{ VDC}$ , up to $1.5 \text{ A}$
Battery lifetime	1 year (typical)
Input voltage range – powered from internal battery	$1.4$ to $3.6 \text{ VDC}$
Input voltage range - external power	$5$ to $15 \text{ VDC}$
Fuse trip point, on sunshine status signal, (when in switch-closure mode)	$0.5 \text{ A}$ , $30 \text{ V}$ (self-resetting)
Max applied voltage to sunshine status output, in contact closure mode	$0$ to $24 \text{ V}$
RS232 connector	5-pin M12
Signal output & power-in connector	8 pin M12
Mounting options:	Camera tripod socket ( $\frac{1}{4}$ inch Whitworth). Holes for $4 \times \text{M4}$ bolts at corners of box.
Size & Weight	$120 \text{ mm} \times 122 \text{ mm} \times 95 \text{ mm}$ , $635 \text{ g}$

### SPN1 Sunshine Pyranometer

For simultaneous outputs of total radiation, diffuse radiation and sunshine status. (SPN1 pictured on upper right hand side of front cover.)

Overall accuracy: Total (Global) and Diffuse radiation	$\pm 5\%$ Daily integrals $\pm 5\% \pm 10 \text{ W.m}^{-2}$ Hourly averages $\pm 8\% \pm 10 \text{ W.m}^{-2}$ Individual readings
Resolution	$0.6 \text{ W.m}^{-2} = 0.6 \text{ mV}$
Range	$0$ to $>2000 \text{ W.m}^{-2}$
Analogue output sensitivity	$1 \text{ mV} = 1 \text{ W.m}^{-2}$
Analogue output range	$0 - 2500 \text{ mV}$
Sunshine status threshold	$120 \text{ W.m}^{-2}$ in the direct beam

Accuracy: Sunshine status	$\pm 10\%$ sun hours with respect to the threshold
Accuracy: Cosine correction	$\pm 2\%$ of incoming radiation over $0\text{-}90^\circ$ Zenith angle
Accuracy: Azimuth angle	$\pm 5\%$ over $360^\circ$ rotation
Temperature coefficient	$0.02\%$ per $^\circ\text{C}$ (typical)
Temperature range	$-40$ to $+70^\circ\text{C}$
Stability	Recalibration recommended every 2 years
Response time	$100 \text{ ms}$ (typical)
Spectral response	$400 - 2700 \text{ nm}$
Spectral sensitivity variation	$10\%$ (typical)
Non-linearity	$< 1\%$
Tilt response	negligible
Zero offsets	$< 3 \text{ W.m}^{-2}$ for a change of $5^\circ\text{C/hr}$ in ambient temperature $< 3 \text{ W.m}^{-2}$ dark reading
Latitude capability	$-90^\circ$ to $+90^\circ$
Environmental sealing	IP67
Sunshine status output	No sun = open circuit Sun = short circuit to ground
Power requirement	$2 \text{ mA}$ (awake ), $<30 \mu\text{A}$ (asleep) $5 \text{ V} - 15 \text{ V DC}$
Heater power	$12 \text{ V} - 15 \text{ VDC}$ , up to $1.5 \text{ A}$
RS232 connector	5-pin M12
Signal output & power-in connector	8 pin M12
Mounting options	$3 \times \text{M5}$ tapped holes in base at $108 \text{ mm}$ dia, $120^\circ$ spacing
Size & Weight	$126 \text{ mm}$ dia. $\times 94 \text{ mm}$ high, $786 \text{ g}$

## Weather Station Masts, Enclosures and Accessories

M2-FSG	2 m mast for GP2 Logger. Comprises 2 m mast, 1 m cross arm, fixed baseplate assembly, logger canopy, 3 x steel guy wires and stakes, light sensor mounting with levelling unit, assembly kit and user manual.
M2-MIN-FSG	M2-FSG 2 m mast, excluding logger canopy. For GP2 Logger. Comprises 2 m mast, 1 m cross arm, fixed baseplate assembly, 3x steel guy wires and stakes, light sensor mounting and user manual.
S/POLE	2 m anodised aluminium pole. Aluminium mast suitable for mounting enclosure. Requires fixing in concrete base.
M-ENCL-B2	Enclosure and 12 V wiring kit for GP2. For Delta-T masts. 12 V battery wiring system with protected input power terminals. Comprises lockable IP54 steel enclosure, cable glands (supplied with 12 glands as standard) and trunking. Suitable for GP2 Logger and cellular modem system. Does not include battery, charger or solar panel.