Delta-T Devices

Environmental and Meteorological

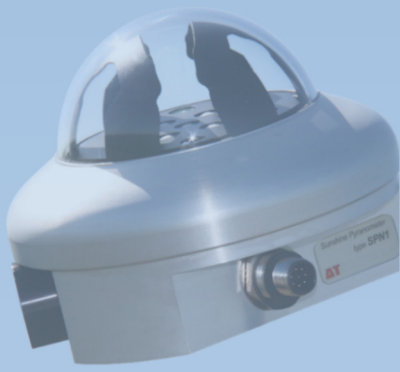
SENSORS & SYSTEMS

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 by researchers and consultants world-wide. Whatever the application, we can help you select the best combination of sensors, data loggers, wireless communications 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

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 built around the GP2 Advanced Data Logger - a powerful core that enables a flexible and expandable system for demanding applications.

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 [a] (°C)	DL6[b] (°C)	GP1[c] (°C)	GP2[d] (°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
ST4-05	Soil temperature probe 10k thermistor, stainless steel sheath, 6s response, IP67.	10 k	±0.2	-10 to +40	PVC	2[e]	-10 to +40	Not available	Not available	±0.14	±0.08
MT2-05	Fast response temperature sensor, 2k, suitable for leaves	2 k	±0.1[f]	-50 to 150	Vy/TEFL[g]	4	Not available	±0.14	±0.4	±0.4	±0.09
AT2-05	Air temperature sensor, 2k thermistor.	2 k	±0.1[f]	-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 and Air Temperature

Type	Description	Units	Measuring range	Accuracy	Operating temp. range	Power requirement	Cable details
RHT-SDI12-T6	SDI-12 RH & air temperature sensor (Tekbox) with M12 connector fitted for connection to existing Delta-T SDI-12 network. NOTE: The RHT-SDI12-T6 is available individually – or as part of a mast mount set (package) which also contains solar radiation shield (SRS-T1) and mounting bracket (MB-T05). The code for this set is RHT-SDI-12+SRS+MB-T6.	%RH	0-100% RH	± 2% RH	-40 to +85°C	6-17 VDC 8 mA (active) 24uA (idle)	3m/3w
		°C	-40 to +85°C	± 0.1°C			
RHTP-SDI12-T6	SDI-12 RH, pressure & air temperature sensor (Tekbox) with M12 connector fitted for connection to existing Delta-T SDI-12 network. NOTE: The RHTP-SDI12-T6 is available individually – or as part of a mast mount set (package) which also contains solar radiation shield (SRS-T1) and mounting bracket (MB-T05). The code for this set is RHTP-SDI-12+SRS+MB-T6.	%RH	0-100% RH	± 2% RH			
		°C	-40 to +85°C	± 0.2°C (0-90degC)			
		hPa	300 to 1250hPa	+/-0.5hPa			

Atmospheric Pressure

Type	Description	Units	Measuring range	Accuracy	Operating temp. range	Power requirement	Cable details
RHTP-SDI12-T6	SDI-12 RH, pressure & air temperature sensor (Tekbox) with M12 connector fitted for connection to existing Delta-T SDI-12 network. NOTE: The RHTP-SDI12-T6 is available individually – or as part of a mast mount set (package) which also contains solar radiation shield (SRS-T1) and mounting bracket (MB-T05). The code for this set is RHTP-SDI-12+SRS+MB-T6.	hPa **Also measures RH and air temperature, see specifications above**	300 to 1250hPa	+/-0.5hPa	-40 to +85°C	6-17 VDC 8 mA (active) 24uA (idle)	3m/3w

Surface Wetness

Type	Description	Operating temp. range	Measurement range	Measurement principle	Measurement response	Current Consumption	Power requirement	Standard cable length
LWS-SDI12-03	SDI-12 surface wetness sensor that mimics the wetness state of a real leaf.	-40 to +80°C	0 to 100%	Capacitive measurement PLL	1 second	active 8mA (for 1 second) - idle 30µA	6-16 V	3m - any other length upon requirement

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 $m.s^{-1}$ (0-167 mph)	±0.1 $m.s^{-1}$ if < 10.1 $m.s^{-1}$ ±1.1% if > 10.1 $m.s^{-1}$ starting threshold 0.4 $m.s^{-1}$	0 to 75 m/s	0.8 Hz per $m.s^{-1}$	-30 to +70 C (minimal icing)	None	*/6w
		Direction	0-360° mechanical 0-356° electrical	±4 degrees 0.5° (resolution) starting threshold 0.4 $m.s^{-1}$	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 $m.s^{-1}$ (170 mph)	1% ±0.1 $m.s^{-1}$ (0 - 55 $m.s^{-1}$) 2% (>55 $m.s^{-1}$)	0.2 to 60 Hz	0.8 Hz per $m.s^{-1}$	-30 to+70°C	None	3m/2w
AN3	Anemometer - high resolution, 3-cup rotor. Digital photodiode pulse and analogue outputs.	Speed	0.15 - 75 $m.s^{-1}$	1% ±0.01 $m.s^{-1}$ (pulsed) 1% (analogue)	3 to 1500 Hz 0 - 2.5 VDC	20 Hz per $m.s^{-1}$ 33 mV per $m.s^{-1}$	-30 to +70C (minimal icing)	7-28 VDC 2.0 mA max	3m/6w
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 $m.s^{-1}$ 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
AN-SDI12-03	Anemometer with SDI-12 interface. It can measure momentary wind speed, or measure average wind speed, maximum wind speed and minimum wind speed over a configurable logging period.	Speed	0.5 m/s to 55 m/s; maximum rating > 70m/s	± 0.35 m/s (over 0.5 – 42 m/s range) 3 decimal digits resolution	0.5m/s to 55m/s	SDI-12 output, no conversion needed	-40 to +70°C	6V to 16V 25mA awake 21uA asleep	3m/3w
WD-SDI12-03	Wind vane with SDI-12 interface. It measure momentary wind direction or measure average wind direction over a configurable logging period.	Direction	0° to 360° No dead band	+/-2% 0.35 deg resolution.	0 to 360 deg, no dead band	SDI-12 output, no conversion needed	-40 to +70°C	6V to 16V	3m/3w

* Cable is separately sold – in multiples of 5 metres

** 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

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 $kW.m^{-2}$	±15% (j k l)	400-1050 nm	-10 to +60°C	10m V per ($kW.m^{-2}$)	5m/2w
ES4	Digital sensor with SDI-12 communication protocol. It incorporates a silicon-cell photodiode with a rugged, self-cleaning sensor housing design, and high-quality cable and M-12 connector.	0 to 2 $kW.m^{-2}$	< ±3%	360 - 1120 nm	-40 to + 70°C	Digital SDI-12, no conversion needed	5m/3w
QS6	Digital sensor with SDI-12 communication protocol. It features a rugged, self-cleaning sensor housing design, and high-quality cable with M-12 connector for easy connection to SDI-12 cable networks.	0-2500umol.m-2.s-1	±5%	370 – 650nm	-20 - 60°C	Digital SDI-12, no conversion needed	5m/3w
GS1	Dome solarimeter (pyranometer), based on thermopile, for WMO Class 2 solar energy reference measurements. Dome 36mm dia.	0 to 2 $kW.m^{-2}$	±10% (l m)	305-2800 nm	-40 to +80°C	10-35 mV per ($kW.m^{-2}$)	10m/2w
GS2	Albedometer using 2 GS1s mounted back-to-back. For measuring both incident and reflected radiation.	0 to 2 $kW.m^{-2}$	±10% (l m)	305-2800 nm	-40 to +80°C	10-35 mV per ($kW.m^{-2}$)	10m/2w 2 cables

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^{-2})	Power requirement	Size	Cable details
UV3pA	A range of 3 UV sensors fitted with a photodiode detector and transimpedence amplifier. Accuracy for all models is ±7.5% at 20°C.	0-150 W m^{-2}	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^{-2}	313 ± 2 nm	26 ± 2 nm				
UV3pAB		0-200 W m^{-2}	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	µmol.m^{-2}.s^{-1}	W.m^{-2}	klux
Overall accuracy: Total	±10 µmol.m^{-2}.s^{-1} ±12%	±5 W.m^{-2} ±12%	±0.600 klux ±12%
Overall accuracy: Diffuse	±10 µmol.m^{-2}.s^{-1} ±15%	±20 W.m^{-2} ±15%	±0.600 klux ±15%
Resolution	0.6 µmol.m^{-2}.s^{-1}	0.3 W.m^{-2}	0.060 klux
Range	0-2500 µmol.m^{-2}.s^{-1}	0-1250 W.m^{-2}	0-200 klux
Analogue output sensitivity	1 mV = 1 µmol.m^{-2}.s^{-1}	1 mV = 0.5 W.m^{-2}	1 mV = 0.100 klux
Analogue output range	0-2500 mV	0-2500 mV	0-2000 mV

Accuracy : Sunshine hours	±10% compared to the WMO definition
Accuracy : Cosine correction	±10% of incoming radiation over 0-90° Zenith angle
Accuracy : Azimuth angle	± 5% over 360° rotation
Temperature coefficient	± 0.15 % /°C (typical)
Temperature range	-20 to + 50°C with Alkaline batteries -20 to + 70°C with Lithium batteries
Stability	Recalibration recommended every 2 years.
Response time	< 250 ms
Spectral response	400-700 nm
Latitude capability	-90° to + 90°
Environmental : Sealing	IP65 (shower and dust proof)
Sunshine status : contact closure	No sun = open circuit Sun = short circuit to ground
Internal battery	2 x 1.5 V AA alkaline batteries
Power requirement	2 mA (awake), <30 µA (asleep)
Heater power	12 V - 15 VDC, up to 1.5 A
Battery lifetime	1 year (typical)
Input voltage range – powered from internal battery	1.4 to 3.6 VDC
Input voltage range - external power	5 to 15 VDC
Fuse trip point, on sunshine status signal, (when in switch-closure mode)	0.5 A, 30 V (self-resetting)
Max applied voltage to sunshine status output, in contact closure mode	0 to 24 V
RS232 connector	5-pin M12
Signal output & power-in connector	8 pin M12
Mounting options:	Camera tripod socket (¼ inch Whitworth). Holes for 4 x M4 bolts at corners of box.
Size & Weight	120 mm x 122 mm x 95 mm, 635 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	±5% Daily integrals ±5% ±10 W.m^{-2} Hourly averages ±8% ±10 W.m^{-2} Individual readings
Resolution	0.6 W.m^{-2} = 0.6 mV
Range	0 to >2000 W.m^{-2}
Analogue output sensitivity	1 mV = 1 W.m^{-2}
Analogue output range	0 – 2500 mV
Sunshine status threshold	120 W.m^{-2} in the direct beam

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