SPN1 Sunshine Pyranometer

Total (Global) and Diffuse Radiation and Sunshine Duration sensor. with thermopile sensors and precision glass dome needing no routine adjustment or polar alignment.

Quick Start Guide *version 3.0*

AT *Delta-T Devices Ltd*

Summary

This guide explains how to use the SunRead PC software to check the SPN1 is working, and how to connect to and program a GP1 data logger.

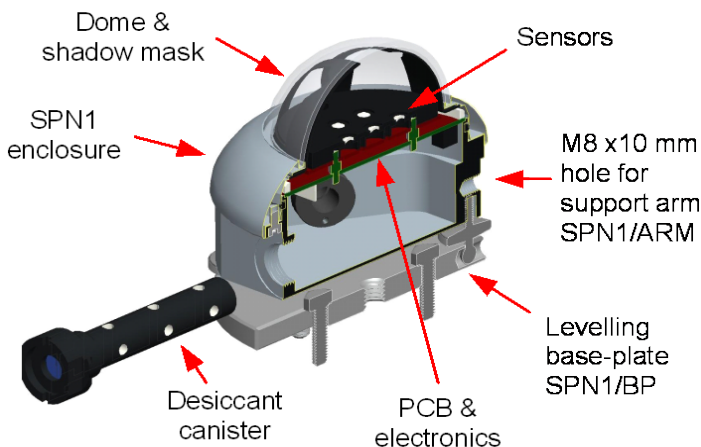# Unpacking

The SPN1 is supplied with
- Serial cable **SP-BF-RS01**
- Analogue cable **SP-BF/w-05**
- User Manual and this Quick Start Guide
- Calibration certificate

Optional accessories
- Levelling baseplate **SPN1/BP**
- Support arm **SPN1/ARM**
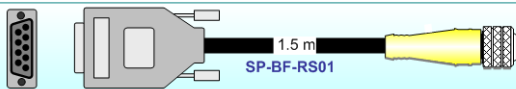- Spare desiccant canisters **SPN1-SD**

Overview

Construction

Dome & shadow mask

Sensors

SPN1 enclosure

M8 x10 mm hole for support arm SPN1/ARM

Levelling base-plate SPN1/BP

Desiccant canister
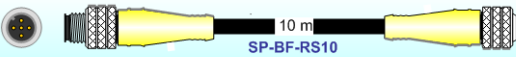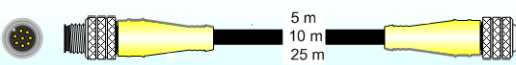
PCB & electronics

Indicators

Red LED flashes when taking readings

Bubble level

Humidity indicators   Upper   Lower

Desiccant canister
30% pink = early warning
Renew if 50% or
upper indicator pink
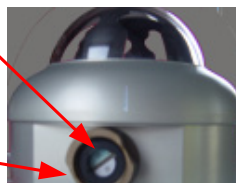
Cabling Options

CABLE OPTIONS

SPN1 end

RS232 cable	9-way serial female	1.5 m SP-BF-RS01	5-way M12 female
RS232 extension cable	5-way M12 male	10 m SP-BF-RS10	5-way M12 female
Logger cable	Flying leads	5 m SP-BF/w-05	8-way M12 female
Logger extension cable	8-way M12 male	5 m 10 m 25 m EXT/8w-5 EXT/8w-10 EXT/8w-25	8-way M12 female

Maximum Cable Lengths

Serial cable: the maximum length usually depends on how good the line driver is in the PC, and can typically vary from 5 to 100m.

Analogue cable: 100m - provided the power supply at the SPN1 exceeds 5V at 2mA for sensor alone, or 12V at up to 1.5A for heater.

Power: Don't exceed the maximum specified supply voltage of 15V.

For a 15V supply, the heater will work as intended up to 50m cable length, and with a reduced effectiveness for longer cable lengths.

Note: **Always use differential sensor measurement when using data loggers**.

(The heater return current can cause large single-ended measurement errors).

System Cabling Options
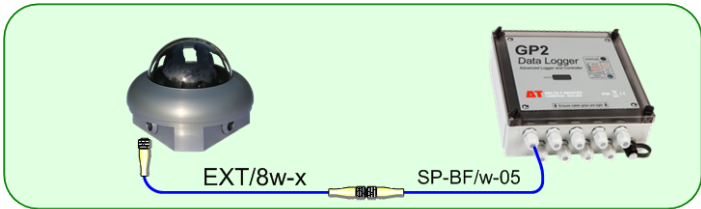
SPN1 analogue port to a data logger e.g. GP1, GP2 or DL2e

SPN1 serial port to PC running SunRead

System Overview

SunRead

DeltaLINK

Reading Units: W.m-2
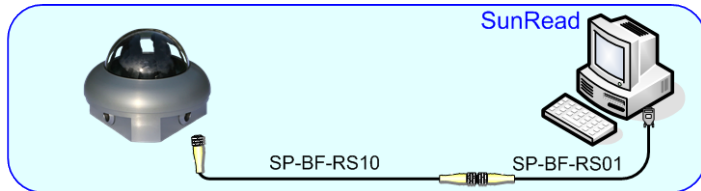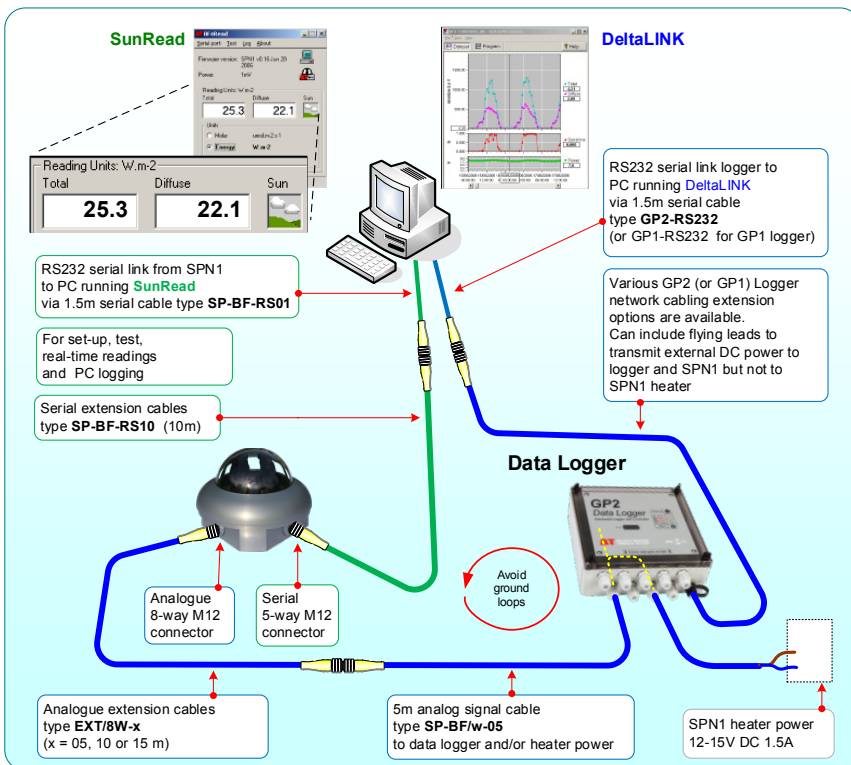
Total	Diffuse	Sun
25.3	**22.1**	

RS232 serial link logger to PC running DeltaLINK via 1.5m serial cable type **GP2-RS232** (or GP1-RS232 for GP1 logger)

RS232 serial link from SPN1 to PC running SunRead via 1.5m serial cable type **SP-BF-RS01**

For set-up, test, real-time readings and PC logging

Serial extension cables type **SP-BF-RS10** (10m)

Various GP2 (or GP1) Logger network cabling extension options are available. Can include flying leads to transmit external DC power to logger and SPN1 but not to SPN1 heater

Data Logger

Analogue 8-way M12 connector

Serial 5-way M12 connector

Avoid ground loops

GP2 Data Logger

Analogue extension cables type **EXT/8W-x** (x = 05, 10 or 15 m)

5m analog signal cable type **SP-BF/w-05** to data logger and/or heater power

SPN1 heater power 12-15V DC 1.5A

Use with a PC running SunRead

SunRead

PC running
SunRead
*for
set-up and test ,
real-time readings &
to log data to PC*

RS232 output from SPN1 to PC
via 1.5m cable type **SP-BF-RS01**

Optional heater power
supply via 5m analog
signal cable
type **SP-BF/w-05**

Optional
Serial extension cables
type **SP-BF-RS10** (10m)

Analogue
8-pole M12
connector

Serial out
5-pole M12
connector
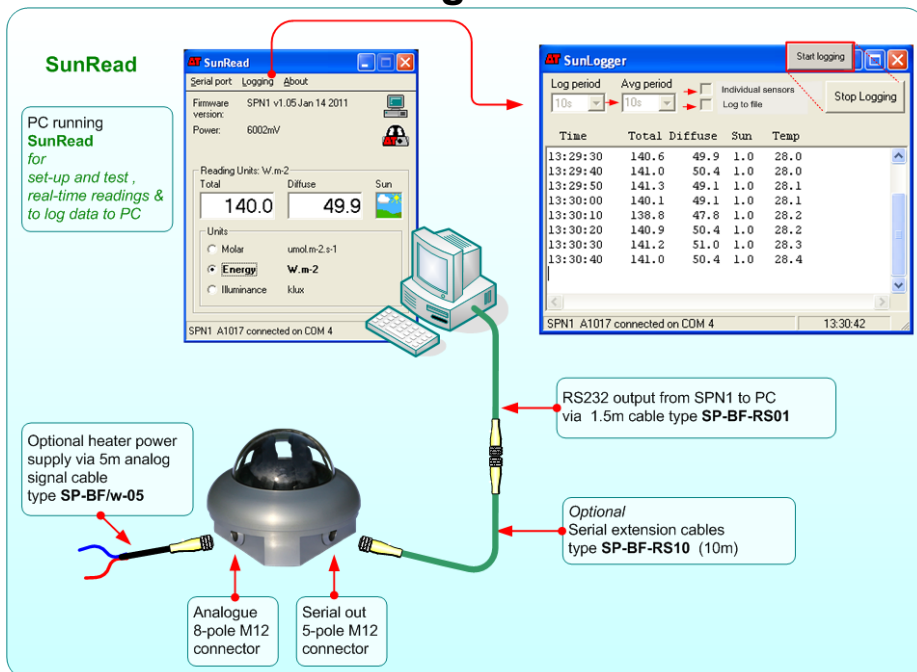
Power connection options

Mains-powered power supply
7-15V DC, 1.5A max at 12V, outputs
isolated from mains

Htr+   Htr-

SP-BF/w-05
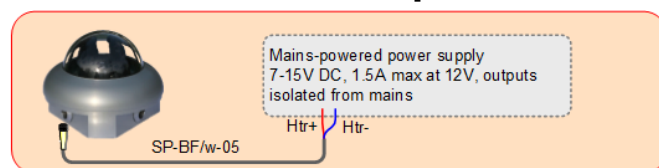
Heater power
(To enable analogue outputs
connect the separate logger
warmup line - see below)

Warm up control:
>3V required for SPN1 to provide its output signals,
<u>if</u> power is provided elsewhere
and/or
External sensor power:
5-15V @ 2mA recommended to power sensor via warm-up line

DL-Power   DL-Gnd

SP-BF/w-05
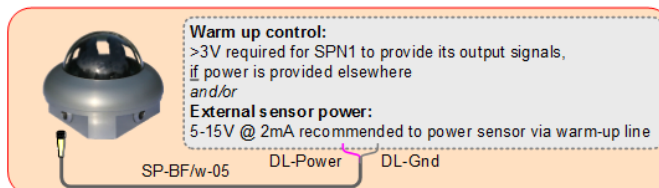
Power via logger warmup.
Analogue outputs enabled.
No heater.

SPN1 power from PC's RS232 serial port
(draws up to 2mA from the RS232 DTR line if no
other power available)

Note: some laptops may not provide enough
current
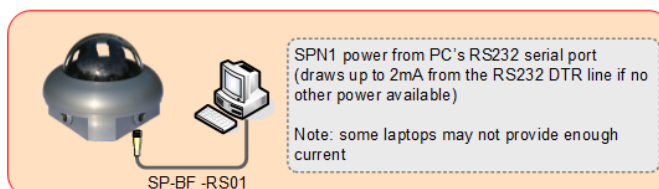
SP-BF -RS01

Power from PC

Use SunRead to check the SPN1

About SunRead

- **Displays Total (global) and Diffuse radiation and sunshine status**
- **Use for *setting up and testing* SPN1**
- Runs on your PC, connected directly to SPN1 via **SP-BF-RS01** cable
- Simple logging capability

Installation Requirements:

- PC running Windows XP, 7 or 8
- One free RS232 serial port, or USB-RS232 adapter
- DVD drive for software installation
- Cable SP-BF-RS01 (not intended for outdoor use)
- Delta-T Software and Manuals DVD
- Acrobat Reader for reading documentation (free download from www.adobe.com)

Installation

1. Install the DVD in the PC. On most PCs, installation will start automatically. If it does not, run the file setup.exe in the root folder of the DVD. This will display an index of software and also of documents.
2. Click on **Install SunRead software**.
3. Check the DVD and also our website at http://www.delta-t.co.uk/support.html for the latest documentation and copy it to your PC if you wish.

For further installation information see SunRead Release Notes on the DVD.

Note 1: Most PCs, but not all, can power the SPN1 via the serial port. If not, power the SPN1 via the analogue cable – see the analogue cable wiring diagram.

Start SunRead

1. Connect your SPN1 to a spare serial port or via a USB-RS232 adapter to your PC, using cable **SP-BF-RS01** plugged into the 5-pole connector- see *Overview* diagram.

2. Run **SunRead** to display the screen shown below.

Serial Port:
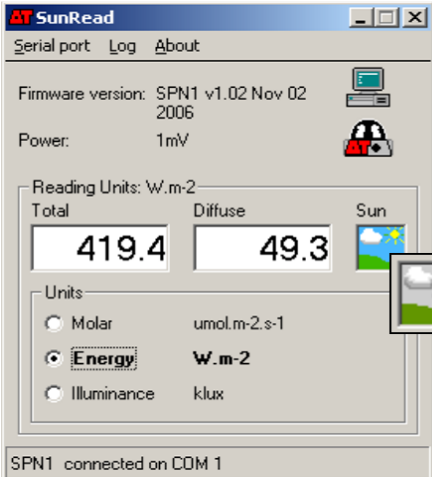*Select from the available serial ports* →

Firmware version →

Ignore
(for BF3 use only) →

Readings, updated every 1-2 seconds →

Units –
SPN1 displays in W.m⁻² →

Status information about serial port connection →
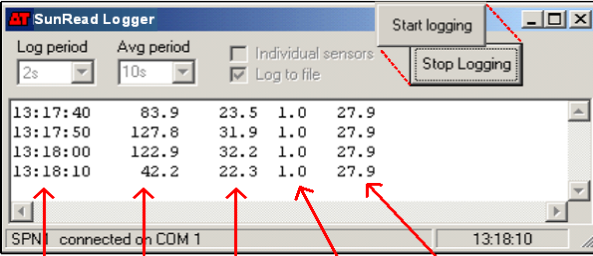
Logs serial SPN1 data using your PC as the logger ↓

Icon indicates sun state

Logging with SunRead

1. Select **Log** to display the logging window.
2. Enter the logging options (see below)
3. Click **Start** Logging.

Logged data is displayed in real-time, and can be saved to file as .csv files which can analysed in Excel.

Time	Total W.m-2	Diffuse W.m-2	Sunshine status	SPN1 Temperature

Logging options

Log period: sets logging frequency.
Avg period: sets averaging period.
Log to file: saves each reading to file as it is logged.
Individual sensors: records all 7 individual thermopile sensors.

See also RS232 Commands in **SPN1 User Manual**

Set up Data Logger

Outputs

The 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 **SP-BF/w-05**.

Note : Avoid simultaneous connection of serial cable to a PC and analogue outputs via a logger to a PC - it may create an earth loop which may reduce signal accuracy.
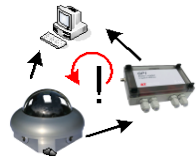
Connect analogue cable to logger

GP2: see SPN1 Info Panel in DeltaLINK, and also the GP2 User Manual.
GP1: see *SPN1 Sunshine Recorder Program* in DeltaLINK Help.
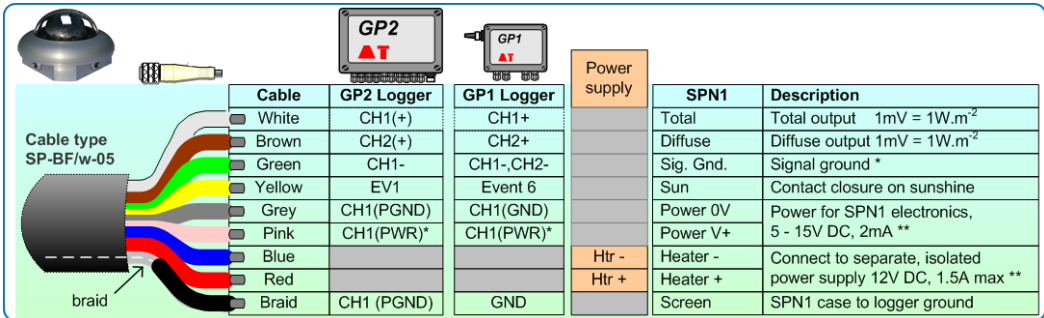DL2e: see SPN1 sensor Help in Ls2Win (service release 5).

Cable	GP2 Logger	GP1 Logger	Power supply	SPN1	Description
White	CH1(+)	CH1+		Total	Total output 1mV = 1W.m^{-2}
Brown	CH2(+)	CH2+		Diffuse	Diffuse output 1mV = 1W.m^{-2}
Green	CH1-	CH1-,CH2-		Sig. Gnd.	Signal ground *
Yellow	EV1	Event 6		Sun	Contact closure on sunshine
Grey	CH1(PGND)	CH1(GND)		Power 0V	Power for SPN1 electronics,
Pink	CH1(PWR)*	CH1(PWR)*		Power V+	5 - 15V DC, 2mA **
Blue			Htr -	Heater -	Connect to separate, isolated
Red			Htr +	Heater +	power supply 12V DC, 1.5A max **
Braid	CH1 (PGND)	GND		Screen	SPN1 case to logger ground

Figure 1: Wiring to GP1 and GP2 data logger and to heater power supply

* Note: Connected internally in the SPN1 to Power 0V
** Note: Analogue cable SP-BF/w-05 and serial cable SP-BF-RS01 braids are both earthed via the connector shells to the SPN1 case and terminate at the data logger or PC case or ground. To avoid ground loops do not interconnect braids elsewhere.
*** Note: SPN1 draws power from Power V+, CTS (PC serial port), or Heater +, whichever voltage is highest. Most PCs can power the SPN1 via the serial port.

Analogue cable wiring for loggers and heater

White (Total output) and **Brown** (Diffuse output): connect to data logger voltage inputs. The normal range of this output is 0V – 1.3V
Green: connect to data logger signal ground or –ve input terminal.
Yellow: connect to a data logger digital input. It gives a short circuit to ground when sunshine is present, and open circuit with no sunshine. Alternatively, connect to a resistance input with a precision resistor in parallel (see also SPN1 User Manual).
Grey 0V and **Pink V+** (SPN1 power): apply >5V to power the SPN1 and enable the sensor output signals.
Red Htr+ and **Blue Htr-** (heater power): connect to a separate, isolated 12V DC 1.5A power supply. The actual heater current depends on the temperature. In cold climates a 40Ah battery would only last one day, so use a mains-powered regulated 12V DC power adaptor.

Do not apply AC mains power to the SPN1.

Program a GP1 Logger

About DeltaLINK-PC software

- **Programs the GP1 logger, starts and stops logging, displays real-time graphs, retrieves, graphs and displays logged SPN1 data.**
- Runs on your PC, connected to GP1 via GP1-RS232 cable
- Includes an SPN1 logging program

You need DeltaLINK 3.0 or later installed along with the Excel Dataset Import Wizard
(see Software and Manuals DVD)
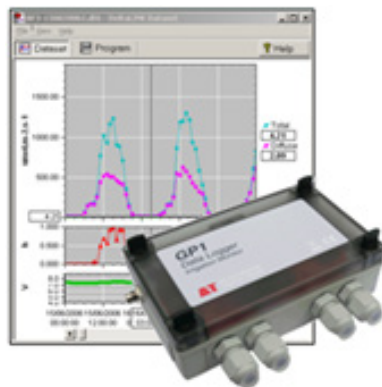
Run DeltaLINK-PC

1. Connect PC to the GP1 with cable **GP1-RS232**, either using a spare serial port or USB-RS232 adapter.
2. Run **DeltaLINK.** The GP1 should respond, populating the DeltaLINK **Logger** page with status information about the logger.
3. Click on **Program** and then **Change** to create a new logging program.
4. Select **Edit, New Program** and select **SPN1 Sunshine Recorder.**
5. Define the logging program you require, from the options as shown.
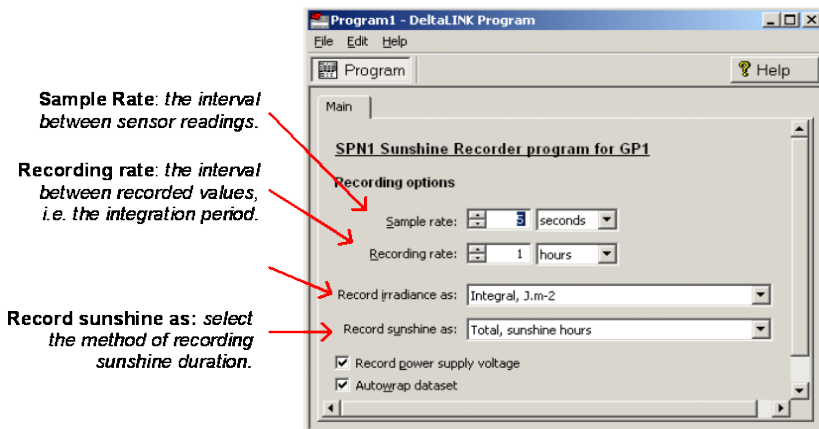
6. Click **Apply** to install the program in the GP1.
7. Click on the **Sensors** page and **Refresh** to show a real-time graph of Total (Global), Diffuse and sunshine status – to check everything seems to be working.
8. On the **Logger** tab select **Start** to start logging.
9. Periodically in the **Dataset** tab select **Refresh** to inspect logged data.
10. **Save** it to file.
11. To import data into Excel, install the **Dataset Import Wizard** from the Start Menu, Delta-T program group, then (in Excel 2010) select **Add Ins, Import Dataset(s).**
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Program a GP2 Logger

Before you start you need DeltaLINK connected to your GP2 or to the GP2 Simulator (see also the GP2 User Manual and/or DeltaLINK Help).
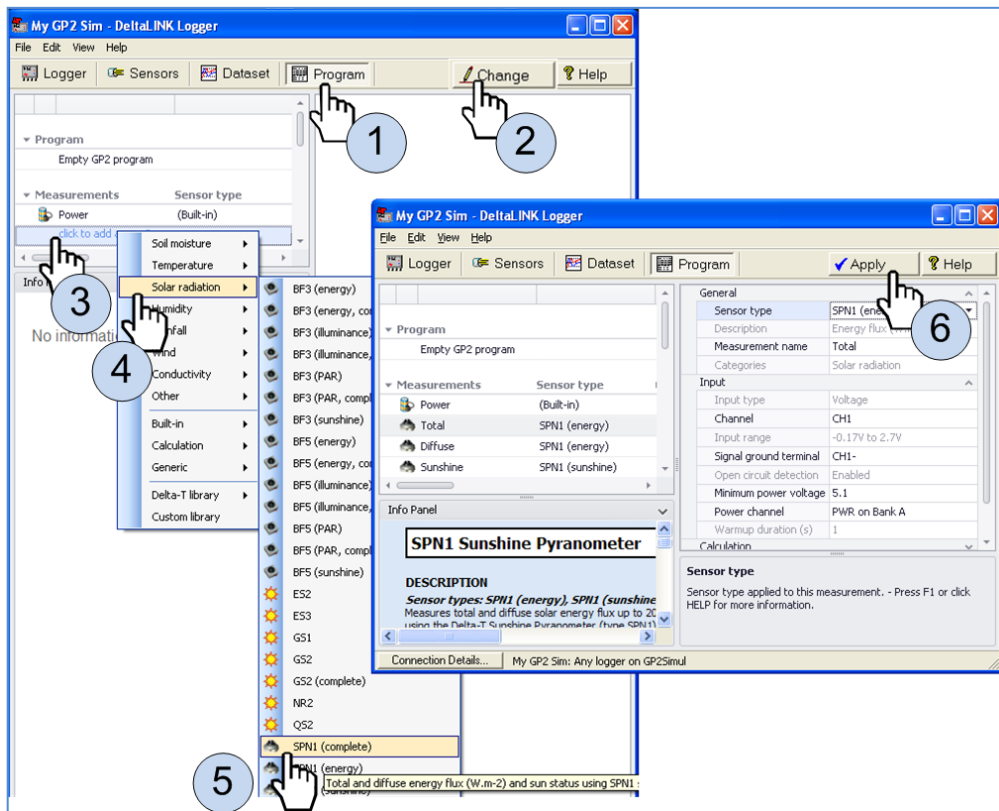
Install the SPN1 on site
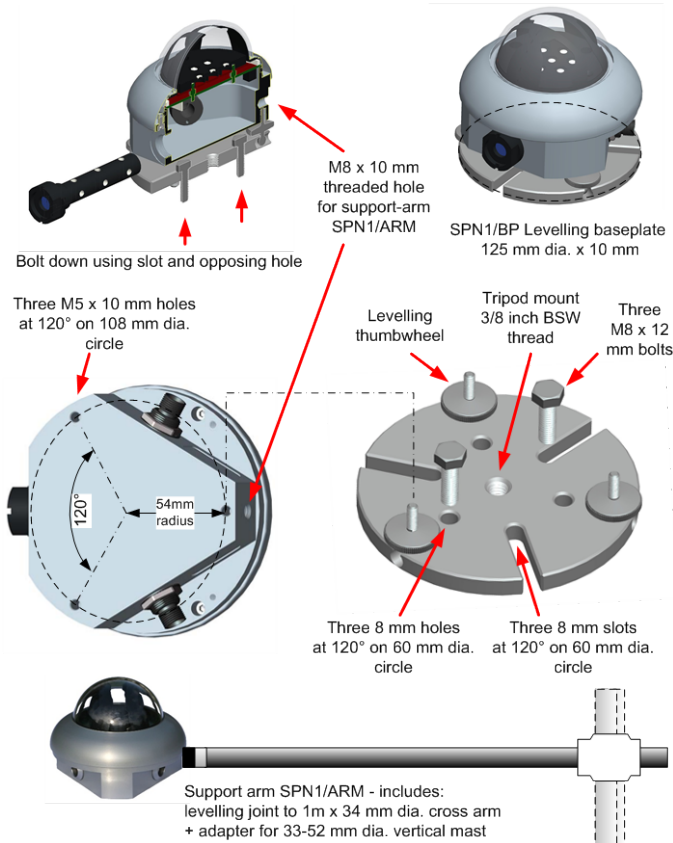
It may be installed at any latitude.

Mount the SPN1 horizontally and at any polar orientation i.e. relative to North.

Use either the **Levelling baseplate** type **SPN1/BP**, or **Support arm** type **SPN1/ARM**. M8 attachment bolts are provided with both.

Do not touch any socket cap screws under the flange holding the dome. These are sealed during manufacture.

Connect the heater power, data logger, and serial port if required, using the cables shown in the *Overview* and the wiring connections shown in Fig 1.

M8 x 10 mm threaded hole for support-arm SPN1/ARM

Bolt down using slot and opposing hole

SPN1/BP Levelling baseplate 125 mm dia. x 10 mm

Three M5 x 10 mm holes at 120° on 108 mm dia. circle

120°

54mm radius

Levelling thumbwheel

Tripod mount 3/8 inch BSW thread

Three M8 x 12 mm bolts

Three 8 mm holes at 120° on 60 mm dia. circle

Three 8 mm slots at 120° on 60 mm dia. circle

Support arm SPN1/ARM - includes: levelling joint to 1m x 34 mm dia. cross arm + adapter for 33-52 mm dia. vertical mast

Maintenance

Keep glass dome clean using clean water with mild detergent or Isopropyl Alcohol.

If any two desiccant indicators turn pink, unscrew the desiccant canister from the indicator cap, and replace with a fresh one (type SPN1-SD).

Notices: The Sunshine Pyranometer is protected by patents EP1012633 & US 6417500. EMC certification: refer to the SPN1 Regulatory Information on the Delta-T Software and Manuals DVD

Specifications

The following accuracy figures give 95% confidence limits, i.e. 95% of individual readings will be within the stated limits under normal climatic conditions. For full specs see SPN1 User Manual

Overall accuracy: Total (Global) radiation and Diffuse radiation	$\pm$ 5% Daily integrals $\pm$ 5% $\pm$10 W.m^{-2} Hourly averages $\pm$ 8% $\pm$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

Other specifications

Accuracy: Sunshine status	$\pm$ 10% sun hours with respect to the threshold
Accuracy: Cosine Correction	$\pm$ 2% of incoming radiation over 0-90° Zenith angle
Accuracy: Azimuth angle	$\pm$ 5% over 360° rotation
Temperature coefficient	$\pm$ 0.02 % /°C typical
Temperature range	-20 to +70°C
Stability	Recalibration recommended every 2 years.
Response time	< 200 ms
Spectral Response	400-2700 nm
Spectral sensitivity	10% typical
Non-linearity	< 1%
Tilt response	Negligible
Zero Offsets	< 3 W.m^{-2} for a 5°C/hour change 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 (excluding heater power), 5 V – 15 V DC
Heater power	12 V – 15 V DC, up to 1.5 A
Heater control	Continuously variable up to 20 W output for external temperatures below 0°C
Lowest snow & ice-free temperatures (using heater)	-20°C at 0 m/s wind speed -10°C at 2 m/s wind speed
Mounting options:	3 x M5 tapped holes in base; 108mm pcd, 120°spacing. (takes optional Levelling baseplate SPN1/BP) M8 tapped hole on side (takes Support Arm SPN1/ARM)
Size & Weight	126 mm dia. x 94 mm high, 786 gm