Pyranometer Delta-T Sunshine SPN1

S65100

سنسور تشعشع سنج – دلتا تی سان شین SPN1

کد سفارش

- **Measures global (total) and diffuse irradiance in W/m²**
- **WMO sunshine threshold: 120 W/m² direct beam**
- **No routine adjustment or polar alignment**
- **No moving parts, shade rings or motorised tracking**
- **Works at any latitude**
- **Unique ground glass dome**
- **Wideband thermopile sensors**
- **Near ideal spectral and cosine response**
- **Standard output sensitivity**
- **Matches or exceeds the ISO First Class standard and the WMO Good Quality standard for a solar pyranometer in all respects apart from the spectral response - which is accurate to ±10% over 0.4 to 2.7 µm**

Description

The Sunshine Pyranometer is a patented, meteorological class instrument, with built-in heating, designed for long-term outdoor exposure. It is an affordable alternative to shade-ring pyranometers, pyrheliometers and traditional sunshine recorders. The SPN1 is exceptionally easy to use; it needs no routine adjustment or polar alignment and works at any latitude.

Unique Design

The Sunshine Pyranometer uses an array of seven, miniature thermopile sensors and a computer generate shading pattern to measure the direct and diffuse components of incident solar radiation. The shading pattern and thermopiles are arranged so that at least one thermopile is always fully exposed to the solar beam, and at least one is fully shaded from it, regardless of the position of the sun in the sky. All seven thermopiles receive an equal amount of diffuse light. From the individual thermopile readings, a microprocessor calculates the global and diffuse horizontal irradiance and from these values an estimate of sunshine state is made. The Sunshine Pyranometer is protected by patents EP 1012633 & US 6417500.

SPN1 Design Principles

The principles used in the Sunshine Pyranometer have been tried and tested in the Delta-T BF3 Sunshine Sensor. The original design has been enhanced, using miniature thermopile sensors, a high quality ground glass dome and aluminium housing. The electronics have also been redesigned for higher accuracy and lower power consumption. The SPN1 computes direct radiation by subtracting the diffuse from the global (total) radiation.

Outputs

The Sunshine Pyranometer provides 2 analogue voltage outputs for global and diffuse radiation, and a digital output for sunshine duration which can be connected to data loggers. Readings can be obtained directly from the RS232 port.

Heating

An internal heating keeps the dome clear of dew, ice and snow down to -20°C (in still air conditions), ensuring reliable readings in difficult climatic conditions.

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Specifications

Characteristic	Description / Value
Spectral range	0 to > 2000 W/m²
Resolution	0.6 W/m² = 0.6mV
Analog output sensitivity	1mV = 1 W/m²
Analog output range	0 ... 2500 mV
Sunshine status threshold	120 W/m²
Sunshine status output	No sun = open circuit Sun = short circuit to ground
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
Quality Standard	SPN1 matches or exceeds ISO First Class standard and WMO Good Quality standard for solar pyranometers in all respects apart from spectral response - which is accurate to ±10% over 0.4 to 2.7 µm
Overall Acuracy	± 5% daily integrals
Global (Total)	± 5% ± 10 W/m² hourly averages
Diffuse Radiation	± 8% ± 10 W/m² individual readings Accuracy figures give 95% confidence limits, i.e. 95% of individual readings will be within stated limits under normal climactic conditions.
Power requirements	2 mA (excluding heating power) 5 ... 15 VDC
Heating power	12 ... 15 VDC, up to 1.5 A
Heating control	Continuously variable up to 20 W output for external temperatures below 0°C
Lowest snow & ice-free temperatures (with heating in use)	-20°C at 0 m/s wind speed -10°C at 2 m/s wind speed
Temp coefficient	± 0.02% per °C typical (-20 ... +70°C)
Temperature range	-40 ... +70°C
Recalibration / stability	Factory calibration recommended every 2 years
Spectral response	400 ... 2700 nm
Spectral sensitivity variation	10% typical
Latitude capability	-90 ... +90°C
Connection	8-pole plug (M12)
Cable	8-wire cable, length: 5 m
Environmental	IP67 sealing
Mounting options	3 x M5 tapped holes in base; 108 mm pcd, 120° spacing
Size / weight	140 mm (diameter) x 100 mm (height), 940g
Manufacturer	Delta-T Devices Ltd.

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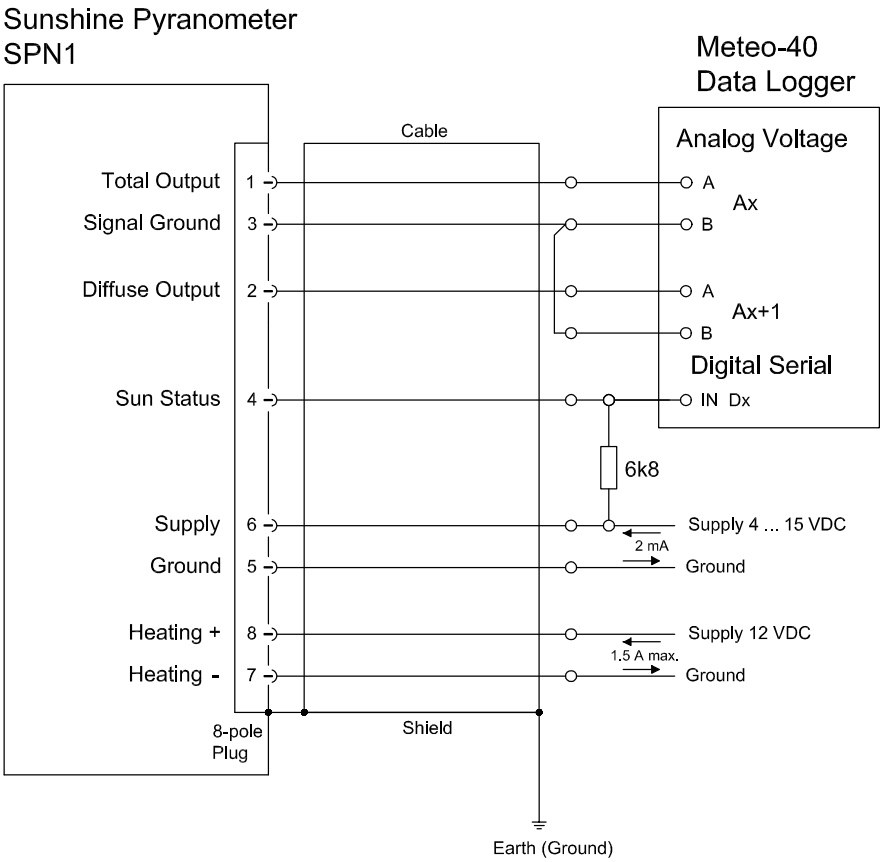
Sensor Connection to Ammonit Meteo-40 Data Logger

Function	Plug Pin No.	Sensor Cable Wire Colour	Meteo-40 Analog Voltage / Digital	Supply Sensor
Gobal irradiance	1	white	Ax A	
Diffuse irradiance	2	brown	Ax+1 A	
Signal ground	3	green	Ax B, Ax+1 B	
Sun status	4	yellow	Dx	
Ground	5	grey		GND
Supply	6	pink		4 ... 15 VDC
Heating	7	blue		12 VDC
Heating	8	red		GND

Sensor Connection Diagram to Ammonit Meteo-40 Data Logger



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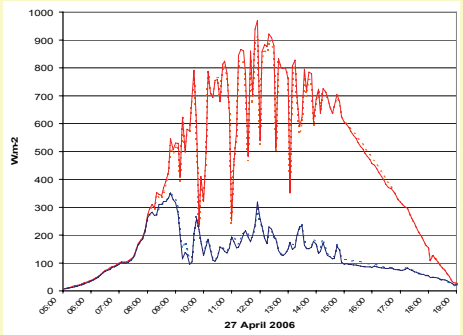
Applications

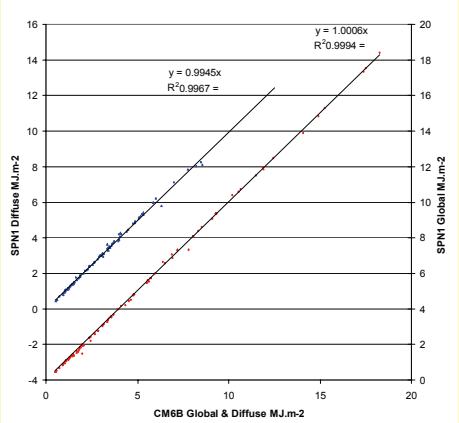
Meteorology
- Solar radiation
- Climate change
- Air pollution
- Sunshine duration
- Cloud cover research

Agronomy & plant science
- ET and heat flux studies
- Canopy analysis and modelling

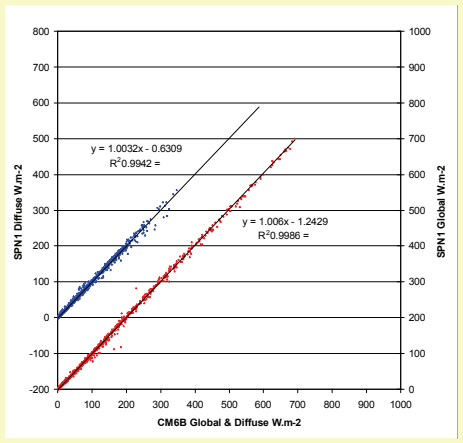
Architecture and building design
- Building Management Systems
- PV efficiency and energy balance



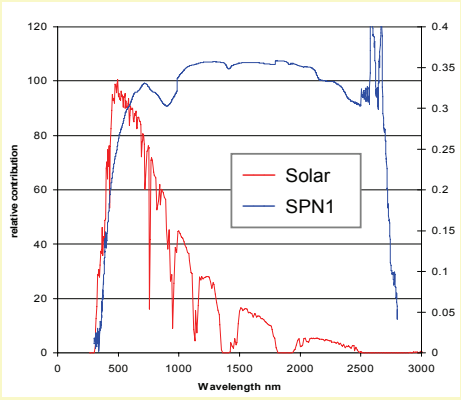
SPN1 Direct and Diffuse Outputs (solid traces) compared with a pair of Kipp CM6B pyranometers with solar tracking and shading disk (broken traces).



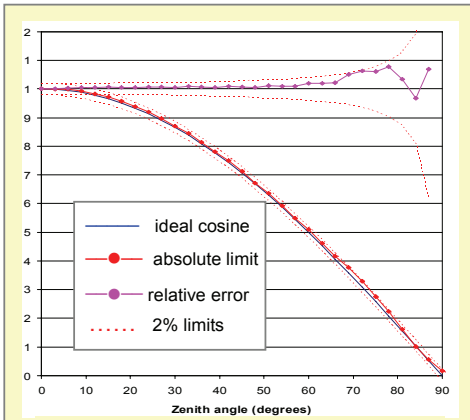
SPN1 Daily Integrals Global & diffuse compared with Kipp CM6B & tracking disk Sept – Dec 2004, daily integrals. (Note use of offset axes to make traces visible).



SPN1 Hourly Averages Global & diffuse compared with Kipp CM6B & tracking disk Sept – Dec 2004, hourly averages. (Note use of offset axes to make traces visible).



SPN1 Spectral Response Graph shows the spectral response of the SPN1 (thermopile, diffusers and dome combined) and the solar spectrum at ground level.



SPN1 Cosine Response Graph shows the typical cosine response of the SPN1 compared to the ideal cosine curve. The upper curve shows the relative accuracy.

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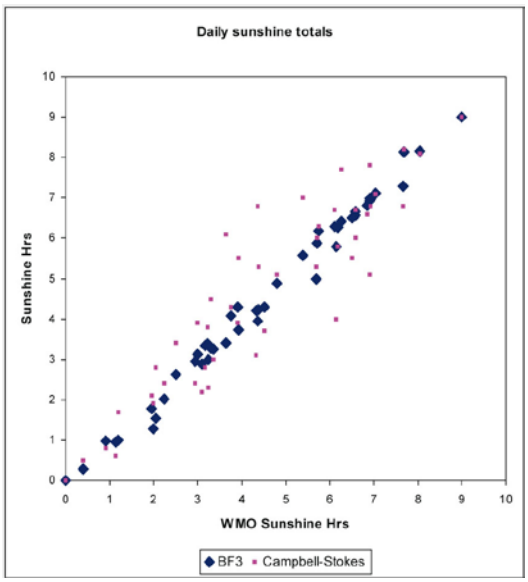

Sunshine Duration

The WMO threshold for bright sunshine is 120 W/m² in a plane perpendicular to the direct solar beam. This cannot be measured directly using horizontal cosine-corrected sensors, and so the SPN1 uses an algorithm based on the ratio of direct to diffuse radiation, combined with their absolute values, to estimate this to within a few percent of the WMO standard.

The graph compares the performance of the BF3* and a Campbell-Stokes sunshine recorder over a trial period of several months. Against the WMO standard, the BF3's typical daily error was 20 minutes. In contrast, the Campbell-Stokes was less precise, giving a typical daily error of nearly an hour.

** The SPN1 is an advanced version of the current BF3 Sunshine Sensor. Both instruments use the same sunshine hours algorithm.*

Comparison of SPN 1 with WMO and ISO pyranometer standards

		ISO: Secondary Standard	ISO: First Class		
		WMO: High Quality	WMO: Good Quality	SPN1	Notes
Response time:	ISO & WMO	< 15 s	< 30 s	0.1 s	To 95% of final value (Actual response time is 100ms)
Zero off-set response:	ISO & WMO	7 W/m²	15 W/m²	< 3 W/m²	To 200 W/m² net radiant loss to sky (ventilation)
Zero off-set response:	ISO & WMO	±2 W/m²	±4 W/m²	< 3 W/m²	For 5°C/hr change in ambient temperature
Resolution:	WMO	±1 W/m²	±5 W/m²	0.6 W/m²	Smallest detectable change
Non-stability:	ISO & WMO	±0.8%	±1.5%	< 1.0%	Change in sensitivity per year
Non-linearity:	ISO & WMO	±0.5%	±1%	< 1%	Deviation from sensitivity at 500 W/m² over 100 to 1000 W/m² range
Directional response:	ISO & WMO	±10 W/m²	±20 W/m²	±20 W/m²	Error due to assuming that the normal incidence response at 1000 W/m² is valid for all directions
Spectral selectivity:	ISO (0.35...1.5 µm) WMO (0.30...3.0 µm)	±3% ±2%	±5% ±5%	± 10% (0.4...2.7 µm)	Deviation to the mathematical product of spectral absorptance and transmittance from the mean
Temperature response:	ISO & WMO	±2%	±4%	± 1%	Error due to 50°C ambient temperature change
Tilt response:	ISO & WMO	±0.5%	±2%	See note*	Deviation from the horizontal responsitivity due to tilt from horizontal to vertical at 1000 W/m²
Achievable uncertainty:	WMO hourly total WMO daily total	3% 2%	8% 5%	5% ±10 W/m² 5%	95% confidence level

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