



USER'S GUIDE for MIDDLETON SOLAR SD4 SUNSHINE DURATION SENSOR

The SD4 Sunshine Duration Sensor is a contrast detector for the measurement of direct sunlight duration. It has four identical omni-directional sensors under a hemispherical shading canopy. An embedded microcontroller executes a sophisticated contrast-evaluation algorithm to accurately discriminate direct sunshine from diffuse sunlight, even in difficult bright-cloud conditions. The algorithm evaluates magnitude, difference, and rate of change, to determine sun status. The sensors are sampled every second and the output state updated every 60 seconds¹. A simple high/low output is used to indicate sunshine/no-sunshine. The SD4 operates at any latitude & longitude, and does not require azimuth alignment. The SD4 is machined from marine-grade aluminium and is hard anodised to provide a durable, corrosion-resistant finish. The four sensors are shielded by a glass dome. The feet are 316 stainless steel.

INSTALLATION. Select a site where obstructions do not exceed 3 degrees of elevation, in the path followed by the sun, between earliest sunrise and latest sunset during the year. Avoid positioning the instrument near light-coloured objects (eg. painted walls) which can cause errors due to reflection of radiation onto the instrument; also avoid siting near sources of artificial light.

Mount the SD4 on a rigid level surface. The instrument has a central M5 x 0.8p hole in its base. Secure the instrument to the platform with a 5mm holding screw; the screw should be brass or stainless steel.

The SD4 has a 4-core lead:

red: supply +V (9-16VDC, 15mA)	yellow: signal +5V (held 60 sec.) ¹
blue: supply 0V	green: signal ground

The SD4 can be powered from a 12VDC power supply. Alternatively, it can be connected to a 9V or 12V batter.

The TTL output signal is +5V for sunshine and 0V for no-sunshine. The signal can be interfaced to a simple Elapsed Time Meter, or to a Datalogger.

Reduced output voltages are available by placing an external resistor across the yellow and clear signal wires:

1000 Ω resistor reduces sunshine signal to about 2.5V

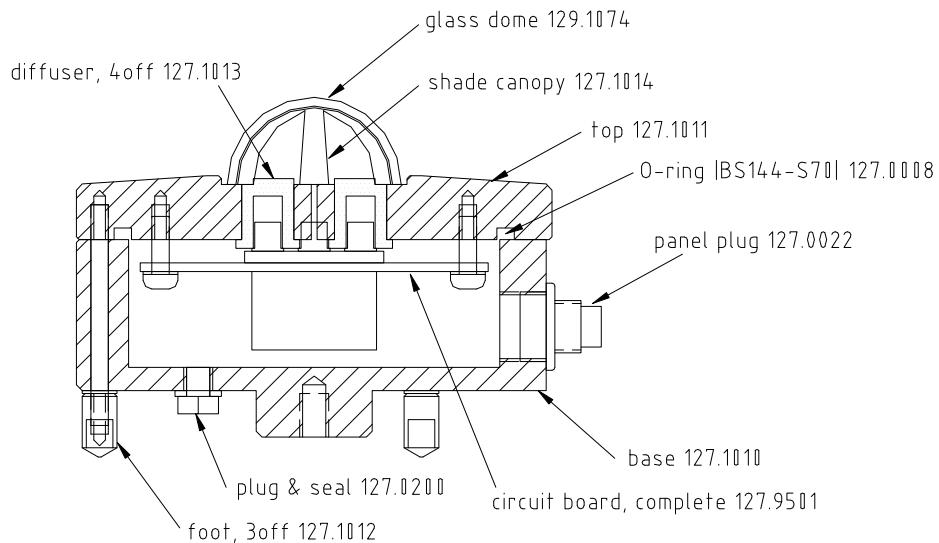
120 Ω resistor reduces sunshine signal to about 0.5V

MAINTENANCE. Keep the outer glass dome clean. Use only water and mild detergent to gently wash the surface. If the outer dome is cracked or badly pitted it should be replaced. The SD4 is hermetically sealed and contains a desiccant sachet to ensure that the interior remains dry and free from condensation. The desiccant is orange silica gel (non-toxic). The silica gel changes from orange to clear if moisture has entered the instrument. It is not necessary to routinely replace the desiccant. To gain access to the desiccant sachet remove the three feet that hold the base to the top. When refitting the base, take care to locate the O-ring in its groove before securing the three feet.

CALIBRATION. Each SD4 is individually adjusted during manufacture so that its four sensors are balanced and have the correct sensitivity. The instruments performance should be checked periodically by comparison to a reference unit.

¹ Optional 30 sec. version also available

SPARE PARTS. Spare parts may be ordered from the manufacturer or through an approved distributor. For your convenience, the part name and number are shown below. Please quote both when ordering. It is also important when ordering parts to include the Serial Number of the instrument, this is inscribed on the identification label of the unit.



Performance Specification	WMO recommended ²	SD4
sunshine duration uncertainty	± 0.1 hour	< ± 0.1 hour
sunshine duration resolution	0.1 hour	0.02hr ¹
sunshine threshold ³ (direct solar irradiance)	120 W.m ⁻² $\pm 20\%$	120 W.m ⁻² $\pm 15\%$
accuracy (monthly sunshine hours)	-	> 90%
unobstructed view of sun above horizon ⁴	> 3°	> 3°

General Specification	
field of view	2π steradians
irradiance	0 - 1500 W.m ⁻²
spectral range	300 - 1150nm
spectral selectivity	-5 to +10%
operating latitude	-90° to 90°
non-stability	< 0.5% per year
temperature response	< 2%
operating temperature	-30 to +60°C
operating humidity	0-100% RH
digital output signal (TTL ⁵)	sunshine = +5V nominal no-sunshine = 0V
response time	< 1 sec, per sample
sampling period	60 sec. (optional 30 sec.)
power supply requirement	9 to 16VDC, 15mA max.
detectors (four)	silicon photodiode, with cosine diffuser
desiccant	orange silica gel (non-toxic)
lead	5m; 4-core
mounting	central M5 hole provided
construction	anodised marine-grade aluminium, stainless steel, permanently sealed to IP67

² WMO Guide to Meteorological Instruments and Methods of Observation, 6th ed., 1996.

³ WMO threshold tolerance of $\pm 20\%$ implies daily uncertainty of $\pm 0.3\text{hr}$ in some scattered cloud conditions.

⁴ Direct sunshine below 3° elevation is ignored.

⁵ TTL (Transistor-Transistor Logic) tolerance is 2.4 to 5V for sunshine, and 0 to 0.8V for no-sunshine