

LPSD18



LPSD18 SUNSHINE DURATION SENSOR

The **Sunshine Duration Sensor LPSD18** measures sunshine status and duration. The WMO (World Meteorological Organization) defines the sunshine duration as the time during which the direct solar radiation exceeds the level of 120 W/m².

The LPSD18 performs the measure of radiation with an array of photodiodes arranged in a particular geometry which allows to obtain an accurate measurement in any weather conditions. This solution avoids the use of mechanical moving parts and ensures high reliability in the time. The instrument, besides indicating the presence of sun as required by WMO, measures also direct radiation (SRD), therefore it can be used as a low cost alternative to a pyrheliometer, which use is bound to a solar tracker.

The instrument is available in three versions, which differ in the type of output:

- LPSD18.1** RS485 MODBUS-RTU output and volt-free contact output
- LPSD18.2** RS485 MODBUS-RTU output, analog voltage output 0...1 Vdc and digital voltage output
- LPSD18.3** SDI-12 output and volt-free contact output

The LPSD18 is equipped with a heating element separately powered and galvanically isolated, which prevents the formation of condensation on the glass surface onto which the sensitive elements are. For cold climates, the above-mentioned versions are available with a second heating element (option R), which prevents the formation of ice and prevents snow from settling.

The instrument has no moving parts and does not need any positioning adjustment during the year and it can be installed on a mast or on a proper fixing base (optional).

The application fields are multiple: from the agronomy (agricultural science) to the study the growth of crops, to photovoltaic systems for verifying their performance, to building automations for automatic opening/closing of blinds, shutters and, in general, to all those areas where it is necessary to monitor the presence of sunlight.

Technical specifications	
Sensitive elements	16 Silicon photodiodes
Spectral range	360...1100 nm
Direct radiation SRD measuring range	0...2000 W/m ²
Accuray of the measurement of direct radiation	Better than 90% on the monthly total
Accuray of the measurement of the sunshine duration sensor	Better than 90% on the monthly total
Response time	< 1 ms
Threshold value	120 W/m ²
Sunshine duration resolution	1 sec
Power supply	7...30 Vdc
Consumption	5mA @ 12 V
Heating system	12...15 Vdc
Anti-condensation device consumption	1 W @ 12V
Antifreezing device consumption	5 W @ 12 V ON for internal Temp. <6 °C OFF for internal Temp. > 10 °C
Internal Temperature	
Measuring Range	-40...+80 °C
Accuracy	± 0.5 °C
Operating Temperature	-40...+80 °C
Weight	0.9 kg
Protection Degree	IP66
Outputs	
LPSD18.1	RS485 MODBUS-RTU Galvanically isolated contact closed = SRD ≥ 120 W/m ² open = SRD < 120 W/m ²
LPSD18.2	RS485 MODBUS-RTU Analog output 0...1 V (0...2000 W/m ²) Digital output 0...1 V 1V = SRD ≥ 120 W/m ² 0V = SRD < 120 W/m ²
LPSD18.3	SDI-12 Galvanically isolated contact closed = SRD ≥ 120 W/m ² open = SRD < 120 W/m ²

Operating Principle

The Sunshine Duration LPSD18 is based on the use of 16 sensors arranged in such a way that, in the presence of sun, at least one of the photo-detectors is exposed to sun light directly from the sun (besides the diffusion component). Those sensors which are not directly illuminated by the sun are used for the measurement of the diffused light that is subtracted from the measurement of the sensor which sees the sun directly to get direct radiation.

The cylindrical glass protects the sensors and the internal circuits of the instrument from the weather and at the same time provides an excellent transparency to sunlight.

In order to avoid the formation of condensation inside the instrument, in addition to the heating element, the LPSD18 is supplied with a cartridge that must be loaded with desiccant material in colloidal silica (Silica-gel).

Installation of the sunshine duration sensor

The sunshine duration sensor should be installed in a place easy to be reached for the periodical cleaning of the glass and the maintenance. At the same time, it should be avoided that buildings, trees or obstructions of any kind exceed the horizontal plane on which the sunshine duration is placed. It is acceptable to choose a location where obstacles in the path of the sun from sunrise to sunset is less than 5° from the horizontal plane of the sunshine duration sensor. It should be also checked that there are no reflective elements that may alter the measure. The LPSD18 does not need any positioning adjustment during the year. Three installation methods are possible:

- 1 - Installation on the basic support LPSD18.19K. The Sunshine Duration Sensor has a fixed inclination of 45° with respect to the fixing plane.
- 2 - Installation on the base LPSD18.O. The base allows the inclination of the sensor up to 80° respect to the vertical, so to fit it to the position of the sun to the latitude of the place of installation. Two adjustable feet and one fixed foot allow to put the sensor on an horizontal plane (Fig.1)
- 3 - Installation on a vertical Ø 40 mm mast by using the LPSD18.V support. This support allows to tilt the sensor up to 80° respect to the vertical, so to fit it to the position of the sun to the latitude of the place of installation (Fig.2)

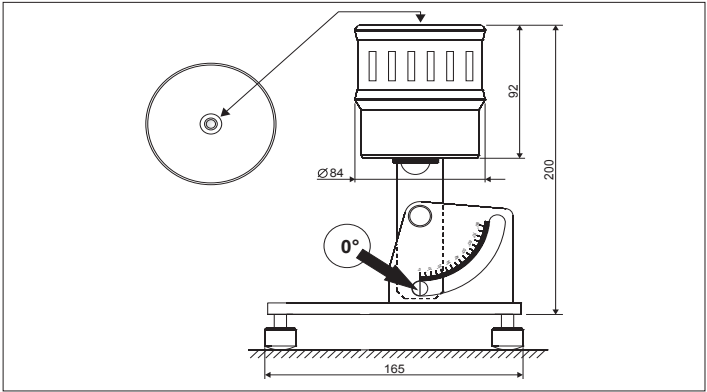


Fig.1 - Base for installation of the sensor on a horizontal plane

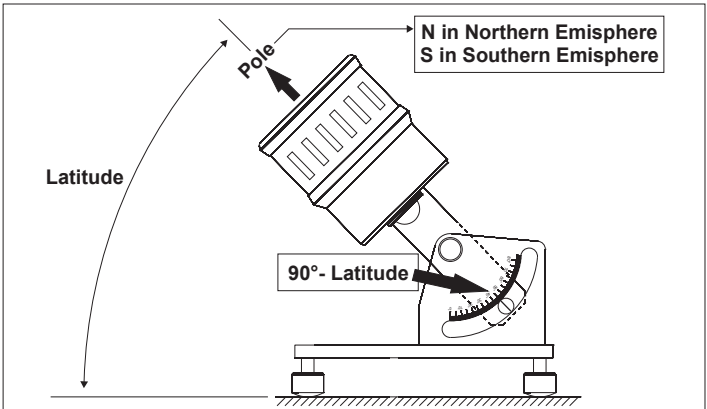


Fig.2 - Support for installation of the sensor on a mast

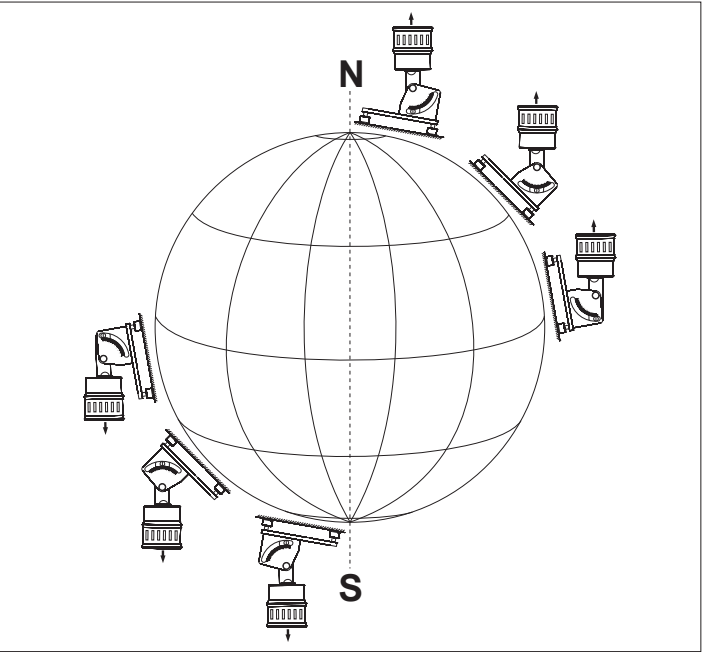
Before orienting the Sunshine Duration Sensor to its final position, place it vertically and verify that the mast or the support base are levelled with the spirit level placed on the upper side of the instrument.



Orient the Sunshine Duration Sensor so that the index of the graduated scale of the support matches the value (90° - Latitude) and the top (where the spirit level is placed) is directed towards the NORTH pole, if used in the northern hemisphere, or towards south, if used in the southern hemisphere

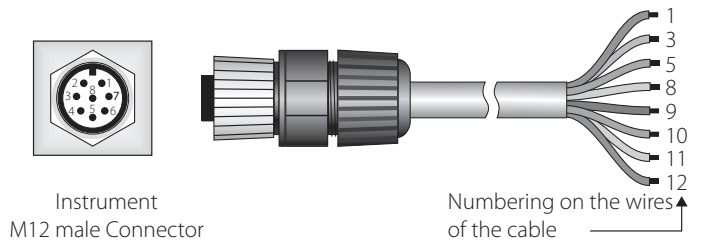


The angle that instrument axis should make with respect to the ground is equal to the latitude of the installation site, this way the axis of the instrument will be parallel to the earth axis North-South.



Electrical Connections

All the versions of the Sunshine Duration Sensor are equipped with an 8-pin M12 connector. Upon request, cables with 8-pin M12 female connector with 5 or 10 m standard length are available (other lengths available upon request).



LPSD18.1 and LPSD18.1R

Connector Numbering	Function	12-pin cable Numbering
1	Power supply negative	12
2	Power supply positive	1
3	Heating (*)	3
4	RS485 A/-	9
5	RS485 B/+	5
6	Volt-free contact output	8
7	Heating (*)	10
8	Volt-free contact output	11

LPSD18.2 and LPSD18.2R

Connector Numbering	Function	12-pin cable Numbering
1	Power supply negative; 0-1V analog output negative 0-1V digital output negative	12
2	Power supply positive	1
3	Heating (*)	3
4	RS485 A/-	9
5	RS485 B/+	5
6	0-1V digital output positive	8
7	Heating (*)	10
8	0-1V analog output positive	11

Connector Numbering	Function	12-pin cable Numbering
1	Power supply negative	12
2	Power supply positive	1
3	Heating (*)	3
4	NC	
5	SDI-12	5
6	Volt-free contact output	8
7	Heating (*)	10
8	Volt-free contact output	11

(*) The connection of the heating is not polarized, the two wires can be reversed.

Maintenance:

In order to ensure the declared high accuracy of the measures it is necessary that the protective glass is kept clean. Cleaning can be performed with optical microfiber cloths for camera lenses and with some water, if not enough, use pure ethyl alcohol. After cleaning with alcohol it is necessary to wash the surface with water and dry thoroughly.

In order to avoid the formation of condensation, a heating element (1W @ 12 Vdc) and a special cartridge with desiccant material (Silica-gel) are present inside the instrument.

The efficiency of Silica-gel decreases over time due to moisture absorption. When crystals of silica gel are efficient their colour is yellow; when gradually losing their efficiency the colour turns blue. The user manual of the instrument describes the procedure for replacing them. Typically, the duration of the silica gel varies from 2 to 6 months depending on the environmental conditions in which the sunshine duration sensor is working.

Serial communication

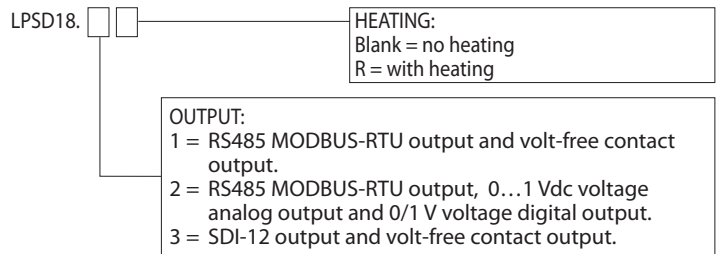
Both LPSD18.1 and LPSD18.2 are equipped with a RS485 MODBUS-RTU protocol output. The measured values and the status of the instrument can be read in MODBUS-RTU mode by using the 04h function code (Read Input Registers). The following table lists the MODBUS registers available:

Register number	Register address	Datum	Format
1	0	Internal temperature °C [x10]	16-bit integer
2	1	Internal temperature °F [x10]	16-bit integer
3	2	Direct radiation (SRD, "Direct Sunshine") in W/m ²	16-bit integer
4	3	Status register Bit0=1 > error in the measure of radiation Bit1=1 > error in the measure of temperature	16-bit integer
5	4	Number of seconds in the last minute with radiation higher than 120 W/m ² (number between 0 and 60)	16-bit integer
6	5	Number of tens of seconds in the last 10 minutes with radiation ≥ 120 W/m ² (number between 0 and 60: for each interval of 10 s, in the last 10 minutes, is counted a 1 if SRD ≥ 120 W/m ² for at least 5 s) For a higher resolution use the register number 5.	16-bit integer
7	6	Status of the sun presence/absence contact 0 = SRD < 120 W/m ² (open contact) 1 = SRD ≥ 120 W/m ² (closed contact)	16-bit integer
8	7	Status of heating: 0 = off, 1 = on	16-bit integer
9	8	Temperature in °C [x10] below this value the heating turns on	16-bit integer

The LPSD18.3... is equipped with an SDI-12 communication interface compliant with the version 1.3 of the protocol, which allows the connection to SDI-12 sensor networks. The commands available are described in detail in the operating manual supplied with the instrument.

For more information about the protocol, visit the website "www.sdi-12.org".

Ordering codes



LPSD18.1: Sensor for measuring sunshine duration. RS485 MODBUS- RTU output and volt-free contact output (closed= direct radiation above the threshold, open = direct radiation below the threshold). Power supply 7...30 Vdc. It can be fixed to a mast with a suitable accessory or installed on an horizontal surface by using the optional mounting base. Built-in levelling device.

The sensor does not require any adjustment of its position during the year. Equipped with anti-condensation system; 8-pin M12 connector included. 5 or 10 m standard cables with 8-pin M12 female connector are available upon request. Available also with heating option (option R)

LPSD18.2: Sensor for measuring sunshine duration. RS485 MODBUS- RTU output, 0...1 Vdc voltage analog output corresponding to 0...2000 W/m² of direct radiation, voltage digital output (1V = direct radiation above the threshold, 0V = direct radiation below the threshold). Power supply 7...30 Vdc. It can be fixed on a mast with a suitable accessory or installed on an horizontal surface by using the optional mounting base. Built-in levelling device.

The sensor does not require any adjustment of its position during the year. Equipped with anti-condensation system; 8-pin M12 connector included. 5 or 10 m standard cables with 8-pin M12 female connector are available upon request. Available also with heating option (option R)

LPSD18.3: Sensor for measuring sunshine duration. SDI-12 output and volt-free contact output (closed= direct radiation above the threshold, open = direct radiation below the threshold). Power supply 7...30 Vdc. It can be fixed on a mast with a suitable accessory or installed on an horizontal surface by using the optional mounting base. Built-in levelling device.

The sensor does not require any adjustment of its position during the year. Equipped with anti-condensation system; 8-pin M12 connector included. 5 or 10 m standard cables with 8-pin M12 female connector are available upon request. Available also with heating option (option R)

LPSD18.O: Base for the installation of the LPSD18... sensor on an horizontal plane. Two adjustable feet and one fixed. It allows the inclination of the sensor up to 80° with respect to the vertical axis, to fit the position of the sun at the latitude of the installation site.

LPSD18.V1: Support for the installation of the LPSD18... sensor on a Ø 40 mm mast. It allows the inclination of the sensor up to 80° with respect to the vertical axis, to fit the position of the sun at the latitude of the installation site.

LPSD18.19K: Basic support for installation of the LPSD18... sensor on a flat base. The Sunshine Duration Sensor has a fixed inclination of 45° with respect to the fixing plane. **It must be assembled at the factory and has to be required when placing the order.**

LPSD18.22K: Adaptor for installation on a Ø 40 mm mast. It allows a rotation of the instrument on a horizontal plane.

HD 2003.83: Ø 40 mm mast, 150 mm length for version V. M37x2 mm thread.

HD 2003.83.1: Ø 40 mm mast, 750 mm length for version V. M37x2 mm thread.

LPSG: Cartridge with desiccant silica-gel crystals, complete with O-ring and cap. Spare part.

LPG Pack of 5 sachets of silica-gel crystals. Spare part.

CP18.5: 12-pole cable. 5 m long. 8-pin M12 connector on one side, free wires on the other side.

CP18.10: 12-pole cable. 10 m long. 8-pin M12 connector on one side, free wires on the other side.

RS48: Cable for RS485 connection with built-in USB/RS485 converter. The cable has USB connector for PC and 3 separate wires for the instruments. This cable is suitable for the models with RS485 output only.

R: Heating option for installation in cold climates, for the removal of ice and snow. Activation of heating below +6 °C. Power absorbed by heating: 5W @ 12 Vdc.