4 – Channel Light Sensor

SKR 1850

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Skye Instruments Ltd.

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1 INTRODUCTION

The SKR 1850 is a four-channel sensor, with the ability to simultaneously detect and measure four separate bands of light that are chosen at the time of ordering by the purchaser. The wavelengths can be between 400 and 1050nm with bandwidths of set widths. The exact wavebands will be shown on the Calibration Certificate of each sensor for each of the four channels in each sensor.

The sensor may be used as either a cosine-corrected head or a narrow angle sensor, by the use of a removable diffuser. To remove the diffuser, grasp the black ring and twist whilst pulling it firmly off the top of the sensor, it should slide gently off of the top of the unit.

Sensors are usually supplied in pairs, one sensor fitted with a cosine-corrected diffuser and one without. The sensor fitted with the cosine-corrected diffuser is usually mounted with the diffuser facing upwards for measuring the incident light. These sensors will have the suffix D after the part number. The sensor supplied without the cosine-corrected diffuser is normally mounted with the light collecting apertures facing downwards, for the measurement of reflected light. These sensors have the suffix ND after the part number.

The sensor may be used with a data logger (e.g. Skye DataHog2) or other readout devices (e.g. Skye SpectroSense 2+, Apollo, etc.), or alternatively with a third party display meter or logger.

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2 OPERATION

The sensor is machined mainly from Delrin Acetyl and anodised aluminium.

The optics and electronics are fully sealed. It is suitable for use in any orientation.

The response of the sensor to light coming from different angles is clearly different depending on whether or not the diffuser is in place. Without the diffuser the response to light is from a 25° cone directly above the sensor. When the cosine diffuser is in place (be sure to twist it gently on to the rubber 'holding' ring), the collection of light depends on the cosine of the angle the ray of light makes to the axis down the length of the sensor.

Please see Appendix 1 for the narrow angle response and area of measurement for these sensors.

The sensor may be mounted to any flat surface using the M6 threaded hole in its base. It may be hand-held in many applications.

From serial number 52367 the sensor is also fitted with a cable gland with strain relief at exit point of cables. This is a crucial part of the ingress protection and should never be undone in case of cable damage and/or affecting ingress protection.

2.1 Sensor Maintenance

Light and Radiation Sensors require very little maintenance apart from cleaning. It is important keeping the light collecting surface clean and dust free.

For the white diffusing disc on cosine corrected Incident or Irradiance sensors, simply wipe clean with a soft cloth dampened with de-ionised water. Take care not to scratch this surface as this may affect the sensor calibration.

For the clear glass disc on the narrow angle Reflected light or Radiance sensors, simply wipe clean with a soft cloth dampened with de-ionised water. Take care not to scratch this surface as this may affect the sensor calibration.

For narrow angle Reflected light or Radiance sensors which have 2 or 4 deep columns, the glass at the bottom of the columns can be cleaned using a cotton ear bud dampened with de-ionised water. Take care not to scratch this surface as this may affect the sensor calibration. When installed permanently outdoors, especially in forestry areas, this should be done at regular periods to ensure it is kept clear of insects and their nests.

For all sensors, ensure the cable is not bent or curled up near the point where it exits the base of the sensor. The cable should not be tightly coiled at any point. These tips will help to increase the cable's lifetime.

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Skye Instruments light sensors and meters are recommended to be calibrated every 2 years. Please return to Skye where the sensor will be calibrated against the reference lamp and a new calibration certificate issued.

3 OUTPUTS

3.1 SKR 1850, SKR 1850D, SKR 1850ND Current Output Sensor

The output from each channel is in the form of a current that is directly proportional to the amount of light falling on the sensor within the waveband of the filter for that channel. The output is linear over many decades of light level, extending well beyond natural ranges. In complete darkness the current will always be zero.

The calibration certificate will show the calibration values relevant to the model ordered. For the model SKR 1850D, only calibration values for the sensor with a diffuser is provided, and likewise for the SKR 1850ND, only calibration values for the sensor without a diffuser is provided.

When the cosine diffusing head is in place the Calibration Certificate shows the output current for a stated amount of light falling on the surface of the sensor. Since the output is linear with no offset, the zero and this stage define the output response of the sensor.

If the outputs of the sensors channels are to be related in an attempt to gain knowledge of spectral distribution then the bandwidth of each channel should be taken into account.

The bandwidth shown on the calibration certificate is the range (around the centre wavelength) over which the sensitivity of the channel is greater than 50% of its peak. This is a common way of defining optical bands, and since the sensitivity of the SKR 1850 channels falls off very sharply beyond these 50% points this band definition includes most of the light detected. It is a consistent way of relating the widths of the channels.

Thus the currents (without the diffuser disc) or the number of µmol m^{-2} s^{-1} (with diffuser disc), detected by any channel, if divided by its bandwidth will then give a figure of, or proportional to, the light intensity per nanometre. Remember however that this will be an approximation, and that it is the mean value of the light level at each wavelength, depending on the bandwidth of the sensor.

If a voltage output is needed to drive a logger or similar, then a resistor may be employed as a current to voltage converter. Appendix 2 shows how this may be accomplished.

The maximum value of resistor that should be used in this connection is 5 to 10 kΩ. In general however the minimum value that can be used to give the desired mV output should be used. This will minimise the pickup of electrical interference. The output will be as follows :-

mV per light unit = µA per light unit * resistor (kΩ)

Note also that if spectral densities are to be considered, i.e. light levels per nm., then the output of each channel will need to be divided by its bandwidth (see calibration certificate). See the discussion of this for the SKR 1850 type sensor in the previous section.

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4. CONNECTIONS

The sensors may be supplied wire ended for connection to the user's own instruments or may be fitted with a waterproof connector suitable for Skye's DataHog logger or SpectroSense2 meter.

4.1 Current Output Sensor (SKR 1850, SKR 1850D, SKR 1850ND, SKR 1850/SS2, SKR 1850/I)

Wire Colour	***Function***	***Skye Connector***
Red	Channel 1 negative current output	Pin 1
Yellow	Channel 2 negative current output	Pin 2
Green	Channel 3 negative current output	Pin 3
Blue	Channel 4 negative current output	Pin 4
White	Ground	Pin 5
Grey	Cable Screen	Pin 5

The current output from this sensor is often very small, e.g. 1 µA or less. If the datalogger or recorder does not have a current input, then a precision resistor may be placed across each of the 4 sensor outputs to give a millivolt signal as below:

The mV signal will be proportional to the current output and resistor value as shown:

mV per unit of light = µA per unit of light * resistor (kΩ)

The resistor value should be as low as possible to get the mV output required for the anticipated light levels, and should not exceed 10 kΩ (10,000 Ω). The millivolt output derived should not be greater than 60 mV otherwise a degree of non-linearity may occur.

4.2 Current Output Sensor with Extension Cable EXT/2 (SKR 1850/X, SKR 1850D/X, SKR 1850ND/X)

Function EXT/2)	***Skye Connector (5 pin connector of***
Channel 1 negative current output	Pin 1
Channel 2 negative current output	Pin 2
Channel 3 negative current output	Pin 3
Channel 4 negative current output	Pin 4
Ground	Pin 5
Cable Screen	Pin 5

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4.3 Current Output Sensor with Extension Cable EXT/3 (SKR 1850/X, SKR 1850D/X, SKR 1850ND/X)

Wire Colour	***Function***
Black	Channel 1 negative current output
Red	Channel 2 negative current output
Yellow	Channel 3 negative current output
Green	Channel 4 negative current output
Blue	Ground
White	Cable Screen / Sensor Body

4.4 Current Output Sensor with Low Temperature Cable (SKR 1850/LT, SKR 1850D/LT, SKR 1850ND/LT)

These sensors are fitted with a grey cable that has the following temperature specifications;

Moving;	-20ºC to +80ºC
Fixed;	-40ºC to +80ºC

Wire Colour	***Function***
Brown	Channel 1 negative current output
Yellow	Channel 2 negative current output
Grey	Channel 3 negative current output
White	Channel 4 negative current output
Green	Ground
Pink	Cable Screen

5. SPECIFICATIONS

	SKR 1850D, SKR 1850ND
Sensor Output	Typically 3-10 nA / µmol m^{-2} s^{-1}
Power supply	Not required
Response Time	Typically < 100 ns
Cable	Screened 7-1-4C military specification. 3m standard length
Sensor Passband	4 channels each between 400-2400nm
Construction	Black Delrin Acetyl and Black Anodised Aluminium Acrylic diffuser and/or optical glass window Cable gland – Do not undo
IP rating	IP65 (not suitable for permanent outdoor use)
Filters	Metal interference and/or Glass
Detectors	Si, GaAsP
Temperature Range	-25 to +75 °C (Standard Cable when Fixed)
Humidity Range	0-100%
Dimensions	Height: SKR1850D - 85mm, SKR1850ND – 82mm Max Diameter of main body: SKR1850D - 55mm, SKR1850ND – 45mm
Weight	300g with 2m cable
Linearity	<0.2% over working range
Cosine Error	Typically 3% to 80 degrees (SKR 1850D and SKR 1850D/A)
Absolute Calibration Error	Typically 3%, but <5% *N.B. This error is to some extent dependant on bandwidth - wide bandwidths will be less subject to error than very low bandwidth channels*
Mounting	M6 x 7mm tapped hole in the base. Sensor supplied with M6 x 16mm screw + 4 x 1.5mm washers to suit panel thicknesses of 3-10mm

APPENDIX 1 – NARROW ANGLE LIGHT ACCEPTANCE AREA

The SKR 1850 and 1850A 4 channel light sensors are fitted with a removable cosine correcting light acceptance head. When taking incident or down-welling light measurements, the head is left in place so that the sensor is fully cosine corrected (accepts light in accordance with Lambert's Cosine Law).

For the measurement of reflected or up-welling light, the cosine head is removed converting the sensor into a narrow angle acceptance instrument. The sensor has a smaller, defined field of view and can accurately measure from a defined ground area.

Without the cosine head, the 4 channel sensors have a 25° cone field of view (12.5° off perpendicular). The area of ground in view to the sensor is then defined by the height above the ground, as shown below:

Sensor 1 is fitted with the cosine correcting head and is measuring incident light.

Sensor 2 is narrow angle and is measuring reflected light.

Both incident and reflected light is measured simultaneously by 2 identical sensors, to eliminat fluctuations in solar radiation

EXAMPLES OF MEASUREMENT AREA

HEIGHT OF SENSOR (h)	RADIUS OF CIRCLE (r)	AREA OF MEASUREMENT
0.50m	0.11m	0.04m^2
0.75m	0.17m	0.09m^2
1.00m	0.22m	0.15m^2
1.25m	0.28m	0.24m^2
1.50m	0.33m	0.35m^2
1.75m	0.39m	0.47m^2
1.80m	0.40m	0.50m^2
2.00m	0.44m	0.62m^2