



Light Sensor and Display Meter System

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1 Waterproof Light Sensors

**SKP 210 - PAR Special
SKP 215 - PAR Quantum
SKL 310 - LUX Sensor
SKE 510 – PAR Energy Sensor**

These four sensors have cosine - corrected heads, each containing a semi conductor diode and filter system responding to light according to the response curves in Appendix 1.

They are all fully waterproof and may be left exposed to rain and used in humid climates. They are guaranteed for underwater use up to 4m depth.

Each sensor has been calibrated against a reference lamp, whose own calibration has been carried out at the National Physical Laboratory (N.P.L.).

SKS 1110 – Silicon Cell Pyranometer

The pyranometer cosine corrected head contains a special high grade silicon photocell, sensitive to light between 350 and 1100nm. The head is completely sealed and can be left indefinitely in exposed conditions.

This sensor has been calibrated under open-sky conditions, against reference pyranometers and hence referred to the World Radiometric Reference. The calibration thus refers to Solar energy in the waveband 300nm to 3000nm, i.e. the acceptance band of thermopile pyranometers.

Because of the different spectral responses of the silicon photocell and the thermopiles, to obtain accurate readings the unit must be used under natural lighting.

Different conditions of sun, cloud, etc., will slightly affect calibration, but absolute errors will always be within 5% and typically much better than 3%.

Linearity is excellent, with a maximum of 1% deviation up to levels of 3000 watts m⁻² (greater than normal solar irradiance).

2 *Splashproof Light Sensors*

**SKP 217 - PAR Quantum
SKL 315 - LUX Sensor
SKE 512 – PAR Energy Sensor
SKP 216ER – Quantum Sensor for Hansatech Leaf Chamber
SKP 216Q - Quantum Sensor for Hansatech Leaf Chamber**

These sensors also have cosine - corrected heads, each containing a semi conductor diode and filter system responding to light according to the response curves in Appendix 1. The curves are the same for both waterproof and splashproof versions alike.

These are splashproof only and are suitable for short term outdoor measurements or in protected environments such as glasshouses, environmental chambers etc.

Each sensor has been calibrated against a reference lamp, whose own calibration has been carried out at the National Physical Laboratory (N.P.L.).

3 *Positioning of All Types of Sensor*

For accurate positioning of all of the sensors except the SKP 216ER and SKP 216Q, we would recommend the use of a levelling unit (SKM 221). Great care should be given to the placing of the sensor, in order to achieve accurate and repeatable results. Avoid objects, trees, etc., that will shade the sensor selectively, compared with the areas under study.

The SKP 216ER and SKP 216Q sensors have been designed to fit in a Hansatech Leaf Chamber. The full system comprises a large area sensor machined to match with the Hansatech Leaf Chamber, and a measuring unit giving direct readout of light levels at the leaf surface in $\mu\text{mols m}^{-2} \text{s}^{-1}$.

4 *Cosine Correction.*

Since the sensor is intended to measure units, on a horizontal plane of unit area from a whole hemisphere, it has to collect light as would that plane. This is why the unit is cosine corrected. Light rays perpendicular to the sensor are fully measured, those at 90° are not accepted (they would pass parallel to the surface of the plane and never intercept it). Rays at intermediate angles are treated according to the cosine of their angle to the perpendicular. The cosine response of the sensor is shown in Appendix 2. The cosine errors to angle of 70° are minimal and are less than 5% to an angle of 80° . The graph shows the actual response of the sensor as a percentage of the ideal response. At 90° , even the most insignificant acceptance of light represents an infinite error, and because of this, accurate plotting beyond 85% is not practical. Errors from such low angle light in nature are generally not material in most studies.

5 *Sensor maintenance*

Sensors require very little maintenance apart from keeping the top light collecting surface (small white diffusing disc) clean and dust free. This can be done using a soft cloth dampened with de-ionised water. Take care not to scratch this surface as this may affect the sensor calibration.

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 the meter adjusted accordingly.

6 *Connections.*

Connection to obtain either mV or microamp output is shown in Appendix 3. Please note that external voltages must not be applied to the sensor, the silicon photocell and precision resistive elements may be damaged by reverse voltage or excess current.

7 *Non-standard Sensors.*

The sensor part number will include a suffix as follows:

/LT

These sensors have been fitted with cable suitable for low temperatures. Whilst the special cable is rated for use at low temperatures, it is still advisable to avoid undue stress, movement, etc., of the cable when at low temperatures. A special modified levelling unit (SKM 221S) is available to give extra support to the cable and minimise unnecessary movement.

A voltage only output is available. The red wire is the positive output and the blue wire is the ground/screen. All other sensor specifications remain the same.

/S

These sensors have a 3 core cable, and a grey wire connected to the screen on the tail end only - there is no connection inside the sensor.

All other specifications remain the same.

8 *The Display Meter*

The SKP 200, SKL 300, SKS 1100 and SKE 500 display meters are normally supplied with and calibrated for their equivalent sensor heads. The relative response curves are shown in Appendix 1.

The serial numbers of the matching sensor and meter are shown on the reverse of the display meter.

The instrument is powered by a single PP3 battery, accessible by removing the cover located on the back of the unit. Alkaline Manganese or rechargeable NiCad types are recommended.

A "low" battery warning appears in the top left hand corner of the display, when the battery drops below 6 volts. The accuracy of the instrument is not impaired until the battery falls below 4 volts, at which point the display begins to fade. However, once the low battery indicator is on, there is only about 10% of the useful life of a dry cell remaining, and a NiCad battery will be harmed by further discharge. Remove exhausted batteries from the unit.

An on/off switch is provided, but regardless of this, the unit is switched off automatically by unplugging the sensor head.

The unit should be protected from extremes of temperature (e.g. when left in a car) as exposures below -10 or above +70°C may cause damage to the Liquid Crystal Display. These display meters are splashproof only and should not be allowed to get wet.

All units are calibrated against standards traceable to the N.P.L., and subsequent recalibration every two years is recommended.

The measuring unit has three ranges, the table below details these.
PLEASE NOTE - the reading displayed on the SKP 200 meter should be multiplied by 10.

DISPLAY METER	SENSOR	SCALE	UNITS
SKP 200	SKP 210	0-200	$\mu\text{mols m}^{-2} \text{ s}^{-1}$
	SKP 217	0-2,000	
	SKP 215	0-20,000	
SKL 300	SKL 310	0-2,000	Lux
	SKL 315	0-20,000	
		0-200,000	
SKE 500	SKE 500	0-20	W m^{-2}
	SKE 512	0-200	
		0-2,000	
SKS 1100	SKS 1110	0-20	W m^{-2}
		0-200	
		0-2,000	
SKP 200H	SKP 216Q	0-20	$\mu\text{mols m}^{-2} \text{ s}^{-1}$
	SKP 216ER	0-200	
		0-2000	

At all times the most sensitive range possible should be selected, the unit will not be damaged by accidental over-ranging.

The meter may require zero adjustment from time to time. This is easily accomplished by covering the top of the sensor completely to exclude all light. The scale should show '-000' with the zero sign showing intermittently. To achieve this, set the instrument to the most sensitive range, and using a small screwdriver adjust the potentiometer located just inside the small hole adjacent to the sensor plug and socket.

This adjustment will not affect full scale calibration.

Extreme conditions of temperature or humidity may cause a zero drift.

9 Display Meter Output Socket

A chart recorder output is available from the unit. This is suitable only for feeding high impedance inputs, such as DVMs, Chart Recorders, Dataloggers, etc.

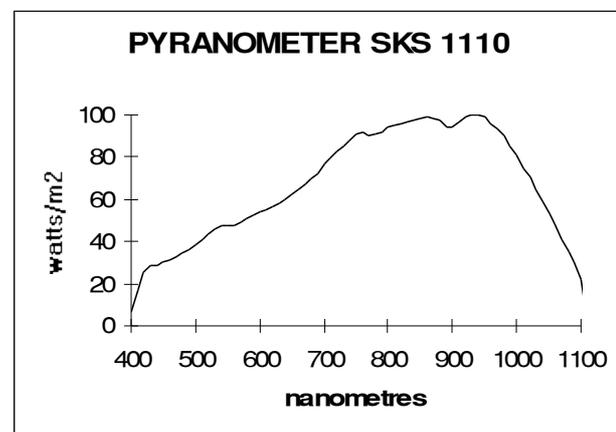
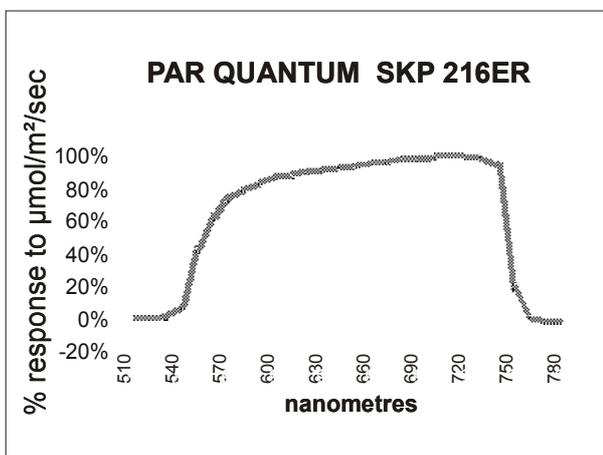
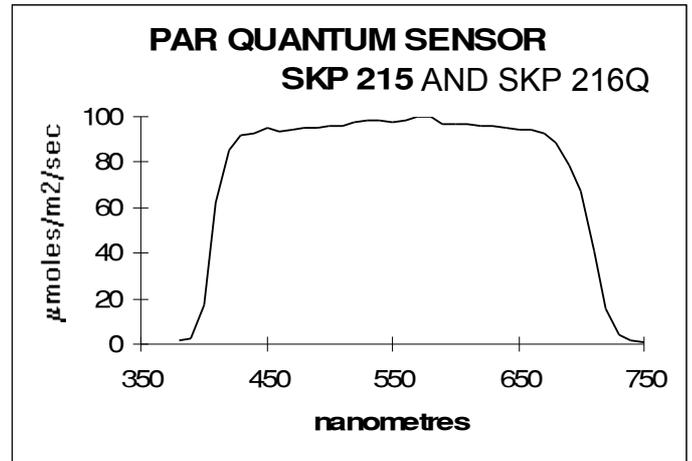
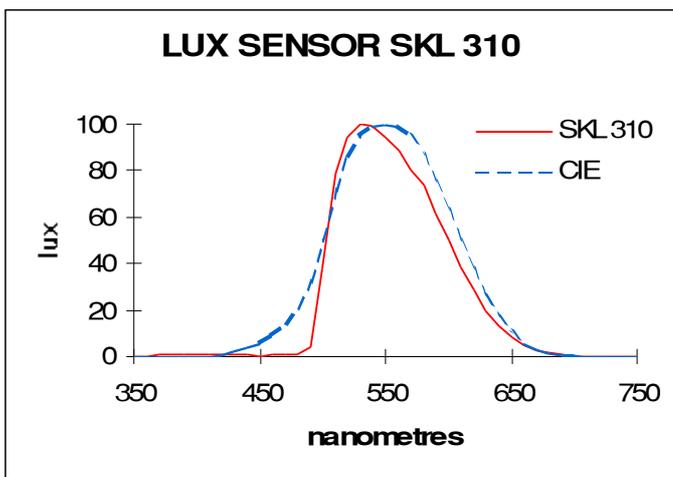
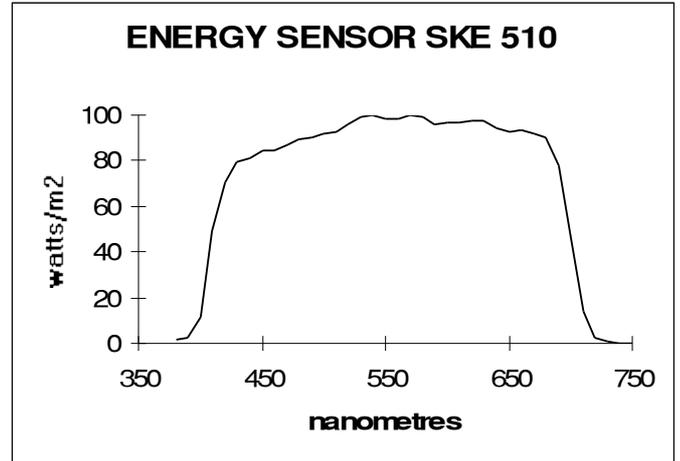
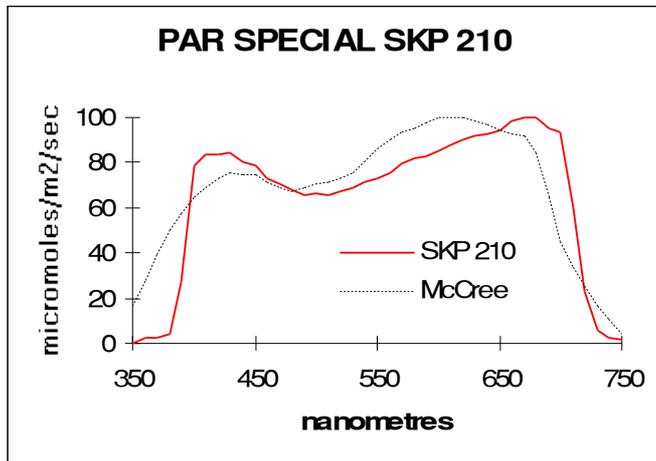
A suitable plug for connection is a 2.5mm 'Jack' (one is supplied with the unit), with the positive connection to the tip and the earth to the body of the plug.

The output is scaled with the display, being normally 0 - 2 V as with the display in three ranges. The chart recorder output however, unlike the display will exceed 2.0 V. For example, on the 0 - 2,000 $\mu\text{mols m}^{-2} \text{ s}^{-1}$ range, 2.0 V at the recorder output corresponds with the display to 2000 $\mu\text{mols m}^{-2} \text{ s}^{-1}$ but if the light input is increased without changing range then the recorder output will increase linearly at the same

scale up to 3 volts (corresponding on this range to 3,000 $\mu\text{mol m}^{-2} \text{s}^{-1}$) even though the display is showing over-range.

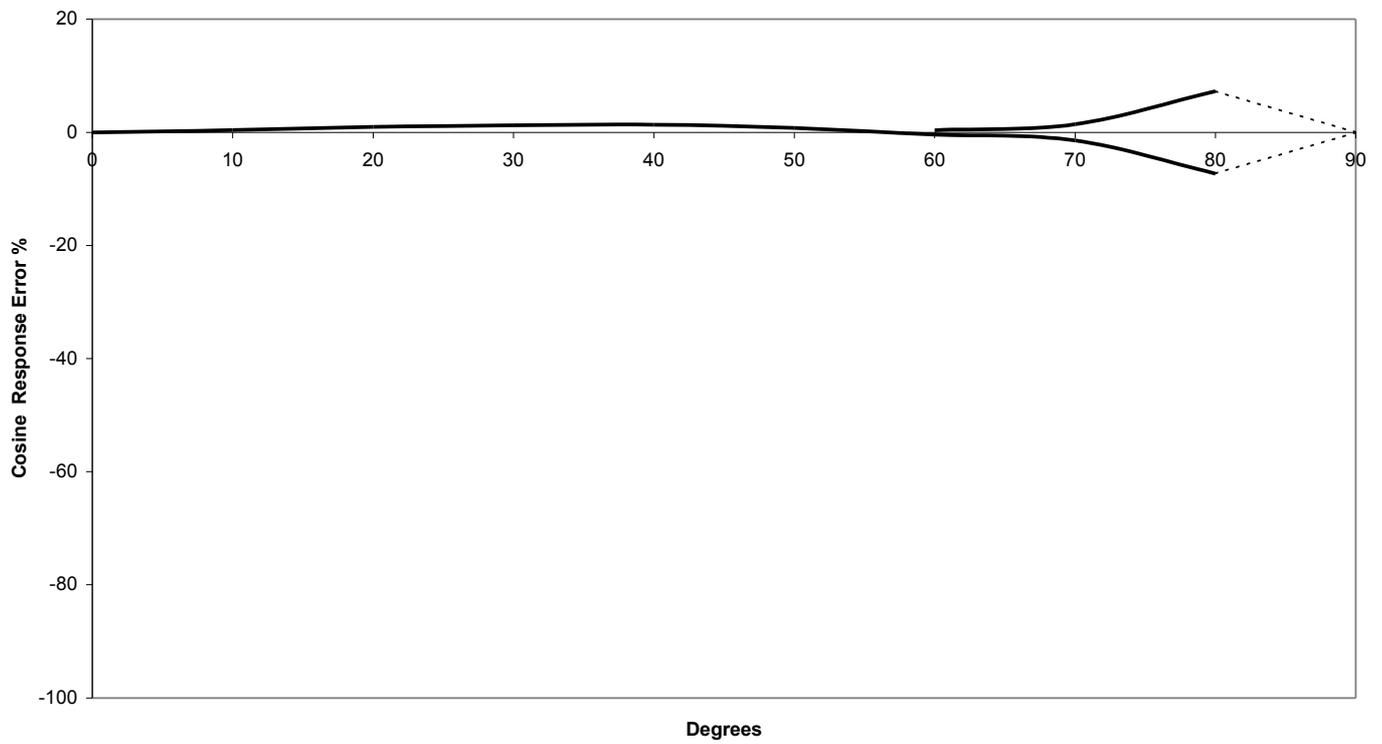
Thus the chart recorder output has three ranges - 0 - 30, 0-300 and 0 - 3,000 over the outputs 0 - 3000 mV.

APPENDIX 1 – SENSOR WAVELENGTH RESPONSE



APPENDIX 2 – SENSOR COSINE RESPONSE

Typical Cosine Response Error Window

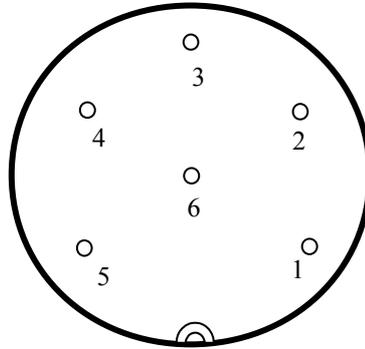


APPENDIX 3 - SENSOR CONNECTIONS

STANDARD 6 PIN PLUG

Connector suitable for Display Meter only

OUTSIDE PIN VIEW



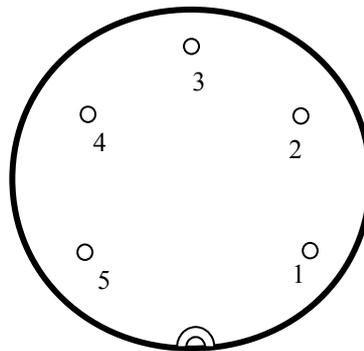
NOTES

- 1 The sensor connector for a Skye Display Meter is wired with the blue wire to Pin 3, green wire to Pin 4 and red wire to Pin 6. Pins 1 and 2 are shorted.
- 2 For a current output connect using pins 3 and 4 (blue and green wires). Leave Pin 6 (red wire) unconnected.
- 3 For voltage output, short together Pins 3 and 6 (blue and red wires). The voltage output is between this junction and Pin 4 (green wire). Pin 4 (green wire) is positive in light.

WATERPROOF BINDER 5 PIN PLUG

Sensor can be used with either the Display Meter or a DataHog logger

OUTSIDE PIN VIEW



NOTES

- 1 The sensor connector for a Skye Display Meter or DataHog logger is wired with the red wire to Pin 3, blue wire to Pin 4, green wire & cable screen to Pin 5.
- 2 When the matching 5 pin socket is fitted to a Display Meter, it will not have the automatic switch off feature which activates when the sensor is removed. Please ensure the Display Meter is switched off after use to prolong battery life.

APPENDIX 4 - SPECIFICATIONS

	SKP 215	SKL 310/315	SKE 510	SKS 110	SKP 210
Sensitivity - current	1.5 μ A / 100 μ mols m ⁻² s ⁻¹	1.4 μ A/ 10 kLux	7.5 μ A/ 100 W m ⁻²	5 μ A/ 100 W m ⁻²	1 μ A/100 W m ⁻²
Sensitivity - voltage	10 μ V/ 100 μ mol m ⁻² s ⁻¹	10 μ V/ 10 kLux	10 μ V/ 100 W m ⁻²	10 μ V/100 W m ⁻²	10 μ V/ μ mol m ⁻² s ⁻¹
Working range	0.5x10 ⁴ μ mols m ⁻² s ⁻¹	0-500 klx	0-5000 W.m ⁻²	0-5000 W.m ⁻²	0.5x10 ⁴ μ mols m ⁻² s ⁻¹
Linearity error - to above level	<0.2%	<0.2%	<0.2%	<0.2%	<2%
Absolute calibration error	typ. <3% 5% max.	typ. <3% 5% max.	typ. <3% 5% max.	typ.<3% 5% max	typ.<3% 5% max
Response time - voltage output	10ns	10ns	10ns	10ns	10ns
Cosine error	3%	3%	3%	3%	3.00%
Azimuth error	<1%	<1%	<1%	<1%	<1%
Temperature Co-efficient	\pm 0.1%/ $^{\circ}$ C	\pm 0.1%/ $^{\circ}$ C	\pm 0.1%/ $^{\circ}$ C	\pm 0.2%/ $^{\circ}$ C	\pm 0.1%/ $^{\circ}$ C
Internal resistance - voltage output	c.650ohms	c.700ohms	c.130ohms	c.200ohms	c.1000ohms
Longterm stability	\pm 2%	\pm 2%	\pm 2%	\pm 2%	\pm 2%
Material	Acetal	Acetal	Acetal	Acetal	Acetal
Dimensions	34mm diameter 38mm height	34mm diameter 38mm height	34mm diameter 38mm height	34mm diameter 38mm height	34mm diameter 38mm height
Cable	3 core screened 7 - 2 - 3C	3 core screened 7 - 2 - 3C	3 core screened 7 - 2 - 3C	3 core screened 7 - 2 - 3C	3 core screened 7 - 2 - 3C
Waveband Measured	400 - 700 nm PAR Quantum	CIE photopic Curve	400 - 700 nm PAR Energy	300 - 3000 nm	McCree Curve
Detector	Silicon photocell	Silicon photocell	Silicon photocell	Silicon photocell	Silicon photocell
Filters	Glass type and/or metal interference	Glass type and/or metal interference	Glass type and/or metal interference	Glass type and/or metal interference	Glass type and/or metal interference