How to use a SOLEMS detection cell for lux measurement

Applicable to lux measurements with a product type C01/XX/YY (singl sensor cell)
See LIGHT DETECTION CELLS data sheet.

1. Principle

The parameter used to measure light is the short circuit current I_{sc} of the cell, or photocurrent under O Volt, because it is directly proportionnal to light intensity (E).

$$I_{sc} = a \times E$$

In orde to get a signal in voltage, easier to measure, impossible at the very short circuit point because V=0, a charge resistance (R_c) will be placed in parallel, so that :

- the load current at this impedance (I_m) is very near the short circuit current
- the voltage (V_m) at this impedance is easy to measure.

$$V_m = R_c \times I_m$$

Remark. This charge resistance R_c can be the entry impedance of an amplifier. .

To keep the linearity law given before, the following rule should be applied :

V_m must remain below 100mV at the maximum light intensity (E_{max}) of the required sensor's range.

This is due to the intensity-voltage chartacteristics of SOLEMS detection cells- see below –

As soon as this rule is fullfilled, I_m and I_{sc} can be considered identical on the hole range from 0 till Emax.
R_c can be determined the following way :

$$R_c = V_m \text{ (required value < 100mV) } / I_{sc} \text{ (short circuit current at } E_{max})$$

This way, the measured signal V_m will be directly proportional to à E :

$$V_m = a \times E \quad \text{from 0 to } E_{max}$$

Caution : In order to measure precisely some flux up to 100 000 lux or more, it can be better to lower the light intensity received by the cells that can sometimes show a current saturation at high light illumination. Ask us for advice in that case.

2. Application

I_{sc} calculation at a given light intensity.

$I_{sc} = S_a \times J_0 \times E / 100000$

where : I_{sc} is in milliamps
S_a = active area of the sensor in cm²
J_0 = current density at 100 000 lux : 9 milliamps/cm²
E = light intensity in lux

The active area is the surface in the center of the cell, between the 2 contact inactive areas (xsee drawing below).

Example : Detection cell with an active area of 1.45cm² at 1000 lux (our curve below)

I_{sc} = 1.45 x 9 x 1000 / 100 000 = 0.13mAmps or 130µAmps

For othe light intensities, we would get I_{sc} = 13µA at 100 lux, 1.3mA at 10 000 lux, 13mA at 100 000 lux etc. …

Charge resistance choice

To scan the domain 0 – 1000 lux with this cell ; we wxant to get V_m (measured voltage) equal to 100mV for 1000 lux (max light intensity)

So R_c = 100mV / 130µA = 10^{-1} / 1.3 10^{-4} = 770 ohms

Therefore, with following items :
- Detecxtion cell with an active area of 1.45cm²
- Charge resistance of 770 ohms,

it is possible to measure th light intensity by a direct voltage measurement in the range 0-1000 lux.

E = 1000 lux → Vm = 100mV
E = 500 lux → Vm = 50mV
E = 100 lux → Vm = 10mV …etc…

Above 1000lux, the signal will slowly come to saturation, and it will never go above 0.8V, which is the open circuit voltage of the cell at the maximum illumination of 100 000 lux.

General remark :
The values of this memo are indicative. For a more precise measurement, it is necessary to test the final circuit in real test conditions, and compare values to a reliable calibrated luxmeter.