

# SolData Pyranometer 80spc

## USER'S GUIDE

pyrano 80spc A4 - UK-oki.wpd

### PURPOSE

The purpose of the instrument is to measure *global irradiance*, i.e. *diffuse* plus *direct* solar irradiance. The pyranometer can be mounted on a horizontal surface or in the same plane as a solar heat collector or photovoltaic (PV) panel when the global irradiation on these surfaces is of interest.

### CALIBRATION FACTOR

A typical calibration factor  $K$  can be expressed as:

$$K = 160 \text{ mV}/(\text{kW}/\text{m}^2) \quad (1)$$

This value means that when the solar irradiance  $S$  is  $1 \text{ kW}/\text{m}^2$  (typical for a clear, sunny day around noon) the pyranometer will provide an output voltage around 160 mV. If the output voltage is found to be 80 mV, this indicates that the solar irradiance is about  $0.5 \text{ kW}/\text{m}^2 = 500 \text{ W}/\text{m}^2$ . Thus:

$$S = U / K \quad (2)$$

where  $U$  is the signal voltage in millivolts and  $S$  is measured in  $\text{kW}/\text{m}^2$ . Note that forward scattering from clouds may cause values 10-20% higher under extreme conditions.

### CABLE CONNECTIONS

The 80spc is supplied with an integral three meter long cable connection. The electrical connections are:

blue - voltage plus (0-200 mV)

black - signal ground

Experience has shown that cable length is non-critical, and cable lengths of up to 30 meters can be used successfully. Atmospheric disturbances such as lightning can of course affect measurements, so it is wise to protect long cables from exposure by burial or by running cables indoors. Shielded cable is not essential unless a high electrical noise environment is anticipated. Connect the end of the 3 meter cable supplied directly to your datalogger or connect it via an extension using a weather-proof electrical housing.



**Figure 1:** The SolData 80spc pyranometer is supplied with a 3 meter long cable and a weather-proof IP54 connection to the instrument.

### APPLICATIONS

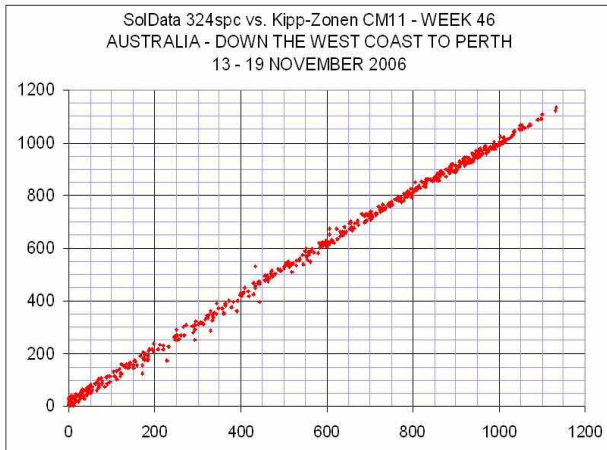
SolData pyranometers are used to measure solar irradiance from as far north at Thule in northern Greenland to the Palmer peninsula in Antarctica.



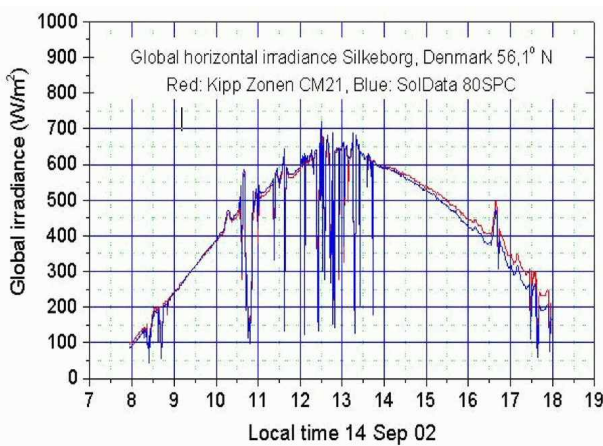
**Figure 2:** Two SolData pyranometers performed measurements during the Danish Galathea 3 Expedition 2006-07 here shown near the Palmer Peninsula.

SolData pyranometers are also in operation high in the Himalayas in Nepal. At the other temperature extreme the instruments are used at hot locations in Australia. Each instrument is temperature compensated for use from  $-10^{\circ}$  to  $+50^{\circ}$  C.

During the Galathea 3 research voyage calibration checks were made continuously against a Kipp-Zonen CM11 meteorological pyranometer. Sample calibration check results are shown in Figure 3.



**Figure 3:** Calibration check of a SolData 80spsc against a Kipp-Zonen CM11.



**Figure 4:** Global radiation data collected using a 80spsc and a Kipp-Zonen CM21 around the spring equinox in Denmark.



**Figure 5:** Continuous display of irradiance in  $W/m^2$  can be achieved using a SolData DM-PYR. Options include relays and a 0-20mA current loop output signal.

### SIGNAL INTEGRATION

In order to measure the *total* solar energy striking each square meter of a

particular surface, e.g. a solar collector, a number of options are available.

#### Datalogger or digital readout module:

The data shown in Figure 4 were collected using a Grant datalogger. Data was recorded every 30 seconds. These data were later downloaded to a PC and then transferred to an *Excel* spreadsheet. Using *Excel* the user can define a column which converts the raw voltage values to the irradiance in watts per square meter using Equation 2. By summing up this column and multiplying by the measurement interval in seconds, a numerical integration is performed of the irradiance over time.

In connection with scientific studies of solar heating (or solar photovoltaic) energy systems it is often of considerable interest to compare the global irradiance on the collector with the total energy supplied by the system during the same period. This can for example be done by regarding the heat storage tank as a calorimeter.

#### PC datalogging:

Modern data acquisition systems can transform an input voltage e.g. from a pyranometer to digital form for computer processing. Equation 2 can be used in the program along with the calibration constant provided with our instrument to continuously record the momentary solar irradiance  $S(t)$ . The global radiation energy  $G$  per unit area is the time integral:

$$\int_{t_1}^{t_2} S(t) dt = G \approx \sum_i S(t_i) \cdot \Delta t_i \quad (3)$$

The programmer will usually choose a time interval  $t_i$  in harmony with the acquisition of other quantities in the program. It is of course necessary to be careful to use correct units:  $kWh/m^2$  or  $MJ/m^2$  are recommended.

$$1 kWh/m^2 = 3,6 MJ/m^2$$

### SolData Instruments

att: Frank Bason, Ph.D.  
Linåbakken 13  
DK-8600 Silkeborg, DENMARK  
fax: +45-86 84 15 97  
e-mail: [soldata@soldata.dk](mailto:soldata@soldata.dk)  
web: [www.SolData.dk](http://www.SolData.dk)

