SolData Pyranometer 114ppy

USER'S GUIDE

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:

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

This value means that when the solar irradiance S is 1 kW/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 kW/m^2 = 500 W/m^2. Thus:

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

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

CABLE CONNECTIONS
The 114ppy is supplied with an integral three meter long cable connection. The electrical connections are:

WHITE - voltage plus (0-200 mV)
BROWN - 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 114ppy 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 minus 10^0 to $+50^0$ 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.

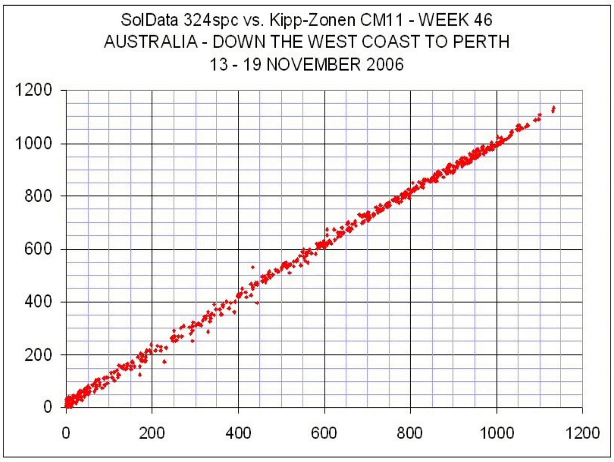

Figure 3: *Calibration check of a SolData 80spc against a Kipp-Zonen CM11.*

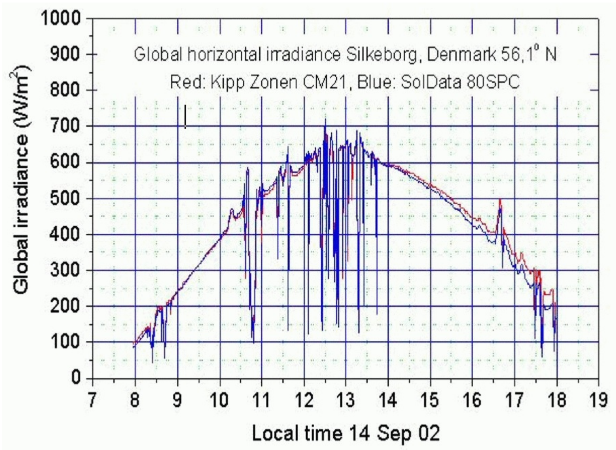

Figure 4: *Global radiation data collected using a 80spc and a Kipp-Zonen CM21 around the spring equinox in Denmark.*

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.*

The 114ppy instrument is supplied with a radiation shield of 3mm aluminum. This keeps the detector cell temperature much lower compared with the 80spc when exposed to direct sunlight. This results in greater accuracy and extended cell lifetime.

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 a 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:

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

Use the correct units, f.eks. kWh/m^2 or MJ/m^2 : 1 kWh/m^2 = 3,6 MJ/m^2.

SolData Instruments
att: Frank Bason, Ph.D.
Linåbakken 13
DK-8600 Silkeborg, DENMARK
cell phone: +45-40 10 66 27
web: http://www.soldata.dk
e-mail: soldata@soldata.dk