Ammonit Solar Information – March 2010

After recognizing an increasing demand for sensor systems in the field of radiation measurements among our partners and customers, Ammonit is presenting an extended range of products to meet this demand.

This introduction gives a short overview over the different surface radiation components, and offers methods to reliably assess them.

Solar radiation

Solar radiation divides into direct and diffuse solar irradiance. While direct solar irradiance travels directly from the sun without any scattering or absorption by microscopic parts in the atmosphere, diffuse solar irradiance only reaches the ground after being scattered by air molecules, dust, cloud particles and alike. Direct and diffuse radiation sum as global radiation.

Different components of the global solar radiation require different technical solutions to measure them. There is a wide range of products, with different specifications in uncertainty and prize. With this portfolio at hand, Ammonit tries to make sure that you find the best solution for your project.

Radiation measurements

Measuring global radiation:

To measure global radiation, a pyranometer is most commonly used. These devices measure the solar radiation flux density within a field of view of 180°. No complex installation methods (e.g. sun trackers) are required. The instrument is available with a wide range of different specifications and accuracy standards.

Example: Pyranometer**:** **CMP 6** for global radiation

Measuring diffuse and direct radiation

Different Methods have been developed to isolate the diffuse and direct components of solar radiation in measurements. Ammonit would like to present four different approaches to enable you choosing the right one for you project:

1. System of pyranometer and pyrheliometers

Pyrheliometers are a very common tool to measure direct solar radiation. The sunlight travels into the instrument and is directed onto a thermopile where the heat is transferred into an electrical signal that is to be recorded.

To guarantee a maximum of accuracy in the measurement, the use of a reliable tracking system to follow the exact orientation of the sun is required.

That can either be a computer controlled, very expensive system, or a less reliable synchronous motor device. The global radiation

is to be measured with a conventional pyranometer. Diffuse radiation results from the deviation between global and direct irradiance. The accuracy of this system is comparably low, since tracking calibration errors is difficult.

Example:	Pyrheliometer	**CHP-1** for direct radiation
	Pyranometer**:**	**CMP 6** for global radiation
	Sun Tracker**:**	**SOLYS 2**

2. System of a shaded and a conventional pyranometer

This system is widely used, especially in scientific research (e.g. World Meteorological Organization). The shaded pyranometer measures diffuse, the conventional pyranometer (as described above) the global irradiance.

The shading of the horizontally fixed pyranometer is achieved with a shading system. The device can either be a computer controlled, very expensive tracking system, or less reliably, a shadow ring, that has to be manually readjusted depending on the sun's course. Incorrect geometry, in both cases, can lead to severe errors.

The second pyranometer should be installed, so it is not affected by the shading system. The direct radiation results from the deviation between global and diffuse irradiance. Installation and maintenance are relatively cost and labour intensive and the system is prone to calibration and installation errors.

To increase the accuracy, a pyrheliometer can be applied additionally, to confirm the results and in case of calibration errors, enable for quick action.

Example:

Pyranometer**:**
CMP 6 for diffuse radiation
CMP 6 for global radiation
Sun Tracker**:**
SOLYS 2

3. Thermopile shadowband radiometer

Another approach to measuring diffuse radiation is a thermopile shadow band radiometer. The moving shadowband, orientated by a smart algorithm, depends on the sun position, alternately shades and exposes the thermopile. From the resultant measurement data, the software can calculate the diffuse radiation component, as well as the global and direct radiation. Using a single detector for all solar components eliminates typical calibration errors, introduced by multiple instrument systems.

Another outstanding feature, that increases accuracy of the TSR, is its ability to correct angular errors of surrounding surfaces.

Hence, this technology enables you to measure all three solar components comfortably with just one instrument, meeting highest accuracy standards.
The MSR-7 variation of this product is capable of performing

spectral measurements at six predefined wavelengths and for the whole spectrum with a broadband channel.

Example 1: Pyranometer **TSR-1** for diffuse, direct and global radiation

Example 2: Pyranometer **MFR-7** for diffuse, direct and global radiation for whole spectrum and at 6 predefined wavelengths

4. SPN-1 Pyranometer

Another system is the quite recent, patented SPN-1 Pyranometer by Delta-T Devices Ltd. It uses seven thermopile sensors and computer-generated shading patterns installed within the dome. The shading pattern and thermopiles are arranged so that at least one thermopile is always fully exposed to the solar beam, and at least one is fully shaded from it., regardless of the position of the sun in the sky. All seven thermopiles receive an equal amount of diffuse light. From the individual thermopile readings, a microprocessor calculates the global and diffuse horizontal irradiance and from these values the direct irradiance is calculated.

In case that your system does not require the highest accuracy this system will be an affordable alternative, since a tracking system is not required anymore and only one sensor delivers global and diffuse radiation measurements.

Example: Pyranometer**:** **SPN-1** for diffuse and global radiation

Compatibility

All sensors described above are compatible with the Wicom and Meteo-Series Data loggers using the corresponding adaptors.

Overview

Last but not least an overview schedule of the presented systems indicating a quantitative estimate of accuracy and price.

	Rad. Measurement			Rad. Calculation		Accuracy	Price
	global	direct	diffuse	direct	diffuse		
System 1	x	x				+	-
System 2	x		x			+	-
System 2 (with PHel.)	x	x	x	x	x	++	-
System 3	x	x	x			+++ (best accuracy)	+
System 4	x		x	x		+	+++ (lowest price)