Hukseflux
Thermal Sensors

Hukseflux pyranometer selection guide

Next level instruments in every class at the most attractive price level

This brochure offers you general guidelines for selection of the right pyranometer for your application. Main examples: use in PV system performance monitoring according to IEC 61724-1, use for diffuse radiation measurement and use in meteorological networks. Customers prefer Hukseflux pyranometers for their unsurpassed measurement accuracy and their lowest total cost of ownership.

Figure 1 *SR30 pyranometers, our most popular solution for PV system performance monitoring according to IEC 61724-1 class A.*

Figure 2 *Example of a Hukseflux spectrally flat Class A pyranometer, model SR25, with a sapphire outer dome. This model is recommended for research grade diffuse radiation measurement. Output is either analogue millivolt or digital via Modbus RTU over RS-485 and analogue 4-20 mA (current loop).*

The right instrument for the application

Choosing the right instrument for your application is not an easy task. We can offer assistance. But first, you should ask yourself the following questions:

- are there standards for my application?
- what level of accuracy do I need?
- what maintenance will be available?
- what measurement capabilities and electrical power is available?

Then talk to us; our recommendation for the best suited pyranometer will include:

- pyranometer class
- maintenance and calibration policy
- estimate of the measurement accuracy
- electrical interfacing
- mechanical mounting

Background: ISO 9060 classification

Users should know that pyranometers are classified according to ISO 9060:

- spectrally flat Class A
- spectrally flat Class B
- spectrally flat Class C

From Class C to Class B and from Class B to Class A, the achievable accuracy improves by a factor 2. (see Figure 3).

Hukseflux pyranometers

Measurand	hemispherical solar radiation
ISO 9060 classification	spectrally flat Class A, B and C
Options	analogue and / or digital output; with Recirculating Ventilation and Heating (RVH™), sapphire outer dome, or use with VU01 ventilation unit; cable length; heaters and internal temperature sensors; various mounting and levelling fixtures

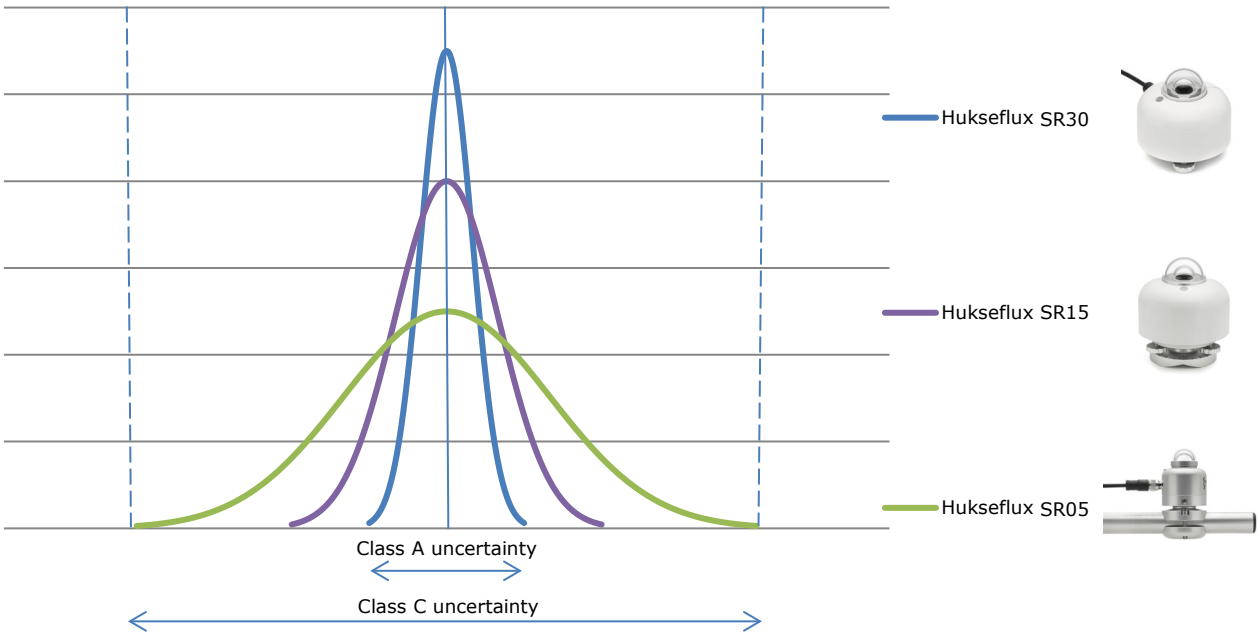

Figure 3 *A visual impression of measurement uncertainty for well maintained instruments of different ISO 9060:2018 pyranometer classes. From Class C to Class B and from Class B to Class A, the achievable accuracy improves by a factor 2.*

Hukseflux pyranometer benefits

Hukseflux is a leading manufacturer, both in technology and market share, of pyranometers. We offer you the best measurement accuracy in every class. In more detail, superior instrument design allows us to claim:

- the best calibration uncertainty
- lowest "zero offset a"
- best data availability, using the heated SR30

Whatever your application is: Hukseflux offers the highest accuracy in every class at the most attractive price level.

Low total cost of ownership

Customers prefer Hukseflux pyranometers for their unsurpassed measurement accuracy and their lowest total cost of ownership. Total costs are mainly determined by costs of installation, on-site inspections, servicing and calibration:

- pyranometers must be calibrated every 2 years. Such recalibration is considered good practice for any measuring instrument and is required by ISO, IEC and WMO standards covering PV system performance - and meteorological monitoring. Cost of recalibration however can be high. Hukseflux' worldwide calibration network will help you reduce these costs. Learn more about Hukseflux pyranometer calibration services
- low demand on infrastructure: SR30's RVH™ requires less than 3 W power, compared to 10 W for traditional ventilation systems
- reduction of unnecessary on-site inspection by remote diagnostics

Use in PV monitoring: IEC 61724-1

For high-accuracy PV system performance monitoring, the IEC 61724-1:2020 *Photovoltaic System Performance Monitoring - Guidelines for Measurement, Data Exchange and Analysis* - requires mitigation of dew and frost. SR30 complies, for both Plane Of Array (POA) and Global Horizontal Irradiance (GHI) without the need for additional accessories. Alternatively, you may use SR20 pyranometer with an external VU01 ventilation unit. For reflected Horizontal Irradiance (RHI) lower class instruments may be used.

Asset management of large scale PV

Asset managers of industrial and utility-scale PV power plants prefer digital Class A pyranometers over PV reference cells and lower Class and analogue output pyranometers. The reasons why:

- better stability than cells used in PV systems
- easy implementation and servicing
- no need to separately calibrate pyranometers and amplifiers
- remote diagnostics of the sensor condition

Asset managers monitor for various reasons. Apart from monitoring as a tool to assess day-to-day performance, they are interested to have documented proof of performance in case of warranty claims, when negotiating (re-) financing and when selling the asset. For monitoring the plant performance, the irradiance sensor must be more stable than the cells used in the PV system. This is only the case with Class A pyranometers, offering a stability of < 0.5 %/yr compared to a typical > 1% /yr PV reference cell degradation.

SR30: for high data availability

High data availability is attained by heating of the outer dome using ventilation between the inner and outer dome. This space forms a closed circuit together with the instrument body; ventilated air is not in contact with ambient air. RVH™ - Recirculating Ventilation and Heating - technology, developed by Hukseflux, suppresses dew and frost deposition and is as effective as traditional ventilation systems, without the maintenance hassle and large footprint.

- low power consumption: SR30 requires only 2 W, compared to 10 W for traditional ventilation systems
- low maintenance: SR30 does not require filter cleaning

Figure 3 *Frost and dew deposition: clear difference between a non-heated pyranometer (back) and SR30 with RVH™ technology (front).*

The dome of SR30 pyranometer is heated by ventilating the area between the inner and outer dome. RVH™ is much more efficient than traditional ventilation, where most of the heat is carried away with the ventilation air. Recirculating ventilation is as effective in suppressing dew and frost deposition at less than 3 W as traditional ventilation is at 10 W. RVH™ technology keeps domes and sensor in perfect thermal equilibrium, which also leads to a reduction of zero offsets.

Use for diffuse radiation measurement

Diffuse solar radiation is usually measured using shaded pyranometers. The dominant measurement error is the zero offset a. SR25, equipped with a high thermal conductivity sapphire dome, has very low offsets. SR25 outperforms the quartz dome instruments, traditionally used for this purpose, at a much lower cost level. SR25 has been tested at NREL National Renewable Energy Laboratories, USA, and has been adopted as one of its diffuse radiation reference sensors.

Use in meteorological networks

In WMO-No. 8, Guide to Meteorological Instruments and Methods of Observation, WMO recommends use of spectrally flat Class B or "good quality" pyranometers such as Hukseflux model SR15 for network operation. Modern networks often use one level higher: spectrally flat Class A; such as our models SR20 and SR30.

Sensors made by Hukseflux passed validation and acceptance testing for a large number of National Meteorological Networks:

- India: National Institute of Wind Energy (NIWE), solar resource assessment network
- USA: National Ecological Observatory Network (NEON), meteorological observation network
- UK: Centre for Ecology & Hydrology (CEH), measurement / monitoring network
- India: India Meteorological Department (IMD), national measurement network
- Japan: Japan Meteorological Agency (JMA), national measurement network
- China: China Meteorological Administration (CMA), national measurement network, sensors supplied through a technology transfer project.
- Ecuador: National Meteorological and Hydrological Institute (INAMHI), national measurement network
- USA: The Atmospheric Radiation Measurement (ARM) multi-laboratory network of the U.S. Department of Energy (DOE)

NOTE: the fact that a sensor is tested or used in a network does not constitute a formal endorsement by the test institute or network owner.

Influence of instrument cleaning

The performance of high class instruments strongly depends on cleaning. At a low maintenance level, the achievable accuracy will not be reliably attained. You may then consider using multiple instruments. The use of redundant instruments allows remote checks of one instrument using the other as a reference, which leads to a higher measurement reliability.
For lower class instruments, the relative loss of accuracy at a low maintenance level is less significant. At low maintenance intervals, use of multiple low class instruments is a good alternative to using a single high class instrument.

Table 1 gives an overview of pyranometers and the most common considerations for choosing a particular one.

Table 1 *The most common considerations when choosing a pyranometer for application in PV system performance monitoring, meteorological networks and for diffuse solar radiation measurement.*

					
	SR30	SR20 with VU01 unit	SR15	SR05	SR25
ISO 9060:2018 classification	Spectrally flat Class A	Spectrally flat Class A	Spectrally flat Class B	Spectrally flat Class C	Spectrally flat Class A
ISO 9060:1990 classification	Secondary standard	Secondary standard	First class	Second class	Secondary standard
PV system performance monitoring IEC 61724-1 compliance	Class A (GHI, POA)	Class A (GHI, POA)	RHI only	RHI only	-
Heating to mitigate dew and frost / improve data availability	++++	++++	++*	-	++++
Ventilation	+++	++++	-	-	-
High accuracy meteorological networks	+++++	++++	++++	-	-
Agro-meteorological networks	+	+	++	++++	-
Remote diagnostics (including tilt and humidity sensor)	++++	-	-	-	-
Diffuse radiation reference (low offset)	+++	++	-	-	+++++
Low relative loss of accuracy at a low cleaning interval	+	+	++	+++++	+

** Models SR15-A1 and SR15-D1*

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Electrical interfacing

We can assist you in optimising the interfacing of the pyranometer to your data collection platform. Solutions vary from using a datalogger as a local connection point for several different sensors to the use of transmitters incorporated in the pyranometer. Ideal for networks and the solar PV industry is SR30. SR30's output is digital and the sensor communicates using the industry standard Modbus RTU protocol over 2-wire RS-485.

Uncertainty evaluation

The ASTM G213-17 provides guidance and recommended practices for evaluating uncertainties when performing outdoor measurements with pyranometers. The ASTM standard follows the ISO Guide 98: Guide to the Expression of Uncertainty in Measurement (GUM) JCGM 100:2008. Consider also reading Comments by Hukseflux on ASTM G213-7.

See also

Hukseflux offers a complete range of pyranometers. Take a look at all solar radiation sensors, accessories and related services.

About Hukseflux

Hukseflux is the leading expert in measurement of energy transfer. We design and manufacture sensors and measuring systems that support the energy transition. We are market leaders in solar radiation- and heat flux measurement. Hukseflux products and services are offered worldwide via our office in Delft, the Netherlands and local distributors.

Need for support in your selection process?
E-mail us at: info@hukseflux.com

SR30 PYRANOMETER

Digital Class A pyranometer with heating

SR15 PYRANOMETER SERIES
Class B pyranometers with various outputs

SR05 PYRANOMETER SERIES
Class C pyranometers with various outputs

SR25 PYRANOMETER

Class A pyranometer with sapphire outer dome

SR20 PYRANOMETER
Class A pyranometer

VU01 VENTILATION UNIT
Ventilation unit for SR20

SRA20 ALBEDOMETER
Class A albedometer

PMF01
Pyranometer mounting fixture PoA