KIPP & ZONEN
SINCE 1830

Pyrgeometers

FOR THE PRECISE MEASUREMENT OF FAR INFRARED RADIATION

Measure incoming thermal radiation from the sky and clouds
Measure outgoing thermal radiation from the ground
Used around the world in meteorology, hydrology and climate research
Reliable all-weather performance
Easily portable for field use

Introduction

Radiation from the sun is mainly in the 'short-wave' range from 300 to 4000 nm (4 µm) that includes the visible and ultraviolet. A proportion of this radiation is absorbed by clouds, aerosols and molecules in the atmosphere, which warms up and radiates 'long-wave' radiation. This is far infrared thermal energy (FIR) at wavelengths from 4.5 µm to beyond 40 µm. Both the short-wave and long-wave radiation reach the Earth, where some is reflected and the remainder warms up the surface. The Earth radiates long-wave thermal energy back to the sky.

The relationship of incoming and outgoing short-wave and long-wave radiation is the 'Energy Balance'. Short-wave radiation is measured by a pyranometer and the long-wave radiation by a pyrgeometer.

Kipp & Zonen pyrgeometers comply with the requirements of the World Meteorological Organisation and are fully traceable to the World Infrared Standard Group (WISG) in Davos, Switzerland, where the Kipp & Zonen CGR 4 forms part of the Group.

Applications

CGR pyrgeometers have been developed for use in all environments, from the Antarctic to deserts. They are installed around the world for meteorology, hydrology, climate research, and agriculture; wherever accurate measurements of the radiation energy balance are required. Kipp & Zonen pyrgeometers are designed for a long operating life with simple maintenance.

Choice of Pyrgeometer

A pyrgeometer provides a voltage that is proportional to the radiation exchange between the instrument and the sky (or ground) in its field of view. The detector signal output can be positive or negative.

For example, if the sky is colder than the pyrgeometer, the instrument radiates energy to the sky and the output is negative.

In order to calculate the incoming or outgoing FIR it is necessary to know the temperature of the instrument housing close to the detector and the data must be recorded simultaneously with the detector signal.

Kipp & Zonen CGR pyrgeometers use silicon windows to transmit infrared radiation and these have an internal thin film coating that blocks short-wave solar radiation from reaching the broadband thermopile detector.

There is an integrated bubble level and a white sun shield prevents the body heating up. The waterproof connector has gold-plated contacts and is fitted with 10m of high quality signal cable as standard. A 10K thermistor internal temperature sensor is fitted (Pt-100 optional).

The instruments do not require power and are supplied with calibration certificates traceable to the WISG. The most appropriate model for an application depends on the desired accuracy and performance.

CGR 3 is the partner to the CMP 3 pyranometer. It has a flat silicon window which provides a field of view of 150 °. The small size and sealed construction make this instrument the ideal choice for horticulture and agriculture. A screw-in mounting rod is available for easy installation.

CGR 4 is the best pyrgeometer currently available and is the choice for scientific use and in top level solar radiation monitoring networks such as the Baseline Surface Radiation Network (BSRN) of the World Meteorological Organisation. It is the partner for CMP 11, CMP 21 and CMP 22 pyranometers.

CGR 4 has a specially designed silicon meniscus dome that provides a 180 ° field of view and has a hard-carbon coating on the outside to smooth the spectral response and provide extra surface protection. The detector is compensated for changes in sensitivity due to temperature variations.

All pyrgeometers use infrared window materials that absorb a large part of the short-wave radiation. The window heats up and creates an offset in the readings. For increased accuracy it is normally necessary to shade the pyrgeometer from direct solar radiation to minimise this effect. However, the unique design of CGR 4 reduces the dome heating offset to a negligible level (particularly when ventilated), eliminating the need for dome temperature measurements or dome shading.

Building a system

The system capabilities of Kipp & Zonen pyrgeometers can be extended with our wide range of compatible products and accessories. Please refer to the specific product brochures, available at our website, www.rg-messtechnik.de

Ventilation Unit

The CVF 3 ventilation unit is designed not only for use with the CMP pyranometers, but also the CGR 4 pyrgeometer. Ventilation helps to keep the dome clean and reduces infrared thermal offsets by stabilization of the dome temperature. The CVF 3 has 2 levels of heating that can be used to remove raindrops, dew, frost and snow.

Sun Tracker

SOLYS 2 and 2AP sun trackers are all-weather reliable instruments used to accurately point a pyrheliometer at the sun for direct radiation measurements. Adding the shading assembly, two pyranometers (one shaded) and a CGR 4 pyrgeometer (shaded) to a sun tracker complies with the requirements for a basic Baseline Surface Radiation Network (BSRN) station.

Data loggers

Kipp & Zonen has a range of high performance data logging products for use with CGR pyrgeometers.

Amplification

Pyrgeometers have low output signals in the mV range. AMPBOX converts this to the industrial standard 4 - 20 mA current loop signal and provides a defined output range in W/m2. The zero point is offset to allow negative readings. Amplification is advised for noisy environments, use with data acquisition equipment with high-level inputs, and for very long cables (> 100 m).

Mounting plates

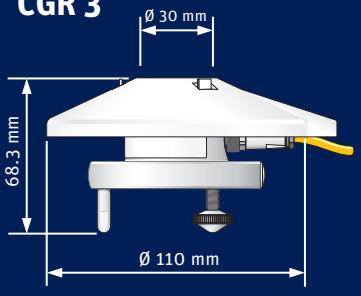
Kipp & Zonen offers two mounting fixtures suitable for both CGR pyrgeometers. CMF 1 is a small round plate with integral rod for mounting upward and/or downward facing pyrgeometers. CMF 2 is a larger version that can also be used for mounting the CGR 4 fitted with the CVF 3 ventilation unit.

Net Long-wave radiometer

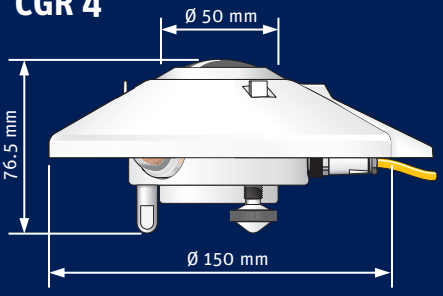
Net long-wave radiation can be calculated using two pyrgeometers, one looking up and one looking down. The CGR 3 is especially designed so that two instruments can be mounted base-to-base and fitted with the optional mounting rod. In this case the temperature of the pyrgeometers is the same and is irrelevant for the net radiation calculation.

Specifications

CGR 3



CGR 4



Response time (95 %)	< 18 s	< 18 s
Non-stability (change/year)	< 1 %	< 1 %
Non-linearity (-250 to 250 W/m²)	< 1 %	< 1 %
Window heating offset (with 1000 W/m² solar radiation)	< 15 W/m²	< 4 W/m²
Temperature dependence of sensitivity	< 5 % (-10 °C to +40 °C)	< 1 % (-20 °C to +50 °C)
Sensitivity	5 to 15 µV/W/m²	5 to 15 µV/W/m²
Operating temperature	-40 °C to +80 °C	-40 °C to +80 °C
Field of view	150 °	180 °
Spectral range (50 % points)	4.5 to 42 µm	4.5 to 42 µm
Irradiance (net)	-250 to 250 W/m²	-250 to 250 W/m²

CGR instruments have a standard cable length of 10 m. Optional cable lengths 25 m and 50 m

Standard 10 K Thermistor (YSI 44031) or optional Pt-100 temperature sensor

Under most conditions the output from CGR pyrgeometers is negative and suitable data acquistion equipment must be used

Note: The performance specifications quoted are worst-case and/or maximum values

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