

GG01

Gardon gauge water-cooled high heat flux sensor

GG01 is a water-cooled sensor that measures heat flux. The Gardon gauge sensor is based on copper and copper alloys, and works at heat flux levels at which other sensors get toasted. Optionally GG01 can be equipped with a sapphire window; to measure radiative heat flux only, and not convective heat flux. GG01 has an on-board thermocouple type K and is available with various dedicated measurement ranges.

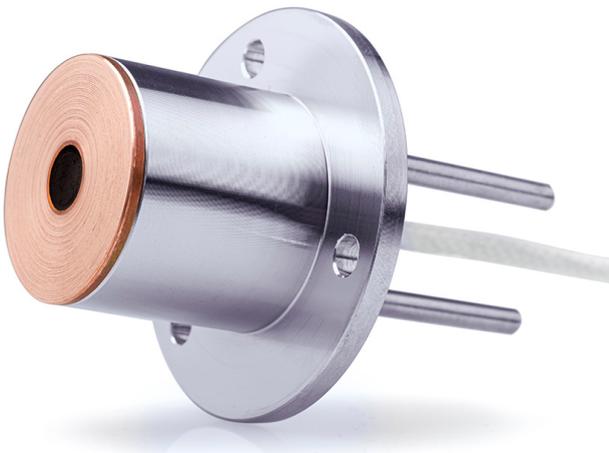


Figure 1 GG01 Gardon gauge water-cooled high heat flux sensor. It works at heat flux levels at which other sensors get toasted.



Figure 2 GG01 sensor in a high heat flux test cabinet. Each sensor is tested at its rated measurement range.

Introduction

GG01 measures heat flux in the range of $(250 \text{ to } 1000) \times 10^3 \text{ W/m}^2$. Equipped with a black absorber, heat flux sensors of this type are designed for measurement in an environment in which heat flux is dominated by radiation. Using an open detector, GG01 is also sensitive to convective heat flux.

The GG01 Gardon gauge sensor, based on thermocouple materials, generates an output voltage proportional to the incoming irradiance. A type K thermocouple measures the body temperature. The sensor is water-cooled. Water cooling is usually supplied by tap water.

There are 3 versions of GG01; each with a different rated measurement range, sensitivity and response time. Irradiance ranges are $(250, 500 \text{ and } 1000) \times 10^3 \text{ W/m}^2$, for GG01-250, GG01-500 and GG01-1000 respectively. The body is equipped with a flange for easy mounting. GG01-250 may be equipped with a sapphire window. See options.

Gardon gauge technology

GG01 is made using oxygen-free high thermal conductivity copper and thin foils of a copper-nickel alloy. The sensor is called "Gardon gauge" after its inventor Robert Gardon. The benefit of this technology is that it can withstand very high heat fluxes.

GG01 has several advantages:

- withstands very high heat fluxes
- fast response time
- equipped with type K thermocouple to measure body temperature
- suitable for use in high vacuum
- safe storage with a practical protection cap

Suggested use

GG01 is the sensor of choice for high heat flux measurements.

Manufacturing and testing

Hukseflux invested in brand new manufacturing and test equipment for producing modern Gardon gauges. Each sensor is tested at its rated range. All GG01s are tested to withstand a cooling water operating pressure of 10 bar.

GG01 design

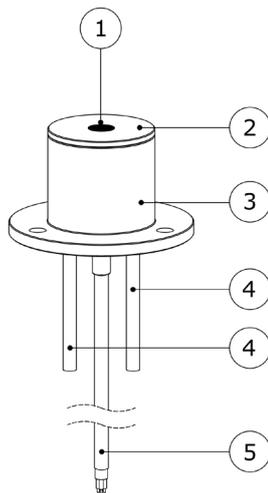


Figure 3 overview of GG01 standard model: (1) Gardon gauge sensor with black coating, (2) copper housing, (3) sensor body with flange, (4) water cooling tubes, (5) cable; standard cable length is 2 m

Calibration

Hukseflux provides a traceable calibration. The reference standard at Hukseflux is of secondary standard level. It has been calibrated by comparison to the primary standard of the **RISE Research Institutes of Sweden AB**. GG01 sensors as supplied by Hukseflux are calibrated according to ISO 14934-3. Hukseflux is ISO 9001 certified, but not an accredited measurement laboratory according to ISO 17025.

Measurement uncertainty

The uncertainty of the measurement with GG01 should be determined case by case. It is a function of:

1. heat flux sensor properties
2. uncertainty of calibration and quality assurance of the local calibration reference standard
3. verification of the stability of GG01 sensors in day to day measurements, before and after use
4. application-related uncertainties, for example caused by the unknown contribution of convection and the representativeness of the measurement location

GG01 specifications

Measurand	heat flux
Measurand in SI units	irradiance in W/m^2
Sensor technology	Gardon
Rated cooling water flow*	> 50 l/h (0.014 l/s)
Rated measurement ranges	(250, 500, 1000) $\times 10^3 W/m^2$
Nominal response time (63 %) at different rated measurement ranges:	
250 $\times 10^3 W/m^2$	250 $\times 10^{-3}$ s
500 $\times 10^3 W/m^2$	200 $\times 10^{-3}$ s
1000 $\times 10^3 W/m^2$	100 $\times 10^{-3}$ s
Limiting measurement range	150 % of rated measurement range
Output signal	DC voltage
Output signal range	> 5 $\times 10^{-3}$ V at rated measurement range
Spectral range	(0 to 50) $\times 10^{-6}$ m
Full field of view angle	180 °
Calibration traceability	to ITS-90
Calibration laboratory:	
-management system certification	ISO 9001
-accreditation	not accredited
Calibration method	secondary calibration method according to ISO 14934-3
Standard cable length	2 m (see options)
Order code standard version	GG01/rated measurement range/cable length

* see manual for more information

Options

- rated measurement range (250, 500, 1000) $\times 10^3 W/m^2$
- sapphire window (for GG01-250 only)
- longer cable (specify either 5 or 10 m)

Optional sapphire window

GG01 may be equipped with a sapphire window (GG01-250-SW). It allows the user to measure only the radiative component of the heat flux.

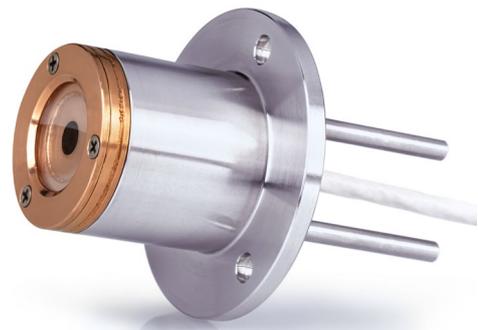


Figure 4 GG01-250-SW with sapphire window

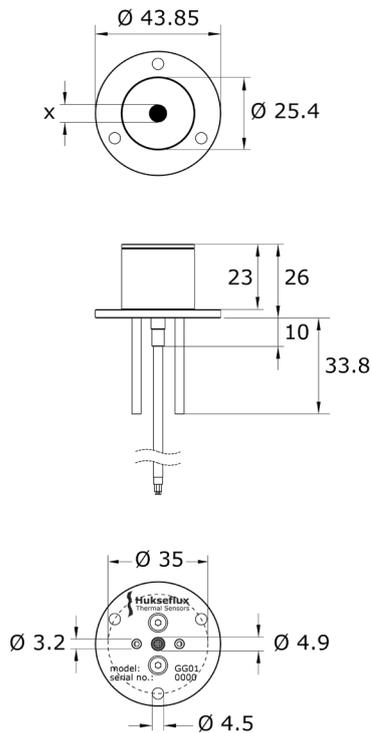


Figure 5 GG01 dimensions in $\times 10^{-3}$ m.
 'x' is the diameter of the sensing area; it varies with the rated measurement ranges of GG01. See the manual for a detailed description.

See also

- alternative model **SBG01** measures lower heat flux levels.
- industrial model **HFS01** also measures high heat fluxes (to $800 \times 10^3 \text{ W/m}^2$), is more robust but has a slower response time than GG01. HFS01 is available with ATEX certification.
- our complete range of **sensors** and **systems**

About Hukseflux

Hukseflux Thermal Sensors makes sensors and measuring systems. Our aim is to let our customers work with the best possible data. Many of our products are used in support of energy transition and efficient use of energy. We also provide services: calibration and material characterisation. Our main area of expertise is measurement of heat transfer and thermal quantities such as solar radiation, heat flux and thermal conductivity. Hukseflux is ISO 9001 certified. Hukseflux products and services are offered worldwide via our office in Delft, the Netherlands and local distributors.

Interested in this product?
 E-mail us at: info@hukseflux.com

Table 1 ordering codes for GG01

VERSIONS OF GG01 (part numbers)	
GG01-250	Gardon gauge water-cooled high heat flux sensor, 250 kW/m ² rated measurement range
GG01-250-SW	Gardon gauge water-cooled high heat flux sensor, 250 kW/m ² rated measurement range, with sapphire window
GG01-500	Gardon gauge water-cooled high heat flux sensor, 500 kW/m ² rated measurement range
GG01-1000	Gardon gauge water-cooled high heat flux sensor, 1000 kW/m ² rated measurement range
CABLE FOR GG01(-SW)	
`-02' after GG01 part number	standard cable length: 2 m
`-05' after GG01 part number	cable length: 5 m
`-10' after GG01 part number	cable length: 10 m

GG01 outperforms competing models: how?

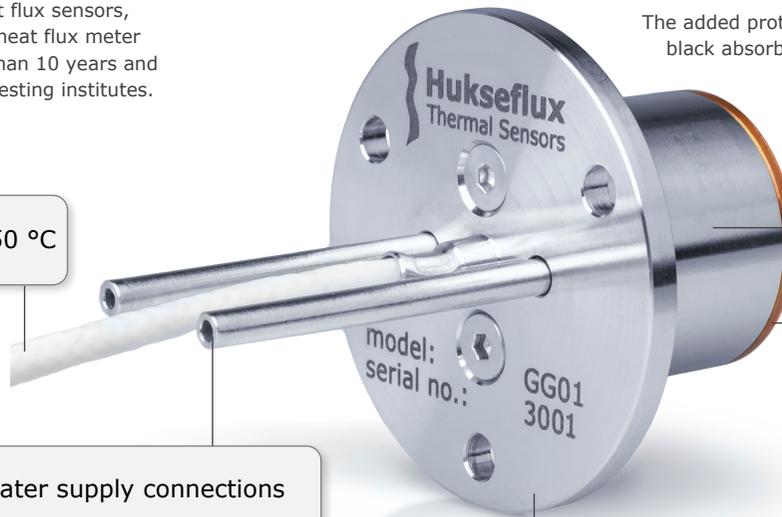
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Market leader

Hukseflux is market leader in heat flux sensors, worldwide. Take for example our heat flux meter SBG01; on the market for more than 10 years and used by the vast majority of fire testing institutes.

Durable cable, temperature resistant up to 250 °C



Supplied with protection cap

The added protection cap is a useful tool to protect the black absorber and guarantees the sensor's lifetime.



Type K thermocouple included

Gardon gauge: all-metal sensor withstands very high heat flux levels

Robust water supply connections

Suitable for a variety of sources
IR emitters, fires, flares etc.



Practical flange used for mounting

Best paperwork

Hukseflux has the paperwork covered; GG01s are provided with formally traceable calibration certificates and test reports. We use a secondary calibration method according to ISO 14934-3.

