HUKX

Sensor
Technology

Brochure

Gardon gauge water-cooled high heat flux sensor

GG01

GG01
Gardon gauge water-cooled high heat flux sensor

GG01 is a water-cooled sensor that measures extremely high heat fluxes, up to 1000 x 10^3 W/m^2. Made from high thermal conductivity copper and copper alloys, this modern all-metal sensor keeps working at heat flux levels where other sensors get toasted. An optional sapphire window allows measurement of radiative heat flux only, excluding the convective heat flux. GG01 features an on-board Type K thermocouple and is available with various dedicated measurement ranges. For lower flux ranges, see our SBG01.

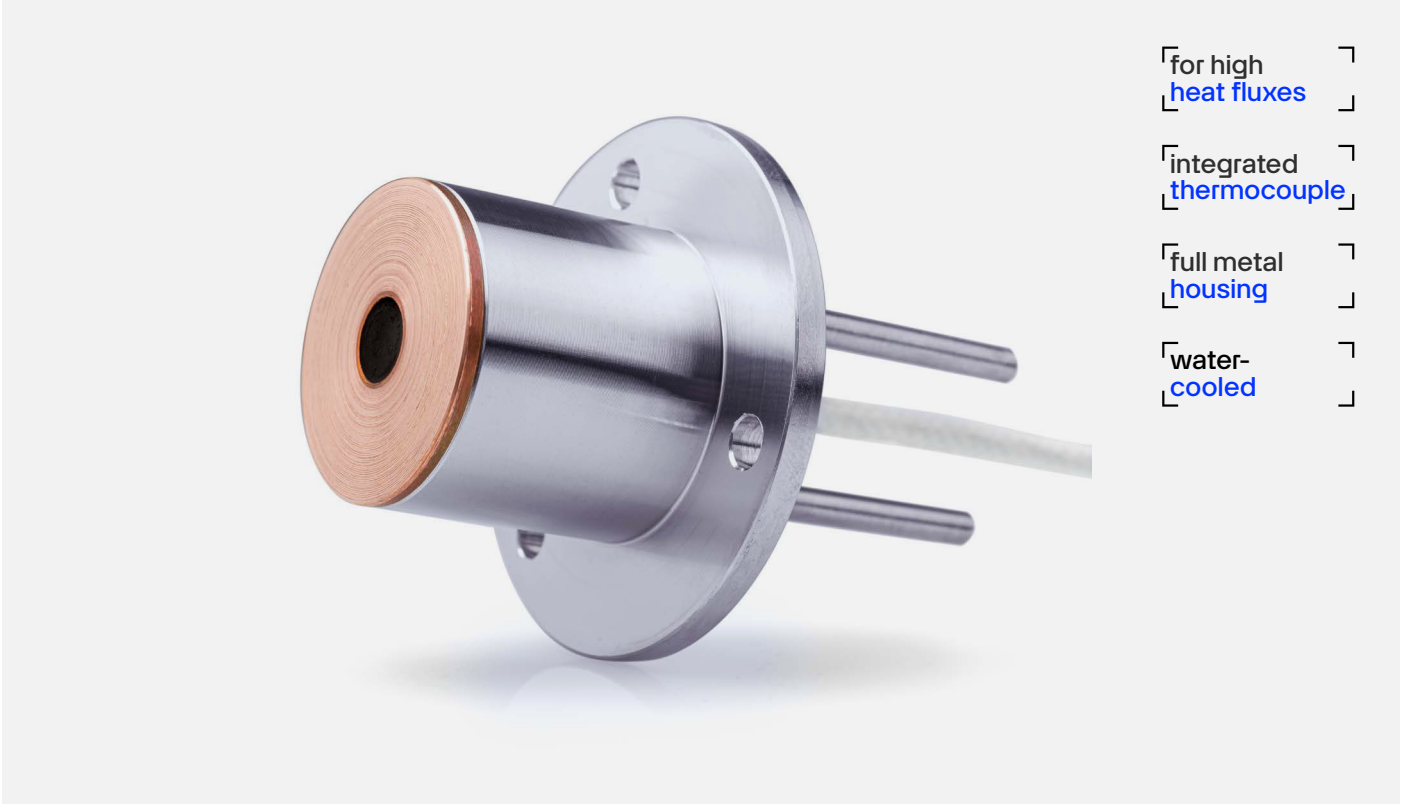
Introduction

GG01 is a modern Gardon gauge sensor that measures heat flux in the range of (250 to 1000) x 10^3 W/m^2. Equipped with a black absorber and water-cooled, the sensor is designed to measure heat flux from strong radiative sources.

Using an open detector, GG01 is also sensitive to convective heat flux—a contribution that is often overlooked.

The GG01 Gardon gauge sensor generates an output voltage proportional to the incoming heat flux. A Type K thermocouple measures the body temperature.

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



The sensor is cooled, usually via tap water, which keeps the sensor body relatively cool despite temperatures of the surrounding air and the radiant source reaching 1000 °C and higher.

There are three versions of GG01, each with a different rated measurement range, sensitivity, and response time. Irradiance ranges are (250, 500, and 1000) x 10^3 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 in Table 1.

Gardon gauge technology

GG01 is made using oxygen-free, high thermal conductivity copper and a thin foil of a copper-nickel alloy. The all-metal sensor is called "Gardon gauge" after its inventor Robert Gardon. The benefit of this technology is that it can withstand extremely 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 environments
– safe transport and storage with a practical protection cap

Suggested use

GG01 is the sensor of choice for extremely high heat flux measurements. Main applications are:

– solar concentrators
– flame research
– fluidized beds
– rocket engine exhaust flames

GG01 design

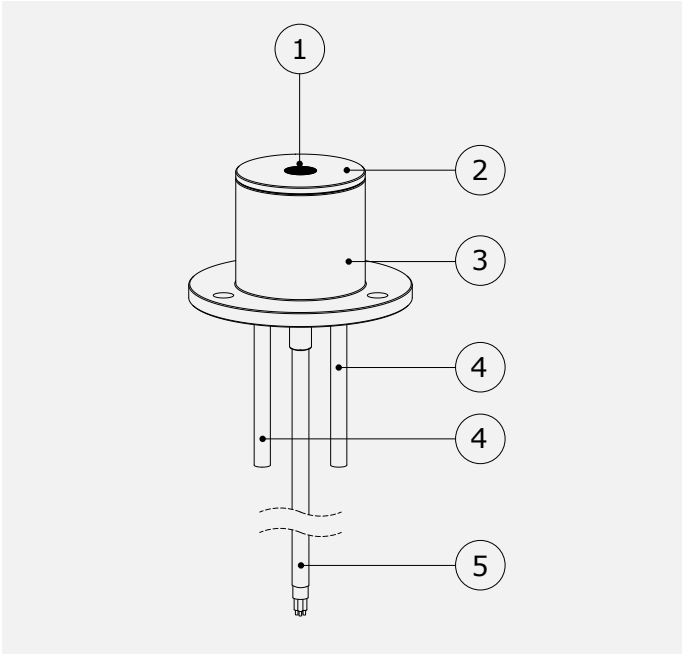


Figure 3 Overview of GG01 standard model:

1. Gardon gauge sensor with black coating
2. copper housing
3. sensor body with flange
4. water cooling tubes
5. cable (standard cable length: 2 m).

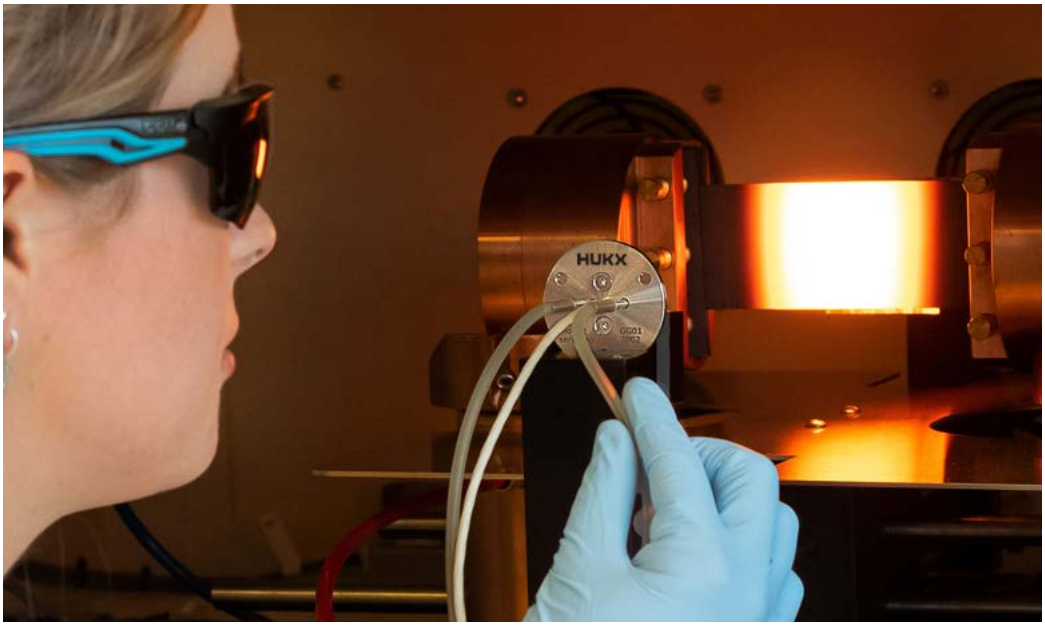


Figure 2 GG01 sensor in a high heat flux test cabinet. Each sensor is tested at its rated measurement range.

Calibration

GG01 sensors are factory calibrated according to ISO 14934-3. With that Hukx provides a calibration traceable to a secondary reference standard.

For GG01 250, 500, and 1000, the reference standard has been calibrated by comparison to the primary standard high temperature source of the RISE Research Institutes of Sweden AB.

Hukx is ISO 9001 certified but not an ISO /IEC 17025 accredited measurement laboratory.

Manufacturing and testing

Hukx invested in brand new manufacturing and test equipment for producing modern Gardon gauges. Each sensor is tested at its rated range, up to 1000 x 10^3 W/m^2.

All GG01s are tested to withstand a cooling water operating pressure of 10 bar.

Measurement uncertainty

The measurement uncertainty of GG01 should be determined on a case-by-case basis. It depends on several factors:

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

Options

– rated measurement ranges: (250, 500, and 1000) x 10^3 W/m^2
– sapphire window (for GG01-250 only)
– longer cable: 5 or 10 m (standard cable: 2 m)

Optional sapphire window

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

Table 1 Ordering codes for GG01.

Versions of GG01 (part numbers)	
GG01-250	Gardon gauge water-cooled high heat flux sensor, 250 kW/m² rated measurement range
GG01-250-SW	Gardon gauge water-cooled high heat flux sensor, 250 kW/m² rated measurement range, with sapphire window
GG01-500	Gardon gauge water-cooled high heat flux sensor, 500 kW/m² rated measurement range
GG01-1000	Gardon gauge water-cooled high heat flux sensor, 1000 kW/m² 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

Figure 4 GG01-250-SW with a sapphire window allows measurement of radiative heat flux only, excluding convective heat flux.

See also

- alternative model SBG01 measures lower heat flux levels
- industrial model HFS01 also measures high heat fluxes (up to 800 x 10^3 W/m²), is more robust, but has a slower response time than GG01. HFS01 is available with ATEX certification
- SBG04 water-cooled sensor—for cone calorimeters
- our complete range of sensors and systems

GG01 specifications

General 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) x 10^3 W/m^2
nominal response time (63 %) at different rated measurement ranges:	
250 x 10^3 W/m^2 500 x 10^3 W/m^2 1000 x 10^3 W/m^2	250 x 10^{-3} s 200 x 10^{-3} s 100 x 10^{-3} s
limiting measurement range	150 % of rated measurement range
output signal	DC voltage
output signal range	> 4 x 10^{-3} V at rated measurement range
spectral range	(0 to 50) x 10^{-6} m
full field of view angle	180°
calibration traceability	to ITS-90
calibration laboratory: – management system certification – accreditation	 ISO 9001 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 the user manual for more information

About Hukx

Hukx is the leading innovator in solar radiation and heat flux sensor technology. We are proud to set the standard in high-accuracy measurement, and to be working at the heart of the energy transition.

Customers worldwide rely on our bestselling pyranometers and heat flux sensors. From sensor design and selection to supply and recalibration, we support you across the entire lifecycle.

Hukx is headquartered in the Netherlands, with locally owned representative sales offices in the USA, Brazil, India, China, Southeast Asia, and Japan.

Let us help you select the best sensor for your application.
Get in touch with our experts today via: info@hukx.com

Version 2508

www.hukx.com

HUKX