Hukseflux
Thermal Sensors

FHF02

Foil heat flux sensor with thermal spreaders, flexible, 50 x 50 mm, with temperature sensor

FHF02 is our standard model for general-purpose heat flux measurement. FHF02 is very versatile: it has an integrated temperature sensor and thermal spreaders to reduce thermal conductivity dependence. It is applicable over a temperature range from –40 to +150 °C. FHF02 measures heat flux from conduction, radiation and convection. It is often applied as part of a larger test- or measuring system.

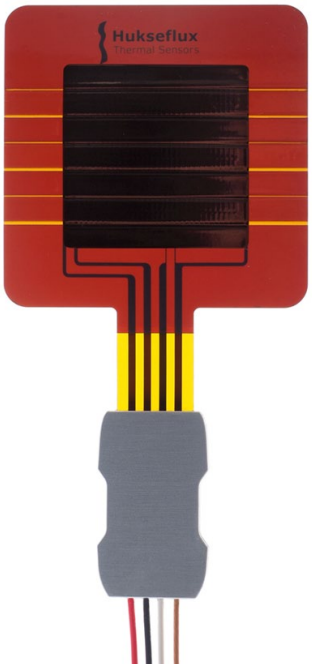

Figure 1 *FHF02 heat flux sensor: thin and versatile*

Figure 2 *FHF02 being installed on a pipe*

Introduction

FHF02 is a sensor for general-purpose heat flux measurement. It is thin and versatile. FHF02 measures heat flux through the object in which it is incorporated or on which it is mounted, in W/m^2. The sensor in FHF02 is a thermopile. This thermopile measures the temperature difference across the flexible body of FHF02.
A type T thermocouple is integrated as well. The thermopile and thermocouple are passive sensors; they do not require power.

A thermal spreader, which is a conductive layer covering the sensor, helps reduce the thermal conductivity dependence of the measurement. With its incorporated spreaders, the sensitivity of FHF02 is independent of its environment. Many competing sensors do not have thermal spreaders. The passive guard area around the sensor redudes edge effects and is used for mounting.

Using FHF02 is easy. It can be connected directly to commonly used data logging systems. The heat flux in W/m^2 is calculated by dividing the FHF02 output, a small voltage, by the sensitivity. The sensitivity is provided with FHF02 on its product certificate.

Unique features and benefits

- flexible (bending radius ≥ 50 x 10^{-3} m)
- low thermal resistance
- wide temperature range
- fast response time
- large guard area
- integrated type T thermocouple
- robustness, including wiring with strain relief block
- IP protection class: IP67 (essential for outdoor application)
- thermal spreader included, low thermal conductivity dependence

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Robust and stable

Equipped with wires with strain relief, protective covers on both sides and potted so that moisture does not penetrate the connection block, FHF02 has proven to be very robust and stable.

Calibration

FHF02 calibration is traceable to international standards. The factory calibration method follows the recommended practice of ASTM C1130-17.

Working with heat flux sensors

When used under conditions that differ from the calibration reference conditions, the FHF02 sensitivity to heat flux may be different than stated on its certificate. See the user manual for suggested solutions.

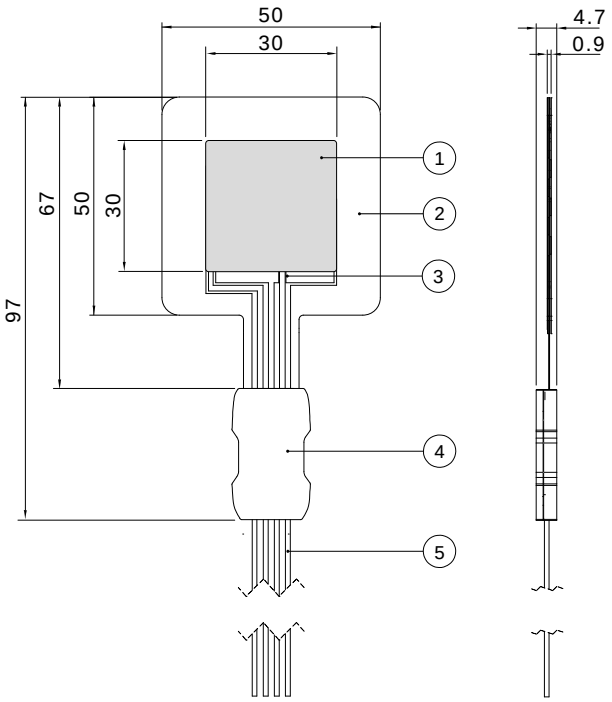


Figure 3 *FHF02 heat flux sensor: (1) sensing area with thermal spreader, (2) passive guard, (3) type T thermocouple, (4) strain relief block, (5) wires, standard length is 2 m. Dimensions in x 10^{-3} m.*

FHF02 specifications

Measurand	heat flux
Measurand	temperature
Temperature sensor	type T thermocouple
Thermal spreaders	included
Rated bending radius	≥ 50 x 10^{-3} m (repeated bending not recommended)
Rated load on a single wire	≤ 1.6 kg
Sensing area	9 x 10^{-4} m^2
Sensor thermal resistance	30 x 10^{-4} K/(W/m^2)
Sensor resistance range	50 to 100 Ω
Sensor thickness	0.9 x 10^{-3} m
Uncertainty of calibration	± 5 % (k = 2)
Measurement range	(-10 to +10) x 10^3 W/m^2
Sensitivity (nominal)	5.5 x 10^{-6} V/(W/m^2)
Operating temperature range	-40 to +150 °C
IP protection class	IP67
Standard wire length	2 m
Options	longer wire length upon request

Options

- longer wire length
- LI19 hand-held read-out unit / datalogger

See also

- model FHF01 for increased flexibility
- model HFP01 for increased sensitivity (also consider putting two or more FHF02's in series)
- view our complete range of heat flux sensors

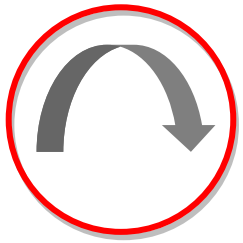
About Hukseflux

Hukseflux Thermal Sensors offers measurement solutions for the most challenging applications. We design and supply sensors as well as test & measuring systems, and offer related services such as engineering and consultancy. With our laboratory facilities, we provide testing services including material characterisation and calibration. 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 sensors, systems 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

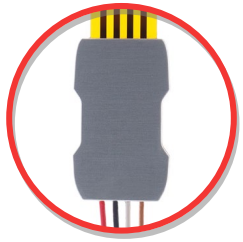
FHF02 outperforms competing models: how?

FHF02 is Hukseflux' standard model for thin and slightly flexible heat flux sensors. Purchasing a FHF02 is a good investment in accurate and stable measurement.



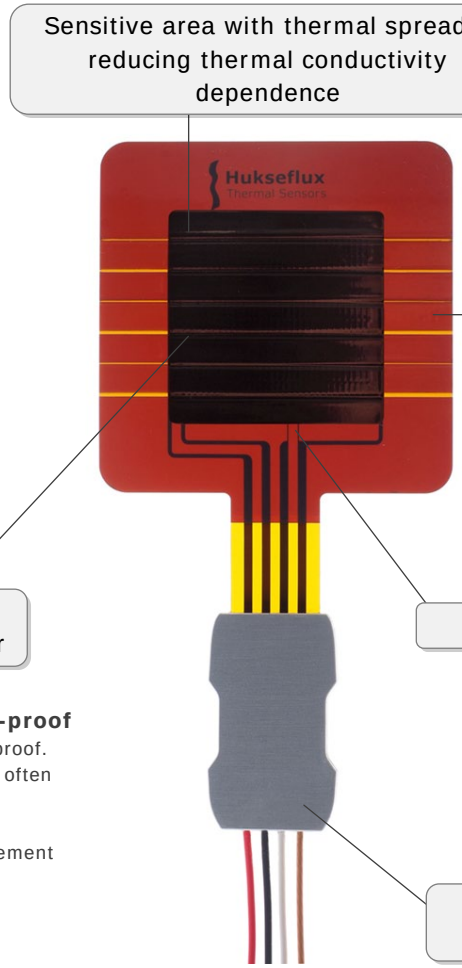
Flexible
FHF02 may be bent to a radius of 50 mm.

Large-area
Larger is better: sensitive area of 30 x 30 mm offers good averaging. FHF02 has a thermal guard around the sensitive area. The guard can also be used for mounting the sensor without disturbing the sensitive area.



Durable: sturdy "student and installer-proof" connection
FHF02's cable-to-sensor connection is a specially designed metal connection piece. It withstands rough handling and repeated installation. Student- and installer-proof! Competing sensors often have wire connections on weak solder pads.

Stable: waterproof (IP67), corrosion-proof
FHF02's sensor connection is glued, and waterproof. Its protection class is IP67. Competing sensors often have wire connections with open contact to the environment. This is a large potential source of damage, as well as a starting point for measurement errors, corrosion, and sensor instability.



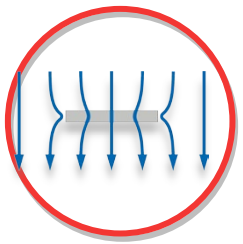
Sensitive area with thermal spreader reducing thermal conductivity dependence

Passive guard area, reducing deflection errors, also used for mounting

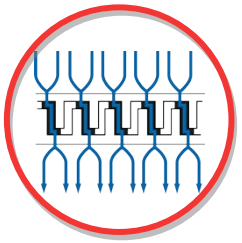
Corrosion-proof plastic cover protecting the thermal spreader

Thermocouple included

Durable waterproof wires with strain relief, temperature resistant up to 150 °C



High accuracy: passive guard included
A passive guard, i.e. a non-sensitive part around the sensor is essential to avoid errors due to edge effects, FHF02 includes guard according to ISO 9869. Competing models often have sensitive parts running to the edge of the sensor, resulting in large potential measurement errors.



Independent of environment: Thermal spreader included
A thermal spreader, i.e. a conductive layer covering the sensor, helps reduce the thermal conductivity dependence of the measurement. Employing a spreader, the sensitivity of FHF02 is independent of its environment. Many competing sensors do not have thermal spreaders.

Best paperwork
Hukseflux has the paperwork covered; FHF02 is provided with formally traceable calibration certificates. We calibrate in accordance with ASTM C1130.