

FHF03

Economical foil heat flux sensor with thermal spreaders, flexible, 30 x 15 mm, with temperature sensor

FHF03 is a general-purpose heat flux sensor. Looking for a relatively small sensor with the best price-performance ratio, this should be your first choice. FHF03 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. FHF03 is designed for robustness with durable wire connections and cabling. Qualities like these are unmatched at this price level.



Figure 1 FHF03 foil heat flux sensor: small, thin and versatile. It packs a lot of qualities at low cost in its flexible foil body.

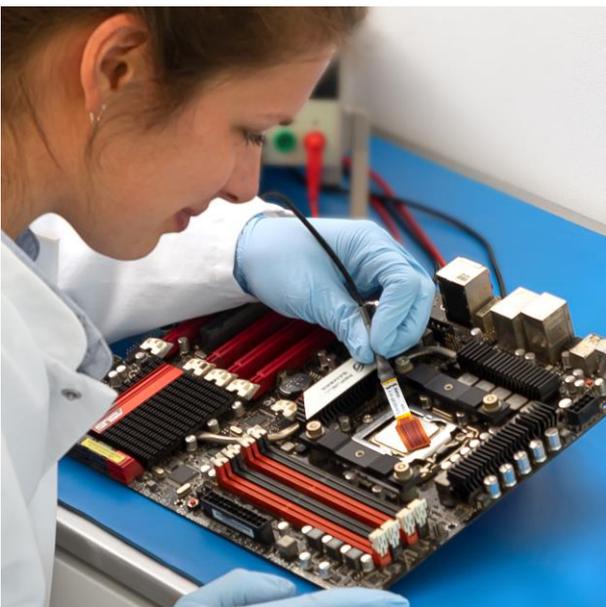


Figure 2 FHF03 measuring heat flux on a PC processor

Unique features and benefits

- flexible (bending radius $\geq 25 \times 10^{-3}$ m)
- low thermal resistance
- wide temperature range
- fast response time
- integrated type T thermocouple
- robust: well-protected wire connections and a sturdy, shielded cable
- IP protection class: IP67 (essential for outdoor application)
- thermal spreader included, low thermal conductivity dependence

Introduction

FHF03 is an economical sensor for general-purpose heat flux measurement. It is small, thin and versatile. FHF03 measures heat flux through the object in which it is incorporated or on which it is mounted, in W/m^2 . The sensor in FHF03 is a thermopile. This thermopile measures the temperature difference across FHF03's flexible body.

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 FHF03 is independent of its environment. Many competing sensors do not have thermal spreaders. Equipped with well-protected wire connections and a sturdy, shielded cable, FHF03 is designed for robustness. Qualities like these are unmatched at this price level.

Using FHF03 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 FHF03 output, a small voltage, by the sensitivity. The sensitivity is provided with FHF03 on its product certificate. For increased sensitivity, robustness and a larger sensing area, consider using model **FHF02** and, in particular for building physics and soil heat flux, model **HFP01**, the world's most popular heat flux sensor.



Figure 3 The flexible FHF03 being installed on a pipe

Calibration

FHF03 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 FHF03 sensitivity to heat flux may be different than stated on its certificate. See the user manual for suggested solutions.

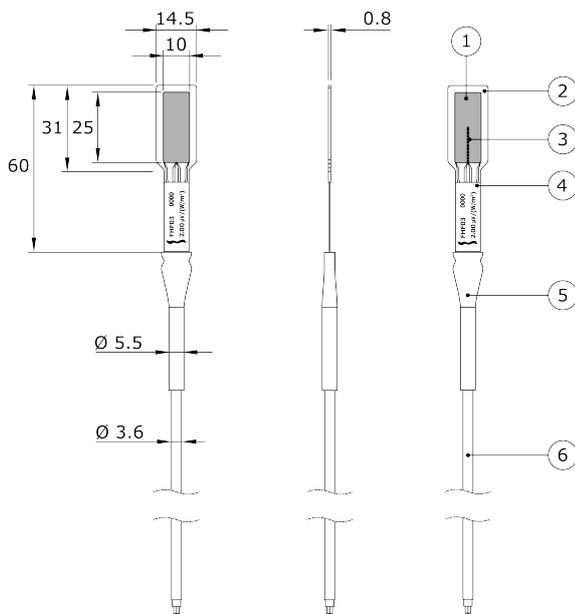


Figure 4 FHF03 heat flux sensor: (1) sensing area with thermal spreader, (2) passive guard, (3) type T thermocouple, (4) sticker showing serial number and sensitivity, (5) strain relief, (6) cable, standard length is 2 m. Dimensions in $\times 10^{-3}$ m.

FHF03 specifications

Measurand	heat flux
Measurand	temperature
Temperature sensor	type T thermocouple included
Thermal spreaders	$\geq 25 \times 10^{-3}$ m (repeated bending not recommended)
Rated bending radius	$\geq 25 \times 10^{-3}$ m
Rated load cable	≤ 10 kg
Outer dimensions foil with guard	$(31 \times 14.5) \times 10^{-3}$ m
Sensing area	2.5×10^{-4} m ²
Sensor thermal resistance	28×10^{-4} K/(W/m ²)
Sensor resistance range	20 to 30 Ω
Sensor thickness	0.8×10^{-3} m
Uncertainty of calibration	$\pm 5\%$ ($k = 2$)
Measurement range	$(-10 \text{ to } +10) \times 10^3$ W/m ²
Sensitivity (nominal)	2×10^{-6} V/(W/m ²)
Operating temperature range	-40 to +150 °C
IP protection class	IP67
Standard cable length	2 m
Options	with 5 m cable

Options

- with 5 metres of cable
- **LI19** hand-held read-out unit / datalogger

See also

- model **FHF02** for increased sensing area and sensitivity
- model **FHF02SC** for a self-calibrating version of FHF02
- model **HFP01** for increased sensitivity (also consider putting two or more FHF02's in series)
- Hukseflux offers a complete **heat flux sensors** with the highest quality for any budget

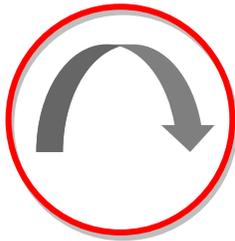
About Hukseflux

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

FHF series outperforms competing models: how?

FHF02 and FHF03 are Hukseflux' standard models for thin and versatile heat flux sensors. With its small footprint, the flexible FHF03 is the most economical one.



Flexible

FHF03 may be bent to a radius of 25 mm. FHF02 may be bent to a radius of 50 mm.

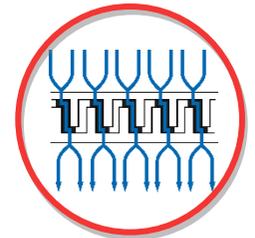
Large-area

Larger is better: FHF02's sensitive area of 30 x 30 mm offers good averaging, leading to increased sensitivity. FHF02 has a thermal guard around the sensitive area. The guard can also be used for mounting the sensor without disturbing the sensitive area.

Sensitive area with thermal spreader reducing thermal conductivity dependence

**Independent of environment:
Thermal spreader included**

Unlike many competing sensors, FHF series sensors have thermal spreaders, i.e. conductive layers covering the sensor. These layers help reduce the thermal conductivity dependence of the measurement. By employing spreaders, the sensitivity of FHF series becomes independent of its environment.



Corrosion-proof plastic cover protecting the thermal spreader

Thermocouple type T included

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

Corrosion-proof plastic cover protecting the thermal spreader

Thermocouple type T included

Durable waterproof wires in a shielded cable, temperature resistant up to 150 °C



Stable: waterproof (IP67), corrosion-proof

FHF series 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.

Best paperwork

Hukseflux has the paperwork covered; all FHF series sensors are provided with formally traceable calibration certificates. We calibrate in accordance with ASTM



FHF02

FHF03