

FHF06 - high temperature foil heat flux sensor - for temperatures up to 250 °C

Patented technology, flexible, with temperature sensor, 25 x 50 mm

*Do you need a thin, flexible and sensitive heat flux sensor that can withstand high temperatures? Hukseflux, the world market leader in heat flux measurement, introduces the FHF06 foil heat flux sensor. Rated temperature range is from -70 to +250 °C. FHF06 measures heat flux from conduction, radiation and convection. In case you do not need the high temperature range, look at our **FHF05 series**. If FHF05 or FHF06 do not comply with your requirements, have a look at other **heat flux sensor** models for special applications.*



Figure 1 FHF06 high temperature foil heat flux sensor being used to monitor the performance of an oven. The sensor is suitable for use under continuous exposure to temperatures up to 250 °C.

FHF06: heat flux measurement in high temperature environments

FHF06 is a high temperature foil heat flux sensor that can be used for temperatures up to 250 °C. This is made possible by its all-polyimide design, not using any glues. Other members of the FHF family, the **FHF05 series** range, can be used up to 120 °C maximum, which makes the FHF06 unique. The sensor is thin, flexible and versatile.

FHF06 measures heat flux through the object in which it is incorporated or on which it is mounted, in W/m^2 .

The sensor in FHF06 is a thermopile. This thermopile measures the temperature difference across FHF06's flexible body. A type T thermocouple is integrated as well, to provide a measurement of temperature. The thermopile and thermocouple are passive sensors; they do not require power.



Figure 2 FHF06 high temperature foil heat flux sensor installed for measurement on a car exhaust pipe. The sensor is mounted on a curved surface.

Multiple small thermal spreaders, which form a conductive layer covering the sensor, help reduce the thermal conductivity dependence of the measurement. With these incorporated spreaders, the sensitivity of FHF06 is independent of its environment.

Using FHF06 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 FHF06 output, a small voltage, by the sensitivity. The sensitivity is provided with FHF06 on its certificate and at the end of FHF06's cable.

Unique features and benefits

- high temperature resistance up to 250 °C continuous use
- flexible (bending radius $\geq 7.5 \times 10^{-3}$ m)
- low thermal resistance
- fast response time
- integrated type T thermocouple
- robustness, including connection block, for strain relief
- IP protection class: IP67 (essential for outdoor application)
- integrated thermal spreaders for low thermal conductivity dependence
- sensor foil only: may be used in vacuum

FHF06 specifications

Measurand	heat flux
Measurand	temperature
Temperature sensor	type T thermocouple, IEC 60584-1:2013 class 2*
Thermal spreaders	included
Rated bending radius	$\geq 7.5 \times 10^{-3}$ m
Rated load on cable	≤ 1.6 kg
Outer dimensions (w x b) foil with guard	$(25 \times 50) \times 10^{-3}$ m
Sensor thermal resistance	12×10^{-4} K/(W/m ²)
Sensor thickness	0.38×10^{-3} m
Uncertainty of calibration	± 5 % (k = 2)
Measurement range	$(-20$ to $+20) \times 10^3$ W/m ²
Sensitivity (nominal)	5×10^{-6} V/(W/m ²)
Asymmetry	< 2 %
Rated operating temperature range	
Continuous use**:	-70 to +250 °C
Cable:	-70 to +250 °C
Connection block:	-70 to +250 °C
Label at the end of the cable	-40 to + 120 °C
IP protection class	IP67***
Rated operating pressure range	up to 25 bar
Standard cable length	2 m
Options	5 or 10 m cable length separate cable without cable****

* temperature measurement uncertainty: ± 2.5 or $0.0075 \times T$ °C. For details, refer to user manual.

** when measuring at temperatures of -160 °C, contact Hukseflux.

*** sensor is not suitable for continuous exposure to water.

**** sensor foil only (without cable and connection block) may be used in vacuum.



Figure 3 FHF06, thin and flexible, can be easily mounted on a curved surface like a pipe or tube.

Robust and stable

Equipped with a connection block, which may serve as strain relief, and with potted protective covers on both sides so that moisture does not penetrate, FHF06 has proven to be very robust and stable.

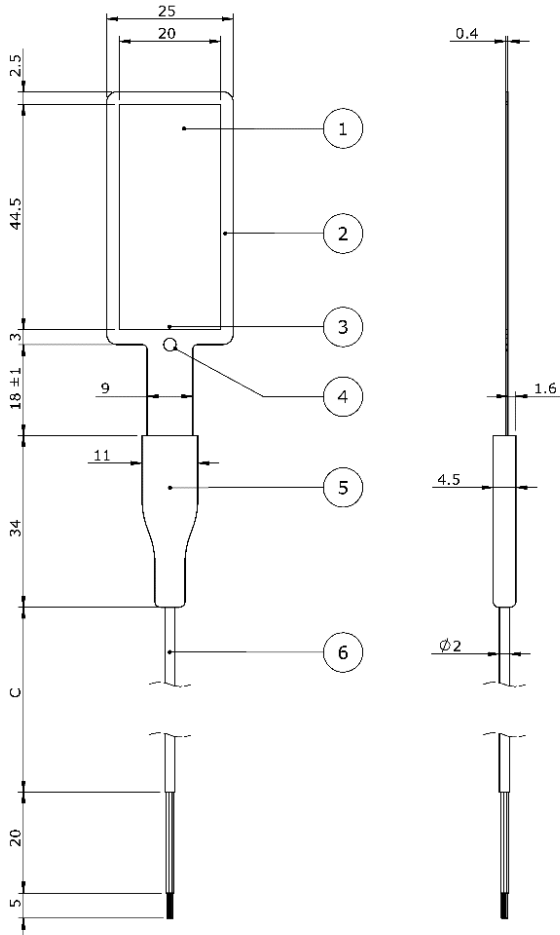


Figure 4 FHF06 high temperature foil heat flux sensor: (1) sensing area with thermal spreaders, (2) passive guard, (3) type T thermocouple, (4) dot indicating front side, (5) connection block for strain relief, (6) cable, standard length is 2 m. C can be 2, 5 or 10 m. All dimensions in $\times 10^{-3}$ m.

Suggested use

Typical applications for FHF06:

- monitoring of plastics and composite moulding
- battery research; thermal runoff
- analysis of industrial ovens

Calibration

FHF06 calibration is traceable to international standards. The factory calibration method follows the recommended practice of ASTM C1130 - 21.

Working with heat flux sensors

When used under high temperature conditions, the FHF06 sensitivity to heat flux may be different than stated on its certificate. See the user manual for correcting this temperature dependence.

For mounting, see our application note [how to install a heat flux sensor](#).

Suitable electronics

The combined measurement of heat flux and temperature offers you a full picture of the thermal behaviour of a system. Heat flux sensor output is a small millivolt signal. Heat flux sensors are often combined with thermocouples. We have several preferred solutions for amplification, data logging and data visualisation. See our application notes on [sensor amplification](#) or [FHF sensors with Hioki dataloggers](#).

Options

- with 5 or 10 metres cable length
 - separate cable in 2, 5 or 10 metres length
 - sensor foil only, without wiring, without connection block
 - LI19 hand-held read-out unit / datalogger
- NOTE: LI19 measures heat flux only*

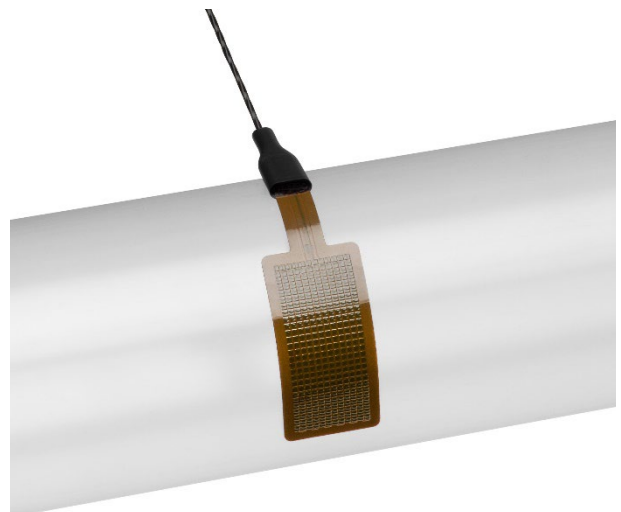


Figure 5 FHF06 high temperature foil heat flux sensor with thermal spreaders: thin, flexible and versatile.

See also

- **FHF05 series**, general purpose heat flux sensor in five sizes with five sensitivities
- **FHF05SC series** for a self-calibrating version of FHF05-50X50 or -85X85
- model **HFP01** for increased sensitivity (also consider putting two or more FHF05's in series)
- **HTR02 series heater**, for calibration and verification of performance of FHF-type sensors

About Hukseflux

Hukseflux is the leading expert in measurement of energy transfer. We design and manufacture sensors and measuring systems that support the energy transition. We are market leaders in solar radiation- and heat flux measurement.

Customers are served through the main office in the Netherlands, and locally owned representations in the USA, Brazil, India, China, Southeast Asia and Japan.

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