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? FHF06 foil heat flux sensor offers all that. 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 the heat flux sensors of 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, sensors of the FHF05 series, can be used up to 120 °C maximum. Like all FHF sensors, FHF06 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 do not require power.

Figure 2 *FHF06 high temperature foil heat flux sensor installed for measurement on a car exhaust pipe. The sensor may be 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.

Unique features and benefits

- high temperature resistance up to 250 °C continuous use
- flexible (bending radius ≥ 7.5 x 10^{-3} m)
- low thermal resistance
- fast response time
- integrated type T thermocouple
- robustness, including cable connection block, for strain relief
- IP protection class: IP67 (essential for outdoor application and in humid environments)
- 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 class 2*
Thermal spreaders	included
Rated bending radius	≥ 7.5 x 10^{-3} m
Rated load on cable	≤ 1.6 kg
Outer dimensions (w x b) foil with guard	(25 x 50) x 10^{-3} m
Sensor thermal resistance	12 x 10^{-4} K/(W/m^2)
Sensor thickness	0.38 x 10^{-3} m
Uncertainty of calibration	± 5 % (k = 2)
Measurement range	(-20 to +20) x 10^3 W/m^2
Sensitivity (nominal)	5 x 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: ± 1 or 0.0075 × T °C. For details, see the user manual.
** when measuring at temperatures of -160 °C, contact Hukseflux.
*** see appendix on long-term use under condensing, wet and underwater conditions
**** sensor foil only (without cable and cable 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 potted cable connection block, that prevents moisture from entering and may also serve as strain relief, FHF06 has proven to be very robust and stable.

Suggested use

Typical applications for FHF06:

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

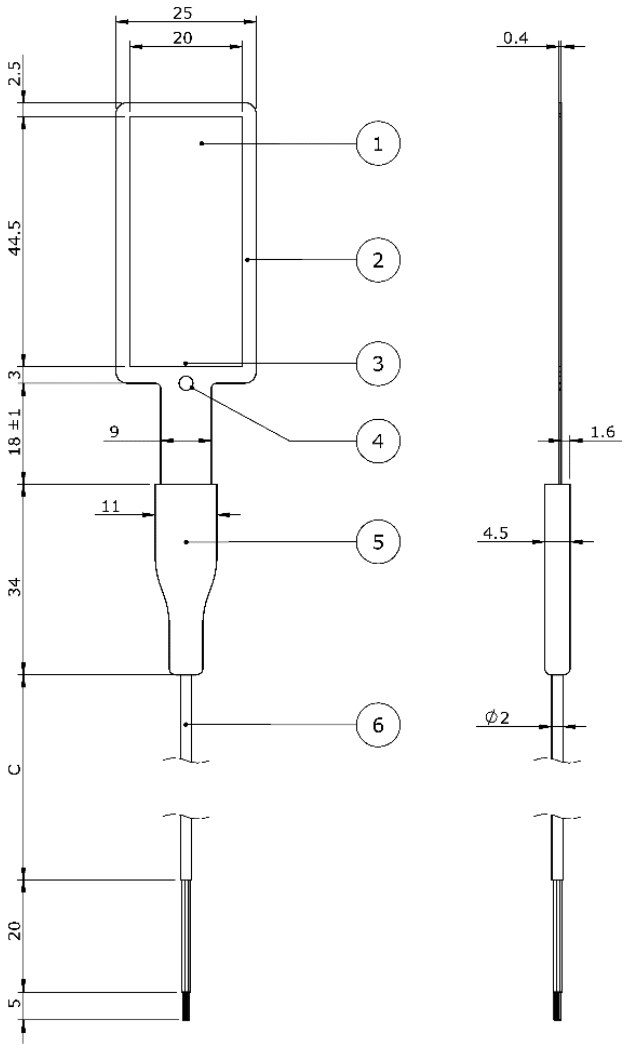

Figure 4 *FHF06 high temperature foil heat flux sensor: (1) sensing area with thermal spreaders, (2) passive guard, (3) type T thermocouple, (4) dot indicating front side, (5) cable connection block for strain relief, (6) cable, standard length is 2 m. Can be 2, 5 or 10 m. All dimensions in x 10^{-3}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

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 data loggers.

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 / data logger
  NOTE: LI19 measures heat flux only

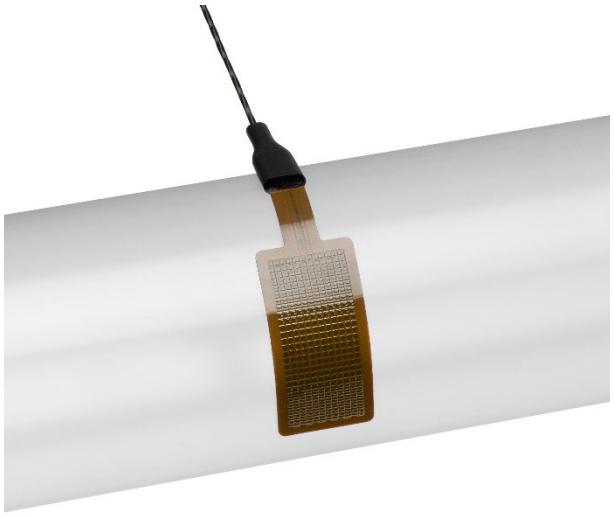

Figure 5 *FHF06 high temperature foil heat flux sensor with thermal spreaders: thin, flexible and versatile.*

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
- 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 our headquarters in the Netherlands, and locally owned representative sales offices in the USA, Brazil, India, China, Southeast Asia and Japan.

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