HukseFluxUSA

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.*

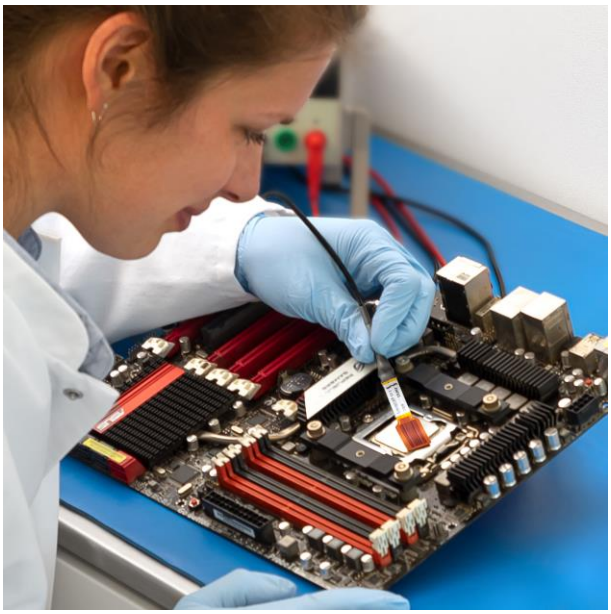


Figure 2 *FHF03 measuring heat flux on a PC processor*

Unique features and benefits

- flexible (bending radius ≥ 25 x 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, flexibility and a larger sensing area, consider using model FHF04 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.

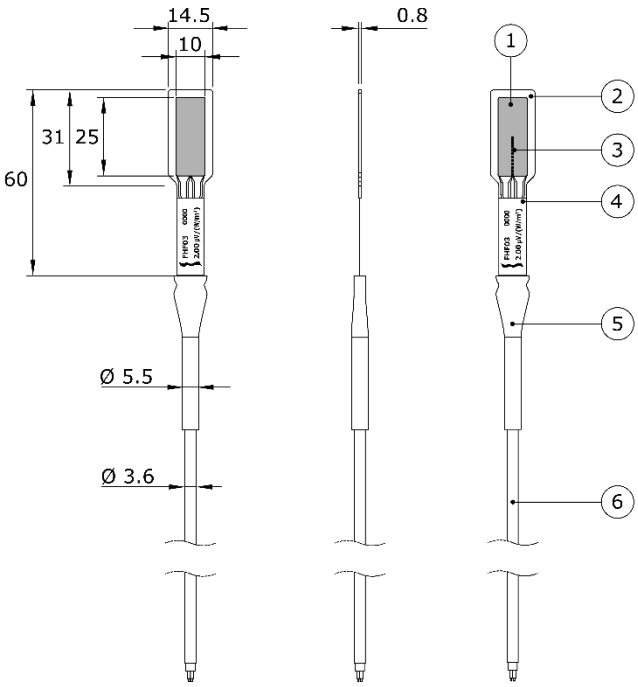


Figure 4 *FHF03 heat flux sensor: (1) sensing area with thermal spreader, (2) passive guard, (3) type T thermocouple, (4) sticker showing serial number and sensitivity, (5) strain relief, (6) cable, standard length is 2 m. Dimensions in x 10^{-3} m.*

FHF03 specifications

Measurand	heat flux
Measurand	temperature
Temperature sensor	type T thermocouple
Thermal spreaders	included
Rated bending radius	≥ 25 x 10^{-3} m (repeated bending not recommended)
Rated load cable	≤ 10 kg
Outer dimensions foil with guard	(31 x 14.5) x 10^{-3} m
Sensing area	2.5 x 10^{-4} m^2
Sensor thermal resistance	28 x 10^{-4} K/(W/m^2)
Sensor resistance range	20 to 30 Ω
Sensor thickness	0.8 x 10^{-3} m
Uncertainty of calibration	± 5 % (k = 2)
Measurement range	(-10 to +10) x 10^3 W/m^2
Sensitivity (nominal)	2 x 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 BLK-3015 black sticker GLD-3015 gold sticker

Options

- with 5 metres of cable
- LI19 hand-held read-out unit / datalogger
- BLK-3015 black sticker (to measure radiative as well as convective heat flux)
- GLD-3015 gold sticker (to measure convective heat flux only)
- BLK - GLD sticker series can also be ordered pre-applied at the factory

GLD and BLK sticker series

Would you like to to study energy transport / heat flux in detail? Hukseflux helps taking your measurement to the next level: order FHF03 with radiation-absorbing black and radiation-reflecting gold stickers. You can then measure convective + radiative flux with one, and convective flux only with the other. Subtract the 2 measurements and you have radiative flux. BLK – GLD stickers can be applied by the user to the sensor. Optionally, they can be ordered pre-applied. See the BLK – GLD sticker series user manual and installation video for instructions.

See also

- BLK – GLD sticker series to separate radiative and convective heat fluxes
- model FHF04 for increased sensing area and sensitivity
- model FHF04SC for a self-calibrating version of FHF04

- model HFP01 for increased sensitivity (also consider putting two or more FHF03s in series)
- Hukseflux offers a complete range of heat flux sensors with the highest quality for any budget

Figure 5 *FHF03 with BLK-3015 and GLD-3015 stickers*

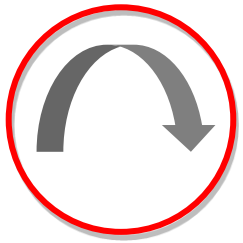
About Hukseflux

Hukseflux products and services are offered worldwide via our office in Delft, the Netherlands and local distributors. 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@huksefluxusa.com

FHF series outperforms competing models: how?

FHF04 and FHF03 are Hukseflux' standard models for thin, flexible and versatile heat flux sensors. With its small footprint, FHF03 is the most economical one.

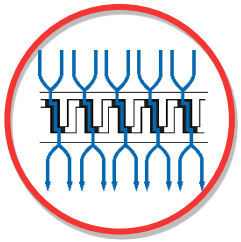


Flexible
FHF04 may be bent to a radius of 7.5 mm.
FHF03 may be bent to a radius of 50 mm.

Large-area
Larger is better: FHF04's sensitive area of 30 x 30 mm offers good averaging, leading to increased sensitivity. FHF04 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 spreaders reducing thermal conductivity dependence

Sensitivity 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.

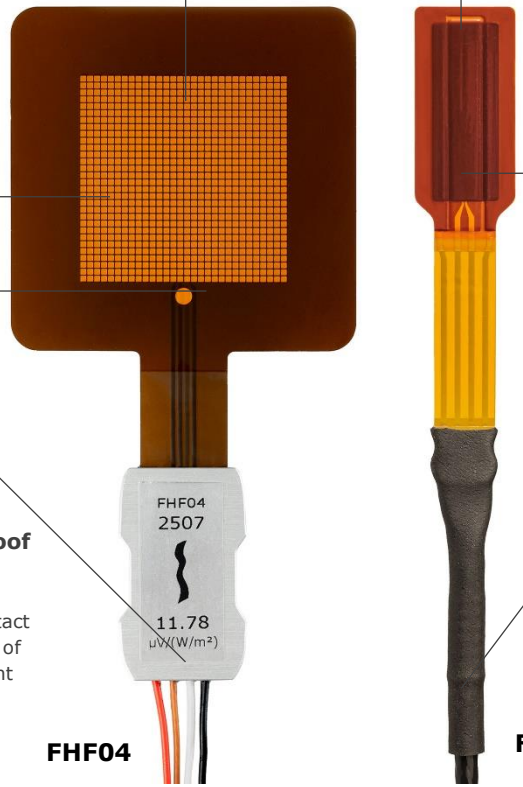


Corrosion-proof plastic cover protecting the thermal spreader

Thermocouple type T included

Durable waterproof wires with metal connection block, may be used as strain relief, temperature resistant up to 150 °C

Stable: waterproof (IP67), corrosion-proof
FHF series sensor connection is potted, 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.



FHF04

FHF03

Thermocouple type T included

Black and gold stickers matching FHF04 and FHF03 to measure radiative and convective heat flux separately

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

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