Hukseflux
Thermal Sensors

Heat flux data logger selection guide
Suitable data loggers and amplifiers to work with Hukseflux heat flux sensors

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. Often heat flux sensors are combined with thermocouples. We have several preferred solutions for amplification, data logging and data visualisation.

This brochure shows a summary only, and does not show all sensor models and options. Also not all relevant electronics specifications are shown. Contact Hukseflux for a final check of your proposed solution.

Figure 1 *FHF04 foil heat flux sensor with thermal spreaders: thin, flexible and versatile.*

Figure 2 *Hioki LR8432: can handle 5 heat flux sensors each with its own temperature measurement and display the measurement results simultaneously on screen.*

Introduction
Hukseflux offers a wide range of sensors for heat flux and temperature measurement. The thermopile heat flux sensor and thermocouple temperature sensor are both passive sensors; they do not require power.

Such sensors can be connected directly to data loggers and amplifiers. The heat flux in W/m^2 is calculated by dividing the heat flux sensor's output, a small voltage, by its sensitivity. The sensitivity is provided with the sensor on its certificate and can be programmed into the data logger.

Optimise system design / reduce cost
The following text helps you to select the right electronics for your application. Selecting the right electronics - sensor combination helps reducing total system costs.

Step 1
Visit the Hukseflux YouTube channel:
- quick intro to heat flux (3 min);
- online course (40 min);
- separating radiation and convection (2 min).

Step 2
Specify your measurement:
- describe the purpose of the experiment;
- estimate the heat flux levels in W/m^2;
- estimate the temperature levels in ˚C;
- select a suitable sensor:
  most common examples are in table 1.

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Step 3

- estimate the output range of the heat flux sensor in [x 10^{-6} V] using table 1:

Microvolt output range = heat flux range in [W/m^2] x sensitivity in [x 10^{-6} V/(W/m^2)].

Step 4

Specify your electronics and sensors:
- look up the brand and model of data logger you have or want to use;
- estimate the number of heat flux - and temperature channels you need.

Step 5

Ask Hukseflux:
- send all information and specifications to Hukseflux, and ask for our input / suggestions.

Figure 3 *Hioki LR8515 can transmit measurements of 1 sensor and 1 thermocouple via Bluetooth.*

Heat flux sensors and the Hioki loggers

Working with sensors and the logger is convenient. See the application notes for the Hioki LR8432 and LR8515. See the user manual for suggested solutions. See also our application note how to install a heat flux sensor.
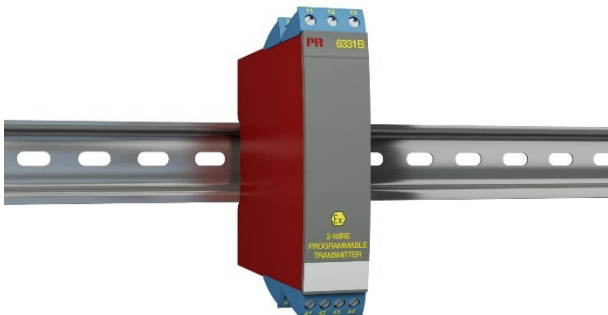
Figure 4 *PR electronics PR6331B programmable transmitter, can be mounted vertically or horizontally on a DIN rail.*

Suggested use

Heat flux + temperature sensors and loggers are used to analyse the causes of temperature change. Also, they are used to validate mathematical CFD simulations.
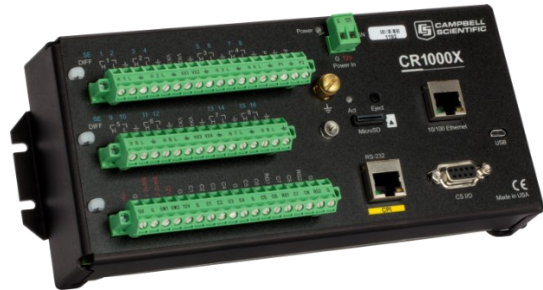
Figure 5 *Campbell CR1000X: 8 differential sensor inputs, heat flux and thermocouples, Micro USB B connection, ethernet, MicroSD data storage expansion.*

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 take measurement to the next level. We are market leaders in solar radiation - and heat flux measurement. Main products are pyranometers and heat flux sensors.

Hukseflux is ISO 9001 certified. Hukseflux products and services are offered worldwide via our office in Delft, the Netherlands and local distributors.

Interested in our products?
E-mail us at: info@hukseflux.com

Figure 6 *dataTaker: up to 15 sensor inputs, heat flux and thermocouples, USB memory for easy data and program transfers.*

Table 1 *examples of different Hukseflux heat flux sensors, their application, sensitivity, temperature sensors and rated operating ranges for temperature and heat flux. This table shows a summary only and does not show all sensor models, options and specifications. Contact Hukseflux for a final check of your proposed solution.*

SENSOR [model]	APPLICATION [description]	RATED T RANGE [°C]	THERMOCOUPLE [type]	SENSITIVITY HEAT FLUX [x 10^{-6} V/(W/m²)]	RATED HF RANGE** [± W/m²]	OPTIONAL RADIATIVE/ CONVECTIVE [y/n]
FHF04	general purpose medium heat flux, flexible	-40 to +150	T	11	10 000	Y (stickers)
FHF03	general purpose high heat flux, flexible	-40 to +150	T	2	10 000	Y (stickers)
IHF01	high temperature / high heat flux, industrial	-30 to 900	K	0.009	1 000 000	Y (coating)
IHF02	high temperature / low heat flux, industrial	-30 to 900	K	0.25	100 000	Y (coating)
HFP01	very low heat fluxes, buildings, soil	-30 to +70	N/A	60	2 000	Y (stickers)
HFP03	extremely low heat fluxes	-30 to +70	N/A	500	2 000	N
SBG01-20	low level fire and flame	water cooled*	N/A	0.30	20 000	N
SBG01-100	fire and flame	water cooled*	N/A	0.15	100 000	N
GG01-250	high intensity flame	water cooled*	K	0.024	250 000	Y (sapphire window)
GG01-1000	concentrated solar, plasma, rockets, hypersonic wind	water cooled*	K	0.008	1 000 000	N

* For water cooled sensor the temperature of surrounding gasses are typically in the range up to 1500 ˚C.
** See the manual for details on the rated heat flux ranges; these may depend on the temperature of the sensor or the heat sink that the sensor is mounted on.

Table 2 *examples of different electronics compatible with Hukseflux heat flux sensors. This brochure shows a summary only and does not show all relevant electronics specifications. Contact Hukseflux for a final check of your proposed solution.*

BRAND	MODEL	OUTPUT	INPUT	PRICE LEVEL	VOLTAGE MEASUREMENT ACCURACY*	COMMENTS
[name]	[model name]	[signal / protocol]	[# of channels, type]	[approximate EUR/unit]	[x 10^{-6} V]	[comments]
Campbell Scientific	CR1000X	Ethernet Modbus stored data via USB	8 (HF + T)	2000	0.2	Optional outdoor and battery powered use. Specs valid from -40 to + 70 ˚C. Channel extension with multiplexer
Keysight	DAQ970A + multiplexer	Digital to PC, USB, LAN or GPIB	14 (HF + T)	2000	0.1	Laboratory use, channel extension with multiplexer
Hioki	LR8515	Bluetooth to PC	2 (1x HF, 1x T)	500	10	2 channel standalone use battery powered
Hioki	LR8432	LCD screen, memory card	10 (HF + T)	1200	0.1	Laboratory use, immediate display
PRElectronics	5331A programmable transmitter	4-20 mA	1 (HF or T)	200	10	Industrial use, also ATEX
PRElectronics	6331B 2 channel programmable transmitter	2 x (4-20 mA)	2 (HF or T)	500	10	Industrial use, also ATEX
dataTaker	DT80	Ethernet Modbus	5 (HF or T)	2000	0.2	Industrial use, channel extension with multiplexer
National Instruments	PXI series 4065, 4070	USB version available	1 (HF or T)	1500	10	Eurocard model, LabVIEW compatible

* For comparing purpose only. Calculation is a rough approximation order of magnitude.

Want to add your data logger / solution to our recommendations?
E-mail us at: info@hukseflux.com