



HUKX

Sensor
Technology

Brochure

Soil temperature profile
sensor with self-test

STP01

STP01

Soil temperature profile sensor

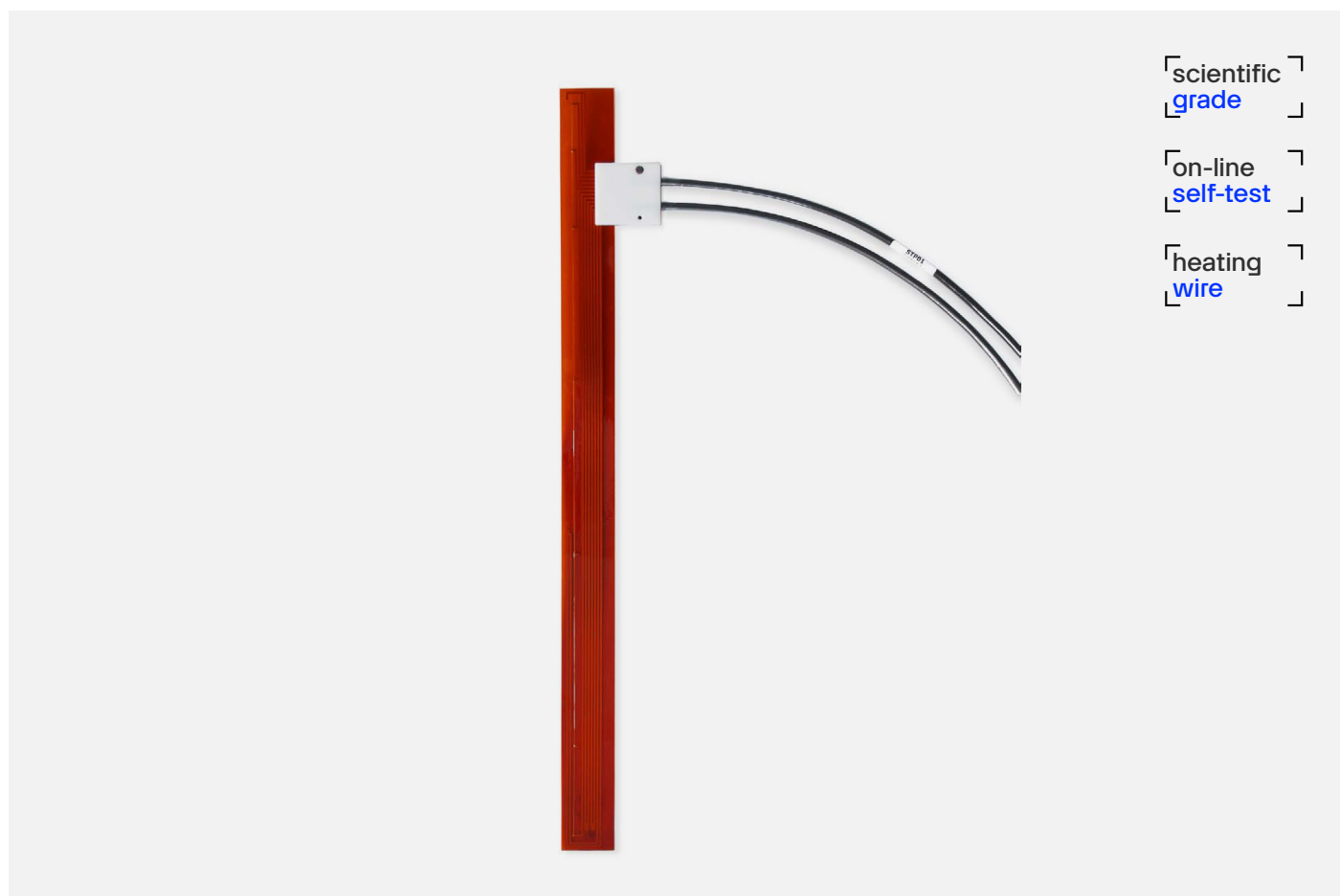
with self-test

STP01 accurately measures the temperature profile of the soil at five depths close to its surface. It is used for scientific-grade surface energy balance measurements. The sensor is buried and usually cannot be taken to the laboratory for calibration. The on-line self-test using the incorporated heating wire offers a solution to verify STP01's measurement stability.

STP01 soil temperature profile sensor offers an accurate temperature difference measurement at five measurement locations at 0.02 , 0.05, 0.1, 0.2, and 0.5 m below the soil surface. It also has a well-specified and fixed distance between the measurement locations. STP01 contains 5 matched thermocouples, at locations A to E in Figure 5, and one reference temperature sensor (Pt100 type) at location E at 0.5 m depth.

By having the reference temperature measurement in the sensor and only measuring differential thermocouple voltages (relative to the reference at 0.5 m), the uncertainty of the temperature difference measurement is very low: ± 0.02 °C is attainable. Simple copper-conductor signal wire is used in STP01's cable.

Figure 1 STP01 soil temperature profile sensor is applied in many large scale networks.



As an extra, a heating wire is incorporated in STP01. Analysis of the temperature change during the heating interval serves as a self-test. Soil temperature sensors are preferably left in the soil for as long as possible, so that the soil properties become representative of natural conditions. Using self-testing, the user no longer needs to take sensors to the laboratory to verify their stable performance. The result is a much improved accuracy & quality assurance of the measurement relative to measurements with conventional sensor types.

Suggested use

- high accuracy, scientific-grade measurement of the soil energy balance, with a high level of data quality assurance

Reference users

The Centre for Ecology and Hydrology (CEH) of the UK included NR01, STP01, and HFP01SC in its new (2014) measurement network.

NOTE: the fact that a sensor is used in a network does not constitute a formal endorsement by the network owner.

STP01 advantages

- high accuracy, scientific measurement of soil energy balance, with a high level of data quality assurance
- high accuracy K/m temperature gradient measurement by accurate positioning of the thermocouple joints (± 0.001 m), and accurate temperature difference measurement (± 0.05 K)
- high accuracy and stability of the relative distance between sensors (± 0.0005 m)
- thin, 0.6×10^{-3} m thickness, construction that leaves the soil structure intact
- simple copper-core signal wire; no special connectors needed
- self-test saves servicing time



Figure 2 STP01 is often used in meteorological surface energy flux measurement stations.

Measurement and control

Requirements for data acquisition and control are:

- for temperature measurement: four millivolt measurements, one Pt100 measurement
- for the optional self-test: one heater voltage measurement
- for the optional self-test: one relay with 12 VDC nominal output, switching the heater current on and off

Self-testing

When activating the heater for a self-test, this will lead to a local increase in temperature at the sensors at 0.02, 0.05, 0.1, and 0.2 m depth. The STP01 stability is monitored by analysis of yearly patterns of this step-response.

Experimental use:

Soil thermal conductivity measurement

The step response of the temperature during the self-test can be used to measure the soil thermal conductivity at 3 depths; 0.05, 0.1, and 0.2 m. For more background on this measurement method, see the manual of model [TP02](#) thermal needle. The possibility to perform this thermal conductivity measurement is an option, with an unspecified measurement accuracy.

Data logger compatibility

Sensors made by Hukx are designed for compatibility with the most commonly used data logger models. For many models we have example programs and wiring diagrams available.

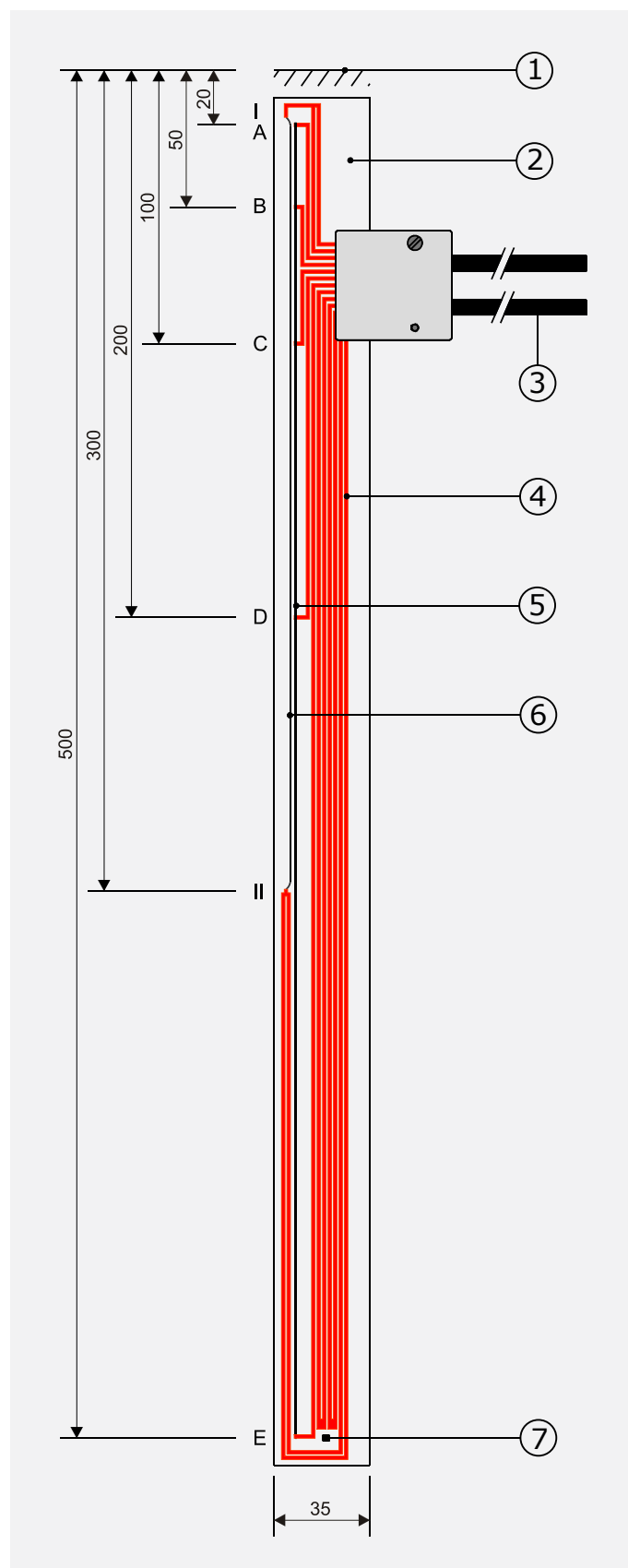


Figure 3 STP01 layout and dimensions:

1. soil surface
 2. sensor foil (0.6×10^{-3} m thickness, 2.5×10^{-3} m at Pt 100)
 3. 2 x cable 5 m (see options)
 4. copper leads
 5. T type thermocouple wire
 6. CuNi heater wire
 7. Pt100 reference temperature sensor (4-wire connection)
- I and II:
- connection points of the heating wire (4-wire connection)
- A, B, C, D and E:
- thermocouple type T joints dimensions in $\times 10^{-3}$ m.

Installation

For ease of installation with a minimum of disturbance of the local soil, Hukx offers IT01 insertion tool.

Options

- longer cable (2 x), in multiples of 5 m, cable lengths above 20 m in multiples of 10 m
- insertion tool IT01

See also

- model [TP01](#) soil thermal properties sensor
- soil heat flux sensors [HFP01](#) and [HFP01SC](#)
- view our complete product range of [surface energy flux measurement](#) products
- view our range of [radiometers](#)



Figure 4 IT01 insertion tool is hammered down into the soil. After retracting it leaves a slit in which STP01 may be inserted.



Figure 5 STP01 is often used in combination with HFP01SC self-calibrating heat flux sensor, shown in the picture.

STP01 specifications

General specifications

measurand	temperature at 5 depths from 0 to 0.5 m
temperature sensors	matched thermocouple type T
uncertainty of temperature difference measurement	1.5 % of measured value plus measurement system uncertainty in $\times 10^{-6}$ V/40
uncertainty of relative position	± 0.001 m
rated operating environment	surrounded by soil
on-line functionality testing	self-test using the incorporated heater
reference temperature sensor	Pt100, IEC 751:1983 class B
sensor foil thickness	0.6×10^{-3} m $2,5 \times 10^{-3}$ m at Pt100

measurement depths	0.02, 0.05, 0.1, 0.2, and 0.5 m
measurement range	-30 to +70 °C
standard cable length (2 cables)	5 m (see options)
IP protection class	IP67
optional non-traceable measurand	thermal conductivity at 3 depths

Heater specifications

heater resistance (nominal)	200 Ω
heater rated power supply	9 to 15 VDC
power consumption daily average	0.005 W
interval between self-test	24 hr
self-test duration	600 s
order code	STP01/cable length in m

About Hukx

Hukx is the leading innovator in solar radiation and heat flux sensor technology. We are proud to set the standard in high-accuracy measurement, and to be working at the heart of the energy transition.

Customers worldwide rely on our bestselling pyranometers and heat flux sensors. From sensor design and selection to supply and recalibration, we support you across the entire lifecycle.

Hukx is headquartered in the Netherlands, with locally owned representative sales offices in the USA, Brazil, India, China, Southeast Asia, and Japan.

Let us help you select the best sensor for your application.
Get in touch with our experts today via: info@hukx.com

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