Hukseflux
Thermal Sensors

# TP01

## THERMAL PROPERTIES SENSOR

*The TP01 is a sensor for the long-term monitoring of soil thermal conductivity, thermal diffusivity and heat capacity.*

TP01 is designed for long term (permanent) installation in soils. It covers the the thermal conductivity (λ) range of 0.3 to 4 W/m.K, which is sufficient for most anorganic soil types. The core of TP01 is a differential temperature sensor (2 thermopiles) (1) measuring the radial differential temperature with record breaking sensitivity. The sensor performs a temperature measurement around a heating wire (2). Both heating wire and sensor are incorporated in a very thin plastic foil. The low thermal mass makes it suitable for estimating thermal diffusivity (a). Dividing λ by the thermal diffusivity, a, gives the volumetric heat capacity $C_v$, which varies with water content. The thermopile signal minus the initial offset ($U - U_0$) when heating with power Q depends on λ and a of the medium.

$$U - U_0 = ( E_\lambda Q / \lambda ) F( a t )$$

$E_\lambda$ is a calibration constant, t is time, F is a function that equals 1 for large at. By looking at the steady state signal amplitude λ can be determined. $C_v$ and a can be found by looking at the 63% response time for F. The detection of changes in $C_v$ (and water content) is the strong point of TP01; the resolution is much better than the accuracy. The product manual can be obtained via e-mail. Programs for use with the Campbell Scientific CR10X and CR1000 are available. Hukseflux has a broad product range of sensors for thermal conductivity measurement; please consult the product catalogue.
See also needle type probes: TP02 and TP08.

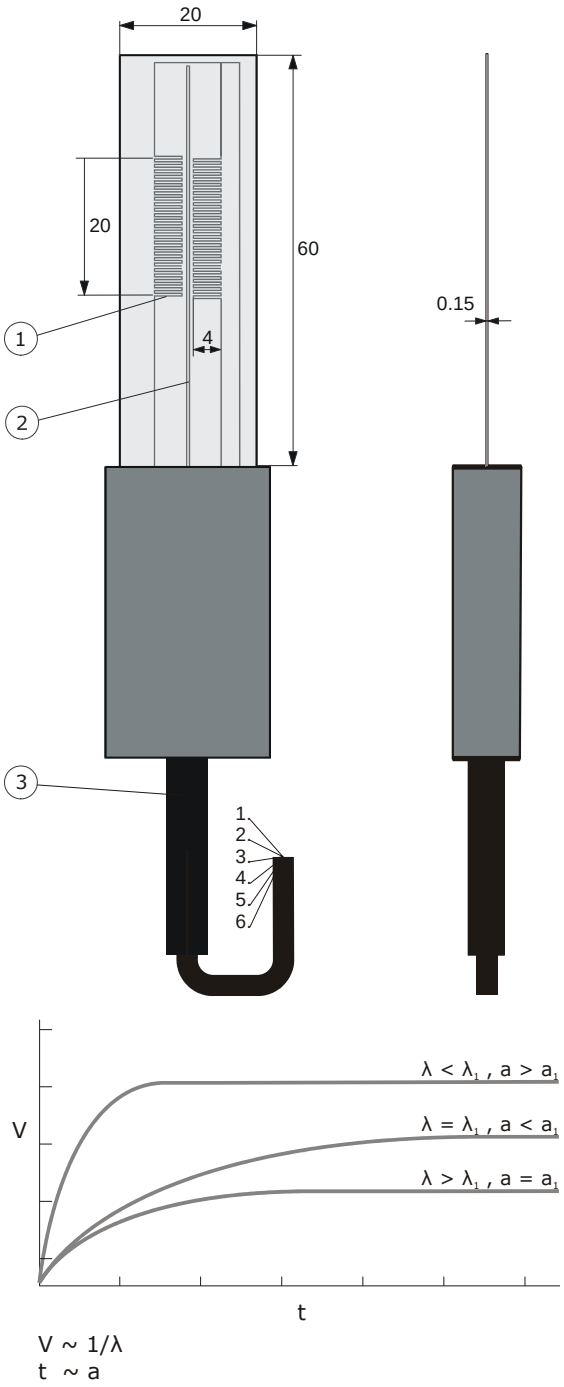


Figure 1 *above: TP01 sensor: thermopiles (1), heating wire (2), cable (3). Dimensions in mm. below: graphs in different soil types: signal amplitude varies with 1/ λ, signal response time varies with a. All dimensions are in mm.*

## SUGGESTED USE

Scientific study of the heat storage as part of the surface energy balance
Redundancy for soil moisture content

## TP01 SPECIFICATIONS

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|---|---|
| Temperature range: | -30 to +80 °C |
| Sensor thickness (nominal): | 0.15 mm |
| Required readout: | 2 diff voltage channels 1 V , 5 mV range |
| Voltage input (nominal): | 1-2 VDC |
| Typical heating cycle duration: | ± 3 min at 0.05 W |
| Range λ: | 0.3 to 4 W/m.K |
| Measurement accuracy λ: | +/- 5% |
| Measurement accuracy a: | +/- 20 % |
| Measurement accuracy $C_v$: | λ / a |
| Measurement resolution $C_v$: | 10% |
| Heating power / m (nominal): | 0.8 W/m |