**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 thermal conductivity (λ) range of 0.3 to 5 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 \( \lambda \) and \( a \) of the medium.

\[
U - U_0 = \left( \frac{E_i Q}{\lambda} \right) F(at)
\]

\( E_i \) is a calibration constant, \( t \) is time, \( F \) is a function that equals 1 for large \( a \). By looking at the steady state signal amplitude \( \lambda \) 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.

**SUGGESTED USE**

Scientific study of the heat storage as part of the surface energy balance

Redundancy for soil moisture content

**TP01 SPECIFICATIONS**

- 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 \( \lambda \): 0.3 to 5 W/m.K
- Measurement accuracy \( \lambda \): +/- 5%
- Measurement accuracy \( a \): +/- 20 %
- Measurement accuracy \( C_v \): \( \lambda / a \)
- Measurement resolution \( C_v \): 10%
- Heating power / m (nominal): 0.8 W/m