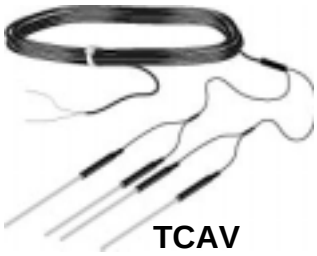
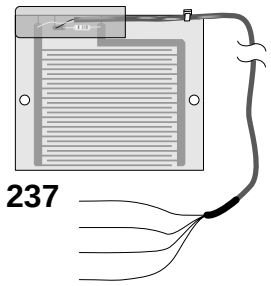
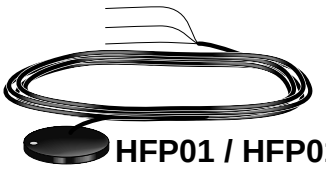
Soil Moisture, Surface Wetness Temperature & Heat Flux Sensors

257/253, 237/237F, HFP01/HFP01SC & IRTS-P







Key Features

- Simple, reliable sensors
- Direct connection to datalogger
- Long cables available to order
- Programming examples provided
- Compatible with multiplexers for large-scale experiments

For measuring soil moisture, heat flux and surface wetness with Campbell Scientific dataloggers

Introduction

This leaflet describes a small selection of the proprietary and third-party sensors offered by Campbell Scientific to enable you to construct customised data acquisition systems.

In conjunction with a Campbell Scientific datalogger, readings from these sensors can be processed on-line to give, for example:

- Soil water potential in bars (257/253)
- Estimated leaf or surface wetness as a percentage (where 100% means the leaf is saturated) (237/237F)
- Soil heat flux in Wm^{-2} (HFP01 and HFP01SC)
- Maximum, minimum, average or standard deviation of any parameter

257 & 253 Soil Moisture Sensors

The 257 and 253 Soil Moisture Sensors are made by Watermark and consist of two concentric electrodes buried in a reference matrix material. The matrix material is surrounded by a synthetic membrane which is intended to protect the matrix material against deterioration. The 257/253 sensors can be left in the soil all year, eliminating the need to remove the sensor during the winter months. An internal gypsum tablet buffers against the salinity levels found in irrigated soils.

Measurement

Calculation of the soil water potential can be done on-line by the datalogger. The calculation needs a soil temperature measurement, which can be done with a sensor such as the Campbell Scientific 107 Temperature Probe.

Compatibility

The 257 is configured for direct connection to the datalogger. The 253 has no blocking capacitors and is for use with the AM16/32 or AM416 multiplexers only.

Please note that a 0.1%, 1kΩ precision resistor (not supplied) is needed for bridge completion with the 253 sensor.

- Measurement range 0 to 2 bar
- Cable length 7.5m standard (long cables may include a splice)
- Size 22mm diameter, 80mm long

NOTE: Please call for information on other methods of Soil Moisture measurement.

Typical Applications

- **Building research**
- **Evapotranspiration estimates**
- **Environmental monitoring**
- **Agricultural trials**

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HFP01 and HFP01SC Heat Flux Plates

These heat flux plates measure heat flows, the most common applications being measurement of heat flux in soils (meteorological energy balance measurements) and in walls (energy balance of buildings). (The HFP01 replaces the HFT-1 and HFT-3.)

The sensor in the HFP01/HFP01SC is a thermopile which measures the differential temperature across the plastic body of thesensor. Assuming that the heat flux is steady, that the thermal conductivity of the body is constant and that the sensor has negligible influence on the thermal flow pattern, the output voltage is directly proportional to the local heat flux.

The HFP01SC includes an on-board heater allowing self-calibration using the 'Van den Bos-Hoeksema' method. Self calibration corrects for errors due to differences in thermal conductivity between the sensor and surrounding medium, temperature variations and slight sensor instability. The calibration process takes approximately eight minutes and is normally performed every two hours.

Expected accuracy:
HFP01: ±20% for daily totals over a thermal conductivity range from 0.1 to 1.7W/mK and temperature range of -30°C to +70°C

HFP01SC: ±3% when self-calibrated
Sensitivity E_{sen} (nominal): 50µV/Wm^{-2}
Resistance (nominal): 2 ohms

Thermal conductivity dependence:
HFP01: ±15% over a thermal conductivity range from 0.1 to 1.7 W/mK

HFP01SC: Eliminated when self-calibrated

Temperature dependence (estimated):
HFP01: < 0.1%/°C
HFP01SC: none when self-calibrated

Stability: < 1% change per year under normal meteorological use
Sensor Thermal conductivity: 0-8W/mK
Sensor Thermal resistance: 6.25x10^{-3}k/W

HFP01SC Heater:
Resistance 90-110 ohms
Input Voltage: 9-15V DC
The datalogger requires a spare switched 12V output or an optional PSW12 switch to control the heater.

Physical:
Diameter 80mm; Thickness 5mm; Standard cable length 5m

IRTS-P Precision Infra-red Thermocouple Sensor

IRTS-P is used for making continuous measurements in field conditions. It is optimised for measuring vegetation, soil or water temperatures. This unique, self-powered sensor measures emitted radiation and outputs the surface temperature as a type-K thermocouple signal. An aluminium body stabilises the reference temperature, and sensor body temperature is output as a second thermocouple signal. Each sensor is supplied with a 12-instruction datalogger program that adjusts for the effect of sensor body temperature on the target temperature.

The IRTS-P is supplied with 4.5m of cable. The sensor body has a threaded hole fitted with a grubscrew. Removal of the screw enables the sensor to be mounted directly to a standard camera tripod. It can also be attached to a Campbell Scientific tripod using a CSD1 mounting arm.

Power: self-powered

Expected accuracy:
±0.2°C from 15° to 35°C
±0.3°C from 5° to 45°C
±0.1°C when sensor body & target are at the same temperature

Repeatability: 0.05°C from 15° to 35°C

Response Time: <1s to changes in target temperature

Target/Body Temp. Output Signal:
Type-K thermoscouple

Optics: Silicon lens

Wavelength Range:6 to 14µm

Field of View: 3:1(i.e. at 3m from the sensor the field-of-view is a 1m diameter circle as calculated from the geometry of the sensor and lens. Under typical conditions 80 to 90% of the IR signal is from the field of view and 10 to 20% is from the surrounding area.)

Weight: 100g

Dimensions: 23mm diameter x 60mm

TCAV Thermocouple Probe

The TCAV is a Type E thermocouple (chromel-constantan) probe which is typically used in conjunction with heat flux plates. It averages four soil temperature measurements within a small vertical or horizontal area.

It is supplied in a 2 x 2 thermocouple configuration (a total of 4 junctions), where the junctions are wired in parallel. Standard cable length is 6m.

237 /237F Wetness Grids

Description
The 237 Wetness Sensing Grid is an artificial leaf type and can be used with all current dataloggers.

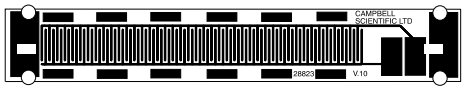
The sensor consists of a circuit board with interlacing gold-plated copper fingers. Condensation on the sensor lowers the resistance between the fingers, and this change is measured by the datalogger. AC excitation is used to prevent degradation of the sensor.

Coating
Droplets small enough not to touch two fingers simultaneously do not change the sensor resistance. For this reason, some users apply a coating of paint to spread the droplets. For more information, please refer to the scientific literature.

- Resistance varies from above 3000kΩ (dry) to about 1kΩ (wet). Transition point of uncoated sensor normally between 50 and 200kΩ.
- Cable length 6m standard
- Size 63mm wide (68mm including cable), 76mm long

237F Flexible Wetness Grid
Based on a design produced by Silsoe Research Institute (Bedford, UK) under sponsorship from the Horticultural Development Council, the 237F is a flexible version of the 237 and is suitable for attaching to uneven and cylindrical surfaces such as plant stems. It is supplied as a bare sensor plus separate bridge resistors, but without cable. It measures 14mm x 90mm.

For more information on configuration and installation please call.



237F Flexible Wetness Grid

These sensors can form part of a comprehensive environmental data acquisition system. Please call for more details.

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Campbell Scientific products are available from: