Middleton Solar

CN3 HEAT FLUX PLATE

CE 1998

Application Note

General.

Heat transfer occurs by *conduction*, convection, or radiation.
The CN3 Heat Flux Plate is designed to directly measure the *conductive* heat transmission in the medium in which the sensor is embedded. It is small and thin to offer minimal disturbance to the heat flow pattern.

where used	**application**
agricultural research	energy balance; moisture transport & evaporation
building components	heat loss through walls
roads & bridges	heat flux for snow melting; thermal expansion heat flow

Operation.

A temperature difference between the top and bottom faces of the CN3 generates a DC voltage from the sensor thermopile.
The temperature difference is proportional to the heat flow in the medium, and the polarity of the output voltage changes in accordance with the direction of the heat flow.

1) Connect the Plate to any commercially available *potentiometric* recorder with a range of ±10mV (eg: multimeter or chart recorder). Avoid galvanometric recorders (eg: moving coil meter) as they draw a current from the Sensor and thus modify the calibrated sensitivity.

The *heat flux (q/A)* is obtained by dividing the measured *voltage (e)* by the sensor *sensitivity (s)*:

$$q/A = e/s$$

where, q/A is in $W.m^{-2}$
e is in μV
s is in $\mu V/W.m^{-2}$

2) Warm one face of the sensor and determine the output voltage polarity in relation to the direction of heat flow.

3) Bury the sensor perpendicular to the thermal flux. Ensure the medium is not locally compacted around the sensor, and that no air pockets are trapped against it.

In soil the Plate should be placed 50 to 100mm below the surface so that it does not interrupt the local moisture flow.

4) If the medium is very conductive compared to the Plate then the factory calibrated sensitivity will need to be corrected:

thermal conductivity of medium	uncorrected error
0.2W/m.°C (dry, aerated soil)	+13%
0.4W/m.°C (same as Sensor)	0%
2.0W/m.°C (wet, compact sand)	-49%

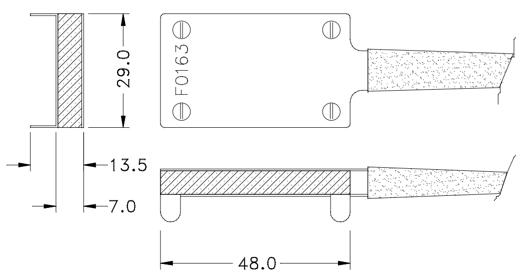
In such cases the following equation should be applied to obtain the correct heat flux through the medium:

$$(q/A)_{medium} = (q/A)_{sensor} \times (0.76 + 0.58k)$$

where, k is the thermal conductivity of the medium in W/m.°C

specifications

sensitivity	21 $\mu V/W.m^{-2}$ (typical) in fine dry sand
impedance	23 Ω (typical)
temperature range	-20° to +70°C
thermal conductivity	0.4W/m.°C
temperature error	0.2%/°C
response time	30sec. to 95% (in air)
insulation resistance	exceeds 0.5 MΩ
construction	stainless steel plates, phenolic core
sensor thermopile	copper-constantan (250 junctions)
weight	43 gm (excluding cable)
cable	2 core, 2m long



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