

Product certificate

Pages: 3
Release date: 15-06-2018

Product code **IR20-T2**
Product identification **serial number 4047**
Product type pyrgeometer
Measurand longwave radiation

Calibration result

Sensitivity **$S_0 = 8.99 \times 10^{-6} \text{ V}/(\text{W}/\text{m}^2)$**
Calibration uncertainty **$\pm 0.40 \times 10^{-6} \text{ V}/(\text{W}/\text{m}^2)$**

the number following the \pm symbol is the expanded uncertainty with a coverage factor $k = 2$, and defines an interval estimated to have a level of confidence of 95 percent

Temperature coefficients
 $a = -16.96 \times 10^{-6} \text{ }^\circ\text{C}^{-2}$
 $b = 2.30 \times 10^{-3} \text{ }^\circ\text{C}^{-1}$
 $c = 0.9608$

Measurement function $E = U/(S_0 \cdot (a \cdot T^2 + b \cdot T + c)) + \sigma \cdot (T + 273.15)^4$
with E irradiance in $[\text{W}/\text{m}^2]$, U voltage output in [V], σ the Stefan-Boltzmann constant in $[\text{W}/\text{m}^2/\text{K}^4]$, T the instrument body temperature in $[\text{ }^\circ\text{C}]$

Product specifications

1: resistance **10.6 Ω**
2: insulation resistance **> 100 x 10⁶ Ω**
3: cut-on wavelength (5 % transmission point)* **4.3 x 10⁻⁶ m**
4: spectral range (50 % transmission points)* **4.5 to 40.0 x 10⁻⁶ m**

*values valid for this instrument, complete transmission curve available on request via info@hukseflux.com

Table 0.1 connections

| PIN | WIRE | |
|-----|--------|------------------------------|
| 2 | Red | 10 k Ω thermistor [+] |
| 3 | Pink | 10 k Ω thermistor [+] |
| 6 | Blue | 10 k Ω thermistor [-] |
| 8 | Grey | 10 k Ω thermistor [-] |
| 1 | Brown | heater |
| 4 | Yellow | heater |
| 9 | Black | ground |
| 7 | White | signal [+] |
| 5 | Green | signal [-] |

The 10 k Ω thermistor is a single four-wire thermistor measuring instrument body temperature.

Calibration procedure according to Hukseflux IR20C. Traceability of calibration is to the WISG (World Infrared Standard Group) operated at the Infrared Radiometry Section of the World Radiation Center in Davos, Switzerland.

Please consult the user manual for information on measurement uncertainty during actual use and for product set up, operation and maintenance instructions.

Person authorising acceptance and release of product:

M. Rietveld

Date:

15-06-2018

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Reference conditions horizontal mounting, downward longwave irradiance, clear sky nights, 20 °C

Measurement process

Metrological characteristic S_0 in $[\text{V}/(\text{W}/\text{m}^2)]$; sensitivity to downward longwave irradiance, with 180° field of view angle, valid for reference conditions

Calibration method outdoor comparison to a reference pyrgeometer

Measurement function $E = U/(S_0 \cdot (a \cdot T^2 + b \cdot T + c)) + \sigma \cdot (T + 273.15)^4$
 with E irradiance in $[\text{W}/\text{m}^2]$, U voltage output in [V], σ the Stefan-Boltzmann constant in $[\text{W}/\text{m}^2/\text{K}^4]$, T the instrument body temperature in [°C] and a, b, c temperature coefficients¹

Uncertainty of the method based on experience the expanded uncertainty is $\pm 1.5\%$

Measurement equipment Hukseflux Outdoor Test Facility

Calibration conditions 2 clear sky night(s) between 06/06/2018 and 12-06-2018.
 Temperature between 11.5 °C and 15.8 °C.
 Net radiation between -76.4 W/m^2 and -70.0 W/m^2

Metrological traceability

Calibration traceability to WISG (World Infrared Standard Group)

Working standard pyrgeometer IR20, serial number 102

Standard sensitivity $S = 17.66 \times 10^{-6} \text{ V}/(\text{W}/\text{m}^2)$

Calibration institute Physikalisch-Meteorologisch Observatorium Davos, World Radiation Center (PMOD/WRC)

Uncertainty of standard $\pm 3.4\%$ expanded uncertainty with a coverage factor $k = 2$, with respect to SI units

Evaluation of the uncertainty of the calibration result

Uncertainty calculation the uncertainty is calculated as the square root of the sum of the squares of the reported uncertainties
 $\sqrt{(1.5)^2 + (3.4)^2} = 4.5\%$

Person performing calibration:

T. Meskers

Date:

12-06-2018

¹ a, b and c are determined in the Hukseflux Temperature Response Characterisation, see separate page

Temperature dependence

Pages: 3
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Product code **IR20-T2**
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 Product type pyrogeometer
 Measurand longwave radiation

Characterisation result

Temperature coefficients
a = -16.96 x 10⁻⁶ °C⁻²
b = 2.30 x 10⁻³ °C⁻¹
c = 0.9608

Measurement process

Characterised parameter dependence of sensitivity to temperature
 Measurement function $S(T) = S_0 \cdot (a \cdot T^2 + b \cdot T + c)$
 with S(T) sensitivity in [V/(W/m²)] at an instrument body temperature T, S₀ sensitivity in [V/(W/m²)] at 20 °C instrument body temperature, T the instrument body temperature in [°C]
 Measurement equipment Hukseflux Temperature Response Characterisation

Table 0.2 temperature dependence test result

| TEMPERATURE DEPENDENCE TEST | | | | | | | | | |
|---|--------|-------|-------|-------|-------|----|-------|-------|-------|
| T [°C] | -30 | -20 | -10 | 0 | 10 | 20 | 30 | 40 | 50 |
| (S(T) - S ₀)/S ₀ | -12.3% | -9.2% | -6.4% | -3.9% | -1.8% | 0 | +1.5% | +2.6% | +3.3% |

Person performing characterisation:

L. Asaa

Date:

01-06-2018