Hukseflux Thermal Sensors B.V.
www.hukseflux.com
info@hukseflux.com

Product certificate

Pages: 3
Release date: 15-06-2018

Product code	**IR20-T2**
Product identification	**serial number 4048**
Product type	pyrgeometer
Measurand	longwave radiation

Calibration result

Sensitivity	**S_0 = 9.52 x 10^{-6} V/(W/m^2)**
Calibration uncertainty	**± 0.43 x 10^{-6} V/(W/m^2)**
	the number following the ± 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 = -15.75 x 10^{-6} °C^{-2}** **b = 2.53 x 10^{-3} °C^{-1}** **c = 0.9556**
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 [W/m^2], U voltage output in [V], σ the Stefan-Boltzmann constant in [W/m^2/K^4], T the instrument body temperature in [°C]

Product specifications

1:	resistance	**10.2 Ω**
2:	insulation resistance	**> 100 x 10^6 Ω**
3:	cut-on wavelength (5 % transmission point)*	**4.4 x 10^{-6} m**
4:	spectral range (50 % transmission points)*	**4.7 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 kΩ thermistor [+]
3	Pink	10 kΩ thermistor [+]
6	Blue	10 kΩ thermistor [−]
8	Grey	10 kΩ thermistor [−]
1	Brown	heater
4	Yellow	heater
9	Black	ground
7	White	signal [+]
5	Green	signal [−]

The 10 kΩ 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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Calibration result

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Calibration uncertainty	**± 0.43 x 10^{-6} V/(W/m^2)**
	the number following the ± 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
Reference conditions	horizontal mounting, downward longwave irradiance, clear sky nights, 20 °C

Measurement process

Metrological characteristic	S_0 in [V/(W/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 [W/m^2], U voltage output in [V], σ the Stefan-Boltzmann constant in [W/m^2/K^4], T the instrument body temperature in [°C] and a, b, c temperature coefficients[1]
Uncertainty of the method	based on experience the expanded uncertainty is ± 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 15.9 °C. Net radiation between -76.4 W/m² and -70.0 W/m²

Metrological traceability

Calibration traceability	to WISG (World Infrared Standard Group)
Working standard	pyrgeometer IR20, serial number 102
Standard sensitivity	S = 17.66 x 10^{-6} V/(W/m^2)
Calibration institute	Physikalisch-Meteorologisch Observatorium Davos, World Radiation Center (PMOD/WRC)
Uncertainty of standard	± 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

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Temperature dependence

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Product identification	**serial number 4048**
Product type	pyrgeometer
Measurand	longwave radiation

Characterisation result

Temperature coefficients	**$a = -15.75 \times 10^{-6}\ °C^{-2}$** **$b = 2.53 \times 10^{-3}\ °C^{-1}$** **$c = 0.9556$**

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, S_0 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
$(S(T) - S_0)/S_0$	-13.4%	-10.1%	-7.1%	-4.4%	-2.1%	0	+1.8%	+3.2%	+4.3%

Person performing characterisation:
L. Asaa

Date:
01-06-2018