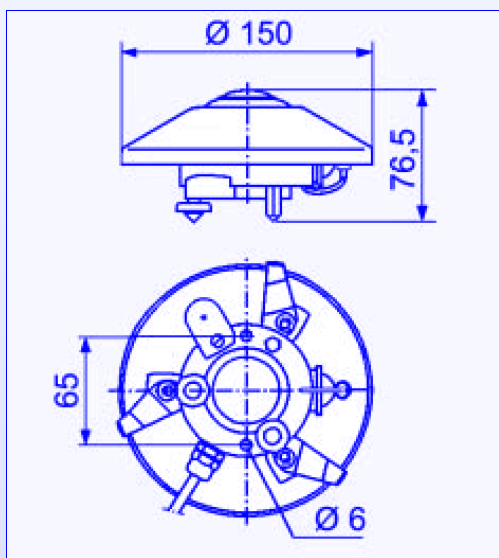


# CG 4 Pyrgeometer



## THE UNIQUE PYRGEOMETER CONCEPT

The CG 4 is designed for meteorological observations of far-infrared radiation. Based on the well-known quality of our suppliers radiometers the CG 4 allows permanent outdoor observations combining outstanding accuracy with measurement ease.



The development of a new dome was highly successful and now allows observations of far-infrared irradiance with a measurement accuracy and ease that was previously unavailable. The excellent thermal stability of the dome construction eliminates the need for dome temperature measurements.

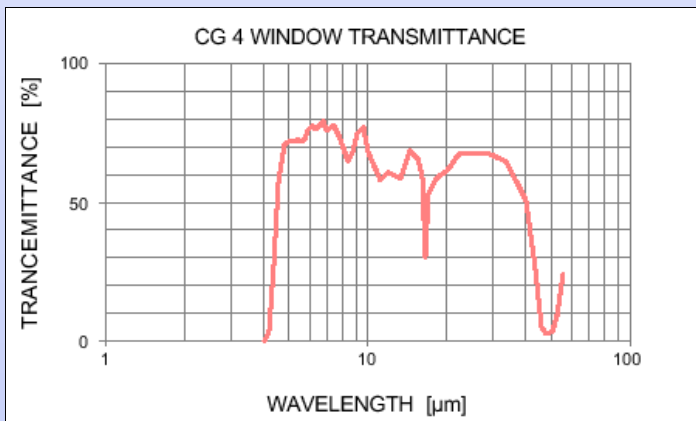
Only the internal temperature, measured with a thermistor (YSI 44031), is required to calculate the downward far-infrared irradiance.



On the inside of the silicone dome a solar blind filter blocks all solar radiation. The spectral transmission curve of the dome is shown in the figure below. A coating on the outer side protects the dome from Environmental influences. Although the dome is not hemispherical it has a 180 ° field of view with a negligible directional response error.

### Specifications

Sensitivity (nominal)	10 $\mu\text{V}/\text{W}/\text{m}^2$
Spectral range	4.5 – 42 $\mu\text{m}$
Window heating offset	<4 $\text{W}/\text{m}^2$ at 1000 $\text{W}/\text{m}^2$ solar irradiance
Operating temperature	-40 °C to +80 °C
Response time (63%)	less than 8 sec
Thermopile output range	-250 to +250 $\text{W}/\text{m}^2$
Temperature dependence	less than $\pm 1\%$ (-20 °C to +50 °C)
Zero offset due to temp. changes	less than $\pm 2 \text{ W}/\text{m}^2$ (5 K/h)
Field of view	180 °



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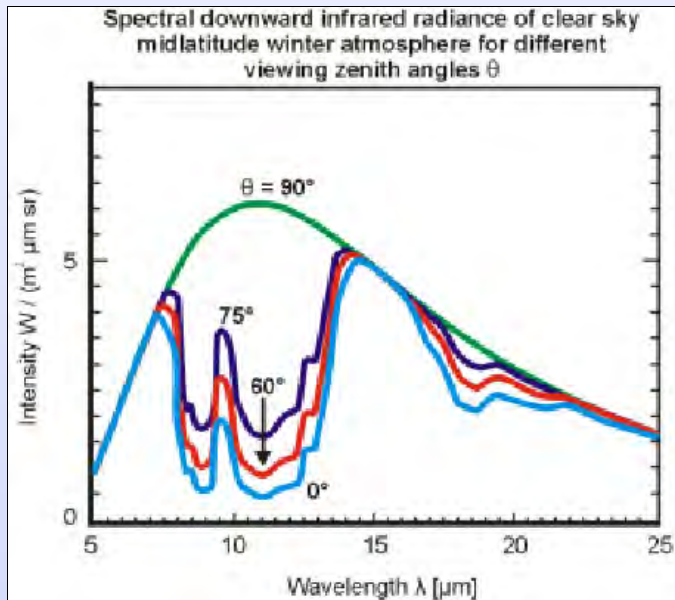
## Directional Response Error

Ground-based observations with the **CG 4** benefit from the directional distribution of far-infrared radiation emitted from the Earth's atmosphere. In the graph below, the intensity of the downward far-infrared radiation as function of wavelength  $\lambda$  is shown for various (viewing) zenith angles "At zenith angle  $\theta = 90^\circ$  the atmospheric window is 'closed' and consequently the atmospheric thermal radiation is equal to the Planck's curve at a temperature  $T_{90}^\circ$ . The Earth's surface temperature is generally close to  $T_{90}^\circ$ . The observations benefit from the small infrared radiation exchange between the **CG 4** and the atmosphere in horizontal directions because the internal temperature is also nearly the same as  $T_{90}^\circ$  (the

internal temperature and Earth's surface temperature are assumed equal). Consequently the influence of the directional response error near horizontal viewing angles on the measurements is small. However, the largest radiation exchanges occur in the vertical direction, where the directional response of the **CG 4** is highly 'lambertian' (nearly perfect).

## Calculation of the Downward Far-infrared Irradiance

*Infrared radiation observations are always influenced by the emission of thermal radiation originating from the instrument itself. In the **CG 4** only the internal temperature is required to account for the radiative heat exchange of the radiation-sensitive surface. The formula below shows how the downward far-infrared irradiance with a wavelength larger than  $4.5 \mu\text{m}$  is obtained with the **CG 4**.*



$$L_d = \frac{U_{emf}}{S} + \sigma \times T_b^4$$

$L_d$	= downward radiation	[W/m <sup>2</sup> ]
$U_{emf}$	= sensor output voltage	[ $\mu$ V]
$S$	= calibration factor	[ $\mu$ V/W/m <sup>2</sup> ]
$T_b$	= body temperature	[K]
$\sigma$	= $5.67 \times 10^{-8}$	[W/m <sup>2</sup> /K <sup>4</sup> ]

(Stefan-Boltzmann Constant)



Ventilated CG 4



Net Radiometer combination



Ventilated Net Radiometer