MIDDLETON SOLAR

CE 2022

NSK4 NET RADIOMETER

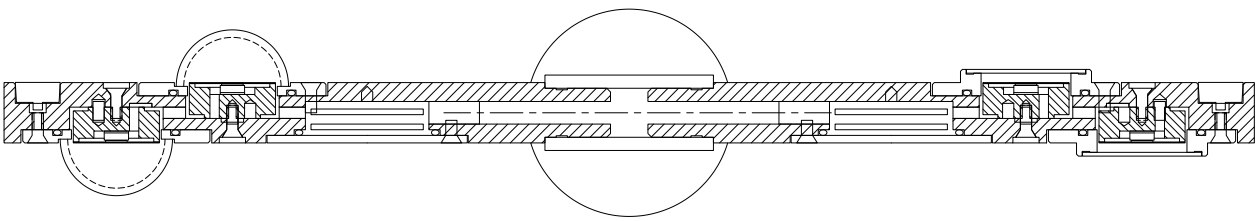
APPLICATION NOTE – QUAD OUTPUT

The Middleton Solar **NSK4 is a 4-component Net Radiometer** to measure solar & thermal radiation downward and upward, through a horizontal plane. It has four thermoelectric sensors, two are shielded by glass domes and two by silicon windows. The glass domes are transparent to shortwave (SW) solar radiation and the silicon windows are transparent to longwave (LW) radiation emitted by the atmosphere or the Earth surface.

Installation. Select a site that has an unobstructed view of the sky and the ground. Secure the output end of the handle and adjust so the instrument is horizontal, approximately 1-2m above the ground, with the bubble level facing upwards. The available *3-Axis Clamp* can facilitate mounting to a flat plate.

Connect the NSK4 output lead to a data acquisition system; use differential inputs.
Use a 3-wire connection for the body temperature sensor.

output lead cores	LW top sensor, signal +ve	red
	LW top sensor, signal –ve	blue
	LW bottom sensor, signal +ve	yellow
	LW bottom sensor, signal –ve	green
	SW top sensor, signal +ve	white
	SW top sensor, signal –ve	black
	SW bottom sensor, signal +ve	grey
	SW bottom sensor, signal –ve	brown
	body temperature; Pt100, 3-wire	
	+ve	pink
	-ve	violet, orange



Each output signal is a passive analogue voltage representing the downward hemispherical irradiance (top sensors) and upward hemispherical irradiance (bottom sensors). The net irradiance can be calculated as the sum of the SW+LW difference between the top and bottom signals (the body temperature signal can be disregarded). Water on the silicon windows (rain or dew) is a strong absorber of near IR radiation and can cause temporary errors to the LW radiation measurement.

Maintenance. Keep the domes and windows of the NSK4 clean and free from debris; use water and mild detergent only.

Shortwave irradiance, $E_s = U_s / C_s$, in $W.m^{-2}$.
Where U_s is the top or bottom SW output in μV; C_s is the SW sensitivity in $\mu V/W.m^{-2}$

Longwave irradiance, $E_l = U_l / C_l + \sigma T_B^4$, in $W.m^{-2}$.
Where U_l is the top or bottom LW output in μV, and is typically negative;
C_l is the LW sensitivity in $\mu V/W.m^{-2}$; T_B is body temperature in Kelvin;
$\sigma = 5.6704 \cdot 10^{-8}$ is the Stephan-Boltzmann constant.

Net irradiance, E_{net} = (E_s down - E_s up) + (E_l down - E_l up)
Note: for E_{net} the σT_B^4 temperature component cancels out, and net E_l is typically negative.

Technical Specification

sensitivity	4-11 $\mu V/W.m^{-2}$ x 4 outputs
calibration traceability	LW: WISG (World Infrared Standard Group) SW: WRR (World Radiometric Reference)
spectral range	LW: 4.5 to 42μm SW: 0.3 to 3μm
field of view	LW: 2 x 170° SW: 2 x 180°
response time (95%)	7s (typical)
irradiance	LW: ±1,000 $W.m^{-2}$ SW: ±2,000 $W.m^{-2}$
impedance	20 Ω x 4 outputs
operating temperature	-40 to +60°C
non-stability (1 year interval)	< ±1%
non-linearity	< ±1%
temperature dependence of sensitivity	< ±2% (-10 to +40°C)
window heating offset (LW signals)	< 10 $W.m^{-2}$, shaded
directional response (w.r.t 1,000 $W.m^{-2}$)	LW: not relevant to isotropic IR SW: < 20 $W.m^{-2}$ (0-80°)
level accuracy	0.4°
desiccant (in endcap)	orange silica gel (non-toxic)
sensors	thermopile x 4
window/dome	LW: solar-blind silicon SW: glass dome
temperature sensor (body)	Pt100 platinum resistor; DIN IEC 751, Class A
output lead	6m, with connector at instrument end
construction	anodized aluminium; stainless steel
IP rating	sealed to IP66
dimensions & weight	head 66x45x330mm; handle Ø16x640; 1.5kg
shipping size & weight	90 x 40 x 9cm; 5kg

Available Options

- 3-Axis Clamp (for mounting to a flat plate), P/N 123.9100