# MIDDLETON SOLAR
# PG01-E PYRGEOMETER
# APPLICATION NOTE

CE 2017

The Middleton Solar PG01-E Pyrgeometer is for measuring long wave radiation emitted by the atmosphere (downwelling) or the Earth surface (upwelling). It uses a passive thermoelectric sensor shielded by a flat silicon window. The window is coated to exclude radiation below 4.5 μm. The PG01-E has in-built signal amplifier. It is sealed and fully weatherproof.

**Installation**. Select a site that has an unobstructed view of the sky. Place the instrument on a flat horizontal platform and adjust the feet until the circular level is centered. Secure the instrument to the platform with the M10 mount knob provided. It is recommended that the sensor be shaded to minimize any window heating offset. Water on the window (rain or dew) is a strong absorber of near IR radiation; the available *EV2-H Ventilator/heater Unit* will prevent dew formation on the window.

Connect the PG01-E output lead to a data acquisition system; use differential inputs.

| | | |
|---|---|---|
| output lead cores | supply +12VDC | red |
| | supply 0V | blue |
| | signal +ve | yellow |
| | signal –ve | green |
| | body temperature; Pt100, 3-wire | |
| | +ve | brown |
| | -ve | white, black |
| | window temperature; Pt100, 3-wire | |
| | +ve | pink |
| | -ve | violet, orange |
| | screen | N/A |

The lead screen is floating at the instrument end; it is recommended that the screen be grounded at the measurement end. The output signal is an analogue voltage and represents the net longwave radiation (downwelling – upwelling).

The nominal fullscale range is -1V (negative). Use a 3-wire connection for the two temperature sensors in order to compensate for voltage drop.

**Longwave net irradiance**, N = $U/C - k_3\sigma(T_D^4 - T_B^4)$, in W.m$^{-2}$
Where $U$ is the output in mV, and is typically negative; $C$ is the sensitivity in mV/W.m$^{-2}$; $T_B$ is body temperature in K; $T_D$ is window temperature in K; $k_3$ = 3.8 is the window heating coefficient; $\sigma$ = 5.6704 · 10$^{-8}$ is the Stephan-Boltzmann constant.

**Longwave downwelling irradiance,** $E = N + \sigma T_B^4$, in W.m$^{-2}$.
$N$ is typically negative, and $\sigma T_B^4$ is the longwave upwelling irradiance.

**Maintenance.** Keep the window of the PG01-E clean and free from debris; use water and mild detergent only.

**PG01-E Technical Specification**

| | |
|---|---|
| sensitivity | $C$ = 4mV/W.m$^{-2}$ (nominal) |
| pyrgeometer coefficients | $k_1$ = 0, $k_2$ = 1, $k_3$ = 3.8 |
| calibration traceability | WISG (World Infrared Standard Group) |
| spectral range (50% point) | 4.5 to 42 µm |
| spectral selectivity (8 to 14 µm) | < 5% |
| field of view | 170° |
| response time (95%) | 11s (typical) |
| irradiance | -250 to +250 W.m$^{-2}$ |
| impedance | 65 Ω |
| power requirement | 5 -15 VDC; < 6mA |
| operating temperature | -35 to +60°C |
| non-linearity (-250 to +250 W.m$^{-2}$) | < 1% |
| temperature dependence of sensitivity | < 2% (-20 to +50°C) |
| tilt response | < 1% |
| window heating offset (shaded) | negligible, if $T_D$ measured<br>< 10 W.m$^{-2}$, if $T_D$ not measured |
| temperature gradient offset (5°C /hr) | < 3 W.m$^{-2}$ |
| directional response | not relevant to isotropic IR |
| uncertaintity in daily total (95% level) | not specified |
| level accuracy | 0.1° |
| desiccant | orange silica gel (non-toxic) |
| IP rating | sealed to IP67 |
| sensor | thermopile, flat white receiver |
| window | silicon, 1mm |
| window coating | diamond like carbon (external)<br>solar blind (internal) |
| temperature sensor (body & window) | Pt100 platinum thin film resistor<br>DIN IEC 751, Class A |
| output lead | 6m, 10-core, with connector at instrument end |
| mounting method | central M10 hole; adjustable feet |
| construction | anodized aluminium; stainless steel |
| size & weight | 160mm diameter x 71mm high; 0.8kg |

**Available options:** EV2-H Ventilator/heater Unit; 10k thermistor for $T_B$;
PG01 Version (without in-built signal amplifier)