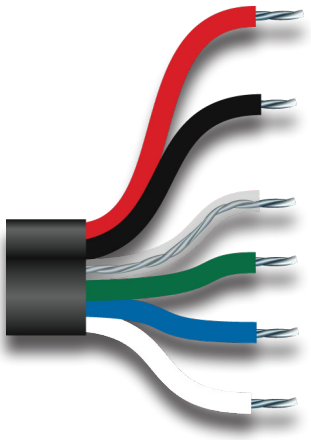
# Infrared Radiometer

## Owners Manual

Model: IRR-P
IRR-PN

apogee instruments inc.

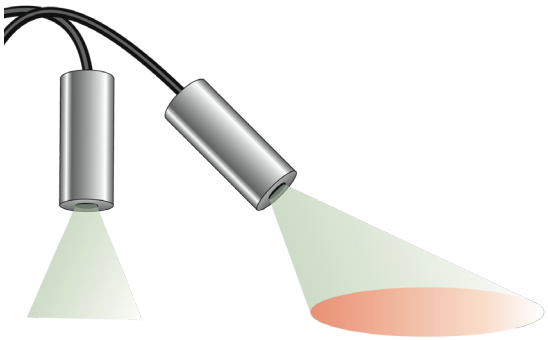
## Wiring Diagram for IRR-P and IRR-PN



| | |
|---|---|
| **Red** | High side of differential channel (positive thermopile lead) |
| **Black** | Low side of differential channel (negative thermopile lead) |
| **Clear** | Analog ground (thermopile ground) |
| **Green** | Single-ended channel (positive thermistor lead) |
| **Blue** | Analog ground (negative thermistor lead) |
| **White** | Excitation channel (excitation for thermistor) |

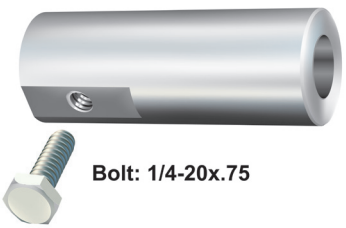
sample programming and instructions available online:
www.apogee-inst.com/programs





## Mounting

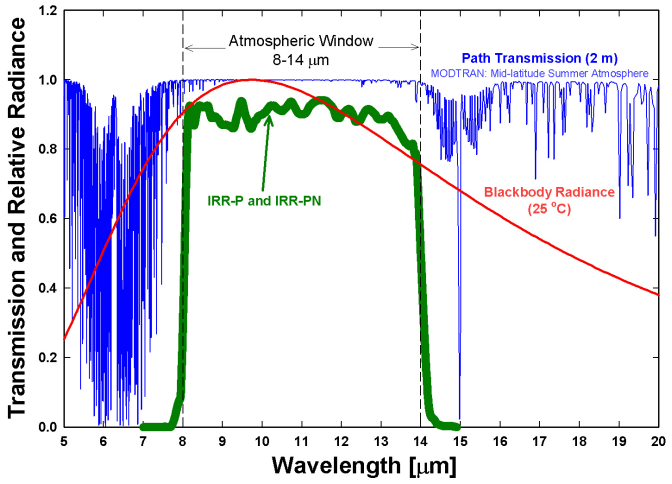
The sensor's FOV (22˚ or 18˚) determines the size of the target area viewed by the detector. This is also influenced by the height and angle at which you mount your IRR. The FOV extends unbroken until it reaches a solid target. Check to be sure you are not detecting unwanted areas within your target diameter, such as the sky.






## About the Atmospheric Window

The 8-14 µm window of the IRR models corresponds to the atmospheric window. This minimizes the effects of water bands below 8 µm and above 14 µm.



# Accuracy and Calibration

During calibration the sensor body temperature ranges from -5 to 45 ˚C at 10 ˚C increments. At each step the target temperature ranges from +20 to -15 ˚C relative to the sensor body temperature.

The output of IRR sensors follows the fundamental physics of the Stefan-Boltzmann Law, which states that radiation transfer is proportional to temperature raised to the fourth power ($T^4$). A version of the S-B equation proposed by Kalma et al. (Calibration of small infra-red surface temperature transducers, Ag. For. Met., 1988) is used to calibrate the sensors taking into account the effect of sensor body temperature (see graph shown above-right):

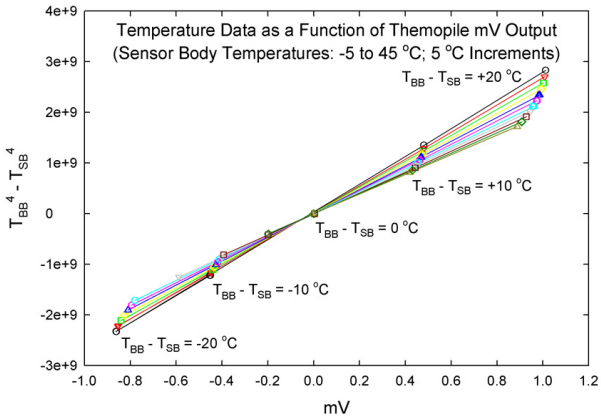
$$T_T^4 - T_D^4 = m \cdot mV + b$$

where $T_T$ [K] is the target temperature (blackbody cone temperature during calibration), $T_D$ [K] is the detector temperature, $mV$ is the millivolt output of the detector and serves as a surrogate for emitted energy, $m$ is the slope and $b$ is the intercept. The coefficients $m$ and $b$ are derived during sensor calibration and are functions of the detector temperature.

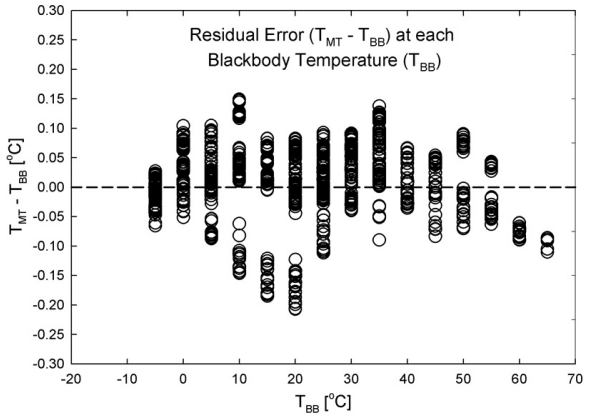
To make temperature measurements, the equation can be rearranged to solve for $T_T$, which is calculated from the measured values of $T_D$ and $mV$, and the calculated values of $m$ and $b$ (calculated from $T_D$):

$$T_T = (T_D^4 + m \cdot mV + b)^{1/4}$$






The graph below shows the residual error ($T_{MT} - T_{BB}$) where $T_{MT}$ is measured temperature and $T_{BB}$ is blackbody temperature).

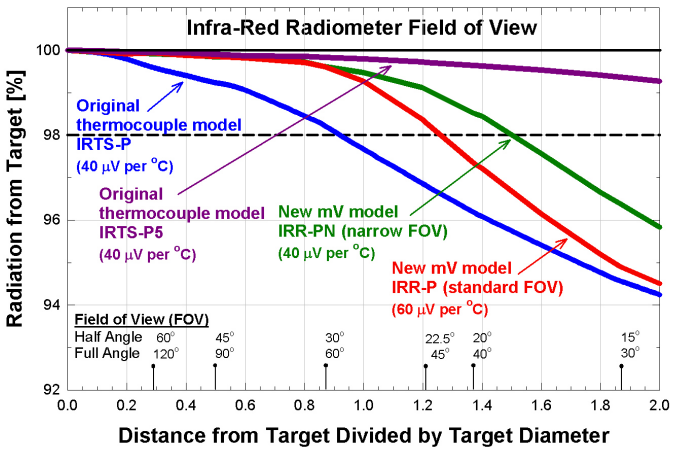





# Field of View

**Field of View** (FOV) is reported as the half-angle of the apex of the cone formed by the target (cone base) and the detector (cone apex). The target is a circle from which 98% of the radiation being viewed by the detector is being emitted.

**Model IRR-P half-angle = 22.0˚**
**Model IRR-PN half-angle = 18.0˚**






# Specifications

| | | Precision (IRR-P) | Precision Narrow (IRR-PN) |
|---|---|---|---|
| **Field of view** | | 22° half angle | 18° half angle |
| **Output** | Target temp. | 60 µV per °C difference from sensor body | 40 µV per °C difference from sensor body |
| | Sensor body temp. | 0-2500 mV | 0-2500 mV |
| **Accuracy** | -10 to 65 °C | ±0.2 °C absolute accuracy | |
| | | ±0.1 °C uniformity | |
| | | ±0.05 °C repeatability | |
| | -40 to 70 °C | ±0.5 °C absolute accuracy | |
| | | ±0.3 °C uniformity | |
| | | ±0.1 °C repeatability and uniformity | |
| **Optics** | | Germanium lens | |
| **Wavelength range** | | 8-14 µm (corresponds to atmospheric window) | |
| **Response time** | | < 1 second to changes in target temperature | |
| **Input power** | | 2.5 V excitation | |
| **Operating environment** | | -55 to 80 °C; 0 to 100 % RH (non-condensing) Water resistant, designed for continuous outdoor use | |
| **Datalogger channels** | | 1 differential (detector) and 1 single-ended (thermistor) | |
| **Cable** | | 4.5 meters twisted, shielded 4 conductor wire with Santoprene casing. Extra cable $2.95 per meter. | |
| **Dimensions** | | 6 cm long by 2.3 cm diameter | |
| **Mass** | | 190 g | |
| **Warranty** | | 1 year parts and labor | |

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