

RADIATION SENSOR

Integrated System for Accurate Solar Radiation Monitoring (DNI, GHI, DNI)

INTRODUCTION:

Solar radiation is a fundamental component of Earth's energy balance and plays a critical role in climate dynamics, weather forecasting, and renewable energy applications. Accurate and continuous monitoring of solar radiation is essential for understanding atmospheric processes and evaluating solar energy potential.

The **Radiation Sensor System** is a fully integrated solar monitoring station designed to measure various components of solar radiation in real-time. Mounted on a precise **sun tracker**, the system is equipped with:

- **Pyranometers** for the measurement of **global, diffuse, infrared, and ultraviolet (UV)** radiation, and
- A **pyrheliometer** for high-accuracy **direct solar irradiance** measurements.

This setup enables comprehensive and reliable assessment of solar energy resources and radiative fluxes in diverse environmental conditions. The system finds wide applications in **solar energy forecasting, climate research, air quality studies, and environmental monitoring networks.**



OBJECTIVE:

- Monitoring of Solar Radiation Components
- Climate Research and Atmospheric Studies
- Renewable Energy Resource Assessment
- Environmental and Air Quality Research
- Long-term Monitoring and Trend Analysis

DATA OUTPUT:

- Global Horizontal Irradiance (GHI)
- Global Horizontal Irradiance (GHI)
- Direct Normal Irradiance (DNI)
- Ultraviolet Radiation (UV-A/B)
- Infrared Radiation

KEY SPECIFICATIONS:

- **Spectral Range:** Pyranometer (285–3000 nm), Pyrheliometer (200–4000 nm)
- **Measurement Range:** 0 – 2000 W/m²
- **Response Time:** < 5 seconds
- **Time Resolution:** 1 Minute
- **Tracking Accuracy (2AP):** < 0.1° (Passive), < 0.02° (Active)
- **Power Supply:** 24 VDC or 115/230 VAC
- **Output:** Analog/Digital (via logger)

MEASUREMENT & WORKING PRINCIPLE:

The radiation sensor system operates based on **thermopile sensors**, which absorb incoming solar radiation and convert it into a measurable voltage signal.

- The **pyranometer** measures **global** and **diffuse** solar radiation over a hemispherical field of view (180°).
- The **pyrheliometer**, mounted on the **2AP sun tracker**, measures **Direct Normal Irradiance (DNI)** by tracking the sun with high precision using a narrow field of view (~5°).

Thermopile sensors consist of a series of thermocouples connected in series, with a black-coated surface that absorbs solar radiation across a wide spectral range. The resulting temperature difference generates a voltage signal proportional to the incoming irradiance.

The **2AP sun tracker** ensures precise alignment with the sun throughout the day, enabling accurate and continuous data collection for solar energy, atmospheric, and climate studies.

KEY FEATURES:

- **High Accuracy Measurements:** ISO 9060 Class A compliant for research-grade radiation monitoring
- **Thermopile-Based Sensors:** Reliable and stable response across a wide solar spectrum
- **Dual Sensor Support:** Measures Direct (DNI), Global (GHI), and Diffuse (DHI) radiation
- **Precision Sun Tracking:** 2AP sun tracker ensures < 0.02° accuracy with optional sun sensor
- **Real-Time Data Acquisition:** Supports 1-second to 1-minute logging intervals
- **Flexible System Design:** Accommodates multiple sensors, shading balls, and accessories
- **Minimal Maintenance Needs:** Only annual inspection and gear greasing for the tracker

Principal Investigator: Shri. Sachin S. Patil, SE-B

Contact: sachin.patil@tropmet.res.in