Kwense Sensor

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1. Introduction

The Kwense Sensor (Silicon-Based Pyranometer) is a compact, all-in-one weather and solar monitoring solution designed specifically for rooftop solar power plants and environmental monitoring applications. The sensor enables accurate measurement of key environmental and solar parameters required for system performance tracking, operational monitoring, and data analytics.

The Kwense Sensor measures global solar irradiance, along with additional parameters such as ambient temperature, relative humidity, and rainfall (where applicable). By integrating multiple sensing capabilities into a single, robust device, it simplifies installation while ensuring reliable data collection in outdoor conditions.

At the core of the system is a silicon-based pyranometer, which utilizes a high-quality silicon photodiode to measure global solar radiation. This includes both direct and diffuse solar energy incident on a horizontal surface. The photodiode converts incoming sunlight into an electrical signal that is directly proportional to the solar radiation intensity, allowing for precise and consistent irradiance measurement.

The Kwense Sensor is engineered to support efficient solar plant monitoring, performance analysis, and environmental data acquisition, making it an ideal solution for modern solar energy systems.

2. Product Overview

The Sourayan Kwense-Advanced Sensor is a robust and reliable monitoring solution specifically engineered for kW-scale solar power plants. Designed to deliver continuous and accurate environmental and performance data, the sensor integrates multiple critical measurements into a single compact unit.

It accurately measures solar radiation, air temperature, relative humidity, barometric pressure, and module temperature, with optional support for wind speed and wind direction, making it ideal for comprehensive rooftop solar plant monitoring. The inclusion of inbuilt roll and tilt angle sensors enhances measurement precision by ensuring correct sensor alignment, even in challenging installation conditions.

Built for long-term stability and low power consumption, the Kwense-Advanced Sensor performs reliably in remote and harsh environments, minimizing maintenance requirements. Its MODBUS RS-485 communication interface allows seamless integration with data loggers, SCADA systems, and third-party monitoring platforms, ensuring flexibility and scalability for various solar monitoring applications.

Overall, the Sourayan Kwense Advanced Sensor offers a well-balanced combination of accuracy, durability, and ease of integration, making it a dependable choice for solar performance analysis, preventive maintenance, and environmental monitoring.

2.1 Key Feature

- Multi-parameter environmental sensing
- Rugged, rooftop-ready design
- Integrated solar irradiance measurement
- Compatible with data loggers and remote monitoring systems
- Easy installation and maintenance.

3. Compiled Specification

3.1 Solar Radiation Sensor

- Type: Silicon Type Irradiance
- Range: 0 to 2000 W/m²Spectral
- Range: 360 to 1100nm
- Uncertainty: ± 3%
- Resolution: 1 W/m²

3.2 Module Temperature Sensor

- Range: -40° to 150°C
- Accuracy**:** ± 0.15°C
- Tolerance: Class AA (T)
- Resolution: 0.01°C

3.3 Air Temperature Sensor

- Range: -40° to 85°C
- Accuracy: ± 0.5°C
- Resolution**:** 0.01°C

3.4 Relative Humidity Sensor

- Range **:** 0 to 100% RH
- Accuracy: ± 3% standard
- Resolution: 0.01% RH

3.5 Barometric Pressure Sensor

- Range: 300 to 1100hPa
- Accuracy: ±1hPa

4. Software tools

4.1 Termie (Serial Terminal software)

A lightweight Windows program used for serial communication (RS-232, COM ports, USB-to-serial). It's often used by engineers or testers to monitor and send commands to hardware devices (like microcontrollers, sensors, or modems).

4.2 Utility Software

Refer to software tools that help you interface with, configure collect, log, analyse, calibrate and manage data from sensor. These utilities are essential in iot system.

5. Model of Kwense

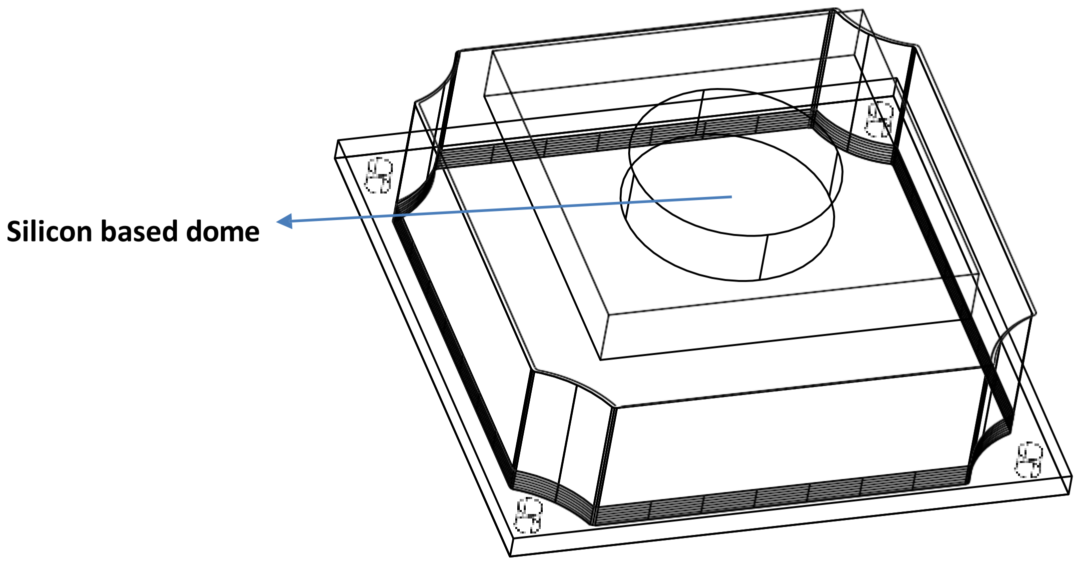
- **Kwense-A01**
  Is a silicon-type irradiation sensor equipped with MODBUS 485 output and supplied with a 10-meter cable.
- **Kwense-A02**
  Is a silicon-type irradiation sensor that also measures module temperature and comes with a 3-meter cable.
- **Kwense-A03**
  Is a silicon-type irradiation sensor that additionally measures module temperature, air temperature, relative humidity, and barometric pressure, and includes MODBUS 485 output with a 10-meter cable.

6. Protocols

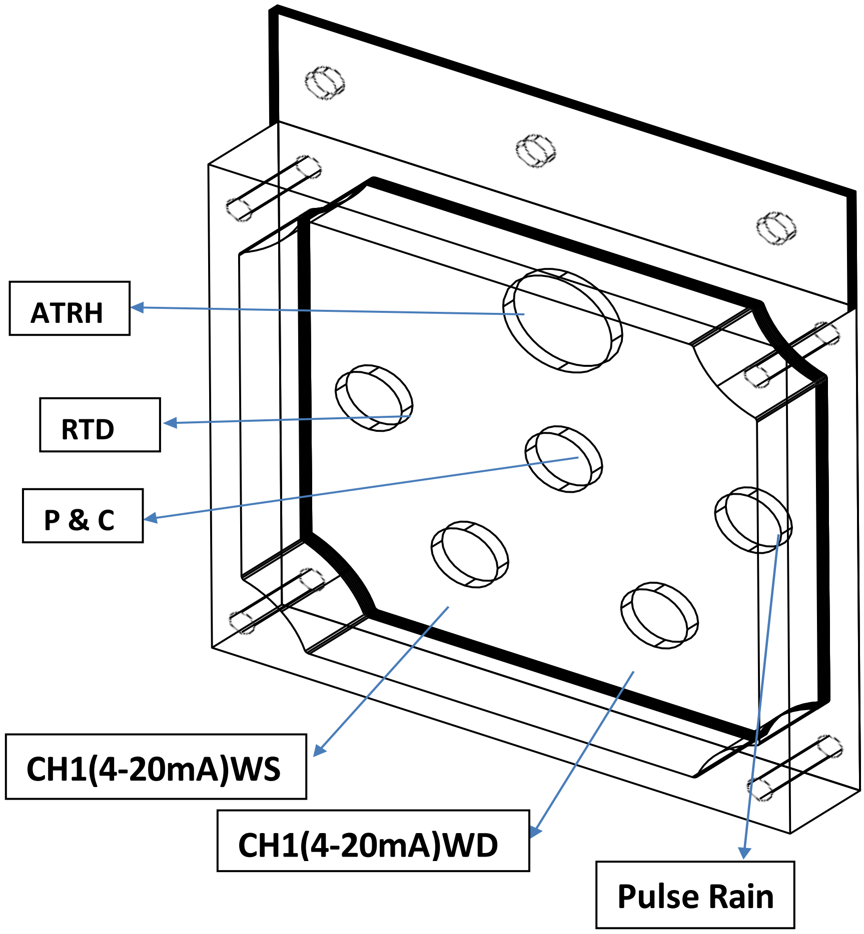
- **Modbus**
  Is a serial communication protocol widely used in industrial automation. When used over Ethernet (Modbus TCP/IP), it supports high-speed network communication with binary data formatting similar to RTU. It is commonly used to connect sensors, PLCs, and controllers across a LAN or even over the Internet.

- **I2C (Inter-Integrated Circuit)**
  is a serial communication protocol designed for short-distance communication within a circuit board. It uses a simple two-wire interface consisting of SDA (Serial Data Line) for carrying data and SCL (Serial Clock Line) for carrying the clock signal. I^2C provides serial, synchronous communication and is well suited for connecting multiple devices such as sensors and microcontrollers with minimal wiring.

7. System Architecture



7.1 Sensor Connection



Power Supply Connections

- **White – (+Ve) Power Supply**
- **Brown – (-Ve) Power Supply**
- **Yellow – RS485-A**
- **Green – RS485-B**

8. Pre-Installation Checklist

- **Tools & Materials**
  The installation requires a mounting bracket or a stable, flat surface along with basic tools such as a wrench or pliers, screwdriver, and drill if necessary. A spirit level or levelling plate should be used to ensure proper alignment. Cable ties and conduit are needed to protect the wiring, while a mustimeter is essential for verifying connections and output. Weatherproof seals or tape must be applied to secure all cable entry points.
- **Site & Environment**
  The sensor should be installed in a location with an unobstructed view of the sky, at least 5° above the horizon, and free from shading caused by trees, buildings, or reflective surfaces. The area must be easily accessible for routine cleaning and maintenance and should be positioned away from sources of strong electromagnetic interference.
- **Orientation & Levelling**
  For GHI sensors, the device must be mounted horizontally. A spirit level should be used to ensure proper leveling and to avoid cosine errors, which can affect measurement accuracy.
- **Mounting & Wiring**
  Sensor Mounting
  Ensure that the ground or mounting bracket is rigid and stable. Secure the sensor firmly using the provided mounting holes and hardware. The protective cover should only be removed after the sensor has been fully mounted.
- **Wiring & Signal Handling**
  The system should not be powered until all cables are properly connected. Cables must be routed through a conduit and kept at a safe distance from high-power electrical lines. Secure all cables to minimize slack and prevent vibration.
- **Levelling & Final Checks**
  Verify that the sensor is perfectly level before operation. Check the orientation of all cables and test the output signal using a multimeter to confirm proper functionality.

9. Post-Installation & Maintenance Tips

The dome or diffuser should be cleaned regularly, typically every week to every month depending on site conditions. Always recheck sensor levelling after storms or any vibration events. Inspect all cables to ensure there is no wear, water ingress, or loose connectors.

1. GHI (Global Horizontal Irradiance) Pyranometer

- **Site Selection**
  The sensor should be installed in an unshaded area with an open horizon. It must be placed over representative ground conditions and kept away from reflective surfaces to avoid measurement distortion.
- **Mounting & Orientation**
  The pyranometer must be mounted horizontally using a rigid mounting arm or tripod. A typical installation height is around 1.5–2 meters, unless the project specifies otherwise. The dome should face directly upward, with the cable outlet positioned toward the north in the Northern Hemisphere or toward the south in the Southern Hemisphere.
- **Electrical Connections**
  Use shielded cables and ensure proper grounding. Signal cables should not be routed alongside high-power electrical lines to avoid interference.
- **Ventilation & Heating (if equipped)**
  If the pyranometer includes ventilation or heating, ensure continuous power is supplied and verify that airflow is unobstructed and filters remain clean.
- **Calibration**
  Enter the calibration factor provided on the calibration certificate. Recalibration is recommended every one to two years to maintain accuracy.
- **Maintenance**
  Regularly clean the dome and check that the sensor remains level. Inspect cables, connectors, and any signs of condensation. All maintenance activities should be documented for records and compliance.
- **Compliance**
  For high-quality or certified measurements, installation and operation should follow **ISO 9060** and **WMO** guidelines.

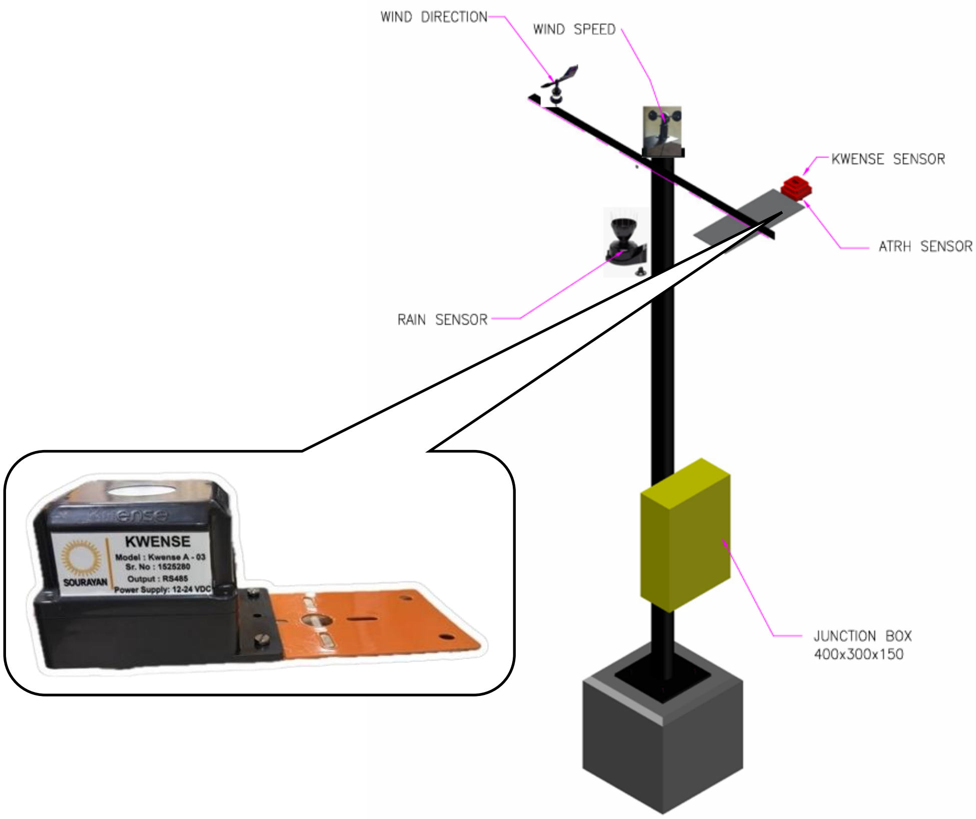
2. GTI (Global Tilted Irradiance / Plane-of-Array) Pyranometer

- **Location & Mounting**
  The GTI pyranometer should be installed parallel to the PV modules, matching both tilt and azimuth. It must be positioned close to the array but free from shading or reflected light. Installation can be on the module frame, a dedicated sensor arm, or a rigid racking system.

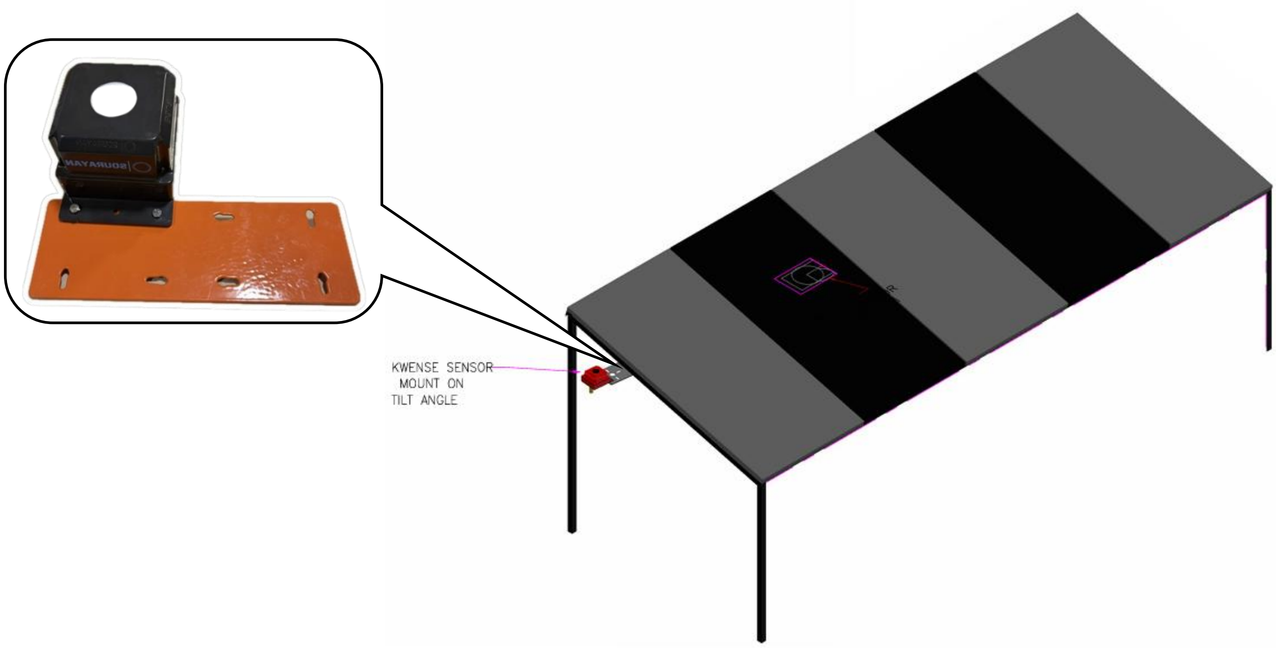
- **Orientation & Levelling**
  Ensure the sensor is aligned exactly with the PV modules. Even small angular errors of ±2° can result in measurement deviations of 2–5%, so precision is essential.
- **Electrical Connections**
  Use shielded cables with proper grounding, and connect the sensor to the data logger or SCADA system. Verify the polarity and confirm the signal type (mV, 4–20 mA, or Modbus) based on system requirements.
- **Calibration & Configuration**
  Enter the calibration factor and configure the sensor settings, including units, a sampling rate between 1–10 seconds, and an averaging interval between 1–15 minutes. Ensure the data logger channel is labeled as GTI or POA irradiance.
- **Commissioning Checks**
  Compare the readings with a reference pyranometer and expected clear-sky irradiance values. Ensure there is no signal clipping and that measurements are stable.
- **Maintenance Best Practices**
  Clean the sensor weekly or biweekly depending on site conditions. Regularly check the sensor’s level, alignment, cables, and mounting hardware to ensure long-term stability.

10. Installation Drawing

10.1 GHI Mounting



10.2 GTI Mounting



10.3 Installation Images

11. Modbus Details

- First, complete all wiring connections for the device. Once the connections are secured, connect the USB-to-RS485 converter to the PC. Then open **Device Manager** on the computer and check the COM port number assigned to the converter.
- Next, launch the **Modscan** software. Enter the required settings, including the device ID and register address. Select the correct COM port and configure the baud rate.

➢ **Use the following parameters:**

- **Address:** 0001
- **Device ID:** 100
- **Length:** 28
- **Modbus Point Type:** Input Register

After setting all parameters, click **Connect** to start reading the Modbus data.

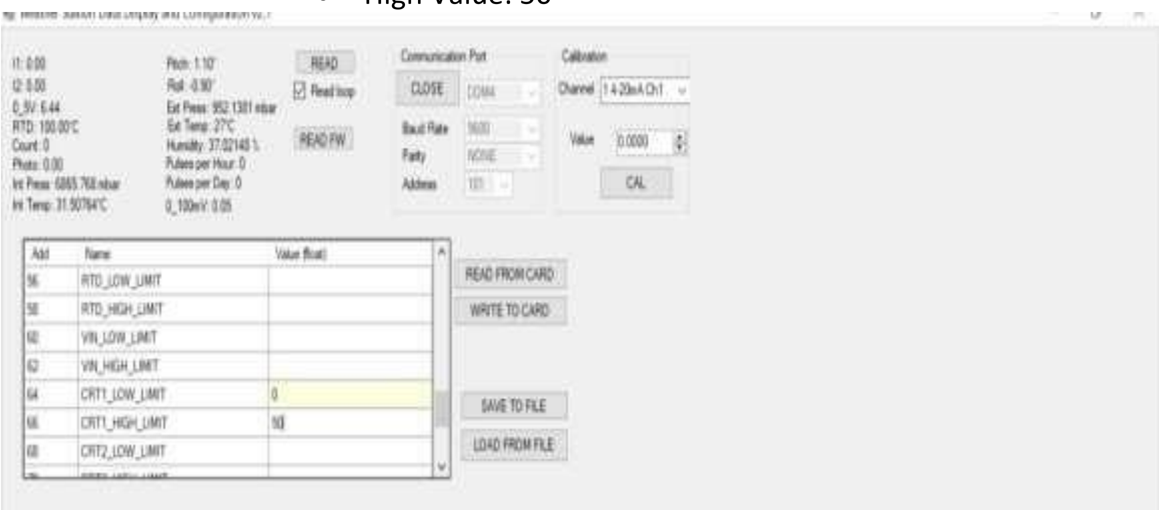
Modbus point type	Input register
Boud Rate	9600
Word Length	8
Parity	None
Stop Bit	1
Register Address	30001 Wind Speed 30003 Wind Direction 30007 Module Temperature 30011 Radiation 30017 Pitch Angle 30019 Roll Angle 30021 Barometric Pressure 30023 Air Temperature 30025 Humidity

12. Calibration process

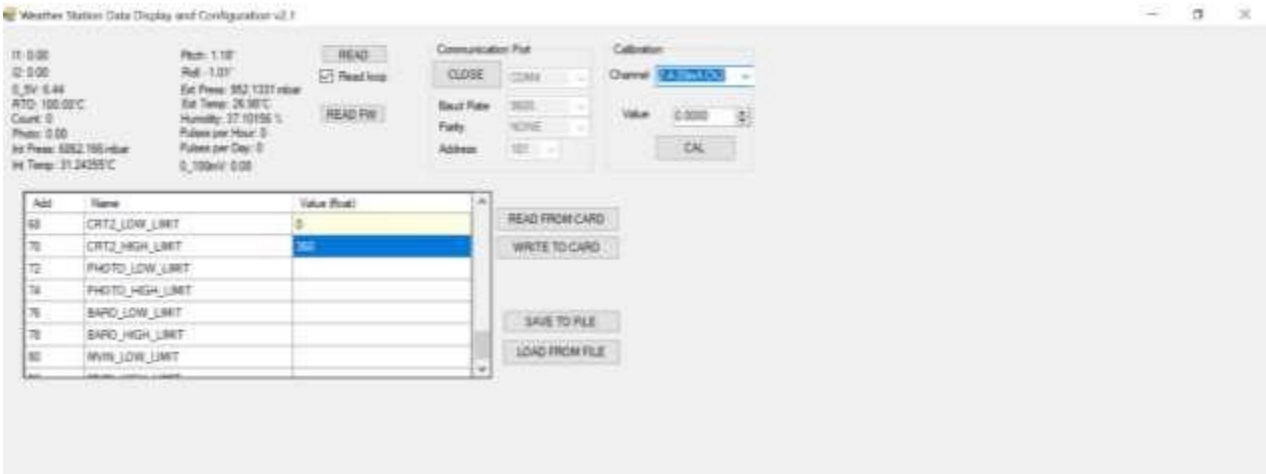
- The **Kwense sensor** is equipped with three calibration channels. The first channel is calibrated for **wind speed (WS)**, the second channel is calibrated for **wind direction (WD)**, and the third channel is calibrated for the **photodiode**. After completing the photodiode calibration, the readings from the silicon-type pyranometer should be compared with those from a reference pyranometer. Once both readings are obtained, calculate the percentage difference between them using the formula:

Percentage Difference = ((Reference Pyranometer – Kwense Reading) / Reference Pyranometer) × 100

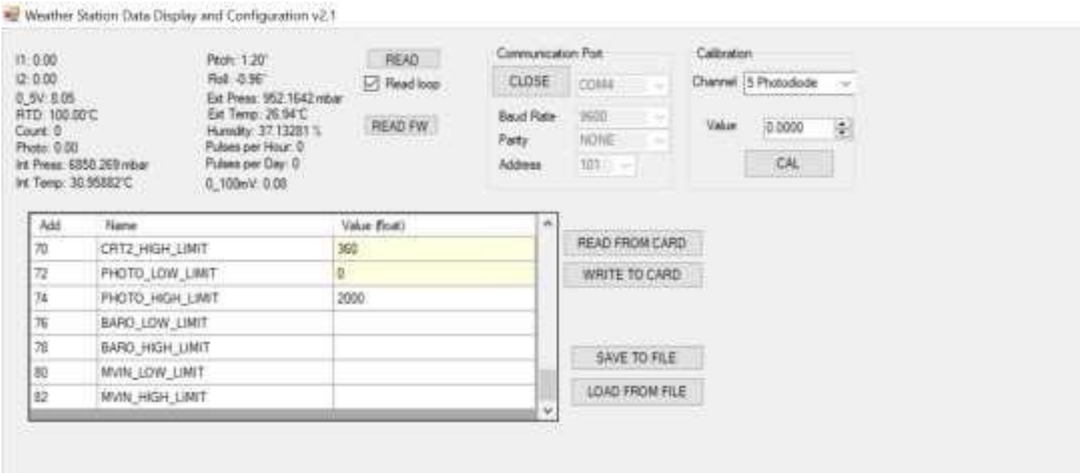
- To begin calibration using the utility software, open the communication port and enter the required settings such as baud rate, parity, and COM port. After filling in the parameters, click on the **Close** option to activate the connection.
- For the **first channel calibration (Wind Speed – WS)**, set the calibration points as follows:
    - Low Value: 0
    - High Value: 50



- For the **second channel calibration (Wind Direction – WD)**, select **Channel 2** in the utility software. Set the **Low Value to 0** and the **High Value to 360**, covering the complete 0–360° directional range.



- For the **third channel calibration (Photodiode)**, select the **Photodiode** option in the utility software. Set the **Low Value to 0** and the **High Value to 2000**, corresponding to the expected irradiance range in W/m².



13. Troubleshooting

1. No Output / Zero Reading

- **Possible Causes**
  - The power supply is not available.
  - A cable is loose, damaged, or disconnected.
  - Wiring is incorrect, such as reversed polarity.
  - The sensor surface is covered, dirty, or shaded.
- **Checks**
  - Verify that the power supply voltage matches the value specified in the datasheet.
  - Inspect all cables and connectors for continuity, damage, or loose connections.
  - Confirm that wiring polarity and terminal connections are correct.
  - Ensure the sensor surface is clean and fully exposed to sunlight.

2. High Reading

- **Possible Causes**
  - An incorrect calibration factor has been applied.
  - The wrong measurement range is selected in the utility software.
  - The pyranometer is not properly leveled.
  - The photodiode has aged or degraded over time.
- **Checks**
  - Confirm the correct calibration constant provided by the manufacturer.
  - Verify that the software configuration settings are correct (e.g., photodiode range 0–2000, WD range 0–360).
  - Ensure the pyranometer is level using a spirit level.
  - Compare readings with a calibrated reference instrument.

3. Unstable or Fluctuating Readings

- **Possible Causes**
  - Loose electrical connections.
  - Electrical noise or improper grounding.
  - Rapid cloud movement, which is a normal environmental effect.
- **Checks**
  - Inspect and tighten all electrical connections.
  - Verify proper grounding and shielding.
  - Confirm that fluctuations correspond to changing weather conditions.

4. Sensor Output is Present, but Software Shows No Data

- **Possible Causes**
  - A communication issue with the USB/RS-485 interface.
  - The wrong COM port is selected.
  - The baud rate or protocol is incorrect.
- **Checks / Actions**
  - Ensure the correct COM port is selected in the utility software.
  - Verify that all communication parameters (baud rate, protocol, etc.) match the instrument manual.
  - Restart the software and reconnect the device.

5. Slow Response Time

- **Possible Causes**
  - A dirty or scratched diffuser.
  - Sensor overheating.
  - Aging silicon photodiode.
- **Checks / Actions**
  - Clean the sensor dome or diffuser carefully.
  - Ensure adequate ventilation to prevent overheating.

6. Drift Over Time

- **Possible Causes**
  - Long-term exposure to UV radiation.
  - Temperature-induced effects.
- **Checks / Actions**
  - Perform periodic recalibration.
  - Compare annual measurements with a standard pyranometer to detect drift.

14. Safety Precaution

14.1 Personal Safety

Wear appropriate PPE, including a safety helmet, gloves, non-slip shoes, and a safety harness when working at height. Avoid performing installation work during rain, strong winds, or lightning conditions. If working near electrical systems, use properly insulated tools to prevent electrical hazards.

14.2 Site Selection Safety

Choose a stable and rigid mounting surface such as a mast, pole, or mounting bracket. Ensure the structure is capable of withstanding wind loads and vibrations. Always maintain a safe distance from overhead power lines and exposed electrical equipment while selecting and preparing the installation site.

14.3 Electrical Safety

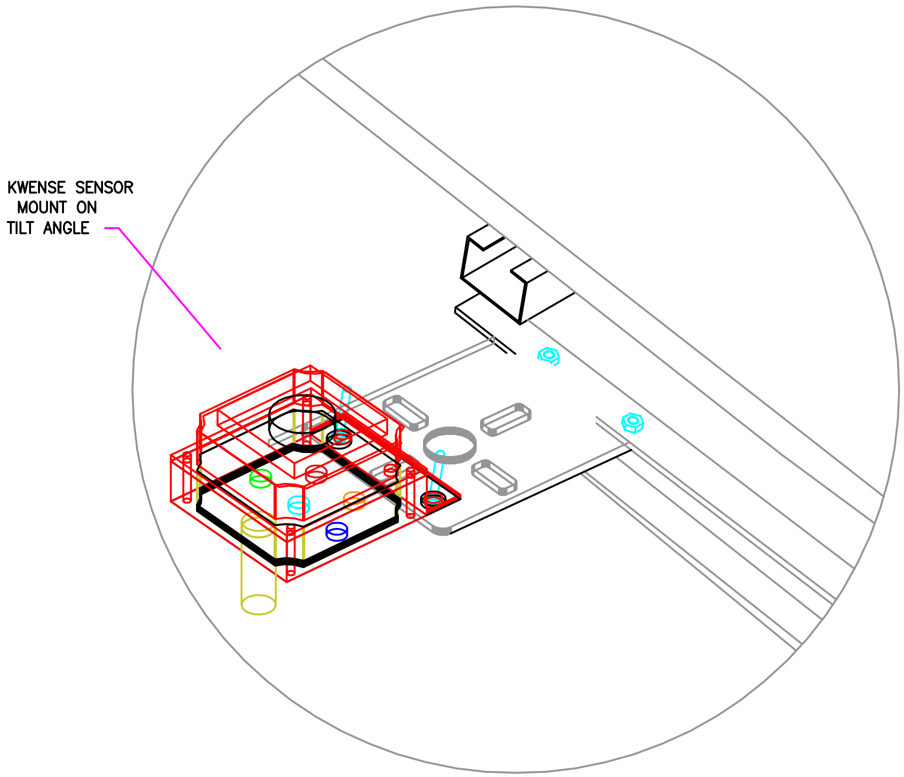
Before performing any wiring work, power off all related electrical systems. Use proper grounding or earthing to protect the equipment and personnel from lightning, electrical surges, and static discharge.

14.4 Sensor Handling Precautions

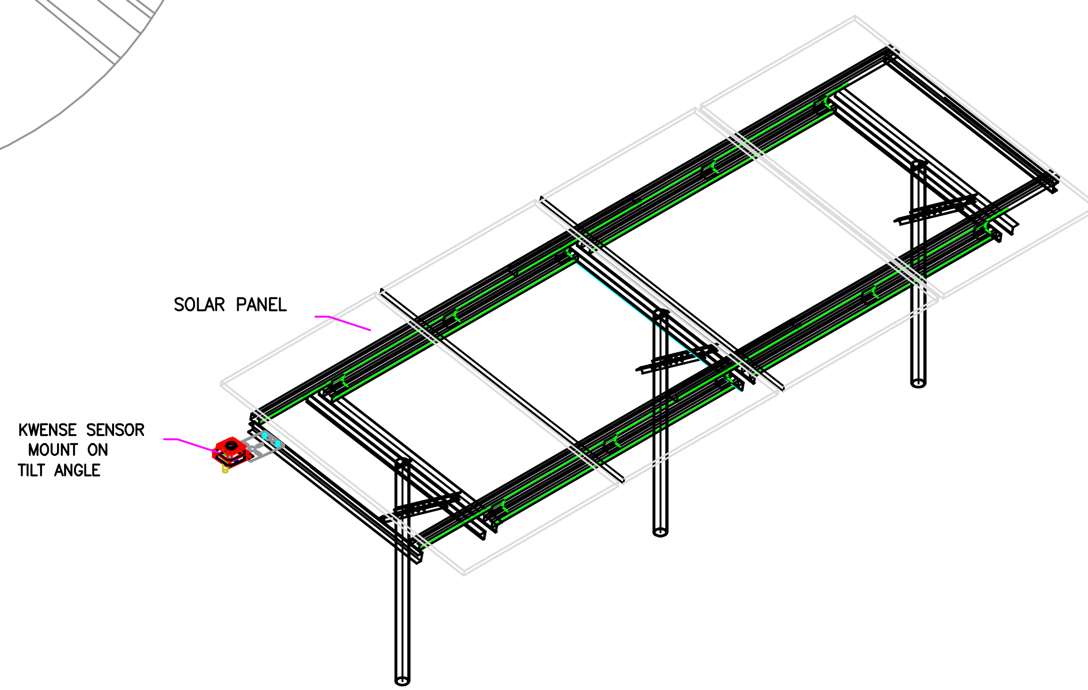
Avoid touching the sensor dome or sensitive surfaces with bare fingers, as oil and dirt can affect measurement accuracy. Handle the sensor carefully, as silicon-based sensors can be damaged by impact. Keep the sensor covered until the final installation stage to prevent contamination from dust or environmental exposure.

15. Support

Sourayan Technologies Pvt. Ltd. provides comprehensive technical support to ensure smooth installation, configuration, and operation of the silicon-based pyranometer. For any assistance related to installation, configuration, troubleshooting, firmware updates, or application guidance, you may contact the support team of Sourayan Technologies Pvt. Ltd. Additional information is available on their official website.



3D VIEW OF
KWENSE SENSOR



WMS Mounting Drawing