Environmental Sensors Overview

This document is intended to assist SolarEdge customers in planning environmental sensor installations in commercial projects and should be used in conjunction with the following documents:

- SolarEdge Control and Communication Gateway installation guide: http://www.solaredge.com/files/pdfs/solaredge-gateway-installation-guide.pdf
- SolarEdge Control and Communication Gateway datasheet: http://www.solaredge.com/files/pdfs/products/inverters/se_control_and_communication_gateway.pdf
- SolarEdge sensors datasheet: http://www.solaredge.com/files/pdfs/products/inverters/se_sensor_datasheet.pdf
- SolarEdge application note on monitoring portal performance ratio calculation: http://www.solaredge.com/files/pdfs/monitoring_performance_ratio_calculation.pdf

Background

Environmental sensors are used to monitor a site's irradiance, temperature and wind conditions and calculate performance ratio (PR). Sensors connect to the SolarEdge Control and Communication Gateway (CCG) and the measurements are displayed in the SolarEdge monitoring server.

Up to three sensors can be connected to a single CCG

- Two sensors with voltage outputs (V1, V2), each with a different voltage range
- One sensor with a current output (I)

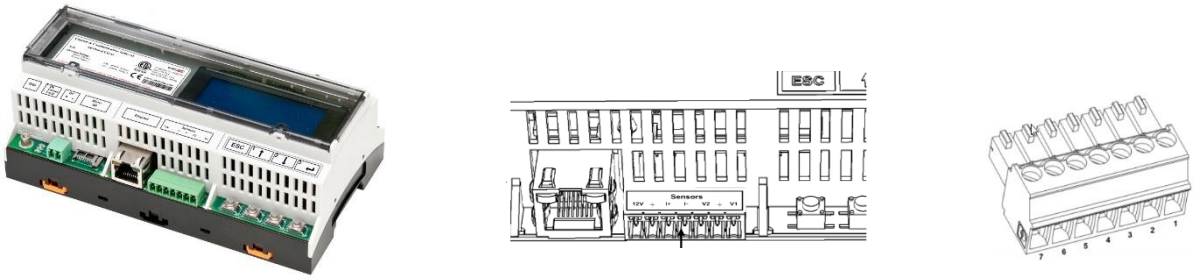


Figure 1: The CCG and its 7 pin sensor terminal block

NOTE

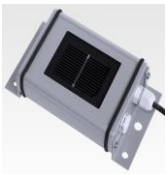
Connecting more than three sensors requires additional CCGs.

Sensor Support

The SolarEdge CCG supports any environmental sensor meeting the specifications found in the CCG datasheet.

SolarEdge offers irradiance, ambient temperature, module temperature and wind velocity sensors, as well as a power supply required for the temperature sensors.

Additional SolarEdge approved sensors are available from *Ingenieurbüro Mencke & Tegtmeyer GmbH*. Please refer to http://www.solaredge.com/articles/se-supported-devices#environmental_sensors for further details and specifications of approved environmental sensors.






Sensor / Output	SI Irradiance	Module Temperature	Ambient Temperature	Pyranometer	Wind Velocity	Wind Direction
0-2V	SE1000-SEN-IRR-S1			SMP11-V	4.3519.00.167	4.3129.00.167
0-10V	Si-13TC-K	Tmodul10	SE1000-SEN-TAMB-S1			
4-20mA	Si-420TC-K	SE1000-SEN-TMOD-S1	Tamb420	SMP11-A	SE1000-SEN-WIND-S1	4.3129.00.141

Figure 3: Approved sensors and output options; sensors available from SolarEdge begin with SE1000

Follow the instructions in the section *Configuring the Sensors in the SolarEdge Gateway* in the CCG installation guide to configure the sensors.

Sensor Connection Options

The following table details the CCG's 7 pin sensor terminal block inputs and their designation; to allow flexible connection of sensors, 3 analog inputs are available with different configurable input ranges:

Pin #	Pin Name	Description
1	V1	Voltage sensor input number 1
2	GND	Ground- common for V1, V2 & GND
3	V2	Voltage sensor input number 2
4	I-	Negative current sensor input
5	I+	Positive current sensor input
6	GND	Ground- common for V1, V2 & GND
7	12V	12VDC output voltage supply to the sensors (limited to 800ma)

The diagram below can be used to assist in planning which sensor models to choose and how to connect them to the CCG. Make sure to utilize the CCG efficiently to save cost.

- Sensor models available from SolarEdge are marked in dark red
- Sensor models available from SolarEdge approved supplier *Ingenieurbüro Mencke & Tegtmeyer GmbH* are marked in light red
- The colors in the bottom row mark the output ranges per sensor type and model, corresponding to the CCG inputs marked in the lower diagram

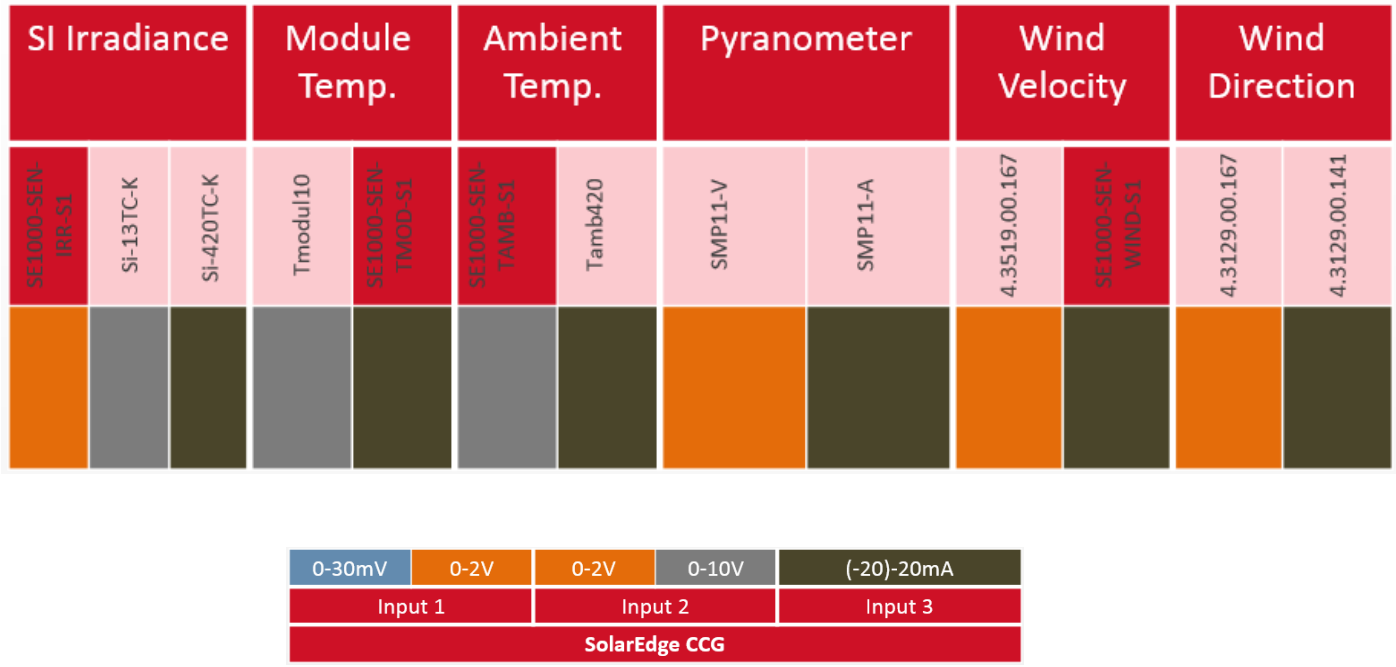


Figure 4: Sensor output and CCG input options

NOTE

Inputs 1 & 2 on the CCG can be configured to accept one of the two options shown (i.e input 2 can be configured to accept 0-2V OR 0-10V).

Sensor Connection Example

- **Ambient temperature sensor** (SE1000-SEN-TAMB-S1)
  - Voltage output sensor, measuring the ambient temperature. Electrical output: 0..10V.
  - Connected to input 2- pin# 2, 6.
- **Module temperature sensor** (SE1000-SEN-TMOD-S1)
  - Current output sensor, measuring the module surface temperature. Electrical output: 4..20 mA.
  - Connected to input 3- pin# 5 & PSU +.
- **Solar irradiance sensor** (SE1000-SEN-IRR-S1)
  - Voltage output sensor, measuring the solar irradiance. Electrical output: 0-1.4 VDC.
  - Connected to input 1- pin# 1, 2, 7.

NOTE

An external 24VDC power supply is required for connecting the temperature sensors (SE1000-SEN-PSU-S1). A single PSU can be used to power two temperature sensors connected to the same CCG. For details refer to the SolarEdge environmental sensors datasheet.

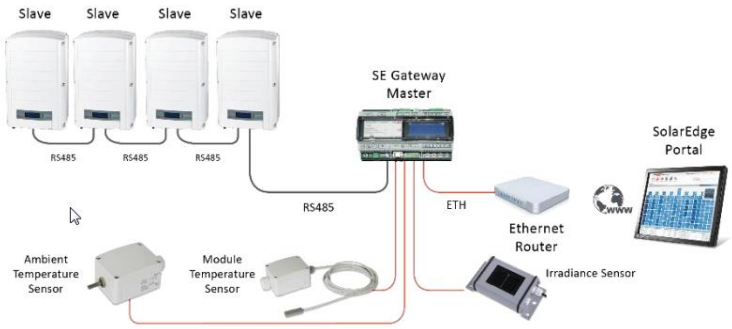


Figure 5: Example installation – system layout

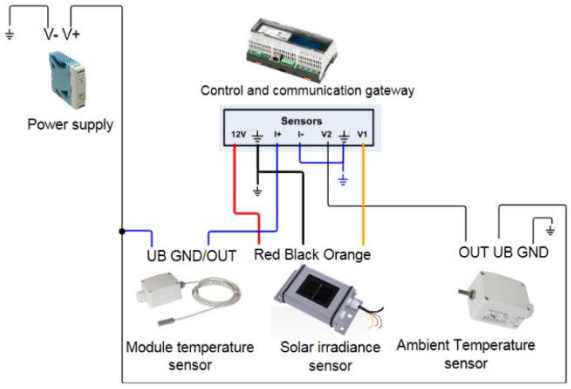


Figure 6: Example installation- wiring diagram

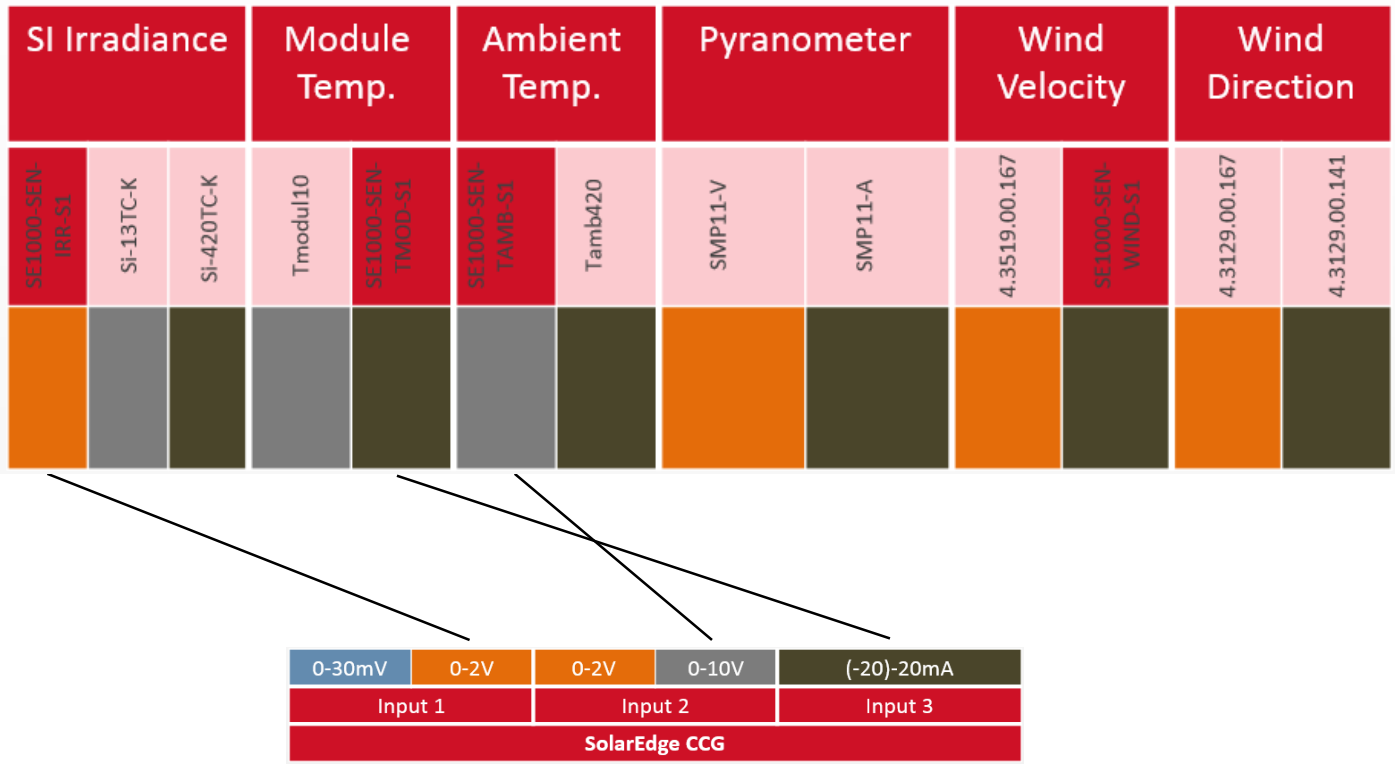


Figure 7: Example installation- CCG connections

Using Sensor Information

Once the CCG and environmental sensors have been installed and configured, the sensor readings are accessible in the monitoring portal: *Charts -> Environmental -> On-site sensors*. See example below displaying information from three installed sensors.

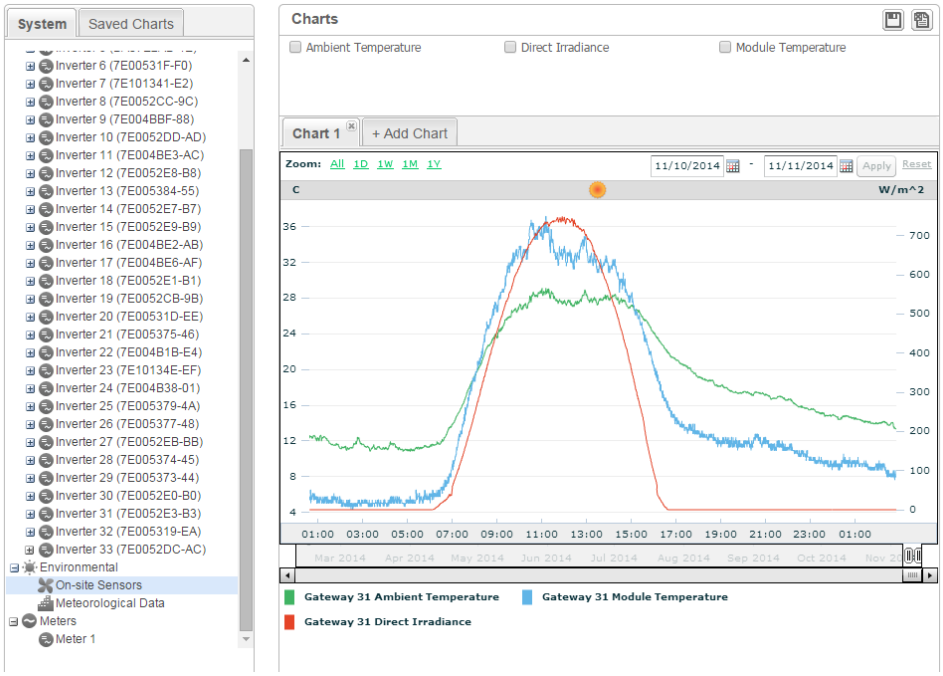


Figure 8: Viewing sensor readings on the monitoring portal

Performance Ratio Calculation

The performance ratio (PR) of a PV installation is the ratio between the actual energy yield of a site (production energy), and the expected energy of the site, based on the module type and environmental sensor measurements. The PR value ranges between 0 and 1 and is used to evaluate the PV system performance, a high PR indicates a properly operating site.

For a PV system with a single CCG and no module temperature sensor, PR is calculated by the following formula:

$$PR = \frac{Production\ energy}{Expected\ energy} = \frac{Production\ energy\ [Wh]}{\sum_t \left[Irradiance\ [\frac{W}{m^2}] \times \frac{Peak\ power\ [W]}{1000\ W/m^2} \right]}$$

To enable accurate PR calculation in the monitoring portal:

- The site should be connected to the monitoring portal
- A planar irradiance sensor should be installed at the site
    - The sensor orientation and tilt should be identical to those of the PV modules so that the sensor will be exposed to the same solar irradiation.

Figure 9: Irradiance sensors installed in line with the monitored array

NOTE

Only one irradiance sensor can be connected to each CCG.

- For a PV system with multiple orientations, it is recommended to connect an irradiance sensor and a CCG on each facet. In this case, the PR calculation is as follows:

$$PR = \frac{Production\ energy}{Expected\ energy} = \frac{Production\ energ\ [Wh]}{\Sigma_t \left\{ \left[Irradiance\ [\frac{W}{m^2}] \times \frac{Peak\ power\ [W]}{1000\ W/m^2} \right]_1 + \left[Irradiance\ [\frac{W}{m^2}] \times \frac{Peak\ power\ [W]}{1000\ W/m^2} \right]_2 \right\} \dots}$$

Adding a module temperature sensor will improve the accuracy of the PR calculation. In this case, the PR calculation is as follows:

$$PR = \frac{Production\ energy}{Expected\ energy} = \frac{Production\ energy}{\Sigma_t \left[Irradiance\ [\frac{W}{m^2}] \times \frac{Peak\ power\ [W]}{1000\ W/m^2} \right] \times \left[1 + (Temp\ [°C] - 25°C) \times Temp\ Coefficient\ [\frac{\%}{°C}] \right]}$$

- Set the PR information in the monitoring portal as described in the performance ratio application note

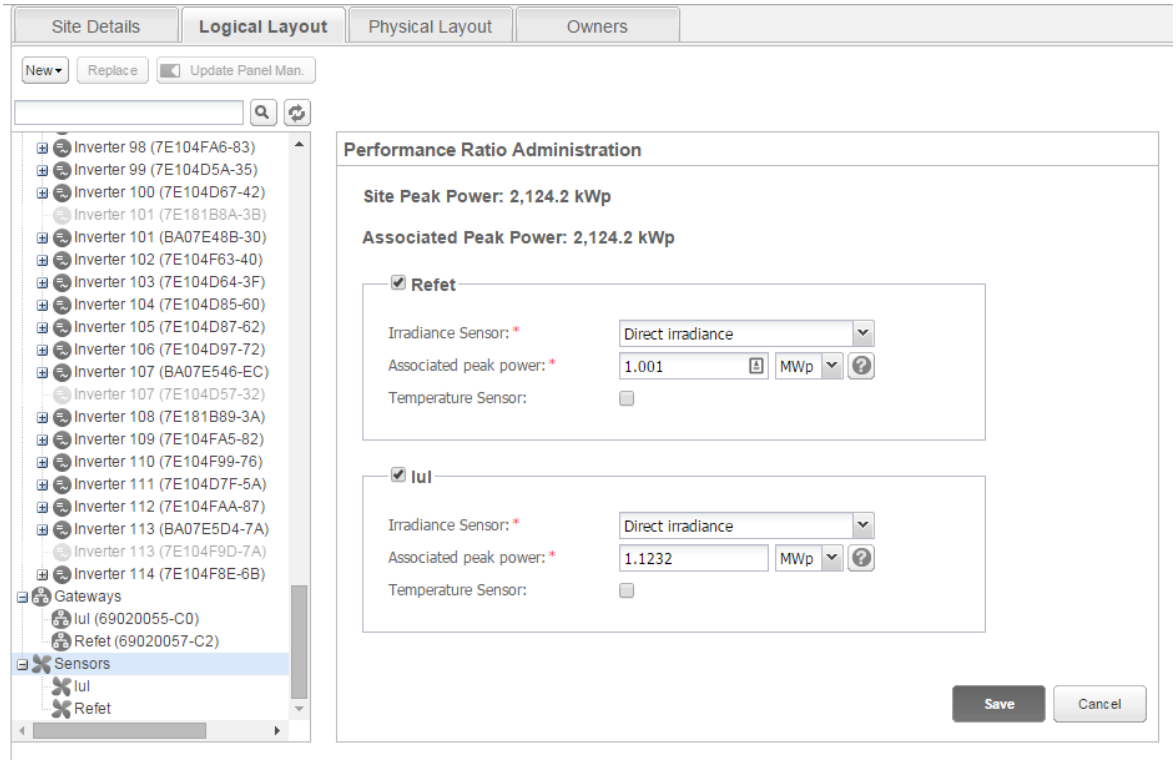


Figure 10: PR calculated for two orientations on one site ('Refet' and 'lul' are names selected by the EPC)

To view the PR in the site dashboard, click the *Dashboard* icon, and scroll down to the last graph - *Performance Ratio*.
Click on the tabs to toggle between *Daily*/ *Monthly*/ *Yearly* views and export selected data to a spreadsheet using the button on the top right. Monthly and yearly views also feature comparisons to past performance.

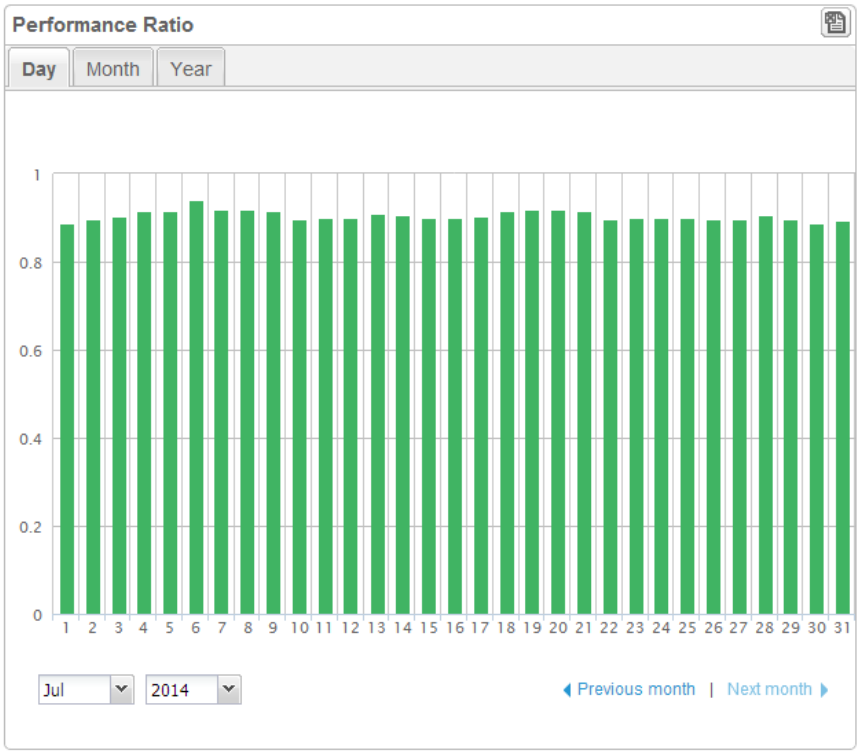


Figure 11: Viewing PR data in the monitoring portal

For additional information please refer to the SolarEdge application note on monitoring portal performance ratio calculation.