SolarEdge Feed-in Limitation Application Note

Version 1.4

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- Increase the separation between the equipment and the receiver.
- Connect the equipment into an outlet on a circuit different from that to which the receiver is connected.
- Consult the dealer or an experienced radio/TV technician for help.

Changes or modifications not expressly approved by the party responsible for compliance may void the user's authority to operate the equipment.

Contents

Chapter 1: Introducing the Feed-in Limitation

The SolarEdge Smart Energy Management solution allows increasing the self-consumption of a site. One method used for this purpose is limiting the feed-in power. This allows installing a larger PV array or installing a larger inverter without violating the feed-in limitations.

With Feed-in Limitation, a SolarEdge device - inverter or Control and Communication Gateway (CCG) - dynamically adjusts the PV power production in order to ensure that feed-in power does not exceed a preconfigured limit. To enable this functionality, an energy meter that measures feed-in or consumption must be installed at the site.

To use Feed-in Limitation, the inverter/CCG communication board firmware (CPU) version must be 2.8xx/3.8xx or higher. If the inverter CPU version is lower, contact SolarEdge support for an upgrade file and instructions (support@solaredge.com).

This document describes how to install energy meters and configure the system for Feed-in Limitation.

Terminology

The following terms are used in this document:

- **Feed-in**: The power injected to the grid.
- **Feed-in meter**: A meter that is installed at the grid connection point and reads the energy/power fed into the grid.
- **Purchased**: The power purchased from the grid. A meter installed at the grid connection point may also read the energy/power purchased from the grid, in addition to the feed-in energy/power.
- **Consumption**: The power consumed by the site.
- **Consumption meter**: A meter that is installed at the load consumption point and reads the energy/power consumed by the site.
- **Self-consumption**: The PV power consumed by the site and not fed into the grid.
- **Production**: The PV power produced by the PV system.
- **Production meter**: A meter that is installed at the inverter output and reads the energy/power produced by the PV system.

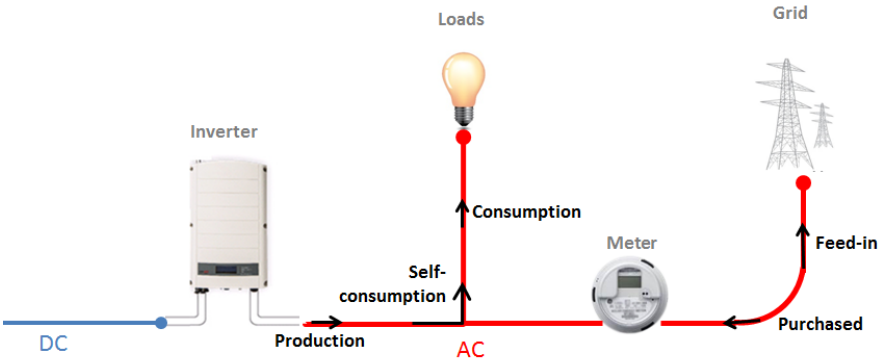


Figure 1: Terminology

Acronyms and Abbreviations

The following acronyms and abbreviations are used in this document:

- **CCG**: Control and Communication Gateway
- **RGM**: Revenue Grade Meter
- **CT**: Current Transformer
- **PV**: Photovoltaic

Chapter 2: Connection Options

For Feed-in Limitation, the feed-in limit is preconfigured in the inverter/CCG. To measure the feed-in or consumed power, an energy meter must be installed at the site.

The inverter/CCG reads the feed-in power from a meter installed at the grid connection point or reads the consumption from a meter installed at the load consumption point, and adjusts PV power production according to the preconfigured limit.

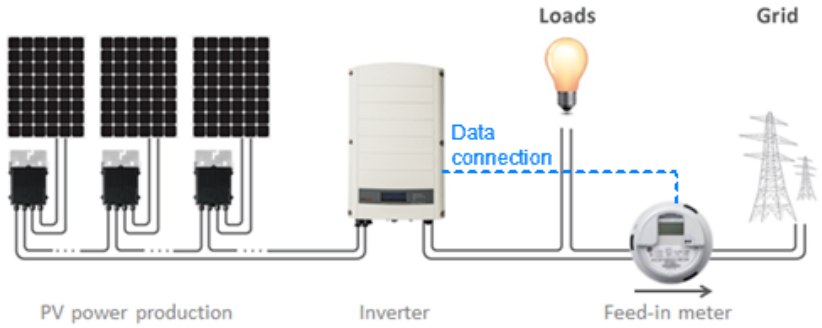


Figure 2: Typical installation with meter measuring feed-in

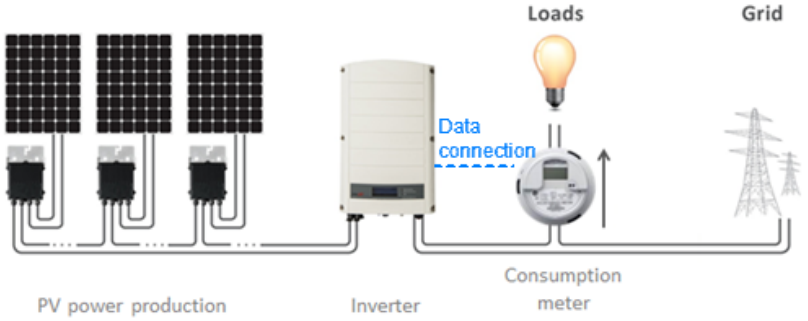


Figure 3: Typical installation with meter measuring consumption

Feed-in Limitation is managed either by an inverter or by a CCG, which is the site's smart energy manager.

The following sections describe meter types, location considerations, meter data displayed in the SolarEdge monitoring portal, and the most common connection scenarios for Feed-in Limitation.

Meter Types and Installation Considerations

Two types of meters may be used: meters with an RS485 interface, which connect to the RS485 port of an inverter/CCG, and meters with an S0 interface, which connect to the Power Control connector of an inverter/CCG.

Meters with an RS485 interface are faster in response time. They can provide instantaneous power measurement and per phase information. When installed in the feed-in location, RS485 meters provide both feed-in and purchased data.

Meters with an S0 interface may be easier to utilize when the S0 meter is already available. The precision of S0 meters may be lower and as a result their resolution and response time is undetermined. Also, in case of a communication problem with the S0 meter, the total count will be lost.

Both types of meters can be installed at the grid connection point (feed-in reading) or at the load consumption point (consumption reading) to allow Feed-in Limitation.

NOTE

When installing an S0 meter at the feed-in point, make sure that it counts the total positive energy, that is, the energy fed into the grid.

Using an RS485 meter can provide consumption information also when installed at the grid connection point.

The meter should measure all grid phases or consumption phases, that is, when a single-phase inverter is connected to a three-phase grid - a three phase meter is required.

NOTE

For installations in Australia: According to Energex and Ergon Energy Connection Guideline (reference EX BMS4286 Ver 1.1 and EE STNW1170 Ver 1.1), power limiting devices must meet the following:

- If current transformers or sensors are used, they shall have their terminals sealed.
- The terminals of the power restricting relay/management system shall also be capable of being sealed to prevent tampering with connections – this could include a Perspex cover or lockable cabinet that the equipment is housed in.

Sealing equipment is not supplied by SolarEdge.

Single Inverter System

In a single inverter system, the meter is connected directly to the inverter, which serves as the smart energy manager. You can use a meter either with an RS485 interface or with an S0 interface.

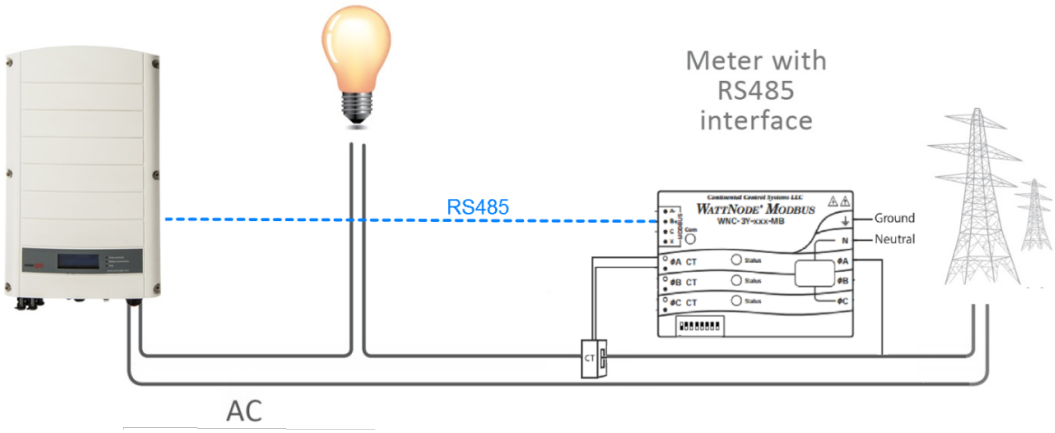


Figure 4: Single-inverter[1] connection with RS485 meter[2]

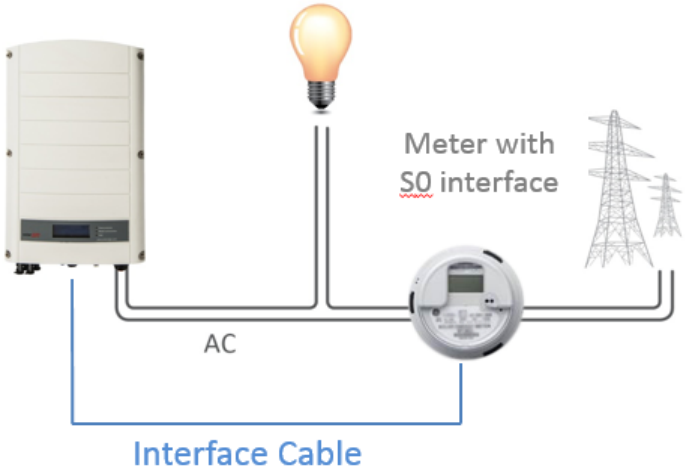


Figure 5: Single-inverter connection with S0 meter

[1] This figure shows a single phase inverter connection. For three phase inverter 3 CTs are required.
[2] The figures show a system with a meter measuring feed-in, but are applicable to systems with meters measuring consumption as well.

Multiple Inverter System

Multiple Inverter System with RS485 Meter

When using an RS485 meter for multiple inverter Feed-in Limitation, two options are available:

- The meter is connected to one of the RS485 ports of a CCG. The CCG is the smart energy manager. The CCG's second RS485 port can be used to create an RS485 bus for communication between the inverters. This option is illustrated in *Figure 6*.
- The meter is connected to the RS485 port of one of the inverters. This inverter serves as the smart energy manager. In this case, as the inverter's RS485 port is occupied by the meter, use ZigBee communication between the inverters.

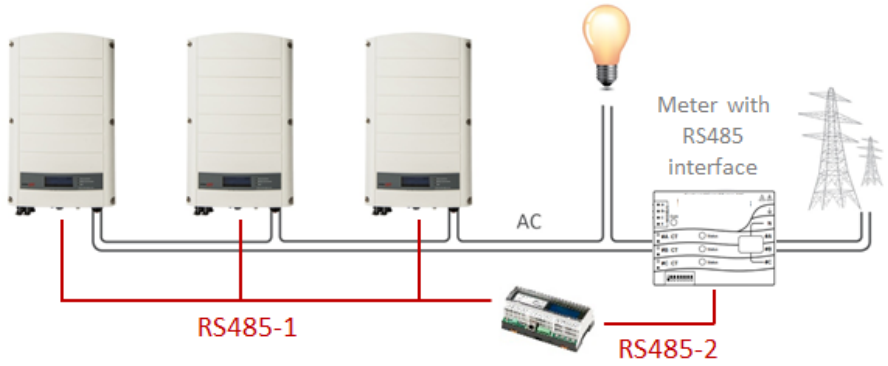


Figure 6: Multi-inverter connection with CCG, RS485 meter and RS485 communications

Multiple Inverter System with S0 Meter

When using an S0 interface meter for multiple inverter Feed-in Limitation, the meter is connected via an S0 meter adapter cable (available from SolarEdge) to one of the inverters or to a CCG. This inverter or CCG serves as the smart energy manager. RS485 or ZigBee communication can be used between the inverters.

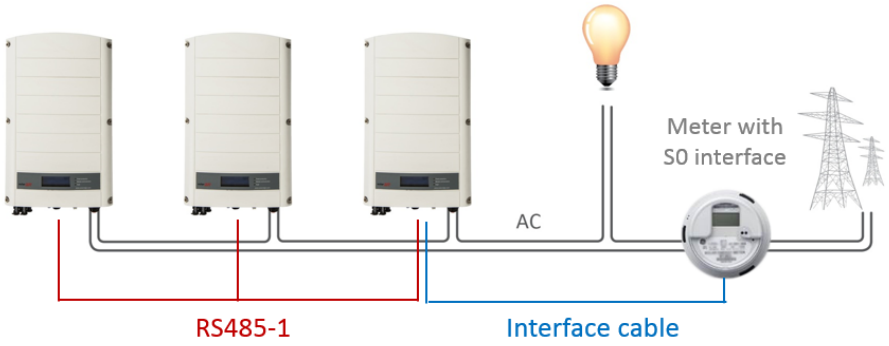


Figure 7: Multi-inverter connection with S0 meter and RS485 communications

Meter Information Displayed in the Monitoring Portal

Calculated meter readings (also referred to as "virtual meters"), such as self-consumption, are calculated using the data measured by the meter and the inverters.

The data from the inverters and from installed meters is displayed in the Dashboard and Charts tabs of the monitoring portal. The displayed data depends on the meter(s) location: grid connection point (feed-in) (See Figure 2), or load consumption point (consumption) (See Figure 3). The following tables detail the displayed information per meter location.

No meter installed:

Data	Displayed in Monitoring Dashboard	Displayed in Monitoring Charts
Production	✔	✔
Consumption	X	X
Self-consumption	X	X
Feed-in	X	X
Purchased	X	X

Meter located at load consumption point:

Data	RS485 Meter		S0 Meter	
	Displayed in Monitoring Dashboard	Displayed in Monitoring Charts	Displayed in Monitoring Dashboard	Displayed in Monitoring Charts
Production	✔	✔	✔	✔
Consumption	✔	✔	✔	✔
Self-consumption	✔ (calculated)	✔ (calculated)	✔ (calculated)	✔ (calculated)
Feed-in	X	✔ (calculated)	X	✔ (calculated)
Purchased	X	X	X	X

Meter located at grid connection point (feed-in):

Data	RS485 Meter		S0 Meter[1]	
	Displayed in Monitoring Dashboard	Displayed in Monitoring Charts	Displayed in Monitoring Dashboard	Displayed in Monitoring Charts
Production	✔	✔	✔	✔
Consumption	✔ (calculated)[2]	✔ (calculated)[2]	X	X
Self-consumption	✔ (calculated)	✔ (calculated)	✔ (calculated)	✔ (calculated)
Feed-in	X	✔	X	✔
Purchased	X	✔	X	X

[1] When installing an S0 meter at the grid connection point, make sure that it counts the total positive energy, that is, the energy fed into the grid.
[2] Available from CPU version 2.10xx/3.14xx

Chapter 3: Installation and Configuration of Meters with an RS485 Interface

Meters with an RS485 interface connect to the RS485 terminal block of the SolarEdge inverter or CCG. The next sections describe the connection of RS485 meters supported by SolarEdge devices. You can connect up to two meters on the same bus. For instructions on installation and configuration of two meters, refer to *Installing Two WattNode Meters* on page 19.

CCS WattNode Meter

CCS WattNode Meter Installation

The CCS WattNode meter is available from SolarEdge. For more details refer to the meter datasheets at http://www.solaredge.com/files/pdfs/products/se_electricity_meter.pdf and http://www.solaredge.com/files/pdfs/products/se-electricity-meter-datasheet-aus.pdf.

The system Feed-in Limitation response time depends on the meter location and on the communication method between the inverters:

- If the meter is installed at the grid connection point and RS485 bus is used for master-slave communication: 1sec.
- If the meter is installed at the grid connection point and RS485 is not used: 2-3 sec.
- If the meter is installed at the load consumption point: up to 10 sec.
- In a multi-inverter installation, if the communication between the inverters is ZigBee: up to 10 sec.

It is recommended to use a four-wire shielded twisted pair cable for this connection.

For outdoor distances longer than 10m/35 ft, always use a shielded twisted-pair cable to prevent interference. When using a shielded cable, connect the shield to earth ground at one end. It is also recommended to use an external lightning protection device on the RS485 communication cable. Refer to *External Lightning Protection Connection* on page 29 for connection example and recommendation.

To connect the AC power to the electricity meter:

For detailed information on how to install the meter and connect the AC side, refer to the meter installation manual.

NOTE

When the meter is located at the grid connection point or the load consumption point, make sure that the CTs (Current Transformers) are installed with its arrow pointing towards the grid. If the meters are intended for production reading, the CTs should be installed with the arrow pointing towards the inverter.

To connect the electricity meter to an inverter or a CCG:

The electricity meter connects to the RS485 terminal block in the inverter or in the CCG.

1. Connect the twisted pair to the meter's A- and B+ terminals, and connect the shield to the C (common) terminal. The X terminal is not used.
2. Check that the electricity meter Modbus address is set to 1 and the Baud Rate is set to 9600 bps: DIP switch 1 (left switch) is set to 1 and all other DIP switches are set to 0 – as shown in *Figure 8*.

3. When connecting to an inverter:
   - Open the inverter cover as described in its manual.
   - Remove the seal from one of the openings in communication gland #2 at the bottom of the inverter and insert the wires from the meter through the opening.
   - Connect the wires as illustrated below.

NOTE

When connecting an electricity meter to an inverter RS485 port, an RS485 master-slave inverter connection is not possible on the same bus.

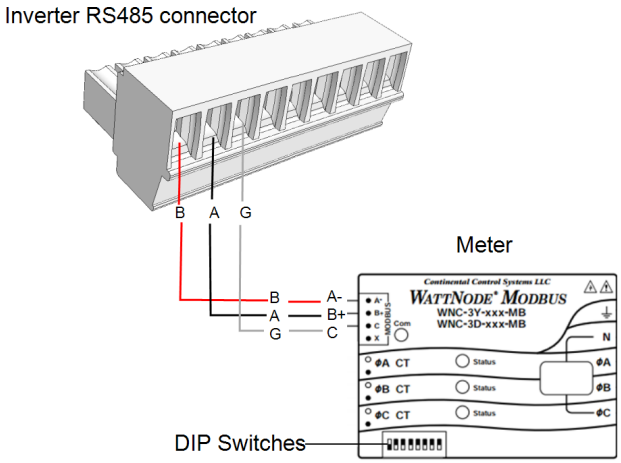


Figure 8: WattNote meter connection to the inverter RS485 connector

4. When connecting to a CCG:
   - Pull out the 3-pin RS485-2 terminal block connector.
   - Connect the wire as illustrated below.
   - Push the connector back in place.

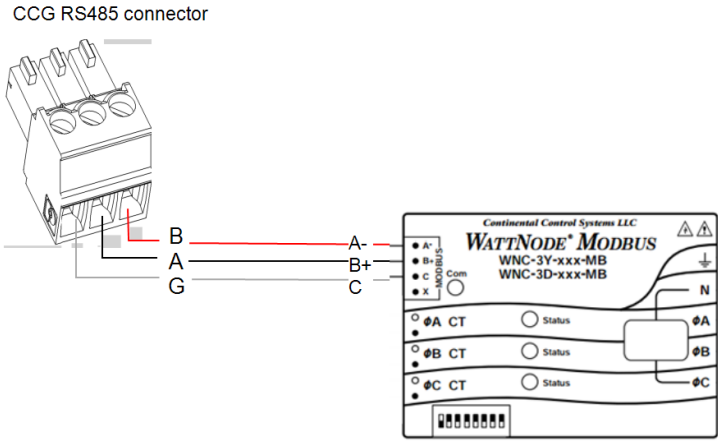


Figure 9: WattNote meter connection to the CCG RS485 connector

5. Terminate the SolarEdge device:
    - Terminate the inverter by switching a termination DIP-switch inside the inverter to ON (top position). The switch is located on the communication board and is marked SW7.
    - Terminate the CCG by switching the SW2 termination DIP-switch to ON.

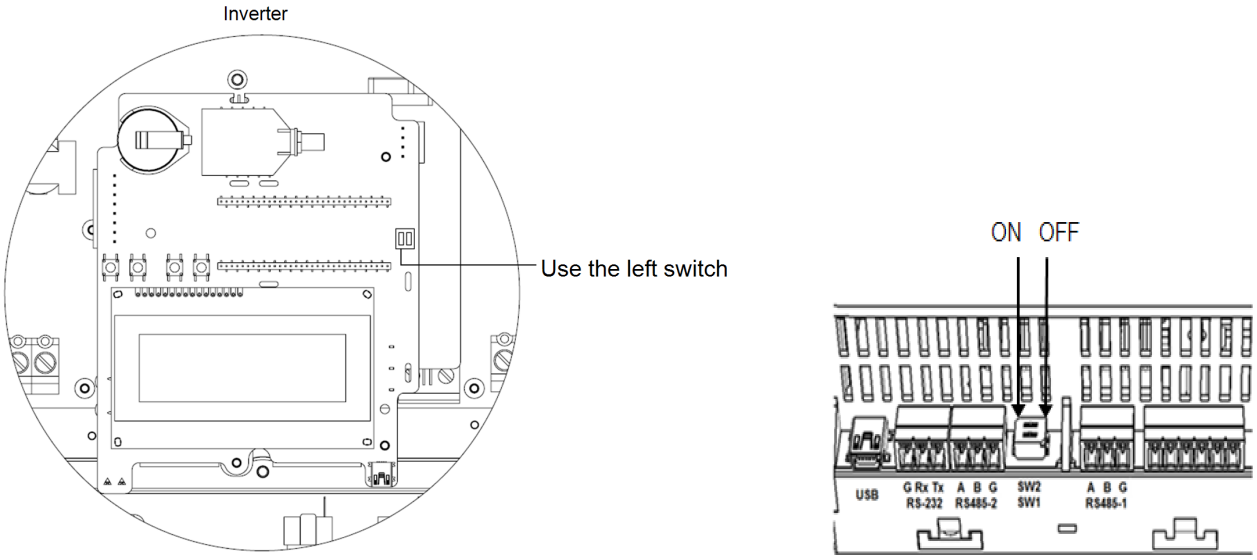


Figure 10: RS485 termination switch

CSS WattNode Meter Configuration

To configure the meter:

1. Verify that the inverter AC is turned ON.
2. If the meter is connected to an AC breaker, verify it is turned ON (the meter LEDs are lit or blinking).
3. Enter Setup mode, scroll to the **Communication** menu and select **Communication ➔ RS485-1 Conf.**
   The following screen is displayed:

```
Device Type<SE>
Protocol<M>
Device ID<1>
Slave Detect<#>
Slave List <#>
```

4. Select **Device Type**. the following screen is displayed:

```
SolarEdge <M/S>
Non-SE Logger <S>
Revenue Meter <M>
Multi-devices <M>
None
```

5. Select **Revenue Meter**, the following screen is displayed:

```
Device Type <MTR>
Protocol <WN>
Device ID <1>
CT Rating <0>
Meter Func. <None>
```

6. Configure the meter parameters as follows:
   - Select **Device Type** ➔ **Revenue Meter**.
   - Select **Protocol** ➔ **WattNode**.
   - Leave **Device ID: 1**.
   - Set the CT rating to the value that appears on the CT: **CT Rating** ➔ **<xxxxA>**. The default is 5 Amperes. If the displayed rating is 0 or you cannot change the value, there is no communication with the meter. Check that the AC power to the meter is on.
   - Select **Meter Func.**➔**Feed-in+Purchased** or **Consumption** according to meter location.

```
Feed-in+Purchased
Feed-in
Consumption
Production
Purchased
None
```

7. In the **RS485 Conf** menu, verify that the **Device ID** is set to 1 and exit Setup mode.

Verifying the Meter Connection

1. Press the Enter button or the LCD external button until the Communication status screen is displayed as shown below. This screen shows the number of external devices that communicate on each port, the device type, and the protocol to which each port was configured.
2. Verify that the setting of the relevant RS485 port is correct and that the port is communicating with the electricity meter.
   For example, if the electricity meter is connected to the RS485-1 port, the Communication status screen should display the following:

```
          Dev Prot ##
RS485-1<MTR><WN>< 1>
RS485-2<--><--><-->
ZigBee <--><--><-->
```

   Dev: the type of device configured to this port. **MTR** indicates an electricity meter

   Prot: the communication protocol: **WN** indicates a WattNode meter.

   - **WN** – WattNode meter

   ## = 1: Indicates that the connection to the electricity meter is successful.

3. Press the Enter button or the LCD external button until reaching the meter status screen showing the total energy [Wh]. If there is more than one meter/function, there is a status screen for each one. The following is an example of a feed-in meter :

```
Feed-in Meter
Status: <OK>
<Error Message>
Total[Wh]:XXXXXXX
```

   Status: Displays OK if the meter is communicating with the communication board.

   <Error message>: If an internal electricity meter error occurs, it will be displayed here. Contact SolarEdge support.

   Total [Wh]: displays the accumulated lifetime energy of the specific meter.

   If the SolarEdge device is connected to the SolarEdge server this value will also be displayed in the monitoring portal.

Chapter 4: Installation and Configuration of Meters with an S0 Interface

Meters with an S0 interface transmit energy measurements with pulses, using a dry contact relay. The pulses are then counted and represented as kWh values.

When using S0, the response time and accuracy depends on pulse resolution and pace of kWh changes; response time can be up to ~1min.

S0 meters are not provided by SolarEdge. Any meter with an S0 interface and minimum 500 pulses per kWh may be used. The meter connects directly to the smart energy manager (typically an inverter) using an S0 meter adapter cable available from SolarEdge.

The S0 meter adapter cable has an 8-pin connector on one end, which connects to the inverter/CCG, and a 2-pin connector at the other end, which connects to a cable from the meter.

The meter cable is not provided by SolarEdge. Its requirements are:

- Min. 2 wires (twisted pair). A CAT5 cable can be used.
- Wire cross section area: 0.2- 1mm² / 24-18 AWG
- Cable outer diameter range: 2-4mm / 0.08-0.16"
- Max. length: 50m / 164 ft

S0 Meter Installation

To connect the AC power to the meter:

For detailed information on how to install the meter and connect the AC side refer to the meter installation manual.

To connect the electricity meter to the inverter:

1. Open the inverter cover as described in its manual.
2. Remove the seal from one of the openings in communication gland #2 at the bottom of the inverter and insert the wires from the meter through the opening.
3. Connect the wires from the meter cable to the 2-pin connector of the S0 cable: Connect the Minus (-) wire to the S- pin and the Plus (+) to the S+ pin.

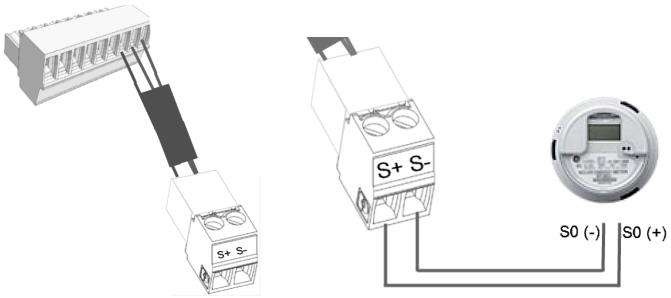


Figure 11: S0 meter connection to the S0 adapter cable

4. Check the S0 adapter cable connections for loose wires, and that S0+ and S0- are not crossed.
5. Connect the 8-pin connector of the S0 cable to the Power Control connector on the inverter communication board.

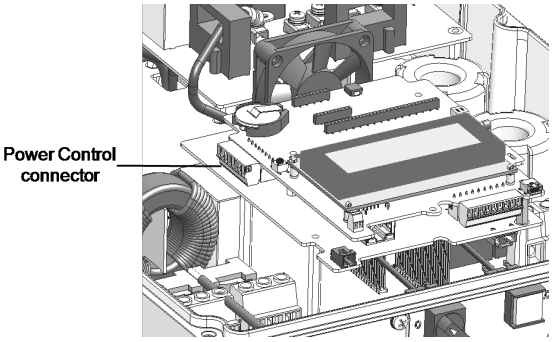


Figure 12: Inverter communication board

S0 Meter Configuration

To configure an S0 meter:

1. Enter Setup mode, scroll to the **Communication** menu and select **GPIO Conf**. The GPIO (General Purpose Input Output) Device Type screen is displayed, enabling to select the GPIO configuration options:

   ```
   Device type <RRCR>
   ```

   RRCR: GPIO is configured to work with RRCR

   S0 Meter: GPIO is configured to work with S0 meter

2. Select **Device Type** ➔ **S0 meter**. The following screen is displayed:

   ```
   Device type <MTR>
   S0 conf<NONE>
   ```

3. Select **S0 conf**. The following configuration screen is displayed:

   ```
   Meter Func.<None>
   PLS per kWh <1000>
   ```

4. Select **Meter Func.** and select either **Feed-in** or **Consumption** according to the actual meter location/measurement:

   ```
   Feed-in
   Consumption
   Purchased
   None
   ```

5. In the **S0 Conf** menu, select **PLS per kWh**. Enter a value between 250 and 10000 for the number of pulses per kWh reading, according to the installed meter specification.

6. Exit the Setup mode.

Chapter 5: Feed-in Limitation Configuration

This step should be done after installing and configuring a meter as described above.

In a multi-inverter system, the limit is configured in the smart energy manager (the inverter or CCG that is connected directly to the meter).

NOTE

The smart energy manager is the device connected to the meter. The manager does not necessarily have to be the communication master.

NOTE

Calculated meter readings (also referred to as "virtual meters"), such as self-consumption, are calculated using the data measured by the meter and the inverters. Virtual meters are only sent when Energy Manager is enabled. If virtual meter information is required, but feed-in limitation is not, the Energy Manager should be enabled without any site limit setting (default).

To configure Feed-in Limitation in the SolarEdge device:

1. Enter Setup mode, scroll down to the **Power Control** menu and select it. A menu similar to the following is displayed:

```
Grid Control <En>
Energy Manager
RRCR Conf.
Reactive Pwr Conf.
Active Pwr Conf.
Wakeup Conf.
Phase Balance <Dis>
P(f)
Advanced
Load Defaults
```

2. Select **Energy Manager**. The available Smart Energy Management options are displayed:

```
Limit Control<Dis>
Energy Control <Dis>
```

3. Select **Limit Control**. The following screen is displayed:

```
Control Mode<Dis>
Site Limit<----->
Limit Mode <Tot>
```

4. Select **Control Mode**. the following screen is displayed:

```
Feed-in Ctrl
Production Ctrl
Disable
```

5. Select **Feed-in Ctrl**.[1]

6. In the **Limit Control** menu select **Site Limit** and enter the limit value at the connection point, in kW. The default value is none (-----), which means that the system is not limited.

```
Set Site Limit[kW]

xxxxxxx.xxx
```

NOTE

The value you enter here is the overall limit to which the site feed-in will be restricted, whether you use the Total or Per Phase limit control modes (as explained in the next step).

[1] Production Control, which limits the system production, may also be selected. For more information, refer to the Production Limitation Application Note.

7. *If using an RS485 meter:*
   a. In the **Limit Control** menu, select **Limit Mode**. The following is displayed:

```
Total

Per Phase
```

   Per Phase: For three phase grid connections, the inverter sets the limit on each phase to 1/3 of the total plant limit. Use this mode if there is a limit on each individual phase.

   Total: The Site Limit is the total feed-in power on all the phases combined. Reverse current on one phase will count as negative power and can compensate for another phase.

   b. Select one of the limit modes above. The selected mode is displayed in the Limit Control screen as **<PH>** for phase or **<Tot>** for total.

   For an example of setting the site limit value, refer to *Appendix C*.

To verify Feed-in Limit operation:

1. Press the Enter button or the LCD external button until reaching the Smart Energy Manager status screen, showing the site level data:

```
Site Limit:    7.0kW
Site Prod:    10.0kW
Site Feed:     4.0kW
Self-consume:  6.0kW
```

   Site Limit: The limit that was defined for the site

   Site Prod: The power produced by the site

   Site Feed: The power that is fed into the grid

   Self-consume: The PV power consumed by the site

NOTE

If you installed an S0 meter, check the Self-Consume line in order to verify the meter connection: assuming the system has production and consumption, the value in this line should display constant changes. If not, check the physical connections of the meter .

2. Check the Power Control status screen of any inverter:

```
PWR CTRL: REMOTE
PWR Limit: 10.04kW
Cos Phi: 0.9
Power Prod:7000W
```

   PWR CTRL: The power control status:

   - **REMOTE** - Communication with the smart energy manager is confirmed/validated. This status should appear in all inverters.
   - **LOCAL** - The power is controlled locally (e.g. by a fixed limit), or this inverter limits the PV power production to its relative portion of the feed-in power limit, as a result of disconnected communication with the smart energy manager. If this status appears, check the communication to the smart energy manager or the communication to the meter.

   Cos Phi: The ratio between active to reactive power

   Power Prod: The power produced by the inverter

   PWR Limit: The inverter maximum output power set by the smart energy manager

Appendix A: Troubleshooting Meter Connection

SolarEdge revenue grade inverters have a built in Revenue Grade Meter (RGM). This section describes how to troubleshoot meter-related installation and performance errors.

Communication Status Screen Troubleshooting

The meter configuration is set automatically when activating the inverter using the activation card. The communication status screen should display the following:

```
          Dev  Prot  ##
RS485-1<MTR><WN><  1>
RS485-2<---><--><-->
 ZigBee  <---><--><-->
```

For troubleshooting dual-meter connection, refer to *Installing Two WattNode Meters* on page 19.

Device Type and Protocol are configured incorrectly

If **MTR** (meter) is not displayed as the device type (DEV), and **WN** (WattNode) is not displayed as the Prot (protocol), the inverter preconfiguration has been overriden. This may be a result of inverter activation or communication board replacement without backing-up and reloading the parameters.

Configure the meter as follows:

1. Select **Communication ➔ RS485-1 Conf ➔ Device Type ➔ Revenue Meter**.
2. Select **Communication ➔ RS485-1 Conf ➔ Protocol ➔ WattNode.**
3. Select **Revenue Meter ➔ Meter Func. ➔ Production**.
4. Check that the Device ID under **Communication ➔ RS485-1 Conf ➔ Device ID** is set to 1.

Number of devices is not displayed

If **<-->** is displayed under the ## column in the Communication status screen shown above, the meter is not communicating with the inverter. Check the following:

- For WattNode meters - Check the physical RS485 Modbus address and baud rate DIP switch setting: The RGM first DIP-switch from the left is in 1 position; the rest are in 0 position.
- The meter configuration is as described above.
- There are no loose connections at the inverter connectors and at the meter, specifically the RS485 wiring.
- The wiring between the black 4-pin terminal block on the meter and the RS485 terminal block on the communication board is correct, as shown below.

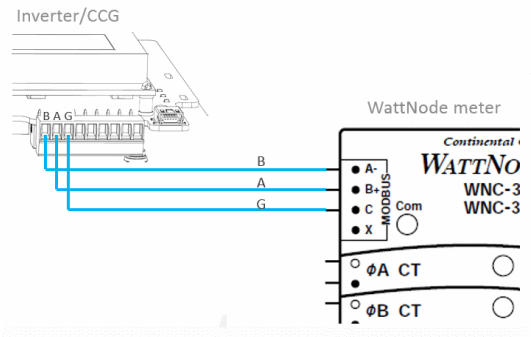


Figure 13: RS485 connection

- Use a Voltmeter to measure the voltage on the meter 10-pin terminal block . The L1 – L2 line to line voltage should be 240 Vac ± 10%.

Meter Status Screen Troubleshooting

<OK> is not displayed

If **<OK>** is not displayed in the Status line of the status screen shown above, the meter is not communicating with the inverter communication board. Check the following:

- There are no loose connections at the inverter communication board and at the meter.
- The wiring between the black 4-pin terminal block on the meter and the RS485 terminal block on the communication board is correct (See Figure 13).

An error message is displayed

- If **Comm. Error** is displayed, verify proper connection of:
  - The RS485 cables and connectors
  - The AC connection of the meter
- If a different error message is displayed in the meter status screen, contact SolarEdge support (support@solaredge.com).

Total [Wh] value is not advancing

If the Total [Wh] value displays a steady value although the the site is consuming power, check the following:

- There are no loose connections at the inverter connectors and at the meter, specifically the AC wiring on the meter 10-pin connector.
- The CT black and white cables are correctly connected to the 6-pin connector on the meter:
  - White CT wire is connected to A white
  - Black CT wire is connected to A black

Figure 14: Meter Connections

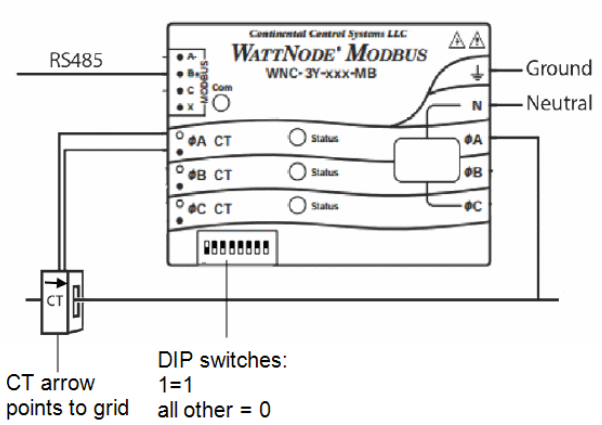


Figure 15: Meter Connection diagram

Status LEDs in WattNode Meter

The three status LEDs on the front of the meter can help indicate correct measurements and operation.

- Normal operation indications:
  - At normal startup - when power is first applied, all LEDs light up sequentially for 1 sec.
  - The following table describes LED indications during normal operation:

LED color	Function	Indication
Red	Flashing ON/Off	Negative power to the phase. Appears only when the meter is connected in the grid connection point (CT directed towards the grid). Indicates feed-in power measurement.
Yellow	Flashing	Communication OK
Green	Flashing ON/OFF	Positive power to the phase. ◦ When the meter is connected at the grid connection point it indicates purchased power measurement (CT directed towards the grid). ◦ When the meter is connected at the load connection point it indicates consumption power measurement (CT directed towards the grid). ◦ When the meter is used for production it indicates power measurement (CT directed toward the inverter).
	ON for >3 sec	No current flow (zero current)

- Abnormal operation indications:
  - If all LEDs are off – the meter is not operating.
  - The following table describes additional LED indications that require troubleshooting and repair.

LED color	Function	Indication	Troubleshooting
Red	ON for >3 sec.	Internal error	Contact SolarEdge Support.
	Flashing ON/OFF	Negative power for the phase	If the meter is connected at the load connection point or if the meter is used for production metering, check for reversed CTs, swapped CT wires, or CTs not matched with line voltage phases.
	Flashing with green LED	Voltage is too high for this model	Disconnect power immediately! Check the line voltages and the meter ratings.
	Flashing with yellow LED	The line voltage is too low for the meter to operate correctly and the meter reboots repeatedly.	Verify that the voltage on the Vac screw terminals is more than 20% of the nominal operating voltages printed in the white rectangle on the front label.
Yellow	ON for >3sec.	Power line frequency is below 45 Hz or above 70 Hz.	Check for the presence of high noise, for example, the meter is too close to an unfiltered variable frequency drive.
	Flashing with red LED	Voltage is too high for this model	Disconnect power immediately! Check the line voltages and the meter ratings.

Appendix B: Installing Two WattNode Meters

You can connect up to two WattNode meters on the same bus.

Connecting Two Meters

To connect two meters:

1. Connect the twisted pair of wires to the meters as shown in *Figure 16*.
2. Connect the meters to the inverter or CCG RS485 connector as illustrated below.

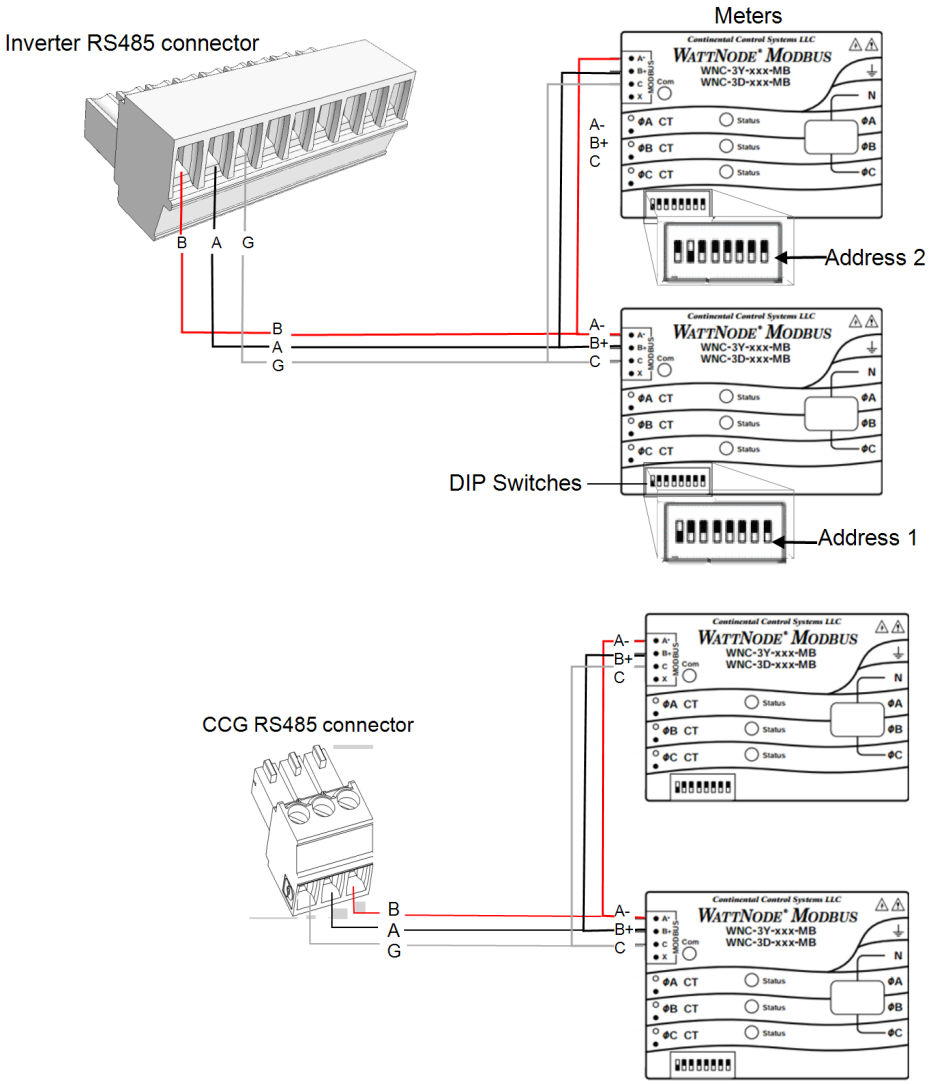


Figure 16: WattNote meters connection to the inverter and CCG RS485 connector

3. Check that the Modbus address of one of the meters is set to 1 and the Baud Rate is set to 9600 bps: DIP switch 1 (left switch) is set to 1 and all other DIP switches are set to 0.
4. Set the other meter to a different address 2: Move DIP switch 2 (second from left) to 2, and all other switches to 0].

5. Terminate the SolarEdge device:
    - *Inverter* - Terminate by switching a termination DIP-switch inside the inverter to ON (top position). The switch is located on the communication board and is marked SW7.
    - *CCG* - Terminate by switching the SW2 termination DIP-switch to ON.

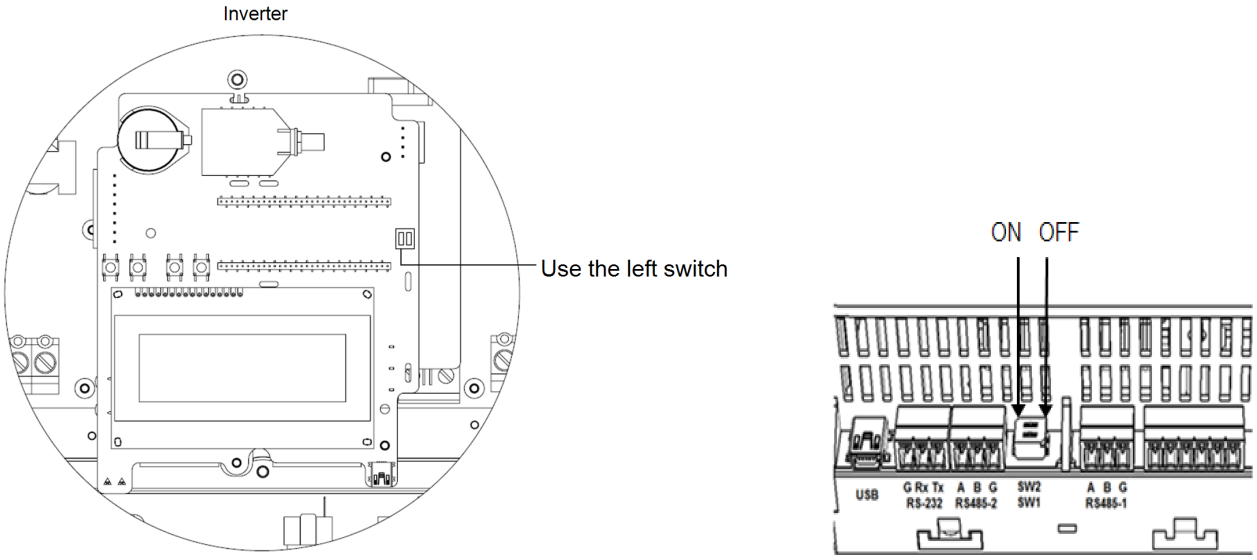


Figure 17: RS485 termination switch

Configuring Dual-meter Connection

1. Verify that the inverter AC is turned ON.
2. If the meter is connected to an AC breaker, verify it is turned ON (the meter LEDs are lit or blinking).
3. Enter Setup mode, scroll to the **Communication** menu and select **Communication ➔ RS485-1 Conf.**
   The following screen is displayed:

```
Device Type<SE>
Protocol<M>
Device ID<1>
Slave Detect<#>
Slave List <#>
```

4. Select **Device Type**. the following screen is displayed:

```
SolarEdge
Non-SE Logger <SE>
Revenue Meter <M>
Multi Devices <M>
```

5. Select **Multi Devices**. The following screen is displayed:

```
Device Type <MLT>
Device 1 <MTR>
Device 2 <---->
```

6. Configure the parameters of the two meters as follows. Make sure that the meter addresses (set in the previous section) correspond with the device IDs and meter functions in the setting below. The settings provided herein are an example of a production meter set to address 1 and a feed-in+purchased meter set to address 2.
   - Select **Device 1**. The following is displayed:

     ```
     Device Type <MTR>
     Protocol <WN>
     Device ID <1>
     CT Rating <0>
     Meter Func. <None>
     ```

     - Select **Device Type ➔ Revenue Meter**.
     - Select **Protocol ➔ WattNode**.
     - Leave **Device ID: 1**.
     - Set the CT rating to the value that appears on the CT: **CT Rating ➔ <xxxxA>**. The default is 5 Amperes. If the displayed rating is 0 or you cannot change the value, there is no communication with the meter. Check that the AC power to the meter is on.
     - Select **Meter Func.➔Production**.
   - Select **Device 2** and configure its settings:
     - Select **Device Type ➔ Revenue Meter**
     - Select **Protocol ➔ WattNode**
     - Set **Device ID ➔ 2**
     - Set **CT Rating ➔ <xxxxA>**
     - Select **Meter Func.➔ Feed-in+Purchased**

Verifying Meter Connection

1. Press the Enter button or the LCD external button until the Communication status screen is displayed as shown below. When two meters are connected, a screen similar to the following should appear:

   ```
            Dev Prot ##
   RS485-1<MLT><02><00>
   RS485-2<---><--><-->
    ZigBee <---><--><-->
   ```

   Dev: The type of device configured to this port. **MLT** indicates two (multiple) meters.

   Prot: The number of configured meters.

   ## : The number here indicates the number of communicating meters. For dual meters it should display 2. If not, refer to *Troubleshooting* below.

2. Press the Enter button or the LCD external button until reaching the Meter status screen showing the total energy [Wh]. There is a status screen for each meter function. For example, for a feed-in+purchased meter and a production meter, there will be three status screens: for feed-in, purchased and production. The following is an example of a feed-in meter:

   ```
   Feed-in Meter
   Status: <OK>
   <Error Message>
   Total[Wh]:XXXXXXX
   ```

   Status: Displays OK if the meter is communicating with the communication board.

   <Error message>: If an internal electricity meter error occurs, it will be displayed here. Contact SolarEdge Support.

   Total [Wh]: The amount of Watts per hour of the designated meter.

   If the SolarEdge device is connected to the SolarEdge server this value will also be displayed in the monitoring portal.

Troubleshooting Dual-meter Connection

Communication Status Screen Troubleshooting

When two meters are connected, the following should appear in the Communication status screen:

```
          Dev  Prot  ##
RS485-1<MLT><02><02>
RS485-2<---><--><-->
ZigBee  <---><--><-->
```

Device Type and Protocol are configured incorrectly

If **MLT** (Multi) is not displayed as the device type (DEV), and **2** is not displayed as the number of meters under Prot (protocol), configure the meter as follows:

1. Select **Communication** ➔ **RS485-1 Conf** ➔ **Device Type** ➔ **Multi Devices**. Select **Device 1** or **Device 2**.
2. Select **Communication** ➔ **RS485-1 Conf** ➔ **Protocol** ➔ **WattNode.**
3. Select **Revenue Meter** ➔ **Meter Func.** ➔ **Production** or **Feed-in+Purchased**.
4. Check that the Device ID under **Communication** ➔ **RS485-1 Conf** ➔ **Device ID** is set to 1 or 2.

Number of devices is lower than configured or not displayed

If **<-->** or **<01>** is displayed under the ## column in the Communication status screen shown above, the meter is not communicating with the inverter. Check the following:

- Check the RS485 Modbus address and baud rate DIP switch settings: For meter with address 1 - its first DIP-switch from the left is in 1 position; the rest are in 0 position; for the meter with address 2 - its second from the left DIP-switch is in 2 position and the rest are 0.
- The meter configuration is as described above.
- There are no loose connections at the inverter connectors and at the meter, specifically the RS485 wiring.

Meter Status Screen Troubleshooting

When two meters are connected, there will be a status screen for each meter function, as described above. For example :

```
Feed-in Meter
Status: <OK>
<Error Message>
Total[Wh]:XXXXXXX
```

<OK> is not displayed

If **<OK>** is not displayed in the Status line of the status screen shown above, the meter is not communicating with the inverter communication board. Check the following:

- There are no loose connections at the inverter communication board and at the meter.
- The wiring between the black 4-pin terminal block on the meter and the RS485 terminal block on the Inverter communication board is correct (see *Figure 13*).

An error message is displayed

- If **Comm. Error** is displayed, verify proper connection of:
  - The RS485 cables and connectors
  - The AC connection of the meter
- If a different error message is displayed in the meter status screen, contact SolarEdge support (support@solaredge.com).

Total [Wh] value is not advancing

If the Total [Wh] value displays a steady value although the the site is consuming power, check the following:

- The LED are lit (refer to *Status LEDs in WattNode Meter* on page 18).
- There are no loose connections at the 10-pin AC wiring of the meter .
- The CT black and white cables are correctly connected to the 6-pin connector on the meter:
  - White CT wire is connected to A white
  - Black CT wire is connected to A black

Appendix C: Examples of Total and Per Phase Limitation

The following examples illustrate the behavior of a system with feed-in limitation when using the **Total** and the **Per Phase** Limit Mode options described in *Feed-in Limitation Configuration* on page 14, step 7.

- **Total**: The Site Limit is the total feed-in power on all the phases combined, that is, the combined production minus the combined consumption, as represented in the formula below. Reverse current on one phase will count as negative power and can compensate for another phase.

$$Feed-in_{Total} = \sum_{x=1}^{3} Production_{phase(x)} - \sum_{x=1}^{3} Consumption_{phase(x)}$$

- **Per Phase**: Each phase will be limited to 1/3 of the configured site limit, that is, the feed-in power is the sum of the production minus the consumption of each phase, as represented in the formula below. The division of the limit to the 3 phases is done internally; the user enters the total site limit.

$$Feed-in_{PerPhase} = \sum_{x=1}^{3} (Production_{phase(x)} - Consumption_{phase(x)})$$

The example system has 12kW DC power connected to a three-phase inverter with a maximum AC power of 10kW.

In each example, the Site Limit and Limit Mode configuration is detailed. Each example includes various production and consumption scenarios and details how the feed-in, consumption and purchased power values are influenced by the conditions. The tables in each scenario detail the following values:

- Potential PV Production
- Consumption (load)
- Production
- Feed-in
- Self-consumption
- Purchased power

In addition, the Smart Energy Management status screen is presented with the values applicable to each scenario.

Example 1 - 70% Feed-in Limit, Total Limit Mode

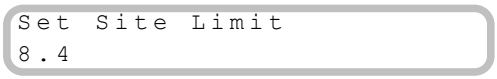
In this example, the system feed-in power limit is set to 70% of max DC power, that is, to 70% x 12kW = 8.4kW, and the **Total** Limit Mode is used.

NOTE

Systems in Germany complying with the EEG2012 70% limitation would be configured using the Total option.

To configure this setting:

1. Enter 8.4 in the **Set Site Limit** screen (refer to *Feed-in Limitation Configuration* on page 14):



2. Select **Limit Control** ➔ **Limit Mode** ➔ **Total**.

Scenario A

PV potential is greater than the loads, which are not distributed evenly across the 3 phases.

The loads are powered from the PV only, and the excess PV power is fed into grid.

PV production is not limited, because the feed-in power is lower than the limit.

	Phase 1 [kW]	Phase 2 [kW]	Phase 3 [kW]	Total [kW]
Potential PV Production	3.33	3.33	3.33	10
Consumption (load)	3	3	0	6
Production	3.33	3.33	3.33	10
Feed-in	Max (∑Production – ∑Consumption, 0) = Max(4,0)			4
Self-consumption	Min (∑Production, ∑Consumption) = Min(10,6)			6
Purchased	∑Consumption – ∑Self consumption			0

The Smart Energy Manager status screen displays the following:

```
Site Limit:   8.4kW
Site Prod:    10.0kW
Site Feed:     4.0kW
Self-consume: 6.0kW
```

Scenario B

PV potential is equal to the loads, which are not balanced across the 3 phases.

The loads are powered from the PV only.

Although on phase 1 the consumption is greater than the production, the difference is compensated for by phase 3, where the production is greater than the consumption. Therefore, PV production is not limited, because there is no feed-in power.

	Phase 1 [kW]	Phase 2 [kW]	Phase 3 [kW]	Total [kW]
Potential PV Production	2	2	2	6
Consumption (load)	3	2	1	6
Production	2	2	2	6
Feed-in	Max (∑Production – ∑Consumption, 0) = Max(0,0)			0 (no feed in)
Self-consumption	Min (∑Production, ∑Consumption) = Min(6,6)			6
Purchased	∑Consumption – ∑Self consumption			0

The Smart Energy Manager status screen displays the following:

```
Site Limit:    8.4kW
Site Prod:     6.0kW
Site Feed:     0.0kW
Self-consume:  6.0kW
```

Scenario C

PV potential is lower than the loads, which are not balanced across the 3 phases.

The loads are powered from the PV and from the grid.

PV production is not limited, because there is no feed-in power.

	Phase 1 [kW]	Phase 2 [kW]	Phase 3 [kW]	Total [kW]
Potential PV Production	1.66	1.66	1.66	5
Consumption (load)	3	2	1	6
Production	1.66	1.66	1.66	5
Feed-in	Max (∑Production – ∑Consumption, 0) = Max(0,0)			0 (no feed-in)
Self-consumption	Min (∑Production, ∑Consumption) = Min(5,6)			5
Purchased	∑Consumption – ∑Self consumption			1

The Smart Energy Manager status screen displays the following:

```
Site Limit:    8.4kW
Site Prod:     5.0kW
Site Feed:    0.0kW
Self-consume: 5.0kW
```

Scenario D

PV potential is greater than the loads, which are not balanced across the three phases.

The loads are powered from the PV only, and the excess PV power is fed into grid. In addition, PV production is limited to maintain the feed-in

limit.

	Phase 1 [kW]	Phase 2 [kW]	Phase 3 [kW]	Total [kW]
Potential PV Production	3.33	3.33	3.33	10
Consumption (load)	1	0	0	1
Production	3.13	3.13	3.13	9.4
Feed-in	Max (∑Production – ∑Consumption, 0) = Max (8.4,0)			8.4
Self-consumption	Min (∑Production, ∑Consumption) = Min (9.4,1)			1
Purchased	∑Consumption – ∑Self consumption			0

The Smart Energy Manager status screen displays the following:

```
Site Limit:    8.4kW
Site Prod:     9.4kW
Site Feed:     8.4kW
Self-consume: 1.0kW
```

Example 2 – 0W Feed-in Limit, Per Phase Limit Mode

In this example the system feed-in power limit is set to 0W – no feed into the grid, and the Per Phase Limit Mode is used.

NOTE

Systems in Australia complying with zero export regulations would be configured with a Site Limit of 0 and using the Per Phase option.

To configure this setting:

1. Enter 0.0 in the **Set Site Limit** screen (refer to *Feed-in Limitation Configuration* on page 14):

```
Set Site Limit
0.0
```

2. Select **Limit Control** ➔ **Limit Mode** ➔ **Per Phase**.

Scenario A

PV potential is lower than the loads, which are distributed evenly across the 3 phases.

The loads are powered from the PV and from the grid.

PV production is not limited, because there is no feed-in power.

	Phase 1 [kW]	Phase 2 [kW]	Phase 3 [kW]	Total [kW]
Potential PV Production	3.33	3.33	3.33	10
Consumption (load)	4	4	4	12
Production	3.33	3.33	3.33	10
Feed-in	0	0	0	0
	Σ [Max (Production – Consumption, 0)] = Σ [Max (-0.66,0) (-0.66,0) (-0.66,0)]			
Self-consumption	3.33	3.33	3.33	10
	Σ [Min (Production, Consumption)] =Σ [Min (3.33,4) (3.33,4) (3.33,4)]			
Purchased	∑Max(Consumption – Self consumption – Feed-in, 0)			2

The Smart Energy Manager status screen displays the following:

```
Site Limit:      0.0kW
Site Prod:      10.0kW
Site Feed:       0.0kW
Self-consume:   10.0kW
```

Scenario B

PV potential is greater than the loads, which are not balanced across the 3 phases.

To maintain a 0W feed-in limit for each phase individually, the production on phase 3 must be limited. Since the three phase inverter is always

phase-balanced, the production on phases 1 and 2 is limited accordingly.

	Phase 1 [kW]	Phase 2 [kW]	Phase 3 [kW]	Total [kW]
Potential PV Production	3.33	3.33	3.33	10
Consumption (load)	4	3	1	8
Production	1	1	1	3
Feed-in	0	0	0	0
	Σ [Max (Production – Consumption, 0)] = Σ [Max (-3,0) (-2,0) (0,0)]			
Self-consumption	1	1	1	3
	Σ [Min (Production, Consumption)] =Σ [Min (1,4) (1,3) (1,1)]			
Purchased	∑Max(Consumption – Self consumption – Feed-in, 0)			5

The Smart Energy Manager status screen displays the following:

```
Site Limit:      0.0kW
Site Prod:       3.0kW
Site Feed:     0.0kW
Self-consume:    3.0kW
```

Example 3 – 3kW Feed-in Limit, Per Phase Limit Mode

In this example, the system feed-in power limit is set to 3kW, and the Per Phase Limit Mode is used. This means that the feed-in power on each phase is limited to 1kW.

NOTE

Systems in Netherlands connected to an AC panel with 3x80A main fuses would be configured using the Per Phase option, with a 55kW Site Limit.

To configure this setting:

1. Enter 3.0 in the **Set Site Limit** screen (refer to *Feed-in Limitation Configuration* on page 14):

```
Set Site Limit
3.0
```

2. Select **Limit Control➔ Limit Mode➔Per Phase**.

Scenario A

PV potential is lower than the loads, which are distributed evenly across the 3 phases.

The loads are powered from the PV and from the grid.

PV production is not limited, because there is no feed-in power.

	Phase 1 [kW]	Phase 2 [kW]	Phase 3 [kW]	Total [kW]
Potential PV Production	3.33	3.33	3.33	10
Consumption (load)	4	4	4	12
Production	3.33	3.33	3.33	10
Feed-in	0	0	0	0
	Σ [Max (Production – Consumption, 0)] = Σ [Max (-0.66,0) (-0.66,0) (-0.66,0)]			
Self-consumption	3.33	3.33	3.33	10
	Σ [Min (Production, Consumption)] =Σ [Min (3.3,4) (3.3,4) (3.3,4)]			
Purchased	∑Max(Consumption – Self consumption – Feed-in, 0)			2

The Smart Energy Manager status screen displays the following:

```
Site Limit: 3.0kW
Site Prod: 10.0kW
Site Feed: 0.0kW
Self-consume: 10.0kW
```

Scenario B

PV potential is greater than the loads, which are not balanced across the 3 phases

To maintain a 1kW feed-in limit for each phase individually, the production on phase 3 must be limited. Since the three phase inverter is always phase-balanced, the production on phases 1 and 2 is limited accordingly.

	Phase 1 [kW]	Phase 2 [kW]	Phase 3 [kW]	Total [kW]
Potential PV Production	3.33	3.33	3.33	10
Consumption (load)	4	3	1	8
Production	2	2	2	6
Feed-in	0	0	1	1
	Σ [Max (Production – Consumption, 0)] = Σ [Max (-2,0) (-1,0) (1,0)]			
Self-consumption	2	2	1	5
	Σ [Min (Production, Consumption)] =Σ [Min (2,4) (2,3) (2,1)]			
Purchased	∑Max(Consumption – Self consumption – Feed-in, 0)			2

The Smart Energy Manager status screen displays the following:

```
Site Limit: 3.0kW
Site Prod: 6.0kW
Site Feed: 1.0kW
Self-consume: 5.0kW
```

Scenario C

PV potential is greater than the loads, which are not balanced across the 3 phases.

To maintain a 1kW feed-in limit for each phase individually, the production on phase 3 must be limited. Since the three phase inverter is always phase-balanced, the production on phases 1 and 2 is limited accordingly.

In this scenario, despite the system production being limited as in the previous scenario, the limitation is less severe because the loads are more balanced, and this allows increased self-consumption.

	Phase 1 [kW]	Phase 2 [kW]	Phase 3 [kW]	Total [kW]
Potential PV Production	3.33	3.33	3.33	10
Consumption (load)	3	2	2	7
Production	3	3	3	9
Feed-in	0	1	1	2
	Σ [Max (Production – Consumption, 0)] = Σ [Max (0,0) (1, 0) (1, 0)]			
Self-consumption	3	2	2	7
	Σ [Min (Production, Consumption)] =Σ [Min (3,3) (3,2) (3,2)]			
Purchased	∑Max(Consumption – Self consumption – Feed-in, 0)			0

The Smart Energy Manager status screen displays the following:

```
Site Limit:      3.0kW
Site Prod:       9.0kW
Site Feed:       2.0kW
Self-consume:    7.0kW
```

Appendix D: External Lightning Protection Connection

Protection devices are most often installed from each data line to the local earth ground, and should be selected to begin conducting current at a voltage as close to the system's normal communication level as possible, but never lower. For RS485 communication lines, the selected voltage rating is typically 6-8 V. Transient suppressors should be installed as close as possible to the port that is being protected, and the user must provide an extremely low impedance connection to the local earth ground of the SolarEdge device. This ground connection is crucial for proper suppression device operation. The ground connection should be made using a heavy gauge wire and kept as short as possible. If the cable between the SolarEdge device and the protection device must be longer than 1m/3.3 ft., a copper strap or a braided cable intended for grounding purposes must be used for the protection device to be effective. In addition to the high frequency nature of transients, extremely high current may flow.

A protective device with surge discharge ratings of **In**: 10kA 8/20µs and **Imax**: 20kA 8/20µs is recommended.

Various lightning protection devices are available for RS485 communication lines.

The diagram below shows a connection example using the ISKRA ZAŠČITE **VM-RS 485** data protocol protection device. A detailed datasheet can be found at: http://iskrazascite.si/uploads/datasheet/1396000869.pdf.

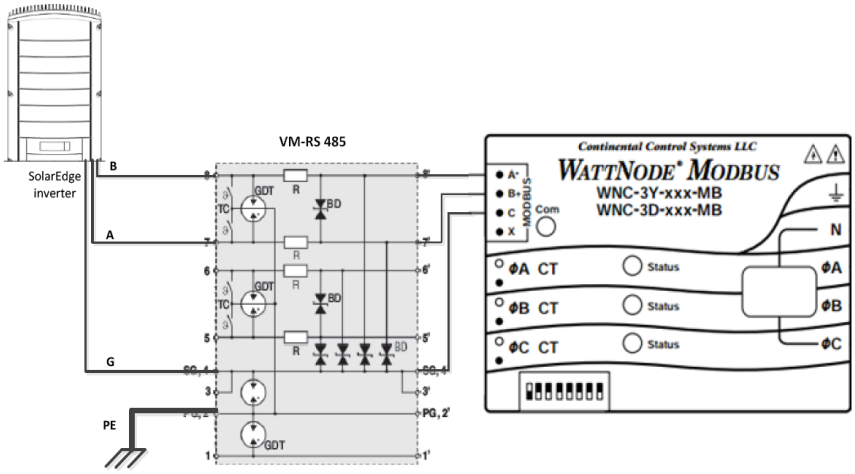


Figure 18: Protection connection