Managing an Alternative Power Source with a Power Plant Controller

Version 1.5
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Managing an Alternative Power Source with a Power Plant Controller
Emission Compliance

This equipment has been tested and found to comply with the limits applied by the local regulations.

These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates, uses and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, you are encouraged to try to correct the interference by one or more of the following measures:

- Reorient or relocate the receiving antenna.
- 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.
Version History

- Version 1.5 (July 2020) – updated connection scheme in Figure 3
- Version 1.4 (April 2020):
  - Updated configuration UI
  - Added section – Dynamic Site Limitation configuration
  - Added Appendix – debug mode configuration
- Version 1.3 (January 2020) – added IOD (Input/Output Driver) algorithm
- Version 1.2, December 2019 – support for external configuration file
- Version 1.1, November 2019 – updated IOD software configuration procedure
- Version 1.0, November 2019 – first release
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Handling and Safety Instructions

During installation, testing and inspection, adherence to all the handling and safety instructions is mandatory. Failure to do so may result in injury or loss of life and damage to the equipment.

Safety Symbols Information

The following safety symbols are used in this document. Familiarize yourself with the symbols and their meaning before installing or operating the system.

**WARNING**

Denotes a hazard. It calls attention to a procedure that, if not correctly performed or adhered to, could result in injury or loss of life. Do not proceed beyond a warning note until the indicated conditions are fully understood and met.

**CAUTION!**

Denotes a hazard. It calls attention to a procedure that, if not correctly performed or adhered to, could result in damage or destruction of the product. Do not proceed beyond a caution sign until the indicated conditions are fully understood and met.

**NOTE**

Denotes additional information about the current subject.

**IMPORTANT SAFETY FEATURE**

Denotes information about safety issues.

Disposal requirements under the Waste Electrical and Electronic Equipment (WEEE) regulations:

**NOTE**

Discard this product according to local regulations or send it back to SolarEdge.
Introduction

Energy-generation systems (such as PV inverters) connected to the grid may include different types of energy generating sources. In some cases, when grid power is disconnected, PV inverters should operate in parallel with other voltage sources, such as diesel generators. In this document, “generator” is used as a general term for such sources.

When inverters operate concurrently with generators, they may be subjected to voltage and frequency fluctuations that exceed trip settings, which are preset according to regional grid connection requirements. To support simultaneous operation of the inverter and a generator, the inverter extends its voltage and frequency operating range once it receives a signal that the grid is unavailable (“Alternative Power Source mode”). When the grid power is restored, the inverter automatically reverts to its default country setting, which includes the original voltage and frequency operating range.

This document describes how to configure a Power Plant Controller (PPC) for use with SolarEdge inverters and for simultaneous operation with a generator.

System Requirements

Alternative Power Source (APS) or Diesel Generation (DGM) mode is supported by SolarEdge inverters as follows:

- Inverters using SetApp: CPU version 4.8.xxx or higher
- Inverters with display: CPU version 3.25xx or higher

To check the inverter’s CPU version, see Appendix A.

The generator must be able to support the entire load independently. The generator must not work in parallel with the grid (either grid or generator supply the power). The generator connected to the PPC must have dry contact discrete outputs.

NOTE

Due to the possibility of a loss of power for a second or more on the site during a state change, it is highly recommended to install a UPS and connect it to the PPC.
System Overview

One or more diesel generators can be used to independently support a power system or be switched on as backup if grid power is unavailable. In the system described here, a single generator is used, together with an Automatic Transfer Switch (ATS). Multiple inverters may be connected in an RS485 bus using the Modbus protocol for communication. The generator is connected to the master inverter via a PPC (Power Plant Controller), communicating via Modbus over TCP or RTU.

Figure 1: Power Plant Controller
The PPC serves as a load manager that ensures that power generating sources are managed in the most efficient and effective way. The Modbus protocol (over TCP or TRU) is used for communication between the PPC and the inverter. Connection of more than one generator can be achieved via the PPC.

When grid power is lost, the ATS switches to diesel generator power. The generator or ATS sends an ON indication to the PPC, which sends an ON signal to the master inverter. Upon receiving the signal, the master inverter starts operating in Alternative Power Source/ Diesel Generation mode and sets all slave inverters to Alternative Power Source/ Diesel Generation mode. In this mode, the inverter trip setting changes from the country grid setting to a wider trip range setting.

Alternative Power Source mode or Diesel Generation mode should be configured on the master inverter (using Modbus command by the PPC). Once configured, the master inverter automatically sets all detected slave inverters to Alternative Power Source mode.

When grid power resumes, the generator turns off and ATS sends an OFF indication to the PPC. Upon receiving the OFF indication, the PPC moves the master inverter out of Alternative Power Source/Diesel Generation mode reverting to the original default country settings. The master inverter sets all slave inverters back to the default country settings.

A system-wide view of the crucial elements and the connectivity between them is depicted in the figure below.
Figure 2: Single Generator with a Power Plant Controller
Installing and Configuring the System

NOTE
Highly detailed installation and configuration information can be found in Appendix B.

Installation and Configuration

→ To install and configure the system:

1. Connect the generator to the PPC dry contacts.

Figure 3: Connection Scheme with DG Trigger to Power Plant Controller
2. Setup the Consumption Meter next to the grid access point (see Figure 2 above). This solution is supported by SolarEdge Meter model WND-3Y-400-MB. Ensure that DIP switches 2 and 7 are in the ON (set to 1) position.

![Consumption Meter](image)

**Figure 4: Consumption Meter**

3. Connect the consumption meter directly to the PPC using an RS485 connection:

![Meter to PPC RS485 Connection](image)

**Figure 5: Meter to PPC RS485 Connection**

*NOTE*

Connect negative to negative (D- to B-), positive to positive (D+ to A+) and GND to G. When configuring the IOD Controller, refer to the left connector as /dev/ttyS1 and to the right connector as /dev/ttyS4 (as labelled in the figure above).
4. Connect the PPC to its power supply (included in the package).

![Figure 6: PPC Power Supply Connector](image)

5. Connect the PPC to the target network using a LAN cable.

![Figure 7: PPC LAN Connection](image)

6. Power on the PPC.

   Following power-up of the PPC, if a DHCP service is active in the router of the target network, an IP address will be automatically allocated to the PPC within a few seconds.

7. Access the configuration page of your router to check if an IP address was allocated.
8. If DHCP is not active and no IP address was allocated, then manually assign an IP address as follows:

- Connect the PPC to a network in which DHCP is enabled.
- Access the PPC configurator UI, and change the IP Address to the address that will be used in the target network, and save the configuration. The new address will be saved in the Linux configuration, and when reset, the PPC will boot up using that address.
- Disconnect the PPC from your network and connect it to the target network.

9. Perform a preliminary configuration – in which the PPC is not connected to the site’s network. Instead, connect it directly to a computer (which is not connected to the network) and assign the following network settings to that computer’s Ethernet adapter, as shown in the figure below:

- Address: 192.168.1.X (where X must not be 1)
- Netmask: 255.255.0.0
- Default Gateway: 192.168.1.1

Figure 8: PC Ethernet Adapter Configuration
10. Open a command prompt and try to ping 192.168.1.1

![Command Prompt](image)

*Figure 9: Command Prompt*

11. Open a browser on the computer and enter the following address in the URL bar:

   - 192.168.1.1

12. Then enter the following to log into the application:

   - Username: “admin”
   - Password: “password”

![Application Login](image)

*Figure 10: Setting Terminal Bit Rate*

**NOTE**

The password can be modified by clicking on the *Settings* button. The Change Password page appears. Enter the *Old password* and the *New password*.

*Managing an Alternative Power Source with a Power Plant Controller*
13. Once logged in, the Network Tab of the Configurator page appears, as shown in the figure below.

14. Change the site’s network configuration settings as required:

- If DHCP is used, check the **DHCP** checkbox.
- If static IP addressing is used, assign an **IP Address**, **Netmask** and **Gateway**.
- Click **Save**. After confirmation – within 5 seconds – the UI is reloaded.
- Once saved, the PPC is ready to be connected to the site’s network.

Figure 11: Network Tab
Managing an Alternative Power Source with a Power Plant Controller

Figure 12: Saving the Network Configuration

Figure 13: Redirecting Message
DSL (Dynamic Site Limit) Configuration

To configure Dynamic Site Limitation (DSL):

1. Open the Configurator page and click on the DSL Controller tab. The tab appears as shown in the figure below. The page is divided into 4 sections:

   - **General Configuration**: for general algorithm parameters
   - **Meter Configuration**: for meter connection configuration
   - **Master Inverter Configuration**: for Leader Inverter connection configuration
   - **Process Management**: for management of the DSL process

![Figure 14: DSL Controller Tab](image)

2. Update the settings as required, and click on the **Save** button. The service MUST be restarted manually to put the updates into effect (see the Process Management section for guidelines on restarting the service).

The individual settings are described in the following sections.
## General Configuration

This section is used for configuration of the basic algorithm parameters.

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Values</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Minimum Required Consumption</td>
<td>Float &gt; 0</td>
<td>The minimum consumption required for applying the algorithm. If the meter reads a value under this threshold, the DSL function on the inverter will receive the value 0 (zero).</td>
</tr>
<tr>
<td>Maximum Required Consumption</td>
<td>Float &gt; 0</td>
<td>The maximum consumption required for applying the algorithm. If the meter reads a value over this threshold, the DSL function on the inverter will receive the value 100.</td>
</tr>
<tr>
<td>Minimum Required Power from DG</td>
<td>Float &gt; 0</td>
<td>If the algorithm is applied (i.e. the consumption from meter is between the values of Minimum Required Consumption and Maximum Required Consumption, this is value of DG power to be used for computation (by subtracting it from the consumption from meter).</td>
</tr>
<tr>
<td>Total Inverter Nominal Production</td>
<td>Float &gt; 0</td>
<td>The sum of each inverter’s nominal power (therefore the total power of the plant) in Watts.</td>
</tr>
<tr>
<td>ALT POWERSOURCE</td>
<td>Integer &gt; 0</td>
<td>The value to be written to inverter register F006 &quot;Alternative power source enable&quot;.</td>
</tr>
<tr>
<td>GPIO TYPE</td>
<td>Integer &gt; 0</td>
<td>The value to be written to inverter register F004 &quot;GPIO Type&quot;.</td>
</tr>
<tr>
<td>CT AMPS</td>
<td>0 &gt; Integer &gt; 30000</td>
<td>Register AC Power on Follower Inverter #2 (#1 is the Leader Inverter)</td>
</tr>
<tr>
<td>DIGITAL INPUT</td>
<td>Always N10</td>
<td>N10 - the leftmost Digital Input port on the PPC (when viewed from the side with the microSD port).</td>
</tr>
</tbody>
</table>
To configure the meter connection:

1. Set the **Connection Type**:
   - **TCP**: Meter is connected via TCP/IP.
     - Enter the IP Address in the **Address** field.
     - Enter the TCP **Port** number.
   - **RTU**: Meter is connected via RS485
     - Enter the **Serial Port** number.
     - When configuring the RTU connection, the string must be in the following format:

```
/dev/ttyS1 9600 8N1 <device id> <baud rate> <numBits parity stopBits>
```
Leader Inverter Configuration

The Leader Inverter should be only configured with an IP Address and TCP Port and Modbus Device ID. If there are follower inverters connected to it, they can be added by clicking on the “Plus” button. The Name is only a mnemonic identifier, the Modbus Device ID represents the slave’s identifier on Modbus (and is mandatory).

![Figure 17: Leader Inverter configuration UI](image)

Process Management

The Process Management section is used for controlling the DSL process. Depending on the status (Running / Not Running) the service can be stopped, started or restarted.

![Figure 18: Process Management UI](image)

Click on the Show Log button to open a window displaying the most recent lines of the log files for further analysis:
Managing an Alternative Power Source with a Power Plant Controller

Figure 19: Log UI
IOD Algorithm

The formula implemented by IOD for computing the DSL value is the following:

- MinRequiredConsumption - constant read from configuration file (minimum_required_consumption)
- MaxRequiredConsumption - constant read from configuration file (maximum_required_consumption)
- PowerFromMeter - load power read from meter
- DGMinPower - constant read from configuration file (dg_min_required_power)
- TotInverterPower - sum of power read from each inverter
- SumMaxInverterValues - constant read from configuration file (max_inverter_value)

The following is an example of an algorithm.

```plaintext
if ( PowerFromMeter <  MinRequiredConsumption )
    DSL = 0;
else if ( PowerFromMeter >  MaxRequiredConsumption )
    DSL = 100;
else
    DSL = ( ( PowerFromMeter - DGMinPower + TotInverterPower ) / (SumMaxInverterValues) ) * 100;
```
Appendix A - Identifying the Inverter CPU Firmware Version

To check the inverter’s CPU firmware version, perform one of the following actions:

- For inverters using the SetApp mobile application: Select **Commissioning ➔ Information**. The information page, containing the CPU version, appears as shown below:

  ![Information Page](image)

- For devices with a display: Short press the LCD light button on the inverter until the screen below is displayed.

  ![ID Screen](image)
Appendix B - Configuration/Installation of the Power Plant Controller (PPC)

CAUTION

If the device is installed inside live electrical cabinets, proceed only after securing the working environment in safety and protection.
Assembly Instructions

The PPC is manufactured in compliance with the IP10 protection class and is only suitable for installation in a closed, dry and dust-free environment. A bracket suitable for insertion on a DIN rail is located at the rear of the device.

When positioning the PPC inside electrical cabinets or other equipment, make sure to leave sufficient space for the connection of communication cables and for the insertion of the field connectors.

The PPC can be installed vertically or horizontally. Position the bracket of the PPC on the DIN rail, hooking the mobile bracket and exerting a slight pressure upwards.

To install the PPC on a wall use the hooks on the back of the unit.

For wall mounting, a special bracket is required (must be purchased separately). Attach the PPC to the bracket using the hooks in the back of the unit.

In the slot marked “μSD”, there is a flash memory card that hosts the management software. Do not remove the card while the PPC is powered on.

Electrical Connections

In the image above there is a view of the top side of the PPC case. In this part of the case there are:

- Power supply connector
- RS 232 port
- SIM card slot
- 3G Modem Antenna connector
Power Supply Terminal Board

Connect the power supply to the peripheral using the supplied three-pole socket and respecting the polarity shown on the screen printing of the container. The terminal block is a screw with section maximum of the conductor of 1.5 sq. mm. The use of an insulated ferrule with a suitable section is recommended.

RS232 Serial Port Connector (Female)

Refer to the pin connections in the table above for connecting a standard RS232 plug.

<table>
<thead>
<tr>
<th>Pin</th>
<th>Name</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>2</td>
<td>RX</td>
<td>Receive data</td>
</tr>
<tr>
<td>3</td>
<td>TX</td>
<td>Transmit data</td>
</tr>
<tr>
<td>5</td>
<td>GND</td>
<td>Signal ground</td>
</tr>
<tr>
<td>7</td>
<td>CTS</td>
<td>Clear to send</td>
</tr>
<tr>
<td>8</td>
<td>RTS</td>
<td>Request to send</td>
</tr>
</tbody>
</table>
SIM Card Slot and 3G Modem Antenna Connector

To insert the SIM card, remove the slide and insert the SIM card into the slot on the side near the antenna connector. Screw the antenna cable connector firmly into the SMA-F socket on the side of the device. Look for a suitable point for the antenna with magnetic support (if equipped) with good reception quality.

Diagnostic and Status LEDs

Please refer to the following table for led description.

<table>
<thead>
<tr>
<th>LED NAME</th>
<th>COLOUR</th>
<th>DESCRIPTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>ASS</td>
<td>Green</td>
<td>XBee module, &quot;Associated&quot; signal</td>
</tr>
<tr>
<td>RX</td>
<td>Green</td>
<td>XBee module, &quot;Receiving&quot; signal</td>
</tr>
<tr>
<td>SIGNAL</td>
<td>Green</td>
<td>HSPA module, network registration status (1)</td>
</tr>
<tr>
<td>3,8V</td>
<td>Green</td>
<td>Power supply + 3.8V (MODEM)</td>
</tr>
<tr>
<td>3,3V</td>
<td>Green</td>
<td>Power supply + 3.3V (CPU)</td>
</tr>
<tr>
<td>5V</td>
<td>Green</td>
<td>Power supply + 5V (SERVICES)</td>
</tr>
<tr>
<td>WD</td>
<td>Green</td>
<td>Processor in operation (FLASH = OK)</td>
</tr>
<tr>
<td>RUN</td>
<td>Green</td>
<td>IOD application process running</td>
</tr>
</tbody>
</table>

2s ON and 200ms OFF = in search / 2s OFF s 200ms ON = registered STEADY OFF = module off, STEADY ON = module in CSD communication
Configuring RS485 Connections

The bottom of the peripheral host’s two RS485 connectors and configuration DIP switches to be connected to two independent RS485 bus lines. The configuration devices, dip-switches SW1 and SW2, are housed at the base of the peripheral device.

The SW1 and SW2 DIPs, allow the insertion of the polarization resistances of the lines D+ D- of the RS485 and of the 120 Ohm resistance for line termination, necessary for adaptation in case of long connections.

<table>
<thead>
<tr>
<th>SWITCH SW1/SW2 (RS485)</th>
<th>Pos.</th>
<th>FUNCTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>ON</td>
<td>Line polarization resistance (120 Ohm) inserted</td>
</tr>
<tr>
<td></td>
<td>OFF</td>
<td>Line polarization resistance (120 Ohm) not inserted</td>
</tr>
<tr>
<td>2</td>
<td>ON</td>
<td>Line D- polarized</td>
</tr>
<tr>
<td></td>
<td>OFF</td>
<td>Line D- non-polarized</td>
</tr>
<tr>
<td>3</td>
<td>ON</td>
<td>Line D+ polarized</td>
</tr>
<tr>
<td></td>
<td>OFF</td>
<td>Line D+ non-polarized</td>
</tr>
<tr>
<td>4</td>
<td>ON</td>
<td>CTS Line connected to RTS</td>
</tr>
<tr>
<td></td>
<td>OFF</td>
<td>Independent CTS and RTS Line</td>
</tr>
</tbody>
</table>

(x) Factory setting
Pin Out USB and Ethernet Connectors

The mini USB connector, referred to as DEBUG, is used only for verification operations. It cannot be used for any field operation and the use is reserved.

<table>
<thead>
<tr>
<th>DEBUG Port</th>
<th>USB1 eUSB2 Ports</th>
<th>ETH—RJ45 Port</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pin</td>
<td>Name</td>
<td>Pin</td>
</tr>
<tr>
<td>RESERVE</td>
<td></td>
<td>1</td>
</tr>
<tr>
<td></td>
<td></td>
<td>2</td>
</tr>
<tr>
<td></td>
<td></td>
<td>3</td>
</tr>
<tr>
<td></td>
<td></td>
<td>4</td>
</tr>
<tr>
<td></td>
<td></td>
<td>1</td>
</tr>
<tr>
<td></td>
<td></td>
<td>2</td>
</tr>
<tr>
<td></td>
<td></td>
<td>3</td>
</tr>
<tr>
<td></td>
<td></td>
<td>4</td>
</tr>
<tr>
<td></td>
<td></td>
<td>5</td>
</tr>
<tr>
<td></td>
<td></td>
<td>6</td>
</tr>
<tr>
<td></td>
<td></td>
<td>7</td>
</tr>
<tr>
<td></td>
<td></td>
<td>8</td>
</tr>
</tbody>
</table>
Expansion Board I/O Configuration

To access the configuration devices (S1-S2-S3-S4 dip-switches), the peripheral device must be uninstalled from the site and free of voltage. Open the rear closing cover by removing the four screws. The view will be as follows:
I/O Terminals and DIP Switch Selection

DI – Digital Inputs

There are eight digital inputs DI. Voltages of 5V, 12V, 24V, 48V are applicable. The S1-S2-S3 Dip switches on the EXP board must be set according to the value of the voltage applied to the DI input signal terminals. The negative input voltage must be applied to terminal "c".

Dip S1 is used for setup of inputs from 1 to 4, Dip S2 for inputs from 5 to 8, Dip S3 for inputs from 1 to 8.

<table>
<thead>
<tr>
<th>SWITCH S1</th>
<th>DI #</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>1</td>
<td>Input voltage +24 Vdc</td>
</tr>
<tr>
<td>2</td>
<td>1</td>
<td>Input voltage +48 Vdc</td>
</tr>
<tr>
<td>3</td>
<td>2</td>
<td>Input voltage +24 Vdc</td>
</tr>
<tr>
<td>4</td>
<td>2</td>
<td>Input voltage +48 Vdc</td>
</tr>
<tr>
<td>5</td>
<td>3</td>
<td>Input voltage +24 Vdc</td>
</tr>
<tr>
<td>6</td>
<td>3</td>
<td>Input voltage +48 Vdc</td>
</tr>
<tr>
<td>7</td>
<td>4</td>
<td>Input voltage +24 Vdc</td>
</tr>
<tr>
<td>8</td>
<td>4</td>
<td>Input voltage +48 Vdc</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>SWITCH S2</th>
<th>DI #</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>5</td>
<td>Input voltage +24 Vdc</td>
</tr>
<tr>
<td>2</td>
<td>5</td>
<td>Input voltage +48 Vdc</td>
</tr>
<tr>
<td>3</td>
<td>6</td>
<td>Input voltage +24 Vdc</td>
</tr>
<tr>
<td>4</td>
<td>6</td>
<td>Input voltage +48 Vdc</td>
</tr>
<tr>
<td>5</td>
<td>7</td>
<td>Input voltage +24 Vdc</td>
</tr>
<tr>
<td>6</td>
<td>7</td>
<td>Input voltage +48 Vdc</td>
</tr>
<tr>
<td>7</td>
<td>8</td>
<td>Input voltage +24 Vdc</td>
</tr>
<tr>
<td>8</td>
<td>8</td>
<td>Input voltage +48 Vdc</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>SWITCH S3</th>
<th>DI #</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>1</td>
<td>Input voltage +5/12 Vdc</td>
</tr>
<tr>
<td>2</td>
<td>2</td>
<td>Input voltage +5/12 Vdc</td>
</tr>
<tr>
<td>3</td>
<td>3</td>
<td>Input voltage +5/12 Vdc</td>
</tr>
<tr>
<td>4</td>
<td>4</td>
<td>Input voltage +5/12 Vdc</td>
</tr>
<tr>
<td>5</td>
<td>5</td>
<td>Input voltage +5/12 Vdc</td>
</tr>
<tr>
<td>6</td>
<td>6</td>
<td>Input voltage +5/12 Vdc</td>
</tr>
<tr>
<td>7</td>
<td>7</td>
<td>Input voltage +5/12 Vdc</td>
</tr>
<tr>
<td>8</td>
<td>8</td>
<td>Input voltage +5/12 Vdc</td>
</tr>
</tbody>
</table>
Example: setup of S1, S2, S3 for +24VDC input voltage (factory setting):

<table>
<thead>
<tr>
<th>SWITCH S1</th>
<th>DI #</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 – ON</td>
<td>1</td>
<td>Input voltage +24 Vdc</td>
</tr>
<tr>
<td>2 – OFF</td>
<td>2</td>
<td>Input voltage +48 Vdc</td>
</tr>
<tr>
<td>3 – ON</td>
<td>3</td>
<td>Input voltage +24 Vdc</td>
</tr>
<tr>
<td>4 – OFF</td>
<td>4</td>
<td>Input voltage +48 Vdc</td>
</tr>
<tr>
<td>5 – ON</td>
<td>5</td>
<td>Input voltage +24 Vdc</td>
</tr>
<tr>
<td>6 – OFF</td>
<td>6</td>
<td>Input voltage +24 Vdc</td>
</tr>
<tr>
<td>7 – ON</td>
<td>7</td>
<td>Input voltage +24 Vdc</td>
</tr>
<tr>
<td>8 – OFF</td>
<td>8</td>
<td>Input voltage +48 Vdc</td>
</tr>
</tbody>
</table>

Example: setup of S1, S2, S3 for +48VDC input voltage:

<table>
<thead>
<tr>
<th>SWITCH S1</th>
<th>DI #</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 – OFF</td>
<td>1</td>
<td>Input voltage +24 Vdc</td>
</tr>
<tr>
<td>2 – ON</td>
<td>2</td>
<td>Input voltage +48 Vdc</td>
</tr>
<tr>
<td>3 – OFF</td>
<td>3</td>
<td>Input voltage +48 Vdc</td>
</tr>
<tr>
<td>4 – OFF</td>
<td>4</td>
<td>Input voltage +24 Vdc</td>
</tr>
<tr>
<td>5 – OFF</td>
<td>5</td>
<td>Input voltage +24 Vdc</td>
</tr>
<tr>
<td>6 – ON</td>
<td>6</td>
<td>Input voltage +48 Vdc</td>
</tr>
<tr>
<td>7 – OFF</td>
<td>7</td>
<td>Input voltage +24 Vdc</td>
</tr>
<tr>
<td>8 – ON</td>
<td>8</td>
<td>Input voltage +48 Vdc</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>SWITCH S2</th>
<th>DI #</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 – ON</td>
<td>1</td>
<td>Input voltage +24 Vdc</td>
</tr>
<tr>
<td>2 – OFF</td>
<td>2</td>
<td>Input voltage +48 Vdc</td>
</tr>
<tr>
<td>3 – ON</td>
<td>3</td>
<td>Input voltage +24 Vdc</td>
</tr>
<tr>
<td>4 – OFF</td>
<td>4</td>
<td>Input voltage +48 Vdc</td>
</tr>
<tr>
<td>5 – ON</td>
<td>5</td>
<td>Input voltage +24 Vdc</td>
</tr>
<tr>
<td>6 – OFF</td>
<td>6</td>
<td>Input voltage +48 Vdc</td>
</tr>
<tr>
<td>7 – ON</td>
<td>7</td>
<td>Input voltage +24 Vdc</td>
</tr>
<tr>
<td>8 – OFF</td>
<td>8</td>
<td>Input voltage +48 Vdc</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>SWITCH S3</th>
<th>DI #</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 – OFF</td>
<td>1</td>
<td>Input voltage +5/12 Vdc</td>
</tr>
<tr>
<td>2 – OFF</td>
<td>2</td>
<td>Input voltage +5/12 Vdc</td>
</tr>
<tr>
<td>3 – OFF</td>
<td>3</td>
<td>Input voltage +5/12 Vdc</td>
</tr>
<tr>
<td>4 – OFF</td>
<td>4</td>
<td>Input voltage +5/12 Vdc</td>
</tr>
<tr>
<td>5 – OFF</td>
<td>5</td>
<td>Input voltage +5/12 Vdc</td>
</tr>
<tr>
<td>6 – ON</td>
<td>6</td>
<td>Input voltage +5/12 Vdc</td>
</tr>
<tr>
<td>7 – OFF</td>
<td>7</td>
<td>Input voltage +5/12 Vdc</td>
</tr>
<tr>
<td>8 – OFF</td>
<td>8</td>
<td>Input voltage +5/12 Vdc</td>
</tr>
</tbody>
</table>
Example: setup of S1, S2, S3 for +5/+12VDC input voltage:

<table>
<thead>
<tr>
<th>SWITCH S1</th>
<th>DI #</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 – OFF</td>
<td>1</td>
<td>Input voltage +24 Vdc</td>
</tr>
<tr>
<td>2 – OFF</td>
<td>2</td>
<td>Input voltage +48 Vdc</td>
</tr>
<tr>
<td>3 – OFF</td>
<td>3</td>
<td>Input voltage +24 Vdc</td>
</tr>
<tr>
<td>4 – OFF</td>
<td>4</td>
<td>Input voltage +48 Vdc</td>
</tr>
<tr>
<td>5 – OFF</td>
<td>5</td>
<td>Input voltage +24 Vdc</td>
</tr>
<tr>
<td>6 – OFF</td>
<td>6</td>
<td>Input voltage +48 Vdc</td>
</tr>
<tr>
<td>7 – OFF</td>
<td>7</td>
<td>Input voltage +24 Vdc</td>
</tr>
<tr>
<td>8 – OFF</td>
<td>8</td>
<td>Input voltage +48 Vdc</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>SWITCH S2</th>
<th>DI #</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 – OFF</td>
<td>5</td>
<td>Input voltage +24 Vdc</td>
</tr>
<tr>
<td>2 – OFF</td>
<td>6</td>
<td>Input voltage +48 Vdc</td>
</tr>
<tr>
<td>3 – OFF</td>
<td>7</td>
<td>Input voltage +24 Vdc</td>
</tr>
<tr>
<td>4 – OFF</td>
<td>8</td>
<td>Input voltage +48 Vdc</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>SWITCH S3</th>
<th>DI #</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 – ON</td>
<td>1</td>
<td>Input voltage +5/12 Vdc</td>
</tr>
<tr>
<td>2 – ON</td>
<td>2</td>
<td>Input voltage +5/12 Vdc</td>
</tr>
<tr>
<td>3 – ON</td>
<td>3</td>
<td>Input voltage +5/12 Vdc</td>
</tr>
<tr>
<td>4 – ON</td>
<td>4</td>
<td>Input voltage +5/12 Vdc</td>
</tr>
<tr>
<td>5 – ON</td>
<td>5</td>
<td>Input voltage +5/12 Vdc</td>
</tr>
<tr>
<td>6 – ON</td>
<td>6</td>
<td>Input voltage +5/12 Vdc</td>
</tr>
<tr>
<td>7 – ON</td>
<td>7</td>
<td>Input voltage +5/12 Vdc</td>
</tr>
<tr>
<td>8 – ON</td>
<td>8</td>
<td>Input voltage +5/12 Vdc</td>
</tr>
</tbody>
</table>

**AI – Analog Inputs**

Dip switch S4 is used to setup the analog inputs. 0-20mA or 0-10V inputs can be used, for a maximum of four input channels, the negative of the measurement must be connected to terminal "C".

Setup as voltage or current analog input. Each channel can be setup independently.
DO – Digital Outputs

The peripheral has eight digital relay outputs, on a clean contact

<table>
<thead>
<tr>
<th>Name</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>OUT0-NC</td>
<td>Normally closed relay contact</td>
</tr>
<tr>
<td>OUT0-C</td>
<td>Common relay contact</td>
</tr>
<tr>
<td>OUT0-NO</td>
<td>Normally open relay contact</td>
</tr>
<tr>
<td>OUT1-NC</td>
<td>Normally closed relay contact</td>
</tr>
<tr>
<td>OUT1-C</td>
<td>Common relay contact</td>
</tr>
<tr>
<td>OUT1-NO</td>
<td>Normally open relay contact</td>
</tr>
<tr>
<td>OUT2-NC</td>
<td>Normally closed relay contact</td>
</tr>
<tr>
<td>OUT2-C</td>
<td>Common relay contact</td>
</tr>
<tr>
<td>OUT2-NO</td>
<td>Normally open relay contact</td>
</tr>
<tr>
<td>OUT3-NC</td>
<td>Normally closed relay contact</td>
</tr>
<tr>
<td>OUT3-C</td>
<td>Common relay contact</td>
</tr>
<tr>
<td>OUT3-NO</td>
<td>Normally open relay contact</td>
</tr>
<tr>
<td>OUT4-NC</td>
<td>Normally closed relay contact</td>
</tr>
<tr>
<td>OUT4-C</td>
<td>Common relay contact</td>
</tr>
<tr>
<td>OUT4-NO</td>
<td>Normally open relay contact</td>
</tr>
<tr>
<td>OUT5-NC</td>
<td>Normally closed relay contact</td>
</tr>
<tr>
<td>OUT5-C</td>
<td>Common relay contact</td>
</tr>
<tr>
<td>OUT5-NO</td>
<td>Normally open relay contact</td>
</tr>
<tr>
<td>OUT6-NC</td>
<td>Normally closed relay contact</td>
</tr>
<tr>
<td>OUT6-C</td>
<td>Common relay contact</td>
</tr>
<tr>
<td>OUT6-NO</td>
<td>Normally open relay contact</td>
</tr>
<tr>
<td>OUT7-NC</td>
<td>Normally closed relay contact</td>
</tr>
<tr>
<td>OUT7-C</td>
<td>Common relay contact</td>
</tr>
<tr>
<td>OUT7-NO</td>
<td>Normally open relay contact</td>
</tr>
</tbody>
</table>

Operating System and Custom Application Setup

Installed on the uSD of the PPC is an embedded operating system based on an embedded GNU/Linux distribution (a Debian derived distribution). This OS is customized to manage all the onboard peripherals. Many support tools and libraries are available to allow you to operate these peripherals in an effective and useful way.

Having a GNU/Linux derived operating system, it allows the user to operate the embedded device as with any GNU/Linux system. To properly operate the PPC, a knowledge in Linux systems is required.
Appendix C – Debug Mode Configuration

To set the PPC to run in debug mode:

1. Connect the LAN cable and make sure that it is connected to the Internet over TCP/IP.

![PPC LAN Connection](image1)

Figure 20: PPC LAN Connection

2. Connect a serial cable to the PPC’s DEBUG port.

![PPC Serial Connection](image2)

Figure 21: PPC Serial Connection

*Managing an Alternative Power Source with a Power Plant Controller*
NOTE
The serial/debug cable must have communications (and not just charging) capabilities.

3. Open the PuTTY tool’s configuration window (on MS-Windows). The connection speed should be set to 115200.

4. Connect the serial cable to a laptop. Open a terminal session on the appropriate COM port (in this example, it is COM6).

Figure 22: Setting Terminal Bit Rate

Figure 23: Open a Terminal Session
5. If the PPC’s IP address was assigned using DHCP, get the address by entering in the terminal:
   `ip a <Enter>`
   The address can be found in the eth0 section of the reply.

   ![Figure 24: Finding the IP Address](image)

6. Connect to the PPC using SSH. You can connect to PPC remotely by opening an SSH connection. Use the IP Address that was configured/discovered previously for setting up the connection. In the example below, the default IP address is used.

   ![Figure 25: Setting up a SSH Connection](image)

7. Click **Open** to save the settings.
Network Setup

Perform the following network setup actions:

→ To change the PPC network configuration:

1. Edit the interfaces file: /etc/network/interfaces

2. To enable DHCP:
   - Uncomment the line (remove the "#" character at the beginning of the line):
     ```
     iface eth0 inet dhcp
     ```
   - Comment the following lines by putting the # character at the beginning of these lines:
     ```
     # iface eth0 inet static
     # address 192.168.0.111
     # netmask 255.255.0.0
     # gateway 192.168.254.250
     ```

3. To enable static IP:
   - Uncomment the DHCP line: # iface eth0 inet dhcp
   - Uncomment the following lines, changing addresses as appropriate for your network:
     ```
     iface eth0 inet static
     address 192.168.0.111
     netmask 255.255.0.0
     gateway 192.168.254.250
     ```

4. Restart networking services: service networking restart
Managing an Alternative Power Source with a Power Plant Controller

PPC IOD Software Configuration

IOD is the software installed on PPC for managing the inverter installed in the plant. The main files in the IOD installation are:

- IOD_IO_cfg.xml - for configuration of the devices connected to the PPC
- IOD_ScriptMain_scr.c - the script that implements the generator-PV management and balancing algorithm
- IOD_SITE_CONFIGURATION_scr.c - the configuration file for the generator-PV management and balancing algorithm

To modify the files, standard Linux editors can be used: Nano or Vi are supported by PPC.

IOD_IO_cfg.xml

This file contains register definitions used by IOD in order to read and write values.

Device PV

→ To configure the PV device (identified by Name="PV"):

1. Set the port parameter:
   <Port Type="TCP">192.168.2.11:502</Port>

   **NOTE**

   Port parameter must contain the IP address of the inverter, followed by “:” and then the Modbus port (usually 502). In this example the inverter is located at IP address: 192.168.2.11

   A guide to using the Linux editor can be found at:

   At this stage, the customer must have set the master inverter with a known, static IP Address. Modbus TCP must be enabled on all the inverters on Port 502 and with IDs from 1 to x (where x is the number of inverters), as follows:
   - Master Inverter: ID 1
   - Slave inverter 1: ID 2
   - Slave Inverter 2: ID 3, and so on.
2. Set the device parameter:

Inside the tag `<Device>` you can configure the addresses of the registers that must be read and written by the controller. To do this, set the `Addr` attribute of each `IOdef` tag (each `IOdef` represents a single register). The syntax for the `Addr` attribute is: `<slaveAddr>:{H}<wordAddr>`

Where:

- `slaveAddr` is the Modbus device ID
- `wordAddr` is the register address
<table>
<thead>
<tr>
<th>Register Tag Id</th>
<th>Slave ID</th>
<th>Register Address</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>DSLCHECK</td>
<td>1</td>
<td>61441</td>
<td>This register maintains the DSL value and is used only for reading. To write the DSL value, use the broadcast address (see DSLBROADCAST).</td>
</tr>
<tr>
<td>DGMODE</td>
<td>1</td>
<td>61445</td>
<td>Represents the DG Mode:</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>• 1 = DG is used</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>• 0 = DG not used (grid on)</td>
</tr>
<tr>
<td>DSL BROADCAST</td>
<td>0</td>
<td>61441</td>
<td>The same address as DSLCHECK; this register is used for broadcasting new values to the inverters (in this definition the slave address is 0).</td>
</tr>
<tr>
<td>ALT_POWER SOURCE</td>
<td>1</td>
<td>61446</td>
<td>Enable/disable the alternative power source (APS):</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>• 1 = enable</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>• 0 = disable</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Enable APS when initiating the generator-PV management and balancing algorithm. Once configured, the master inverter automatically sets all detected slave inverters to APS mode.</td>
</tr>
<tr>
<td>GPIO_TYPE</td>
<td>1</td>
<td>61444</td>
<td>GPIO Type. Set to ‘2’ when initiating the generator-PV management and balancing algorithm. Write once at IOD start-up - IOD will retry until the register is correctly written. The value to be written is the value of gpio_type in the configuration file, IOD_SITE_CONFIGURATION_scr.c</td>
</tr>
<tr>
<td>AC_POWER_M1</td>
<td>1</td>
<td>40083</td>
<td>Register AC Power on Master Inverter</td>
</tr>
<tr>
<td>AC_POWER_S2</td>
<td>2</td>
<td>40083</td>
<td>Register AC Power on Slave inverter #2 (#1 is the Master)</td>
</tr>
<tr>
<td>AC_POWER_S3</td>
<td>3</td>
<td>40083</td>
<td>Register AC Power on Slave inverter #3 (#1 is the Master)</td>
</tr>
<tr>
<td>AC_POWER_S4</td>
<td>4</td>
<td>40083</td>
<td>Register AC Power on Slave inverter #4 (#1 is the Master)</td>
</tr>
</tbody>
</table>
The following is an example of the PV <Device> section. The underlined values are to be modified if needed.

```
<Device Name="PV" Protocol="Modbus" Disabled="F">
  <Port Type="TCP">192.168.2.11:502</Port>
  <MaxStatusUpdateDelaySec>20</MaxStatusUpdateDelaySec>
  <MaxMeasureUpdateDelaySec>15</MaxMeasureUpdateDelaySec>
  <IOgroup TagId="INVERTER" Addr="1">
    <!--
    The DSLCHECK register is read only, because the script uses it only for check that broadcast works. No need to write directly the DSL
    -->
    <Iodef TagId="DSLCHECK" IO="I" Addr="1:H61441S16" >Dynamic Site Limit</Iodef>
    <Iodef TagId="DGMODE" IO="O" Addr="1:H61445" >Diesel Generator Mode</Iodef>
    <!--
    Tag for sending broadcast values to the master inverter (it will forwards value to each slave inverter if received on device id 0)
    -->
    <Iodef TagId="DSLBROADCAST" IO="O" Addr="0:H61441" >Dynamic Site Limit BROADCAST</Iodef>
    <Iodef TagId="ALT_POWERSOURCE" IO="O" Addr="1:H61446" >Alternative power source Enable</Iodef>
    <Iodef TagId="GPIO_TYPE" IO="O" Addr="1:H61444" >GPIO Type</Iodef>
    <Iodef TagId="AC_POWER_M1" IO="I" Addr="1:H40083S16" >AC Power - Master Inverter</Iodef>
    <Iodef TagId="AC_POWER_S2" IO="I" Addr="2:H40083S16" >AC Power - Slave 2</Iodef>
    <Iodef TagId="AC_POWER_S3" IO="I" Addr="3:H40083S16" >AC Power - Slave 3</Iodef>
    <Iodef TagId="AC_POWER_S4" IO="I" Addr="4:H40083S16" >AC Power - Slave 4</Iodef>
  </IOgroup>
</Device>
```
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Device METER

To configure the PV device (identified by Name="METER"):

1. Set the port parameter:
   
   `<Port Type="Com">/dev/ttyS1,9600,8N1</Port>`

   This tag defines parameters for the communication on serial port. It is composed of a CSV string in the following format:

   `<devId>,<baudRate>,<numBits><parity (E=even, O=odd, N=none)><stopBits>`

   - **devId** is the device port connected on PPC (see paragraph "Setup the I/E Meter (next to the Loads)") and can be `/dev/ttyS1` or `/dev/ttyS4`
   - **baudRate** should be 9600
   - **numBits/parity/stopBits** should be set to 8N1

2. Set the device parameter:

   As with the Device PV, inside the tag `<Device>` you can configure the addresses of the registers that must be read and written by the controller. To do this, set the Addr attribute of each IOdef tag (each IOdef represents a single register). The syntax for the Addr attribute is: `<slaveAddr>:H<wordAddr>`

   Where:
   - **slaveAddr** is the Modbus device ID
   - **wordAddr** is the register address

<table>
<thead>
<tr>
<th>Register Tag Id</th>
<th>Register Address</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>P</td>
<td>1036</td>
<td>This register maintains the power collected from the meter</td>
</tr>
<tr>
<td>CT_AMPS_01</td>
<td>1604</td>
<td>Consumption Meter CT 01 Rating (0 to 30000 amps)</td>
</tr>
<tr>
<td>CT_AMPS_02</td>
<td>1605</td>
<td>Consumption Meter CT 02 Rating (0 to 30000 amps)</td>
</tr>
<tr>
<td>CT_AMPS_03</td>
<td>1606</td>
<td>Consumption Meter CT 03 Rating (0 to 30000 amps)</td>
</tr>
</tbody>
</table>
NOTE

The register “P” is responsible for tracking power collection. The register’s address is 1036 (see the example below) on the Device ID 3. Change only those two values (underlined in the example below) if a different Device ID and/or Register Address is to be used and leave the remainder of the string unchanged.

<IOdef TagId="P" IO="I" Addr="3:H1036S32Z" Fmt=".00" Eng="Dword2Float1">Active Power</IOdef>

NOTE

The CT_AMPS_XX registers are used to set the CT ratio that the consumption meter uses to the current flowing through each phase. The register is set once.

Each register has a unique address (see the example below) on the Device ID 3. Change only those two values (underlined in the example below) if a different Device ID and/or Register Address is to be used and leave the remainder of the string unchanged.

<IOdef TagId="CT_AMPS_01" IO="O" Addr="3:H1604" >CT1 rated current</IOdef>
<IOdef TagId="CT_AMPS_02" IO="O" Addr="3:H1605" >CT2 rated current</IOdef>
<IOdef TagId="CT_AMPS_03" IO="O" Addr="3:H1606" >CT3 rated current</IOdef>
The following is an example of the METER `<Device>` section. The underlined values are to be modified if needed.

```xml
<Device Name="METER" Protocol="Modbus" Disabled="F">
  <Port Type="Com">/dev/ttyS1,9600,8N1</Port>
  <MaxStatusUpdateDelaySec>20</MaxStatusUpdateDelaySec>
  <MaxMeasureUpdateDelaySec>15</MaxMeasureUpdateDelaySec>

  <IOgroup TagId="LOAD_METER" Addr="2">
    <IOdef TagId="P" IO="I" Addr="3:H1036S32Z" Fmt=".00" Eng="Dword2Float1">Active Power</IOdef>
    <IOdef TagId="CT_AMPS_01" IO="O" Addr="3:H1604">CT1 rated current</IOdef>
    <IOdef TagId="CT_AMPS_02" IO="O" Addr="3:H1605">CT2 rated current</IOdef>
    <IOdef TagId="CT_AMPS_03" IO="O" Addr="3:H1606">CT3 rated current</IOdef>
  </IOgroup>
</Device>
```
IOD_ScriptMain_scr.c

This file contains the generator-PV management and balancing algorithm. It uses three parameters that must be set before starting IOD. The parameters are configured in the file: IOD_SITE_CONFIGURATION_scr.c

IOD_SITE_CONFIGURATION_scr.c

This file contains three variables that can be changed depending on the site configuration:

- **minimum_required_consumption** - this is a value that represents the minimum consumption needed for application of the generator-PV management and balancing algorithm. If a value read from the meter is less than the minimum, the value of 0 (zero) is written to the DSLCHECK register.

- **percentage_of_actual_required_power** - if the algorithm is applied (that is, the consumption is greater than the minimum_required_consumption), then this percentage of actual required power is to be used for computation.

- **max_inverter_value** - represents the sum of each inverter's nominal power (that is, total of the plant) in Watts.

The following variables are used to set a register on the inverter or meter at IOD startup; registers are set only once.

- **alt_powersource** - the value to be set on the inverter register F006, "Alternative Power Source Enable".

- **gpio_type** - the value to be set on the inverter register F004, "GPIO Type".

- **ct_amps_01** - represents CT1 rated current (allowed value: 0 to 30000) to be set on the meter.

- **ct_amps_02** - represents CT2 rated current (allowed value: 0 to 30000) to be set on the meter.

- **ct_amps_03** - represents CT3 rated current (allowed value: 0 to 30000) to be set on the meter.

**NOTE**

Only the last three parameters on the above list should be modified if needed. The rest of the file should remain unchanged.

*Managing an Alternative Power Source with a Power Plant Controller*
The following is an example of a site configuration file.

```xml
<Device Name="METER" Protocol="Modbus" Disabled="F">

/*
   Customer defined constant. If power read from meter is below
   this value, the DSL must be set to 0 (zero), otherwise the
   algorithm is implemented
*/
minimum_required_consumption = 5000;

/*
   Customer defined constant. If power read from meter is above
   this value, the DSL must be set to 100
*/
maximum_required_consumption = 170400;

/*
   Minimum DG power to be used for computation algorithm
*/
dg_min_required_power = 54000;

/*
   Sum of each connected inverter nominal power
*/
max_inverter_value = 110400;

/*
   Alternative power source
*/
alt_powersource = 1;

/*
   GPIO Type
*/
gpio_type = 2;

/*
   CTx rated current
*/
ct_amps_01 = 5;
c_t_amps_02 = 5;
c_t_amps_03 = 5;
</Device>
```
PPC IOD Software Startup/Shutdown

→ To launch IOD at PPC boot:

1. Open a shell on PPC and edit the file:
   /etc/crontab
2. Search for a line similar to the following:
   # @reboot root IOD.sh /opt/IOD/BIN
3. If there is a ‘#’ character at the beginning, remove the character (otherwise the line is a comment), and reboot PPC. This line specifies that following every reboot, the IOD software is launched as root user.

→ To launch IOD using the command line:

1. Open a shell on the PPC.
2. Navigate to the /opt/IOD/BIN directory.
3. Execute the following command:
   ./IOD.sh /opt/IOD/BIN

   The following output means that IOD has been started:
   
   root@MSDC:/opt/IOD/BIN# ./IOD.sh /opt/IOD/BIN
   ==Starting IOD==

   To terminate IOD, press CTRL-C in the IOD shell, and wait for completion. IOD log files are generated for the last hour’s activity, and stored in the directory, /opt/IOD/LOG. The filename format is: IOD_DDHH.log, where DD represents the day of current month and HH the hour of the day. For example, IOD_0214.log indicates the file contains logs for the hour between 14:00 and 15:00 of the second of the current month.
Supported Standards

- Low Voltage Directive 2006/95/CE for electrical equipment (voltage between 50-1000VAC 75-15000VDC)
- Restriction of Hazardous Substances Directive 2002/95/EC
- EMI Standards EN 55022; EN 55024
- Safety Requirement EN 61010-1
Support Contact Information

If you have technical problems concerning SolarEdge products, please contact us:

https://www.solaredge.com/service/support

Before contact, make sure to have the following information at hand:

- Model and serial number of the product in question.
- The error indicated on the product SetApp mobile application LCD screen or on the monitoring platform or by the LEDs, if there is such an indication.
- System configuration information, including the type and number of modules connected and the number and length of strings.
- The communication method to the SolarEdge server, if the site is connected.
- The product's software version as it appears in the ID status screen.