Managing Active/Reactive Power with a Power Plant Controller

Version 1.1

Disclaimers

Important Notice

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 1.1, May 2020 – updated UI screenshots
- Version 1.0, March 2020 – first release

Contents

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 to Dynamic Export Limitation

Due to the growth in the use of decentralized PV generation systems, the percentage of fluctuating generation capacity in national and international electricity grids has significantly increased in recent years. High levels of PV generation can lead an excess of thermal energy or voltage in the grid and jeopardize its stability – especially in the case of low-voltage grids.

As a consequence, grid operators require PV system operators to take measures in order to improve grid integration so that future PV deployment will not have to be restricted because of limited grid capacity. In severely congested grids, PV system operators are obliged to configure their systems to ensure that no electricity is fed into the public grid at any time. To accomplish this, PV systems must support a so-called *export limitation scheme* ("zero feed-in" / "zero export") whereby either:

- the energy generated is consumed by the producer (100 % consumption), or
- the power output of the PV system is limited.

Therefore, in the event of weather-related fluctuations in PV generation or sudden load changes, the feed-in of excess PV power must automatically be reduced to the agreed export capacity. These requirements can be met using a Power Plant Controller (PPC), which performs continuous measurement of the active power at the grid connection point and implements the export limitation function.

This document describes how to configure a Power Plant Controller (PPC) for use with SolarEdge inverters, in support of dynamic export limitation/zero feed-in requirements.

System Requirements

- 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.

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

In the system described here, multiple inverters may be connected in an RS485 bus using the Modbus protocol for communication. The Export/Import meter is connected to the leader inverter via a PPC (Power Plant Controller), communicating via Modbus over TCP/IP.

To achieve zero feed-in, the PPC de-rates the PV inverters and curtails their active power output when power generation exceeds consumption, and the PV system is in a position to export more than the agreed maximum export level. The controller sends active power set point commands within a highly dynamic, zero-closed-loop control, and matches the power output limit of the PV system to the actual customer power demand. If an active power load / appliance in the customer site is switched off, the feed-in of excess PV power will automatically be reduced.

When the inverter production or the load consumption reach low values due to zero export limitation and low load consumption, the inverter supports the ability to open the AC relays as a result of a control order from the PPC. For zero export, the default setting is to open the relays. For non-zero export settings, the relays are closed by default. The relays are controlled via Modbus by the PPC, and by slave control support hysteresis parameter settings (internal). When the relays are opened at the defined threshold, the inverter closes them again at a load consumption level of (minimum production power + x %).

The PPC serves as a multi-zone power manager that ensures that power sources behind a single grid connection point are managed in the most efficient and effective way. The Modbus protocol (over TCP or TRU) is used for communication between the PPC and each of the leader inverters.

A system-wide view of the crucial elements and the connectivity between them is depicted in the figure below.

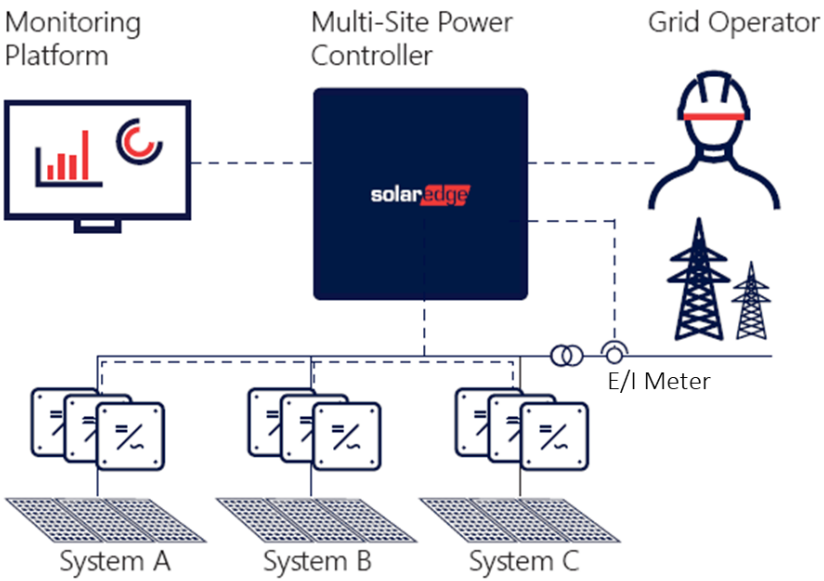


Figure 1: Multi-Zone with a Power Plant Controller

Installing and Configuring the System

Installation and Configuration

→ **To install and configure the system:**

1. Connect the PPC to its power supply (included in the package).

Figure 2: PPC Power Supply Connector

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

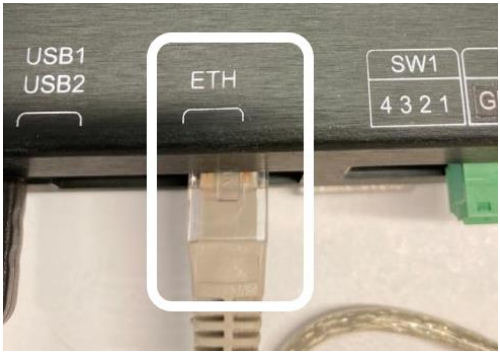


Figure 3: PPC LAN Connection

3. 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.

4. Access the configuration page of your router to check if an IP address was allocated.

5. 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.

6. 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

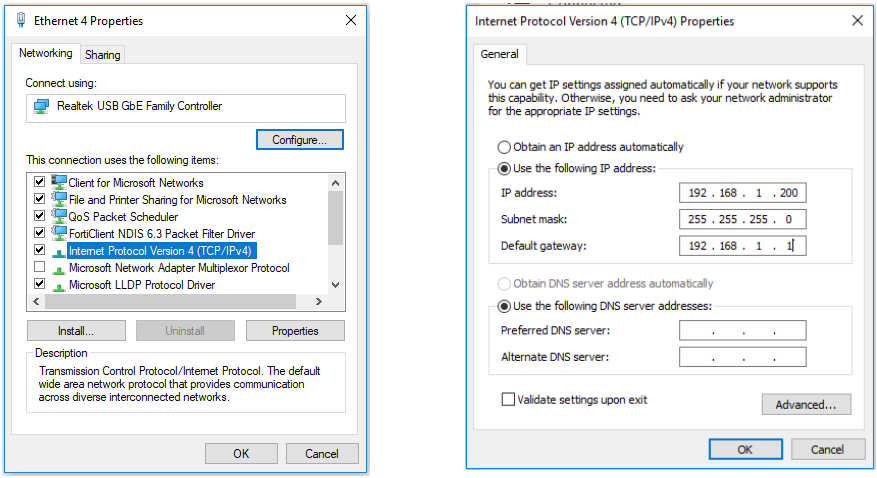


Figure 4: PC Ethernet Adapter Configuration

7. Open a command prompt and try to ping 192.168.1.1

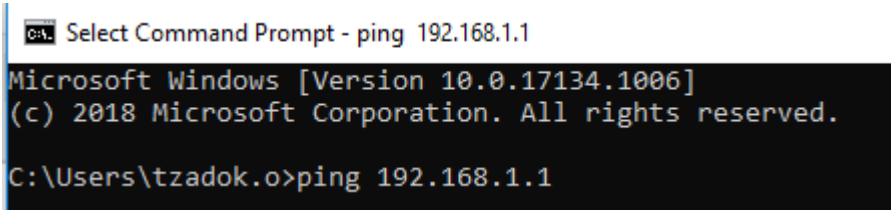


Figure 5: Command Prompt

8. Open a browser on the computer and enter the following address in the URL bar:
   - 192.168.1.1
9. Then enter the following to log into the application:
   - Username: “admin”
   - Password: “password”

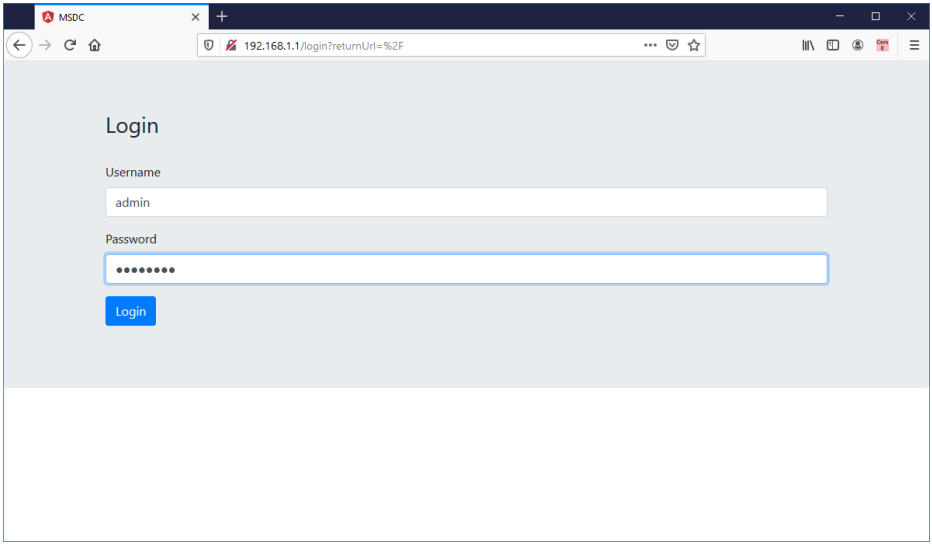


Figure 6: Login Page

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**.

10. Once logged in, the Network Tab of the Configurator page appears, as shown in the figure below.
11. 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 MSDC is ready to be connected to the site's network.

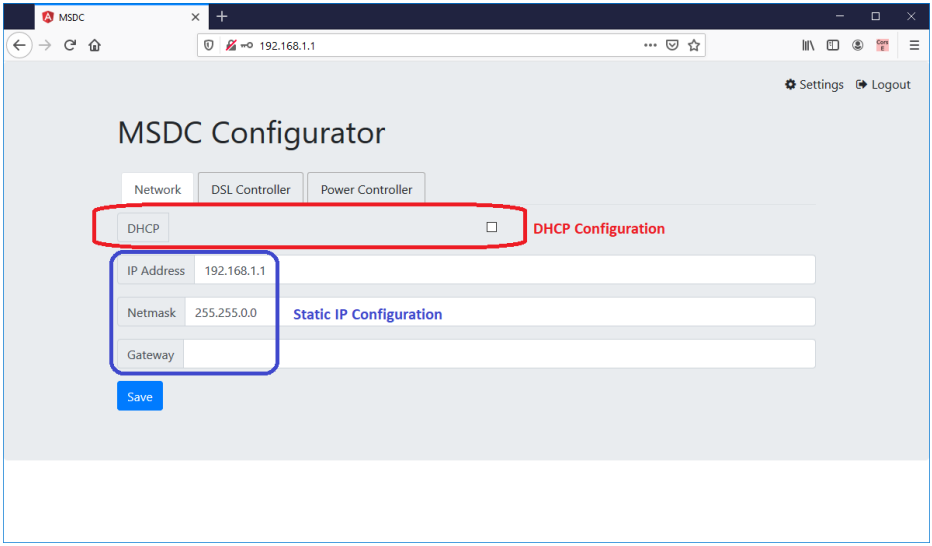


Figure 7: Network Tab

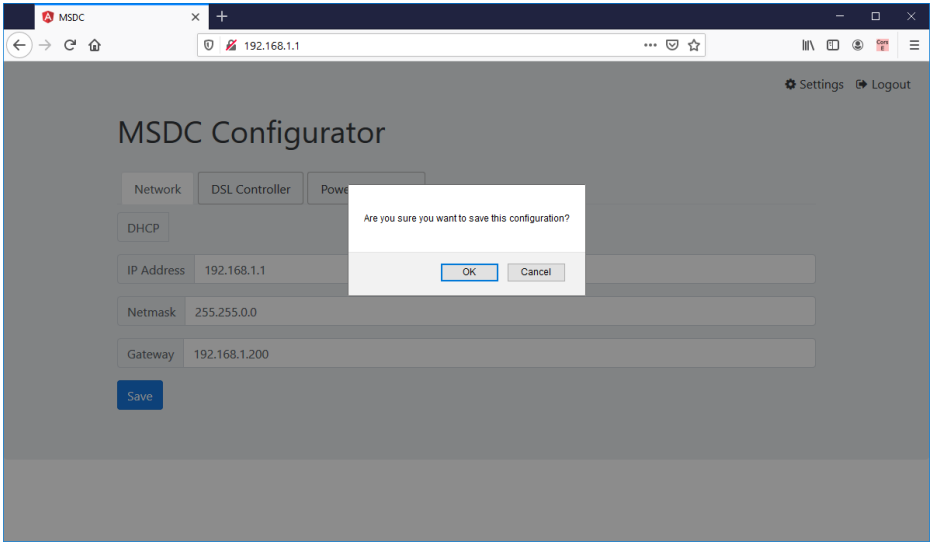


Figure 8: Saving the Network Configuration

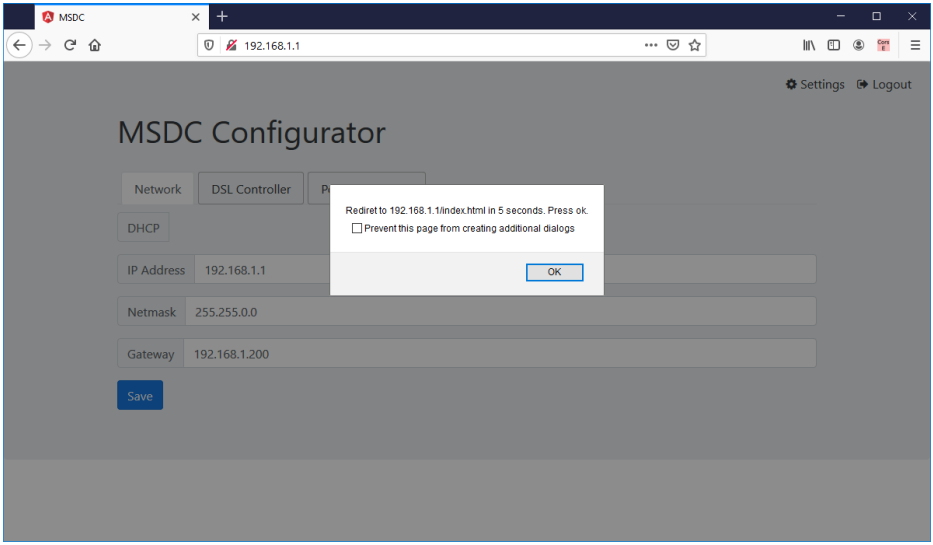


Figure 9: Redirecting Message

12. Click on **Power Controller** tab on the MSDC Configurator page, as shown below. The page is divided into 3 sections:

    - CCG Configuration: for SolarEdge Commercial Gateway connection configuration
    - Inverter Configuration: for leader inverter connection configuration
    - Process Management: for control of the power controller process

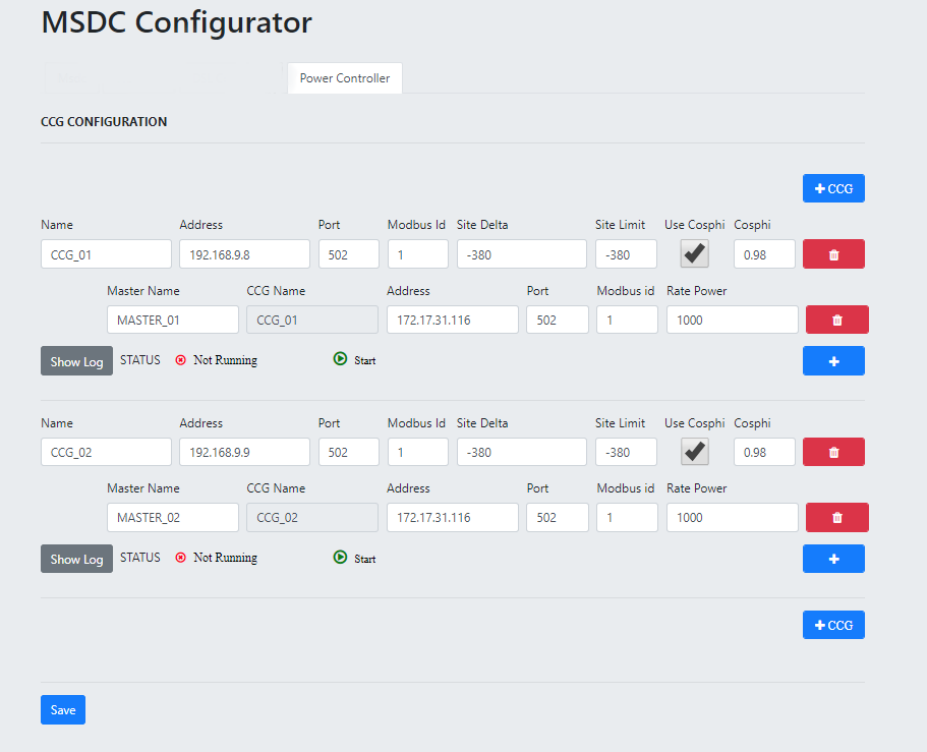


Figure 10: Power Controller Tab

13. Configure the sections as required (see the instructions in the sections below), and click on the **Save** button. The service MUST be restarted manually in order to put the updated configuration into operation (see the Process Management section for guidance on the restarting process).

Commercial Gateway Configuration

The Commercial Gateway can be used to manage to set up an export limitation scheme for a complete site – consisting of the Commerical Gateway, the inverters installed in the site, and the export/import meter.

The PPC supports configuration of export limitation settings on multiple sites (each managed by a Commercial Gateway. The configuration page is shown in the figure below.

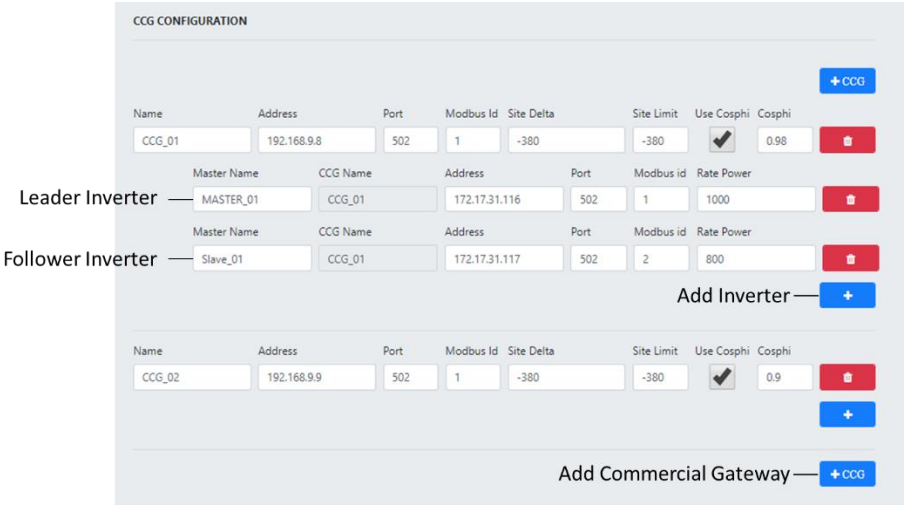


Figure 11: Commercial Gateway configuration

This section contains SolarEdge Commercial Gateway configuration settings:

- **IP address** and **Port Number** of the Commercial Gateway
- **Modbus ID** of the Commercial Gateway
- Available delta below the configured Site Limit (in percent). For example, if the Site Limit is 1000, and the delta is set at 2%, the Export/Import will be stabilized between 980-1000)
- Required **Site Limit**
- **Use Cosphi**. If checked, CosPhi control is specified.

- **Cosphi**. The maximum CosPhi value. CosPhi represents the absolute value of the Active Power/Apparent Power ratio, and the maximum permitted value is 0.98.

Click on the blue "+" button to add a leader or follower inverter. For a description of the inverter settings, see the section, Inverter Configuration.

Inverter Configuration

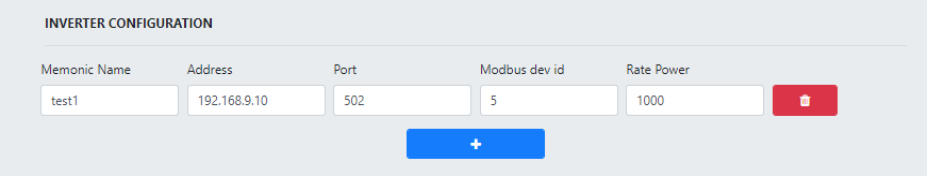


Figure 12: Inverter configuration

This section contains inverter configuration settings:

- Number of inverters under this leader inverter. Each leader inverter represents a different sub-site.
- List of leader inverter configurations (for each leader there are 3 required parameters):
  - IP address of leader inverter
  - Modbus ID of the leader inverter
  - Rated power of the leader inverter and its followers

In case the leader inverters are single inverters (Commercial Gateway's follower inverters only), each inverter should be configured in the list.

Process Management

Process Management section is used for managing the power control process. Depending on the current status (Running / Not Running) the service can be stopped, started or restarted.

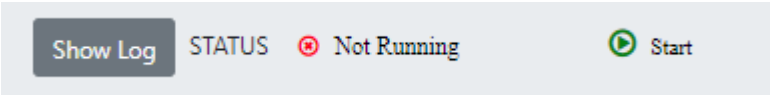


Figure 13: Process Management

Click on the **Show Log** button to open a window displaying the most recent log file records for further analysis:

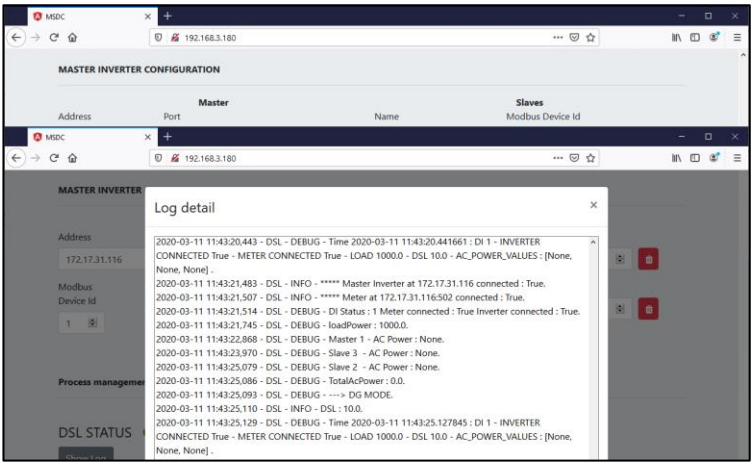


Figure 14: Log Detail

Zero Export / Cosphi Logic

→ **General zero export / cosphi guidelines:**

1. Establish a Modbus over TCP connection with the Commercial Gateway and each leader inverter. All inverters must have Modbus TCP enabled.
2. Sample the Export/Import meter and read export power values.
3. The PPC performs calculations and sends (if required) a correction broadcast to all inverters. Following the correction broadcast, export value is monitored until

desired production level reached. Notice that change rate of the system is 100% PN per minute

NOTE

CosPhi control is enabled only on negative export values (at least 1 kW)

CosPhi values are dynamic and are controlled by reactive power produced by the inverter.

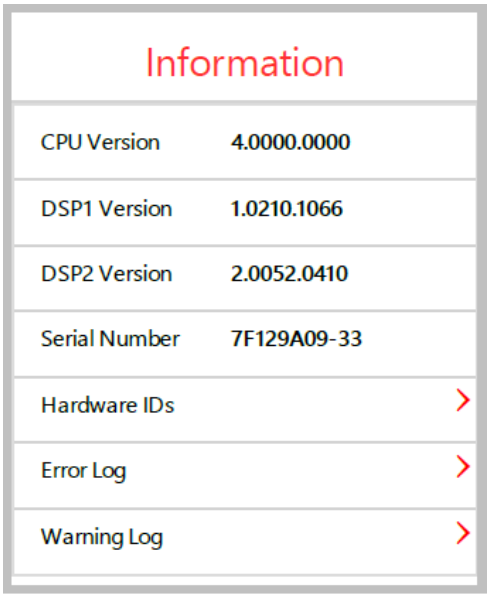
Supported Standards

- Directive 2004/108/CE Electromagnetic Compatibility
- Low Voltage Directive 2006/95/CE for electrical equipment (voltage between 50-1000VAC 75-15000VDC)
- Restriction of Hazardous Substances Directive 2002/95/EC
- Waste Electrical & Electronic Equipment (WEEE) Directive 2012/19/CE
- EMI Standards EN 55022; EN 55024
- Safety Requirement EN 61010-1

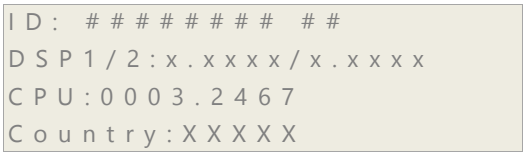
Appendix A - Identifying the Inverter CPU Firmware Version

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:



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



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.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