



Managing an Alternative Power Source with a Power Plant Controller

Version 1.6

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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 1.6 (January 2021) – updated configuration process
- Version 1.5 (July 2020) – updated connection scheme
- 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.

A diesel generator (DG), specifically, requires a minimum production value in order to maintain healthy operation. When a DG runs in parallel with a PV inverter, and the solar power generated is similar to the power consumed by the site, the DG might not carry enough load to reach its minimum recommended production value. In a worst case scenario, a reverse power flow may occur, tripping generator protections, and causing a site outage, or possibly damaging the generator.

To prevent such a scenario, while maintaining the benefits of a PV inverter installation, the SolarEdge Power Plant Controller (PPC) can be used to dynamically limit solar production in order to ensure a minimum required power supply from the DG. This capability, known as Alternative Power Source (APS) Controller, also protects the DG in the event of an extreme load drop. This allows the PV inverter to continuously maximize power production without harming the other components in the system.

This document describes how to configure a PPC for use with SolarEdge inverters and for simultaneous operation with a generator.

System Requirements

Alternative Power Source (APS) or Diesel Generation (DG) 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

The PPC's digital input is connected to the generator's dry contacts. When an outage occurs and the generator is started, the normally-open dry contact closes, and the PPC signals the PV inverters to transition to DG mode. In DG mode, the PPC manages the inverters' production levels - reading the consumption meter and tracking inverter power production, calculating the current site load, and dynamically setting production limitation levels on the inverters.

The PPC is connected to the leader inverter via Modbus-TCP, while the leader inverter is connected to its follower inverters via RS485. The PPC receives meter consumption meter readings via Modbus-RTU (Over RS-485). The following table and diagram summarize the connections.

Component connected to the PPC	Connection Method
Leader inverter	Modbus/TCP
Consumption Meter	RS-485
Diesel Generator dry contacts	2 wire

Table 1: PPC Connections

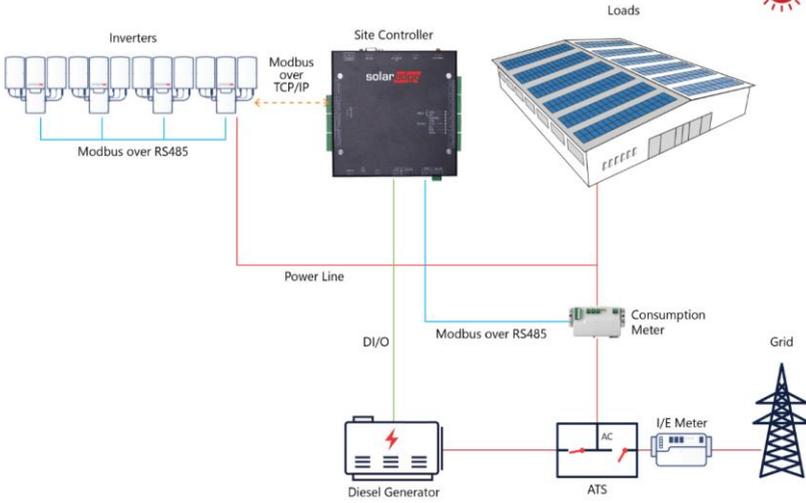


Figure 1: Single Generator with a Power Plant Controller

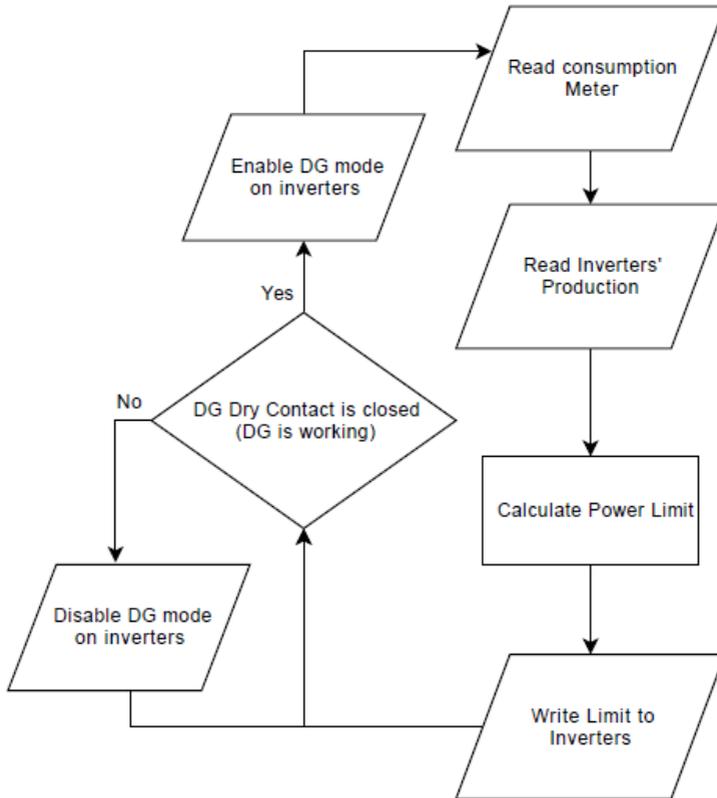


Figure 2: System Flowchart

Installing and Configuring the System

Installation and Configuration

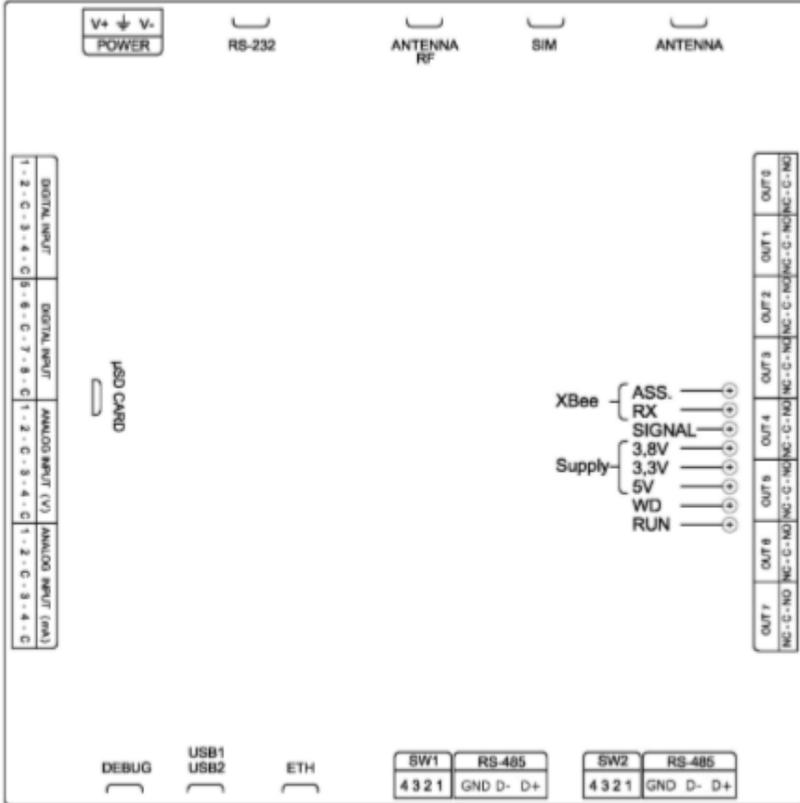


Figure 3: Power Plant Controller

→ To install and configure the system:

1. Connect the generator to the PPC dry contacts.

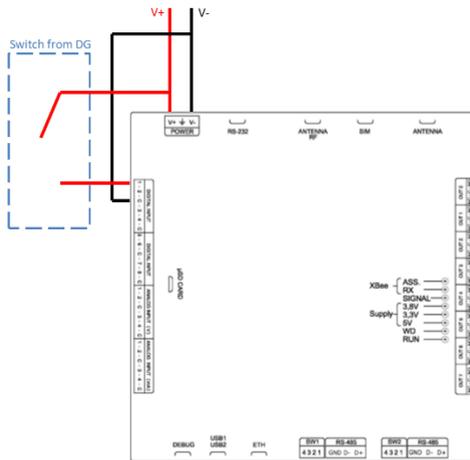
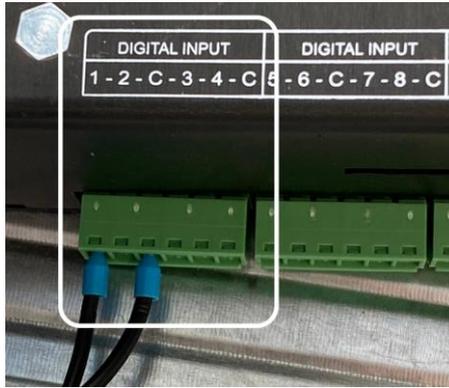


Figure 4: Connection Scheme with DG trigger to Power Plant Controller

- Setup the Consumption Meter next to the grid access point (see **Error! Reference source not found.** 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.



Figure 5: Consumption Meter

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

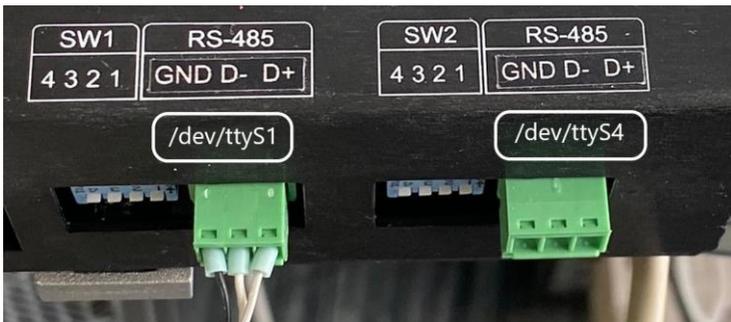


Figure 6: Meter to PPC RS485 Connection



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 7: PPC Power Supply Connector

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

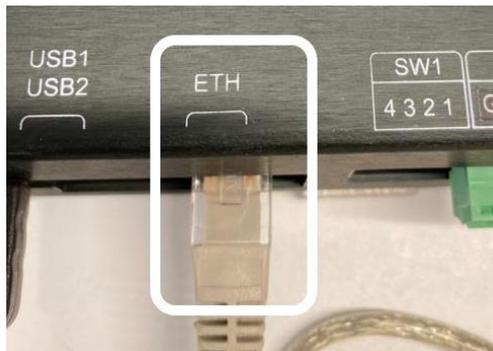


Figure 8: PPC LAN Connection

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.

In order to learn the automatically assigned IP address, look at the router's client table or use an IP scanner. If these options are not available, refer to [Appendix B – Debug Mode Configuration](#), which provides guidelines for connecting a debug cable to the PPC.

7. Use your browser to connect to the PPC configuration software.
The default credentials are:

- User: Admin
- Password: password

It is recommend to change the password following login.

8. Click on SYSTEM in the sidebar menu. Configure the required network details and timezone.

The screenshot displays the PSC configurator web interface. The top navigation bar includes the text "PSC configurator" on the left, "admin" in the center, and the "solar**edge**" logo on the right. A vertical sidebar on the left contains four menu items: "GENERAL" (with a document icon), "SYSTEM" (with a red triangle icon and highlighted in red), "EVENTS" (with a calendar icon), and "SUPERVISOR" (with a document icon). Below "SUPERVISOR" is a section for "APS CONTROLLER" with a server icon. The main content area is divided into two sections. The "NETWORK" section has a "DHCP" dropdown set to "Enabled". It contains four input fields: "Connection Type" with the value "192.168.88.8", "Netmask" with "255.255.255.0", "Gateway" with "192.168.88.1", and "DNS" with "0.0.0.0". A red "Save" button is located at the bottom right of this section. The "TIMEZONE" section features a dropdown menu currently set to "Africa/Johannesburg". A second red "Save" button is positioned at the bottom right of this section.

APS (Alternative Power Source) Configuration

→ To configure APS:

1. Click on **APS CONTROLLER** on the sidebar menu. The APS Controller page 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 controlling process automatic start.

The screenshot displays the 'PSC configurator' interface for the 'APS CONTROLLER'. The page is organized into four main sections:

- GENERAL CONFIGURATION:** Contains four input fields: 'Minimum Required Consumption' (2500), 'Minimum Required Power from DG' (5000), 'Total Inverter Nominal Production' (30000), and 'CT AMPs' (100).
- METER CONFIGURATION:** Includes a 'Modbus Device ID' field (2), a 'Serial Port' dropdown menu (Serial Port 1 (/dev/ttyS1)), and a 'Meter location' dropdown menu (After ATS (load side)).
- INVERTERS CONFIGURATION:** Divided into 'Leader' and 'Followers'. The 'Leader' section shows 'IP address' (192.168.1.101), 'Port' (502), and 'Modbus Device ID' (3). The 'Followers' section shows 'Follower1' with 'Modbus Device ID' (1) and a red status indicator.
- PROCESS MANAGEMENT:** Features a 'Start at boot' status with a yellow indicator and a 'Save' button.

Figure 9: APS Controller Tab

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 **Error! Reference source not found.** 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.

Parameter	Values	Description
Minimum Required Consumption	Float > 0 [Watts]	The minimum consumption required for applying the algorithm. If the meter reads a value under this threshold, the site will be limited to 0 percent production.
Minimum Required Power from DG	Float > 0 [Watts]	The minimum power required by the generator to operate normally. The controller will use the input from the consumption meter to limit the solar system in order to hold this minimum value.
Total Inverter Nominal Production	Float > 0 [Watts]	The sum of each inverter's nominal power (therefore the total power of the plant) in Watts.
CT AMPS	Integer 0 - 3000	Register AC Power on Follower Inverter #2 (#1 is the Leader Inverter)

Meter Configuration

Parameter	Values	Description
Modbus Device Id	Integer 1-255	The meter device id (Default is 2)
Serial Port		A drop-down menu to choose one of the 2 serial ports on the controller
Meter Location		If the meter is connected on the load side and is always powered on, choose "After ATS". If the meter is connected on the generator side and is powered on only when the generator is working choose "DG supply only".

Leader Inverter Configuration

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

Supervisor Tab

This tab is used for controlling the services running on the controller in real time.

Supervisor STATUS

REFRESH | RESTART ALL | STOP ALL

State	Description	Name	Action
RUNNING	pid 26476, uptime 3 days, 17:50:23	APSTelemetry	Restart Stop Clear Log Tail-f
RUNNING	pid 27211, uptime 1 day, 3:53:20	MsdcMonitor	Restart Stop Clear Log Tail-f
STOPPED	Dec 21 11:08 AM	APS	Start Clear Log Tail-f

Supervisor 3.3.1 © 2006-2020 Appearities Consulting and Contributors

There are three services running on the controller:

- **APS** – Contains the main logic for the APS solution. This service needs to be restarted after a configuration change. By clicking on “Tail -f” you can see the operation in real time.
- **APSTelemetry** – Used to feed the Professional services monitoring tab in the SolarEdge monitoring portal.
- **MsdcMonitor** – Used for monitoring purposes by the Professional-Services team.

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	
CPU Version	4.0000.0000
DSP1 Version	1.0210.1066
DSP2 Version	2.0052.0410
Serial Number	7F129A09-33
Hardware IDs	>
Error Log	>
Warning Log	>

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

```

ID : # # # # # # # # # #
DSP1 / 2 : x . x x x x / x . x x x x
CPU : 0 0 0 3 . 2 4 6 7
Country : X X X X X
  
```

Appendix B – 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.

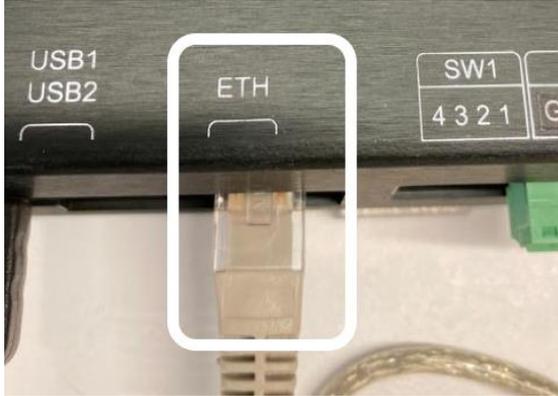


Figure 10: PPC LAN Connection

1. Connect a serial cable to the PPC's DEBUG port.



Figure 11: PPC Serial Connection

**NOTE**

The serial/debug cable must have communications (and not just charging) capabilities.

2. Open the Device Manager and locate the serial port being used:

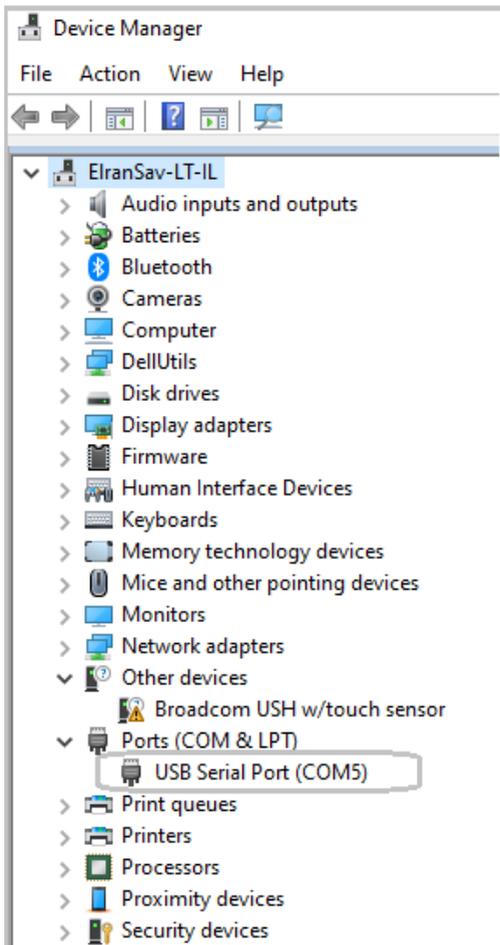


Figure 12: Device Manager Tree

- Open the PuTTY tool's configuration window (on MS-Windows). **Serial line** should be set to the serial port displayed in the Device Manager. The connection **speed** should be set to 115200.

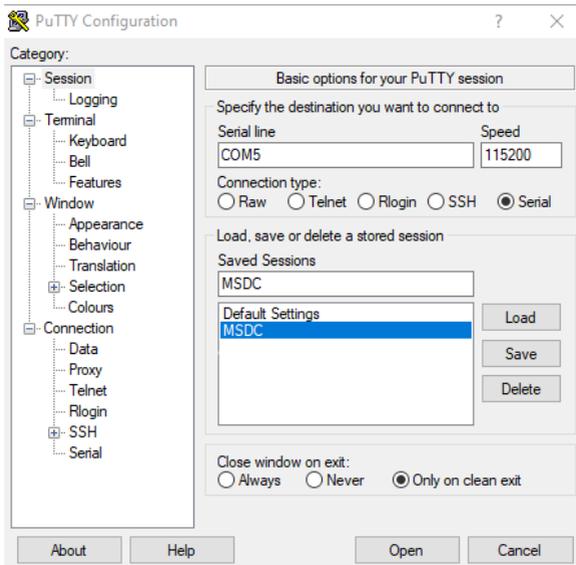


Figure 13: Setting Terminal Bit Rate

- Connect the serial cable to a laptop. Open a terminal session on the serial port displayed in the Device Manager, as shown above.

5. Login using the following credentials:

- User: Installer
- Password: PSinstaller

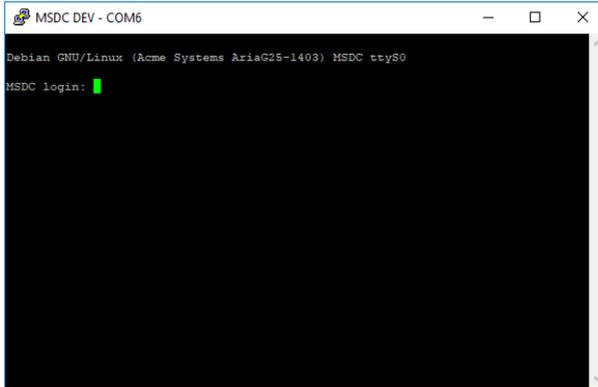


Figure 14: Open a Terminal Session

6. The PPC's IP address was assigned using DHCP, get the address by entering in the terminal:

```
ifconfig <Enter>
```

The address can be found in the eth0 section of the reply.

```
installer@MSDC:~$ ifconfig
eth0      Link encap:Ethernet  HWaddr 6a:59:0a:f7:24:83
          inet addr:192.168.88.8  Bcast:192.168.88.255  Mask:255.255.255.0
          inet6 addr: 2a0d:6fc2:4480:5a01:6859:aff:fef7:2483/64  Scope:Global
          inet6 addr: fe80::6859:aff:fef7:2483/64  Scope:Link
          UP BROADCAST RUNNING MULTICAST  MTU:1500  Metric:1
          RX packets:4721 errors:0 dropped:0 overruns:0 frame:0
          TX packets:2761 errors:0 dropped:0 overruns:0 carrier:0
          collisions:0 txqueuelen:1000
          RX bytes:358018 (349.6 KiB)  TX bytes:1028703 (1004.5 KiB)
          Interrupt:31 Base address:0xc000

lo        Link encap:Local Loopback
          inet addr:127.0.0.1  Mask:255.0.0.0
          inet6 addr: ::1/128  Scope:Host
          UP LOOPBACK RUNNING  MTU:65536  Metric:1
          RX packets:105 errors:0 dropped:0 overruns:0 frame:0
          TX packets:105 errors:0 dropped:0 overruns:0 carrier:0
          collisions:0 txqueuelen:0
          RX bytes:15020 (14.6 KiB)  TX bytes:15020 (14.6 KiB)

installer@MSDC:~$
```

Figure 15: Finding the IP Address

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

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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