Installation and Operation Manual

Energy Management Unit (EMU)

August 2008

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FCC Compliance

This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to part 15 of the FCC Rules. 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, the user is 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.

Table of Contents

Important Safety Information

Read this First

This manual contains important instructions to follow during installation and maintenance of the Enphase Energy Management Unit (EMU).

To reduce the risk of electrical shock, and to ensure the safe installation and operation of the EMU, the following safety symbols appear throughout this document to indicate dangerous conditions and important safety instructions.

WARNING: This indicates a situation where failure to follow instructions may cause a serious hardware failure. Use extreme caution when performing this task.

NOTE: This indicates information particularly important for optimal system operation. Follow these instructions closely.

Safety Instructions

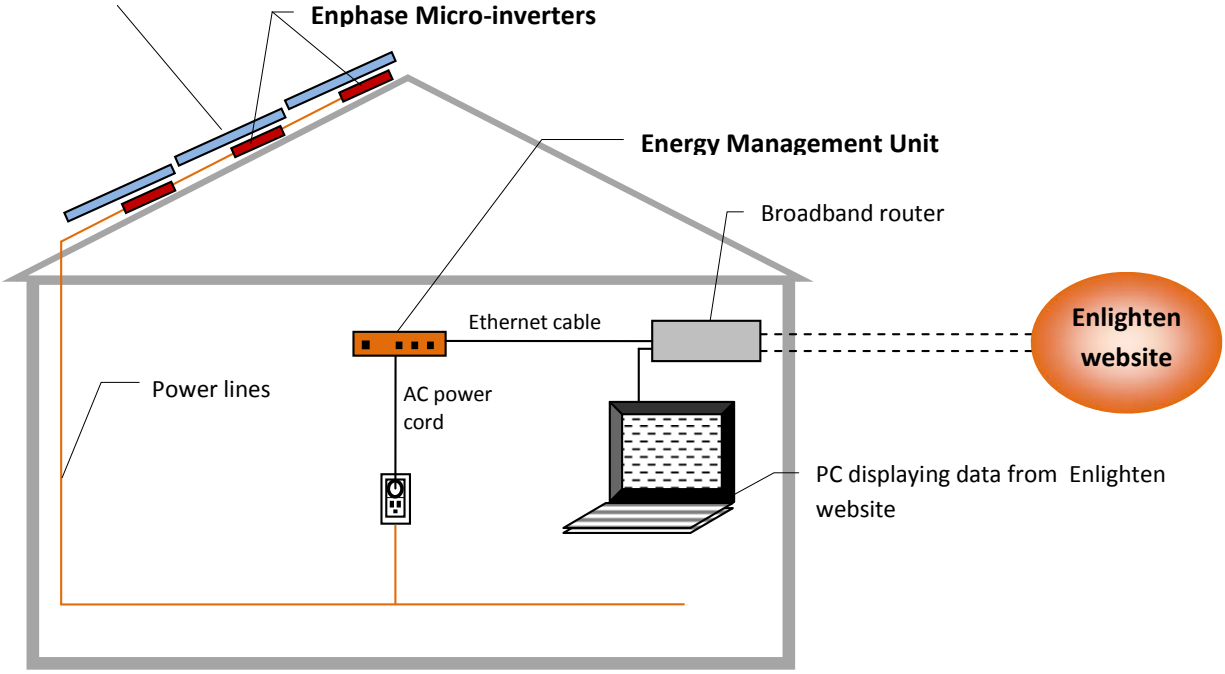
- Perform all electrical installations in accordance with all local electrical codes and the National Electrical Code (NEC), ANSI/NFPA 70.
- Be aware that only qualified personnel shall install or replace the Enphase Energy Management Unit.
- Do not attempt to repair the Enphase EMU; it contains no user-serviceable parts. If the Enphase EMU fails, please return the unit to your distributor for maintenance. Tampering with or opening the EMU will void the warranty.
- Before installing or using the Enphase EMU, please read all instructions and cautionary markings in the technical description and on the Enphase EMU.

NOTE: For Enphase EMU Warranty Terms and Conditions see the Appendix on page 23 of this manual.

1 The Enphase Energy Management Unit

The EMU is an integral component of the Enphase Energy Micro-inverter system. It operates between the Enphase Micro-inverters and the Enphase Enlighten™ web-based monitoring and analysis. The EMU functions as a gateway and monitors the Micro-inverters that are connected to the photovoltaic modules. The EMU collects energy and performance data from the Micro-inverters over in-home AC power lines. It then forwards that data to the Enphase Enlighten™ web-based monitoring and analysis, via the Internet, for statistical reporting.

The following diagram shows the EMU in the system.



Other Elements in the Enphase System

The **Enphase Micro-inverter** system is a fully integrated device that converts the DC output of a single solar module into grid-compliant AC power. In addition to performing the DC to AC conversion, it optimizes the modules' Maximum Power Point Tracking (MPPT). This integrated system maximizes energy harvest, increases system reliability, and simplifies design, installation and management.

The **Enphase Enlighten™** web-based monitoring and analysis analyzes the per-module data collected by each Micro-inverter. Enlighten automatically detects any shortfall in energy production, identifies possible causes, and suggests solutions to correct the problem. The Enphase Enlighten website is constantly monitoring and managing every module on every installation.

How the EMU Works

Installation and operation of the EMU requires no special computer or networking knowledge, nor any specialized equipment. It simply plugs into the house router for communications with the Enphase Enlighten™ monitoring and analysis website. The EMU communicates with the individual Micro-inverters over the existing power wires in the residence or business. After the EMU is installed, no additional configuration work is required.

After the EMU is installed and completes its initial scan, it assembles an internal database of all known Enphase Micro-inverters at the site it manages. At regular intervals, the EMU polls each Micro-inverter for its energy data. Using your site's Broadband router, the EMU then forwards that information on to the Enphase Enlighten™ monitoring and analysis website. The EMU also reports any error conditions that affect itself or the Micro-inverters. You can view both energy data and error conditions at the Enphase Enlighten™ web-based monitoring and analysis.

NOTE: The EMU will automatically report system performance data to Enphase upon connection to the Internet. Please consult the Enphase privacy policy at http://www.enphaseenergy.com/legal/privacy.html to learn more about Enphase's use of this data.

2 EMU Installation

Preparation

Before installing the EMU, make sure that your site meets the following minimum requirements:

- Internet connection
- Web access to view Enlighten
- Router / LAN with Ethernet port
- Standard AC electrical outlet

Check the EMU box for the following items:

- Ethernet cable
- AC power cord
- mounting kit (one bracket, four screws, and four rubber feet)
- user documentation

Placement

Place the EMU as close as possible to the Service-Panel (load center).

After installing your EMU, you may want to perform a Communications Check as described to page 14 to optimize the location of your EMU.

The EMU can be placed on a table top or it can be bracket mounted on a wall. For bracket mounting instructions, see

Bracket Mounting on page 9.

Do **not** plug the EMU into a power strip, surge protector, or uninterruptable power supply (UPS). The EMU contains the protective circuits required for long, reliable operation. The surge suppression or filtering components of a power strip or other protective device can substantially diminish communication performance.

Although, you do not necessarily need to place the EMU near a Broadband router, it may be best to do so for convenience of network cabling.

Table top Placement

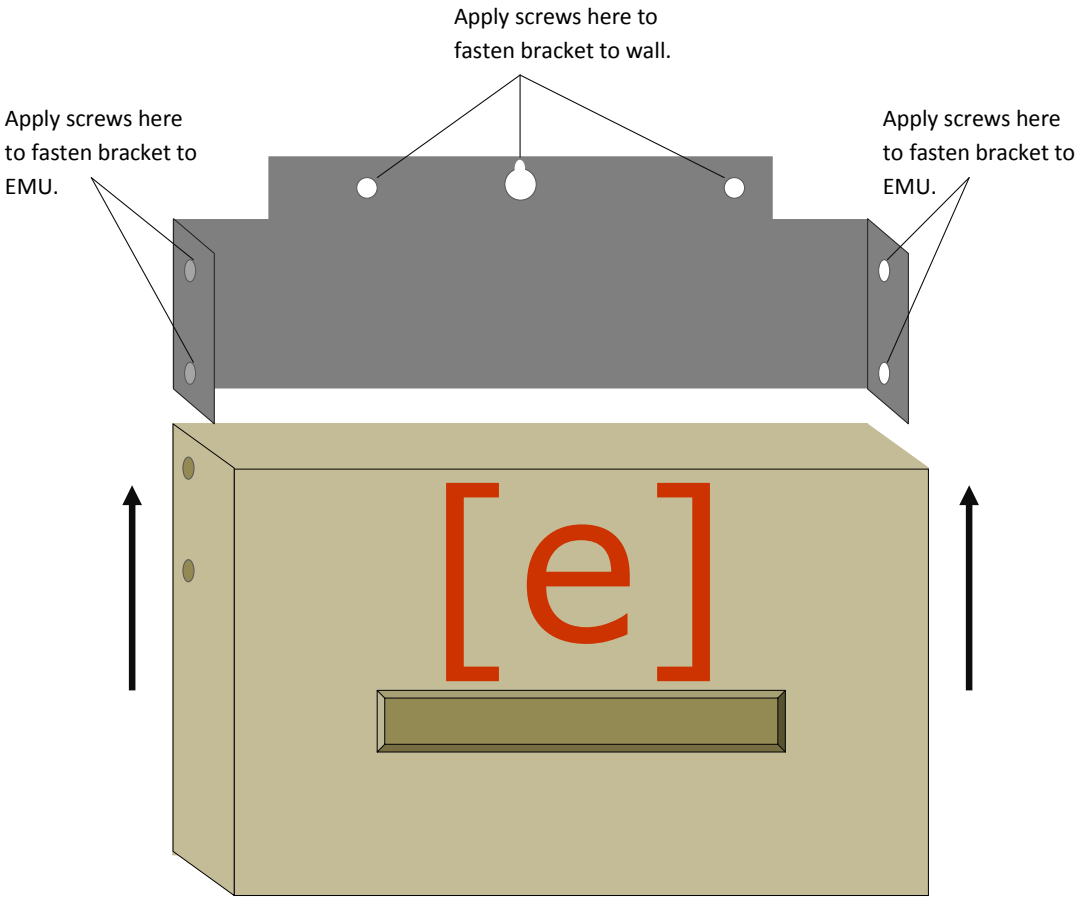
To prepare the EMU for placement on a table top:

1. Remove the adhesive backing from the four rubber feet provided with the EMU mounting kit.
2. Apply the rubber feet to the bottom of the EMU at each of the four corners.

Bracket Mounting

To mount the EMU on a wall:

1. Use three screws to affix the bracket to the wall (not included in kit).
2. Slide the EMU into the bracket aligning the EMU screw holes with those in the bracket.
3. Use four screws to fasten the bracket to the EMU (included in kit).

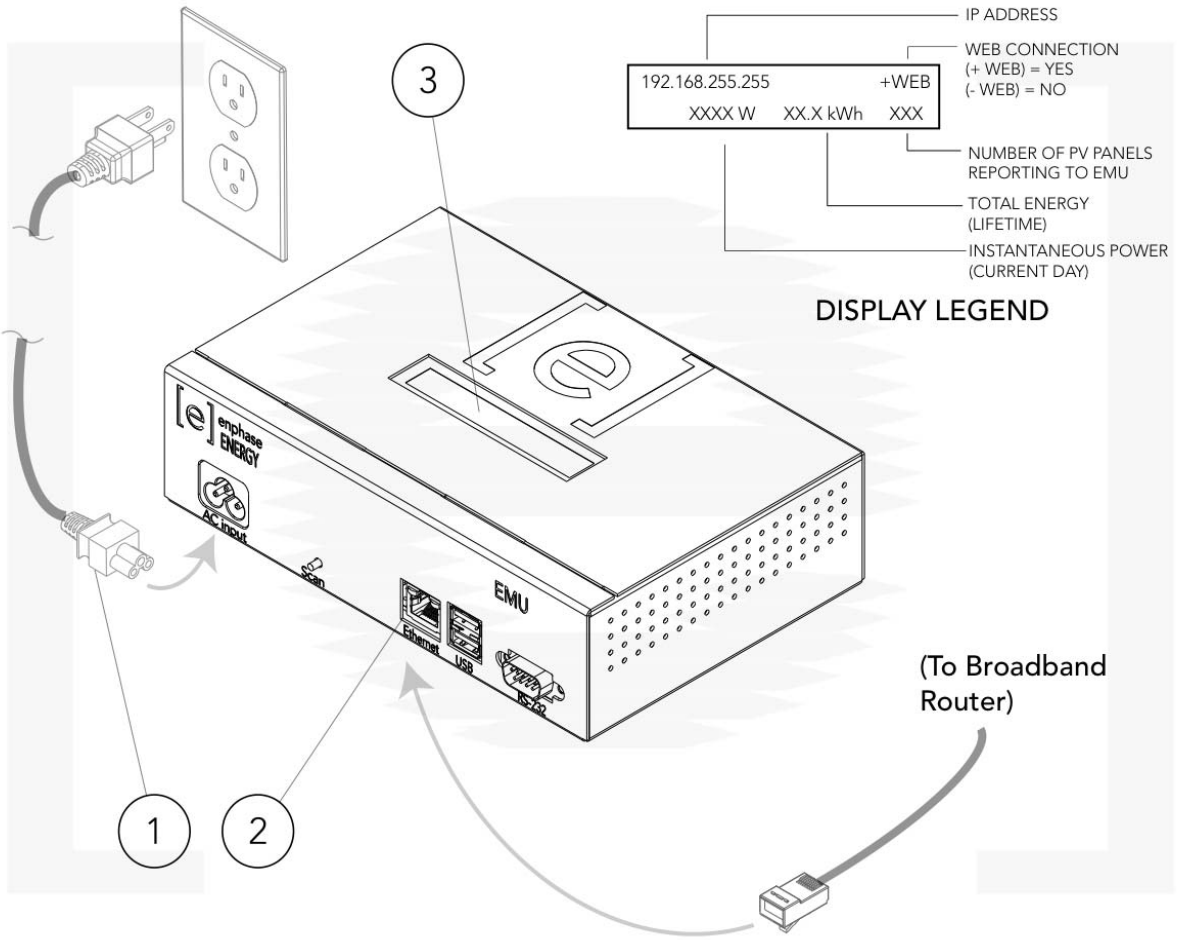


Install the EMU Connections

To install the EMU, perform the steps below while referring to the installation diagram below.

1. Plug the AC power cord into the AC Input on the EMU, and then plug the other end of the power cord into an ordinary 120VAC power outlet (not a power strip) located somewhere near your Broadband router.

Reminder: Do **not** plug the EMU into a power strip, surge protector, or uninterruptable power supply (UPS). The EMU contains the protective circuits required for long, reliable operation. The surge suppression or filtering components of a power strip or other protective device can substantially diminish communication performance.



NOTE: To the right of the Ethernet port on the EMU, you will notice ports labeled "USB" and "RS-232". Ignore these ports as they are not currently used.

2. Plug the Ethernet cable into the RJ-45 port, labeled "Ethernet" on the EMU, and plug the other end of the cable into a spare port on the Broadband router.
   The Ethernet cable is the same type you would use for any computer. This cable doesn't need to plug directly into a router. It could also connect to a normal LAN (Local Area Network) connection as it needs only to be able to obtain a DHCP (Dynamic Host Control Protocol) IP address and have a path to the Internet.

3. Watch the LCD display for progress. Refer to Normal Operation on page 16 for more information.

4. Register the EMU as soon as possible. After starting up the EMU and connecting it to a Broadband router, call Enphase Customer-Support at 877-797-4743 or visit https://enlighten.enphaseenergy.com/register and register the EMU by its serial number.

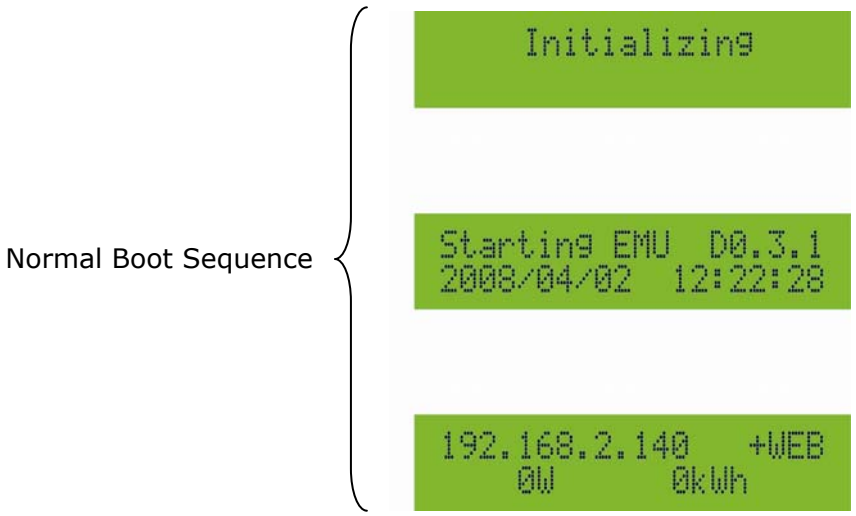
Relocating the EMU

If you ever lose power, or need to relocate the EMU to somewhere else on the premises, just plug it in (if not already done) and let the EMU start up again. It will resume operation when power and internet connection are restored.

3 EMU Operation

Starting the EMU

It takes less than five minutes for the EMU to be ready to work after applying power. This five-minute period is known as a boot sequence. You know the EMU has completed booting and has started normal operation when it displays both an IP address and the "+WEB" indication in the LCD window.



After the EMU establishes an IP address and Internet connectivity, the EMU contacts an NTP (Network Time Protocol) server so that it can set an accurate, local time.

How the EMU Scans for Micro-Inverters

A newly installed EMU automatically performs an initial scan to discover its associated Micro-inverters. This initial scan continues to search for new Micro-inverters for one week from initial start up of the EMU. The purpose of this long scanning period is to account for additional Micro-inverters that may be installed during this initial one-week time-frame. This scan identifies all Micro-inverters at the managed site. This one-time process is not repeated. During the scan, you will notice some of the values increasing on the EMU's LCD display.

NOTE: If the EMU is power cycled (power turned off and on) during this initial one-week scan, the week-long scan will resume.

The EMU identifies each Micro-inverter via the unique serial number assigned to each Micro-inverter. If a Micro-inverter is ever added or replaced at your site, you must initiate a new scan so that the EMU can "see" the new Micro-inverter.

The EMU LCD Panel Menu

You can access the EMU LCD panel menu by using the EMU SCAN button. Press and hold this button; after two seconds you will enter the EMU menu. Continue holding the SCAN button and Menu items will appear in the following order:

To select a menu item, release the SCAN button when the desired menu option appears. The menu continues to cycle as long as you are pressing the SCAN button. See the following sections for detailed procedures.

Initiating a Scan for New Micro-Inverters

To initiate a scan:

1. Press and hold the SCAN button on the front of the EMU for two seconds to view the EMU menu on the LCD. When the LCD window displays: "Enable New Device Scan"; release the SCAN button.

   The LCD window then indicates:

2. The EMU begins a 30 minute scan, if a longer scan is not already in progress, to identify all of the Micro-inverters deployed at the premises.
3. Log into the Enphase Enlighten™ web-based monitoring and analysis to view data on a per Micro-inverter basis (and, hence, a per PV module basis).
4. To disable or cancel a scan, press and hold the SCAN button on the front of the EMU for two seconds to view the EMU menu on the LCD. When the LCD window displays: "Disable New Device Scan"; release the SCAN button.

Performing a Communication Check

If, when you are installing the EMU, you are unsure of where it should be located for maximum performance, you may want to install the EMU and initiate a communication check to check signal strength. In addition to this user-initiated communication check, a communication check also begins automatically after an EMU restart.

To initiate a communication check:

1. Press and hold the SCAN button on the front of the EMU for two seconds to bring up the EMU menu on the LCD window. When the LCD window displays: "Enable Communication Check"; release the SCAN button.

The LCD window then indicates:

The EMU begins a 20 minute communication check to assess the signal strength between the EMU and the devices deployed at your site.

2. Until the EMU begins detecting devices (Micro-inverters), the display reads:

3. When the EMU begins detecting devices (Micro-inverters), the display reads:

The "LEVEL" indicator in the LCD window may display any number of bars from zero to five. You can assume that the communication check is progressing normally and that signal strength is acceptable if two to five bars are displayed. If fewer than two bars are displayed, you may want to try the following options:

- Relocate your EMU closer to the electrical service-panel (load-center) as possible. This ensures that the EMU receives the strongest possible signal from each Micro-inverter.
- Plug the EMU into another circuit supporting fewer electronic devices, as these devices may interfere with communication between the Micro-inverters and the EMU.

Elapsed minutes and seconds are displayed ("mm:ss" in the example). The "Devices" counter displays the numbers of devices detected and will ascend until all devices are detected

4. After 20 minutes, the communication check times out. If you want to end the communication check before it times out, press the scan button to activate the EMU menu. When the LCD indicates "Disable Communication Check", release the scan button.

Restarting the EMU

If you ever lose power, or need to restart the EMU, just plug it in (if not already done) and let the EMU start up again. It will resume operation when power and internet connection are restored. When it resumes operation, the LCD window displays the auto-start sequence. The system performs an automatic communications check. The LCD window alternates between two displays like those shown in the following:

For information on the "Level" and "Devices" indicators, refer to the descriptions in "Performing a Communication Check" on page 14. The auto-start sequence continues for 20 minutes after starting up the EMU. After this check, normal operation resumes.

Normal Operation

Once the EMU completes a scan, it begins or resumes normal operation. At this point, the indicators in the LCD window show current values for your system:

The displayed values are:

- Local IP address, for example: **192.168.2.140** (your actual local IP address will be different)
- Web connection indication: **+WEB**

NOTE: The following indicators may take several minutes to appear after starting up the EMU or initiating a scan.

- Indication of the present power-production, in watts: **(n)W** (where n is a number)
- Indication of the life-time kilowatt hours reported to this EMU: **(n)kWh** (where n is a number)
- Indication of the number of online Micro-inverters producing power and reporting in to the EMU: **(n)** (where n is a number)

Networking/Firewall Info

The EMU communicates with the Enphase Enlighten website by initiating outbound TCP (Transmission Control Protocol) connections to Enphase over HTTPS (Hypertext Transfer Protocol over Secure Socket Layer) (TCP:443). You do not need to open any inbound firewall ports for normal operation.

4 Troubleshooting

The following sections describe possible problems. For information on system status and events messages see Event Messages on page 20.

Potential Problems and Solutions

IP ADDRESS Problem: If the IP address displayed on the EMU's LCD window does not match the DHCP subnet on your internal network and shows something beginning with "169.254.x.x", this means that it was unsuccessful in obtaining a DHCP lease from your router.

- Check network connectivity to the router or other DHCP server. You may also wish to contact your Internet Service Provider or refer to your router documentation for assistance.

LCD Window displays "-WEB": This means that the EMU could not connect to the Internet to find an NTP server and could not connect to the Enlighten website.

- Check network connectivity to the premises router or switch. You may also wish to contact your Internet Service Provider or refer to your router documentation for assistance.

LCD Window displays "EMU Failure +WEB or -WEB": This message displays after the EMU has tried unsuccessfully three times to initialize. At this point, the EMU attempts to open a VPN tunnel to allow Enphase to perform remote diagnostics addressing the problem. This attempt to open a tunnel occurs every hour on the hour. If successfully opened, the tunnel stays open for 50 minutes. The EMU displays "**EMU Failure +WEB**" to indicate that the tunnel is open. After the 50 minute period, the tunnel is closed and the **"-WEB**" indication may again be displayed.

NOTE: Attempts to open a tunnel continue until recovery takes place, at which point the EMU resumes normal operation.

Micro-Inverter count doesn't match number of installed units: This message may indicate that the EMU is not done scanning/discovering the entire array, or it may indicate that the EMU is having difficulty communicating over the power lines.

- Try plugging the EMU into an electrical socket in a different location, closer to your main electrical panel. Also, make sure that the EMU is plugged directly into the wall and **not** into a power strip or surge protector.

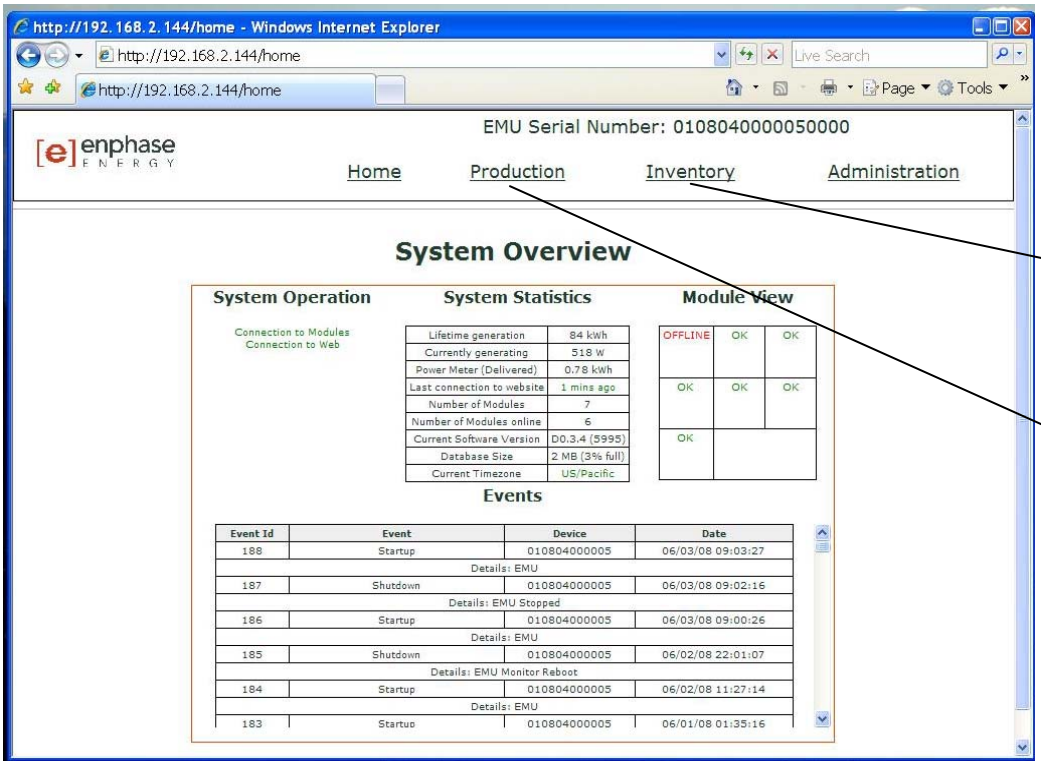
5 EMU Local Interface

Connection to the Enphase Enlighten™ web-based monitoring and analysis requires an Internet connection. However, if there is no Internet access at the installation site, it is still possible to communicate directly with the EMU using the Ethernet port and a personal computer with a web browser. The following steps describe how to access the EMU and the data that is available through the local connection.

1. Connect one end of the Ethernet cable supplied with the EMU to the EMU port labeled "Ethernet".
2. Connect the other end of the Ethernet cable to the RJ45 network port of the computer.
3. Open the Internet browser application on the computer.
4. In the browser address window enter the IP address displayed in the LCD window of the EMU (192.194.2.141 in this example).
   If you fail to make a connection at this point, you can try to manually configure your subnet to match any address from the range 169.254.x.x/16 (for example, 169.254.5.39). If this does not correct the problem, call Enphase Customer Support at 877-797-4743.

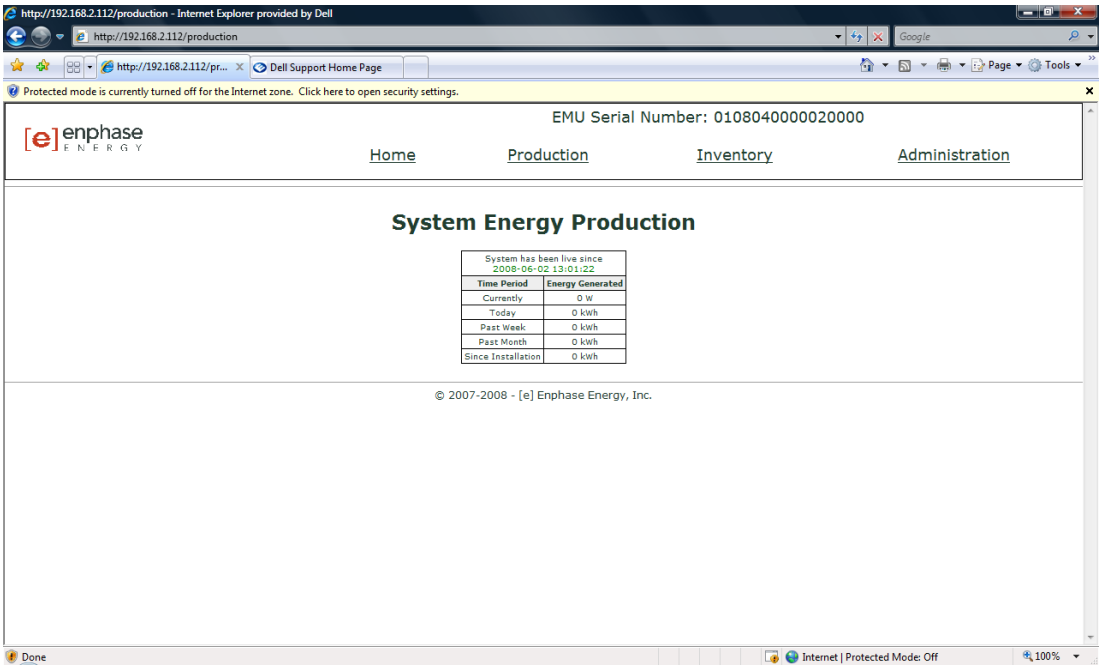
Home Screen

Once the browser has successfully connected with the EMU, the following screen is displayed in the browser. This home screen provides a system overview and shows the current status of the inverters that have been identified by this EMU. From this screen, you can access other screens in the interface.



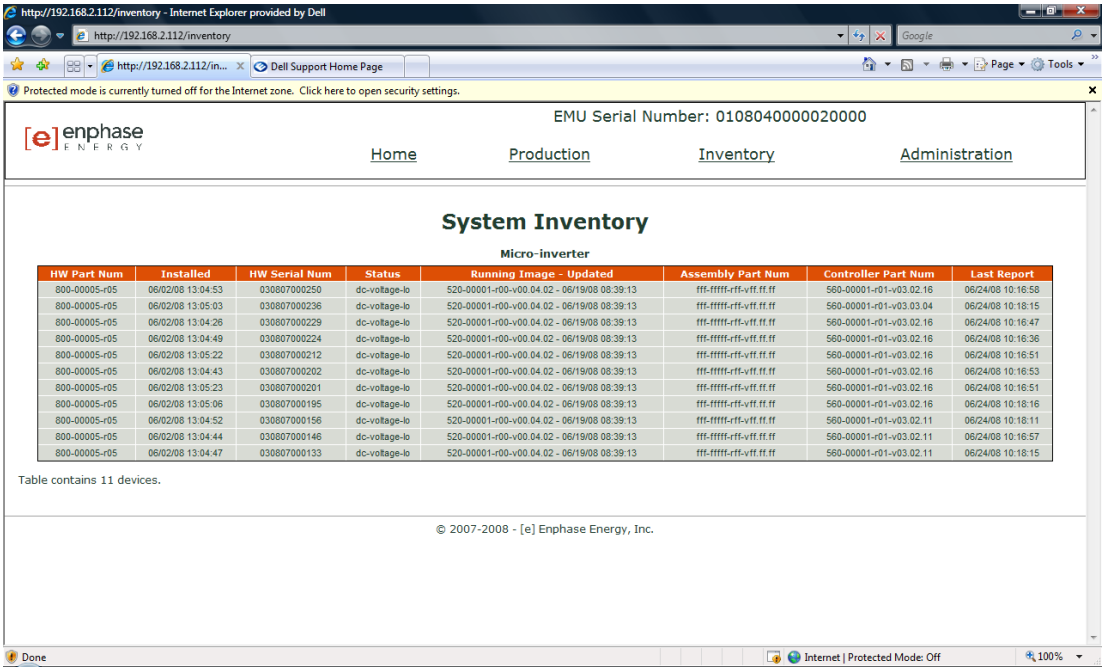
Production Screen

To view system energy production statistics for your system, click "Production" from the EMU home screen to navigate to the production screen.



Inventory Screen

To view a listing of the Micro-inverters in your system, click "Inventory" from any screen to navigate to the inventory screen.



Event Messages

The table below lists messages that the EMU can produce to indicate certain conditions. These messages appear on screen when your computer is connected to the EMU local interface. These messages can provide Enphase Customer Support with valuable information, should you need to call for assistance.

Where message is displayed:		
Home Screen	**Inventory Screen**	**Description**
AC Frequency Out Of Range	ac-freq-oor	The frequency of the AC grid has exceeded the limits specified by UL 1741.
AC Voltage Out Of Range	ac-voltage-oos-p# (# = 1, 2 or 3)	The voltage of the indicated AC phase (relative to neutral) has exceeded the limits specified by UL 1741.
Audible alarm active	audible-active	The inverter's buzzer is active, either due to an internally detected error or by user command.
Bad Flash Image	bad-flash-image	The inverter is not producing power because one of its flash memory images is corrupt. Contact Enphase Energy customer support at 877-797-4743 for assistance.
Commanded Reset	commanded-reset	The inverter has reset, either following a successful image download or by user command.
Control Request		This event logs a user control request made using the Administration > Device Conditions and Controls page or via Enlighten.
Critical Temperature	critical-temp	The inverter is producing less power in an attempt to not overheat (see Over Temperature)
DC Too High	dc-voltage-hi	The DC input voltage to the inverter is too high; check that the PV module and inverter are compatible.
DC Too Low	dc-voltage-lo	The DC input voltage to the inverter is too low; this is a normal condition at night, but during the day may indicate a bad or missing DC connection to the inverter.
Download to module begun		The EMU has begun an image download to the indicated inverter.
Download to module ended		The EMU has successfully downloaded an image to an inverter.
Download to module failed		The EMU was unable to successfully download an image to an inverter.

Where message is displayed:		
Home Screen	**Inventory Screen**	**Description**
GFI Tripped	gfi-tripped	An inverter has detected ground fault current greater than one amp. The error can only be cleared via the EMU after the ground fault condition has been remedied. The GFI can be cleared using the Device Conditions and Controls page unless the failure is permanent. Contact Enphase Energy customer support at 877-797-4743 for assistance.
Grid Gone	grid-gone	The AC utility grid is no longer present.
Grid Instability	grid-instability	The inverter is not producing power due to one or more of these conditions: AC Frequency Out Of Range, AC Voltage Out Of Range, or Grid Gone. Note that Grid Instability will remain for about 5 minutes after the underlying conditions clear.
Module added		The EMU has detected and is now associated to a new inverter.
Module failed to report		The EMU has not received a response to the last three messages sent to an inverter.
Over Temperature	over-temp	The inverter is not producing power, because it is too hot.
Power generation off by command	forced-pwr-prod-off	The inverter is not producing power by user command.
Power On Reset	power-on-reset	The inverter has powered on after having both AC and DC disconnected.
Shutdown		The EMU shut down its internal processing.
Skipped Cycles	skipped-cycles	The inverter has not produced power for more than 5% of the most recent production interval; this may be due to real problems in the grid, or a hardware failure of the inverter.
Startup		The EMU started its internal processing.

6 Technical Data

Interface	
Powerline	Enphase Proprietary
Ethernet	10/100/1000 Auto-sensing, Auto-negotiation
Power Requirements	
AC Outlet	120VAC, 60Hz, 100mA
Power Consumption	5 Watts
Mechanical Data	
Dimensions (WxHxD)	7 3/4" x 5" x 2 3/8"
Weight	2 lbs
Ambient Temperature Range	0°C to 40°C (32° to 104°F)
Cooling	Natural Convection – no fans
Enclosure Environmental Rating	Indoor - NEMA 1
Features	
Standard Warranty Term	1 year
Compliance	UL 1950, EN 6950, FCC Part 15 Class B

7 Appendix

Limited Warranty

Enphase Energy Inc. ("**Enphase**") has developed a highly reliable Energy Management Unit (EMU) that is designed to withstand normal operating conditions when used for its originally intended purpose in compliance with the Enphase User Manual supplied with the originally shipped system. The Enphase limited warranty ("**Limited Warranty**") covers defects in workmanship and materials of the Enphase Energy Management Unit ("**Defective Product**") for a period of one (1) years from the date of original purchase of such Energy Management Unit at point of sale to the original end user customer (the "**Warranty Period**").

During the Warranty Period, Enphase will, at its option, repair or replace the Defective Product free of charge, provided that Enphase through inspection establishes the existence of a defect that is covered by the Limited Warranty. Enphase will, at its option, use new and/or reconditioned parts in repairing or replacing the Defective Product. Enphase reserves the right to use parts or products of original or improved design in the repair or replacement of Defective Product. If Enphase repairs or replaces a Defective Product, the Limited Warranty continues on the repaired or replacement product for the remainder of the original Warranty Period or ninety (90) days from the date of Enphase's return shipment of the repaired or replacement product, whichever is later.

The Limited Warranty covers both parts and labor necessary to repair the Defective Product, but does not include labor costs related to un-installing the Defective Product or re-installing the repaired or replacement product. The Limited Warranty also covers the costs of shipping repaired or replacement product from Enphase, via a non-expedited freight carrier selected by Enphase, to locations within the United States (including Alaska and Hawaii) and Canada, but not to other locations outside the United States or Canada. The Limited Warranty does not cover, and Enphase will not be responsible for, shipping damage or damage caused by mishandling by the freight carrier and any such damage is the responsibility of the freight carrier.

To obtain repair or replacement service under this Limited Warranty, the customer must comply with the following policy and procedure:

- All Defective Product must be returned with a Return Merchandise Authorization Number (RMA) which customer must request from Enphase. Before requesting the RMA, however, the customer should contact an Enphase technical support representative to evaluate and troubleshoot the problem while the Enphase Energy Management Unit is in the field, since many problems can be solved in the field.
- If in-field troubleshooting does not solve the problem, Customer may request the RMA number, which request must include the following information:
    - Proof-of-purchase of the Defective Product in the form of (1) the dated purchase receipt from the original purchase of the product at point of sale to the end user, or (2) the dated dealer invoice or purchase receipt showing original equipment manufacturer (OEM) status, or (3) the dated invoice or purchase receipt showing the product exchanged under warranty.
    - Model number of the Defective Product

- Serial number of the Defective Product
- Detailed description of the defect
- Shipping address for return of the repaired or replacement product

- All Defective Product authorized for return must be returned in the original shipping container or other packaging that is equally protective of the product
- The returned Defective Product must not have been disassembled or modified without the prior written authorization of Enphase

The Limited Warranty does not cover normal wear and tear of Enphase Energy Management Units or costs related to the removal, installation, or troubleshooting of the customer's electrical systems. The Limited Warranty does not apply to, and Enphase will not be responsible for, any defect in or damage to any Enphase Energy Management Unit: (1) that has been misused, neglected, tampered with, altered, or otherwise damaged, either internally or externally; (2) that has been improperly installed, operated, handled or used, including use under conditions for which the product was not designed, use in an unsuitable environment, or use in a manner contrary to the Enphase User Manual or applicable laws or regulations; (3) that has been subjected to fire, water, generalized corrosion, biological infestations, acts of God, or input voltage that creates operating conditions beyond the maximum or minimum limits listed in the Enphase Energy Management Unit specifications, including high input voltage from generators or lightning strikes; (4) that has been subjected to incidental or consequential damage caused by defects of other components of the network system; or (5) if the original identification markings (including trademark or serial number) of such Energy Management Unit have been defaced, altered, or removed. The Limited Warranty does not extend beyond the original cost of the Enphase Energy Management Unit.

THE LIMITED WARRANTY IS THE SOLE AND EXCLUSIVE WARRANTY GIVEN BY ENPHASE AND, WHERE PERMITTED BY LAW, IS MADE EXPRESSLY IN LIEU OF ALL OTHER WARRANTIES, EXPRESS OR IMPLIED, STATUTORY OR OTHERWISE, INCLUDING, WITHOUT LIMITATION, WARRANTIES OF TITLE, QUALITY, MERCHANTABILITY, FITNESS FOR A PARTICULAR PURPOSE OR NON-INFRINGEMENT OR WARRANTIES AS TO THE ACCURACY, SUFFICIENCY OR SUITABILITY OF ANY TECHNICAL OR OTHER INFORMATION PROVIDED IN MANUALS OR OTHER DOCUMENTATION. IN NO EVENT WILL ENPHASE BE LIABLE FOR ANY SPECIAL, DIRECT, INDIRECT, INCIDENTAL OR CONSEQUENTIAL DAMAGES, LOSSES, COSTS OR EXPENSES HOWEVER ARISING, WHETHER IN CONTRACT OR TORT, INCLUDING WITHOUT LIMITATION ANY ECONOMIC LOSSES OF ANY KIND, ANY LOSS OR DAMAGE TO PROPERTY, OR ANY PERSONAL INJURY.

To the extent any implied warranties are required under applicable law to apply to the Enphase Energy Management Unit, such implied warranties shall be limited in duration to the Warranty Period, to the extent permitted by applicable law. Some states and provinces do not allow limitations or exclusions on implied warranties or on the duration of an implied warranty or on the limitation or exclusion of incidental or consequential damages, so the above limitation(s) or exclusion(s) may not apply. This Limited Warranty gives the customer specific legal rights, and the customer may have other rights that may vary from state to state or province to province.

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