

Installation and Operations Manual

Enphase Microinverter

Model M215™



Contact Information

Enphase Energy Inc.
201 1st Street
Petaluma, CA 94952
Phone: 707-763-4784 Toll Free: 877-797-4743
Fax: 707-763-0784

<http://www.enphase.com>

info@enphaseenergy.com

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.

Other Information

Product information is subject to change without notice. All trademarks are recognized as the property of their respective owners.

Copyright © 2011 Enphase Energy. All rights reserved.

Table of Contents

- Important Safety Information 4
 - Read this Before Installing or Using the M215 4
 - Safety Instructions 4
- The Enphase Microinverter System 5
 - How the Microinverter Works 6
 - System Monitoring 6
 - Optimal Reliability 6
 - Ease of Design 6
- Enphase Microinverter Installation 7
 - Compatibility and Capacity 7
 - Parts and Tools Required 8
 - Lightning Surge Suppression 8
 - Installation Procedure 9
 - Step 1 – Measure AC at the Electrical Utility Connection 9
 - Step 2 – Install the AC Branch Circuit Junction Box 10
 - Step 3 – Position the Enphase Engage Cable 11
 - Step 4 – Attach the Microinverters to the PV Racking 12
 - Step 5 – Dress the Engage Cable 13
 - Step 6 – Terminate the Unused End of the Engage Cable 15
 - Step 7 – Connect the Engage Cable to AC Junction Box(es) 16
 - Step 8 – Ground the System 17
 - Step 9 – Complete the Paper Map 18
 - Complete the Enphase Map 18
 - Alternative: Create Your Own Map 18
 - Step 10 – Connect the PV Modules 18
 - Step 11 – Build the Virtual Array 19
- Commissioning and Operation 20
 - Commissioning 20
 - Operating Instructions 20
- Troubleshooting 21
 - Status LED Indications and Error Reporting 21
 - Startup LED Operation: 21
 - GFDI Fault: 21
 - Other Faults: 21
 - Troubleshooting an Inoperable Microinverter 22
 - Disconnecting a Microinverter from the PV Module 23
 - Installing a Replacement Microinverter 24
- Technical Data 25
 - Technical Considerations 25
 - Technical Specifications 26
 - Enphase M215 Microinverter Parameters 26
 - Enphase Installation Map 28
 - Sample Wiring Diagram – M215, 240 Vac 29
 - Sample Wiring Diagram – M215, 208 Vac 30

Important Safety Information

Read this Before Installing or Using the M215

This manual contains important instructions for use during installation and maintenance of the Enphase M215™ Microinverter. User documentation is updated frequently; Check the Enphase website

(<http://www.enphase.com/support/downloads>) for the latest information.

To reduce the risk of electrical shock, and to ensure the safe installation and operation of the Enphase Microinverter, 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 be a safety hazard or cause equipment malfunction. Use extreme caution and follow instructions carefully.



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

Safety Instructions

- Perform all electrical installations in accordance with all applicable local electrical codes and the National Electrical Code (NEC), ANSI/NFPA 70.
- Be aware that only qualified personnel should install or replace Enphase Microinverters.
- Do not attempt to repair the Enphase Microinverter; it contains no user-serviceable parts. If it fails, please contact Enphase customer service to obtain an RMA (return merchandise authorization) number and start the replacement process. Tampering with or opening the Enphase Microinverter will void the warranty.
- Before installing or using the Enphase Microinverter, please read all instructions and cautionary markings in the technical description and on the Enphase Microinverter System and the PV equipment.
- Connect the Enphase Microinverter to the utility grid only after receiving prior approval from the electrical utility company.
- Be aware that the body of the Enphase Microinverter is the heat sink. Under normal operating conditions, the temperature is 15°C above ambient, but under extreme conditions the microinverter can reach a temperature of 80°C. To reduce risk of burns, use caution when working with microinverters.
- Do NOT disconnect the PV module from the Enphase Microinverter without first removing AC power.

The Enphase Microinverter System

The Enphase Microinverter System is the world's most technologically advanced inverter system for use in utility-interactive applications. This manual details the safe installation and operation of the Enphase Microinverter.

The three key elements of an Enphase Microinverter System include the:

- Enphase M215 Microinverter
- Enphase Envoy™ Communications Gateway
- **Enphase Enlighten™** web-based monitoring and analysis software

This integrated system maximizes energy harvest, increases system reliability, and simplifies design, installation and management.



1 Enphase Microinverters

- installed on the racking beneath each solar module
- maximize energy harvest

2 AC power travels over AC wiring to the load center

- performance data is also sent via the AC wiring
- plug and play communications

3 Envoy Communications Gateway

- plugs into any AC outlet
- collects information via the AC wiring
- transmits data through a standard broadband router to the Internet

4 Standard Broadband Router

- information collected by the Enphase Envoy is then transmitted to Enlighten in 5-minute intervals

5 Enphase Enlighten Monitoring

- provides monitoring and analysis
- performance information can be viewed from any web browser

How the Microinverter Works

The Enphase Microinverter maximizes energy production from your photovoltaic (PV) array. Each Enphase Microinverter is individually connected to one PV module in your array. This unique configuration means that an individual Maximum Peak Power Point Tracker (MPPT) controls each PV module. This ensures that the maximum power available from each PV module is exported to the utility grid regardless of the performance of the other PV modules in the array. That is, although individual PV modules in the array may be affected by shading, soiling, orientation, or PV module mismatch, the Enphase Microinverter ensures top performance for its associated PV module. The result is maximum energy production from your PV system.

System Monitoring

Indoors, you can install the Envoy Communications Gateway by plugging it into any convenient 120Vac wall socket and providing an Ethernet connection to your broadband router or modem. After installation of the Envoy, the Enphase Microinverters automatically begin reporting to the Enphase Enlighten web server. The Enlighten software presents current and historical system performance trends, and it informs you when the PV system is not performing as expected.

Optimal Reliability

Microinverter systems are inherently more reliable than traditional inverters. The distributed nature of a microinverter system ensures that there is no single point of system failure in the PV system. Enphase Microinverters are designed to operate at full power at ambient temperatures as high as 65° C (150° F). The microinverter housing is designed for outdoor installation and complies with the NEMA 6 environmental enclosure rating standard:

NEMA 6 rating definition: Indoor or outdoor use primarily to provide a degree of protection against hose-directed water, and the entry of water during occasional temporary submersion at a limited depth, and damage from external ice formation.

Ease of Design

PV systems using Enphase Microinverters are very simple to design and install. You will not need string calculations, and you can install individual PV modules in any combination of PV module quantity, type, age and orientation. **You won't need to** install cumbersome traditional inverters. Each microinverter quickly mounts on the PV racking, directly beneath each PV module. Low voltage DC wires connect from the PV module directly to the co-located microinverter, eliminating the risk of personnel exposure to lethal 600Vdc power.

Enphase Microinverter Installation

Follow the instructions in this section to install Enphase M215™ Microinverters.



WARNING: Be aware that only qualified personnel should connect the Enphase Microinverter to the utility grid.



WARNING: Be aware that installation of this equipment includes risk of electric shock. Normally grounded conductors may be ungrounded and energized when a ground fault is indicated.

Compatibility and Capacity

The Enphase M215 Microinverters are electrically compatible with most 60-cell PV modules. For more information, see Technical Data page 25 of this manual.



WARNING: The M215 should be paired only with a 60-cell PV module.

Refer to the Enphase website (<http://www.enphase.com/support/downloads>) for a list of **electrically**-compatible PV modules and approved PV racking systems. To ensure **mechanical** compatibility, be sure to order the correct connector type for both microinverter and PV module from your distributor.

Electrical Compatibility

Model Number	Works with PV Module Type	PV Module Connector Type
M215-60-2LL-S22 M215-60-2LL-S22-NA	60 cell	MC-4 Type 2 Locking or Amphenol H4 Locking
M215-60-2LL-S23 M215-60-2LL-S23-NA	60 cell	Tyco Solarlock Locking

Capacity

Maximum number of M215s per 20 amp AC Branch Circuit	
Service type	Max M215s per AC branch circuit
Split phase 240V	17
Three phase 208V	25

Parts and Tools Required

In addition to the M215 Microinverters, PV modules, racking, and associated hardware, you will need the following items.

Enphase equipment:

- Engage Cable, as needed
- Cable clips
- Sealing caps, as needed (for any unused drops on the Engage Cable)
- Terminators, as needed (one needed at the end of each AC branch circuit)
- Enphase disconnect tool (a number 2 Phillips screwdriver can be substituted)

Other items:

- AC junction boxes
- Gland or strain relief fitting (one per AC junction box)
- Continuous grounding conductor, grounding washers
- Number 2 Phillips screwdriver
- Torque wrench, sockets, wrenches for mounting hardware
- Adjustable wrench or open-ended wrench (for terminators)
- Handheld mirror (for viewing indicator lights on the undersides of the microinverters)

Lightning Surge Suppression

Lightning does not actually need to strike the equipment or building where PV system is installed to cause damage. Often, a strike nearby will induce voltage spikes in the electrical grid that can damage equipment. Enphase Energy Microinverters have integral surge protection, greater than most traditional inverters. However, if the surge has sufficient energy, the protection built into the Microinverter can be exceeded, and the equipment can be damaged.

Since the Enphase **Limited Warranty does not cover “acts of God” such as lightning strikes**, and since lightning strikes can occur anywhere, it is best practice to install surge protection as part of any solar installation. We recommend the following protection device. It has been tested to ensure that it does not interfere with power line communications. Install per vendor instructions.

Vendor: Citel, **Part Number:** DS72RS-120

Application: Residential 120/240V Split Phase where N-G bond exists.

See the vendor datasheet for DS70R, (which includes the DS72RS-120) at http://www.citelprotection.com/english/citel_data_sheets/ac_protection/.

Installation Procedure

Installing the Enphase Microinverter System involves several key steps. Each step listed below is detailed in the following pages.

- Step 1** – Measure AC at the Electrical Utility Connection
- Step 2** – Install the AC Branch Circuit Junction Box
- Step 3** – Position the Enphase Engage Cable
- Step 4** – Attach the Microinverters to the PV Racking
- Step 5** – Dress the Enphase Engage Cable
- Step 6** – Terminate the Unused End of the Engage Cable
- Step 7** – Connect the Engage Cable to AC Junction Box(es)
- Step 8** – Ground the System
- Step 9** – Complete the Installation Map
- Step 10** – Connect the PV Modules
- Step 11** – Build the Virtual Array

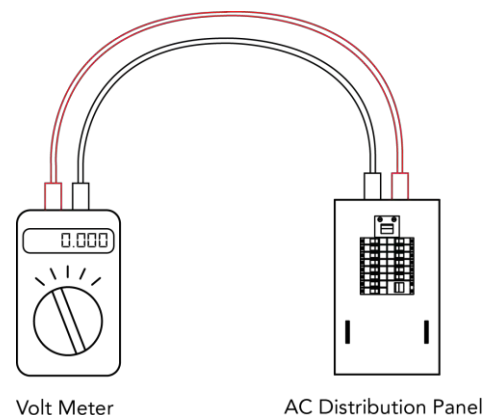


WARNING: DO NOT connect Enphase Microinverters to the utility grid or energize the AC circuit(s) until you have completed all of the installation procedures as described in the following sections.

Step 1 – Measure AC at the Electrical Utility Connection

Measure AC line voltage at the electrical utility connection to confirm AC service at the site. Acceptable ranges are shown in the following table.

Single-phase 240 Volt AC	
L1 to L2	211 to 264 Vac
L1, L2 to neutral	106 to 132 Vac
Three-phase 208 Volt AC	
L1 to L2 to L3	183 to 229 VAC
L1, L2, L3 to neutral	106 to 132 VAC



NOTE: Be sure the Engage Cable you are using matches the electrical utility connection at the site. Use 208 Vac (208 Vac three-phase) Engage Cable at sites with three-phase 208 Vac service, or use 240 Vac Engage Cable at sites with 240 Vac single-phase service. Check the labeling on the drop connectors to verify the voltage type.

Step 2 – Install the AC Branch Circuit Junction Box



DANGER: Risk of Electrical Shock. Be aware that installation of this equipment includes risk of electric shock. Do not install the AC junction box without first removing AC power from the Enphase System.



WARNING: Only use electrical system components approved for wet locations.



WARNING: Do NOT exceed the maximum number of microinverters in an AC branch circuit as listed on page 27 of this manual. You must protect each microinverter AC branch circuit with a 20A maximum breaker.

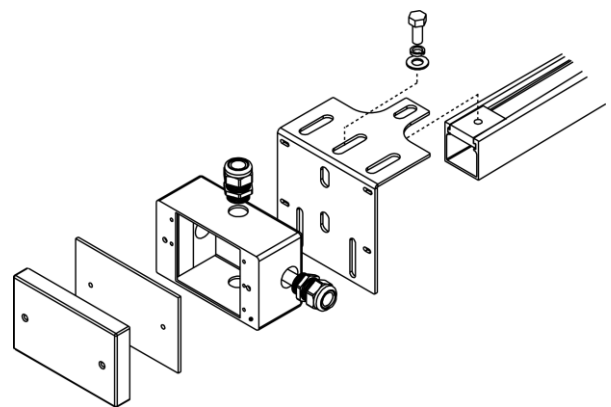
- a. Size the AC wire gauge to account for voltage drop. Select the correct wire size based on the distance from the beginning of the microinverter AC branch circuit to the breaker in the load center.

All components of system wiring must be considered, including internal voltage drop within the length of Engage Cable. Typically, three wire sections and several wire terminations must be quantified. There is also some resistance associated with each circuit breaker. As all of these resistances are in series, they add together. Since the same current is flowing through each resistance, the total voltage drop is total current times the total resistance. For a single-phase system, the total resistance is equal to two times the one-way resistance. For a three-phase system, each of the three line currents and resistances must be calculated.

Standard guidelines for voltage drop on feeder and AC branch circuit conductors might not be sufficient for microinverter AC branch circuits that contain the maximum allowable microinverters. This is due to high inherent voltage rise on the AC branch circuit.

For more information, refer to our *Voltage Drop Calculations Application Note* at <http://www.enphase.com/support/downloads>.

- b. Install an appropriate junction box at a suitable location on the PV racking system (typically at the end of a row of PV modules).
- c. Provide an AC connection from the AC junction box back to the electrical utility connection using equipment and practices as required by the NEC and local jurisdictions.



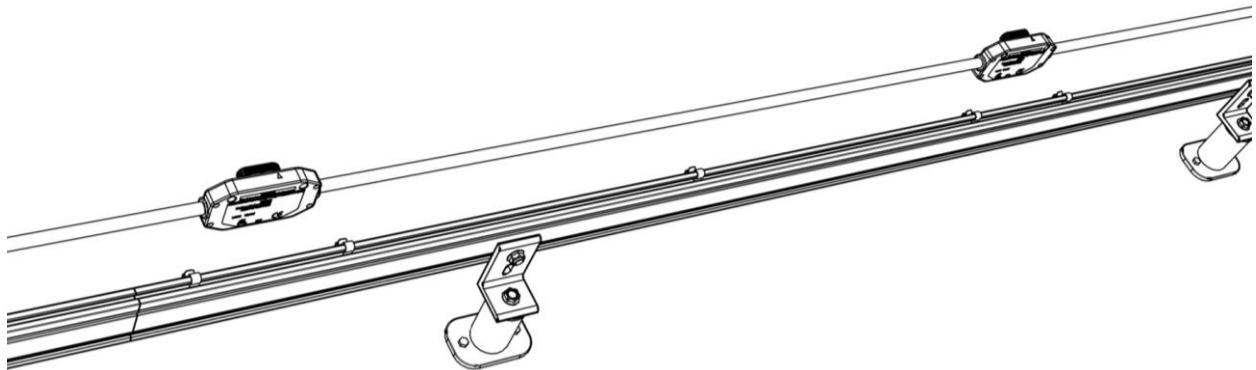
Step 3 – Position the Enphase Engage Cable

The Engage Cable is a continuous length of 12 AWG (2.5 mm²), outdoor rated cable with integrated connectors for microinverters. These connectors are preinstalled along the Engage Cable at intervals to accommodate PV module widths. The microinverters plug directly into the connectors, and the Engage Cable is terminated into the junction box that feeds electricity back to the system AC disconnect.

- a. Lay the Engage Cable along the route it will travel, positioning the connectors so that they align with the PV modules.



WARNING: Plan the AC branches so that they do not exceed the maximum number of microinverters in an AC branch circuit as listed on page 27 of this manual. You must protect each microinverter AC branch circuit with a 20A maximum breaker.



NOTE: Many PV modules have a central stiffening brace. In these cases, do **not** position the connector and microinverter at the exact center of the PV module, but position the Engage Cable so that the connectors do not conflict with the braces.

- b. PV module widths vary by manufacturer. On the Engage Cable, connectors are spaced at intervals to allow for the widest PV modules compatible with Enphase Microinverters. If narrower PV modules are used, it may be necessary to account for excess cable by looping the cable at suitable intervals.

Step 4 – Attach the Microinverters to the PV Racking

- a. Mark the approximate centers of each PV module on the PV racking.
- b. Evaluate the location of the microinverter with respect to the PV module DC junction box or any other obstructions.
- c. Ensure that the microinverter does not interfere with the PV module frame or stiffening braces.
- d. Ensure that the connector from the microinverter can easily reach the connector on the Engage Cable.
- e. Allow a minimum of 1.9 cm (0.75 inches) between the roof and the bottom of the microinverter. Also allow 1.3 cm (0.50 inches) between the back of the PV module and the top of the microinverter.



WARNING: Do not mount the microinverter in a location that allows long-term exposure to direct sunlight (i.e., the microinverter should be covered by the PV module).

- f. Ground the microinverters using either a continuous, unbroken grounding conductor or approved grounding washers. If using grounding washers (e.g., WEEB) to ground the microinverter chassis to the PV module racking, choose one that is approved for the racking manufacturer. Install one grounding washer per microinverter. Torque the microinverter fasteners to the values below.

- 6 mm (1/4") mounting hardware – 5 N m (45 in-lbs) minimum
- 8 mm (5/16") mounting hardware – 9 N m (80 in-lbs) minimum



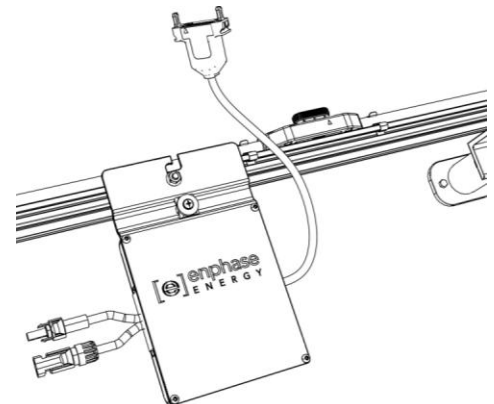
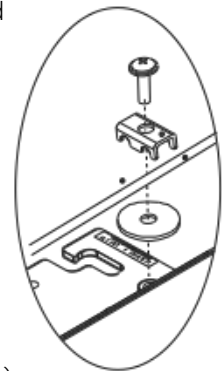
NOTE: Using a power screwdriver to tighten the grounding clamp screw is not recommended due to the risk of thread galling.



NOTE: Compatible grounding washer part numbers are included in the *Racking Compatibility Application Note*. Installation guidelines are included in the *WEEB Installation Application Note*. Refer to both at:

<http://www.enphase.com/support/downloads>.

- g. With the **silver side of the microinverter facing up** and the black side facing down, mount one microinverter at each location using suitable hardware. The indicator light on the underside of the microinverter will be facing the roof.



Step 5 – Dress the Engage Cable

- a. Attach the Engage Cable to the PV racking using the cable clips, or you may use tie wraps. The cable clips are designed so that the connector from the microinverter can also be dressed into the clip underneath the Engage Cable.

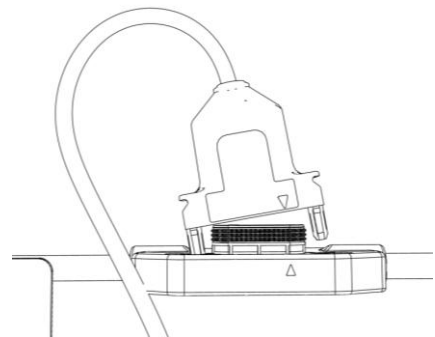
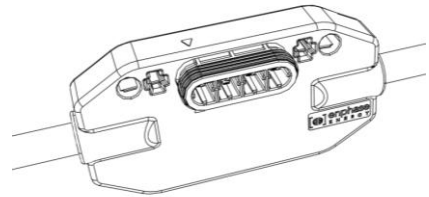
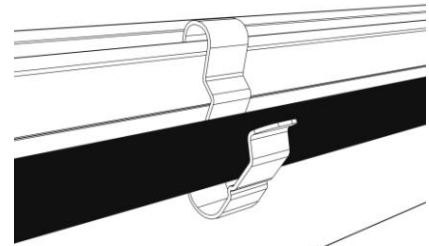


NOTE: There are two through-holes in the connector on the cable. These are **not** for mounting but are used to disconnect the connector. **Keep these release holes clear and accessible.**

- b. Dress any excess in loops so that the Engage Cable does not contact the roof.

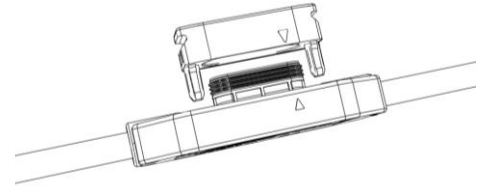
Do **not** allow the Engage Cable to rest on the roof. There are several ways to support the cable. One method is to place tie wraps or clips on either side of the connector. Use one or two additional clips, tie wraps, or other support scheme to secure the cable between connectors.

- c. Remove the temporary shipping cap from the Engage Cable and connect the microinverter. There are two latching mechanisms within the connectors. Listen for **two** clicks as the connectors engage. Ensure that **both** latching mechanisms have engaged.

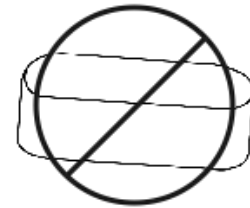


Step 5 – Dress the Engage Cable (continued)

- d. Repeat for all microinverters in the AC branch circuit.
- e. Cover any unused connector with a sealing cap. Listen for two clicks as the connectors engage. Ensure that **both** latching mechanisms have engaged.



Do not use the shipping cap to cover unused connectors. The shipping cap does not provide an adequate environmental seal. Enphase sealing caps are required for the system to be UL compliant and to protect against moisture ingress.



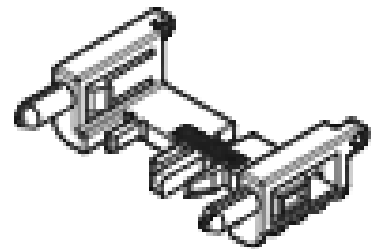
NOTE: Enphase sealing caps are IP67 rated. Within the term “IP67”, “IP” indicates an Ingress Protection (IP) rating against dust and liquids. This specific rating of IP67 indicates that this connector protects against all dust particles and immersion in liquid.



WARNING: Make sure protective sealing caps have been installed on **all** unused AC connectors. Unused AC connectors are live when the system is energized by the utility system.



NOTE: If you need to remove a sealing cap, you must use the Enphase disconnect tool or a #2 Phillips screwdriver. Sealing caps may not be reused.



Step 6 – Terminate the Unused End of the Engage Cable

Terminate the far end of the Engage Cable.

a. Remove 60mm (2.5 inches) of the cable sheath from the conductors.

b. Slide the hex nut onto the Engage Cable.

c. Insert the Engage Cable all the way into the wire organizer (up to the stop).

d. Bend the individual wires back into the recesses in the wire organizer so that they angle back toward the cable.

e. Cut the individual wires so that no excess extends outside of the wire organizer. The portions that angle back will need to extend enough to fit neatly into the 0.5 cm (0.2 in) recesses in the wire organizer and flush with the edge of the cap.

f. Screw the hex nut onto the cap.

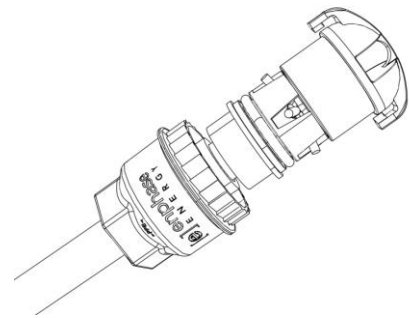
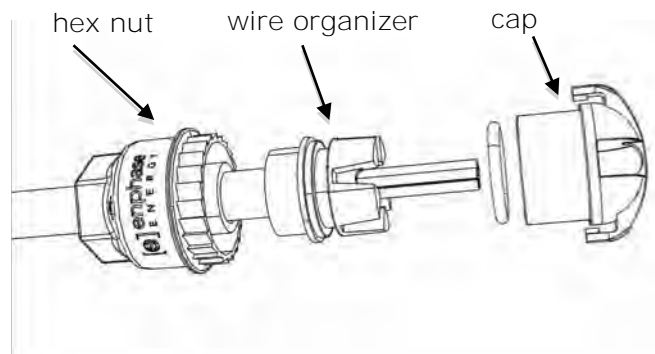
Never unscrew the hex nut as this can twist and damage the cable.

g. Hold the cap with an Enphase disconnect tool, or insert a #2 Phillips screwdriver.

h. Use a 24mm (7/8 inch) wrench to tighten the hex nut until the latching mechanism is screwed all the way to the base.

i. Use a tie wrap or cable clip to attach the cable to the PV racking, so that the Engage Cable and terminator do not touch the roof.

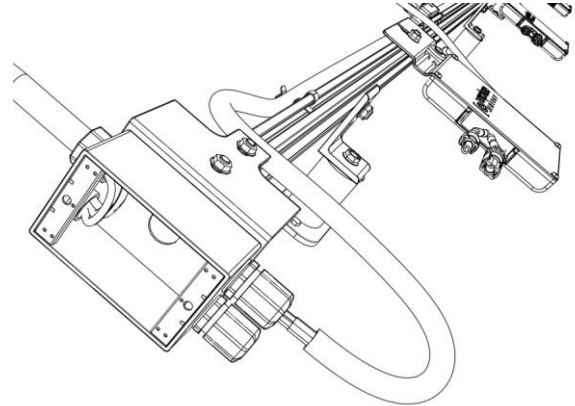
j. Ensure that all cabling is located underneath the PV module.



Step 7 – Connect the Engage Cable to AC Junction Box(es)

- a. Connect Engage Cable into the AC branch circuit junction box using an appropriate gland or strain relief fitting. The Engage Cable requires a strain relief connector with an opening of 1.3 cm (0.5 inches) in diameter.
- b. Connect the Engage Cable into additional AC junction boxes as needed to transition to conduit between smaller sub-arrays.

Refer to the wiring diagrams located in the Appendix of this manual for more information.



NOTE: The Engage Cable uses a different wiring scheme than used with other Enphase Microinverters. Be aware of the difference in wire color code.

Wires are identified as follows: L1 is sheathed in Black, L2 is sheathed in red, L3 is sheathed in blue, Neutral is sheathed in white, and Ground is sheathed in green. The grounding wire is used to ground the microinverters. A WEEB or continuous ground is required in addition to this green grounding wire.

Balanced 208 VAC is accomplished by alternating phases between microinverters.

240 Volt AC Split Phase Wiring	208 Volt AC Three-Phase Wiring
Black – L1 Red – L2 White – Neutral Green - Ground	Black – L1 Red – L2 Blue – L3 White – Neutral Green - Ground



NOTE: The green wire acts as equipment ground. A continuous GEC for system ground is also required as described in the next step.

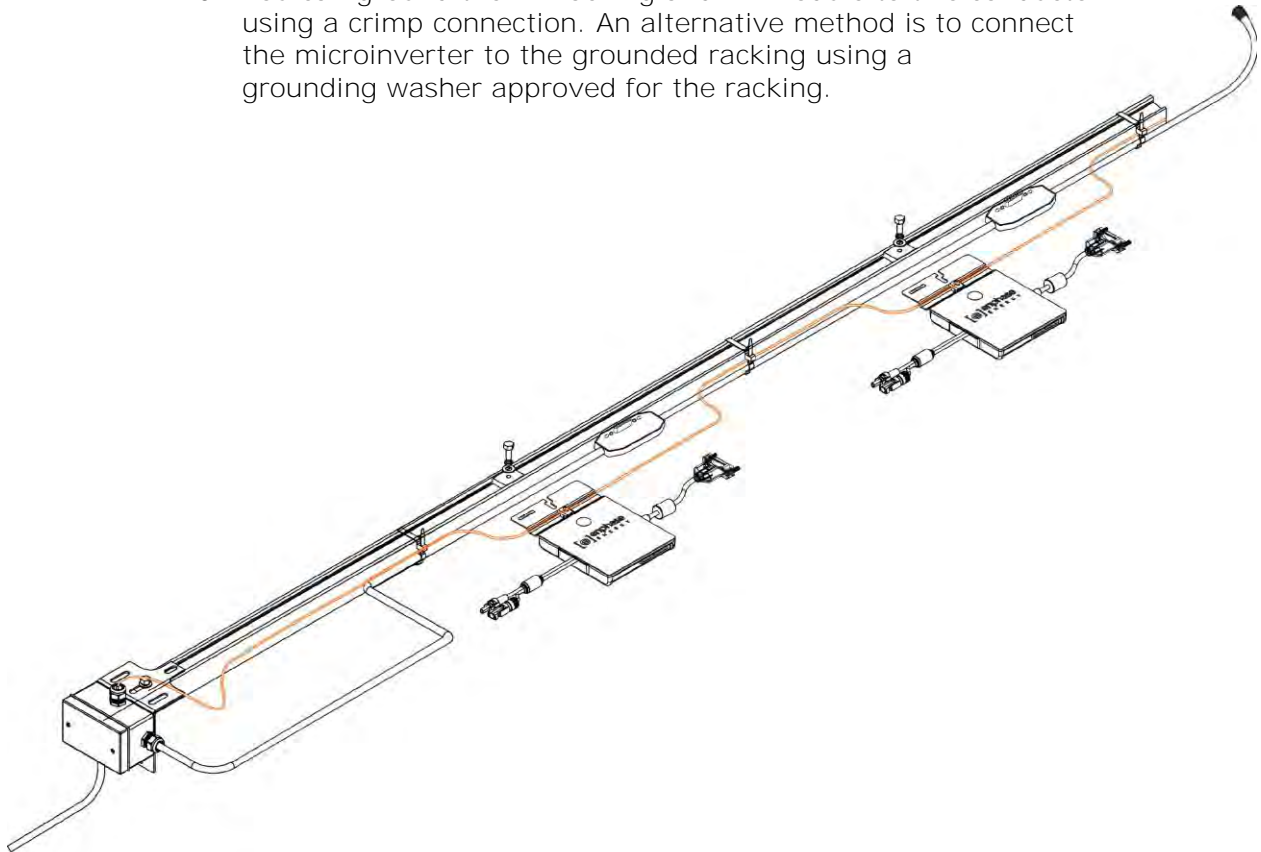
Step 8 – Ground the System

If you are not using WEEB grounding washers to ground the microinverter chassis as described in step 4, follow the steps below. Each Enphase Microinverter comes with a cable clip that can accommodate a 6-8 AWG conductor.



NOTE: The AC output neutral is not bonded to ground inside the microinverter.

- a. Route a continuous GEC through each of the microinverters to the NEC-approved AC grounding electrode.
- b. You can ground the PV racking and PV module to this conductor using a crimp connection. An alternative method is to connect the microinverter to the grounded racking using a grounding washer approved for the racking.



- c. Torque the microinverter fasteners to the values below.
 - 6 mm (1/4") mounting hardware – 5 N m (45 in-lbs) minimum
 - 8 mm (5/16") mounting hardware – 9 N m (80 in-lbs) minimum



NOTE: Using a power screwdriver to tighten the grounding clamp screw is not recommended due to the risk of thread galling.

Step 9 – Complete the Paper Map

The Enphase Installation Map is a diagrammatic representation of the physical location of each microinverter in your PV installation. The virtual array in Enlighten is created from the map you create. Use the blank map in the Appendix to record microinverter placement for the system, or provide your own layout if a larger or more intricate installation map is required.

Complete the Enphase Map

- a. Each Enphase Microinverter has a removable serial number label located on the mounting plate. Peel the removable serial number label from each Enphase Microinverter and affix it to the respective location on the Enphase installation map (see map on page 28). Remember to keep a copy of the installation map for your records.

Alternative: Create Your Own Map

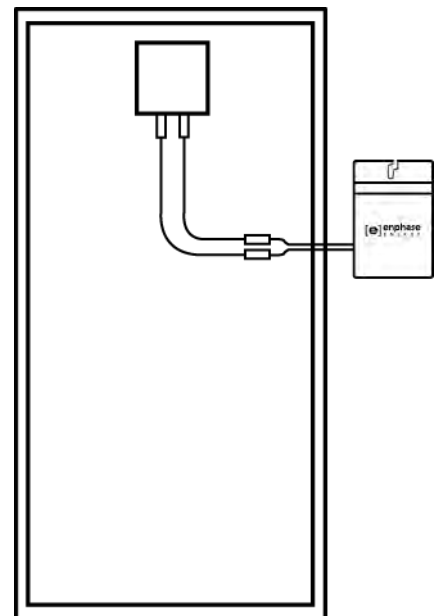
- a. Draw a top-down view of the array using the Array Map template (using either the grid on Side A or the freeform area on Side B). Make sure to leave enough room to place the serial number stickers.
- b. When installing the microinverters, remove the serial number labels located next to the DC input cables and place them in the correct order on your drawing of the system. Remember to keep a copy of the installation map for your records.

Step 10 – Connect the PV Modules



NOTE: Completely install all microinverters and all system AC connections prior to installing the PV modules.

- a. Mount the PV modules above the microinverters.
- b. Mate the microinverters and PV modules as required. Repeat for all remaining PV modules using one microinverter for each PV module.



Step 11 – Build the Virtual Array

When the system is energized and the Envoy detects all the installed microinverters, you can create the virtual array in Enlighten from the Enphase map you created. Once the virtual array is built, Enlighten displays a graphic representation of the PV system. It also shows detailed current and historical performance information. Please go to <http://www.enphase.com> for more information on the Enphase Enlighten web-based monitoring and analysis.

- a. Scan the paper installation map and upload it to the Activation form online.
- b. Use Array Builder to create the virtual array in Enlighten. Use the paper map created in step 9 as your reference.



NOTE: Go to <http://www.enphase.com/support/learningcenter> to view an Array Builder demo.

- c. If you do not already have an account, go to <http://www.enphase.com> and click “Enlighten Login” to register.

Commissioning and Operation



WARNING: Be aware that only qualified personnel must connect the Enphase Microinverter to the utility grid.



WARNING: Ensure that all AC and DC wiring is correct. Ensure that none of the AC and DC wires are pinched or damaged. Ensure that all AC junction boxes are properly closed.



WARNING: Connect the Enphase Microinverter to the utility grid only after receiving prior approval from the electrical utility company.



NOTE: The Status LED on the underside of each microinverter will blink green six times to indicate normal start-up operation approximately one minute after DC power is applied.

Commissioning

To commission the Enphase Microinverter PV system:

1. Turn ON the AC disconnect or circuit breaker for each microinverter AC branch circuit.
2. Turn ON the main utility-grid AC circuit breaker. Your system will start producing power **after a five-minute wait time**.
3. The Enphase Microinverters will begin communicating over the power lines to the Envoy. The time required for all microinverters to report to the Envoy will vary with the number of microinverters in the system. The first units should be detected within 15 minutes but the entire system could take hours to detect.

For more information on Envoy operation, refer to the *Envoy Installation and Operation Manual* at <http://www.enphase.com/support/downloads>.

Operating Instructions

The Enphase Microinverter is powered on when sufficient DC voltage from the PV module is applied. The Status LED of each microinverter will blink green six times to indicate normal start-up operation approximately one minute after DC power is applied. You may need to use a handheld mirror to view indicator lights on the undersides of the microinverters.

Troubleshooting

Adhere to all the safety measures described throughout this manual. Qualified personnel can use the following troubleshooting steps if the PV system does not operate correctly.



WARNING: Do not attempt to repair the Enphase Microinverter; it contains no user-serviceable parts. If it fails, please contact Enphase customer service to obtain an RMA (return merchandise authorization) number and start the replacement process.

Status LED Indications and Error Reporting

Startup LED Operation:

The Status LED of each microinverter will blink green six times to indicate normal start-up operation approximately one minute after DC power is applied.

Six short red blinks after DC power is first applied to the microinverter indicate a failure during microinverter startup.

Post-Startup LED Indications: Use a handheld mirror to view indicator lights on the undersides of the microinverters:

Flashing Green – Producing power and communicating with Envoy

Flashing Orange – Producing power and not communicating with Envoy

Flashing Red – Not producing power

GFDI Fault:

A solid red status LED when DC power has been cycled indicates the microinverter has detected a ground fault (GFDI) error. The LED will remain red and the fault will continue to be reported by the Envoy until the error has been cleared.

The condition should clear with operator intervention unless conditions causing the event have not been remedied or if the failure is permanent.

Follow the instructions in the *Envoy Communications Gateway Installation and Operation Manual* to clear this condition. Or, for assistance, contact Enphase Energy customer support at 877-797-4743 or at support@enphase.com.

Other Faults:

All other faults are reported to the Envoy. Refer to the *Envoy Installation and Operation Manual* for troubleshooting procedures.



WARNING: Be aware that only qualified personnel should troubleshoot the PV array or the Enphase Microinverter.



WARNING: Never disconnect the DC wire connectors under load. Ensure that no current is flowing in the DC wires prior to disconnecting. An opaque covering may be used to cover the PV module prior to disconnecting the PV module.



WARNING: Always disconnect AC power before disconnecting the PV module wires from the Enphase Microinverter. The AC connector of the microinverter is suitable as a disconnecting means.



WARNING: The Enphase Microinverters are powered by DC power from the PV modules. Make sure you disconnect the DC connections and reconnect DC power to watch for the six short LED blinks one minute after DC is applied.

Troubleshooting an Inoperable Microinverter

To troubleshoot an inoperable microinverter, follow the steps in the order shown:

1. Check the connection to the utility grid and verify the utility voltage and frequency are within allowable ranges shown in the Technical Data section on page 25 of this manual.
2. Verify that AC line voltage at the electrical utility connection and at the AC junction box for each AC branch circuit are within the ranges are shown in the following table:

240 Volt AC Split Phase		208 Volt AC 3 Phase	
L1 to L2	211 to 264 Vac	L1 to L2 to L3	183 to 229 Vac
L1, L2 to neutral	106 to 132 Vac	L1, L2, L3 to neutral	106 to 132 Vac

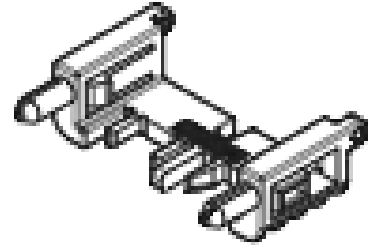
3. Verify utility power is present at the microinverter in question by removing AC, then DC power. **Never disconnect the DC wires while the microinverter is producing power.**
4. Re-connect the DC PV module connectors. The Status LED of each microinverter will blink green six times to indicate normal start-up operation one minute after DC power is applied.
5. Check the AC branch circuit between all the microinverters. As described in the previous step, verify that all microinverters are energized by the utility grid.
6. Make sure that any upstream AC disconnects, as well as the dedicated circuit breakers for each AC branch circuit, are functioning properly and are closed.
7. Verify the PV module DC voltage is within the allowable range shown in the Technical Data section on page 25 of this manual.
8. Check the DC connections between the microinverter and the PV module.
9. If the problem persists, please call Customer Support at Enphase Energy.

Disconnecting a Microinverter from the PV Module

To ensure the microinverter is not disconnected from the PV modules under load, adhere to the following disconnection steps in the order shown:

1. Disconnect the microinverter from the Engage Cable.

The Enphase AC connectors are tool-removable only. The installation kit includes a disconnect tool with two prongs. To disconnect a microinverter from the Engage Cable, insert these two prongs into the two holes in the AC cable connector. Rock the connector back and forth while pulling gently to disengage.



If the disconnect tool is not available, a #2 Phillips screwdriver can be used in its place. Insert the screwdriver into one hole, rock that side of the drop connector out, then insert the screwdriver into the other hole and pull the connector out entirely.

2. Cover the PV module with an opaque cover.
3. Using a clamp on meter, verify there is no current flowing in the DC wires between the PV module and the microinverter.
4. Take care when measuring DC current as most clamp-on meters must be zeroed first and tend to drift with time.
5. Disconnect the PV module DC wire connectors from the microinverter using the Enphase disconnect tool.
6. Remove the microinverter from the PV racking.



WARNING: Do not leave the AC connector on the Engage Cable uncovered for an extended period. If you do not plan to replace the microinverter immediately, you must cover any unused connector with a sealing cap.

Installing a Replacement Microinverter

1. With the silver side of the microinverter facing up and the black side facing down, attach the replacement microinverter to the PV racking using hardware recommended by your PV racking vendor.
2. If you are using grounding washers (e.g., WEEB) to ground the chassis of the microinverter, the old grounding washer should be discarded, and a new grounding washer must be used when installing the replacement microinverter. Torque the microinverter fasteners to the values below.
 - 6 mm (1/4") mounting hardware – 5 N m (45 in-lbs) minimum
 - 8 mm (5/16") mounting hardware – 9 N m (80 in-lbs) minimum



NOTE: Using a power screwdriver to tighten the grounding clamp screw is not recommended due to the risk of thread galling.

3. If you are using a grounding electrode conductor to ground the microinverter chassis, attach the grounding electrode conductor to the microinverter ground clamp.
4. Remove the temporary shipping cap from the Engage Cable and connect the microinverter. There are two latching mechanisms within the connectors. Listen for two clicks as the connectors engage. Ensure that **both** latching mechanisms have engaged.
5. Mount the PV module above the microinverter.
6. First connect the positive DC wire from the PV module to the negatively marked DC connector (male pin) of the microinverter. Then connect the negative DC wire from the PV module to the positively marked DC connector (female socket) of the microinverter.
7. Energize the AC branch circuit breaker, and verify operation of the replacement microinverter by checking the indicator light on the underside of the microinverter. You may need a handheld mirror to see the indicator light.
8. Initiate a device scan at the Envoy. To do this, press and hold the Menu button on Envoy for two seconds to bring up the Envoy menu on the LCD window. When the LCD window **displays "Enable Communication Check"**, release the Menu button.
9. Use Enlighten's Array Builder function to add the newly detected microinverter to the virtual array.

Technical Data

Technical Considerations

The Enphase M215 Microinverters are designed to operate with most 60-cell PV modules. Be sure to verify the voltage and current specifications of your PV module match those of the microinverter. For more information, refer to the Enphase website (<http://www.enphase.com/support/downloads>) for a list of compatible PV racking and PV modules.



WARNING: You must match the DC operating voltage range of the PV module with the allowable input voltage range of the Enphase Microinverter.



WARNING: The maximum open circuit voltage of the PV module must not exceed the specified maximum input voltage of the Enphase Microinverter.

The output voltage and current of the PV module depends on the quantity, size and temperature of the PV cells, as well as the insolation on each cell. The highest PV module output voltage occurs when the temperature of the cells is the lowest and the PV module is at open circuit (not operating). The maximum short circuit current rating of the PV module must be equal to or less than the maximum input DC short circuit current rating of the microinverter.

A list of compatible PV modules is maintained on the Enphase website (<http://www.enphase.com/support/downloads>).

Technical Specifications

Enphase M215 Microinverter Parameters				
Topic	Unit	Min	Typical	Max
DC Parameters				
MPPT voltage range	V	22	29	36
Operating range	V	16		36
Maximum DC input voltage	V			45
Minimum / Maximum start voltage	V	26.4		45
Maximum DC input short circuit current	A			15
Maximum DC input current	A			10.5
Ground fault protection	mA			1000
Maximum input source backfeed current to input source	A			0
AC Parameters				
Maximum AC output Power (-40 to 65 °C)	W	215		
Output power factor		0.95	0.99	1
Nominal AC output voltage range				
240 Vac (split phase)	Vrms	211	240	264
208 Vac (three phase)	Vrms	183	208	229
Extended AC output voltage range				
240 Vac (split phase)	Vrms	206	240	269
208 Vac (three phase)	Vrms	179	208	232
Maximum AC output current				
240 Vac (nominal)	A		0.9	
208 Vac (nominal)	A		1.0 ¹	
Nominal AC output frequency range	Hz	59.3	60	60.5
Extended AC output frequency range	Hz	59.2	60	60.6
Maximum AC output over current protection	A	20 A		
Maximum AC output fault current & duration	A _p /ms	25.2A _{peak} over 1.74ms 1.05A _{rms} over 3 cycles 1.04A _{rms} over 5 cycles		
High AC Voltage trip limit accuracy	%	±2.5		
Low AC Voltage Trip limit accuracy	%	±4.0		
Frequency trip limit accuracy	Hz	±0.1		
Trip time accuracy	ms	±33		

¹ Arms at nominal voltage

Enphase M215 Microinverter Parameters				
Topic	Unit	Min	Typical	Max
Miscellaneous Parameters				
Maximum inverters per 20 amp AC branch circuit				
240 Vac (split phase)		1		17
208 Vac (three phase)		1		25
Peak inverter efficiency	%			96.3
CEC weighted efficiency	%			96.0
Static MPPT efficiency (weighted, ref EN 50530)	%			99.8
Total Harmonic Distortion	%		3.0	5
Operating temperature range (internal)	°C	-40		85
Ambient temperature range	°C	-40		65
Night Tare Loss	mW		46	
Storage temperature range	°C	-40		65
Features				
Dimensions not including mounting bracket (approximate)	17.3 cm x 16.4 cm x 2.5 cm (6.8" x 6.45" x 1.0")			
Weight	3.5 Lbs (1.6 Kg)			
Enclosure environmental rating	NEMA 6			
Cooling	Natural convection – no fans			
Communication	Power line			
Standard warranty term	25-year limited warranty			
Compliance	UL1741, IEEE1547, FCC Part 15 Class B CAN/CSA-C22.2 NO. 0-M91, 0.4-04, and 107.1-01			
Integrated AC disconnect	The AC connector has been evaluated and approved for use as the load-break disconnect required by the NEC.			



Enphase Installation Map

Panel Group: Azimuth: Tilt: sheet ___ of ___		Customer information:					Installer information:					N S E W (circle one)			
1	2	3	4	5	6	7	1	2	3	4	5	6	7		
A															
B															
C															
D															
E															
F															
G															
H															
J															
K															
L															
M															

To Sheet: _____ ↑ ↓ _____ To Sheet:

DOCUMENT NUMBER
140-00003
REVISION
03

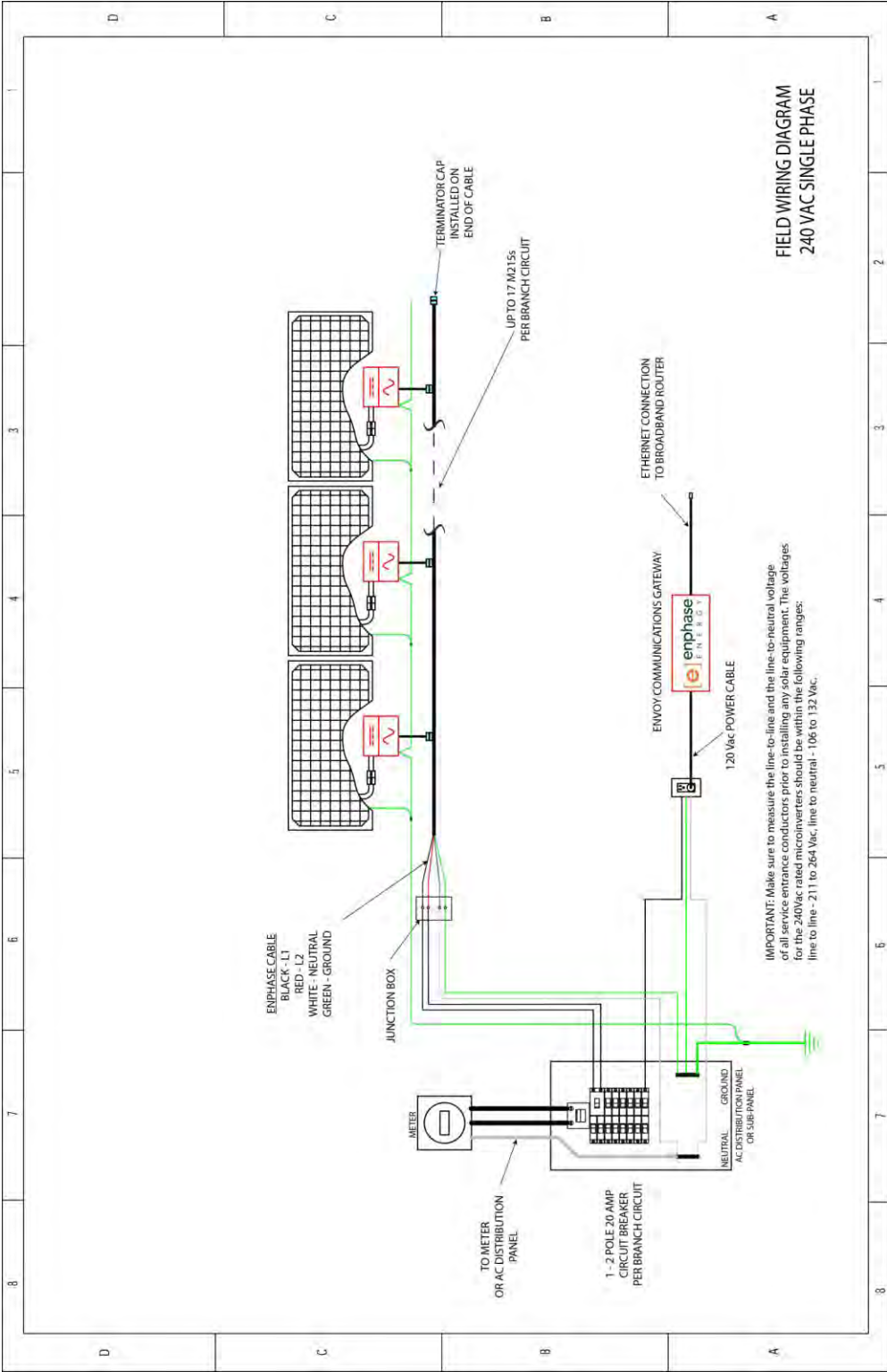
INSTALLATION MAP



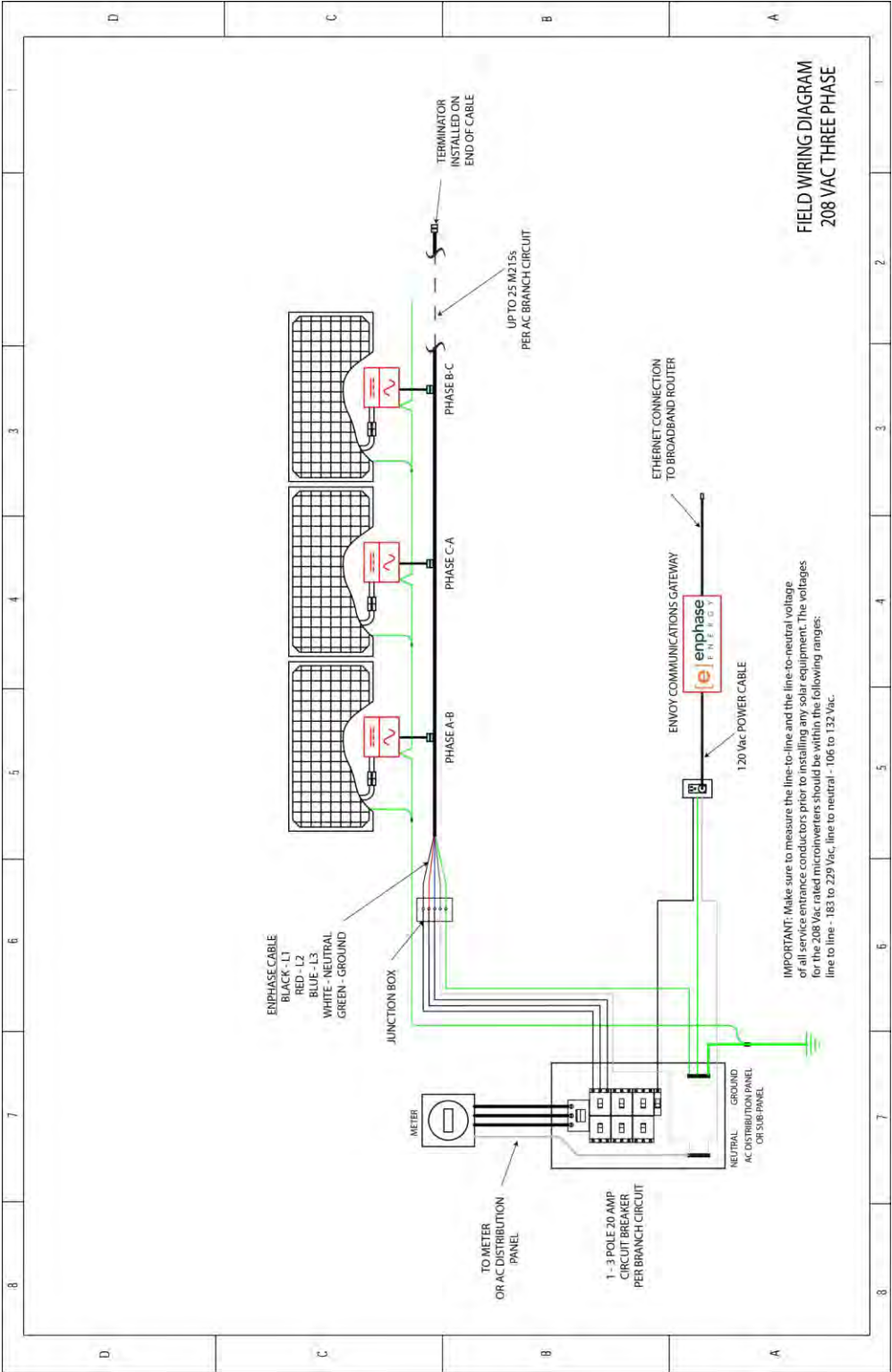
Envoy Serial Label

Scan completed map and upload to the Activation page online at www.enphaseenergy.com. Use this map to build the virtual array in Enlighten Array Builder.

Sample Wiring Diagram – M215, 240 Vac



Sample Wiring Diagram – M215, 208 Vac







Enphase Energy Inc.
201 1st Street
Petaluma, CA 94952
Phone: 707-763-4784
TOLL FREE: 877-797-4743
Fax: 707-763-0784
www.enphase.com
info@enphaseenergy.com