SIEMENS

Installation and Operations Manual

Siemens Microinverter

Model SMIINV215R60XX

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Contact Information

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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.

Other Information

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

For Siemens Microinverter Warranty Terms and Conditions, see the Appendix on page 28 of this manual.

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Table of Contents

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Important Safety Information

Read this First

This manual contains important instructions for use during installation and maintenance of the Siemens SMIINV215R60XX Microinverter.

Symbol Legend

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

DANGER Hazardous voltage. Will cause death or serious injury. Turn off Power before working on this equipment. This indicates a situation where the present voltage could cause injury or death. Extreme caution is required when servicing or installing the equipment referenced.

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 local electrical codes and the National Electrical Code ® (NEC), ANSI/NFPA 70.
- Be aware that only qualified personnel should install and/or replace Siemens Microinverters.
- Do not attempt to repair the Siemens Microinverter; it contains no user-serviceable parts. If it fails, please contact Siemens customer service to obtain an RMA number and start the replacement process. Tampering with or opening the Siemens Microinverter will void the warranty.
- Before installing or using the Siemens Microinverter, please read all instructions and cautionary markings in the technical description and on the Siemens Microinverter System and the Photovoltaic (PV) array.
- Connect the Siemens Microinverter to the electrical utility grid only after receiving prior approval from the utility company.
- Be aware that the body of the Siemens Microinverter is the heat sink and can reach a temperature of 80° C (176° F). To reduce risk of burns, do not touch.
- Do NOT disconnect the PV module from the Siemens Microinverter without first removing AC power. Disconnect AC power by disengaging the circuit breaker or disconnect before the first inverter connection.

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The Siemens Microinverter System

The Siemens 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 Siemens Microinverter.

The three key elements of a Siemens Microinverter System are:

- the Siemens Microinverter
- the Envoy™ Communications Gateway
- the Enlighten™ web-based monitoring and analysis system

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

1 Siemens 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 Ethernet router to the Internet

4 Standard Ethernet 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 Siemens Microinverter maximizes energy production from your photovoltaic (PV) array. Each Siemens Microinverter is individually connected to one PV module in your array. This unique configuration means that an individual Maximum 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 module mismatch, the Siemens Microinverter insures 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 Siemens Microinverters automatically begin reporting to the 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. Siemens Microinverters are designed to operate at full power at ambient temperatures as high as 65° C (150° F). The inverter 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 Siemens 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 module quantity, type, age and orientation. You won't need to install cumbersome centralized or string 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 dangerous 600 Vdc power.

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Siemens Microinverter Installation

Follow the instructions in this section to install Siemens SMIINV215R60XX Microinverters.

DANGER Hazardous voltage. Will cause death or serious injury. Turn off Power before working on this equipment. 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.

WARNING: Before installing the Siemens Microinverter, read all instructions and cautionary markings in the user manual, on the Siemens Microinverter, and on the photovoltaic array.

WARNING: Perform all electrical installations in accordance with all local electrical codes and the NEC®, ANSI/NFPA 70.

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

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

Compatibility and Capacity

The Siemens SMIINV215R60XX Microinverters are electrically compatible with most 60-cell PV modules. For more information, see Technical Data page 25 of this manual.

Refer to the Siemens website (http://www.usa.siemens.com/microsolar) for a list of **electrically**-compatible PV modules and approved PV module 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	Module Connector Type
SMIINV215R60MC	60 cell	MC-4 Type 2 Locking or Amphenol H4 Locking
SMIINV215R60TY	60 cell	Tyco Solarlock Locking

Voltage and Capacity

Maximum number of SMIINV215R60XXs per 20 amp AC Branch Circuit		
Service type	**Max SMIINV215R60XXs per branch**	**Max PV modules per branch**
Single phase 240 V or 208 V	17	17
Three phase 208 V	25	25

Parts and Tools Required

In addition to the SMIINV215R60XX microinverters, PV modules, racking, and associated hardware, you will need the following items.

Siemens equipment:

- Trunk and Drop cabling, as needed

NOTE: Order the correct Trunk and Drop Cable type. Installers must order cable for either split phase 240 VAC, typical for residential applications, or three phase 208 VAC, typical for commercial installations. All drop connectors on the Trunk and Drop Cable bear labels indicating the cable voltage designation. Use split phase 240 VAC cable at sites with 208 single phase service.

- Grounding clips
- Drop connector seals, as needed (for any unused drops on Trunk and Drop Cabling)
- Terminator caps, as needed (for unused ends of Trunk and Drop Cabling)
- Trunk and Drop disconnect tool (a number 3 Phillips screwdriver can be substituted)

Other items:

- Appropriate 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 terminator caps)
- Tool for PV module locking connectors
- Mechanics 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 the PV system is installed to cause damage. Often, a strike nearby will induce voltage spikes in the electrical grid that can damage equipment. Siemens 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.

As the Siemens 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 devices. These have been tested to ensure that they do not interfere with power line communications. Install per vendor instructions.

Vendor: Siemens, **Part Number**: TPS3 03

Application: Residential 120/240V Split Phase where a Neutral to Ground (N-G) bond exists.

Vendor: Siemens, **Part Number**: TPS3 12

Application: Commercial branch panel protection

(See the vendor datasheet for these models at http://www.usa.siemens.com/tvss).

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Installation Procedure

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

Step 1 – Measure VAC at Service Entrance Conductors

Step 2 – Install the AC Junction Box

Step 3 – Position the Trunk and Drop Cabling

Step 4 – Attach the Microinverters to the Racking

Step 5 – Dress the Trunk and Drop Cable

Step 6 – Connect the Microinverters

Step 7 – Terminate the unused end of the Trunk and Drop Cable

Step 8 – Connect the Cable to AC Junction Box(es)

Step 9 – Ground the System

Step 10 – Complete the Paper Map

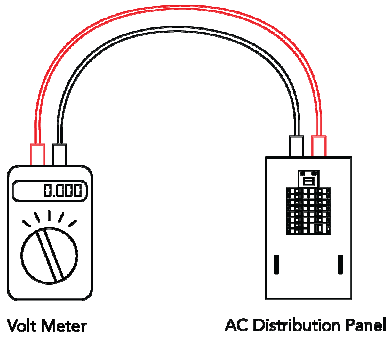
Step 11 – Connect the PV Modules

Step 12 – Build the Virtual Array

DANGER Hazardous voltage. Will cause death or serious injury. Turn off Power before working on this equipment. DO NOT connect Siemens Microinverters to the utility grid until you have completed all of the installation procedures as described in the following sections.

Step 1 – Measure AC at Service Entrance Conductors

Measure AC line voltage at the service entrance conductors to confirm AC service at the site. Acceptable ranges are shown in the following table.



120/240 VAC or 208Y/120 VAC Single Phase		208Y/120 VAC Three 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

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Step 2 – Install the AC Branch Circuit Junction Box

DANGER Hazardous voltage. Will cause death or serious injury. Turn off Power before working on this equipment. 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 20 A maximum breaker.

DANGER Hazardous voltage. Will cause death or serious injury. Turn off Power before working on this equipment. Size the AC wire gauge to account for voltage drop. All components of system wiring must be considered, including internal voltage drop within the length of Trunk and Drop cabling.

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

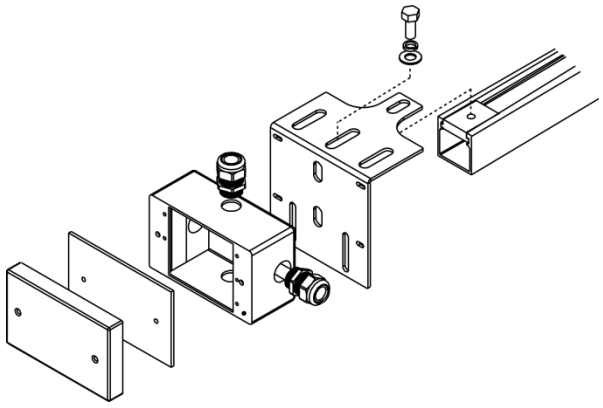
a. Size the AC wire gauge to account for voltage drop. Select the correct wire size based on the distance from the beginning of the microinverter AC branch circuit to the breaker in the load center.

All components of system wiring must be considered, including internal voltage drop within the length of Trunk and Drop 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.

Use the voltage drop charts at: http://www.usa.siemens.com/microsolar to select the correct wire size. NEC®[1] guidelines for voltage drop on feeder and branch circuit conductors will not be adequate for microinverter branch circuits that contain the maximum allowable microinverters.

b. Install an appropriate junction box at a suitable location on the PV racking system. You can center feed the branch, or you can install the junction box at the end of a row of PV modules.

c. Provide an AC connection from the junction box back to the utility interconnection using equipment and practices as required by the NEC® and local jurisdictions.



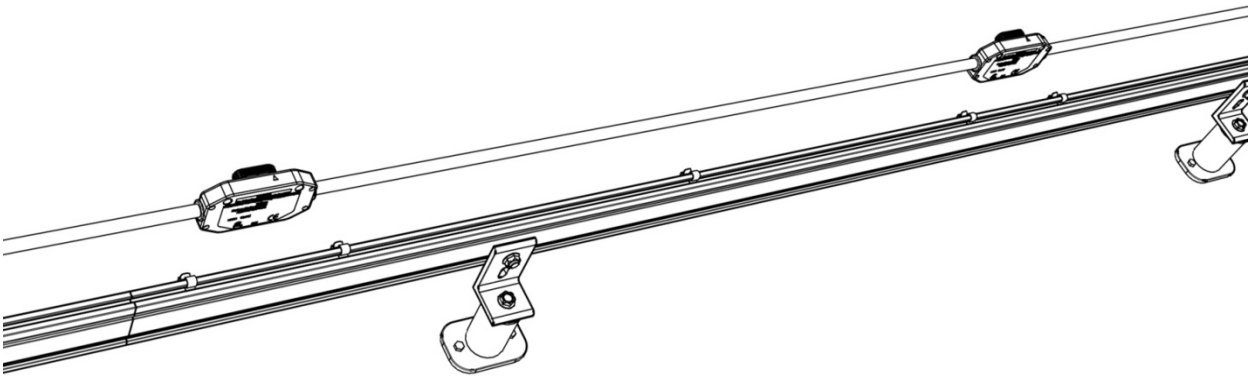
[1] National Electrical Code is Registered Trademark of the National Fire Protection Association

Step 3 – Position the Trunk and Drop Cabling

The cabling is a continuous length of 12 AWG, outdoor rated cable with a connector for each microinverter placed each PV module width. The microinverters plug directly into the cable, and the cable is terminated into the junction box that feeds electricity back to the system AC disconnect.

WARNING! Make sure you using the correct cable type. Installers must order Trunk and Drop Cable for either 240 VAC single phase, typical for residential applications, or 208 VAC three phase, typical for commercial installations. All drop connectors on the cable bear labels indicating the cable type. Installers can use 240 VAC cable at sites with 208 single phase service.

a. Lay the Trunk and Drop cabling along the route it will travel, positioning the connectors so that they align with the PV modules.



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

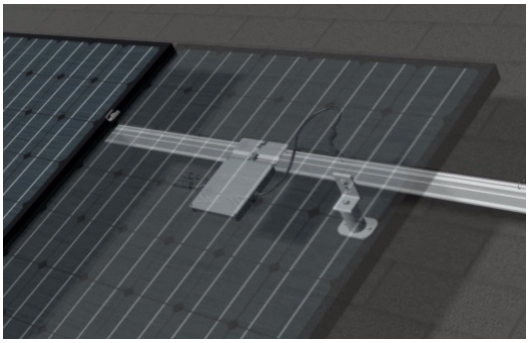
b. Module widths vary by manufacturer. The connector cable spacing is designed for the widest PV modules compatible with Siemens Microinverters. If narrower modules are used, it may be necessary to account for excess cable by adding a 'loop' of cable at suitable intervals.

Step 4 – Attach the Microinverters to the Racking

a. Mark the approximate centers of each PV module on the racking system.

b. Evaluate the location of the microinverter with respect to the PV module junction box or any other obstructions.

c. Ensure both that the microinverter does not interfere with the PV module frames or stiffening brace, and that the drop cable from the microinverter can easily reach the connector on the Trunk and Drop cable.



DANGER Hazardous voltage. Will cause death or serious injury. Turn off Power before working on this equipment. 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.

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

d. 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 a grounding washer that is approved for the racking manufacturer. Install one grounding washer per microinverter. Torque the microinverter fasteners to the values below.

- 1/4” mounting hardware – 45 lb-in minimum
- 5/16” mounting hardware – 80 lb-in minimum

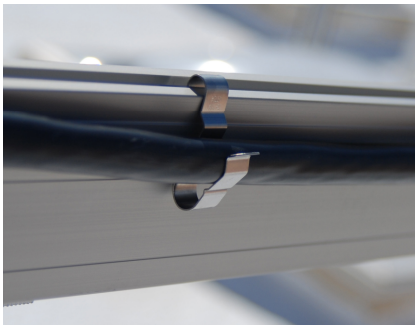
NOTE: Using a power screwdriver is not recommended due to risk of galling.

Compatible grounding washer part numbers are included in the Racking Compatibility Application Note. Installation guidelines are included in the Grounding Washer Application Note. Refer to both documents at:
http://www.usa.siemens.com/microsolar

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

Step 5 – Dress the Trunk and Drop Cable

a. Attach the Trunk and Drop cabling to the rack using the recommended clips, or you may use tie wraps. The cable clips are designed so that the drop cable from the microinverter can also be dressed into the clip underneath the Trunk and Drop cable.



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

b. Dress any excess cabling in loops so that it does not contact the roof. Do **not** leave the cabling 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 Trunk and Drop Connector. Use one or two additional clips, tie wraps, or other support scheme to secure the cable between connectors.

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Step 6 – Connect the Microinverters

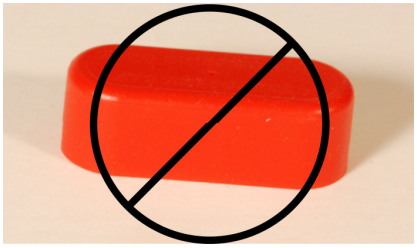
a. Remove the temporary shipping cap from the Trunk and Drop Cable and connect the inverter. There are two latching mechanisms within the connectors. Listen for **two** clicks as the connectors engage. Ensure that **both** latching mechanisms have engaged.

b. Repeat for all microinverters in the branch.

c. Cover any unused connector with a sealing cap. Listen for **two** clicks as the connectors engage. Ensure that **both** latching mechanisms have engaged.

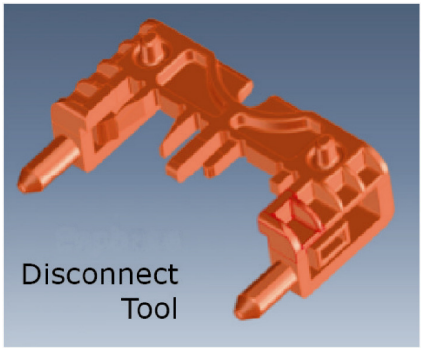
Do not use the shipping cap to cover unused connectors. The shipping cap does not provide an adequate environmental seal. IP67-rated sealing caps are required for the system to be UL compliant and to protect against moisture ingress.

NOTE: 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.



DANGER Hazardous voltage. Will cause death or serious injury. Turn off Power before working on this equipment. Make sure protective IP67 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 an IP67 sealing cap. You must use the Siemens disconnect tool or a #3 Phillips screwdriver. Sealing caps may not be reused.



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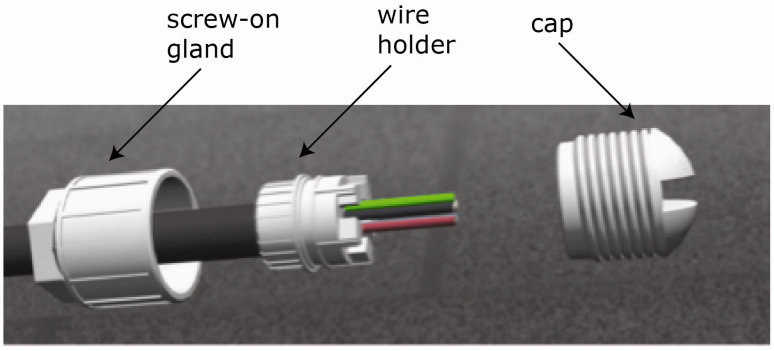
Step 7 – Terminate the unused end of the Trunk and Drop Cable

You must terminate the far end of the Trunk and Drop cable.

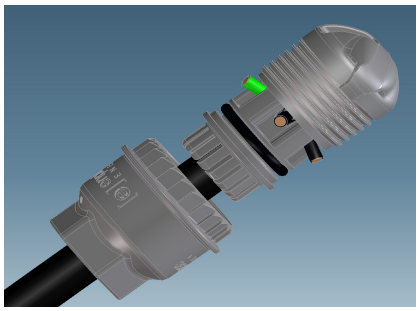
a. Remove 60mm (2.5 inches) of the outer jacket of the cable end.

b. Take the screw-on gland portion of the cable terminator and run the cable end through it.



c. Take the wire holder and run the cable end through it.

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



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

f. Insert the wire holder into the cap, and screw the gland portion onto the cap. **Ensure that the gland portion is rotating, not the cap**.

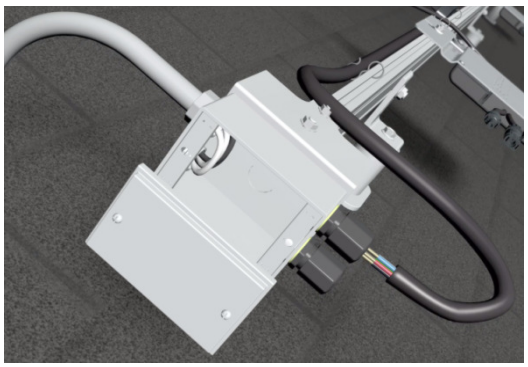
g. Hold the cap with an Siemens disconnect tool, or insert a #2 Phillips screwdriver. Hold the gland portion with a 24 mm (7/8”) wrench. Tighten the gland portion until the ratcheting feature on the cap bottoms out.

h. Attach the terminated cable end to the racking using a clip or tie wraps so that the Trunk and Drop Cable and terminator do not touch the roof.

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

Step 8 – Connect the Cable to Junction Box(es)

a. Connect Trunk and Drop cable into the AC junction box using an appropriate gland or strain relief fitting. The trunk and drop cable requires a strain relief connector with an opening of 1.3 cm (0.5 inches) in diameter.



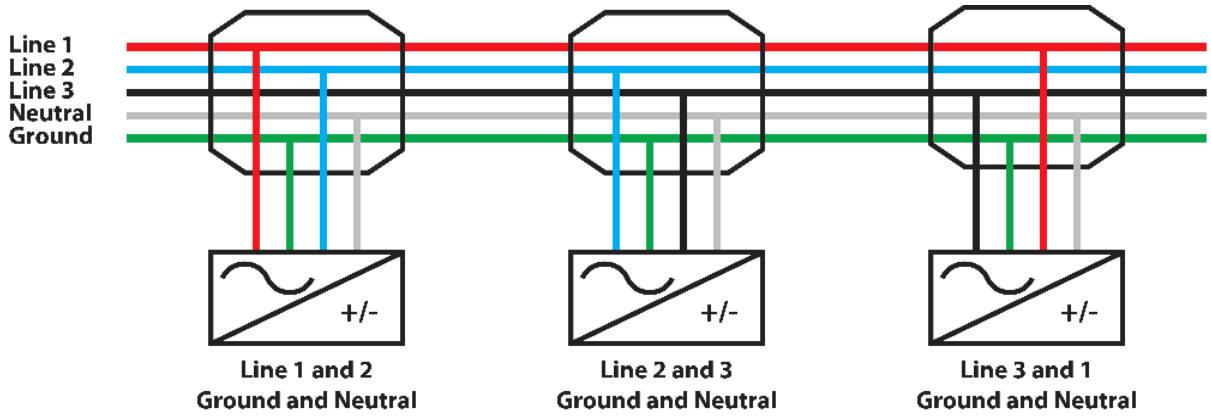
b. Connect the TRUNK AND DROP cable into additional junction boxes as needed to transition to conduit between smaller sub-arrays.

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

NOTE: 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.

120/240 or 208Y/120 VAC SINGLE PHASE WIRING	Y/120 VAC PHASE WIRING	
BLACK - L1 RED - L2 BLUE - UNUSED WHITE - NEUTRAL GREEN - GROUND	BLACK - L1 RED - L2 BLUE - L3 WHITE - NEUTRAL GREEN - GROUND	

Balanced 208 VAC three phase is accomplished by alternating phases between microinverters as shown:



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

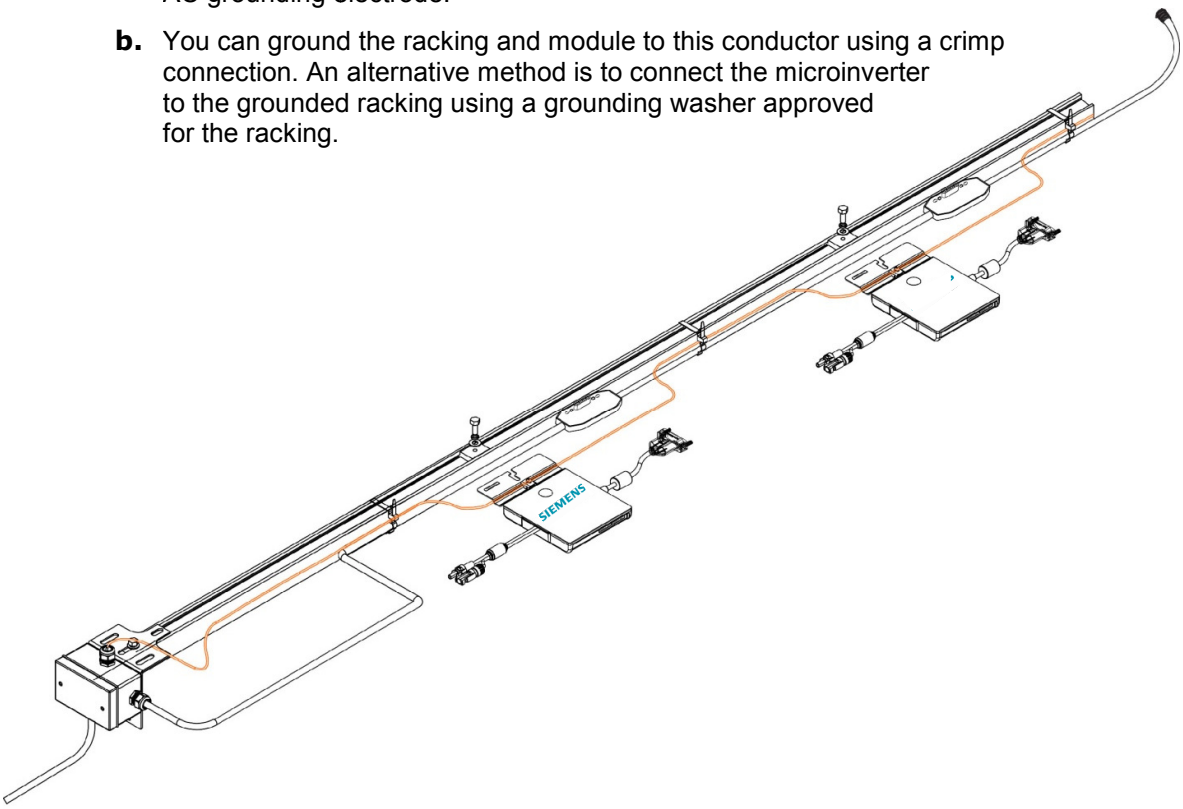
Step 9 – Ground the System

If you are not using WEEB grounding washers to ground the microinverter chassis as described in step 4, follow the step below. Each Siemens Microinverter comes with a ground 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 ®[2]-approved AC grounding electrode.

b. You can ground the racking and 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.

- 1/4” mounting hardware – 45 lb-in minimum
- 5/16” mounting hardware – 80 lb-in minimum

NOTE: Using a power screwdriver is not recommended due to risk of galling.

[2] National Electrical Code is Registered Trademark of the National Fire Protection Association

Step 10 – Complete the Installation Map

The Siemens 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 Siemens Map

a. Each Siemens Microinverter has a removable serial number label located on the mounting plate. Peel the removable serial number label from each Siemens Microinverter and affix it to the respective location on the Siemens installation map (see map in the Appendix). You can also download installation maps and examples from www.usa.siemens.com/microsolar. 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.

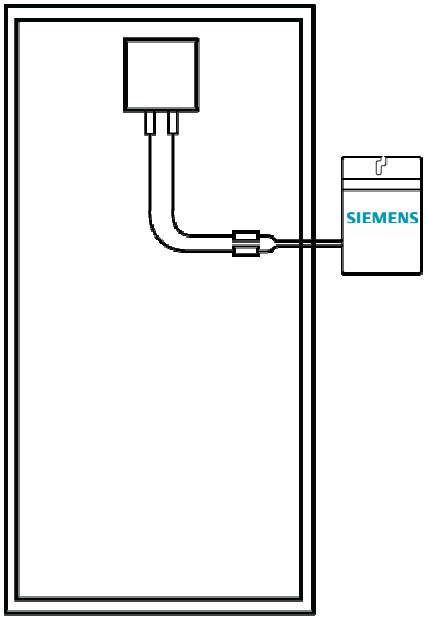
Step 11 – Connect the PV Modules

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

a. Mount the PV modules above the microinverters. Each microinverter comes with two sets of oppositely sexed multi-contact connectors.

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

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



Step 12 – Build the Virtual Array

When the system is energized and all microinverters are detected by the Envoy Communications Gateway, you can create the virtual array in Enlighten from the Siemens 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://enlighten.enphase.com for more information on the 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 Installation map created in step 10 as your reference.

NOTE: Go to http://enphase.com/support/videos/ to view an Array Builder demo.

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

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Commissioning and Operation

WARNING: Be aware that only qualified personnel must connect the Siemens Microinverter to the electrical 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 junction boxes are properly closed.

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

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

Commissioning

To commission the Siemens Microinverter PV system:

1. Turn ON the AC disconnect or circuit breaker on each microinverter AC branch circuit.

2. Turn ON the main utility-grid AC circuit breaker (if applicable). Your system will start producing power **after a five-minute wait time**.

3. The Siemens Microinverters will begin sending performance data 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.

4. The SMIINV215R60XX has field adjustable voltage and frequency trip points. If adjustments are required by your local utility, the installer can use the Envoy to Manage the Grid Profile after all microinverters have been detected.

For more information on Envoy operation, refer to the *Envoy Installation and Operation Manual* at http://www.usa.siemens.com/microsolar.

Operating Instructions

The Siemens Microinverter is powered on when sufficient DC voltage from the module is applied. One minute after DC voltage is applied, the status LED blinks green six times indicating proper start–up. You may need to use a mechanics mirror to view indicator lights on the undersides of the microinverters.

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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 Siemens Microinverter; it contains no user-serviceable parts. If it fails, please contact Siemens customer service to obtain an RMA number and start the replacement process.

Status LED Indications and Error Reporting

Startup LED Operation:

One minute after DC power is first applied to the microinverter, six short green blinks indicate a successful microinverter startup sequence.

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 mechanics 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
Solid Red – GFDI Fault

Ground Fault Detection Indicator (GFDI) Fault:

A solid red status LED when DC power has been cycled indicates the microinverter has detected a ground fault 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 Siemens customer support at 1-800-241-4453 or at info.us@siemens.com.

Other Faults:

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

Troubleshooting an Inoperable Microinverter

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

DANGER Hazardous voltage. Will cause death or serious injury. Turn off Power before working on this equipment. Always disconnect AC power before disconnecting the PV module wires from the Siemens Microinverter.

DANGER Hazardous voltage. Will cause death or serious injury. Turn off Power before working on this equipment. 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 module prior to disconnecting the module.

WARNING: The Siemens 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.

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 service entrance conductors and at the junction box for each Siemens branch are within the ranges are shown in the following table:

120/240 VAC or 208Y/120 VAC Single Phase		208Y/120 VAC Three Phase	
L1 to L2	211 to 264 Vac	L1 to L2 to L3	183 to 229 Vac
L1 to neutral L2 to neutral	106 to 132 Vac	L1 to neutral L2 to neutral L3 to neutral	106 to 132 Vac

3. Verify utility power is present at the inverter in question by removing AC, then DC power. **Never disconnect the DC wires while the microinverter is producing power.** Re-connect the DC module connectors. After one minute, watch for six short LED blinks.
4. Check the AC branch circuit interconnection harness between all the microinverters. Verify that each inverter is energized by the utility grid as described in the previous step.
5. Make sure that any upstream AC disconnects, as well as the dedicated circuit-breakers for each microinverter branch circuit, are functioning properly and are closed.
6. Verify the PV module DC voltage is within the allowable range shown in the Technical Data section on page 25 of this manual.
7. Check the DC connections between the microinverter and the PV module.
8. If the problem persists, please call Siemens customer support at 1-800-241-4453 or at info.us@siemens.com.

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Disconnecting a Microinverter from the PV Module

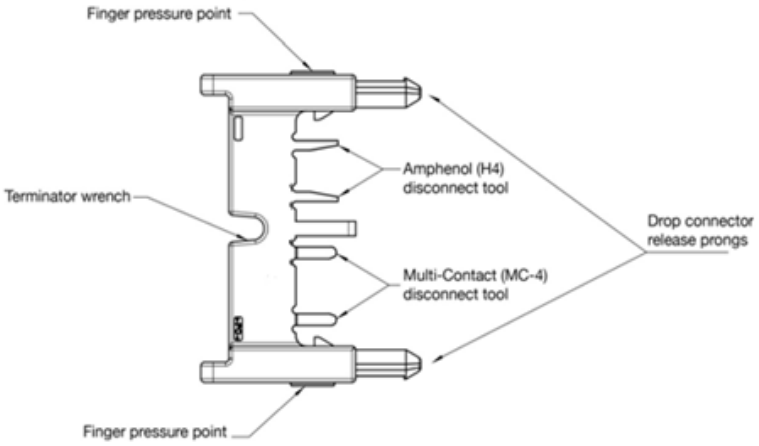
To ensure the microinverter is not disconnected from the PV modules under load, adhere to the following disconnection steps in the order shown:

1. Disconnect the AC by opening the branch circuit breaker.

DANGER Hazardous voltage. Will cause death or serious injury. Turn off Power before working on this equipment. Disconnect the Siemens Microinverter from the electrical utility grid prior to servicing.

2. Disconnect the first AC connector in the branch circuit.

   The Siemens Microinverter AC connectors are tool-removable only. To disconnect a microinverter from the Trunk and Drop Cable, insert the two large prongs of the disconnect tool (shown below) into the two holes in the drop connector. Rock the connector back and forth while pulling gently to disengage.



   If the disconnect tool is not available, insert a #3 Phillips screwdriver into one hole, and rock that side of the drop connector out. Then, insert the screwdriver into the other hole and pull the connector out entirely.

3. Cover the module with an opaque cover.

4. Using a DC current probe, verify there is no current flowing in the DC wires between the PV module and the microinverter.

5. Care should be taken when measuring DC currents due to the fact that most clamp-on meters must be zeroed first and tend to drift with time.

6. Disconnect the PV module DC wire connectors from the microinverter.

7. Remove the microinverter from the PV array racking.

DANGzardous voltage. Will cause death or serious injury. Turn off Power before working on this equipm not leave the drop connector uncovered for an extended period. If you do not plan to replace croinverter immediately, you must cover any unused connector with a sealing cap. Listen for two clicks as the connectors engage. Ensure that **both** latching mechanisms have engaged. Note that the shipping cap does not provide an adequate environmental seal. IP67-rated sealing caps are required for the system to be UL compliant and to protect against moisture ingress.

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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 module racking using hardware recommended by your module 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.
   - 1/4” mounting hardware – 45 lb-in minimum
   - 5/16” mounting hardware – 80 lb-in minimum

NOTE: Using a power screwdriver is not recommended due to risk of 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 sealing cap from the Trunk and Drop Cable and connect the inverter. 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. Each microinverter comes with two sets of oppositely sexed multi-contact connectors.

6. Mate the microinverters and PV modules as required. Repeat for all remaining PV modules using one microinverter for each module.

7. Energize the 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 mechanics 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.

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Technical Data

Technical Considerations

The Siemens SMIINV215R60XX 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 Siemens website (http://www.usa.siemens.com/microsolar) for a list of compatible PV module racking systems and PV modules.

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

WARNING: The maximum open circuit voltage of the PV module must not exceed the specified maximum input voltage of the Siemens 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 solar insolation on each cell. The highest PV module output voltage occurs when the temperature of the cells is the lowest and the module is at open circuit (not operating). The maximum short circuit current rating of the 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 Siemens website (http://www.usa.siemens.com/microsolar).

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Technical Specifications

Siemens SMIINV215R60XX Microinverter Operating Parameters				
Topic	**Unit**	**Min**	**Typical**	**Max**
DC Operating Parameters				
MPPT voltage range	V	22	29	36
Operating Range	V	16		36
Maximum DC input voltage	V			45
Minimum / Maximum start voltage	V	22		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 Operating 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 208 Vac	 Vrms Vrms	 211 183	 240 208	 264 229
Extended AC output voltage range 240 Vac 208 Vac	 Vrms Vrms	 206 179	 240 208	 269 232
Maximum AC output current 240 Vac 208 Vac	 A A		 0.9 1.0	
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_{peak}, ms	25.2 A_{peak} over 1.74 ms		
	A_{RMS}, Cycles	1.05 A_{RMS} over 3 cycles 1.04 A_{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		

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Siemens SMIINV215R60XX Microinverter Operating Parameters				
Topic	**Unit**	**Min**	**Typical**	**Max**
Miscellaneous Operating Parameters				
Inverters per 20 amp AC branch circuit 240 Vac or 208 Vac Single Phase 208 Vac Three phase		 1 1		 17 25
Peak inverter efficiency	%			96.3
CEC weighted efficiency	%			96.0
Static MPP tracking efficiency (weighted EN 50530)	%			99.6
Total Harmonic Distortion	%		3.0	5
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			
Enclosure environmental rating	NEMA 6			
Cooling	Convective – no fan			
Communication	Power line			
Standard warranty term	25 years, limited			
Applicable Standards	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 ®[3].			

[3] National Electrical Code is Registered Trademark of the National Fire Protection Association

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Appendix

Limited Warranty

Siemens Industry Inc. ("**Siemens**") has developed a highly reliable Microinverter that is designed to withstand normal operating conditions when used for its originally intended purpose in compliance with the Siemens User Manual supplied with the originally shipped system. The Siemens limited warranty ("**Limited Warranty**") covers defects in workmanship and materials of the Siemens Microinverter ("**Defective Product**") for a period of twenty-five (25) years from the date of original purchase of such Microinverter at point of sale to the originally-installed end user location (the "**Warranty Period**"). During the Warranty Period, the warranty is transferable to a different owner as long as the Microinverter remains installed at the originally-installed end user location.

During the Warranty Period, Siemens will, at its option, repair or replace the Defective Product free of charge, provided that Siemens through inspection establishes the existence of a defect that is covered by the Limited Warranty. Siemens will, at its option, use new and/or reconditioned parts in repairing or replacing the Defective Product. Siemens reserves the right to use parts or products of original or improved design in the repair or replacement of Defective Product. If Siemens 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 Siemens'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 Siemens, via a non-expedited freight carrier selected by Siemens, 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 Siemens 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 Siemens. Before requesting the RMA, however, the customer should contact a Siemens technical support (1-800-241-4453) representative to evaluate and troubleshoot the problem while the Siemens Microinverter 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 Siemens

Siemens Microinverters are designed to withstand normal operating conditions and typical wear and tear when used for their original intent and in compliance with the installation and operating instructions supplied with the original equipment. The Limited Warranty does not apply to, and Siemens will not be responsible for, any defect in or damage to any Siemens Microinverter: (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 Siemens 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 Siemens Microinverter 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 solar system; or (5) if the original identification markings (including trademark or serial number) of such Microinverter have been defaced, altered, or removed. The Limited Warranty does not cover costs related to the removal, installation or troubleshooting of the customer's electrical systems. The Limited Warranty does not extend beyond the original cost of the Siemens Microinverter.

THE LIMITED WARRANTY IS THE SOLE AND EXCLUSIVE WARRANTY GIVEN BY SIEMENS 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 SIEMENS 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 Siemens Microinverter, 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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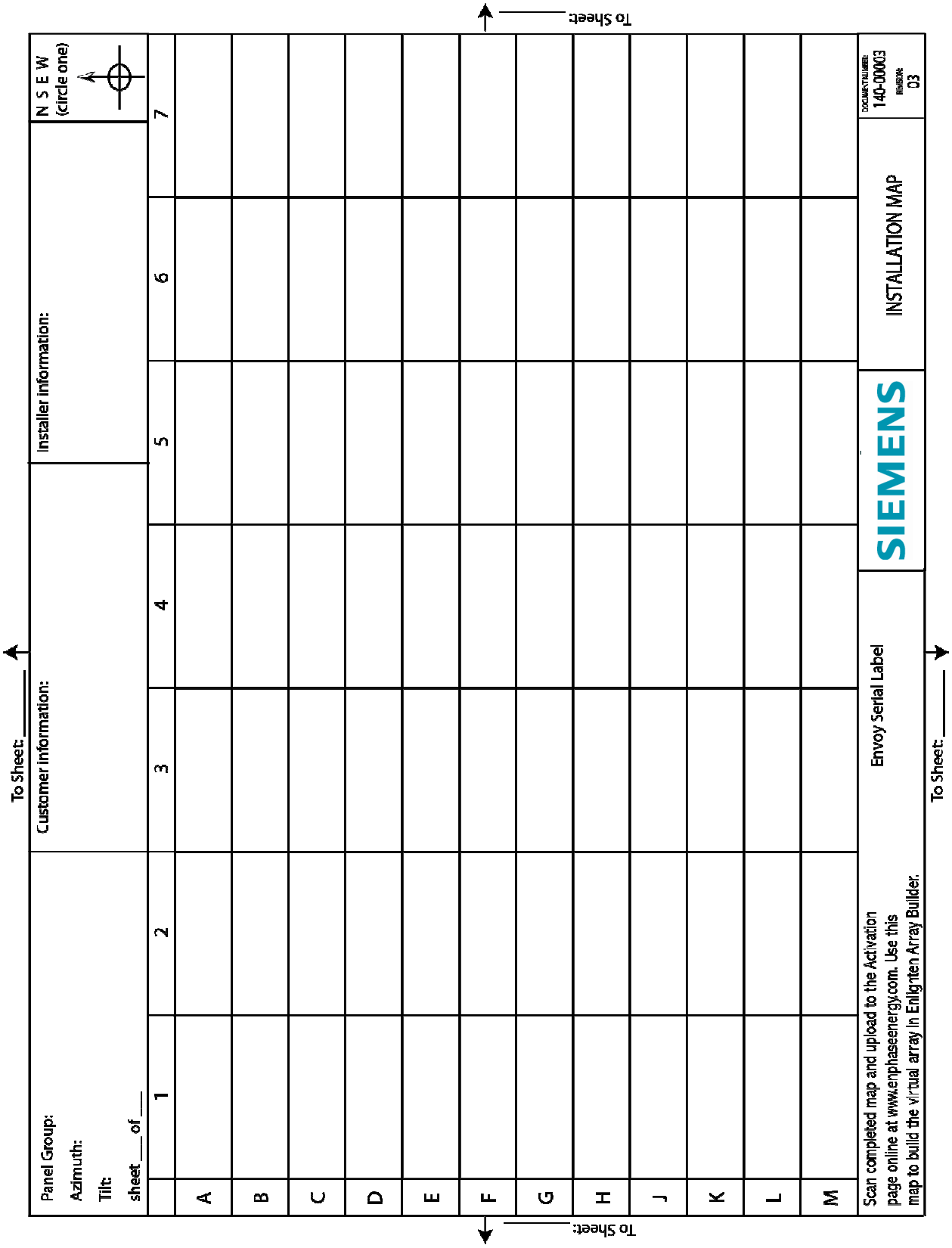
Siemens Installation Map



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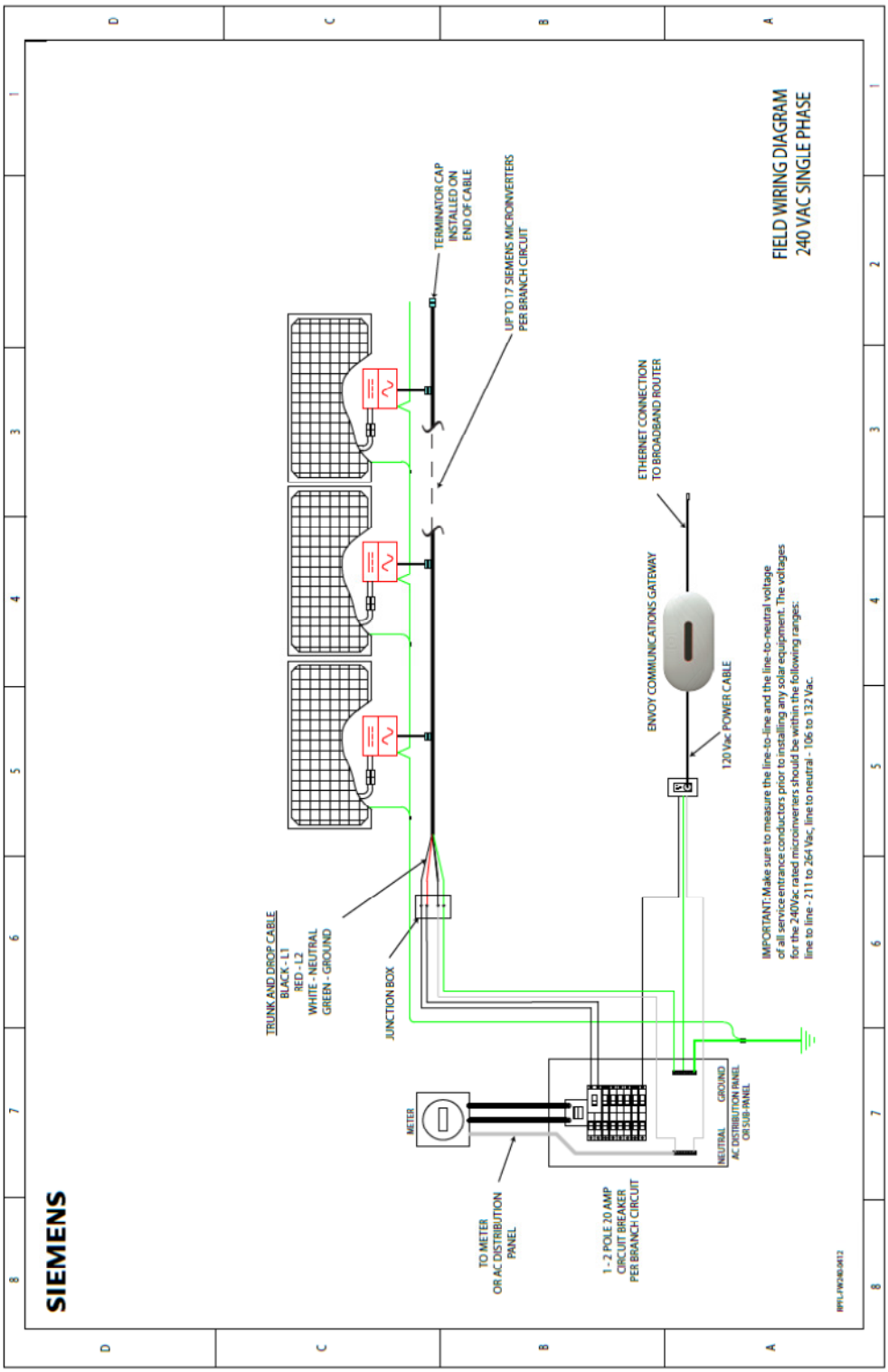
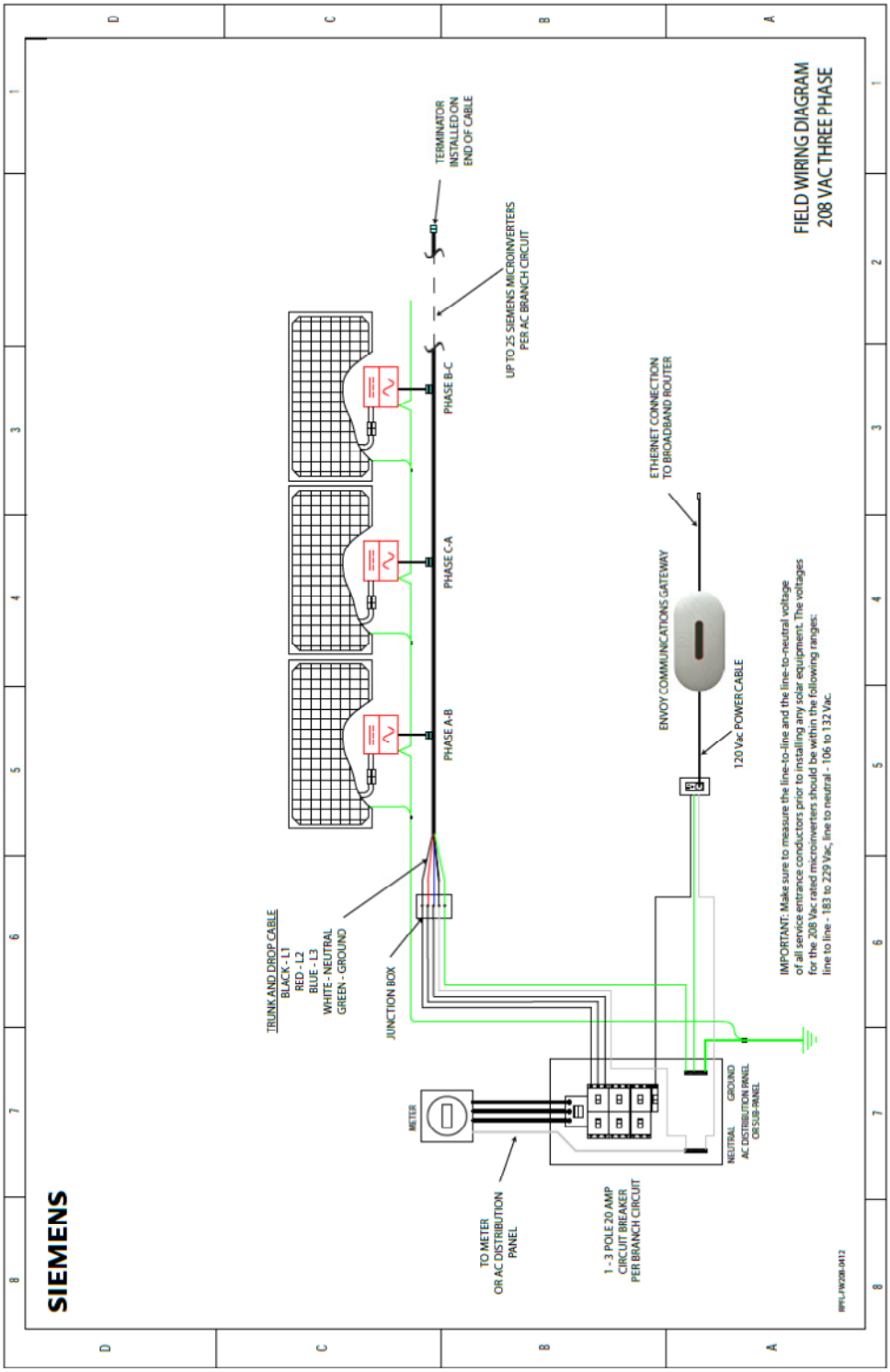
Sample Wiring Diagram – SMIINV215R60XX, 240 Vac or 208 Vac Single Phase



Sample Wiring Diagram – SMIINV215R60XX, 208 Vac



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