

General Installation Manual

Photovoltaic Module HIT[®]

AC MODULE

Model No. VBHN330SA17E



Microinverter IQ7X-96-ACM-US (Enphase Energy, Inc.)

Mounting on back of PV module



VBHN330SA17E

Thank you for choosing Panasonic photovoltaic module HIT[®]. Please read this manual completely before you install or use HIT[®]. With proper operation and maintenance, HIT[®] will provide you with clean, renewable solar electricity for many years. This manual contains important installation, maintenance and safety information. The word “module” as used in this manual refers to one or more PV modules. Retain this manual for future reference.

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Specifications and information in this Installation Manual may change without notice.

Check the latest version from the following website.

<https://na.panasonic.com/us/energy-solutions/solar/ac-series-ac-module>

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SAFETY PRECAUTIONS

- This document is an installation manual for a PV module with an Enphase IQ7X-96-ACM-US Microinverter. For detailed information about configuring and operating the microinverter, please read "ENPHASE Microinverters Installation Guide" .

<https://enphase.com/sites/default/files/downloads/support/IQ7-7plus-7X-Micro-Manual-EN-US.pdf>

- All instructions should be read and understood before attempting to install, wire, operate, and maintain the module.
- The installation of modules requires a great degree of skill and should only be performed by qualified licensed professionals, including licensed contractors and licensed electricians.
- The installer assumes the risk of all injury that might occur during installation, including the risk of electric shock.
- AC disconnects or breaker shall be provided in the installation.
- Before installing modules, contact the appropriate authorities to determine permissions, installation and inspection requirements should be followed.
- Confirm that the construction or structure (roof, etc.) where the modules are being installed has enough strength.
- Both roof construction and module installation design have an effect on the fire resistance of a building. Improper installation may contribute to fire hazards. Additional devices such as ground fault, fuses, and disconnects may be required.
- For a non-integral module or panel, the assembly is to be mounted over a fire resistant roof covering rated for the application.
- For modules mounted on roofs, special construction or structures may be required to help provide proper installation support.
- **Do not install** the module where

flammable gases or vapors are present.

- **Do not use** modules of different specifications in the same system.
- Follow all safety precautions of other system components used.
- In some areas, local electrical codes may govern the installation and use of modules.



WARNING

To avoid the danger of **electric shock, sparks, fire** and **injury**

- The modules generate electrical energy when exposed to sunlight or other light sources, so cover the entire front surface of the modules with a dense, opaque material such as a cardboard box, during installation and handling of the modules.
- The shock hazard increases as modules with nominal open-circuit voltage (Voc) in excess of 50 V, and/or modules rated for maximum system voltage in excess of 50 V.
- Wear suitable clothing, gloves and guards to prevent direct contact with 30 VDC or greater.
- Work only in dry conditions, with dry modules and dry tools.
- Children and unauthorized persons should not be allowed near the installation of modules.
- **Do not damage** the back sheet, cable and connector of a module. Do not use the PV module if conductive part is found on the back sheet, cable and connector. In such cases, exchange to new PV module.
- **Do not disassemble** the module, or remove any parts installed by the manufacturer.
- **Do not open** a junction box's lid and microinverter.
- **Do not touch** the junction box and microinverter terminals.
- **Do not change** the wiring of bypass diodes.
- **Do not connect or disconnect** termi-

nals while modules generate electricity and connect electrical load.

- **Never leave** a module unsupported or unsecured.



CAUTIONS

To avoid the danger of **injury, burn and damage to the module**

- Use a module for its intended purpose only.
- Confirm that all other system components are compatible, and they do not subject the module to mechanical or electrical hazards.
- **Do not artificially concentrate** sunlight on a module.
- **Do not stand or step** on a module.
- When carrying a module, **two or more people** should carry it by its frame and **wear non-slip gloves**.
- **Do not carry** a module by its wires or junction box.
- **Do not drop** a module.
- **Do not drop** anything on the surface of a module.
- **Do not hit** the back side of a module by the connector or other object. Back side is easily damaged.
- **Do not stack** anything on back side of module.
- **Do not disassemble** a module, attempt any repair, open the junction box cover, nor remove any parts installed by Panasonic. There are no user serviceable parts within the module or junction box.
- **Do not treat** the back sheet or front surface with paint or adhesives.
- **Do not use or install** broken modules. If you find a breakdown such as glass breakage, contact the professional installer to replace it promptly.
- **Do not touch** a module unnecessarily to avoid the risk of getting burned. There is a possibility that glass surface and frame are high temperature.

MODULE SPECIFICATIONS

- Module specifications are shown in Table 1-1 and Figure 1. (Electrical specifications, mechanical specifications, module dimensions)
- 1) Rated electrical characteristics are within the range of -5% to +10% of the values measured at Standard Test Conditions (STC). STC conditions are; Irradiance of 1000W/m², 25°C cell temperature, AM1.5 and solar spectral irradiance per IEC 60904-3. Note: At the time of shipment, Panasonic guarantees the output level of its modules to be -0/+10% against Rated Power in SPECIFICATIONS based on factory inspection at STC conditions.
- 2) Under real conditions, a photovoltaic module may experience conditions that produce more current and/or voltage than reported at Standard Test Conditions. Therefore, the I_{sc} value of modules should be multiplied by a factor of 1.25 to determine ampacity. An additional factor of 1.25 may be required for sizing conductors, fuses, disconnects, etc. Please refer to **section 690.8 of the National Electric Code (NEC)** for guidelines. The V_{oc} must be factored according to the lowest recorded ambient temperature recorded for the location where the modules will be installed. Please refer to **section 690.7 of the NEC** for more information regarding voltage temperature factors.
- VBHN330SA17E is equipped with a Microinverter.
- Microinverters are DC-AC inverters connected to PV modules in order to maximize power harvesting by performing Maximum Power Point Tracking (MPPT) at the module level.

MECHANICAL LOADING

- The modules should be mounted at the four (4) quarter points by the means shown in Figure 1.
- This method offers a maximum load shown as "Mount Location and Load Resistance" in Table 1-2 in a static state on the module surface.
- Note: This mechanical loading value was tested using the mounting device specified in section "MODULE INSTALLATION"
- As UL Certified Load Ratings, this module meets design loads as below.
- 1) Positive load with Long frame mounting
 - 33 psf (0-450mm range from edge)
 - 75 psf (230-380mm range from edge)
- 2) Negative load with Long frame mounting
 - 33 psf (0-450mm range from edge)
 - 61 psf(230-380mm range from edge)
 - 75 psf (230-345mm range from edge)
- 3) Positive load with Short frame mounting
 - 33 psf (0-250mm range from edge)
- 4) Negative load with Short frame mounting
 - 33 psf (0-250mm range from edge)

STANDARDS

VBHN330SA17E comply with the requirements of UL1703 (PV module) and UL 1741 (Microinverter, ENPHASE ENERGY, Inc., Type IQ7X-96-ACM-US

FIRE CLASS OF PRODUCT

- The fire rating of this module is valid only when mounted in the manner specified in the mechanical mounting instructions.
- The models in this instructions are suitable to maintain the System Fire Class Rating A when used with a Listed mounting system and a roof covering that have been rated as a Class A System when installed on a steep slope roof and/or a low slope roof with "Type 2" modules.

Table 1-1. Module Specification

DC Electrical Specifications*

Model	VBHN330SA17E
Cell Number in Series	96
Rated Power, Watts (Pmax)	330
Maximum Power Voltage (Vpm)	58.0
Maximum Power Current (Ipm)	5.70
Open Circuit Voltage (Voc)	69.7
Short Circuit Current (Isc)	6.07
Cell Type	Silicon hetero-junction**
Factory Installed Bypass Diodes	4

*This specification shows the characteristics of the PV module not via the microinverter.

Silicon hetero-junction**: Mono crystalline silicon/amorphous silicon hetero-junction.

AC Electrical Specifications ***

Model	VBHN330SA17E	
Peak Power Output	320VA	
Maximum Continuous Output Power	315VA	
Nominal (L-L) voltage	240Vac	208Vac
Nominal (L-L) voltage range	211 – 264V	183 – 229V
Maximum Continuous Output Current	1.31A	1.51A
Number of Maximum AC module	12 units	10 units
CEC Weighted Efficiency	97.5%	96.5%
Nominal Frequency	60Hz	
Extended Frequency Range	47 – 68Hz	
Power Factor Setting	1.0	
Power Factor (adjustable)	0.7 or 0.85 leading / 0.7 or 0.85 lagging	

UTILITY INTERCONNECTION VOLTAGE TRIP LIMITS AND TRIP TIMES***

Overvoltage, Fast	288V / 0.16Sec	249.6V / 0.16Sec
Overvoltage, Slow	264V / 1.0Sec	228.8V / 1.0Sec
Undervoltage, Slow	211.2V / 2.0Sec	183.0V / 2.0Sec
Undervoltage, Fast	120V / 0.16Sec	104V / 0.16Sec

FREQUENCY TRIP LIMITS AND TRIP TIMES***

OverFrequency	60.5Hz / 0.16Sec
UnderFrequency	59.3Hz / 0.16Sec

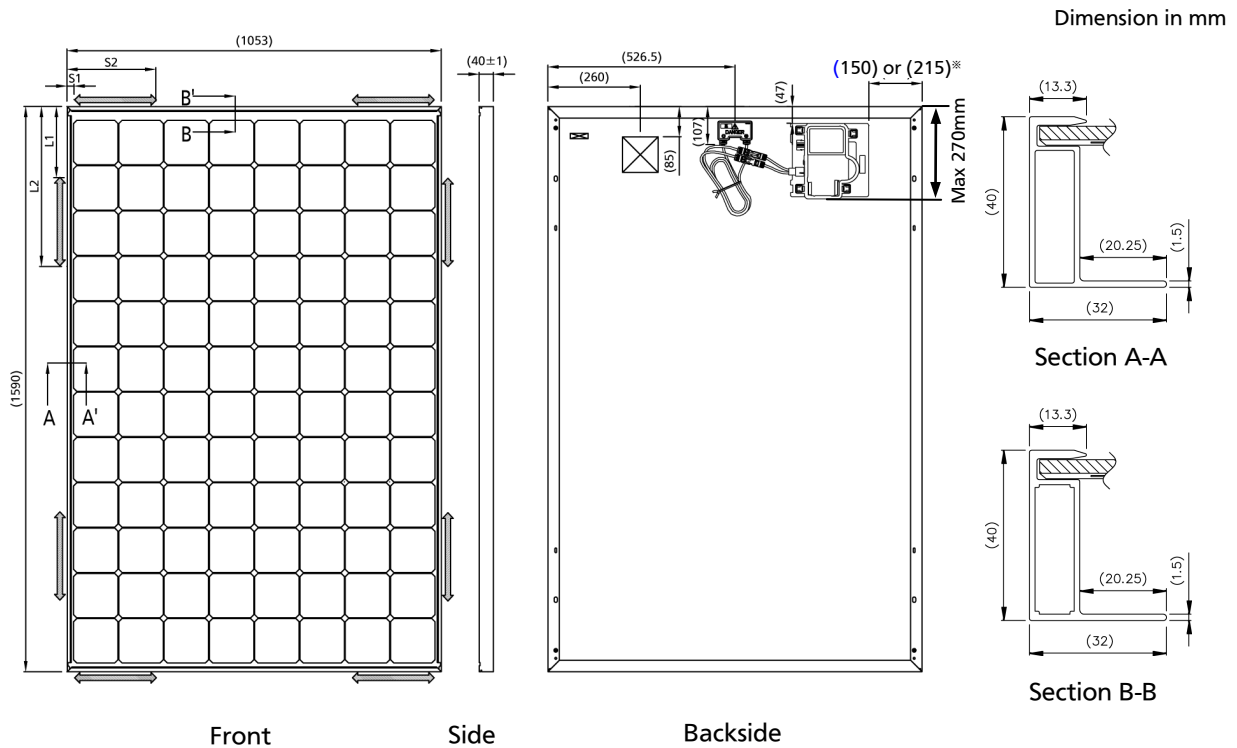
***AC Electrical Specifications, UTILITY INTERCONNECTION VOLTAGE TRIP LIMITS AND TRIP TIMES, and FREQUENCY TRIP LIMITS AND TRIP TIMES are may change without notice.

Please refer to website the below about these latest specification.

<https://enphase.com/en-us/products-and-services/microinverters/family>

Mechanical Specifications

Model	VBHN330SA17E
Length, mm (inches)	1590 (62.60)
Width, mm (inches)	1053 (41.46)
Frame Depth, mm (inches)	40 (1.57)
Weight, kg (pounds)	19.5 (42.99)



Note) A module is installed using 4 points, symmetrical mounting within setting range (Black arrows).
 Setting range parameters are shown in "Mount Locations and Load Resistance" table.
 Note) *Production up to October 2019 is 150mm. Production after November 2019 is 215mm.
 So, Please check the production date properly.

**Figure 1. Module Dimension
 (VBHN330SA17E)**

Table 1-2. Mount location and Load Resistance

Mounting location range (mm)	L1	0	230	230	-
	L2	450	380	345	-
	S1	-	-	-	0
	S2	-	-	-	250
Load Resistance (Positive Load)		50 psf (2400 Pa)	112 psf (5400 Pa)	112 psf (5400 Pa)	50 psf (2400 Pa)
Load Resistance (Negative Load)		50 psf (2400 Pa)	91 psf (4400 Pa)	112 psf (5400 Pa)	50 psf (2400 Pa)

Note) Load Resistance shown above is UL Test-Load.
 Design load is a value obtained by multiplying the above value by two thirds.

JUNCTION BOX, MICROINVERTER AND TERMINALS

- Modules equipped with one junction box contain terminals for both positive and negative polarity, and bypass diodes.
- Each terminal is dedicated to one polarity (with the polarity symbols engraved onto the body of the junction box) . See Figure 2-1.
- A microinverter has an input / output terminal. See Figure 2-2.
- Each terminal is provided with factory installed lead cables and a latch-

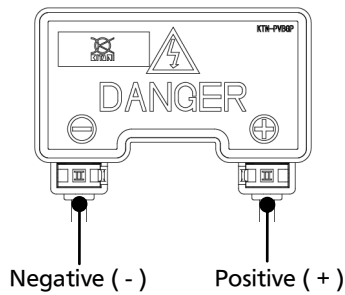
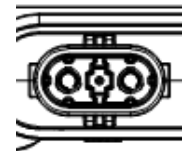
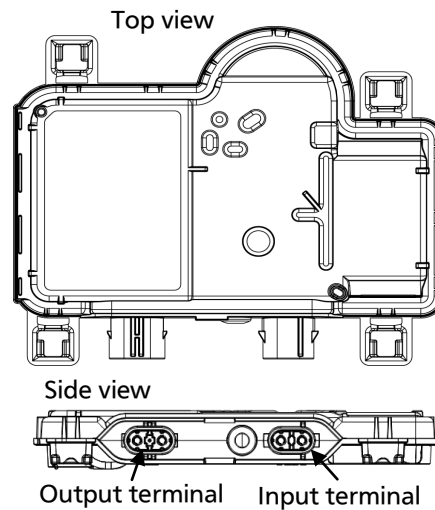


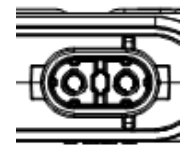
Figure 2-1. Junction Box

ing connector. Always use these connectors and do not detach them from cables.

- The PV module and a microinverter come pre-wired. Each module has two **#12 AWG type PV-wire** stranded sunlight resistant output cables each terminated with connectors. The positive (+) terminal has a male connector while the negative (-) terminal has a female connector.
- Latching connectors are **type IV** and supplied by **STAUBLI ELECTRICAL CONNECTORS AG**, which are listed by UL.



Enlarged view of output terminals



Enlarged view of input terminals

Figure 2-2. Output / input terminal of a Microinverter

BYPASS DIODE

- When the module is shaded partially, it may cause reverse voltage across cells, because the current from other cells in the same series is forced to flow through the shaded area. This may cause undesirable heating.
- The use of a diode to bypass the shaded area can minimize both heating and module current reduction.
- All modules are equipped with factory installed bypass diodes. The factory installed diodes provide proper circuit protection for the systems within the specified system voltage, so that you do not need any other additional bypass diodes.
- Specification of bypass diode is as follows; Type: Number of bypass diode: 4 diodes, Number of series cells per bypass diode: 24 cells / diode. See Figure 3.

INSTALLATION GENERAL

Please read this guide completely before installation or use of the modules.

OPERATING CONDITIONS

Panasonic recommends that modules be operated within the following Operating Conditions. An installation location with conditions beyond the Operating Conditions or with other Special Conditions (see below) should be avoided. Operating Conditions of Panasonic modules are as follows:

24 cells /
24 cells /
24 cells /
24 cells /

Figure 3. Number of series cells per bypass diode

- 1) The modules should be operated only in terrestrial applications. No space or other Special Conditions.
- 2) The operating module temperature must be within **-30°C (-22°F) to 85°C (185°F)**.
- 3) The wind pressure load of the installation site should be less than Load Resistance shown in "Mount Locations and Load Resistance" refer to table 1-2.

UNPACKING AND HANDLING

- **Do not hit** the back sheet of a module with the connector when unpacking and handling.
- Please do not expose the connector to rain water and dust.
- To avoid damage to the back sheet by the connector, Do not cut the string binding the cables of junction box. See Figure 4.
- **Do not handle** modules while holding their cables, junction box or microinverter. Handle them while holding the frame with both hands in any situation.
- The anti-reflection glass of a module is easily soiled, when it is grasped by hand or hand gloves. So it is recommended to hold frames when carrying or installing the solar module. When cables and connectors touch the surface of the glass, it may soil the surface too. It is also recommended to avoid contact of cables and connectors with surface of the glass. (If the glass surface becomes dirty, see section of "anti-reflection glass surface cleaning".)

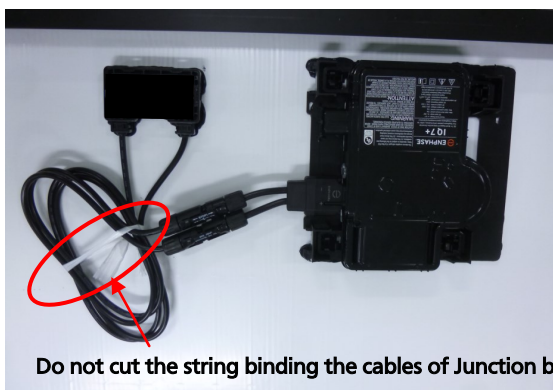


Figure 4. The string binding the cables of Junction box

PREPARE THE MICROINVERTER

- Before installing the PV module the microinverters must be lifted from the shipping position. On the ground, turn the PV module so that the microinverter faces you.
- Using both hands, lift the microinverter up. You will hear four clicks as the microinverter locks into the installation position (Deployed position). Ensure that the four latches are locked, and the microinverter is not tilted.
- Place the PV modules on the roof. Do not place the PV modules in such a way that places pressure on the microinverter.

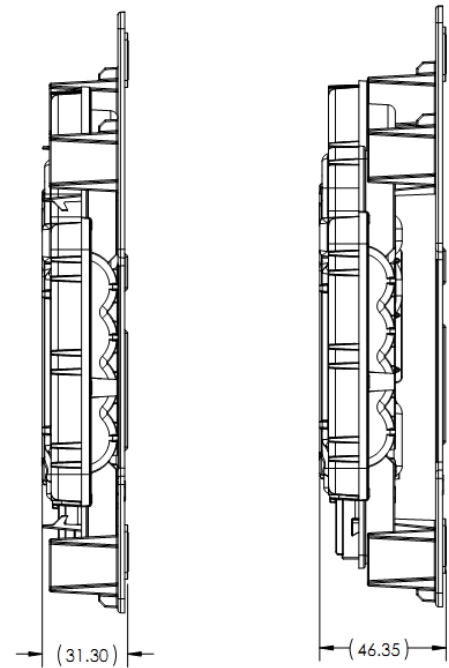
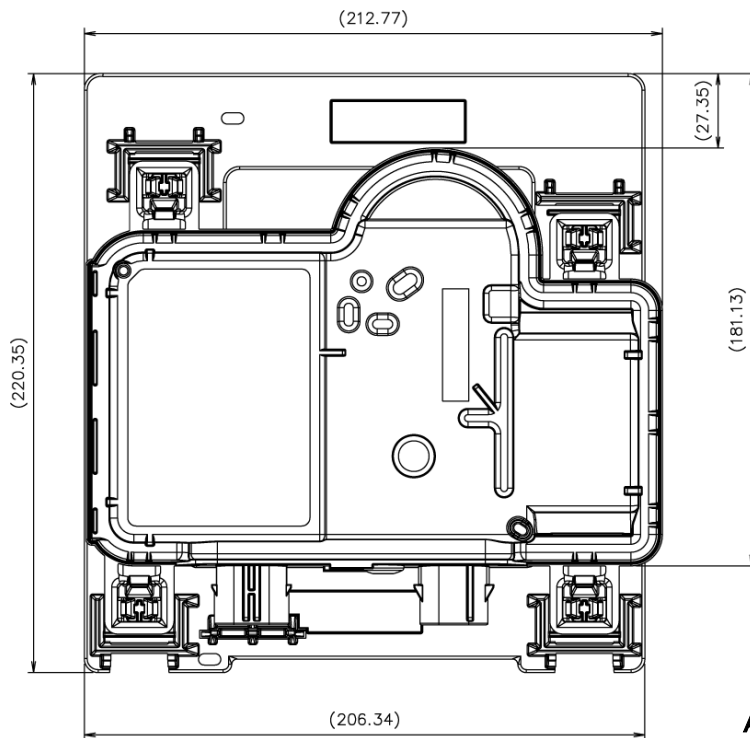
- If you need to service, you can return the microinverter to the shipping position using the Enphase Disconnect Tool. Use the tool to depress the four locking switches on each corner of the microinverter to return it to the shipping position. (See Figure.5)
- If the problem persists, contact Customer Support at Website as follows, <https://enphase.com/en-us/company/contact-us>

POSITION THE ENPHASE Q CABLE

- Plan each cable segment to allow drop connectors on the Enphase Q Cable to align with each PV module. Allow extra length for slack, cable

turns, and any obstructions.

- Mark the approximate centers of each PV module on the PV racking.
- Lay out the cabling along the installed racking for the AC branch circuit. Make sure that the cable is positioned in a way that allows you to connect it to the microinverter.
- Cut each segment of cable to meet your planned needs.
- When transitioning between rows, secure the cable to the rail to prevent cable damage or connector damage. Do not count on connector to withstand tension.
- When transitioning, Please do not damage at cable or connector.



A) Shipping Position B) Deployed Position



Figure 5. How to move to the shipping position using the Enphase Disconnect Tool.

Note) Do not return to A) Shipping Position except when necessary, such as removing the module for transportation.



CONNECT THE MICROINVERTER

- Connect the Q Cable to the microinverter. Listen for a click as the connectors engage. (See Figure 6)
- Cover any unused connectors with Enphase Sealing Caps. Listen for a click as the connectors engage.
- You must lift the microinverter in order to connect it. A protective shield prevents connection.

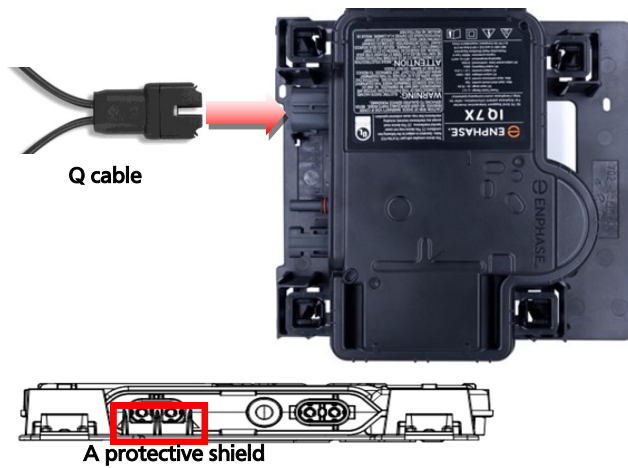


Figure 6. Connect the Q Cable to the microinverter

CREATE AN INSTALLATION MAP

- The Installation Map is a diagram of the physical location of each Module in your PV installation.
- Copy or use the blank map (See Figure 8 and 9) to record the Module placement for the system, or provide your own layout if you require a larger or more intricate installation map.
- Each PV Module and Enphase IQ Envoy has a removable serial number label. Build the installation map by peeling the serial number labels from the Modules and placing the labels on the map. See Figure 7.
- After you have created the installation map, use the Enphase Installer Toolkit mobile app to record the serial numbers and configure the system.
- For Installer Toolkit details, refer to "Detecting Microinverters" in the help topics of the Installer Toolkit app.
- Peel the removable serial number label from each Module frame and affix it to the respective location on the installation map paper.
- Always keep a copy of the installation map for your records.

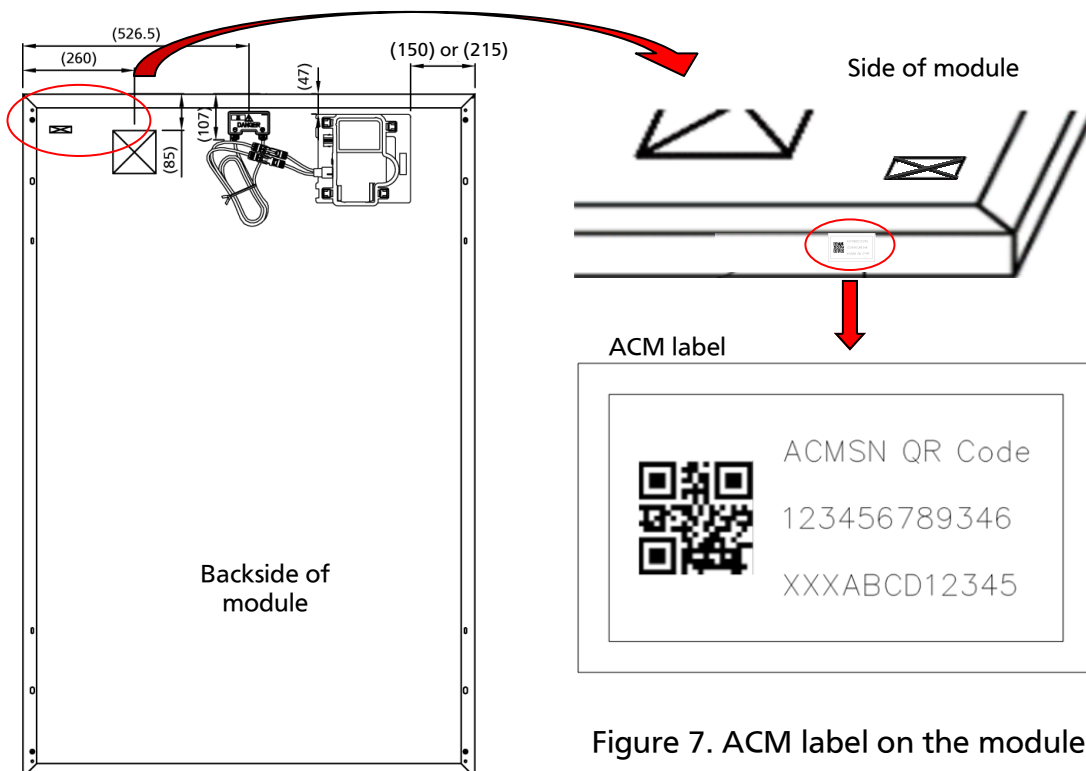


Figure 7. ACM label on the module frame

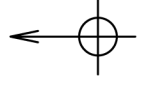
Panel Group :		Customer :		Installer :		N S E W 	
Azimuth :							
Tilt :							
Sheet :							
1 ()		2 ()		3 ()		4 ()	
A ()							
B ()							
C ()							
Scan completed map and upload it to Enphase. Click "Add a New System" at https://enlighten.enphaseenergy.com . Use this map to build the virtual array in Enlighten's Array Builder.				Envoy Serial Number Label		Panasonic®	

Figure 8. Installation Map (1)

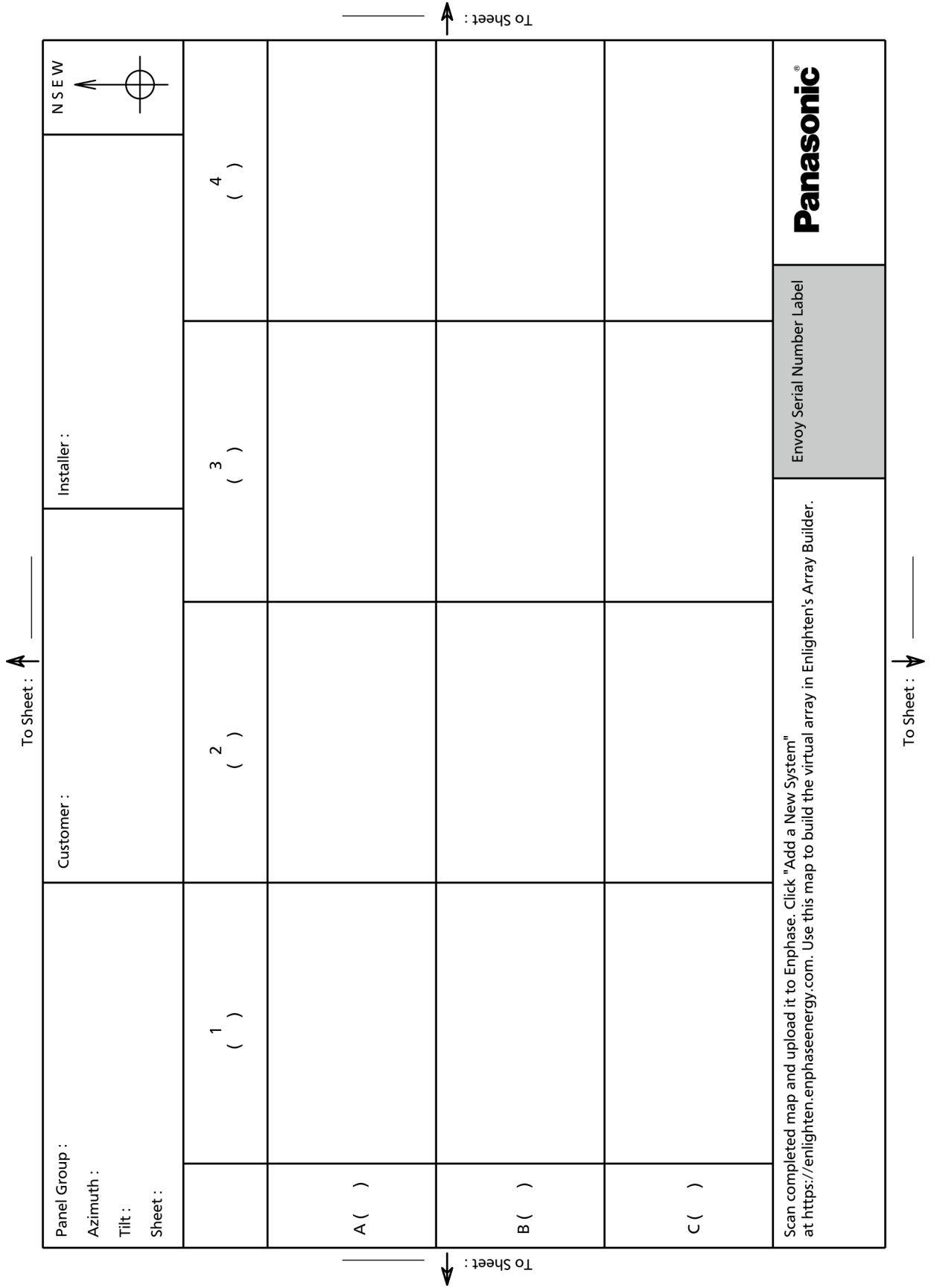


Figure 9. Installation Map (2)

MODULE INSTALLATION

- Install modules where they are not shaded by obstacles like buildings or trees. Especially pay attention to avoid partially shading the modules by objects during the daytime. If a part of the PV module is always shaded, hot spot may occur and the PV module may break down.
- Water stains might be caused when rain water remains on the glass surface for a long time. To avoid water stains, Panasonic recommends to install modules at a slope steeper than the water gradient.
- Modules should be firmly fixed in place in a manner suitable to withstand all expected loads, including wind and snow loads.
- Metals used in locations that are exposed to moisture shall not be employed alone or in combinations that could result in deterioration or corrosion.
- The clamps should be made of aluminum alloy or other material that will reasonably protect against a risk of electrolytic corrosion.
- Clearance between the roof surface and module frame is required to allow cooling air to circulate around the back of the module. This also

allows any condensation or moisture to dissipate. The required clearance between the roof surface and the module is **more than 4 inch**.

- The modules should be mounted basically at the four (4) quarter points by the means shown in Figure 1, and based on installation methods shown in Figure 10
- Figure 10 shows using a bolt and nut for mounting.
- **Do not contact** allow the bolt to contact the back sheet of the module when fixing the module to the mounting structure rail.
- **Do not** allow the microinverter to interfere with the mounting structure rail when fixing the module to the mounting structure rail. (See Figure 11)
- Recommendation of bolt torque: 10 ft-lbs.
- Appropriate material should be used for mounting hardware (the module frame, mounting structure, and hardware) to prevent itself from corrosion.
- Panasonic does not provide a warranty for clamps. The module warranty Panasonic provides shall be voided if clamps selected by the customer are an improper material

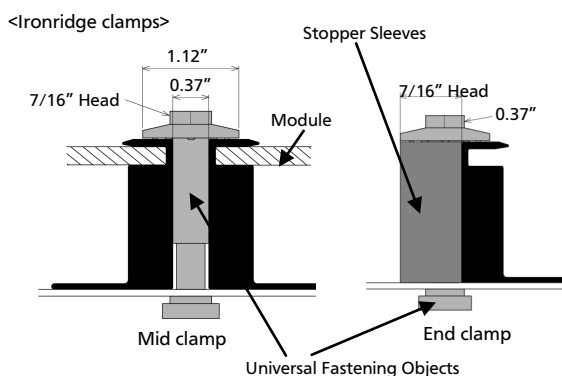
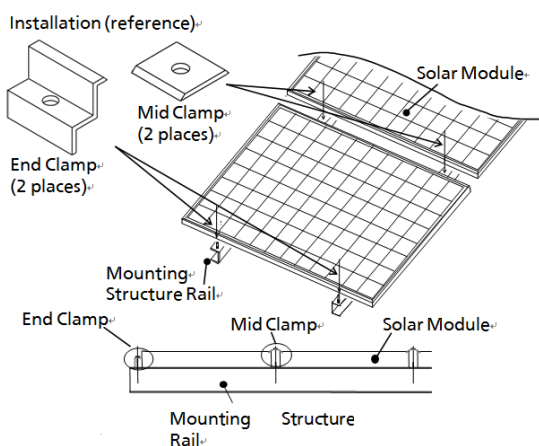
or size.

- Please contact your Panasonic Authorized Representative with questions regarding mounting profiles for modules if needed.

- The module was tested using IronRidge clamps with the specifications see Figure 10 and below;

IronRidge clamps:

- Provider: IronRidge Inc.
- Product Line: RoofMount
- Clamps type: Top Mounting Clamps (Universal Fastening Objects(UFOs) and Stopper Sleeves)
- IronRidge Part No. UFO-CL-001, UFO-CL-001B, UFO-STP-40MM, UFO-STP-40MM-B
- Width: Universal Fastening Objects; 1.12"(28.4 mm), Stopper Sleeves; 1.09"(27.7 mm)
- Thickness: Universal Fastening Objects 0.29"(7.4mm),
- Torque: 9.04 N.m (80 in-lbs).
- Material: Universal Fastening Objects; 300 Stainless steel, Stopper Sleeves; 6000 Aluminum alloys
- Note: Please refer to IronRidge manual, for installation method.



<Cross section of clamps>

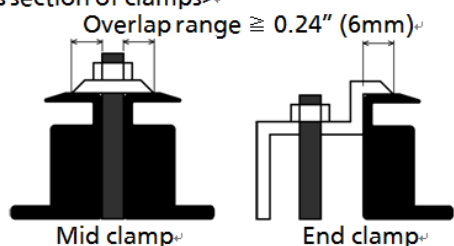


Figure 10. Module Installation

NG

OK

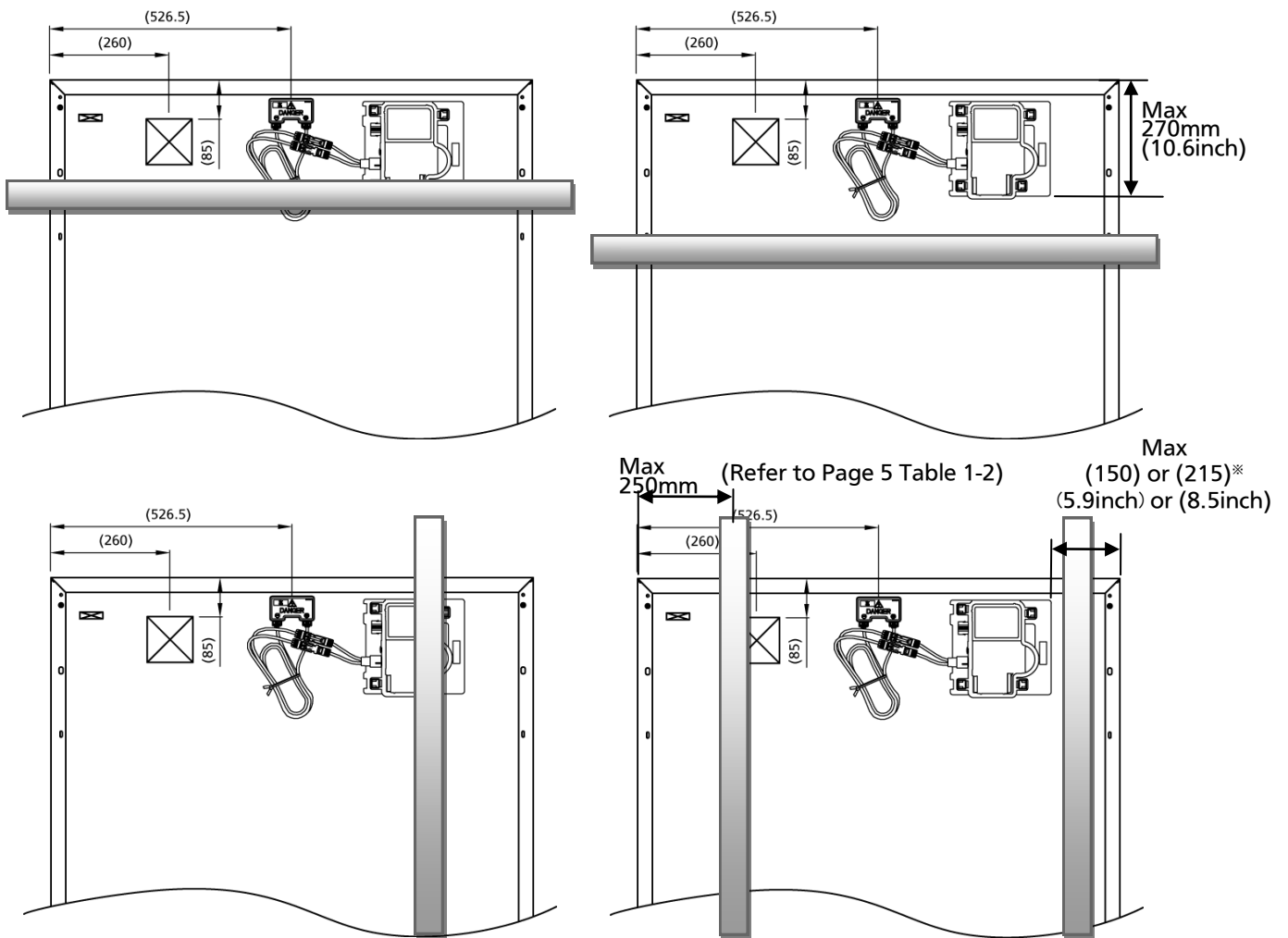


Figure 11. Position of the mounting structure rail

Note) Please fix the module so that the microinverter is not placed on the mounting structure rail.

Note) *Production up to October 2019 is 150mm. Production after November 2019 is 215mm.
So, Please check the production date properly.

MANAGE THE CABLING

- Use cable clips to attach the cable to the PV module frame. Leave no more than 1.8 m (six feet) between cable clips. (See Figure 12)
- Dress any excess cabling in loops so that it does not come into contact with the roof. Do not form loops smaller than 12 cm (4¾ inch) in diameter.
- Tripping Hazard. Loose cables can become a tripping hazard. Dress the Enphase Q Cable to minimize this potential.

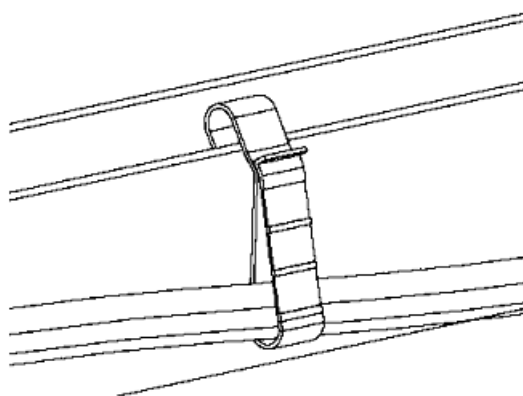


Figure 12 . Cable clip

TERMINATE THE UNUSED END OF THE CABLE

- Terminate the unused end of the Enphase Q Cable (See Figure 13).
- Remove 13 mm (½ inch) of the cable sheath from the conductors. Use the terminator loop to measure 13 mm.
- Slide the hex nut onto the cable. There is a grommet inside of the hex nut that should remain in place.
- Insert the cable into the terminator body so that each of the two wires

land on opposite sides of the internal separator.

- Insert a screwdriver into the slot on top of the terminator to hold it in place, and use a 27 mm wrench or channel lock pliers to tighten the hex nut to 7 Nm.
- Hold the terminator body stationary with the screwdriver and turn only the hex nut to prevent the conductors from twisting out of the separator.
- Turn only the hex nut to prevent conductors from twisting out of the

separator.

- Attach the terminated cable end to the PV racking with a cable clip or tie wrap so that the cable and terminator do not touch the roof.
- The terminator cannot be reused. If you unscrew the nut, you must discard the terminator.

Terminator Body 13mm

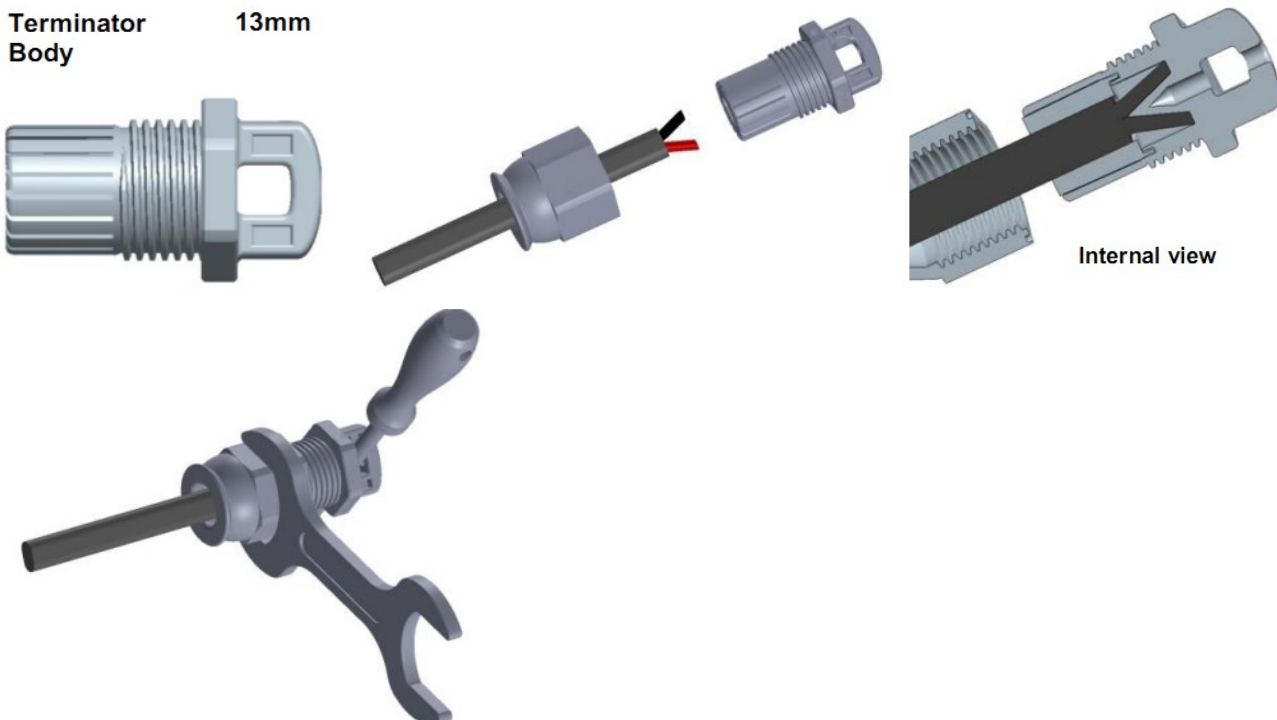


Figure 13. Terminate the Unused End of the Cable

CONNECT TO A JUNCTION BOX OR AN ENPHASE Q AGGREGATOR

- Connect the Enphase Q Cable into the Enphase Q Aggregator (See Figure 14). The Enphase Q Cable uses the following wiring color code. A ground lug is provided on the Q Aggregator for convenient PV module/rack/balance of system (BOS) grounding.
- Refer to the wiring diagrams on Figure 15 for more information. Wire colors are listed in the following table.

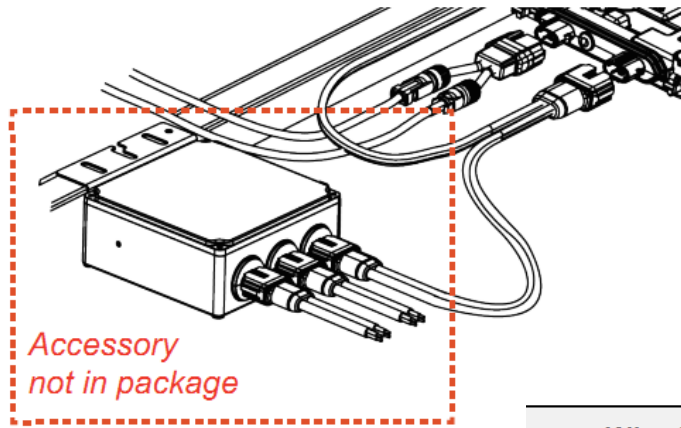


Figure 14. Connect to a junction box or an Enphase Q Aggregator

Wire Colors
L1 – Black
L2 – Red

ENERGIZE THE SYSTEM

- Turn ON the AC disconnect or circuit breaker for the branch circuit.
- Turn ON the main utility-grid AC circuit breaker. Your system starts producing power after a five-minute wait time.
- Check the LED on the connector side of the microinverter:

LED color	Indicates
Flashing green	Normal operation. AC grid function is normal there is communication with the IQ Envoy.
Flashing orange	The AC grid is normal but there is no communication with the IQ Envoy.
Flashing Red	The AC grid is either not present or not within specification.
Solid Red	There is an active "DC Resistance Low, Power Off Condition." To reset, see "DC Resistance Low – Power Off Condition" on page 22

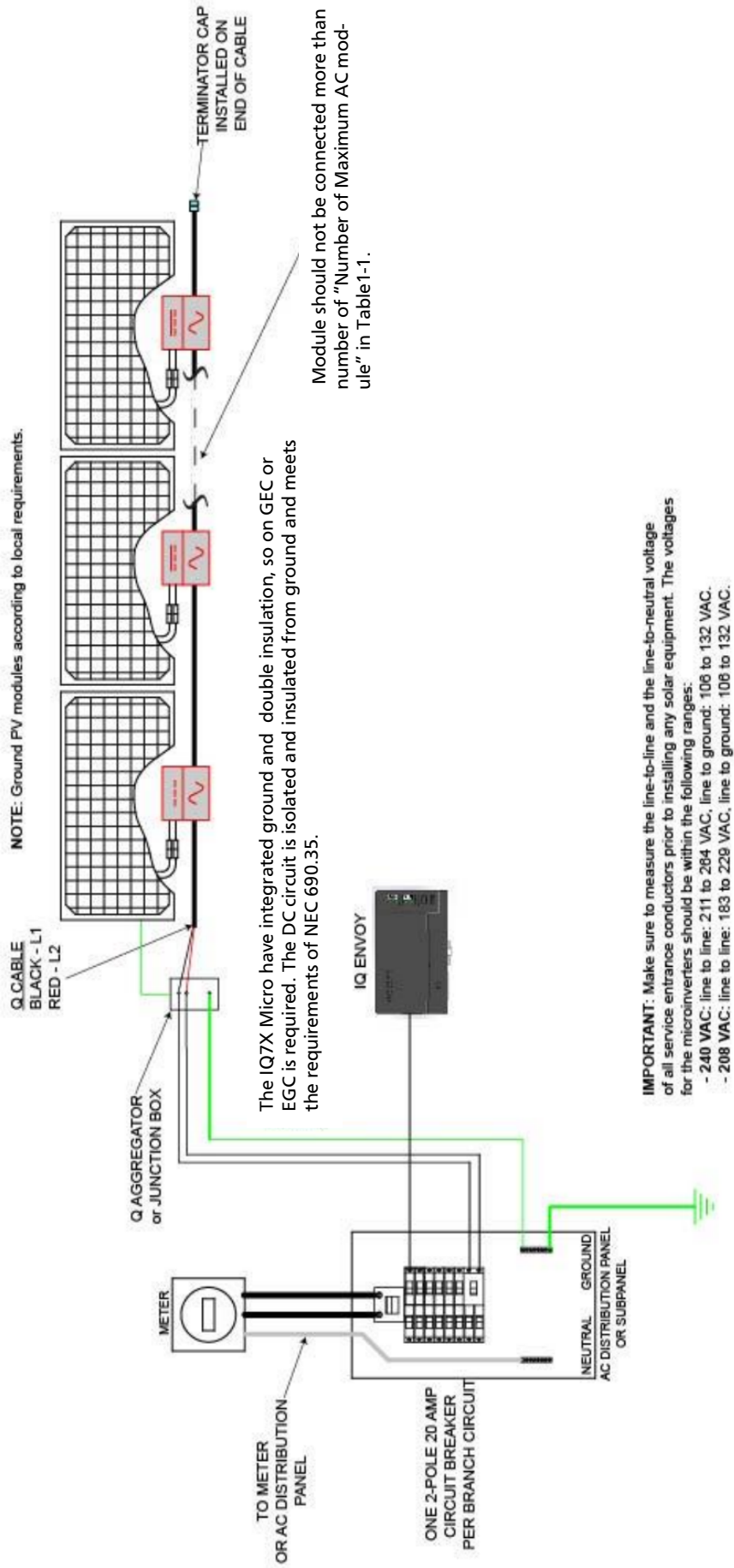


Figure 15. Sample Wiring Diagram

WIRING GENERAL

- All wiring should be done in accordance with applicable electrical codes.
- Wiring methods should be in accordance with the NEC in USA.
- All wiring should be done by a qualified, licensed professional.
- Wiring should be protected to help ensure personal safety and to prevent its damage.
- Connectors between Microinverters must be inserted until they click.
- When connecting the connectors, please make sure that foreign matter such as water, sand and so on do not get inside the connector. Also, please keep in mind that if you leave the connector in a non-connected state for a long period of time, contamination of foreign matter is likely to occur.
- If an extreme load is applied to the cable, the cables may come off the junction box body or the connectors. Please connect so that a strong load is not applied to the cable.
- When fixing the cable to the stand, make sure the minimum bending radius of the cable is 30 mm or more.
- **Do not disconnect** terminals while modules generate electricity and connect electrical load to avoid the hazard of electrical shock.
- Cable conduits should be used in locations where the wiring is inaccessible to children or small animals.
- Please contact your Panasonic Authorized Representative with questions regarding other electrical connections if needed.

MODULE WIRING

- All modules with microinverter connected in parallel by Enphase's Q cable should be of the same model number and/or type.
- Figure 15 is sample Wiring Diagram.
- Please follow "ENPHASE INSTALLATION AND OPERATION MANUAL"

for construction method about Q cable connection, AC connector connection, and other connection

- Please follow "ENPHASE Microinverters Installation Guide" for configuration and operation of a Microinverter.

<https://enphase.com/sites/default/files/downloads/support/IQ7-7plus-7X-Micro-Manual-EN-US.pdf>

- Module should not be connected more than number of "Number of Maximum AC module" in Table 1-1.

ARRAY WIRING

- The term "array" is used to describe the assembly of several modules on a support structure with associated wiring.
- When installing a PV array, the system design must be completed with reference to the module and inverter electrical specifications for proper selection of fuses, breakers, charging controllers, batteries and other storage devices. In particular, as the temperature characteristic of the PV module, the voltage value rises on the low temperature side. Consider the lowest temperature in the area where the system is installed and select the equipment so that it does not exceed the rated voltage of the equipment.
- Use copper wire which is insulated to withstand the maximum possible system open circuit voltage. For applications where wire conduits are used, follow the applicable codes for outdoor installation of wires in conduits. Minimum diameter of wire conduit is 4 mm². The temperature rating of conductor is -40 ~ 90 °C.
- In order to avoid submerging cables and connectors in the water, cables must be fixed either to the module frame using cable fixing holes or to the mounting structure. Also, if the cable is not secured, a force may be applied to the cable from the outside, and the module may be damaged.
- **Do not insert** PV cable between back side and mounting structure rail. When snow or wind load is

applied to the module, load may be applied to the cable.

- Verify that all fittings are properly installed to protect cables against damage and prevent moisture intrusion.
- Check your local codes for requirements.

EARTH GROUND WIRING

- A module with exposed conductive parts is considered to be in compliance with UL 1703 only when it is electrically grounded in accordance with the instructions presented below and the requirements of the National Electrical Code.
- The array frame shall be grounded in accordance with NEC Article 250 (USA) or the CEC.
- All modules should be grounded. All structures or metallic components in direct contact with the modules or electric wires should be properly grounded too.
- Each ledge on the module frame has two larger holes for bolts (0.205" diameter (5.2 mm)). These ground holes are marked with "earth indication mark" adjacent to their location on the frame rail (see Figure 16-1.).
- Ground wires must be connected to the module's metal frame at one of these locations.
- **Length of bolt should not be more than 0.78" (20 mm)** in order to avoid contacting the back-sheet of the module.

- Lay-in lugs or grounding clips can be used to ground Panasonic PV modules. Both methods are explained below, please choose one.
- Great care should be exercised to ensure that corrosion caused by the grounding means be avoided.
- Corrosion can increase the resistance of the grounding connection on the module, or can even cause the grounding connection to fail entirely. Corrosion can be caused by the effects of weather, humidity, dirt and so on. It can also be caused when two dissimilar metals are in contact (galvanic reaction).
- The module frame material is aluminum/magnesium alloy.
- All fasteners (nuts, bolts, washers, screws, etc.) must be stainless steel unless otherwise specified.
- We recommend installing a lightning rod and SPD (Surge protection device) to reduce damage or breakdown to the PV module caused by lightning. Check with your local AHJ on specific code requirements related to the grounding of PV Systems.

GROUNDING METHODS

- Where common grounding hardware (nuts, bolts, star washers, splicing lock washers, flat washers and the like) is used to attach a listed grounding/bonding device, the attachment must be made in conformance with the grounding device manufacturer's instructions.
- Common hardware items such as nuts, bolts, star washers, lock washers and the like have not been evaluated for electrical conductivity or for use as grounding devices and should be used only for maintaining mechanical connections and holding electrical grounding devices in the proper position for electrical conductivity. Such devices, where supplied with the module and evaluated through the requirements in UL 1703, may be used for grounding connections in accordance with the instructions provided with the module.

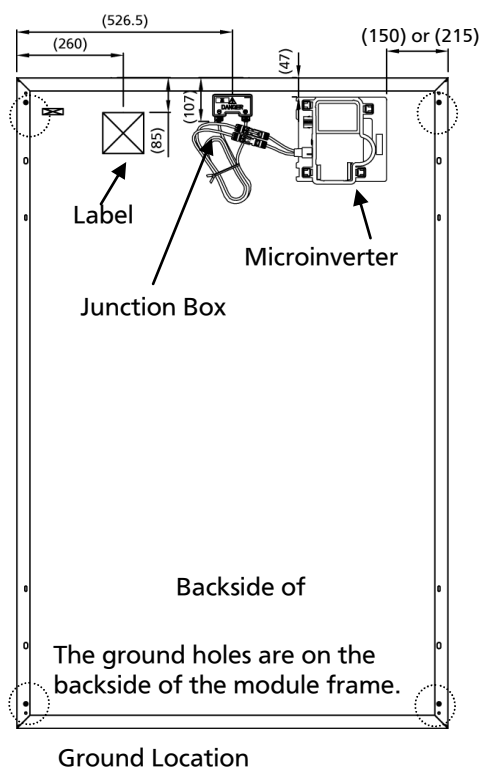


Figure 16-1.
Module Ground Position

Using bolt and nut

(see Figures 16.2)

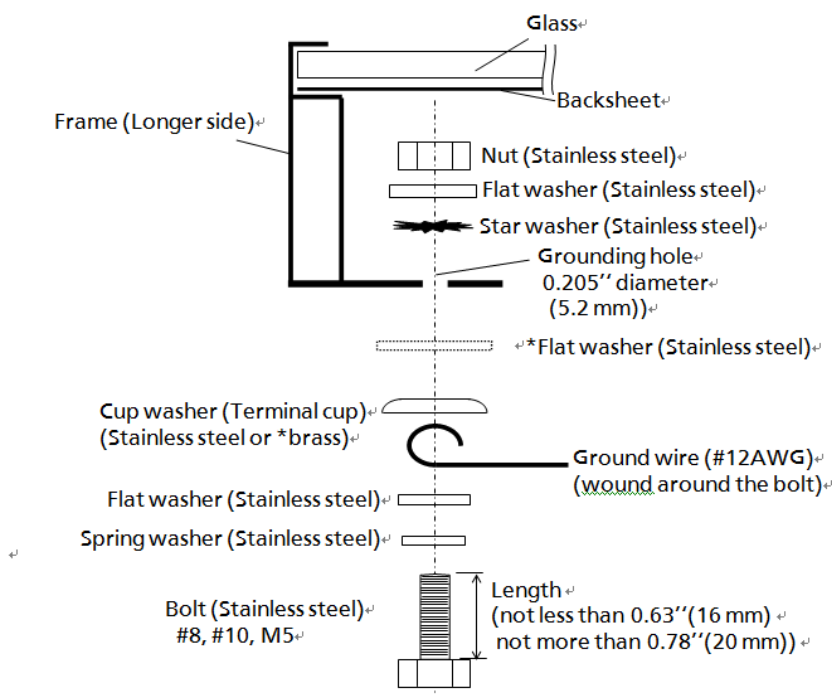
- If using this method, use one of the larger holes with diameter of 0.205" (5.2 mm)
- The bolt and nut size should be No.8 (0.164" diameter (4.16 mm)), or No.10 (0.190" diameter (4.83 mm)) or M5 (0.197" diameter (5.0 mm)).
- Star washers must be used to make contact through the anodization of the module for this method.
- In this case, the screw threads are not providing the electrical ground contact.
- Recommended torque value in tightening bolt and nut is 2.3 N.m (20in-lb).

Using cup washers

(see Figures 16.2)

- The use of cup washers is to prevent wire from slipping out from under the screw head (and/or the flat washer).
- Make sure that the cup washer is placed between the wire and the module frame.
- Choose an adequate size for the cup washer and the flat washer so that the wire is fully clamped between them.
- Note: Cup washers are also called terminal cup washers.
- The cup washers should be stainless steel, or a cup washer made of brass may be used only if a large flat washer made of stainless steel is inserted between the module frame and the cup washer.
- Choose the adequate size for the large flat washer (between the module frame

and the cup washer) so that the cup washer doesn't contact the module frame and is fixed stably to the module frame.



Note: Use the ground holes illustrated in Figure 16-1.

*If using a brass cup washer, a flat washer must be inserted between the cup washer and module frame, and the flat washer diameter must be greater than the cup washer diameter.

Figure 16-2.
Using bolt and nut

Using a lay-in lug with bolt and nut (see Figure 16-3.)

- If using this method, please follow instructions in previous section regarding using bolts and nuts with larger grounding holes.
 - Use a grounding tin plated solid copper lay-in lug rated for direct burial and outdoor use. Lug must be used ILSCO GBL-4DBT, BurndyCL501TN.
 - Attach grounding lug to module frame using a stainless steel bolt and lock-nut.
 - Tighten stainless steel set screw at the torque specified by lug manufacturer to secure copper wire.
 - The specified torque is following
 - ◇ IlSCO Corp. GBL-4DBT
 - 10-14AWG-Solid -> 20 in-lbs,
 - 4-6AWG-Strand -> 35 in-lbs,
 - 8AWG-Strand -> 25 in-lbs, 10-14AWG-Strand -> 20 in-lbs
 - ◇ Burndy L L C CL501TN 14AWG-Solid -> 35 in-lbs, 14AWG-Strand -> 35 in-lbs, 4AWG-Strand -> 45 in-lbs
- Recommended torque value in tightening bolt and nut is 2.3 N.m (20in-lb).

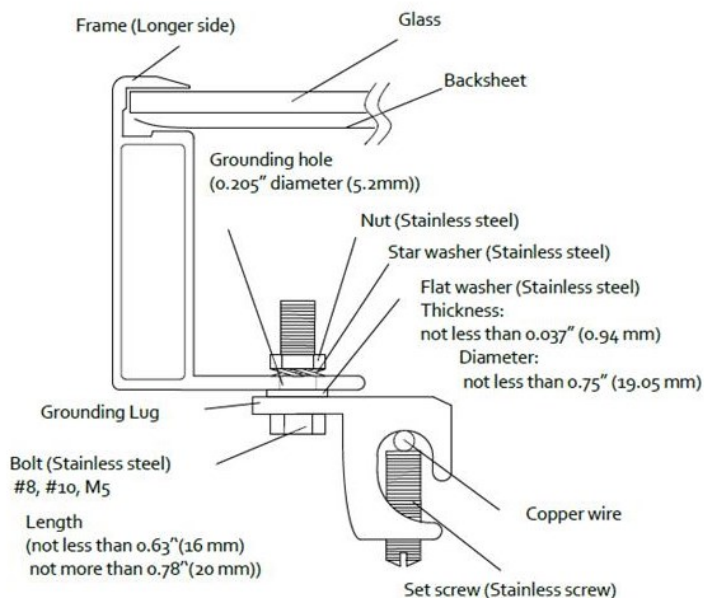


Figure 16-3.

Using a lay-in lug with bolt and nut

Note: Use the ground holes illustrated in Figure 16-1.

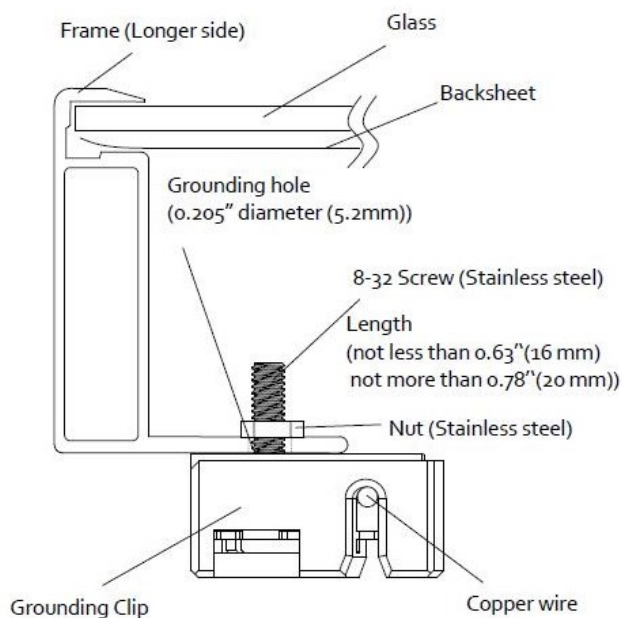
Select a grounding the following lug.

ILSCO GBL-4DBT,
Burndy CL501TN

Using a Grounding Clip with bolt and nut (see Figure 16-4.)

For more information, please refer to Instruction sheet issued by Tyco Electronics.

- Use Tyco Electronics 1954381-2 as grounding clip.
- Place the grounding clip onto the module frame.
- Thread the hex nut onto the end of the screw, then using a 3/8-in. wrench, tighten the nut. Recommended torque value in tightening bolt and nut is between 1.7 and 2.2 Nm.
- Insert the wire into the wire slot. Press down on both ends of the wire.
- Manually, or using channel lock pliers, push the slider over the base until it covers the base. This will terminate the wire.



Note: Use the ground holes illustrated in Figure 16.1.

Grounding Clip Assemblies:
Tyco Electronics 1954381-2

Figure 16-4.
Using a Grounding Clip with bolt and nut

MAINTENANCE

- In order to maintain the optimum output of the module, quality and safety, please conduct periodic inspection or cleaning.
- It is also recommended to inspect the electrical and mechanical connections annually.
- If you need electrical or mechanical inspection or maintenance, it is recommended to have a licensed authorized professional carry out the inspection or maintenance to avoid the hazards of electric shock or injury.

ANTI-REFLECTION GLASS SURFACE CLEANING

- Light dirt that does not shield light completely does not significantly degrade power generation performance, but if the module surface becomes dirty, it may reduce output power, malfunction or hotspot may occur.
- It is recommended to clean the surface of the module with water and a soft cloth or sponge.
- When cleaning with neutral glass detergent or weak alkaline glass detergent, it is recommended to start with smallest area and from the edge of solar modules in order to check no damage occurs to the glass.
- After that, clean surface of glass with wet and clean cloth.
- Recommended detergent: "Glass Magiclean"¹⁾ or "Windex® Original"²⁾
 - 1) Glass Magiclean is a trademark of Kao Corporation.
 - 2) Windex® is a trademark of SC Johnson & Son, Inc.
- It is recommended to read carefully the manuals of detergent and understand notes on usage and first-aid treatment.
- To remove persistent dirt, the module can be washed with a micro-fiber cloth and ethanol.
- **Never use** abrasive detergent, strong alkaline detergent, strong

acid detergent or a detergent which forms a protective layer on the surface of the glass to clean any part of the module. The performance of a solar modules may be reduced. Please be very careful since the warranty will not cover the damages caused by detergents.

- When cleaning the PV module, please do not put detergent on junction box or connector. If detergents and chemical substances adhere, junction box and connector may be deteriorated or damaged.

REPLACE ONLY MICROINVERTER

- If Enphase authorizes a replacement only Microinverter, follow the steps below 1)~13).
- Do not damage the module back-sheet or glass surface during replacement work.
- Do not step on any module during module replacement work.
- Use appropriate protective equipment such as protective gloves or safety belt.
- Refer to the installation manual or following video link provided by Enphase.

<https://enphase.com/en-us/support/ac-module-rma-process-installer-toolkit?destination=%2Fen-us%2Fsearch%2FRMA>

- 1) Turn off the AC branch circuit breaker.
- 2) Remove fixing clamps of the failure module on mounting location.
- 3) Disconnect the Enphase AC Q Cable from Microinverter by inserting the Enphase disconnect tool.
- 4) Put the failure module on the ground from the roof.
- 5) Disconnect the DC connector from Microinverter using Enphase disconnect tool.
- 6) Remove Microinverter by expanding the nails of the four corners. (See Figure 17).
- 7) Install new replacement Microinverter to the deployed position.
- 8) Connect the DC connector to new

Microinverter.

- 9) Scan the Micro serial No of the new Microinverter.
- 10) Bring the AC Module back onto the original mounting location.
- 11) Connect the AC Q Cable to the new AC module.
- 12) Fix new module using mounting clamps.
- 13) Energize the AC branch circuit breaker, and verify operation of the replacement Microinverter by checking the Status LED on the connector side of the Microinverter.

REPLACE ENTIRE MODULE

- If Enphase authorizes a replacement entire AC module, follow the steps below 1)~9).
 - Refer to notes of REPLACE ONLY MICROINVERTER before replace entire module.
- 1) Turn off the AC branch circuit breaker.
 - 2) Remove fixing clamps of the failure module on mounting location.
 - 3) Disconnect the Enphase AC Q Cable from Microinverter by inserting the Enphase disconnect tool.
 - 4) Put the failure module on the ground from the roof.
 - 5) Scan the ACM serial No of the new module.
 - 6) Bring the AC Module back onto the original mounting location.
 - 7) Connect the AC Q Cable to the new AC module.
 - 8) Fix new module using mounting clamps.
 - 9) Energize the AC branch circuit breaker, and verify operation of the replacement Microinverter by checking the Status LED on the connector side of the Microinverter.

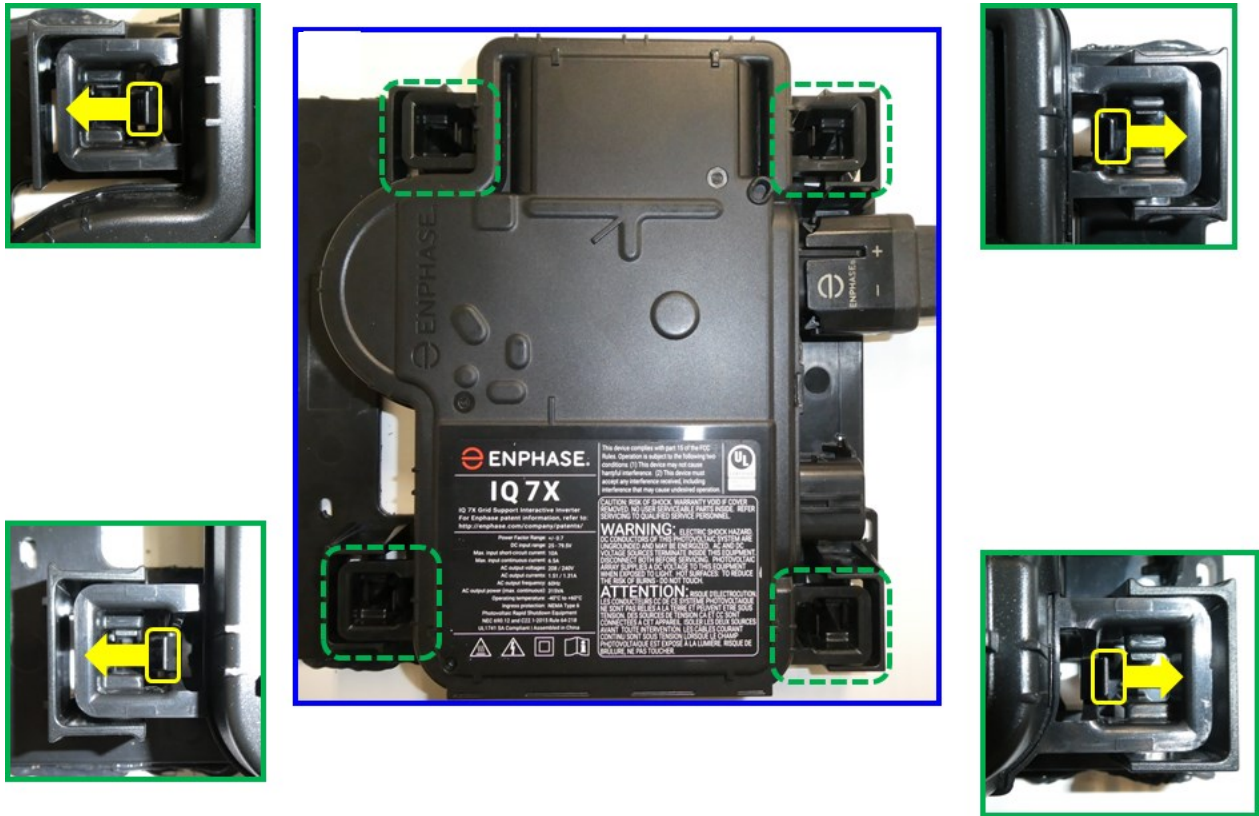


Figure 17. Expanding the nails of the four corners.

DISCLAIMER OF LIABILITY

Panasonic does not assume responsibility and expressly disclaims liability for loss, damage, or expense arising out of, or in any way connected with installation, operation, use, or maintenance by using this manual.

Panasonic assumes no responsibility for any infringement of patents or other rights of third parties, which may result from use of modules.

No license is granted by implication or under any patent or patent rights. The information in this manual is believed to be reliable, but does not constitute an expressed and/or implied warranty.

As part of our policy of continuous improvement Panasonic reserves the right to make changes to the product, specifications, or manual at any time without prior notice.

The return of any modules will not be accepted by Panasonic unless prior written authorization has been given by Panasonic.

CONTACT INFORMATION

If you suspect a PV module or system failure, please contact the shop you purchased, the installer, or the following contact information.

ENPHASE ENERGY, Inc.

Headquarters

47281 Bayside Pkwy. Fremont, CA
94538 USA

TEL: (877) 797 4743

Petaluma, California

1420 N. McDowell Blvd. Petaluma, CA
94954 USA

TEL: (877) 797-4743

Customers may also contact ENPHASE via its website as follows,

<https://enphase.com/en-us/company/contact-us>

Panasonic Life Solutions Company of America

Two Riverfront Plaza. 5th Floor, Newark, NJ 07102

panasonicHIT@us.panasonic.com

na.panasonic.com/us/solar

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REVISION HISTORY

Edition	Revision Date	Revised Item	Revised Content
NEW Edition	2019.1.16	-	-
2 nd Edition	2019. 2. 8	<ul style="list-style-type: none"> · Request from UL and Enphase · Correction of mistakes 	<ul style="list-style-type: none"> · Request AC disconnect or breaker installation · Change Enphase registered trademark statement
3 rd Edition	2019.2.12	<ul style="list-style-type: none"> · Correction of missing sentence · Delete unnecessary sentence 	<ul style="list-style-type: none"> · Correction of missing sentences (p.8 PREPARE THE MICROINVERTER~ POSITION THE ENPHASE Q CABLE) · Delete sentence about bypass diode (p.17)
4 th Edition	2019.5.16	<ul style="list-style-type: none"> · Company name change · Revision of spec table · Other 	<ul style="list-style-type: none"> · Company name change of CONTACT INFORMATION (p23) · Addition of AC spec table, revision of DC spec table and deletion of Microinverter spec table. (p4) · Updated website URL. (front page) · Deletion of MC4 connectors. (p.6) · Marking (○ / × →OK / NG)(p.14)
5 th Edition	2019. 11. 11	<ul style="list-style-type: none"> · Change of AC electrical specification · Change of Microinverter position · Addition of replacement method for Microinverter and module · Other 	<ul style="list-style-type: none"> · RF value change in AC electrical specification (p.4) · Change of Microinverter position(P.5, P.9, P.13) · Addition of REPLACE ONLY MICROINVERTER and REPLACE ENTIRE MODULE (p.22) · Change notation about Number of Maximum AC module (P.16, 17)