AC Module

Installation Guide Content

for ET-P660250AC

May 9, 2012

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PN: ETM-0001-AC Rev. 01

Content

Read this First!

This document contains important information and instructions to safely install an array of alternating current photo-voltaic (AC) solar modules. Failure to follow these instructions can result in equipment damage or failure, or personal injury, and might void the system warranty.

The following symbols are used throughout this document to alert you to important safety information that you will need during the installation:

	This symbol indicates that failure to follow instructions may result in serious hardware failure. Use caution when completing this task.
	This symbol indicates that failure to follow instructions may result in serious personal injury. Use extreme caution when completing this task.

IMPORTANT SAFETY INSTRUCTIONS

Perform all electrical installations in accordance with any local codes, the National Electrical Code (NEC) ANSI/NFPA 70 for US installations, or the Canadian Electrical Code Part I, CSA C22.1 for Canada.

- This unit or system is provided with fixed trip limits and shall not be aggregated above 30 kW on a single Point of Common Connection. See "Utility Interaction" on page 25 for voltage and frequency trip limits.
- This AC module is intended for operation in an environment having a maximum ambient temperature of 85℃.
- Work with the local electric company and authorities having jurisdiction (AHJ) before, during, and after the installation of the solar electric system. The following are examples of possible requirements the electric company might have regarding the installation:
    - An upgrade of the existing meter
    - A readily accessible AC system disconnect and a diagram showing its placement
    - An inspection or approval before connecting the system to the utility grid
    - Qualified personnel or electric company employee to connect the system to the utility grid

	AC wiring from the utility to the array junction box is energized by both utility dedicated branch circuit(s) and AC modules rated as "Utility Interactive". Opening the array's dedicated branch disconnect will also cause the AC

	modules to stop producing power. Proper safety procedures must be followed when installing or accessing the dedicated branch circuit wiring, which includes unplugging the AC Modules from the dedicated branch circuit.

- The AC module interconnecting cable system includes an internal equipment grounding conductor (EGC) connected to each module through pluggable connectors with a longer ground pin.
- The AC module does NOT require a DC or AC grounding electrode conductor (neutral) at the inverter, and the neutral within the AC module is isolated from ground.
- The AC module must be connected to a dedicated branch circuit from an AC supply system with the neutral referenced to ground at the building or structure electrical service entrance.
- The connector on the AC interconnecting cables is rated for disconnect under load and can be used as an NEC disconnect device. Some AHJs might require a separate disconnect next to the AC module system as well as a readily accessible disconnect.
- The AC cables and connectors are listed for outdoor use, are rated for 20A, and have insulation rated to a minimum temperature of 90℃. These cables are listed for use with AC modules.
- The AC dedicated branch circuit wiring from the readily accessible disconnect to the AC module array must include an equipment grounding conductor (EGC) run in the same raceway or cable as the AC circuit conductors. This EGC must be connected to the green colored conductor of the transition cable, which is part of the AC module interconnecting cable system.
- The AC module interconnecting cable system provides an internal EGC for grounding the AC modules only. Other metal structures, such as mounting systems, must be grounded per code.
- If a module is removed from within the string, it is recommended that you bridge the gap in the string using an AC extension cable. Inserting an extension cable maintains ground continuity to subsequent modules in the string. Other auxiliary grounding methods may be used.
- The metal components of the AC module, including frame and micro inverter, can reach temperatures of approximately 80℃or more under extreme environmental conditions. To reduce risk of burns, use appropriate safety procedures when handling.

To reduce the risk of fire, connect only to a circuit that has a dedicated 20 amperes maximum overcurrent protection in accordance with the National Electrical Code, ANSI/NFPA 70.

- The AC module output is Utility Interactive.

- To provide proper ventilation to the underside of the module, install modules with a minimum space of 1.5 inch between the module and the mounting surface.

The AC Module is provided with an integral micro inverter and is NRTL listed as an assembly for outdoor PV applications. There is no direct current (DC) field wiring required and the integral micro inverter has no serviceable parts inside. The following caution is provided as part of the micro inverter certification:

Warning - Risk of Electric Shock!

- Do not remove cover. No user serviceable parts inside. Refer servicing to qualified service personnel.
- Both AC and DC voltage sources are terminated inside this equipment. Each circuit must be individually disconnected before servicing the micro inverter.
- When the photovoltaic module is exposed to light, it supplies a DC voltage to the micro inverter.

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 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.

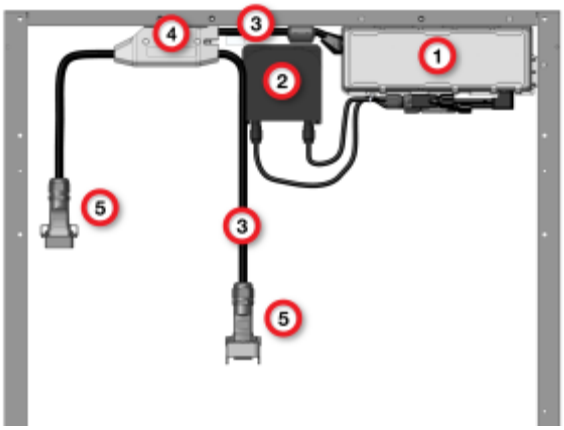
Changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate the equipment.

Introduction

Integrating this micro inverter with the standard PV module results in an AC module, which is the safest module on the market. You no longer need to connect the DC power to a separate micro inverter or to a large, centralized inverter, eliminating exposure to potentially lethal DC voltages.

Modules arrive at the installation site with the integrated micro inverter and its fully-insulated AC connection cable already installed. The DC voltage produced by the module is fed directly into the micro inverter. Wiring the modules together is a simple matter of plugging the attached AC cable into the insulated cable of the neighboring module. The reduced risk has the added benefit of reducing the overall installation time.

Components of an AC Module



1	Micro inverter
2	Module's Junction Box
3	Insulated AC Cable, which contains an equipment grounding conductor (EGC)
4	Mid-Cable Junction
5	AC Cable Connector

Caution

DO NOT disconnect the AC cable connectors under load!

Grounding in the AC Cables

The AC cable attached to the micro inverter and all accessory cables are fully insulated and contain an equipment grounding conductor (EGC). The full ground path from the transition cable to the module frame follows:

- The transition cable's green conductor is connected to the EGC from the utility dedicated branch circuit.

- All connectors have green ground contacts that are longer than the circuit contacts. This extra length ensures the ground is the first to make contact when connecting modules and the last to break contact when disconnecting modules.
- The AC ground wire inside the micro inverter makes a bolted termination to the micro inverter chassis and is environmentally sealed.
- The micro inverter chassis is bonded at the factory to the module frame with stainless steel hardware to provide ground continuity to the AC PV module frame.

The AC cable grounding path has been tested by a NRTL. Before an AC module assembly can be labeled with the NRTL certification mark and shipped from an authorized and inspected factory, each assembly must pass a ground continuity check to verify electrical continuity from the AC cable ground contact to the module frame.

The AC cable provides equipment grounding for the AC module only. It is the installer's responsibility to ensure that any metallic parts in contact with the module (i.e. mounting systems) are provided with a means of equipment grounding according to the manufacturer's instructions and local code.

Because the DC power is internal to the module, a grounding electrode conductor (GEC) is not required.

Because the AC modules are connected in a "daisy chain" fashion, disconnecting one module from within the string removes power and ground from subsequent modules in the string. Extreme care should be taken to ensure that no other energized sources are adjacent to these ungrounded modules, or auxiliary grounding methods must be provided.

If a module is removed from within the string, it is recommended that you bridge the gap in the string using an AC extension cable. Inserting an extension cable maintains ground continuity to subsequent modules in the string. Other auxiliary grounding methods may be used.

A best practice for all solar module installers, especially those in areas with frequent lightning, is to secure the module support rails and hardware using grounding hardware that has been certified to meet requirements for grounding systems. Connect the entire structure to a grounding electrode system using a dedicated, suitably sized, copper conductor.

Module Layout Diagram

A module layout diagram is a paper model describing the configuration of the array and the placement of each module in the array. Following the installation, this information is

recreated within the monitoring tool enabling the module owner, service providers, and system administrators to monitor the performance of each module.

The layout diagram uses the serial number of the micro inverter to identify where each module is installed in the array.

Use the module layout template below to create a module layout diagram of your installation site.

1. Fill in the data requested at the top of the table.
2. Before a module is installed, peel the serial number sticker from the mid-cable junction.
3. Place the sticker in the same location in the table relative to the micro inverter's position in the actual array.
4. Fill in the sheet number information at the bottom of the table.
5. When complete, use the layout diagram to recreate the array in the monitoring tool.

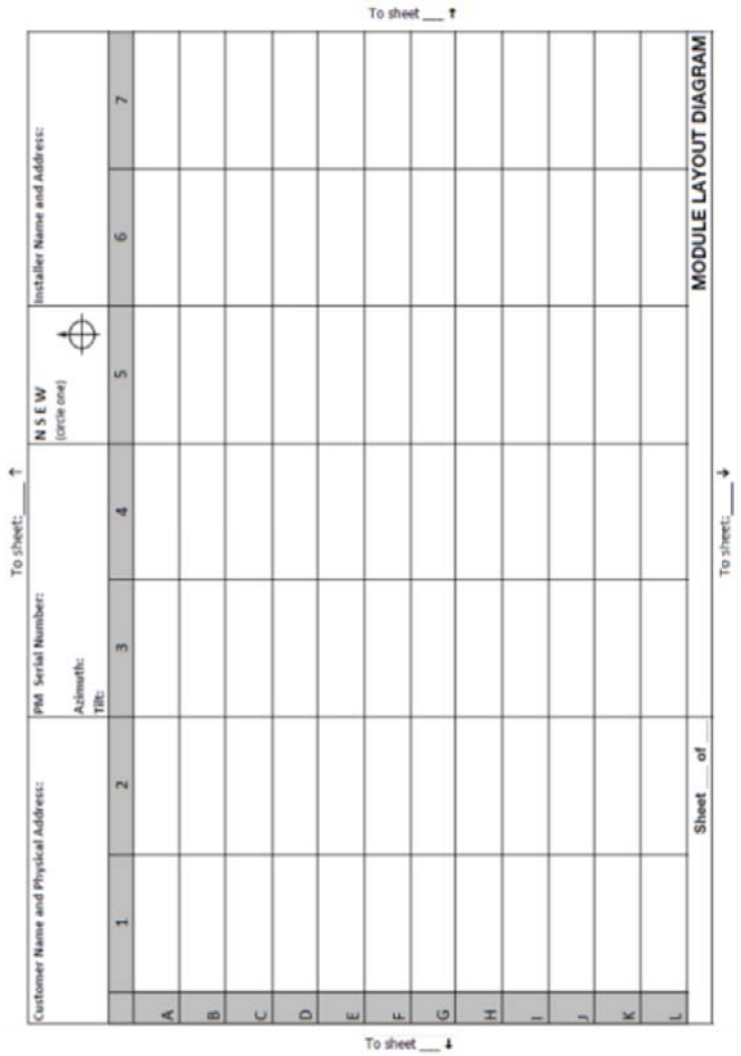


Table 1: Module Layout Diagram

Connecting Latching Cables

1. Align and insert the female connector into the latch male connector.

   Each connector has alignment groves and ridges that ensure the connectors cannot be plugged together incorrectly. Ensure both ends are fully seated before attempting to close the latch.

1	Latch male connector
2	Female connector
3	Alignment grooves

2. Snap the latch in place to secure the connectors. Ensure both sides of the latch are engaged.

Disconnecting Latching Cables

Use the provided disconnect tool to safely release the latching connectors.

1. Insert the ends of the tool into the latch recesses as shown in the imag
   feel and hear a click when the tool is fully seated.

2. Use your thumbs, firmly push or pull the top of the disconnect tool toward the latch male connector until the latch snaps free.

Module Preparation

Whether the box is located to the left or right of the array (as viewed from the ground facing the installed array) determines which transition cable you need (male or female) and what preparation is needed for the final module in the string. With the junction or transition box to the left, a female transition cable is required. The final module in the string will require an end cap be plugged into the mid-cable junction. With the junction or transition box to the right of the array, a male transition cable is needed. The final module will require additional cable management to secure the end of the AC cable.

Before connecting the transition cable, calculate the distance from the transition box to the module plus the distance under the module to reach the appropriate AC connector. This will determine the length of transition cable that you will need.

NOTE: Always place cable clips at least three inches from a plug or mid-cable junction to ensure proper stress relief.

- Do you need any extension cables? Will the extension cable reach from connector to connector or is it necessary to modify the standard cable management of one or both modules to make the connection easier?

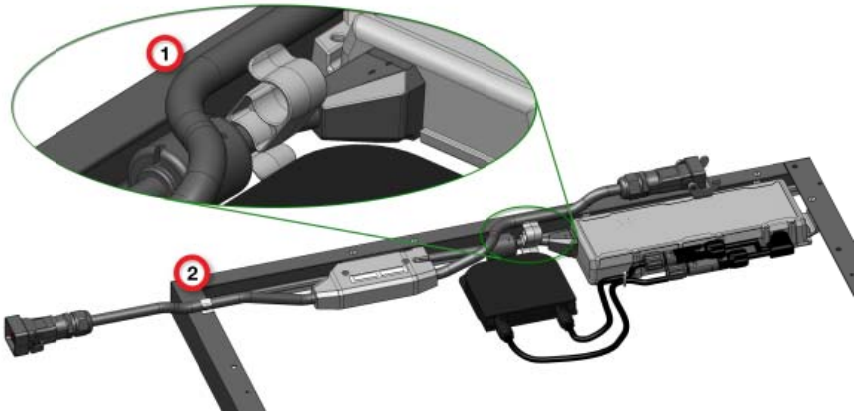
  How will you manage the extension cables? If the extension cables will connect two rows of modules in the same string, use cable clips to secure the transition cable to the module frame. Including waves or loops in the cable between clips can help manage slack.

  If the extension cable is running across open roof, another cable management system will be needed to keep the extension cable off of the roof and protected from the sun. If the distance to be crossed is longer than the length of the extension cable, you must transition back to standard building wiring systems to span the distance. Use a transition cable to connect the module into a junction or transition box and wire according to local and NEC or CEC standards.

The preparation and installation instructions included in this section are general instructions for installing AC modules on most mounting systems. In some cases, it might be necessary to modify these instructions to accommodate specific installation requirements. For example, if you encounter more cable slack than is represented in these diagrams, use standard cable management practices to secure the excess cable off of the roof.

Preparing the Modules

AC modules require minimal preparation before installation. Simply secure the connector cable in the already attached cable clip and attach the 90degree clip to the side of the module frame. You're ready to install.



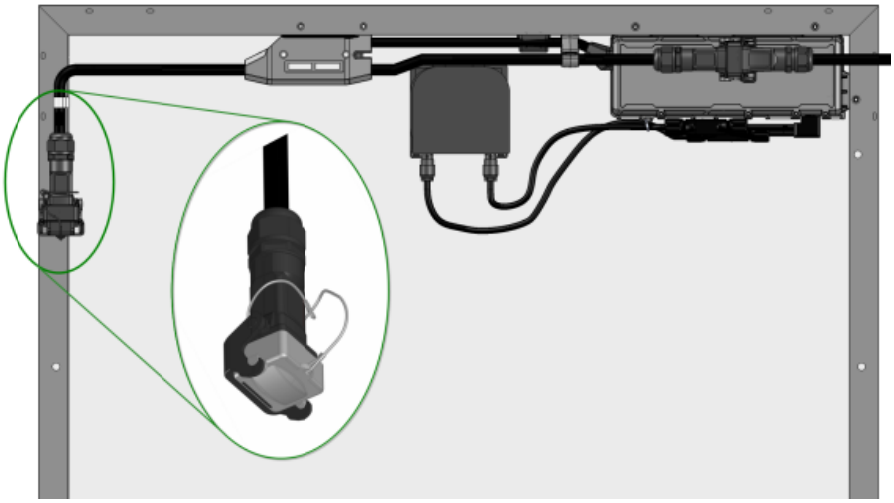
1	Secure the cable in the S clip.
2	Attach the 90degree clip to the side frame.

⚠	During shipping, the AC cable connectors are securely fastened to prevent movement. Use caution when unpacking the module to ensure the connectors do not swing loose and cause damage to the module backsheet or underlying solar cell.

Preparing the Last Module in the String

The last module in the string will require a slightly different preparation.

The last module will have an unused AC connector. One end or the other will not be plugged into a neighboring module. This unused connector must be secured under the modules and off of the rooftop. Use an appropriate cable clip and end cap as shown in the following example:



Module Installation

This section describes how to lay down and interconnect AC modules on a previously installed mounting system. No attempt is made to describe how to install the mounting system on the roof or how to use module clamps.

Before installing the mounting system, ensure that mounting rails will be positioned below the micro inverter once the module is installed. The micro inverter extends beyond the edge of the frame of most modules. Do not install modules with the micro inverter resting on the mounting rail.

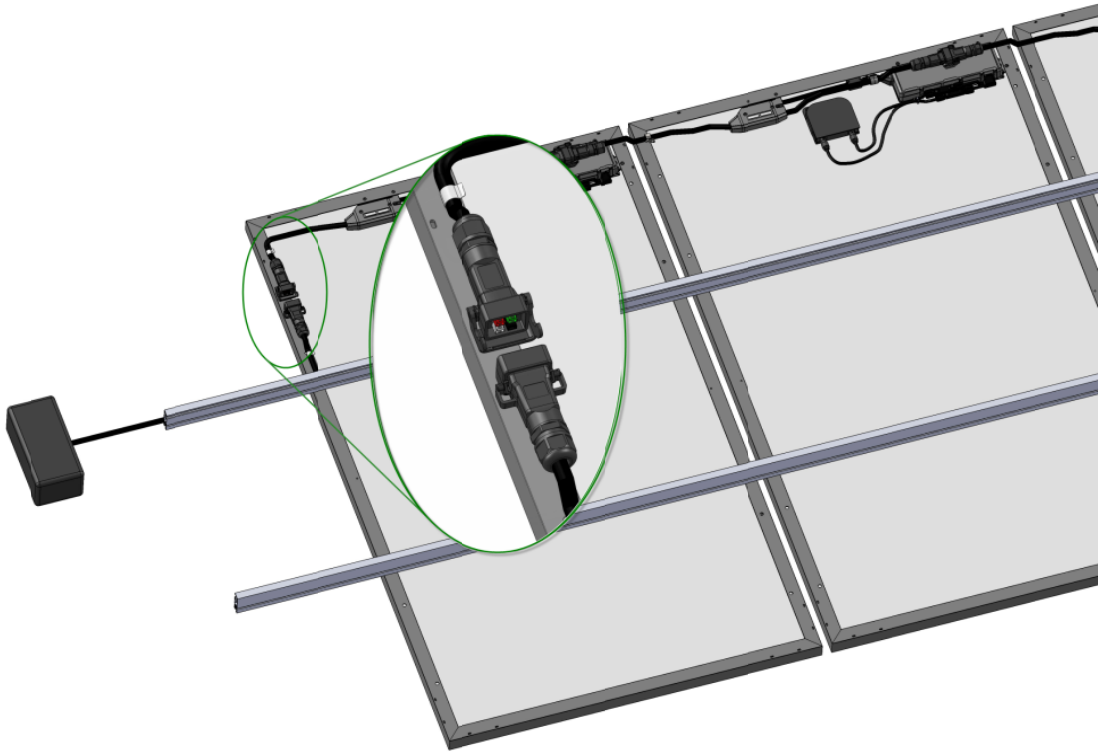
The frame of the installed module must rest firmly on the mounting rail. Installing a module with the micro inverter resting on the rail and uneven contact between the frame and the rail can cause damage to the micro inverter and the module.

The metal components of the AC module, including frame and micro inverter, can reach temperatures of approximately 80℃. To reduce risk of burns, use appropriate safety procedures when handling.

Installing the Modules

The ideal installation path is to begin closest to the installed transition box and plug in each module as you move away from the box. Depending on the configuration of your array and the location of the transition box, this path may not be feasible. For example, in a 2-row configuration, we recommend installing the bottom row first and working up toward the transition box, which is likely mounted higher up the roof.

The following diagram shows two installed modules as viewed from the bottom or underside of the module.



1. Connect the transition cable to the junction or transition box according to NEC/CEC and local standards.
2. Install the first module, nearest to the transition box, according to racking system instructions.
3. Plug the transition cable into the connector of the first module and close the connector latch.

Before connecting modules to transition cable, ensure the neutral and ground wires are properly landed and the AC string overcurrent protection device is in the OFF position.

4. Install the second module.
5. Reach under the top edge of the first module and plug in the AC cable from new module. Close the latch.

NOTE: For end- or edge-mount racking systems, it might be necessary to lift the top of the module slightly above the frame to reach the plug.

6. Repeat steps 4 and 5 until you reach the end of the row.

   See "Module Preparation" on page 12 for information on preparing the final module in the string.

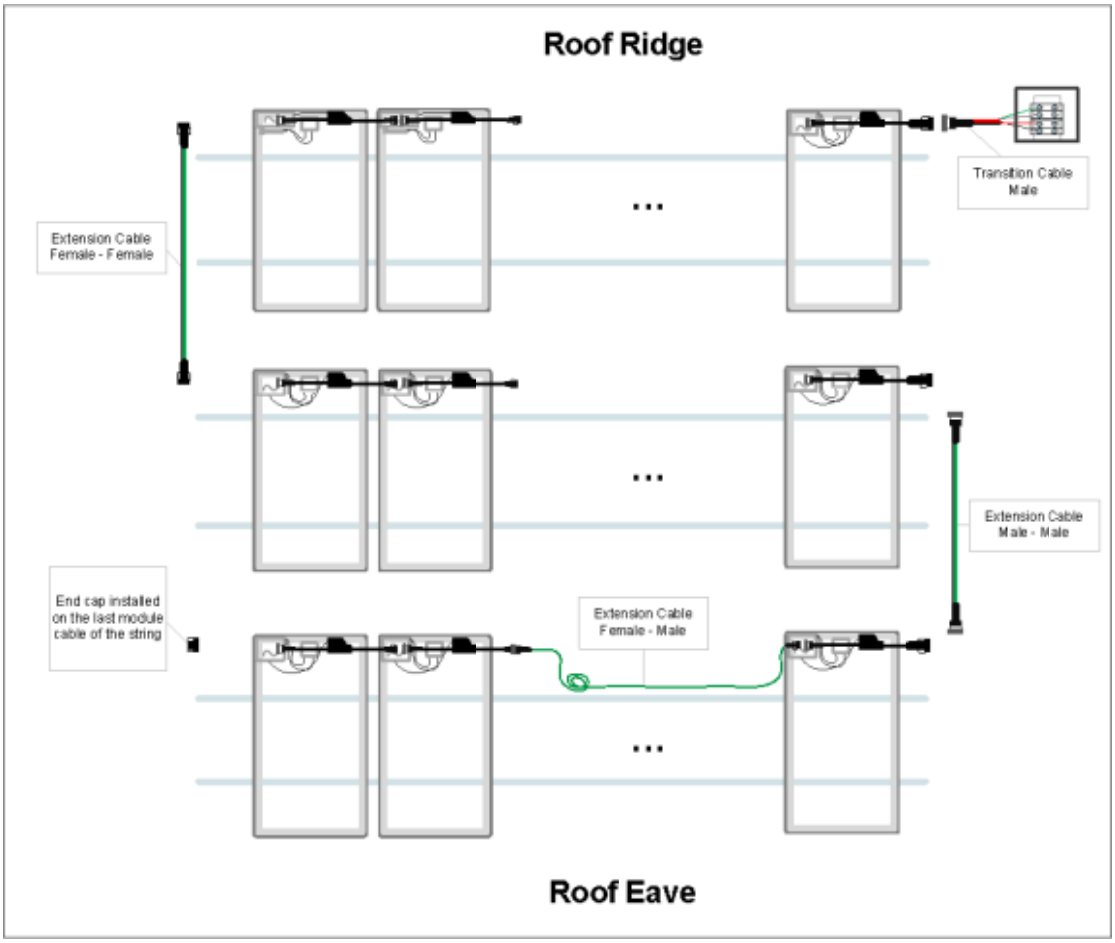
   If the string will continue to another row, then an extension cable is needed. Plug the extension cable into the current module and place it in the general vicinity of where the next module will be installed. Use appropriate cable management strategies to secure the extension cable.

NOTE: For rail mount systems, lay the extension cable over the rails on which the next module will be installed. This ensures that the cable remains under the module for protection from the sun and uses the rails to keep the cable off the roof surface. Once the module is installed, you can also secure the cable to the module frame with cable clips, if necessary.

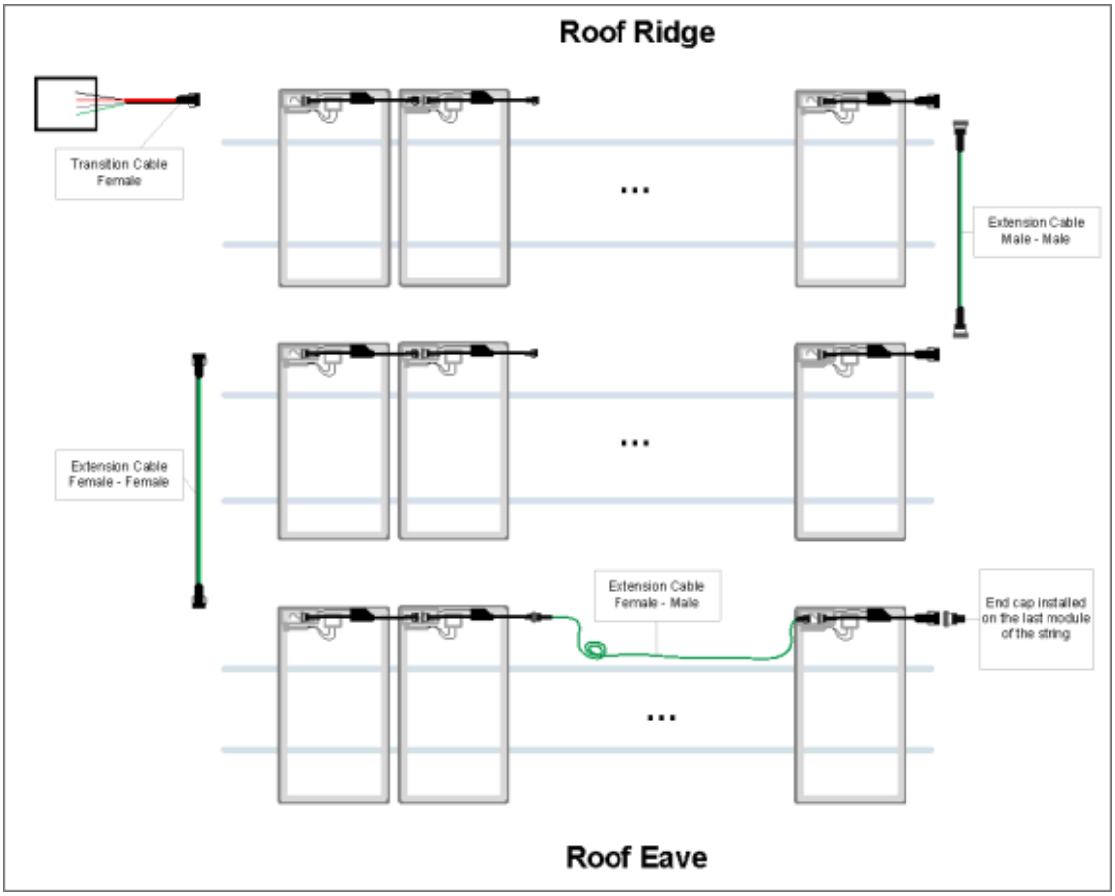
Examples

The diagrams in this appendix provide examples of array configurations you might encounter and the types of cables necessary for each configuration. The graphics in this appendix view the front of the module as you would see it when installed.

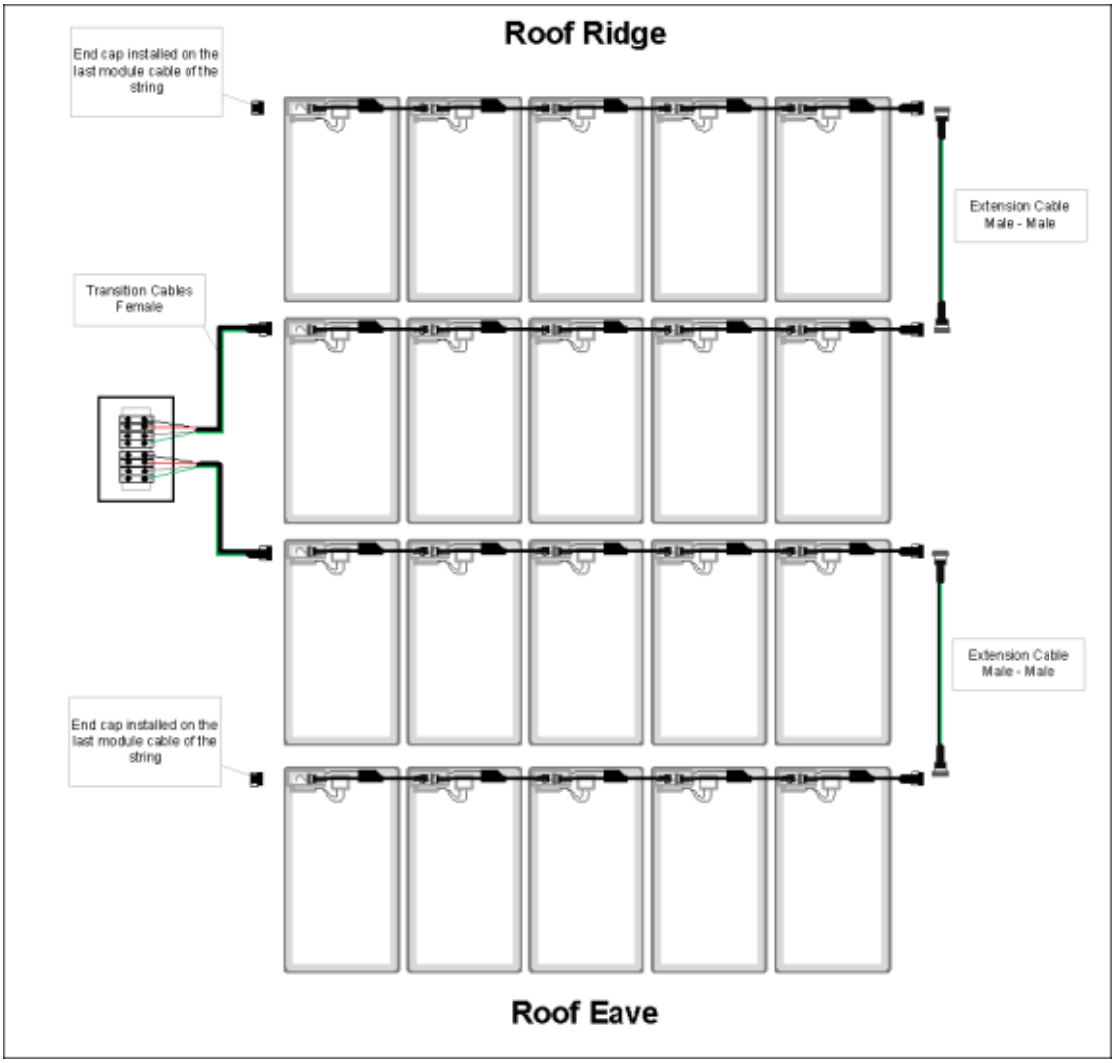
Junction Box - Top Right



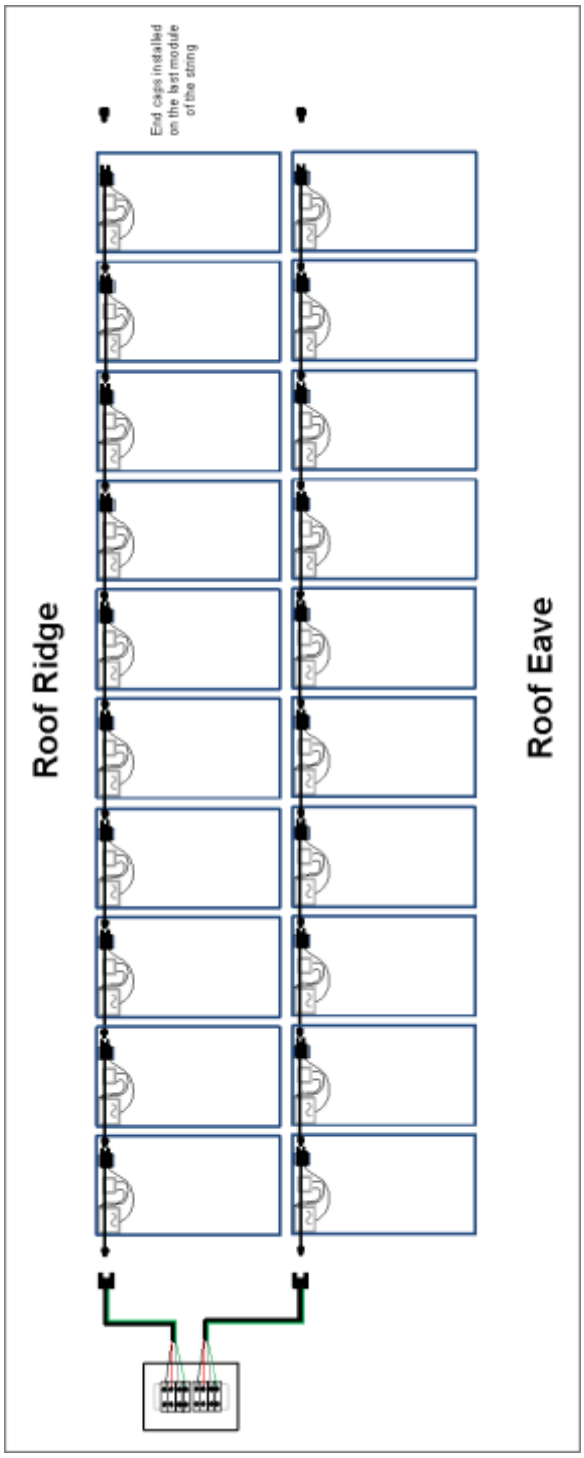
Junction Box - Top Left



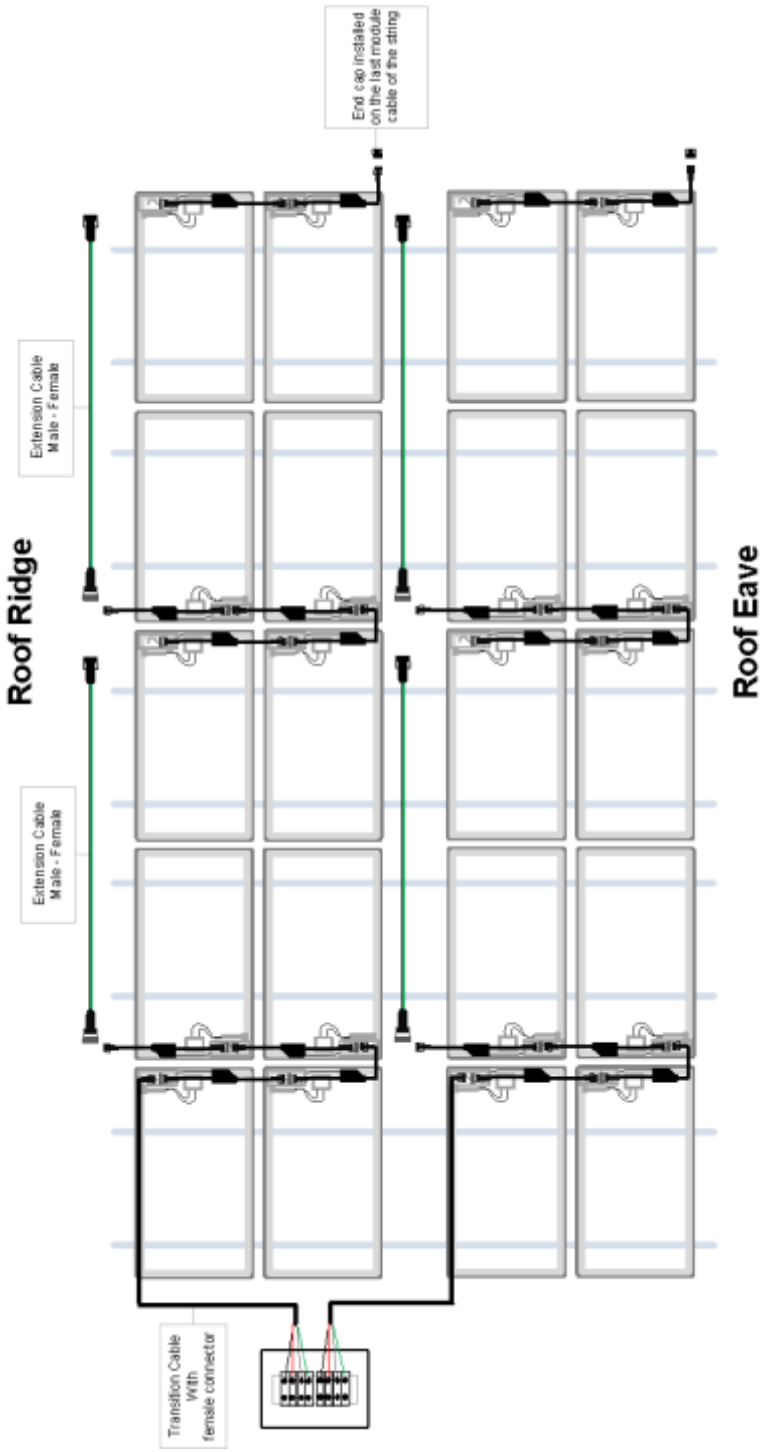
Two Strings – Two rows each



Two Strings – Single Rows



Landscape – Two Strings



Three-line Diagram

This appendix includes the following three-line diagrams for installing AC modules.

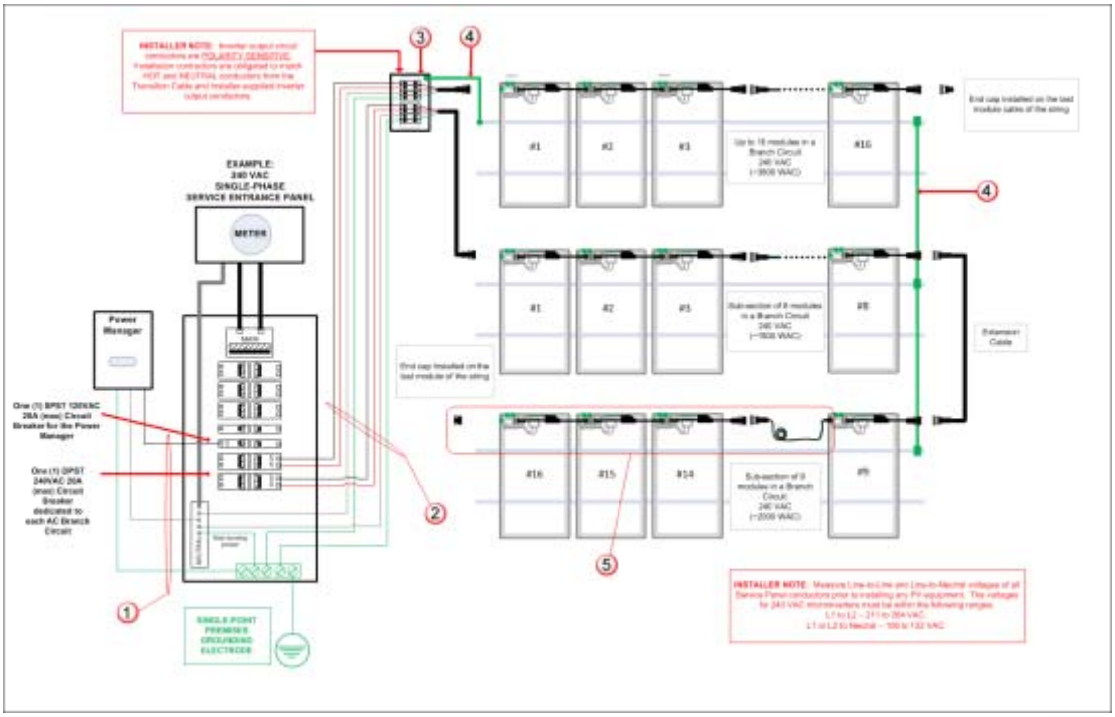
- Single-phase 240V for residential installations

Single-Phase 240 V Diagram

The table below contains information and installer notes relevant to the 3-line drawing on the next page. Locate the numbered callouts in the diagram.

1	Typical Wire Type: THWN or THWN-2 Power Manager is connected directly to the service panel. Optionally, the Power Manager can be connected to a NEMA 5-15 single receptacle outlet wired directly to the service panel.
2	Inverter output circuit: Direct to service entrance panel (as shown) or to a sub-panel off a higher rated breaker in the service entrance panel. Supplied by installation company as part of Balance of System (BOS) components. Typical Wire Type: Depends on wiring method to array. Size for 20 amp dedicated branch: minimum 12Awg but may be larger due to temperature derating in conduit or voltage drop due to distance. Transient voltage surge suppressor recommended for sites subject to lightning.
3	Exterior-rated electrical work box with distribution block or terminal strip rated for 240 VAC 20A (supplied by installation contractor). NOTE: Check with the AHJ for requirements for a separate AC disconnect to be installed next to the PV array
4	Grounding lugs and external ground wires: The AC cable provides equipment grounding for the AC module only. It is the installer's responsibility to ensure that any metallic parts in contact with the module (i.e. mounting systems) are provided with a means of equipment grounding according to the manufacturer's instructions and local code. In areas subject to lightning, it is recommended to provide auxiliary grounding between the AC module frame and the racking to bond all metal together. This can be done with straps or fasteners approved for grounding PV module frames. The entire array structure should then be connected directly to the ground electrode using a suitably sized copper conductor. NOTE: Do not run this conductor in the conduit with the EGC or AC power conductors. Failure to provide proper grounding can void equipment warranty in the case of lightning strike. Typical Wire Type: Green insulated wire size must be no smaller than largest conductor in the PV system. If the ground wire is external, use a minimum 6 AWG per NEC or CEC.
5	AC Module Interconnecting Cables: Exterior-rated AC cable with equipment grounding conductor (EGC) integrated into the AC module. Cables are rated for disconnect under load and can be used

	as an NEC disconnect device. Plug and Play locking connectors require cable release tool to disconnect.



Technical Specifications

Parameter	240V
Peak Power (Pmax)	250W
Module Efficiency	15.37%
Maximum Power Voltage (Vmp)	30.02V
Maximum Power Current (Imp)	8.33A
Open Circuit Voltage (Voc)	37.58V
Short Circuit Current (Isc)	8.98A
Power Tolerance	±3%
Maximum System Voltage	DC1000V
Normal Operating Cell Temperature	45.3±2℃
Temp. Coeff. Of Pmax	-0.43%/℃
Output power factor rating	0.99
Operating voltage range (ac) (L-L)	211 – 264 V
Operating frequency range or single frequency	59.3 - 60.5 Hz
Number of phases	1
Nominal output voltage (ac)	240 V
Normal output frequency	60 Hz
Maximum continuous output current (ac)	0.992 A
Maximum output power (ac)	238 W
Utility interconnection voltage and frequency trip limits and trip times	See "Utility Interaction" on page 25
Total Demand Distortion (TDD) /Individual harmonics (per IEEE 1547)	< 5% (Passed up to 40th harmonic)
Maximum units per 2-pole 20 amp dedicated branch circuit	16
Maximum output fault current (ac) and duration	11.9 Apk, 0.31 Arms, total duration 1.2 ms

Parameter	240V
Maximum output overcurrent protection	20 A
Dimension	1640x992x57.5mm 64.57x39.06x2.26 inch
Weight	21.59kg 47.59 lbs
Cooling	Natural Convection /No Fans
Protection Level	IP 65(NEMA 6)

Utility Interaction

Voltage and frequency limits for utility Interaction[c]			
Condition	Simulated utility source		Maximum time (sec) (cycles) at 60 Hz[a] before cessation of current to the simulated utility
	Voltage (V)	Frequency (Hz)	
A	$< 0.50\ V_{nor}$[b]	Rated	0.16
B	$0.50\ V_{nor}$[b] $\leq V < 0.88\ V_{nor}$	Rated	2
C	$1.10\ V_{nor}$[b] $< V < 1.20\ V_{nor}$	Rated	1
D	$1.20\ V_{nor} \leq V$	Rated	0.16
E	Rated	f > rated + 0.5	0.16
F	Rated	f < rated –0.7	0.16

a - Non-adjustable maximum clearing times

b - Nominal voltage equals 120V phase to neutral

c - Trip limit accuracy: Voltage - ±2.5% based on 120V nominal, frequency- ±0.1 Hz