



Installation/User Manual

APsystems YC1000-3 Photovoltaic 3-Phase Grid-connected Microinverter

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IMPORTANT SAFETY INSTRUCTIONS

SAVE THESE INSTRUCTIONS! *This manual contains important instructions to follow during installation and maintenance of the APsystems YC1000-3-480 Photovoltaic Grid-connected Inverter (microinverter). To reduce the risk of electrical shock and ensure the safe installation and operation of the APsystems microinverter, the following symbols appear throughout this document to indicate dangerous conditions and important safety instructions.*

WARNING: This indicates a situation where failure to follow instructions may cause a serious hardware failure or personnel danger if not applied appropriately. Use extreme caution when performing this task.

NOTE: This indicates information that is important for optimized microinverter operation. Follow these instructions closely.



**WARNING
SYMBOL**



**NOTE
SYMBOL**

SAFETY INSTRUCTIONS

- ✓ **Do NOT disconnect the PV module from the APsystems Microinverter without first disconnecting the AC power.**
- ✓ Only qualified professionals should install and/or replace APsystems microinverters.
- ✓ Perform all electrical installations in accordance with local electrical codes.
- ✓ Before installing or using the APsystems microinverter, please read all instructions and cautionary markings in the technical documents and on the APsystems microinverter system and the PV-array.
- ✓ Be aware that the body of the APsystems microinverter is the heat sink and can reach high temperatures. To reduce risk of burns, do not touch the body of the microinverter.
- ✓ **Do NOT** attempt to repair the APsystems microinverter. If it fails, contact APsystems Customer Support (206-855-5100) to obtain an RMA number and start the replacement process. Damaging or opening the APsystems microinverter voids the warranty.
- ✓ **Do NOT** expose the connections to directed, pressurized liquid (pressure washer, etc.).

- ✓ **Do NOT** expose the connections to continuous immersion.
- ✓ **Do NOT** over-tension the AC connector (tension due to pulling or bending the cable near the connector).
- ✓ Use only provided/authorized connectors and cables.
- ✓ **Do NOT** allow contamination into the connectors.
- ✓ Use an authorized terminator to seal the end of the AC Bus Cable. Using another sealing method voids the warranty.
- ✓ To reduce the risk of fire, connect only to a circuit provided with 25 amperes maximum branch circuit overcurrent protection – in accordance with the National Electrical Code (NEC), ANSI/NFPA 70.
- ✓ Both AC and DC voltage source are terminated inside this equipment. Each circuit must be individually disconnected before servicing.
- ✓ DC voltage is supplied to this equipment when the photovoltaic array is exposed to light.
- ✓ This Utility-Interactive Inverter contains active anti-islanding protection (IEEE1547) and is tested per FCC/IC.

Radio Interference Statement

RADIO INTERFERENCE STATEMENT

FCC Compliance: The equipment can comply with the limits for a class B digital device, pursuant to part 15 of the FCC Rules, which are designed to protect against harmful interference in a residential installation. The equipment could radiate radio frequency energy and this might cause harmful interference to radio communications if not following the instructions when installing and using the equipment. But there is no guarantee that interference will not occur in a particular installation. If this equipment causes harmful interference to radio or television reception, the following measures might resolve the issues:

- A. Relocate the receiving antenna and keep it well away from the equipment
- B. Consult the dealer or an experienced radio/TV technical for help

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

APsystems YC1000-3 System Introduction

The APsystems microinverter is used in utility-interactive grid-tied applications, comprised of three (3) key elements:

- **APsystems microinverter**
- **APsystems Energy Communication Unit (ECU)**
- **APsystems Energy Monitor and Analysis (EMA) web-based monitoring and analysis system**

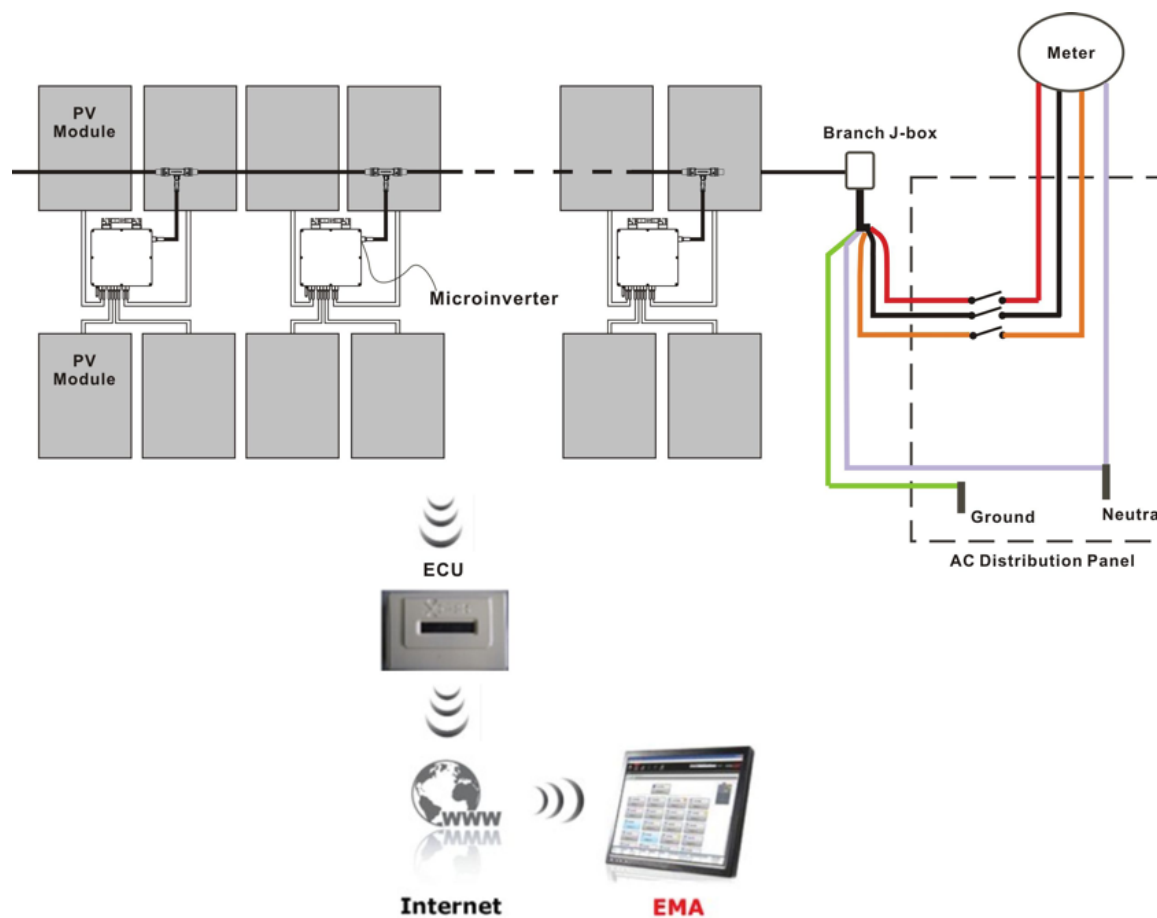


Figure 1

This integrated system improves safety, maximizes solar energy harvest, increases system reliability, and simplifies photovoltaic (PV) system design, installation, maintenance, and management.

APsystems microinverters maximize energy production

Each PV module is operating at the maximum peak power point, which ensures that the maximum power is exported to the utility grid. The APsystems microinverter ensures top performance from the array by maximizing the performance of the module within the array when PV modules in the array are affected by shading.

More reliable than centralized or string inverters

The distributed microinverter system ensures that no single point of system failure exists across the PV system. APsystems microinverters are designed to operate at full power at ambient temperatures of up to +65°C (+149° F). The inverter housing is designed for outdoor installation and complies with the NEMA 4X environmental enclosure rating.

Simple to install

You can install individual PV modules in any combination of module quantity, orientation, type, and power rating.

Smart system performance monitoring and analysis.

The APsystems Energy Communication Unit (ECU) is installed by simply plugging it into any wall outlet and providing it with an Ethernet or Wi-Fi connection to a broadband router. After installing the ECU, the full network of APsystems microinverters automatically reports to the APsystems Energy Monitor and Analysis (EMA) web server. The EMA software displays performance trends, informs you of abnormal events, and controls system shutdown when it is needed. Reference the ECU Manual for installation and operation instructions.

APsystems Three-phase Microinverter YC1000-3

The APsystems YC1000-3-480 microinverters connect with the three-phase grid, and operate with most 60 and 72 cell PV modules. For more information, please see the Technical Data page (p. 20-21) of this manual.

MODEL NUMBER	AC GRID	PV MODULE	MODULE CONNECTOR
YC1000-3-480	277V/480V	60,72 Cell	MC-4 Type
YC1000-3-208	208V	60,72 Cell	MC-4 Type

Maximum number of inverters per branch/480V = 11 for 15A X 3 Breaker
Maximum number of inverters per branch/208V = 4 for 15A X 3 Breaker

The following diagram shows the APsystems YC1000-3 microinverter schematic:

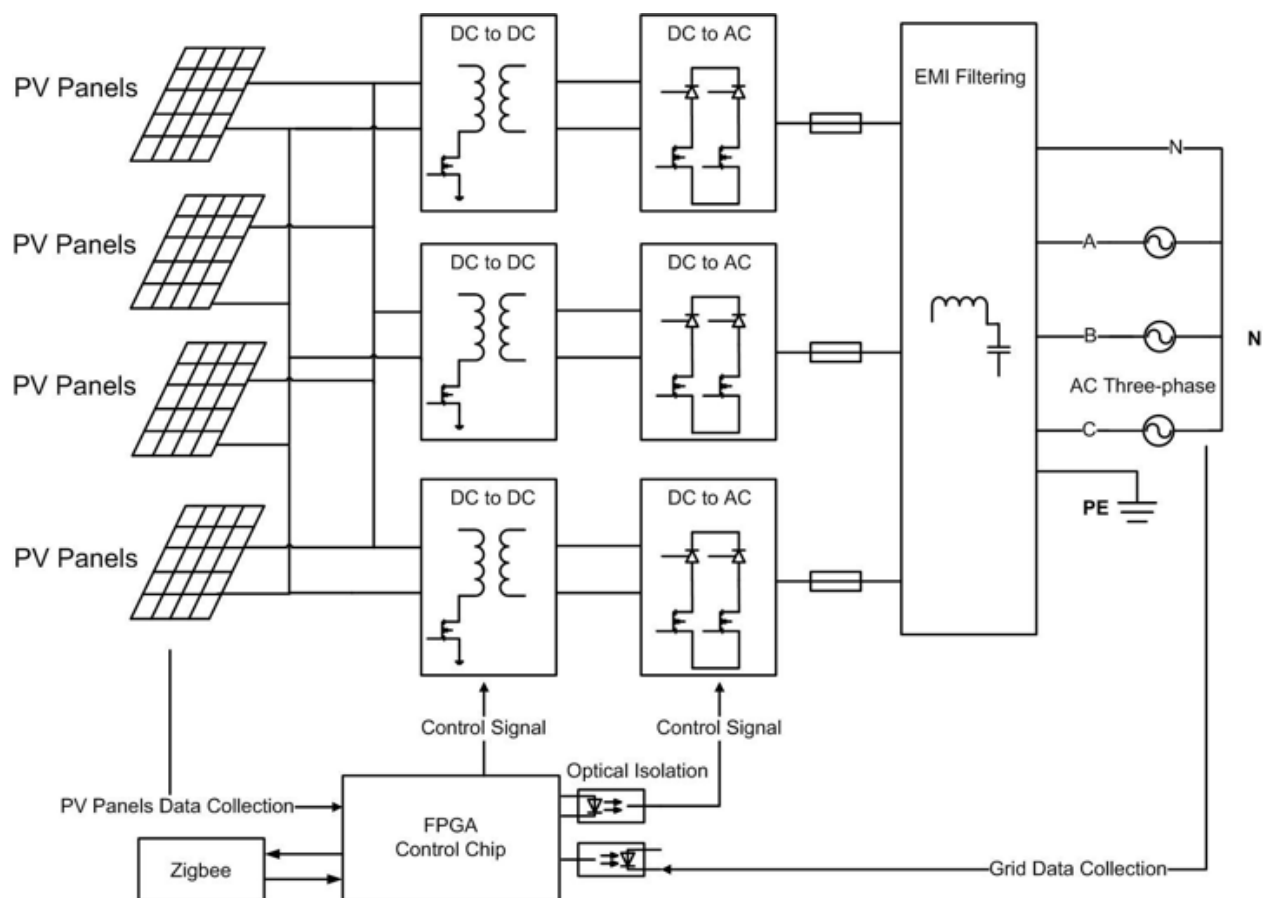


Figure 2

APsystems Microinverter System Installation

A PV system using Apsystems Microinverters is simple to install. Each Microinverter easily mounts on the PV racking, directly beneath the PV module(s). Low voltage DC wires connect from the PV module directly to the Microinverter, eliminating the risk of high DC voltage. Installation *MUST* comply with local regulations and technical rules.

WARNING: Perform all electrical installations in accordance with local electrical codes.

NOTE: An AC GFCI device **should not** be used to protect the dedicated circuit to the Apsystems microinverter even though it is an outside circuit. None of the small GFCI devices (5mA-30 mA) are designed for back feeding and will be damaged if back fed. In a similar manner, AC AFCIs have not been evaluated for back feeding and may be damaged if back fed with the output of a PV inverter.

WARNING: Be aware that only qualified professionals should install and/or replace Apsystems microinverters.

WARNING: Before installing or using an Apsystems microinverter, please read all instructions and warnings in the technical documents and on the Apsystems microinverter system itself as well as on the PV array.

WARNING: Be aware that installation of this equipment includes the risk of electric shock.

WARNING: Do not touch any live parts in the system, including the PV array, when the system has been connected to the electrical grid.

NOTE: We strongly recommend that you install surge protection devices in the dedicated meter box.



Additional Installation components from APsystems

- * Protective end cap (sold separately)
- * Sealing Cap (sold separately)

Required Parts and Tools

- * AC connection junction box(s)
- * Mounting hardware suitable for module racking
- * Sockets and wrenches for mounting hardware
- * Phillips screwdriver
- * Torque wrench

NOTE: The AC output is bonded to ground. The neutral is not. Over-current protection for the AC output circuit needs to be provided in the end installation. A disconnect switch needs to be provided for the AC output circuit (may be required by local code or jurisdiction).



Installation Procedures

APsystems microinverters are designed to only operate when they can sense power coming from the grid. Even if they are plugged into the PV array, they will not turn themselves on until they can read power from the grid.

WARNING: Do NOT connect APsystems microinverters to the utility grid or energize the AC circuit until you have completed all of the installation procedures as described in the following sections.



NOTE: It is best to plug in the ECU and verify Internet connectivity early in the installation process if you are going to be installing an ECU to monitor the system. This allows the ECU software to update itself with the latest firmware.



Step 1 - Install the AC Branch Circuit Junction Box

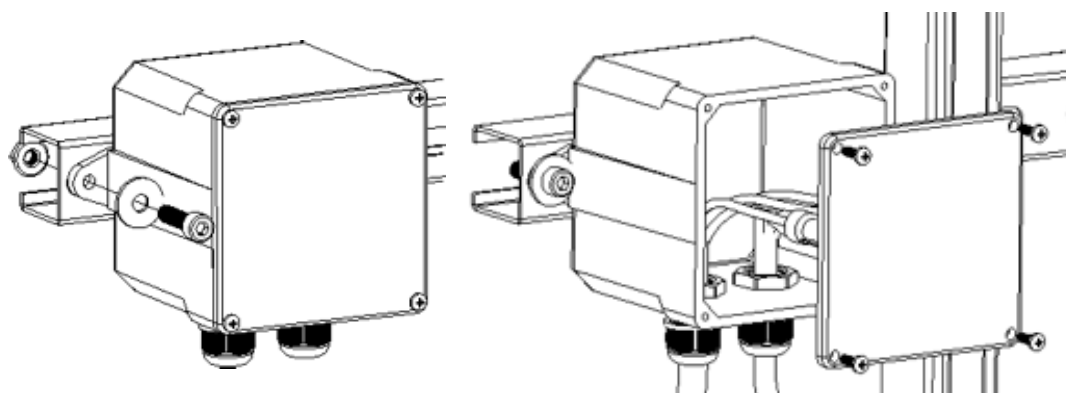


Figure 3

- A. Install an appropriate junction box at a suitable location on the PV racking system (typically at the end of a branch of modules).
- B. Connect the open wire end of the AC bus cable into the junction box using an appropriate gland or strain relief fitting.
- C. Wire the conductors: L1- RED; L2 - BLACK; L3 - ORANGE; N - WHITE; PE – GREEN.
- D. Connect the AC branch circuit junction box to the point of utility interconnection.

Step 2 – Attach the APsystems Microinverters to the Racking

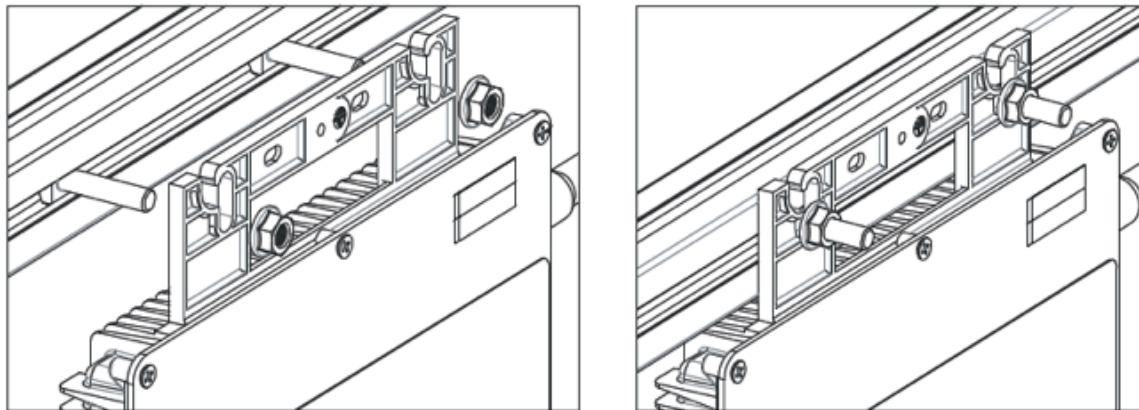


Figure 5

- A. Mark the location of the microinverter on the rack, with respect to the PV module junction box or any other obstructions.
- B. Mount one microinverter at each of these locations using hardware recommended by your module racking vendor.

WARNING: Prior to installing any of the microinverters, verify that the utility voltage at the point of common connection matches the voltage rating on microinverter label.

WARNING: Do not mount the microinverter in a location that allows exposure to direct sunlight. Allow a minimum of $\frac{3}{4}$ " (1.5 cm) between the top of the roof and the bottom of the microinverter for proper ventilation.



Step 3 - Attach the ZigBee Antenna to the Microinverter

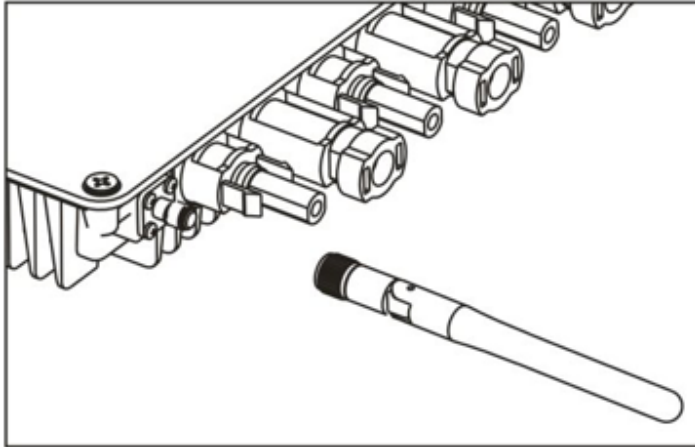


Figure 6

Step 4 - Connect the APsystems Microinverter AC

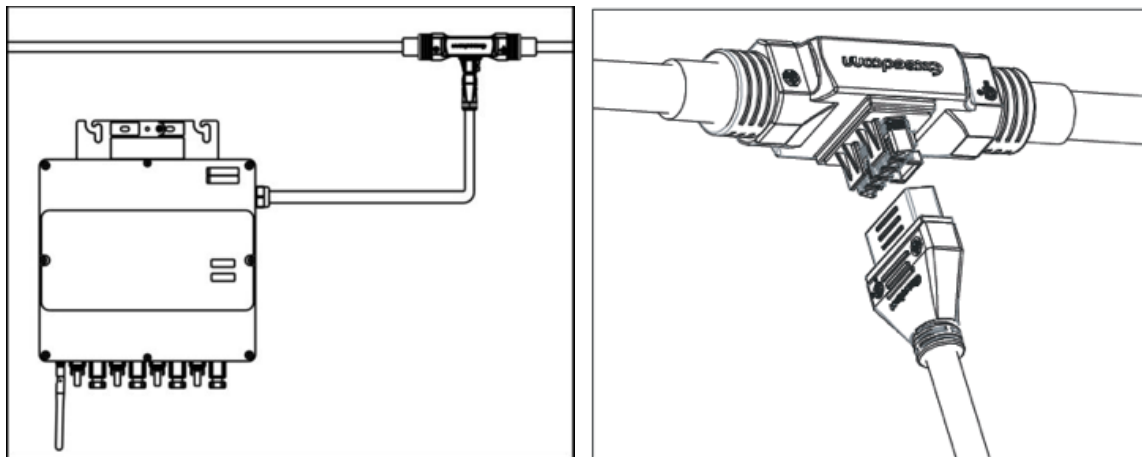


Figure 7

NOTE: Cover all unused “T” connectors on the AC BUS Cable with Sealing Cap to protect the “T” connectors.



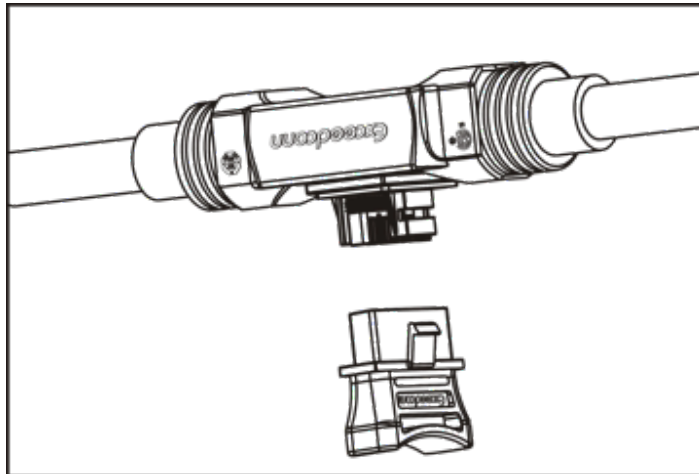


Figure 8

Step 5 - Install a Protective End Cap at the end of the AC Bus Cable

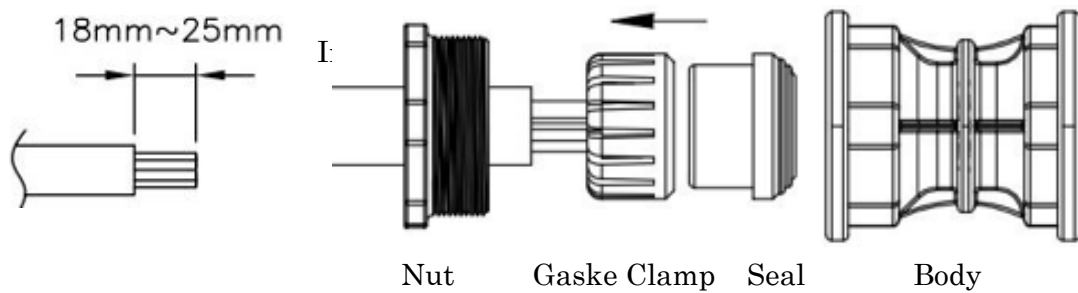


Figure 9

- C.** Insert five wires into the five cable clamps
- D.** Rotate the nut until the latching mechanism meets the base



Figure 10 & 11

Step 6 - Connect the APsystems Microinverters to the PV Modules

Place the PV modules into position on the racking and connect the DC input cables to the microinverters based on optimum layout configuration (up to four PV modules per microinverter).

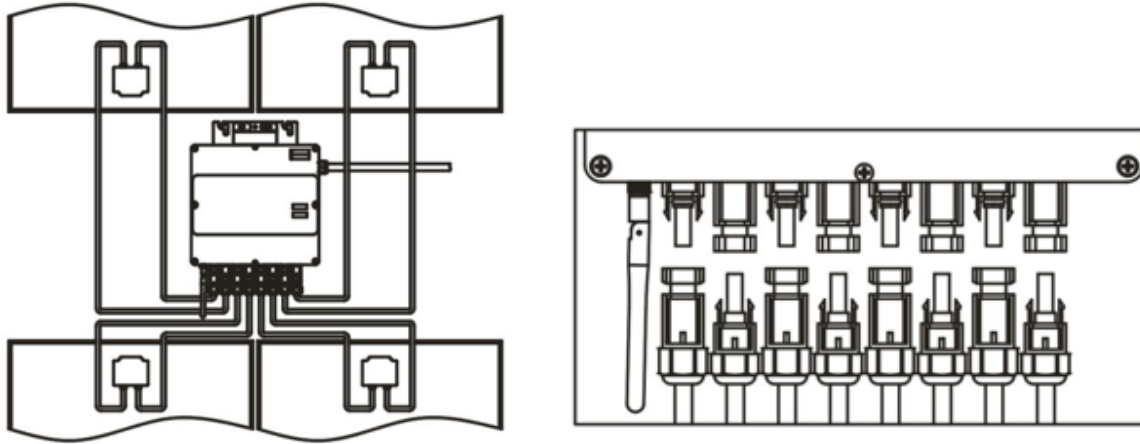


Figure 12 & 13

WARNING: Double check to make sure all of the AC and DC wiring has been correctly installed. Ensure that none of the AC and/or DC wires are pinched or damaged. Make sure that all of the junction boxes are properly closed.



Step 7 - Complete the APsystems Installation Map

Fill in the APsystems Warranty Cards, which provide system information and the installation map. Feel free to provide your own layout if a larger or more intricate installation map is required. The layout map provided is designed to accommodate labels in vertical or horizontal orientation to meet all the field PV connections.

1. Each APsystems microinverter has removable serial number labels. Peel a label off, and affix it to the respective location on the APsystems installation map.
2. Fill out the warranty cards and email to APsystems at support@APsystems.com.

3. Register the system using your Installer Account on the APsystems EMA. You can then use the EMA website to view detailed performance of the PV system.

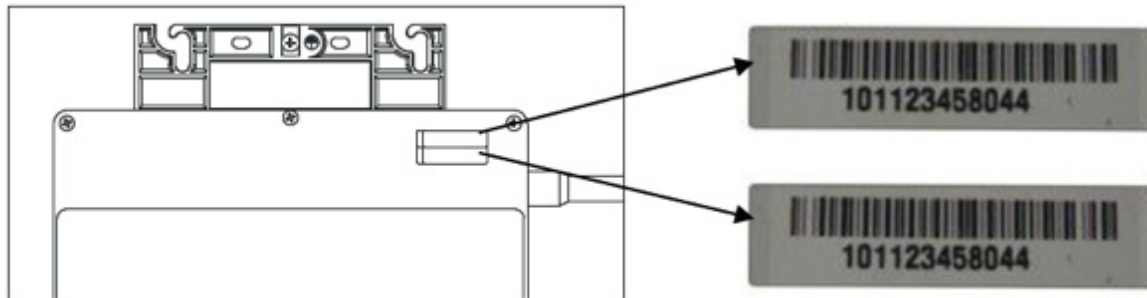


Figure 14

APsystems Microinverter System Operating Instructions

To operate the Apsystems microinverter PV system:

1. Turn ON the AC circuit breaker on each microinverter branch circuit.
2. Turn ON the main utility-grid AC circuit breaker. Your system will start producing power after a five-minute safety delay period.

NOTE: The status LED for on each microinverter will blink green three (3) times to indicate normal operation once DC power is applied. It is important to understand that this “start up” sequence occurs once the first module is connected to the microinvert and is successfully generating DC power. The “start up” sequence does NOT reoccur as additional modules are connected to the same microinverter.



3. The Apsystems microinverters will start to send performance data to the ECU. The time required for all the microinverters in the system to report to the ECU will vary depending on the number and configuration of microinverters in the system. You can verify proper operation of the Apsystems Microinverters via the ECU. See the ECU Installation and Operation Manual for more information.

Troubleshooting

Qualified personnel can use the following troubleshooting steps if the PV system does not operate correctly:

Status Indications and Error Reporting

START UP LED

Three (3) short green blinks, when DC power is first applied to the microinverter, indicates a successful microinverter start up. It is important to understand that this “start up” sequence occurs once the first module is connected to the microinvert and is successfully generating DC power. The “start up” sequence does NOT reoccur as additional modules are connected to the same microinverter.

OPERATING LED

Flashing Slow Green (10 sec. gap) – Producing power and communicating with ECU

Flashing Fast Green (2 sec. gap) – Producing power and not communicating with ECU

Flashing Red – Not producing power

Other Faults

All other faults are reported to the ECU. Refer to the *ECU Installation and Operation Manual* for a list of additional faults and troubleshooting procedures.

WARNING: Only qualified personnel should troubleshoot the APsystems microinverter.

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

WARNING: Always disconnect AC power before disconnecting the PV module wires from the APsystems microinverter. The AC connector of the first microinverter in a branch circuit is suitable as a disconnecting means once the AC branch circuit breaker in the load center has been opened.



WARNING: The APsystems microinverter is powered by PV module DC power. Make sure you disconnect and reconnect the DC connections to watch for the three short LED flashes indicating start up.



Troubleshooting a non-operating APsystems microinverter

To troubleshoot a non-operating APsystems microinverter, follow the steps below in order:

1. Verify the utility voltage and frequency are within ranges shown in the Technical Data of this manual.
2. Check the connection to the utility grid. 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 and watch for three short LED flashes.
3. Check the AC branch circuit interconnection between all the microinverters. Verify that the inverters are energized by the utility grid as described in the previous step.
4. Make sure that any AC breaker are functioning properly and are closed.
5. Check the DC connections between the microinverter and the PV module.
6. Verify the PV module DC voltage is within the allowable range shown in the Technical Data of this manual.
7. If the problem persists, please call APsystems Technical Support at (206) 855-5100 (Option #2).

WARNING: Do not attempt to repair the APsystems microinverter. If troubleshooting methods fail, return the microinverter to your distributor for replacement.



Qualified personnel can use the following troubleshooting steps if the PV system does not operate correctly:

Replace an APsystems Microinverter

Follow the following procedure to replace a failed APsystems microinverter:

1. Remove the APsystems microinverter from the PV Module, in the following order:
 - a. Disconnect the AC by opening the branch circuit breaker.
 - b. Cover the module with an opaque cover.
 - c. Disconnect the first AC connector in the branch circuit.
 - d. Disconnect the PV module DC wire connectors from the microinverter.
 - e. Remove the microinverter from the PV array racking.
2. Install a replacement microinverter to the rack.
3. Connect the AC cable of the replacement microinverter and the neighboring microinverters to complete the branch circuit connections.
4. Close the branch circuit breaker, and verify operation of the replacement microinverter.

TECHNICAL DATA

WARNING: Be sure to verify the voltage and current specifications of your PV module match with those of the microinverter.

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

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



APsystems YC1000-3 Microinverter Datasheet

INPUT DATA (DC)

Recommended PV Module Power Range (STC)	Up to 310W (4 Module Configuration) Up to 360W (3 Module Configuration)
MPPT Voltage Range	16-55V
Maximum Input Voltage	60V
Maximum Input Current	14.8A x 4
Startup Voltage	22V

OUTPUT DATA (AC)

	277/480V	208V
Maximum Output Power	900W	900W
3-Phase Grid Type	277V/480V	208V
Nominal Output Current	1.08Ax3	2.50Ax3
Nominal Output Voltage	277Vx3	120Vx3
Nominal Output Frequency	60Hz /59.3-60.5Hz*	60Hz /59.3-60.5Hz*
Power Factor	>0.99	>0.99
Total Harmonic Distortion	<3%	<3%
Maximum Units per Branch	11 for 15Ax3 Breaker	4 for 15Ax3 Breaker

EFFICIENCY

Peak efficiency	95%
CEC Weighted Efficiency	94.5%
Nominal MPPT efficiency	99.9%

MECHANICAL DATA

Operating Ambient temperature range	-40°F to +149°F (-40°C to +65°C)
Storage Temperature Range	-40°F to +185°F (-40°C to +85°C)
Dimensions (W x H x D) inches	10.2" X 9.5" X 1.4"
Dimensions (W x H x D) mm	259mm X 242mm X 36mm
Weight	8.4lbs (3.8kg)
Enclosure rating	277/480V: NEMA 4X 208V: NEMA 6
Cooling	Natural Convection - No Fans

FEATURES

Communication	ZigBee (wireless)
Integrated Ground Fault Protection (GFP)	The DC circuit meets the requirements for ungrounded PV arrays in NEC690.35. No additional ground is required. Ground fault protection (GFP) is integrated into microinverter.
Emissions & Immunity (EMC) Compliance	FCC Part15; ANSI C63.4; ICES-003
Safety Class Compliance	UL1741xCSA C22.2 No.107.1-01
Grid Connection Compliance	IEEE1547
Warranty	10 years standard, extendable to 25 years

* Programmable per customer and utility requirements. All settings UL approved
Specifications subject to change without notice – please ensure you are using the most recent update found at www.APsystems.com

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APsystems YC1000-3 Microinverter Datasheet (Cont.)

Note 1: Utility Interconnection Voltage and Frequency Trip Limits and Trip Times

Voltage and frequency limits for utility Interaction			
Condition	Simulated utility source		Maximum time (sec) (cycles) at 60 Hza before cessation of current to the simulated utility
	Voltage (V)	Frequency (Hz)	
A	$< 0.50 V_{nor}$	Rated	80ms \pm 80ms
B	$0.50 V_{nor} \leq V < 0.88 V_{nor}$	Rated	200ms \pm 200ms
C	$1.10 V_{nor} < V < 1.20 V_{nor}$	Rated	200ms \pm 200ms
D	$1.20 V_{nor} \leq V$	Rated	80ms \pm 80ms
E	Rated	$f > 60.5$	160ms \pm 160ms
F	Rated	$f < 59.3$	160ms \pm 160ms

Wiring Diagram

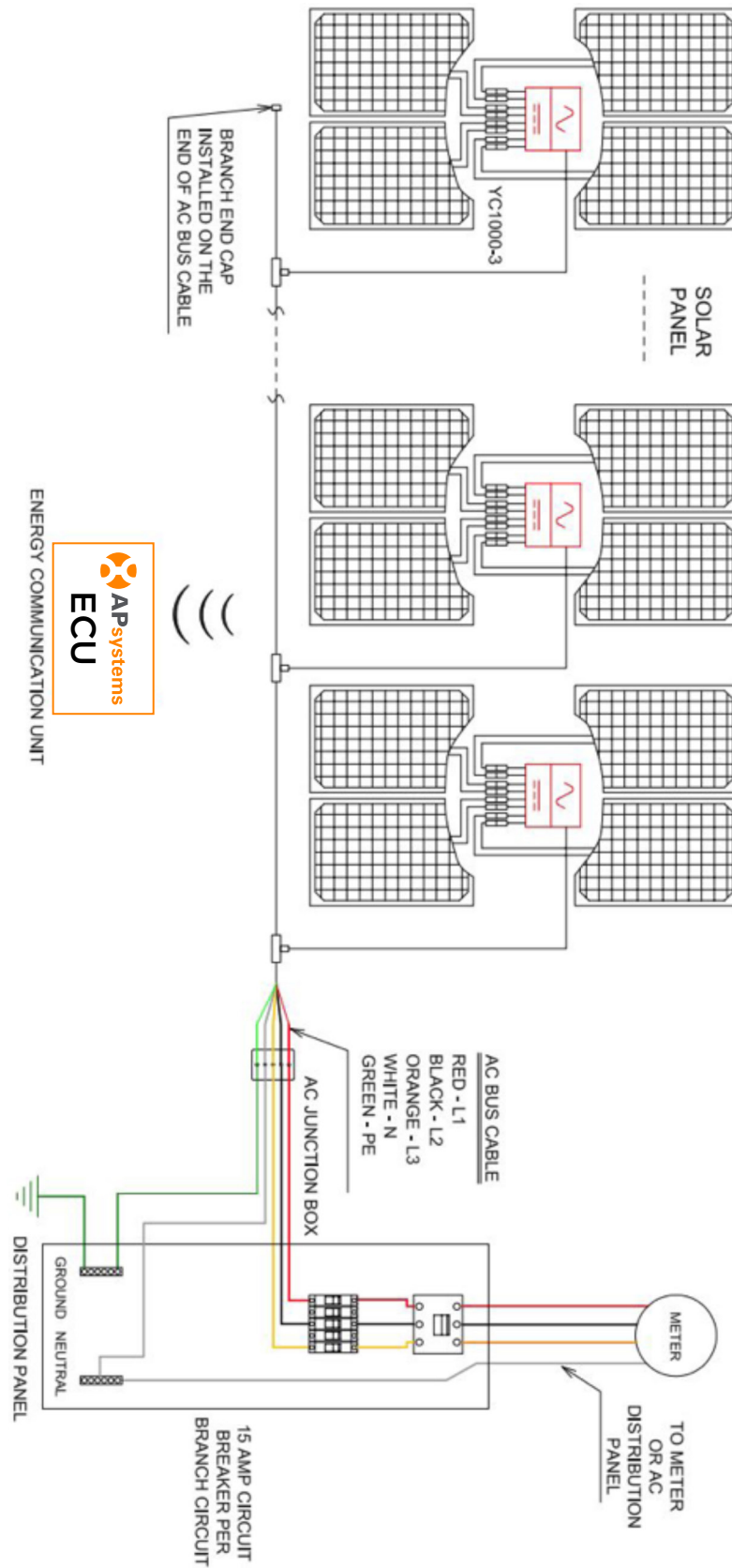


Figure 15