

# Installation/User Manual

## APsystems YC500i Photovoltaic Grid-connected Inverter

Version 1 7/16



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## IMPORTANT SAFETY INSTRUCTIONS

This manual contains important instructions to follow during installation and maintenance of the APsystems 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.

**SAVE THESE INSTRUCTIONS!** *This manual contains important instructions for the YC500i that must be followed during Installation and maintenance of the Photovoltaic Grid-connected Inverter.*

Specifications subject to change without notice - please ensure you are using the most recent update found at [www.APsystems.com](http://www.APsystems.com).

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**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.

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

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## 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 (844-666-7034) to obtain an RMA number and start the replacement process. Damaging or opening the APsystems microinverter will void the warranty.

# 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 technician for help.

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

# APSYSTEMS YC500I SYSTEM INTRODUCTION

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

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

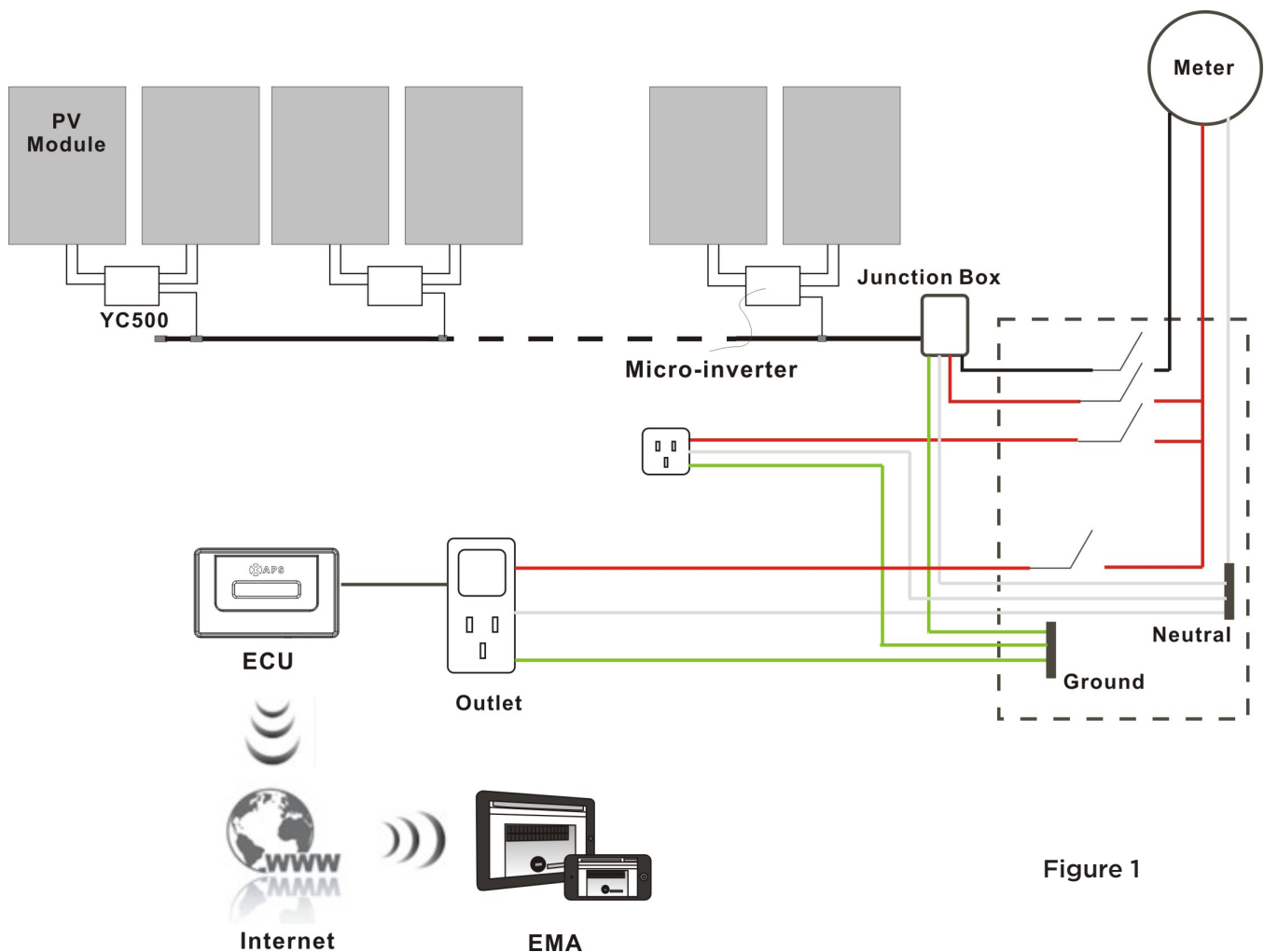


Figure 1

This integrated system improves safety; maximizes solar energy harvest; increases system reliability, and simplifies solar system design, installation, maintenance, and management.

## APsystems microinverters maximize PV energy production

Each PV module has individual Maximum Power Point Tracking (MPPT) controls, which ensures that the maximum power is exported to the utility grid regardless of the performance of the other PV modules in the array. When PV modules in the array are affected by shade, dust, orientation, or any situation in which one module underperforms compared with the other units, the Apsystems microinverter ensures top performance from the array by maximizing the performance of each module within the array.

## More reliable than centralized or string inverters

The distributed Apsystems microinverter system ensures that no single point of system failure exists across the PV-array. Apsystems microinverters are designed to operate at full power at ambient outdoor temperatures of up to 149°F (65°C). The inverter housing is designed for outdoor installation and complies with the NEMA 6 environmental enclosure rating.

## Simple to install

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

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**NOTE:** The YC500i is “chassis grounded”, and the ground wire (PE) is embedded in the AC Bus Cable, eliminating the need to install an additional external copper grounding wire.

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## Smart system performance monitoring and analysis

The Apsystems Energy Communication Unit (ECU) is installed by simply plugging it into any wall outlet and providing an Ethernet or Wi-Fi connection to a broadband router or modem. 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. (See ECU manual for instructions).

The APsystems YC500 microinverters connect with the Split-phase grid, and operate with most 60 and 72 cell PV modules. For more information, please see the Technical Data page (page 16) of this manual.

MODEL NUMBER	AC GRID	PV MODULE	MAX.# PER BRANCH	MODULE CONNECTOR
YC500i	60Hz/240V	60,72 Cell	7 for 20A breaker	MC-4 Type or Customize
YC500i	60Hz/208V	60,72 Cell	6 for 20A breaker	MC-4 Type or Customize

# 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.

## Special Statement!

*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. Also, AC AFCIs have not been evaluated for back feeding and may be damaged if back fed with the output of a PV inverter.*

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

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**WARNING:** Only qualified professionals who have been trained by APsystems should install and/or replace APsystems microinverters.

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**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.

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

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

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**NOTE:** Strongly recommend you install surge protection devices in the dedicated power distribution box.

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## Required parts and tools

In addition to your PV array and its associated hardware, you will need the following items:

- \* AC connection junction box
- \* Mounting hardware suitable for module racking
- \* Sockets and wrenches for mounting hardware
- \* AC Connector Unlock Tool
- \* Phillips screwdriver
- \* Torque wrench

## YC500i INSTALLATION PROCEDURES

### Step 1 - Position the AC bus cable

### Step 2 - Install the AC branch circuit junction box

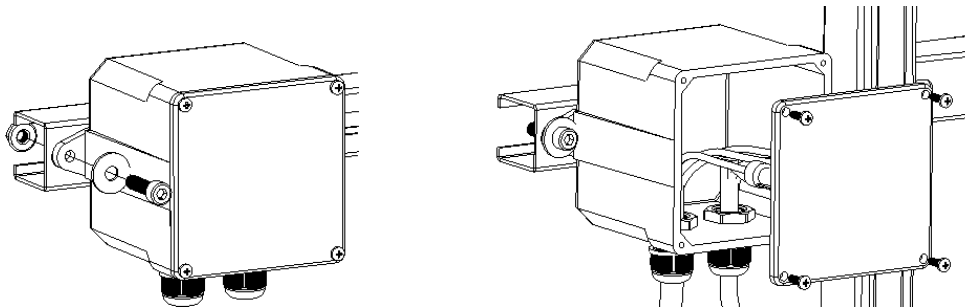


Figure 2

- 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-BLACK; L2-RED; N-WHITE; PE-GREEN
- d) Connect the AC branch circuit junction box to the point of utility interconnection.

### Step 3 – Attach the APsystems microinverters to the racking or the PV module frame

#### Attach to the racking

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

#### Option 1:

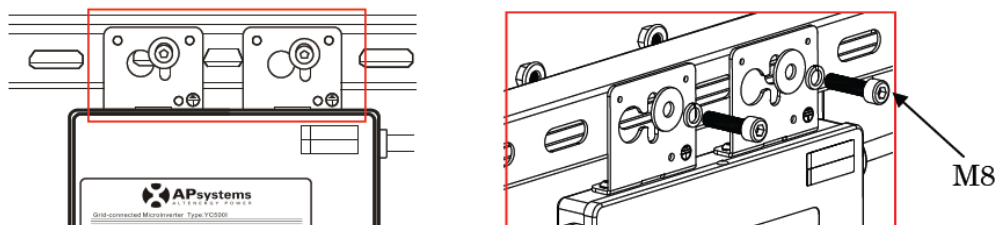


Figure 3

#### Option 2:

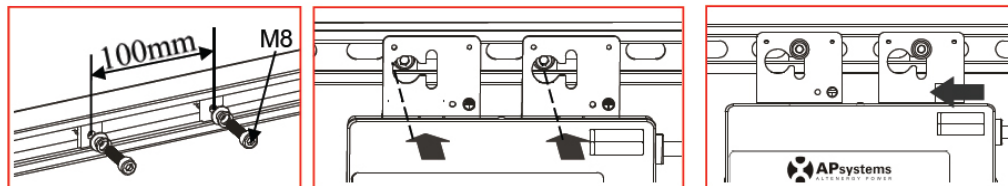


Figure 4

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**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.

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**WARNING:** Do not mount the microinverter in a location that allows exposure to direct sunlight. Allow a minimum of 3/4" (1.5cm.) between the roof and the bottom of the microinverter to allow proper air flow.

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#### Step 4 – Connect the APsystems microinverter to AC bus cable

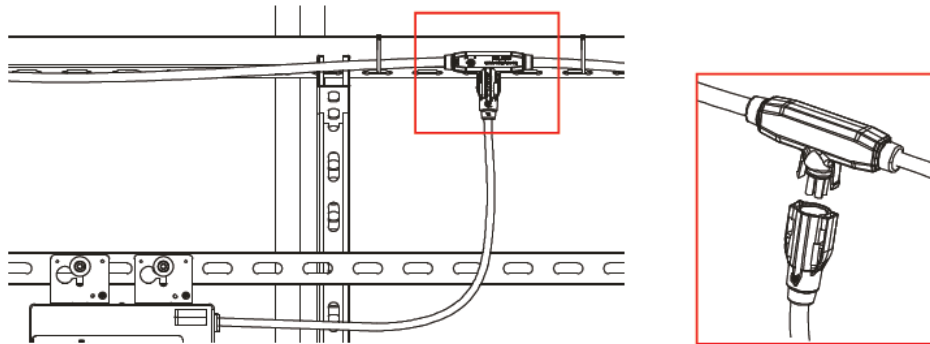


Figure 5

**Best Practice:** Use the AC Connector Unlock Tool to split the connectors.

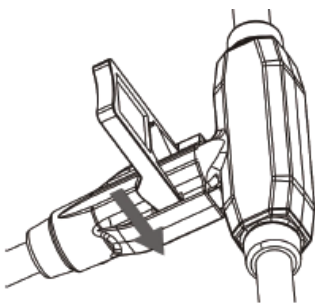


Figure 6

- Check the microinverter Technical Data page (page 16) for the maximum allowable number of microinverters on each AC branch circuit.
- Plug the AC connector of the microinverter into the AC bus cable.
- Install an AC bus protective end cap on the open end of the AC bus cable.

#### Connector Interface

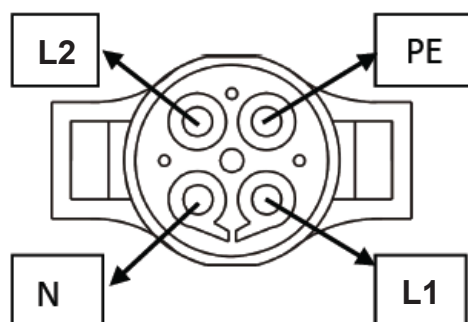


Figure 7

Cover any unused connectors with sealing caps to protect the connectors.

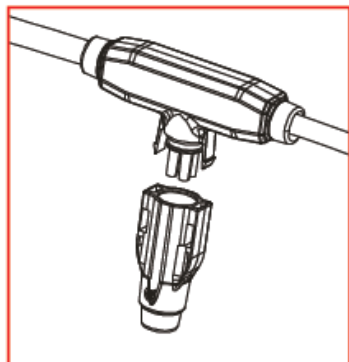


Figure 8

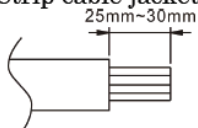
**WARNING:** Do NOT exceed maximum number of microinverters in an AC branch circuit, as displayed on the Technical Data page (page 16) of this manual.



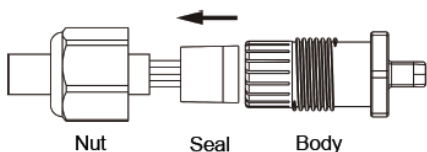
### Step 5 - Install an AC bus protective end cap at the end of AC bus cable

Figure 9

- a. Strip cable jacket.



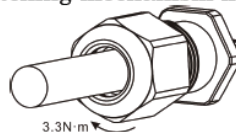
- b. Insert the cable end into the seal.



- c. Insert the wires into the cable clamps.



- d. Rotate the nut with 3.3N·m until the latching mechanism meets the base.



### Step 6 - Connect APsystems Microinverters to the PV Modules

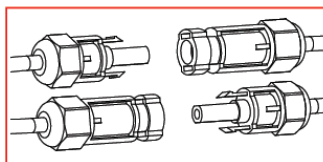
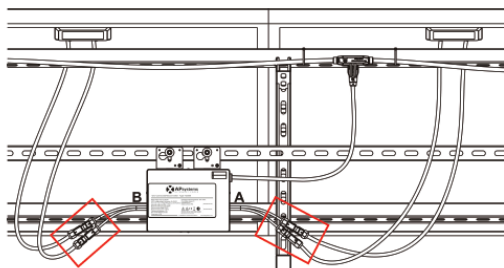


Figure 10

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**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.

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**NOTE:** When plugging in the DC cables, the microinverter should immediately blink green three (3) times. This will happen as soon as the cables are plugged in and will indicate that the microinverter is functioning correctly. This entire check function will start and end within 5 seconds of plugging in the unit, so pay careful attention to these lights when first connecting the DC cables.

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## Step 7 - Complete the APsystems Installation Map

- a) Fill in the APsystems Registration 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. Each APsystems Microinverter has removable serial number labels. Peel labels off, affix one to the respective location on the APsystems installation map, and fill in A,B in the label below (figure 11) according to the layout on the roof. Then affix another label to the PV module frame which is easy to see. The warranty cards can be obtain from the appendix of this manual or APsystems website [www.APsystems.com](http://www.APsystems.com)

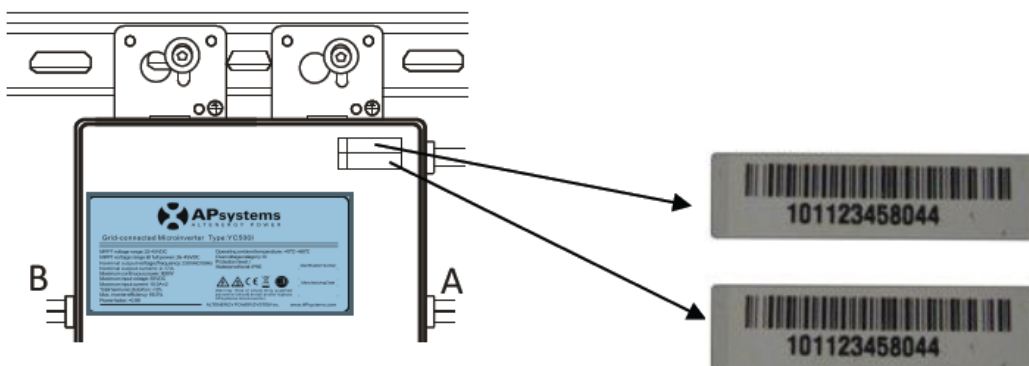


Figure 11

## To operate the APsystems microinverter PV system:

1. Turn ON the AC circuit breaker on each microinverter AC branch circuit.
2. Turn ON the main utility-grid AC circuit breaker. Your system will start producing power after a standard five-minute safety related delay. The units should start blinking green every two (2) seconds, five (5) minutes after turning on the AC circuit breaker. This means they are producing power normally, but have not yet connected to the ECU. After the ECU has been plugged in and acknowledges the microinverters, they will start to blink green every 10 seconds.
3. Plug in the ECU and follow the instructions according to the instructions in the ECU Installation and Operation Manual.
4. The APsystems microinverters will start to send performance data over power line to the ECU. The time required for all the microinverters in the system to report to the ECU will vary with the number 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.

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**NOTE:** Once AC power is applied, about 0.1A current and 25VA(W) power for each microinverter may be measured with a meter. This Current and Power are Reactive. The inverters ARE NOT operating. The inverters will energize following the 300 second safety period.

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# TROUBLESHOOTING

## Status Indications and Error Reporting

### Start up LED

One (1) quick red light followed by three (3) short green blinks when DC power is first applied to the microinverter indicates a successful microinverter startup.

### Operation 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 over 60 minute period

**Flashing Red** - Not producing power

**Steady Red** - Electrode assembly ground fault protection

### GFDI Error

A solid red LED indicates the microinverter has detected a Ground Fault Detector Interrupter (GFDI) error in the PV system. Unless the GFDI error has been cleared, the LED will remain red and the ECU will keep reporting the fault. After the ground fault error is fixed, follow the instructions in the ECU Installation and Operation Manual to clear this GFDI error reporting.

### 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.

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**WARNING:** Only qualified professionals who have been trained by Apsystems should install and/or replace APsystems microinverters.

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**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.

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**WARNING:** Always disconnect AC power before disconnecting the PV module wires from the APsystems microinverter. Either disconnecting by the appropriate AC circuit breaker or unplugging the first AC connector of the first microinverter in a branch circuit is suitable as a means of disconnection.

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**WARNING:** The APsystems microinverter is powered by the PV module DC power. AFTER disconnecting the DC power, when reconnecting the PV modules to the microinverter, be sure to watch for the three (3) short green LED flashes.

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## TROUBLESHOOTING A NON-OPERATING APsystems MICROINVERTER

There are two possible overall areas of trouble:

- A. The microinverter may be malfunctioning.
- B. The microinverter is working fine but it is having trouble communicating with the ECU. The items below refer to microinverter issues, not communication issues (addressed in the ECU manual).

A quick way to tell whether the issue is the microinverter or a communication problem with the ECU:

1. **Diagnosing from the microinverter:** A red light – either blinking or solid on the microinverter, or no light at all. No light, or a red light, means it is definitely a microinverter related malfunction. A flashing red LED – also check to make sure that AC power is reaching the inverter.
2. **Diagnosing from the ECU:**
  - a. **“No Data” Display:** This is probably a communication issue, not a microinverter malfunction.
  - b. **Problems with an erratic display:** Data is displayed for some period and then no data is displayed. This is most likely a communication issue.
  - c. **0 watts, or 2 watts:** Possibly a microinverter problem.
  - d. **Erratic data display that is not coordinating with data displays from other units:** This is most likely a microinverter problem.

**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 section (page 16) 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 (3) short green LED flashes.
3. Check the AC branch circuit interconnection between all of the microinverters. Verify that each inverter is energized by the utility grid as described in the previous step.
4. Make sure that all AC breakers 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 section (page 16) of this manual.
7. If the problem persists, call APsystems Customer Support.

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

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## Replace a microinverter

**Follow the procedure to replace a failed APsystems microinverter:**

- A. Disconnect the APsystems microinverter from the PV Module, in the order shown below:
  - 1. Disconnect the AC by turning off the branch circuit breaker.
  - 2. Disconnect the PV module DC wire connectors from the microinverter.
  - 3. Remove the microinverter from the PV array racking.
  - 4. Cover the module with an opaque cover.
- B. Install a replacement microinverter to the rack. Remember to observe the flashing LED light as soon as the new microinverter is plugged into the DC cables.
- C. Close the branch circuit breaker, and verify operation of the replacement microinverter.

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**WARNING:** Be sure to verify the voltage and current specifications of your PV module match with those of the Microinverter. Refer to the APsystems YC500i datasheet for Input specifications.

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

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

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# APsystems YC500i EnergyMax™ Microinverter Datasheet

## INPUT DATA (DC)

MPPT Voltage Range	22-45V
Operation Voltage Range	16V-52V
Maximum Input Voltage	55V
Startup Voltage	22V
Maximum Input Current	12A X 2

## OUTPUT DATA (AC)

Nominal Output Voltage	208V*	240V*
Peak Output Power	548W	548W
Maximum Continuous Output Power	500W	500W
Nominal Output Current	2.4A	2.08A
Default Output Voltage Range	183V-229V**	211V-264V**
Maximum Output Fault Current (peak)	33.4A	54.8A
Maximum Output Fault Current (RMS)	2.79A	4.85A
Maximum Output Fault Current Duration	1.875ms	1.639ms
Reactive Current	0.1A	
Extended Output Voltage Range	181V-298V	
Nominal Output Frequency	60Hz	
Default Output Frequency Range	59.3Hz-60.5Hz**	
Extended Output Frequency Range	55.1Hz -64.9Hz	
Total Harmonic Distortion	<3%	
Maximum Units Per Branch	6 for 20A Breaker	7 for 20A Breaker

## EFFICIENCY

Peak Efficiency	95.5%
CEC Weighted Efficiency	95%
Nominal MPPT Efficiency	99.5%
Night Power Consumption	120mW

## 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 (WxHxD) inches	8.75" x 6.5" x 1.1"
Dimensions (WxHxD) mm	221mm x 167mm x 29mm
Weight	5.5 lbs (2.5kg)
AC Bus (trunk cable)	12AWG
Enclosure Rating	NEMA 6
Cooling	Natural Convection - No Fans

## FEATURES & COMPLIANCE

Communication (Inverter to ECU)	Power line Communication
Emissions & Immunity (EMC) Compliance	FCC PART 15, ANSI C63.4, ICES-003
Safety Class Compliance	UL1741 CSA C22.2 No.1071-01
Grid Connection Compliance	IEEE 1547
Monitoring	Via EMA Software

\*The default AC output is 240V mode. Programmable to 208V mode.

\*\*Programmable per customer and utility requirements. All settings UL approved.

Specifications subject to change without notice - please ensure you are using the most recent version found at [APsystems.com](http://APsystems.com)

## YC500i Sample Wiring Diagram - 120V/240V Split Phase

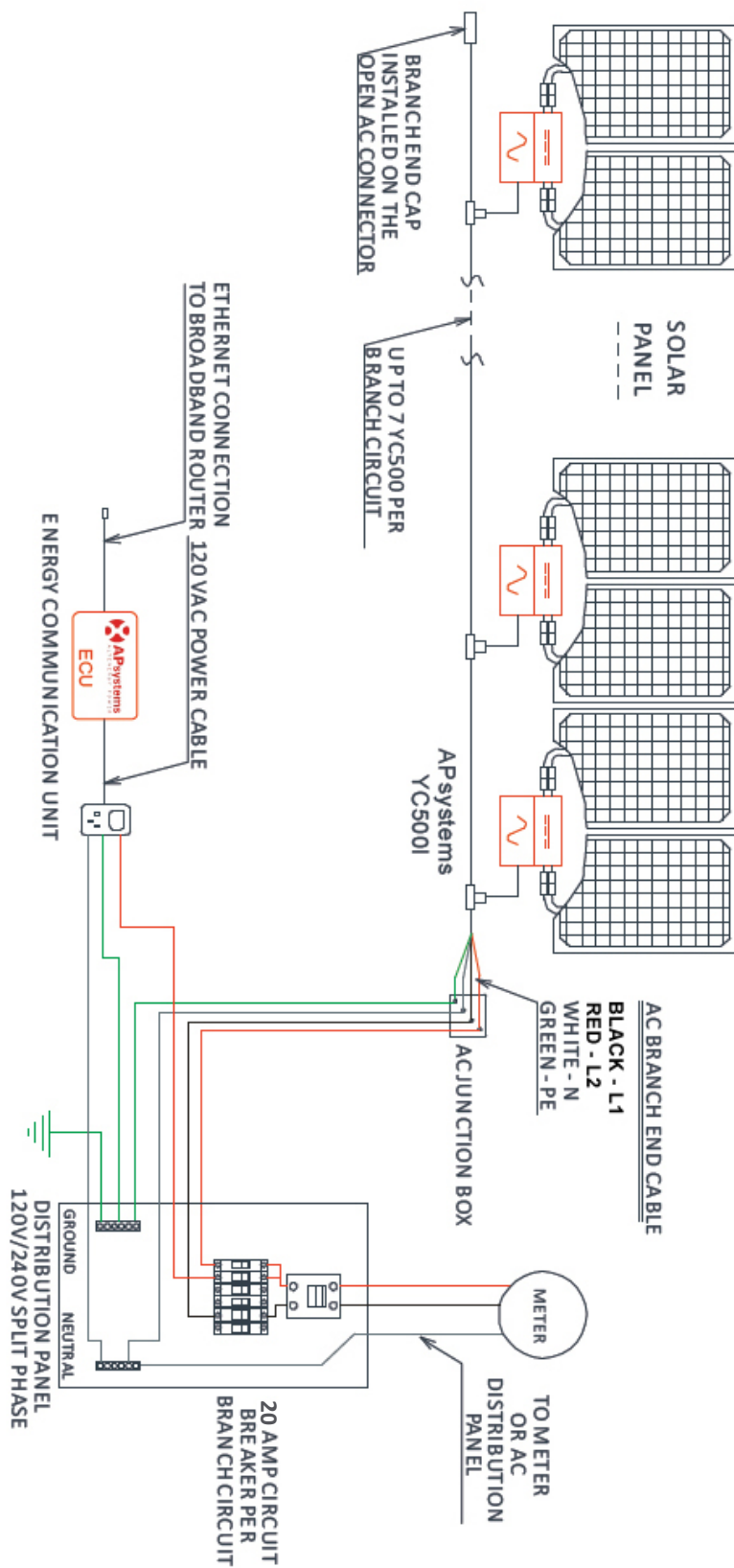


Figure 12