

AP AC Combiner-SP User Manual



Please scan this QR code to have access to our APPs and Products Information.

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1. Important Information

1.1 Read This First

Please read all the instructions and warnings in the manual carefully before installation and operation.

1.2 Safety Instructions

	High Voltage The product may contain high voltage, causing a risk of death.
	Hot Surface The product may become hot during operation. Do not contact with metal surfaces.
	Caution Risk of electrical shock.
	Read the manual first Read this manual carefully before performing any installation, operation, or maintenance.
	Treatment Electrical equipment that has reached the end of life must be collected separately and returned to an approved recycling facility to comply with European Directive 2002/96/EC on Waste Electrical and Electronic Equipment and its implementation as national law. Return any devices you no longer need an authorized dealer or an approved collection and recycling facility.

DANGER	This indicates situational hazards that may lead to high-level electric shocks or severe physical injuries.
WARNING	This signifies the importance of strictly following directions to avoid safety hazards, including damage to equipment and personal injury.

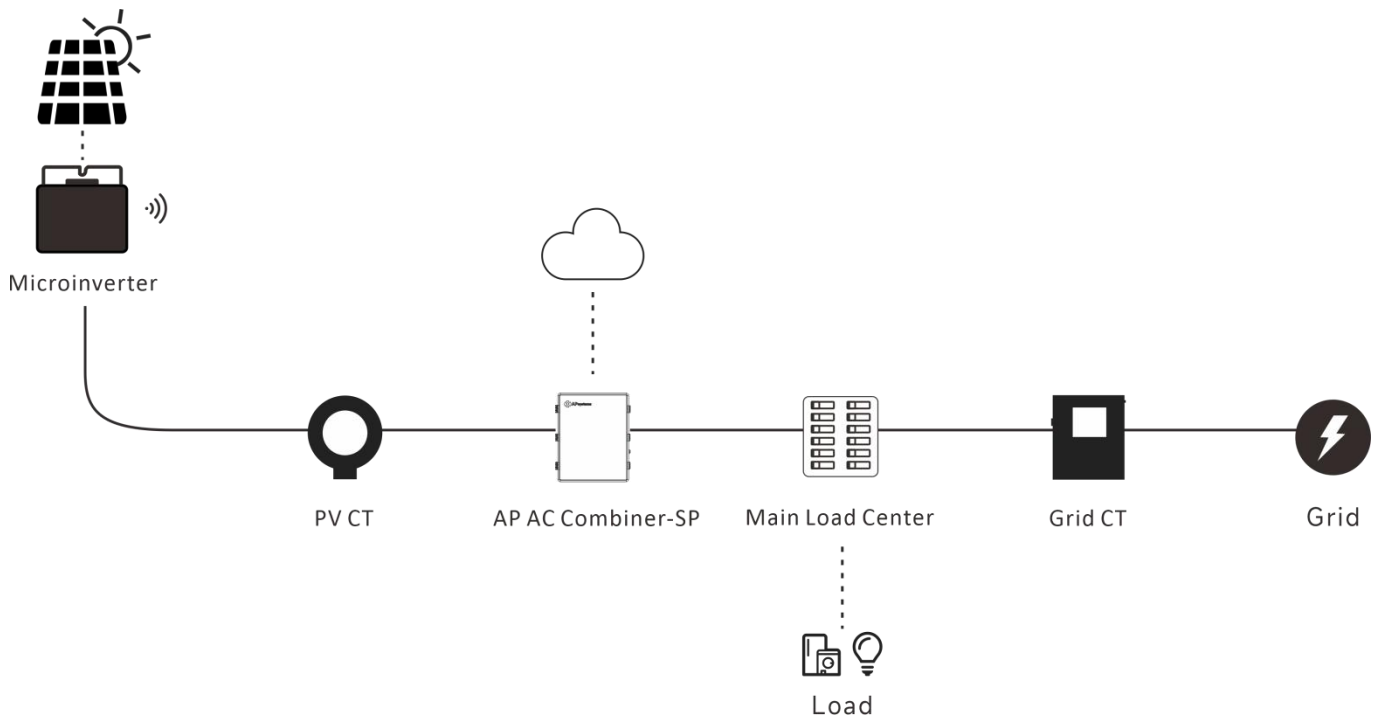
DANGER:

- Please read all the instructions and warnings in this manual carefully.
- Do not attempt to repair or disassemble the Combiner Box without APsystems' permission, otherwise it will invalidate the remaining warranty period. Please send the Combiner Box back to your installer for repair/replacement.
- Do not use APsystems products in a way that is not suggested by the manufacturer. Otherwise it can cause death, personal injuries, or equipment damage.

WARNING:

The installation, replacement, and repair of the Combiner Box must be carried out by qualified persons only. APsystems is not liable for damages resulting from improper installation and use.

2. APsystems Microinverter System



A typical APsystems microinverter system is composed of multiple APsystems series microinverters, a Combiner Box (with a built-in ECU), and the EMA monitoring platform.

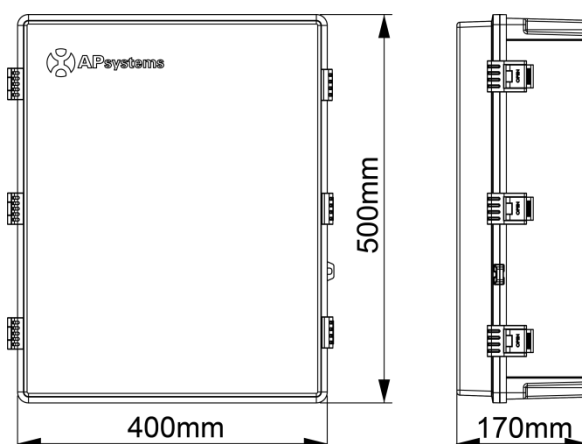
Conversion of direct current (DC) to alternating current (AC) is done by the microinverters.

The Combiner Box combines the AC output of the microinverters, collecting module-level data from them using its built-in ECU. Its two PV Current Transformers (CT) and two Grid CTs track the amount of electricity generated and consumed by the system. The data is sent to the EMA.

The EMA is a comprehensive monitoring and analysis platform. It provides real-time insights into the whole system performance, enabling you to keep track of your PV system's status. It also enables remote monitoring, module-level monitoring, as well as efficient operations and maintenance (O&M).

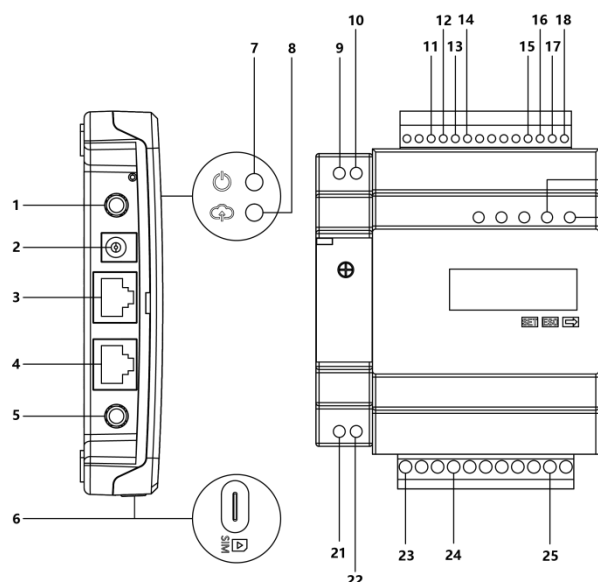
3. Product Introduction

3.1 Appearance and Dimensions



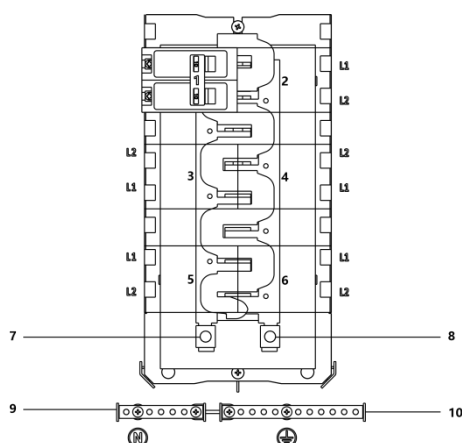
3.2 Interface Layout

Communication Module



No.	Description	No.	Description
1	ZigBee	14	Grid CT2-1 I1*
2	Power Connection Port	15	PV CT1-2 I2
3	RS485	16	PV CT1-2 I2*
4	RJ45-Internet	17	PV CT1-1 I1
5	Cellular	18	PV CT1-1 I1*
6	SIM card slot	19	485A Port
7	LED1	20	485B Port
8	LED2	21	Power Input N
9	Power Output (V+)	22	Power Input L
10	Power Output (V-)	23	Power Input L1
11	Grid CT2-2 I2	24	Power Input L2
12	Grid CT2-2 I2*	25	Power Input N
13	Grid CT2-1 I1		

Load Center



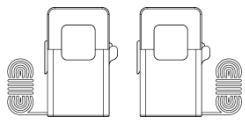
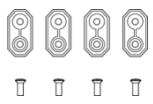
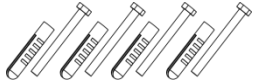
No.	Description
1	Communication Module Breaker
2-6	Installation Positions for distributed generation (DG) Breakers
7	Main Lug Output L1
8	Main Lug Output L2
9	Neutral Bar
10	Ground Bar

4. Installation

4.1 Packing List and installation tools

Packing List

Upon receiving the product, check whether all items listed below are included and are free of damage. Immediately contact your supplier or distributor upon noticing any damaged or missing parts.

					
Combiner Box × 1	Grid CT (split-core) × 2	Mounting Set × 4	User Manual × 1	Double-sided tape × 2	Expansion Screws Ø 10mm Expansion Sleeve × 4

Installation tools

The following tools are recommended for use during installation. Other auxiliary tools may be used on-site as needed.

										
A	B	C	D	E	F	G	H	I	J	K

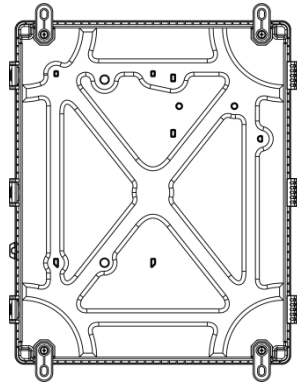
A	B	C	D	E	F
Marker	Electrical Screwdriver	Small Drill Bit	Step Drill Bit	Diagonal Cutter	Wire Stripper
G	H	I	J	K	
Copper Cable	Conduit Hub Fitting (Rain-tight, UL-listed)	Conduit (UL-listed)	Ethernet Cable (if needed)	DG Breaker	

NOTE:

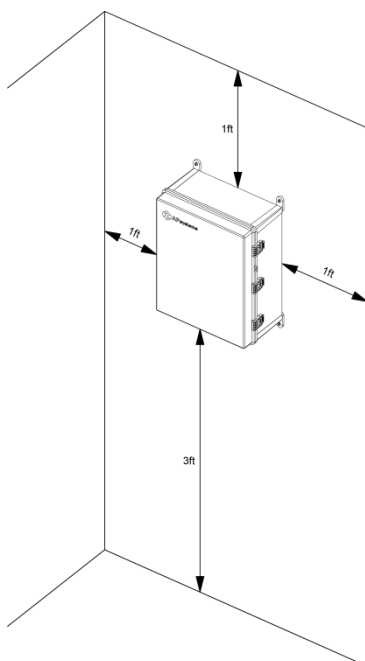
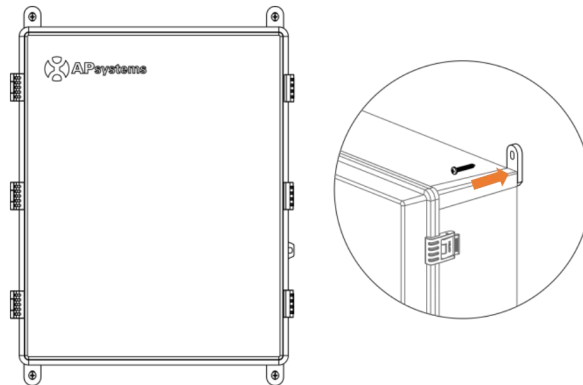
1. Suitable mounting hardware: Utilize expansion screws to securely mount the Combiner Box to the vertical surface.
2. Use copper conductors, ensuring they are sized in accordance with local code requirements and considerations for voltage drop/rise. Refer to the unit's door for wire sizes and torque values.
3. The ECU provides two options for internet connectivity: Cellular data, LAN. When using wired network to access the Internet, you need to prepare the network cable. When using cellular data to access the Internet, make sure to insert the SIM card into the ECU-R, and you need to prepare your own Nano-SIM card.
4. The Combiner Box accommodates up to FIVE Breakers (one for each PV branch circuit). Only Eaton BR-style breakers are compatible. Approved options include Eaton BR210, Eaton BR215, Eaton BR220, and Eaton BR230 circuit breakers. The sum of all Breaker ratings must not exceed 110 A.

4.2 Mounting the Combiner Box

1. Install the mounting brackets into the Combiner Box and secure them using the provided screws.
(Torque: 1.5-2 N•m)



2. Vertically mount the Combiner Box onto the installation surface, securing it with #8 screws (or expansion screws) as illustrated below.



NOTE:

For safe operation and to avoid damage to the Combiner Box, observe the following requirements when selecting the installation site.

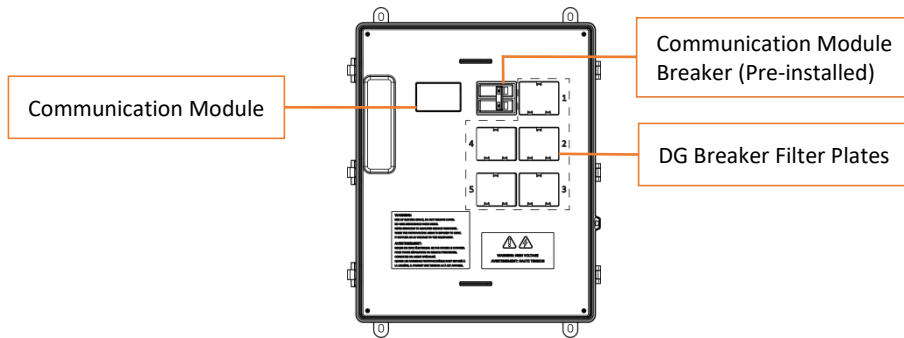
- **Basic Requirements:** The installation site must be convenient for electrical connection, operation, and maintenance. Additionally, it must be shielded from direct rainfall.
- **Mounting Structure Requirements:** The installation surface must be suitable for the weight (12.79 lbs.), dimensions, and cable length of the Combiner Box.
- **Installation Space Requirements:** To ensure air circulation, the installation site must have sufficient air clearances around the Combiner Box. Clearances may vary depending on specific installations, and we suggest a general minimum guideline: maintain 1 foot (30 cm) clearance to the nearest adjacent sidewall on the up, left, and right sides, and maintain 3 feet (90 cm) clearance to the bottom side.

4.3 Installing DG Breaker(s)

WARNING:

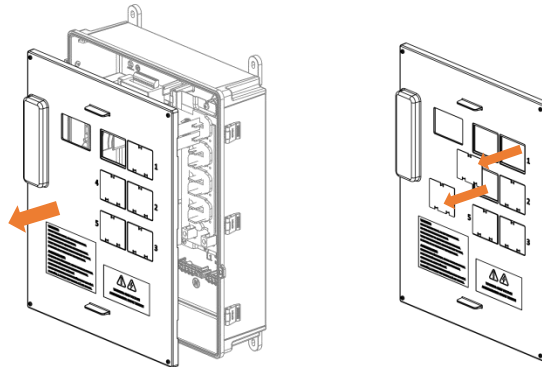
1. Before installing the Breaker, ensure that its handle is positioned toward the OFF position.
2. The Communication Module (meter, ECU, and power supply) has been pre-installed in the Combiner Box; do not take any action regarding them to prevent potential damage.

The Combiner Box comes with a pre-installed Communication Module Breaker (2P, 10 A) for connecting the Communication Module. Given the Combiner Box's capacity to accommodate a total of 110 A (sum of Breaker ratings, excluding the pre-installed Communication Module Breaker), if you intend to install additional Breakers, you can install up to FIVE Breakers. Make sure to follow all NEC and local electrical codes during installation.



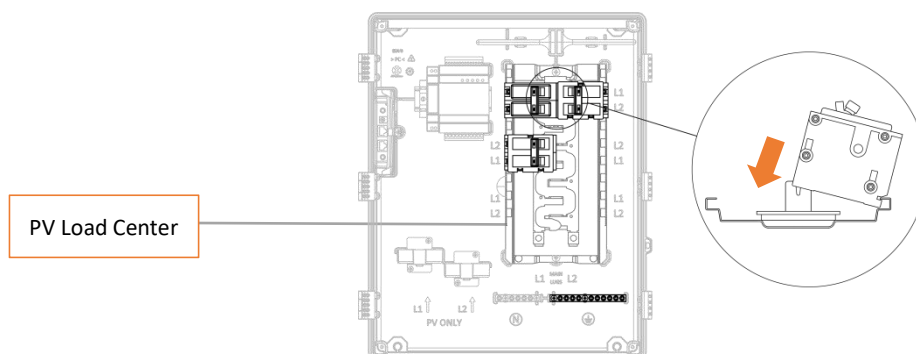
Step 1 Removing the Dead Front

1. Use an electric screwdriver to loosen the four screws supporting the dead front. (Torque: 1.0 N•m)
2. Pull the dead front away from the Combiner Box.
3. Remove the filter plate on the dead front for each Breaker position to be used.



Step 2 Mounting the DG Breaker(s)

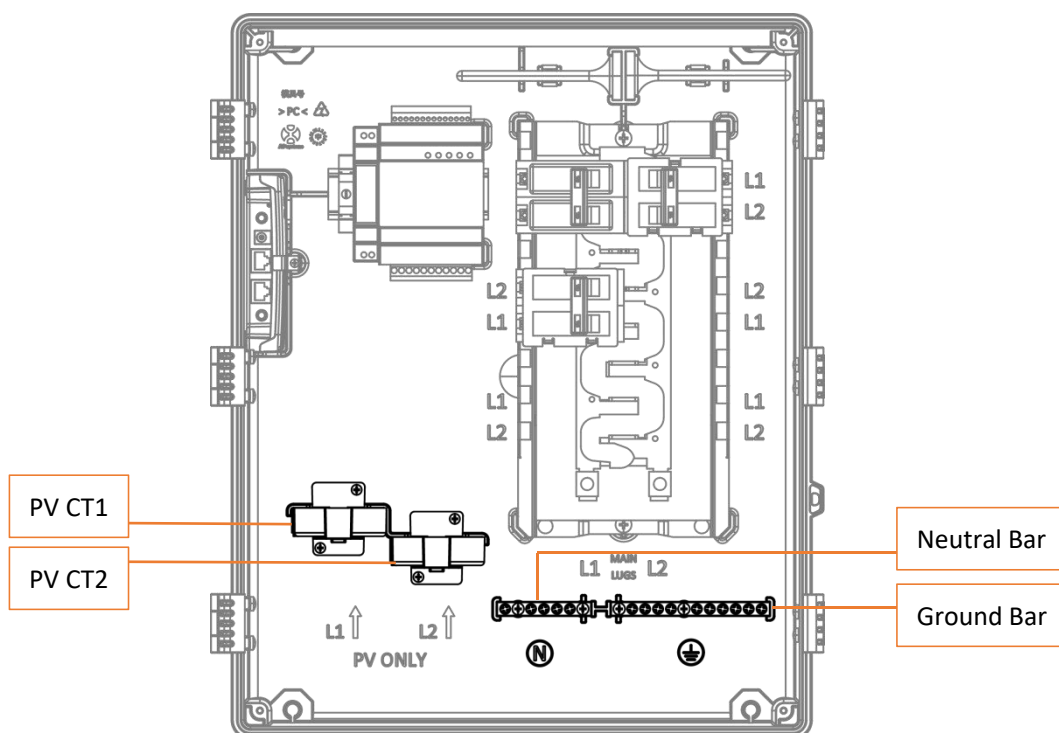
In the position where you removed the filter plate, snap the Breaker onto the PV Load Center.



4.4 Connecting the Circuit Wiring to the Panel

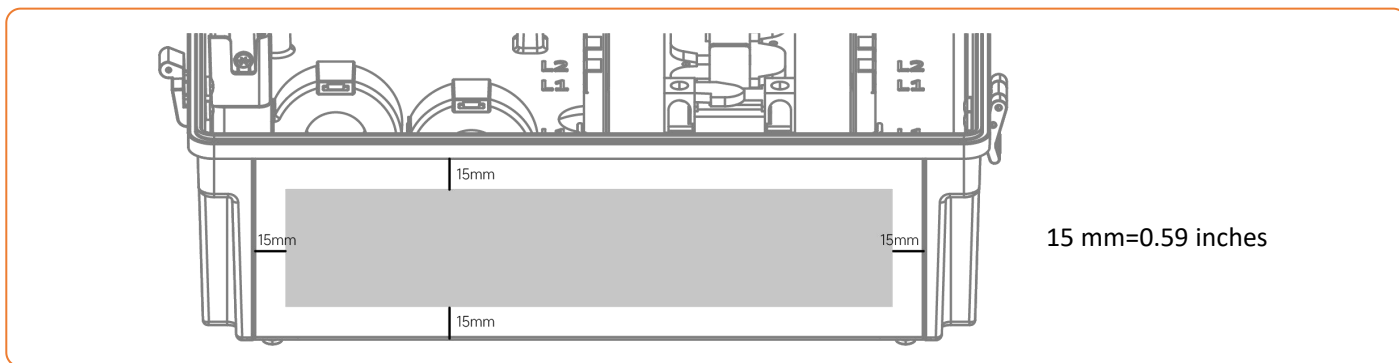
WARNING:

1. Wear safe clothing and eye protection.
2. You can only create openings on the bottom side of the enclosure. Do not drill conduit holes on the top of the Combiner Box or any locations that may permit moisture ingress. When drilling, consider the internal parts of the Combiner Box.
3. Each Breaker can only manage one branch circuit.
4. Use copper conductors sized in accordance with local code requirements and considerations for voltage drop/rise.

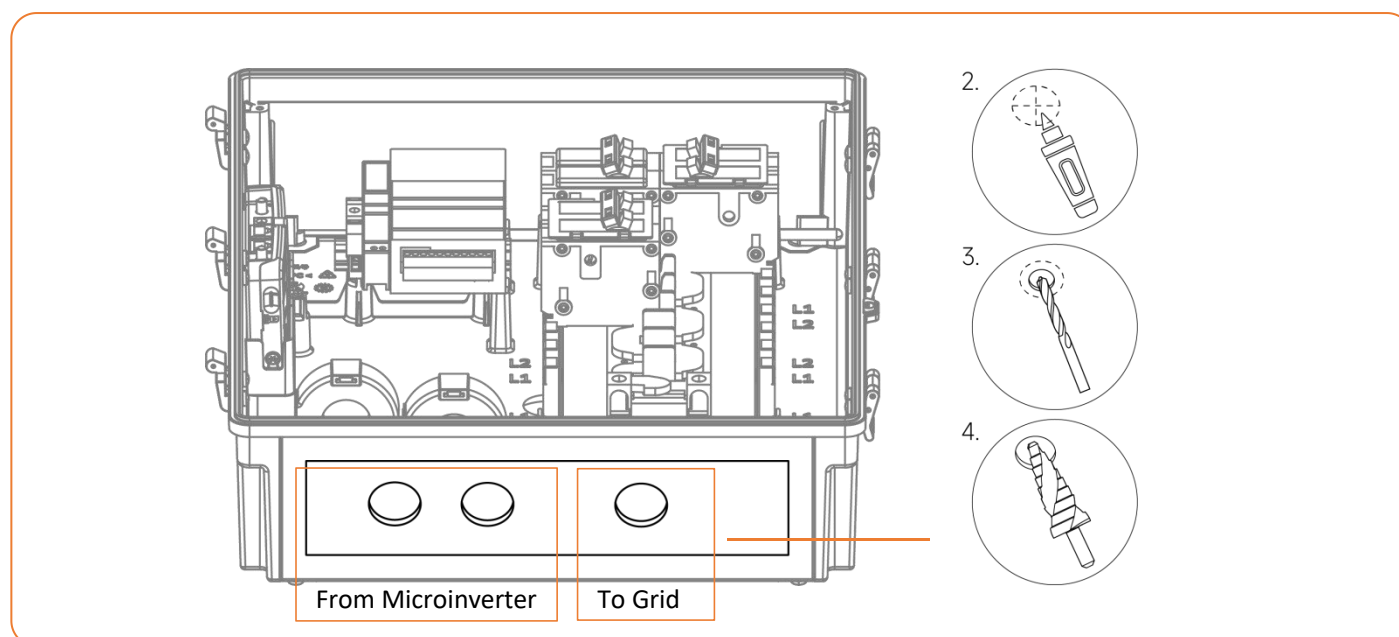


Step 1 Drilling Conduit Holes

1. Use a marker to outline the drilling area (Only drill within this area, and make sure not to go beyond its boundaries.).



2. Mark drilling spots on the bottom of the enclosure.
3. Use a small drill bit to create shallow pilot holes where marked.
4. Use a step drill bit to drill holes for conduit hub fittings.



NOTE:

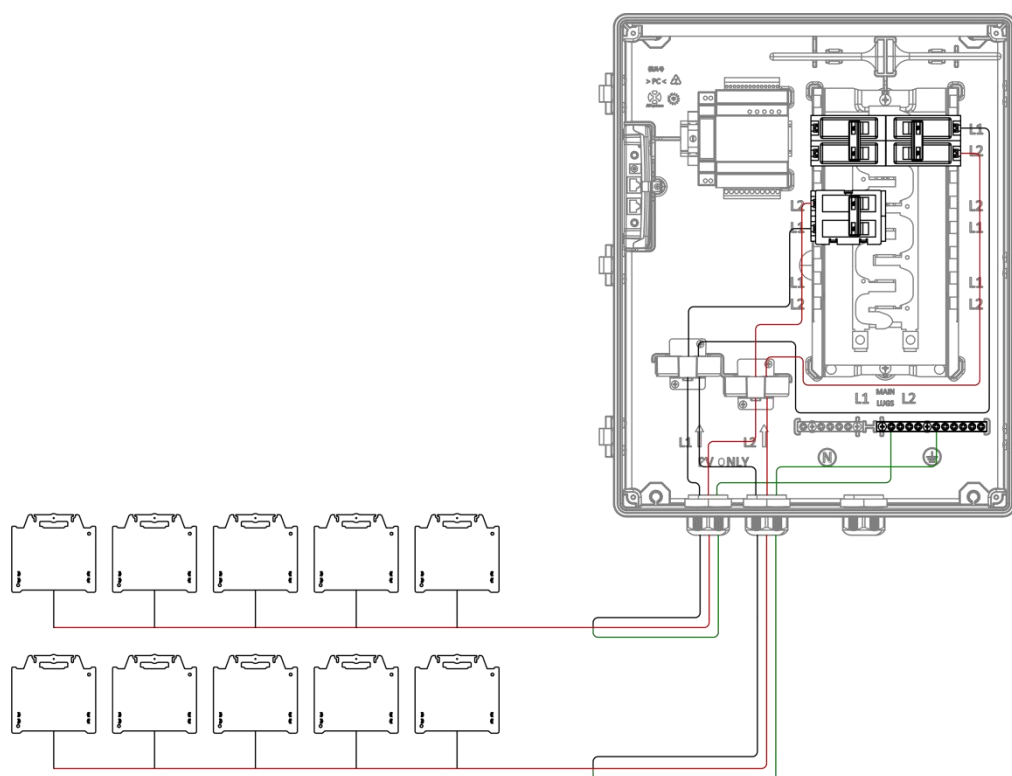
The number of holes to drill in the enclosure depends on the specific requirements of your system setup. In the example shown, three holes are drilled: two on the left for PV input branch circuit wiring and one on the right for grid output wiring. This example is just a reference; you should follow local electrical codes and configure the specific number of holes based on your system's needs.

Step 2 Installing Conduits

1. Insert conduit hub fittings into each corresponding hole and fully tighten the fittings.
2. Slide the conduits into the fittings as required by local regulations.

Step 3 Wiring Input From the PV

1. Connect the green (or green and yellow) ground wires to the Ground Bar.
2. Pass the L1 conductors from each PV branch circuit through the PV CT1 in the same direction as the arrow printed on the side of the CT.
3. Pass the L2 conductors from each PV branch circuit through the PV CT2 in the same direction as the arrow printed on the side of the CT.
4. Plug the L1 and L2 conductors into each Breaker's terminal slots. Observe the L1 and L2 polarity marking at each breaker position.



5. Torque all connections as indicated in the table below.

Connection	Wire sizes	Torque
DG Breaker	14-10 AWG	2.2 Nm (20 lb-in)
	8 AWG	2.8 Nm (25 lb-in)
	6-4 AWG	3.0 Nm (27 lb-in)
Neutral and Ground	14-10 AWG	2.2 Nm (20 lb-in)
	8 AWG	2.8 Nm (25 lb-in)
	6 AWG	3.9 Nm (35 lb-in)
Main Lug	10-4 AWG	5.0 Nm (45 lb-in)
	3-2/0 AWG	5.6 Nm (50 lb-in)
Copper conductors only, rated min. 75°C. Follow NFPA 70(NEC), or CSA C22.1 part 1, and all local codes		

Table 1 -Recommended Wire Size and Torque Specifications

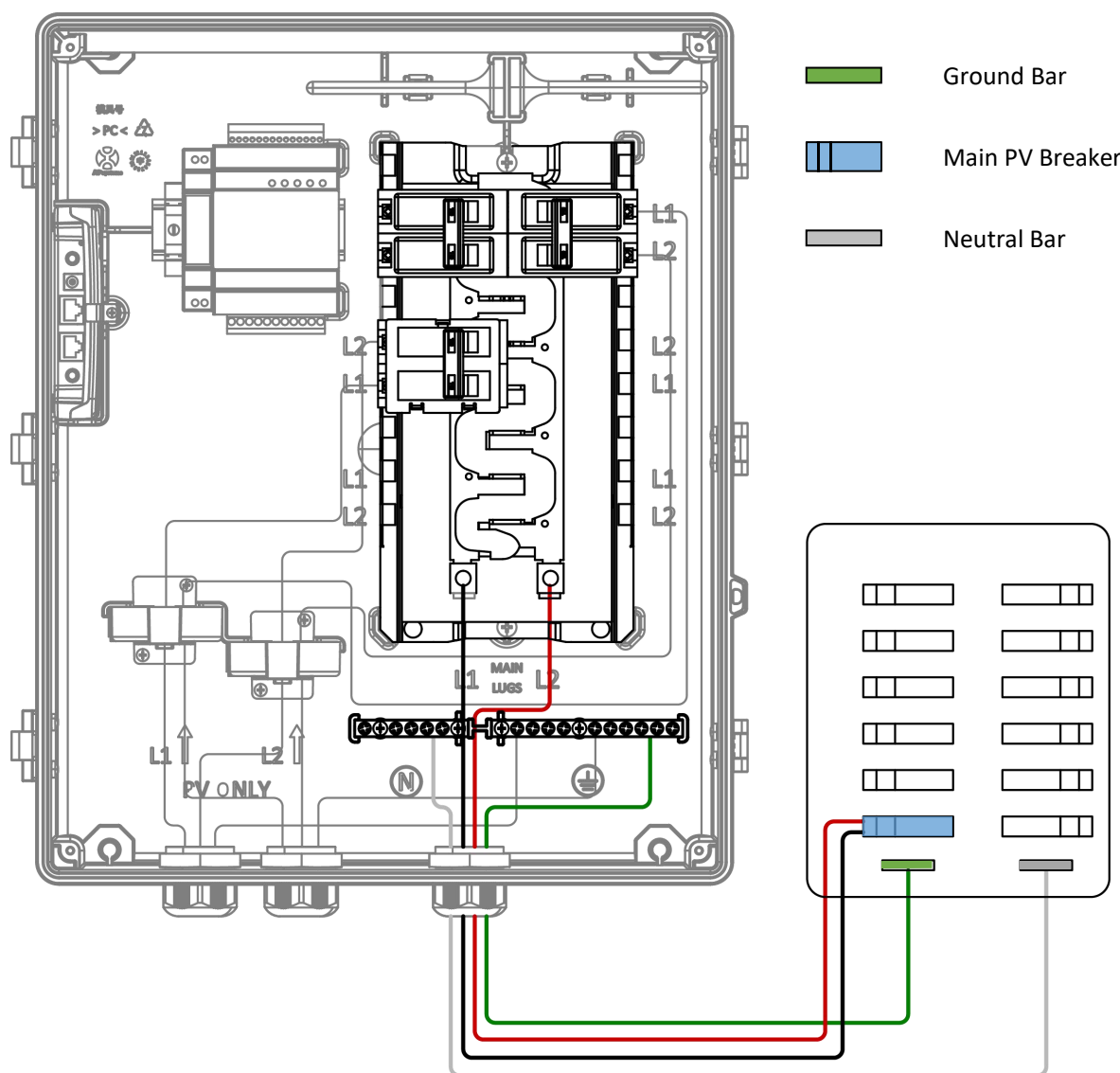
Step 4 Wiring the Output Connections

WARNING:

Use copper conductors sized in accordance with local code requirements, while considering aspects such as voltage drop/rise and the capacity of the Main PV Breaker.

Refer to the diagram on the door of the Combiner Box and do the following:

1. Connect the L1 and L2 outputs from the main lugs on the Combiner Box to the Main PV Breaker (located in the Main Load Center).
2. Plug the white neutral wire into the Neutral Bar's terminal slot.
3. Plug the green (or green and yellow) ground wire into the Ground Bar's terminal slot.
4. Torque all connections as indicated in Table 1.



4.5 Installing Grid CTs

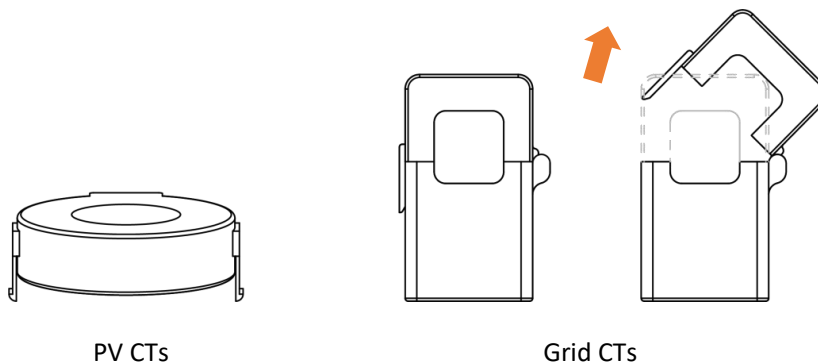
DANGER:

1. To prevent electric shock or other injuries, always de-energize the Main Load Center before starting the wiring process.
2. There is a risk of electrocution and equipment damage. Do not install CTs when current is flowing in the sensed circuit. Always install CT lead wires in the terminal blocks before energizing the sensed circuit.
3. Due to variances in load center design, there may not always be enough space to install Grid CTs. Please check and ensure there are adequate spaces in the Main Load Center to install the Grid CTs.
4. Ensure consistent matching of CT and load current. The provided Grid CTs are rated at 250 A, and the load current must not exceed 250 A.
5. It is crucial to match CT and sense voltage phases. To properly measure power and energy, CT inputs must align with the respective voltage inputs. Ensure the polarity between the Main Load Center and the two main AC lines is consistent.

NOTE:

On the meter's label, you'll find designations like CT1-1, CT1-2, CT2-1, and CT2-2, which match with the PV CT1, PV CT2, Grid CT1, and Grid CT2 as mentioned in this document.

Two PV CTs (solid-core) for PV metering are already pre-installed and pre-wired in the Combiner Box upon delivery. The package also includes two Grid CTs (split-core) for grid metering. To install the Grid CTs, create a protected route using conduit for the CT lead wires, running them from the Main Load Center to the Combiner Box.

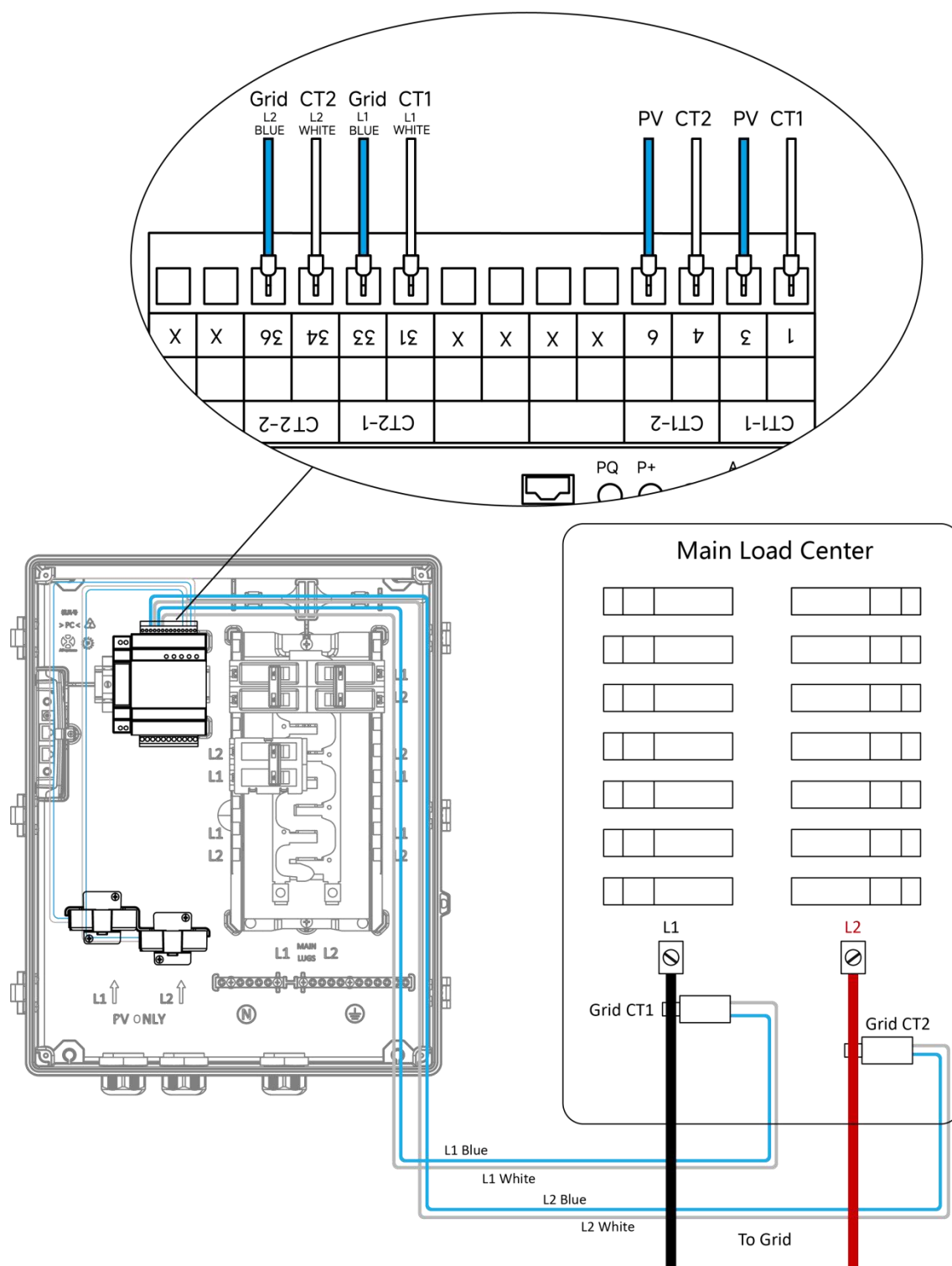


Procedure

- 1.Position two Grid CTs on the Main Load Center
- 2.Guide the Grid CT lead wires from the mounting position through the conduit to the Combiner Box.
3. Connect the Grid CT lead wires to the meter as shown below.
4. Clamp the Grid CTs in place, making sure the arrows marked on the CTs are aligned with the current flow to the Load.

DANGER:

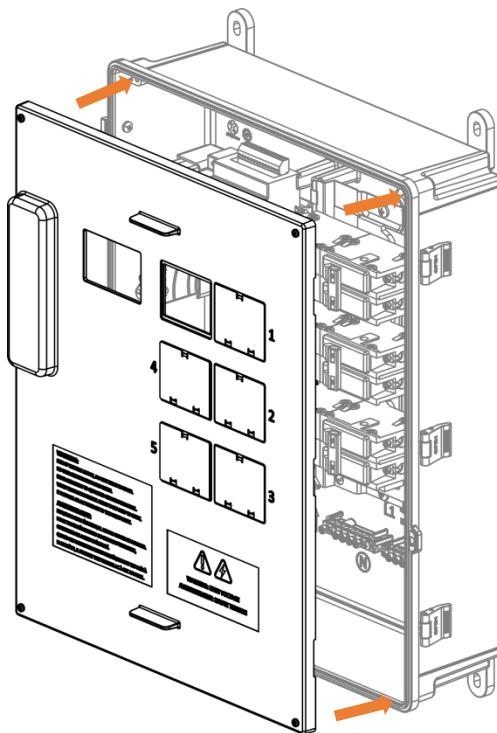
It is not permitted to open the Grid CT openings or to jam the Grid CTs on the cable at this time!
If you need to enable the anti-back flow function, please refer to Section 8.1.



4.6 Energizing the Combiner Box

Step 1 Installing the Dead Front

Verify all connections are correct and securely tightened. Re-install the dead front.



Step 2 Energizing the Combiner Box

1. Make sure all breakers are in the OFF position.
2. Turn on the Main PV Breaker.
3. Turn on the Communication Module Breaker.
4. Turn on the other Breaker(s).
5. Wait briefly for the microinverters to boot up. Once the boot-up is complete, the meter will show the current and power.

NOTE:

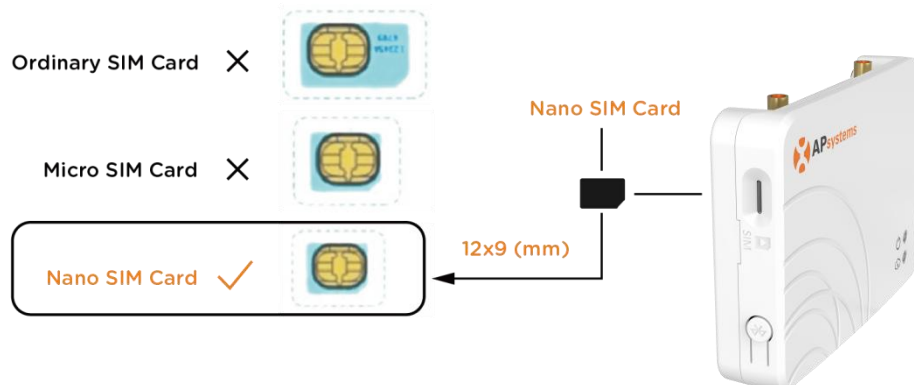
If all connections are correct, the meter will display the voltage, the ECU will start up.

5. SIM Card

5.1 SIM Card Slot And SIM Card Type

Following up the direction of the arrow, press the casing while sliding horizontally to open the SIM card slot:

ECU-R-4G card slot is adapted to Nano SIM Card.



5.2 SIM Card Activation (for some specific countries only)

In some specific countries, the SIM Card may need to be activated via a PIN code (default PIN is usually "0000").

In order to use the cellular option of the ECU, the PIN code needs to be deactivated first.

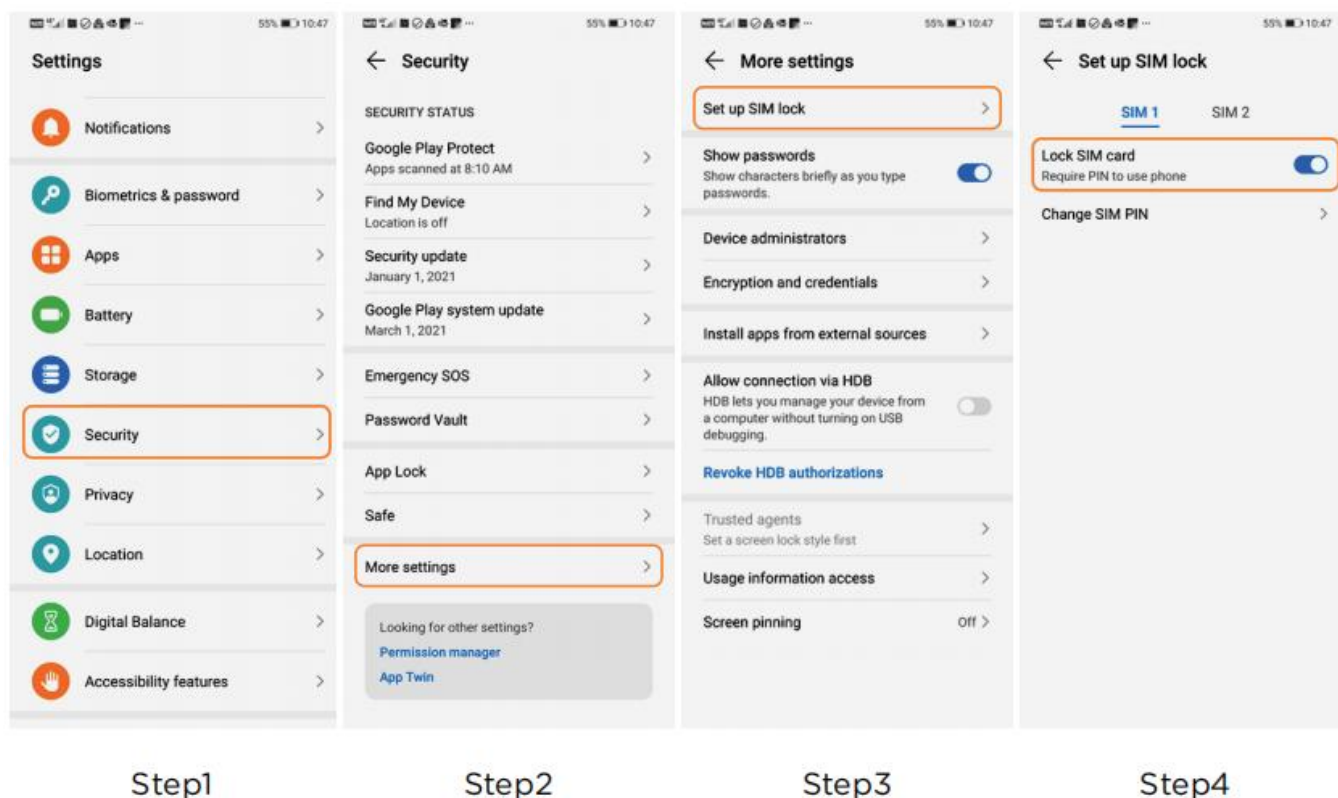
After inserting the SIM card in your smart phone, typical deactivation steps are as shown below:

Step1: Open Settings menu in your smartphone, then click « Security » .

Step2: Click « More settings ».

Step3: Click « Set up SIM lock ».

Step4: Uncheck the box.



6.ECU User Interface

6.1 ECU power on and APP download

Close the Communication Module Breaker, and the power indicator of ECU-R will start to light up.

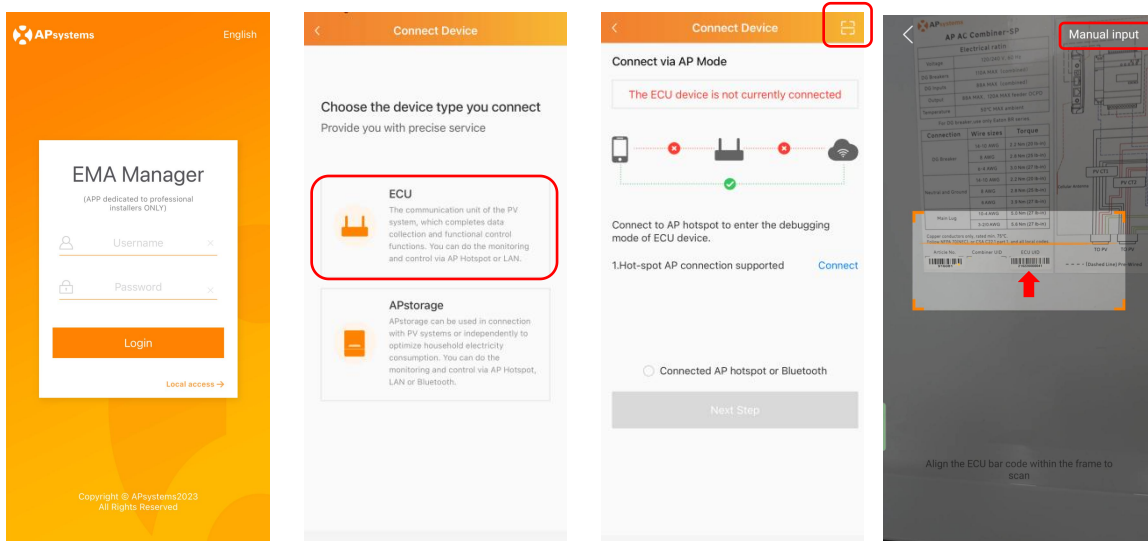
Scan the QR code to download our app from the browser.

The EMA app is suitable for end-users and DIY users, while the EMA Manager app is specially designed for professional installers.

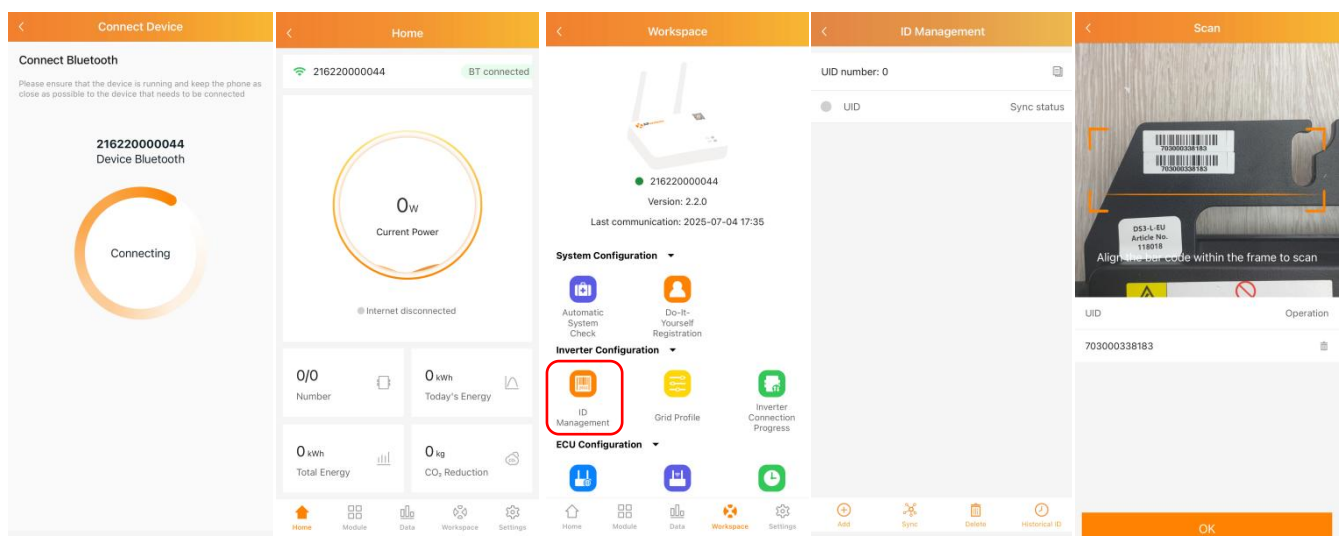


6.2 Local Access, binding ECU to microinverter

1.Connect your mobile phone to the Internet and enable the Bluetooth function of the phone. Open EMA Manager, click "Local Access", select the device connection type "ECU", click the scan code icon in the upper right corner, and scan the code to input; at the same time, you can also manually input the ECU UID starting with "21622xxxxxx".

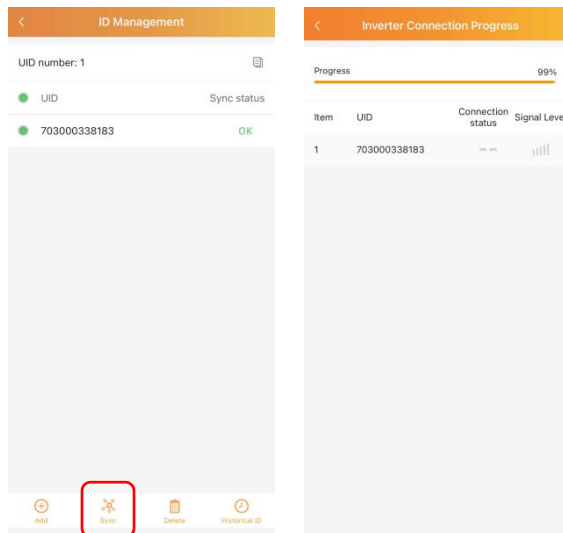


2.Wait for connection, enter the local homepage, click "Workbench" → "ID Management" → "Add" (including two adding methods: scanning code and manual input).



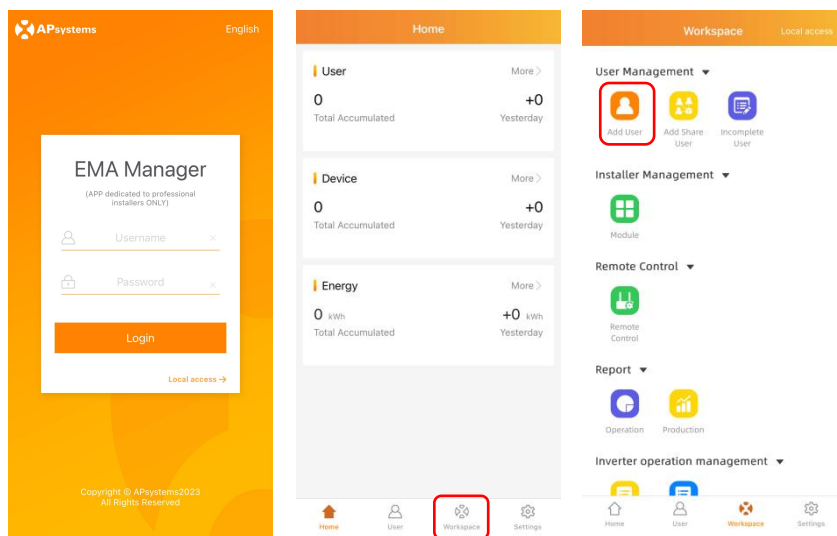
3. Finally, click "Synchronize" to complete the binding of the local ECU and the micro-inverter. You can check the connection progress and networking status of the micro-inverter in the inverter connection progress. Once the network connection progress reaches 100%, it indicates that the connection between the ECU and the micro-inverter is completed.

Note: If you have an installer, please contact them to obtain the company code so as to use the after-sales operation and maintenance services provided by the installer.

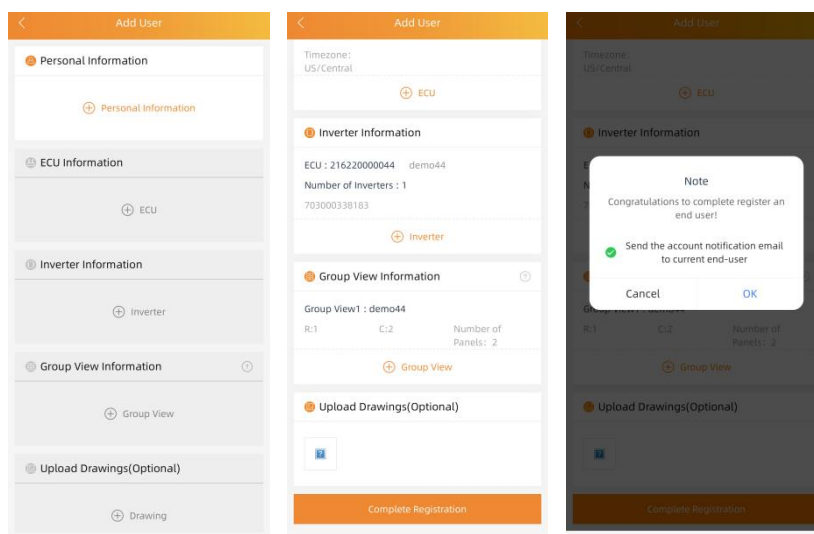


6.3 Account registration

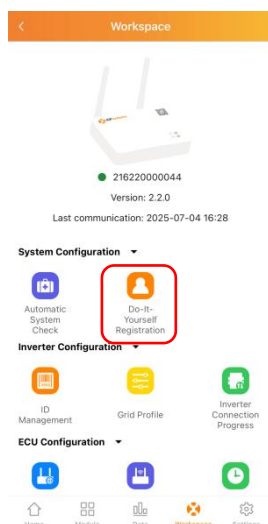
1. The installer needs to connect their mobile phone to the Internet, open EMA Manager, enter their installer account and password, access the "Workbench", and find "Add User".



2.Fill in the user's "Personal Information", "ECU Information", "Inverter Information", "Group View Information", and "Upload Drawings (Optional)". After completion, click "Complete Registration".



3.If you do not have an installer and need to register by yourself, you can click "DIY Registration" locally.



6.4 Remote or Local Monitoring

Remote Monitoring: After logging into your registered account via EMA Web or EMA APP, you can remotely monitor the system.

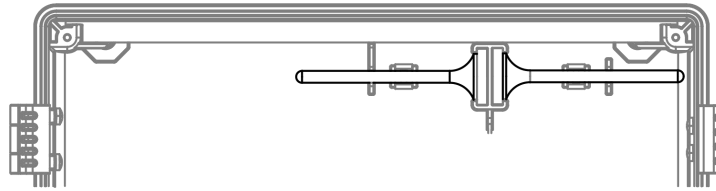
Local Monitoring: Click "Local Access", turn on your phone's Bluetooth, connect to the ECU via Bluetooth, and you can access the local monitoring system.

7. Troubleshooting and Replacement

7.1 Using the Standby Antenna

WARNING:

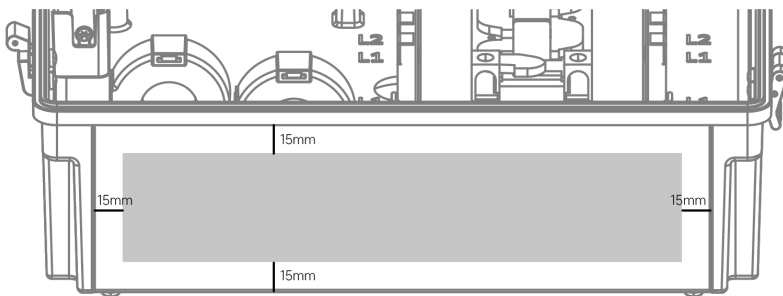
1. Wear safe clothing and eye protection.
2. You can only create openings on the bottom side of the enclosure. Do not drill holes on the top of the Combiner Box or any locations that may permit moisture ingress. When drilling, consider the internal parts of the Combiner Box. A standby antenna is placed inside the Combiner Box. Users can use it to replace the pre-installed one to improve the communication between the Combiner Box and the microinverter.



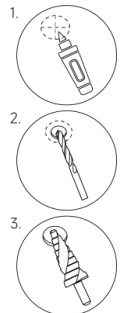
Procedure

Step 1 Drilling a Hole

1. Mark a drilling spot on the bottom of the enclosure within the drilling area (Only drill within this area, and make sure not to go beyond its boundaries). The specific position and size should be determined based on the actual situation.
2. Use a small drill bit to create a shallow pilot hole where marked.
3. Use a step drill bit to drill a hole for the antenna cable.



15 mm=0.59 inches

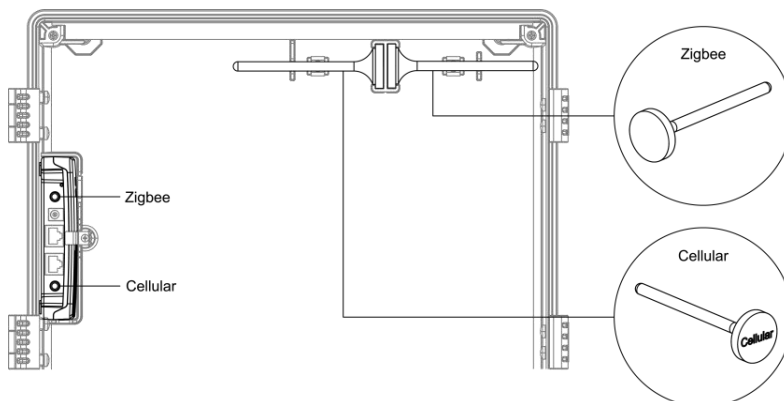


Step 2 Connect the antenna and check the signal.

Check the microinverter communication status. Adjust the antenna position until the signal quality becomes good.

NOTE:

When fixing a suction cup antenna, you can use the double-sided tape in the accessory box for pasting.



7.2 Replacing Devices

WARNING:

The replacement of the Combiner Box and devices in it must be carried out by qualified persons only. APsystems is not liable for damages resulting from improper installation and use.

7.2.1 Replacing the Combiner Box

1. Turn off the Breaker(s) and the Communication Module Breaker.
2. Turn off the main PV Breaker of the Main Load Center.
3. Open the buckle of the Grid CTs to remove them from the Main Load Center.
4. Remove the dead front.
5. Disconnect the Grid CTs from the meter.
6. Disconnect wires from the main lugs, Neutral Bar, and Ground Bar.
7. Disconnect wires from the Breaker(s).
8. Disconnect the standby antenna from the ECU if the antenna is used.
9. Remove the conduits at the bottom of the enclosure.
10. Remove the Breaker(s).
11. Install the dead front and close the Combiner Box's door.
12. Unscrew the screws to remove the Combiner Box from the installation surface.
13. Follow the instructions in Chapter 4 to install a new Combiner Box.
14. Change the ECU UID on the EMA.

7.2.2 Replacing the ECU

1. Turn off the Breaker(s) and the Communication Module Breaker.
2. Turn off the main PV Breaker of the Main Load Center.
3. Open the buckle of the Grid CTs to remove them from the Main Load Center.
4. Disconnect all the wires from the ECU.
5. Replace the ECU with a new one.
6. Connect all the wires to the newly-installed ECU in place.
7. Clamp the Grid CTs in place, making sure the arrows marked on the CTs are aligned with the current flow to the grid.
8. Turn on the main PV Breaker of the Main Load Center.
9. Turn on the Breaker(s) and the Communication Module Breaker.
10. Change the ECU UID on the EMA.

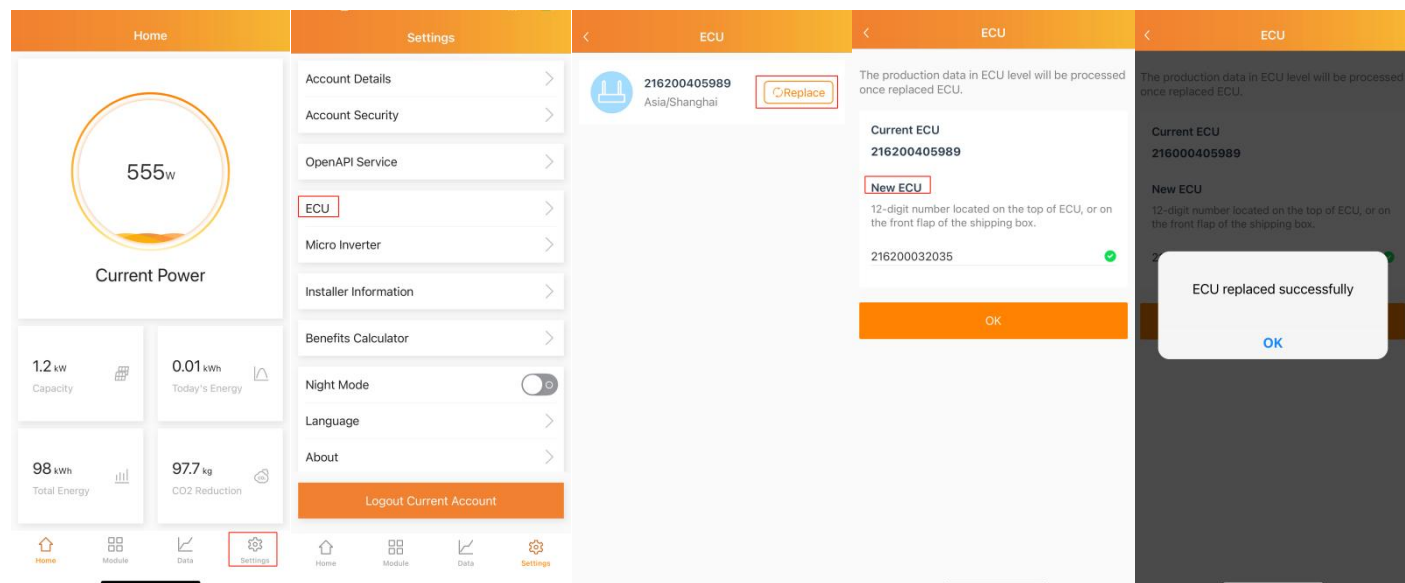
7.2.3 Replacing the Meter

1. Turn off the Breaker(s) and the Communication Module Breaker.
2. Turn off the main PV Breaker of the Main Load Center.
3. Open the buckle of the Grid CTs to remove them from the Main Load Center.
4. Disconnect all the wires from the meter.
5. Replace the meter with a new one.
6. Connect all the wires to the newly-installed meter in place.
7. Clamp the Grid CTs in place, making sure the arrows marked on the CTs are aligned with the current flow to the grid.
8. Turn on the main PV Breaker of the Main Load Center.
9. Turn on the Breaker(s) and the Communication Module Breaker.
10. Viewing data on the EMA.

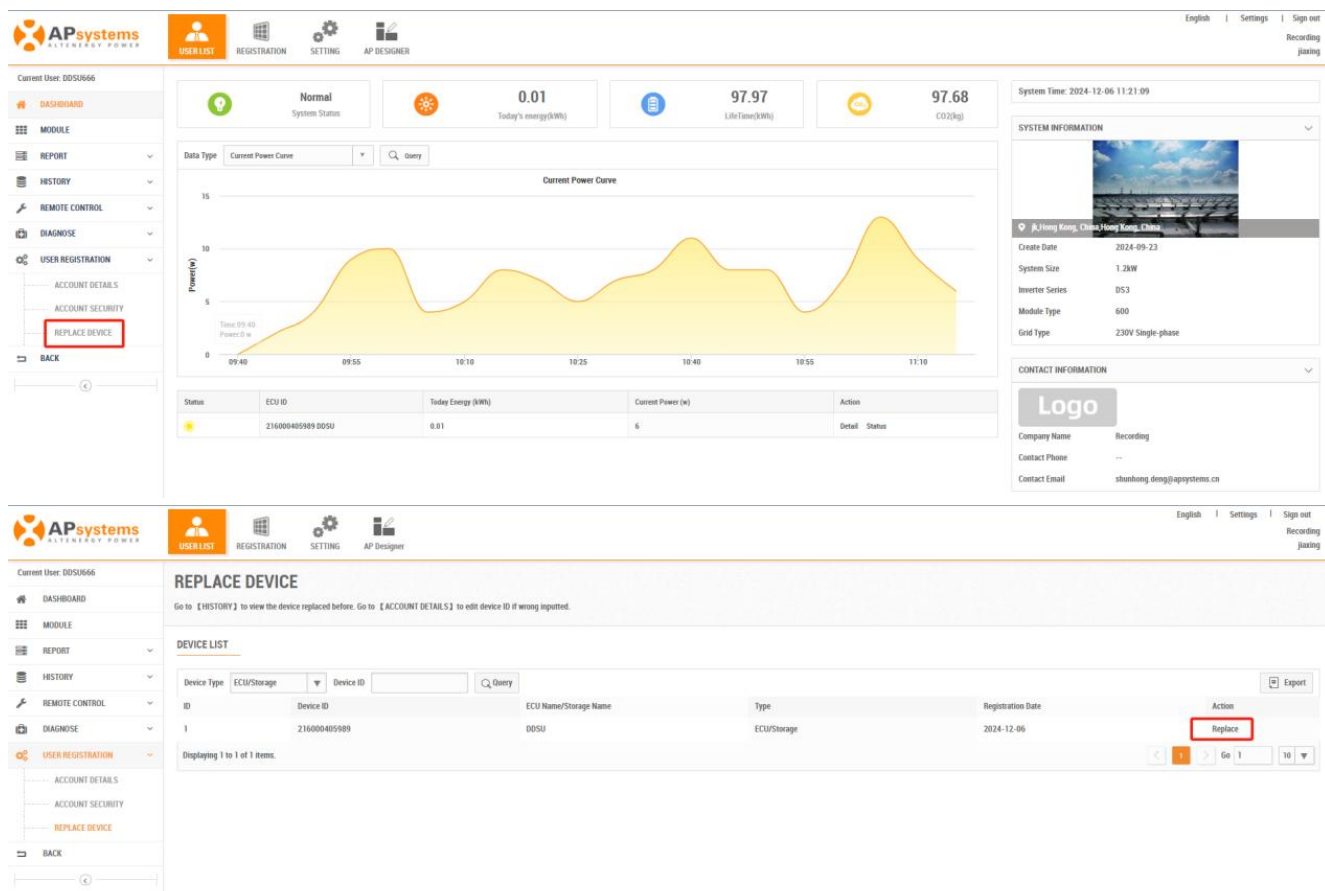
7.2.4 Replacing the ECU on the EMA

Option 1: Replace the terminal account ECU.

Open the "EMA APP", enter the end user's "account" and "password", enter the homepage, click "Settings" - click "ECU" - click "Replace" - enter the new UID - click "OK" - display "ECU replaced successfully".



Option 2: The operation of replacing device accounts for EMA web installers and distributors is as follows



8.Powering Off/On the Combiner Box

8.1 Powering Off the Combiner Box

1. Turn off the Breaker(s) and the Communication Module Breaker.
2. Close the door to protect the inside of the Combiner Box from water.
3. Turn off the Main PV Breaker.

8.2 Powering On the Combiner Box

Step 1 Turning On All the Breakers

1. Turn on the Main PV Breaker.
2. Turn on the Breaker(s) and the Communication Module Breaker.

Step 2 Checking the Microinverter Communication Status

1. Launch and log in to the EMA Installer app using your credentials.

9.Electric Meter Settings

9.1 Power Limit Setting on EMA

If you want to modify the electric meter configuration, click "Back" to go back to the meter configuration page.

Current User: thirdMeterTest04

DASHBOARD

MODULE

REPORT

HISTORY

REMOTE CONTROL

ECU STATUS

ECU SETTING

GRID PROFILE

AC PARAMETERS

SWITCH ON/OFF

METER SETTING

INVERTER IRD/GFDI

Meter Setting

You can selectively turn on the function of Meter Zero Export,And set related parameters.

METER SETTING

ECU ID

216000391702

Meter Display

Open

Zero Export/Redundant Energy

Zero Export

Power Limit(W)

500

Back

3 Phase Setting

Submit

10.Data Display on EMA

The electric meter transfers export/import power data and photovoltaic power generation data to the ECU-R via RS-485. Then, the ECU-R uploads the data to the EMA platform by using the router or a wireless network. Users can view energy information on the EMA platform or through the mobile application.

10.1 Photovoltaic Power Generation, Consumed Power, and Export/Import Power Data



11.AP AC Combiner-SP Datasheet

Model

AP AC Combiner-SP

Electrical SpecificationsPV Input

Rating	110 A
System voltage	120/240 V, 60 Hz
Eaton BR series busbar rating	125 A
Maximum continuous current rating (input from PV)	88 A
Branch circuits (Solar)	Supports up to five 2-Pole Eaton BR series breakers (not included), such as BR210, BR230, BR250,etc.
Maximum total branch circuit breaker rating (input)	110 A
Communication module breaker	10 A/15 A
Wire size	20 A to 50 A breaker inputs: 14 to 4 AWG conductors
	Main lug combined output: 10 to 2/0 AWG conductors
	Neutral and Ground: 14 to 6 AWG conductors
	Always follow local code requirements for conductor sizing

Mechanical Data

Dimensions (W × H × D)	19.67 × 15.75 × 6.69 inch. (500 × 400 × 170 mm)
Weight	12.79 lbs. (5.8kg)
Ambient temperature range	-13°F to 122°F (-25°C to 50°C)
Cooling	Natural convection
Enclosure rating	Outdoor, IP65, Polycarbonate Construction
Altitude	Up to 6,562 feet (2, 000 meters)

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