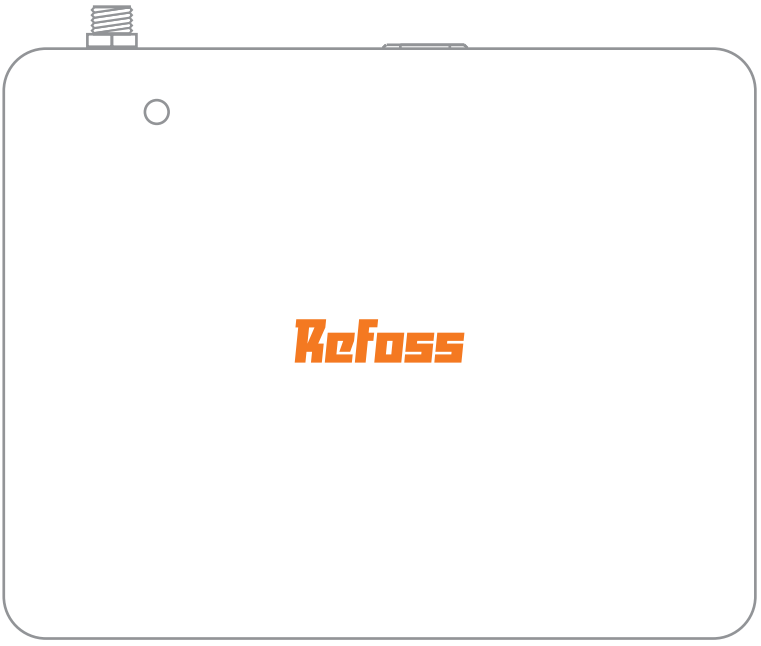
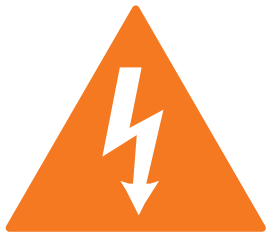
Refoss



Smart Energy Monitor

EM16P

User Manual



WARNING!

The Refoss EM16P needs to be installed in the electrical panel of a home and operates in an environment that may pose a risk of injury or electric shock. Refoss recommends that the unit be installed by a licensed professional electrician or other qualified professional in accordance with the electrical codes for the area in which it is to be used.

Incorrect installation and incorrect use of equipment may result in electrical safety injuries. Refoss shall not be liable to any person or third party for direct or indirect injuries and damages resulting from failure to comply with the following safety guidelines.

3.5mm and 2.5mm ports should only be used to connect the supplied CT clamps to the energy monitor. They are not intended to carry any audio signal.

Safety Information

- Always wear Personal Protective Equipment (PPE) when installing the Refoss EM16P.

- Do not use the Refoss EM16P in any manner other than specified in this installation guide.

- If you believe any of the Refoss EM16P components may have been damaged, do not attempt to use them.

- Do not attempt to open, disassemble, or repair any of the components of the Refoss EM16P.

- Do not install the Refoss EM16P in environments with explosive gas or vapors; nor in damp or wet environments; nor in direct sunlight; nor where temperatures are consistently below -4° F (-20° C) or above 104° F (40° C).

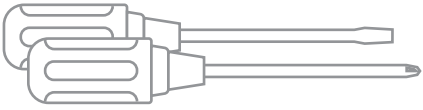
- Make sure the Refoss EM16P is not connected to the power supply during any manual processes, such as installation or removal.

- Do not perform any maintenance, service, or cleaning of the Refoss EM16P after installation.

- The CT must be connected to the main unit before it is clamped onto the line for measurement.

Before You Get Started

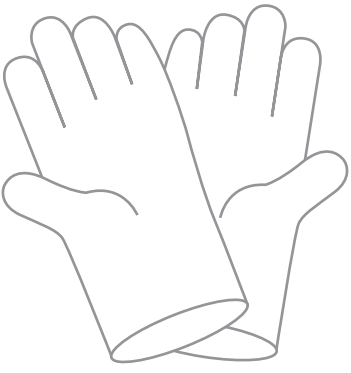
The Refoss EM16P is installed in your home's electrical panel. You'll turn off the main breaker, which will shut off all of the power in your home. However, the service mains will remain dangerously energized. The following items may help with safe installation. Refoss recommends that the unit be installed by a licensed professional electrician or other qualified professional in accordance with the electrical codes for the area in which it is to be used.



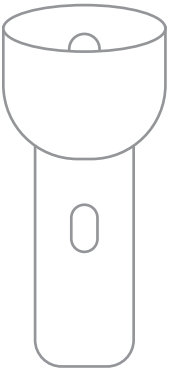
Phillips and Flathead Screwdrivers



Protective Eyewear



Protective Gloves



Alternative Light Source

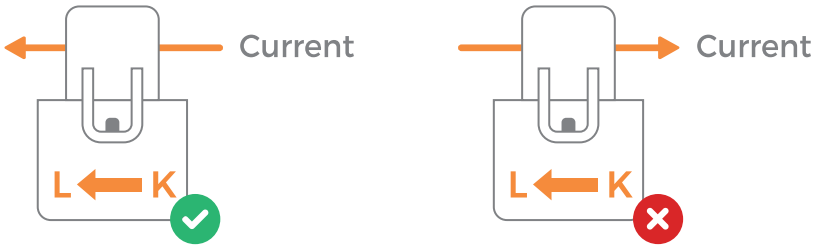
Manual & Video

Online Manual

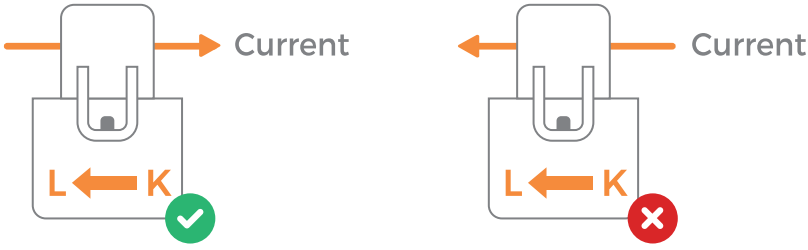
Installation Video

Common Questions

CT Direction



Consumption



Production

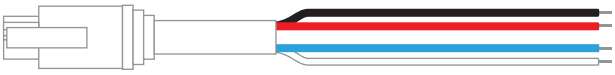
1. When monitoring consumption, the current through the CT should flow K → L; when monitoring generation (e.g., solar PV), the current should flow L → K.

2. With correct installation, a positive value indicates consumption, while a negative value indicates generation (e.g., solar PV).

3. If the readings are reversed (positive vs. negative), the CT is likely installed in the opposite direction. This does not affect the product's function or performance and can be corrected in two ways:
1) Adjust the CT direction (may require opening the panel).
2) Modify the setting in Device Settings → Circuit Factor.

Wire Harness

Wire colors may not match your system!



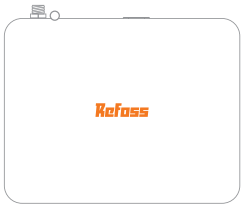
- La: Provides power and voltage sensing
- Lb: Enable voltage sensing only
- Lc: Enable voltage sensing only
- Neutral

Need Help

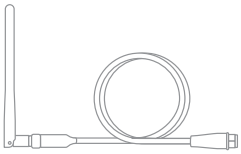
Need Help?
If you have any question during hardware installation or setup process, please contact us at:
https://support.refoss.net/support/email_support

Package Contents

Your newly Refoss EM16P contains the following items. If any of these items are missing or damaged, please contact technical support immediately.



Energy Monitor



Wi-Fi Antenna Assembly



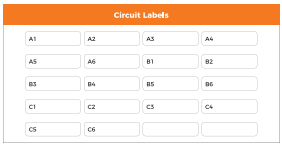
User Manual x1



200A Current Transformer x 2



60A Current Transformer x8 or x16



Circuit Labels x 1



3.5mm Insulation Plug x 2



2.5mm Insulation Plug x 16



Wire Nut x 3

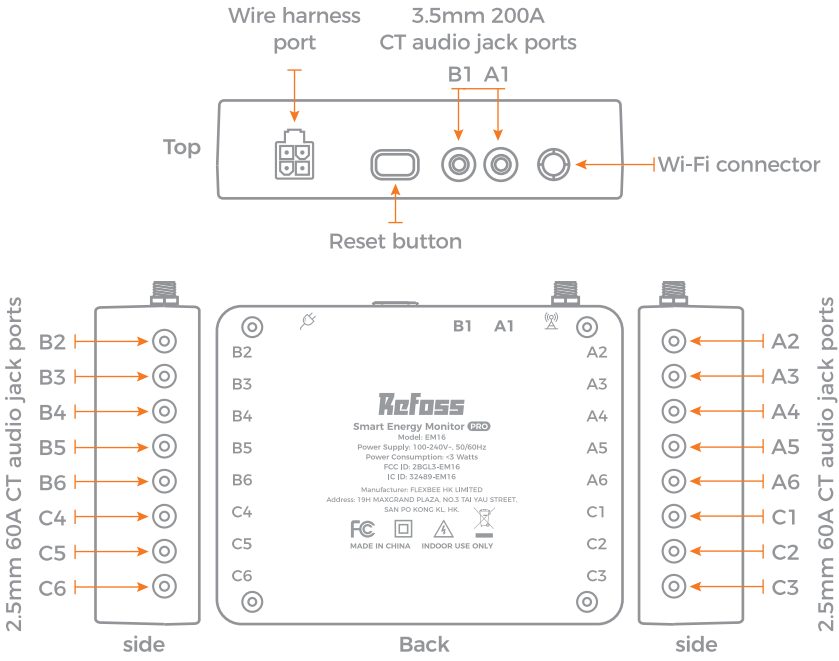
Extra Wire x 3



Wire Harness

Energy Monitor Connections

The energy monitor is the core of the Refoss EM16P. The 3.5mm A and B audio jack ports on the top of the monitor serve as the input ports for the 200A main CTs. The coaxial connector for the Wi-Fi cable and the port for the wiring harness are also located at the top. The 2.5mm audio jack ports numbered 1 through 16 on the sides of the monitor are the input ports for the 60A CTs. All ports are clearly labeled on the back of the energy monitor.



Installation Guide

Step 1: Download the Refoss app

Scan the QR code to download the Refoss app and register an account.

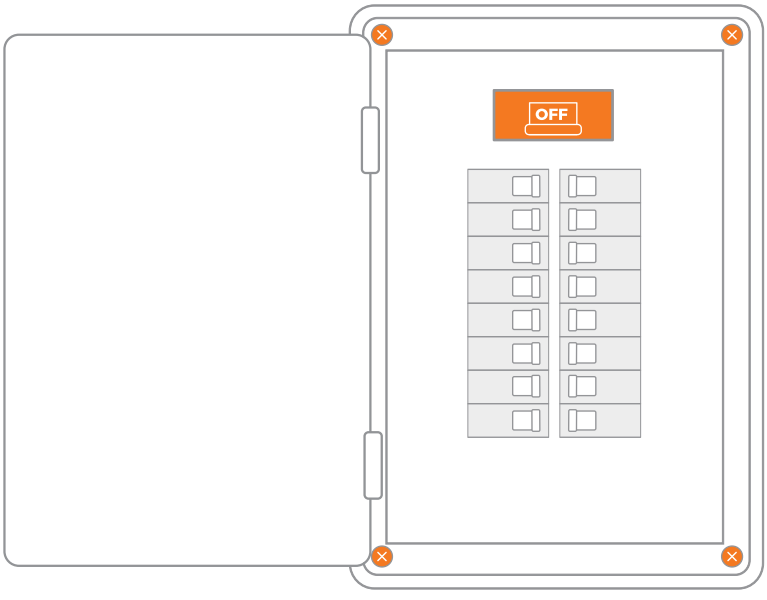
Download on the App Store

GET IT ON Google Play

amazon apps Available at amazon

Step 2: Turn Off the Main Breaker

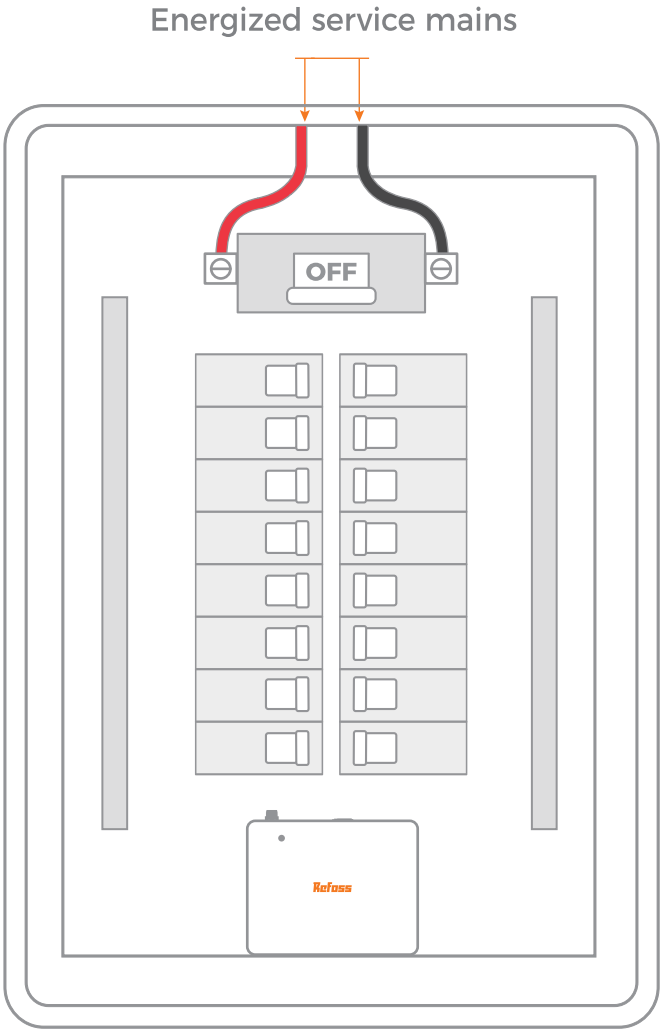
Within your electrical panel, deactivate the main circuit breaker to disengage all circuits in your residence. Subsequently, uninstall the securing panel and make necessary preparations for wiring and installation tasks.



Danger: The service mains are energized!

Step 3: Find a Place for the Monitor

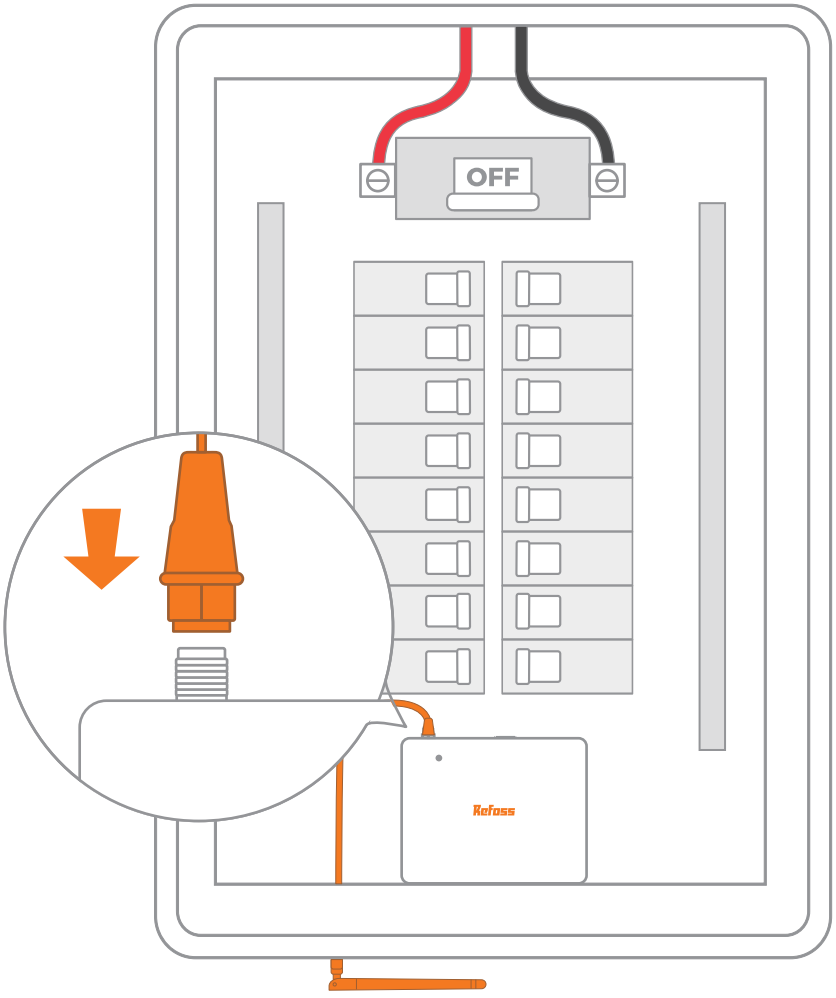
Locate a place within the electrical panel for the Refoss EM16P Energy monitor ensuring it is at least 50.8mm (2 in.) from any live parts including primary conductors, primary terminals, and primary lugs; but excluding insulated cables. The breaker box may be oriented differently than below, but the monitor is small and designed to fit easily in the box. Find a place that works.



Danger: The service mains are energized!

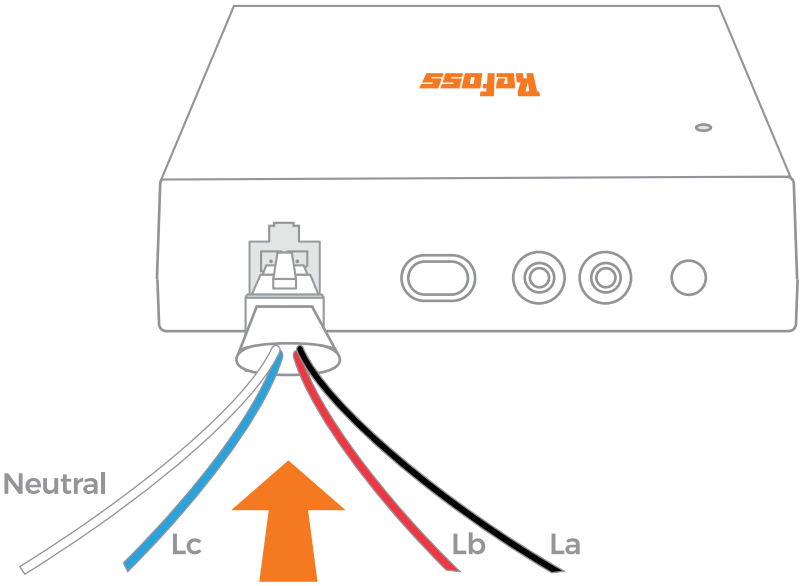
Step 4: Installation of Antenna

Insert the antenna assembly cable into the antenna labeled jack located at the top of the energy monitor and tighten it securely. Next, locate or create a small aperture in the electrical panel and thread the antenna through it. Remember that the antenna should not be enclosed within the distribution box. If the antenna is placed inside the distribution box, it will experience signal interference.



Step 5: Plug In the Wire Harness

Insert the power harness into the top of the energy monitor until it snaps securely into place. This harness allows access to single phase power, two phase power and three phase power.



Step 6: Wire Installation

Identify and determine whether the line you currently need to monitor is single-phase, split-phase or three-phase, with different wiring for different systems for accurate monitoring.

6(a) Single-phase, 3-wire systems
In North America, it is also referred to as split phase or dual phase.
(Common in North American homes and small commercial power scenarios.)

6(b) Single-phase, 2-wire systems
(Common in North American homes for lighting, appliances, etc.)

6(c) Three-phase, 4-wire Wye systems with earthed (TN or TT) neutral (no-Delta)
(Common in North American industrial and large commercial power scenarios.)

How to determine my electricity type?

1. Inspect the Electrical Meter Box or Distribution Panel Open the panel (ensure safety, do not touch any exposed wires) and check:
- **Single-phase, 3-wire systems:** Typically have three connections, two hot wires (black and red) and one neutral wire (white). This system is common in U.S. residences, providing 240 volts (between the two hot wires) and 120 volts (between either hot wire and the neutral wire).
- **Single-phase, 2-wire systems:** Typically have two connections, one hot wire (black or red) and one neutral wire (white).
- **Three-phase, 4-wire Wye systems:** Typically have four connections, three hot wires (usually black, red, and blue) and one neutral wire (white). This system is common in commercial and industrial applications, not typical in residential settings.

2. Observe the Main Circuit Breaker's Rating
- **Single-phase, 3-wire systems:** The main circuit breaker is usually a 240-volt breaker, common in residential homes.
- **Single-phase, 2-wire systems:** The main circuit breaker is typically a 120-volt breaker.
- **Three-phase, 4-wire Wye systems: T**he main circuit breaker is typically a three-phase breaker and has a higher current rating.

Step 6(a): Single-phase, 3-wire Systems Circuits Harness Wiring Method

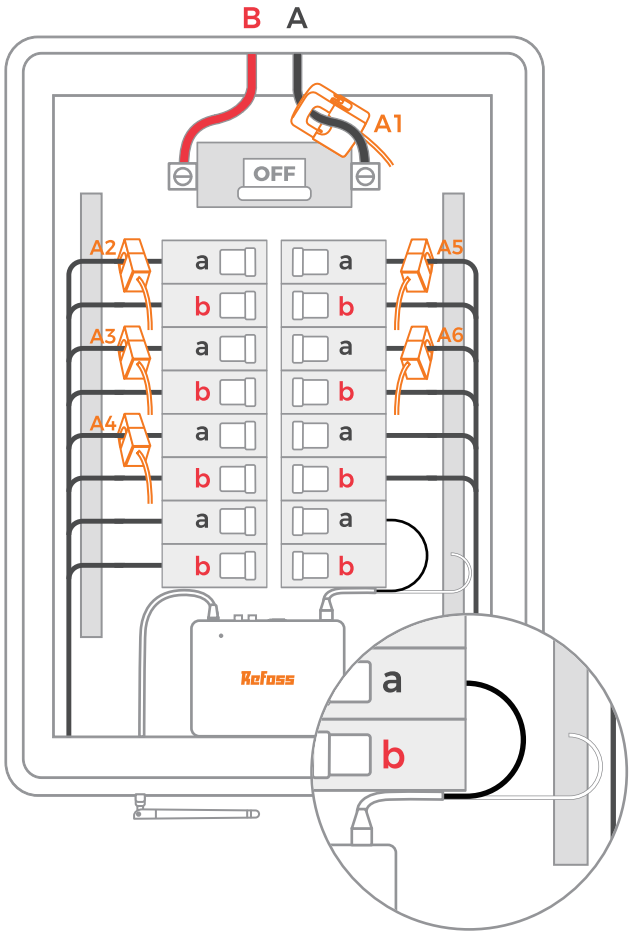
In North America, it is also referred to as split phase or dual phase.

(Common in North American homes and small commercial power scenarios.)

Please connect the neutral wire to the neutral busbar first, then proceed with the subsequent steps.

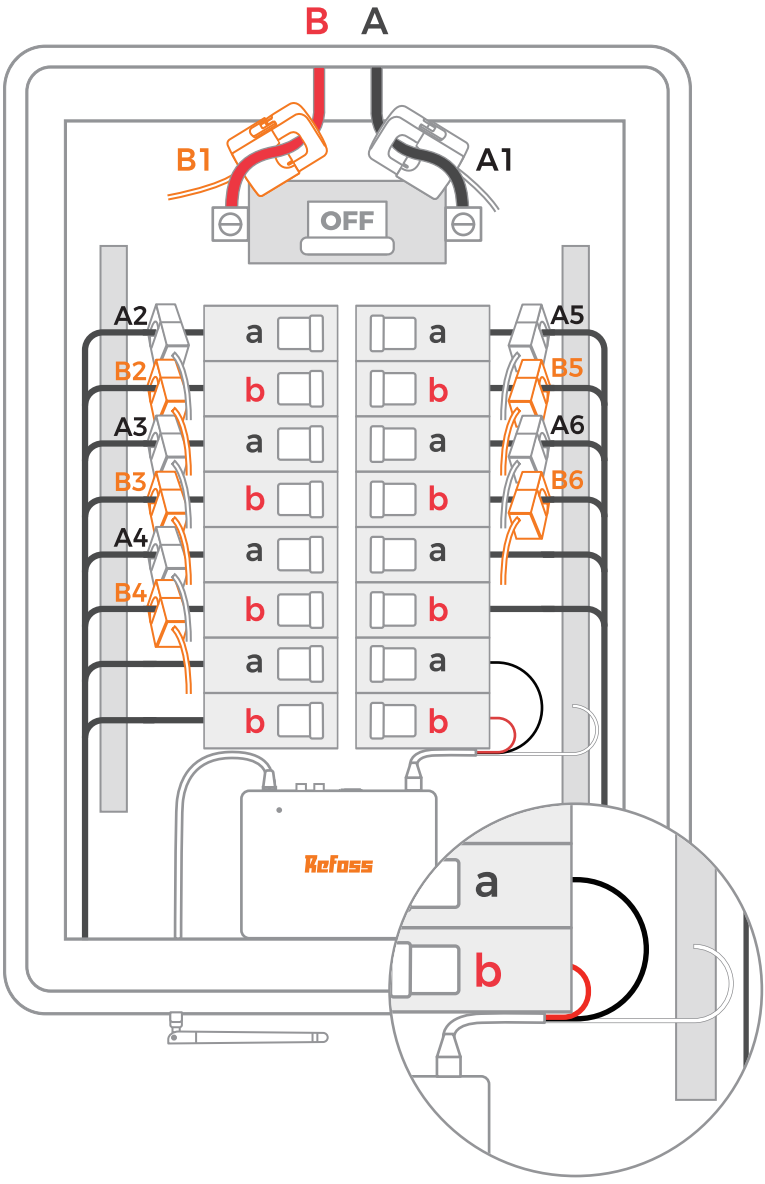
(1) La Black Wire Connection

Connect the La wire to the a-phase circuit breaker to provide power to the equipment and monitor the a-phase voltage. For higher accuracy in monitoring, the current transformers **(A1-A6)** corresponding to the La phase voltage should be clamped onto the a-phase wire to monitor the current. (For the installation method of the current transformers, please refer to Steps 7 and 8.)



(2) Lb Red Wire Connection

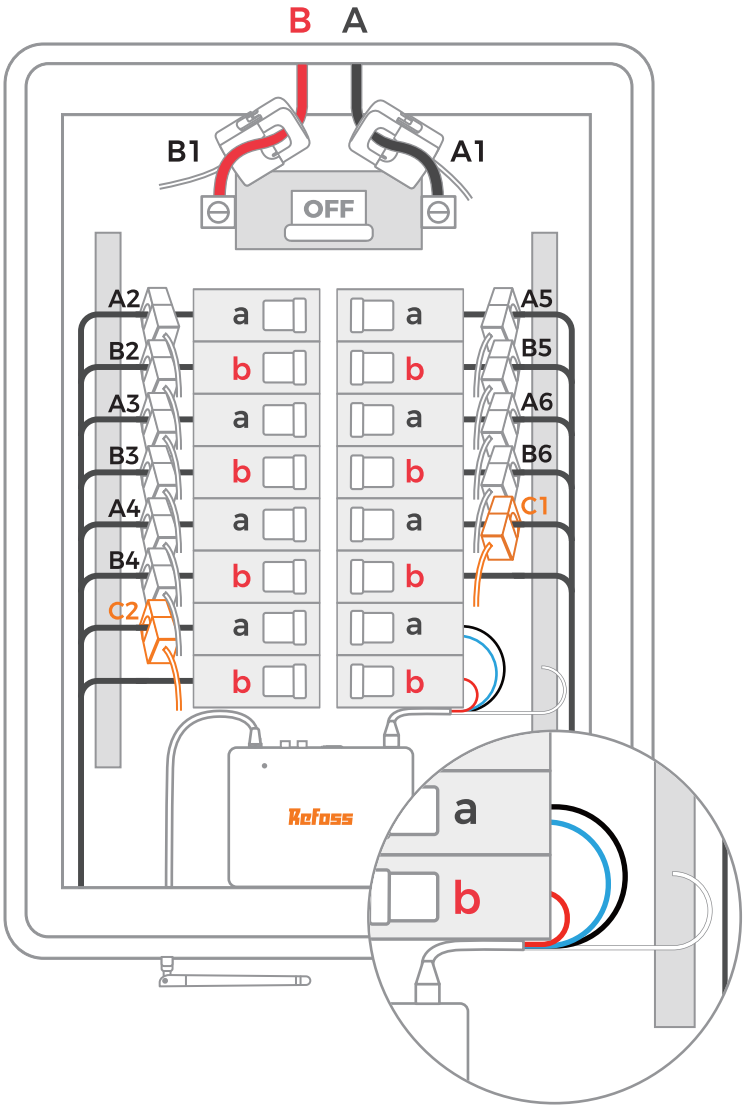
Connect the Lb wire to the b-phase circuit breaker to monitor the b-phase voltage. For higher accuracy in monitoring, the current transformer corresponding to the Lb phase voltage **(B1-B6)** should be clamped onto the b-phase wire to monitor the current. (For the installation method of the current transformer, please refer to Steps 7 and 8.)



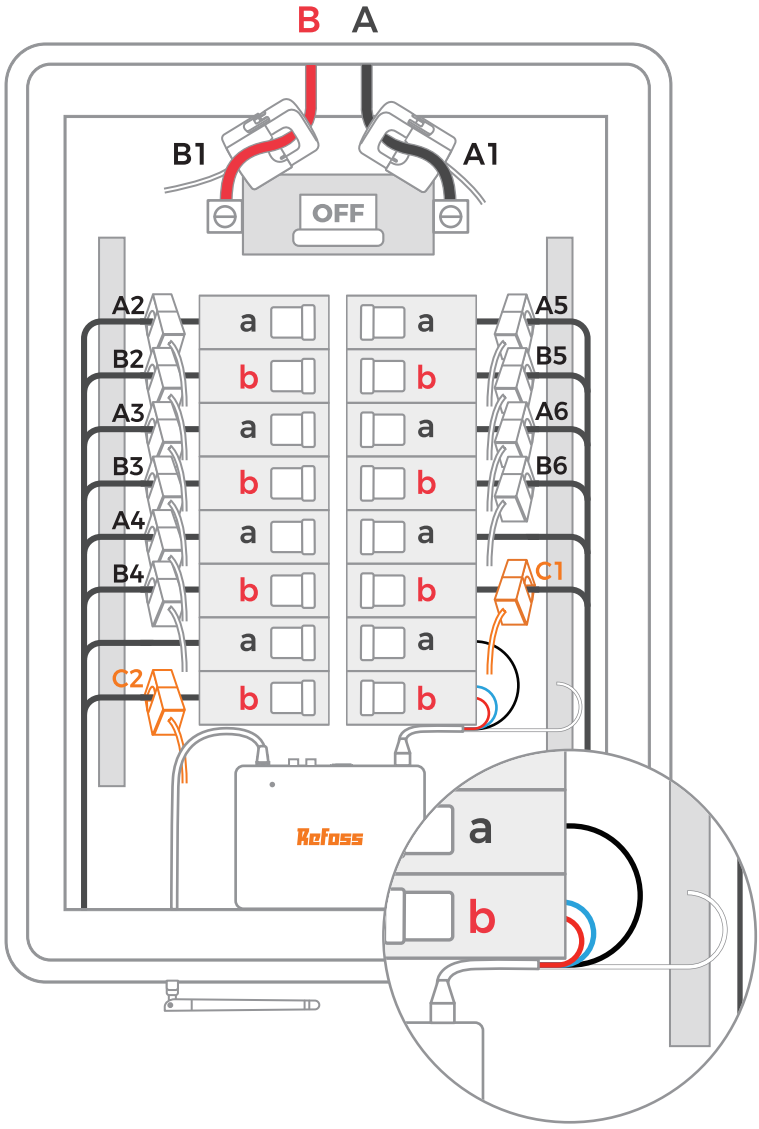
(3) Lc Blue Wire Connection

If more circuits need to be monitored on the a-phase, connect the Lc wire to the a-phase circuit breaker to monitor the a-phase voltage. If more circuits need to be monitored on the b-phase, connect the Lc wire to the b-phase circuit breaker to monitor the b-phase voltage. For higher accuracy in monitoring, the current transformer corresponding to the Lc phase voltage **(C1-C6)** should be clamped onto the corresponding phase wire to monitor the current. (For the installation method of the current transformer, please refer to Steps 7 and 8.)

① Lc blue wire connection **a-phase** voltage



② Lc blue wire connection **b-phase** voltage



The wiring method for 6(b) and 6(c) is similar to that of 6(a). Please refer to the instructions provided for 6(a) for wiring guidance.

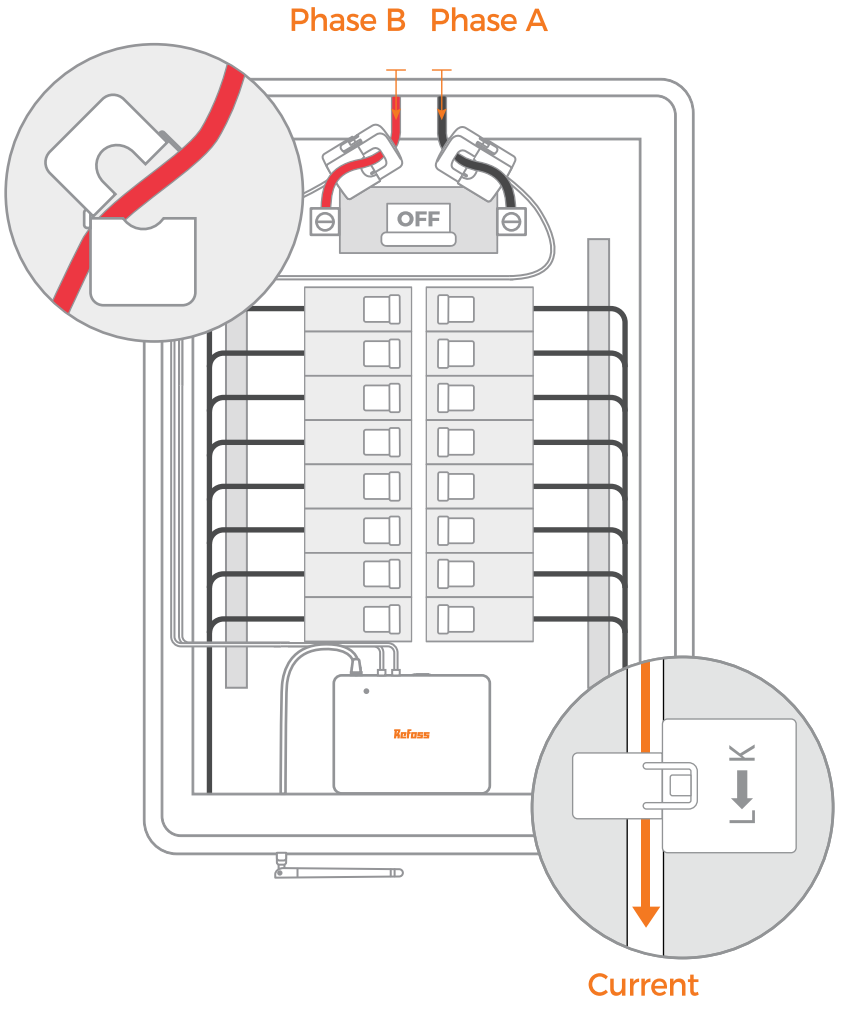
6(b) Single-phase, 2-wire systems
(Common in North American homes for lighting appliances, etc.)

6(c) Three-phase, 4-wire Wye systems with earthed (TN or TT) neutral (no-Delta)
(Common in North American industrial and large commercial power scenarios.)

Step 7: Connect the Main Current Transformers

Open the clasps on the main CTs, and according to the phase labels on the transformer, secure each clamp around one of the main service cables. Then, shut the clasps to secure the CTs.

When monitoring consumption, the current through the CT should flow K → L. Finally, insert the 200A current transformer audio jacks into the audio jack ports on the top of the energy monitor.

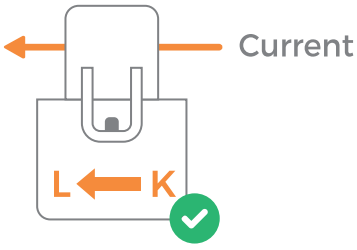


Danger: The service mains are energized!

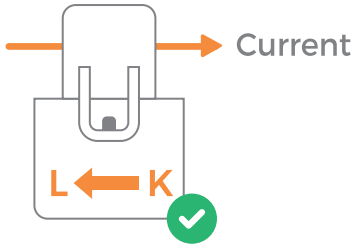
Step 8: Connect Current Transformers

Attach each CT clip securely to the hot leg of the circuit breaker you wish to monitor. Subsequently, connect the audio jack to the audio jack port located on the side of the Energy Monitor. Note the port number to name the circuit within the app.

1. Current direction
- When monitoring the wiring of your consumption, ensure that the current direction is as follows: K -> L.
- When monitoring the wiring of your solar feeder, ensure that the current direction is as follows: L -> K.



Consumption



Production

2. Phase and monitoring lines
Ensure the current transformer is correctly matched with its respective voltage collection line.

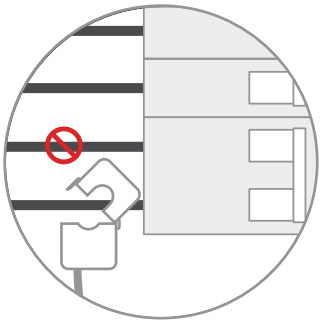
- La wire corresponds to the voltage of terminals **A1 to A6**.
- Lb wire corresponds to the voltage of terminals **B1 to B6**.
- Lc wire corresponds to the voltage of terminals **C1 to C6**.

(In single-phase, 3-wire systems, the wiring phase of the blue voltage detection line can be adjusted according to the number of circuits to be monitored.)

* If 2- or 3-pole breakers are to be monitored, we recommend that one CT be used for on each pole; however, to conserve the number of CTs, a single CT can be used. To use a single CT, clasp the clamp around either one of the non-neutral leads coming off the breaker (it doesn't matter which). When only one CT is used, input a circuit multiplier in the app to double or triple the reading by entering a "2" or "3". Using a single CT to monitor a multi-pole breaker does not accurately monitor unbalanced loads.
(When the circuit loads are similar, the error is smaller; when the circuit loads vary significantly, the error increases. Refoss recommends using this method only when there are insufficient current transformers available).



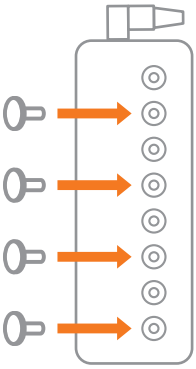
Most accurate
Attach one branch sensor on each leg of the breaker.



Less accurate
Attach one branch sensor on a single leg and use an app multiplier.

Step 9: Insulate Empty CT Audio Jack Ports

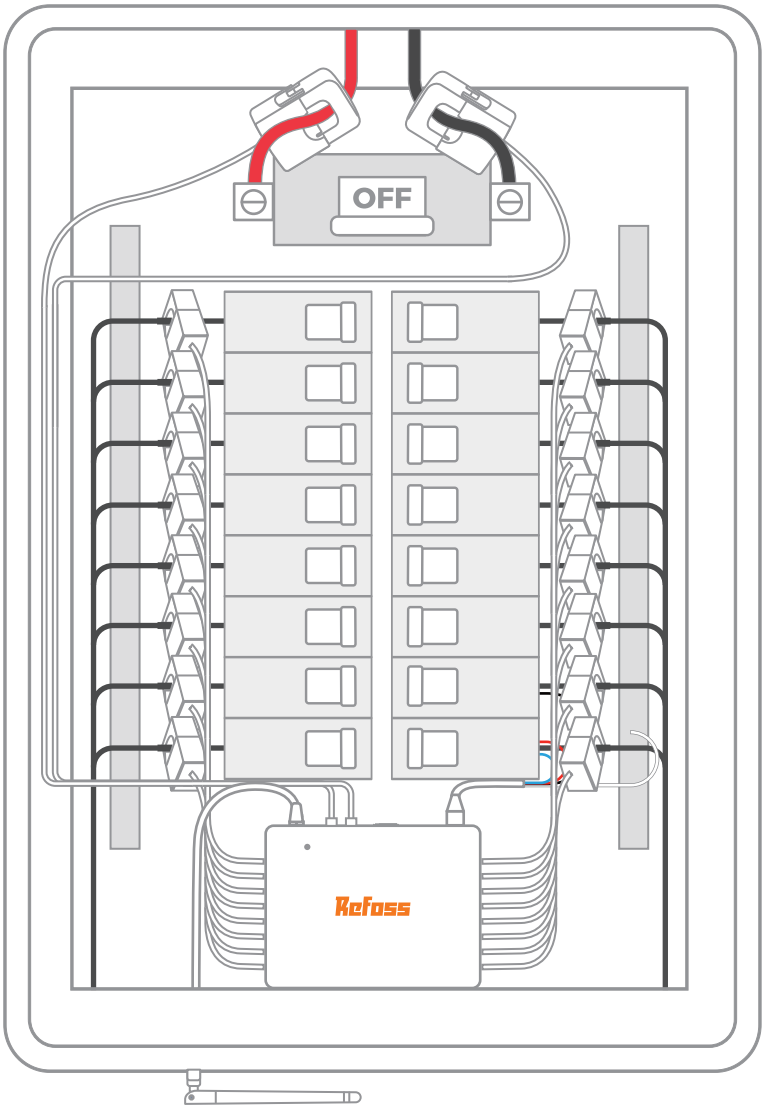
Securely insert the supplied 2.5 mm insulation plugs into each empty port on the EM16P to ensure complete insulation.



Step 10: Take a photo of your system

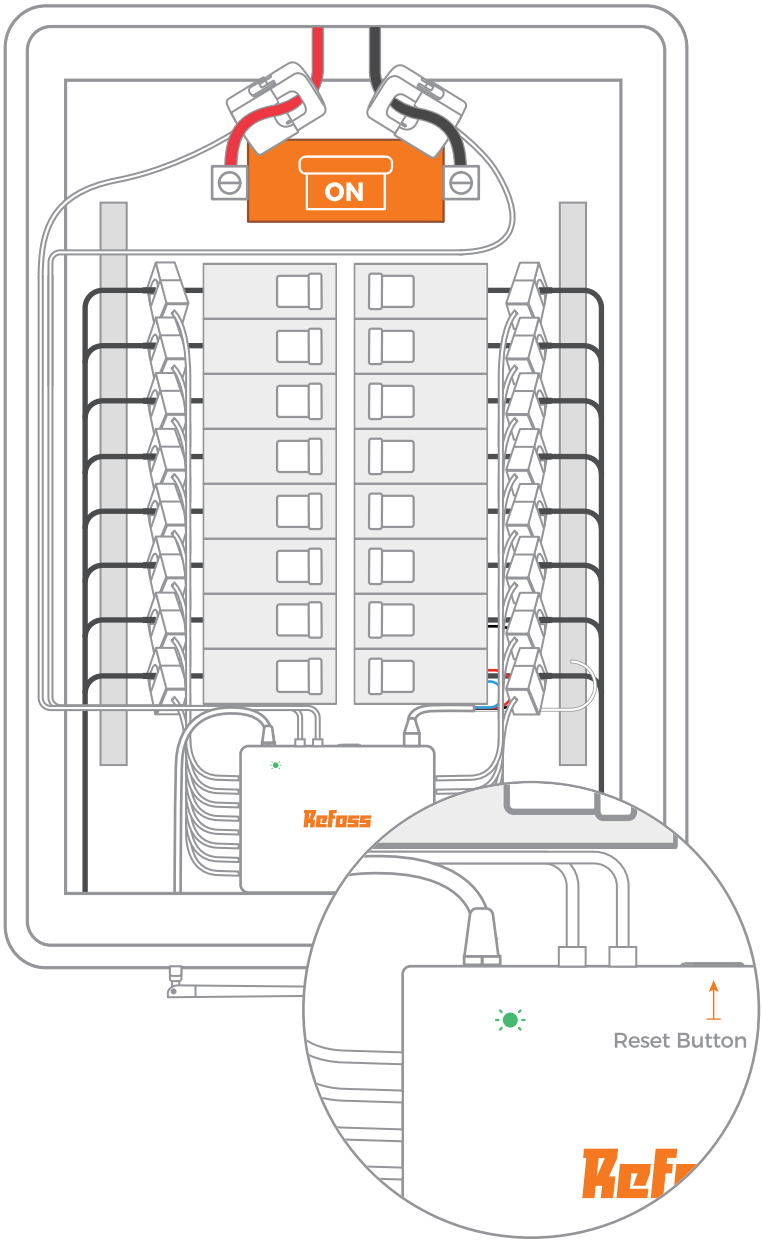
Before replacing your panel cover, take photos of the installation in case you need to contact support.





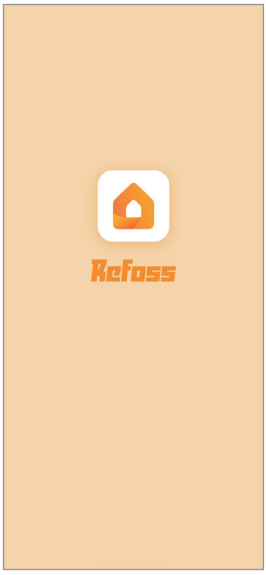
Step 11: Turn on the Power

Restore power to all circuits by reattaching the electrical box panel and turning on all circuit breakers that were turned off during installation. The unit's green LED should begin to flash slowly after 2 seconds. If the LED is flashing slowly, the unit is ready for configuration. If the LED is not blinking normally, press and hold the reset button for 5 seconds to reinitialize the unit.

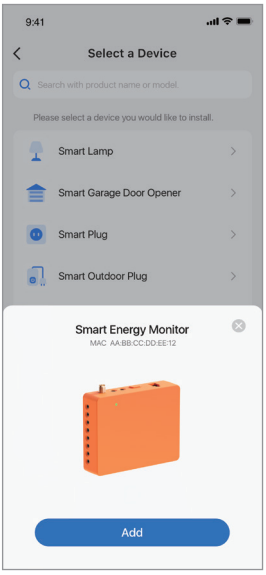


Step 12: Complete Setup

Open the Refoss app and click on the "+" in the upper right corner of the home page to add a discovered device via Bluetooth pairing.

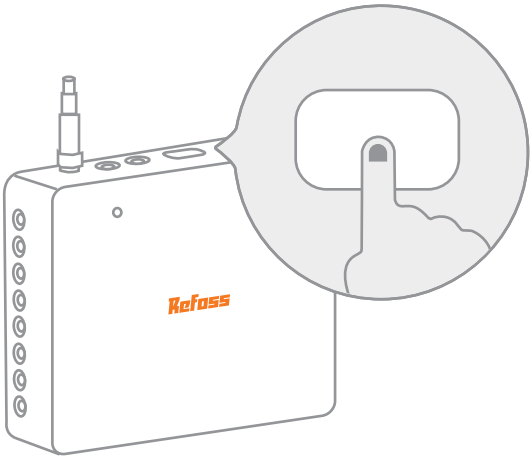






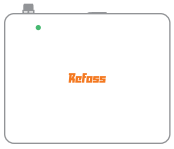
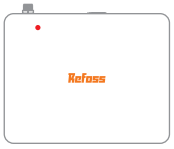
Button Function

Press and hold the button for 10s and then release the button, the device will reset. Device will enter the pairing mode after completing the reset, the green light blinks. Press and hold the button for 5 seconds to activate AP Mode for device configuration.



LED Rules

The Refoss EM16P Energy monitor features a single LED light on its front, providing insight into the internet connection status and power availability.

Solid Green	Green Blinking	Solid Red	Red Blinking
Normal operation	In pairing mode or firmware upgrade	Network unavailability	Wi-Fi disconnected
			

Tips:

In pairing mode: To connect, ensure Bluetooth is enabled and use the Refoss app to discover your device.

Network unavailability: The device is connected to the router, but the router has no internet connection. Please check the network status.

Wi-Fi Disconnected: Your device has lost connection with the router. Please check if the router is functioning properly and ensure that the Wi-Fi network is still available.

Web UI

This device supports local operation without connecting to the manufacturer's cloud services and without requiring any app download or registration, ensuring your privacy and data remain under your control.

After completing the initial setup via the device's built-in Wi-Fi hotspot, you can access the local web interface directly from your browser to perform all basic configurations and view device status.

1. Connect to the Wi-Fi **Refoss_xx_xxxxxxxx** (device hotspot). If it doesn't appear, long-press the button for 10s to reset.
2. Open your browser and go to **10.10.10.1**.
3. Set your home Wi-Fi under Settings > Network Settings > Wi-Fi. Once connected, note the new local IP address.
4. Use this IP to access the web interface or integrate with Home Assistant or other platforms.

Home Assistant Integration

For the full setup guide, please refer to the official documentation: https://github.com/Refoss/refoss_rpc

Home Assistant version required: 2025.2.5 or above.

Troubleshooting Guide

Here are some of our most frequent troubleshooting tips. For more help, please contact us at: **https://support.refoss.net/support/email_support**

After installing the EM16P, if the Refoss app cannot detect your device, follow these trouble-shooting steps:

a) Ensure power supply to EM16P:
- Confirm the EM16P has power by checking if the device LED blinks slowly in green (once every 0.5s). If not, press and hold the button for 10s to reset.
- Ensure the wire harness is securely connected and properly wired.
- Verify that the main circuit breaker is switched on.
- Ensure the breaker powering the EM16P is turned on.

b) Ensure Phone Connectivity:
- Make sure your phone is authorized for the Refoss app and has Bluetooth enabled.
- For Android users, activate Location Services to enable proper Bluetooth device scanning.
- iPhone users should ensure Bluetooth is allowed in Settings > Refoss app > Bluetooth Permissions.

c) Confirm EM16P Wi-Fi antenna installation:
- Check if the antenna is securely screwed into the energy monitor.
- Ensure the antenna is positioned outside the switch-board to avoid signal interference caused by the metal enclosure. If the antenna is placed inside the distribu-tion box, it will experience signal interference.

d) Attempt Power Cycling: Try power cycling the breaker connected to the EM16P.

e) Restart Refoss App: Restart the Refoss app on your phone.

f) Reboot Phone: If issues persist, reboot your phone.

Why is the Refoss app unable to obtain real-time current and consumption data from the EM16P?

- Ensure Proper Connection of Current Transformer: Check that the current transformer is securely plugged into the monitor. Loose connections can disrupt data transmission.
- Verify Load Device Status: Check that the cable with the transformer clipped to it is not connected to a load device that is not working. If the load device is not operational, it may not be drawing any current, resulting in no data being recorded.

Technical Specifications

Energy Monitor

Power Supply: 100-240V~, 50/60Hz

Supported System:

- Single-phase, 3-wire systems (split phase or dual phase)
- Single-phase, 2-wire systems
- Three-phase, 4-wire Wye systems with earthed (TN or TT) neutral (no-Delta)

Voltage-current Correspondence:

- Black -> A1~ A6, Power
- Red -> B1~ B6
- Blue -> C1~ C6

Dimensions(W x D x H): 4.5 x 3.5 x 1.1 in. (Monitor size)

Wireless Standard: IEEE 802.11 b/g/n, 2.4GHz

Operating Conditions: -20˚C~40˚C (-40˚F~104˚F), 0%~80% RH (Non-condensing)

System Requirement:

-Smartphone running iOS 13 or later or Android 8.0 or later, supporting Bluetooth 4.0 or later

-Existing 2.4GHz Wi-Fi network

Main Current Transformers

Max Primary Current: 200A

Max Voltage: 250V (Primary) / 333mV (Secondary)

Burden Resistor: 7.2ohm, 1%, 62.5mW

Cable Length: 1m

Inside Diameter: 24 mm

Accuracy: ±2%

Branch Current Transformers

Max Primary Current: 60A

Max Voltage: 250V (Primary) / 333mV (Secondary)

Burden Resistor: 18.2ohm, 1%, 62.5mW

Cable Length: 1m

Inside Diameter: 10 mm

Accuracy: ±2%

Warranty

Refoss products are covered by a 12-month limited warranty from the date of its original purchase. If any problems occur, please contact **support@refoss.net** for help.

Disclaimer

1. The function of this smart device is tested under a typical circumstance described in our specifications. Refoss does NOT guarantee that the smart device shall perform exactly the same as described under all circumstances.

2. Refoss's total liability is limited to what is expressly covered in its Privacy Policy.

3. Damages arising from ignorance of the SAFETY INFORMATION shall not be covered by Refoss after-sales service, nor does Refoss take any legal responsibility therefrom.

Customers acknowledge understanding of these articles clearly by reading this manual.

FCC Compliance Information Statement

Changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate the equipment.
This device complies with Part 15 of the FCC Rules, operation is subject to the following two conditions:

(1) this device may not cause harmful interference, and
(2) this device must accept any interference received, including interference that may cause undesired operation.

Note: 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.

This equipment complies with FCC radiation exposure limits set forth for an uncontrolled environment. This equipment should be installed and operated with a minimum distance of 20cm between the radiator & your body. This transmitter must not be co-located or operating in conjunction with any other antenna or transmitter.

Canadian Compliance Statement

This device contains licence-exempt transmitter(s)/receiver(s) that comply with Innovation, Science and Economic Development Canada's licence-exempt RSS(s). Operation is subject to the following two conditions:
(1) This device may not cause interference.
(2) This device must accept any interference, including interference that may cause undesired operation of the device.

L'émetteur/récepteur exempt de licence contenu dans le présent appareil est conforme aux CNR d'Innovation, Sciences et Développement économique Canada applicables aux appareils radio exempts de licence. L'exploitation est autorisée aux deux conditions suivantes :

1) L'appareil ne doit pas produire de brouillage;
2) L'appareil doit accepter tout brouillage radioélectrique subi, même si le brouillage est susceptible d'en compromettre le fonctionnement.

The device meets the exemption from the routine evaluation limits in section 6.6 of RSS 102 and compliance with RSS-102 RF exposure, users can obtain Canadian information on RF exposure and compliance.

Le dispositif rencontre l'exemption des limites courantes d'évaluation dans la section 6.6 de RSS 102 etla conformité à l'exposition de RSS-102 rf, utilisateurs peut obtenir l'information canadienne surl'exposition et la conformité de rf.

This transmitter must not be co-located or operating in conjunction with any other antenna or transmitter. This equipment should be installed and operated with a minimum distance of 20 centimeters between the radiator and your body.

Cet émetteur ne doit pas être Co-placé ou ne fonctionnant en même temps qu'aucune autre antenne ouémetteur. Cet équipement devrait être installé et actionné avec une distance minimum de 20 centimètres entre le radiateur et votre corps.

SIMPLE DEVICE
SIMPLIFY YOUR LIFE

Email: support@refoss.net
Website: www.refoss.net

MADE IN CHINA
INDOOR USE ONLY CAN ICES-3(B)/NMB-3(B)
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