

## Best Practices for Using Enphase Current Transformers (CTs) in Australia and New Zealand

### Introduction

A Current Transformer (CT) is a current measurement device used in conjunction with the Enphase Envoy-S Metered to measure power flowing through a cable. Enphase provides a proprietary CT solution.


**Only use Compatible CTs for Enphase Installations.**

This document provides information on:

- Identifying the correct CT
- Identifying the correct CT terminals on the Envoy
- Extending CT wiring
- Confirming CTs are installed correctly
- Tips for installing CT's


### Identifying the Correct CT

The Enphase Envoy-S Metered is supplied with two CTs: one to measure the solar generation current (production) and one to measure the consumption current.

Envoy Type	Compatible CT
<b>Envoy-S Metered + DRM</b> SKU: ENV-S-WM-230 Note: All units are multiphase	Rated for 200A Enphase SKU: CT-100-SPLIT 
2x supplied with every Envoy-S Metered You can order additional CTs individually for monitoring multiphase site installations.	



## Enphase Compatible CTs

Some installations may require alternative CTs to complete the site requirements.

Envoy Type	Compatible CT
<b>Envoy-S Metered + DRM</b>  SKU: ENV-S-WM-230 Note: All units are multiphase	Rated for 100A Enphase SKU: CT-100-SPLIT-ROW 

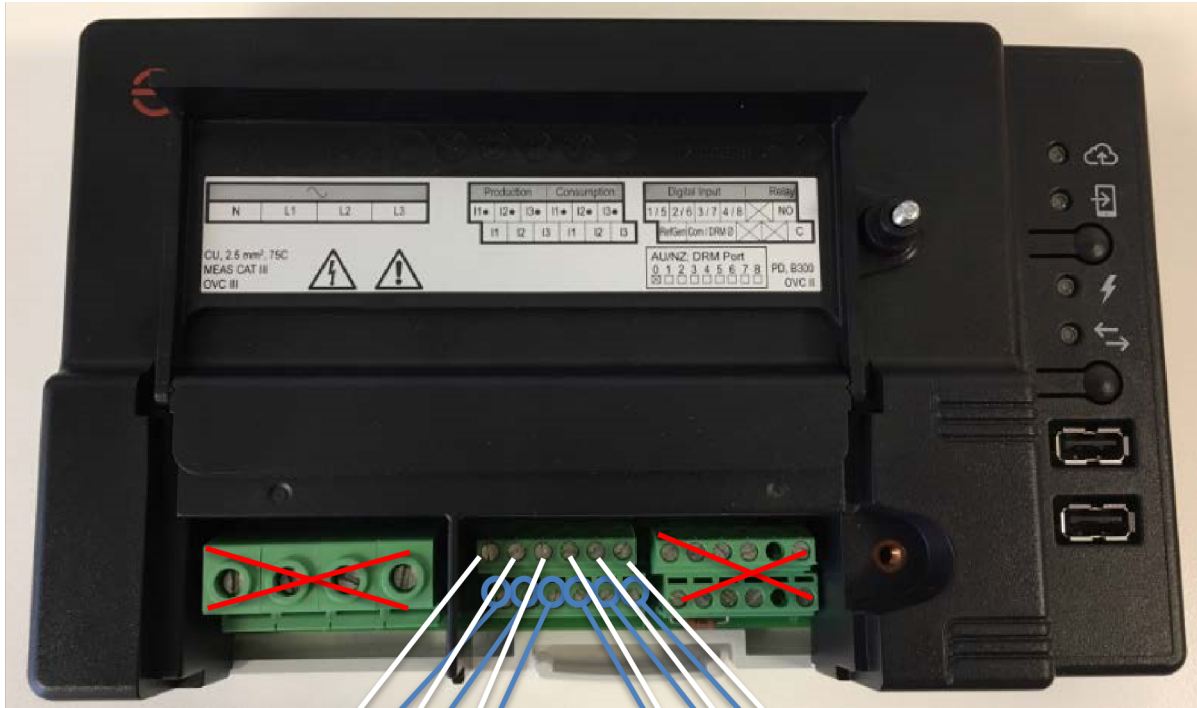
## Third Party Compatible CTs

Some installations may require alternative CTs to complete the site requirements. This table lists the compatible products available through Authorised Enphase Distributors.

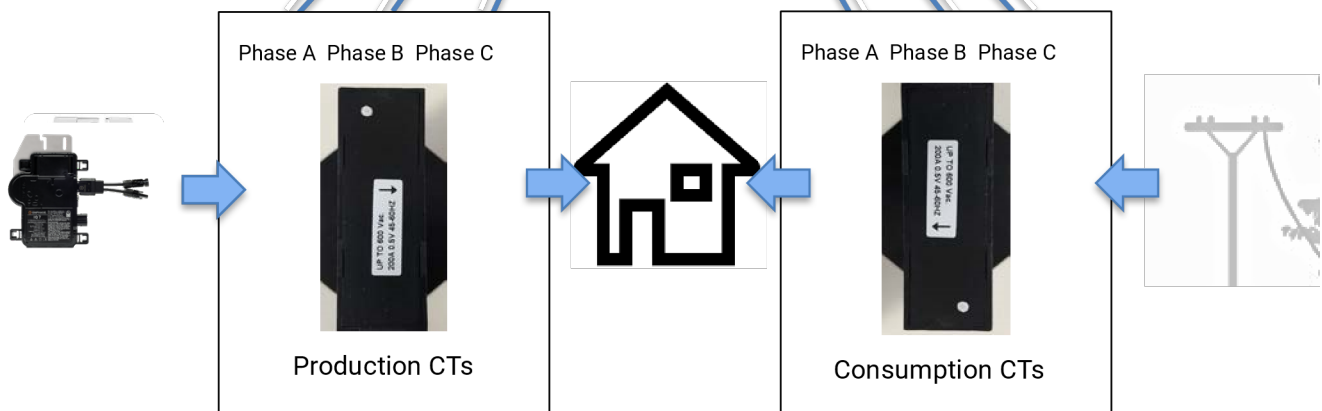
Envoy Type	Compatible CT
<b>Envoy-S Metered + DRM</b>  SKU: ENV-S-WM-230 Note: All units are multiphase	Rated for 80A 3 <sup>rd</sup> Party Product 
<b>Envoy-S Metered + DRM</b>  SKU: ENV-S-WM-230 Note: All units are multiphase	Rated for 400A 3 <sup>rd</sup> Party Product 

## Identifying the correct CT terminals on the Envoy-S Metered

### Envoy-S Metered + DRM (SKU ENV-S-WM-230)



### Envoy-S Metered + DRM (SKU ENV-S-WM-230-WM-M)



## Extending CT Wiring

Each CT includes a 2m flying leads for wiring the CT directly into the Envoy-S metered terminals.

These wires may be extended to a maximum 1.5 Ohms per wire, 3 Ohms for both wires end to end.

Appropriately rated, 0.75mm<sup>2</sup> to 1.5mm<sup>2</sup>, twisted pair wire cable is recommended. Install in accordance with all applicable electrical codes and standards.

Some options:

Manufacturer	Cable Description	Recommended Max CT Extension (m)
Elcon Cables	Elcon/ <a href="#">LAPP</a> Instrumentation cable 1.5 mm <sup>2</sup> (1 or 3 core). 500 VAC, test voltage 2,000 Vac (PCV/Foil/PVC V90 -30°C to 105°C)	100
Clipsal CBus	Cat. 5e rated 4 pair Unshielded Twisted Pair (UTP) cable but with a unique pink coloured main rated outer sheath that unlike standard Cat5E, can legally cohabitate in electrical enclosures with 240-volt wiring.	50
Belden	Belden 8471NH Unshielded Twisted pair cable (1.33mm <sup>2</sup> )	75
Olex, General Cable, Electra Cables	Twin Active 1.5mm <sup>2</sup> TPS (AS/NZS 5000.2) (must be twisted gently by hand 20 twists per metre, V-90, PVC, 90°C)	100
Olex, General Cable, Electra Cables	Twin Active 2.5mm <sup>2</sup> TPS (AS/NZS 5000.2) (must be twisted gently by hand 20 twists per metre, V-90, PVC, 90°C)	200

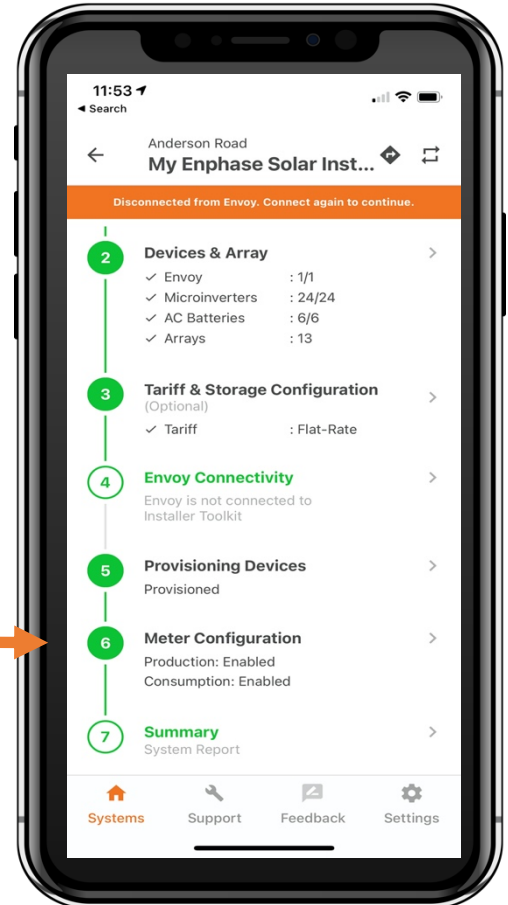
## Confirming CTs are Correctly Installed

Use Enphase Installer Toolkit to verify that the CTs are correctly installed and measuring accurately. Use the Installer Toolkit Wizard, to commission the CTs,

To confirm CTs are correctly commissioned, you can also follow these steps:

### Check that Meters are enabled

1. Connect the Enphase Installer Toolkit app to the Envoy via network or AP mode.
2. Select **Meters** from the menu.
3. Verify the required meters are **enabled** (indicated by the green ticks).
4. If not select the meter, and enable them as described in the in-app support of Installer Toolkit.

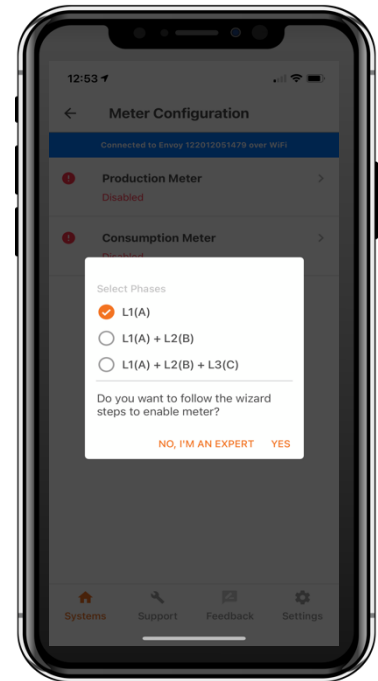


## Verify Production & Consumption Meter Readings

### Select the **Production Meter**.

(NOTE: you will also repeat this step for Consumption Metering)

1. Verify the number of phases is correct.
  - Single Phase: L1(A)
  - Two Phase: L1(A) and L2(B)
  - Three Phase: L1(A), L2(B), and L3(C)

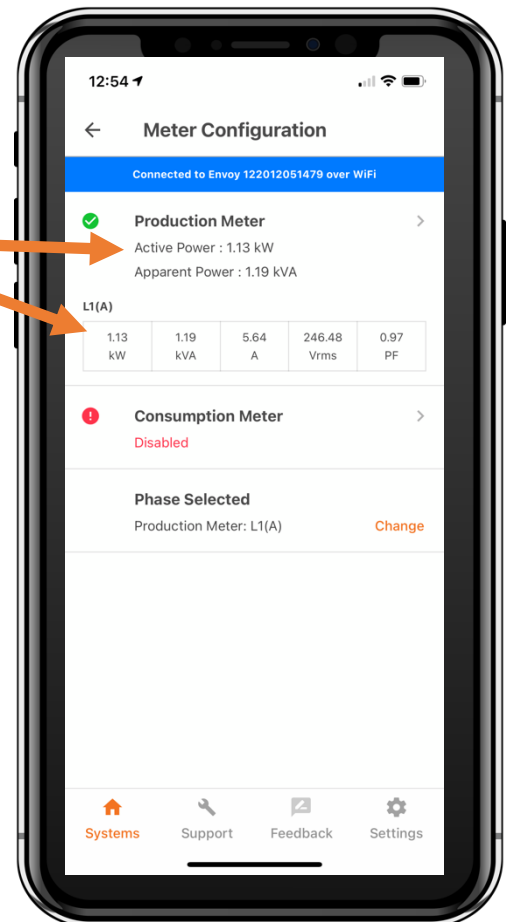


2. Expand the active power measurements by selecting the drop down arrow on the right.
3. Confirm that the power measurement is positive, for each reading on the Toolkit display.

In the example, this value is 1.13 kW.

If Installer Toolkit displays a **negative** power level, check that CT polarity is correct. The production CT arrow should point away from the microinverters towards the switchboard.

4. Confirm that the CT is reading current correctly. In the example, 5.64 A is the current flowing from the inverters to the switchboard. Confirm this reading with an AC clamp meter. If this reading is not correct, check that the CT is closed and connected to the correct terminal of the Envoy.
5. Confirm that the Envoy has measured the correct AC voltage with an AC Voltmeter. In the example, the Envoy measured 246.48 V.
6. Confirm the power factor (PF) is correct. In the example, this value is 0.97 PF. Generally, the power factor will be in the range 0.7 to 1 when the microinverter production is at least 230W.

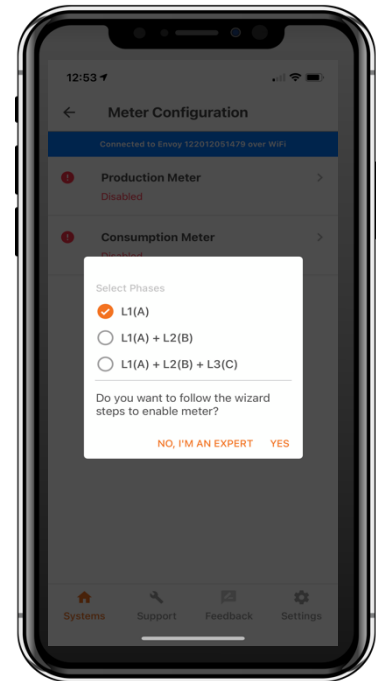


## Select the **Consumption Meter**.

7. Verify in **Phase Selected** that the number of phases is correct.
8. Verify that the **Metered Circuit** is correct. When selecting CT option **Load with solar production**, ensure the Consumption CT is:
  - Installed line side of the Main Switchboard loads.  
(Note any solar export will also be measured in this position)
  - CT direction arrow is pointing towards the switchboard, (pointing away from the electricity meter).
  - CT in wired into the correct Envoy Terminals, and phase connections.

Only use the **Load only** mode if the CT is installed only on the load circuits

9. Select **Yes**, if you want to be guided through a Metering setup Wizard, or **No, I'm an Expert**, and proceed to the next step.



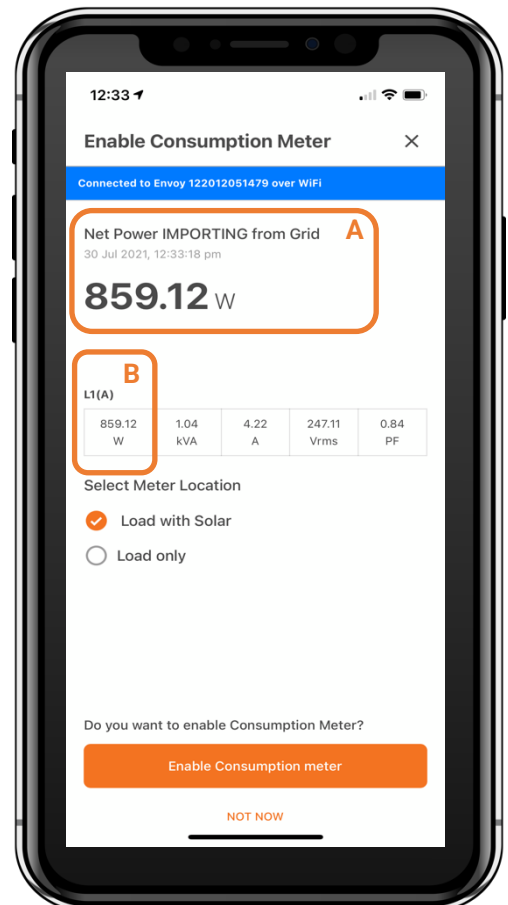
### A. CT MEASUREMENTS – IMPORT

10. Confirm power measurement is reading positive. Ensure the Active Power reading also displays (Importing from Grid). **Always ensure this is a positive value and is correctly reflects what is occurring in the property.**

In the example, this shows a value **859.12W (Net Power IMPORTING from Grid (A))**. When Importing from Grid, the Installer Toolkit also displays the W power level in the data table (B), this is a positive number, because production is less than Consumption, so loads are importing from the meter.

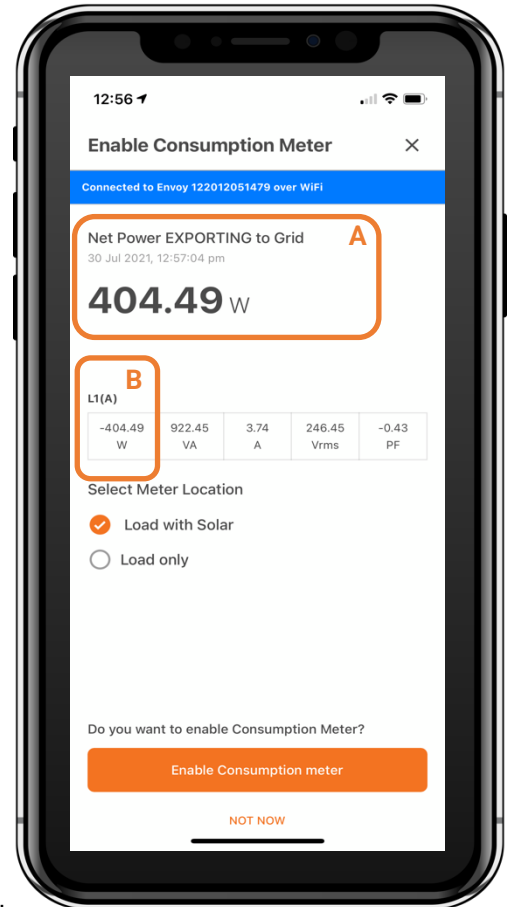
Re-check that the consumption CT polarity is correct, and are installed around the active conductor. The CT arrow should ALWAYS point from the grid supply on the street to the switchboard.

11. Use an AC current clamp to confirm that the consumption CT is reading current correctly. In the example, this value is 4.22A. If this reading is not correct, check that the CT is closed and connected into the correct terminal of the Envoy.
12. Confirm that the Envoy has measured the correct AC voltage with an AC Voltmeter. In the example, the Envoy measured 247.11V.
13. Confirm the power factor (PF) is correct. In the example, the value is 0.84 PF. Generally, the power factor for load will be in the range 0.5 to 0.99 when the load is at least 230 W. A very low power factor is possible when voltage is out of phase to current measurement. Ensure that each CT and Envoy voltage supplies always match in multiphase sites.



## B. CT MEASUREMENTS – EXPORT

14. In the example, this shows a value **404.49W (Net Power EXPORTING to Grid (A))**. When Exporting, the Installer Toolkit also displays the W power level in the data table (B). This is a **negative** number because production is greater than consumption (Solar production is now exporting to the meter, so the Consumption CT is seeing a reverse current flow).
15. Re-check that the consumption CT polarity is correct, and installed around the active conductor. The CT arrow should ALWAYS point from the grid supply on the street towards the switchboard.
16. Use an AC current clamp to confirm that the consumption CT is reading current correctly. In the example, this value is 3.74A. If this reading is not correct, check that the CT is closed and connected to the correct terminal of the Envoy.
17. Confirm that the Envoy has measured the correct AC voltage with an AC Voltmeter. In the example, the Envoy measured 246.45V.
18. Confirm the power factor (PF) is correct. In the example, the value is -0.43 PF. Generally, the power factor for load will be in the range 0.5 to 0.99 when the load is at least 230 W. A very low power factor is also possible when exporting, or voltage is out of phase to current measurement. Ensure that all CTs and Envoy voltage supplies match across multiphase sites.





## Multiphase CT Measurements

Use the Toolkit to confirm each of your multiphase CT connections are measuring correctly:

### Production Meter

In the example, this shows per phase power readings for Production Meter, and Consumption Meter values.

L1(A), L2(B), and L3(C) each show approximately 1kW of solar generation.

The total Production is displayed as 3.33kW Active Power.

### Confirm the power factor (PF) is correct:

In the example, Power factor on each phase is between 0.98-0.99. Generally, the power factor for load will be in the range 0.5 to 0.99 when the load is at least 230 W.

When solar is producing, if the PF is very low on all phases, or on 2/3 phases, this is an indicator of mis-wired CTs across the phases, at the Envoy CT terminals, or crossed phase connections within the installation.

### Consumption Meter

This example displays total Active Power of 2.18kW (Exporting to Grid). **Always ensure this is a positive value and is correctly reflects what is occurring in the property.**

Note consumption per phase readings are now **negative**. L1(A), L2(B), and L3(C) each show **negative** readings. This is a negative number because production is greater than consumption (Loads are exporting to the meter, so the Consumption CT is seeing a reverse current flow).

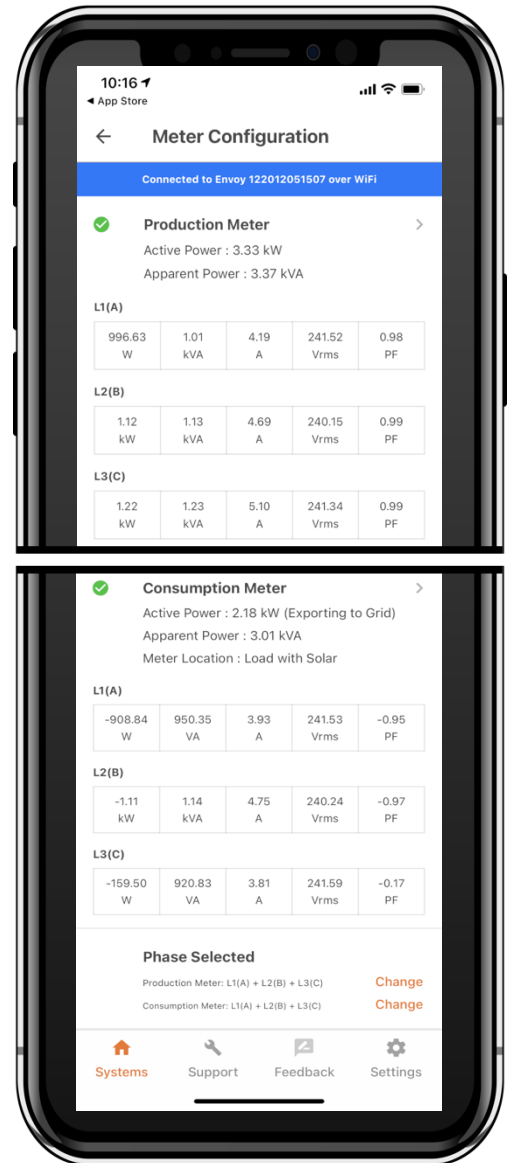
**TIP:** When exporting, the Consumption PF readings may read lower than 0.5.

Turn off, the Solar and turn on loads to correctly measure load, and confirm PF for each phase. each consumption CT is correctly connected.

Re-check that the consumption CT polarity is correct and installed around the corresponding, active conductor. The CT arrow should ALWAYS point from the grid supply on the street towards the switchboard.

Use an AC current clamp to confirm that the consumption CT is reading current correctly. In the example, this value is 3.74A. If this reading is not correct, check that the CT is closed and connected to the correct terminal of the Envoy.

Confirm that the Envoy has measured the correct AC voltage with an AC Voltmeter. In the example, the Envoy measured 246.45V.



## Tips for Installing CTs Safely and Successfully

Install the CTs as directed in the *Envoy-S Metered Quick Install Guide*, following all safety instructions and warnings.



**DANGER:** Risk of electric shock. Always de-energise circuits before wiring for power and CTs.

**DANGER:** Risk of electrocution! Do not install CTs when current is flowing in the sensed circuit. Always install CT wires in the terminal blocks before energising the sensed circuit.

### Mark Each End of the CT Wires

Colour code each end of the CT wiring so you can quickly identify the correct CT Envoy terminal. This can be especially helpful in a multiphase installation.

### Terminate the CT Wiring Before Closing the CT

Remember, CTs can produce dangerous voltage and current if left unterminated while closed around an active conductor.

### CT Noise

If the CT is making a buzzing noise, it has not been terminated to the Envoy correctly or there may be a break in the wiring. Open the CT and check the wiring.

### Close the CT

If a CT is not fully closed, measurements will not be accurate. Always ensure that the CT is fully closed once fitted.

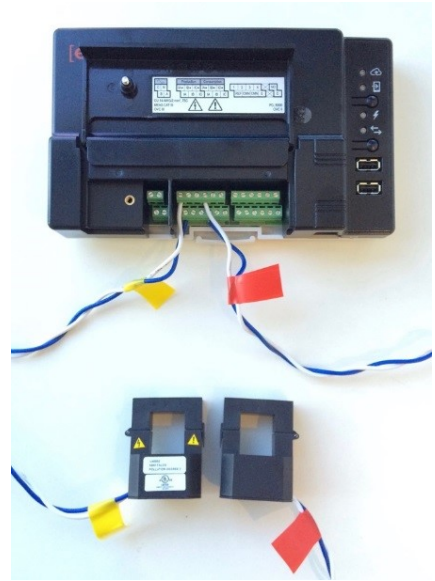
### CT Polarity

Using Enphase Installer Toolkit, confirm that the CTs are enabled and measuring correctly. Confirm readings with an AC clamp meter. The arrows on an AC clamp meters indicate the direction of typical energy flow. For example, solar (production) energy should flow from the solar modules to the switchboard. Consumption energy should flow from the electricity supply to the switchboard.

### Parallel CTs into the Envoy

The Envoy can allow a maximum of 2x CT-100-SPLIT, (or corresponding matching CT), per CT screwed terminal. Each CT has an output current of 80mA. The Envoy CT terminals can absorb a maximum current of 160mA.

This can be useful when measuring total production where Enphase AC microinverters are installed alongside other existing solar installations on one property, and on the same phase.



Colour coded CT Wires



A closed CT

### ***CT Polarity***

Enphase CTs must be facing the correct direction using the CT arrows to confirm. CTs cannot be remotely changed via software if installed in reverse on site.

### ***Enphase Customer Support***

Enphase Customer Support technicians can make some adjustments to the Envoy-S Metered remotely if an internet connection is in place. Adjustments that may be made remotely on request:

- Enabling CTs
- Number of Phases
- Metered Circuit

Call **1800 006 374** to reach Enphase Customer Support.