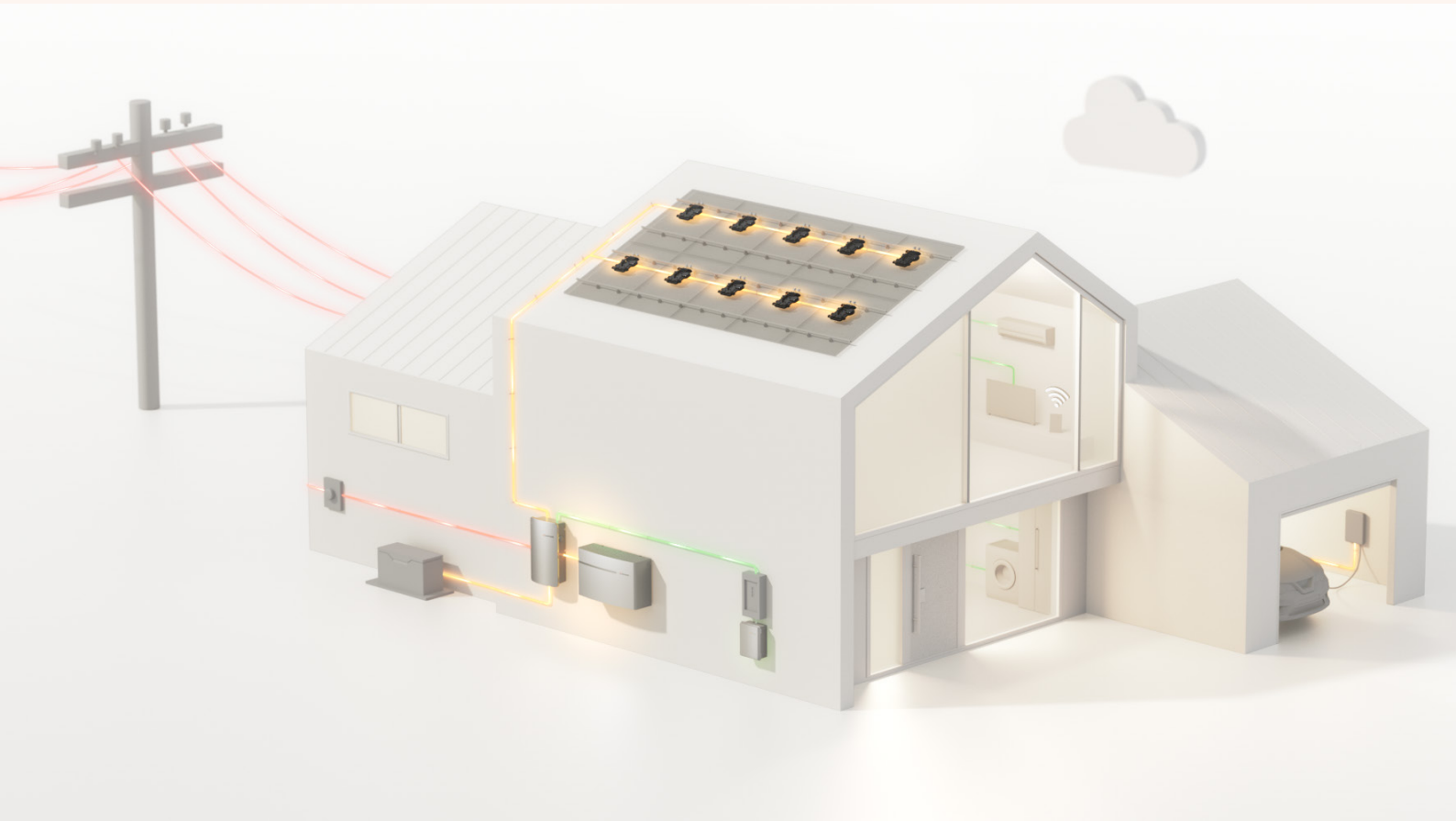


Enphase current transformer (CT) troubleshooting



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1 Introduction

This technical brief explains how to troubleshoot and correct Enphase current transformer issues. Current transformers (CTs) measure current on their primary circuit by creating an accurate ratio reference current on their secondary circuit based on the current flow on the primary circuit. They achieve this by a pre-defined ratio of the primary and secondary turns of the transformer.

2 How is energy flow created with CTs?

Enphase systems use CTs for consumption and production monitoring. That way, energy production and energy consumption data is captured. The number of CTs required is determined by the number of phases present in the system. Usually, if the system is single-phase, two CTs are needed, one for production and a second for consumption measurement. If the system is three-phase, six CTs are required. Three on the production side, one per phase, and three on the consumption side, one per phase.

3 Common issues with CTs

If measurements are incorrect and one or more of the following symptoms are observed on monitoring, CT installations must be checked.

- Missing measurements
- Negative consumption (during nighttime or when PV is switched off)
- Negative production
- Incorrect power factor

Each issue could happen due to various reasons. The installation must be checked methodically.

4 How to troubleshoot CT issues

Issues generally happen due to the miswiring of CTs. Troubleshooting should start with the simplest checks. The following are the recommended steps:

1. Make sure the arrows on the CT body always point toward the electrical load.
2. Phase labels at the CTs match phase labels on the IQ Gateway terminals.
3. Terminate each CT cable at the correct IQ Gateway terminal.

5 Checking Consumption CT installation

5.1 If the Consumption CTs are far away from the IQ Gateway



WARNING: Switch the main circuit breaker to the OFF position before starting any electrical work on CTs. Make sure that the circuit breaker is not accidentally energized during work. Measure the voltage on the circuit breaker's load side to make sure the circuits are not live, and it is safe to work. Remember that there will always be voltage present in the input of the main circuit breaker.

Check the arrow on the Consumption CTs: There is an arrow on each Consumption CT. This arrow must always point toward the electrical loads. If the arrow points in the wrong direction, it must either be physically corrected on-site, or each CT polarity can be flipped using the Enphase Installer Portal via a software setting.

Check the phase labels match: The IQ Gateway terminal labels identify phase and neutral. This must match the phases measured. Remember that in a three-phase system, consistency in labelling is crucial. L1 labelled phase may be different from L1 from the grid.

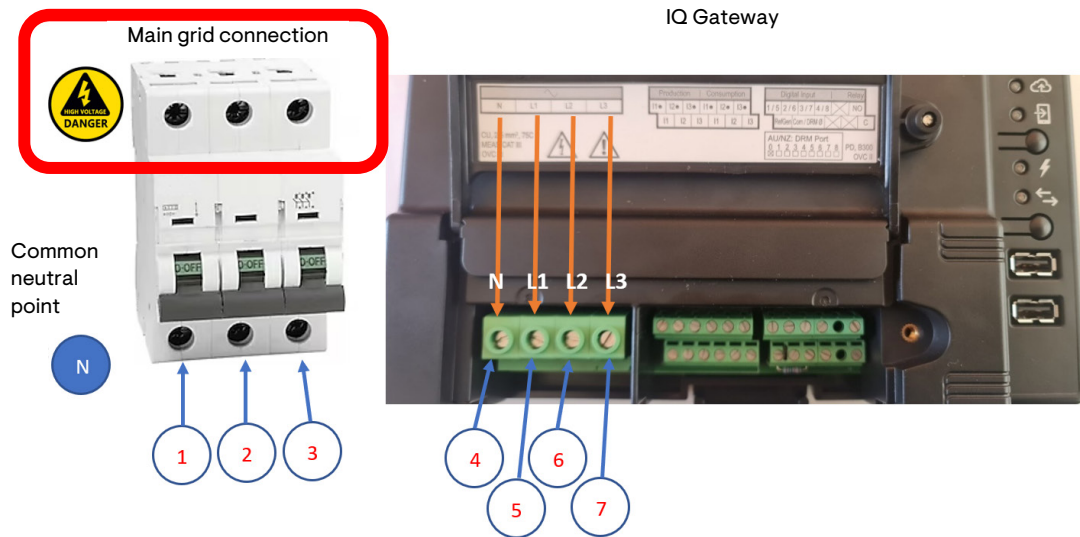


Figure 1: Numbering the points

Label the points: Label each terminal as shown in [Figure 1: Numbering the points](#). Label the Consumption CTs based on the numbers of the circuit breaker terminals.

Short circuit N with point numbers 1, 2, and 3 one after another:



DANGER: Ensure that terminals are not live. If this process is done under voltage, it will cause a short circuit which can lead to injury or death.

Switch all circuit breakers to the OFF position except for the PV circuit breaker in the distribution box, which should be in the ON position. This is necessary because all the loads connected to the system must be disconnected. If they are not disconnected, measurements will be incorrect.

Bridge N and point 1. Set the multimeter to resistance measurement and measure between points 4 and 5. Measurement should be a short circuit or very low resistance, depending on the cable length between the IQ Gateway and the main electrical panel. If the measurement shows a different value, such as an open circuit, continue measuring between points 4 and 6 and points 4 and 7. The measurement which shows a short circuit or very low resistance is the phase to which IQ Gateway should be connected. Repeat the test until all phases are identified. Change the bridge N between 1 to points 2 and 3 (phases) after each phase identification.

5.2 If the Consumption CTs are close to the IQ Gateway

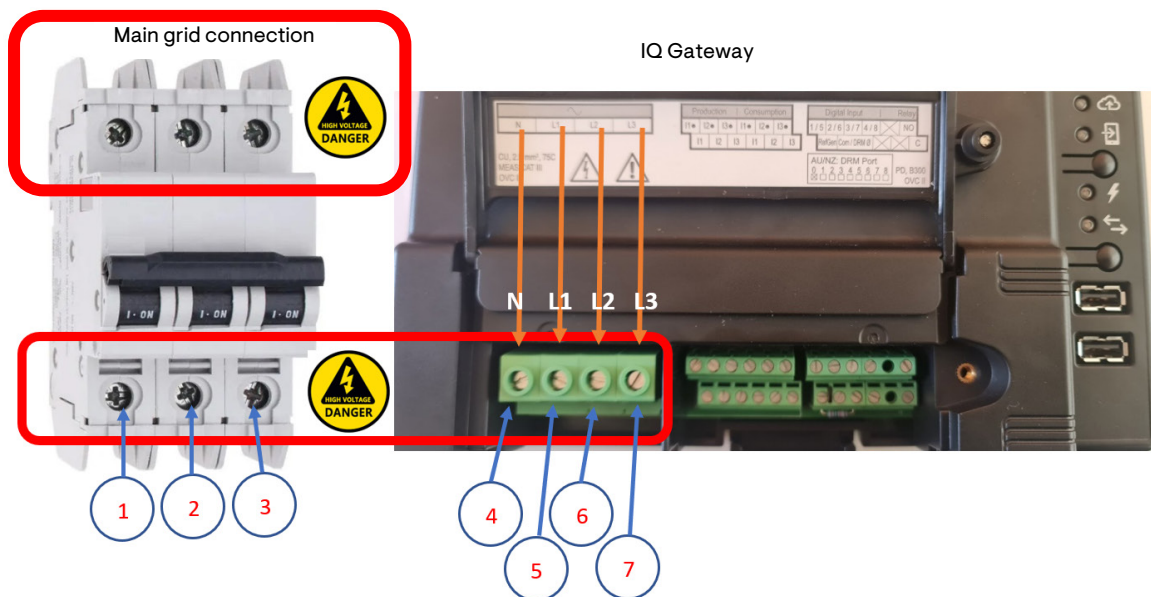


Figure 2: Numbering the points



WARNING: Measurements must be made while the measurement points are live. Take the necessary precautions since the circuits to be tested are live.

Check the arrow on the Consumption CTs: There is an arrow on each Consumption CT. This arrow must always point toward the electrical loads. If the arrow is pointing in the wrong direction, it must either be physically corrected on-site, or each CT polarity can be flipped via the Enphase Installer Portal via a software setting.

Check the phase labels match: The IQ Gateway terminal labels identify phase and neutral. This must match the phases measured. Remember that in a three-phase system, consistency in labelling is crucial. L1 labelled phase may be different from L1 from the grid.

Label the terminals: Label each terminal as shown in [Figure 2: Numbering the points](#). Label the Consumption CTs based on the marking shown on the circuit breaker.

Measure phases on the circuit breaker against the IQ Gateway: Set the multimeter to AC measurement and measure the voltage between points 1 and 5. Measurement should be around 0 V depending on the cable length between the IQ Gateway and the main electrical panel. If the measurement shows a different value, such as 400 V, continue measuring between points 1 and 6 and points 1 and 7. The measurement which shows close to 0 V is the phase to which the IQ Gateway should be connected. Repeat the test until all phases are identified.

6 Checking Production CT installation

6.1 If the Production CTs are far away from the IQ Gateway



WARNING: Switch the main circuit breaker to the OFF position before starting any electrical work on CTs. Make sure that the circuit breaker is not accidentally energized during work. Measure the voltage on the circuit breaker's load side to make sure the circuits are not live, and it is safe to work. Remember that there will always be voltage present in the input of the main circuit breaker.

Check the arrow on Production CTs: There is an arrow on each Production CT. This arrow must always point toward the electrical loads. If the arrow is pointing in the wrong direction, it must either be physically corrected on-site, or each CT polarity can be flipped via the Enphase Installer Portal via a software setting.

Check the phase labels match: The IQ Gateway terminal labels identify phase and neutral. This must match the phases measured. Remember that in a three-phase system, it is not related to phase rotation. Phase rotation does not need to be matched with the labels. Phase and neutral are also labelled on the IQ Relay.

Short circuit N with phases on the IQ Relay (grid side):



DANGER: Ensure that terminals are not live. If this process is done under voltage, it will cause a short circuit which can lead to injury or death.

Bridge N and L1 on the IQ Relay (grid side). Set the multimeter to resistance measurement and measure between points 4 and 5, as shown in [Figure 2: Numbering the points](#). Measurement should be short-circuited or very low resistance depending on the cable length between IQ Gateway and PV electrical panel. If the measurement shows a different value, such as an open circuit, continue measuring between points 4 and 6 and points 4 and 7. The measurement shows short circuit or very low resistance is the phase on which IQ Gateway should be connected. Repeat the test until all phases are identified. Change the bridge between phases and Neutral connection on IQ Relay (grid side) after each phase identification.

6.2 If the Production CTs are close to the IQ Gateway



WARNING: Measurements must be made while the measurement points are live. Take the necessary precautions since the circuits to be tested are live.

Check the arrow on Production CTs: There is an arrow on each Production CT. This arrow must always point toward the electrical loads. If the arrow is pointing in the wrong direction, it must either be physically corrected on-site, or each CT polarity can be flipped via the Enphase Installer Portal via a software setting.

Check the phase labels match: The IQ Gateway terminal labels identify phase and neutral. This must match the phases measured. Remember that in a three-phase system, it is not related to phase rotation. Phase rotation does not need to be matched with the labels.

Measure phases on the IQ Relay against the IQ Gateway: Set the multimeter to AC measurement and measure the voltage between L1 on the IQ Relay (PV side) and L1 on the IQ Gateway. Measurement should be around 0 V depending on the cable length between IQ Gateway and PV electrical panel. If the measurement shows a different value, such as 400 V, continue to measure between L1 on IQ Relay (PV side) and L2 on IQ Gateway and L1 on IQ Relay (PV side) and L3 on IQ Gateway. The measurement which shows near 0 V is the phase to which IQ Gateway should be connected. Repeat the test until all phases are identified.

7 CT allocation check via Enphase Installer App

To check the CT allocation through the Enphase Installer App, follow these steps:

1. Connect the Enphase Installer App to the IQ Gateway by activating its AP mode as described in the *IQ Gateway Quick Installation Guide*.
2. Switch the PV circuit breaker to the OFF position or turn the PV power to the OFF position via the Enphase Installer App.
3. Go to the consumption monitoring in the Enphase Installer App to turn on some loads to consume power on each phase.
4. If Production CTs are to be checked, PV production must be available, and if Consumption CTs are to be checked, PV production must not be present.



NOTE: The PV main breaker can be flipped, or PV production can be stopped via the Enphase Installer App.

5. Navigate to **Meter Configuration** in the Enphase Installer App and then, select **Production Meter** for Production CT check or **Consumption Meter** for Consumption CT check.

7.1 Consumption CTs check for phase allocation

Switch the PV main circuit breaker to the OFF position. This ensures that PV production will not affect the test. Run loads on each phase to see that consumption values are showing in the Enphase Installer App. Unclip the CT and remove it from the cable on the phase identified in the [Checking Consumption CT installation](#) section 5. The Unclipped phase measurement should disappear from the Enphase Installer App. If not, there is incorrect wiring. Correct the measurement by connecting the disappeared phase to the correct IQ Gateway terminal. Repeat the same test for each phase and make sure that all CTs are on the correct phase.

In case of negative measurement on any phase, it should mean that CT orientation is wrong, and it can be corrected by changing the orientation physically on-site, or CT polarity can be flipped using the Enphase Installer Portal via a software setting.

7.2 Production CTs check for phase allocation

Put PV main circuit breaker in the ON position. Unclip the CT and remove it from the cable on the phase identified in the [Checking Production CT installation](#) section 6. The Unclipped phase measurement should disappear from the Enphase Installer App. If not, there is incorrect wiring. Correct the measurement by connecting the disappeared phase to the correct IQ Gateway terminal. Repeat the same test for each phase and make sure that all CTs are in the correct phase.

In case of negative measurement on any phase, it should mean that CT orientation is wrong, and it can be fixed by changing the orientation physically on-site, or polarity can be flipped via Enphase Installer Portal.

8 Flip CT polarity via Enphase Installer Portal

To flip the CT polarity through the Enphase Installer Portal, follow these steps:

1. Log in to your Enphase Installer Portal and select the site in question.
2. Select **Devices** and go to **Consumption Meter** for Consumption CTs or go to **Production Meter** for Production CTs.
3. Select **Reverse Polarity**, and a pop-up window appears. The desired phase CT polarities can be flipped by ticking the box and clicking **Switch the polarity**.

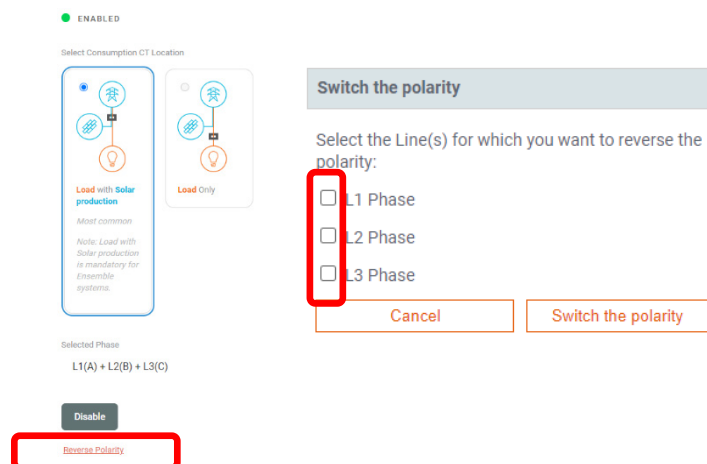


Figure 3: Flip CT polarity

Revision history

Revision	Date	Description
TEB-00053-1.0	August 2023	Initial release