Microinverter Power Line Communication (PLC) Troubleshooting

This document provides guidance to overcome electrical noise when it causes power line communication issues.

What Is Power Line Communication and Why is 'Noise' a Problem?

The Enphase Envoy™ communicates with Enphase Microinverters over the AC electrical conductors using a 110kHz communication signal (144kHz in North America). This technology is known as Power Line Communication, or PLC. It is widely used in networking (Ethernet bridges or HomePlugs) and home automation applications (X10 for example).

Some common appliances produce electrical noise at similar frequencies. Noise produced may be continuous or intermittent at certain times of the day. If this noise occurs on the same electrical conductors as the PLC, it can disrupt communication between the Envoy and microinverters. In some cases, noise on the AC circuit can be so great that the Envoy is unable to communicate adequately with the microinverters.

Examples of common equipment and appliances known to create noise and cause microinverter communication problems:

- **Impulse noise:** light switches, dimmer switches, irons, microwaves, touch lamps, and export limiting devices (or automatic controllers) using phase angle technology, such as the Solar iBoost & Power Diverter.
- **Unintended tonal noise:** personal computers, battery chargers, mobile phone chargers, laptop chargers and power supplies, compact florescent lights with a failed ballast, uninterruptible power supplies (UPS), battery backup units, RCD sockets, power strips, and surge protectors.
- **Intended tonal noise:** devices using power line communication such as Ethernet bridges, heavy rotating motors such as water pumps or refrigerators, workshop equipment such as drill-presses or wood routers, and many common kitchen appliances.

Problems are often not observed when the microinverters are first installed. When the system owner later purchases a new computer or refrigerator, or when older appliances start to fail, noise may appear and the microinverters can fail to report. Follow the best practices described in this document during installation to avoid potential communication issues at the site.

What Are the Best Practices to Avoid Communication Problems?

With planning, communication problems due to noise can be avoided or easily overcome by doing the following:

1) Install a dedicated PV sub-board for the Envoy and AC branch circuit breakers.

2) Keep the cable run between the Envoy and the microinverters as short as possible. Sites with long cable runs from the array to the Envoy are more susceptible to noise interference.

3) Install a dedicated socket for the Envoy or wire the Envoy directly to a breaker. Avoid circuits where any appliances or equipment share the circuit with the Envoy.

4) Fit toroid ferrite rings to the phase conductors running from the PV sub-board back to the main distribution board or load centre. These are a simple, economic, and effective filtering mechanism.

5) Install a phase coupler at three-phase sites. Enphase Customer Support can supply a list of suitable products.

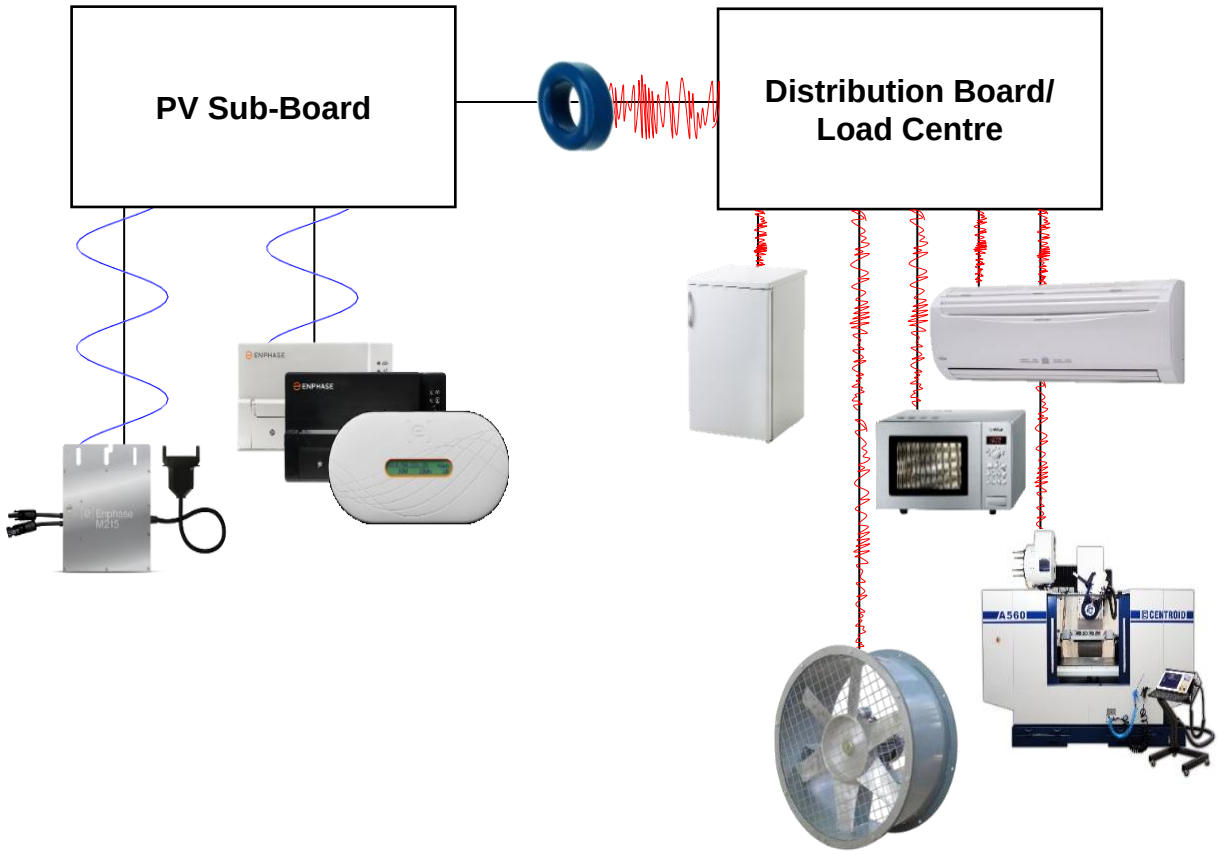

Figure 1: PLC Best Practice

What are the Signs of Poor PLC and Noise?

There are several ways to understand if there are issues with the PLC with a specific site or Envoy using Enlighten Manager.

View the Array Map

The array map in Enlighten can indicate noise issues. A site with poor communication will show some modules as grey or black and issue alerts when microinverters are not communicating.

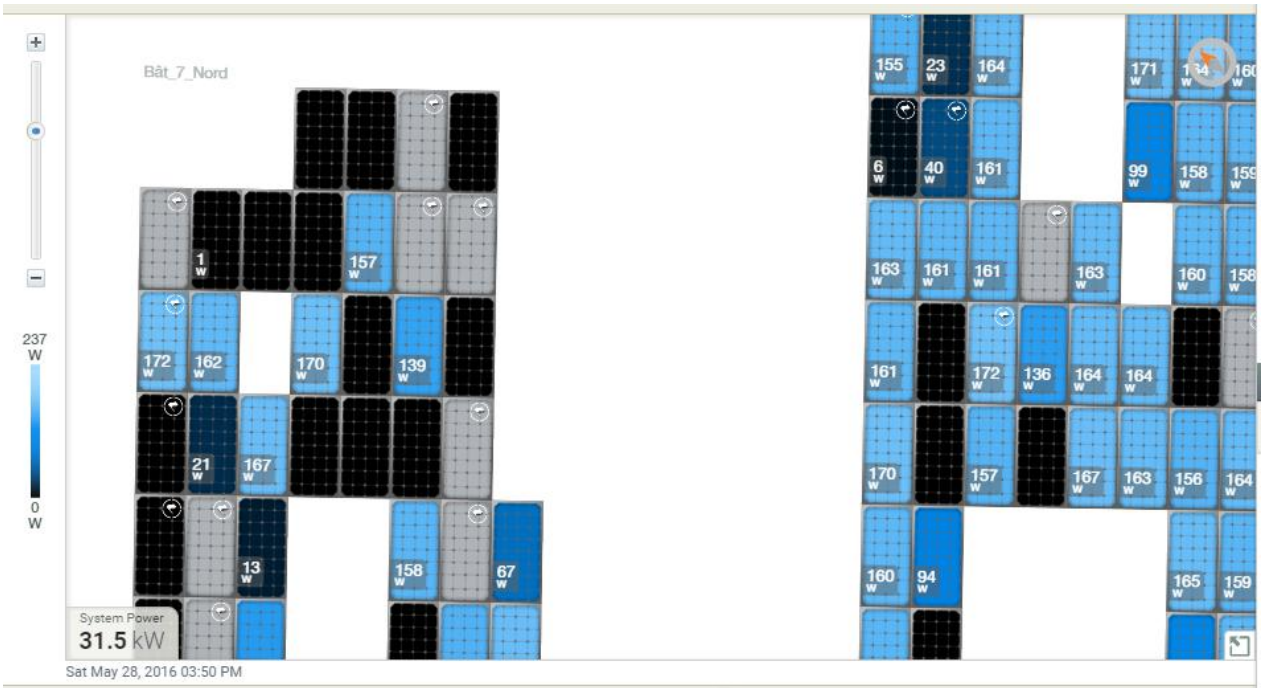

Figure 2: Array view on Enlighten Manager; site with Poor PLC

Check Envoy Status Page

Check the Envoy's signal strength on the **Devices** page in Enlighten. This will show the following parameters:

- **Signal strength:** 4/5 or 5/5 bars indicates very good communication, fewer than 3/5 bars is poor. Signal strength can also be impacted by a very long cable run between the Envoy and the microinverters. Make sure to keep this distance as short as possible.

1/5 4/5

- **Number of microinverters detected:** This section displays the number of microinverters communicating and indicates when any microinverters have failed to report.

Figure 3: Communication Parameters Accessible on Enlighten Manager

Request Customer Support to Make a Noise Check

Enphase Customer Support can help confirm that noise is present by performing a noise check by connecting with the Envoy installed at the site. Examples are shown below:

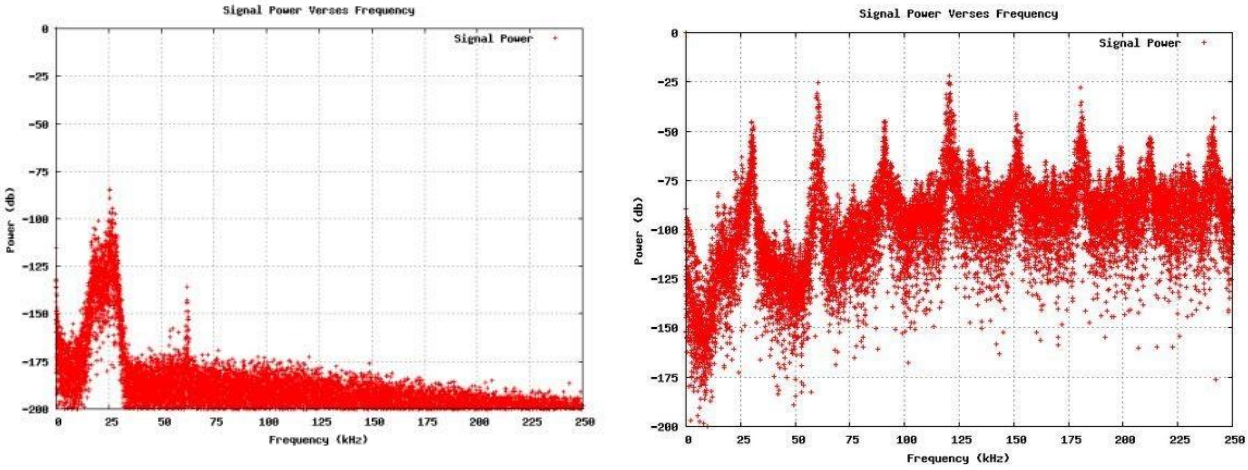

Figure 4: Example of a "clean" electrical line without noise (left) and with noise (right)

We use these plots to isolate the source of noise by turning circuits off at the breaker and repeating the check until we find the affected circuit.

What to do if My System is Correctly Installed but Noise Remains?

Equipment Required

The noise can be isolated by installing toroid rings or a PLC filter. For example, in simple single phase applications you might use either of the following:

Toroid (Ferrite) Ring Products:

- R 41.8 × 26.2 × 12.5 – EPCOS/TDK B64290L0022X087 or EPCOS/TDK B64290L0022X830
- R 50.0 × 30.0 × 20.0 – EPCOS/TDK B64290L0082X087 or EPCOS/TDK B64290L0082X830

Single-Phase PLC Filter:

- Legrand 003609 Phase Filter 63A 400 V

Check with Enphase Customer Support for three-phase or other complex applications.

How and Where to Install

Ideally, you will fit the toroid ring or filter between the PV sub-board and the main distribution board/load centre. Alternatively, if a specific piece of fixed equipment is emitting the noise, fit the rings on the supply cable to that equipment.

Pass the conductor through two rings multiple times for optimal results. For smaller conductors, loop the cable through the ring as many times as is practical. If the cross section of the conductor won't allow this, use multiple rings. If the existing cables are too short, you may need to extend them to allow the rings to be fitted and looped.

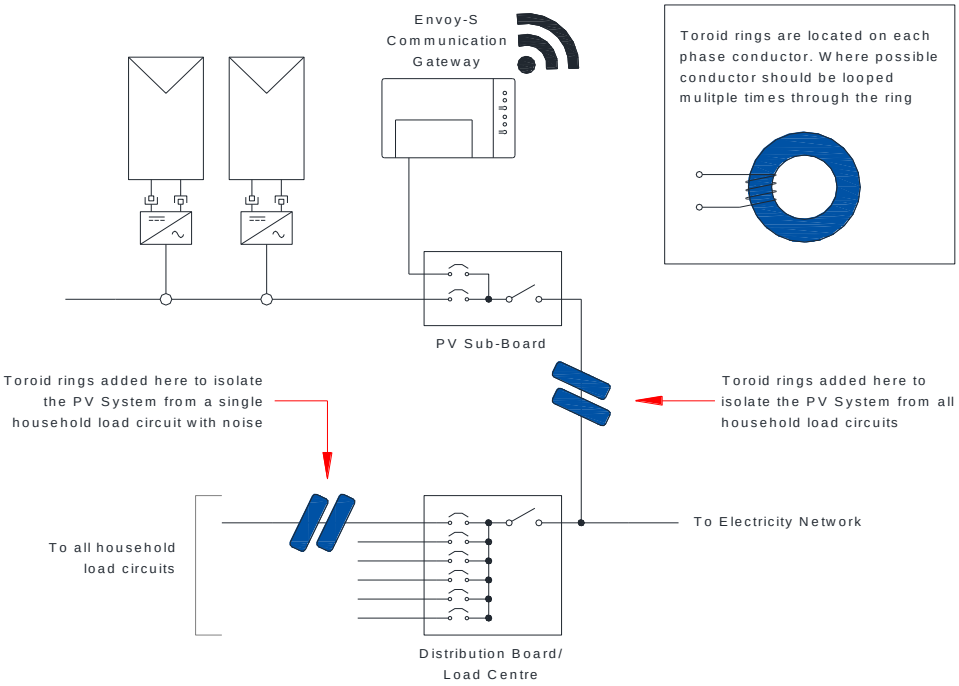

Figure 5: Toroid Ferrite Ring Installation Diagram

General Examples of Fitted Toroid Ferrite Ring(s) and PLC Filters:

Figure 6: Toroid Rings Fitted on a Small Core Phase Cable

Figure 7: Multiple Toroid Rings Fitted on a Larger Core Cable

Figure 8: Toroid Rings Fitted in a Single Phase Distribution Board/Load Centre

Figure 9: Legrand Filter Fitted in a Single Phase Distribution Board/Load Centre

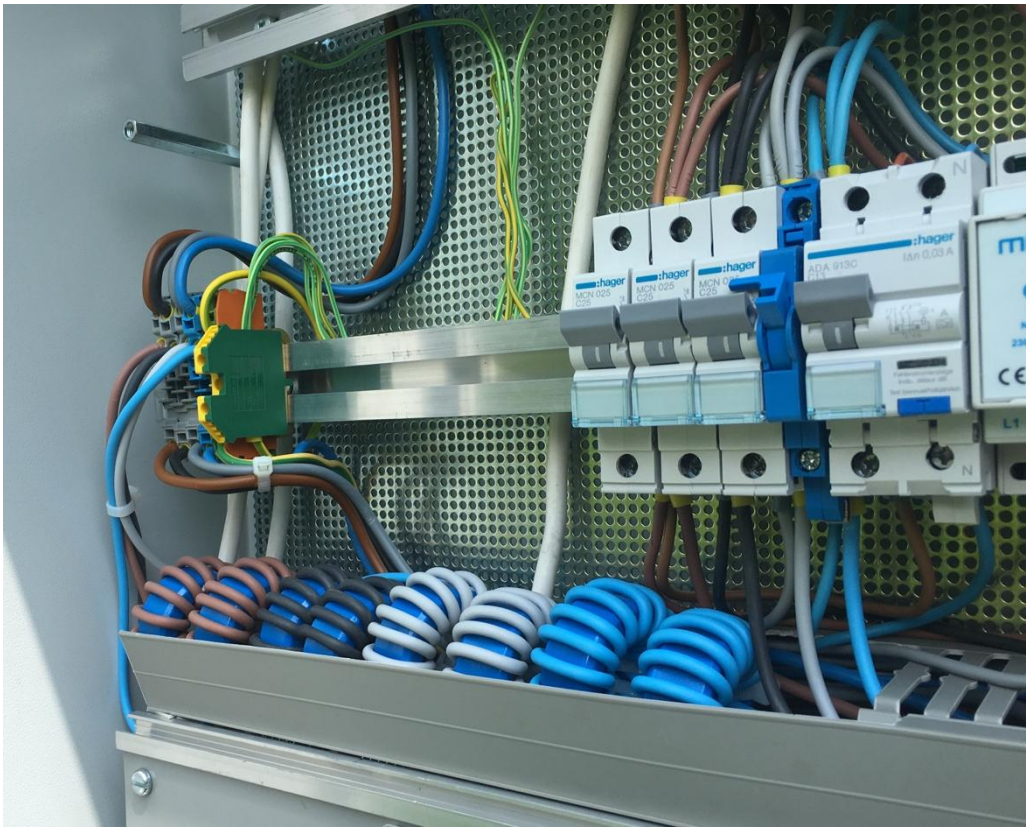

Figure 10: Toroid Rings Fitted in a Three-Phase Distribution Board/Load Centre

Frequently Asked Questions

1) If there is no communication, do the microinverters still produce electricity?

Yes. After the system installation is complete, communication is only required for system monitoring.

2) If poor communication interrupts data transfer, are the system total kWh figures still accurate?

Yes, they are. When communication levels improve and the microinverters resume reporting to the Envoy, the production information stored in the microinverters will be uploaded. However, the data will not be as detailed, which may result in flat lines in the Enlighten Graph view during periods of poor communication.

Further Resources

For more detailed information about Enphase Microinverters installation and operation, refer to this and other documents at http://www.enphase.com/support.