

Application Note: Addressing PLC Signal Crosstalk on PV Conductors



Multiple rapid shutdown PLC signal transmitters on a single roof can create crosstalk, reducing rapid shutdown receiver functionality and system performance

Background

Crosstalk: *a disturbance caused by the electric and magnetic fields of one electronic signal on another nearby signal causing interference and loss of communication in one or both systems.*

It is common to see large residential and commercial PV system sites where multiple Solis US PV grid-tie inverters are installed and operating in parallel. In June 2021, Solis technical support staff and engineers noticed PLC signal crosstalk at more than one site where multiple rapid shutdown transmitters (integrated into multiple Solis inverters) had been installed. PLC signal crosstalk on PV dc conductors in close proximity to each other caused the module-level rapid shutdown receivers to shutdown when the rapid shutdown transmitters had not been turned off causing loss of PV system output.

Ginlong Solis US PV String Inverters with Integrated PLC Signal Transmitters

After January 01, 2019, all Ginlong Solis rooftop PV systems installed in jurisdictions enforcing the 2017 or later editions of the NEC are required to be protected by PV module-level rapid shutdown (NEC 690.12). These systems consist of two main components. First, there is the PLC signal transmitter installed at or in the PV system inverter. Second, there are the PLC signal receivers mounted at the PV modules within the PV array. The PLC signal transmitter communicates with the PLC signal receivers via the PV array dc conductors.

A separate rapid shutdown transmitter can be installed near the inverter(s), in its own enclosure, with a small power supply and current transducers to communicate on the PV dc conductors. Alternatively, the rapid shutdown PLC signal transmitter can be integrated into the inverter (dc side), at the Ginlong Solis factory, saving the installer time and cost.

PLC Signal Crosstalk Between PV DC Conductors

Wiring PV modules into an array typically involves routing PV dc conductors together in bundles. These bundles may be in conduit or in cable trays to manage multiple PV dc circuits and organize the wires before connection to the Solis inverter(s). In larger PV systems where multiple inverters with PLC signal transmitters are installed, technicians must understand how PLC crosstalk can occur and how to mitigate potential problems with multiple transmitters.

PLC signal crosstalk can occur between any two PLC signal transmitters and their associated PV dc conductors when these conductors are bundled or positioned in close proximity to each other. At sites with multiple PLC signal transmitters and adjacent PV arrays, installers must follow best practices for wire management of PV dc circuit conductors to reduce PLC signal crosstalk. High frequency PLC signals can be induced between any nearby conductors even with thick wire insulation, jacketed conductors, separate electrical metallic tubing, or conductors on opposing sides of PV module support rails. The PLC signal is more easily induced across dc conductors of the same polarity.

Application Note: Addressing PLC Signal Crosstalk on PV Conductors



PLC Signal Crosstalk at Sites with Multiple PV String Inverters

The best way to eliminate crosstalk is to use a single PLC signal transmitter. At sites where multiple inverters are installed close to one another, installers can disable the inverter-integrated PLC signal transmitters and install a single, external PLC signal transmitter to broadcast PLC signal across the dc conductors for multiple inverters. At sites where multiple PLC signal transmitters are necessary to control rapid shutdown within large PV arrays, PV system designers can reduce the potential for crosstalk by breaking the array into discrete separated blocks. Each block should have its own inverters, dc wiring, and PLC transmitter. No dc wiring from adjacent blocks should be near one another. PV array block should have a dedicating single PLC signal transmitter for the block. A good method to delineate blocks is to utilize the 4-foot fire access pathways between arrays to separate the blocks and PLC transmitter sections. This provides ample separation to mitigate signal crosstalk.

Wiring Methods to Reduce PLC Signal Crosstalk

1. Keep array blocks, wire bundles, conduit and tray associated with different PLC signal transmitters as far from each other as possible (minimum 1 foot and recommend 4 feet).
2. Keep PLC signal loops to less than 1000 feet roundtrip (~300 meters)
3. Run the positive and negative conductors of PV dc circuits together for long wire homeruns.
4. Lightly twist together the positive and negative PV dc circuit conductors of homeruns to further discourage crosstalk with other circuits.
5. If PV conductors associated with two different PLC signal transmitters are run in common tray or conduit, keep these nearby wire runs as short as possible. Expect crosstalk in conductor lengths in close proximity to each other and expect performance problems.

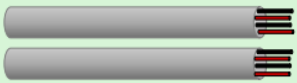
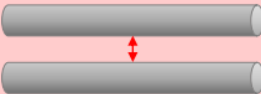
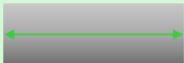
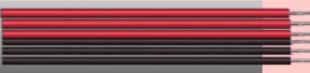
Commissioning

Multiple PLC signal transmitters and lack of separate of wire bundling and routing in these systems will often result in PLC signal crosstalk and the malfunction of rapid shutdown receivers at the PV array. Should crosstalk between conductors become severe, rapid shutdown receivers can unexpectedly shutdown and even overheat. Installers are encouraged to manage PV dc conductors with greater care when installing systems that include multiple PLC signal transmitters for PV rapid shutdown. At installation, the three best rules are “separate, separate, separate”. This may add unanticipated cost to the installation, but the cost of physical separation will likely be much less than the costs to roll trucks to the site to respond to ongoing arc-fault alarms at the inverter, inverter shutdowns, low production or even damage to PLC signal transmitters and rapid shutdown receivers.

For sites with multiple rapid shutdown PLC signal transmitters and PV dc wiring associated with different transmitters in close proximity to each other, the installer must test the rapid shutdown system during commissioning. To ensure continuous safe operations, installers are encouraged to monitor inverter performance for several days after installation to ensure PLC signal crosstalk is not affecting the PV system safety and performance

Application Note: Addressing PLC Signal Crosstalk on PV Conductors



Recommended ✓	Avoid ✗
 Run positives and negatives of strings and home runs together	 Do not separately run all positives together and all negatives together
 Keep conduit associated with different transmitters as far apart as possible	 Running conductors in conduit does not significantly help mitigating potential cross-talk
 Cable trays containing conductors from multiple transmitters should be as short as possible	 The longer the cable tray the higher chance of experiencing cross talks between transmitters
 Once inside a cable tray keep strings (+) and (-) as close as possible to a twisted pair	 Keeping the positive and negative conductors of a string apart inside a cable tray is not recommended

