APsmart Rapid Shutdown System

TROUBLESHOOTING GUIDE

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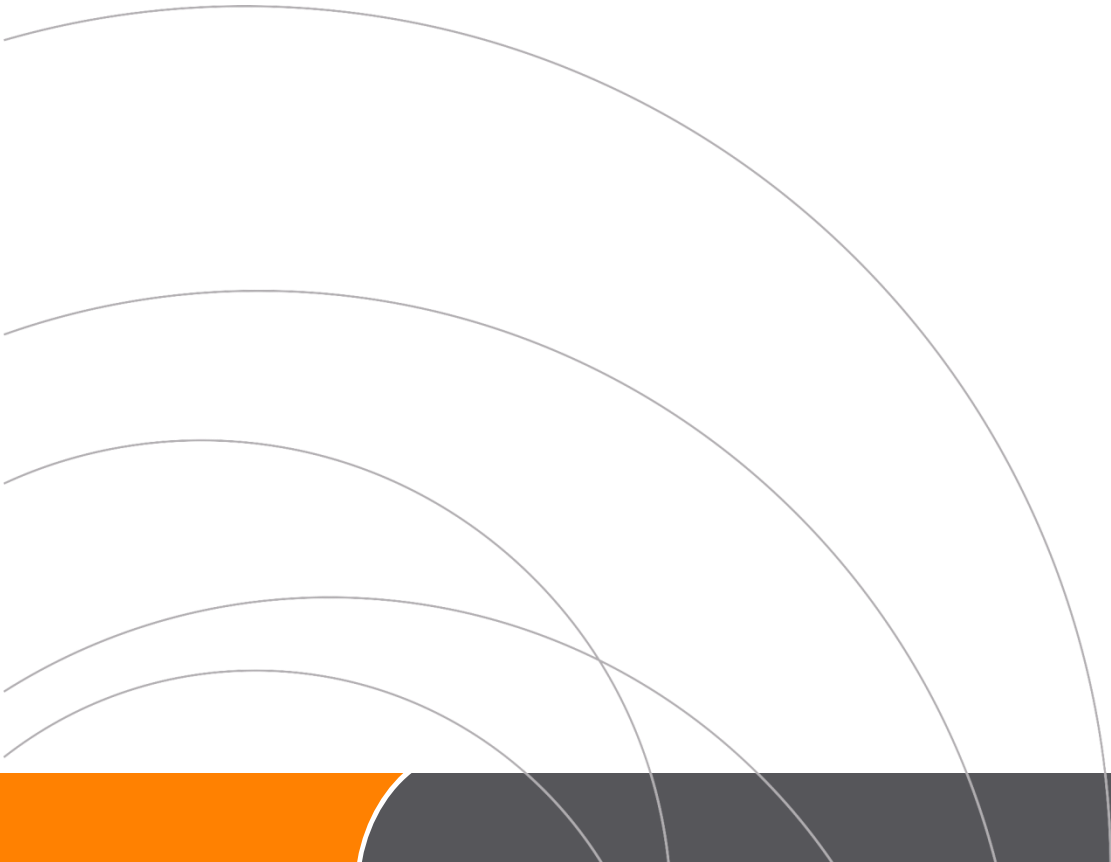
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Product Item：	RSD-S-PLC	Sub-system：	
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1. RSD-S-PLC & Transmitter-PLC Introduction

RSD-S-PLC module-level Rapid Shutdown system meets Sunspec compliance requirements: to maintain proper functionality by continually receiving "heartbeat" signals from the Transmitter-PLC through Power Line Communication (PLC). In the meantime, users could stop the Transmitter-PLC by switching off AC power in case of emergency to activate the module-level rapid shutdown. The wiring diagram is shown in Figure 1.
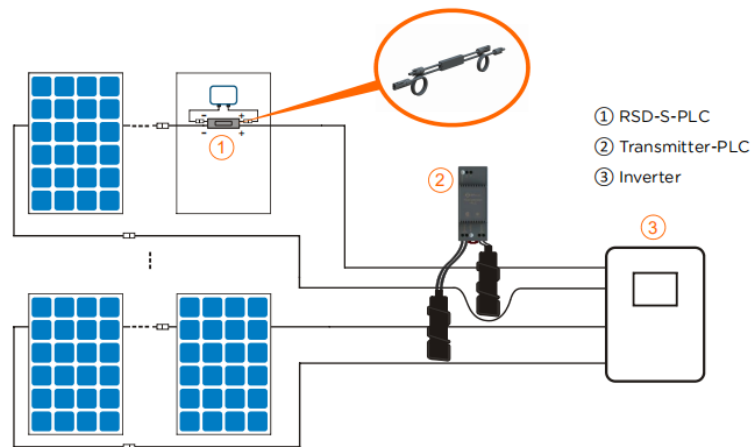

Figure 1. RSD-S-PLC Wiring Diagram.

2. General Information

This document will introduce a step-by-step procedure on how to troubleshoot the APsmart Rapid Shutdown (RSD) System and review how the RSD-S-PLC and Transmitter-PLC operate in the field.

Before and during any service and maintenance activities on a PV array, technicians should consistently check for visible equipment damage and any physical damage on all PV modules, wiring, connectors and MLPE components, and take appropriate action if any is found. This includes taking clear pictures of any damaged MLPE component with its serial numbers recorded.

The following system configuration questions should be answered before starting service and troubleshooting:

1. Was the installed system the RSD-S-PLC?
2. Was the installed system the APsmart Transmitter-PLC, or any non-APsmart Sunspec compliant RSS transmitter?

All Transmitter-PLC related troubleshooting procedures in this guide refer specifically to the APsmart Transmitter-PLC, whether stand-alone or inside a combiner box or inverter. If there is any non-APsmart transmitter installed, please refer to its own manufacturer's product manual for service information.

3. Troubleshooting Guide

3.1 String has no DC voltage (0V)

Description	Each RSD-S-PLC on the string will output a DC voltage about 0.7v when its DC input is properly connected to the PV module and it does not receive the Sunspec "heartbeat" signal sent from the active Transmitter-PLC. If the string voltage measured is 0V, it indicates there is open circuit condition caused by wiring problems.
Troubleshooting	
Step 1	Verify the string inverter is properly disconnected from the grid before performing any measurements or actions.
Step 2	Visually inspect the PV module, RSD-S-PLC, wiring, connectors and other devices to ensure they are connected properly.
Step 3	Performing standard electrical tests as necessary to localize the potential open circuit.
Step 4	Checking Sunspec "heartbeat" signals by RSD-EYE detector, measure the power line from Transmitter-PLC core to string, follow the sequence of each RSD-S-PLC until you find the signal's missing point, if the open circuit issue is due to RSD-S-PLC, please check "3.2 RSD-S-PLC has no DC output voltage (0v)".

3.2 RSD-S-PLC has no DC output voltage (0V)

Description	Each RSD-S-PLC in the string will output a DC voltage about 0.7v when its DC input properly connected with PV module and does not receive the Sunspec "heartbeat" signal sent from the active Transmitter-PLC. If the output voltage is measured at 0V, then it is damaged by high current or overheating conditions.
Troubleshooting	
Step 1	Visually inspect that the PV module, RSD-S-PLC, wiring, connectors and other devices are connected properly.
Step 2	Replace it with another functional RSD-S-PLC: 1. Measure to check that its DC output voltage is 0.7v when transmitter-PLC is off to confirm its functionality. 2. Measure to check that its DC output voltage is V_{oc} when transmitter-PLC is active to confirm performance. If the

	output is less than V$_{oc}$, check the PV module open circuit voltage.
Step 3	Disconnect the PV module from RSD-S-PLC. Measure its DC output voltage. If equal to V$_{oc}$, report failure to vendor.

3.3 String has less DC output voltage than it should.

Description	Each RSD-S-PLC in the string will output a DC voltage about equal to the PV module's Voc when its DC input is properly connected and receive the Sunspec "heartbeat" signals sent from the active transmitter-PLC. When the string has less DC output than: (RSD-S-PLC numbers) X (Vmod_oc)
Troubleshooting	
Step 1	Confirm the following installations are correct: 1. RSD-S-PLC is compatible with the Sunspec RSS transmitter 2. Each transmitter-PLC core has a maximum of 10 strings. 3. Each string has a maximum of 30 PV modules. 4. Each transmitter-PLC core has a max of 150A. 5. Transmitter-PLC is properly connected to the power supply. 6. Transmitter-PLC wiring distance to PV string no more than 1000 meters（Inverter PV+ to PV- loop） 7. For any non-APsmart RSS transmitter, refer to the OEM transmitter manual.
Step 2	Check the Sunspec "heartbeat" signals by using RSD-EYE signal detector, both on transmitter-PLC and RSD-S-PLCs. Refer to "Figure 2 RSD-EYE signal detector user manual". If RSD-S-PLC has no signals received from transmitter-PLC, indicate there is a wiring or connector issue in the string, then troubleshoot with RSD-EYE to locate the loss point.
Step 3	There are three more ways to diagnose the system and to locate the potential failed RSD-S-PLC position in the string when the transmitter-PLC is active: 1. By using an Infrared camera to search the "dark" modules in the string.

	2. By using a thermometer to search the modules in the string, to find which has a lower operating temperature with RSD-S-PLC vs higher operating temperature. 3. By using a clamp multimeter to compare DC voltages between each RSD-S-PLC output (-) and output (+). If there are no voltage differences, indicate no power output from the module and the RSD-S-PLC failed: V_output(-) = V_output(+) After locating the failed RSD-S-PLC position, refer to "3.2, RSD-S-PLC has no DC output voltage (0V)."

3.4 Transmitter-PLC Operating Guide

Description	When the APsmart transmitter-PLC is off, the RSD-S-PLC does not receive the Sunspec "heartbeat" signals then shuts down the PV module power output, maintaining only 0.7v output. The string voltage is: V_{string} = 0.7v X RSD-S-PLC numbers When the transmitter-PLC is active, the RSD-S-PLC receives the Sunspec "heartbeat" signals and turns on all PV modules power output. The string voltage is: V_{string} = Vmod_oc X RSD-S-PLC numbers
Operating	When the APsmart transmitter-PLC is active, the "Power LED" shows yellow, "Signal LED" shows green. Check its operating status as below： • Power LED (yellow) is steady on, • Signal LED (green) is blinking. --Indicates the transmitter-PLC has powered on and is operating properly. • Power LED (yellow) is off. • Signal LED (green) is off. --Indicates the transmitter-PLC is powered off or is malfunctioning. Check its wiring and confirm AC grid status and make sure it is connected properly. Otherwise, this transmitter-PLC is possibly damaged.

	• **Power LED (yellow) is steady on.** • **Signal LED (green) is off.** --**Indicates the system needs to be rebooted.**
Wiring	Check the RSS transmitter-PLC is wired according to the manufacturer's instructions. If the APsmart transmitter-PLC is used, refer to "Figure 3 Transmitter-PLC Installation Guide."
Signaling	If the APsmart transmitter-PLC is installed, verify there is no additional non-APsmart RSS transmitter that has been installed inside the inverter. This could cause Sunspec "heartbeat" signal collision and attenuation, leading to turn on the rapid shutdown function in the RSD-S-PLC. The maximum number of APsmart transmitter-PLCs that can be installed in series are 10 inside a combiner box.

4. Appendix

4.1 RSD-EYE Detector Operating Guide

    With the RSD-S-PLC fully installed and the Transmitter-PLC connected and powered on, place the sensor area of the RSD-EYE within 2cm of the RSD-S-PLC output line. Test each RSD-S-PLC with the RSD-EYE to confirm the presence of a keep-alive signal.

    During detection, the switch button should be held and the power LED will be lit. Once you release the button, the RSD-EYE is OFF. When the keep-alive signal is detected, the signal LED will be lit, and an audible alert will sound to confirm.
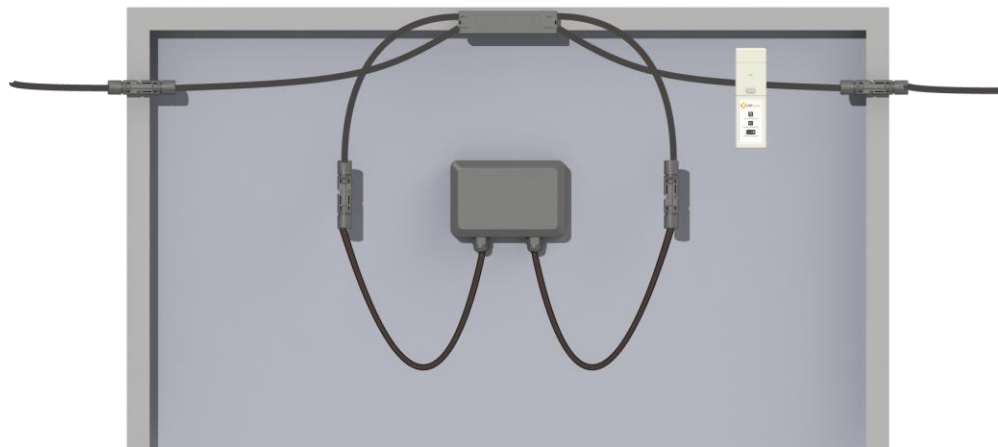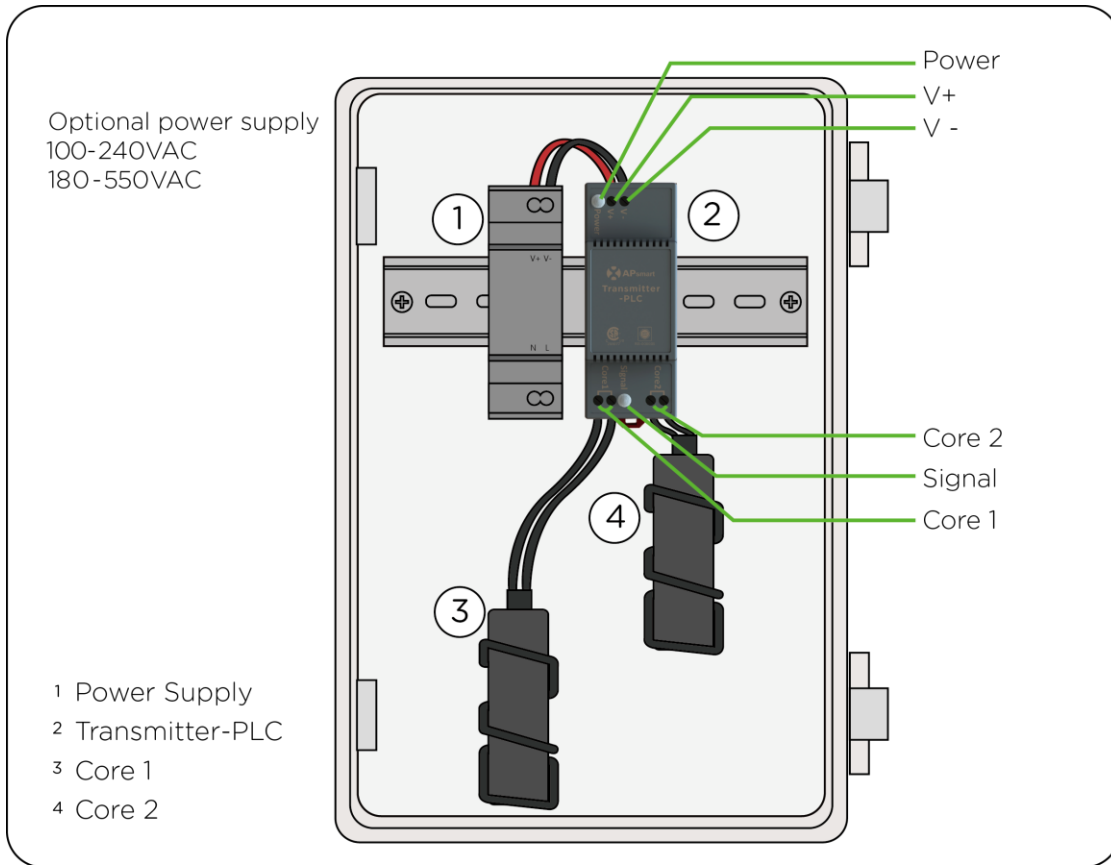
Power LED

Signal LED

Switch Button

Sensor Area

Place the sensor area of the RSD-EYE within 2cm of the RSD-S-PLC output line

Figure 2. RSD-EYE signal detector operating guide.

4.2 Transmitter-PLC Installation Guide

Optional power supply
100-240VAC
180-550VAC

Power
V+
V -

Core 2
Signal
Core 1

¹ Power Supply
² Transmitter-PLC
³ Core 1
⁴ Core 2

Transmitter power supply must be on same AC branch circuit as inverter to meet rapid shutdown requirements.
The Power LED should be lit and the Signal LED should be blinking during operation.

Note: Install RSD-S-PLC before powering on Transmitter.

• Mount Transmitter-PLC and power supply on DIN rail
• Connect DC leads from power supply to Transmitter-PLC
• Connect single/dual core(Core 1 and Core 2) to Transmitter-PLC

Place rapid shutdown system label no more than 1m (3ft) from Transmitter or AC disconnect if not at same location.
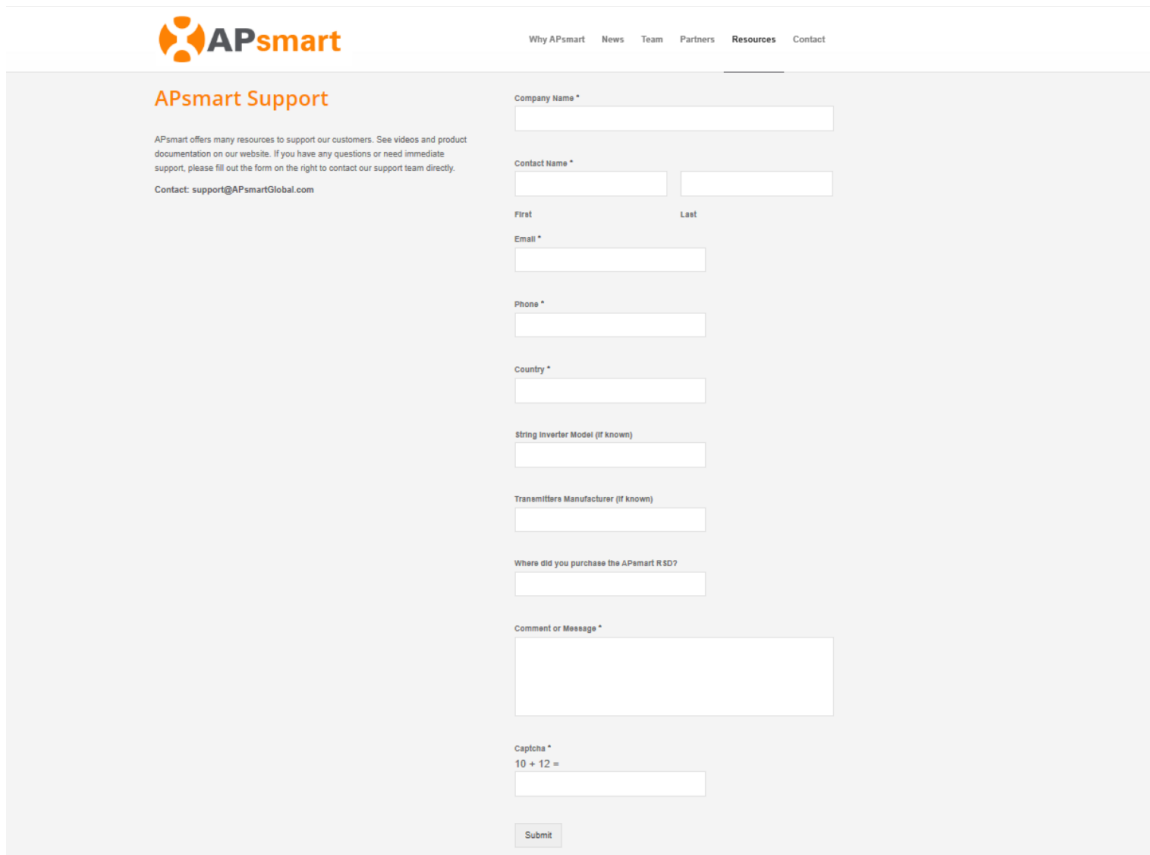
Figure 3. Transmitter-PLC installation guide.

4.3 Technical Support Guide

1) **APsmart Technical support website:**
   https://apsmartglobal.com/support/

   Please fill in as much information requested in the technical support form as possible:

2) **APsmart Technical support email:**
   apsmart.support@apsystems.com

   Please send an email to the APsmart technical support team for any technical questions and services.

3) **Please contact your distributor, inverter equipment manufacturer or installer/EPC customer services for help.**