APsmart
ALTENERGY POWER

BRIGHT SOLAR SOLUTIONS

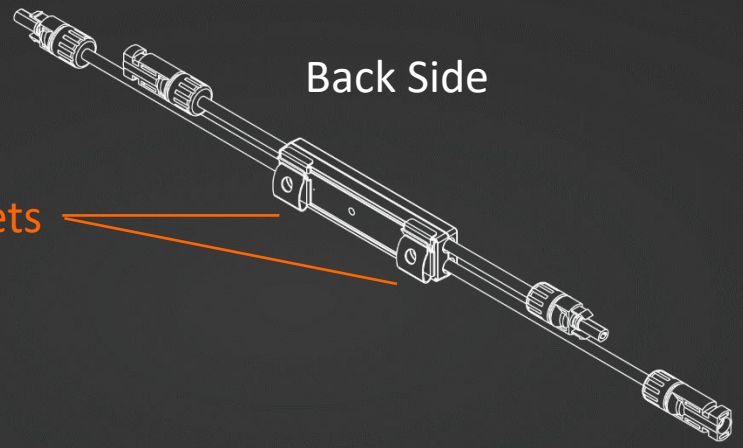
APsmart Rapid Shutdown Solution Technical Training for SMA Inverters

RSD-S-PLC Installation, commission and application

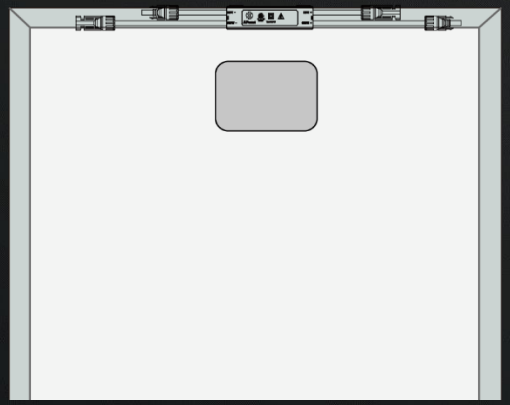
Step 1: RSD-S-PLC Mounting

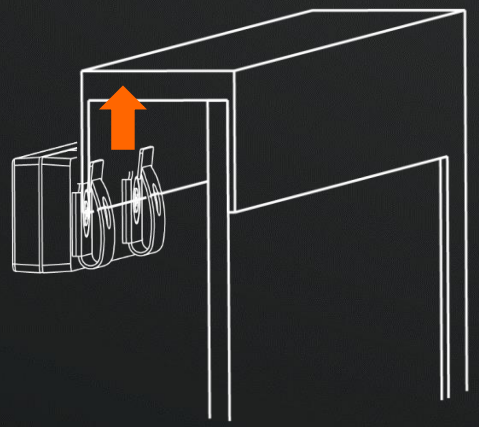
Front Side

Back Side

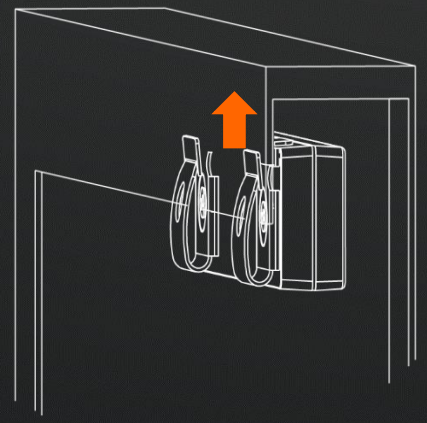


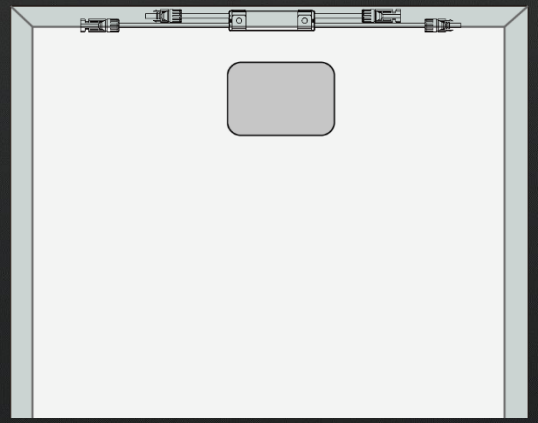
Method 1： Clip the RSD-S-PLC facing out on the outside of the module frame. (Recommend)





Method 2: Clip the RSD-S-PLC facing the back of the module under the lip of the module frame

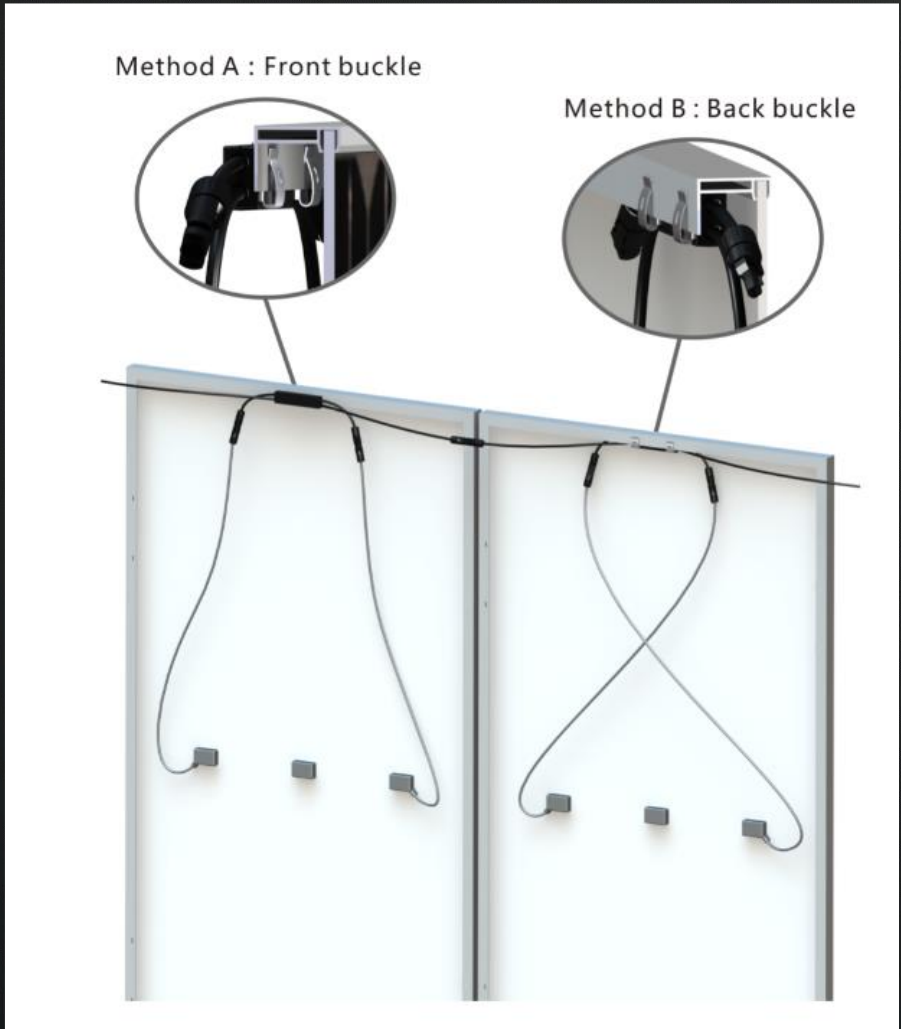


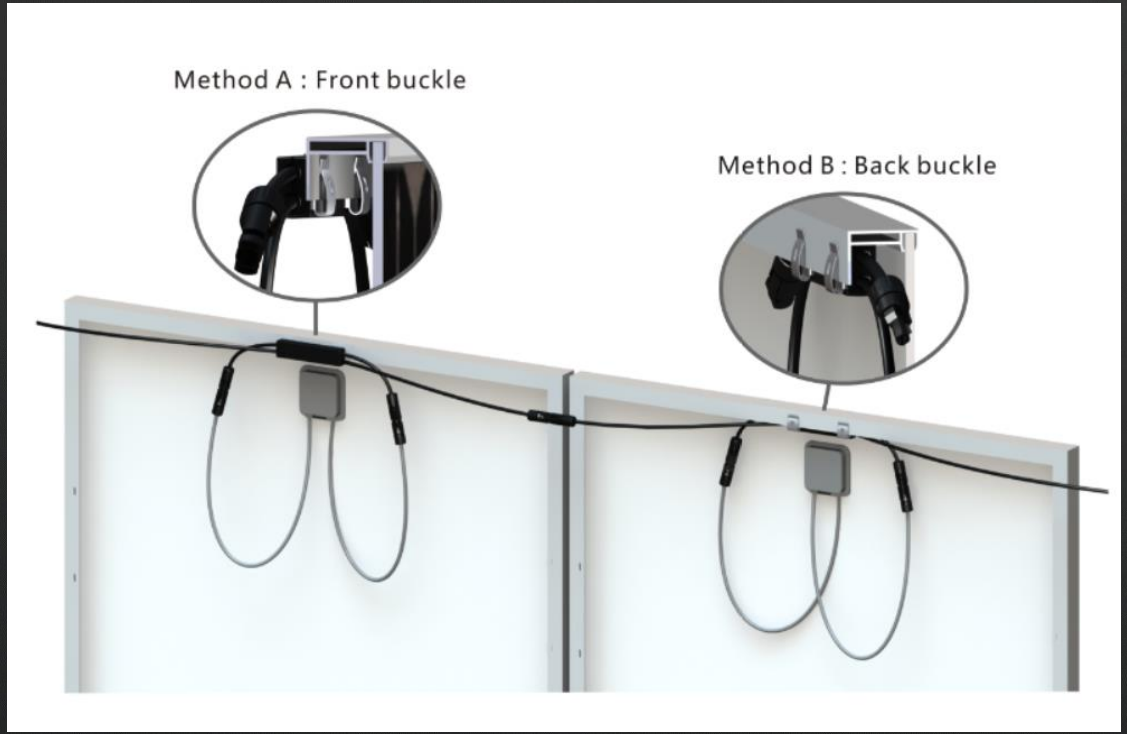


RSD-S-PLC outputs a DC voltage of **0v** when out of box.

Step 1: RSD-S-PLC Mounting

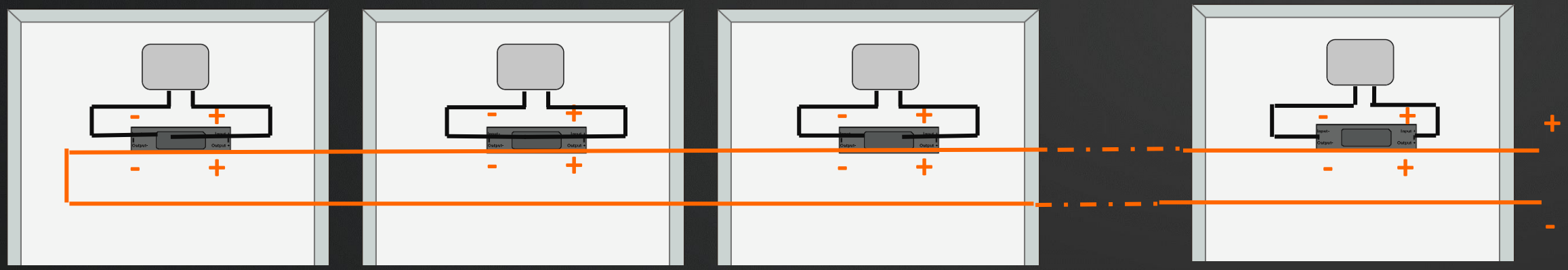
Step 2: Connect With PV Module





- After connected with PV module, RSD-S-PLC outputs a DC voltage range **0.6 – 1v.**
- Do **NOT** short-circuit the RSD （RSD string) output cables, otherwise will damage the devices.

Step 1: RSD-S-PLC Mounting | Step 2: Connect With PV Module | Step 3: String Wiring



Installation best practices:

- **Step 1: Connecting RSD-S-PLC with PV module first, device will be turned on as shutdown mode, only has DC output:**

  V_rsd = 0.6 ~ 1v

- **Step 2: Connecting RSD-S-PLCs together into string, measure each string's open-air DC voltages before connect to MPPT:**

  V_avg = V_rsd X #RSD-S-PLCs

- **Step 3: Comparing each string's DC voltages, all should be identical (V_avg) as balanced strings on the same MPPT :**

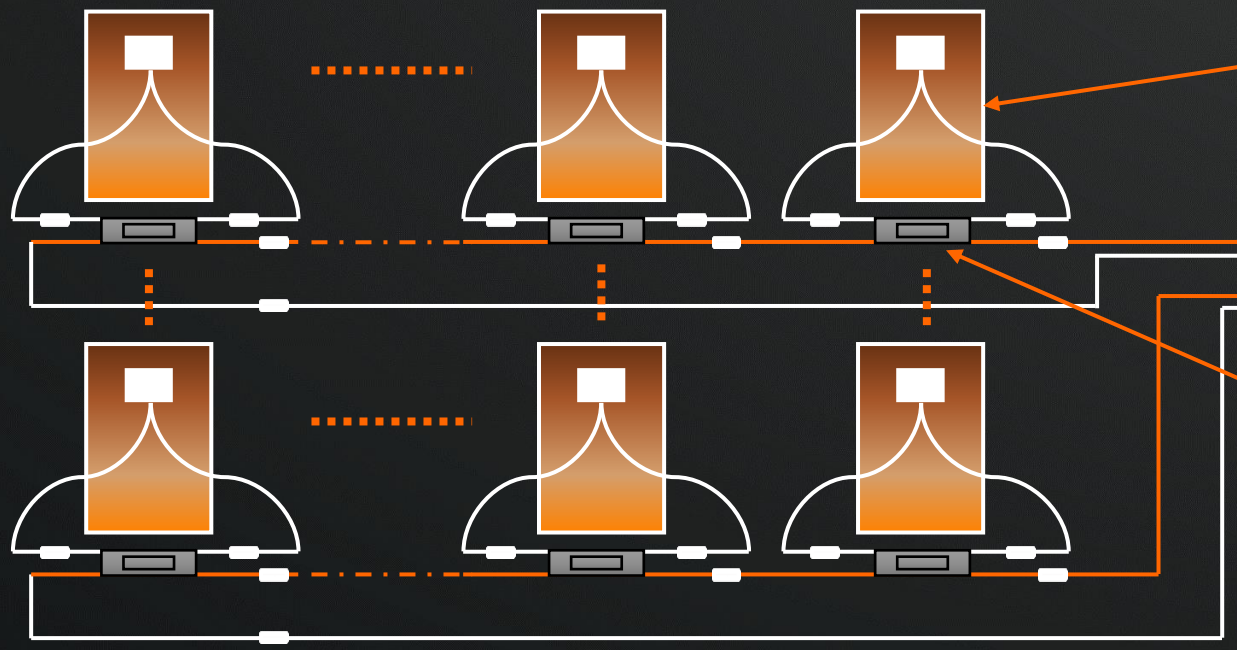
  Checking connections & receivers if: V_string < V_avg OR V_string >> V_avg OR V_string = 0

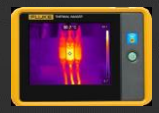
Step 1: RSD-S-PLC Mounting | Step 2: Connect With PV Module | Step 3: String Wiring | Step 4: Connect to String Inverter

RSD Installation Commissioning Steps:

- Checking RSD-S-PLC's DC output AFTER mounting on PV modules to confirm device is functional: V_rsd = 0.6 ~ 1v
- Checking string open-air DC voltages AFTER wiring to confirm connections: V_avg = V_rsd X #RSD-S-PLCs
- Checking DC voltages on MPPT AFTER turning on inverter to confirm PV arrays fully powering up: V_mppt = V_mpp X #Modules

RSD Installation Commissioning Tests & Troubleshooting:




Infrared Camera


Megger Insulation String Voc

RSD-Start Kit

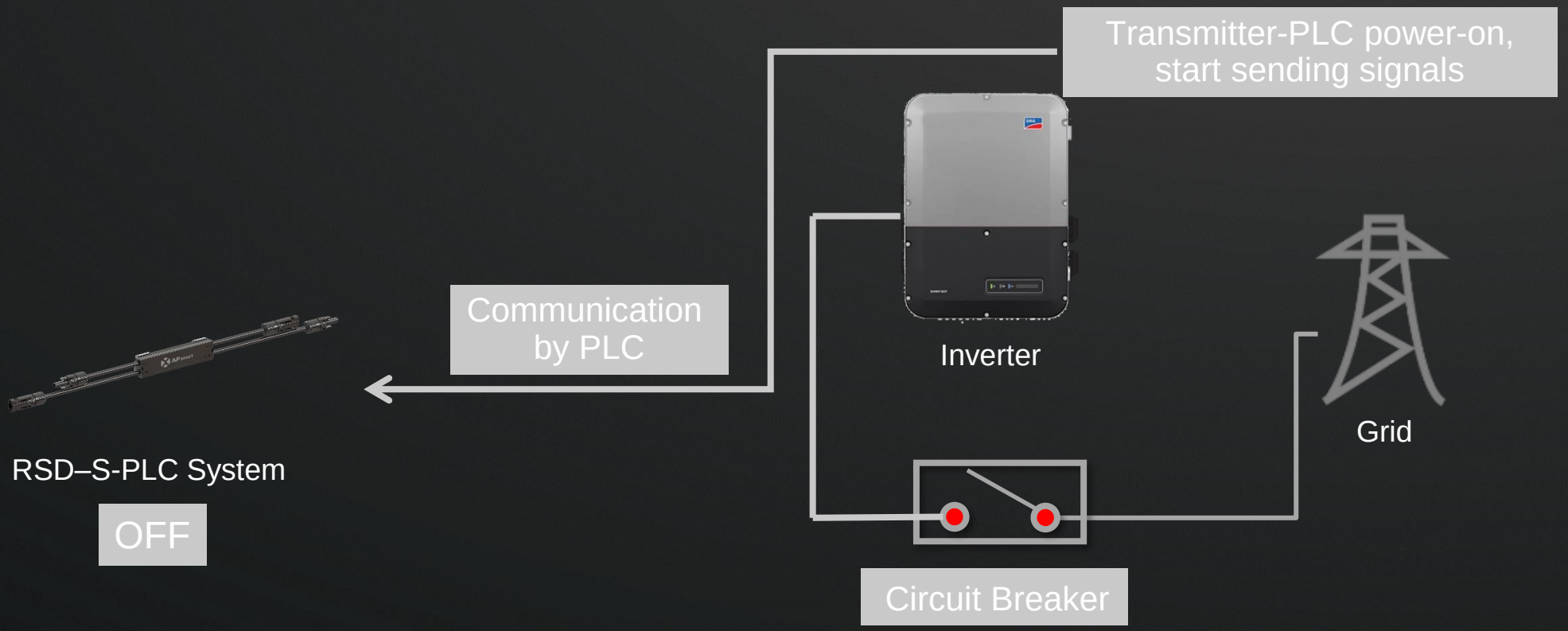

IV Curve Analyzer


RSD-EYE+


Inverter Functional self-check

System Initial State

After the system is set up, the initial state of the RSD-S-PLC is **OFF**, the PV strings must less than **30V** voltage output. Confirming the communication protocol profile inside SMA cloud portal is on **“SunSpec”** before turn on inverter.

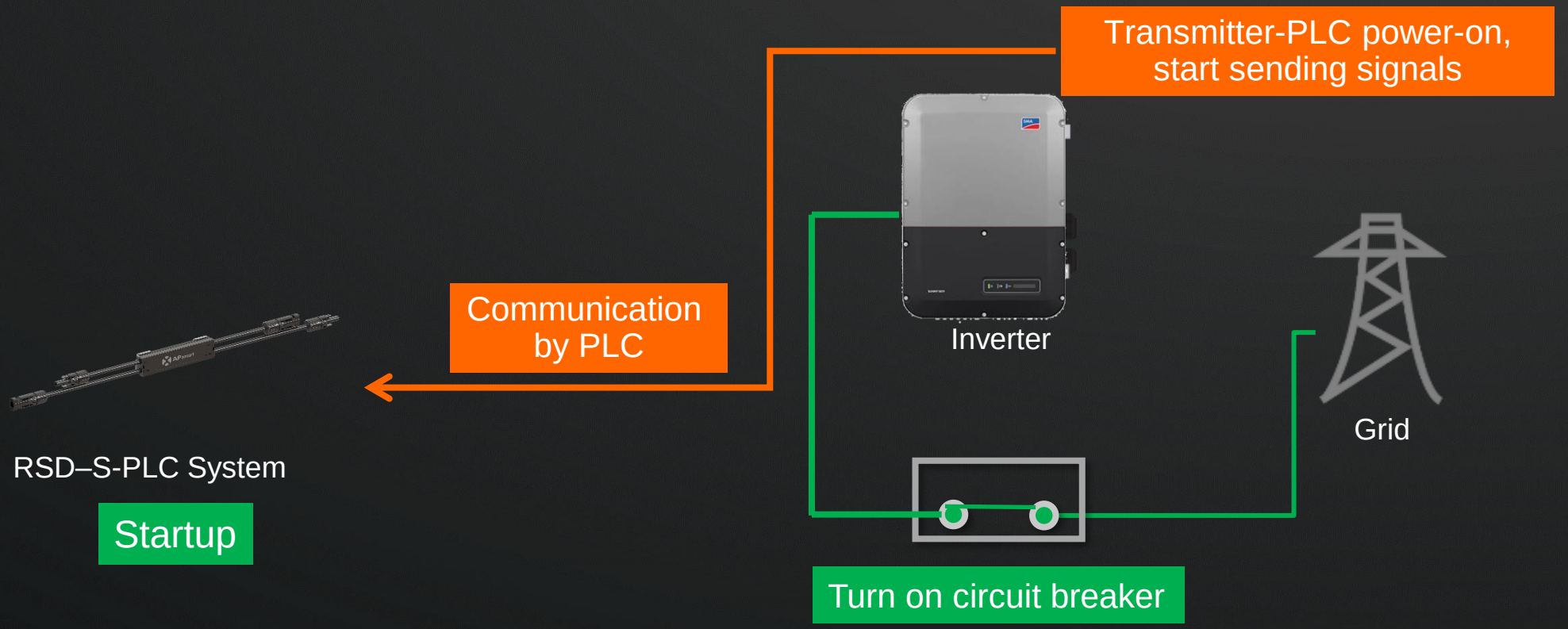


System Startup

After turning on circuit breaker from AC grid, the inverter and its transmitter will be powered on at the same time. The transmitter then sends PLC signal to the RSD-S-PLC units, they will turn on PV modules power outputs within 10s after receiving the signal.

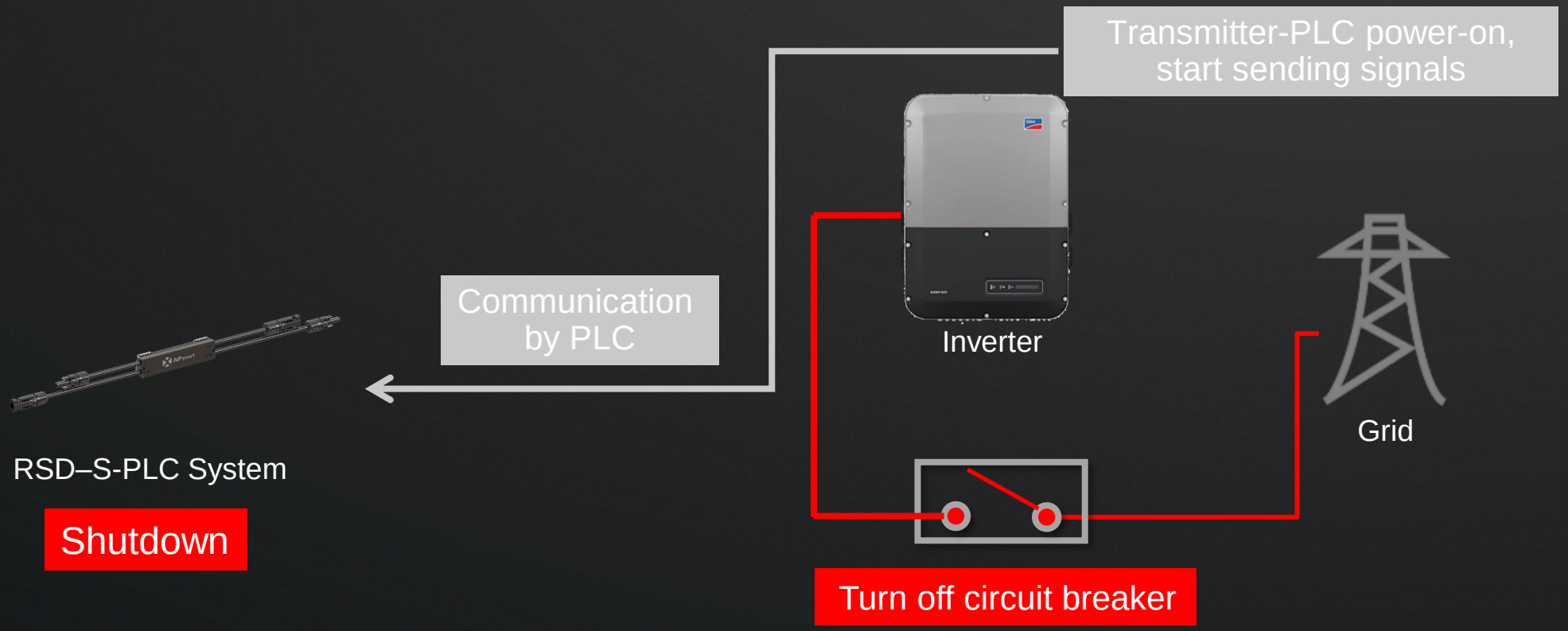
SMA inverter requires string level DC voltages **between minimal of 6 PV modules (above 3.5v), below 30 modules (30v)** based on SunSpec RSD requirement. System will not be able to turn on if string voltages out of this range.

After waiting 5 minutes, check the MPPTs DC voltage on the inverter screen, ensuring that all RSD-S-PLCs have successfully started up.



System Shutdown

After switching off the AC circuit breaker, the transmitter-PLC will be powered off immediately, and stop sending PLC signals to the RSD-S-PLC units, then RSD receivers will turn off channels to shutdown the PV modules power within 10s. Using a multi-meter to monitor the PV string DC output voltage — if it turns down to less than **30V** within **30s**, and each RSD-S DC output only within **1v**, then it is fulfilled NEC 2014, 2017 & 2020 successfully.



Most Questions for RSD Installations in the Field

- **Why cannot get full power from the system after installing RSD?**

  As NEC code require, Rapid Shutdown receivers will be shutdown mode as default to seal PV module's power, it is only be able to turn on all receivers after switching on breaker from Grid.

- **How could I know the installation is good?**

  Measuring string open-air voltages is the easiest way to collect DC voltage data after installed each string, calculate by previously introduced equation then comparing all strings voltage values on MPPT. Normally same MPPT requires to be balanced by modules installed, so its DC open-air voltages should be identical within tiny variations from measuring.

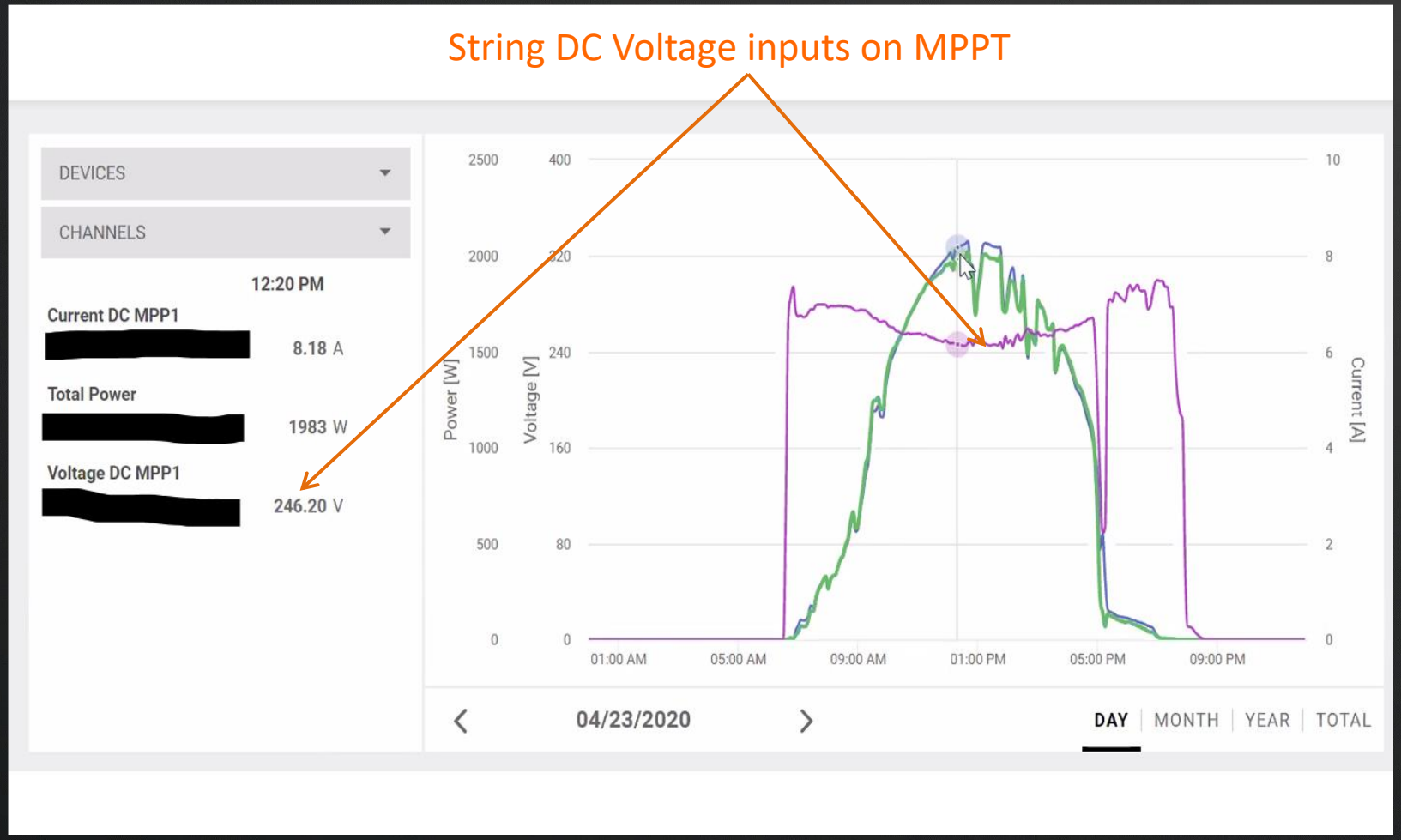
- **How can I find out the failed receiver location inside the string during installation?**

  $V_{string} < V_{avg}$ or $V_{string} >> V_{avg}$ – Using DMM to measure each receiver's DC input & output: $V_{rsd} = 0$ or > 1v

  $V_{string} = 0$ – Bypassing half of string to measure its open-air DC voltages, keep repeating same steps down to 1/4, 1/8….., until find out the break down location.

APsmart MLRSD Monitoring & Troubleshooting

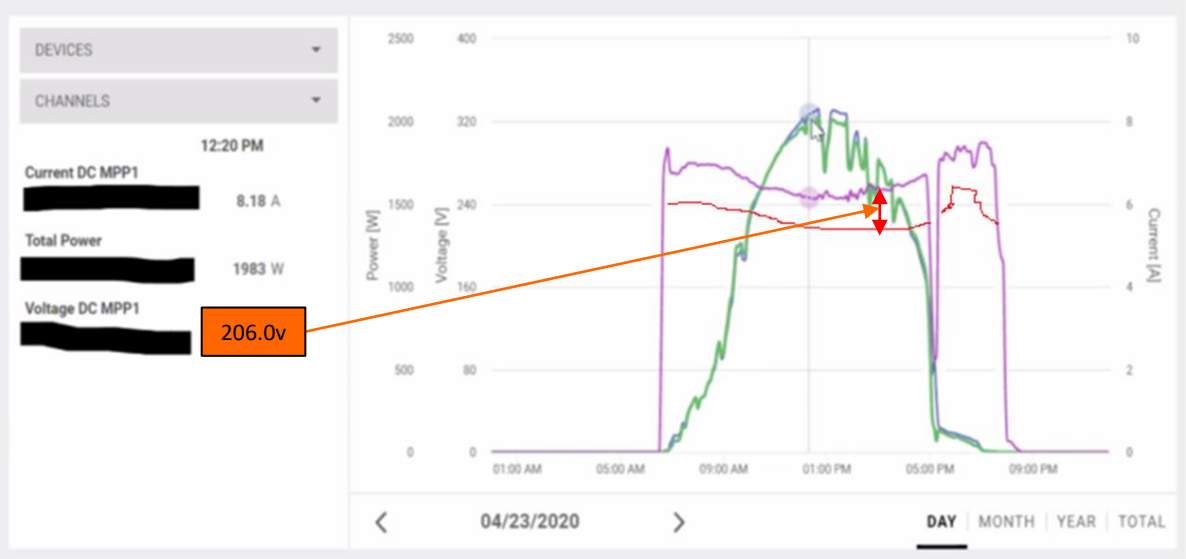
String Inverter Real-Time Monitoring Portal – DC Voltages on MPPTs



APsmart RSD Device Failure Modes: MOSFET Failures

MOSFETs Failure Mode:

- RSD-S-PLC is opened to *bypass* the module (V_{rsd_out}=0v), cause PV system has *string operating DC voltage dropped constantly during operating*.



Performance: MPPT DC Voltages drop

Visual Inspection: Enclosure bubbling

- RSD-S-PLC is shorted to *open* the module (V_{rsd_out}>1v), cause device lost its Rapid Shutdown function, *string open-air DC voltage will be greater than 1v X # RSD-S-PLCs, then bubbled by thermal & bypass.*

RSD Receivers Troubleshooting 4 Steps:

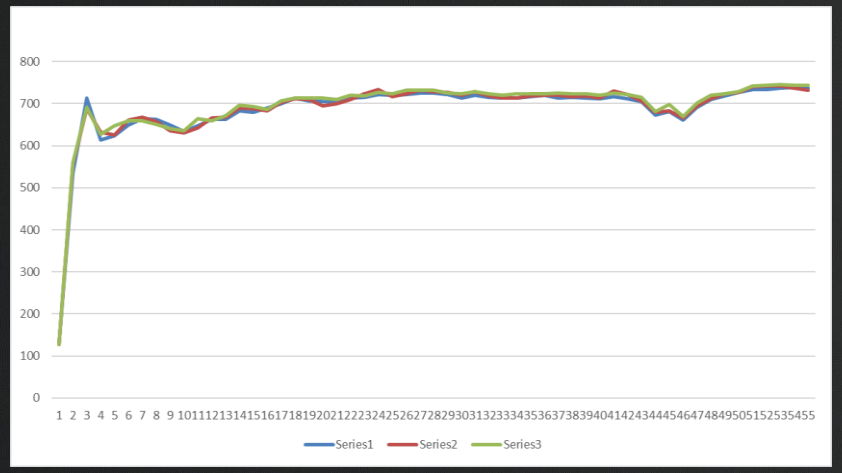
Step1： Identify failed inverter/MPPT have dropped DC output voltages

Step2： Identify failed strings on MPPT have changed DC open-air voltages

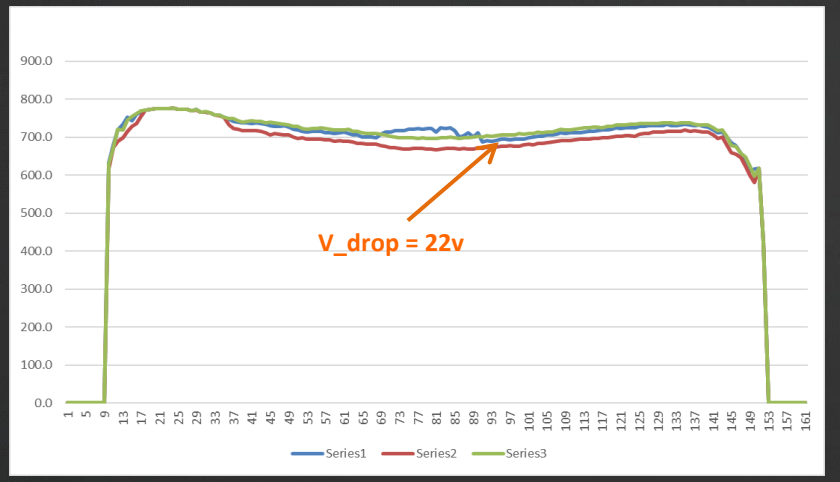
Step3： Locate failed devices inside this string by thermal detectors.

Step4： Switch-off grid, confirm suspect device by DMM & RSD-EYE+

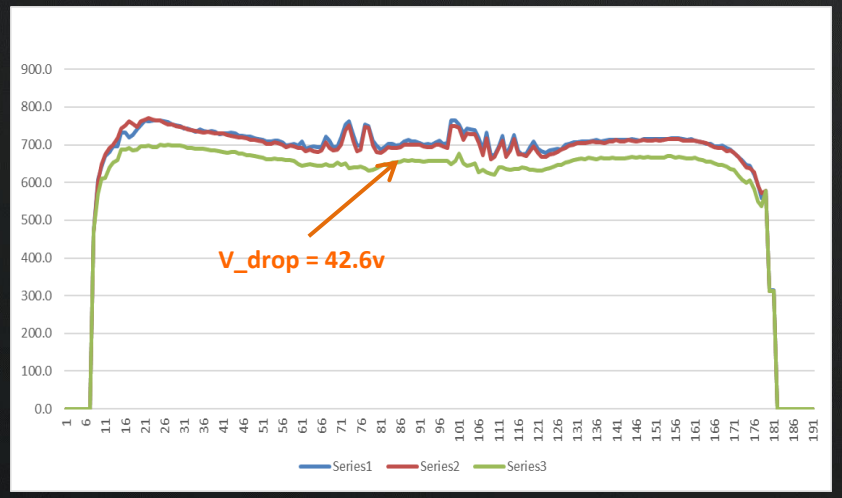
RSD Failures Determined on System Level – Inverter/MPPT's Operating Voltages Drop



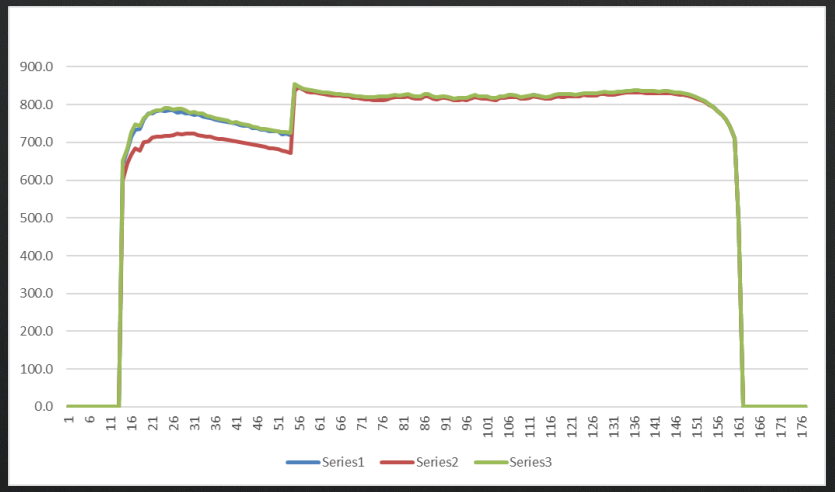
Inverter has no failed devices



Inverter has one failed devices in MPPT#3

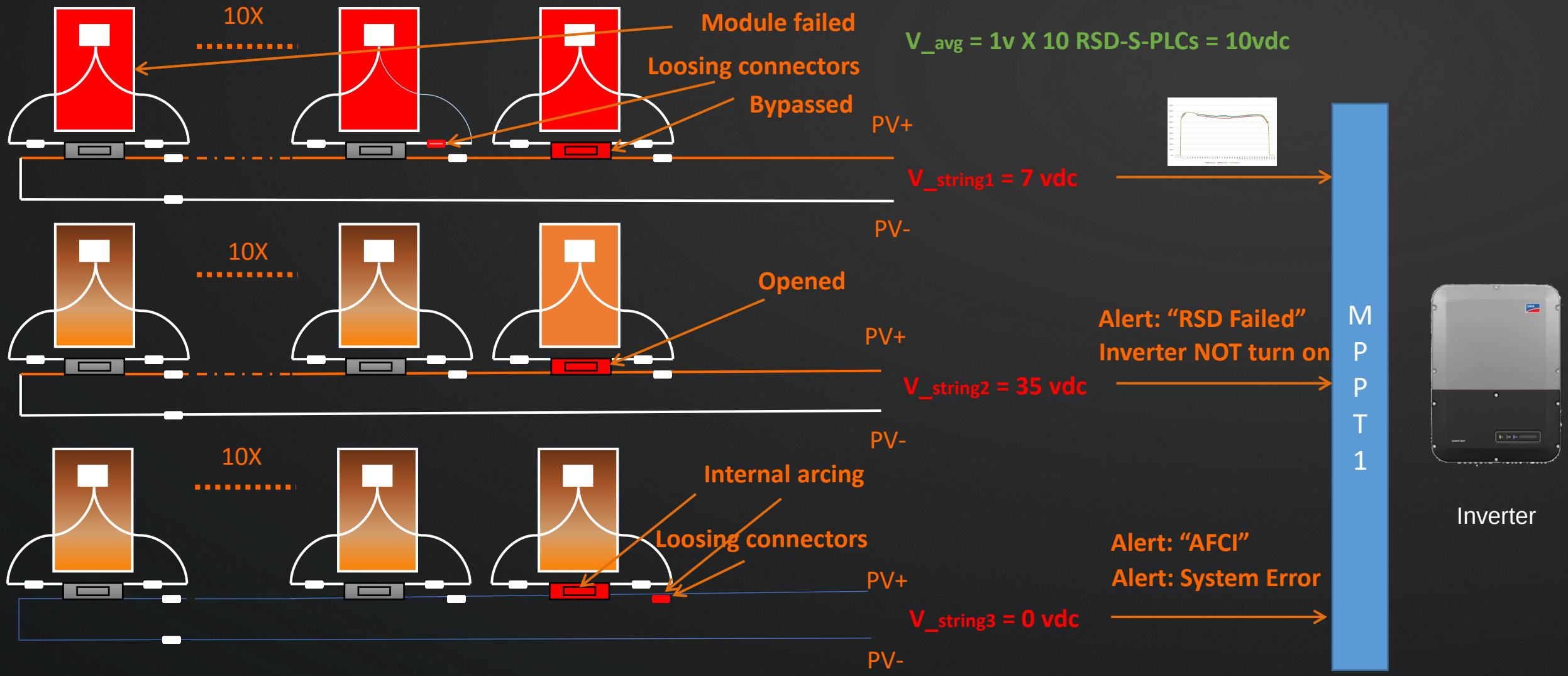


Inverter has 2 failed devices in MPPT#3



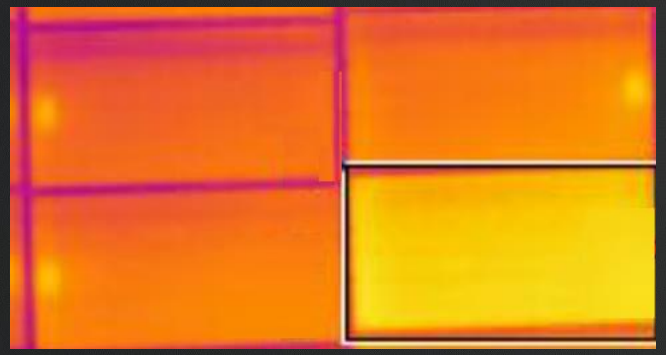
Inverter replaced failed devices and system recovered

RSD Failures Determined on String Level – String Open-Air Voltages Changed



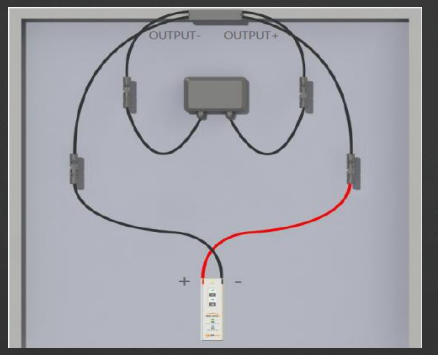
RSD Failures Determined on Module Level – Located by vary tools

Infrared Camera



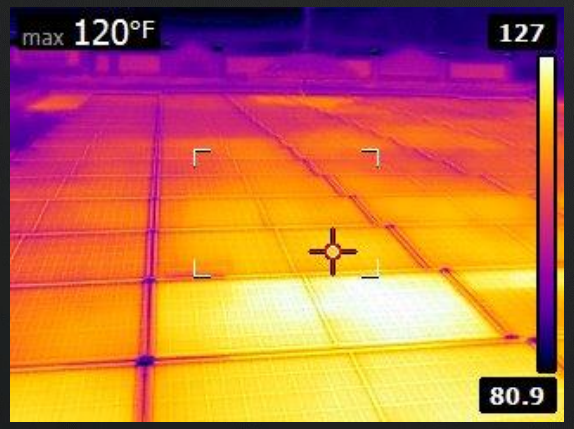
Bypassed: “Light module” when RSD receivers are on
Opened: “Dark module” when RSD receivers are off

RSD-EYE+ Detector



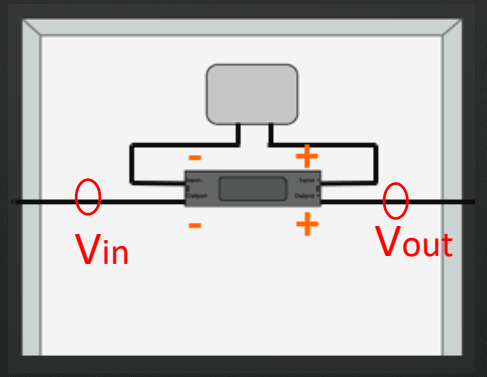
Bypassed: V_on = 0v
Opened: V_off >1v

Thermometer



Low Voltages Arcing: “Hot-Spot” when RSD Receiver is on

Clamp DMM



Bypassed: $V_{in} - V_{out} = 0v$
Opened: $V_{out} - V_{in} > 1v$

RSD Systems Troubleshooting Guidelines & Best Practice:

- **RSD system troubleshooting procedure recommendation:**

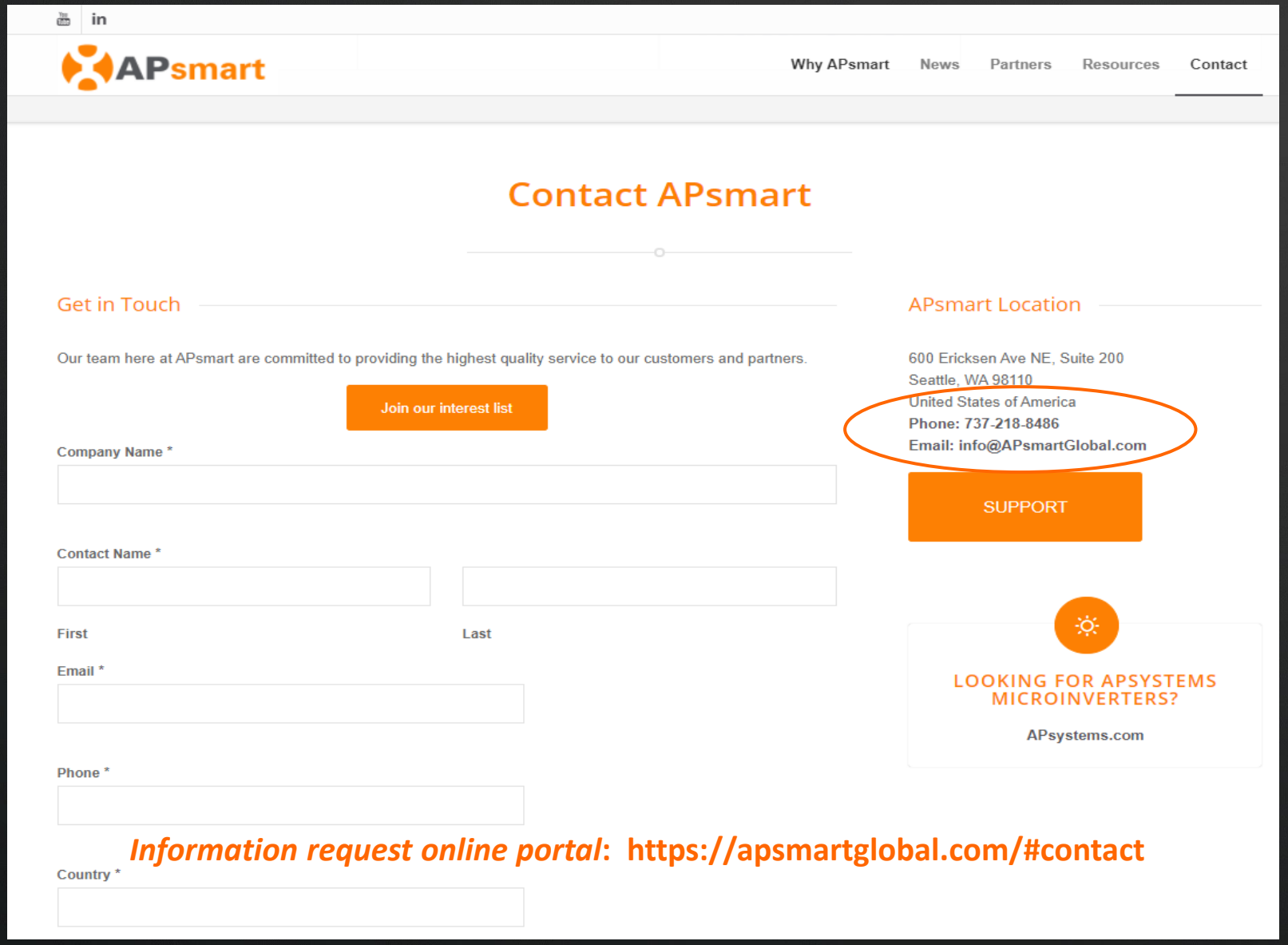
  It is better to diagnostic the PV arrays first, filtering out failing possibility from PV system side, then checking the string inverter function. Always calling APsmart technical support first!

- **APsmart RSD devices had been carefully designed to ignore the "AFCI Unwanted Tripping" issue, so if inverter is alerting on AFCI, it must have the arcing occurred, engineers need to investigate immediately onsite ASAP. By investigating on AFCI alerts earlier will reduce the comprehensive thermal damage on modules very much!**

- **Troubleshooting best practices:**
  - **De-energize inverters, switch-off DC disconnect/fuses inside inverter if applicable.**
  - **Disconnect homeruns from inverter MPPTs, follow troubleshooting steps to find out failed strings;**
  - **Using combination of RSD Start Kit & thermal detector (IR camera or thermometer) to locate failures;**
  - **Using RSD-EYE+ or DMM to confirm the failed devices.**

APsmart MLRSD Technical Support & RMA Process

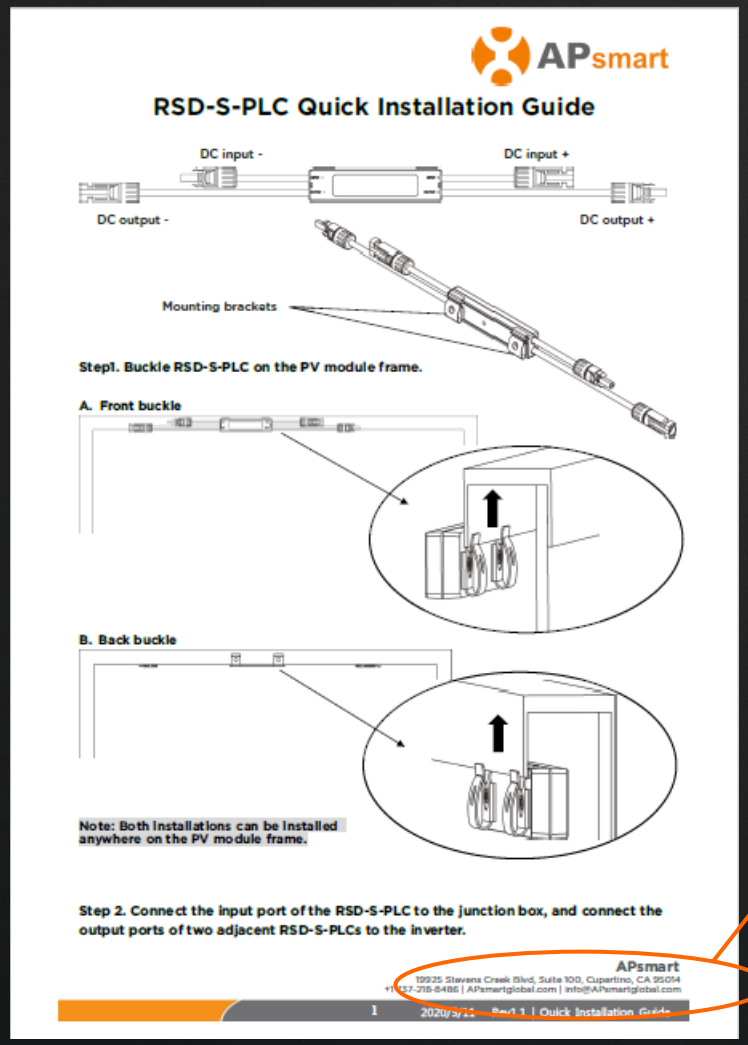
Applications Support: https://apsmartglobal.com/library/



***Information request online portal*: https://apsmartglobal.com/#contact**

Installers Support:

RSD-S-PLC



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RSD-S-PLC Quick Installation Guide

DC input -

DC input +

DC output -

DC output +

Mounting brackets

Step1. Buckle RSD-S-PLC on the PV module frame.

A. Front buckle

B. Back buckle

Note: Both installations can be installed anywhere on the PV module frame.

Step 2. Connect the input port of the RSD-S-PLC to the junction box, and connect the output ports of two adjacent RSD-S-PLCs to the inverter.

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19925 Stevens Creek Blvd, Suite 100, Cupertino, CA 95014

+1-737-218-8486 | APsmartglobal.com | info@APsmartglobal.com

1 2020/3/31 Rev1.1 | Quick Installation Guide

Technical Support:

Email: support@apsmartglobal.com

Web: https://apsmartglobal.com/support/

Support Hotline: 1-866-374-8538

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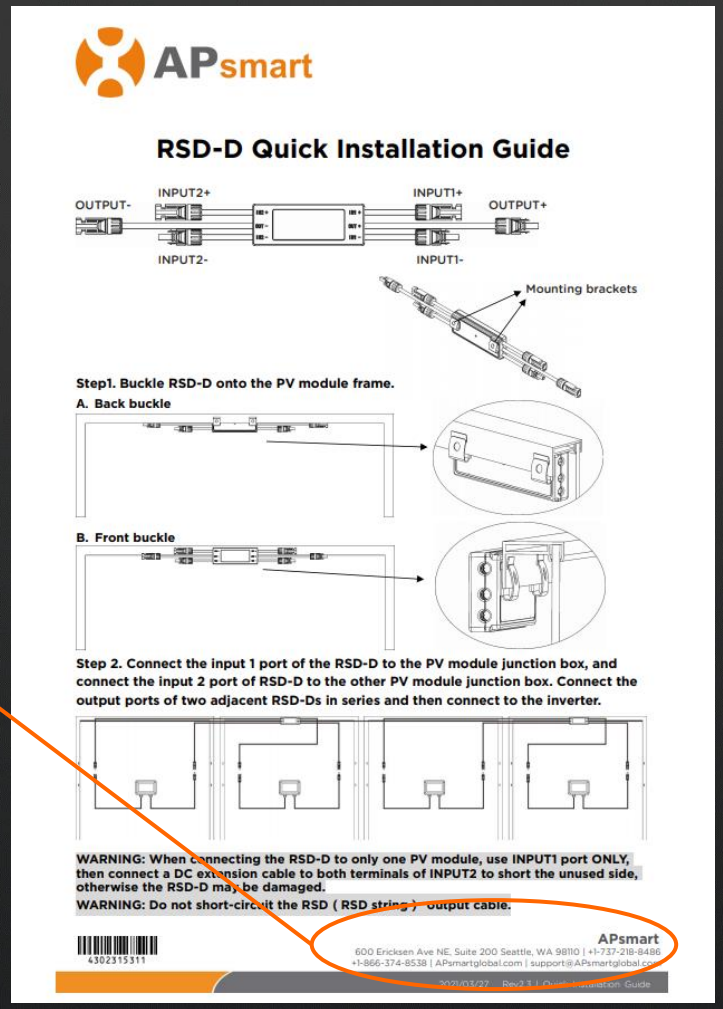
Product Label

RSD-D



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RSD-D Quick Installation Guide

OUTPUT-

INPUT2+

INPUT1+

OUTPUT+

INPUT2-

INPUT1-

Mounting brackets

Step1. Buckle RSD-D onto the PV module frame.

A. Back buckle

B. Front buckle

Step 2. Connect the input 1 port of the RSD-D to the PV module junction box, and connect the input 2 port of RSD-D to the other PV module junction box. Connect the output ports of two adjacent RSD-Ds in series and then connect to the inverter.

WARNING: When connecting the RSD-D to only one PV module, use INPUT1 port ONLY, then connect a DC extension cable to both terminals of INPUT2 to short the unused side, otherwise the RSD-D may be damaged.

WARNING: Do not short-circuit the RSD (RSD string) output cable.

4302315311

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600 Ericksen Ave NE, Suite 200 Seattle, WA 98110 | +1-737-218-8486

+1-866-374-8538 | APsmartglobal.com | support@APsmartglobal.com

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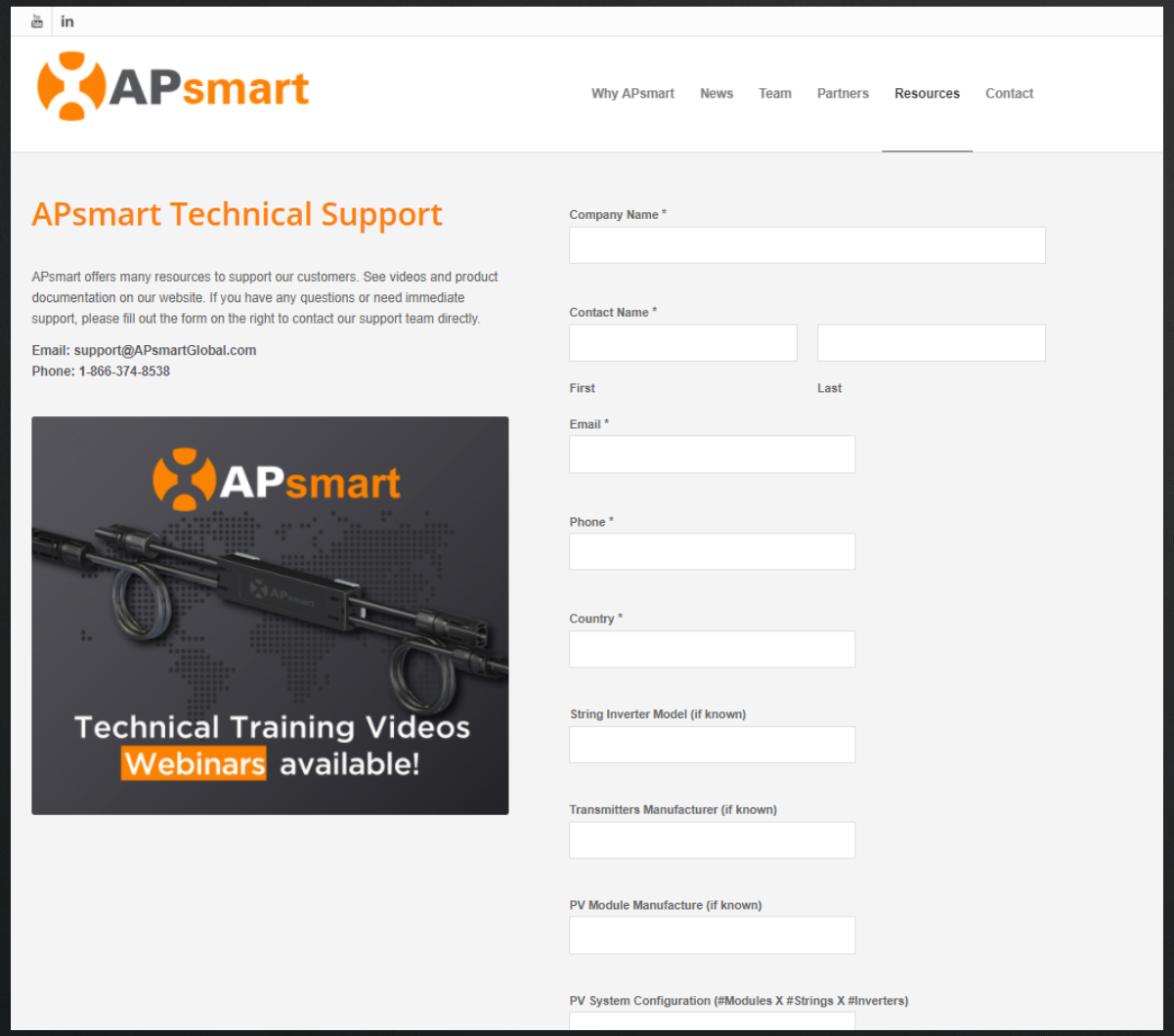
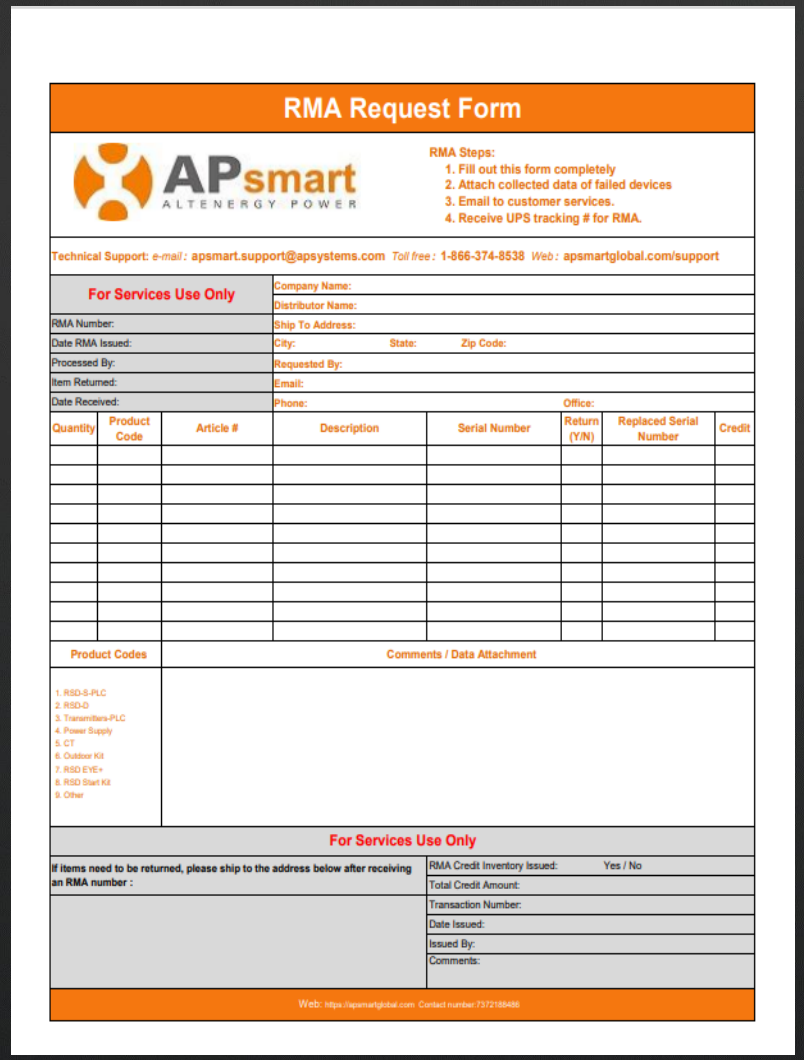
O&M Support: Technical Support Request Online Portal & RMA Request Form

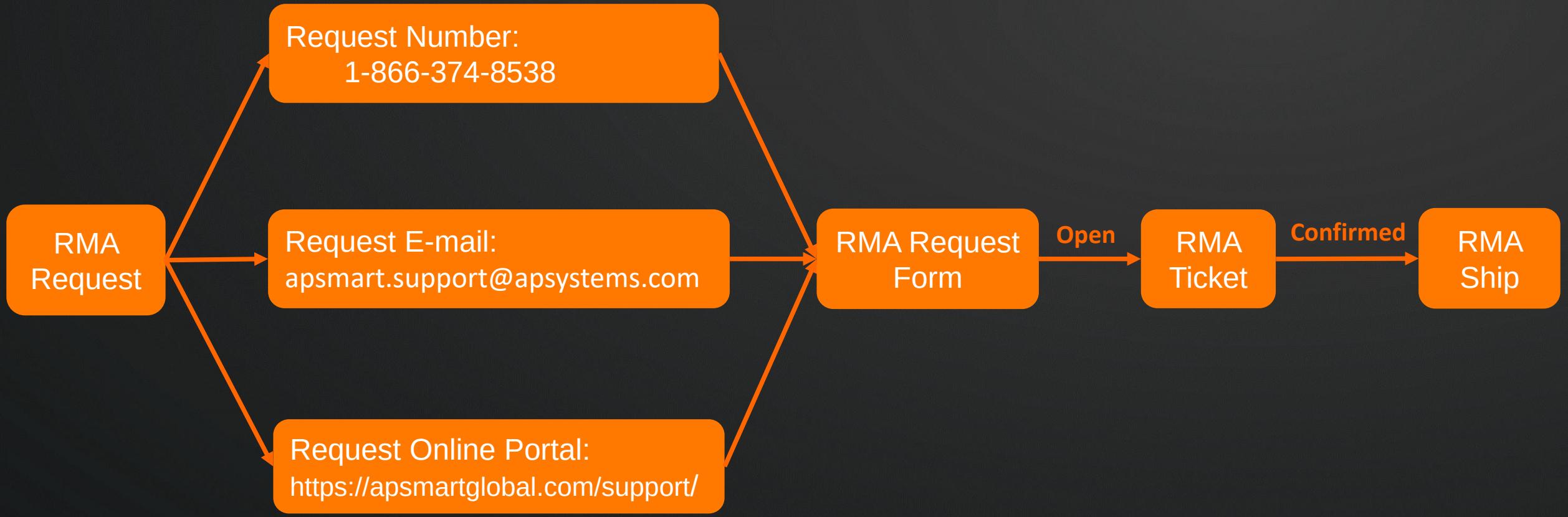


https://apsmartglobal.com/support/



https://apsmartglobal.com/library/

APsmart RMA Process: For All End Users



Manufacture Warranty

APsystems
ALTENERGY POWER

APsystems Limited Warranty for Rapid Shutdown Devices & Transmitter

Altenergy Power System, Inc. ("APsystems") provides Rapid Shutdown Devices, including RSD-S-PLC and RSD-D, Transmitter-PLC, Transmitter-PLC Outdoor Kit, and RSD-EYE+. This Limited warranty ("Limited Warranty") covers defects in workmanship and materials of the Equipment for the specified duration ("Warranty Period") described below:

- RSD-S-PLC and RSD-D: twenty-five (25) years beginning on the earlier of ("Warranty Start Date"): (i) 4 months from the date the Equipment is shipped from APsystems; and (ii) the installation of the Equipment ("Warranty Start Date"). For PV module-embedded Equipment, the Warranty Period shall not exceed the maximum of (1) the PV module product warranty period and (2) the PV module power warranty period provided by the PV module manufacturer.
- Transmitter-PLC: ten (10) years beginning on the Warranty Start Date. For inverter-embedded Equipment, the Warranty Period shall not exceed the inverter product warranty period provided by the inverter manufacturer.
- Transmitter-PLC Outdoor Kit: three (3) years beginning on the Warranty Start Date, when used with the APsystems Rapid Shutdown Devices.
- RSD-EYE+: one (1) year beginning on the Warranty Start Date, when used with the APsystems Rapid Shutdown Devices.

https://apsmartglobal.com/library/

Thank you!

For more information, visit

APsmartglobal.com

You can also email us at: info@APsmartGlobal.com

call us at: 7372188486