APsmart Rapid Shutdown Solution

Technical Training

APsmart
ALTENERGY POWER

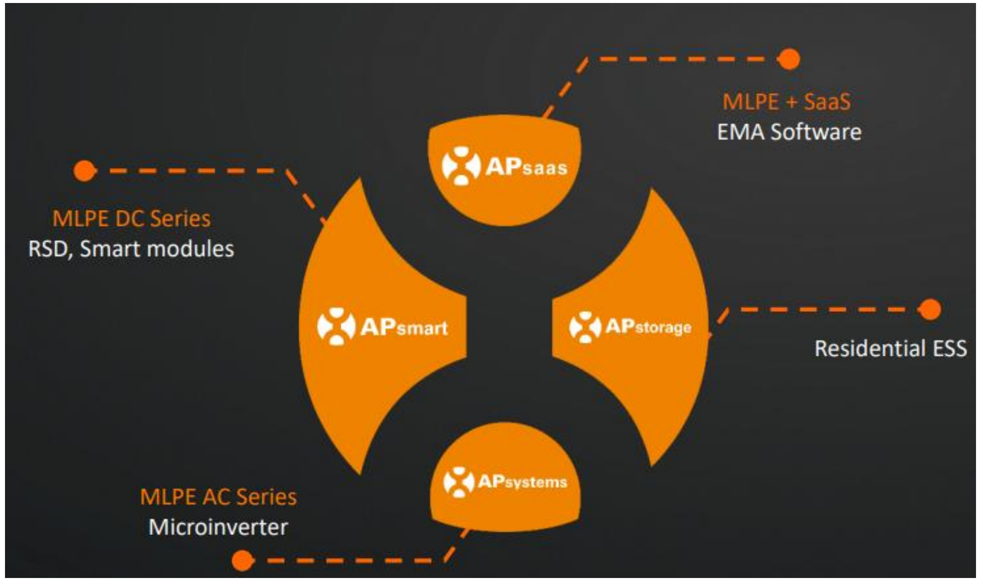
BRIGHT SOLAR
SOLUTIONS

who we are?

Who is APsmart ?

- Global provider of MLPE (module level Power Electronics) equipment for the solar industry.
- Worldwide BUs and offices: USA (Seattle, San-Francisco); EMEA (Lyon - France, Rotterdam - Netherlands), China (Jiaxing, Shanghai), Australia (Sydney) and LATAM (Guadalajara - Mexico).
- Manufacturing capabilities include Jiaxing in China and Miao-Li in Taiwan.
- R&D centers in Cupertino - USA and Jiaxing - China
- Serving customers in more than 90 countries, with local teams dedicated directly to customers.

Global Multi Platform MLPE Technology Leader



MLPE + SaaS
EMA Software

MLPE DC Series
RSD, Smart modules

Residential ESS

MLPE AC Series
Microinverter

MLPE Product Lines & Bankability

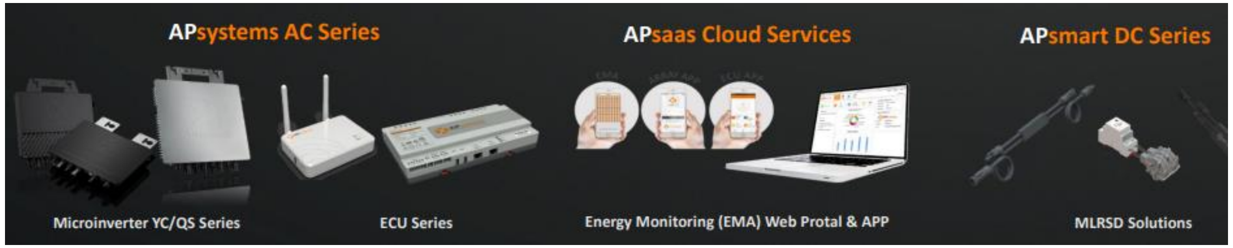
Founded in
Sillicon Valley
in 2010

More than 100K
installations monitored
worldwide

Company Profitable
since 2012, strong
bankability

ISO 9001, ISO
14001
QA Certified

Technology
protected by
over 100 patents



APsystems AC Series

APsaas Cloud Services

APsmart DC Series

Microinverter YC/QS Series

ECU Series

Energy Monitoring (EMA) Web Protal & APP

MLRSD Solutions

who we are?

Who is APsmart & What its MLRSD Solutions

- Dedicated business division for DC applications
- Leverages APsystems' proven expertise in MLPE
- Excellent SoC (System on Chip) IC design capability
- Meets NEC 2017/2020 690.12 Rapid Shutdown requirements
- Ideal for all existing String or Central inverters.
- Applications for any Residential, Industrial systems.

Partnership Examples

QCELLS
CanadianSolar
SUNPOWER
Trinasolar
JinKO Solar
WattPower
SMA
CPS AMERICA
YASKAWA SOLECTRIA SOLAR
DELTA
Fronius
solis
GOODWE YOUR SOLAR ENGINE
Growatt
SOLAX POWER
SUNGROW
HUAWEI
TESLA
sunrun
FIMER
ISOLAR BROKERS
CES
krannich global solar distribution
CED GREENTECH
BayWa r.e.
THE POWERSTORE Solar and Storage Specialists

+Many More are coming

Authorize official distributor in Thailand and Vietnam market

APS Alternative Power Solution Co., Ltd

JST INTERTECH SUPPLY CO.,LTD.

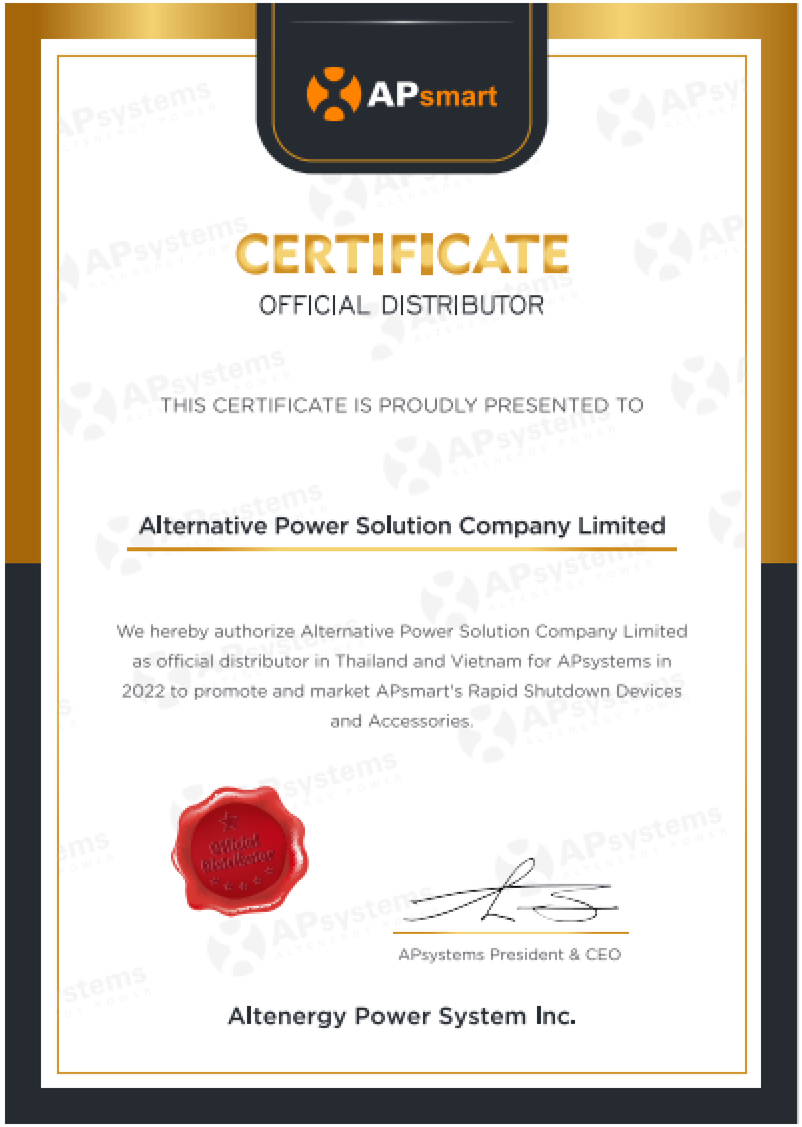
who we are?

Who is Alternative Power Solution Co., Ltd. ?

COMPANY BACKGROUND

- Alternative Power Solution Co., Ltd. (APS) is Thai companies in the field of Renewable energy system, Electrical power system 0.4kV-115kV and Constructions, providing engineering design, installation, test and commissioning of renewable energy power plant and electrical power system.

- APS was established in A.D. 2010 with its head office in Bangkok, Thailand and is owned by its management and staff. It has more than 10 professional engineers who are well qualified and experienced in their respective fields of engineering. Most of the APS is engineering staff draws from electrical, civil and mechanical fields of disciplines.



APsmart

CERTIFICATE

OFFICIAL DISTRIBUTOR

THIS CERTIFICATE IS PROUDLY PRESENTED TO

Alternative Power Solution Company Limited

We hereby authorize Alternative Power Solution Company Limited as official distributor in Thailand and Vietnam for APsystems in 2022 to promote and market APsmart's Rapid Shutdown Devices and Accessories.

APsystems President & CEO

Altenergy Power System Inc.

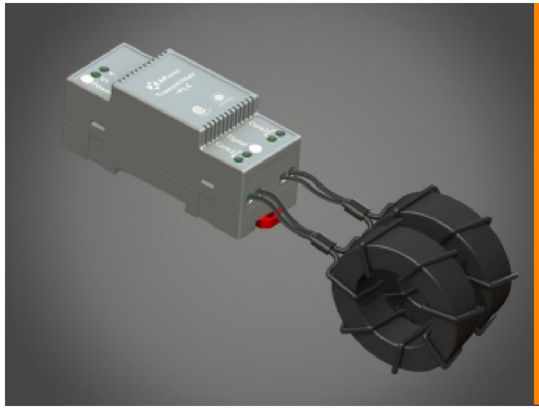
Rapid Shutdown Solutions Product & System Introduction

Meets NEC 2017/2020 690.12 Rapid Shutdown requirements

Raising the bar in innovative
DC **MLPE** solar power systems

RSD-S-PLC

- Meets NEC 2017 & 2020 (690.12) requirements
- Executes rapid shutdown of system when Transmitter-PLC signal is absent
- Meets SunSpec requirements



Raising the bar in innovative
DC **MLPE** solar power systems

TRANSMITTER-PLC

- Meets NEC 2017&2020 (690.12) requirements
- Switching off Transmitter-PLC results in rapid shutdown of the output of PV modules
- Meets SunSpec requirements
- Equipped with single/dual core
- Optional 85-264VAC power supply
- Optional 180-550VAC power supply

Raising the bar in innovative
DC **MLPE** solar power systems

RSD-D

- Meets NEC 2017 & 2020 (690.12) requirements
- Executes rapid shutdown of system when Transmitter-PLC signal is absent
- Meets SunSpec requirements
- Dual-input channel

RSD START KIT

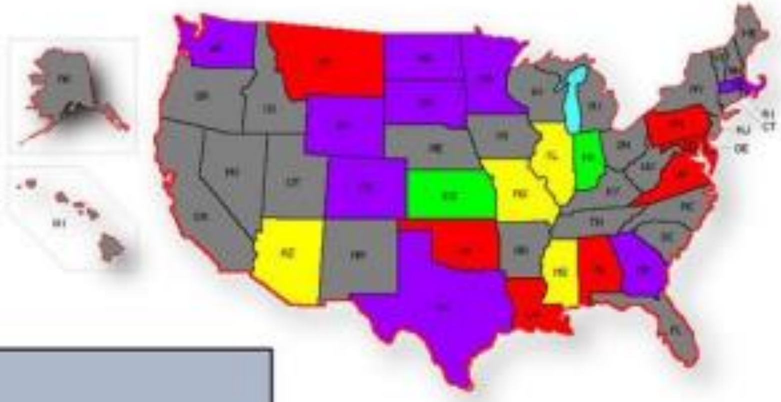
APsmart
12V
Signal LED
IN-
OUT-
IN+
OUT+
RSD-START-KIT

Smart Signal Detector
RSD-EYE+
Operation Manual

A
B
RSD-EYE+
APsmart

NEC 2017 690.12 Module Level Rapid Shutdown

NEC® in Effect
1/1/2021



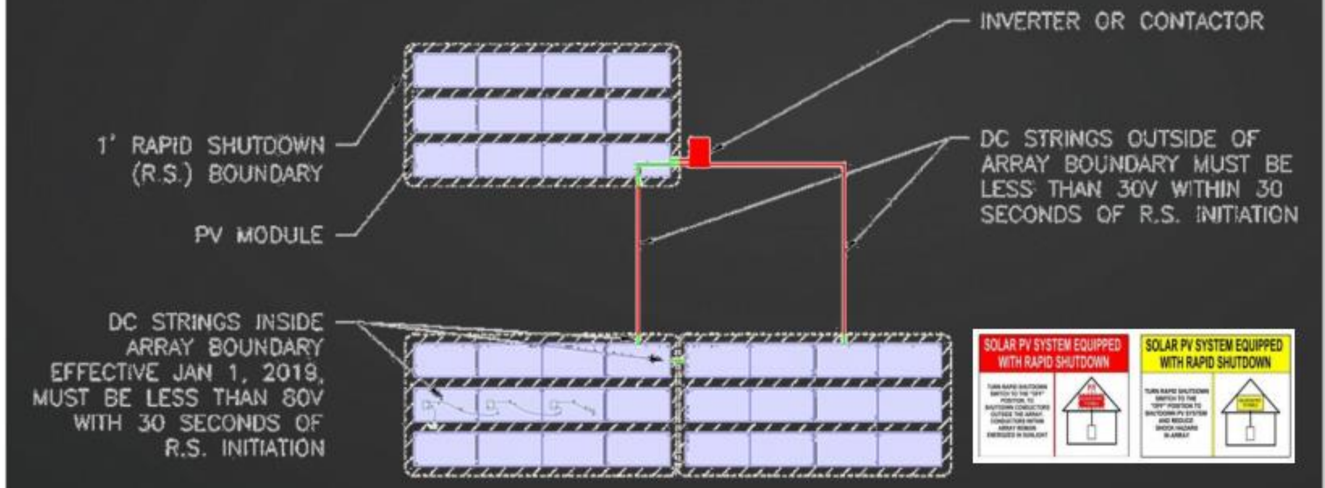
- 2020 NEC® - 9
- 2017 NEC® - 27
- 2014 NEC® - 8
- 2008 NEC® - 2
- County/Municipality NEC® regulation only - 4

PV module-level power control and safety ("rapid shutdown") is required in 24 states starting in January 2019

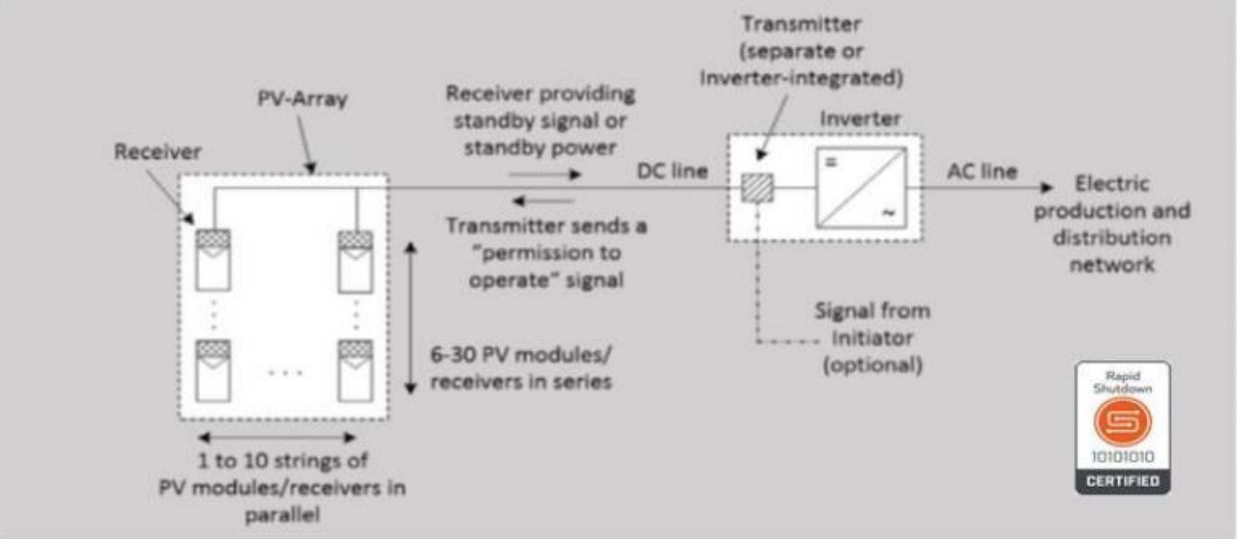
SunSpec Alliance global leaders have developed an open standard rapid shutdown communication solution

SunSpec is launching a Rapid Shutdown Certification Program

nec
2017 Edition
SunSpec Communication Signal for Rapid Shutdown Functional Specification
Rapid Shutdown
10101010
CERTIFIED



INVERTER OR CONTACTOR
1' RAPID SHUTDOWN (R.S.) BOUNDARY
PV MODULE
DC STRINGS OUTSIDE OF ARRAY BOUNDARY MUST BE LESS THAN 30V WITHIN 30 SECONDS OF R.S. INITIATION
DC STRINGS INSIDE ARRAY BOUNDARY EFFECTIVE JAN 1, 2019, MUST BE LESS THAN 80V WITH 30 SECONDS OF R.S. INITIATION
SOLAR PV SYSTEM EQUIPPED WITH RAPID SHUTDOWN
SOLAR PV SYSTEM EQUIPPED WITH RAPID SHUTDOWN



Transmitter (separate or Inverter-integrated)
PV-Array
Receiver providing standby signal or standby power
Inverter
Receiver
DC line
AC line
Electric production and distribution network
Transmitter sends a "permission to operate" signal
6-30 PV modules/ receivers in series
Signal from Initiator (optional)
1 to 10 strings of PV modules/receivers in parallel
Rapid Shutdown
10101010
CERTIFIED

APsmart Rapid Shutdown System Solution

Rapid shutdown the output of PV modules,

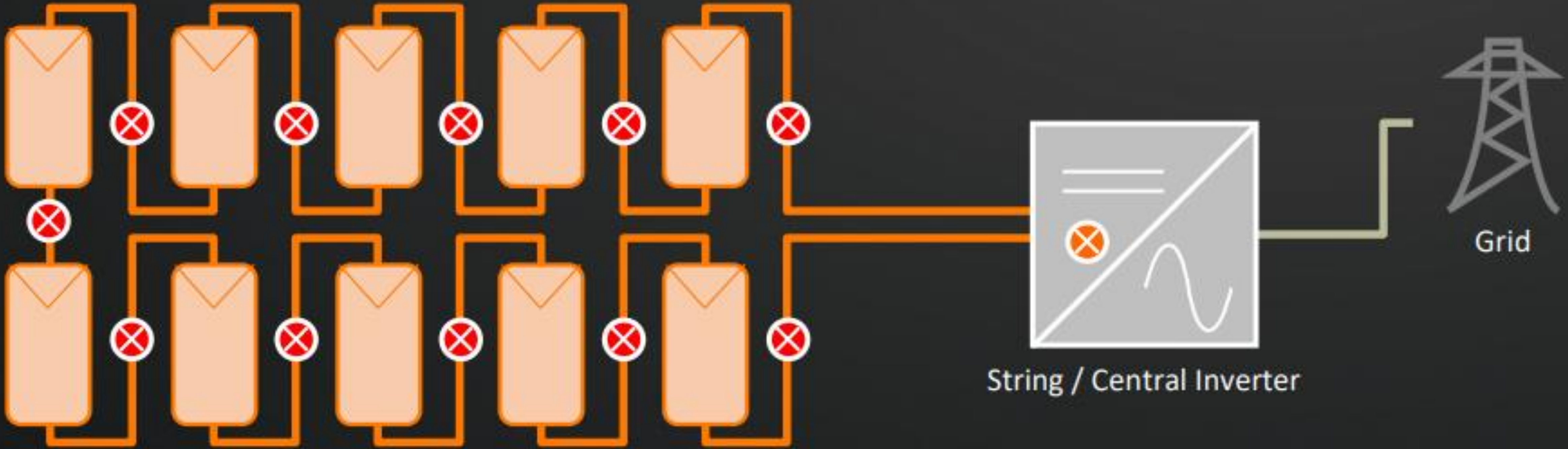
Module DC Voltage < 80V within 30s in 1 foot.

(NEC2017)

Rapid shutdown the output of strings,

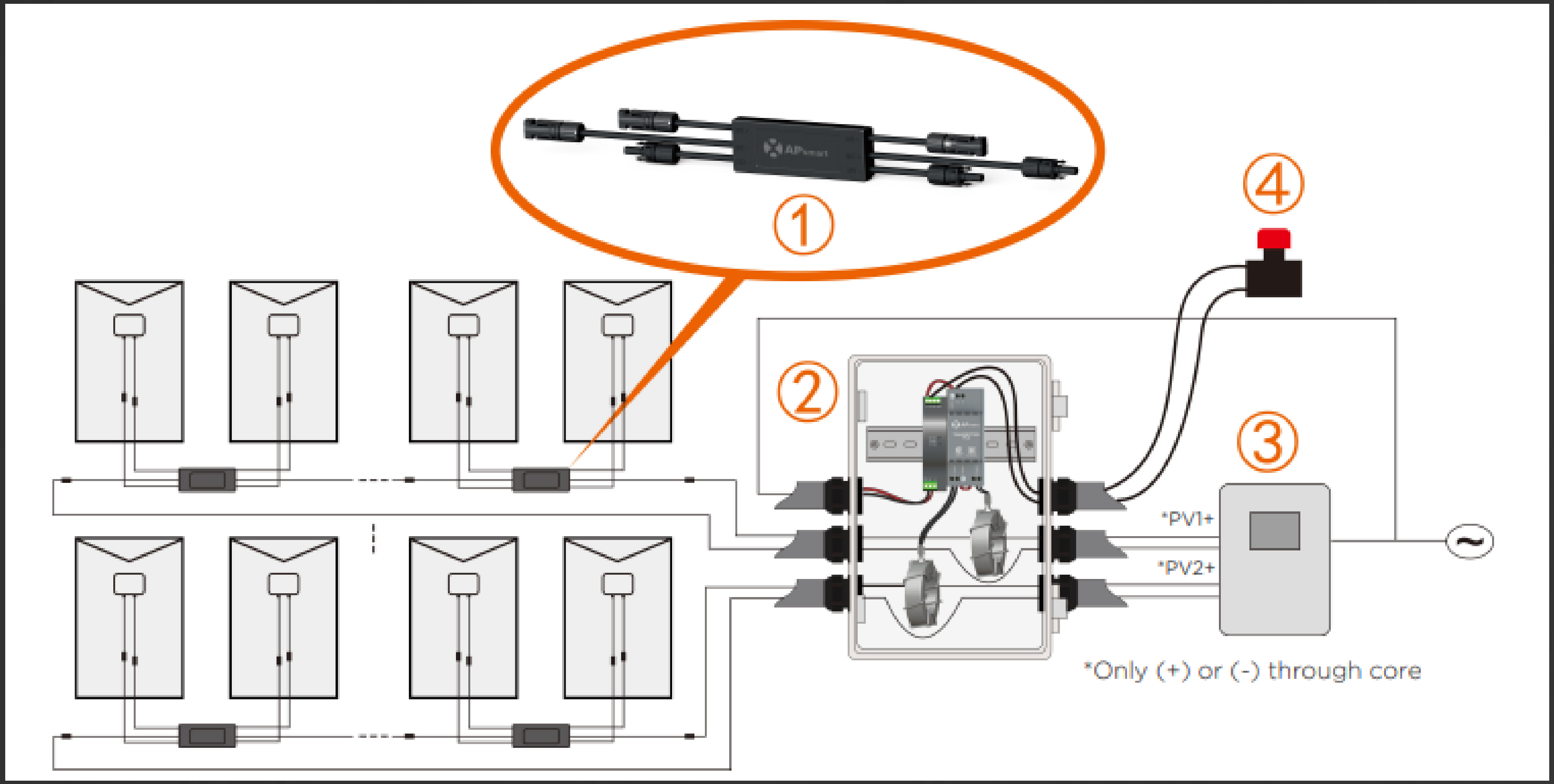
Array DC Voltage < 30V within 30s.

(NEC2014)



RSD-S-PLC (receiver) connects to each PV module to realize module-level rapid shutdown, receive the "heartbeats" signals sent from **Transmitter-PLC (transmitter)**.

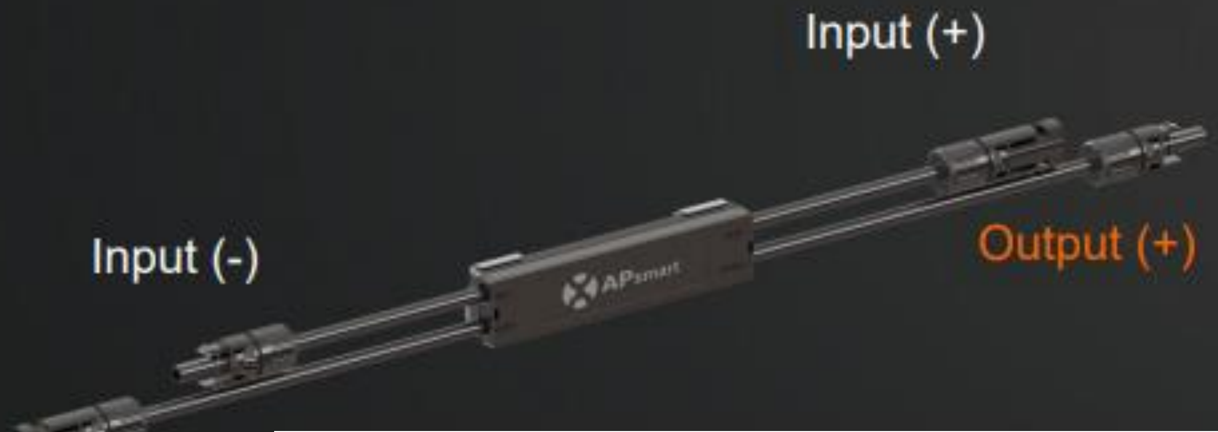
APsmart Rapid Shutdown System Solution

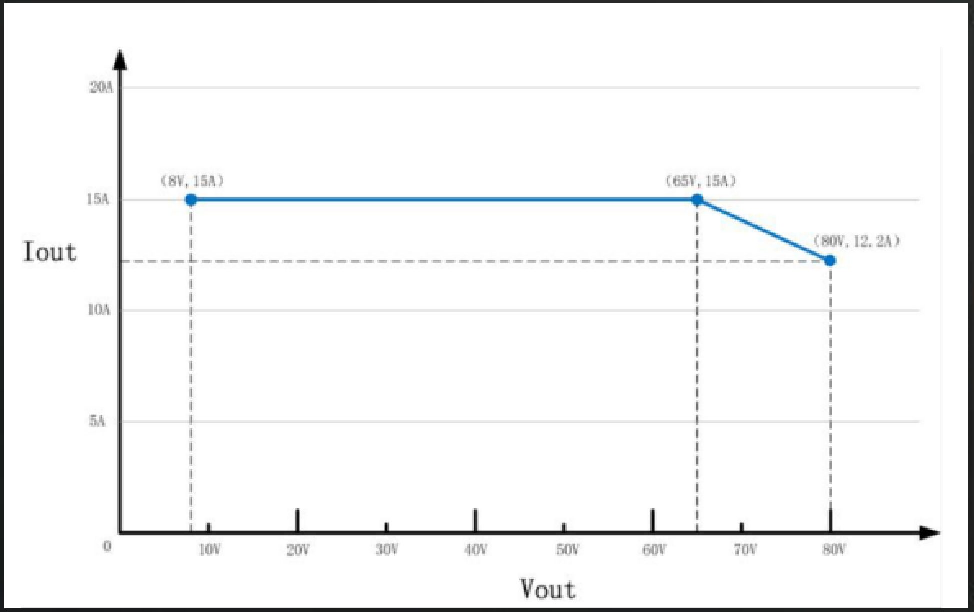


*Only (+) or (-) through core

① RSD-D
② Transmitter-PLC-Outdoor Kit
③ Inverter
④ Emergency stop button box: Press the emergency stop button, the transmitter 12VDC power supply is disconnected, the RSD closes the output, and the system rapid shutdown

Receiver: RSD-S-PLC Structure & Features





Simple

- Meets NEC 2017(690.12) & SunSpec RSD requirements.
- Depend on inverter monitoring function, limited noises.

Flexible

- Small and light, clips to module frame with no drilling.
- Works with Bifacial & corner J-box applications

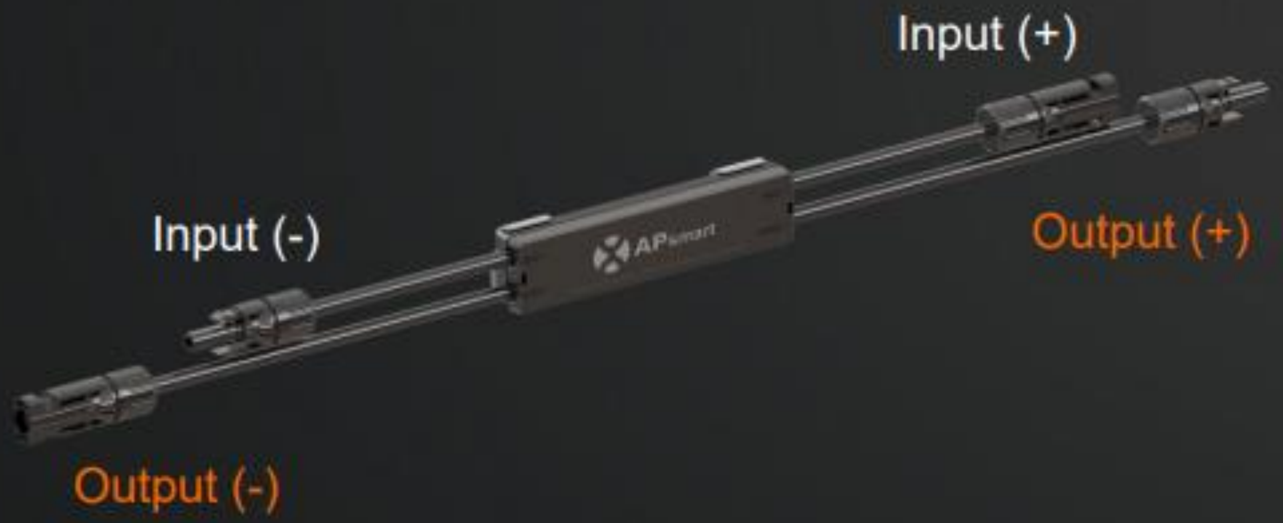
Reliable

- Designed with redundancy topology.
- Highly integrated RSD ASIC chip designed by APsystems, fewer electrical components on PCB.

Powerful

- Less power consumption (<1W), higher power rating.
- Lower minimum operation voltage (7.7v), longer module operating period and more energy deliver.

Receiver: RSD-S-PLC Structure & Features



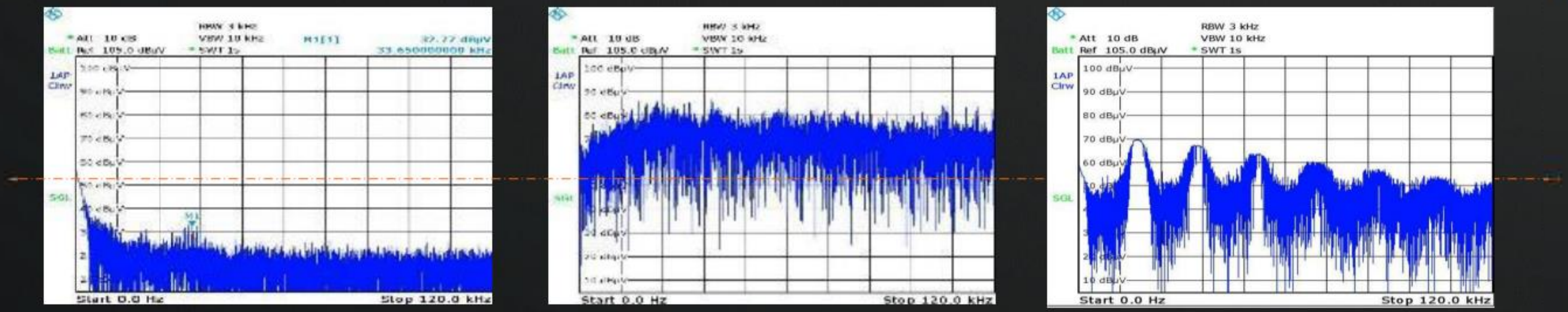
Stable

- Eliminates AFCI Unwanted Tripping
- RSD-S-PLC Noise Spectrum Density is far away from AFCI noise

Compatible

- Protected by bleed-down circuit, can survive over 40A reverse current, feasible to 25A fuse rated PV modules.
- It is feasible with PV + Storage systems.

Noise Spectrum Density Comparison

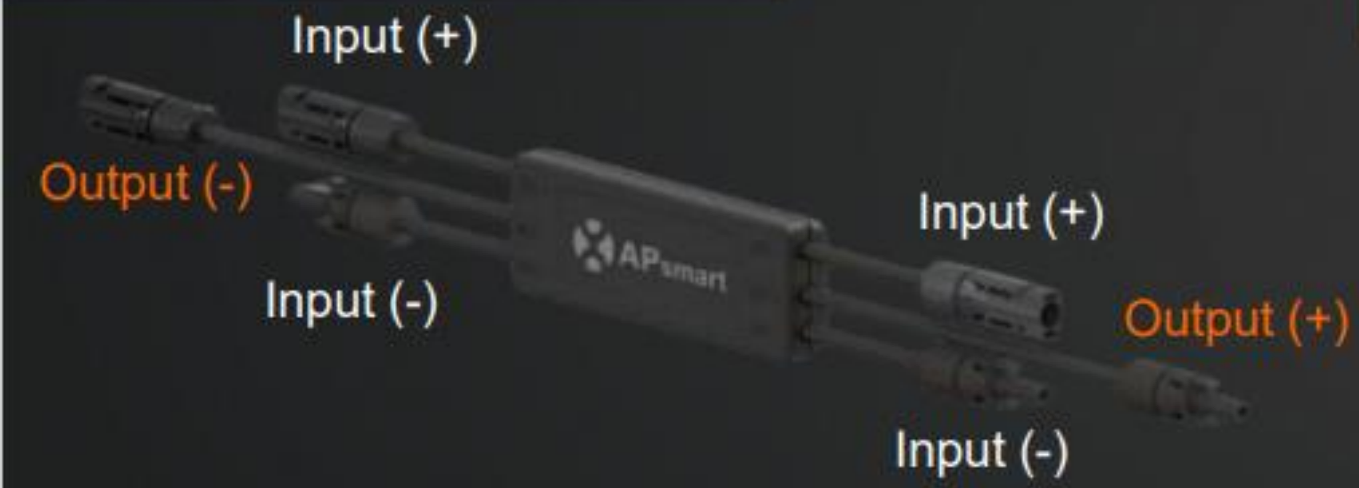


RSD-S-PLC Noise

Arcing Noise

AFCI Tripped Device Noise

Coming Now! RSD-D



More Cost Effective

- Dual-Input channels allowing two modules controlled by one RSD device.

More Flexible

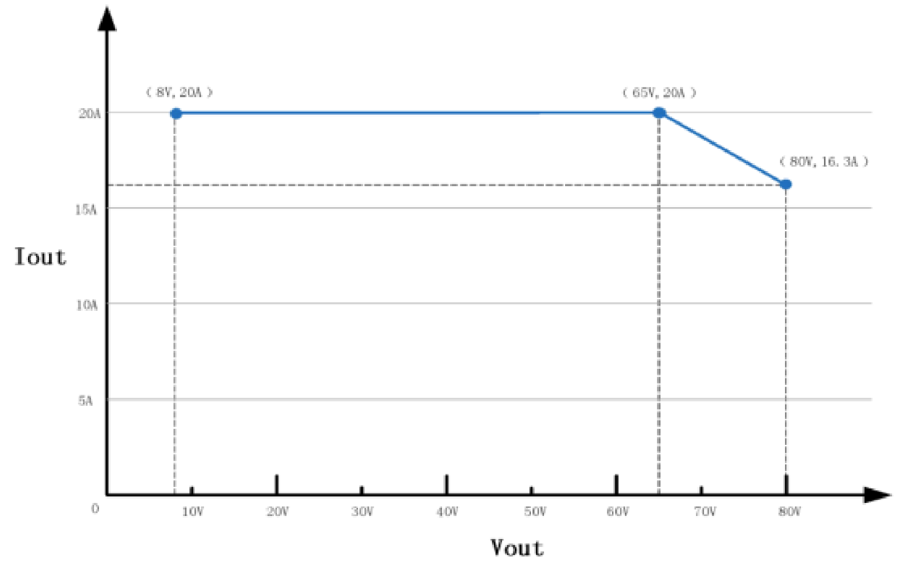
- Input 500mm/Output default: 2200mm, optional: 2400mm, easier to install and spend half time.

More Powerful

- Designed for large cell PV module up to 800W, come with 3 models based on maximum input current (Imax): 15A, 20A and 25A.

I-V Curve

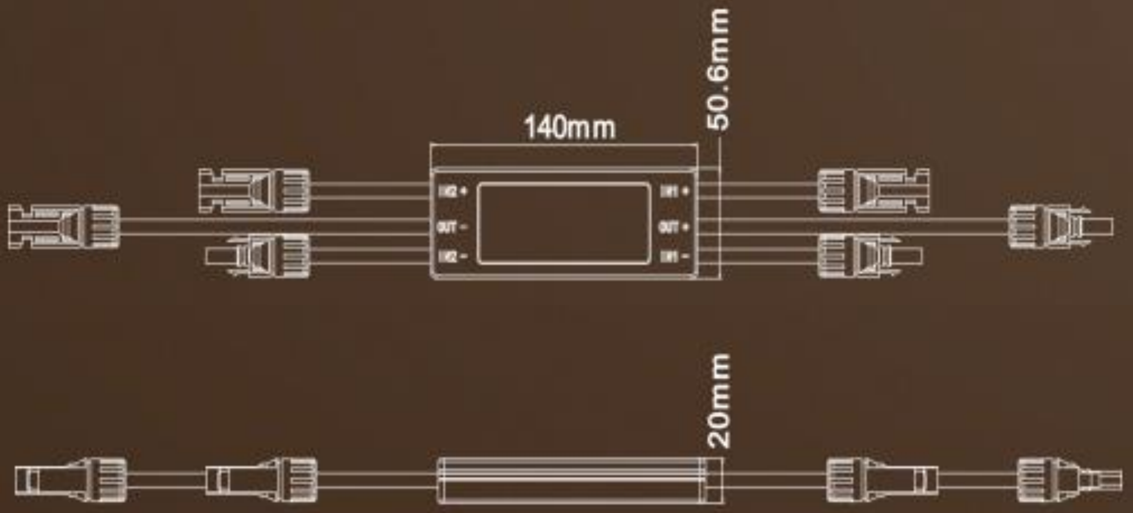
RSD-D-20



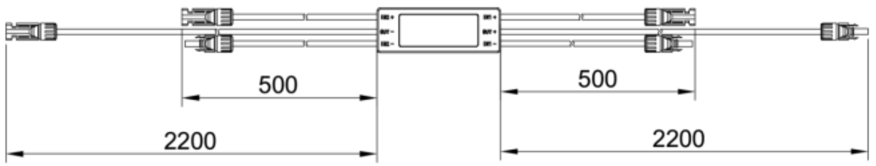
Rating type	RSD-D-15-1500	RSD-D-20-1500	RSD-D-25-1500
a) Maximum System Voltage	1500V	1500V	1500V
b) Number of Input Channel	2	2	2
c) Range of input operating voltage (dc)	8V-80V for each Channel	8V-80V for each Channel	8V-80V for each Channel
d) Max cord guage	12 AWG/4mm2	12 AWG/4mm2	10 AWG/6mm2
e) Max Input short circuit current	25A for each Channel	25A/38A* for each Channel	38A for each Channel
f) Max Output Voltage (dc)	160V	160V	160V
g) Max Output Current (dc)	15A	20A	25A

RSD-D Technical Data and Dimensions

Dimensions


140mm
50.6mm
IN2 +
OUT -
IN2 -
IN1 +
OUT +
IN1 -
20mm

RSD-D cable length


500
500
2200
2200

Technical Data

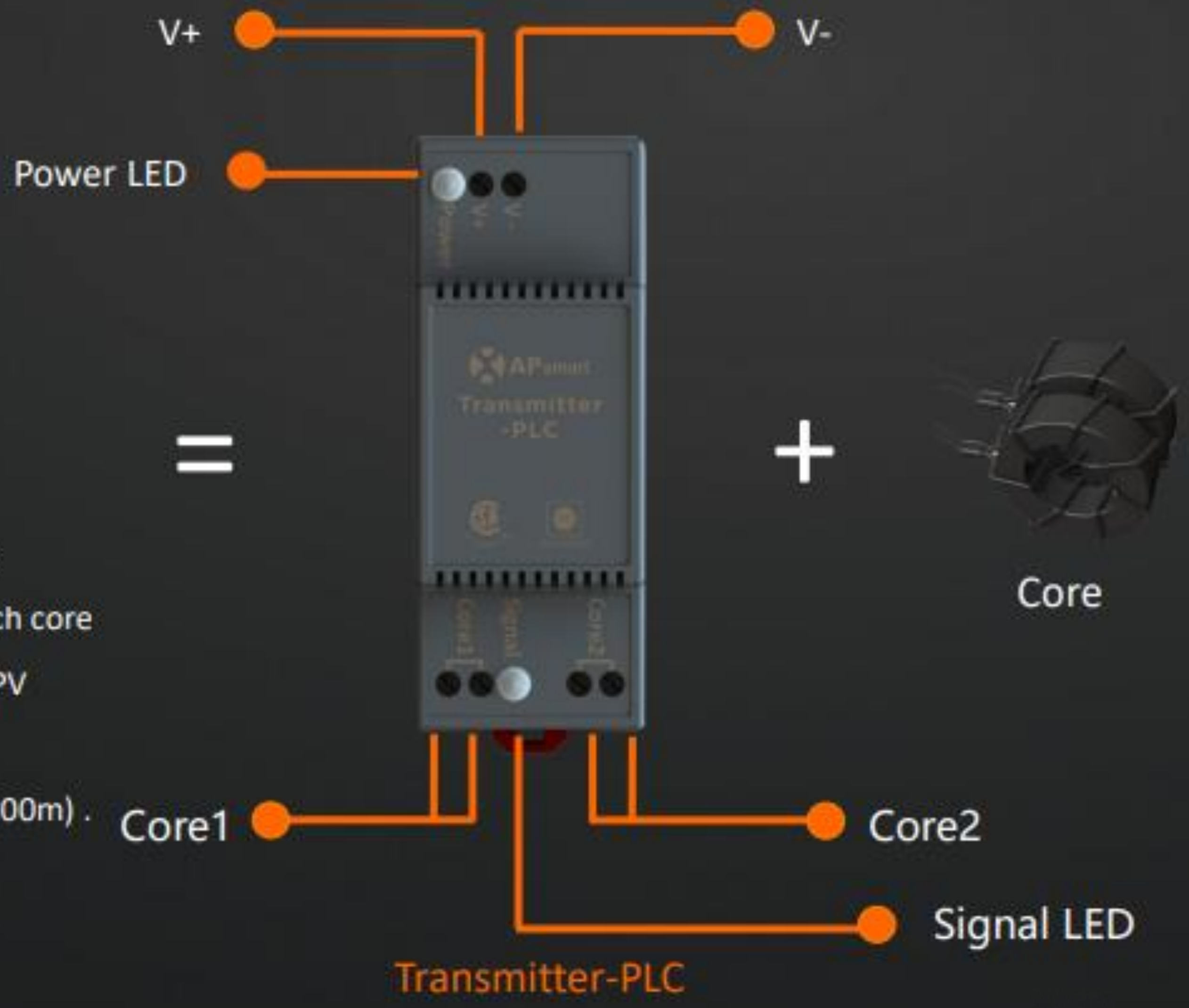
Input (Output) Voltage Range	8-80V V Per Channel
Maximum Cont. Input Current (Imax)	15A/20A Per Channel
Output operating Voltage Range	16-160V
Maximum Output Current	15A/20A
Maximum System Voltage	1000V/1500V
Ambient Temperature Range	-40°C to +75°C (-40°F to +167°F)
Connector	MC4 or MC4 Compatible
Over temperature protection	Yes
Enclosure Rating	Type6P/IP68
Safety Compliance	NEC2017 & 2020 (690.12));UL1741;

Transmitter-PLC: Structure & Features

LEDs	Power	Signal	Indicated
Colors	Yellow	Green	
Status	On	Blink	Power on & operating
	Off	Off	Power off or Malfunctions
	On	Off	Reboot

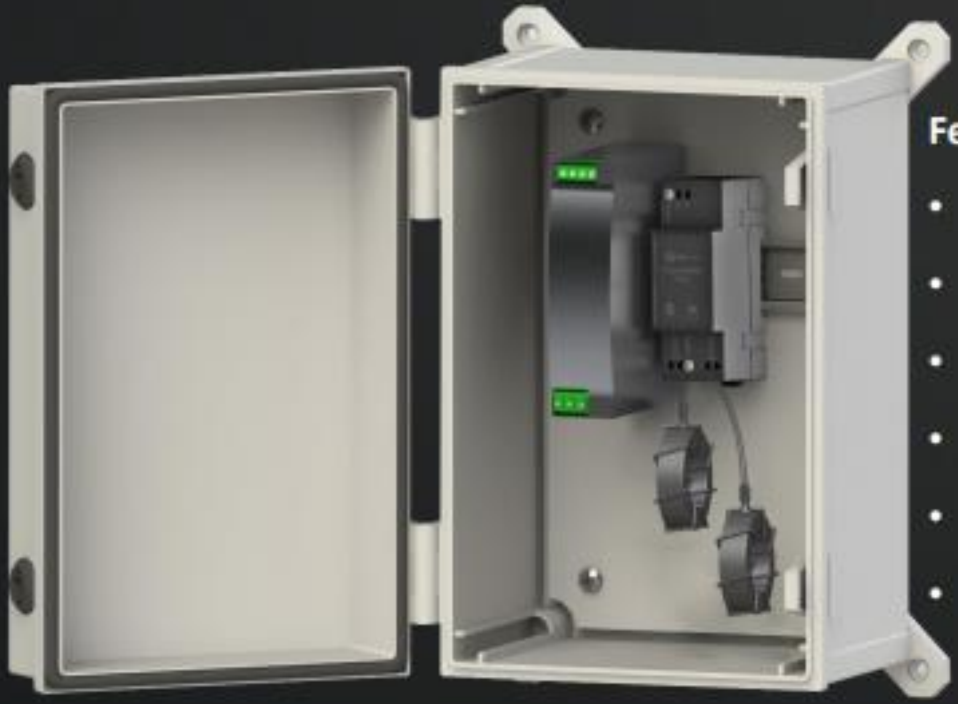
Features

- Meets NEC 2017 (690.12) and SunSpec requirements.
- Switch off transmitter-PLC, rapid shutdown the output of PV modules
- Equipped with single/dual core, large core to hold up to 10 strings, each core maximum allowing current is 150A, each string maximum allowing 30 PV modules based on SunSpec required.
- Max length for homerun from PV (+) to PV (-) on inverter is 1000 ft (~300m) .
- Pass either positive or negative homerun through cores only.


V+
V-
Power LED
Power
V+
V-
=
APsmart
Transmitter
-PLC
+
Core
Core1
Signal
Core2
Core1
Core2
Signal LED
Transmitter-PLC

Package: Outdoor Kit Structure & Features

Transmitter-PLC Outdoor Kit includes a Transmitter-PLC with one or two cores, outdoor enclosure, 85-264VAC or 180-550VAC power supply. It could be used in residential or commercial project.

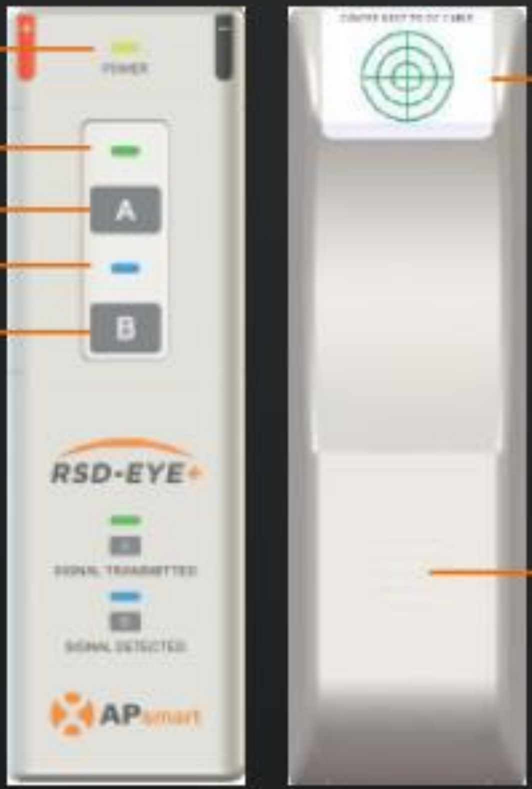


Transmitter-PLC Outdoor Kit

Features

- Meets NEC 2017/2020 (690.12) requirements
- Switch off transmitter-PLC, rapid shutdown the output of PV modules
- Meets SUNSPEC requirements
- Equipped with single core with 85-264VAC power supply for single phase.
- Equipped with dual cores with 180-550VAC power supply for 3 phases.
- Connect wires (22AWG) to AC side of power supply must be from the grid AC branch.

Tool: RSD-EYE+ Detector


POWER
A
B
RSD-EYE+
SIGNAL TRANSMITTED
SIGNAL DETECTED
APsmart

Power LED

Detect LED

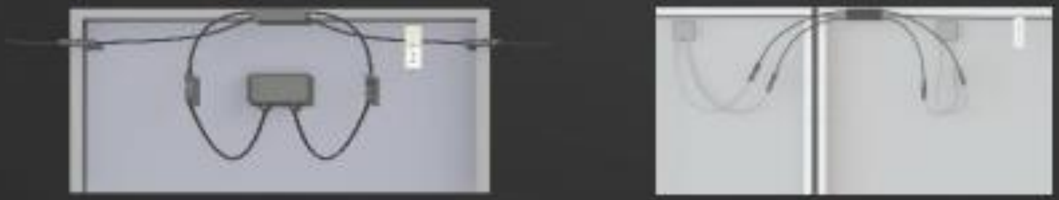
Detect Button

Transmit LED

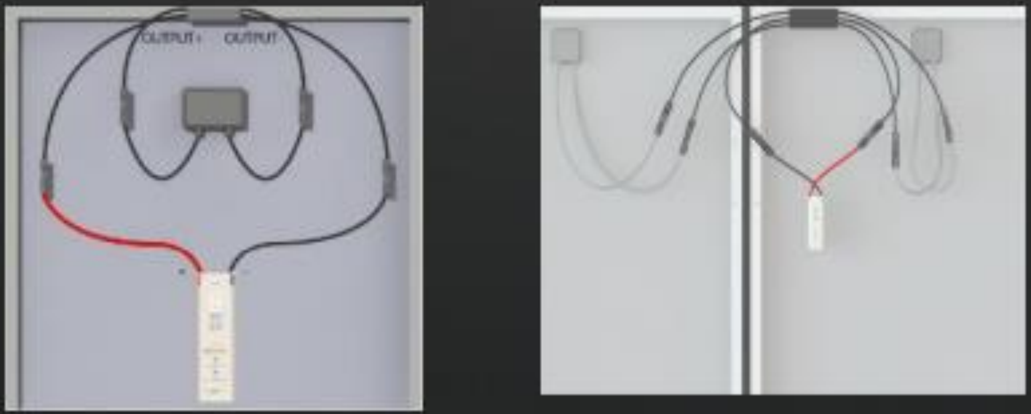
Transmit Button

Sensor Area

9v Battery

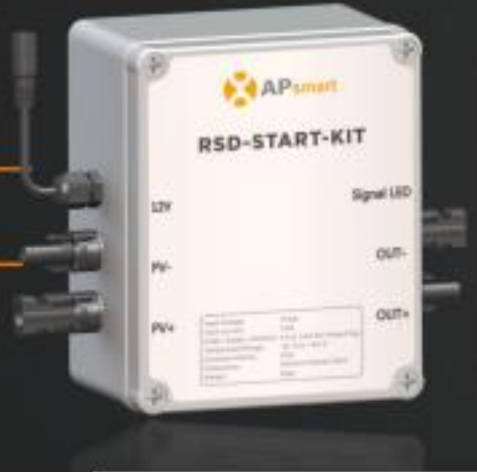


Detect Mode


OUTPUT+
OUTPUT-

Transmit Mode

Tool: RSD-START KIT

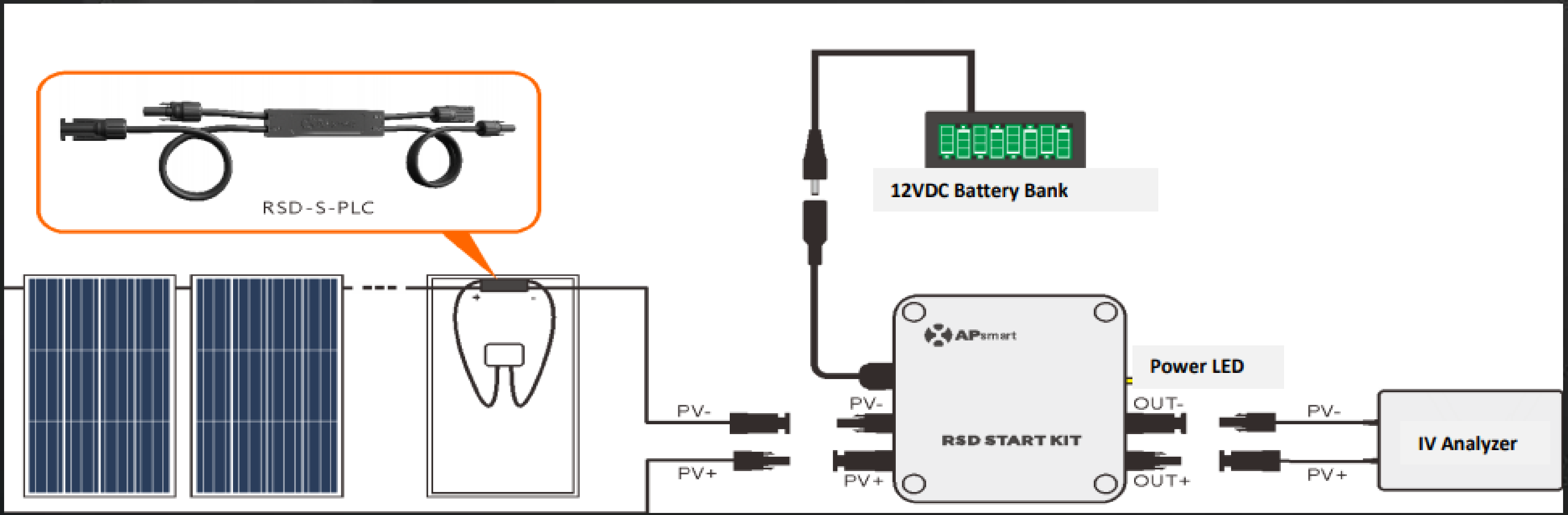

APsmart
RSD-START-KIT
12V
PV-
PV+
Signal LED
OUT-
OUT+

12vDC Battery input

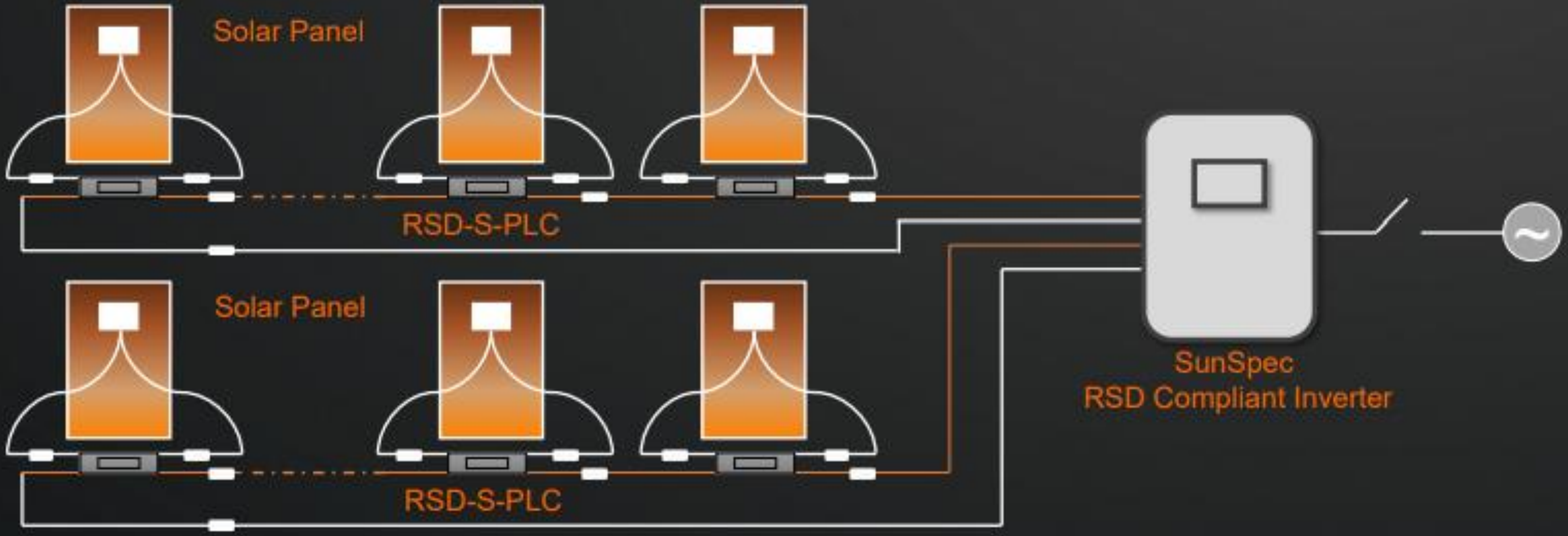
DC Power Input

For PV system installed SunSpec RSD compliant solutions:

- Measure string DC voltages with DMM.
- Perform megger test by turn on string independently.
- Perform IV curve tracing for string level by PV Analyzer.
- Perform string inverter self-checking function without turning on grid.

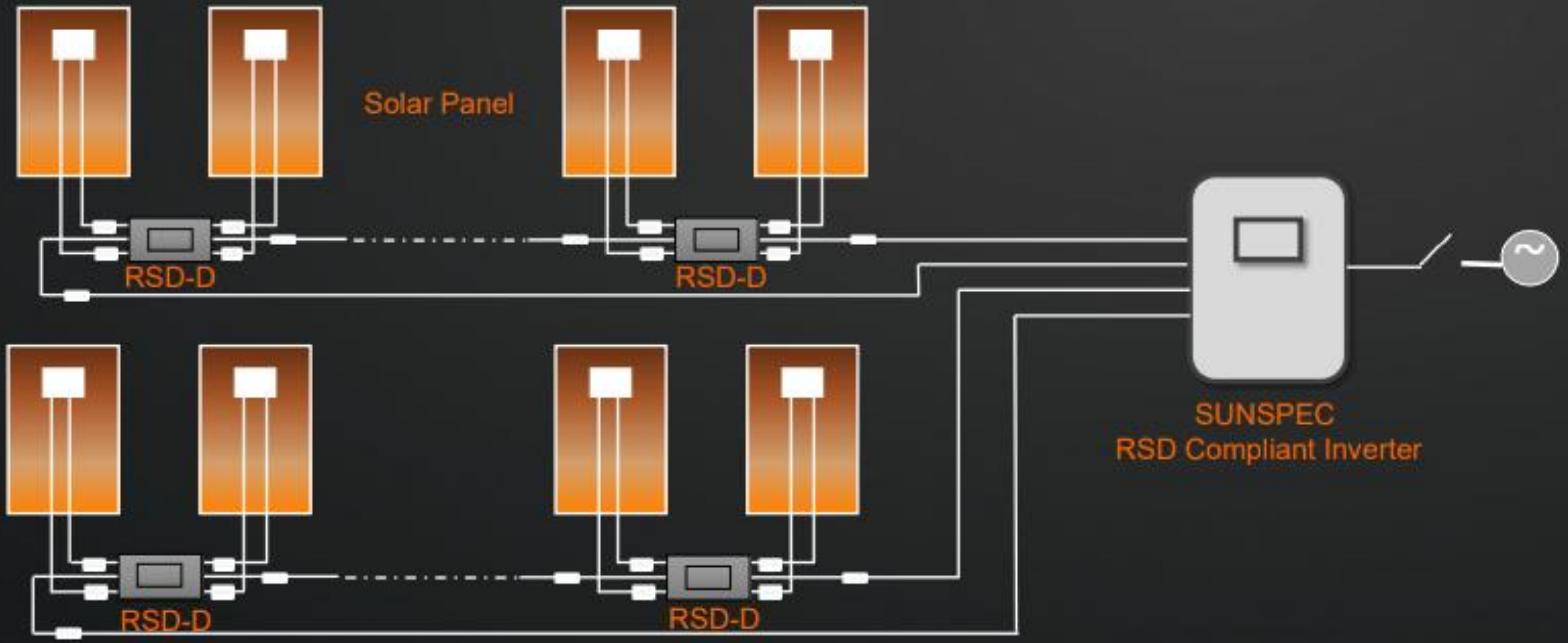

RSD-S-PLC
12VDC Battery Bank
APsmart
Power LED
PV-
PV+
PV-
PV+
RSD START KIT
OUT-
OUT+
PV-
PV+
IV Analyzer

Application #1: For SunSpec RSD Compliant Inverters with RSD-S

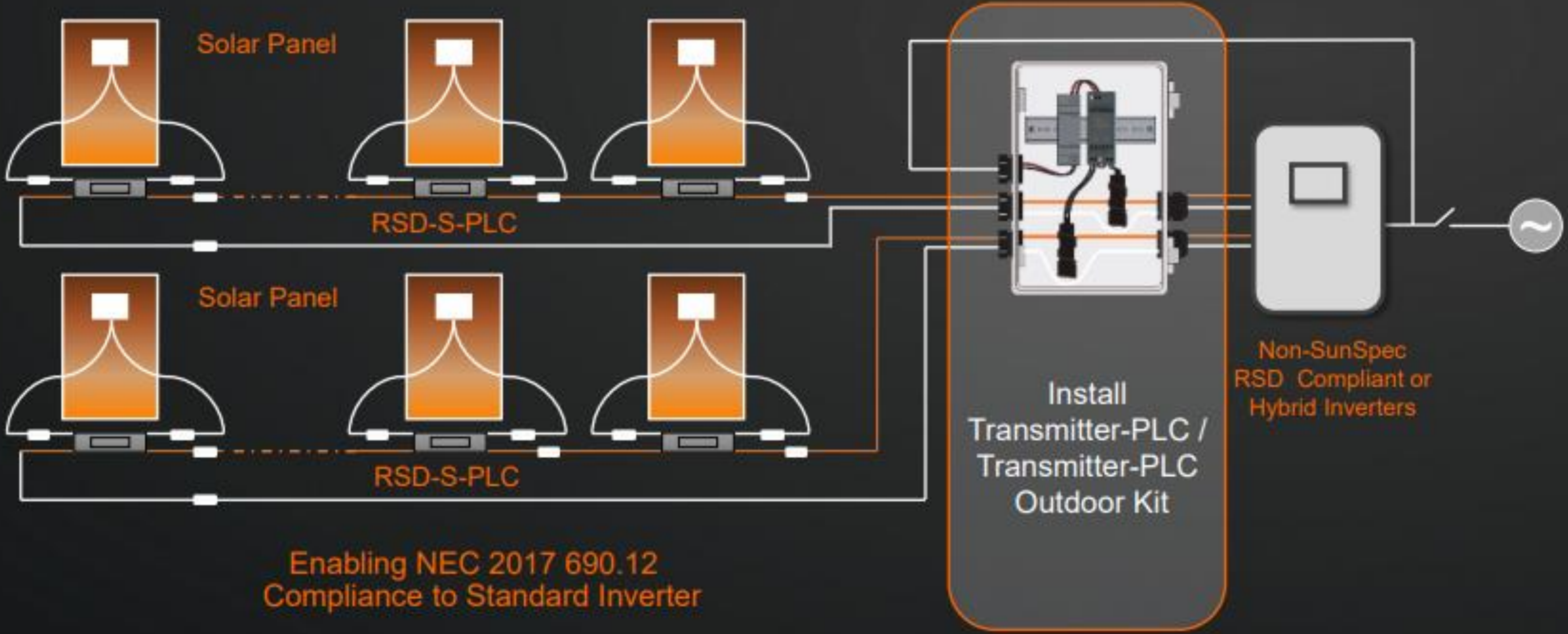

Solar Panel
RSD-S-PLC
Solar Panel
RSD-S-PLC
SunSpec
RSD Compliant Inverter

Only need RSD-S-PLC for Modules

Application #1: For SunSpec RSD Compliant Inverters with RSD-D

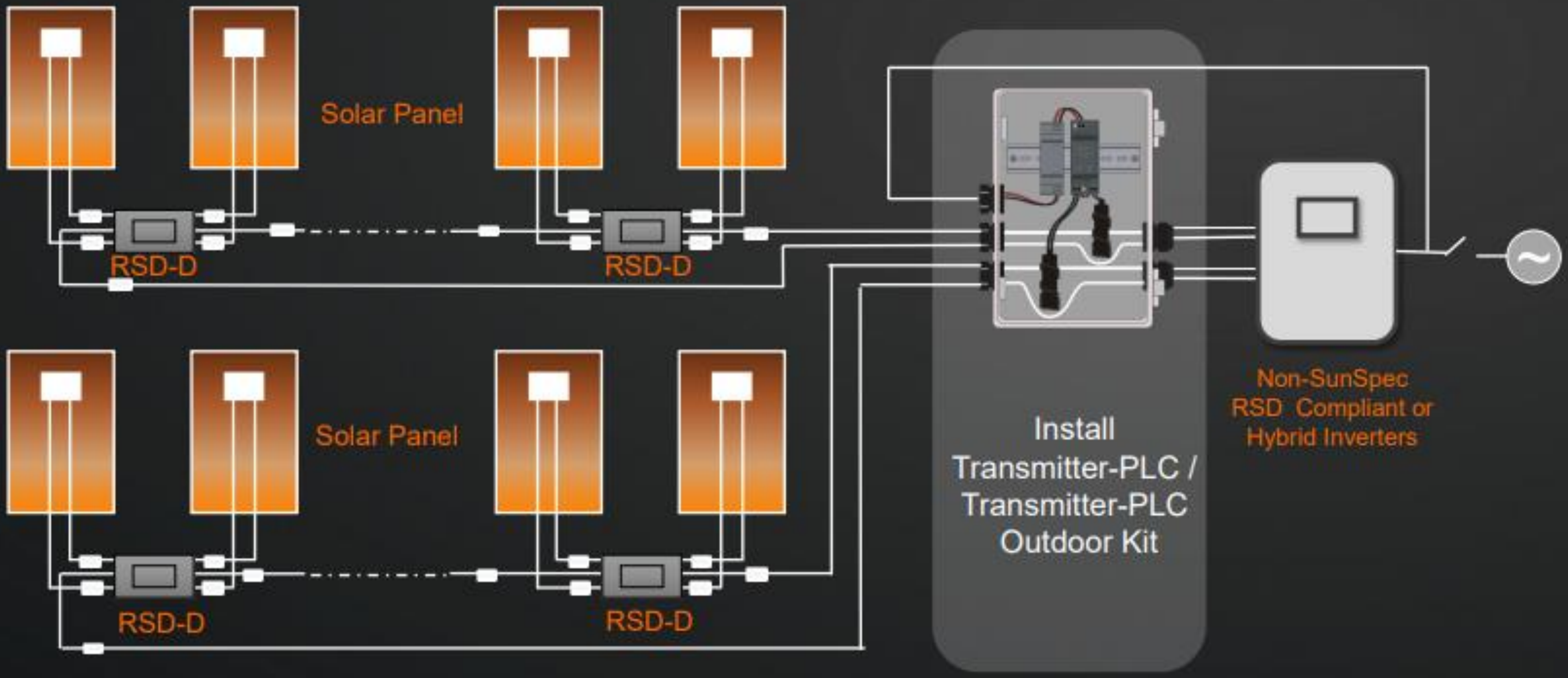

Solar Panel
RSD-D
RSD-D
RSD-D
RSD-D
SUNSPEC
RSD Compliant Inverter

Application #2: Non SunSpec RSD Compliant & Hybrid Inverters with RSD-S


Solar Panel
RSD-S-PLC
Solar Panel
RSD-S-PLC
Install Transmitter-PLC / Transmitter-PLC Outdoor Kit
Non-SunSpec RSD Compliant or Hybrid Inverters

Enabling NEC 2017 690.12
Compliance to Standard Inverter

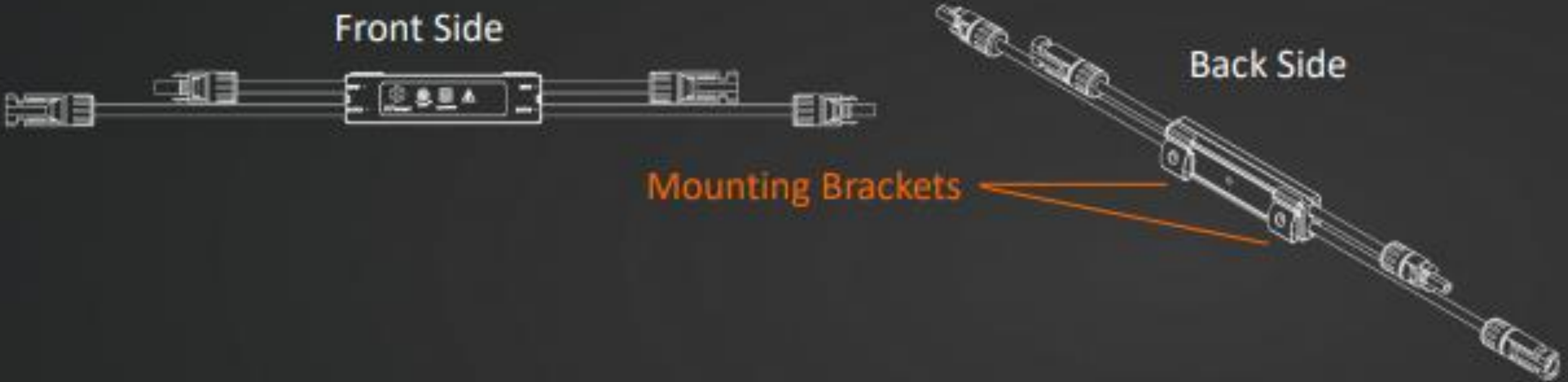
Application #2: Non SunSpec RSD Compliant & Hybrid Inverters with RSD-D


Solar Panel
RSD-D
RSD-D
Solar Panel
RSD-D
RSD-D

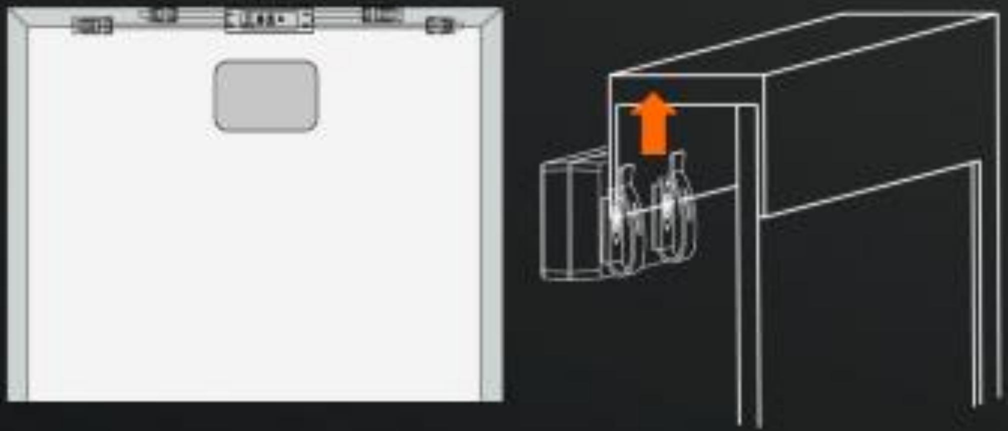
Install
Transmitter-PLC /
Transmitter-PLC
Outdoor Kit

Non-SunSpec
RSD Compliant or
Hybrid Inverters

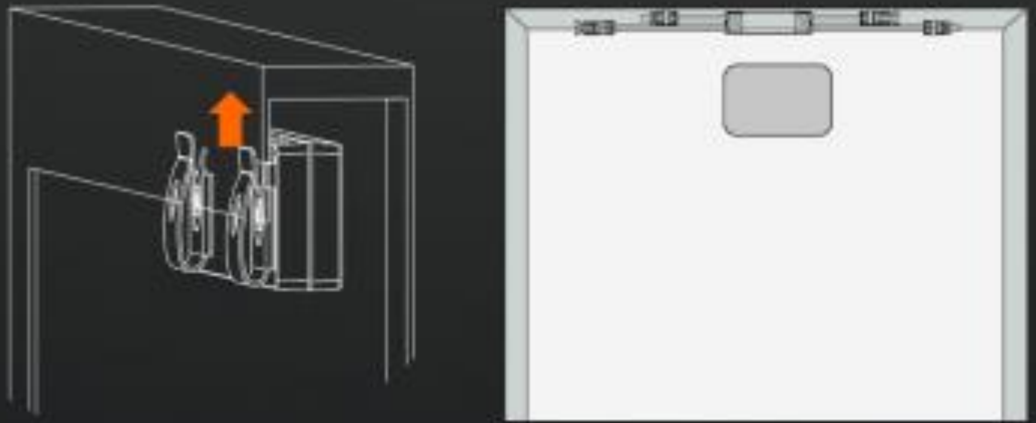
Step 1: RSD-S-PLC Mounting


Front Side
Back Side
Mounting Brackets

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



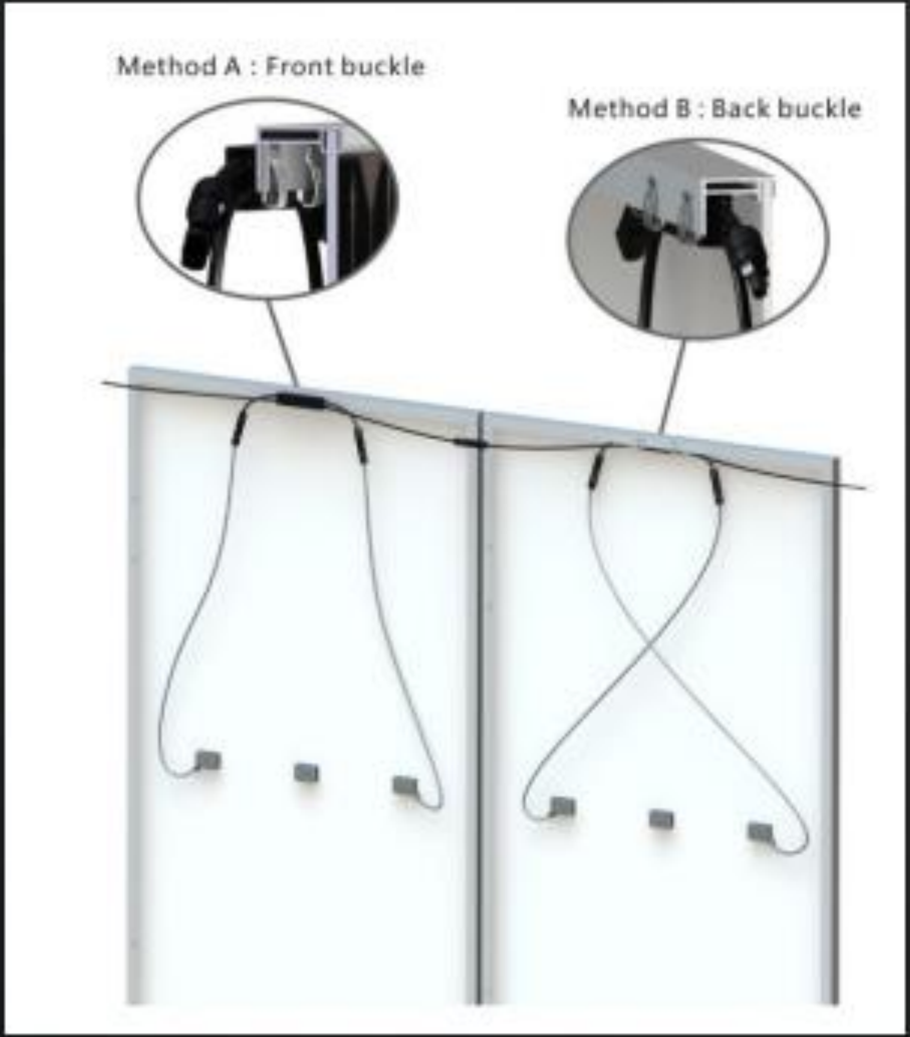
Method 2: Clip the RSD-S-PLC facing the back of the module under the lip of the module frame

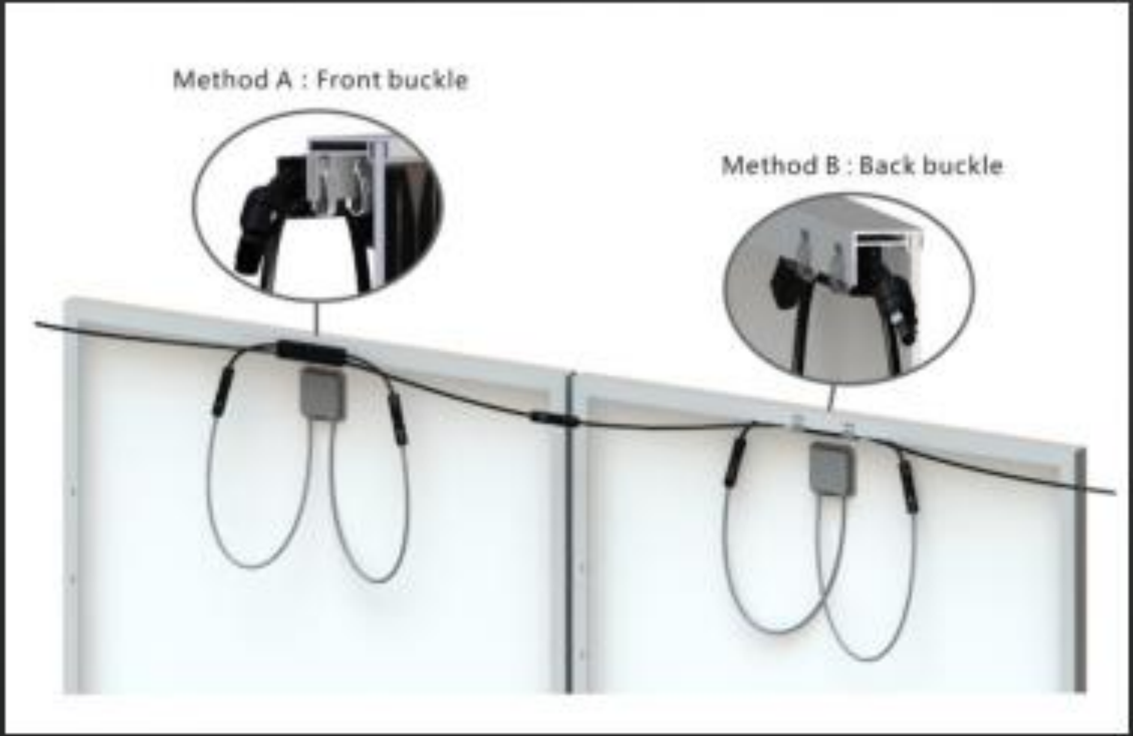


RSD-S-PLC outputs a DC voltage of **0v** when out of box.

Step 1: RSD-S-PLC Mounting

Step 2: Connect With PV Module


Method A : Front buckle
Method B : Back buckle

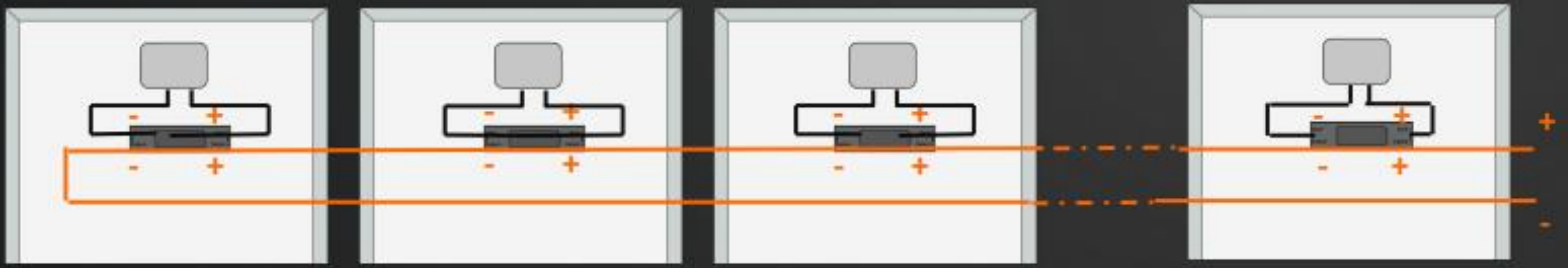

Method A : Front buckle
Method B : Back buckle

- After connected with PV module, RSD-S-PLC outputs a DC voltage range **0.6 – 1v.**
- Always connected with PV modules **before** connecting homerun to inverter's MPPT.

Step 1: RSD-S-PLC Mounting

Step 2: Connect With PV Module

Step 3: String Wiring



Installation best practice & confirmation:

- **Step 1: Connecting RSD-S-PLC with PV module first:**

  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_string = (0.6 ~ 1v) 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 & devices 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

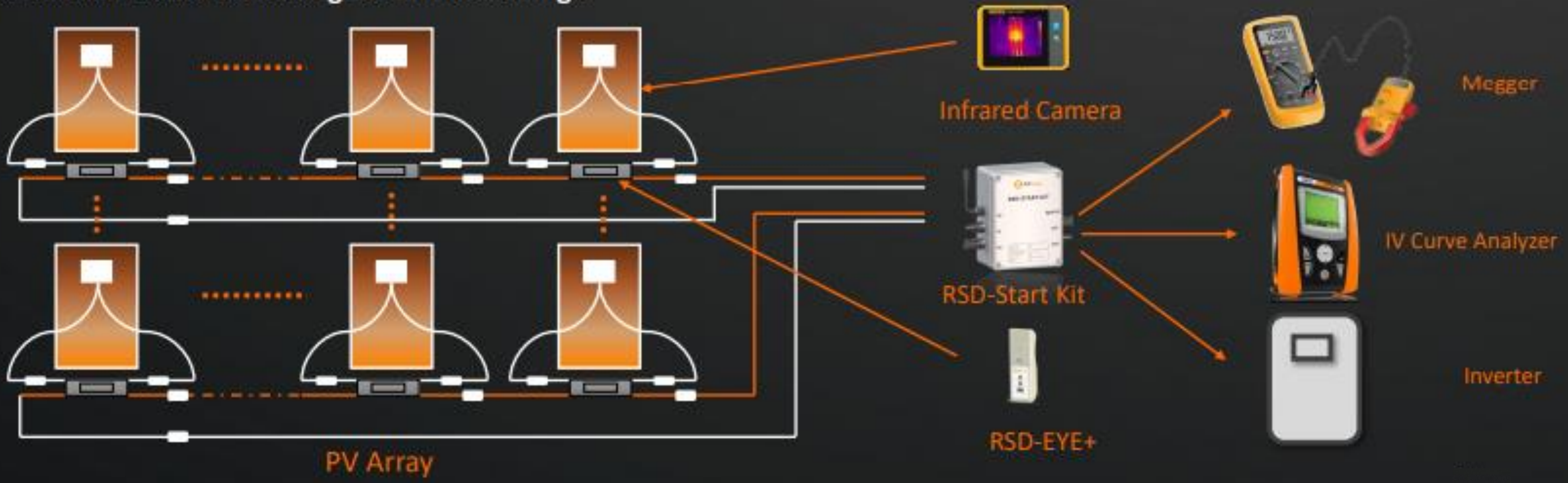
Step 3: String Wiring

Step 4: Connect to String Inverter

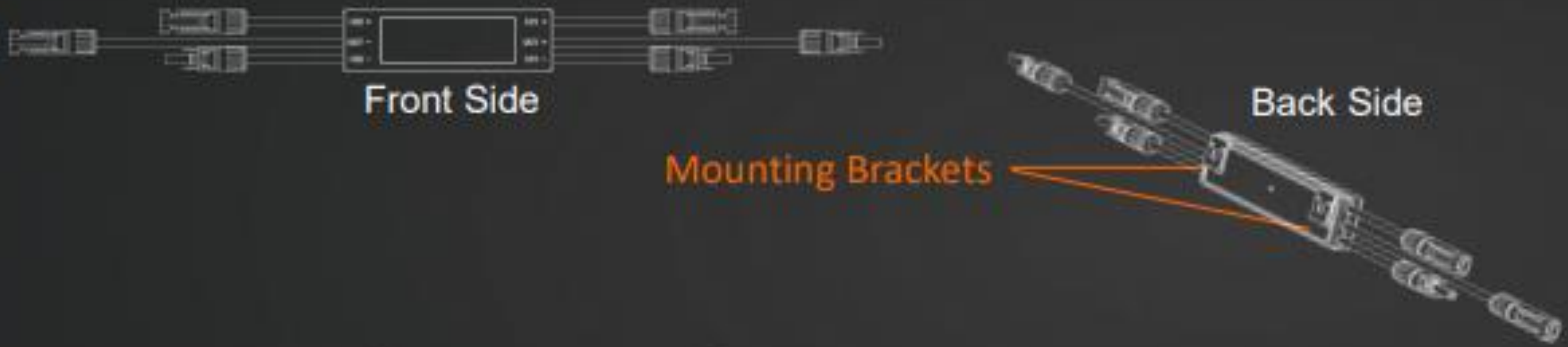
Installation recommendation:

- Mounting RSD-S-PLC devices to PV modules on the ground, then move the whole package up to the roof.
- Always connecting homerun to inverter as the LAST step after finishing all installs & tests.
- Always disconnecting homerun from inverter as the FIRST step before operating any electrical test on modules.

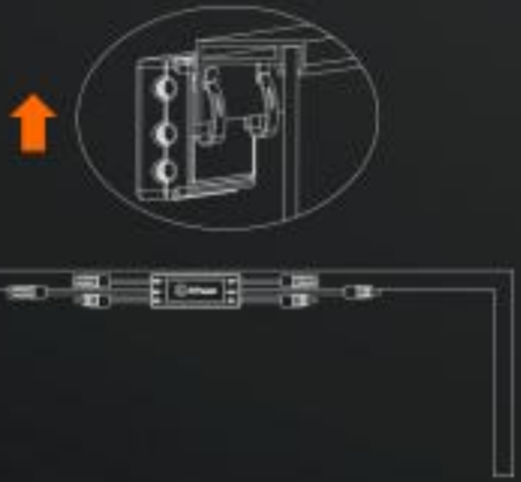
Installation troubleshooting & commissioning :


Infrared Camera
Megger
RSD-Start Kit
IV Curve Analyzer
Inverter
RSD-EYE+
PV Array

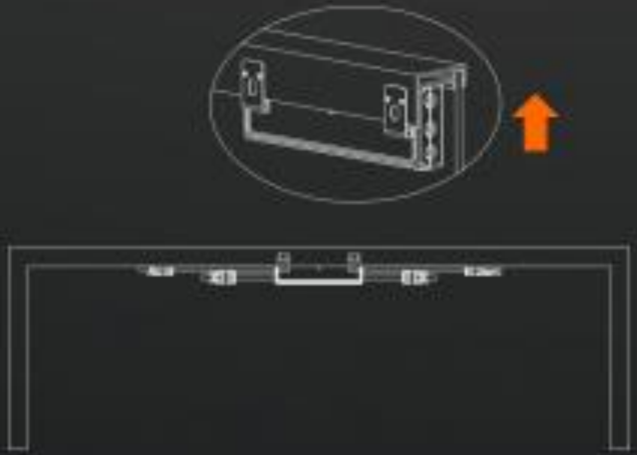
Step 1: RSD-D Mounting


Front Side
Back Side
Mounting Brackets

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



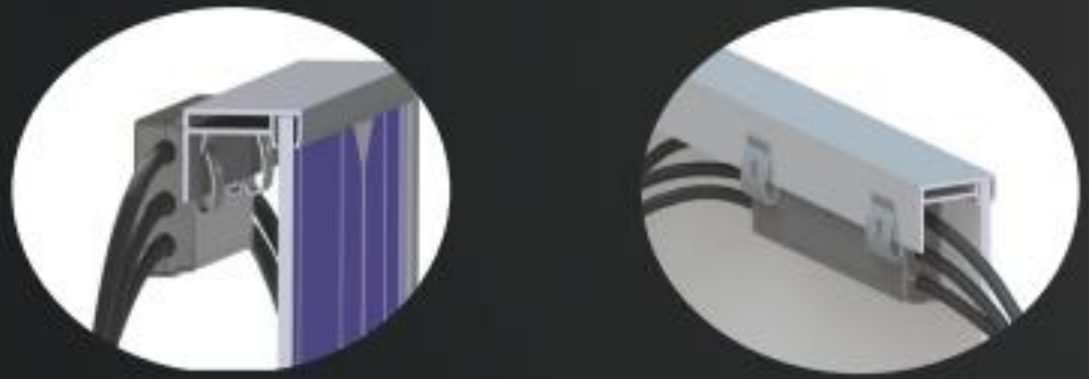
Method 2: Clip the RSD-D facing the back of the module under the lip of the module frame

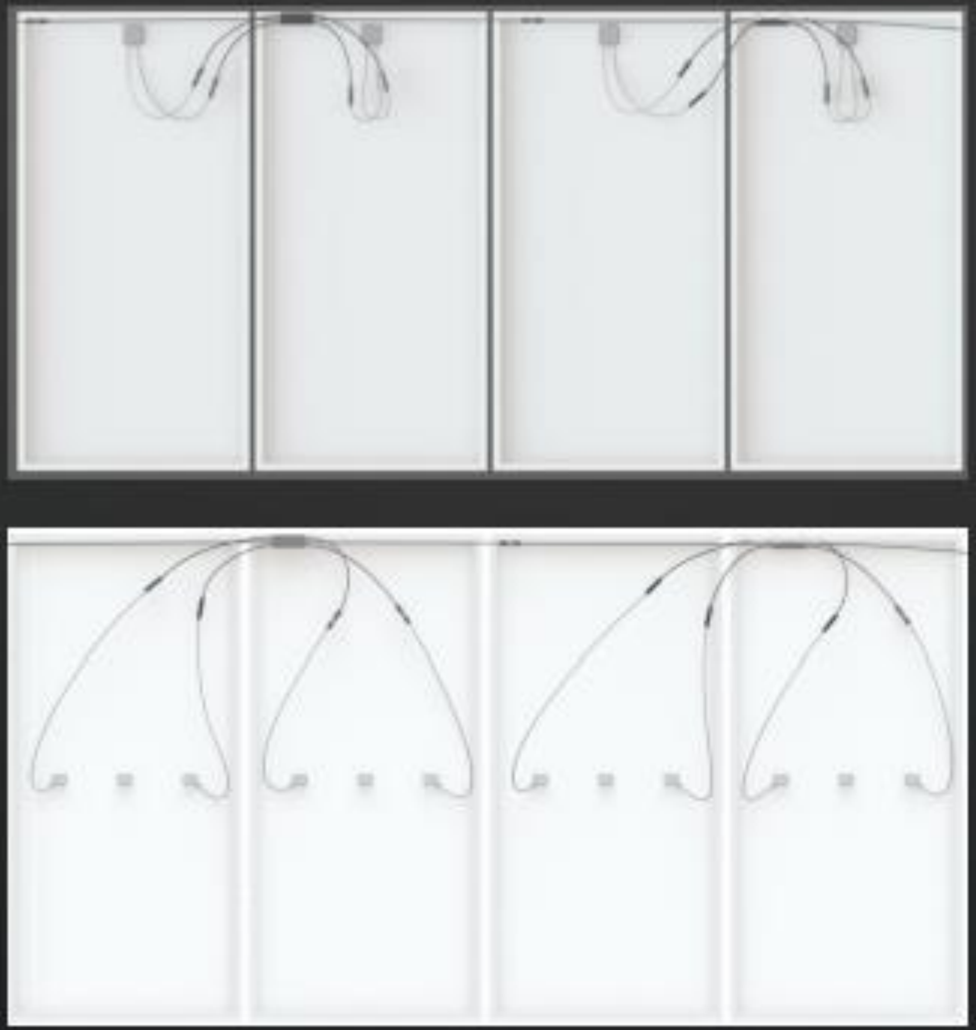


RSD-D outputs a DC voltage of **0v** when out of box.

Step 1: RSD-D Mounting

Step 2: Connect With 2 PV Modules



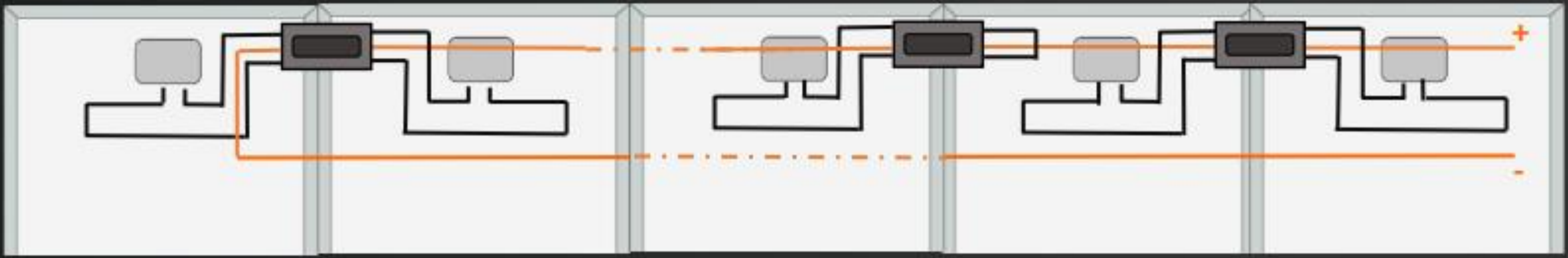


- After connected with both PV modules, RSD-D outputs a DC voltage range is **1.2v – 2v.**
- Do **NOT** disconnect the PV module from RSD-D without first disconnecting the AC power.
- Do **NOT** short-circuit the RSD （RSD string) output cables, otherwise will damage the devices.

Step 1: RSD-D Mounting

Step 2: Connect With 2 PV Modules

Step 3: String Wiring



- After connecting all devices into strings, its total string DC open-air voltages is **V_string = 1.2 ~ 2v X #RSD-Ds**
- Following the same installation best practices & confirmation, troubleshooting & commissioning process as RSD-S-PLC, replaced its DC output value as above.
- RSD-D-15A and RSD-S-PLC are **compatible** to be installed together in the same string, but **NOT** for RSD-D-20A.
- When connecting the RSD-D to only one PV module, use **INPUT1** port **ONLY,** then short **INPUT2** on the unused side, otherwise the RSD-D will have risk of be damaged. It has the same DC output value remain as **1.2 ~ 2v.**

Step 1: RSD-D Mounting

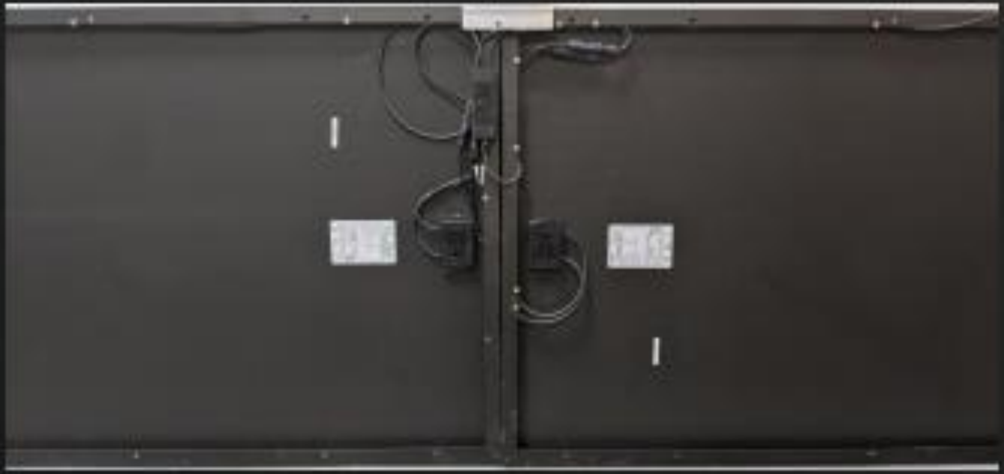
Step 2: Connect With 2 PV Modules

Step 3: String Wiring

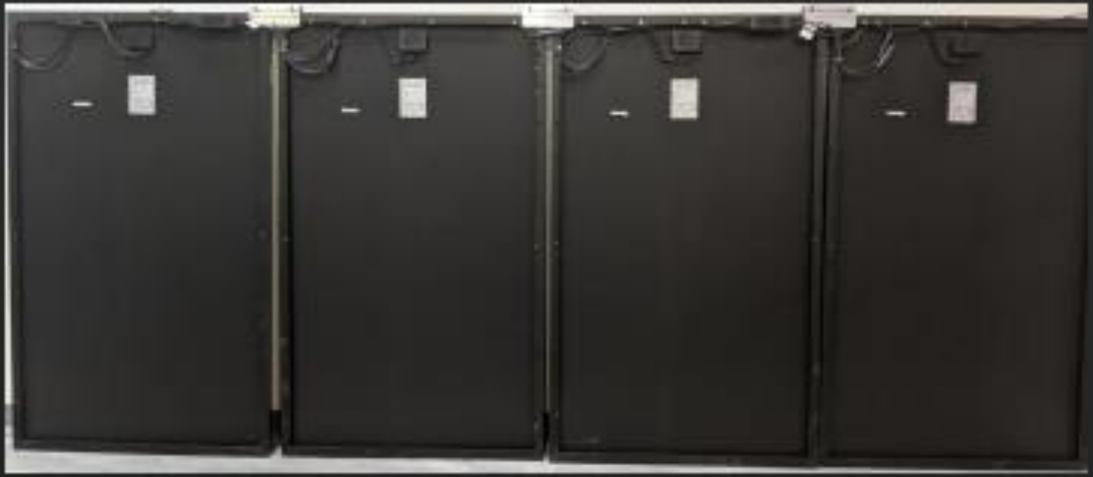
Step 4: Connect array to Inverter

Installation recommendation:

- Mounting RSD-D devices to PV modules on the roof rather than on the ground.
- Following same installation recommendations as RSD-S-PLC for connecting with inverters.
- Mounting devices on the position where are close to both modules' junction boxes as much as possible, also where can be easy to reach by operators as much as possible.



Horizontal



Vertical

Step 1: RSD-D Mounting

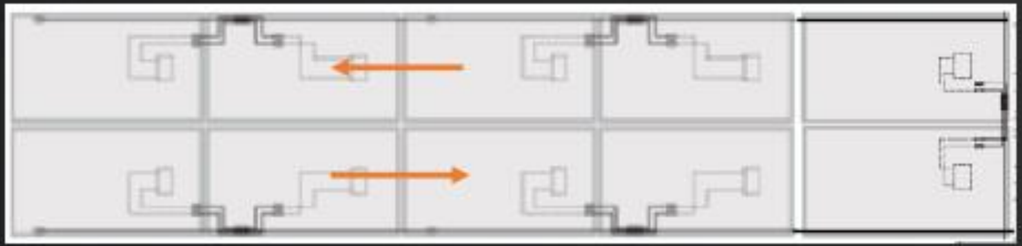
Step 2: Connect With 2 PV Modules

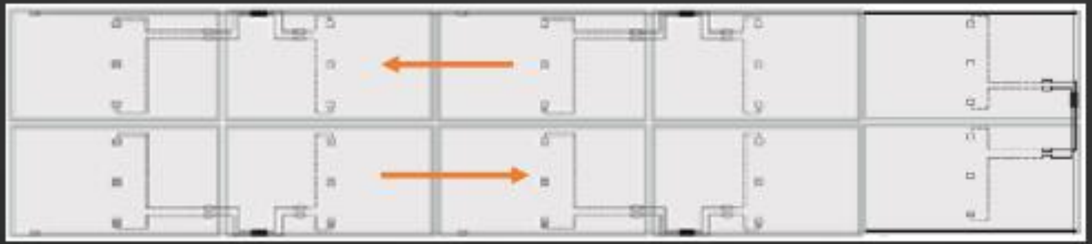
Step 3: String Wiring

Step 4: Connect array to Inverter

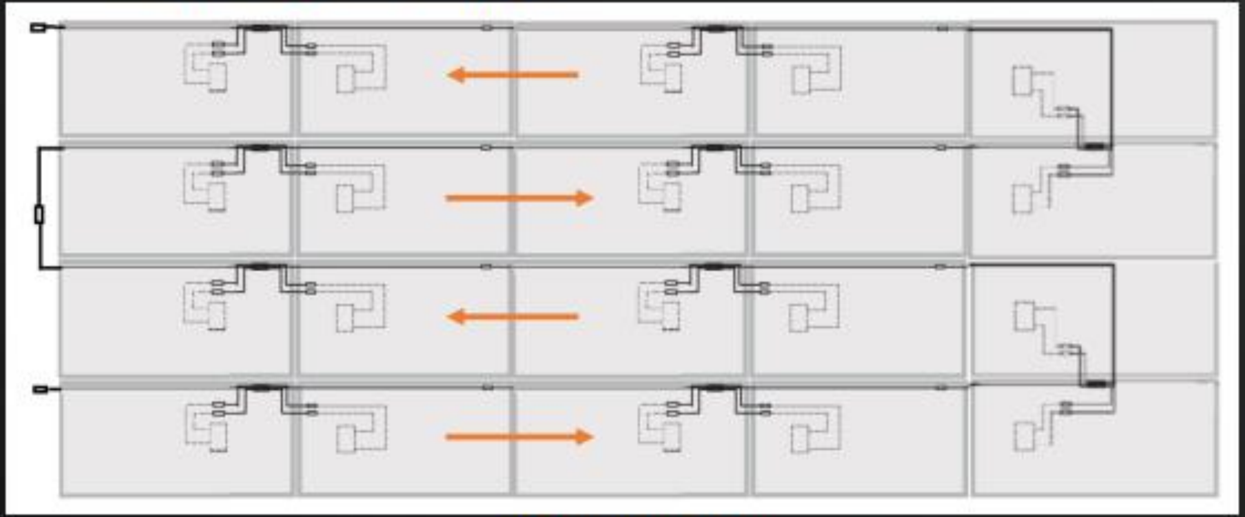
- Horizontal array design example for RSD-D 2200mm output (Default)

Array with walking path

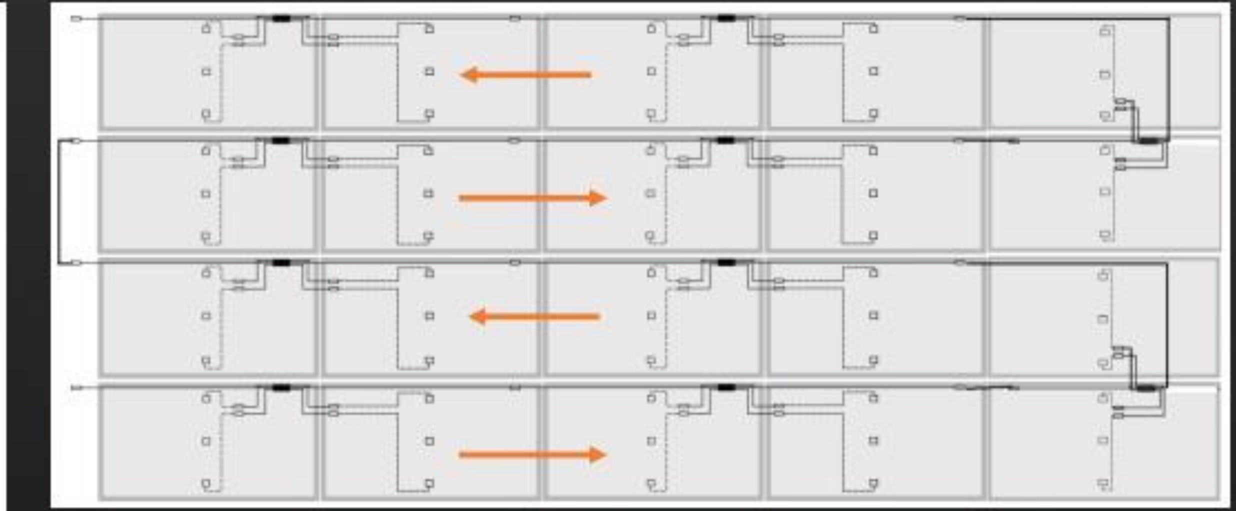




Array without walking path



Integrated J-Box



Triad J-Box

Step 1: RSD-D Mounting

Step 2: Connect With 2 PV Modules

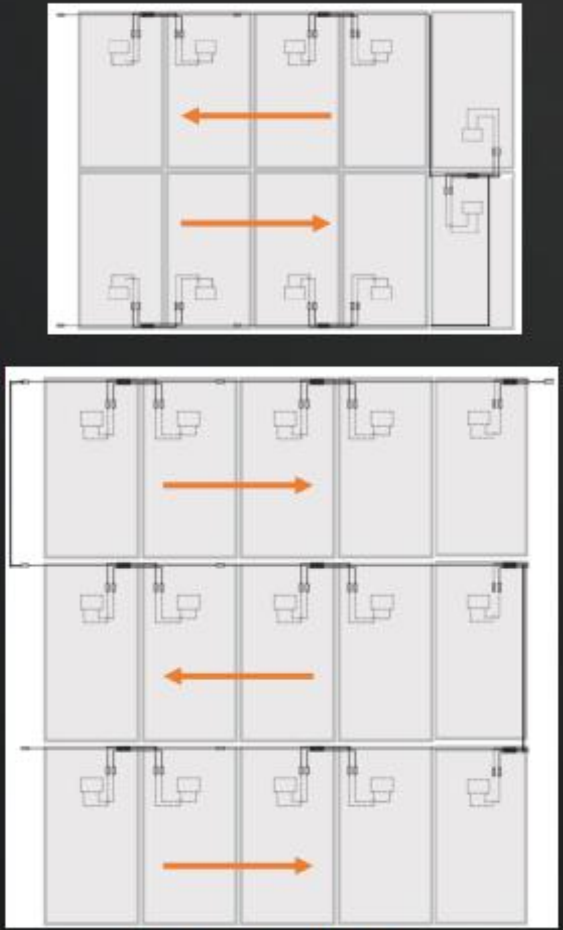
Step 3: String Wiring

Step 4: Connect array to Inverter

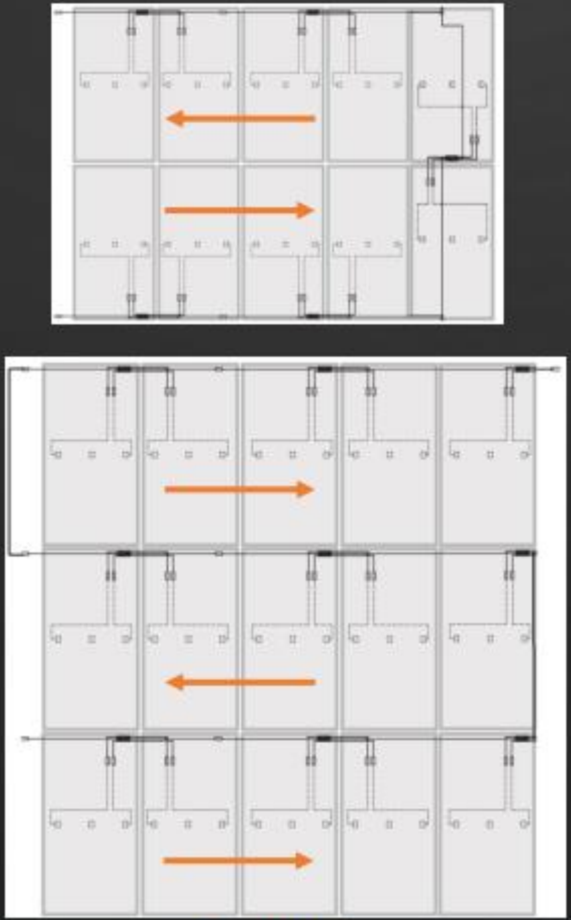
- Vertical array design example for RSD-D 2200mm output (Default)

Array with walking path

Array without walking path



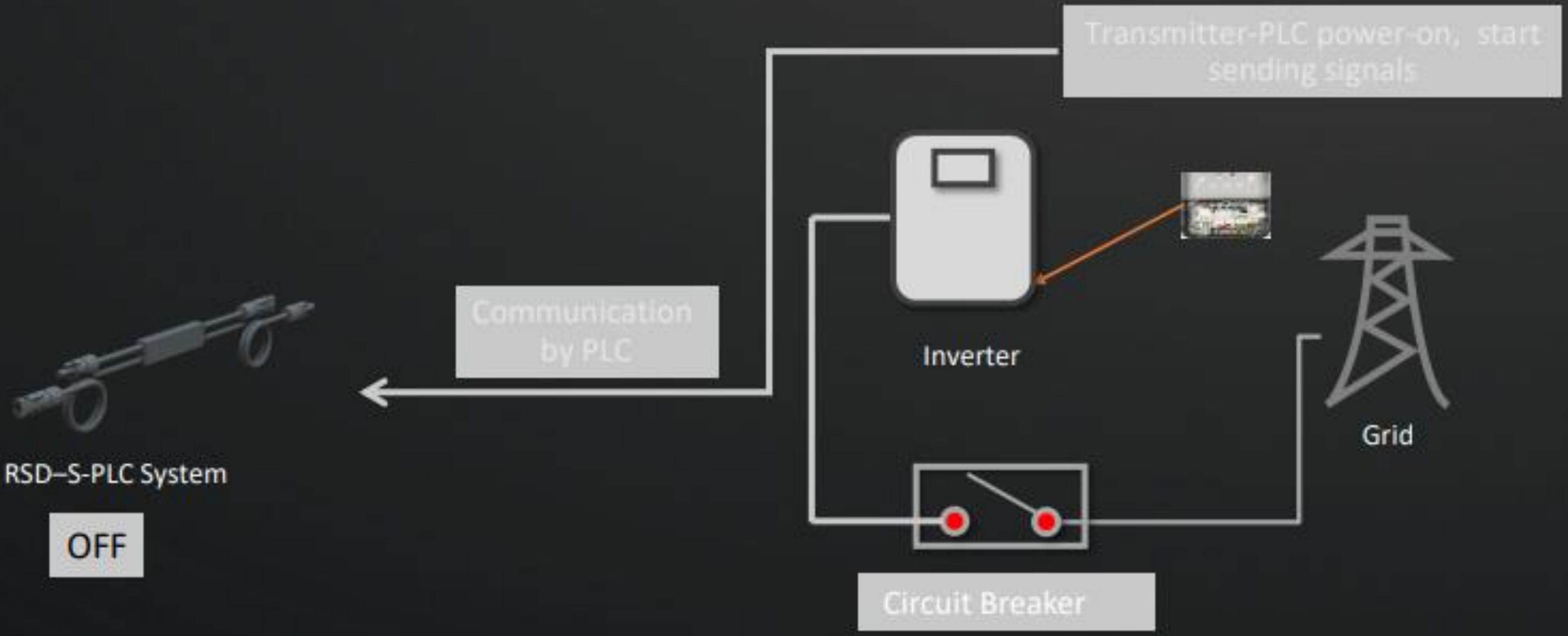
Integrated J-Box



Triad J-Box

System Initial State

After the system is set up, the initial state of the RSD-S-PLC is **OFF**, the PV array has less than **30V** voltage output.



Transmitter-PLC power-on, start sending signals

Communication by PLC

Inverter

Grid

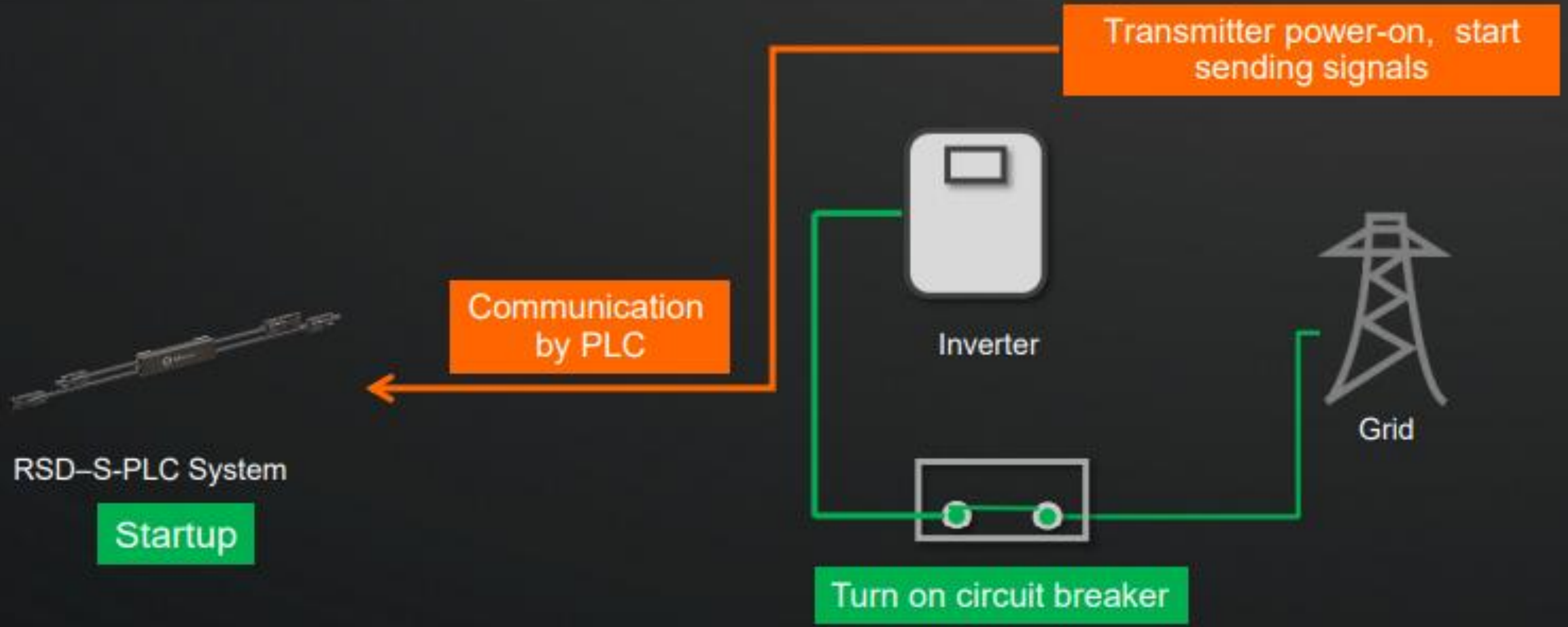
RSD–S-PLC System

OFF

Circuit Breaker

System Startup

When setting the circuit breaker on the inverter AC side to the on position, the inverter and transmitter will be powered on at the same time. The Transmitter then sends a signal to the RSD-S-PLC units which start up within 10s of receiving the signal, keeping their PV modules connected and supplying energy. After waiting a few minutes (wait time determined by the inverter), check the string DC voltage on the inverter screen, ensuring that the RSD -S-PLC have successfully started up.



Transmitter power-on, start sending signals

Communication by PLC

Inverter

Grid

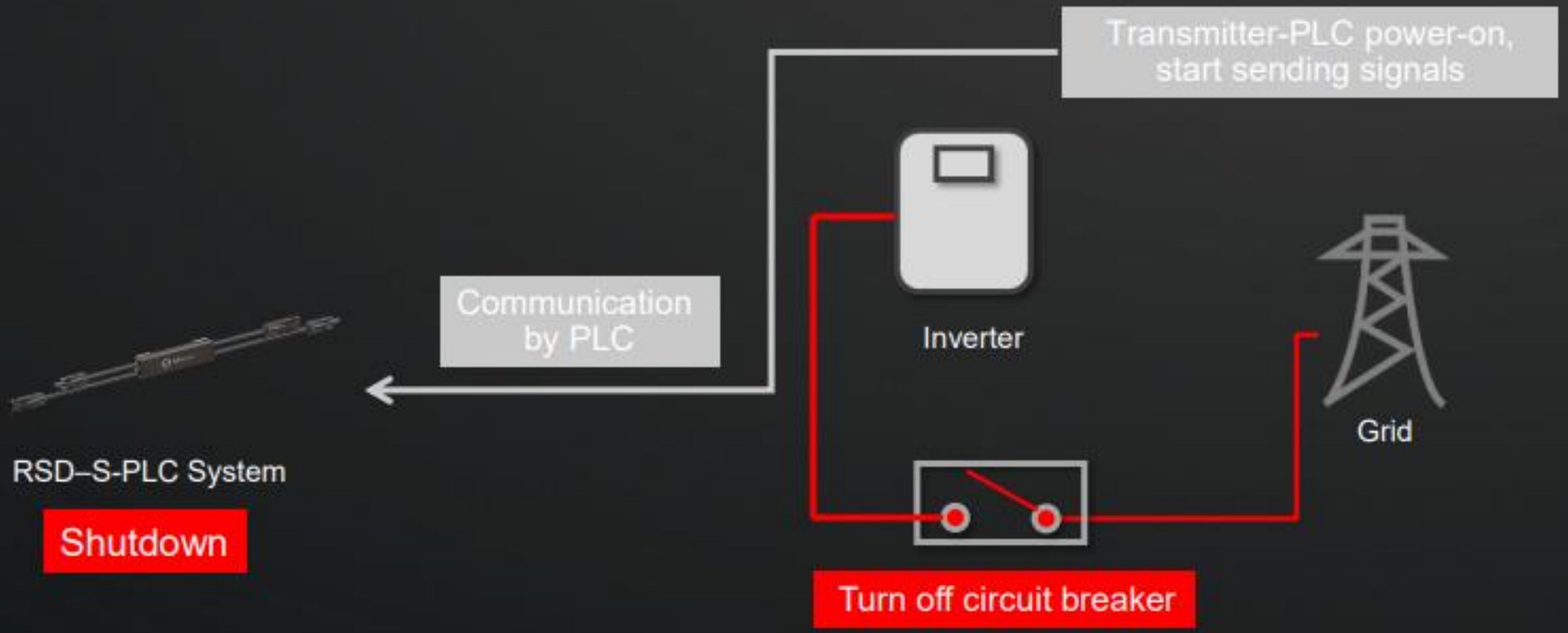
RSD–S-PLC System

Startup

Turn on circuit breaker

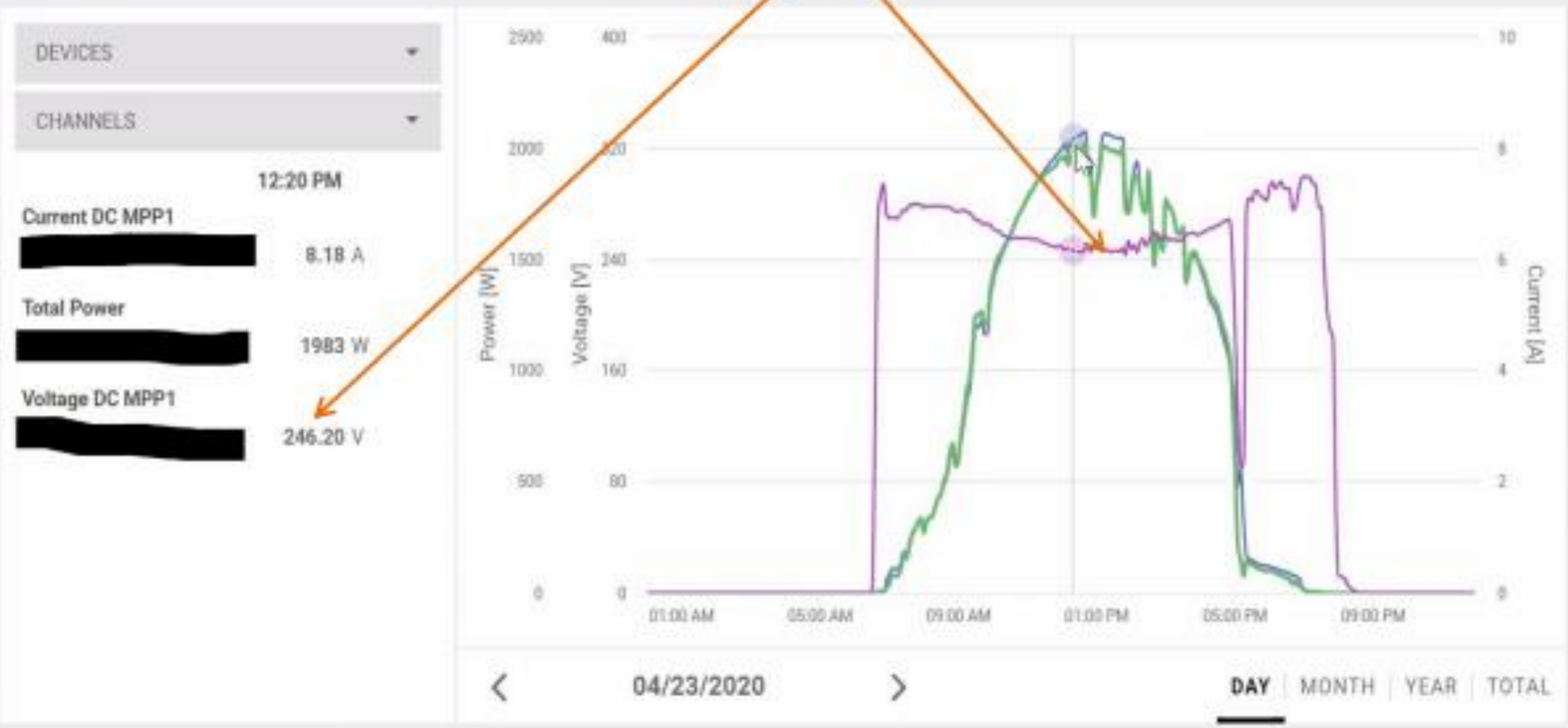
System Shutdown

When the circuit breaker on the inverter AC side is on the off position, the inverter and transmitter will be jointly powered off. The transmitter then stops sending the signal to the RSD-S-PLC units, then it will shut down the PV module power output within 10s.


Transmitter-PLC power-on, start sending signals
Communication by PLC
Inverter
Grid
RSD–S-PLC System
Shutdown
Turn off circuit breaker

APsmart MLRSD Monitoring & Troubleshooting

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


DEVICES
CHANNELS
2500
2000
1500
1000
500
0
Power [W]
400
320
240
160
80
0
Voltage [V]
10
8
6
4
2
0
Current [A]
01:00 AM
05:00 AM
09:00 AM
01:00 PM
05:00 PM
09:00 PM
DAY
MONTH
YEAR
TOTAL

String DC Voltage inputs on MPPT

12:20 PM

Current DC MPP1 [redacted] 8.18 A

Total Power [redacted] 1983 W

Voltage DC MPP1 [redacted] 246.20 V

04/23/2020

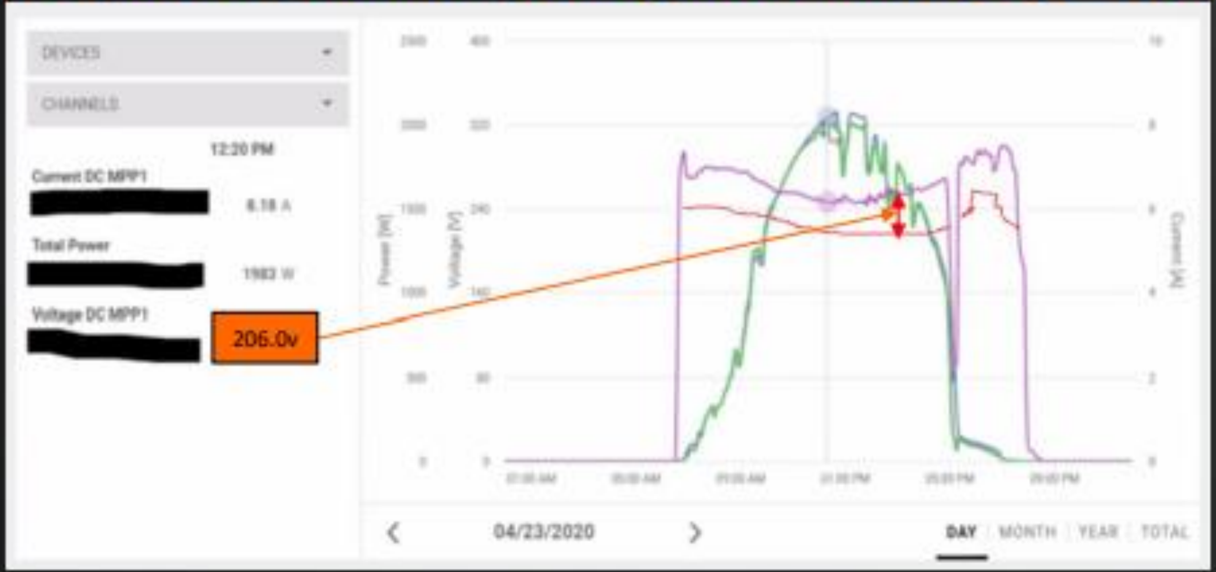
RSD-S-PLC Performance in the Field Summary

- Since APsmart RSD devices exactly followed NEC 2017 690.12 Rapid Shutdown standard, it only applied single PV module voltages (< 80v) on terminals, also device is fully potted by Silicone within UL rated enclosure, fundamentally reduced the risk of MLPE firing on the rooftop. Based on field data so far, has been proved APsmart RSD solution will NOT cause fire on the rooftop, with 0% & 0 case over 500K installed worldwide.
- The highest failure rate component is MOSFETs, caused them either opened or shorted with thermal runaway, eventually bubbled on enclosure and bypass the module. It is detectable by monitoring string inverter's performance portal each MPPT voltages level.
- The overall failure rate in the field so far is less than 0.02% for above 500K devices are running WW (based on the RMA data from Q2 2021).

APsmart Products Failure Mode: RSD-S-PLC's MOSFETs

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 after system turns on.*



DEVICES
CHANNELS
Power [W]
Voltage [V]
Current [A]
2500
2000
1500
1000
500
0
400
320
240
160
80
0
10
8
6
4
2
0
DAY
MONTH
YEAR
TOTAL

12:20 PM

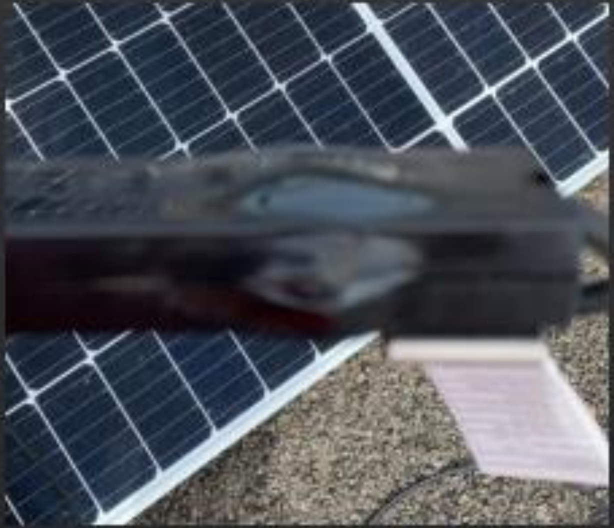
Current DC MPP1 [redacted] 8.18 A

Total Power [redacted] 1983 W

Voltage DC MPP1 [redacted] 206.0v

04/23/2020

Performance: MPPT DC Voltages drop



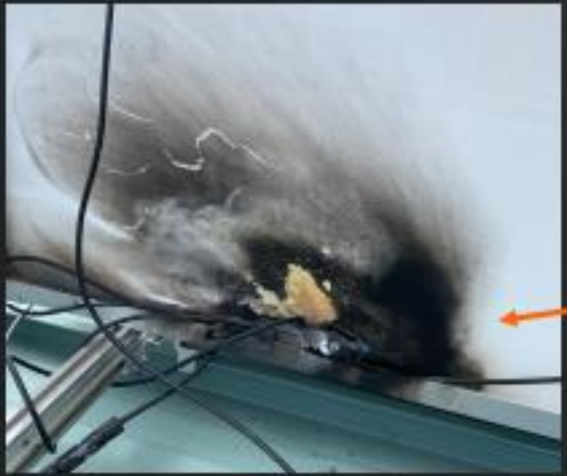
Visual Inspection: Enclosure bubbling

- 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 damaged by thermal & bypass.*

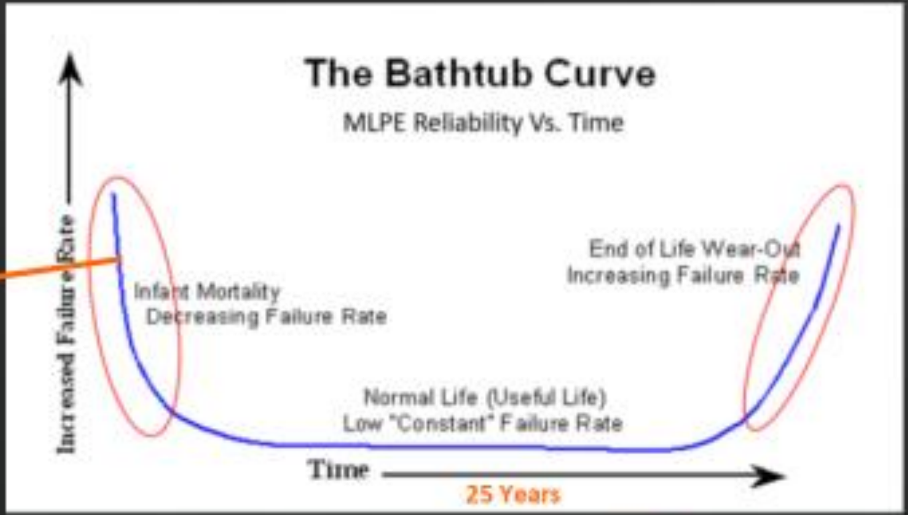
APsmart Products Failure Mode: Solder Joint Arcing (Worst Case)

Low voltages arcing < 80v Failure Mode (Failure rate is very low):

- RSD-S-PLC is arcing on positive input terminal due to soldering joint variations, caused *thermal damaging on PCBA and melting the enclosure, Silicone potting will be smoking out without flaming .*



Visual Impact: Silicone smoking out, discolored backsheet, melted enclosure



MLPE Products Reliability & Lifetime

High voltages arcing > 80v Failure Mode (Failure rate is extremely low):

- RSD-S-PLC is arcing on positive output terminal, under full homerun string voltages, caused homerun *opening circuit (V_string = 0v), triggering AFCI alert on string inverter then shut down the system.*

RSD Receivers Troubleshooting Steps:

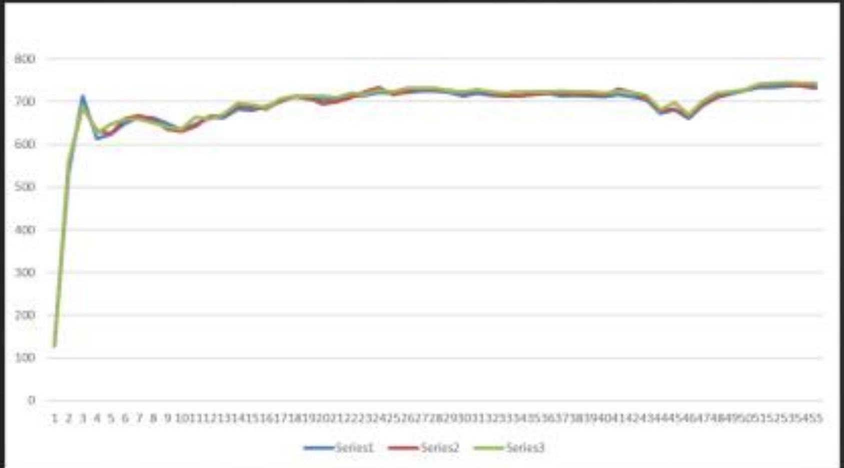
Step1： Identify failed inverter/MPPT have dropped DC output voltages

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

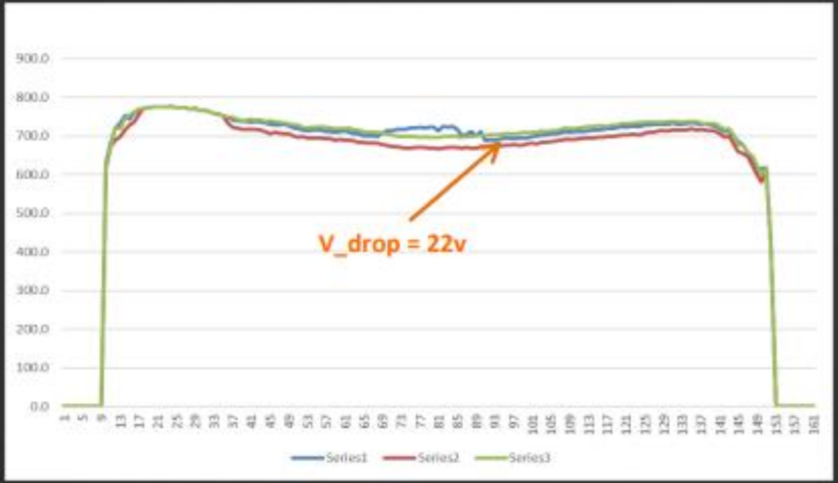
Step3： Locate failed devices inside this string by thermal detectors.

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

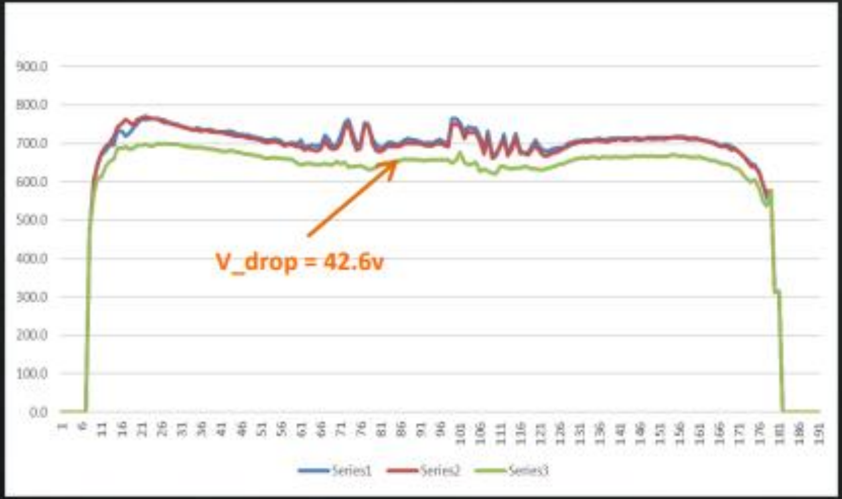
RSD Failures Determined on System Level – Inverter/MPPT's Operating Voltages Drop



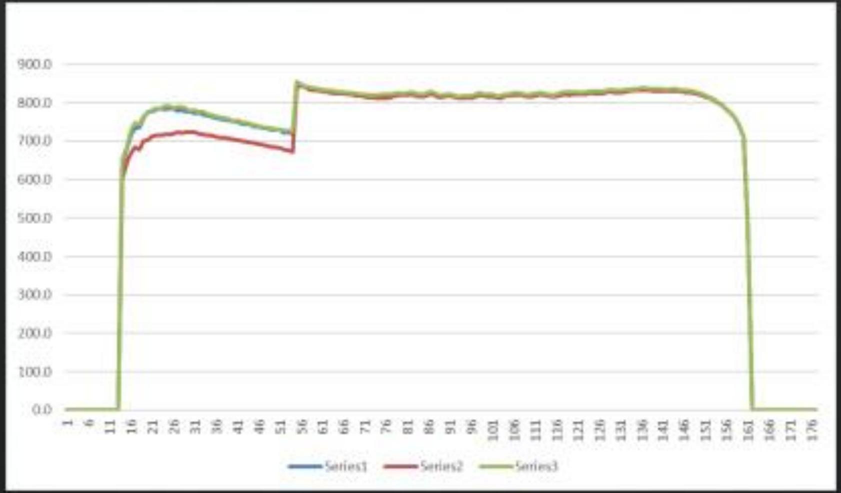
Inverter has no failed devices



Inverter has one failed devices in MPPT#3

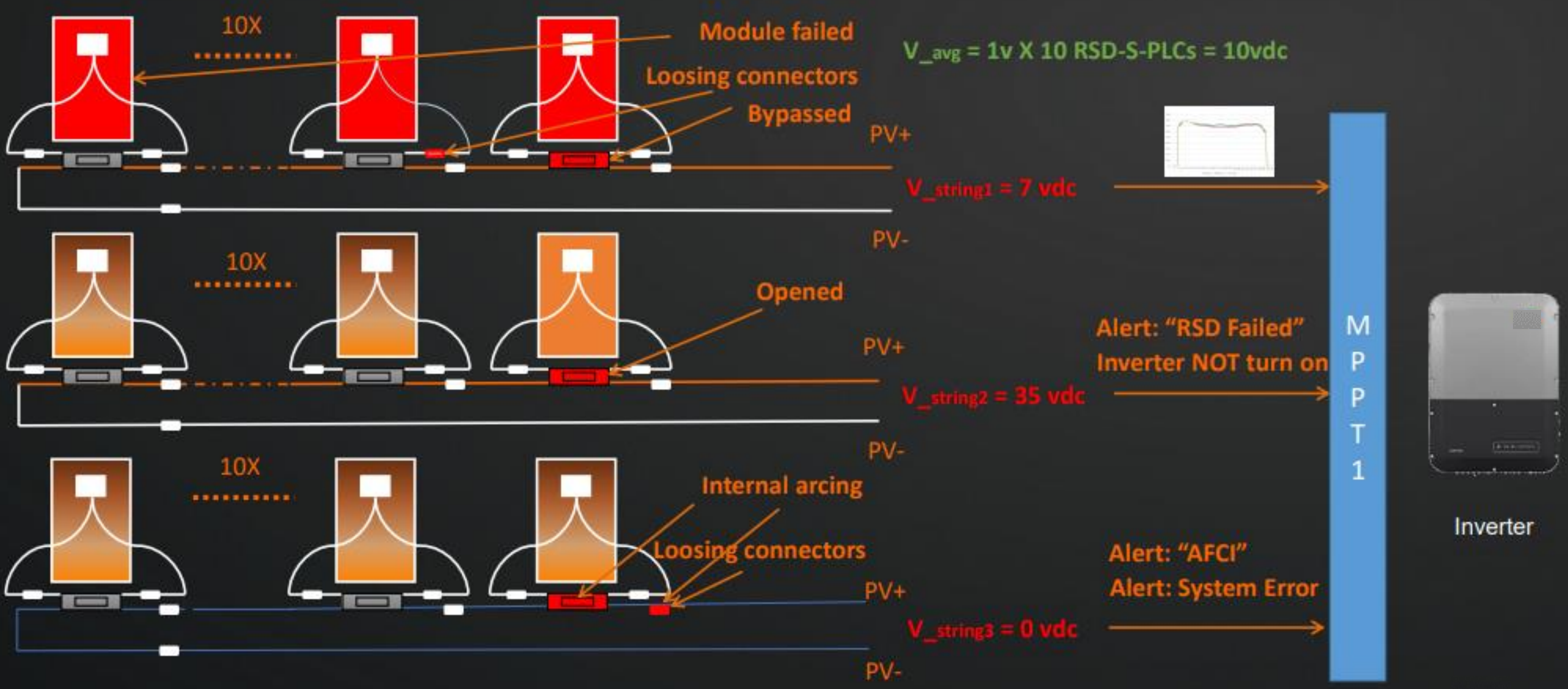


Inverter has 2 failed devices in MPPT#3



Inverter replaced failed devices and system recovered

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



10X

Module failed

Loosing connectors

Bypassed

V_{avg} = 1v X 10 RSD-S-PLCs = 10vdc

PV+

$V_{string1}$ = 7 vdc

PV-

10X

Opened

PV+

Alert: “RSD Failed”

Inverter NOT turn on

$V_{string2}$ = 35 vdc

PV-

10X

Internal arcing

Loosing connectors

PV+

Alert: “AFCI”

Alert: System Error

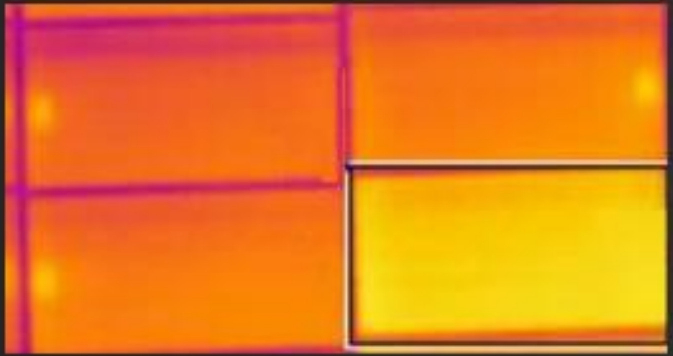
$V_{string3}$ = 0 vdc

PV-

Inverter

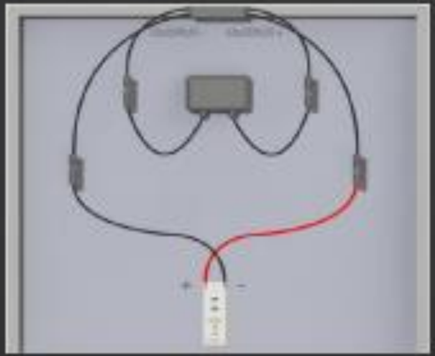
RSD Failures Determined on Module Level – Located by vary tools

Infrared Camera



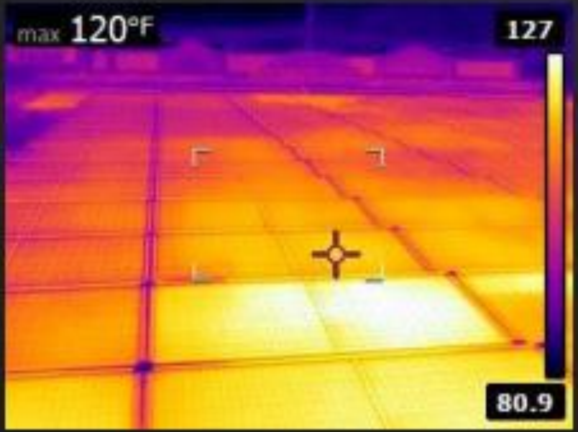
Bypassed: “Light module” when RSD receivers are on
Opened: “Dark module” when RSD receivers are off

RSD-EYE+ Detector



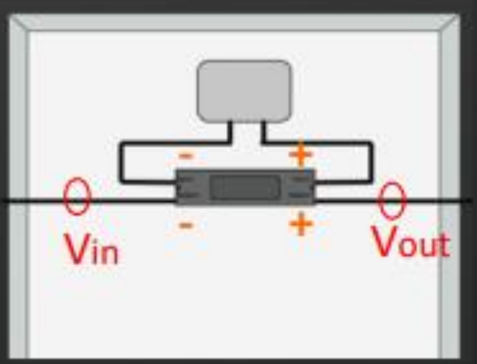
Bypassed: V_on = 0v
Opened: V_off >1v

Thermometer



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

Clamp DMM



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

RSD Devices Troubleshooting Guidelines & Best Practice:

- RSD system troubleshooting procedure recommendation: it is better to diagnostic the failing points from PV system side to inverter/Grid side, in order to isolate and locate the failed parts easier. After confirming PV array has no issues, then next to check the 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 somewhere in the system, engineers need to investigate immediately onsite. If AFCI caused by RSD internal arcing, by investigating earlier, it will significantly reduce the comprehensive thermal damages on module!

- Troubleshooting best practices: De-energize system and inverters first.
    - Disconnecting homerun from inverter first, then following the troubleshoot steps to find out failed strings;
    - Using combination of RSD Start Kit & thermal detectors (IR camera or thermometer) to locate failed parts;
    - Using RSD-EYE+ or DMM to confirm the failed RSD devices.

Reliability Evaluation Program by PVEL – Accelerated Lifetime Test

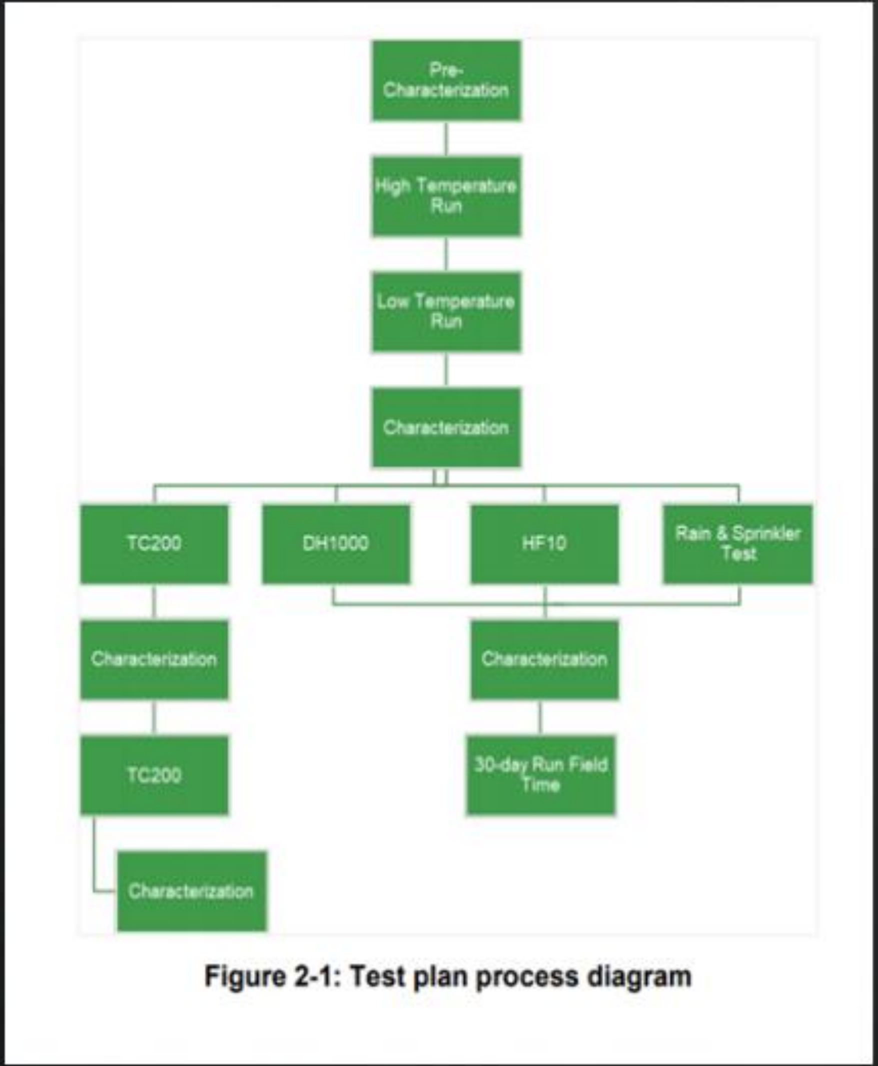
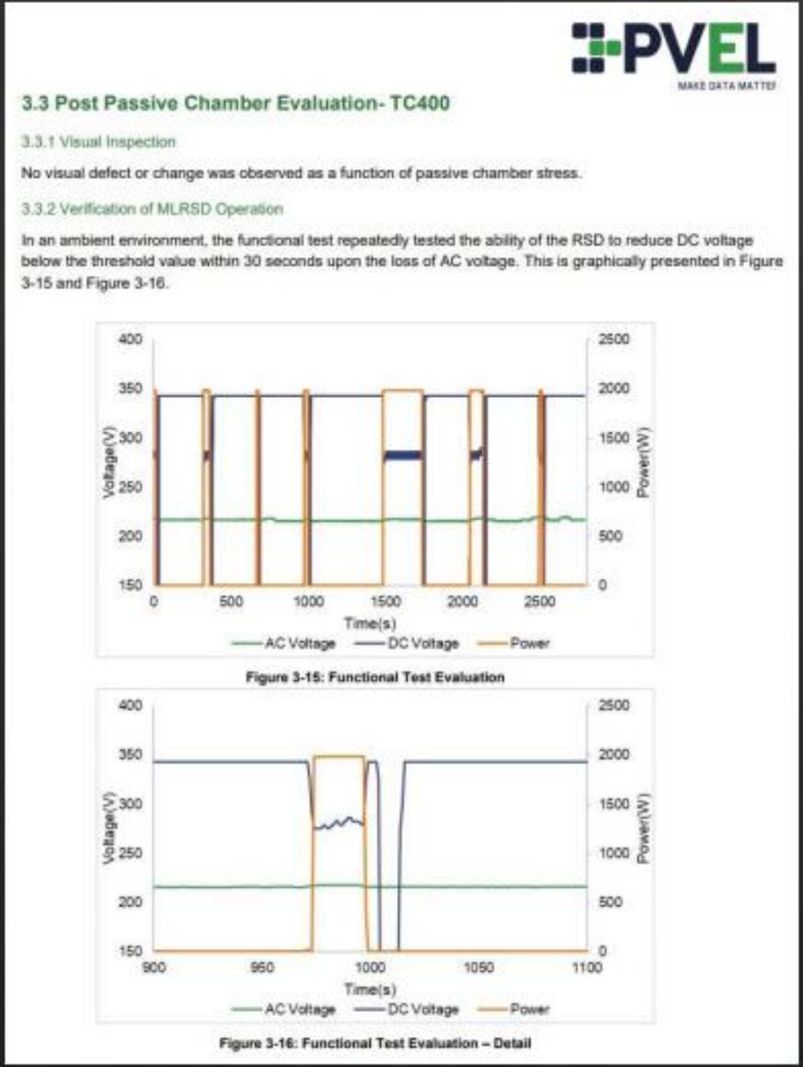

Pre-Characterization
High Temperature Run
Low Temperature Run
Characterization
TC200
DH1000
HF10
Rain & Sprinkler Test
Characterization
Characterization
TC200
30-day Run Field Time
Characterization

Figure 2-1: Test plan process diagram

PVEL ALT Program



3.3 Post Passive Chamber Evaluation- TC400

3.3.1 Visual Inspection

No visual defect or change was observed as a function of passive chamber stress.

3.3.2 Verification of MLRSD Operation

In an ambient environment, the functional test repeatedly tested the ability of the RSD to reduce DC voltage below the threshold value within 30 seconds upon the loss of AC voltage. This is graphically presented in Figure 3-15 and Figure 3-16.

PVEL
MAKE DATA MATTER
400
350
300
250
200
150
Voltage(V)
0
500
1000
1500
2000
2500
Time(s)
2500
2000
1500
1000
500
0
Power(W)
AC Voltage
DC Voltage
Power

Figure 3-15: Functional Test Evaluation

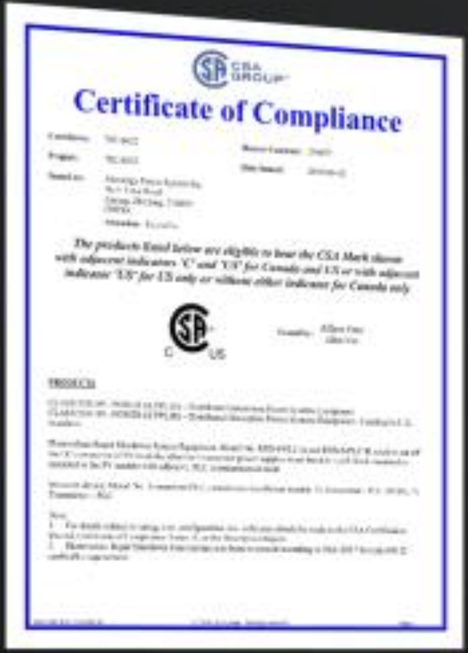
400
350
300
250
200
150
Voltage(V)
900
950
1000
1050
1100
Time(s)
2500
2000
1500
1000
500
0
Power(W)
AC Voltage
DC Voltage
Power

Figure 3-16: Functional Test Evaluation – Detail

Thermal Cycling 400 Cycles Result

Certifications

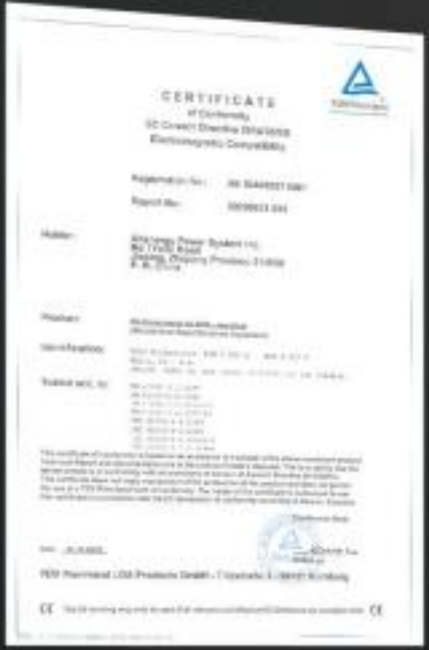
CSA certified



CSA GROUP

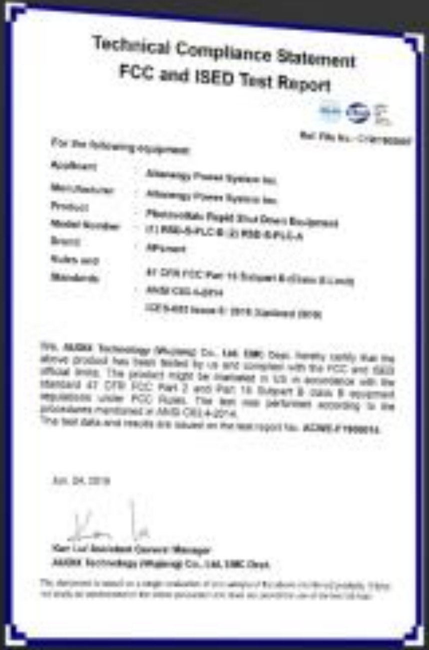
Certificate of Compliance

TUV certified



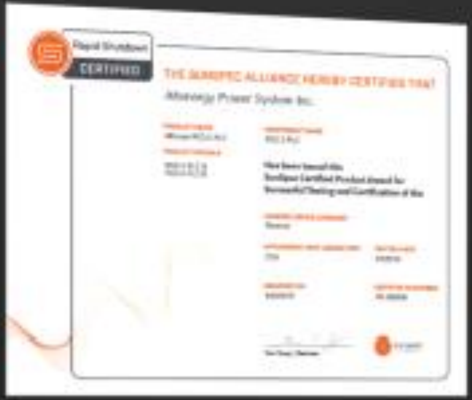
CERTIFICATE

FCC certified



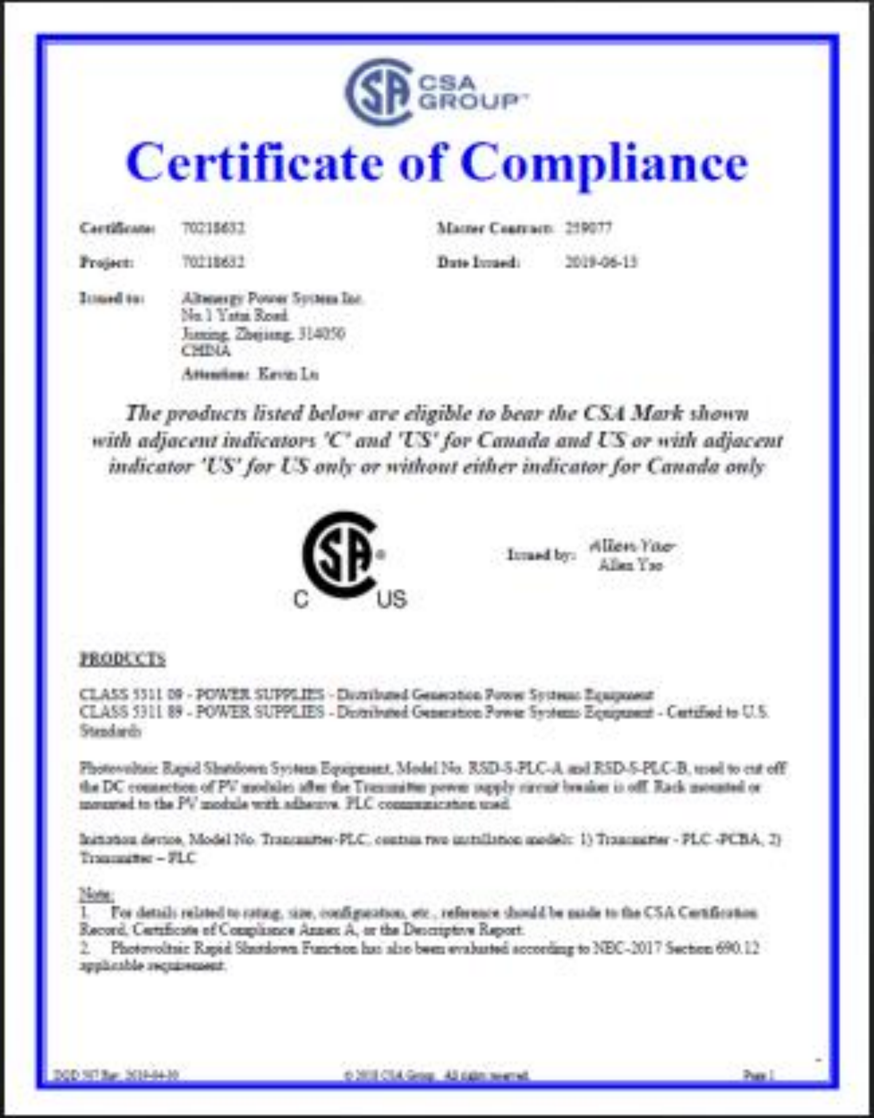
Technical Compliance Statement
FCC and ISED Test Report

SUNSPEC certified



Rapid Shutdown
CERTIFIED

CSA Certifications – UL 1741 E2. Tested & CSA C22.2 PVRSS Certified



CSA GROUP

Certificate of Compliance

Certificate: 70218632 **Master Contract:** 259077

Project: 70218632 **Date Issued:** 2019-06-13

Issued to:
Altenergy Power System Inc.
No.1 Yatai Road
Jiaxing, Zhejiang, 314050
CHINA
Attention: Kevin Lu

The products listed below are eligible to bear the CSA Mark shown with adjacent indicators 'C' and 'US' for Canada and US or with adjacent indicator 'US' for US only or without either indicator for Canada only

C US

Issued by: Allen Yao
Allen Yao

PRODUCTS

CLASS 5311 09 - POWER SUPPLIES - Distributed Generation Power Systems Equipment
CLASS 5311 89 - POWER SUPPLIES - Distributed Generation Power Systems Equipment - Certified to U.S. Standards

Photovoltaic Rapid Shutdown System Equipment, Model No. RSD-S-PLC-A and RSD-S-PLC-B, used to cut off the DC connection of PV modules after the Transmitter power supply circuit breaker is off. Rack mounted or mounted to the PV module with adhesive. PLC communication used.

Initiation device, Model No. Transmitter-PLC, contain two installation models: 1) Transmitter - PLC -PCBA, 2) Transmitter – PLC

Note:
1. For details related to rating, size, configuration, etc., reference should be made to the CSA Certification Record, Certificate of Compliance Annex A, or the Descriptive Report.
2. Photovoltaic Rapid Shutdown Function has also been evaluated according to NEC-2017 Section 690.12 applicable requirement.

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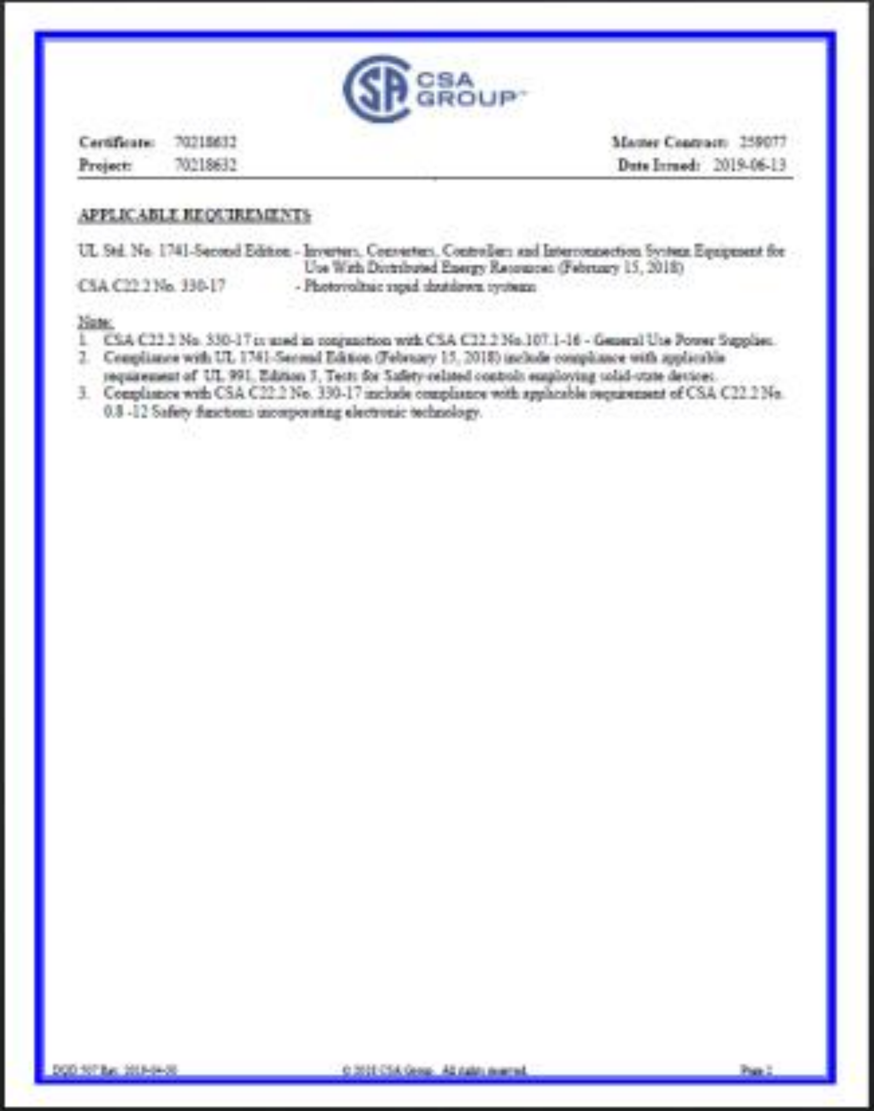

CSA GROUP

Certificate: 70218632 **Master Contract:** 259077
Project: 70218632 **Date Issued:** 2019-06-13

APPLICABLE REQUIREMENTS

UL Std. No. 1741-Second Edition	- Inverters, Converters, Controllers and Interconnection System Equipment for Use With Distributed Energy Resources (February 15, 2018)
CSA C22.2 No. 330-17	- Photovoltaic rapid shutdown systems

Note:
1. CSA C22.2 No. 330-17 is used in conjunction with CSA C22.2 No.107.1-16 - General Use Power Supplies.
2. Compliance with UL 1741-Second Edition (February 15, 2018) include compliance with applicable requirement of UL 991, Edition 3, Tests for Safety-related controls employing solid-state devices.
3. Compliance with CSA C22.2 No. 330-17 include compliance with applicable requirement of CSA C22.2 No. 0.8 -12 Safety functions incorporating electronic technology.

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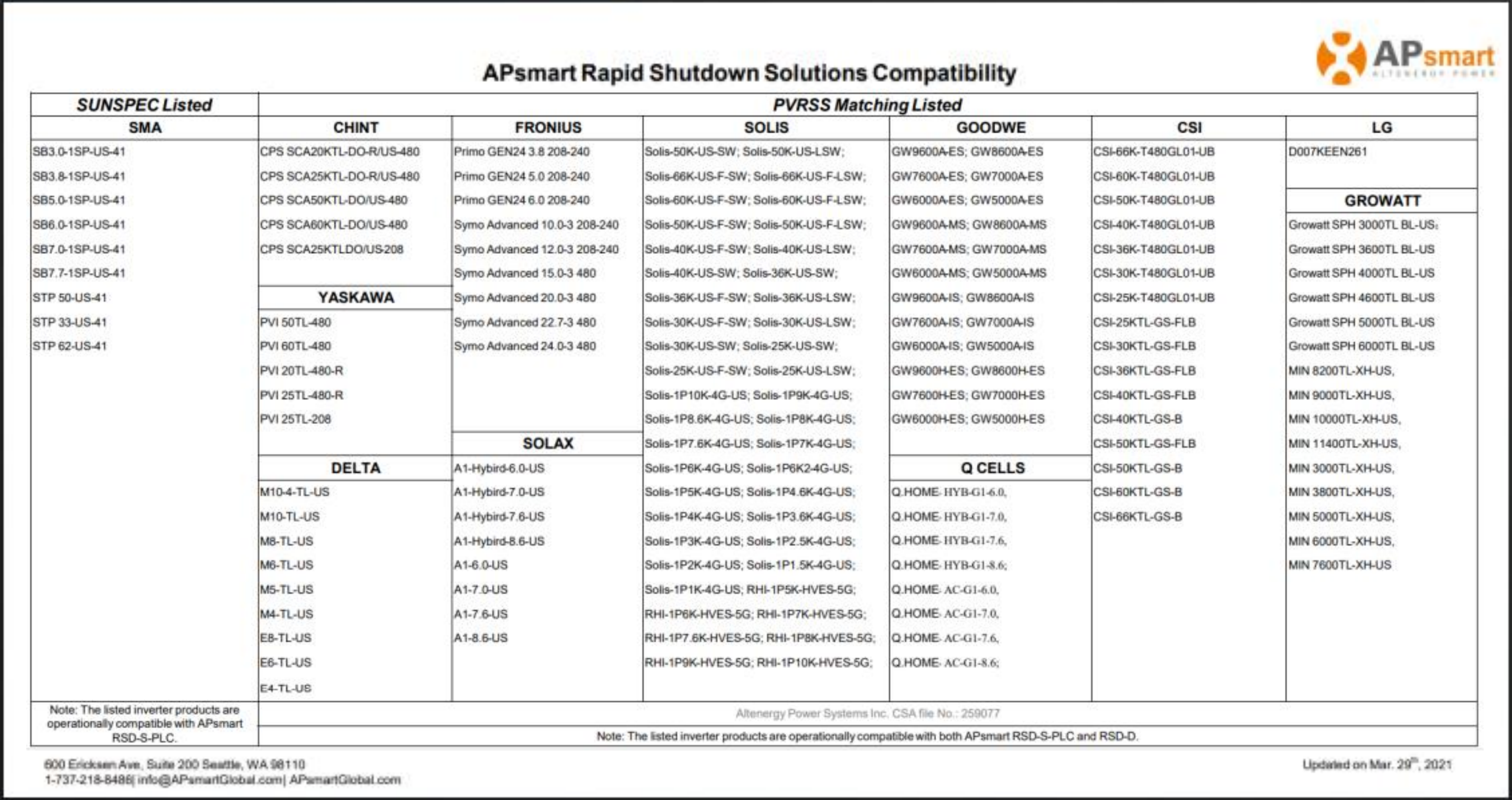
CSA PVRSS Compatible Inverter List



APsmart Rapid Shutdown Solutions Compatibility

SUNSPEC Listed	***PVRSS Matching Listed***					
SMA	**CHINT**	**FRONIUS**	**SOLIS**	**GOODWE**	**CSI**	**LG**
SB3.0-1SP-US-41	CPS SCA20KTL-DO-R/US-480	Primo GEN24 3.8 208-240	Solis-50K-US-SW; Solis-50K-US-LSW;	GW9600A-ES; GW8600A-ES	CSI-66K-T480GL01-UB	D007KEEN261
SB3.8-1SP-US-41	CPS SCA25KTL-DO-R/US-480	Primo GEN24 5.0 208-240	Solis-66K-US-F-SW; Solis-66K-US-F-LSW;	GW7600A-ES; GW7000A-ES	CSI-60K-T480GL01-UB	
SB5.0-1SP-US-41	CPS SCA50KTL-DO/US-480	Primo GEN24 6.0 208-240	Solis-60K-US-F-SW; Solis-60K-US-F-LSW;	GW6000A-ES; GW5000A-ES	CSI-50K-T480GL01-UB	**GROWATT**
SB6.0-1SP-US-41	CPS SCA60KTL-DO/US-480	Symo Advanced 10.0-3 208-240	Solis-50K-US-F-SW; Solis-50K-US-F-LSW;	GW9600A-MS; GW8600A-MS	CSI-40K-T480GL01-UB	Growatt SPH 3000TL BL-US;
SB7.0-1SP-US-41	CPS SCA25KTLDO/US-208	Symo Advanced 12.0-3 208-240	Solis-40K-US-F-SW; Solis-40K-US-LSW;	GW7600A-MS; GW7000A-MS	CSI-36K-T480GL01-UB	Growatt SPH 3600TL BL-US
SB7.7-1SP-US-41		Symo Advanced 15.0-3 480	Solis-40K-US-SW; Solis-36K-US-SW;	GW6000A-MS; GW5000A-MS	CSI-30K-T480GL01-UB	Growatt SPH 4000TL BL-US
STP 50-US-41	**YASKAWA**	Symo Advanced 20.0-3 480	Solis-36K-US-F-SW; Solis-36K-US-LSW;	GW9600A-IS; GW8600A-IS	CSI-25K-T480GL01-UB	Growatt SPH 4600TL BL-US
STP 33-US-41	PVI 50TL-480	Symo Advanced 22.7-3 480	Solis-30K-US-F-SW; Solis-30K-US-LSW;	GW7600A-IS; GW7000A-IS	CSI-25KTL-GS-FLB	Growatt SPH 5000TL BL-US
STP 62-US-41	PVI 60TL-480	Symo Advanced 24.0-3 480	Solis-30K-US-SW; Solis-25K-US-SW;	GW6000A-IS; GW5000A-IS	CSI-30KTL-GS-FLB	Growatt SPH 6000TL BL-US
	PVI 20TL-480-R		Solis-25K-US-F-SW; Solis-25K-US-LSW;	GW9600H-ES; GW8600H-ES	CSI-36KTL-GS-FLB	MIN 8200TL-XH-US,
	PVI 25TL-480-R		Solis-1P10K-4G-US; Solis-1P9K-4G-US;	GW7600H-ES; GW7000H-ES	CSI-40KTL-GS-FLB	MIN 9000TL-XH-US,
	PVI 25TL-208		Solis-1P8.6K-4G-US; Solis-1P8K-4G-US;	GW6000H-ES; GW5000H-ES	CSI-40KTL-GS-B	MIN 10000TL-XH-US,
		SOLAX	Solis-1P7.6K-4G-US; Solis-1P7K-4G-US;		CSI-50KTL-GS-FLB	MIN 11400TL-XH-US,
	DELTA	A1-Hybird-6.0-US	Solis-1P6K-4G-US; Solis-1P6K2-4G-US;	**Q CELLS**	CSI-50KTL-GS-B	MIN 3000TL-XH-US,
	M10-4-TL-US	A1-Hybird-7.0-US	Solis-1P5K-4G-US; Solis-1P4.6K-4G-US;	Q.HOME- HYB-G1-6.0,	CSI-60KTL-GS-B	MIN 3800TL-XH-US,
	M10-TL-US	A1-Hybird-7.6-US	Solis-1P4K-4G-US; Solis-1P3.6K-4G-US;	Q.HOME- HYB-G1-7.0,	CSI-66KTL-GS-B	MIN 5000TL-XH-US,
	M8-TL-US	A1-Hybird-8.6-US	Solis-1P3K-4G-US; Solis-1P2.5K-4G-US;	Q.HOME- HYB-G1-7.6,		MIN 6000TL-XH-US,
	M6-TL-US	A1-6.0-US	Solis-1P2K-4G-US; Solis-1P1.5K-4G-US;	Q.HOME- HYB-G1-8.6;		MIN 7600TL-XH-US
	M5-TL-US	A1-7.0-US	Solis-1P1K-4G-US; RHI-1P5K-HVES-5G;	Q.HOME- AC-G1-6.0,		
	M4-TL-US	A1-7.6-US	RHI-1P6K-HVES-5G; RHI-1P7K-HVES-5G;	Q.HOME- AC-G1-7.0,		
	E8-TL-US	A1-8.6-US	RHI-1P7.6K-HVES-5G; RHI-1P8K-HVES-5G;	Q.HOME- AC-G1-7.6,		
	E6-TL-US		RHI-1P9K-HVES-5G; RHI-1P10K-HVES-5G;	Q.HOME- AC-G1-8.6;		
	E4-TL-US					
Note: The listed inverter products are operationally compatible with APsmart RSD-S-PLC.	Altenergy Power Systems Inc. CSA file No.: 259077					
	Note: The listed inverter products are operationally compatible with both APsmart RSD-S-PLC and RSD-D.					

600 Ericksen Ave, Suite 200 Seattle, WA 98110
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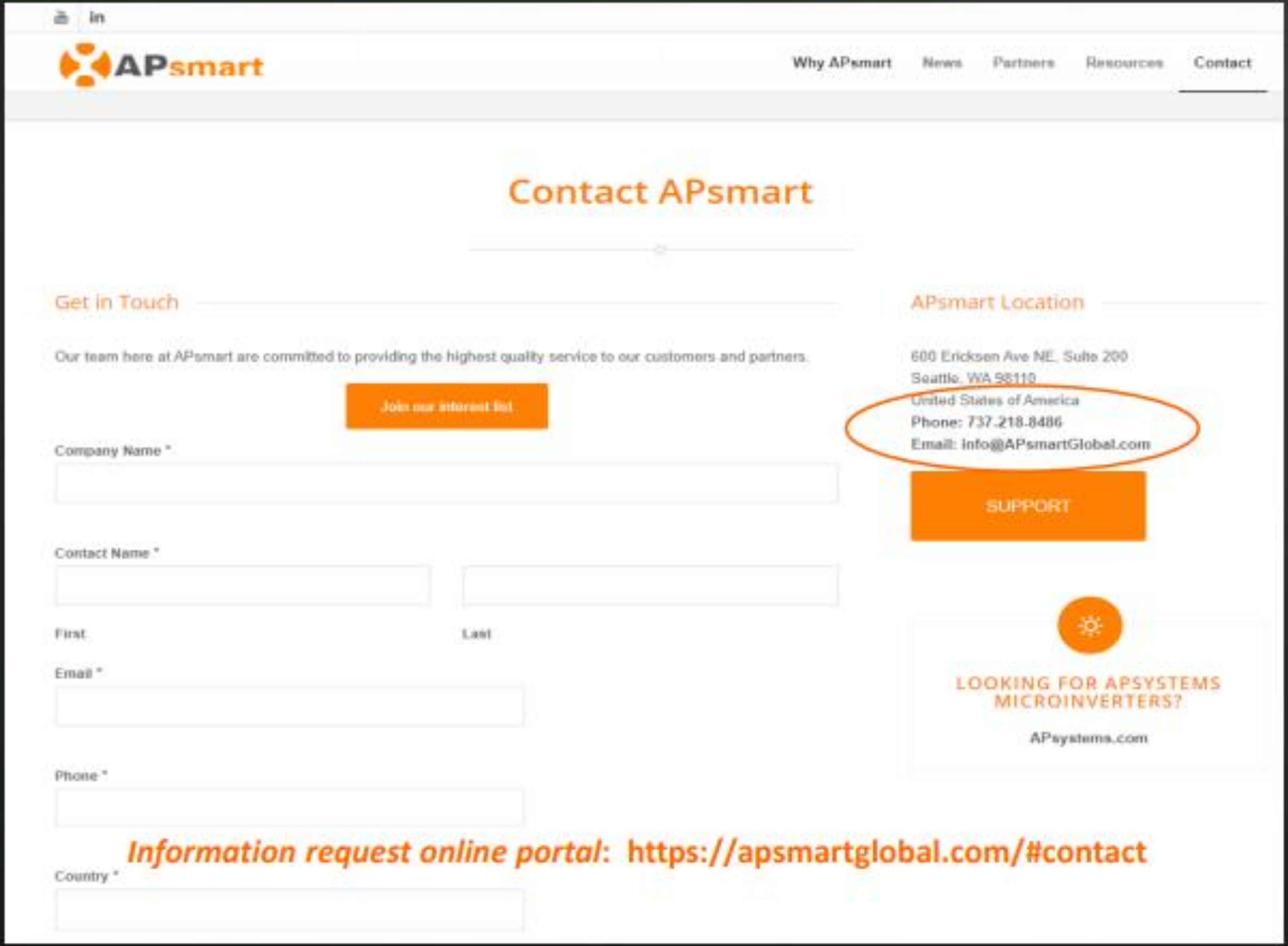
Updated on Mar. 29th, 2021

APsmart MLRSD Technical Support & RMA Process

Applications Support: https://apsmartglobal.com/library/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Phone: 737.218.8486
Email: Info@APsmartGlobal.com

SUPPORT

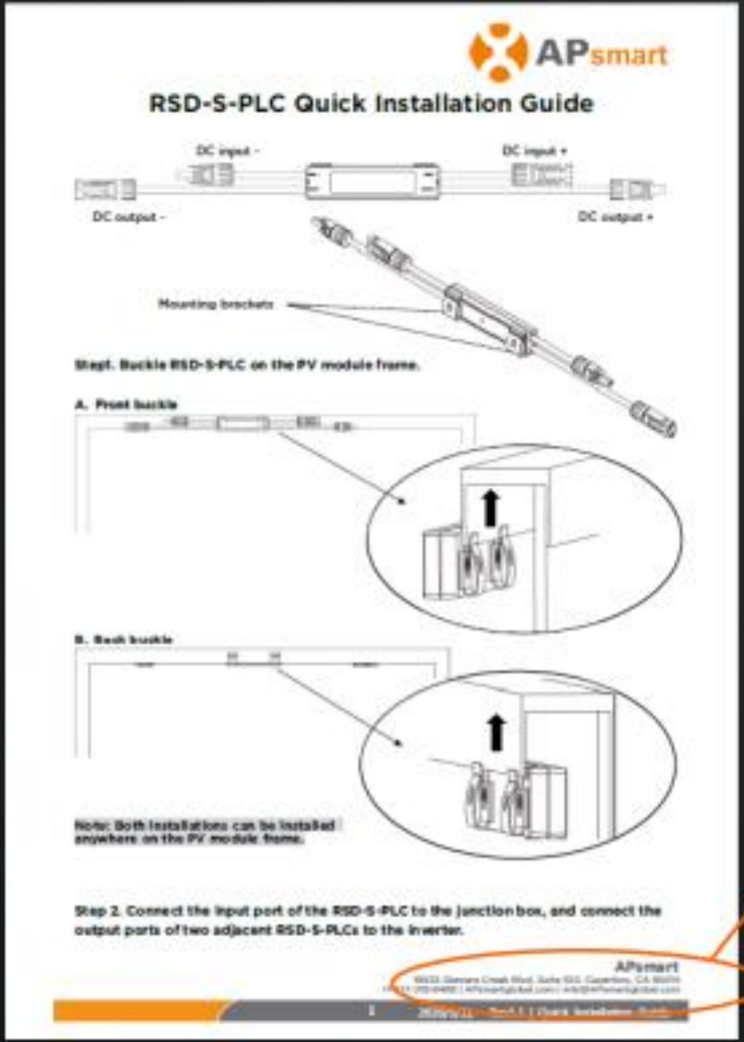
LOOKING FOR APSYSTEMS MICROINVERTERS?

APsystems.com

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

Installers Support:

RSD-S-PLC



APsmart

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.

APsmart

Technical Support:

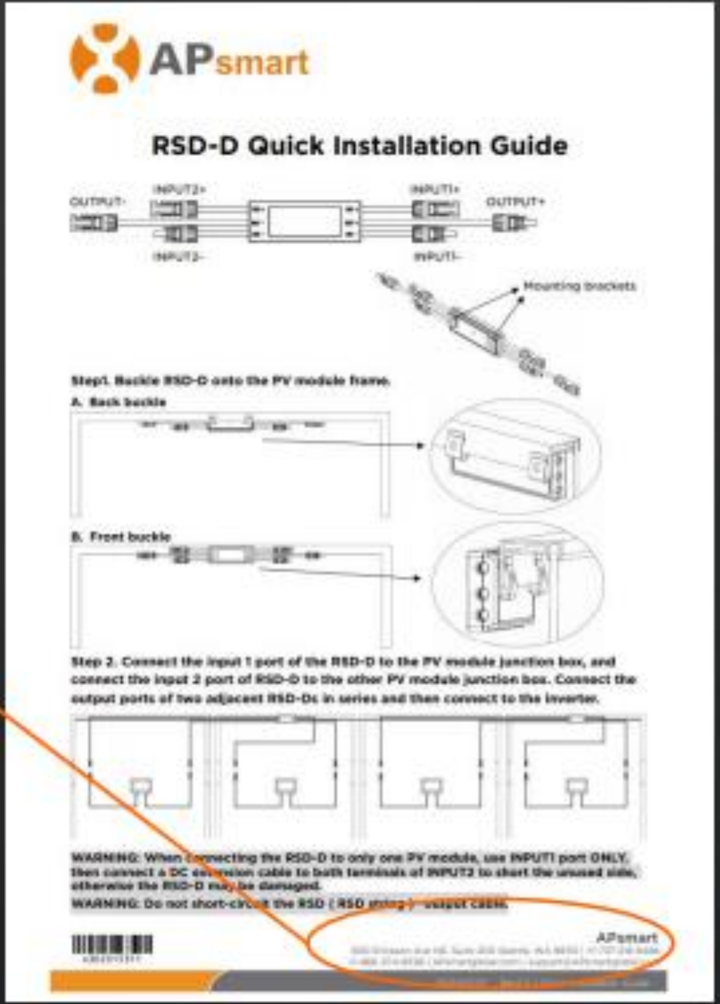
Email: support@apsmartglobal.com

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

Support Hotline: 1-866-374-8538

Product Label

RSD-D



APsmart

RSD-D Quick Installation Guide

OUTPUT-
INPUT2+
INPUT2-
INPUT1+
INPUT1-
OUTPUT+
Mounting brackets

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

A. Back buckle

B. Front buckle

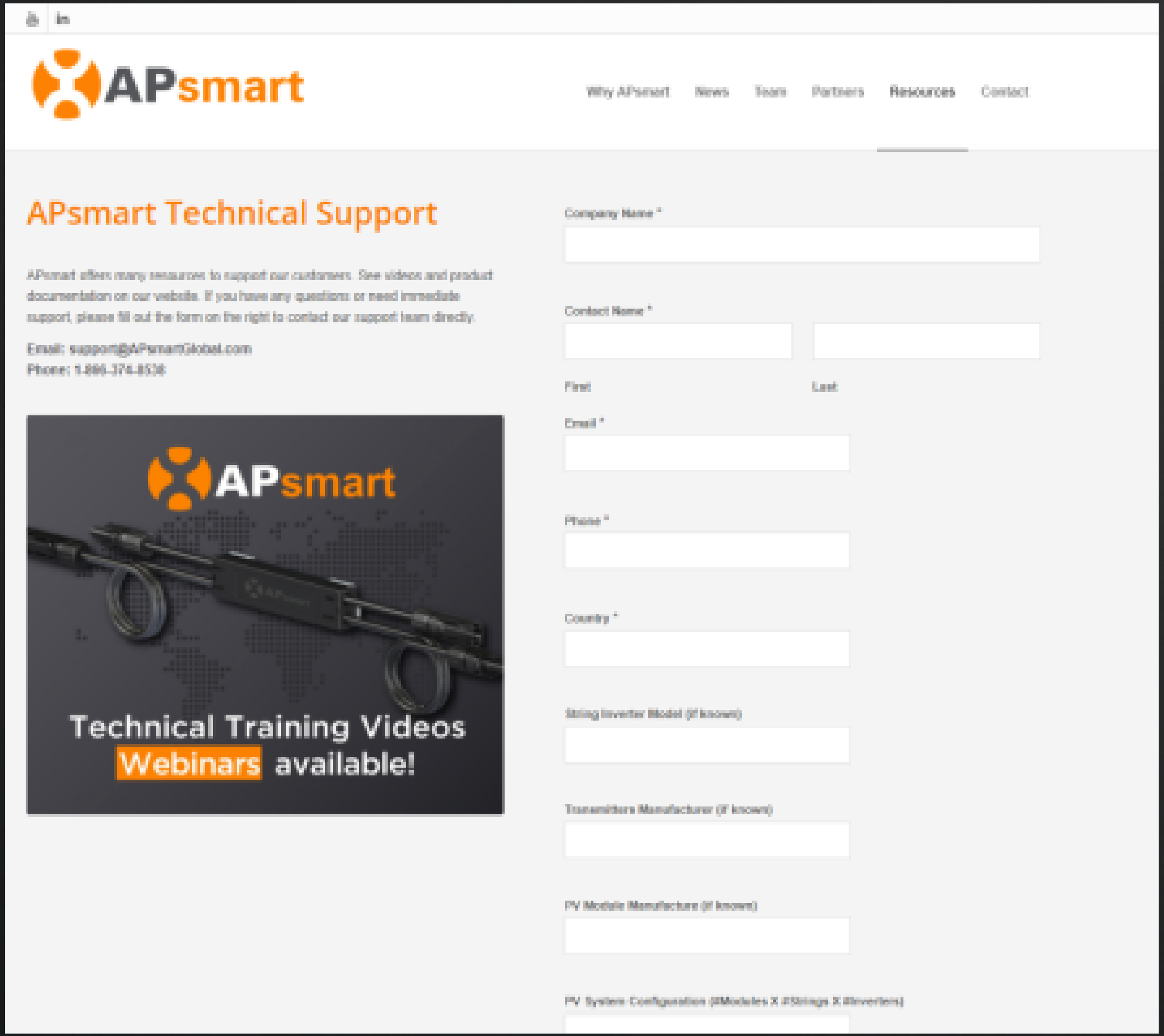
Step 2. Connect the input 1 port of the RSD-D to the PV module junction box, and connect the input 2 port of RSD-D to the other PV module junction box. Connect the output ports of two adjacent RSD-Ds in series and then connect to the inverter.

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.

APsmart

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



APsmart Technical Support

APsmart offers many resources to support our customers. See videos and product documentation on our website. If you have any questions or need immediate support, please fill out the form on the right to contact our support team directly.

Email: support@APsmartGlobal.com
Phone: 1-866-374-8538

Company Name *

Contact Name *
First
Last

Email *

Phone *

Country *

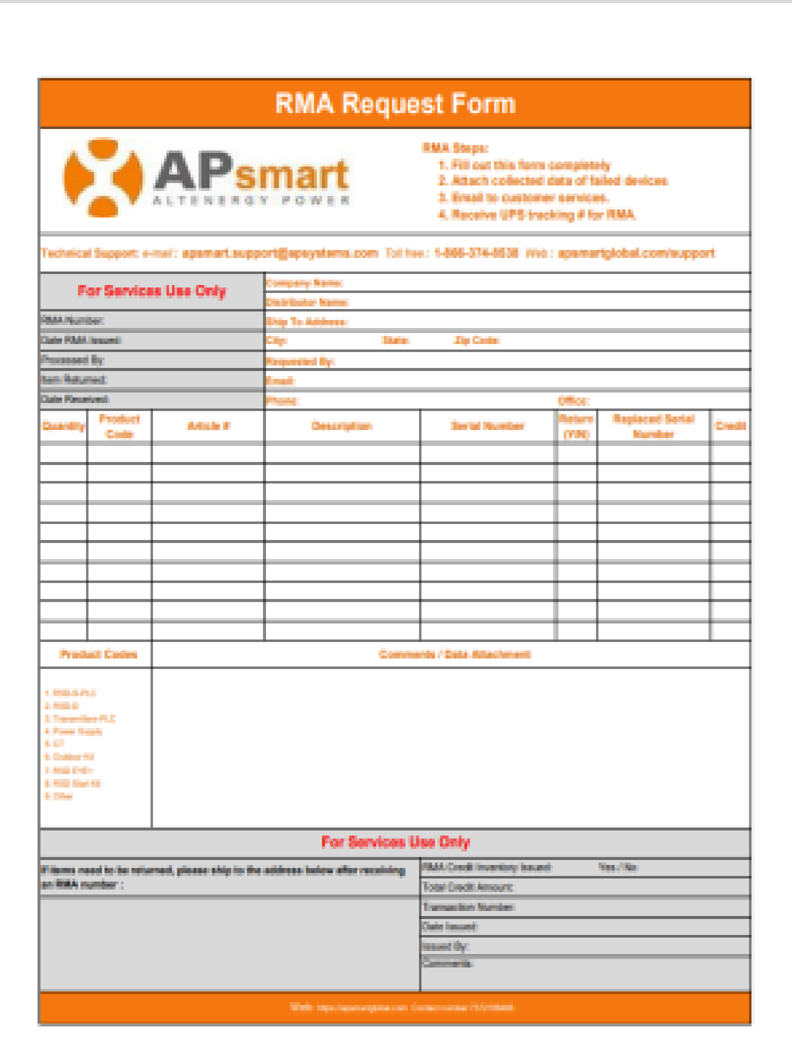
String Inverter Model (if known)

Transmitters Manufacturer (if known)

PV Module Manufacture (if known)

PV System Configuration (#Modules X #Strings X #Inverters)

https://apsmartglobal.com/support/



RMA Request Form

APsmart
ALTENERGY POWER

RMA Steps:
1. Fill out this form completely
2. Attach collected data of failed devices
3. Email to customer services.
4. Receive UPS tracking # for RMA.

Technical Support: e-mail : apsmart.support@apsystems.com Toll free : 1-866-374-8538 Web : apsmartglobal.com/support

For Services Use Only	Company Name:
	Distributor Name:
RMA Number:	Ship To Address:
Date RMA Issued:	City: State: Zip Code:
Processed By:	Requested By:
Item Returned:	Email:
Date Received:	Phone: Office:

Quantity	Product Code	Article #	Description	Serial Number	Return (Y/N)	Replaced Serial Number	Credit

Product Codes

Comments / Data Attachment

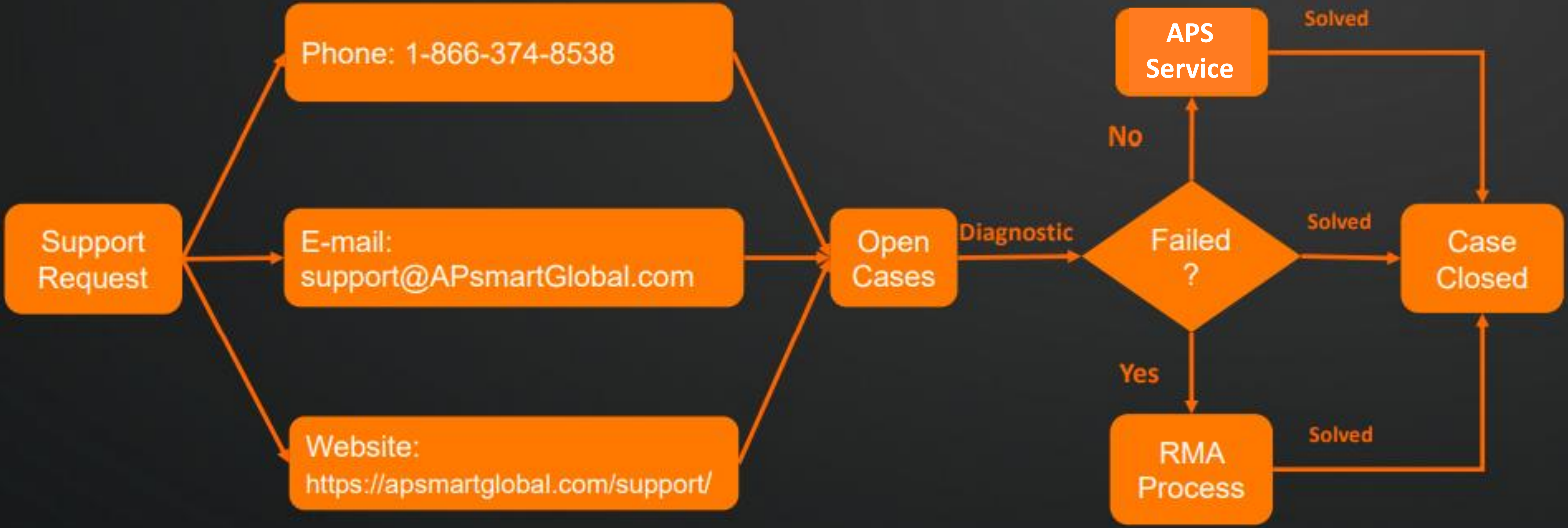
For Services Use Only

If items need to be returned, please ship to the address below after receiving an RMA number :

RMA Credit Inventory Issued: Yes / No
Total Credit Amount:
Transaction Number:
Date Issued:
Issued By:
Comments:

https://apsmartglobal.com/library/

Technical Support Process Cooperating with APS Service



Support Request

Phone: 1-866-374-8538

E-mail: support@APsmartGlobal.com

Website: https://apsmartglobal.com/support/

Open Cases

Diagnostic

Failed ?

No

APS Service

Yes

RMA Process

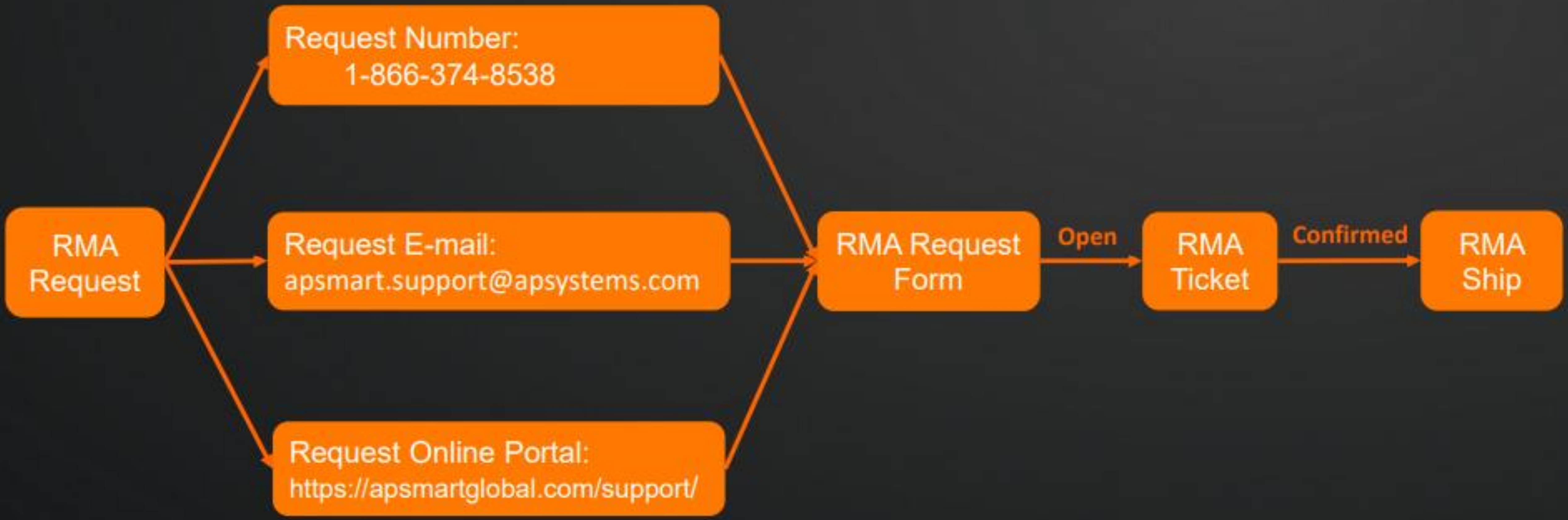
Solved

Solved

Solved

Case Closed

APsmart RMA Process: For All End Users



RMA Request

Request Number:
1-866-374-8538

Request E-mail:
apsmart.support@apsystems.com

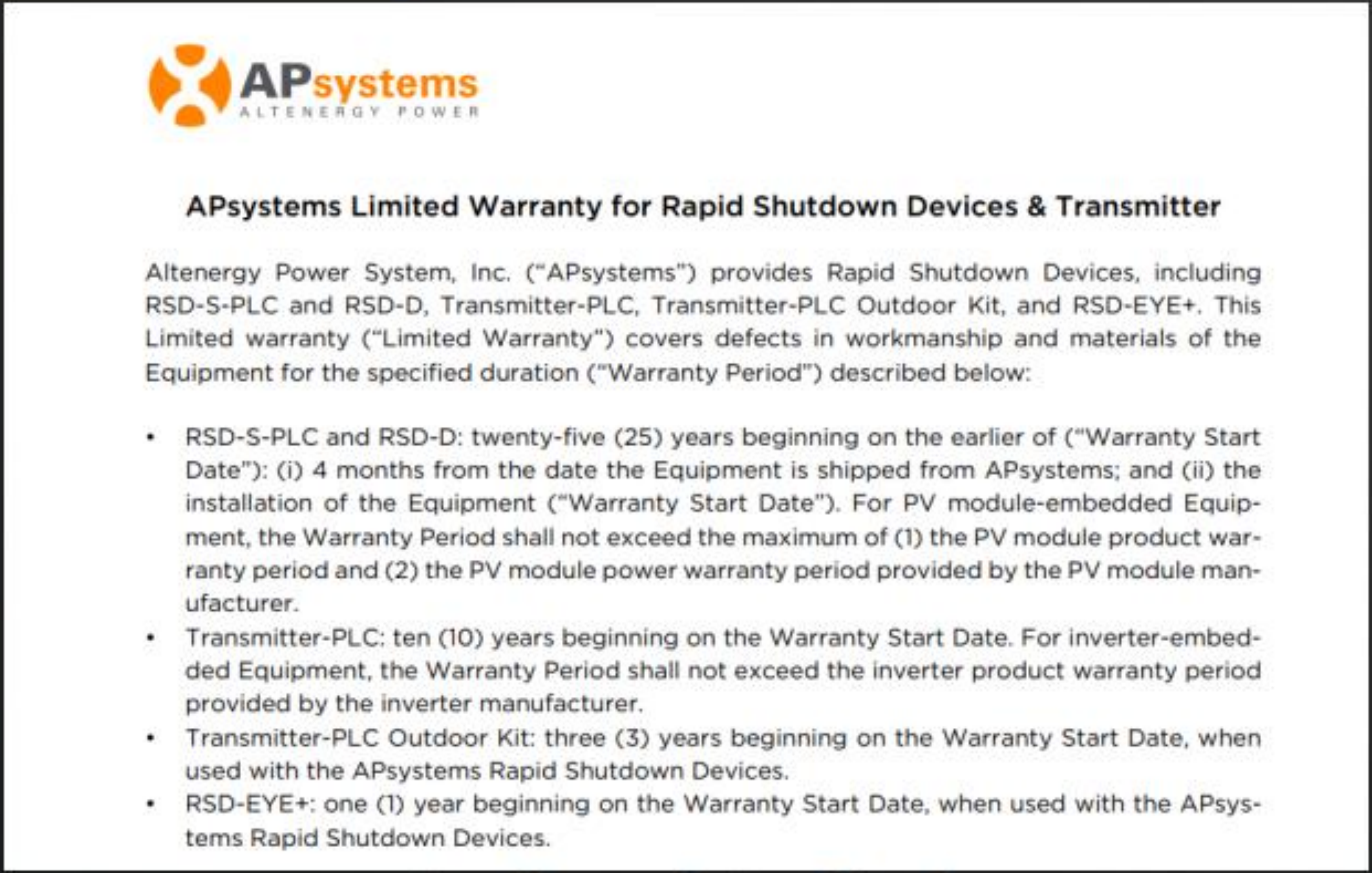
Request Online Portal:
https://apsmartglobal.com/support/

RMA Request Form

RMA Ticket

RMA Ship

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.

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