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SILICONDUCTOR

PV Monitoring Rapid Shutdown Device

USER MANUAL

PVM-C16H/C18H/C20H-T2

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Release time：2024-11-19

CONTENTS

1 Overview

1.1 Overview of Manual

This user manual details the functional characteristics and installation methods of PV Rapid Shutdown Device and PV Monitoring Rapid Shutdown Device series products ("hereinafter referred to as "Shutdown Device"). Before installing and using the device, carefully read the user manual, requirements and the precautions.

1.2 Intended Audience

This manual is suitable for Installers, O&M Staff, FAE, Technical Support Engineers, Sales Engineers and Owners.

1.3 Symbol Conventions

Symbol	Description
⚠ DANGER	Indicates a hazard with a high level of risk which, if not avoided, will result in death or serious injury.
⚠ WARNING	Indicates a hazard with a medium level of risk which, if not avoided, could result in death or serious injury.
⚠ CAUTION	Indicates a hazard with a low level of risk which, if not avoided, could result in minor or moderate injury.
NOTICE	Indicates a potentially hazardous situation which, if not avoided, could result in equipment damage, data loss, performance deterioration, or unanticipated results. NOTICE is used to address practices not related to personal injury.

1.4 Revision Record

No.	Description	Document version	Release time
1	Creating First Release	V1.0.0	2024-09-19
2	Add New Model PVM-C18H-T2	V1.1.0	2024-10-25
3	Product Topology Changes	V1.1.1	2024-11-19
4			

1.5 Manual Statement

The contents described in this User's Manual may be outside the scope of the user's purchase or use of products or services, etc. The user's purchase or use of products or services, etc. shall be subject to the commercial contracts and terms and conditions of siliconductor.

The contents of the User's Manual may be updated from time to time due to product version upgrades or other reasons. Unless otherwise agreed, this user manual is intended as a guide to use only and all statements, information and suggestions contained herein do not constitute any warranty, express or implied.

2 Precautions

2.1 Liability Exemption

Before transporting, storing, installing, operating, using and maintaining the product, please read this user manual and carry out comprehensive product research. The product should be used in an environment that meets the requirements of the design specifications, and the precautions required in this user manual should be strictly followed during use, in compliance with applicable local laws, regulations, standards and normative requirements. The Company shall not be liable for the occurrence of any of the following events or the results thereof:

- Product damage and accidents due to force majeure factors (e.g., extreme conditions such as earthquakes, floods, fires, wars, etc.).
- Product damage and accidents due to poor transportation conditions.
- Product damage and accidents due to poor storage conditions.
- Failure to comply with local laws and regulations in installation and use, and failure to meet local standard requirements.
- Non-professional, untrained personnel operate and use the product.
- Unauthorized or unpermitted disassembly, alteration of the product or modification of the software code.
- Operation of the product outside of the specified technical parameters or outside of the warranty period.
- Negligence, intentionality, gross negligence, or improper operation by the user or a third party (not caused by the Company), resulting in personal injury, death, or property damage.
- The warning labels on the shutdown device contain important information for its safe operation and must not be altered or damaged.
- A nameplate is affixed to the back of the shutdown device, which contains important parameter information related to the product and is strictly prohibited from being altered or damaged artificially.

⚠ DANGER

Specialized protective equipment must be used during operation, such as protective clothing, insulated shoes, goggles, safety helmets and insulated gloves etc.

2.2 Operator Requirements

- The operator should read through this user manual and be aware of all precautions.
- The operator should know the composition and working principle of the PV power generation system.

- The operator should comply with safety regulations and requirements related to electrical systems, mechanical work, work at height, etc.
- The operator should comply with the safety and electrical regulations and standards of the country or region where the product is located.
- The operator should be trained in the installation and operation of siliconductor PV products and be familiar with the operation and use of the products.
- The operator must wear protective gear and good insulation protection, it is strictly prohibited to wear easily conductive items (such as watches, rings, etc.).
- Personnel operating special scenarios such as electrical operations, work at heights, and operation of special equipment must have special operating qualifications required by the local country/region.

⚠ DANGER

When equipment is energized, unregulated and incorrect operation may produce fire, electric shock, or explosion, resulting in injury, death, or property damage.

⚠ DANGER

Special insulated tools must be used during operation to avoid electric shock or short-circuit faults, and the insulation voltage withstand level must meet the requirements of local laws and regulations, standards and codes.

⚠ DANGER

Before making electrical connections, make sure that the equipment is undamaged, otherwise electric shock or fire may result.

⚠ DANGER

Unregulated and incorrect operation may cause accidents such as fire or electric shock.

⚠ DANGER

During operation, foreign objects must be prevented from entering the interior of the equipment, as failure to do so may result in short-circuit failure or damage to the equipment, derating or loss of power to the load supply, and personal injury.

2.3 Prepare for Operation

- Before installing the equipment：

1）The environment in which the equipment is stored should be suitable in temperature and humidity, clean and dry, and well ventilated.

2）Avoid storing equipment in environments with high levels of dust and volatile gases.

3）It is strictly prohibited to install, use and operate the equipment in bad weather (e.g., lightning, heavy rain, high winds, etc.).

4）Installation tools should be safe and professional, ensuring that they are insulated and

secure and not overloaded.

5) Before installing the shutdown device, make sure that it is not electrically connected and energized.

6) A certain distance should be reserved between the shutdown device and the surrounding objects to ensure that there is enough space for installation and heat dissipation.

- Equipment installation in progress:

1) Ensure that the cables are securely connected and well insulated, and that all electrical connections meet national/regional electrical standards.

2) Ensure that switches such as shutdown device, inverters, and power supplies are off to ensure that there is no voltage to the PV string.

3) Do not touch parts other than those required for the wiring job during installation.

4) Ensure that all electrical component protective shells, insulation sleeves and other devices are in place after installation to avoid the risk of electric shock.

- During operation of the equipment:

1) Do not touch the equipment to avoid electric shock, burns or other accidents.

2) The shutdown device output terminals are not hot-swappable; otherwise, the shutdown device may be damaged.

3) Comply with local regulations and specifications when operating equipment.

4) Check the device connection terminal screws regularly to make sure they are tight and not loose.

2.4 Personal Safety

3 Product Overview

3.1 Products Introduction

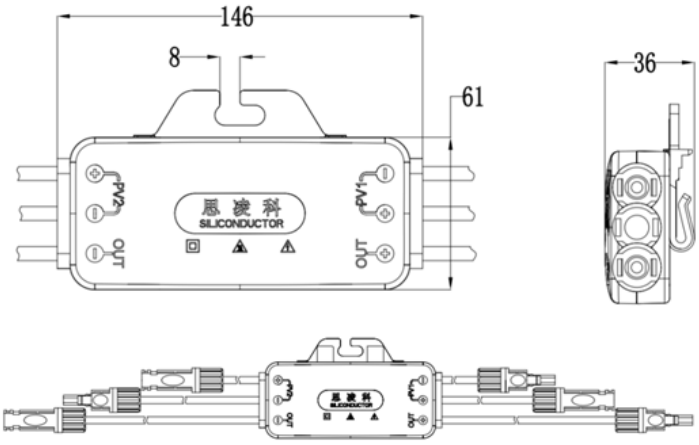
The shutdown device is a safety device installed on the back of PV module in PV system, its main function is to reduce the voltage outside 30cm from the PV module to below 30V within 30s after starting the shutdown device. When the building where the PV module is located needs to be repaired or firefighting rescue, it can effectively eliminate electric shock and other safety hazards, and protect the life safety of maintenance personnel and firefighters. At the same time, the shutdown device can monitor the operation status of each PV module in real time, and report the operation parameters of each PV module such as voltage, current, temperature, etc. to the SLC cloud platform at regular intervals, which can be queried and monitored in real time on the SLC cloud platform to monitor the operation of each PV module.

3.2 Product Model

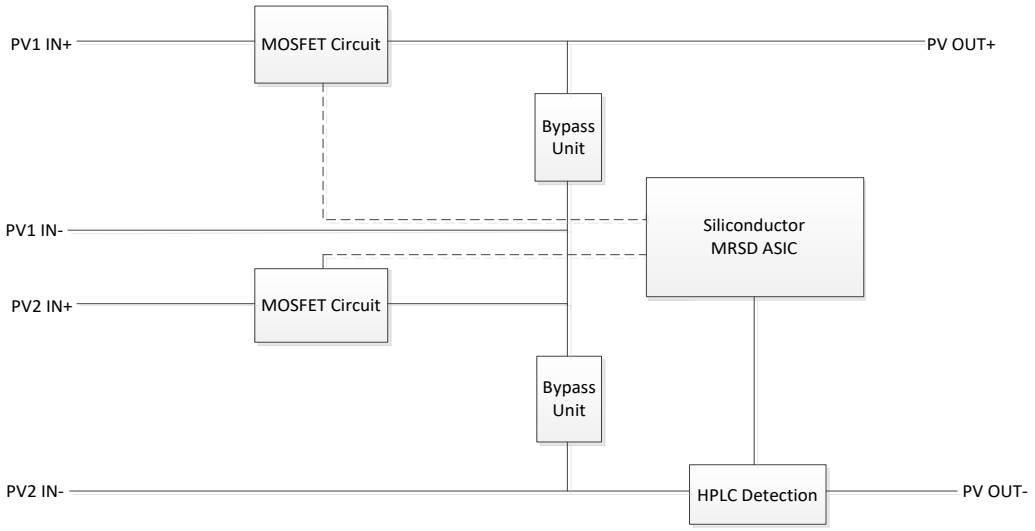
This user manual mainly covers the following product models:

Product Model
PVM-C16H-T2
PVM-C18H-T2
PVM-C20H-T2

3.3 Structure of Product

Product Model	Diagram
PVM-C16H/C18H/C20H-T2	

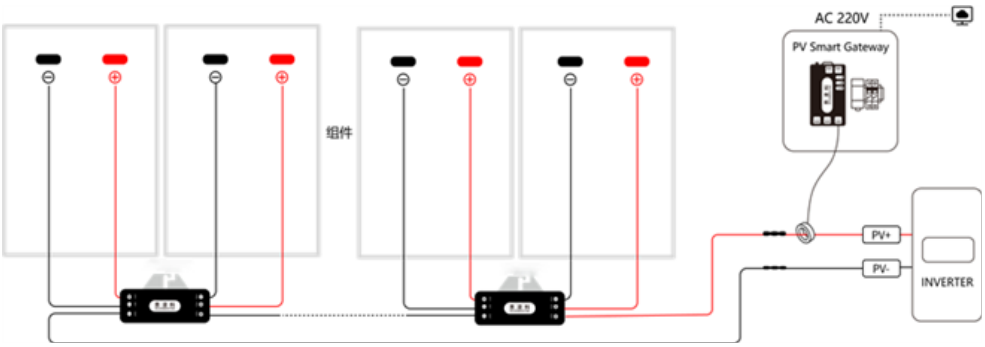
3.3 Electrical Schematic Diagram



3.4 Label Description

Label	Description
	Beware of electrocution
	Beware of burns
	Enhanced insulation
	View Instructions
	Scrap recycling

3.5 On Grid Scenarios



4 Installation and Commissioning

4.1 Environment Requirement

- Please reserve enough space to rationalize the hanging position of the shutdown device behind the PV module.
- Ensure that the shutdown device are properly connected to the PV module cables and to the cables between neighboring shutdown device.
- The loopback distance between the shutdown device and the inverter should not exceed 300m (i.e., the distance between the farthest end of the shutdown device and the magnet ring should be less than 150m, if it is greater than this distance, it will lead to the loss of communication data packets).
- Prohibit exposure of the shutdown device to direct sunlight.
- Prohibit storage of flammable and explosive materials in the area where the shutdown device is installed.
- Prohibit install the shutdown device in a submerged environment.

4.2 Pre-installation Check

- Inspection of outer packaging

  Before unpacking the outer packaging, check the outer packaging for visible damage, such as the appearance of voids, cracks or other signs of possible internal damage. If there is any

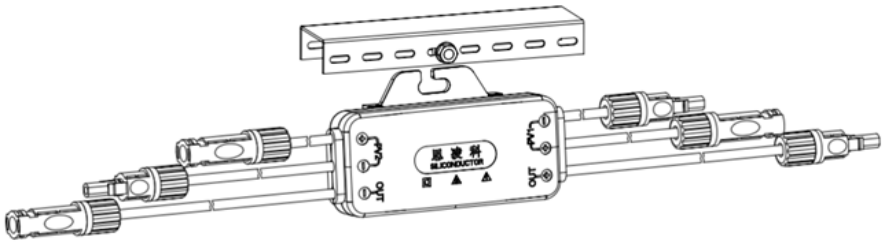
damage to the outer packaging, do not open it and contact your dealer as soon as possible!

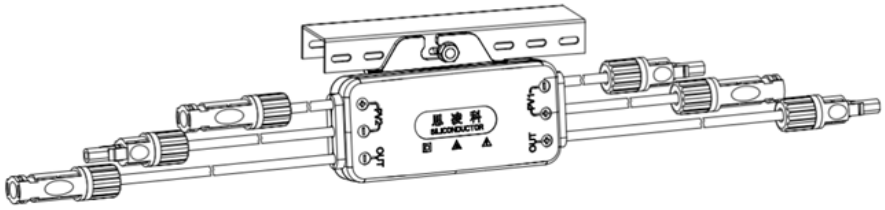
- Inspection of deliverables

  If the outer packaging is undamaged, after unpacking the outer packaging, please check that the deliveries inside the package are complete and that there is not any visible external damage. If you find objects missing or damaged, please contact your dealer as soon as possible.

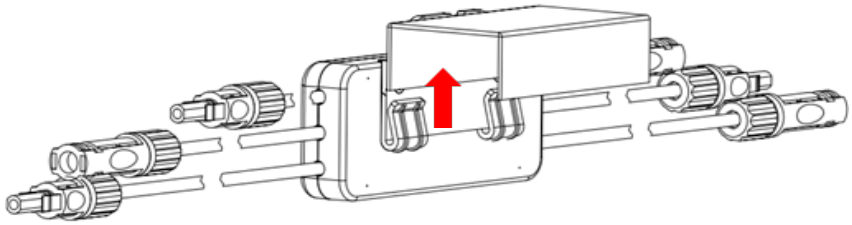
4.3 Installation Position

Option 1: mounted on a C-beam bracket, hang the shutdown device on the bolt and fix it with a nut.





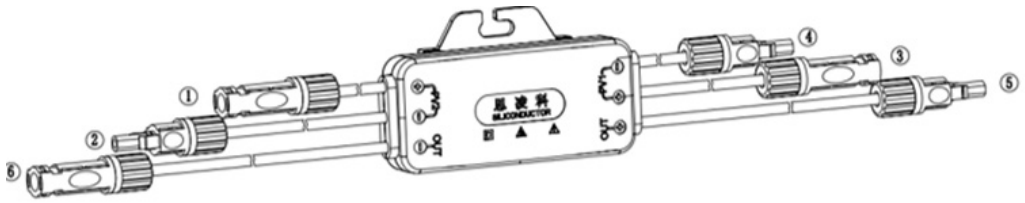
Option 2: Mounted on the PV module frame, snap the shutdown devie back plate onto the frame and make sure it is tightened in place.



NOTICE

Prohibit the installation of the shutdown device in areas exposed to direct sunlight, rain and snow, including gaps between the PV modules; a fully shaded mounting point is preferable. A minimum of 1.5 cm should be provided between the shutdown device and the PV module above it.

Option 3: 3, the DC input terminal of the shutdown device and the DC output terminal of the photovoltaic module are plugged, "click" sound proves that the terminal position is correct.



① PV1 Postive Input Port
② PV1 Negative Input Port
③ PV2 Postive Input Port
④ PV2 Negative Input Port
⑤ PV Postive Ouput Port
⑥ PV Negative Ouput Port

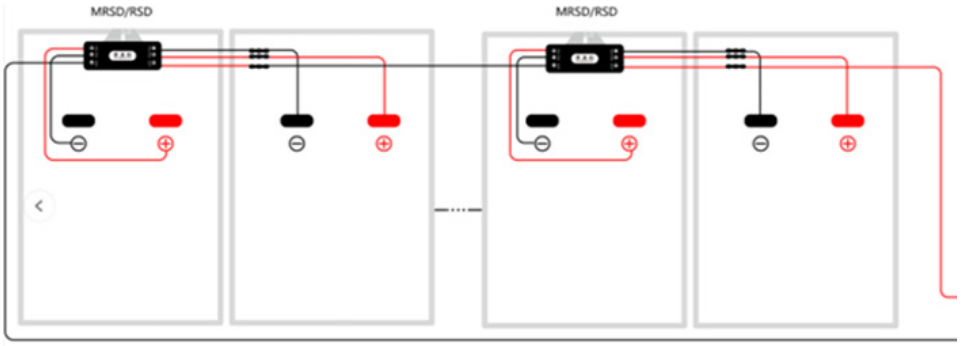
Others: Confirmation of other options depends on the actual situation of the plant and PV modules, and does not exclude the need to contact a third party to purchase supporting materials.

4.4 Installation step

1.Determine the location of the shutdown device mounting, take a piece of SN code labeling paper from the shutdown device hanging plate and stick it on the SN code sticker sheet.

2.Connection of the shutdown device to the PV module：

- Shutdown device [PV1 Input Negative (IN-)] cable connected to the negative terminal of the PV1 module junction box.
- Shutdown device [PV1 Input Positive (IN+)] cable connected to the positive terminal of the PV1 module junction box.
- Shutdown device [PV2 Input Negative (IN-)] cable connected to the negative terminal of the PV2 module junction box.
- Shutdown device [PV2 Input Positive (IN+)] cable connected to the positive terminal of the PV2 module junction box.
- Shutdown device X1 [Output Negative (OUT-)] cable connected to the Shutdown device X2 [Output Positive (OUT+)].



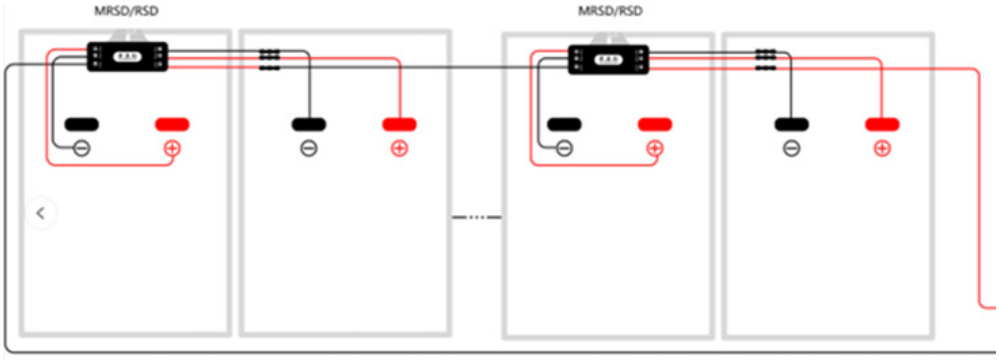
3.Connection between neighboring shutdown device：

If more than one shut down device (X1 to Xn) has been installed in a PV string, then neighboring shutdown device need to be connected to each other.

- Sequence the shutdown devices from left to right in one row, specifying the leftmost shutdown device X1 and the rightmost shutdown device Xn.
- Shutdown device X1: set aside [Output Negative (OUT-)] to connect the [Output Positive

(OUT+)] of shutdown device X1 to the [Output Negative (OUT-)] of shutdown device X2.

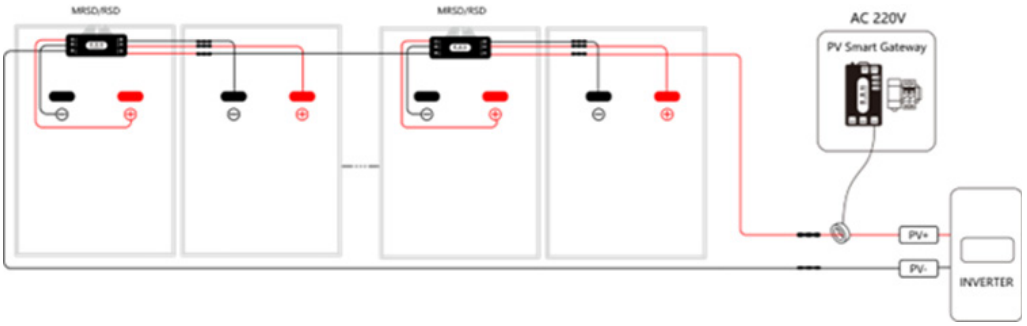
- Shutdown device X2: Connect [Output Positive(OUT+)] of shutdown device X2 and [Output Negative (OUT-)] of shutdown device X3 (the connection of shutdown device X2 to shutdown device Xn follows the same way).
- Shutdown device Xn: Reserved for [Output positive (OUT+)].



4.Connection of the shutdown device to the inverter：

If multiple shutdown device (X1 to Xn) have been installed in a group of PV strings and neighboring shutdown device have been interconnected

- Connect [Output Negative (OUT-)] of shutdown device X1 to Inverter Negative (PV-).
- Connect [Output Positive (OUT+)] of shutdown device Xn to inverter Positive (PV+).



NOTICE

Make sure that the DC connectors to be mated are of the same type or compatible with each other. Using incompatible DC connectors may result in serious consequences, and we are not responsible for any damage to equipment or safety accidents caused by such use.

NOTICE

Under any conditions, the sum of the open-circuit voltages of all PV modules in a string shall not exceed the maximum input voltage of the inverter.

NOTICE

When installing, the bending radius of the cable must be more than 50MM.

5 Siliconductor Cloud

This series of shutdown device need to be used in conjunction with the PV smart gateway (hereinafter referred to as "gateway") and the Siliconductor Cloud (hereinafter referred to as "SLC Cloud") in order to realize the Siliconductor Cloud. Please refer to the user's manual of the corresponding product for details of the connection and use of the supporting products (please contact the distributor to obtain the manual or download it by scanning the code).

6 Functional Check

When the shutdown device and gateway have been configured, the PV cloud platform can be used to check the function of the whole set of PV module smart O&M system. The checking steps are as follows：

6.1 Shutdown device and gateway connectivity checks

- In general, after the file is imported into the gateway, the gateway will send the heartbeat signal to the shutdown device; at this time, to carry out the check, you need to use the local computer to read the parameter information of the shutdown device under the gateway; if it can be read normally, it means that the two-way communication between the shutdown device and the gateway is normal.
- Open the inverter PV Isolated switch, after 1 minute, use the local computer to read the current information, if it can be read, it means that the shutdown device has been closed normally.

6.2 Malfunction replacement

- Use insulated tools, wear protective gloves, and strictly prohibit the wearing of easily conductive objects.
- Disconnect gateway AC switch or emergency stop switch.
- Adjust the inverter PV disconnect switch to OFF.
- Inverter DC bus disconnect.
- Ensure that the inverter has been disconnected from the grid.
- Multimeter to measure the PV string voltage, to confirm that the PV string voltage has been reduced to a safe voltage, the string current is 0.
- Verify that the PV module is normal, if so, carry out shutdown device removal and replace with a new shutdown device. If the PV module is anomalous, replace the PV module.
- Connect the gateway AC switch or turn on the gateway emergency stop switch to put the gateway in normal operating mode.
- Delete the anomaly SN address of the shutdown device in the local computer or PV cloud platform, enter the interface of device debugging, select "Maintenance>Add/Delete Device", and add a new SN address of the shutdown device.
- In the device debugging interface, select "Maintenance > Monitor Shutdown device Layout" to bind a new shutdown device.
- After the communication is connected, make sure that the replacement shutdown device is

normal.

- Open the PV isolated switch of the inverter, close the circuit breaker between the AC side of the inverter and the power grid, the PV string works normally.

6.3 Troubleshooting

Troubleshooting		
Alarm name	Cause	Solution
Input overvoltage	Output voltage of PV module exceeds shutdown device input voltage specification	1.Check that the open circuit voltage specification of the shutdown device input PV module does not exceed 80V. 2.Check for PV module series connection.
Abnormal output voltage	The shutdown device output voltage is abnormal	1. When the sunlight is normal, wait for the gateway to resend the power-up command. 2. Check the corresponding PV string voltage, if the PV string voltage is greater than or equal to n*1V (n represents the number of shutdown devices), it means the system is normal. 3. Check the corresponding PV string voltage, if the PV string voltage is less than n*1V (n represents the number of shutdown devices), power down the system, check the PV string wiring, if there is a breakpoint, check the corresponding PV string wiring, if the polarity is incorrect, change the polarity of the PV string, if the breakpoint or polarity problem is solved, power up the system again and wait for the shutdown device to close the circuit breaker, if the alarm still exists, check the extension line of the faulty shutdown device to see if it is correct or not. 4. If the fault persists, contact the installer. Note: Extension cords must have opposite polarity at each end (positive connector at one end, negative connector at the other).
Over-temperature alarm	High ambient temperature or not installed as required	1. Check that the shutdown device installation location is well ventilated and that the ambient temperature does not exceed the maximum allowable ambient temperature range. If there is no ventilation or the ambient temperature is too high, improve the ventilation and heat dissipation. 2. If ventilation and ambient temperature are normal and the alarm persists, contact your installer.
Output backfeed	Shutdown device output backfeed occurred	1. Check for heavy shading of PV modules when PV strings in parallel using connected to the same MPPT. 2. If the fault persists, contact the installation contractor.
Internal hardware fault	The shutdown device is not properly installed or is faulty internally	Execute system power down, disconnect the input side and output side wiring of the shutdown device after 5 minutes, restore the input side and output side wiring after 1 minute, and then execute system power up, if the fault still exists, please contact the installer .
Upgrade failed	The shutdown device firmware upgrade failed	1. When the sunlight is normal, perform the shutdown device upgrade again. 2. If the fault persists, contact the installation contractor.

7 Product certification and quality management

National Management System Certification

- GB/T 19001-2016 / IS0 9001:2015"Quality Management System"
- GB/T 24001-2016 / IS0 14001:2015 "Environmental Management System"
- GB/T 45001-2020 / IS0 45001:2018 "Occupational Health and Safety Management System"

Supplier Management Description

- Strict supplier qualification audit and regular assessment, incoming material control standardization, material quality improvement, product quality control from the source, to provide customers with more reliable products.

Product Certification

- UL 1741: UL Std. No. 1741-2021
- CSA C22.2 No. 330-23
- UL 3741: ANSI/CAN/UL 3741-2020

Rapid shutdown certification

- NEC-2017/NEC-2020/NEC-2023 Section690.12

FCC Certification Description

- FCC: 47 CFR Part 15B

IC Certification Description

- IC: ICES-003: Issue7 October 2020

8 Datasheet

Product Name	Monitor Rapid Shutdown Device		
Product Model	PVM-C16H-T2	PVM-C18H-T2	PVM-C20H-T2
INPUT			
Max Input Voltage Per String	80V		
Max Input Current	16A	18A	20A
Max Short-circuit Current	20A	22.5A	25A
Combined Efficiency	＞99.5%		
OUTPUT			
Max Output Voltage	160V	160V	160V
Max Output Current	16A	18A	20A
Passby	YES	YES	YES
Output Shutdown Voltage	1V	1V	1V
COMMUNICATION			
Communication	HPLC		
CERTIFICATION			
Safety	UL1741		
	UL3741		
	CSAC22.2No.330-23		
	NEC690.12-2017&2020&2023		
EMC	FCC:47CFRPart15B		
	ICES-003:2020		
GENERAL PARAMETERS			
Number Of Input/Output Ports	2/1		
Dimension	136mm(L)x61mm(W)x35mm(H)		
Weight (including cable)	610g		
Shutdown Time	＜15s		
Mounting Position	Backplane mounting/Edge mounting		
Operating Altitude	3000M		
Input Interface	MC4 compatible/Staubli MC4 (Optional)		
Output Interface	MC4 compatible/Staubli MC4 (Optional)		
Cable Length	PV1 750mm PV2 750mm PVOUT 2700mm/ Customised lengths		
Working Temperature	-40 ～ 85°C		
Allowable Relative Humidity Range	0 ～ 100%		
Degree Of Protection	IP68		
Maximum System Voltage	1500V		

Appendix

Abbreviation Description

- D

DC	direct current

- M

MPPT	maximum power point tracking
MRSD	monitor rapid shutdown device

- E

EMC	electromagnetic compatibility
EFT	electrical fast transient
EMI	electromagnetic interference
EMS	electromagnetic susceptibility
ESD	electrostatic discharge

- H

HPLC	highspeed power line communication

- S

SRSD	siliconductor rapid shutdown device

WARNING-THIS PHOTOVOLTAIC RAPID SHUTDOWN SYSTEM (PVRSS) INCORPORATES ONE OR MORE PIECES OF EQUIPMENT THAT EXERCISE THE RAPID SHUTDOWN CONTROL OF PV SYSTEM CONDUCTORS REQUIRED BY SECTION 690.12 OF THE NEC (NFPA 70). OTHER EQUIPMENT INSTALLED IN OR ON THIS PV SYSTEM MAY ADVERSELY AFFECT THE OPERATION OF THIS PVRSS. IT IS THE RESPONSIBILITY OF THE INSTALLER TO ENSURE THAT THE COMPLETED PV SYSTEM MEETS THE APPLICABLE RAPID SHUT DOWN FUNCTIONALI REQUIREMENTS. THIS EQUIPMENT MUST BE INSTALLED ACCORDING TO THE MANUFACTURER'S INSTALLATION INSTRUCTIONS.

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