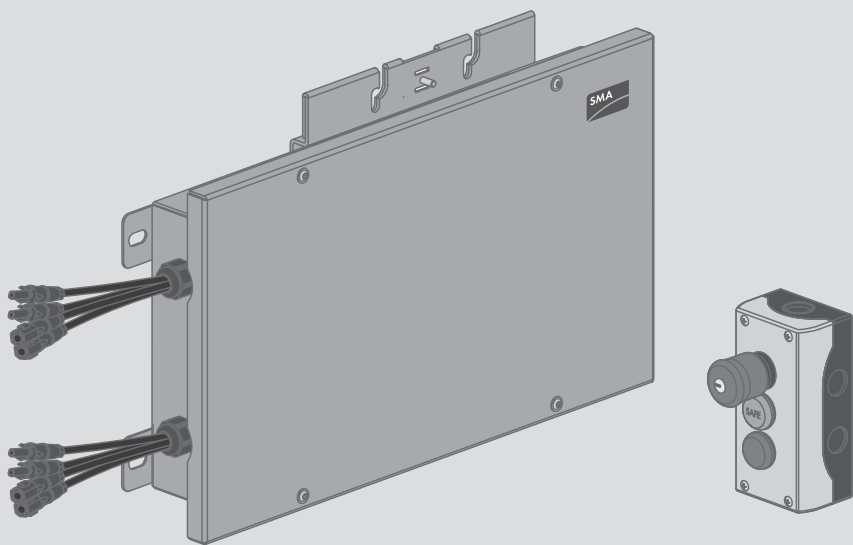


SMA RAPID SHUTDOWN SYSTEM



ENGLISH

Installation Manual

ESPAÑOL

Instrucciones de instalación

FRANÇAIS

Instructions d'installation



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1 Information on this Document

1.1 Validity

This document is valid for:

- RSB-2S-US-10 (SMA Rapid Shutdown Box)
- RSC-1X-US-10 (SMA Rapid Shutdown Controller)

1.2 Target Group

The tasks described in this document must only be performed by qualified persons. Qualified persons must have the following skills:

- Knowledge of how PV systems work and are operated
- Training in how to deal with the dangers and risks associated with installing, repairing and using electrical devices and installations
- Training in the installation and commissioning of electrical devices and installations
- Knowledge of all applicable laws, standards and directives
- Knowledge of and compliance with this document and all safety information




1.3 Content and Structure of this Document

This document describes the installation, commissioning and decommissioning of the product.






Illustrations in this document are reduced to the essential information and may deviate from the real product.

1.4 Levels of warning messages

The following levels of warning messages may occur when handling the product.

 DANGER
Indicates a hazardous situation which, if not avoided, will result in death or serious injury.
 WARNING
Indicates a hazardous situation which, if not avoided, could result in death or serious injury.
 CAUTION
Indicates a hazardous situation which, if not avoided, could result in minor or moderate injury.
NOTICE
Indicates a situation which, if not avoided, can result in property damage.

1.5 Symbols in the Document

Symbol	Explanation
	Information that is important for a specific topic or goal, but is not safety-relevant
	Indicates a requirement for meeting a specific goal
	Desired result
	A problem that might occur
	Example

1.6 Designation in the document

Complete designation	Designation in this document
SMA Rapid Shutdown Box	Rapid Shutdown Box
SMA Rapid Shutdown Controller	Rapid Shutdown Controller
SMA Rapid Shutdown System	Rapid Shutdown System, system, product

2 Safety

2.1 Intended Use

The Rapid Shutdown System consists of one or more Rapid Shutdown Boxes and one Rapid Shutdown Controller. PV systems equipped with the Rapid Shutdown System satisfy the requirements of UL 1741, Second Edition 2015 and Canadian Electrical Code 2015. The Rapid Shutdown Controller activates and deactivates the Rapid Shutdown System and signals the status of the Rapid Shutdown System via the green and red LEDs. The Rapid Shutdown Box electrically discharges the PV array conductors from the Rapid Shutdown Box to the inverter within ten seconds of activation of the emergency switch on the Rapid Shutdown Controller to ≤ 30 V. This is done by the disconnection of the PV array on the input side of the Rapid Shutdown Box while the stored leading energy of the inverters is discharged simultaneously. When the irradiation on the PV array is sufficient and the voltages have been electrically discharged in accordance with specification, the green LED on the Rapid Shutdown Controller glows green constantly. When none of the LEDs of the Rapid Shutdown Controllers are glowing after actuating the emergency switch, either the irradiation on the PV array is too low and, thus, the supply voltage of the Rapid Shutdown System insufficient or the installation of the Rapid Shutdown System is faulty or the Rapid Shutdown Box is defective.

A maximum of 16 Rapid Shutdown Boxes can be operated in a Rapid Shutdown System.

The product is certified for use with the following SMA inverters:

- SB 3000TL-US-22 / SB 3800TL-US-22 / SB 4000TL-US-22 / SB 5000TL-US-22 / SB 6000TL-US-22 / SB 7000TL-US-22 / SB 7700TL-US-22
- SB3.0-1SP-US-40 / SB3.8-1SP-US-40 / SB5.0-1SP-US-40 / SB6.0-1SP-US-40 / SB7.0-1SP-US-40 / SB7.7-1SP-US-40
- SB3.0-1TP-US-40 / SB3.8-1TP-US-40 / SB5.0-1TP-US-40 / SB6.0-1TP-US-40 / SB7.0-1TP-US-40 / SB7.7-1TP-US-40

Use of the product with inverters of manufacturers other than SMA is not permitted.

The product is suitable for indoor and outdoor use.

All components must remain within their permitted operating ranges and their installation requirements at all times.

The product is approved for the US and Canadian market.

Use this product only in accordance with the information provided in the enclosed documentation and with the locally applicable laws, regulations, standards and directives. Any other application may cause personal injury or property damage.

Alterations to the product, e.g. changes or modifications, are only permitted with the express written permission of SMA. Unauthorized alterations will void guarantee and warranty claims and in most cases terminate the operating license. SMA shall not be held liable for any damage caused by such changes.

Any use of the product other than that described in the Intended Use section does not qualify as the intended use.

The enclosed documentation is an integral part of this product. Keep the documentation in a convenient place for future reference and observe all instructions contained therein.

This document does not replace and is not intended to replace any local, state, provincial, federal or national laws, regulations or codes applicable to the installation, electrical safety and use of the product. SMA assumes no responsibility for the compliance or non-compliance with such laws or codes in connection with the installation of the product.

The type label must remain permanently attached to the product.

2.2 IMPORTANT SAFETY INSTRUCTIONS

SAVE THESE INSTRUCTIONS

This section contains safety information that must be observed at all times when working on or with the product.

The product has been designed and tested in accordance with international safety requirements. As with all electrical or electronical devices, there are residual risks despite careful construction. To prevent personal injury and property damage and to ensure long-term operation of the product, read this section carefully and observe all safety information at all times.

DANGER

Danger to life due to electric shock when live components or DC conductors are touched

When exposed to sunlight, the PV modules generate high DC voltage which is present in the DC conductors. Touching live DC conductors results in death or lethal injuries due to electric shock.

- Disconnect the system from voltage sources and make sure it cannot be reconnected before working on the device.
- Do not touch non-insulated parts or cables.
- Disconnect the DC connectors on the input strings.
- Wear suitable personal protective equipment for all work on the product.

DANGER

Danger to life due to electric shock when touching live system components in case of a ground fault

If a ground fault occurs, parts of the system may still be live. Touching live parts and cables results in death or lethal injuries due to electric shock.

- Disconnect the system from voltage sources and make sure it cannot be reconnected before working on the device.
- Once disconnected from voltage sources, wait five minutes before touching any parts of the PV system or the system.

3 Scope of Delivery

Check the scope of delivery for completeness and any externally visible damage. Contact your distributor if the scope of delivery is incomplete or damaged.

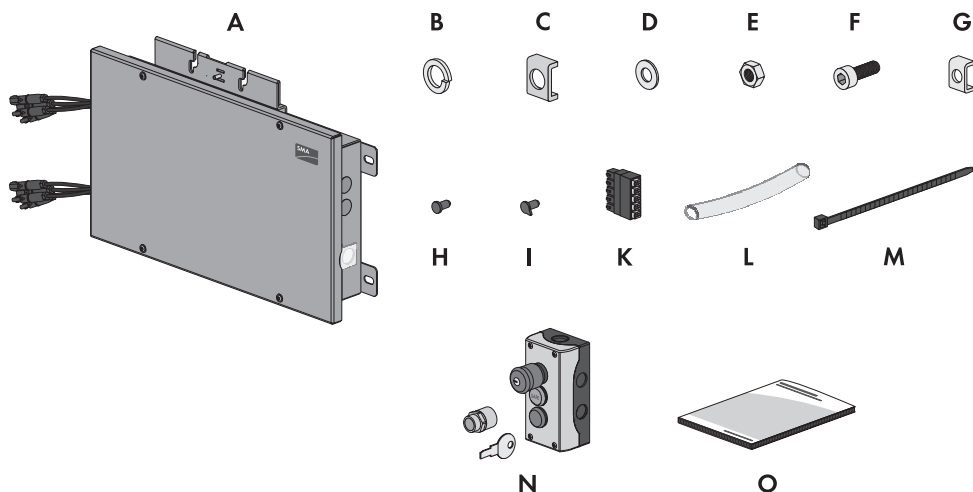


Figure 1 : Components included in the scope of delivery

Position	Quantity	Designation
A	1	Rapid Shutdown Box
B	3	Spring lock washer
C	2	Clamping bracket
D	3	Washer
E	1	Hex nut
F	2	Cylindrical screw
G	1	Clamping bracket
H	3	Sealing plug for positive MC4 connector
I	3	Sealing plug for negative MC4 connector
K	3	Five-pole plug
L	2	Silicone tube (500 mm (20 in))
M	1	Cable tie
N	1	Rapid Shutdown Controller, adapter and key*
O	1	Installation manual

* Delivered in separate packaging

4 Product Overview

4.1 Rapid Shutdown System

The Rapid Shutdown System consists of one or more Rapid Shutdown Boxes and one Rapid Shutdown Controller. PV systems equipped with the Rapid Shutdown System satisfy the requirements of UL 1741, Second Edition 2015 and Canadian Electrical Code 2015. The Rapid Shutdown Controller activates and deactivates the Rapid Shutdown System and signals the status of the Rapid Shutdown System via the green and red LEDs. The Rapid Shutdown Box electrically discharges the PV array conductors from the Rapid Shutdown Box to the inverter within ten seconds of activation of the emergency switch on the Rapid Shutdown Controller to ≤ 30 V. This is done by the disconnection of the PV array on the input side of the Rapid Shutdown Box while the stored leading energy of the inverters is discharged simultaneously. When the irradiation on the PV array is sufficient and the voltages have been electrically discharged in accordance with specification, the green LED on the Rapid Shutdown Controller glows green constantly. When none of the LEDs of the Rapid Shutdown Controllers are glowing after actuating the emergency switch, either the irradiation on the PV array is too low and, thus, the supply voltage of the Rapid Shutdown System insufficient or the installation of the Rapid Shutdown System is faulty or the Rapid Shutdown Box is defective.

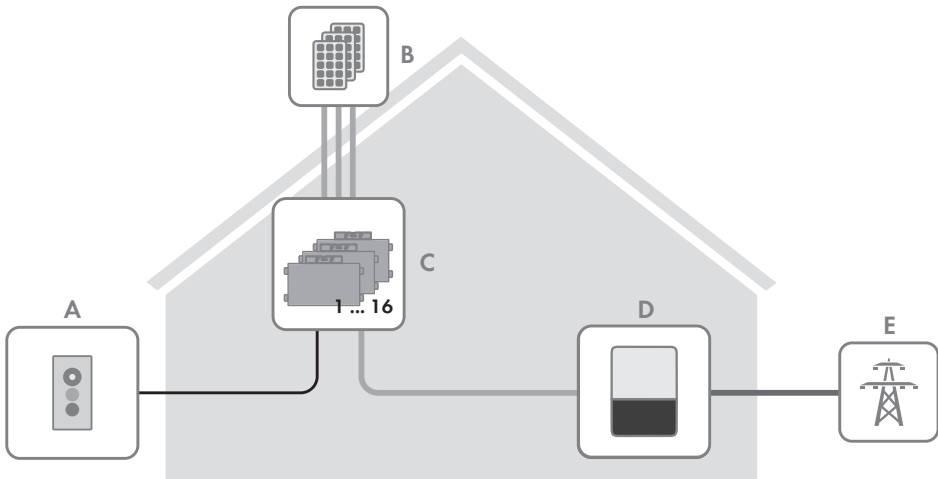


Figure 2 : Schematic diagram of a Rapid Shutdown system

Position	Designation
A	Rapid Shutdown Controller
B	PV modules
C	Rapid Shutdown Box
D	Inverter
E	Utility grid

Design of the Rapid Shutdown Box and Rapid Shutdown Controller

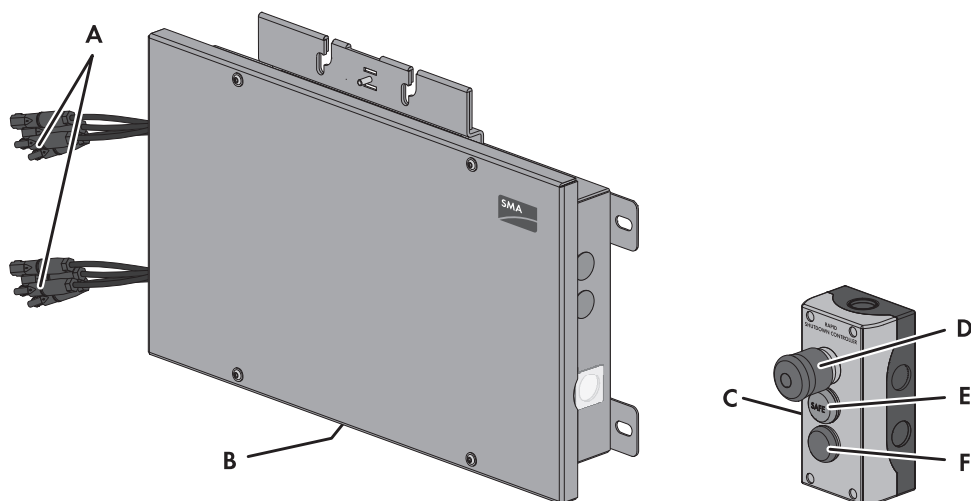


Figure 3 : Design of the Rapid Shutdown Box and Rapid Shutdown Controller

Position	Designation
A	DC connection for the input strings
B	Rapid Shutdown Box type label
C	Rapid Shutdown Controller type label
D	Rapid Shutdown Controller emergency switch
E	Rapid Shutdown Controller green LED
F	Rapid Shutdown Controller red LED

5 Mounting

5.1 Requirements for Mounting

Requirements for the mounting location:

WARNING

Danger to life due to fire or explosion

Despite careful construction, electrical devices can cause fires.

- Do not mount the Rapid Shutdown Box or Rapid Shutdown Controller in areas containing highly flammable materials or gases.
- Do not mount the Rapid Shutdown Box or Rapid Shutdown Controller in areas exposed to explosion hazards.

- ☐ The Rapid Shutdown Controller must be mounted in such a way that it is visible and freely accessible to first responders.
- ☐ The mounting location of the Rapid Shutdown Controller must be suitable for the weight and dimensions of the Rapid Shutdown Controller.
- ☐ The Rapid Shutdown Box can be mounted on the mounting system of the PV array, directly on the roof or on a wall. Here, there must be a distance of at least 13 mm (0.5 in) between the Rapid Shutdown Box and the module backsheet and the permissible cable length between the PV array and the Rapid Shutdown Box must be observed.
- ☐ The mounting location of the Rapid Shutdown Box must be suitable for the weight and dimensions of the Rapid Shutdown Box (see Section 11 "Technical Data", page 39).
- ☐ The specified ambient conditions at the mounting location of the Rapid Shutdown Box and Rapid Shutdown Controller must be observed (see Section 11 "Technical Data", page 39).

Permissible cable lengths:

- ☐ The maximum cable length of 50 m (164 ft) from the Rapid Shutdown Box to the Rapid Shutdown Controller must be observed.
- ☐ The maximum cable length of 100 m (328 ft) from the first Rapid Shutdown Box to the last Rapid Shutdown Box in the system must be observed.
- ☐ Observe the maximum cable length between the PV array and Rapid Shutdown Box as specified in the *National Electrical Code*® ANSI/NFPA 70 or the *Canadian Electrical Code*® CSA C22.1.

Dimensions for mounting the Rapid Shutdown Box:

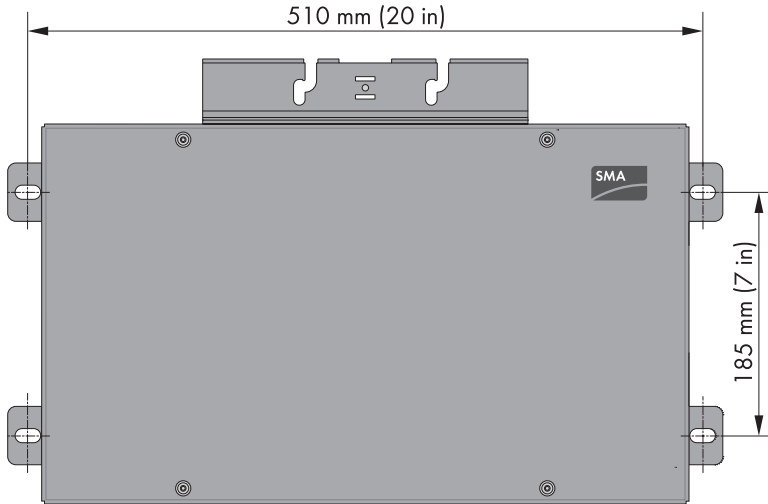


Figure 4 : Position of the anchoring points of the Rapid Shutdown Box

Permitted and prohibited mounting positions:

- The Rapid Shutdown Box and Rapid Shutdown Controller may only be mounted in a permissible position. This ensures that moisture can not penetrate the Rapid Shutdown Box or Rapid Shutdown Controller.

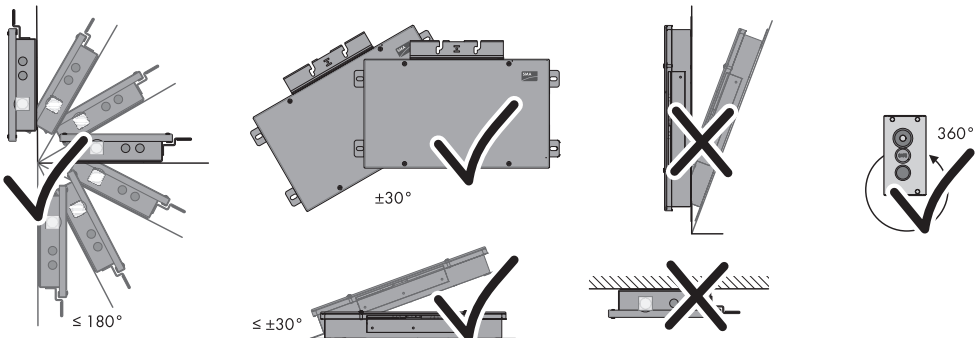


Figure 5 : Permitted and prohibited mounting positions

5.2 Mounting the Rapid Shutdown Box on a Mounting System

There are several ways of attaching the Rapid Shutdown Box to the mounting system of the PV array. In the following example, mounting with T-head bolts is described.

⚠ WARNING**Risk of falling when working on the roof**

There is a risk of falling or slipping when working on the rooftop. Observe the applicable accident prevention regulations for work on rooftops.

- Before stepping on the rooftop, ensure the load bearing capacity of all parts subjected to load.
- In accordance with the accident prevention regulations, a safety harness must be worn or a safety scaffold must be used.
- Use fall protection.

NOTICE**Damage to the PV module due to screws being too long**

The length of the screws must be suitable for the distance between the Rapid Shutdown Box and the underside of the PV module.

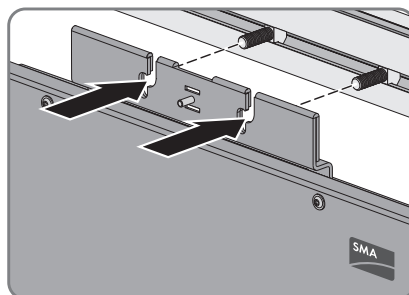
- Make sure that the PV module will not be damaged by the screws being used.

Additionally required mounting material (not included in the scope of delivery):

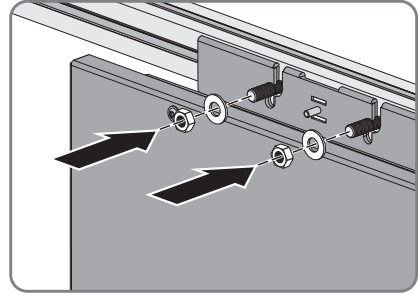
- ☐ The required fastening material must be selected according to the mounting system used.
- ☐ The mounting material must be made of stainless steel.
- ☐ Diameter of the screws: maximum 8 mm (0.3 in)

Procedure:

1. Insert the T-head bolts into the mounting system and turn by 90°. This will firmly anchor the screws in the rack rail.
2. Place the Rapid Shutdown Box onto the anchored screws. Here, insert the screws into the oblong holes up to the desired fastening point.



3. Attach the Rapid Shutdown Box using suitable washers and nuts.



4. Ensure that the Rapid Shutdown Box is securely attached.

5.3 Mounting the Rapid Shutdown Box with Mounting Brackets

If you would like to mount the Rapid Shutdown Box on the wall or directly on the roof, proceed as described in the following.

Additionally required mounting material (not included in the scope of delivery):

- ☐ The mounting material must be made of stainless steel.
- ☐ 4 screws suitable for the support surface (diameter: 8 mm (0.3 in))
- ☐ 4 washers suitable for the screws (outer diameter: 16 mm (0.6 in))
- ☐ Where necessary, 4 screw anchors suitable for the support surface and the screws

Procedure:

1.

⚠ CAUTION

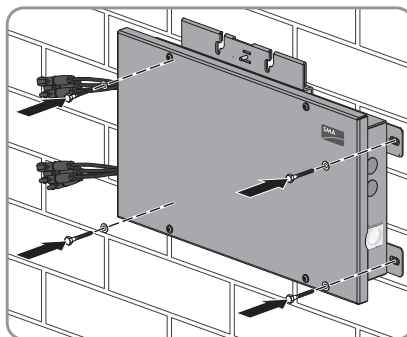
Risk of injury due to damaged cables

There may be power cables or other supply lines (e.g. gas or water) routed in the wall.

- Ensure that no lines are laid in the wall which could be damaged when drilling holes.

2. Align the Rapid Shutdown Box horizontally and mark the positions of the drill holes through the mounting brackets.
3. Place the Rapid Shutdown Box to one side and drill the drill holes at the positions marked.
4. Insert screw anchors into the drill holes if the support surface requires them.

5. Align the Rapid Shutdown box over the drill holes and attach it using suitable screws and washers.



5.4 Mounting the Rapid Shutdown Controller

Additionally required mounting material (not included in the scope of delivery):

- ☐ 4 screws suitable for the support surface (diameter: 4 mm (0.16 in))
- ☐ Where necessary, 4 screw anchors suitable for the support surface and the screws

Procedure:

1.

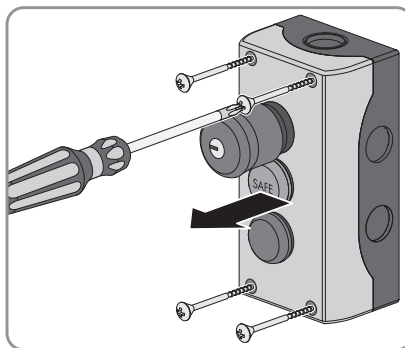
⚠ CAUTION

Risk of injury due to damaged cables

There may be power cables or other supply lines (e.g. gas or water) routed in the wall.

- Ensure that no lines are laid in the wall which could be damaged when drilling holes.

2. Unscrew the 4 screws in the upper enclosure part of the Rapid Shutdown Controller using a cross-head screwdriver (PZ 2), remove the upper enclosure part and place to one side.



3. Mark the positions of the drill holes using the 4 screw holes in the lower enclosure part of the Rapid Shutdown Controller as a guide (see the rear side of the Rapid Shutdown Controller for hole distances).
4. Place the Rapid Shutdown Controller to one side and drill the drill holes at the positions marked.
5. Insert screw anchors into the drill holes if the support surface requires them.
6. Screw the lower enclosure part of the Rapid Shutdown Controller to the wall using the screws.

6 Electrical Connection

6.1 Safety during Electrical Connection

NOTICE

Damage to the Rapid Shutdown Box from moisture and dust ingress.

Dust and moisture ingress can damage the Rapid Shutdown Box and impair its functionality.

- Do not open the Rapid Shutdown Box during rain, snow or high levels of humidity (> 95%).
- Only use listed rain-tight or liquid-tight conduit fittings to attach the conduits to the enclosure. SMA recommends using conduit fittings with flat, pliable, thick rubber sealing gaskets. The sealings should be roughly 2.54 mm (0.1 in / $\frac{7}{64}$ in) in thickness. SMA recommends against using thinner, harder sealings (typically yellow or green colored). These sealing types may not make reliable seals for this application. These sealings are approximately 1.9 mm (0.075 in / $\frac{5}{64}$ in) thick or less. Do not remove or attempt to alter the rubber plugs in any way.
- SMA recommends against and does not accept using conduit fittings with round cross section and o-ring type sealings as these types of seals are not reliable for this application.
- Seal all unused openings tightly.

i Electrical installations

All electrical installations must be carried out in accordance with the local standards and the *National Electrical Code*® ANSI/NFPA 70 or the *Canadian Electrical Code*® CSA C22.1.

- The electrical connection of the Rapid Shutdown System may only be made by qualified persons with appropriate skills.
- Ensure that no cables used for electrical connection are damaged.

i The Rapid Shutdown function is only available if strings are correctly connected at the inverter.

The Rapid Shutdown Box controls only strings which are connected to a Rapid Shutdown Box. The Rapid Shutdown function is not available if the strings from a Rapid Shutdown Box are connected in parallel with any string not connected to a Rapid Shutdown Box.

- Do not connect any output strings of various Rapid Shutdown Boxes in parallel to a single input of an inverter or to another parallel connection point.
- The output strings of the Rapid Shutdown Box must not be connected in parallel.
- Always connect the output strings of the Rapid Shutdown Box to the same inverter. The output strings must not be connected to various inverters.

6.2 Overview of the Rapid Shutdown Box Connection Area

6.2.1 Exterior View

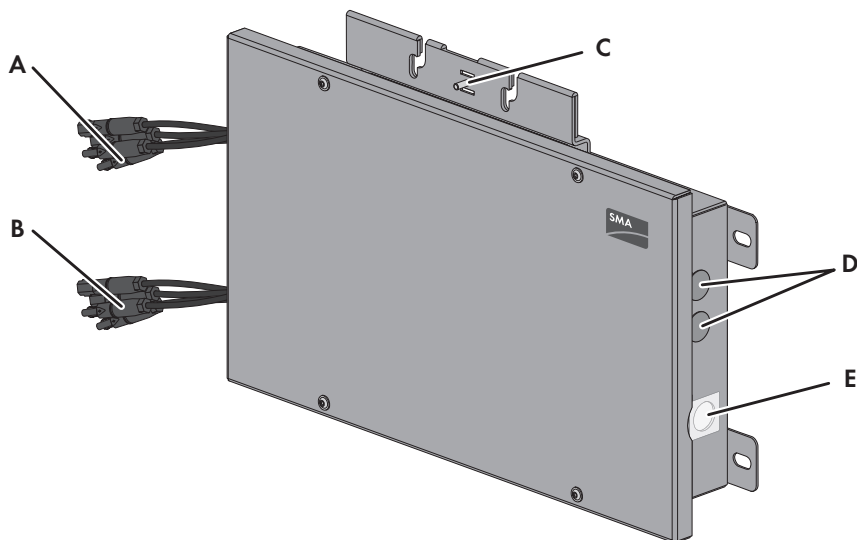


Figure 6 : Exterior view of the Rapid Shutdown Box

Position	Designation
A	DC connection for the input strings 1 and 2, channel A
B	DC connection for the input strings 3 and 4, channel B
C	Connection point for the equipment grounding conductor
D	Enclosure opening for the Rapid Shutdown Controller conductors and where necessary for the conductors of an additional Rapid Shutdown Box (for conduits of trade size 16 mm (0.5 in))
E	Enclosure opening for maximum 2 output strings* and where necessary for the conductors of the Rapid Shutdown Controller (for conduits of the trade size 21 mm (0.75 in))

* The input strings 1 and 2 (channel A) as well as 3 and 4 (channel B) are connected in parallel inside the Rapid Shutdown Box.

6.2.2 Interior View

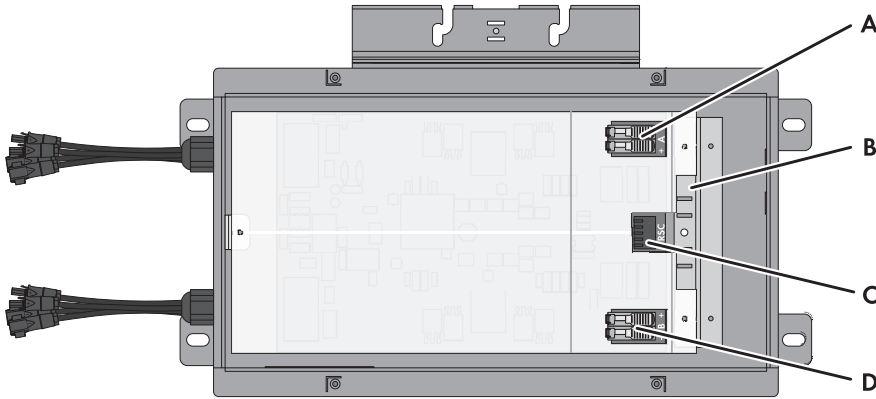


Figure 7 : Connection area inside the Rapid Shutdown Box

Position	Designation
A	Terminal block for the connection of the first output string, channel A
B	Equipment Ground Bar
C	Terminal block for the connection of the Rapid Shutdown Controller and/or for the connection of an additional Rapid Shutdown Box
D	Terminal block for the connection of the second output string, channel B

i Note when only installing one output string

If only installing one output string to the Rapid Shutdown Box, ensure you connect it to channel A, otherwise the Rapid Shutdown System will not be powered and not function properly.

6.3 Connecting the Equipment Grounding Conductor to the Rapid Shutdown Box

Each Rapid Shutdown Box can be grounded separately or several Rapid Shutdown Boxes can be connected to one equipment grounding conductor. The required material for the connection of the equipment grounding conductor are included in the scope of delivery.

Additionally required material (not included in the scope of delivery):

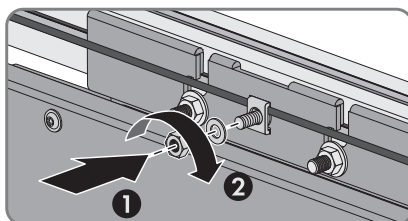
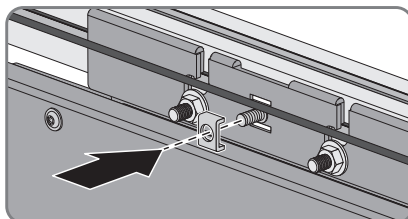
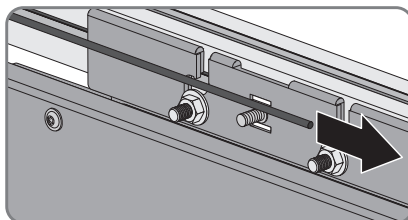
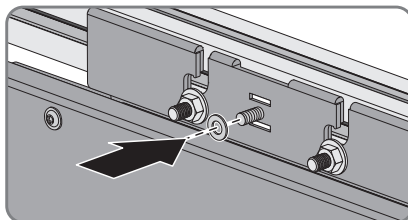
- ☐ Equipment grounding conductor

Equipment grounding conductor requirements:

- ☐ Conductor type: copper wire
- ☐ The conductor must be of solid wire.
- ☐ Conductor cross-section: 4 mm² to 16 mm² (12 AWG to 6 AWG)

Procedure:

1. Place a washer onto the thread.
2. Position the equipment grounding conductor horizontally below or above the thread.
3. Place the clamping bracket onto the thread and over the equipment grounding conductor.
4. Place a spring lock washer and a hex nut onto the thread and tighten the hex nut (torque: 3.5 Nm (31 in-lb)).

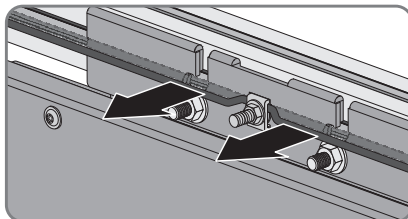


5.

NOTICE**Prevention of contact corrosion by bending the equipment grounding conductor**

The equipment grounding conductor should not be in contact with the Rapid Shutdown Box enclosure. Contact may result in corrosion at the contact surface. Contact between fastening screws and nuts is permitted.

- Bend the equipment grounding conductor in such a way that it is not in contact with the Rapid Shutdown Box enclosure.



6.4 Connecting the Rapid Shutdown Box and Rapid Shutdown Controller Together

Additionally required material (not included in the scope of delivery):

- ☐ Conduit: either a separate conduit (trade size: 16 mm (0.5 in) or smaller with suitable reducer bush) or use the conduit of the output strings to lay the conductors.
- ☐ If the conductors for the connection of the Rapid Shutdown Controller are to be laid in a separate conduit: raintight or liquidtight conduit fitting (trade size: 16 mm (0.5 in) or smaller with suitable reducer bush).
- ☐ When laying a tray cable for exposed run (TC-ER): use cable gland which is suitable for the cable and the enclosure opening.

Requirements on the conductors:

- ☐ When laying in outdoor areas without conduit, a tray cable for exposed run (TC-ER) must be used.
- ☐ Conductor type: copper wire
- ☐ Number of conductors: 5
- ☐ If the conductors for the connection of the Rapid Shutdown Controller are laid in one conduit together with the output strings, the conductors for the connection of the Rapid Shutdown Controller must be insulated for the maximum PV system voltage.
- ☐ The conductors must be made of solid wire, stranded wire or fine stranded wire. When using fine stranded wire, bootlace ferrules must be used.
- ☐ Conductor cross section: 0.75 mm² to 1.5 mm² (18 AWG to 16 AWG)
- ☐ Maximum length of the conductors from the Rapid Shutdown Box to the Rapid Shutdown Controller: 50 m (164 ft)

Complying with the requirements for class 2 circuits

The circuit of the Rapid Shutdown Controller meets all requirements for class 2 circuits. The maximum open-circuit voltage is 20 V and maximum short-circuit current is 400 mA.

Information on laying tray cables for exposed run (TC-ER)

The procedure for using conduits is described in this section. Instead of conduits, you can also use tray cables for exposed run (TC-ER).

- When using tray cables for exposed run (TC-ER), select suitable cable glands and attach to the enclosure opening instead of the conduit. When doing so, ensure that the enclosure opening is sealed and no moisture can enter.

Requirement:

- All electrical installations must be carried out in accordance with the locally applicable electrical standards and the *National Electrical Code*® ANSI/NFPA 70 or the *Canadian Electrical Code*® CSA C22.1.

Procedure:

If several Rapid Shutdown Boxes are present in your Rapid Shutdown System, connect the first Rapid Shutdown Box to the Rapid Shutdown Controller first. To do so, first connect one end of the conductors to the Rapid Shutdown Box and then connect the other end of the conductors to the Rapid Shutdown Controller.

- Connect the conductors to the Rapid Shutdown Box.
- Connect the conductors to the Rapid Shutdown Controller.

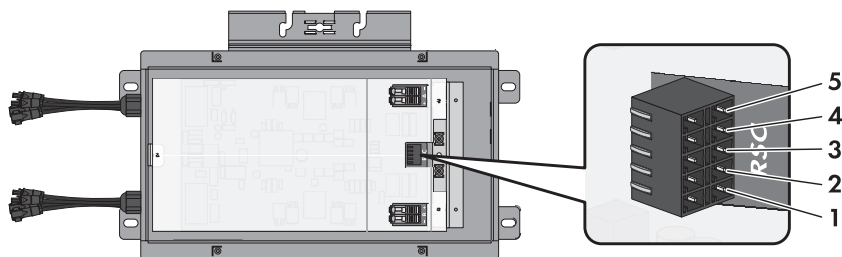
Connecting the conductors to the Rapid Shutdown Box

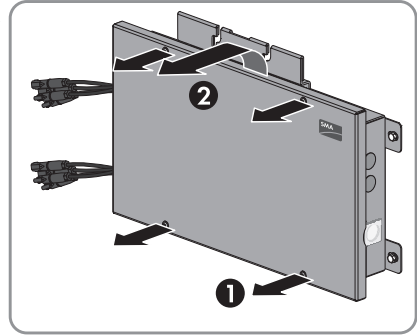
Figure 8 : Pin assignment of the lower pin row on the terminal block **RSC** in the Rapid Shutdown Box

Pin	Assignment
1	Supply voltage (+12 V)*
2	Rapid Shutdown Controller switch
3	Ground (0 V)
4	Rapid Shutdown Controller green LED
5	Rapid Shutdown Controller red LED

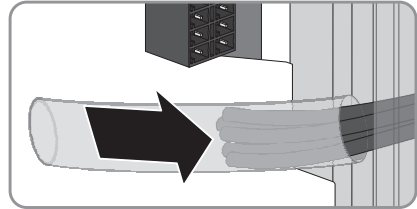
* The open-circuit voltage may be up to 20 V. The maximum short-circuit current is 400 mA.

Procedure:

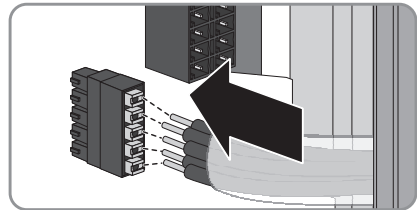
1. Unscrew the four screws of the Rapid Shutdown Box enclosure lid using a hex socket screwdriver (TX25) and remove the enclosure lid.



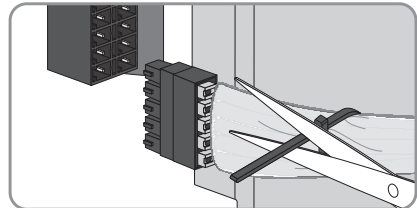
2. If the Rapid Shutdown Controller conductors are led into a separate conduit, remove the sealing plug from one of the two enclosure openings with sealing plugs.
3. If the Rapid Shutdown Controller conductors are laid in the same conduit as the output strings, pull off the adhesive tape on the enclosure opening.
4. Insert the conduit fitting into the opening on the Rapid Shutdown Box and tighten from the inside using the counter nut.
5. Attach the conduit at the conduit fitting in the Rapid Shutdown Box enclosure.
6. Lead the conductors up to the terminal block **RSC** in the Rapid Shutdown Box.
7. Lead a silicone tube over the conductors inside the Rapid Shutdown Box.



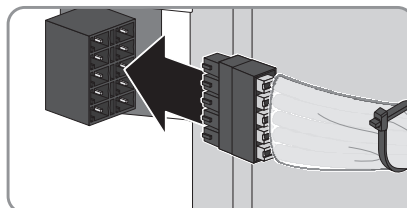
8. Strip off the conductor insulation by 8 mm (0.31 in).
9. In the case of fine stranded wire, provide each conductor with a bootlace ferrule.
10. Connect the conductors to a five-pole plug. Observe the pin assignment.



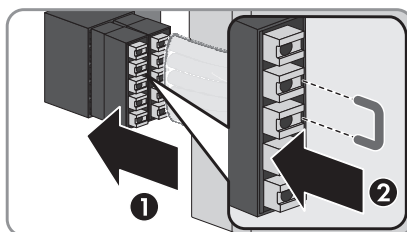
11. Place the cable tie onto the silicone tube, tighten and cut off the projecting end of the cable tie. This connects the conductors and the silicone tube together securely.



12. Plug the five-pole plug with the connected conductors into the lower pin row of the terminal block **RSC**.



13. If there is only one Rapid Shutdown Box in the system, plug the second five-pole plug into the upper row of the terminal block **RSC** and place a jumper wire between pins 3 and 4. Here, use a jumper wire that is rated for the maximum system voltages or insulate the jumper wire using a piece of one of the supplied silicone tubes.



Connecting the conductors to the Rapid Shutdown Controller

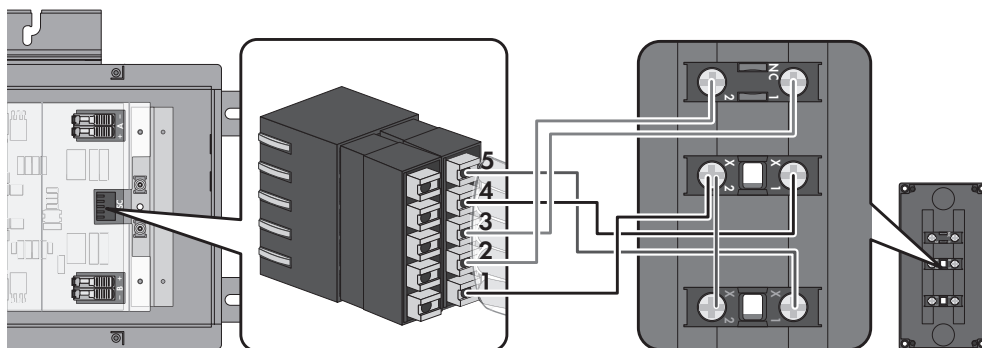


Figure 9 : Overview of the terminal blocks in the Rapid Shutdown Controller

Pin of the terminal block in the Rapid Shutdown Box	Terminal in the Rapid Shutdown Controller	Assignment
1	X2	Supply voltage (+12 V)*
2	2	Rapid Shutdown Controller switch
3	NC 1	Ground (0 V)
4	X1	Rapid Shutdown Controller green LED
5	X1	Rapid Shutdown Controller red LED

* You can select on which terminal the connection is to be made, because a bridge must be placed between the connections later.

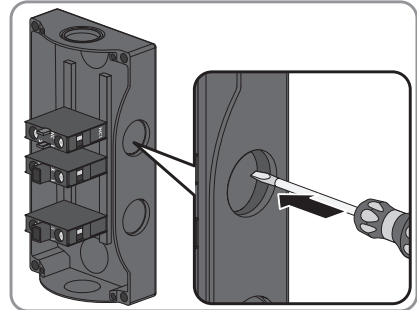
i Information on laying tray cables for exposed run (TC-ER)

The procedure for using conduits is described in this section. Instead of conduits, you can also use tray cables for exposed run (TC-ER).

- When using tray cables for exposed run (TC-ER), select suitable cable glands and attach to the enclosure opening instead of the conduit. When doing so, ensure that the enclosure opening is sealed and no moisture can enter.

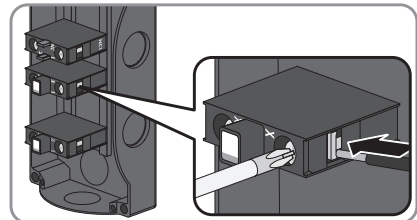
Procedure:

1. Break out the desired knockout on the Rapid Shutdown Controller using a hammer and a screwdriver. When doing so, note that when using the knockouts above and below in the lower enclosure part, that the supplied adapter must be used for conduits of the trade size 16 mm (0.5 in).



2. Where necessary, insert the supplied adapter in the position knocked out on the Rapid Shutdown Controller and tighten from the inside using the counter nut.
3. Attach the conduit to the conduit fitting or onto the adapter in the Rapid Shutdown Controller enclosure.
4. Lead the conductors up to the terminal blocks in the Rapid Shutdown Controller.
5. Strip off the conductor insulation by 8 mm (0.31 in).
6. In the case of fine stranded wire, provide each conductor with a bootlace ferrule.

7. Connect the conductors to the terminal blocks in accordance with the assignment. To do so, insert each conductor into the corresponding terminal and tighten the screw on the terminal using a cross-head screwdriver (PZ2).



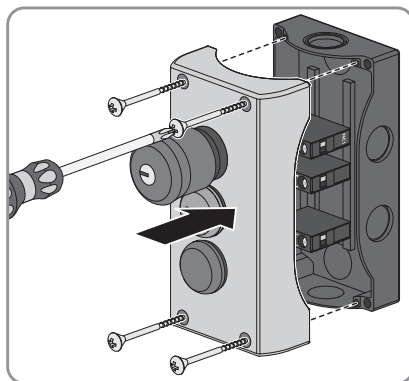
8. Place a jumper wire between the terminal **X2** of the green LED and terminal **X2** of the red LED.
9. Ensure that all terminals are allocated to the correct conductors.
10. Ensure that the conductors are plugged completely into the terminals up to their insulation. Tip: To release the conductors from the terminals, the terminals must be opened. To do so, loosen the screw on the terminal using a cross-head screwdriver (PZ2).

11.

NOTICE**Damage to the Rapid Shutdown Controller due to moisture penetration**

Moisture ingress can damage the Rapid Shutdown Controller and impair its functionality.

- Place the upper enclosure part onto the lower enclosure part and tighten the four screws using a cross-head screwdriver (PZ2) (torque: 1.8 Nm (16 in-lb).



- Ensure that the screws with a torque of 1.8 Nm (16 in-lb) are tightened.

6.5 Connecting Rapid Shutdown Boxes Together

If several Rapid Shutdown Boxes are present in your Rapid Shutdown System, the Rapid Shutdown Boxes must be connected together as described in the following. You can connect a maximum of 16 Rapid Shutdown Boxes together.

Additionally required material (not included in the scope of delivery):

- ☐ Conduit (trade size: 16 mm (0.5 in) or smaller with suitable reducer bush)
- ☐ Raintight or liquidtight conduit fitting (trade size: 16 mm (0.5 in) or smaller with suitable reducer bush)
- ☐ When laying a tray cable for exposed run (TC-ER): cable gland suitable for the cable and the enclosure opening.

Requirements for the conductors:

- ☐ When laying in outdoor areas without conduit, a tray cable for exposed run (TC-ER) must be used.
- ☐ Conductor type: copper wire
- ☐ Number of conductors: 5
- ☐ The conductors must be made of solid wire, stranded wire or fine stranded wire. When using fine stranded wire, bootlace ferrules must be used.
- ☐ Conductor cross section: 0.75 mm² to 1.5 mm² (18 AWG to 16 AWG)
- ☐ Maximum length of the conductors between two Rapid Shutdown Boxes: 50 m (164 ft)
- ☐ Maximum length of the conductors from the first Rapid Shutdown Box to the last Rapid Shutdown Box: 100 m (328 ft)

i Information on laying tray cables for exposed run (TC-ER)

The procedure for using conduits is described in this section. Instead of conduits, you can also use tray cables for exposed run (TC-ER).

- When using tray cables for exposed run (TC-ER), select suitable cable glands and attach to the enclosure opening instead of the conduit. When doing so, ensure that the enclosure opening is sealed and no moisture can enter.

Requirement:

- ☐ All electrical installations must be carried out in accordance with the locally applicable electrical standards and the *National Electrical Code*® ANSI/NFPA 70 or the *Canadian Electrical Code*® CSA C22.1.

Pin assignment:

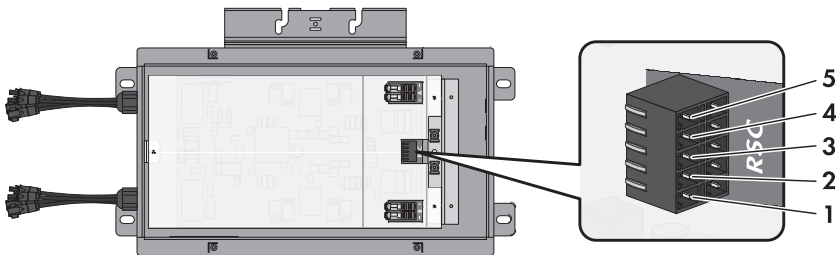


Figure 10 : Pin assignment of the upper pin row on the terminal block **RSC** in the Rapid Shutdown Box

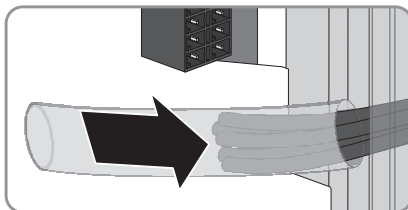
Pin	Assignment
1	Supply voltage (+12 V)*
2	Rapid Shutdown Controller switch
3	Ground (0 V)
4	Rapid Shutdown Controller green LED
5	Rapid Shutdown Controller red LED

* The open-circuit voltage may be up to 20°V.

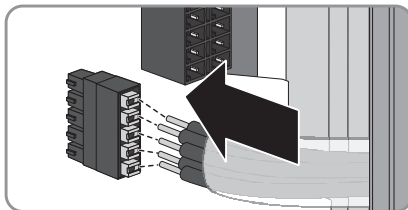
Procedure:

1. Remove the sealing plug from one of the enclosure openings with sealing plugs.
2. Insert the conduit fitting into the opening of each Rapid Shutdown Box and tighten from the inside using the counter nut.
3. Attach the conduit at the conduit fitting in each Rapid Shutdown Box enclosure.
4. Lead the conductors up to the terminal block **RSC** in the first Rapid Shutdown Box.

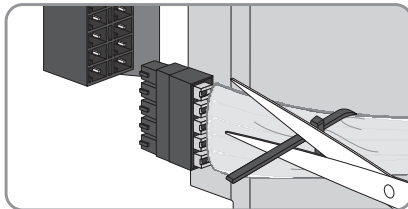
5. Lead a silicone tube over the conductors inside the Rapid Shutdown Box.



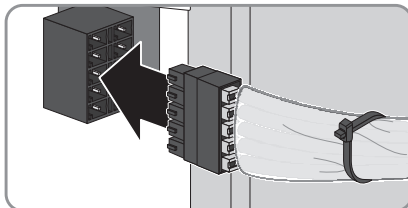
6. Strip off the conductor insulation by 8 mm (0.31 in).
7. In the case of fine stranded wire, provide each conductor with a bootlace ferrule.
8. Connect the conductors to a five-pole plug. Observe the pin assignment.



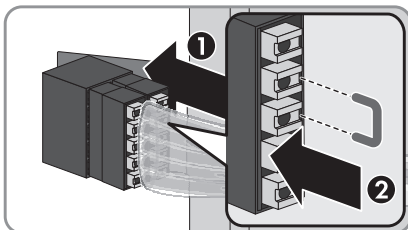
9. Place the cable tie onto the silicone tube, tighten and cut off the projecting end of the cable tie. This connects the conductors and the silicone tube together securely.



10. Plug the five-pole plug with the connected conductors into the upper pin row of the terminal block **RSC**.



11. Connect the Rapid Shutdown Boxes together. To do so, connect the incoming conductors to a plug and plug this into the lower pin row of the connecting terminal block **RSC**, and always connect the outgoing conductors to a plug and plug this into the upper pin row of the terminal block **RSC**.
12. In the last Rapid Shutdown Box, plug the second five-pole plug into the lower pin row of the terminal block **RSC** and place a jumper wire between pins 3 and 4. Here, use a jumper wire that is rated for the maximum system voltages or insulate the jumper wire using a piece of one of the supplied silicone tubes.



6.6 Connecting the Strings to Rapid Shutdown Box

Up to four input strings and two output strings can be connected to the Rapid Shutdown Box. In the Rapid Shutdown Box, two of the four input strings are connected in parallel. The input strings must be connected to the DC conductors fitted with MC4 connectors that lead from the Rapid Shutdown Box. The output strings must be connected to the corresponding terminal blocks inside the Rapid Shutdown Box.

i Faulty operation of the inverter due to incorrect connection of the output strings to the Rapid Shutdown Box

The output strings must lead to the same inverter if two output strings are connected to the Rapid Shutdown Box. The operation of at least one inverter is interrupted if the two output strings are connected to different inverters.

- Connect only output strings to the terminal block **A** and **B** which are leading to the same inverter.

i Note when only installing one output string

If only installing one output string to the Rapid Shutdown Box, ensure you connect it to channel A, otherwise the Rapid Shutdown System will not be powered and not function properly.

Procedure:

- Connect the output strings.
- Connect the input strings.

Connecting the Output Strings

Additionally required material:

- ☐ Conduit (trade size: 21 mm (0.75 in) or smaller with suitable reducer bush)
- ☐ Raintight or liquidtight conduit fitting (trade size: 21 mm (0.75 in) or smaller with suitable reducer bush)

Requirements on the conductors:

- ☐ Conductor type: copper wire
- ☐ The conductors must be made of solid wire, stranded wire or fine stranded wire. When using fine stranded wire, bootlace ferrules must be used.
- ☐ Conductor cross-section: 4 mm² to 10 mm² (12 AWG to 6 AWG)
- ☐ The maximum permitted temperature for the terminal blocks for the connection of the output strings of +90°C (+194°F) must be observed.
- ☐ The conductors with regards to its ampacity, rated temperatures, operating conditions and its power loss must be made in accordance with the local standards and the *National Electrical Code*® ANSI/NFPA 70 or the *Canadian Electrical Code*® CSA C22.1.

Procedure:

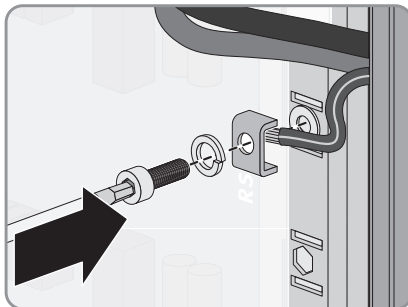
1.

⚠ DANGER**Danger to life due to high voltages of the PV array**

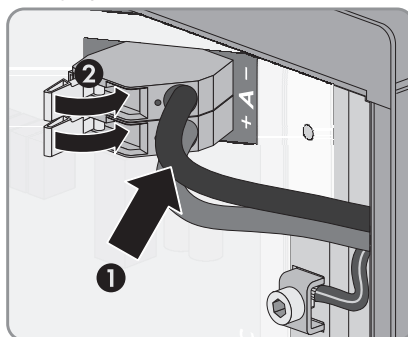
When exposed to sunlight, the PV array generates dangerous DC voltage which is present in the DC conductors. Touching live DC conductors leads to lethal electric shocks.

- Switch off the DC load-break switch on the inverter.
- Only touch the DC conductors on their insulation.

2. Pull off the adhesive tape on the enclosure opening.
3. Attach the conduit at the conduit fitting in the Rapid Shutdown Box enclosure.
4. Lead the positive and negative conductors of the first output string up to the terminal block **A**.
5. Lead the positive and negative conductors of the second output string up to the terminal block **B**.
6. Lead the existing equipment grounding conductors of the output strings to the equipment ground bar and connect them:
 - Strip the insulation of the equipment grounding conductor by 12 mm (0.5 in).



- Thread the cylinder-head screw through the spring lock washer, the clamping bracket and the washer.
 - Lead the equipment grounding conductor between the washer and the clamping bracket and tighten the cylinder-head screw using a hex socket screwdriver (TX25) (torque: 6 Nm \pm 0.6 Nm (53 in-lb \pm 5 in-lb)).
7. Strip the insulation from the conductors of each output string by 12 mm (0.5 in).
 8. Connect the conductors of the first output string to the terminal block **A**. To do so, push the locking levers upwards to the stop and insert the conductors into the terminals. When doing so, ensure that the positive terminal and negative terminal have the correct polarity at the inverter.



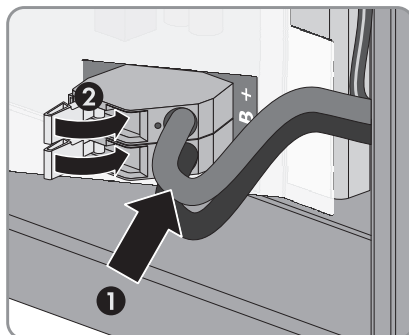
9.

⚠ CAUTION**Danger of pinching fingers when the terminal block locking levers snap shut**

The locking levers close by snapping down fast and hard.

- Press the locking levers of the terminal block **A** down with your thumb only. When doing so, ensure that your fingers can not be pinched when the locking levers snap into place.

10. Connect the conductors of the second output strings to the terminal block **B**. To do so, push the locking levers upwards to the stop and insert the conductors into the terminals. When doing so, ensure that the positive terminal and negative terminal have the correct polarity at the inverter.



11.

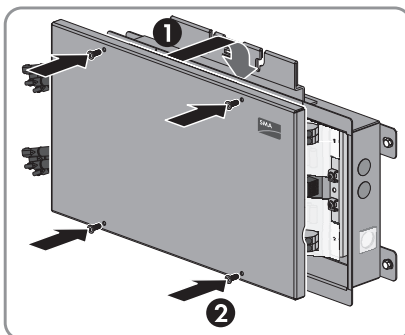
⚠ CAUTION**Danger of pinching fingers when the terminal block locking levers snap shut**

The locking levers close by snapping down fast and hard.

- Press the locking levers of the terminal block **B** down with your thumb only. When doing so, ensure that your fingers can not be pinched when the locking levers snap into place.

12. Ensure that all terminals are allocated to the correct conductors.

13. Hang the enclosure lid in the bracket of the upper enclosure edge and tighten the four screws using a hex socket screwdriver (TX25) (torque: 6 Nm \pm 0.6 Nm (53 in-lb \pm 5 in-lb)).



Connecting the Input Strings

Requirements:

- ☐ The two PV strings of each separate input are connected in parallel inside the Rapid Shutdown Box. For the parallel connection of the input strings, a correct dimensioning of the strings must be used.
- ☐ The maximum permitted system voltages of the Rapid Shutdown System may not be exceeded (see Section 11 "Technical Data", page 39).
- ☐ Each positive DC conductor of a string must be equipped with a male MC4 connector (refer to the connector manual for information on equipping).
- ☐ Each negative DC conductor of a string must be equipped with a female MC4 connector (refer to the connector manual for information on equipping).

Procedure:

1.

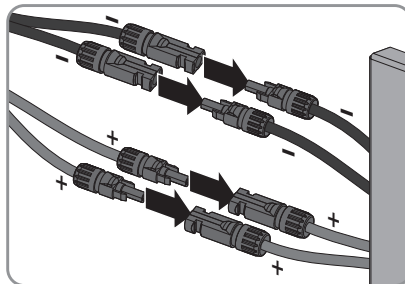
⚠ DANGER

Danger to life due to high voltages

When exposed to sunlight, the PV array generates dangerous DC voltage which is present in the DC conductors. Touching the DC conductors can lead to lethal electric shocks.

- Ensure that no voltage is present on the input strings.
- Ensure that the Rapid Shutdown Box is closed.

2. Connect the input strings to the MC4 connectors that lead from the Rapid Shutdown Box. When doing so, ensure that the the conductors are not connected to the incorrect polarity. The negative DC conductors to be connected must be equipped with female MC4 connectors and the positive DC conductors with male MC4 connectors.



- ☒ The connectors snap audibly into place.

3.

NOTICE

Damage to the MC4 connectors due to moisture ingress.

The MC4 connectors are only sealed if all MC4 connectors leading from the Rapid Shutdown Box that are not required are sealed using the supplied sealing plugs.

- Plug the supplied sealing plugs into the MC4 connectors that are not required.

7 Commissioning the Rapid Shutdown System

1. Commission all inverters in the system (see inverter manual).
2. Check whether the inverter to which the strings of the Rapid Shutdown Box are connected starts feed-in operation.

If the inverters display no errors and start feed-in operation, the Rapid Shutdown System is connected correctly and automatically commissioned.

If the inverters do not start feed-in operation despite sufficient irradiation and display an error, it is likely that an installation error is present. Ensure that the Rapid Shutdown System is installed correctly.

3. If the Rapid Shutdown System has been commissioned, check the function of the Rapid Shutdown System (see Section 8, page 34).

8 Checking the Function of the Rapid Shutdown System

The Rapid Shutdown System is supplied via the PV array. If there is insufficient irradiation on the PV array, the supply voltage of the Rapid Shutdown System is too low and the function of the Rapid Shutdown System is not able to be checked.

Requirements:

- The Rapid Shutdown System must be commissioned.
- Wait a minimum of 60 seconds from powering on the system before testing the Rapid Shutdown System functionality.
- There must be sufficient irradiation on the PV array.

Procedure:

1. Press the emergency switch on the Rapid Shutdown Controller. This starts the automatic self-test of the Rapid Shutdown Box and activates the Rapid Shutdown System.
 - ☑ The red LED on the Rapid Shutdown Controller lights briefly or flashes. The Rapid Shutdown Box reduces the voltage on the output string side. As soon as the voltage is within the permitted range, the green LED on the Rapid Shutdown Controller glows constantly.
 - ☑ The green LED on the Rapid Shutdown Controller glows constantly. The Rapid Shutdown System is active and the voltages on the output string side of the Rapid Shutdown Box are ≤ 30 V.
 - ✗ None of the LEDs on the Rapid Shutdown Controller are glowing?
 Several causes are possible: Either the irradiation on the PV array is too low and, thus, the supply voltage of the Rapid Shutdown System insufficient or the installation of the Rapid Shutdown System is faulty or the Rapid Shutdown Box is defective.
 - Make sure that the supply voltage of the Rapid Shutdown System is sufficient.
 - Ensure that the Rapid Shutdown System is installed correctly.
 - When the Rapid Shutdown System has enough supply voltage and is installed correctly and still none of the LEDs are glowing, the Rapid Shutdown Box is faulty and must be replaced. Contact the Service (see Section 12, page 41).
 - ✗ The red LED on the Rapid Shutdown Controller glows constantly?
 The Rapid Shutdown Box is defective and the Rapid Shutdown System is not active.
 - Contact the Service (see Section 12, page 41).
2. Reset the Rapid Shutdown function (see Section 9.2, page 35).

9 Operating the Rapid Shutdown Controller

9.1 Triggering the Rapid Shutdown Function

- Press the emergency switch on the Rapid Shutdown Controller.
- ☑ The red LED on the Rapid Shutdown Controller lights briefly or flashes. The Rapid Shutdown Box reduces the voltage on the output string side. As soon as the voltage is within the permitted range, the green LED on the Rapid Shutdown Controller glows constantly.
- ☑ The green LED on the Rapid Shutdown Controller glows constantly. The Rapid Shutdown System is active and the voltages on the output string side of the Rapid Shutdown Box are ≤ 30 V.
- ✗ None of the LEDs on the Rapid Shutdown Controller are glowing?
Several causes are possible: Either the irradiation on the PV array is too low and, thus, the supply voltage of the Rapid Shutdown System insufficient or the installation of the Rapid Shutdown System is faulty or the Rapid Shutdown Box is defective.
 - Make sure that the supply voltage of the Rapid Shutdown System is sufficient.
 - Ensure that the Rapid Shutdown System is installed correctly.
 - When the Rapid Shutdown System has enough supply voltage and is installed correctly and still none of the LEDs are glowing, the Rapid Shutdown Box is faulty and must be replaced. Contact the Service (see Section 12, page 41).
- ✗ The red LED on the Rapid Shutdown Controller glows constantly?
The Rapid Shutdown Box is defective and the Rapid Shutdown System is not active.
 - Contact the Service (see Section 12, page 41).

9.2 Resetting the Rapid Shutdown Function

1. Ensure that the PV system can be reset to operating mode.
2. Insert the key into the keyhole of the emergency switch on the Rapid Shutdown Controller and turn the key clockwise.
If the key for resetting the Rapid Shutdown Function is lost, contact the Service and request a new key.
 - ☑ The emergency switch returns to its starting position.
3. Remove the key from the keyhole and store safely in a location accessible to the PV system operator.

10 Decommissioning the Rapid Shutdown System

Procedure:

1.

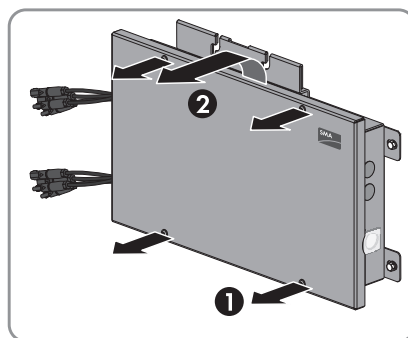
⚠ DANGER

Danger to life due to high voltages of the PV array

When exposed to sunlight, the PV array generates dangerous DC voltage which is present in the DC conductors. Touching live DC conductors leads to lethal electric shocks.

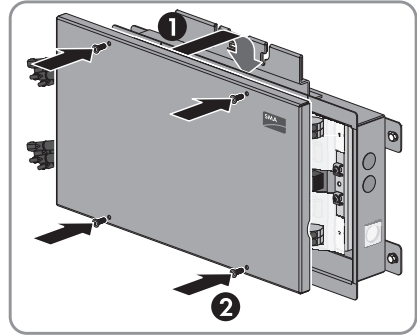
- Switch off the DC load-break switch on the inverter.
- Disconnect the DC connectors on the input strings.
- Only touch the DC conductors on their insulation.

2. Unscrew the four screws of the Rapid Shutdown Box enclosure lid using a hex socket screwdriver (TX25) and remove the enclosure lid.

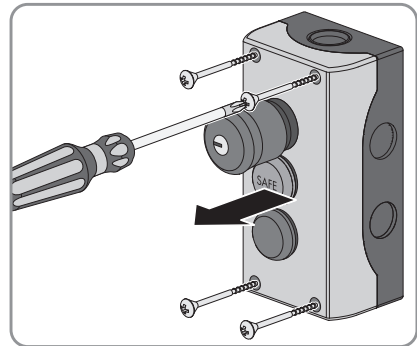


3. Remove the conductors of the Rapid Shutdown Controllers and, if present, those of an additional Rapid Shutdown Box, from the Rapid Shutdown Box. To do so, pull the respective five-pole plugs with the connected conductors out of the terminal block **RSC** and remove from the Rapid Shutdown Box.
4. Remove the output string conductors from the terminal blocks **A** and **B**. To do so, push the locking levers upwards to the stop and pull the conductors out of the terminals.
5. Remove each output string equipment grounding conductor from the equipment ground bar. To do this, unscrew the cylinder-head screw using a hex socket screwdriver (TX 25) and remove the cylinder-head screw, spring lock washer, the clamping bracket and the washer.
6. Remove the output string conductors and each equipment grounding conductor from the Rapid Shutdown Box.
7. Remove the conduits and conduit fittings from the enclosure openings of the Rapid Shutdown Box.

8. Hang the enclosure lid in the bracket of the upper enclosure edge and tighten the four screws using a hex socket screwdriver (TX 25) (torque: $6 \text{ Nm} \pm 0.6 \text{ Nm}$ ($53 \text{ in-lb} \pm 5 \text{ in-lb}$)).

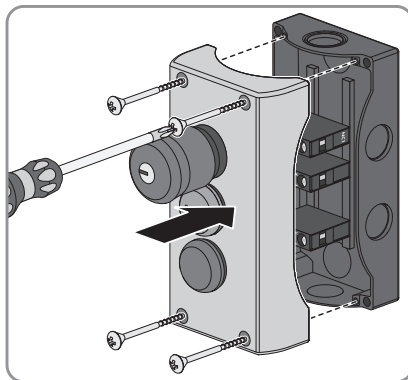


9. Remove the equipment grounding conductor of the Rapid Shutdown Box. To do so, loosen the hexagon nut using a wrench and remove the hexagon nut, the spring lock washer and the clamping bracket from the grounding bolt.
10. Remove the Rapid Shutdown Box. To do this, depending on the mounting type, unscrew the screws for attachment using a suitable screwdriver and remove the Rapid Shutdown Box from the rack rail, from the wall or from the roof.
11. Unscrew the 4 screws in the upper enclosure part of the Rapid Shutdown Controller using a cross-head screwdriver (PZ2), remove the upper enclosure part and place to one side.



12. Remove the conductors from the terminal blocks. To do so, loosen the screw of each terminal using a cross-head screwdriver (PZ2) and pull the conductors out of the terminal.
13. Remove the conduits and conduit fittings or the adapter from the Rapid Shutdown Controller.
14. Remove the Rapid Shutdown Controller. To do this, unscrew the four screws for attachment using a cross-head screwdriver (PZ2) and remove the Rapid Shutdown Controller from the wall.

15. Place the upper enclosure part onto the lower enclosure part and tighten the four screws using a cross-head screwdriver (PZ2).



11 Technical Data

11.1 Rapid Shutdown Box

Maximum input voltage	600 V
Input voltage range	110 V to 600 V
Nominal current per channel	20 A
Maximum input short-circuit current per channel	36 A
Conductor type for the connection of the output strings	Copper wire
Maximum permitted temperature for the terminal blocks for the connection of the output strings	+90°C (+194°F)
Width x height x depth, without input strings sticking out of the Rapid Shutdown Box	542 mm x 340 mm x 75 mm (21.3 in x 13.4 in x 3 in)
Length x width x height of the packaging	770 mm x 395 mm x 125 mm (30.3 in x 15.5 in x 4.9 in)
Weight of the Rapid Shutdown Box, without packaging	3.8 kg (8.4 lb)
Weight of the Rapid Shutdown Box, including packaging	5.5 kg (12.1 lb)
Operating temperature range	-40°C to +75°C (-40°F to +167°F)
Maximum permissible value for relative humidity, condensing	4% to 100%
Maximum operating altitude above mean sea level (MSL)	3000 m (9843 ft)
Enclosure degree of protection according to UL 50	4X
Torque of the enclosure lid screws	6 Nm ± 0.6 Nm (53 in-lb ± 5 in-lb)

11.2 Rapid Shutdown Controller

Width x height x depth, without input strings	80 mm x 153 mm x 104 mm (3.15 in x 6.02 in x 4.1 in)
Weight, without packaging	328 g (0.72 lb)
Operating temperature range	-25°C to +70°C (-13°F to +158°F)

Maximum operating altitude above mean sea level (MSL)	3000 m (9843 ft)
Enclosure degree of protection according to UL 50	4X
Torque of the upper enclosure lid screws	1.8 Nm (16 in-lb)

12 Contact

If you have technical problems with our products, please contact the SMA Service Line. The following data is required in order to provide you with the necessary assistance:

- Serial numbers

United States	SMA Solar Technology America LLC Rocklin, CA	Toll free for USA and US Territories +1 877-MY-SMATech (+1 877-697-6283) International: +1 916 625-0870
Canada	SMA Solar Technology Canada Inc. Mississauga	Toll free for Canada / Sans frais pour le Canada : +1 877-MY-SMATech (+1 877-697-6283)
México	SMA Solar Technology de México Mexico City	Internacional: +1 916 625-0870