



## Technical Information

# **Rapid Shutdown of PV Systems on Buildings (NEC 2014) with SMA Residential Inverters, SMA Rapid Shutdown Box (RSB) and SMA Rapid Shutdown Controller (RSC)**



## **Introduction**

The purpose of this note is as follows:

- to explain and identify acceptable combinations of SMA Residential Inverters and the SMA Rapid Shutdown Box (RSB).
- to identify recommended types of wire/cable for Rapid Shutdown Controller (RSC) connection, multi-tap connectors for the inverters SBx.x-1 SP-US-40 (Sunny Boy x.x-US), and sealing gaskets for raintight conduit fittings and cable glands.

This document is intended for use by SMA customers.

The Background is as follows:

- NEC 2014 690.12 specifies a requirement for rapid shutdown of PV systems installed on buildings
- SMA supplies a UL listed device meeting NEC 2014 690.12.

# 1 Applicable Products

## SMA Inverters

- SBx.x-1SP-US-40
- SB xx00TL-US-22

## SMA Rapid Shutdown System

- RSB-2S-US-10

Version	RSB channels	Maximum channel Short circuit current per channel [adc]	Enclosure Rating
RSB-2S-US-10	2	36	NEMA 4X

- RSC-1X-US-10

# 2 SMA Rapid Shutdown Controller Wiring/Cabling

The SMA Rapid Shutdown System consists of a Rapid Shutdown Box (RSB) and a Rapid Shutdown Controller (RSC). As shown and specified in the Installation Manual, RSBs and RSCs are connected with control wires, and multiple RSBs can be controlled with a single RSC. Below are the specifications and examples of recommended wire types and sources.

## Requirements for Control Wires

18 AWG to 16 AWG copper conductors  
Solid wire, stranded wire or finely stranded wire. When using finely stranded wire, bootlace ferrules must be used.

## Examples

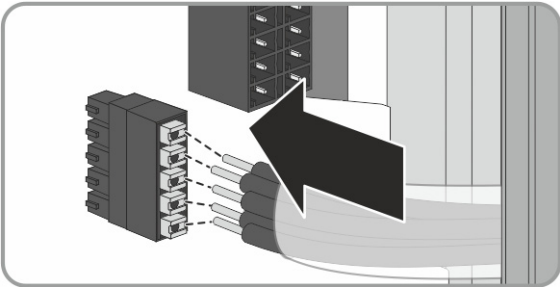
### Tray cables for exposed run (TC-ER)

Where 600V rated cable is required:  
Belden 28335A Multi-Conductor – 600V Type TC-ER Cable or similar

### In conduit with PV output conductors (600V rated)

TFFN individual copper conductors sizes AWG 18–16, 600 V  
or  
600 Vdc tray cable. Verify conduit fill.  
Belden 28335A Multi-Conductor – 600V Type TC-ER Cable or similar

## Diagram from installation manual



### 3 Multi-tap Connector use with SMA Rapid Shutdown System and SBx.x-1SP-US-40 Inverters

The SMA Rapid Shutdown System consists of one or more Rapid Shutdown Boxes (RSB) and one Rapid Shutdown Controller (RSC). The RSB is a two channel device. Each channel is capable of operating at 20 Amps of PV current and has a Maximum Circuit Current rating of 36 Amps. In many cases, three or more strings may be connected to each Rapid Shutdown Box with each channel operating at 16 Amps or more. See the installation manual for more details.

#### For example

For a three string installation of typical PV modules with approximately 8.5 Amps  $I_{mp}$  and 9.5 Amps  $I_{sc}$ , an installer can connect two strings to RSB Channel A input giving a total combined  $I_{mp}$  of 17 Amps and a total Maximum Circuit Current of 23.8 Amps. Channel B would be connected to a single string of PV modules with a total  $I_{mp}$  of 8.5 Amps and a total Maximum Circuit Current of 10.6 Amps.

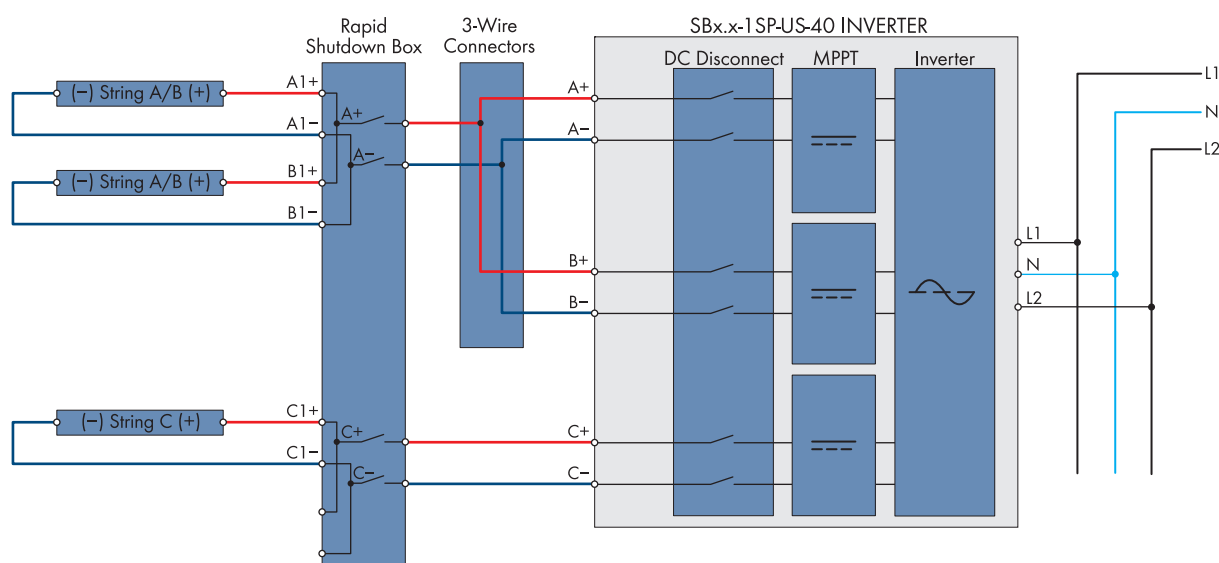
For the SBx.x-1SP-US-40 inverters, each inverter can be wired with

- Up to 3 independent MPP inputs – (A), (B), and (C) – operating at up to 10 Amps and rated at 18 Amps Maximum Circuit Current

or

- 2 combined MPP inputs and a single MPP input – (A | B) and (C) – inputs A and B operating in parallel at up to 20 Amps and rated at 36 Amps Maximum Circuit Current. This configuration has two strings on input (A | B) and one on input (C) per the diagram below. Three wire, insulated, multi-tap connectors are used to combine inputs A and B on the inverter.

#### Reference Diagram



#### Important

A/B Strings need to have the same quantity of modules in series.

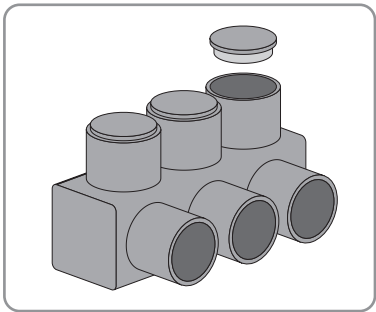
3-Wire Connectors needed to transition from one conductor to two conductors are not provided by SMA.

4 Requirements for Insulated Multi-Tap Connector

600 V, 90 °C, rated for copper conductors  
Compatible wire range 10 AWG to 6 AWG

Examples

- ILSCO Nimbus PBTS Series Part # PBTS-3-4
- Polaris IPL Series Part # IPL 4-3 or IPL4-3A
- Polaris IPLM Series Part # IPLM 4-3 or IPLM 1/0-3
- Polaris Grey Series Part # IPLG6-3 or IPLG1-3
- Burndy UNITAP Series Part # BIBS43



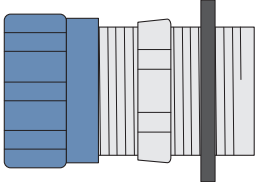
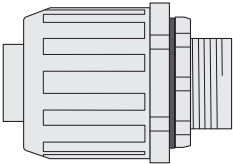

5 SMA Rapid Shutdown System Sealing Gaskets for Raintight Conduit Fittings and Cable Glands

The SMA Rapid Shutdown System consists of one or more Rapid Shutdown Boxes (RSB) and one Rapid Shutdown Controller (RSC). As shown and specified in the Installation Manual, the RSB and RSC require *listed raintight or liquidtight conduit fittings to attach the conduits to the enclosure*. The RSC ships with the appropriate raintight RSC knockout to 3/4 NPT adapter. Installers must procure conduit fittings for the RSB and RSC.

SMA recommends using fittings with flat, pliable, thick rubber sealing gaskets per the diagrams below. Thickness should be of approximately 0.1 inch (approximately 7/64 inch).

SMA recommends against using fittings with thinner, harder sealing gaskets, typically yellow or green colored. These types of gaskets may not make reliable seals for this application. Gasket is approximately 0.075 inch (5/64 inch) thick or less.

SMA recommends against and does not accept using fittings with round cross section, o-ring type sealing gaskets as these types of seals are not reliable for this application.

Recommended	Not Recommended	Not Acceptable
0.1 inch flat gasket	0.075 inch flat gasket	O-ring
		

## 6 Configuration Recommendations and Reference Diagrams

### 6.1 Important Notes

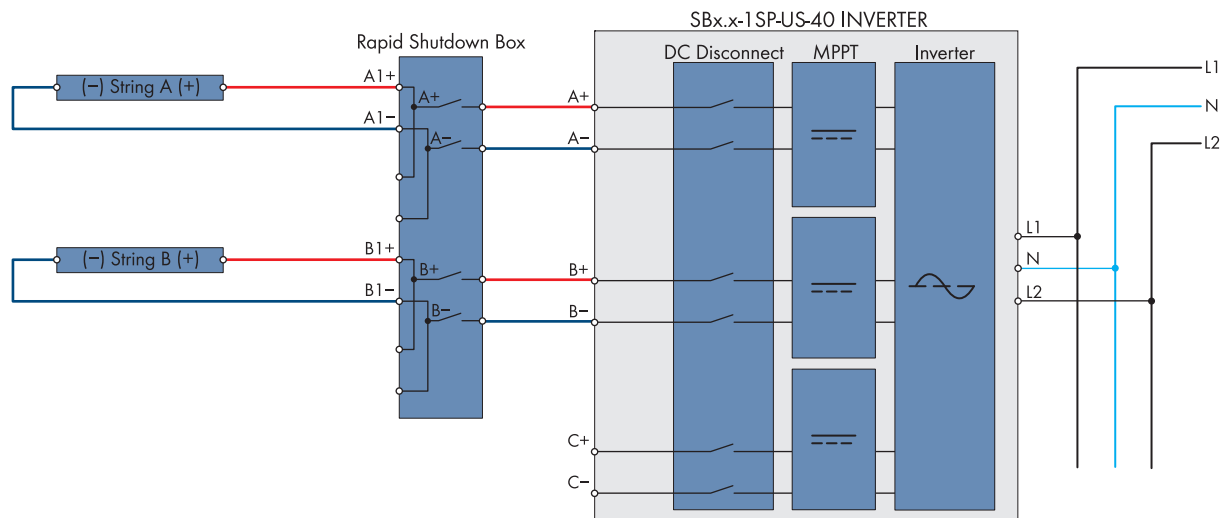
- If PV subarrays on a roof are separated by distances greater than defined in 2014 NEC 690.12, then at least one RSB will be required per subarray.
- Two strings can be directly connected to one channel of the SMA RSB if the total module short circuit current is equal to or less than 36A Isc.
- Each channel has two string inputs. Unused channels should be capped. MC4 caps are supplied with the RSB.
- Per NEC 690.9(A)(b) fuses are not required for two strings. Always consult module manufacturers’ installation instructions.

Two parallel strings per one SMA MPP input may cause power clipping at full sun conditions. The significance of this occurrence is inverter, module, and site dependent.

### 6.2 Reference Diagrams

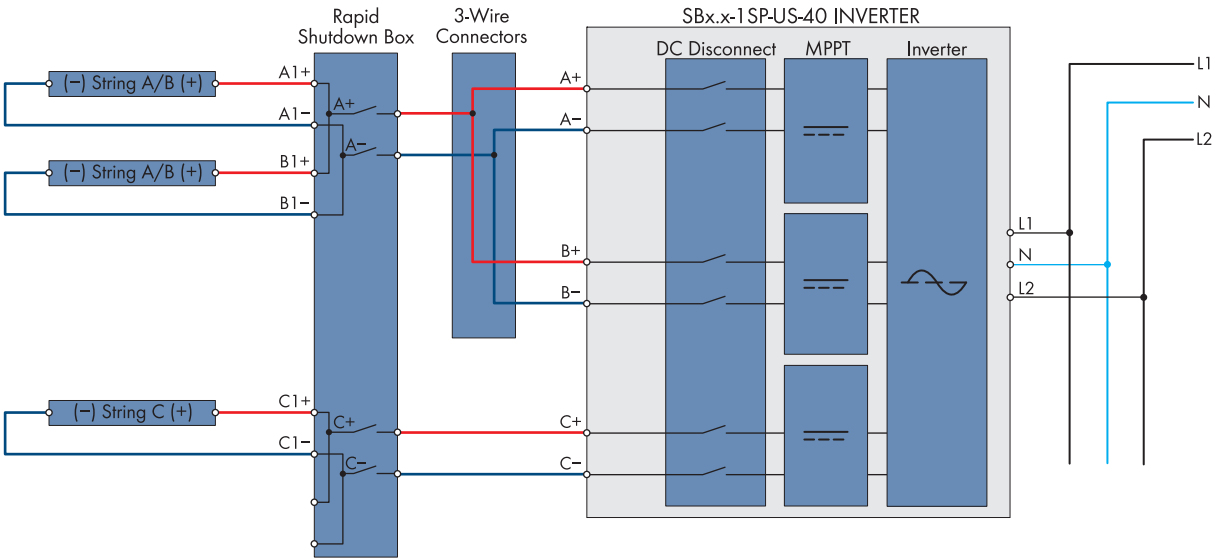
#### SMA Sunny Boy Part numbers SBx.x-1 SP-US-40

Installed Strings	RSB Qty.	MPP1 String per RSB-1 CH 1	MPP2 String per RSB-1 CH 2	MPP3
2	1	1	1	0



SMA Sunny Boy Part numbers SBx.x-1 SP-US-40

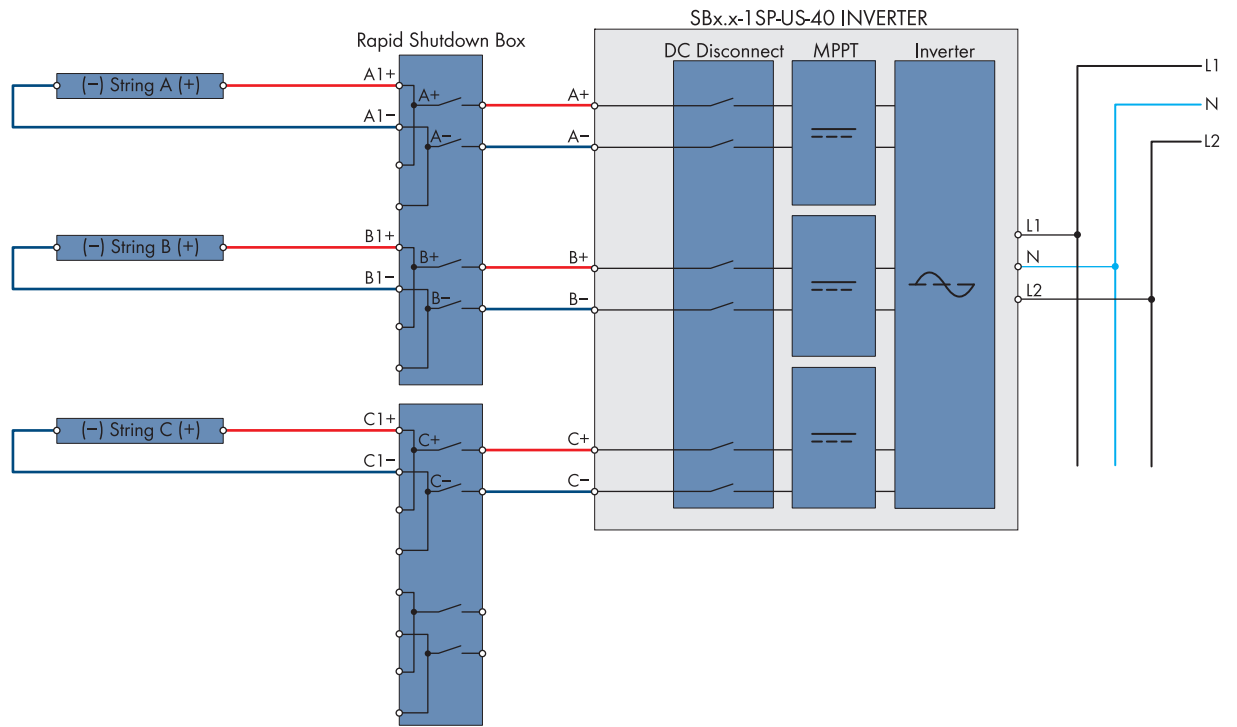
Installed Strings	RSB Qty.	MPP1 String per RSB-1 CH 1	MPP2	MPP3 String per RSB-1 CH 2
3	1	2		1



- Important**  
A/B Strings need to have the same quantity of modules in series.  
3-Wire Connectors needed to transition from one conductor to two conductors are not provided by SMA.

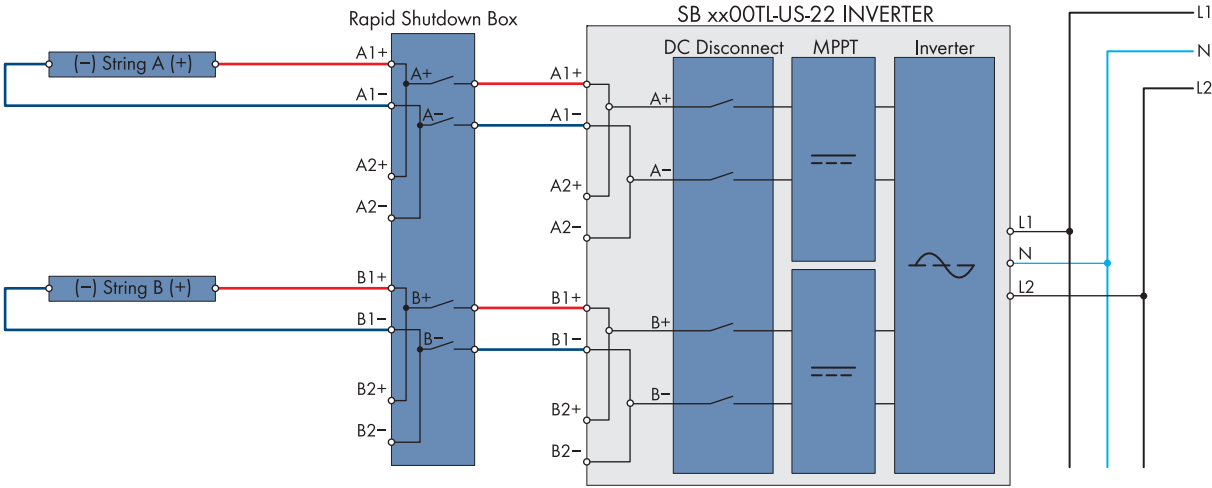
SMA Sunny Boy Part numbers SBx.x-1 SP-US-40

Installed Strings	RSB Qty.	MPP1 String per RSB-1 CH 1	MPP2 String per RSB-1 CH 2	MPP3 String per RSB-2 CH 1
3	2	1	1	1



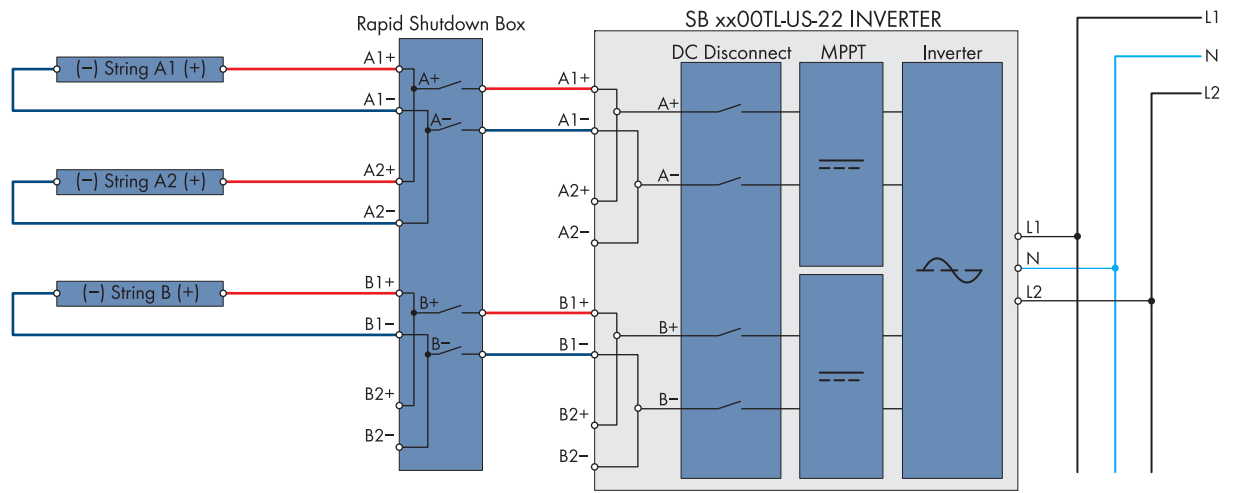
SMA Sunny Boy Part numbers SB xx00TL-US-22

Installed Strings	RSB Qty.	MPP1 String per RSB-1 CH 1	MPP2 String per RSB-1 CH 2
2	1	1	1



SMA Sunny Boy Part numbers SB xx00TL-US-22

Installed Strings	RSB Qty.	MPP1 String per RSB-1 CH 1	MPP2 String per RSB-1 CH 2
3	1	2	1



SMA Sunny Boy Part numbers SB xx00TL-US-22

Installed Strings	RSB Qty.	MPP1 String per RSB-1 CH 1	MPP2 String per RSB-1 CH 2
4	1	2	2

