

PV Fact Sheet

06 | Combination of PV strings

How to combine PV strings and when is this efficient?

This fact sheet focuses on photovoltaic installations on top of buildings within the European Union. One essential part of such an installation is the combiner box. These boxes are used to combine several strings and to protect against overvoltage and feature many more functions.

Efficient combining of strings

Depending on lightning protection requirements or installation conditions, it may be necessary to install a combiner box (see the fact sheet “How do you protect PV installations against lightning strikes?”). Combiner boxes that can be installed close to the PV modules or at the building entry point are particularly popular, as they allow for early string combination. The advantage lies in the reduced installation effort and the savings in cabling.

An Example: A building is equipped with PV modules on the east and west side of the roof. There is a 2 MPP string inverter in the basement. To save cables, the installer mounts a combiner box on the attic. He combines 2 strings (each with +/-) from the east side and 2 strings (each with +/-) from the west side. In doing so, he saves a total of 40 metres of cable and corresponding installation time.

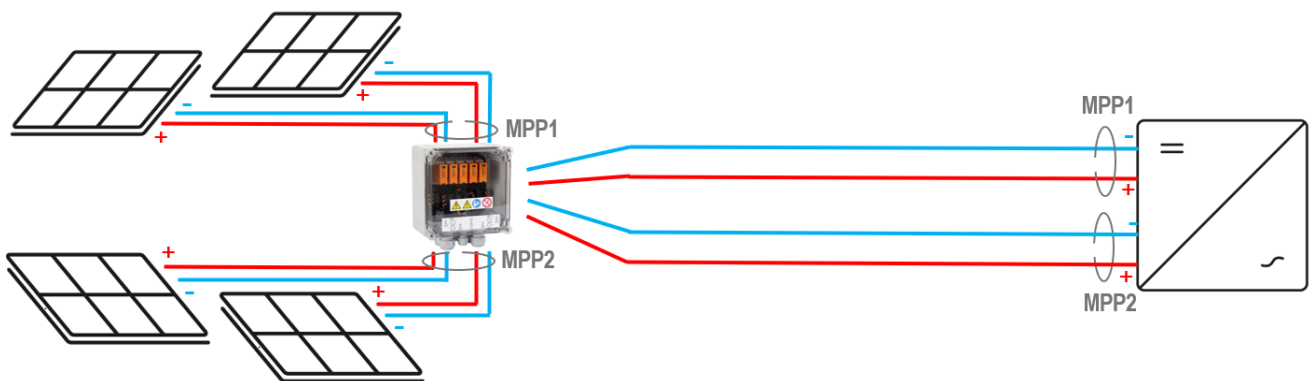


Figure 1: Combining PV strings with PV Next combiner box

PV Fact Sheet

06 | Combination of PV strings

Important hint: When designing the strings with a combiner box, the same rules apply as when designing the strings for an inverter. That means the voltage of the first and the second string (same MPPT) should be as equal as possible. Here it is always important that the start voltage of the inverter is reached.

Cable diameters for combined strings

One question that arises from this configuration is which cross connection is required for the combined strings. Is it 4 mm² or more? The answer can be found in the following table from EN 50618:2014:

Cable dimension	Current for single cable in free space	Current for single cable on a surface	Current for two cables contacting each other on a surface
4 mm ²	55 A	52 A	44 A
6 mm ²	70 A	67 A	57 A
10 mm ²	98 A	93 A	79 A
16 mm ²	132 A	125 A	107 A

Figure 2: Current rating of PV cables at 60°C ambient temperature, source: EN 50618:2014

That means for a combination of 2 or 3 strings (each with max. 15 A) a 4 mm² cable can be used. Nevertheless, to avoid power losses, it is recommended to use a larger cross-section depending on the length of the cable. There are several free web-based online tools available for this. Feel free to contact us for more information.

Connecting combined strings to an inverter

One last question remains: Can the string inverter handle the combined strings at the input? This strongly depends on the technical specifications in the inverter's datasheet. Let's assume it is an inverter with 24A per input. If 2 strings with 15A each are combined, the input current to the inverter will be 30A. This current is higher than the specification in the datasheet and therefore not ok.

PV Fact Sheet

06 | Combination of PV strings

For this case, there is a simple technical solution. So-called Y-cables or Y-connectors can be used to decouple the two strings. The current will be evenly distributed to the Y-connections or to the two inputs of the inverter according to its physical properties. For the above example, this means that the 30A will be split back into 2x 15A. As a result, the current per input at the inverter is not higher than 15A and well below the datasheet specification of 24A.

An example: The following connection diagram illustrates the interaction of the various components. Two strings per MPP are introduced into the PV Next combiner box (variant 2737600000). A bundled string is then routed to the inverter. Before the inverter, the bundled string is connected to a Y-cable from Weidmüller (order numbers: 2877850000, 2877860000), thus distributing the current evenly to the two inputs of the Huawei SUN2000-30KTL-M3. For illustration purposes, only the positive connections are shown here.

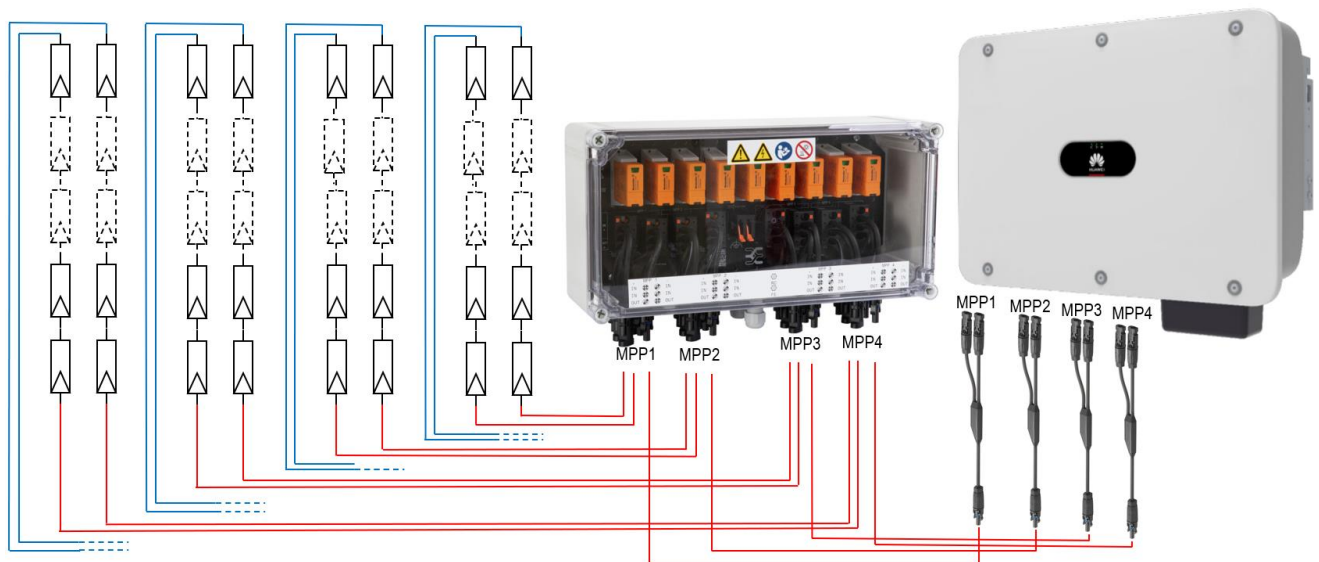


Figure 3: Installation with PV Next combiner box, Y-cable/ Y-connector and inverter

In this installation variant, eight cables are saved due to the early bundling of the strings in the combiner box. For example, in an office building, this amounts to approximately 160 meters less cable. Additionally, only the eight Y-cables need to be procured. This ultimately saves time, space, and material.

PV Fact Sheet

06 | Combination of PV strings

Advantages of Weidmüller products

PV Next is the global combiner box portfolio for rooftop installations made by Weidmüller. These products are based on a modular concept. Specifically, Weidmüller offers PV Next combiner boxes for residential and commercial installations, which always offer the option of combining 2 strings into one.



Figure 4: Weidmüller PV Next combiner box



Pascal Niggemann

Head of PV Systems Home & Business,
Weidmüller Interface GmbH & Co. KG, Germany

Pascal.Niggemann@weidmueller.com | www.weidmueller.com/pv-rooftop