String solar panels

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One aspect of designing a solar PV system that is often confusing, is calculating how many solar panels you can connect in series per string. This is referred to as string size.

If you are unfamiliar with the terms "series" and "string", it could be a good idea to head over to our article Introduction to Electricity for Solar PV Systems to get familiar with the electrical terminology used in solar.

This article will focus on calculating string size when using string inverters or charge controllers. If you are planning to use DC optimizers or Micro-inverters in your system then this information does not apply. Optimizers and micro-inverters have specific rules around how many panels can be connected to them, and how they can be connected together. The rules vary between manufacturers and components, and can be found in the manufacturer design guidelines and product datasheets.

There are two main steps in calculating string size.

If the maximum input voltage of your inverter is exceeded on a cold day, the inverter can be damaged. Even if the inverter is not damaged by over voltage, having too many panels in a string may void the inverter warranty, so that you are not covered for other inverter issues.

To make sure you don"t exceed the maximum voltage of your inverter, the first thing you need to understand is how the voltage of the solar panels changes with temperature.

The voltage of a solar panel is not fixed. As the temperature of a panel increases, its voltage decreases, and as its temperature decreases, its voltage increases.

The rate at which the open circuit voltage of a solar panel will change as its temperature changes is defined by the Temperature Coefficient of Voc. You can always find this value on the solar panel datasheet.

The temperature coefficient will be given in %/?C, (percentage per degree celsius). That is, is the percentage that Voc will rise, for every degree celsius the temperature of the panel drops.

For example, if you have a solar panel that has a Voc (at STC) of 40V, and a Temperature Coefficient of 0.27%/?C. Then for every degree celsius drop in panel cell temperature, the voltage will rise by:

Since STC is at 25?C, then at 24?C, the new Voc would be 40.108V.

Some datasheets will give the temperature coefficient in mV/?C. In this case you can convert to %/?C by dividing the mV/?C figure by the Voc value. Just be sure to convert from mV to V first.

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