V$_{OC}$ and I$_{SC}$ in SolarEdge Systems - Technical Note

Modules short circuit current (I$_{SC}$) and the open circuit voltage (V$_{OC}$) are fundamental figures in the design of solar systems. The Voc is determining the maximum string length (number of modules in one string), and Isc is required for calculating the maximum current in the string. In SolarEdge systems, due to the addition of power optimizers between the PV modules and the inverter, Voc and Isc hold different meanings from those in traditional systems. This document describes these differences, in Isc and Voc in SolarEdge system compared to their traditional meanings.

String Current and Voltage

In traditional systems (string inverters), the string V$_{OC}$ is the sum of the V$_{OC}$ of all modules in the string and the Vmpp is the sum of all modules Vmpp. As such, the total Voc voltage must be below the inverter's maximum input voltage (Max absolute rating) and the minimal string Vmpp must be above inverter's lowest MPPT point.

SolarEdge inverters are operating in a fixed string voltage point (see the *SolarEdge Fixed String Voltage Application Note* on the SolarEdge website), therefore the string voltage is always the same, regardless of the number of modules connected in the string or the irradiance power or modules temperature.

The power optimizers serve as power sources and since all optimizers in the string share the same output current, each optimizer's output voltage is proportional to its module power, out of the string power:

$$V_{out} = \frac{Module\ MPP\ power}{total\ string\ power} \cdot fixed\ string\ voltage$$

The power optimizer output current equals the string current:

$$I_{out} = I_{string} = \frac{total\ string\ power}{fixed\ string\ voltage}$$

In any case, if SolarEdge inverter connected to a string of power optimizers, the string voltage will not exceed the maximum voltage specified in the inverter datasheet.

> **Note**
> The instantanuse power/voltage/current can be seen on the inverter LCD screen (in case regulatory inspection requires actual measurement)

V$_{OC}$

The SafeDC^{TM} mechanism (see the *SolarEdge SafeDC Application Note* on the SolarEdge website) assures that whenever an optimizer is disconnected from the inverter or when there is no AC in the system (due to inverter shutdown or grid fault), it will output only 1V (±0.1V). This ensures safe voltage when installing and maintaining the system, and easy validation of installation since the string open circuit voltage equals the number of modules connected expressed in volts, e.g. a 16-module string has a V$_{OC}$ of ~16V.

The string V$_{OC}$ is dependent only on the number of optimizers in the string x1V and not on the module specifications.

Once the string is connected to an operating inverter, and there is enough light, the string voltage will rise to the fixed string voltage operating point.

I$_{SC}$

Short circuit current is measured when the string is disconnected from the inverter. In this state, the optimizers are at SafeDC mode (see above) and output 1V. The output current in this state is limited to 300-600 mA, dependent on temperature and module voltage, both positively correlated.

> **Note**
> For cabling calculations related to maximum current (i.e. wire gauges), use the maximum output current as appear in the power optimizer datasheet