

Recommendation on the system design of the Fronius Eco and Fronius Tauro

Fronius International GmbH

herby confirms that, for system designs containing the inverters

- **Fronius Eco 25.0-3-S - 27.0-3-S**
- **Fronius Tauro ECO 50-3-D (P) - 99.0-3-D (P) - 100-3-D (P)**
- **Fronius Tauro 50-3-D (P)**

the minimum temperature limit can be raised from -10 °C to 0 °C, without voiding the manufacturer's warranty conditions, provided that:

- the Fronius Eco or Fronius Tauro is installed in one of the listed countries within the attached country list,
- the installation location is less than 1000 m above sea level and
- the PV-Modules are not installed on PV-Tracking Systems.

Based on extensive analyses of simulation models as well as analyses of installed systems lasting several years, Fronius International GmbH has determined that a cell temperature of -10 °C and a simultaneous insolation of 1000 W/m² will not occur under the aforementioned conditions. Therefore, when the strings and voltage limits are correctly configured in accordance with the operating instructions, no system voltages above 1000 V DC will occur, even with the adapted temperature limits.

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ATTACHMENT "Country list"

- Cyprus
- Italy
- Greece
- Spain

ATTACHMENT - "Recommendation on the system design of the Fronius Eco and Fronius Tauro"

When designing a photovoltaic system, the module temperature limits established on the market are $-10\text{ }^{\circ}\text{C}$ and $+70\text{ }^{\circ}\text{C}$

Investigations carried out by Fronius have shown that these limits can be modified without this giving rise to adverse effects or risks during system operation. These limits can be adjusted where necessary, depending on the environmental conditions of the system (insolation at site, site temperatures, alignment, installation type, etc.).

Maximum open circuit voltage Voc

The maximum open circuit voltage that occurs is dependent on the minimum ambient temperature (T_a). In many cases, the minimum module temperature T_m can be increased from $-10\text{ }^{\circ}\text{C}$ to $0\text{ }^{\circ}\text{C}$ in the system design.

This is permitted if the actual maximum DC voltage occurring ($V_{oc,max,real}$) is below the calculated value for the maximum open circuit voltage at 1000 W/m^2 and $0\text{ }^{\circ}\text{C}$ T_m ($V_{oc,max}$).

Analyses have shown that, with constant ambient temperatures (in the example, $T_a = -20\text{ }^{\circ}\text{C}$), the maximum open circuit voltage ($V_{oc,max}$) occurs at approx. 400 W/m^2 (with a module temperature of $T_m = -10\text{ }^{\circ}\text{C}$) (see

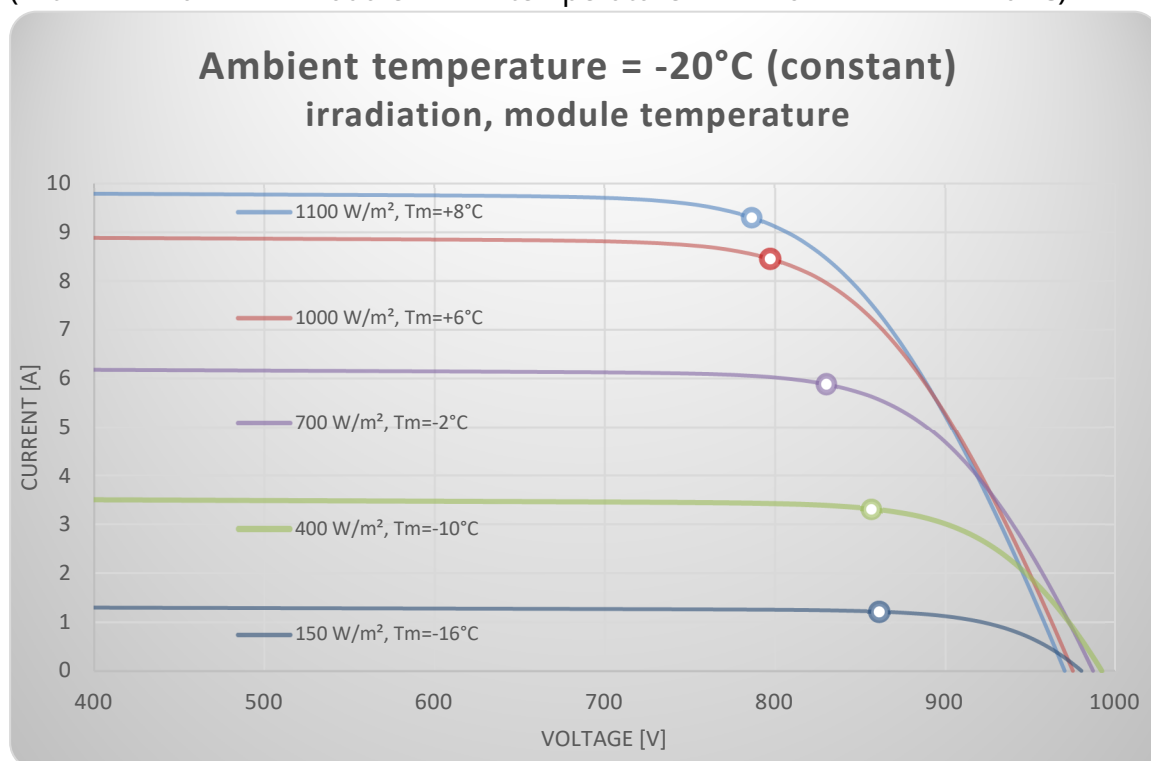


Figure 1). With lower insolation values, the module temperatures fall and the MPP voltage may increase, but the open circuit voltage will be lower.

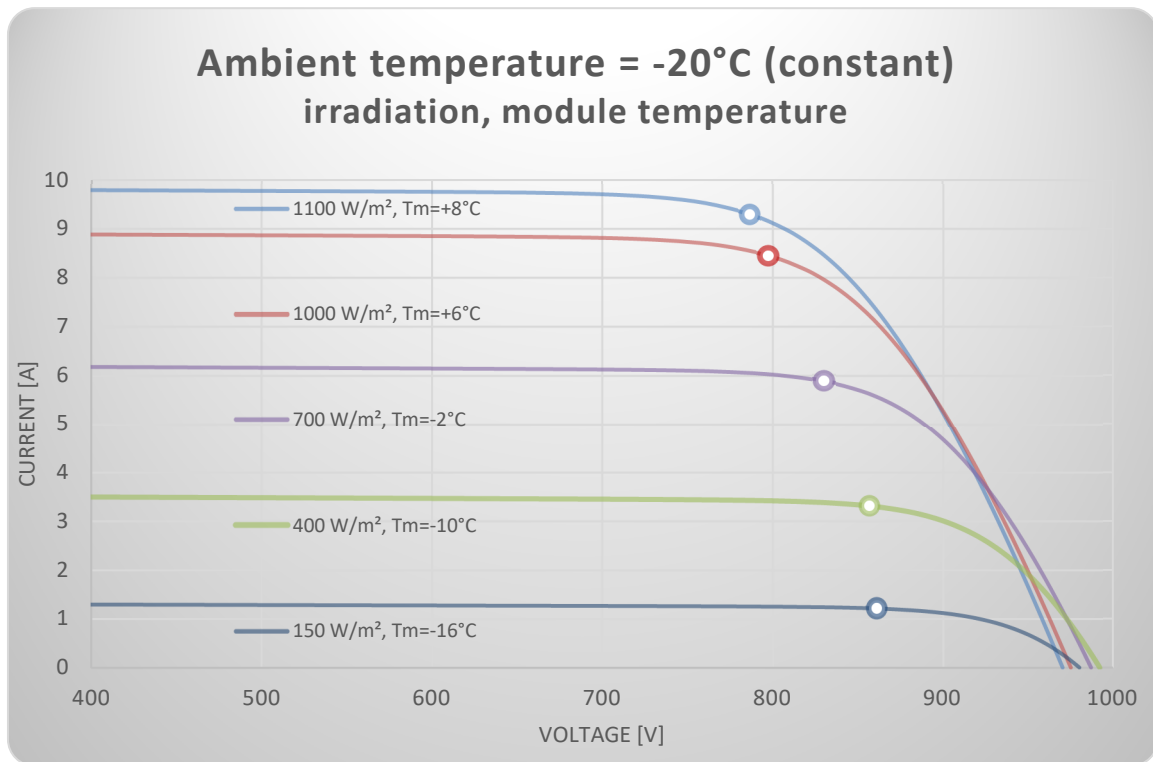


Figure 1: Characteristics $T_a = -20^\circ\text{C}$ (source: internal analysis - Fronius International GmbH)

The maximum open circuit voltage that occurs, calculated at 1000 W/m^2 and $T_m = 0^\circ\text{C}$, is just above the maximum open circuit voltage in Figure 1, while the maximum open circuit voltage calculated at 1000 W/m^2 and $T_m = -10^\circ\text{C}$ is significantly higher than 1000 V (see Figure 2).

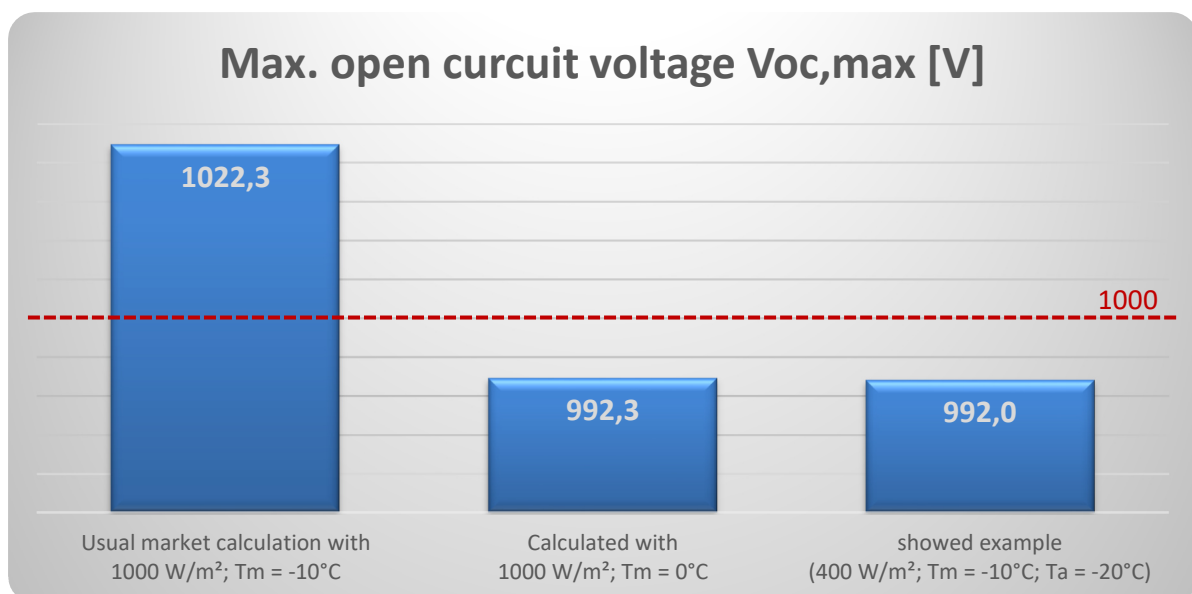


Figure 2: Max. open circuit voltage (source: internal analysis - Fronius International GmbH)

Consequently, under these conditions, calculation using an adapted minimum module temperature of $T_m=0\text{ }^{\circ}\text{C}$ is permitted.