

Wels, 02/06/2016

## RECOMMENDATION ON THE SYSTEM DESIGN OF THE FRONIUS ECO

### Fronius International GmbH

hereby confirms that, for system designs containing the inverters

#### / Fronius ECO 25.0-3-S and Fronius ECO 27.0-3-S,

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

- / the Fronius ECO is installed in Australia,
- / the installation location is less than 1000 m above sea level
- / 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/m<sup>2</sup> 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 “RECOMMENDATION ON THE SYSTEM DESIGN OF THE FRONIUS ECO”

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

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 $V_{oc}$

The maximum open circuit voltage that occurs is dependent on the minimum ambient temperature ( $T_a$ ).

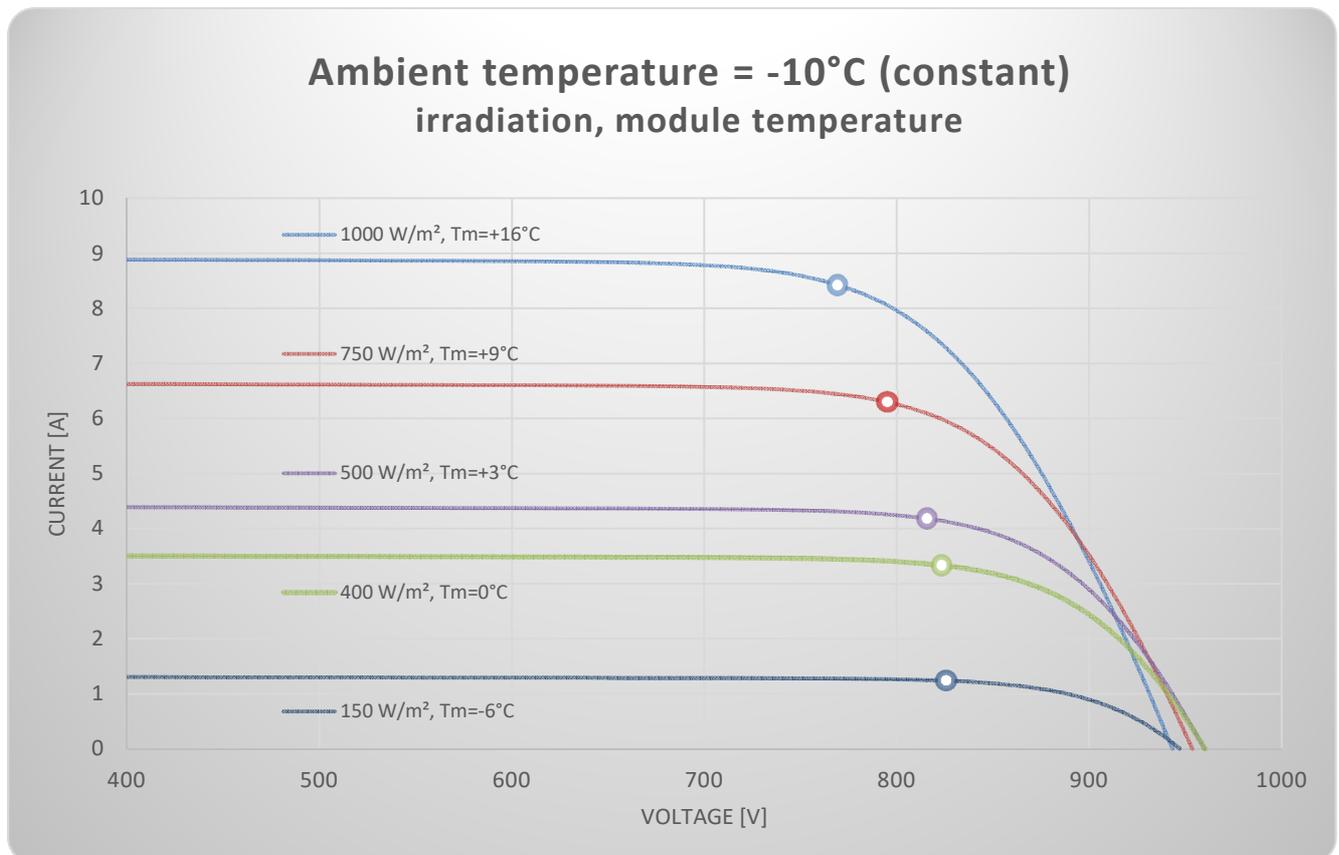
In many cases, the minimum module temperature  $T_m$  can be increased from  $-10\text{ °C}$  to  $+10\text{ °C}$  in the system design.

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  $1000\text{ W/m}^2$  and  $+10\text{ °C}$   $T_m$  ( $V_{oc,max}$ ).

**Analyses have shown that, with constant ambient temperatures (in the example,  $T_a=-10\text{ °C}$ ), the maximum open circuit voltage ( $V_{oc,max}$ ) occurs at approx.  $400\text{ W/m}^2$  (with a module temperature of  $T_m=0\text{ °C}$ ) (see**

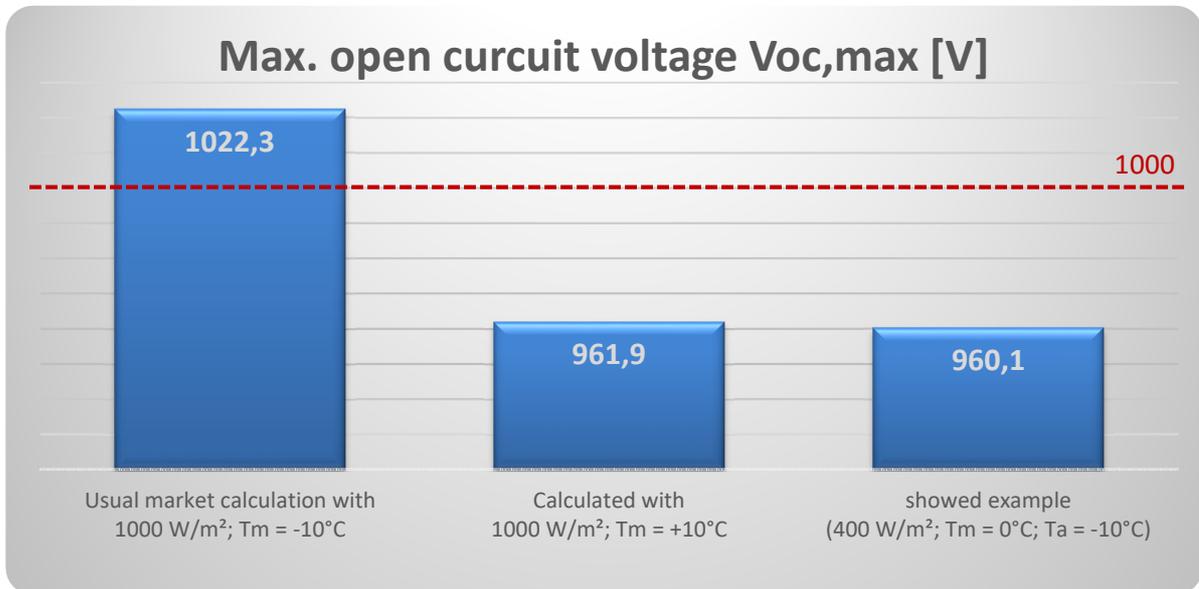
Figure 1).

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  $T_a=-10\text{ °C}$  (source: internal analysis - Fronius International GmbH)**

The maximum open circuit voltage that occurs, calculated at 1000 W/m<sup>2</sup> and T<sub>m</sub>=+10 °C, is just above the maximum open circuit voltage in Figure 1, while the maximum open circuit voltage calculated at 1000 W/m<sup>2</sup> and T<sub>m</sub>=-10 °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<sub>m</sub>=+10 °C is permitted.