



Application Guide

Direct connection with Fronius Tauro 50-3-P

Reducing costs with a new connection concept and state-of-the-art module technology

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Version 1.0 03/2022

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1 Introduction

The robust Fronius Tauro commercial inverter is available in two variants: Direct and Precombined. The variant in question can be identified by the suffix -D or -P in the item designation.

The Fronius Tauro 50-3 in the Precombined version is developed for centralized plant design and has integrated V-type terminals on the DC side for the straightforward connection of DC busbars. In order to realize the desired configuration, different numbers of strings are connected to the 3 MPP trackers of the Fronius Tauro-50-P depending on the module type and power output. Until now, PV modules with a maximum MPP current of 12 A were considered standard on the market. In the system configuration with this module class, more than 2 strings per MPP tracker were always connected to the Fronius Tauro Precombined.

Due to further development in module technology, an increasing number of PV modules with higher current but almost identical voltage are now being brought onto the market. The higher string powers that result open up new connection possibilities for the Tauro 50-3-P. Due to new module technologies, the Precombined variant of the Fronius Tauro can now also be used for a decentralized system design. These new possibilities not only save time, but result in significant BOS cost savings.

2 Basic function of the Tauro Precombined

The three-phase Fronius Tauro Precombined in the 50 kW power category features a smart hardware design that not only contributes to BOS cost optimization, but also offers corresponding flexibility in system design. The Precombined version is specially designed for use in systems with centralized plant design.

		Tauro			
		50-3-P			
Input data	Number of MPP trackers		3		
	Max. input current ($I_{dc\ max}$)	A	134		
	Max. short circuit current ($I_{sc\ max, inverter}$)	A	240		
	DC input voltage range ($U_{dc\ min} - U_{dc\ max}$)	V	200 - 1000		
	Feed-in start voltage ($U_{dc\ start}$)	V	200		
	Usable MPP voltage range ($U_{mpp\ min} - U_{mpp\ max}$)	V	400 - 870		
	Max. PV generator power ($P_{dc\ max}$)	kWp	75		
			PV1	PV2	PV3
	Max. input current module field	A	36	36	72
	Max. short circuit current	A	72	72	125
Number of DC connections		1	1	1	

The Tauro 50-3-P has 3 MPP trackers. The PV1 and PV2 trackers have a maximum permissible MPP current of 36 A, while the third tracker PV3 has 72 A. The maximum short circuit current of PV1 and PV2 is 72A, while that of PV3 is 125A.

Figure 1: Extract from Fronius Tauro 50-3-P data sheet

Up to 75 kW DC power may be connected to the device, whereby attention must be paid here to the maximum load of the respective inputs. The inputs can be assigned a maximum of 25 kW or 50 kW.

Fronius Tauro 50-3-P inverters come with DC inputs as standard, which allow cable cross-sections of up to 95 mm². Furthermore, Fronius Tauro devices have integrated V-type terminals. It is permissible to dismantle the integrated V-type terminals if necessary. In this case, a cable lug can be connected to the M12 bolt.

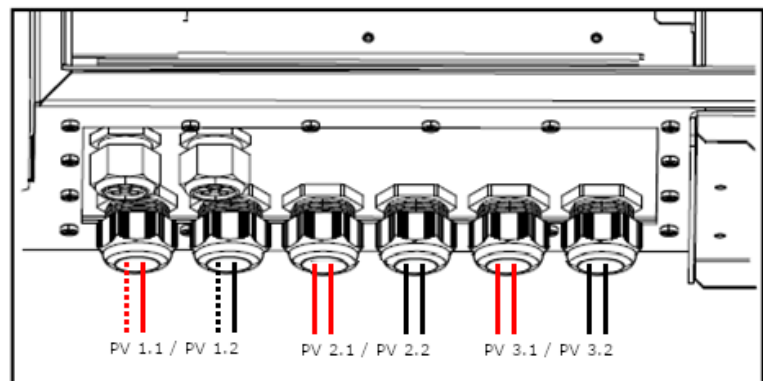


Figure 2: DC connection of Fronius Tauro 50-3-P

3 New module technologies

Until now, PV modules with a maximum MPP current of 12 A were considered standard on the market. With the possible string power of this module class, several strings per MPP tracker were always connected to the Fronius Tauro Precombined. Due to major advances in module technology, an increasing number of module classes are being developed with higher MPP currents, which also enable higher string power.

3.1 PV modules up to 18A I_{mpp}

Modules with MPP currents of up to 18 A are becoming more and more common on the market. The table below shows two products with new module technology from two well-known manufacturers.

Trina Vertex TSM-DE19 -555W		Risen RSM120-5-605M	
Peak Power Watts- P_{max} (Wp)*	555	Model Number	RSM120-8-605M
Power Tolerance- P_{max} (W)		Rated Power in Watts- P_{max} (Wp)	605
Maximum Power Voltage- V_{MPP} (V)	31.8	Open Circuit Voltage- V_{oc} (V)	41.80
Maximum Power Current- I_{MPP} (A)	17.45	Short Circuit Current- I_{sc} (A)	18.37
Open Circuit Voltage- V_{oc} (V)	38.1	Maximum Power Voltage- V_{mpp} (V)	34.88
Short Circuit Current- I_{sc} (A)	18.56	Maximum Power Current- I_{mpp} (A)	17.35
Module Efficiency η_m (%)	21.2	Module Efficiency (%) ★	21.4

Table 1: Extract from the data sheets for the Trina Vertex TSM-DE19-555W and Risen RSM120-5-605M

As the table shows, both PV modules listed have an MPP current of just under 17.4 A, with the voltage per module being comparable to standard modules on the market to date. The higher MPP current results in higher overall string power than was previously common on the market. This is achieved by giving the individual photovoltaic cells on the PV module a larger surface area, allowing a higher current flow at the same voltage. If less modules have to be installed, the work required for assembly

and commissioning is also reduced - which in turn saves costs. These large PV modules are increasingly used where there is sufficient space for the module installation (open space, roof area on industrial buildings)

In the case of the Risen module listed in the table above, one string therefore delivers approximately 13.4 kW.

$$P_{string} = I_{mpp,modul} * U_{mpp,modul} * \frac{\text{Number of moduls}}{\text{string}} = 17,4 A * 35V * 22 = 13,4 kW$$

3.2 PV modules up to 14A I_{mpp}

Another type of module that is currently establishing itself on the market operates with 13-14 A MPP current. This module type is physically slightly smaller than the 18 A module class. Furthermore, a direct connection can be realized on the Fronius Tauro Precombined with this type of module.

The graphic below shows an excerpt from the data sheet of a well-known module manufacturer. An increase in the MPP current can also be seen here, which is just under 13 A.

Electrical data at STC

Rated power P _{mpp} [Wp]	410.00
P _{mpp} range to	416.49
Rated current I _{mpp} [A]	12.99
Rated voltage V _{mpp} [V]	31.58
Short-circuit current I _{sc} [A]	13.72
Open-circuit voltage U _{oc} [V]	37.60
Efficiency at STC up to	21.30%

Figure 3: Extract from Luxor LX-410M/182-108+ data sheet

Accordingly, string powers of up to **9.85 kW** can be achieved with these PV modules. The smaller modules are used where utilization of the available space is critical, for example on small or angled roofs.

$$P_{string} = I_{mpp,modul} * U_{mpp,modul} * \frac{\text{number of moduls}}{\text{string}} = 12,99 A * 31,58 * 24 = 9,85 kW$$

4 New connection options

Modern PV modules from well-known manufacturers with MPP currents between 14 A and 18 A allow for higher overall string powers, which results in new possibilities when it comes to connecting the Fronius Tauro *Precombined*.

With a standard module with 9 A MPP current (which has been common on the market to date), a total of 12 strings were usually distributed evenly among the 3 MPP trackers of the Fronius Tauro. In this case, 4 strings per MPP tracker were connected via busbars and fused accordingly.

As the graphic below shows, new module technologies are enabling new connectivity options, which in turn leads to significant savings in overall system costs.

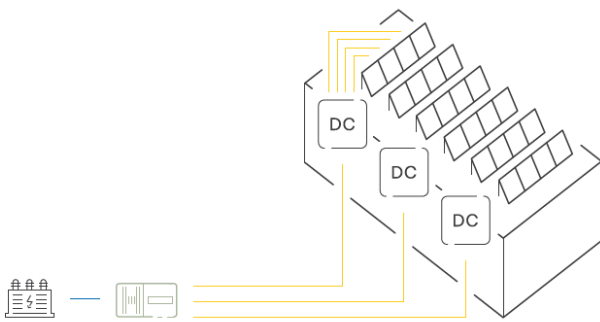


Figure 4: Connection by means of string collector

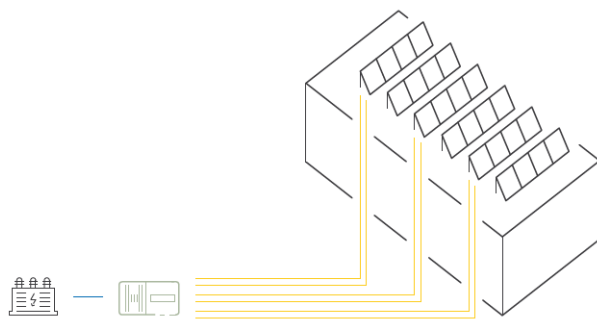


Figure 5: Direct connection by means of cable lugs (6 strings)

As the diagram illustrates, for string configurations with PV modules up to 9 A I_{mpp} , 4 strings each were combined in a general junction box and connected to an MPP tracker of the Fronius Tauro 50-3-P by means of a busbar. Due to the 4 individual strings coming from the module field, corresponding fuses were required for the individual strings.

With the help of the new module classes with an I_{mpp} current of up to 18 A, a direct connection can now also be established with the *Precombined* variant, thereby significantly reducing BOS costs.

Instead of a general junction box, this module class can therefore be used to connect 2 strings in parallel directly to each input of the Fronius Tauro **without a fuse**. The connection can be established either by means of a simple Y-connector in front of the device or by means of two suitable cable lugs directly on the M12 bolt in the connection area of the Tauro.

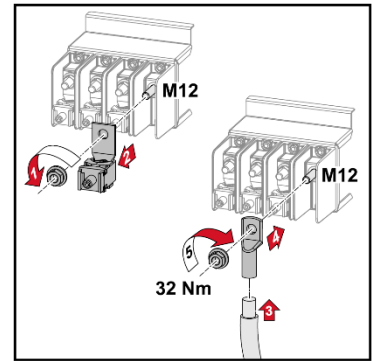


Figure 6: Possible connections with M12 bolt or cable lug to V-type terminals

5 Configuration examples

Based on the new direct connection option, in future the Tauro *Precombined* can also be established as a direct variant in a system in combination with suitable module classes. Direct connection significantly reduces the BOS costs and time required. The following table shows three string configurations of Fronius Tauro 50-3-P with powerful PV modules from well-known and commercially available manufacturers as examples.

Configuration of Trina Vertex TSM-DE19 - 555W	Configuration of Risen RSM120-5-605M	Configuration of Luxor LX-410M/182-108+
<p>String configuration: 5 strings with 24 PV modules</p> <p>I_{mpp} per string: 17.45 A</p> <p>I_{sc} per string: 18.52 A</p> <p>String voltage at 25 °C: 763.2 V (31.8 V_{mpp} per module)</p> <p>Strings per MPP tracker: 1 or 2 strings per MPP</p> <ul style="list-style-type: none"> • 1*18.52 = 18.52 < 72 A (I_{sc,mpp1}) • 2*18.52 = 37.04 < 72 A (I_{sc,mpp2}) • 2*18.52 = 37.04 < 125 A (I_{sc,mpp3}) <p>String power: 763.2*17.45 = 13.32 kW per string</p> <p>Generator output: 5 strings*13.32 kW = 66.59 kW with Tauro 50-3-P (DC/AC = 1.33) at 25 °C</p>	<p>String configuration: 5 strings with 22 PV modules</p> <p>I_{mpp} per string: 17.35 A</p> <p>I_{sc} per string: 18.37 A</p> <p>String voltage at 25 °C: 767.36 V (34.88 V_{mpp} per module)</p> <p>Strings per MPP tracker: 1 or 2 strings per MPP</p> <ul style="list-style-type: none"> • 1*18.37 = 18.37 < 72 A (I_{sc,mpp1}) • 2*18.37 = 36.74 < 72 A (I_{sc,mpp2}) • 2*18.37 = 36.74 < 125 A (I_{sc,mpp3}) <p>String power: 767.36 V *17.35 = 13.32 kW per string</p> <p>Generator output: 5 strings *13.32kW = 66.57kW with Tauro 50-3-P (DC/AC = 1.33) at 25 °C</p>	<p>String configuration: 6 strings with 24 PV modules</p> <p>I_{mpp} per string: 12.99 A</p> <p>I_{sc} per string: 13.72 A</p> <p>String voltage at 25 °C: 757.36 V (31.58 V_{mpp} per module)</p> <p>Strings per MPP tracker: 2 strings per MPP</p> <ul style="list-style-type: none"> • 2*13.72 = 27.44 < 72 A (I_{sc,mpp1}) • 2*13.72 = 27.44 < 72 A (I_{sc,mpp2}) • 2*13.72 = 27.44 < 125 A (I_{sc,mpp3}) <p>String power: 757.36 V *12.99 = 9.83 kW per string</p> <p>Generator output: 6 strings *9.83 kW = 59.03 kW with Tauro 50-3-P (DC/AC = 1.18) at 25 °C</p>

Table 2: Example string configuration with PV modules from commercially available manufacturers

As is clearly apparent, these example string configurations **never require more than 2 strings per MPP tracker** and **string fuses are therefore not** required with this configuration.

The connection of 2 strings per tracker also makes it **easy to detect** any **defect** in a string. A possible defect would mean a 50% reduction in MPP tracker power and can therefore be easily detected by a direct comparison with a fully functional MPP tracker. Eliminating string fuses and general junction boxes also results in a **significant reduction in BOS costs** and **extensive time savings**.

6 Conclusion

As explained, the latest module technology enables more powerful PV module classes with MPP currents of 14-18 A. In PV systems implemented with this type of module, the Fronius Tauro 50-3-P can therefore also be used for decentralized plant design by means of direct connection.

Using Fronius Tauro *Precombined* devices within a decentralized system design offers a number of advantages. Instead of the previously required busbars, up to 2 strings can be connected directly to the integrated V-type terminals of the Tauro *Precombined* for modules with higher MPP amperages. This eliminates the need for fuses and DC junction boxes, which **significantly reduces BOS costs** and also **saves time-consuming installation work**.

This new option of connecting the Fronius Tauro 50-3-P also enables so-called "**double string monitoring**", because, thanks to the connection of 2 strings per tracker, a possible string defect can be easily detected in the Fronius Solar.web monitoring portal - as this would cause a 50% drop in the total power per tracker.

New module technologies therefore not only open up new possibilities when it comes to system design, but also offer great potential for even more cost-efficient projects.