

**Application Note:
Interconnection Guidelines for
Yaskawa Solectria Solar PVI Transformerless Inverters**

PVI 25TL-208
PVI 25TL-480-R
PVI 36TL-480
PVI 36TL-480-V2
PVI 50TL-480
PVI 60TL-480

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1. Interconnection Service Requirements

Yaskawa Solectria Solar PVI line three-phase transformerless inverters prefer a wye configured service with solidly grounded neutral. If the transformer neutral is not connected to ground, additional ground fault detection must be added external to the inverter per NEC 250.21. Acceptable service configurations are depicted in the table below.

While it is preferable to connect these inverters to a service that is a wye with a solidly grounded neutral service, no physical neutral conductor from the transformer to the inverter is required. The optional neutral conductor is used by the inverter for voltage sensing and does not carry current. Therefore, the size of the neutral conductor may be reduced to the same size (not smaller) as the EGC. Ultimate approval of such configuration lies with the authority having jurisdiction (AHJ). Please contact Yaskawa Solectria Solar should you have any questions.

If needed, a delta service is permissible. In a Delta connected system, the inverter does not detect AC Side Ground Faults. Only DC Side Ground Fault protection is provided by the inverter. Additional AC ground fault detection must be added external to the inverter per NEC 250.21.

Acceptable Service Configurations

Inverter Transformer Winding	Inverter Configurations	Utility Windings	Inverter Compatibility
<p>Wye grounded w/ Neutral</p> <p>*If transformer neutral not connected to ground, additional ground fault detection must be added external to the inverter</p>		<p>WYE, Grounded-WYE, Delta</p>	<p>Compatible (Preferred)</p>
<p>Delta</p> <p>**In a Delta Connected system, inverter does NOT detect AC side ground faults. Only DC side ground fault protection is provided by the inverter. Additional detection is required by NEC 250.21</p>		<p>WYE, Grounded-WYE, Delta</p>	<p>Compatible (Allowed, but not preferred)</p>
<p>Other Configurations</p>	<p>All other configurations that are not described above</p>		<p>Not Compatible, Use Intermediary Transformer</p>

2. Paralleling Multiple Inverters

2.1 Maximum Numbers of Inverters in Parallel

The following Yaskawa Solectria Solar three-phase, transformerless inverters may be connected in parallel to one common point of connection in a single building block using up to the following number of inverters:

Inverter Model	Allowed Parallel Qty.
PVI 25TL-208	70 inverters per transformer
PVI 25TL-480-R, PVI 36TL-480, PVI-36TL-480-V2, PVI 50TL-480, PVI 60TL-480	70 inverters per transformer (any combination of inverter models)

2.2 Direct Connection to Grid Service

Yaskawa Solectria Solar’s PVI xxTL line of three phase transformerless inverters may be installed in parallel with AC output at a single point of connection creating a low voltage building block. The low voltage blocks may then be connected directly to a grid service without a step up transformer if the inverter AC voltage matches the supply voltage. The requirements for this set-up are:

1. The grid’s nominal voltage/frequency and variation range shall follow U.S. grid standard/code.
2. The inverter AC voltage shall match the supply voltage.
3. System voltage drop between the inverter’s output and the grid connection point should not significantly affect the grid voltage at the inverter. If the system AC voltage drop is too high, the inverter will disconnect from the grid due to excessive voltage. The AC side wiring voltage drop should be limited to minimize the power loss in the wires. **Therefore, Yaskawa Solectria Solar recommends the voltage drop be < 2% of Vnom (nominal AC voltage) at maximum power production.** The temperature rise in cables and the ambient temperature should be considered in the voltage drop calculation.

Inverter Model	Nominal Voltage
PVI 25TL-208	208/120 VAC
PVI 25TL-480-R, PVI 36TL-480, PVI 50TL-480, PVI 60TL-480	480/277 VAC

2.3 Connection via Transformer

The use of a transformer is acceptable if required to step-up/down nominal voltage and/or to comply with the above acceptable service configurations for Yaskawa Solectria Solar's PVI xxTL line of three-phase transformerless inverters.

If the connection to the grid is through a transformer, then the following additional requirements apply:

1. The transformer short circuit impedance (Z%) shall be no greater than 6%.
2. No oversizing of the transformer is required by Yaskawa Solectria Solar. However, the transformer VA rating shall be at least 100% the sum of the kVA ratings of all the inverters connected to it.
3. The transformer does not require a static shield.
4. Additionally, it is suggested that the transformer be selected based on IEEE C57.159-2016 Guide on Transformers for Application in Distributed Photovoltaic (DPV) Power Generation Systems and IEEE C57.91-2011 Guide for Loading Mineral Oil Immersed Transformers. It is the responsibility of the system designer to determine the reliability of the transformer and other system parameters.

Example 1: 3MW building block with PVI 60TL-480 inverters, standard (default) mode

PVI 60TL-480 inverters have a standard continuous apparent output power rating of 60kVA. If fifty (50) of these inverters were paralleled onto one winding of a transformer, the minimum rating of the transformer should be calculated in the following manner:

(# inverters) x (inverter apparent power rating) = minimum apparent power rating of transformer
 $50 \times 60\text{kVA} = 3,000\text{kVA}$ or 3.0MVA

A transformer with a **minimum** rating of 3.0MVA may be used with (50) PVI 60TL-480 inverters connected in parallel to a secondary winding or to the low voltage side of the transformer if run in the default mode of 60kVA.

Example 2: 3MW building block with PVI 60TL-480 inverters, apparent power overhead mode (via password protected selection)

PVI 60TL-480 inverters have a continuous apparent output power rating of 66kVA when run in the Apparent Power Overhead mode. If fifty (50) of these inverters were paralleled onto one winding of a transformer, the minimum rating of the transformer should be calculated in the following manner:

(# inverters) x (inverter apparent power rating) = minimum apparent power rating of transformer
 $50 \times 66\text{kVA} = 3,300\text{kVA}$ or 3.3MVA

A transformer with a **minimum** rating of 3.3MVA may be used with (50) PVI 60TL-480 inverters connected in parallel to a secondary winding or to the low voltage side of this transformer in Apparent Power Overhead mode.

Conclusion

System designs utilizing multiple inverters in parallel shall follow the above recommendations. Additional requirements for installation of these inverters can be found in their respective Installation and Operation Manuals (<https://www.solectria.com/support/documentation/>). It is recommended that customers contact a Yaskawa Solectria Solar Application Engineer to review projects with complex AC system designs.

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For further questions, please contact:

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