

Application Note: Interconnection Guidelines for Yaskawa Solectria Solar Transformerless Inverters

PVI-23TL-480, PVI-28TL-480, PVI-36TL-480
PVI-50TL-480, PVI-60TL-480
XGI 1000-50/60-UL, XGI 1000-60/60-UL
XGI 1000-60/65-UL, XGI 1000-65/65-UL
XGI 1500-125/125-UL, XGI 1500-125/150-UL
XGI 1500-150/166-UL, XGI 1500-166/166-UL

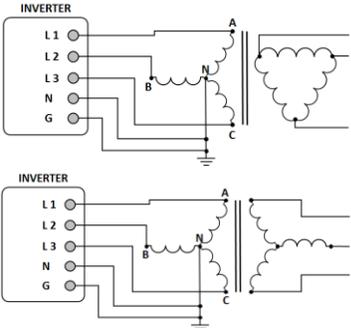
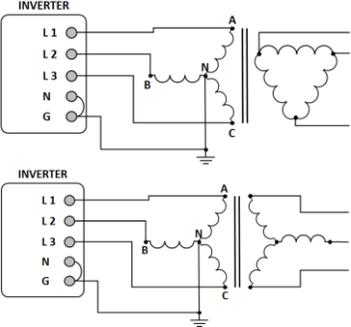
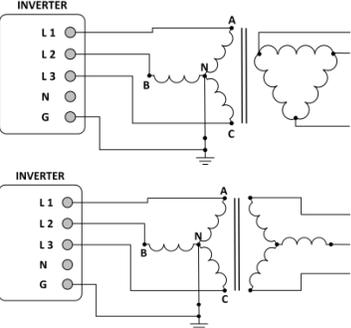
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1. Interconnection Service Requirements

Yaskawa Solectria Solar three-phase transformerless inverters require a wye with solidly grounded neutral service. The 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. Acceptable service configurations are depicted in the table below.

It is permissible to connect the neutral terminal of the inverter to ground inside the inverter wiring box through the use of a jumper. In this configuration, no neutral conductor is required. If terminated properly this connection will not impact the function of the inverter or create an unsafe condition. Ultimate approval of such configuration lies with the authority having jurisdiction (AHJ). Please contact Yaskawa Solectria Solar should you have any questions.

Acceptable Service Configurations

Description	Configuration	Inverter Compatibility
Wye w/ Neutral		Compatible (Preferred)
Wye w/ Neutral Jumper on inverter		Compatible (Consult Local AHJ)
*XGI 1500 ONLY Wye w/ No Neutral Jumper on inverter		Compatible (Consult Local AHJ)
Other Configurations	All other configurations that are not a grounded wye	Not Compatible, Use Intermediary Transformer

2. Paralleling Multiple Inverters

2.1 Maximum Numbers of Inverters in Parallel

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-23TL-480, PVI-28TL-480, PVI-36TL-480, PVI-50TL-480, PVI-60TL-480	70 inverters per transformer
XGI 1000-50/60-UL, XGI 1000-60/60-UL, XGI 1000-60/65-UL, XGI 1000-65/65-UL	60 inverters per transformer
XGI 1500-125/125-UL, XGI 1500-125/150-UL, XGI 1500-150/166-UL, XGI 1500-166/166-UL	30 inverters per transformer

2.2 Direct Connection to Grid Service

Yaskawa Solectria Solar 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-23TL-480, PVI-28TL-480, PVI-36TL-480, PVI-50TL-480, PVI-60TL-480	480/277 VAC
XGI 1000-50/60-UL, XGI 1000-60/60-UL, XGI 1000-60/65-UL, XGI 1000-65/65-UL	480/277 VAC
XGI 1500-125/125-UL, XGI 1500-125/150-UL, XGI 1500-150/166-UL, XGI 1500-166/166-UL	600/347 VAC

2.3 Connection via Transformer

The use of a transformer is acceptable if required to step-up/down nominal voltage and/or to provide a wye with solidly grounded neutral as required for Yaskawa Solectria Solar three-phase transformerless inverters.

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

1. The transformer impedance 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 the sum of the kVA ratings of all the inverters connected to it.
3. 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 XGI 1000-60/60-UL inverters

XGI 1000-60/60-UL inverters have a 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 is calculated by the following:

(# 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) XGI 1000-60/60-UL inverters connected in parallel to a secondary winding or to the low voltage side of the transformer.

Example 2: 3MW building block with XGI 1000-60/65-UL inverters

XGI 1000-60/65-UL inverters have a continuous apparent output power rating of 65kVA. If fifty (50) of these inverters were paralleled onto one winding of a transformer, the minimum rating of the transformer is calculated by the following:

(# inverters) x (inverter apparent power rating) = minimum apparent power rating of transformer
 $50 \times 65\text{kVA} = 3,250\text{kVA}$ or 3.25MVA

A transformer with a **minimum** rating of 3.25MVA may be used with (50) XGI 1000-60/65-UL inverters connected in parallel to a secondary winding or to the low voltage side of this transformer.

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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