

**Power-One Aurora Inverter:
Conformity of Aurora string inverters to the Technical Guideline
UTE C 15-712-1 (July 2010 edition)**

“Photovoltaic installations connected to the public low voltage distribution network”

SCOPE

This document provides an official statement from Power-One about the conformity of Aurora transformer-less and high frequency transformer isolated string inverters to the UTE C 15-712-1 July 2010 edition technical guideline.

APPLICABLE AREA

The document refers to the inverters listed in table no.1 and table no.2 in the following.

TRANSFORMER-LESS INVERTER CONFORMITY

The inverters listed in below table are conforming to the following relevant requirements of the UTE C 15-712-1 standard.

Type	Model
<i>Transformer-less Single-phase Inverter</i>	PVI-2000-FR, PVI-2000-OUTD-FR
	PVI-3600-FR
	PVI-3.0-TL-OUTD, PVI-3.0-TL-OUTD-S (*)
	PVI-3.6-TL-OUTD, PVI-3.6-TL-OUTD-S (*)
	PVI-4.2-TL-OUTD, PVI-4.2-TL-OUTD-S (*)
	PVI-6000-TL-OUTD, PVI-6000-TL-OUTD-S (*)
<i>Transformer-less Three-phase Inverter</i>	PVI-10.0-TL-OUTD, PVI-10.0-TL-OUTD-S (*), PVI-10.0-TL-OUTD-FS (*)
	PVI-12.5-TL-OUTD-FR, PVI-12.5-TL-OUTD-S (*), PVI-12.5-OUTD-TL -FS (*)
	TRIO-20.0-TL-OUTD-400, TRIO-20.0-TL-OUTD-400-S2 (*), TRIO-20.0-TL-OUTD-400-S2F (*), TRIO-20.0-TL-OUTD-400-S2X (*)
	TRIO-27.6-TL-OUTD-400, TRIO-27.6-TL-OUTD-400-S2 (*), TRIO-27.6-TL-OUTD-400-S2F (*), TRIO-27.6-TL-OUTD-400-S2X (*)

Table no.1: Power-One transformer-less inverters the document refers to.

- The inverters integrate a Residual Current Monitoring Unit (RCMU), to detect ground faults in compliance with the DIN VDE 0126-1-1 requirements.
- The Residual Current Monitoring Unit is sensitive to all components of the ground fault current, including the DC components.
- In case the residual current (shown as I_{leak}) exceeds the limits specified in the VDE 0126-1-1 standard, the inverters immediately disconnect from the grid. A visual alarm is also generated upon detection of the ground fault.
- In compliance with VDE 0126-1-1, all inverters integrate an insulation resistance to ground surveillance and protection system.
- The DC insulation resistance (shown as R_{iso}) is measured every day at the start-up and for all cases after any grid disconnection event, before the inverter initiate the grid-connection sequence (with the inverter not connected to the grid).
- In case the measured value of the insulation resistance to ground is below the limit specified in the VDE 0126-1-1 standard, the inverters do not connect to the grid. A visual alarm is also generated upon detection of the low insulation resistance fault.
- The inverters provide the additional PE connection. Please refer to application note **Inv_Str-All_Add. GND Connection** for details.

Notes:

(*) The UTE C 15-712-1 requires, for emergency purposes, that an EXTERNAL load-breaking disconnect switch shall be installed on the DC side of the system.

The load-breaking disconnect switch installed on all “S”, “FS”, “S2”, “S2F” and “S2X” variants of the Aurora inverters, shall be considered compliant to the basic requirements of UTE C 15-712-1, as additional and auxiliary protection devices.

In addition, in case string over current protection is needed, this function shall be accomplished with appropriate series fuses installed on BOTH polarities of each string.

The series fuses on the positive inputs additionally integrated in the “FS” variants or with the series fuses on both inputs (positive and negative) additionally integrated in the “S2F” and “S2X” variants, shall be considered compliant to the basic requirements of UTE C 15-712-1, as additional and auxiliary protection devices.

HIGH FREQUENCY TRANSFORMER ISOLATED INVERTER CONFORMITY

The inverters listed in table no.2 are the ones which integrate a high-frequency isolation transformer. In these inverters there is the possibility of PV generator grounding.

The inverters listed in table no.2 are conforming to the following relevant requirements of the UTE C 15-712-1 standard.

Type	Model
Transformer-less Single-phase Inverter	UNO-2.0-I-OUTD, UNO-2.0-I-OUTD-S (*)
	UNO-2.5-I-OUTD, UNO-2.5-I-OUTD-S (*)
	PVI-3.8-I-OUTD, PVI-3.8-I-OUTD-S (*)
	PVI-4.6-I-OUTD, PVI-4.6-I-OUTD-S (*)
PV HF-isolated 3-phase Inverter	PVI-10.0-I-OUTD, PVI-10.0-I-OUTD-S (*)
	PVI-12.0-I-OUTD, PVI-12.0-I-OUTD-S (*)

Table no.2: Power-One high-frequency isolated inverters the document refers to.

- In case no grounding is selected (floating PV generator):
 - All inverters integrate an insulation resistance to ground surveillance and protection system.
 - The DC insulation resistance (shown as Riso) is measured prior the connection to the grid. The inverters do not connect to the grid if the isolation impedance of PV generator is lower than a configurable threshold (default value: 200kOhm value); in this case a visual alarm is shown. This check is performed every day at the start-up and for all cases after any grid disconnection event, before the inverter initiate the grid-connection sequence (with the inverter not connected to the grid).
 - During the grid parallel operation, the inverters continuously check the isolation of the PV generator by positive terminal and negative terminal voltage measurement respect to ground. This measurement is used to evaluate the insulation resistance: in case the insulation resistance is lower than a configurable threshold (default value: 200kOhm value), the inverter disconnect from the grid.
- In case of grounding (positive or negative grounded PV generator):
 - All inverters integrate an insulation resistance to ground surveillance and protection system. The ground connection is made inside the inverters through a PTC resistor (please refer to application note **Inv_Str-HF_Iso Ctrl and GND Method** for details).
 - The DC insulation resistance is measured prior the connection to the grid removing the grounding connection inside the inverter. The inverters verify the isolation impedance of PV generator: if this is higher than a configurable threshold (default value: 200kOhm value) the inverters connect to the grid. This check is performed every day at the start-up and for all cases after any grid disconnection event, before the inverter initiate the grid-connection sequence (with the inverter not connected to the grid). In case the isolation impedance is lower than set threshold, the inverters do not connect to the grid and show a visual alarm.
 - All inverters integrate a continuous monitoring of DC-side leakage current by measuring the voltage across the grounding resistor (shown as Vgnd); the control disconnects the inverter from the grid in case the voltage exceeds a fixed threshold and shows a visual alarm.
- The inverters provide the additional PE connection. Please refer to application note **Inv_Str-All_Add. GND Connection** for details.

Notes:

(*) The UTE C 15-712-1 requires, for emergency purposes, that an EXTERNAL load-breaking disconnect switch shall be installed on the DC side of the system.

The load-breaking disconnect switch installed on all “S” variant of the Aurora inverters, shall be considered compliant to the basic requirements of UTE C 15-712-1, as additional and auxiliary protection devices.