Module Grounding in Single-phase Xantrex GT-SP and Xantrex GT-AU Series Inverters

Technical Note

GT5.0-SP and GT5.0-AU

976-0229-01-01 Rev. C

THIS TECHNICAL NOTE IS IN ADDITION TO, AND INCORPORATE BY REFERENCE, THE RELEVANT PRODUCT MANUAL FOR THE GT5.0-SP AND GT5.0-AU INVERTERS. BEFORE REVIEWING THIS TECHNICAL NOTE YOU MUST READ THE PRODUCT MANUAL.

Module Grounding

The Spanish (-SP) and Australian/New Zealand (-AU) GT series single-phase inverters are designed for use with floating PV arrays, and they are provided with ground fault protection that measures the array impedance to ground, which should be a high value in a floating system and trips if the value falls too low. However, certain thin-film modules must be grounded to ensure their optimal performance. This Technical Note provides details on how to ground the PV array with GT Series Spanish (GT2.8-SP, GT3.8-SP and GT5.0-SP) and Australian/ New Zealand (GT2.8-AU and GT5.0-AU) model inverters by connecting one of the terminals of the string to ground through a fuse.

To make this grounded array setup work properly and safely, two main points must be taken into account:

1. Grounding must be done via a safety agency certified fuse for 600 VDC. The fuse is mandatory to prevent potential fire hazards due to ground fault currents reaching dangerous levels. However, to avoid dangerous situations, it is also mandatory to stop the inverter operation if the fuse is blown and signal a fault. This can be achieved in the GT series inverters by using a fuse and fuseholder with a trip indicator, and then feeding the indicator signal into one of the auxiliary ports, which will trigger a shutdown. The inverter will stop operation and signal a fault if pins 1 and 4 (the two outermost contacts of the auxiliary [RJ-11] port) are short circuited.
2. The internal ground fault detector must be disabled. This is done using the GT-SP/AU Config software.

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Do not disable the internal ground fault detector unless the system is provided with an external ground fault fuse with a trip indicator circuit connected to the auxiliary port as described above.

Test that the indicator circuit properly shuts down the inverter before putting the system into operation.

Failure to follow these instructions will result in death or serious injury.

Circuit Isolation and Fuse and Fuse Holder Selection

In the electronics industry, there are special fuses provided with a trip indicator: a small pin that moves when the fuse trips and is used to activate a micro-switch. The micro-switch, generally located in the fuseholder, provides a galvanically isolated voltage-free circuit (so called “dry-contacts”) which can be used to stop the inverter. Use only this type of fuse and fuseholder.

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Do not apply external voltage to the auxiliary connector under any condition.

Use only an indicator fuse and fuseholder combination that provides galvanic isolation between the PV circuit and the auxiliary connector circuitry.

Failure to follow these instructions will result in death or serious injury.

The external ground fault system must be designed so that it does not apply any voltage to the auxiliary connector under normal or ground fault conditions. A fuse holder that provides galvanic isolation between the fuse and the fuse holder's trip indicator circuit must be used so that the auxiliary connector circuitry is isolated from any electrical connection to the fuse and the PV system. In some cases, a relay might need to be added to ensure separation of the PV system from the GT auxiliary connector circuitry.

The fuse selected must be rated at least 600 VDC. The size (trip rating) of the fuse should be no more than 1 A, or as required by local regulations regarding ground fault protection.

As an example, the following parts may be used to ground the array:

Fuse: Ferraz-Shawmut Catalog Number FD27GRB66V1T. 1 A DC Ferrule Fuse of the gRB series with a rated voltage of 660 VDC and a trip indicator used to activate the micro-switch in the matching fuse holder.

Fuse Holder: Ferraz-Shawmut Catalog Number US271M (with micro-switch) or US271M I (with micro-switch and visual indicator).

Figure 1 Fuse Holder

Where more than one PV string feeds a single inverter, only ground one of the strings since the GT inverter puts the two strings (GT2.8-SP, GT3.8-SP, and GT2.8-AU models) or up to three strings (GT5.0-SP and GT5.0-AU models) in parallel internally. Grounding more than one string would result in reduced ground fault protection, current flowing in ground loops, and blown fuses.

GT5.0-SP and GT5.0-AU Positive Grounding

Negative grounding of the GT5.0-SP and GT5.0-AU models will work in the above manner, but for positive grounding other factors have to be considered. The GT5.0 contains an internal 3-string combiner which, if used with three strings, must be provided with combiner fuses. The product design places those internal combiner fuses in the PV positive conductors. Since overcurrent protection must always be in the ungrounded conductors, a positive-grounded PV system is not allowed if the unit is set up this way. Furthermore, the maximum input current rating of each of the three inputs on the GT5.0 is 15 ADC, so it is not possible to connect the full PV input power through just one input. To solve these problems, the installer must not use the internal combiner. An external fused combiner must be used, and then two sets of positive and negative wires must be run from the external combiner box into two of the inputs of the GT5.0. Combiner fuses would not be installed inside the inverter – they would be in the external combiner and would be installed in the negative conductors.

Connections

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Follow all requirements for personal protective equipment and safe work methods when following these instructions.

De-energize the PV circuit by covering the array with opaque material or opening all PV disconnect switches before working on the PV circuit.

Disconnect the inverter system from the grid by opening the AC disconnect or breaker before proceeding.

Route and secure the signal wiring from the fuseholder to the auxiliary connector away from all wiring and live parts in the PV and AC circuits.

Failure to follow these instructions will result in death or serious injury.

Connection of the fuse and fuse holder to ground and to the terminal of the array must be done with insulated wire rated 600 VDC and sized according to local regulations for system grounding conductors. Note that the fault current available through this grounding path is limited to the value of the fuse selected, so normally these conductors do not need to be sized for the full array current or array short-circuit current. The wire size must be adequate to ensure a low impedance path that allows sufficient current to flow to trip the ground fault fuse.

Connect the Common and Normally Open contacts of the fuseholder trip indicator circuit to pins 1 and 4 of either of the two auxiliary ports on the inverter. Use standard telephone cable with an RJ-11, 4-wire connector at the end that will connect to the auxiliary connector on the GT inverter. Connect the other end of the telephone cable to the fuseholder terminals by whatever method the terminals are intended for. Make sure the telephone cable is routed and secured away from cabling and live parts of the PV and AC systems. See Figure 2 on page 5.

Use an ohm-meter to check the wiring to make sure the trip indicator Common and Normally Open contacts are wired to pins 1 and 4 of the auxiliary connector and to verify that there is no connection between the PV circuit/fuse and the trip indicator/auxiliary connector circuits.

Circuit Operation

Under normal conditions, the fuse is not tripped, the indicator circuit will be in its normally open condition, pins 1 and 4 will not be short-circuited, and the inverter will operate normally. If the fuse is blown, the indicator circuit will short pin 1 to pin 4, the inverter will shut down, a fault will be displayed on the LCD, and a fault message will be sent on the Xanbus™ port to any connected Xanbus-enabled equipment.

It might be required to make sure that other inverters in the system also shut down when one unit trips off due to a ground fault, for example in a 3-phase system. In this case, additional cables can be daisy-chained from the unused auxiliary connector on the unit to which the ground fault fuse trip indicator is connected to one of the auxiliary connectors on each of the other inverters in the system. Daisy-chain cable configurations will work for up to six inverters, as long as each cable is less than five meters long.

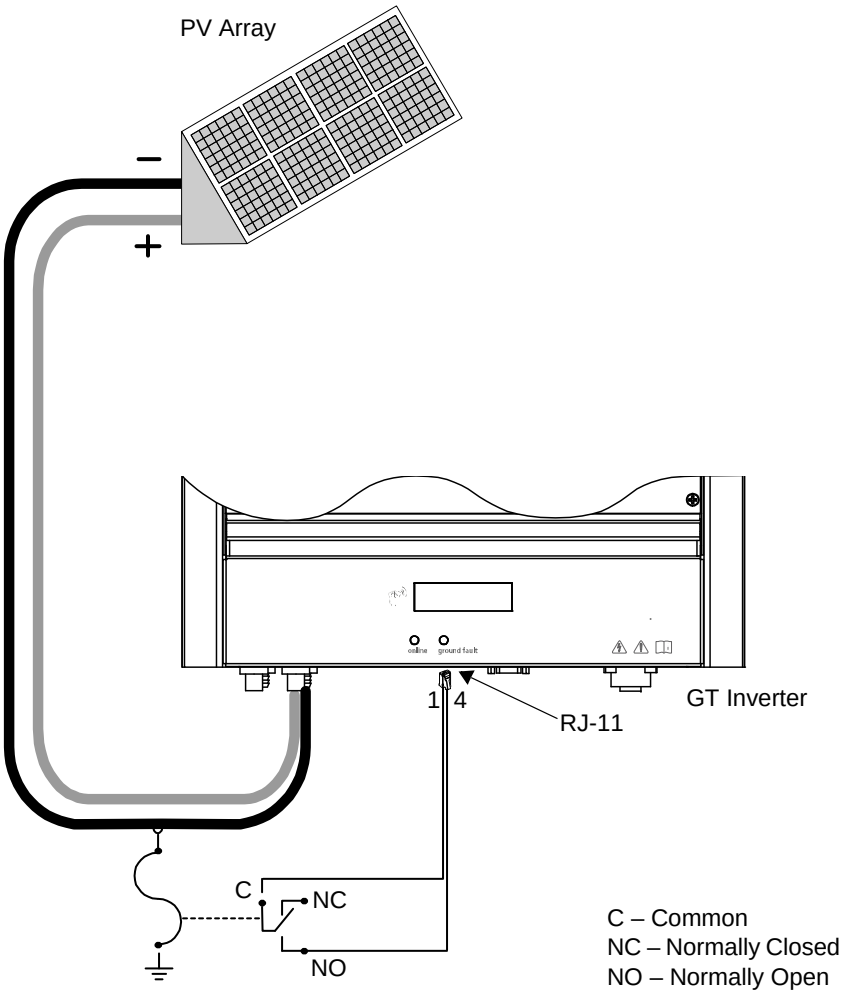

Figure 2 Connections (PV Negative Ground Configuration Shown)

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When applying the methods in this Technical Note, a ground fault will result in the fault message, *External Shutdown*. The message will not indicate a ground fault and the Ground Fault LED will not illuminate. If the *External Shutdown* fault is present, normally grounded conductors of the PV array may be ungrounded and at hazardous voltage.

Follow all requirements for personal protective equipment and safe work methods, and de-energize or disconnect the array, before attempting to clear the ground fault and resume operation.

It is the responsibility of whoever is applying the methods in this Technical Note to train the system operator and service personnel regarding the possibility that a ground fault is causing the *External Shutdown* fault message, the resulting hazards that may be present, and appropriate actions and protection needed to avoid the hazards.

Failure to follow these instructions will result in death or serious injury.

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