Bulletin 64-2-5
Grounding and bonding of solar photovoltaic systems
Rules 64-064, 64-066, 64-068, 64-070 and 64-222

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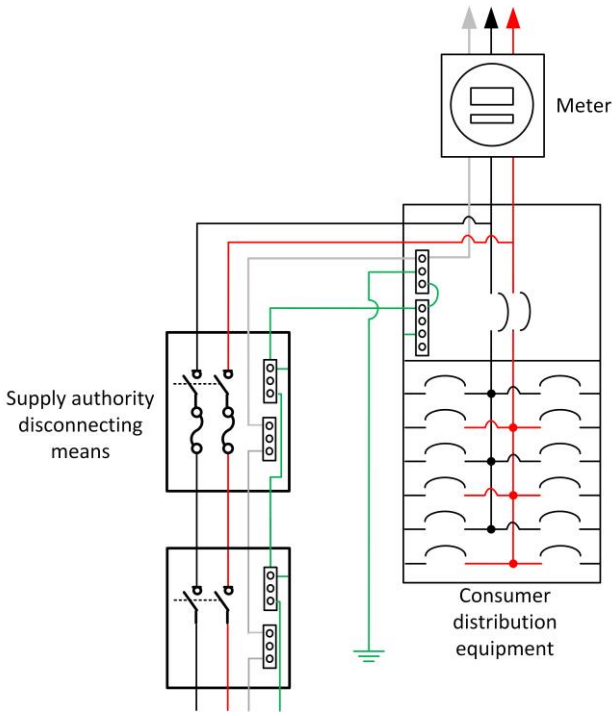
Scope

1) Grounding of solar photovoltaic system output, ac grounding
2) Grounding of ac modules and micro-inverters
3) Functionally Grounded Systems
4) Bonding

1) Grounding of solar photovoltaic system output, ac grounding

Diagram B1 shows the connection of solar photovoltaic (PV) systems where the PV system is connected on the line side of the service box. The utility disconnecting means is required to be an approved service box. Rule 10-210 d) requires the grounded conductor of a solidly grounded ac system supplied by the supply authority shall have no other connection to the non-current-carrying conductive parts of electrical equipment on the supply side or the load side of the grounding connection. Bonding from the system grounding enclosure to the utility disconnecting means, as well as to the inverter, shall be maintained.

Diagram B1 – PV system is connected on the line side of the service box



Question 1
For distributed generation systems where the generator(s) and inverter(s) are located remotely from the utility interface switch and meter base, is it permitted to re-establish grounding of the identified (neutral) conductor at the remote location in lieu of carrying the circuit bonding conductor with the circuit conductors?

Answer 1
No, it is not permitted to re-establish grounding of the identified (neutral) conductor at the remote location.

Rationale 1
The grounded conductor of a solidly grounded ac system supplied by the supply authority shall have no other connection to the non-current-carrying conductive parts of electrical equipment on the supply side or the load side of the grounding connection as per Rule 10-210 d).

2) Grounding of ac modules and micro-inverters

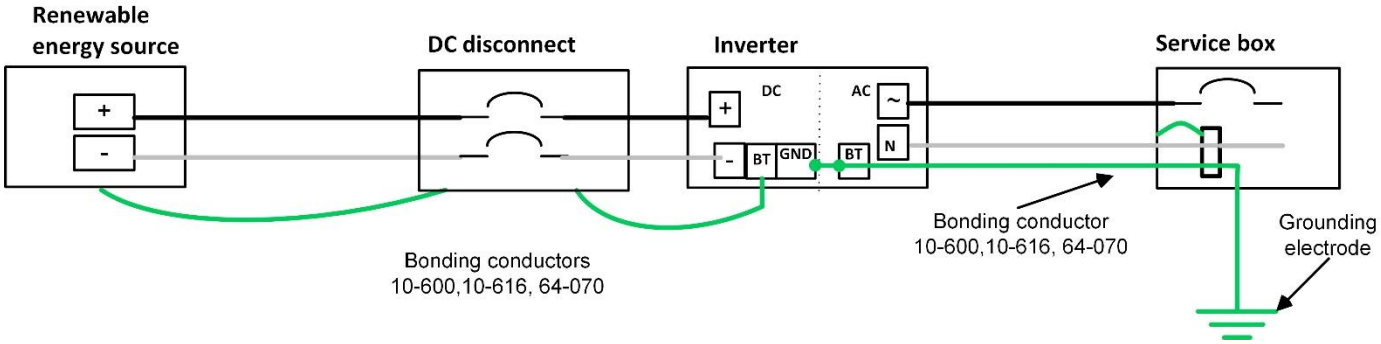
Rule 64-002 defines an ac module and Bulletin 64-5-* provides clarification for ac module unique installation requirements.

For ac modules where the inverter is an integral part of the generator (i.e. photovoltaic system) and there is no accessible dc wiring, there is no requirement or provision for dc grounding.

3) Functionally Grounded Systems

Rule 64-066 2) permits 2 wire PV source and output circuits to be functionally grounded and Rule 64-066 10) does not require them to be connected to a grounding conductor or grounding electrode. Functionally grounded systems shall be connected to an AC bonding conductor sized and installed in accordance with section 10 requirements as shown in diagram B6.

Diagram B6 – Functionally grounded systems



4) Bonding

Rule 64-224 requires exposed, non-current carrying metal parts of photovoltaic modules to be bonded in accordance with Section 10. The bonding conductor shall be sized as per Rule 10-616 and shall be not less than that given in Table 16.

The equipment bonding conductor shall be installed in accordance with Rule 10-612 7) and 8) requirements. Rule 10-612 7) b) and 8) b) require a bonding conductor smaller than No. 6 AWG copper or No. 4 AWG aluminum respectively, to be installed and protected in the same manner as the circuit conductors, or be installed in a raceway or armoured cable.

In accordance with Rule 64-224 4) requirements, the connection to a module or panel shall be arranged so that removal of a single module or panel from a photovoltaic source circuit shall not interrupt bonding continuity to the inverter or controller. Photo B1 is an example of non-compliant installation.

Photo B1 – Unacceptable bonding conductor connection



There is more than one way to satisfy this Rule requirement, e.g. bonding the frame, where the frame is electrically continuous or connecting the bonding conductor, as per Photo B2. Photo B2 shows a bonding conductor that is continuous through the two bonding clamps, so that the panel can be removed without interrupting the continuity of the uncut conductor.

Photo B2 – Example of acceptable connection of bonding conductor



A bonding means for modules shall be installed per the module manufacturer instructions and Rule 64-224 2), in order to minimize deterioration from galvanic action that may result from the combination of dissimilar metals, as referenced by Rule 10-504.

Question 2
When PV racking is used as the bonding means for PV modules or panels, is the racking required to be approved for the purpose?

Answer 2
Yes, as per Rules 02-022 and 02-024.

A PV racking system is required to be approved in order to verify that the metal structure is electrically continuous and represents the adequate continuation of the bonding path for modules and panels.

Approval options:

- Approval agency programs, such as the one created by CSA, LTR AE-001-2012;
- UL standard, UL 2703 *Mounting Systems, Mounting Devices, Clamping/ Retention Devices, and Ground Lugs for Use with Flat-Plate Photovoltaic Modules and Panels;* or
- Field evaluation

Notes

- UL Standard, UL2703 *Mounting Systems, Mounting Devices, Clamping/Retention Devices, and Ground Lugs for Use with Flat-Plate Photovoltaic Modules and Panels* is permitted in Ontario, since there is no specific applicable Canadian standard or TIL (Technical Information Letter) for certification of PV racking systems.
- List of Technical Requirements (LTR) AE-001-2012 takes into consideration: bonding and grounding, corrosion protection, metal compatibility, mechanical strength, construction requirements for metal parts and parts made of polymeric material, etc.