

Bulletin 64-2-0
Grounding and bonding of solar photovoltaic systems
Rules 64-064, 64-066, 64-068, 64-070 and 64-222

Issued May 2016
 Supersedes Bulletin 50-2-4

Scope

- (1) Introduction
- (2) Grounding of solar photovoltaic system output, ac grounding
 - (a) Grounding of the utility disconnecting means that is required to be a service box
 - (b) Grounding of solar photovoltaic systems located remotely from the utility interface switch
- (3) Grounding of ac modules and micro-inverters
- (4) Bonding

(1) Introduction

Solar photovoltaic systems are now included in Section 64 “Renewable Energy Systems”. Rules 64-064, 64-066, 64-068 and 64-070 state the grounding and bonding requirements for Renewable Energy systems.

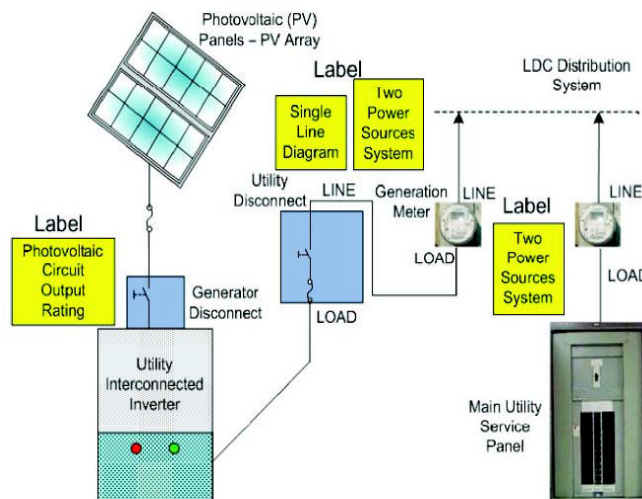
(2) Grounding of solar photovoltaic system output, ac grounding

For parallel connection of solar photovoltaic systems, depending on the point of connection, the utility disconnecting means may be required to be an approved service box, as per Diagrams B1 and B3.

- Diagram B1 shows the parallel connection of solar photovoltaic systems where the PV system is directly connected to the supply authority. The utility disconnecting means is required to be an approved service box. In accordance with Rule 10-204, the utility disconnecting means is required to be grounded, as per Rule 10-106(1) requirements.

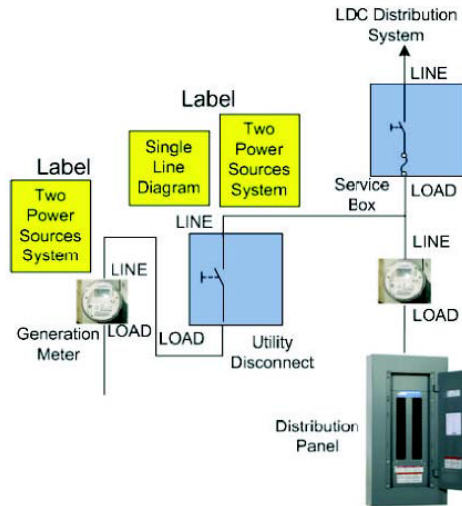
The same requirements related to Diagram B1 are applicable where the PV system is indirectly connected to the supply authority, on the line side of the customer meter.

Diagram B1 – PV system is directly connected to the supply authority



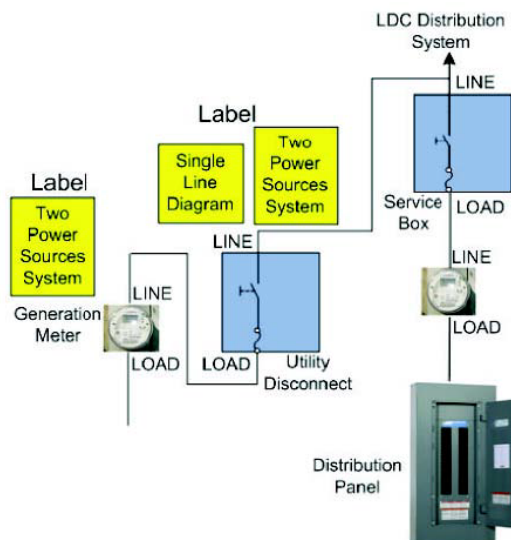
- Diagram B2 shows the parallel connection of solar photovoltaic systems where the PV system is indirectly connected to the supply authority, on the load side of the service box. The utility disconnecting means is not required to be an approved service box. Rule 10-204(1)(c) requires that no connection between the grounded circuit conductor and ground be made on the load side of the service disconnecting means. It is important not to connect the neutral conductor to the generation meter enclosure, in order to eliminate parallel paths for neutral current. The neutral bonding jumper in the generation meter enclosure shall be removed or the neutral block shall be isolated from the meter base, to prevent unintentional connection. Bonding from the meter enclosure to the utility disconnecting means, as well as to the inverter, shall be maintained.

Diagram B2 – PV system is indirectly connected to the supply authority, on the load side of the service box



- Diagram B3 shows the parallel connection of solar photovoltaic systems where the PV system is indirectly connected to the supply authority, on the line side of the service box. The utility disconnecting means is required to be an approved service box. In accordance with Rule 10-204, the utility disconnecting means is required to be grounded, as per Rule 10-106(1) requirements. The same requirements of not connecting the neutral conductor to the generation meter enclosure, as clarified in Diagram B2, are applicable.

Diagram B3 – PV system is indirectly connected to the supply authority, on the line side of the service box



(a) Grounding of the utility disconnecting means, that is required to be a service box

Where the utility disconnecting means is required to be an approved service box, to satisfy Rule 10-204 requirements, the utility disconnect service box shall be grounded to:

- a new grounding electrode installed for the new service box. The two grounding electrodes (the new and the existing) shall be interconnected, as per Rule 10-702 requirements (as per Diagram B4); or
- the new service box is grounded to the existing grounding electrode (as per Diagram B5)

Diagram B4 – Service box grounded to a new grounding electrode

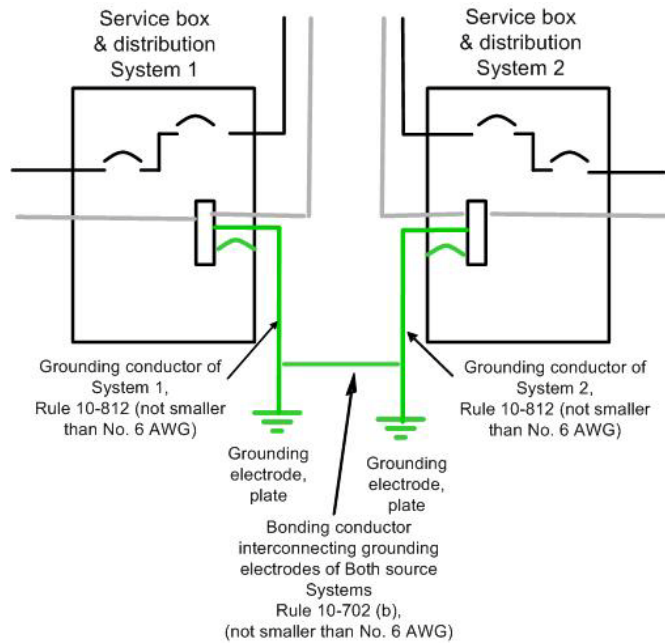
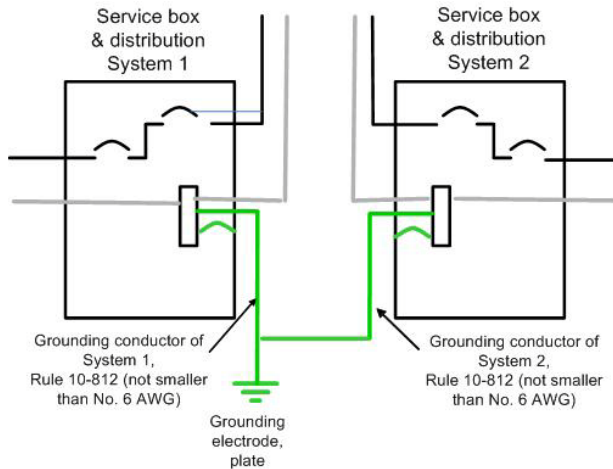


Diagram B5 – Service box grounded to the existing grounding electrode



(b) Grounding of solar photovoltaic systems located remotely from the utility interface switch

Question 1

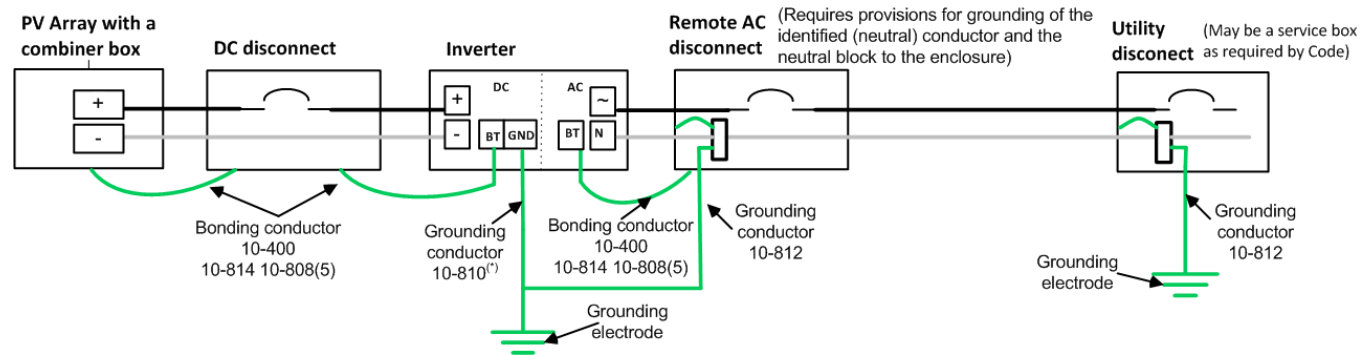
For Distributed Generation systems where the generator(s) and inverter(s) are located remotely from the utility interface switch and meter base, is it permitted to re-establish grounding of the identified (neutral) conductor at the remote location, in accordance with Rule 10-208(a), in lieu of carrying the circuit bonding conductor with the circuit conductors?

Answer 1

Yes, it is permitted to re-establish grounding of the identified (neutral) conductor at the remote location, provided that the conductor is routed from the utility interface switch (service box) to the remote location and is grounded in a Code compliant manner. Examples of acceptable remote locations where the grounding is permitted to be re-established:

- A disconnect switch that has provisions for grounding of the identified (neutral) conductor as well as bonding of the neutral block to the switch/device enclosure as per Diagram B6.
- An inverter that has a provision for grounding of the identified (neutral) conductor and termination of the grounding conductor.

Diagram B6 – Grounding of solar photovoltaic systems at a disconnect switch located remotely from the utility interface switch



BT – equipment bonding terminal

GND – grounding conductor (electrode) terminal

(*) - The size of dc grounding conductor for solar photovoltaic systems is clarified with Question 1 in Section (2)(a).

Rationale 1

The answer is provided applying Rule 10-208 and considering the remote generation structure as a remote structure fed from the main building or the pole where the LDC metering and main service box are located. Rule 10-208 permits the practice for other types of installations where two or more buildings or structures are fed from a single service, and in fact requires this for buildings housing livestock.

(3) 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.

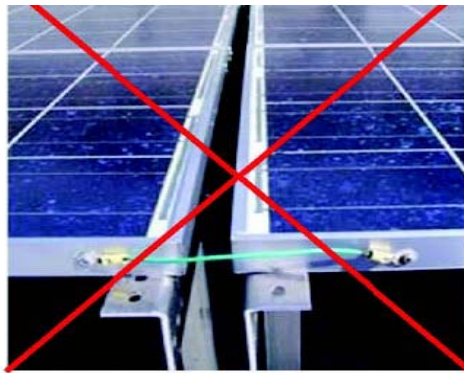
(4) Bonding

Rule 64-222 requires exposed, non-current carrying metal parts of photovoltaic modules to be bonded to ground. The bonding conductor shall be sized as per Rule 10-814 and shall be not less than that given in Table 16A.

The equipment bonding conductor shall be installed in accordance with Rule 10-808(5) and (6) requirements. Rule 10-808(5)(b) and (6)(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 Rules 64-070 and 64-222(4) requirements, the connection to a module or panel shall be arranged so that removal of a module or panel from a photovoltaic source circuit shall not interrupt a bonding conductor to other photovoltaic source equipment. 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 64-222(2), in order to minimize deterioration from galvanic action that may result from the combination of dissimilar metals, as referenced by Rule 10-602.

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 Rule 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 Outline of investigation, UL2703 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.