



*Based on
the 2018*

*Canadian
Electrical
Code*

*Effective:
January 1,
2019*

V3.0

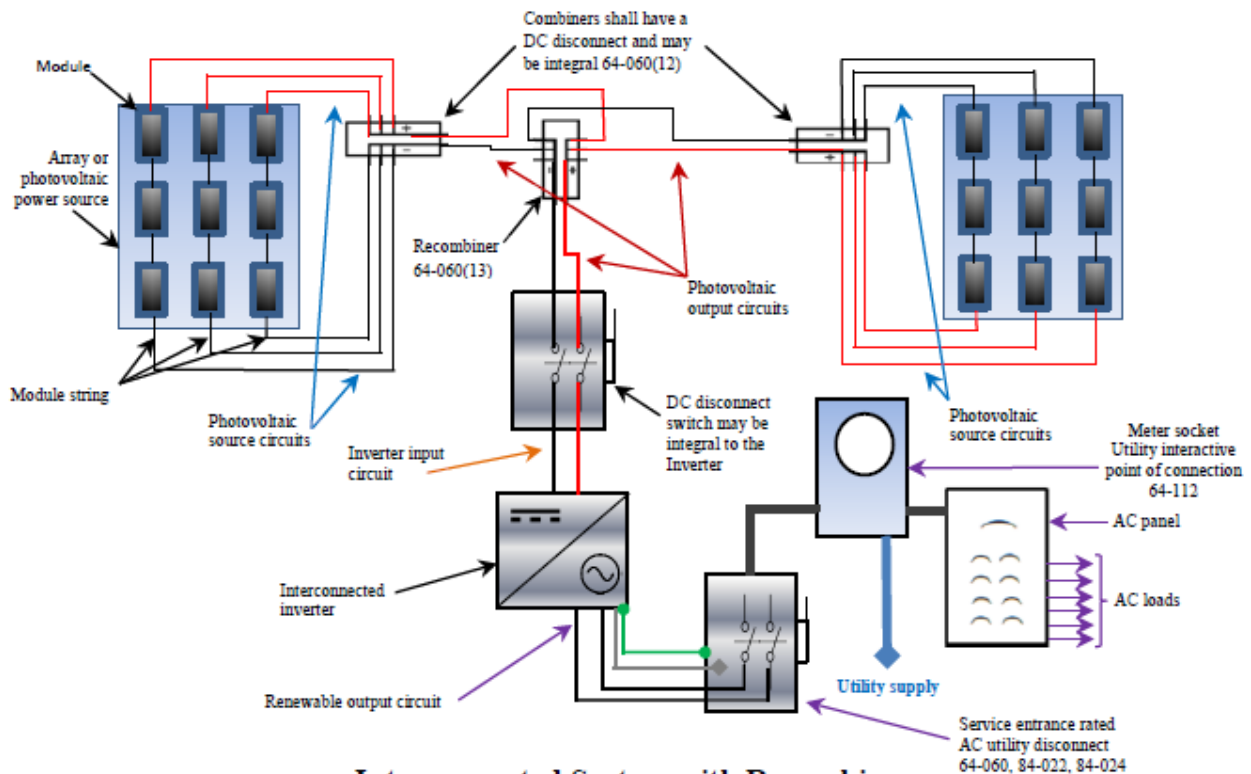
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SECTION 64 - RENEWABLE ENERGY SYSTEMS

NOTE: Rules for marking, warning notices and Diagrams - see [Appendix M](#)

64-002 - Special terminology

In this section, please refer to the attached diagram for terminology and components of a DC interconnected system with recombiners.



Interconnected System with Recombiner

Figure 1

64-058 - Overcurrent protection (all renewable energy systems)

Where circuit conductors are connected to more than one source, all overcurrent devices shall be located in such a way that they provide overcurrent protection from all sources.

Overcurrent devices marked or **approved only for AC use** shall not be used in DC circuits.

Circuit breakers that are marked “Line” and “Load” have been evaluated for connection only in the direction marked.

Note:

To facilitate the inspection of the installation contractor photos can be attached to the permit in the Permit System or made available on site to show the wiring installation, bonding of the racking and installation of the equipment.

64-060 - Disconnecting means (see also [84-022](#), [84-024](#) & [Appendix M](#))

- (2) The disconnecting means shall be capable of being energized from both sides, indicate open or closed, lockable in the open position, conform to Section 14, capable of opening at the rated load, capable of being closed under fault conditions and located within sight and 9 m (30') of or integral to the equipment.
- (6) Solid state devices shall not be used as isolating switches or as a disconnecting means.
- (7) Output circuits rated 48V and greater shall have a means to disable and isolate them.
- (8) Disconnecting means shall be provided to disconnect a fuse from all sources of supply if the fuse is energized from both directions as required by Rule 14-402.
- (9) Disconnecting means on DC circuits shall be marked for the purpose.
- (12) For combiners, a single disconnect within 2 m (6') or integral to and interlocked with the combiner door, is required for the photovoltaic output circuit rated in accordance with Rule 64-206.
- (13) For recombiners a single disconnect within 2 m (6') or integral to and interlocked with the recombiner door, is required for the inverter input circuit rated in accordance with Rule 64-206.

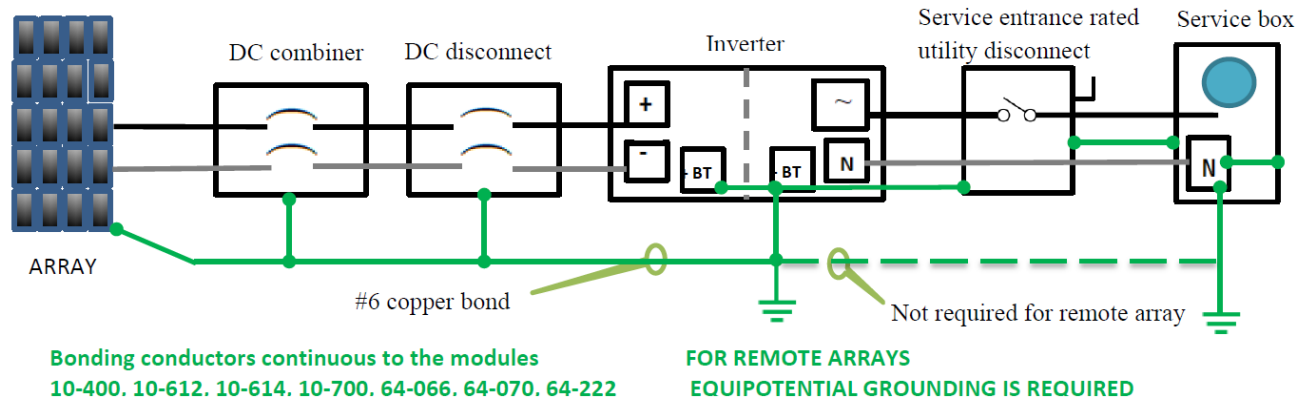
64-062 - Wiring methods

- (1) Insulated conductors for DC renewable energy sources or supply circuits of an interactive inverter, installed inside a building or structure, must be contained in metallic raceways, metallic enclosures or cables which are metal-sheathed or metal armoured;

64-066 - Ungrounded renewable energy power systems

Renewable energy systems are permitted to operate with ungrounded source and supply circuits if the system complies with the following:

- All source and supply conductors must have overcurrent protection (positive and negative conductors) except as per [64-214\(1\)](#);
- Inverters or charge controllers must be suitable for the purpose;
- The system must be provided with ground fault protection; and
- A suitable warning must be installed at each junction box, disconnect or any other device where these circuits can be exposed during service. See [Appendix M](#).

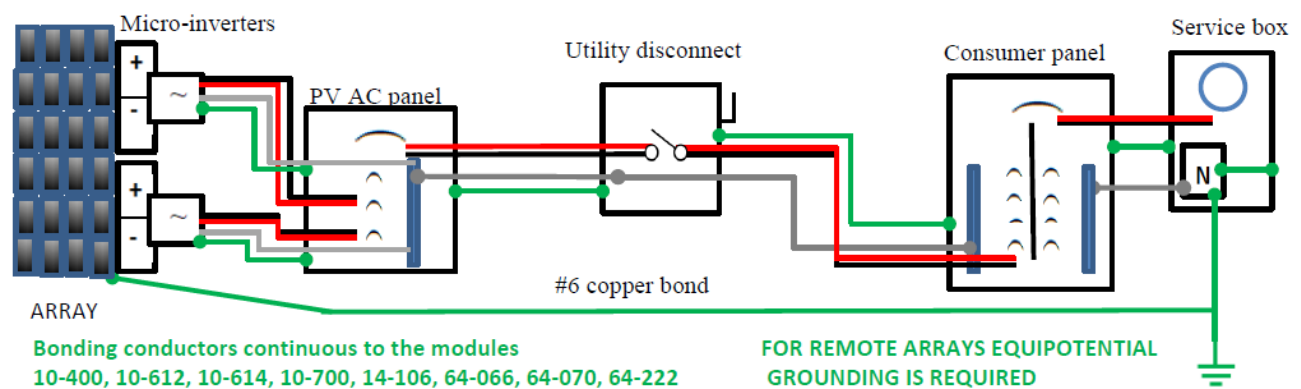


Ungrounded solar photovoltaic power source

Figure 2

Legend

BT – equipment bonding terminals



Solar Photovoltaic Power Source with Micro-Inverters

Figure 3

64-070 - Equipment bonding

The installation of a #6 copper bond conductor, continuous from the module bonding system, to the system ground in conjunction with and external to the feeder cable, shall be installed to meet the intent of this rule for the removal of combiner boxes, inverters or other equipment.

See also Rule [64-222](#), 10-708, & 22-200.

Racking systems

Racking systems shall be approved as a bonding system for the specific modules, and the modules must appear in the 'verified compatible modules list' of the racking system. Racking systems used to bond the modules shall be installed as per the racking system installation manual. If the racking is not approved as a bonding system, the solar modules shall be bonded in compliance with the module installation manual. Modules cannot be drilled. (See manufactures' instructions)

64-110 - Unbalanced interconnections (inverters)

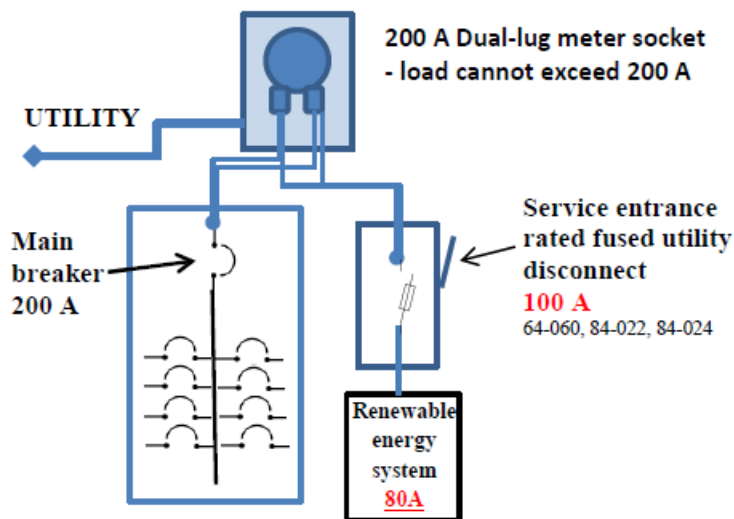
Single phase inverters shall not be connected to a three-phase utility system unless:

- The inverters used are certified as utility interconnected and approved for use in three-phase systems;
- The single-phase inverters are designed such that under normal operating conditions the resulting three-phase system voltages are balanced within the limits of the supply authority;
- The installation complies with Rules 84-008 and 84-018;
- Confirmation that the installation is acceptable to the supply authority; and
- The installation meets the inverter manufacturer's requirements.

64-112 - Utility-interactive point of connection (inverters)

(1) The output of an interactive inverter shall be connected to the supply authority system in accordance with Section 84.

(2) The output of an interactive inverter is allowed to be connected to the line side of the service disconnecting means at a dual lug meter socket or other source(s).



Example:

Meter rating = 200A

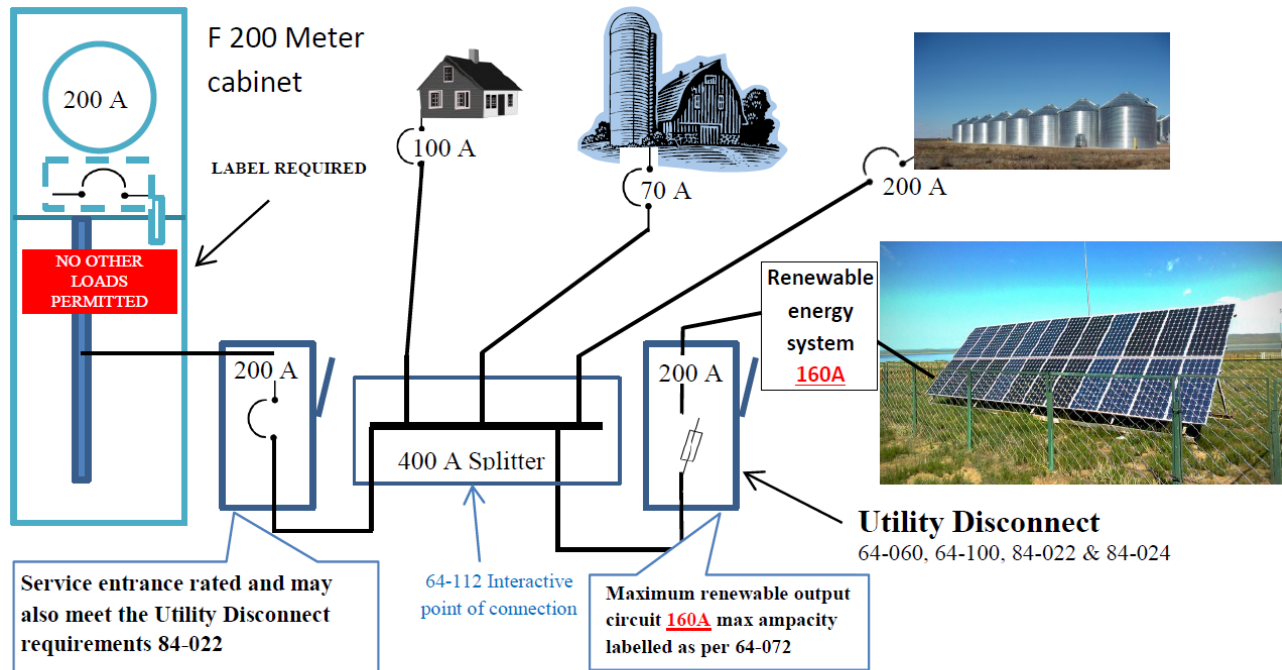
Main breaker = 200A

Maximum inverter output
circuit = **80A**

Supply Side Connection

Figure 4

(3) The output of an interactive inverter is allowed to be connected to the load side of the service disconnecting means provided that each source interconnection is made at a dedicated circuit breaker or fused disconnecting means. This point of connection shall be positioned at the opposite (load) end of the panelboard, busbar or conductor from the input feeder location or main circuit breaker location.



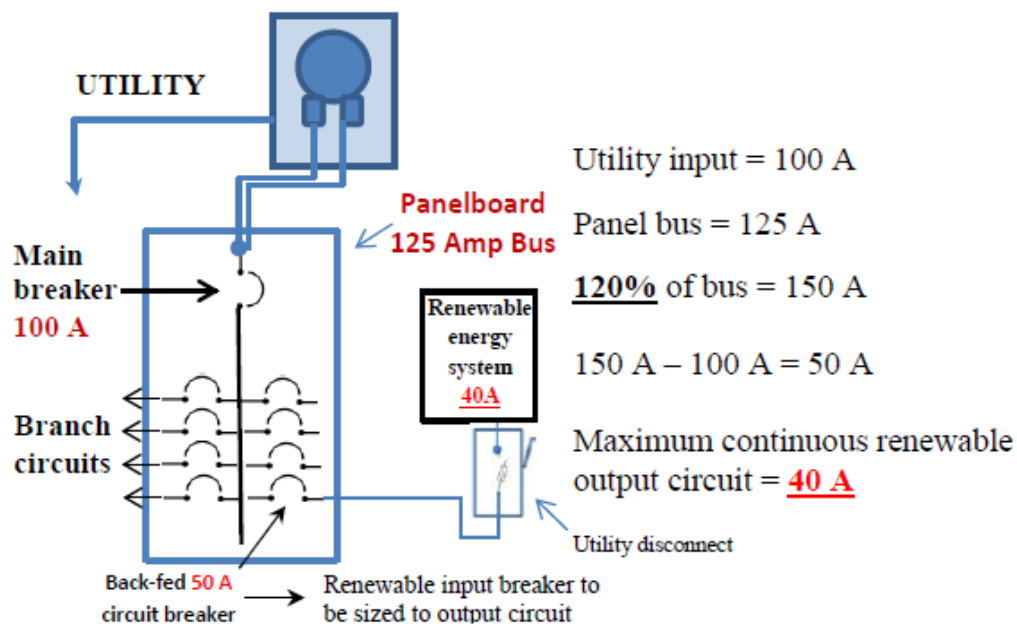
Interactive point of connection

The sum of all renewable energy overcurrent devices must not exceed the rating of the consumer's service

Figure 5

Non-dwelling units

(4)(c) The sum of the overcurrent devices supplying power to a busbar or conductor is allowed to exceed the rating of the busbar or conductor to a maximum of 120%.

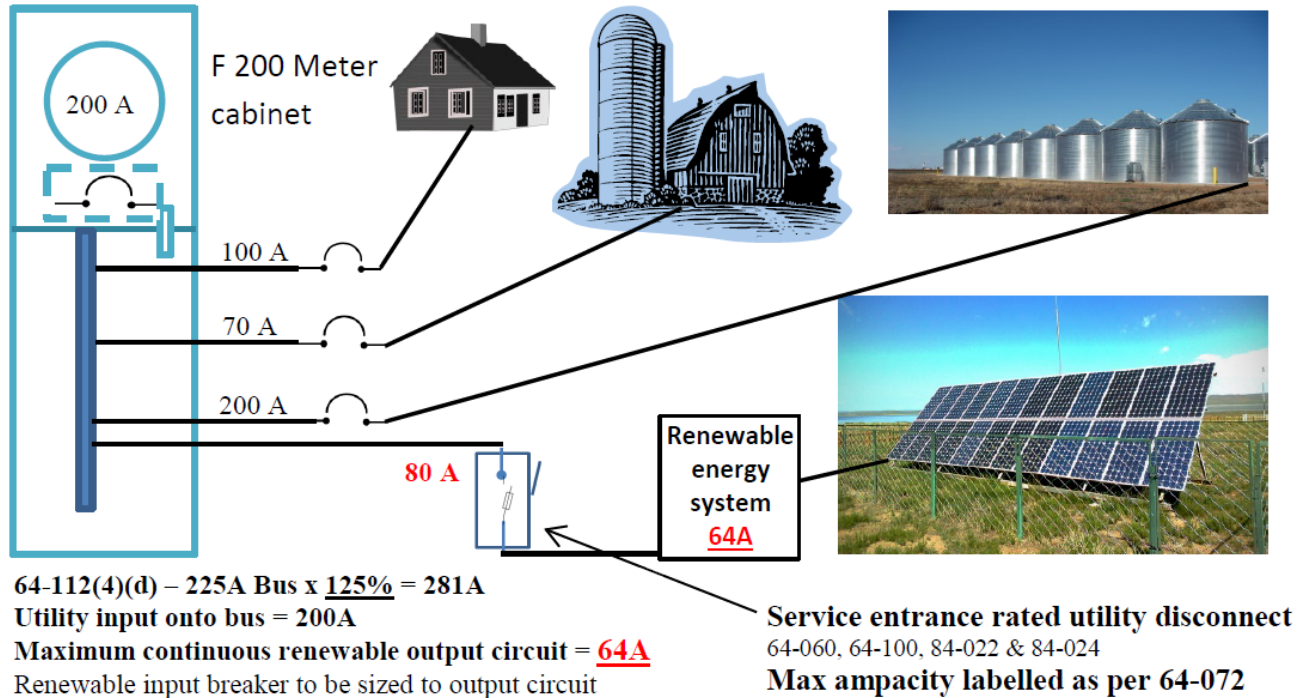


Load side connection – non-dwelling unit

Figure 6

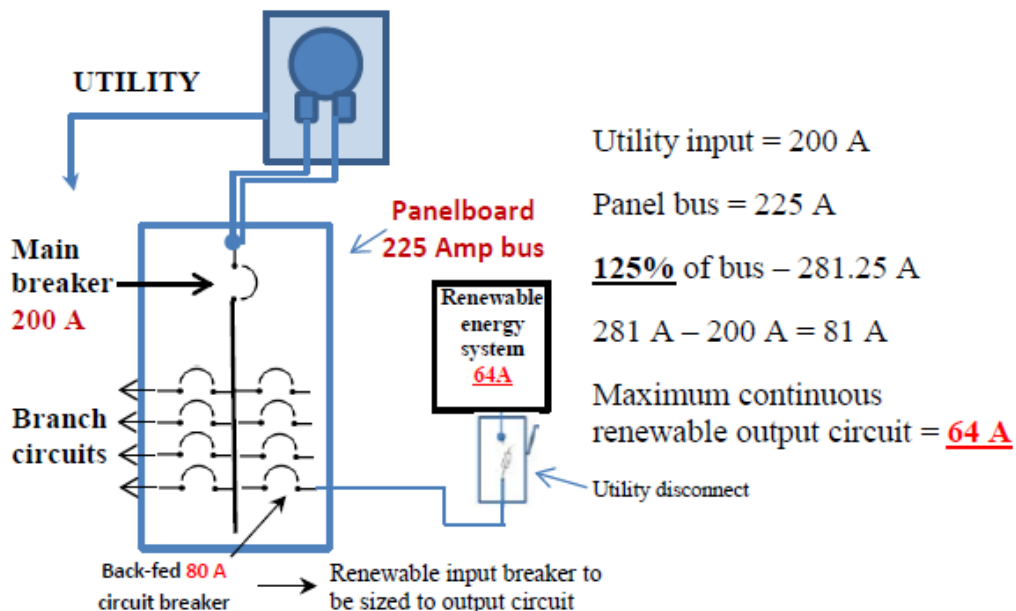
Dwelling units

(4)(d) The sum of the overcurrent devices supplying power to a busbar or conductor is allowed to exceed the rating of the busbar or conductor to a maximum of 125%.



F200 Farm/Acreage installation

Figure 7



Load side connection – dwelling unit

Figure 8

64-202 - Voltage of solar photovoltaic systems

- (1) The maximum photovoltaic source and output circuit voltage shall be the rated open circuit voltage (V_{oc}) of the photovoltaic power source X 125%; or
- (2) The source and circuit output voltage (V_{MPC}) may be calculated using the open circuit voltage (V_{oc}) of the photovoltaic power source, the difference between 25 °C and the lowest expected daily minimum temperature (T_m) (available from Environment Canada “Canadian Climate Norms”) and the voltage temperature coefficient (T_k) as specified by the manufacturer.

$$V_{MPC} = V_{oc} \times [1 + (T_m - 25) \times T_k]$$

Calculation of V_{MPC}					
	V_{MPC}	=	V_{oc}	x	$(1 + ((T_m - 25) \times T_k (\% / ^\circ C)))$
Step 1	V_{MPC}	=	45.8	x	$(1 + ((-23.2 - 25) \times -0.31 (\% / ^\circ C)))$
Step 2	V_{MPC}	=	45.8	x	$(1 + ((-23.2 - 25) \times -0.0031))$
Step 3	V_{MPC}	=	45.8	x	$(1 + (-48.2 \times -0.0031))$
Step 4	V_{MPC}	=	45.8	x	$(1 + 0.1494)$
Step 5	V_{MPC}	=	45.8	x	1.1494
Step 6	V_{MPC}	=	52.6434	Volts	
	TOTAL	=	947.582	Volts	
	V_{oc}	=	45.8	Volts	Note: Input information into blue cells only.
	T_m	=	-23.2	°C	
	T_k	=	-0.31	%	
	# of panels	=	18		

- (4) The photovoltaic source and output circuits for installations in or on a dwelling unit shall be permitted to have a voltage not exceeding 600V DC.

- (5) The voltages of solar photovoltaic systems may exceed 750V DC but not more than 1500 V DC and shall not be required to meet the requirements of 36-204, 36-208 & 36-214 provided they are maintained by qualified persons, are inaccessible to the public, and labelled “DANGER _____ V DC”. See [Appendix M](#).

64-210 - Wiring methods (see 12-200)

- (2) & (3) Where the source and output circuits operate at a maximum system voltage greater than 30V, the wiring is deemed inaccessible to the public and not readily accessible if it is:
- contained in a raceway;
 - contained behind metal screening or guarding with holes not exceeding 13mm (1/2”) x 13mm (1/2”);
 - elevated 2.5 m or more above grade level; or
 - located within a fenced enclosure in accordance with Rule 26-304, 26-312, and 26-314
- (4) Conductors and cables shall be supported 300 mm (12”) from every box and at intervals not more than 1 m (39”) throughout the run;

(5) **Rodent protection is required** on all insulated conductors or cables, with the exception of armoured cables or MI cables, installed on or above a building by enclosing them in material such as approved raceways, expanded metal, solid metal, metal screening (maximum 13 mm (1/2") x 13 mm (1/2") holes) or other acceptable protection.

(7) RPV conductors shall be permitted for the module interconnections if they are contained in a raceway;

(9) Types RPV and RPVU conductors installed inside a building or structure shall be contained in a metallic raceway. See [64-062](#)

Notes:

- For rodent protection, module level arc fault protection must be part of the module and listed in the module manufacturers' installation instructions.
- **Modules cannot be drilled into for mounting of rodent protection.**

64-212 - Insulated conductor marking or colour coding

RPVU or RPV conductors shall be coloured red for positive, black for negative or permanent surface printing of the polarity on the insulated conductors. TECK 90 cables may be field marked in a permanent manner (heat shrink).

64-214 - Overcurrent protection for apparatus and conductors

1) Maximum photovoltaic source circuit short-circuit-current (I_{sc}) is equal to the sum of the short circuit current for all the source circuits connected in parallel minus the short circuit current for one of the photovoltaic source circuits.

2) If the photovoltaic source circuit short-circuit-current (I_{sc}) (sum of all parallel strings minus one string) exceeds the maximum series fuse rating (reverse current rating) (typically 15A or 20A) or the ampacity of the source circuit conductor, then OC protection will be required on each ungrounded conductor.

Eg. String $I_{sc} = 9.5A \times 3(\text{strings}) = 28.5 - 9.5 = 19A \times 125\% = 23.75A$; DC fusing is required for 15A or 20A series fuse rating.

3) Where the value specified in Subrule 2) does not correspond to the standard rating of an overcurrent device, the next higher standard rating shall be permitted.

4) DC overcurrent devices shall be accessible and grouped where practicable.

Note - AC overcurrent protective devices must be readily accessible. See Rule 14-106.

64-216 - Photovoltaic DC arc-fault protection (solar photovoltaic systems)

Photovoltaic systems with DC source or output circuits, or both, and operating at a system voltage of 80V or greater, shall be DC arc-fault protected.

64-218 - Rapid shutdown

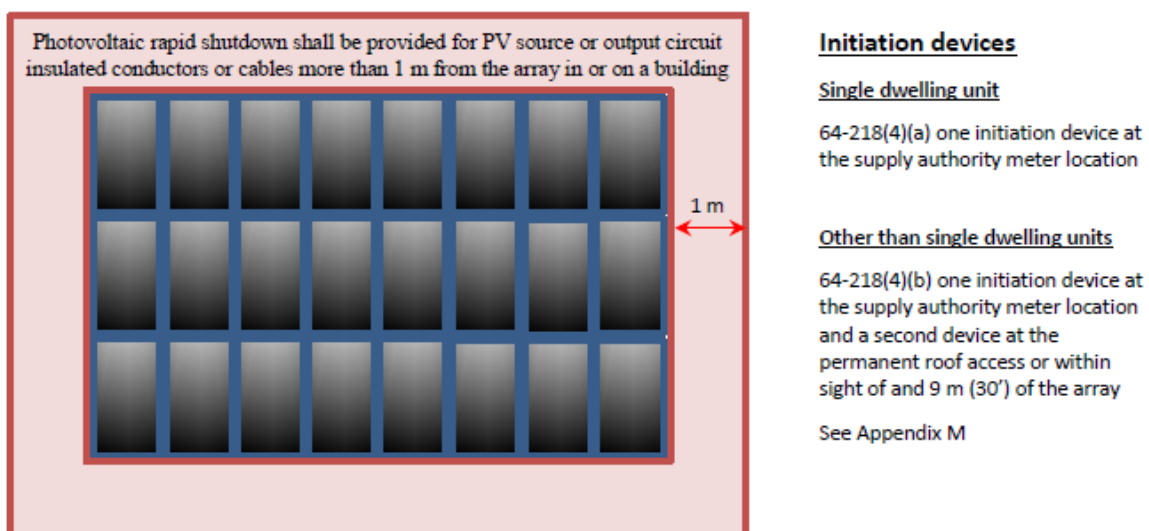
A photovoltaic system rapid shutdown device shall be provided for a photovoltaic system installed on buildings or structures where the photovoltaic source or output **insulated conductors or cables** installed on or in buildings are more than 1m (39") from the photovoltaic array. See Figure 9.

The rapid shut down initiating device, for single dwelling units, shall be located at the utility meter location.

For other than single dwelling units, one initiating device shall be at the utility meter location **and** a second initiating device at the permanent access to the building roof **or** within sight of and 9 m (30') of the array.

(6) Placards shall be located at the supply authority meter location and the consumer's service equipment location. The location of these placards (or additional placards) on buildings without exterior metering may require discussion with the local fire department (i.e. near the gas meters, water standpipe, service splitter, fire annunciation panel, etc.).

If the utility disconnect serves a dual function as a rapid shutdown, it shall be labeled as such (e.g. systems using micro-inverters or optimizers.).



Photovoltaic rapid shutdown

Figure 9

64-220 - Attachment plugs and similar wiring devices (see Appendix B)

PV connectors are only tested and approved as mated pairs in accordance with CSA 22.2 no 182.5 (UL 6703). Equipment with different types of mated connectors will not be accepted for interconnection.

64-222 - Photovoltaic module bonding (solar photovoltaic systems)

All exposed metal parts of photovoltaic modules shall be bonded to ground in accordance with the module installation instructions. If the racking system is used to bond the PV modules, the racking system shall be approved for the specific modules and installed as per the module and racking installation instructions.

Use of unapproved racking systems will require interconnection of modules with a bonding conductor and approved module bonding lugs. The bonding connections shall be arranged so that removal of a photovoltaic module from the array does not interrupt a bonding conductor to other equipment. See [64-070](#).

**SECTION 66 - AMUSEMENT PARKS, MIDWAYS, CARNIVALS, FILM AND TV SETS,
TV REMOTE BROADCASTING LOCATIONS, AND TRAVELLING SHOWS****66-404 - Receptacles**

All Receptacles having CSA configuration 5-15R or 5-20R installed in or around travelling midways, carnivals, fairs and festivals in outdoor or damp locations shall be protected by ground fault circuit interrupters of the Class A type and have weatherproof in-use covers marked for “Extra Duty”.

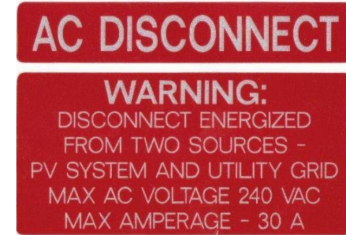
Appendix M - Renewables Marking, Warning Notices and Diagrams

A warning sign for a photovoltaic system shall be in capital letters with a minimum height of 9.5 mm, in white on a red background.

Appendix M

64-060(10) - Disconnecting means

- all AC disconnects with 2 sources of power.



64-066(1)(b) - Ungrounded renewable energy power systems

- ungrounded DC circuits.



64-072(1) - Marking

- for each interconnecting AC power source.



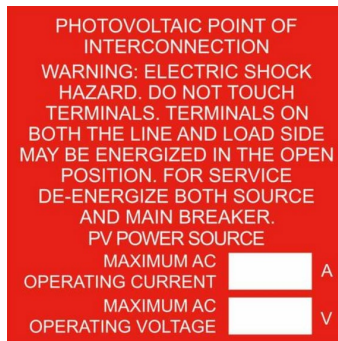
64-074(4) - Warning notice and diagram

- for energy storage systems.



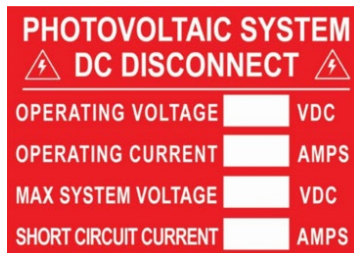
64-112(4)(b)(iii) - Interactive point of connection

- PV input breaker in electrical panelboard.



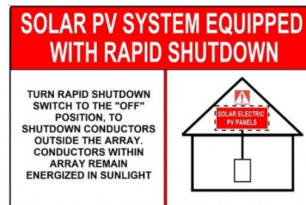
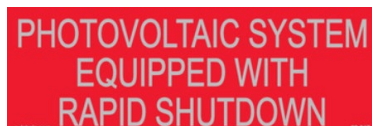
64-200(1) - Marking

- String inverters - DC Disconnect.



64-200(2) - Marking

- When rapid shutdown is installed labelling at the DC disconnect is required.



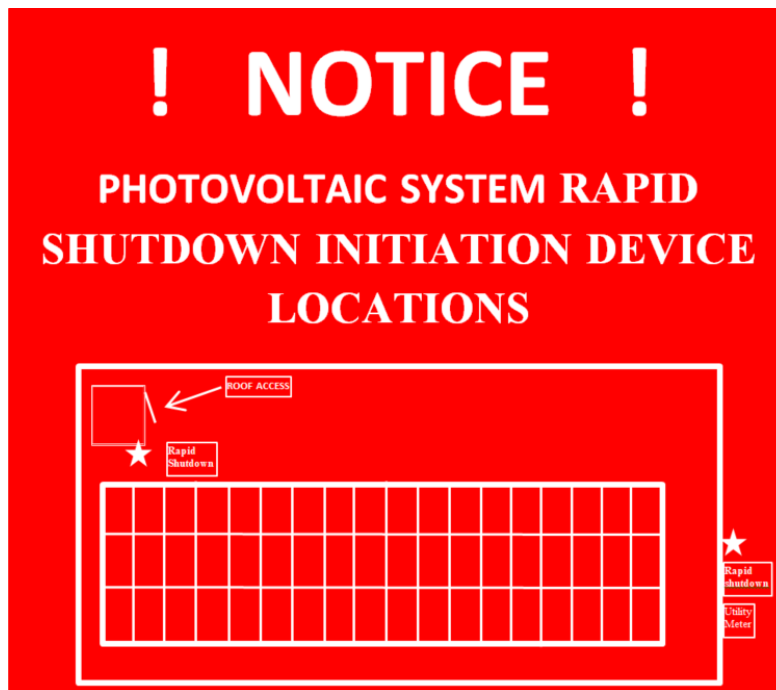
64-202(5)(c) - Voltage of solar photovoltaic systems

- For all DC circuits over 750 VDC.



64-218(5) - Photovoltaic rapid shutdown

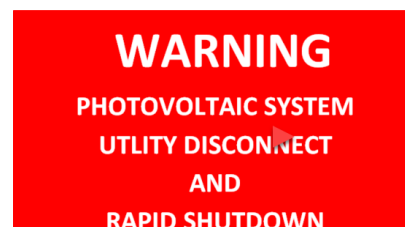
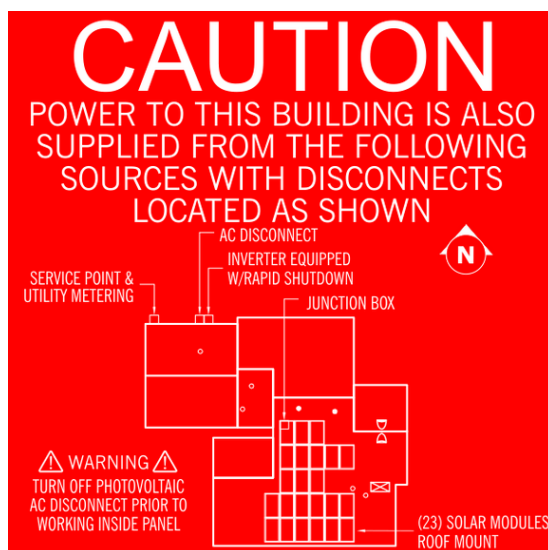
- Rapid shutdown initiation device shall be shown on the diagram of 84-030(2).



64-218(6) - Photovoltaic rapid shutdown

- Placards **shall be** located at the supply authority meter location and the consumer's service equipment location.

The location of these placards (or additional placards) on buildings without exterior metering may require discussion with the local fire department (i.e. near the gas meters, water standpipe, service splitter, fire annunciation panel...).



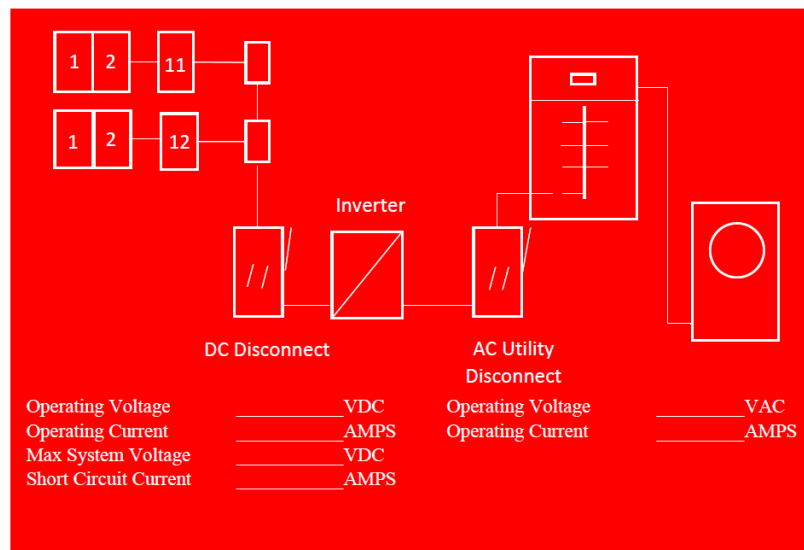
84-030(1) - Warning notice and diagram

- utility disconnect and interconnected system information at the utility disconnect and meter location.

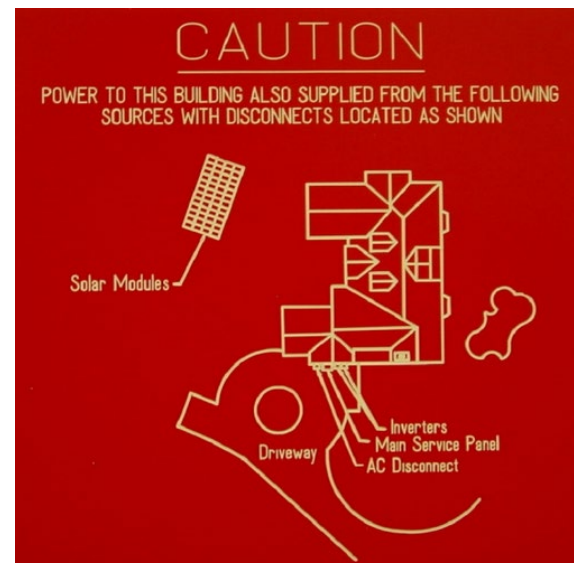
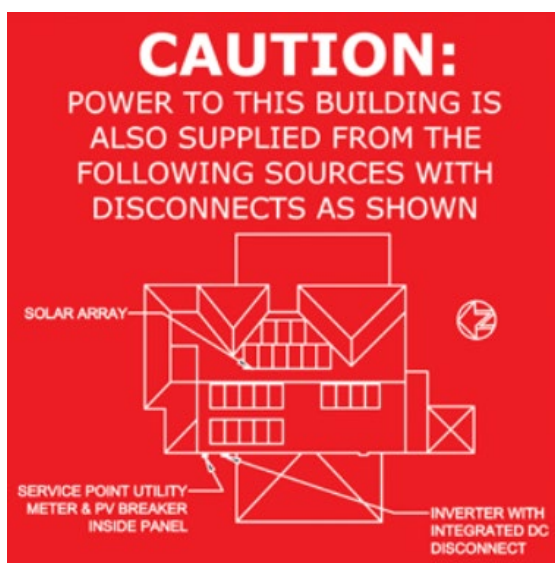


84-030(2) - Warning notice and diagram

- Single-line, permanent, legible drawing of the interconnected system, and equipment locations ...



- shall be installed at the utility disconnect and meter location.



[illegible]

