

#### 2-4-4. Method #4 (use of the bolts and nuts in the mounting hole)

- All hardware used in this method must be stainless steel.
  - Examples of acceptable grades of stainless steel are: 18-8, 316, and 410.
- A 1 1/4" bolt and double nuts of No.5/16 diameter (or M8) shall be used to mount the PV module to the mounting structure through the 9mm diameter mounting hole.
- Torque to secure the bolt: 5N·m (3.7 ft-lb)
- External toothed stainless steel washers shall be inserted between the module frame and ring washer, and also between the mounting structure and ring washer.
- A spring washer shall be used to avoid loosening of the bolt.
- All 4 mounting holes of each PV module must be secured to the mounting structure.
- At least 2 of the 4 locations must have external toothed washers.
- All four locations shall have 2 nuts installed.
- A grounding electrode system for the mounting structure must be provided in accordance with the NEC or CEC standards.
- Recommended mounting structure characteristics:
  - Alloys with resistivity less than 1.61 micro-ohms / inch
  - Wall thickness of at least 1/8"

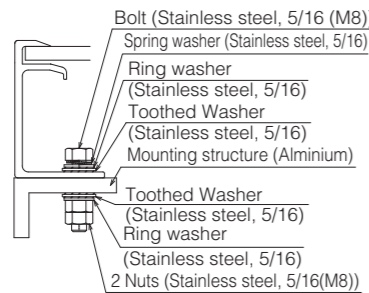


Fig. 6 Grounding method #4

#### 2-4-5. Method #5 (WEEB clips/ barbed washers and associated racking)

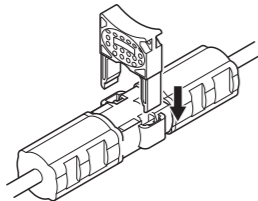
- Barbed washers listed under UL467 intended for use in bonding photovoltaic modules to mounting structures may be used for grounding as described in the NEC or CEC standards.
- When installing the WEEB UMC Clip or UniRac UGC-1 Clip as a means of grounding the modules, tighten the mounting bolt to 13.5N·m (10lb-ft).
- Barbed washers identified for grounding must be installed in accordance with the manufacturer's specified instructions.
- Recommended mounting structures that accommodate barbed washers are manufactured by UNIRAC.
- Approved options of WEEB clips/ barbed washers to be used in conjunction with UNIRAC racking solution are:
  - WEEB UMC clip
  - UNIRAC UGC-1 clip

**Note: Barbed washers are intended for one time use only.**  
If a module is removed, replaced, repositioned or remounted, the associated barbed washer(s) must be replaced. Follow instructions of the manufacturer.

#### 2-5. WIRING

#### WARNING

- DO NOT short the positive and negative cables.
- Make sure connectors are fully engaged and locked without any gap between the insulators. In case there is a gap, a fire and/or an electrical shock may occur.
- Use the appropriate tool provided by SMK for disconnecting.



#### CAUTION

- Connect the required number of PV modules to meet the voltage specification of the equipment used in the system.
  - Max. in series: 20pcs due to max. system voltage
  - Max. in parallel: 2 strings due to fuse rating
- Connect the output cable connectors so that they do not exert any strain on the base of the cable at the junction box. Secure the cable to the mounting framework using approved fasteners. The connectors should be placed behind the mounting framework so that the connectors are not directly exposed to sunlight, wind or rain.
- DO NOT apply external force (stepping on, etc.) to the connector.

- The PV module has a pair of male and female waterproof connectors. For an electrical connection in series, connect the positive (+) connector of the first PV module to the negative (-) connector of the following module.
- These modules employ UL Recognized connectors for output wiring. Final output field wiring should be done with CCT9901-3301F (R51-27) (male), CCT9901-3511F (R51-27) (female) connectors from SMK using minimum 14 AWG copper wire cables rated for 90°C (194°F). These products provide final system output wiring in accordance with the U.S. National Electrical Code, NFPA 70-2008 or CEC accordingly. Please refer to Article 690 of the NEC for additional guidance.
- To extend the cable, use proper commercial cables and connectors rated for at least 1000V that can withstand outdoor use for long periods. Select the appropriate cable size according to its length to avoid excessive voltage drop. Follow the cable manufacturer's instructions.

### 3.MAINTENANCE

#### WARNING

- Maintenance must be done only by qualified personnel.
- Be sure the circuit breaker is switched off, if applicable. Always use appropriate safety equipment (insulated tools, insulating gloves, etc.).
- Be sure to cover the front surface of the PV modules with an opaque cloth to block sunlight when connecting or disconnecting modules.

#### ANNUAL INSPECTION

- Check if the nuts and bolts of the mounting framework are secure. Tighten all loose components.
- Check the connections of cables, including grounding cables and connectors.
- Check that all electrical and mechanical connections are free of corrosion.
- Check the ground resistance of metal parts such as the module frames and the mounting framework.

#### Others

- Clean the glass surface of the modules when dirty. (Wash or wipe only the glass surface of module without using detergent.)



ETL LISTED  
CONFORMS TO STANDARD UL 1703  
CERTIFIED TO ULC ORD C1703

# PHOTOVOLTAIC MODULE INSTALLATION INSTRUCTIONS

## 1.INTRODUCTION

- BEFORE INSTALLATION, OPERATION, AND MAINTENANCE, BE SURE TO READ THESE INSTRUCTIONS IN ORDER TO USE THE PV MODULES SAFELY.
- FOR INSTALLATIONS IN THE USA, REFER TO THE NATIONAL ELECTRIC CODE (NEC) AND ALL APPLICABLE LOCAL CODES. FOR INSTALLATIONS IN CANADA, REFER TO THE CANADIAN ELECTRIC CODE (CEC) AND ALL APPLICABLE LOCAL CODES.
- FAILURE TO OBSERVE THE FOLLOWING INSTRUCTIONS MAY RESULT IN DEATH OR PERSONAL INJURY AND PROPERTY DAMAGE.
- KEEP THIS MANUAL FOR FUTURE REFERENCE.

#### WARNING

#### 1. GENERAL USE

- Avoid touching the front surface of the module with bare hands.
- DO NOT handle except for installation and maintenance.
- Ensure that unauthorised personnel, including children, are not allowed to access the modules.

#### 2. GENERAL HANDLING

- DO NOT alter or remove any component.
- DO NOT stand or step on the modules.
- DO NOT damage the front or rear surface of the PV modules. The rear surface can be damaged by sharp objects.
- DO NOT throw or drop the PV modules.
- DO NOT lift the modules by the connectors or cables.

#### 3. INSTALLATION

- Only licensed professionals should handle the modules.
- Secure yourself to avoid falling from the installation area.
- DO NOT use damaged PV modules. A damaged PV module may cause fire and/or an electrical shock resulting in personal injury or even death.

- DO NOT expose the PV modules to artificially concentrated sunlight.
- Cover the front surfaces of the PV modules with an opaque cloth to prevent the generation of high voltage and electric current during installation.
- Securely fasten the PV modules to the mounting framework to prevent them from falling due to wind or snow loads. The modules should be installed as instructed in this installation manual.
- Securely ground the PV module frame and the mounting framework following local regulations.
- Install a residual current device (RCD) as prescribed by local regulations.
- DO NOT expose the backside of the module to sunlight.
- DO NOT install the modules in places where they can be shaded by objects such as buildings or trees.

## ELECTRICAL SPECIFICATIONS

MODEL	Pmax	Voc	Isc	Vmp	Imp	*1 [A]	*2 [A]	MAXIMUM SYSTEM VOLTAGE
PV-MLE265HD2	265 W	38.2 V	9.08 A	31.7 V	8.38 A	15	12.5	1000V (IEC61215, IEC61730, UL1703)
PV-MLE270HD2	270 W	38.4 V	9.18 A	31.9 V	8.48 A	15	12.5	
PV-MLE275HD2	275 W	38.5 V	9.28 A	32.1 V	8.58 A	15	12.5	
PV-MLE280HD2	280 W	38.6 V	9.37 A	32.4 V	8.68 A	15	12.5	
TOLERANCE	*3	-	-	-	-	-	-	-

\*1 FUSE RATING BASED ON MAX. BYPASS DIODE AMPACITY WITHIN THE PV MODULE

\*2 MINIMUM BYPASS DIODE RATING

\*3 +5/-0% OF NOMINAL VALUE

The electrical characteristics are within ±10% of the indicated values of Isc, Voc, and within +5/-0% of Pmax under standard test conditions (irradiance of 1000 W/m<sup>2</sup>, AM1.5 spectrum, and a cell temperature of 25°C (77°F)). Standard: IEC61215 ed. 2 (2005), IEC61730 ed. 1 (2004) Application Class A, UL1703

## SYMBOL DEFINITIONS

Pmax	MAXIMUM POWER
Voc	OPEN CIRCUIT VOLTAGE
Isc	SHORT CIRCUIT CURRENT
Vmp	MAXIMUM POWER VOLTAGE
Imp	MAXIMUM POWER CURRENT

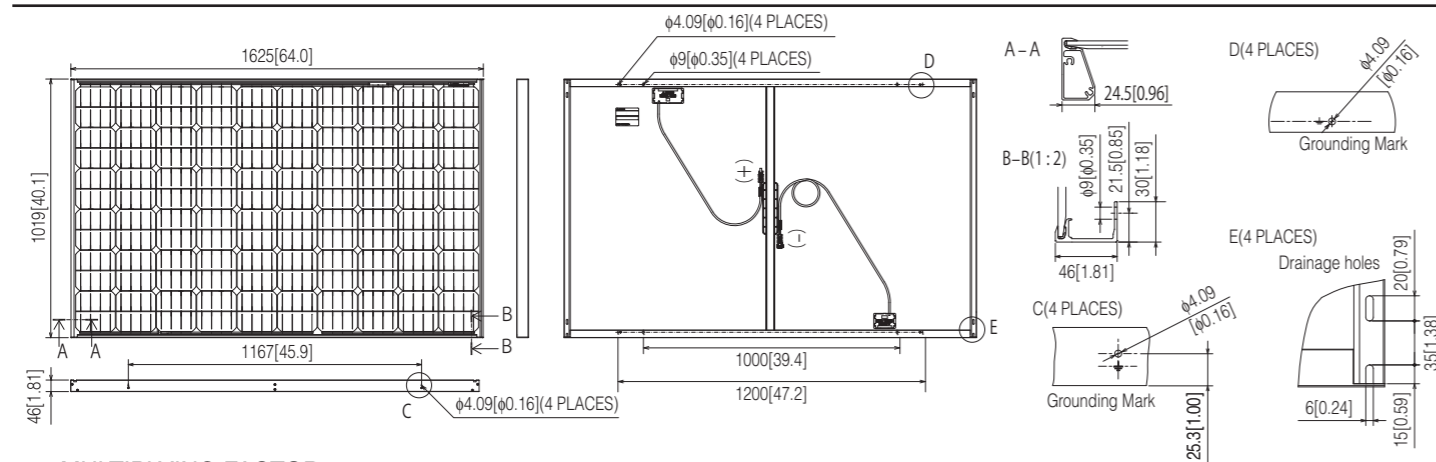


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## 1-1. STRUCTURE



## 1-2. MULTIPLYING FACTOR

Under normal conditions, the PV module is likely to experience conditions that produce more current and/or voltage than reported under Standard Test Conditions. Accordingly, the values of  $I_{sc}$  and  $V_{oc}$  marked on this module should be multiplied by a factor of 1.25 when determining component voltage ratings, conductor capacities (cross sectional area), fuse sizes, and size of controls connected to the PV output. Customers in US should refer to article 690.8 of the National Electrical Code for an additional multiplying factor of 125 percent (80 percent derating), which may be applicable. Customers in other locations should refer to the codes relevant to the location of installation for further guidance.  $V_{oc}$  should be increased by a factor based on the lowest ambient temperature recorded for the location. To determine the corrected value for Maximum System Voltage follow the guidelines in article 690.7 of the NEC or applicable section in the CEC. The voltage temperature coefficient for the module in use should be used when determining Maximum System Voltage.

## 2. INSTALLATION

Refer to Local Code (US: National Electrical Code) standards, construction rules and safety instructions regarding installation of the PV modules.

Electrical installations in Canada shall be in accordance with CSA C22. 1, Safety Standard for Electrical Installations, Canadian Electrical Code, Part 1.

### 2-1. CLIMATE CONDITIONS

Install the PV module within the following conditions:

- Ambient monthly mean temperature:  $-20^{\circ}\text{C}$  to  $40^{\circ}\text{C}$  ( $-4^{\circ}\text{F}$  to  $104^{\circ}\text{F}$ )
- Operating temperature:  $-40^{\circ}\text{C}$  to  $83^{\circ}\text{C}$  ( $-40^{\circ}\text{F}$  to  $181^{\circ}\text{F}$ )  
Do not install modules in areas where the module temperature can fall below  $-40^{\circ}\text{C}$ .
- Allowable pressure: up to 3600Pa
- Water resistance/damage: The PV modules shall not be immersed in water and shall not be continually exposed to a source of water, such as a sprinkler, fountain, etc.
- Corrosion warning: The PV modules shall not be installed in corrosive areas such as:
  - Salty areas: areas where salty water such as ocean spray comes in direct contact with the module, or
  - Sulfurous areas: areas near sulfurous volcanos and sulfurous springs.

#### Note

In case of installation in Asian countries, PV modules shall not be installed in corrosive areas within 500m from a body of salt water and/or areas where there is direct contact with salty wind.

### 2-2. ORIENTATION

- Install the PV modules facing South in the Northern Hemisphere or North in the Southern Hemisphere.
- PV modules connected in series should be installed in the same orientation and angle. Different orientation or angles may cause loss of output power due to the different amount of sunlight being absorbed by the modules.
- Do not allow the modules to be shaded at anytime. Shade causes loss of electrical output, even though the factory fitted bypass diode will reduce such loss to some extent.

### 2-3. MOUNTING

#### WARNING

- Use mounting framework that can withstand forces from wind pressure and snowfall pressure specific to your local climate.
- Use mounting framework and brackets that can withstand the environment where the PV modules are to be used. Select proper corrosion resistant materials and coatings.
- Use appropriate safeguards and components to install the modules.
- PV modules shall be mounted over a fire resistant roof covering rated for the application and on any slope less than 5in/ft (127mm/305mm) to maintain a fire Class rating.
- Installing the modules at an angle less than  $2^{\circ}$  can result in decreased module output due to dirt and dust accumulating on the module surface.

#### CAUTION

- Make sure there is enough space for air circulation behind the PV modules to dissipate heat.
- DO NOT open any additional holes in the modules.
- The module is Type 2 of Fire Performance.
- Consider the effects of thermal expansion/contraction and select the appropriate module installation materials and methods.

#### 2-3-1. Mounting using bolt holes

Mounting examples:

- Fasten the corner holes of the PV module with M8 (5/16") stainless steel bolts to the mounting framework with a torque of 4.5 to 6N-m (3.3 to 4.4 ft-lb).
- Use spring washers and flat washers to fasten the PV module as shown in figure 1.
- Install the PV module securely by fastening the appropriate bolts with double nuts and locking washers.
- Make sure that there is more than a 5 mm gap between modules to prevent buckling caused by thermal expansion.

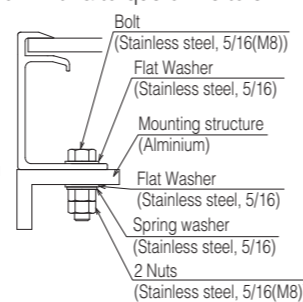


Fig. 1 Module mounting

#### 2-3-2. Mounting using the "Clipping method"

"The clipping method" is a way to secure modules on steady base profiles (rail structures, etc.) with "clipping" materials to hold the top of the frame, without directly securing it with bolts and nuts on the back of the module.

Mitsubishi Electric Corp. doesn't specify or warrant any materials, e.g. base profile and clipping materials etc., related to the clipping method.

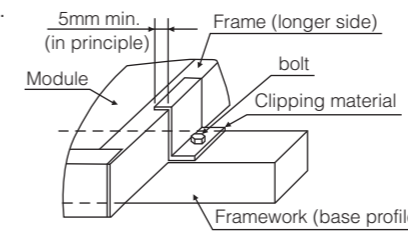
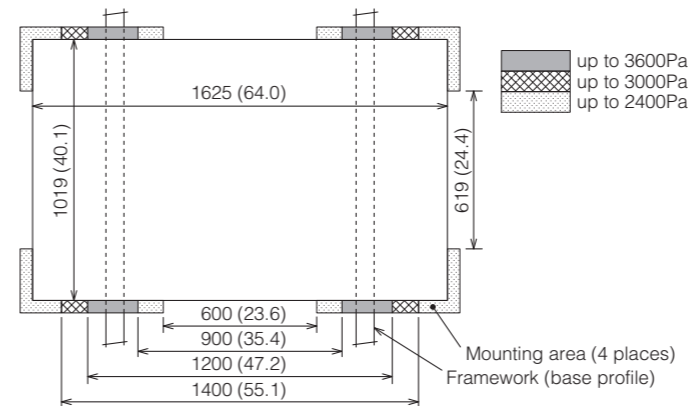


Fig. 2 Clipping method

#### CAUTION

- Note that the drainage holes at each corner of module should not be blocked by the base profile.

- The base profile should be perpendicular to the longer side of the module (see figure below).
- The module shall be attached at 4 points or more on the frames.
- Refer to the figure for the proper attachment.
- Secure the clips using M6 (1/4") or larger (M8 (5/16")) bolts for where heavy snow loads are expected.
- Make to use clips that reach at least 5mm in from the edge of the module frame.
- Use clipping material with sufficient strength and proper form that can withstand forces from wind pressure and snowfall pressure specific to the local climate.
- Secure bolts with the appropriate torque to avoid deformation of the module frame.
- Take precaution in utilizing locking fasteners to avoid loosening of the panel from its original anchored position.



Required mounting area to be fixed

### 2-4. GROUNDING

#### WARNING

- The grounding method should satisfy the Local Codes and the NEC or CEC accordingly.
- Securely ground the PV modules and the mounting framework.

Examples of proper grounding technique:

#### 2-4-1. Method #1 (use of self-tapping screws)

- Install a stainless steel screw (M5 or No.10) with 32 threads per inch to the grounding hole with a torque of 2.3N-m (20lbf-in).
- Ensure that at least 2 threads are engaged in the module frame.
- As shown in the figure 3, the copper wire should be compressed by the screw head.
- A stainless steel washer with an appropriate corrosion resistant coating should be inserted between the copper wire and screwhead.
- A proper cupped washer should be inserted between the copper wire and frame to avoid galvanic corrosion.
- The copper wire must be #14 AWG or thicker, and be secured to the module frame.

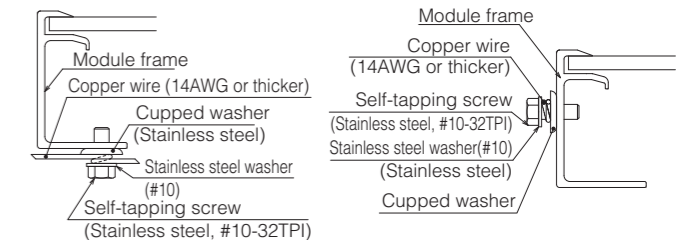


Fig. 3 Grounding method #1

#### 2-4-2. Method #2 (use of a ground lug)

- An appropriate device such as UL Listed ILSCO ground lug, Cat. No. GBL4-DBT should be secured by a stainless steel screw (M5 or No. 10) with 32 threads per inch with a torque of 2.3N-m (20lbf-in) as shown in the figure 4.
- A star or toothed washer shall be inserted between the ground lug and module frame.
- The copper wire must be #14 AWG or thicker, and be secured to the ground lug screw.

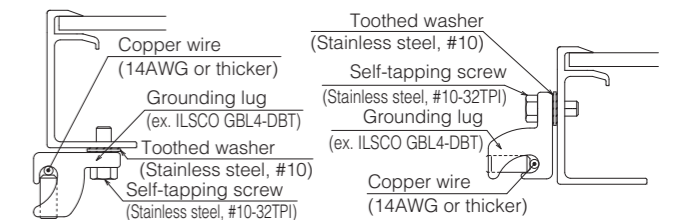


Fig. 4 Grounding method #2

#### 2-4-3. Method #3 (use of bolts and nuts)

- A No.8 stainless steel bolt and nut with 32 threads per inch can be used instead of a No.10 self-tapping screw in Method #2 under the following conditions:
  - Torque to secure the bolt: 1.8N-m (16lb-in)
  - A lock or spring washer shall be inserted between the nut and toothed washer.

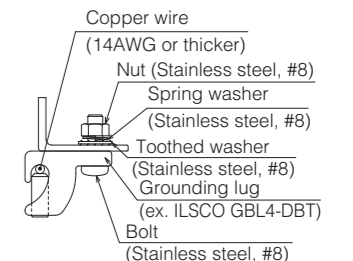


Fig. 5 Grounding method #3