Panasonic

Installation Manual and Safety Instructions (UL)

Please read the following product documentation and safety instructions carefully.

Non-compliance with these instructions may void the module warranty.

1.0 Documentation Overview

Panasonic is one of North America's premier suppliers of high-quality PV modules.

This guide contains basic information regarding Panasonic standard photovoltaic modules, their installation and safe handling. All instructions should be read and understood before attempting installation. Failure to follow these instructions may result in death, injury, or damage to the modules. If there are any questions, please contact your dealer or Panasonic for further information.

This documentation refers to the PV-modules themselves and is not meant to be a complete installation manual for personnel not specifically trained to PV-modules. It serves as a general reference.

Generally, the installer must conform to all safety precautions in this documentation, as well as the applicable national codes and standards when installing PV-modules. Before installing a solar photovoltaic system, the installer should become familiar with the mechanical and electrical requirements for photovoltaic systems. Keep this documentation in a safe place for future reference.

2.0 Disclaimer of Liability

Because the use of this documentation and the conditions or methods of installation, operation, use and maintenance of photovoltaic products are beyond Panasonic's control, Panasonic does not accept responsibility and expressly disclaims liability for loss, damage, or expense arising out of or in any way connected with such installation, operation, use or maintenance. No responsibility is assumed by Panasonic for any infringement of patents or other rights of third parties, which may result from use of the PV product. No license is granted by implication or otherwise under any patent or patent rights.

The information in this documentation is based on Panasonic's knowledge and experience and is believed to be reliable, but such information including product specification (without limitations) and suggestions does not constitute a warranty, expressed or implied. Panasonic reserves the right to change the manual, the product, the specifications, or product information sheets without prior notice.

3.0 Product Information

3.1 Specifications

Typical electrical ratings of Panasonic standard 60 and 72 cell modules.

	Panasonic 60 cell	Panasonic 72 cell
Maximum Power (P_{MPP})	250 W	300 W
Rated Voltage (V_{MPP})	30.32 V	36.54 V
Rated Current (I_{MPP})	8.26 A	8.22 A
Open Circuit Voltage (V_{OC})	37.38 V	44.87 V
Short Circuit Current (I_{SC})	8.79 A	8.73 A
Maximum System Voltage	600 V	600 V
Fire Class (UL 790)	C	C
NOCT	45	45
Maximum reverse current	15 A	15 A

Note: The electrical characteristics are within ±3 % of the indicated values of I_{SC}, V_{OC}, and P_{MPP} under Standard Test Conditions (irradiance of 1000 W/m^2, AM 1.5 spectrum, and a cell temperature of 25°C (77°F)).

3.2 Component Overview

Standard NRG photovoltaic modules consist of aluminum framed glass/foil laminates with interconnected crystalline silicon solar cells, permanently attached junction box, and double insulated 4mm^2 wires terminated in touch safe specific PV DC-connectors.

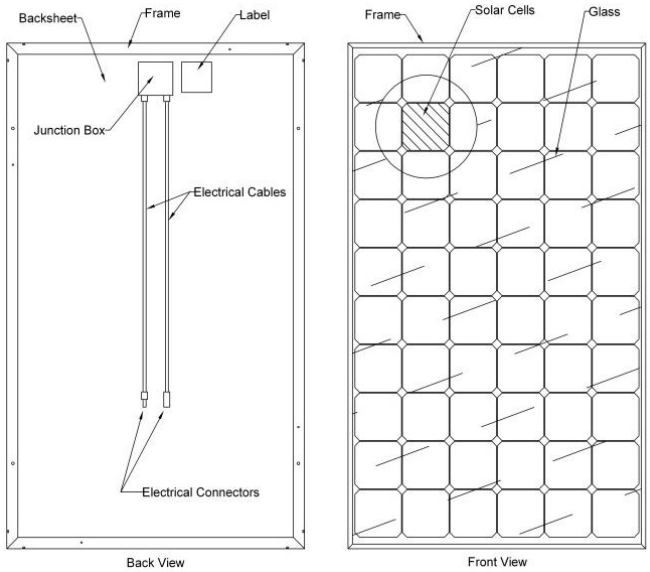

Figure 1: Panel Overview

4.0 Warranty

Please consult your dealer or the manufacturer concerning the warranty of your modules. If you have any further questions, your dealer will gladly assist you.

5.0 Handling Instructions

At Panasonic, we take pride in packaging and shipping our product with the upmost care. After the modules have left our facility, we expect that they will be handled by the same standard of care.

5.1 Transport

- Be sure to unload the modules as you would a larger load, on secure and level ground.
- Modules are fragile and contain glass; they should be transported and handled with care.
- The modules are packed and protected to avoid transportation and handling damage. Packaging must not be removed until the moment of installation to avoid damage.
- During transport and handling, shock loads and vibrations should be avoided.

5.2 Handling

- Never leave a module in a free-standing position, unsupported or unsecured.
- Handle solar modules as you would a glass product, do not drop or place objects on the modules as that may damage the glass.
- Only carry a module by its frame with a minimum of two people.
- Do not use the junction box or the connection cables to hold or transport the module. This could damage the module's environmental and electrical integrity.
- Do not set the modules down carelessly or on their corners.
- Wear appropriate personal protective equipment (for example safety gloves, glasses, boots etc.) and use appropriate, insulated tools when handling the modules.

5.3 Storage

- The modules should be stored in a cool and dry environment.
- Never leave a module in a free-standing position, unsupported or unsecured.
- Do not stack individual modules one on top of the other outside of their original packaging.
- Do not stack pallets of modules on top of each other.
- The modules must not be immersed or continuously exposed to water.

5.4 Recycling

All packaging should be recycled in the appropriate manner or returned to Panasonic after installation.

Old, broken or defective modules must be properly disposed of, they may not be thrown out with household waste. Contact Panasonic for more information on acceptable disposal methods.

6.0 General Safety Warnings

Do not attempt to disassemble the module, and do not remove any attached nameplates or components. Doing so will void the warranty.

- **Do not stand, step or sit on module. Danger of breaking the glass or slipping off with possibility of severe injury or death!**

PV solar modules should only be installed by qualified installers with adequate solar installation experience. You must comply with the standards and regulations applicable to PV installations, such as National Electrical Code (NEC) and other building codes, the grid operator's technical connection requirements, and trade association rules concerning accident prevention. Failure to comply can lead to significant personal injury and equipment damage.

- Installing solar photovoltaic systems requires specialized skills and knowledge. It should only be performed by qualified and specially instructed personnel. The installer assumes all risk of injury, including risk of electric shock.
- When installing modules, observe all applicable local, regional and national codes and regulations. Obtain a building and/or electrical permit where required.
- Use only equipment, connectors, wiring and mounting methods / hardware specifically designed for use in a photovoltaic system.
- Modules are made of glass; handle modules with care to avoid personal injury and damage to the glass.
- Do not drop the module or place heavy objects on or allow objects to fall onto the module.
- Do not wear jewellery of any kind or other metallic devices while installing or troubleshooting photovoltaic systems.
- Do not apply paint or adhesives to the module.
- Artificially concentrated sunlight shall not be directed on the module or panel. Do not use mirrors or other magnifiers or hardware to artificially concentrate sunlight on the modules.
- Wear appropriate personal protective equipment (for example safety gloves, glasses, boots etc.) and use appropriate, insulated tools when handling the modules.
- It is recommended to completely cover the active surface of the module with an opaque material, even when it is not connected to any other device, since the modules generate electricity when they are exposed to any source of light.
- Keep children well away from the system while transporting and installing mechanical and electrical components.
- Do not lift the module by grasping the module's junction box or electrical leads.

6.1 Mechanical Safety Precautions

- Do not install or operate broken or damaged modules.
- Do not carry out the installation in heavy rain, wind or thunderstorms.
- Do not attempt to repair or make any changes to the PV modules. Doing so will void the warranty.
- Do not drill holes in the glass surface of the module or additional mounting holes in the module frame. Doing so may destroy the module and will void the warranty.
- The mounting structure and hardware must be made of appropriate, durable, corrosion- and UV-resistant materials.

- Exposure to salt and sulphur sources risks module corrosion.
- Solar modules are designed for installation with specific photovoltaic mounting systems. Other use lies within the full responsibility of the installer.
- The mounting system must be capable of securely fixing solar modules while exposed to uplift or load pressures of snow and wind loads.
- Observe all instructions and safety precautions as included by the mounting system manufacturer to be used with the module installation.
- In Portrait orientation, the preferred method to orient the module is vertical with the junction box on the higher (top) side. This will ensure that the junction box will be better protected and not be exposed to additional rain or water.
- In Landscape orientation, junction box position is not critical on either the left or right side of the module.

6.2 Electrical Safety Precautions

Lethal voltages and/or a shock hazard may be present in modules and arrays during sunlight hours, even at low light level. This hazard increases when multiple modules are connected together to provide higher system voltage or current levels. Dangerous voltages may also be present at night from connections to batteries and feedback from inverters or other parts of the system.

- Under normal conditions, a photo-voltaic module is likely to experience conditions that produce more current and/or voltage than reported at 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 ampacities, fuse sizes and size of controls connected to the PV output. Refer to Sec. 690-8 of the National Electric Code for an additional multiplying factor of 125 percent (80 percent derating) which may be applicable.
- Photovoltaic modules convert light energy to direct-current electrical energy. They are designed for outdoor use.
- Note that a full open circuit voltage is generated in the modules even at low ambient light levels.
- Contact with any of the electrically active parts of the module, such as terminals, can result in injury or death, regardless whether the module is connected or not.
- Before proceeding at the installation location, first switch off the AC-side followed by the DC-side of the inverter or charge controller.
- When disconnecting wires connected to a photovoltaic module that is exposed to light, an electric arc may occur. Arcs can cause burns, start fires or otherwise create safety (up to lethal electric shock) problems.
- Check for remaining voltage before starting, and observe the local safety relevant regulations for such working conditions.
- Contact with a DC voltage of 30 V or more is potentially hazardous. Exercise caution when wiring or handling modules exposed to sunlight.
- Always use the same type of module within a particular photovoltaic system.
- Observe the instructions and safety precautions for all other components used in the system, including wiring and cables, connectors, DC-breakers, inverters, etc.
- Use appropriate safety equipment (insulated tools, insulating gloves, etc) approved for use on electrical installations.
- Keep all electrical contacts clean and dry.

7.0 Installation Guidelines

- All installations must be performed in compliance with all applicable regional, local and building codes.
- For detailed information on optimal module orientation, refer to standard solar photovoltaic installation guides or a reputable solar installer or systems integrator.
- Do not attempt to open the junction box located on the back side of the module, there are no user serviceable parts within.

7.1 Mechanical Installation

The design load for Panasonic modules ranges from ±33.4 lb/ft2 to +75.2 / -33.4 lb/ft2 [±163 kg/m2 to +367 / -163 kg/m2] as per UL-1703 standards.The positive value indicates downward pressure as from accumulated snow. The negative value indicates uplift pressure as from wind suction. In addition to the standard loading conditions Panasonic modules have also been certified for heavy downward snow load conditions of maximum 5,400Pa depending on mounting configuration.

Mounting Configuration Options:

1) Portrait Mounting
   a. Bolts or clamps and support rails attach to the long edge of the module as per the specified methods and areas in Figure 3.
   b. With this configuration, modules are certified for a maximum downward load of 5,400Pa and upward load of 2,400Pa.
2) Landscape Mounting
   a. Bolts or clamps and support rails attach to the short edge of the module as per the specified methods and areas in Figure 3.
   b. With this configuration, modules are certified for a maximum downward load of 2,400Pa and upward load of 2,400Pa.

The solar modules have also been tested to withstand standard downward design loads of up to 2,400Pa and upward design loads (suction) of up to 2,400Pa, as per IEC-61730 standards.

The modules must not be mounted in regions where higher wind- and snow loads are expected. As well, the complete support structure needs to be strong enough to cope with above loads.
All load calculations, system design and verifications with regards to the installation are within the responsibility of the system planner or installer.

- Do not install the module near equipment or in locations where flammable gases can be generated or collected.
- For rooftop installations, (i) follow the mounting methods for minimum mechanical methods for securement of the module or panel to the roof, (ii) the assembly is to be mounted over a fire resistant roof covering or fireproof underlay rated for the application. Observe all applicable local, regional and national codes and regulations.
- A minimum slope of 5 in/ft for installation is required to maintain fire class rating. Further consult local, regional and national building fire statutory regulation.
- There are small openings on the underside of the module frame closest to the corners to allow water to drain out. Ensure these openings are not obstructed after mounting.
- The mounting structure and hardware must be made of appropriate, durable, corrosion- and UV-resistant materials.

It is important to position the modules in such a way as to absorb the most sunlight throughout the year. This means facing South in the Northern hemisphere, and North in the Southern hemisphere. Generation of maximum power occurs when sunlight shines perpendicularly onto the PV modules. The modules should not be installed at a tilt angle below 15^{o} to ensure adequate self-cleaning and drainage. It is also important to align all the modules at the same angle, both vertically and horizontally, to avoid partial shadowing on neighbouring modules and consistent power output. Also ensure to install the modules with the junction box positioned at the top to avoid pooling and to allow for proper drainage.

The modules must also be positioned out of the shade. Even the slightest partial shading will cause a reduction in yield. A module is considered “shadow-free” if it is unobstructed across its entire surface for the whole year. Even on the shortest day of the year, unobstructed sunlight can reach the module.

When attaching a module to a roof or building, ensure that the panels are securely fastened and cannot fall as a result of wind or snow loads. Sufficient clearance (at least 15 cm) between the module frame and the supporting structure is required to allow air to circulate around the back of the module. This allows for condensation or moisture to dissipate. The minimum distance between two modules for linear thermal expansion of the frames is 5mm, but it is recommended that the modules be installed 20mm apart to allow wind circulation to reduce loads and improve ventilation. The maximum distance between modules should not exceed 12” based on using standard wiring.

7.1.1 Mounting Methods

The mounting design must be certified by a registered, professional engineer. The system designer and installer are responsible for the load calculation and support structure design. The mounting system does not form part of Panasonic’s supply.

Mounting the modules to their support structures can be achieved by either using bolts or clamping hardware:

Mounting with Bolts

- Mounting holes are located on the backside of the frames along their long sides.
- The module must be attached and supported by at least four bolts M8 through the indicated mounting holes.
- Do not drill additional holes or modify the module frame.
- Stainless steel hardware, spring washers and flat washers with a torque of 8 Newton-meters should be used for normal installation.
- Depending in the local wind and snow loads, additional mounting points may be required.

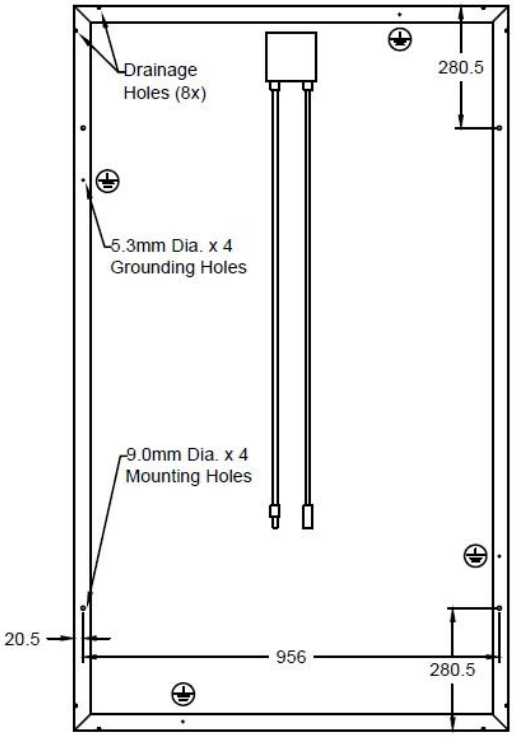

Figure 2: Mounting Hole Locations

Mounting with clamping hardware

- In lieu of nuts and bolts, clamps may be used to mount the modules.
- A minimum of four clamps must be used for each module, two on each frame side. Modules can be clamped on either the short or long edge frame (landscape or portrait configuration) and they must be in the area denoted by the hatching on the drawing.
- Be sure that the clamps overlap the module frame by at least 9 mm, do not bend or damage the surface of the frame.
- Clamping methods will vary, be sure to follow the proper mounting instructions as provided by the mounting system supplier.
- Depending in the local wind and snow loads, additional mounting clamps may be required.
- In the case of improper clamps or installation methods, the modules warranty will be voided.

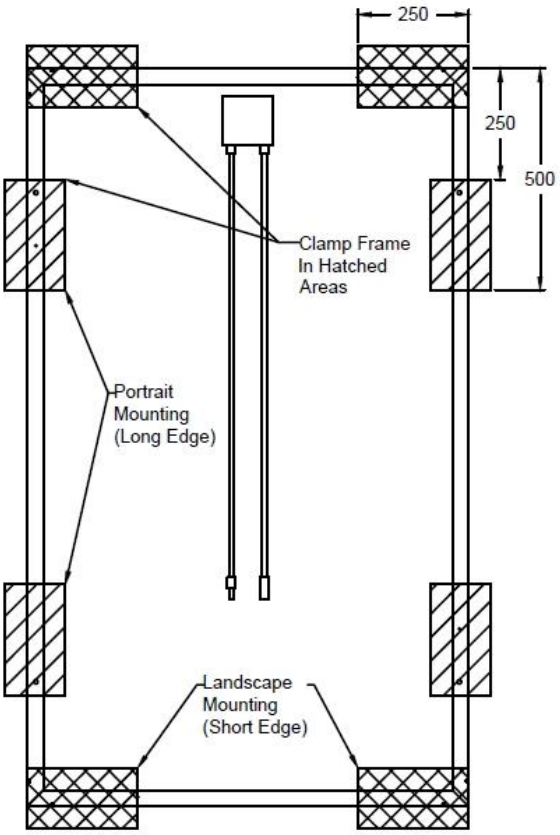

Figure 3: Mounting Configurations

7.2 Electrical Installation

WARNING! Electrical shock hazard! Do not touch bare conductors or other potentially energized parts.

WARNING! Under normal conditions, a photo-voltaic module is likely to experience conditions that produce more current and/or voltage than reported at 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 ampacities, fuse sizes and size of controls connected to the PV output. Refer to Sec. 690-8 of the National Electric Code for an additional multiplying factor of 125 percent (80 percent derating) which may be applicable.

- Local policies on connecting such energy systems to their grids vary from region to region, consult a qualified system designer or integrator to design such a system. Be sure to follow all national, local and building codes and regulations.
- Any installations in Canada shall be in a accordance with CSA C22.1; Safety Standard for Electrical Installations, Canadian Electrical Code, Part I.
- Wear appropriate personal protective equipment (for example safety gloves, glasses, boots etc.) and use appropriate, insulated tools when handling the modules.
- Do not use different types of modules in the same circuit. Modules must be of the same type and power class. The maximum system voltage must not be exceeded, even at low temperatures.
- Do not use modules in systems that can exceed 600 volts open circuit under any combination of solar irradiation and ambient temperature.
- Ensure that polarity is correct when connecting the modules and when connecting the modules to the inverter.
- For best performance, ensure that positive and negative DC wires run closely together avoiding loops, which will also reduce the strength of inductive impacts from nearby lightning strike.
- Make sure the connection of plug connectors is safe and tight. There should not be any outer stress to the connections. They should only be used to connect the circuit.
- Use UV-resistant cable ties to secure the cables to the mounting system and protect cables from damage with appropriate precautions.
- Solar modules are supplied with certified cables and connectors for electrical connections. Use only additional connectors and cables which are qualified for the expected maximum current, maximum voltage and environmental conditions. Use only copper wire with a minimum temperature rating of 90°C with a cross section of min 4mm^2 (#12 AWG) and max 6 mm^2 (#10 AWG).
- Specific connectors of the same type as provided with the module the must be used in the field to complete the installation.
- The PV-DC-connectors must never be disconnected under load.
- Refer to the relevant standards in your country to determine over current, conductor ampacity and size requirements.
- Following the installation of a module string, its performance must be checked with appropriate equipment and circuit breakers to ensure proper function.

Modules can be connected in either series or parallel to form a PV array, especially for application with a high operation voltage.

- Only connect modules with the same rated output current in series. When connected in series, the total voltage is equal to the sum of the individual module voltages.
- Only connect modules or series combinations of modules with the same voltage in parallel. When connected in parallel, the total current is equal to the sum of individual module or series combination currents.
- With a serial interconnection of the modules, the sum of the open circuit voltage at Standard Test Conditions (V_{oc} @ STC) must not pass over the maximal system voltage indicated, both indicated in the modules datasheet.
- If the sum of short circuit currents of the parallel connected modules passes over the reverse current (indicated in the table of chapter 3), string diodes or fuses have to be used in each string of modules connected in parallel. These string diodes or fuses have to be qualified for the maximum expected current and voltage.
- Use a Series Fuse (overcurrent protection) rating of max 15A.
- When connecting modules in series, do not exceed 20, 60-cell modules or 16, 72-cell modules.
- Suitable measures are required to protect against overcurrent for parallel connection of modules.

The electrical characteristics are within +/- 3 % of the indicated values of I_{SC}, V_{OC} and P_{MAX} under standard test conditions (irradiance of 1000 W/m^2, AM 1.5 spectrums, and a cell temperature of 25°C (77°F)).

7.2.1 Grounding

All modules and mounting racks must be properly earth grounded. Be sure to observe all applicable national, local and building codes and regulations when integrating the module with existing lightning protection measures. There are several different grounding methods that can be used to provide the required connection through the frame.

- Appropriate, conductive parts should be used to make the grounding connection.
- Do not use a thread-cutting screw to attach the earth ground to the module frame.
- The earth grounding connection should be made by a qualified electrician. Be sure to use an approved grounding method and test to make sure your grounding is adequate.
- There are four grounding holes located on the backs of the module frames marked with a ground symbol.
- Do not drill additional holes or modify the module frame.
- Take care not to damage the backside of the module with the driver or wrench, as this will void the warranty.
- A bolt, screw or other part used for bonding purposes within a module or panel shall not be intended for securing the complete device to the supporting surface or frame.
- Where other methods are not available, a lay-in grounding lug listed to UL467 or UL1703 is recommended. The lug must be installed according to the lug manufacturer's instructions.
- A bolded or screwed connection is required, it incorporates:
    - GBL-4DBT Lay-in Lug or Equivalent: solid copper, tinned, with SS (Stainless Steel) set screw
    - #10-32 x ¾" SS Machine Screw
    - #10 SS Star Washer
    - #10 SS Flat Washer
    - #10 SS Spring Washer
    - #10-32 SS Nut
- Devices listed and identified for grounding metallic frames of PV modules are permitted to ground the exposed metallic frames of the module to grounded mounting structures.
- The grounding screws, bolts or other parts have to be used separately from mounting parts of the module.
- Torque the #10-32 SS Machine Screw to 2.825 Nm (25 in-lb) using a calibrated torque driver.
- Test all connections for connectivity.

See Figure 4 for an example of accepted practices for mounting a module frame grounding lug.

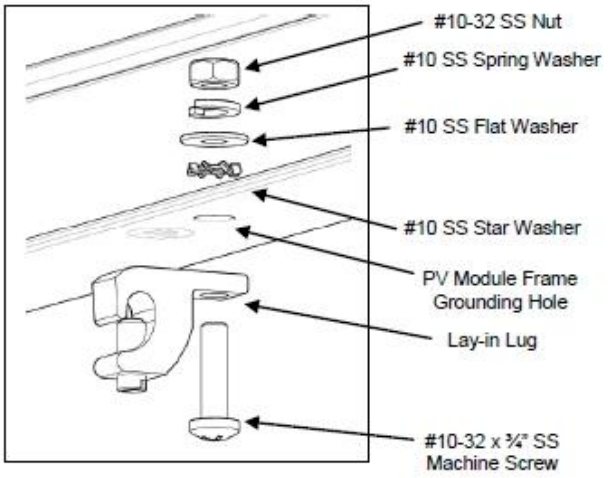

Figure 4: Suggested method of attaching Lay-in Lug to PV Module frame for grounding

Array Electrical Grounding

Note that there is a difference between earth grounding and array grounding.

To ensure maximum performance, modules in array must operate at positive voltages, or above ground voltage. Although most inverters have an explicit ground connection to the lowest voltage module in an array, there are some inverters without transformers, which allow the module array to operate with a floating ground, thus some modules operating below zero volts. Modules operating below ground voltage may significantly degrade in power production in some climates and at extreme operating voltages. This may also occur if modules are connected to each other but are not grounded via the inverter, and left in an Open Circuit Voltage condition (Ungrounded) for a length of time. Such a situation could occur if there is a period of time between module connection to each other and module connection to the inverter. It is therefore required to explicitly ground the negative return of the array immediately after the modules are connected to each other. Failure to ground the negative return of the array shall void the power rating warranty of the modules.

7.2.2 System Shutdown

- Disconnect system from all power sources in accordance with instructions for all other components used in the system.
- The PV-DC-connectors must never be disconnected under load.
- The system should now be out of operation and can be dismantled. In doing so, observe all safety instructions as applicable to installation.

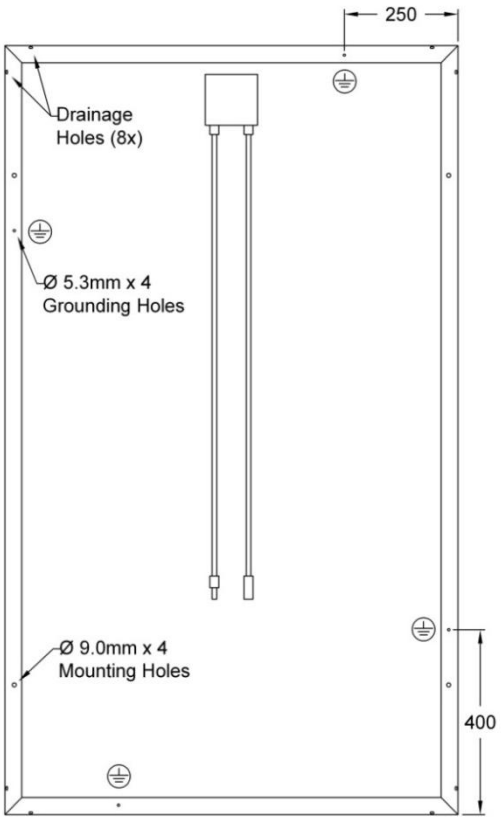

Figure 5: Grounding Locations

8.0 Care and Maintenance

Panasonic recommends the following maintenance items to ensure optimum performance of the module:

- Clean the glass surface of the modules as necessary. Use water and a soft sponge or cloth for cleaning. A mild, non-abrasive cleaning agent can be used if necessary. Do not use dishwasher detergent.
- Only licensed, authorized professionals should perform any service, maintenance and electrical or mechanical inspection.
- Electrical and mechanical connections and the general condition of an installed PV-system should be checked periodically by qualified personnel to verify that they are clean, secure and undamaged. It is recommended to perform regular scheduled maintenance every 6 months.
- Routine maintenance of a module or panel shall not involve breaking or disturbing the bonding path.
- Do not attempt to open the junction box located on the back side of the module, there are no user serviceable parts within.
- Use a brush with soft bristles for snow removal.
- Do not attempt to remove ice.
- Rainfall is sufficient to keep the modules free of dirt, pollen, fallen leaves etc. when installed at a tilt of 15^{o}.
- The small openings on the underside of the modules allow rain to drain out. Make sure these openings are not obstructed after mounting.

Panasonic

Notes: