

General Installation Manual

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General Installation Manual for SANYO HIT[®] Double Photovoltaic Modules. Please read this manual completely before installation or use of HIT Double modules. This manual applies to the following products:

- HIT Double 200 (HIP-200DA3)
- HIT Double 195 (HIP-195DA3)
- HIT Double 190 (HIP-190DA3)
- HIT Double 186 (HIP-186DA3)
- HIT Double 180 (HIP-180DA3)

INTRODUCTION

Thank you for choosing SANYO HIT[®] Double PV modules. With proper operation and maintenance, SANYO modules will provide you with clean, renewable solar electricity for many years. This manual contains important installation, maintenance and safety information. The word “module” as used in this manual refers to one or more PV modules. Retain this manual for future reference.

Disclaimer of Liability

SANYO does not assume responsibility and expressly disclaims liability for loss, damage, or expense arising out of, or in any way connected with installation, operation, use, or maintenance by using this manual.

SANYO assumes no responsibility for any infringement of patents or other rights of third parties, which may result from use of modules.

No license is granted by implication or under any patent or patent rights. The information in this manual is believed to be reliable, but does not constitute an expressed and/or implied warranty.

SANYO reserves the right to make changes to the product, specifications, or this manual without prior notice.

The return of any modules will not be accepted by SANYO unless prior written authorization has been given by SANYO.

General Information

The installation of solar modules requires a great degree of skill and should only be performed by qualified licensed professionals, including, without limitation, licensed contractors and electricians.

WARNING

All instructions should be read and understood before attempting to install, wire, operate, and/or maintain the photovoltaic module. PV modules generate DC electrical energy when exposed to sunlight or other light sources. Contact with electrically active parts of the module such as terminals

can result in burns, sparks, and lethal shock whether the module is connected or disconnected.

The shock hazard increases as modules are connected in parallel, producing higher current, and as modules are connected in series, producing higher voltage.

The installer assumes the risk of all personal injury or property damage that might occur during installation and handling of modules.

To avoid injury or damage:

- Cover the entire front and back surface of the bifacial modules with a dense, opaque material such as a cardboard box or heavy cloth.
- Work only in dry conditions, with dry modules and tools.
- Do not stand or step on a module.
- Do not drop a module.
- Do not break the glass surfaces of a module.
- Do not allow children and unauthorized persons near the installation site or storage area of modules.
- Completely ground all modules according to applicable electric codes.
- Do not disassemble the module, or remove any part installed by the manufacturer.
- Do not open the cover of the junction box.
- Wear suitable protection (gloves, clothes, etc.) to prevent direct contact with 30V DC or greater.
- Carry a module by its' frame with two or more people. Do not carry a module by its wires or junction box. Wear non-slip gloves.
- Do not drop or place heavy items on the surfaces of a module (such as tools).
- Check that all other system components (inverters, wires, racks, balance of system materials, etc.) are mechanically and electrically compatible.
- Do not install the module where flammable gases or vapors are present.
- Never leave a module unsupported or unsecured.
- Do not use or install broken modules.
- Do not artificially concentrate sunlight on a module by mirror, Fresnel lens, magnification, etc.
- Do not touch the junction box terminals.

- Do not change the wiring of bypass diodes.
- Do not touch a PV module unnecessarily. The glass surface and frames get hot. There is a risk of burn.

CAUTIONS

- Use a module for its intended purpose only.
- Do not treat any portion of the module with paint or adhesives, to avoid damage to the module, inoperable conditions, or reducing the module's functionality.
- HIT Double modules have bifacial performance. These modules produce power from both surfaces of the module at the same time and may generate up to 30% more output power than its' STC rated value. Refer to Figure 5 for these output electrical characteristics.
- This additional power depends upon the level of incident light irradiance (albedo) available to the back side of the module, and can be increased or decreased depending upon site characteristics, installation design, weather, etc.
- Treat the back side of the module the same as the front side and avoid objects that directly shade the solar cells. Refer to “Notes on installation” section.

GENERAL SAFETY

Follow all permission, installation and inspection requirements.

- Before installing modules, contact the appropriate authorities to determine permissions, installation and inspection requirements that apply to your site and installation.
- Electrically ground modules for all systems of any voltage. If not otherwise specified, it is recommended that requirements of the latest National Electrical Code (USA) or Canadian Electric Code (Canada) or other national or international electrical standards be followed. Refer to “Earth Ground Wiring” section.
- Check applicable building codes to ensure that the construction or structure (roof, facade, support, etc.) where the modules are being installed has enough strength.
- For modules mounted on roofs, special construction or structures may be required to help provide proper installation support.

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- Both roof construction and module installation design have an effect on the fire resistance of a building. Improper installation may contribute to fire hazards. Additional devices such as ground faults, fuses, and disconnects may be required.
- Do not use modules of different specifications in the same series string.
- Do not use modules of different specifications in parallel.
- Check and follow all safety precautions of other system components used.

UL Listing Information

To satisfy UL standard 1703 requirements, when installing modules, be sure to:

- Use only stranded or solid copper single-conductor type UF cable or USE cable, rated sunlight resistant, for modules and interconnect wiring that is exposed to weather.
- Observe the requirements described in sections labeled INSTALLTION and SPECIFICATIONS.

INSTALLATION

General

Please read this guide completely before installation or use of the modules. This section contains electrical and mechanical specifications needed before using your SANYO PV modules.

- Modules should be firmly fixed in place in a manner suitable to withstand all expected loads, including wind and snow loads.
- Metals used in locations that are exposed to moisture shall not be employed alone or in combinations that could result in deterioration.
- Install modules where they are not shaded by obstacles like buildings and trees. Especially pay attention to avoid partially shading modules by objects during the daytime.
- Modules are water resistant, but not waterproof. Moisture may leak through where the frame and glass connect.
- Please contact your SANYO Authorized Representative with questions regarding mounting profiles for modules if needed.

Notes on Installation

- Clearance between the roof surface and module frame is *required* to allow cooling air to circulate under the back side of the module. This also allows any condensation or moisture to dissipate. Install modules so that air can circulate between the roof and the module as freely as possible.

- Leave 4 inches of clearance between the roof and the module frame.
- SANYO recommends (but does not require) the installation method and mounting profile shown in Figure 1.
- A module should be attached on a mount or support structure rail by metal fittings (Size: 27x27x14mm, Material; SUS304 or NSSC180). The metal fitting must meet the following specifications. Size: not less than 1.06" (27mm) width
Thickness: not less than 0.12" (3 mm)
Material: Stainless steel
- Bolting torque must be more than 8N.m.

The following information is provided to help customers obtain good performance without exceeding a module's operating conditions or warranty parameters.

- Do not artificially concentrate sunlight on a module by mirror, Fresnel lens, magnification, etc.
- The surface upon which modules are installed is recommended to be flat, to prevent artificially concentrated sunlight.

- Additional output power from the back face of the panel can be increased or decreased depending upon angles of installation, height from surfaces, shade from structures or rails, and the albedo of surrounding surfaces.
- Please see Figure 6 for the effect of angles of installation on output power.
- The height of a module above a surface affects the power potential of the module's back face.
- When possible, maximize the height of modules above surfaces in order to maximize ambient light beneath the modules.
- Always position support structures and rails along the edges of a module, or between modules, and do not allow rails to shade a module's back surface.
- Light colored surfaces reflect more light than dark colored surfaces. Installing HIT Double modules over light colored surfaces will increase the output power potential from the back side.

Operating Conditions

SANYO requires that modules be operated

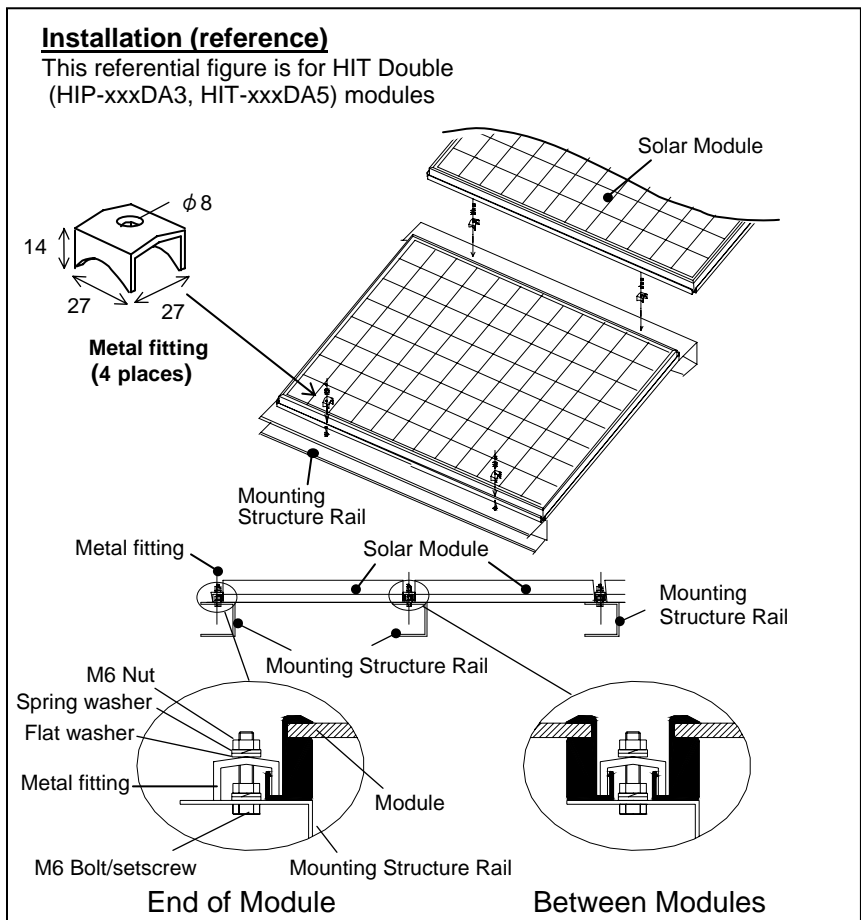


Figure 1. Installation

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within the following conditions:

- 1) Terrestrial applications only—no outer space use.
- 2) The ambient temperature must be within -20°C (-4°F) to 46°C (115°F). The temperature limits are defined as the monthly average low and high of the installation site.
- 3) The wind pressure load of the installation site should be less than $1,440\text{Pa}$ (30PSF)*.
*Note: HIT Double modules were tested at 30PSF at UL's testing lab. Modules of exactly the same structure successfully achieved 50PSF load ratings at JET's (Japan Electrical Safety & Environment Technology Laboratories) testing lab, and are certified as fully compliant at 50PSF .
- 4) Modules must not be installed nor operated in areas where, salt, hail, snow, sand, dust, air pollution, chemically active vapors, acid rain, soot, etc., are excessive.

SPECIFICATIONS

- Rated electrical characteristics are within -5% to $+10\%$ of the values measured at STC. STC Conditions are; Irradiance of $1000\text{W}/\text{m}^2$, 25°C cell temperature, and solar spectral irradiance per IEC 60904-3.
- Under normal conditions, a photovoltaic module may 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 modules should be multiplied by a factor of 1.25 when determining voltage ratings, conductor capacities, fuse sizes, and size of controls connected to the module output. **Refer to Section 690 of the National Electrical Code (NEC) for an additional multiplying factor of 1.25, which may be applicable.**
- The current output for the modules shown in the SPECIFICATIONS section is measured at Standard Test Conditions. These conditions may not be frequently observed in actual practice.

Mechanical Loading

- HIT Double modules should be mounted at four (4) symmetrical quarter points within the shaded areas (Range A) shown in Figure 4, or any mounting method with a continuous attachment, by which those four points are included in each side.
- The four symmetrical quarter point method offers a maximum loading of

$1,440\text{Pa}$ (30PSF) in a static state on the module surface.

Note: This mechanical loading value was tested using the following mounting device:

Provider: AKATSUKI Industries, Ltd.
Part number: PVK-AJ4B

Note: HIT Double modules were tested at 30PSF at UL's testing lab. Modules of exactly the same structure successfully achieved 50PSF load ratings at JET's (Japan Electrical Safety & Environment Technology Laboratories) testing lab, and are certified as fully compliant at 50PSF .

WIRING

- All wiring should be done in accordance with applicable electrical codes.
- Wiring methods should be in accordance with the NEC in the USA or the CEC in Canada.
- A qualified, licensed professional should do all wiring.
- Wiring should be protected to help ensure personal safety and to prevent its damage.
- All modules connected in series should be of the same model number and/or type.
- Do not connect modules in parallel without using a connection box that connects appropriate FUSE for each series string or each module.
- Do not disconnect terminals while PV modules generate electricity and connect electrical load to avoid the hazard of electrical shock.
- To avoid the hazard of electric shock and sparks, please connect each cable after confirming the polarity of them is correct.
- Cable conduits should be used in locations where the wiring is inaccessible to children or small animals.
- Use caution and design the system in consideration of the increased output power (P_{max}) and current (I_{sc}) from the bifacial effect (see Table 1).
- Additional electrical values are provided up to 30% beyond the STC values for accurate system sizing including the bifacial effect.
- If in doubt about the expected power potential from the bifacial effect for your particular site, please use the values stated under the 30% column.

Module Wiring

- The number of modules that can be wired in series is recommended at

seven (7) or fewer. If connecting eight (8) modules in series, check local temperature conditions and follow the National Electric Code (690.7) to ensure compliance with maximum voltage limitations. Also, be sure to calculate and account for the bifacial effect of the modules.

- HIT Double modules are not designed for "off-grid" or battery charging systems, because of their operating voltage. Therefore, it is not recommended to use them to charge batteries.
- These modules contain factory installed bypass diodes. If these modules are incorrectly connected to each other, the bypass diodes, cable, or junction box may be damaged.

Array Wiring

- The term "array" is used to describe the assembly of several modules on a support structure with associated wiring.
- Use copper wire that is sunlight resistant and is insulated to withstand the maximum possible system open circuit voltage.
- Check local codes for requirements.

Earth Ground Wiring

- Grounding should be carried out by attachment to the module or array frame, to avoid the hazards of electric shock or fire.
- The array frame shall be grounded in accordance with NEC Article 250 (USA) or CEC in Canada.
- Bonding shall be by a positive means, such as clamping, riveting, bolted or screwed connectors, or welding, soldering or brazing. If the bonding

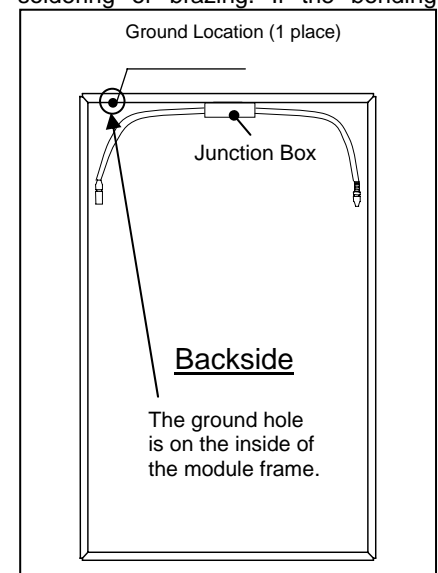


Figure 2. Module Ground Position

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means depends upon screw threads two or more screws or two full threads of a single screw must engage the metal.

- All the washers illustrated in Figure 4.1 are required as part of the grounding connection.
- Great care should be exercised to ensure that corrosion caused by the grounding means be avoided. Corrosion can increase the resistance of the grounding connection on the module, or can even cause the grounding connection to fail entirely. Corrosion can be caused by the effects of weather, humidity, dirt and so on. It can also be caused when two dissimilar metals are in contact (galvanic action).
 - Note that the module frame material is aluminum/magnesium alloy.
 - All fasteners (nuts, bolts, washers, etc.) must be stainless steel unless otherwise specified.
- Length of bolt should not be more than 1.26"(32 mm).
- Acceptable grounding wire is following. IlSCO Corp. GBL-4DBT 10-14AWG-Solid, 4-6, 8, 10-14AWG-Strand Burndy L L C CL501TN 14AWG-Solid, 14-4AWG-Strand Tyco Electronics Corp. 1954381-2 10-12AWG Solid
- Each framed module has a hole for a bolt (0.205" diameter (5.2 mm)). This ground hole is marked with a "G" adjacent to the location on the frame rail (see Figure 2). Ground wires must be connected to the module's metal frame at this location.

Grounding Locations (or grounding holes)

- If using this method, use one of the larger holes with diameter of 0.205" (5.2 mm)
 - The bolt and nut size should be No.8 (0.164" diameter (4.16 mm)), or No.10 (0.190" diameter (4.83 mm)) or M5 (0.197" diameter (5.0 mm)).
- Star washers must be used to make contact through the anodization of the module frame.
- In this case, the screw threads are not providing the electrical ground contact.

Grounding Method

Wire connection using cup washers (see Figures 4.1)

- Use a bolt and nut (see Figures 2 Figures 4.1)
- The use of cup washers is to prevent wire from slipping out from under the screw head (and/or the flat washer).

- Make sure that the cup washer is placed between the wire and the module frame.
- Choose an adequate size for the cup washer and the flat washer so that the wire is fully clamped between them.
- Note: Cup washers are also called as terminal cup washers.
- The cup washers should be stainless steel, or a cup washer made of brass may be used only if a large flat washer made of stainless steel is inserted between the module frame and the cup washer.
- Choose the adequate size for the large flat washer (between the module frame and the cup washer) so that the cup washer doesn't contact the module frame and is fixed stably to the module frame.
- Star washers must be used to make contact through the anodization of the module for this method.
- In this case, the screw threads are not providing the electrical ground contact.
- Recommended torque value in tightening bolt and nut is 2.3N.m (20in-lb).

Using "grounding lug" (see Figures 4.2)

Use a bolt and nut (see Figures 2 and 4.2)

- The bolt and nut size should be No.8 (0.164" diameter (4.16 mm)), or No.10 (0.190" diameter (4.83 mm)) or M5 (0.197" diameter (5.0 mm))
- Star washers must be used to make contact through the anodization of the module for this method..
- In this case, the screw threads are not providing the electrical ground contact. As shown in Figures 4.2, tighten the set screw (stainless steel) to ground wire at the torque specified by lug manufacturer.

The specified torque is following

IlSCO Corp. GBL-4DBT
10-14AWG-Solid -> 20 in-lbs,
4-6AWG-Strand -> 35 in-lbs, 8AWG-Strand -> 25 in-lbs, 10-14AWG-Strand -> 20 in-lbs

Burndy L L C CL501TN
14AWG-Solid -> 35 in-lbs,
14AWG-Strand -> 35 in-lbs, 4AWG-Strand -> 45 in-lbs

- Recommended torque value in tightening bolt and nut is 2.3N.m (20in-lb).
- Use a grounding tin plated solid copper lay-in lug rated for direct burial and outdoor use. Lug must be used ILSCO GBL-4DBT, Burndy CL501TN.

Using a Grounding Clip with bolt and nut

Use a bolt and nut (see Figures 2 and 4.2)

- Use Tyco Electronics 1954381-2 as grounding clip.
- As shown in figure2, place the grounding clip onto the module frame.
- Thread the hex nut onto the end of the screw, then using a 3/8-in. wrench, tighten the nut. Recommended torque value in tightening bolt and nut is between 1.7 and 2.2 Nm.
- Insert the wire into the wire slot. Press down on both ends of the wire.
- Manually, or using channel lock pliers, push the slider over the base until it covers the base. This will terminate the wire.
- For more information, please refer to Instruction sheet issued by Tyco Electronics.

Additional ground hole – If needed, drilling one hole allowed in specified locations on the frame of the module (see Figures 4.3(a) and (b)). This hole is for grounding purposes only. The grounding hole size should be 0.205" 5.2 mm.

1. Scratch the hole centers of additional ground hole both side of frame.
2. Fix a module and Drill the pilot holes from outside of frame. (hole diameter: 2 mm)
3. Fix a module and Drill the pilot holes from inside of frame. (hole diameter: 2 mm)
4. Fix a module and Drill plated through hole from outside of frame (hole diameter: 5.2 mm)
5. If barr side of frame outside is more than 1 mm, remove the barr by using sandpaper.



WARNING

Do not damage the back side of module when the holes are drilled.

Junction Box and Terminals

- Modules are equipped with one junction box containing terminals for both, positive and negative polarity, and bypass diodes.
- Each terminal is provided with factory installed lead cables and Multi Contact MC3 connectors for series and string connections. Always use these connectors and do not detach them from cables.

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Bypass Diodes

- When modules in series strings are partially shaded, it may cause reverse voltage across the cells or modules, because the current from other cells in the same series is forced to flow through the shaded area. This may cause undesirable heating to occur.
- The use of a diode to bypass the shaded area can minimize both heating and array current reduction.
- Modules are equipped with four (4) factory installed bypass diodes. The factory-installed diodes provide proper circuit protection for the systems within the specified system voltage, so that you do not need any other additional bypass diodes.

MAINTENANCE

- Some maintenance is recommended to maintain optimal output performance of the HIT Double solar modules.
- When a module's front or back surface becomes dirty, power output is reduced.
- It is recommended to clean the front surface of the module with water and a soft cloth or sponge, twice or more per year. It is recommended to clean the back surface as needed.
- A mild non-abrasive detergent may be applied for persistent dirt.
- It is also recommended to inspect the electrical and mechanical connections annually.
- If you need electrical or mechanical inspection or maintenance, it is recommended to have a licensed authorized professional carry out the inspection or maintenance to avoid the hazards of electric shock or injury.

For further information, please visit www.sanyo.com/solar or contact your SANYO Authorized Representative.

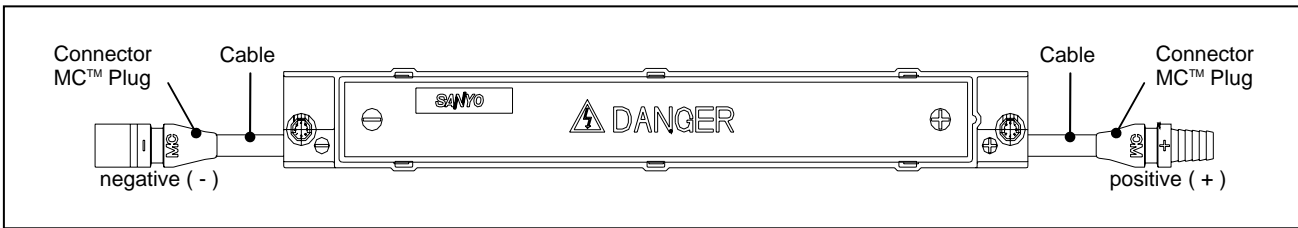


Figure 3-1. Configuration of Junction Box for HIP-xxxDA3

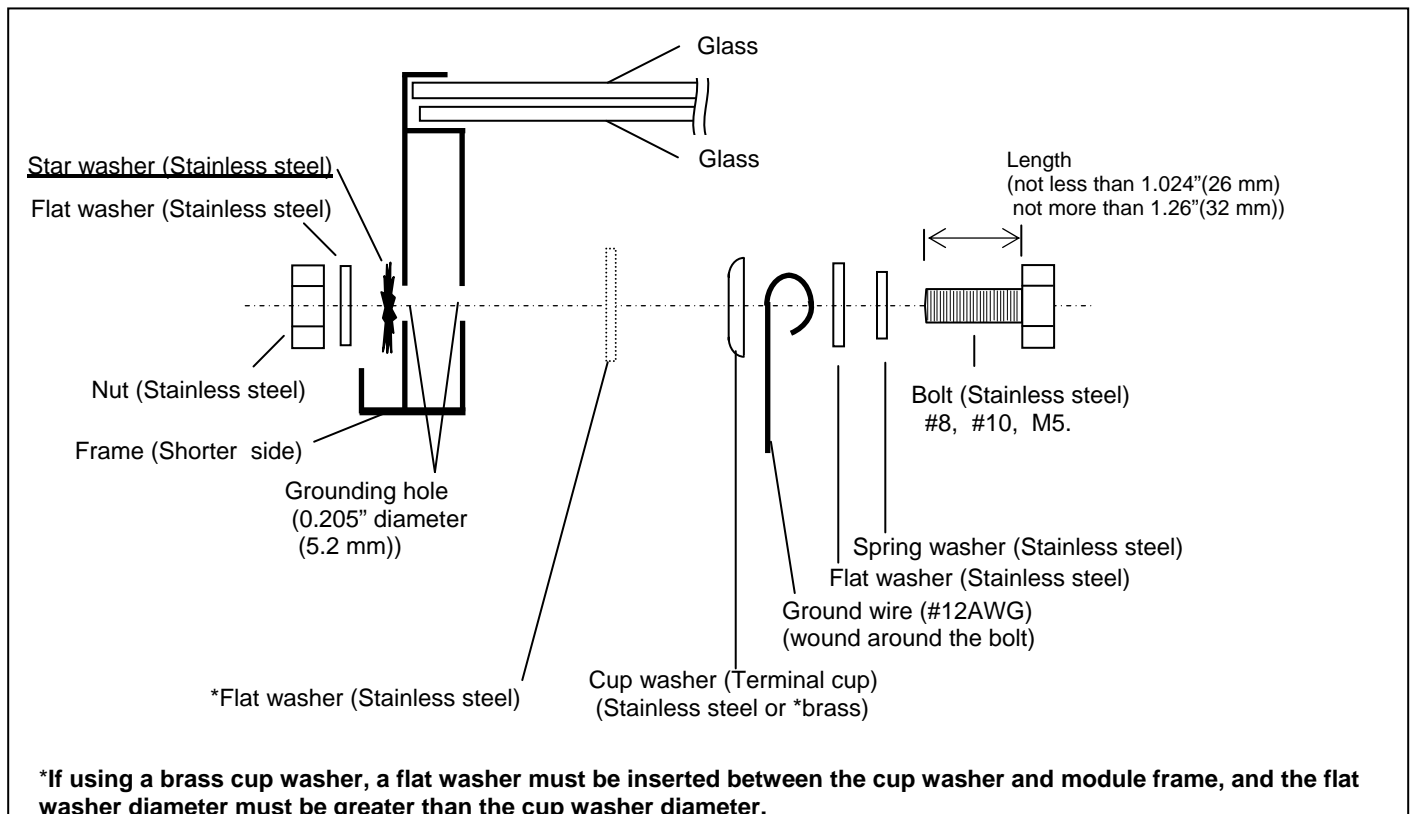


Figure 4.1
Grounding method using cup washer

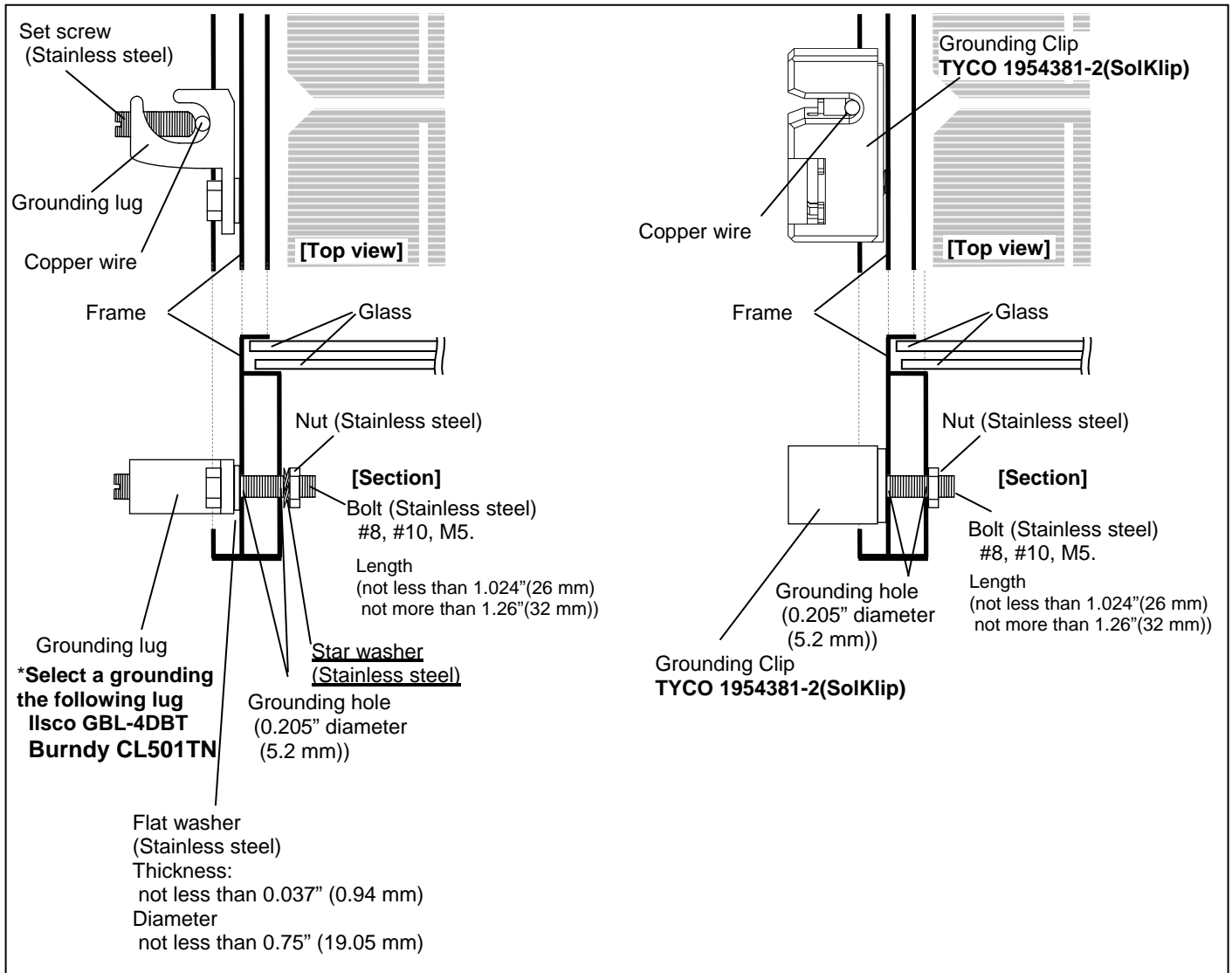


Figure 4.2
Grounding method using grounding lug

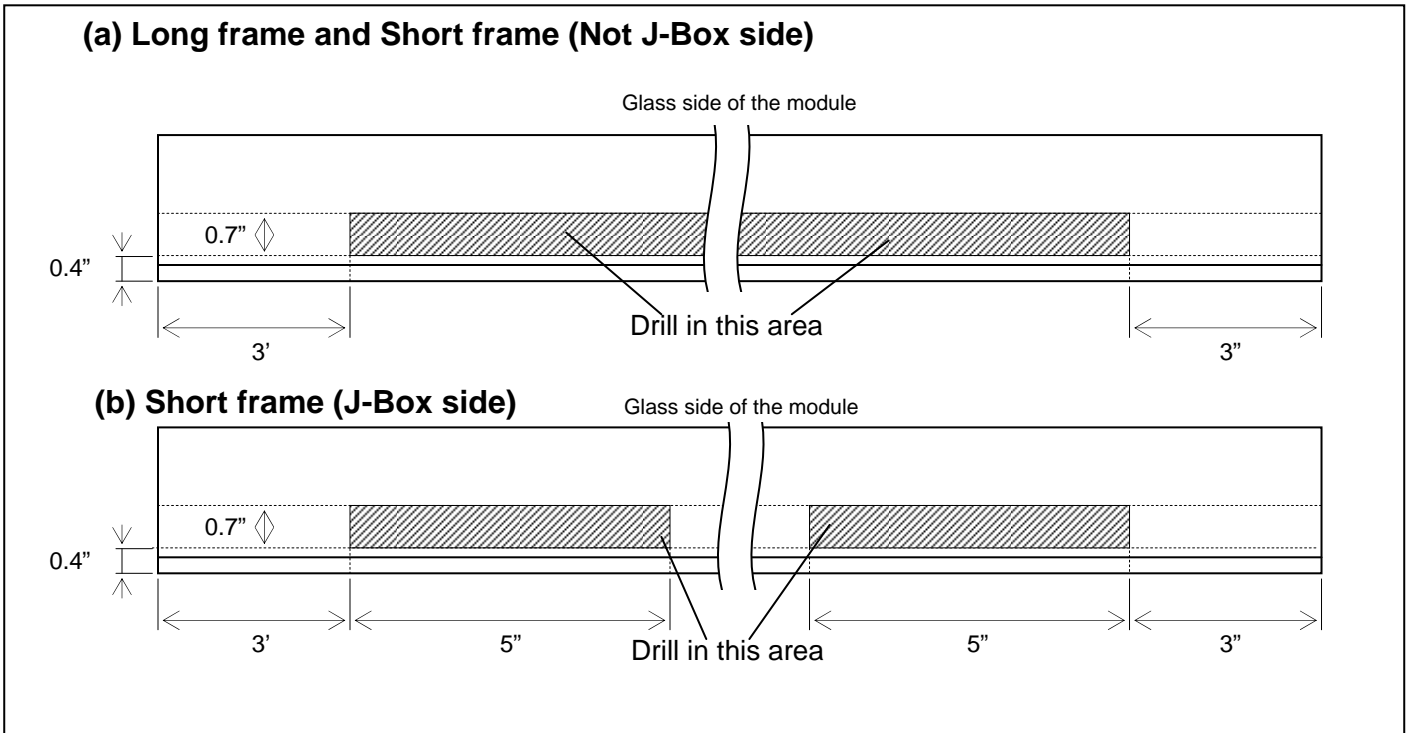


Figure 4.3
Acceptable area for drilling

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SPECIFICATIONS

HIT Double Series (HIP-xxxDA3)

Specifications

Cell Number in Series [Pieces]	96
Cell Type	HIT* (hybrid of amorphous and monocrystalline silicon)
Maximum System Voltage [V]	600
Bypass Diodes	4 Bypass Diodes
Maximum Series Fuse (A)	15
Panel Area	13.06 ft ² (1.21m ²)
Panel Weight	50.7 lbs. (23kg)
Panel Dimensions LxWxH	53.2x35.35x2.36in (1351x898x60mm)
Cable Lengths	39.4in each (1000mm)
Cable Size / Connector Type	No.12 AWG / MC Connectors
Static Wind / Snow Load	50PSF (2400Pa) / 39PSF (1876Pa)
Pallet Dimensions LxWxH	54.3x36x70.1in (1379x912x1781mm)
Full Pallet Quantity / Full Pallet Weight	20pcs / 1014Lbs (460kg)
Quantity per 20', 40', 53' Container	200pcs / 420pcs / 540pcs

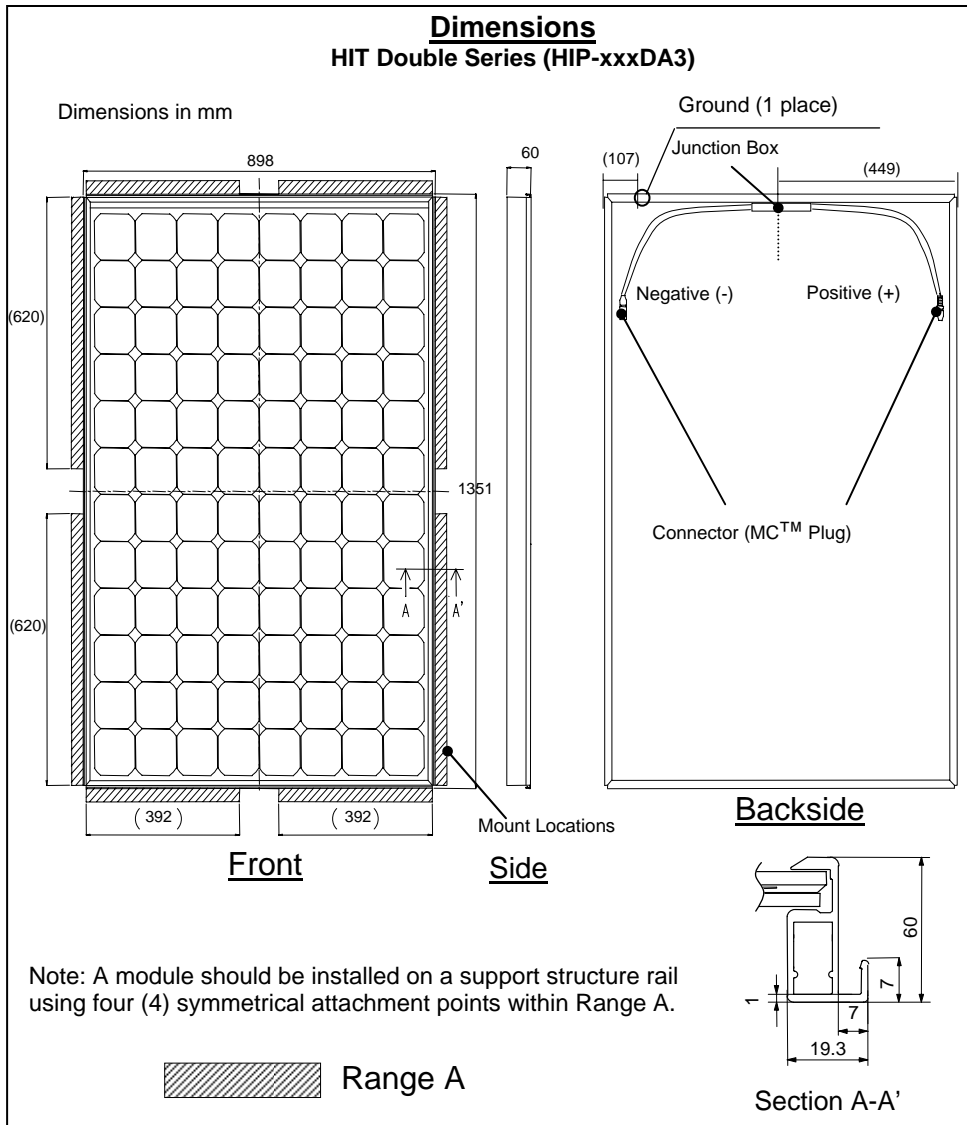


Figure 5. Dimensions

Electrical Specifications Including Bifacial Effect

Model		Rated	Specifications Including Backside Irradiation Contribution in Isc as a Percent of STC						
			STC	5%	10%	15%	20%	25%	30%
HIT Double 200 HP-200DA3	Maximum Power (Pmax)	W	200	209	219	228	237	246	256
	Maximum Power Voltage (Vpm)	V	56.2	56.3	56.3	56.4	56.4	56.5	56.5
	Maximum Power Current (Ipm)	A	3.56	3.72	3.88	4.04	4.20	4.36	4.52
	Open Circuit Voltage (Voc)	V	68.8	69.0	69.1	69.2	69.4	69.3	69.6
	Short Circuit Current (Isc)	A	3.75	3.94	4.13	4.31	4.50	4.69	4.88
HIT Double 195 HP-195DA3	Maximum Power (Pmax)	W	195	204	213	222	231	240	249
	Maximum Power Voltage (Vpm)	V	55.8	55.8	55.8	55.9	56.0	56.0	56.1
	Maximum Power Current (Ipm)	A	3.50	3.66	3.82	3.97	4.13	4.29	4.45
	Open Circuit Voltage (Voc)	V	68.7	68.9	69.0	69.1	69.2	69.2	69.5
	Short Circuit Current (Isc)	A	3.73	3.92	4.10	4.29	4.48	4.66	4.85
HIT Double 190 HP-190DA3	Maximum Power (Pmax)	W	190	199	208	216	225	234	243
	Maximum Power Voltage (Vpm)	V	55.3	55.3	55.4	55.4	55.5	55.5	55.6
	Maximum Power Current (Ipm)	A	3.44	3.60	3.75	3.91	4.06	4.22	4.37
	Open Circuit Voltage (Voc)	V	68.1	68.3	68.4	68.5	68.6	68.6	68.8
	Short Circuit Current (Isc)	A	3.70	3.89	4.07	4.26	4.44	4.63	4.81
HIT Double 186 HP-186DA3	Maximum Power (Pmax)	W	186	195	203	212	220	229	238
	Maximum Power Voltage (Vpm)	V	54.8	54.8	54.8	54.9	54.9	55.0	55.1
	Maximum Power Current (Ipm)	A	3.40	3.55	3.71	3.86	4.01	4.16	4.32
	Open Circuit Voltage (Voc)	V	67.5	67.7	67.8	67.9	68.0	68.0	68.2
	Short Circuit Current (Isc)	A	3.68	3.86	4.05	4.23	4.42	4.60	4.78
HIT Double 180 HP-180DA3	Maximum Power (Pmax)	W	180	188	197	205	213	222	230
	Maximum Power Voltage (Vpm)	V	54.4	54.4	54.5	54.5	54.6	54.6	54.6
	Maximum Power Current (Ipm)	A	3.31	3.46	3.61	3.76	3.91	4.06	4.21
	Open Circuit Voltage (Voc)	V	67.0	67.2	67.3	67.4	67.5	67.5	67.7
	Short Circuit Current (Isc)	A	3.62	3.80	3.98	4.16	4.34	4.53	4.71

Table 1. Specifications Including Bifacial Effect

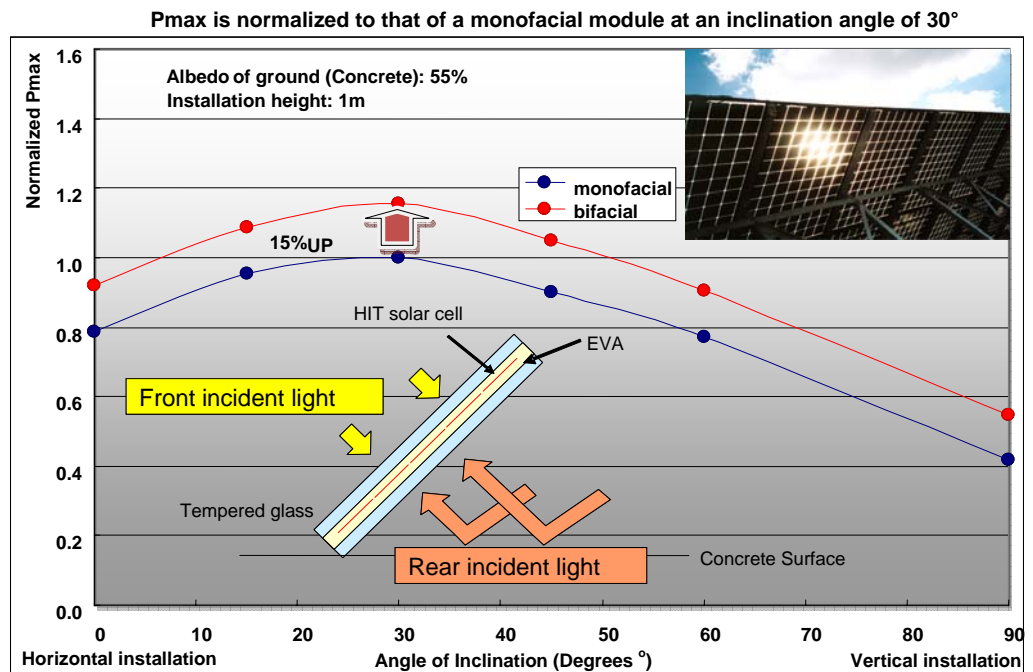


Figure 6. Installation angles and output changes.