Installation Manual – Solar PV Modules

Registered Office (Head Office):
Panasonic Life Solutions India Pvt. Ltd. (Formerly known as Anchor Electrical)
12th floor, Ambience tower, Ambience Island, NH-48, Gurugram,
Haryana - 122002, India. T: (9122) 4222 8888 | F: (9122) 4222 8888
Website: www.Isin.panasonic.com Email: solar@in.panasonic.com

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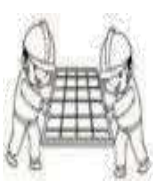
1. RESPONSIBILITY DECLARATION

- This Installation manual meets the requirement of Anchor by Panasonic Solar PV Modules.
- This manual is for trained & skilled professionals only. PLSIND is not responsible for any type of mishandling or failure to follow instruction manual. Any type of Loss, Damage, Hazard, Injury or Expense because of improper installation, Handling, Usage & Maintenance is not in scope of PLSIND.
- PLSIND doesn't consider any liability for the infringement of intellectual property rights or other rights of third parties that may result from use of the module. No license is granted in this regard, either expressly or implicitly, or under any patent rights.
- Information in this Instruction manual is based on Anchor by Panasonic expertise. This manual & specification can be changed by the company without any prior information. PLSIND has rights to amend this document any time including solar module specification without prior notification.
- The Installation Manual is applicable for both 1500V & 1000V series modules.

2. SAFETY PRECAUTIONS

- The installation of solar modules requires qualified professionals to install.
- Before installation, wiring, operation or maintenance, professional needs a comprehensive understanding of Solar PV Modules or system's installation, operation or maintenance requirements.
- Use properly insulated tools and appropriate protective equipment to reduce risk of electric shock.
- Do not stand/step on the module.
- Do not damage the back or front of the solar module.
- Do not use solar module with broken glass or back sheet. Broken Modules cannot be repaired, touching the broken module surface or frame can lead to electrical shock.



Use Both hands When handling Modules

Ensure Modules are fixed properly

Do not step on Modules

Do not drop or throw Modules

Do not touch Modules with bare or dirty hands

- Do not disconnect the modules under load conditions.

- Anchor Modules produce >35V DC individually and even higher voltages when connected in series in a string. Hence the connection and disconnection of modules should be done by a experienced professional.

- Prevent connector contamination; don't make connection terminal plug dirty.

- Do not handle or install modules when it is raining or during periods of high wind. Also do not allow the modules or parts of modules be submerged fully under water.

2.1 Fire Precautions

You can consult your local authorities for proper guidance during installation. Installers also should be aware of building fire safety codes, and local ordinances.

- Rooftop installations should be placed over fire resistant roof coverings only. Roof constructions and installations may affect the fire safety of a building; improper installation may lead to hazards in the event of a fire.

- Unskilled installation procedure, using defective /worn out parts may result in an electrical hazard during operation. In order to prevent the risk of fire in this case , SPV modules should not be installed near highly inflammable liquids or gases , or locations with hazardous materials.

- In the case of a fire, SPV Modules may produce very dangerous voltage / current, even if they have been disconnected from the inverter or have been partly or entirely destroyed, or the naked wiring destroyed. In the event of fire, inform the fire/ safety team about the particular hazards from the PV system, and stay away from all elements during and after a fire until the necessary steps have been taken to mitigate the risk.Anchor by Panasonic PV Modules are Class A modules with Class C fire resistance rating in accordance with IEC 61730 certification. The front surface of the module made with tempered glass and so it must be handled with utmost care. If a person comes in contact with PV module surface having damaged / broken glass can lead to electric shock particularly when wet ambient condition exists. Broke modules cannot be repaired, so should be disposed properly.

2.2 Marking on Hot enclosure:

Product under normal operation will be at higher temperature of 45°C ± 2°C. User is suggested to take precautionary measure while touching the solar panels.

3. PV MODULE UNPACKING & PRE-MOUNTING GUIDANCE

- Customers are requested to check the product specification whether it is as per order or not, after receiving PV Modules. All the serial numbers and other details are present on PV Module box.
- Do not stack more than two pallets one above the other. Pallets stored in open area (i.e. open to sky) should be always covered with a protective cover.
- Two persons should be there during unpacking of module box as per picture.
- Improper handling of PV Module may cause scratches and damage to module.
- Do not short the +ve and -ve terminal of the junction box of the Solar PV module at any time. Unskilled persons should avoid electrical connection of these PV modules if a skilled electrical supervisor not be there.
- Always use cutting pliers to cut the cable tie of the PV module. Do not use any knife as it can damage the PV module.

3.1 Module identification

Every module has a unique serial number that has been laminated within the front glass and back sheet. It is installer's responsibility to record all serial nos. of received modules.

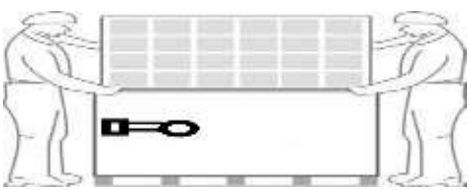


Fig 1: Module unpacking

4. ENVIRONMENTAL FACTORS

4.1 CLIMATIC CONDITIONS

Anchor by Panasonic Solar PV modules are certified for IEC 61215/ IS14286 , IEC 61701, IEC 61730, UL 61730 , IEC 62716 and IEC 62804 . The modules are qualified for Application class A. Modules qualifies for safety through IEC / UL 61730. Anchor by Panasonic PV Modules are certified for Salt Mist Corrosion test (IEC 61701 - Severity I). As per severity level I, Anchor by Panasonic Modules can be installed in marine climate also.

No.	Environment condition	Range
1	Ambient temperature	-40°C to +50°C.
2	Working Temperature	-40°C to +85°C
3	Storage temperature	-40°C to+40°C.

4	Humidity	Below 85RH%
5	Mechanical Load Pressure- 1) Wind load 2) Snow load	 1)As per datasheet 2)Below 5400 Pa

Mechanical load bearing of each module is based on mounting methods. Professional solar system installers should be responsible for calculating mechanical loads when system design.

MMS Structure stability

The mounting structures must be designed by qualified structural engineers, and installation design and procedures shall be consistent with the relevant local standards. The mounting structure must be made of durable, corrosion & UV resistant materials to withstand 25 years of Life span of Poly Mono, and Mono PERC modules & 30 years for Topcon Solar modules Please consult the Anchor by Panasonic technical support department for more information on the use of modules in special climatic conditions.

Guidelines for Mounting

Ensure that the mounting system is designed to withstand the wind loads as per the relevant wind codes and snow load. The load should not cross the maximum rated load bearing capacity of PV module that is 2400 Pa for wind and 5400 Pa for snow. Anchor by Panasonic advices the customer to choose the modules carefully considering the environmental conditions.

- Anchor by Panasonic Modules are tested for maximum snow load capacity of 5400 Pa.
- It is recommended to mount the modules on a tilted angle depending upon zonal latitude to optimize maximum power tracking. The Modules shall be installed so as to maximize solar exposure and to minimize shading by trees, buildings or other obstacles in the surrounding area.
- PV modules should not be installed under shadow as it may lead to current mismatch across the solar cells affecting the performance of the solar module. A permanent or regular shade will cause will lead to hot spots causing permanent damage to solar modules, which results in the invalidity of product's limited warranty. Installers should avoid such place to install PV modules.
- Modules connected in a series must be installed at same angle. Variation in angles may cause power loss due to uneven exposure to solar irradiance.

Logistics of PV Module

- Anchor by Panasonic PV modules are supplied in packed condition to the client. The product details and quantity are always indicated in sticker pasted on the PV module box. If customer

received any lose module / open box condition at the time of receipt of consignment, Receiver is advised to hold unloading and inform PLSIND - Logistics team.

- It is client responsibility to compare receipt no. of Pallets qty. Against mentioned qty. On transporter's LR / PLSIND packing list at the time of receiving of consignment, for any difference in QTY of no. of pallets , recipient is advised to mention discrepancy clearly on LR and obtain signature of vehicle driver and also obtain driving License copy of driver . The customer should get in touch with Anchor by Panasonic logistics team for further procedures.

- Customers are requested to intimate PLSIND for any physical damage of pallets on vehicle , along with support photographs of damaged pallets on vehicle for Insurance claim purpose on same day of receipt of container and same need to inform PLSIND- Logistics team.

- It is necessary to obtain signature of driver on LR / POD. The discrepancy remarks should be agreed by Vehicle driver. All LR (POD) shall be stamped and duly signed by customer mentioning number of pallets received.

1. SITE SELECTION

- Install Modules at the places with sufficient sunlight and without shade at any time. If a module is shaded or even partially shaded, it will result in lower power output.

- PV module can be installed in portrait or landscape orientation, impact of dirt shading can be minimized by orienting the PV modules in portrait. The module facing should be south in northern hemisphere and north in southern hemisphere.

- Anchor by Panasonic recommends that the module should be installed at a working ambient temperature of -20 ℃ to 50 ℃. The module's working ambient temperature range is from -40℃ to 85℃.

- For optimum energy production, solar modules should normally be mounted facing the equator at an angle to the horizontal plane equivalent to the latitude of the installation. If the PV module is placed at a different angle or orientation, this could have a direct impact on the power output.

- At any condition PV module should not be installed by immersing the module under water. PV module should not be installed on moving objects like vehicle or vessel.

- Avoid using drain holes to mount the PV Modules on MMS.

2. MOUNTING INSTRUCTION

a. Mounting Methods

- Anchor by Panasonic PV modules can be installed using bolts as well as clamp methods. For bolts method, M8x35- A4 (DIN 933) Stainless steel bolt to be used.

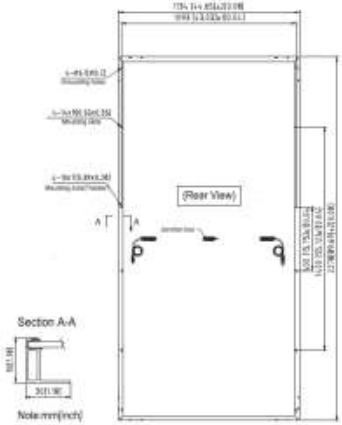
- Minimum distance required between module frame and surface of the roof or wall is 100 mm.
- Minimum standard gap in between adjacent Solar PV modules should be 20 mm.
- Drainage holes should be kept open and no blockage is allowed in the drainage hole.

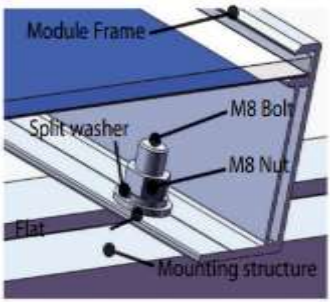
PV Modules should not be considered for installation where the wind or snow load exceeds the maximum permissible loads and should not be considered for excessive force due to thermal expansion of support structure. Micro level detailing has to be done during system design and installation such that thermal expansion of support structures does not cause any damage to PV Modules. The damaged caused to PV modules because of the external factors will not be covered under standard warranty clause. In case of ground mounted systems, ensure to maintain sufficient ground clearance to prevent the lowest portion of the module getting covered by snow for long time in area that experience severe snow fall. If snow pile on the PV modules , the regular sweeping of snow and dirt is highly recommended to ensure the long - term reliability of the PV modules. Failure to comply may result in damage to the module and lead to drop in power output which will not be considered for warranty claim.
In compliance with UL 61730, it is necessary to mount the modules as being instructed in this manual.
PLSIND supplies all modules with anodized Aluminum frame. As per PLSIND modules design, it can be mounted in 2 manners:
a) Bolt type fixing
b) Clamp type fixing

A. Bolt Type Mounting

All Aluminum frames of Anchor by Panasonic PV Modules contain 8 mounting holes of 9 mm X 14mm. It is recommended by PLSIND to use M8x35-A4 (DIN 933) stainless steel Hex nut-bolt system for 4 mounting holes and the additional installing holes would be also used in the case of strong wind and/or heavy snow. Each module needs to be secured by at least two 4-point opposite sides. The Modules should be firmly fastened to MMS structure assembly using M8 bolt, 2 set of Flat Washer, One split washer and nut. For reference, please see the below image for the sequence (Bolt + Plain Washer + Module Frame + Plain Washer + Split Washer + Nut). The recommended torque value for fasteners used for mounting the PV modules is around 20-25 N-m.

Mechanical Drawing of PV module "AE14HXXXVHC10B

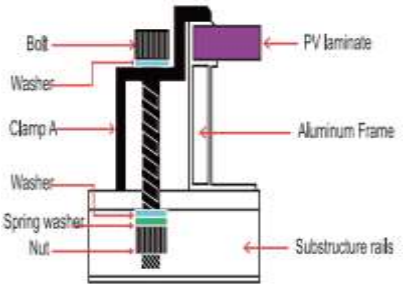




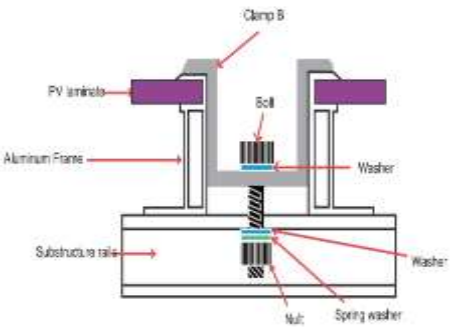
B. Clamp Type Mounting

- Total 4 numbers of clamps are required to fix the PV Module on structure or mounting rail**.**
- To avoid any kind of breakage of glass, clamps should not touch the glass and the shadow of clamp should not come on the module front surface.
- The minimum length of the clamps used for mounting should be atleast 50mm and the maximum overlap over the module frame should be maximum 7mm. During tightness of the clamps, the recommended maximum compression for each clamp is 2900 PSI (20MPa) in order to avoid potential damages to module frame.
- Also during the tightening of the clamps one needs to ensure the anodizing coating of the module frame should not get damaged. Else it would lead to corrosion failure and which shall not be covered under warranty.
- No modification or changes in the structure of module frame is permissible.

When modules are installed with clamp type fixing method, minimum 4 clamps are required to install the module as shown in the below image.



PV Module installed with end clamping method



PV Modules with Mid Clamps

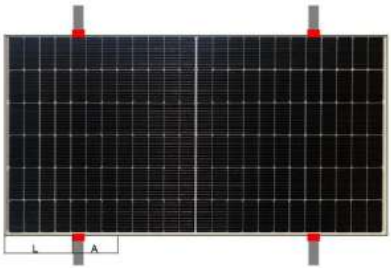
BOLT MOUNTING MECHANISM

At 2400 Pa load condition

At 5400 Pa load condition

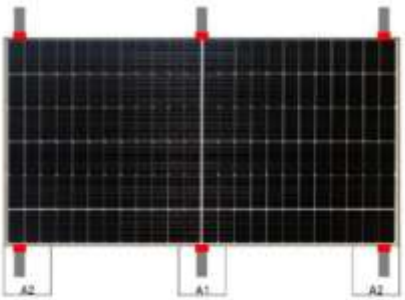
CLAMPING MECHANISM

Long frame fixture mounting
(Beam perpendicular to long frame)



Module type	L(mm)	A(mm)	Maximum mechanical load (Pa)
AE10HXXXUHC10B1/2	200	200	+5400/-2400
AE14HXXXVHC10B	400	250	+5400/-2400
AE10TXXXUHC16B6	200	200	+5400/-2400
AE14TXXXVHC16B5	400	250	+5400/-2400
AE13TDXXXTHC16B5	430	160	+5400/-2400

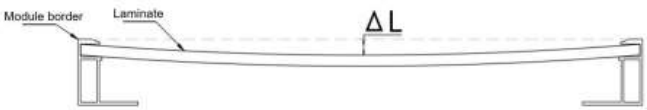
Six-press block mounting with beam

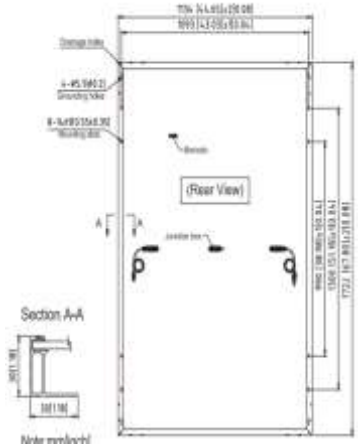


Module type	A1(mm)	A2(mm)	Maximum mechanical load (Pa)
AE10HXXXUHC10B1/2	100	80-380	+6000/-3800
AE14HXXXVHC10B	100	300-500	+6000/-3600
AE10TXXXUHC16B6	100	80-380	+6000/-3800
AE14TXXXVHC16B5	100	300-500	+6000/-3600
AE13TDXXXTHC16B5	100	550-650	+5400/-2400

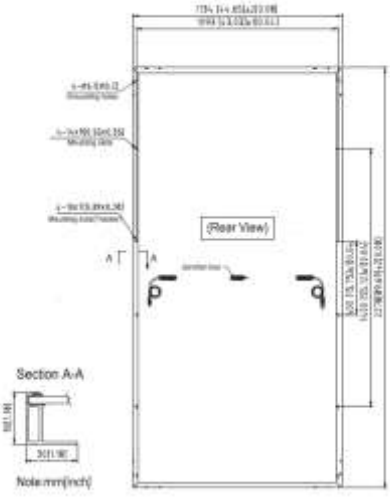
Under the action of gravity, the glass surface of the module will produce different degrees of subsidence. When storing, transporting, and mounting modules, applying additional forces to the surface of the modules may cause the module shape variable to increase.

In the absence of wind load, snow load and other external forces, the maximum allowable shape variable of the module center ΔL=20mm. This is an elastic deformation, the module can be restored after removing or removing the load, will not produce hidden cracks and power attenuation , but it is easy to produce dust, need to improve the frequency of cleaning the dust on the surface of the module

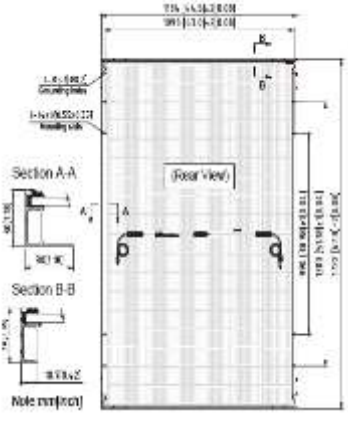



(Rear View)
Section A-A

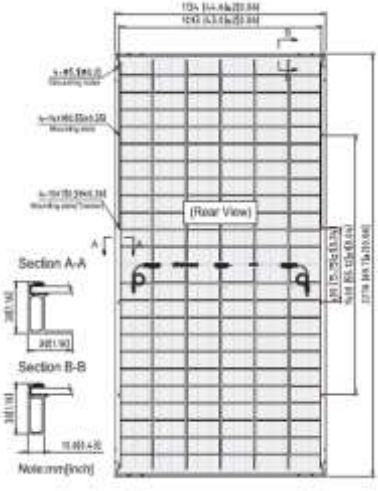
(A)


(Rear View)
Section A-A

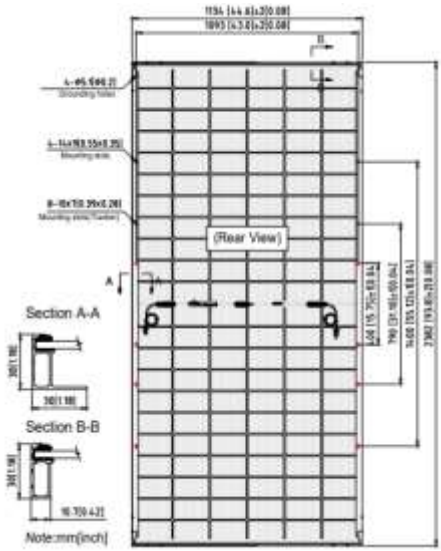
(B)


(Rear View)
Section A-A
Section B-B

(C)


(Rear View)
Section A-A
Section B-B

[D]



[E]

A] 108 HALF-CELL MONO PERC MODULE – AE10HXXXUHC10B1/2
B] 144 HALF-CELL MONO PERC MODULE – AE14HXXXVHC10B
C] 108 HALF-CELL N-TYPE TOPCON DUAL GLASS BIFACIAL MODULE – AE10TXXXUHC16B6
D] 144 HALF-CELL N-TYPE TOPCON DUAL GLASS BIFACIAL MODULE - AE14TXXXVHC16B5
E] 132 HALF-CELL N-TYPE TOPCON DUAL GLASS BIFACIAL MODULE -AE13TDXXXTHC16B5

Module type and Dimensions (in mm)

Sr. No.	Model Name	Length	Width	X-Pitch (Mounting hole to hole dist.)	Y-Pitch (Mounting hole to hole dist.)	Mounting hole dimension	Drainage hole dimension	Earthing hole
A]	108 HALF-CELL MONO PERC MODULE AE10HXXXUHC10B1/2 (390-410Wp)	1722	1133	1093	1400&990 0	For 1300:4 4 Nos.-ø9x14 For 990: 4 Nos: ø9x14	16Nos	4Nos. -ø4
B]	144 HALF-CELL MONO PERC MODULE – AE14HXXXVHC10B (540-560Wp)	2278	1134	1093	1400 & 400	For 1400:4 4 Nos.-ø9x14 For 400: 4 Nos: ø7x10	16Nos.	4Nos. - ø5
C]	108 HALF-CELL N-TYPE TOPCON DUAL GLASS ALL BLACK BIFACIAL MODULE-(420-440Wp) AE10TXXXUHC16B6	1722	1134	1093	1400&990 0	For 1300:4 4 Nos.-ø9x14 For 990: 4 Nos: ø9x14	16Nos	4Nos. -ø4

D]	144 HALF-CEL L N-TYPE TOPCON DUAL GLASS BIFACIAL MODULE - AE14TXXXVHC16B5 (570-590Wp)	2278	1133	1093	1400&400	For 1400:4 4 Nos.-ø9x14 For 400: 4 Nos: ø7x10	16Nos	4Nos. -ø5
E]	132 HALF-CELL N-TYPE TOPCON DUAL GLASS BIFACIAL MODULE – AE13TDXXXTHC16B5 (605-620Wp)	2382	1134	1093	1400&790	For 1400:4Nos - 14X9 790:8Nos-10X7	16Nos	4Nos .-ø5.1

b. PV Module Grounding

National Electrical code (NEC Guidelines) demands all the PV Module (modules under UL spec) frames and mounting structures to be grounded properly for safety of people on the site. The module frame must be properly grounded as per NEC clause 250.

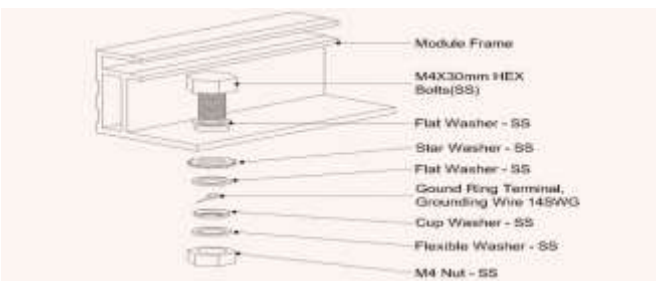
Proper grounding is done by bonding the module frames and all the metallic structure together with the help of a grounding conductor made of copper , copper alloy or other material as per the electrical norms of respective national standards . The grounding connector should be connected to earth with the help of earth electrode.

The surface of the frame must be electroplated for any metallic support.

Installers have to strip 16mm of the insulating jacket from grounding wire end carefully to avoid cutting conductors, insert the wire into the slot of the lug (see picture) and screw down the slotted screw.

To fulfill the grounding and bonding requirements, please refer to the regional & national safety and electrical standards. Always use recommended connectors for grounding.

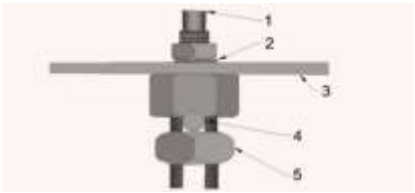
Grounding wire must be properly fastened to the module frame to ensure safety.
Screw must be tightening with torque of 2.3 to 2.8 Nm. The head of the screw must be flushed with the base and base must be flush with the frame.



"A module with exposed conductive parts is considered to be in compliance with UL 61730 only when it is electrically grounded in accordance with the instructions presented below and the requirements of the

National Electrical Code.

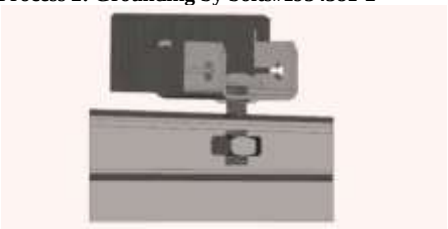
Process 1: Grounding by bolts 2058729-1

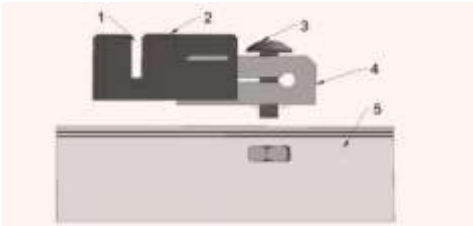


1) Wire bolt & slot 2) Mounting wash hex nut 3) Aluminum frame
4) 4 to 16mm2 cable 5) Hex nut

- Tyco made grounding hardware comes with grounding bolt, mounting and grounding hex nut.
- Electrical contact developed by penetration of anodized coating of the aluminum frame and tightening the mounting.
- Grounding wire dimension should be considered of 6 to 12 AWG solid bar copper and installed under the wire binding bolt.
- Tightening of wire binding bolt must be done at proper torque level 5 N-M.

Process 2: Grounding by bolts#1954381-2

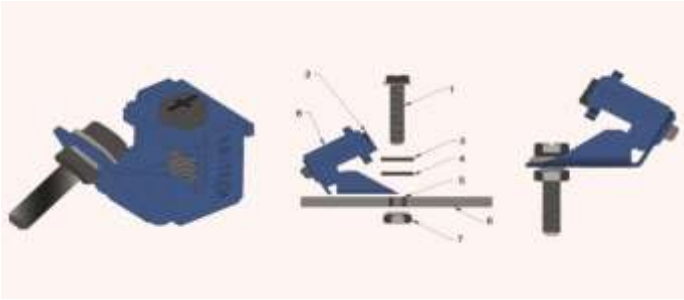




1) Wire slot (available for 4-6 mm² cable)
2) Slider
3) Bolt
4) Base
5) Nut

- Tyco made grounding hardware comes with grounding bolt, mounting and grounding hex nut.
- Electrical contact developed by penetration of anodized coating of the aluminum frame and tightening the mounting hex nut by applying proper torque of 2.8N-M. Hex nut comes with a star washer.

- Grounding wire dimension should be considered of 6 to 12 AWG solid bar copper and installed under the wire binding bolt.
- Tightening of wire binding bolt must be done at proper torque level 5 N-M.
- Tyco grounding bolt is only recommended to use with 6 to 12 AWG solid copper wire.



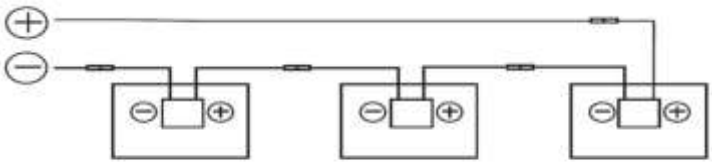
1) Machine bolt A
2) Machine bolt B
3) Belleville washer
4) Flat washer
5) Clearance hole for 10 [M5] machine bolt
6) Aluminum frame
7) Machine bolt hex nut with lock washer
8) Grounding bolt

Lug should be installed on such a surface that is larger than the bottom surface of the lug.

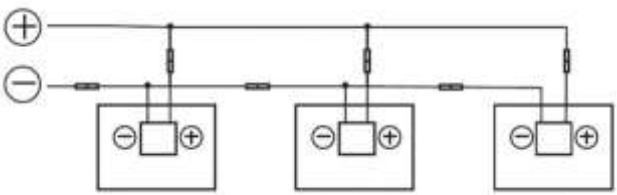
- Lug should be fixed on the grounding hole present on the PV Module.
- To secure grounding bolt to the module frame machine bolt A should be torque to 4N-M
- Grounding bolt can be used with only 6-12 AWG bare copper wire.
- Machine bolt must be torqued up to 4N-M for the proper wire binding.
- "Where common grounding hardware (nuts, bolts, star washers, spilt-ring lock washers, flat washers and the like) is used to attach a listed grounding/bonding device, the attachment must be made in conformance with the grounding device manufacturer's instructions."

c. PV Module Wiring

Series wiring



Parallel wiring



Incorrect Routing

Correct Routing

- Perform all wiring by well-trained installers as per local codes and standards.

- Anchor by Panasonic recommends string connection of modules in such a way that system voltage should not exceed the rated value at any time of the year. The Installer has to choose the best design on the inverter MPPT ratings & operating voltage conditions and the environmental conditions considering the lowest temperature at site.

- For multiplying the operating voltage, PV Modules shall be connected in series. PV Modules connected in series is known as string. Please ensure to hear a sound of click while making the necessary connection using MC-4 connectors. Click sound shows the proper connectivity between the two terminals. Anchor by Panasonic recommends a maximum of 2 strings to be connected in parallel with appropriate string fuse for circuit protection.

- If any module/array/string is connected in reverse polarity, in that case product can be damaged permanently and repair is not possible and Warranty will not rendered to those modules. Before making parallel connection always verify voltage level and polarity of the string. If during measurement any reverse polarity or a voltage difference reverse polarity or a voltage difference of 10 V found between the strings then check the strings circuit or string configuration before making connection. All the wiring should be performed by well trained and qualified technicians only.

- Anchor by Panasonic modules contain copper cables with 4mm2 cross-sectional area with voltage rating 1000V/1500V (IEC &UL) for maximum system voltage, 90° C and are also UV Resistant.

- Maximum system voltage should be less than the rated system voltage or the maximum input voltage of the inverter.

d. Connectors

- It is Installer's responsibility to protect unplugged connectors against moisture, dust and any environmental pollution. Only clean and dry plugged connectors fulfill their ingress protection (IP) class. Ensure that connector caps are hand tight before connecting the modules. Do not attempt making an electrical connection with wet, soiled , or otherwise faulty connectors . Avoid sunlight exposure and water immersion of the connectors. Avoid connectors resting on the ground or roof surface.

- Incorrect connections may cause for arcs and electrical shock. Check that all electrical connections are safely fastened. Make sure that all locking connectors are fully engaged and locked.

- The junction boxes used in Anchor by Panasonic PV modules contain bypass diodes wired in parallel with the PV cell strings. In the case of partial shading, the diodes bypass the current generated by the non-shaded cells, thereby limiting module heating and performance losses. Bypass diodes are not over current protection devices.

- Module equipped with PV wiring connectors should comply with the Standard for Connectors for Use in Photovoltaic Systems.

e. Bypass Diodes

- It causes diversion of current from the cell strings during partial shading. In this way, it assists in prevention of power loss.

- Anchor by Panasonic use pre-potted Junction box in manufacturing and diode replacement is not possible in potting type JB in case of any failure. If any bypass diode fails, only solution is to replace a new junction box in the place of old one.

f. Cables & Wiring

- Anchor by Panasonic modules are supplied with 2 stranded, UV resistant output cables, that are terminated with PV connectors (MC4) ready for most installation. Positive (+) and negative (-) terminals both come with male and female MC4 connectors respectively.

- Use field wiring with standard cross-sectional areas that are approved for use at the maximum short-circuit current of the PV module . Anchor by Panasonic recommends installers to use only UV resistant cables qualified for direct current (DC) wiring in PV systems. The minimum wire size should be 12 AWG/4 Sq.mm. The temperature range of the cables is -40°C to 90°C.

- Proper heat resistant cable ties should be used for fastening these cables on MMS structure PV Cables should be fixed to the mounting structure in such a way that mechanical damage to the cable and/or the module is avoided . Maintain a minimum cable bending radius greater or equal than five times the cable diameter. Route the cable in a way that tensile stress on the conductor or connections is prevented. While the cables are sunlight resistant and waterproof, where possible, avoid direct sunlight exposure and water immersion of the cables.

Lightening & Protection of PV Modules

Anchor by Panasonic recommends the EPC Installer and the customer to analyse the risk of lightening as per IEC 62305-2 and install Lightening arrestors and SPD's such that no part of PV system and PV Module is affected by Lightening or any other high voltage surges. To ensure effective protection for entire power plant along with PV modules, a lightning protection system with optimally coordinated elements with air-termination system, earth-termination system, lightning equipotential bonding, surge protective devices for any DC input /output devices as per IEC 61643-11.

Fuse Rating

Connect Fuse in non-grounded pole of solar array. Maximum fuse rating connected in series is as per the recommended value in the datasheets. Actual fuse rating is mentioned in PV module specification sheet and on the PV Module's back label. Fuse rating value also indicates the maximum reverse current that can flow from the module.

7 Electrical safety & awareness

PV modules are rated to operate at potentially dangerous voltage level of just under a specified system voltage; coming in contact of this high voltage may cause electrical hazards, Arcing and Fire hazards. It is recommended that the entire solar Module, Module array and the DC combiner box should be handled by only trained persons. Anchor by Panasonic is not responsible for any hazard on the site and to the trained manpower in event of any safety hazard or causality.

Electrical Hazards

While disconnecting the array from the circuit, use suitably rated Isolator or DC switch. DC power after disconnection may be active for some time and hence it is recommended only trained persons should operate or carry out maintenance activity on solar panel. Anchor by Panasonic is not responsible for any type of accident occurring in Power plant using Anchor panels.

7.1 Inverter Selection & Compatibility

The quantity of modules to be connected in series and parallel connections should be as per the recommendation of Inverter manufacturer considering the local weather conditions.

8 PV MODULE OPERATION & MAINTENANCE

For running a Solar PV system smoothly, a minimum of maintenance is required in well-designed PV plants.

Check the mounting structure status and ensure any all the modules should be tightly fitted on the structure and should be as per the mounting instruction provided above.

Check for any shading on PV module, area of module on which light is falling should not be shaded by any trees, objects and leaves. All these obstructing objects should be removed immediately.

Ensure all cable assemblies are tightly fitted and no part of the cable is immersed or exposed to water logging.

To clean the module always use soft module cleaning kit or do cleaning with soft cloth (Water Hardness- less than 75Mg / Ltr, Ph=7 and water pressure should not exceed 35 bar at the nozzle,). Cleaning can be performed by Wet Cleaning , Soft Cleaning , Compressed Air cleaning , rotating brush and dry brush cleaning. In case of wet cleaning it should be ensured that water is properly wiped off (use soft and non-abrasive methods) from the module glass surface, in order to prevent any depositions or water marks. Cleaning should be performed in a way that no stress on PV modules is caused and no cracks on solar cells to be caused out of cleaning. Module cleaning shall be done at early mornings and late nights and at regular frequency as per the need. Water used for cleaning should be of the same temperature as of the module and if not used , temperature difference can create thermal shocks by which PV module can be damaged and will devoid of Warranty claim . During cleaning, always ensure at all condition module should not be damaged from micro crack and other type of defects. Climbing of personal on the PV modules is strictly prohibited as it can cause irreversible damage to the solar cells of the PV modules. The PV Modules are advised to be cleaned regularly ensuring dust/dirt free and clean any bird droppings. Failing to clean the same can cause damage to the solar cells of the PV modules.

9 PRODUCT RECYCLING & END OF LIFE

After end of its life cycle, it should be recycled without any loss to environment. Kindly get in touch with Anchor by Panasonic service team to recycle the PV Modules.

10 WARNING

During any type of electrical maintenance, all the system should be isolated / shutdown and maintenance should be performed by well trained professionals only. Any failure to follow instruction may results in lethal electric shocks, burns, other injuries and some time may death also. Anchor by Panasonic is not responsible for any type of accident occurring in Power plant using Anchor panels.

11 CONTACT DETAILS (For Queries and communications)

Panasonic Life Solutions India Pvt. Ltd. (Formerly known as Anchor Electrical)

3rd floor, B Wing, I-Think Techno Campus, Pokhran Road No 2, Thane (West),

Thane-400607, India. T: (9122) 4222 8888 | F: (9122) 4222 8888

Website: www.Isin.panasonic.com Email: solar@in.panasonic.com

ANNEX 4

ANNEX 4 Standards for screw fastening area design

1 Material, surface processing and strength categories of screws

While satisfying the following regulations in relation to the conditions under which screws are to be used, screws from the appropriate material, surface processing and strength categories shall be selected.

1) In exposed outdoor and even indoor areas where temperature differences frequently cause condensation, austenitic stainless steel materials shall be used and hot dip galvanizing and some other appropriate anti-corrosion treatment shall be applied to the screws.
2) Screws used in extremely corrosive environments shall be made of highly corrosion-resistant stainless steel (SUS316) or other highly corrosion-resistant materials, shall be finished with a highly corrosion-resistant treatment, or shall be coated with corrosion-resistant paint after the screws have been fastened.
3) Zinc die-cast shall not be used for screws that support loads.
4) Screws in a strength category of 12.9 or higher shall not be used due to the risk of delayed fractures.

[Comments]

1) If condensation forms frequently in the vicinity of screw fastening areas, then anti-corrosion measures equivalent to those that would be taken if the screws were to be used outdoors and exposed to rainwater shall be taken.
2) Examples of "extremely corrosive environments" include workplaces of fishermen in coastal areas (exposure to seawater spray), the insides of tunnels in snowy regions (use of snow melting substances), indoor swimming pools (chlorine use), volcanic and hot-spring regions (emission of sulfur-based gases), and sewage treatment plants and metal-plating factories (emission of various corrosive gases). In chlorine environments, there have been instances where even screws made of highly corrosion-resistant stainless steel have broken at an early stage due to stress-corrosion cracking or other factors, and so the appropriate screw surface treatment shall be implemented according to the conditions under which the screws are to be used. Furthermore, the term "highly corrosion-resistant treatment" refers to a treatment that offers corrosion resistance properties equivalent to dacrotizing, which is widely used. However, since dacrotizing is subject to restrictions under the RoHS Directive, an environmentally friendly material such as "Geomet" shall be used instead.
3) Zinc die-cast shall not be used because its creep resistance is poor when exposed to stress or certain temperatures, and because even at room temperature, items made of zinc die-cast are liable to crack and break when they are fastened firmly or subject to high stress levels.
4) A "delayed fracture" refers to a phenomenon in which a sudden fracture occurs with no externally visible plastic deformation after a static tensile load or bending load has been applied for a given period of time at normal temperature. Since the tensile strength of steel materials with tensile strengths of 1.5 GPa or more are greater than that displayed in delayed fractures, the delayed fractures occur first. The number "12" in the strength category of 12.9 refers to a tensile strength of 1200 N/mm^2 (=1.2 GPa), and the "9" refers to a yield stress that is 90% of the tensile strength, i.e., 1080 N/mm^2 (=1200 x 90%).

2 Tightening torque

The recommended tightening torque shall be set in order to guarantee satisfactory screw fastening and prevent screws from breaking.

[Comments]

The tightening torque value at which the minimum required axial force is achieved serves as the lower limit while the tightening torque value at which the fastening axial force of a screw that is 90%

of the yield stress (or yield strength) is achieved serves as the upper limit.
The required axial force of a male screw can be calculated using the following formula:
Required axial force ≥ design load value/number of male screws + a value equivalent to the permanent setting and other factors

3 Minimum length of fit

When fastening screws that support the loads of products installed in locations such as high places and walls, the required minimum length of fit shall be maintained so as to ensure that the screw thread shear fracture strength exceeds the tension breaking strength of the male screws. However, this does not apply when the anticipated axial force does not exceed the shear fracture strength of the screw threads.

[Comments]

When designing screw fastening areas, allowable external forces and tightening torques are determined based on the tension breaking strength of the male screws. Therefore, if the shear fracture strength of the screw threads of the male or female screws is weaker than the tension breaking strength of the male screws, the screw tightening and external forces will cause the screw threads to break and the screws to fall out. To prevent this from happening, the length of fit shall be studied. However, when nuts and bolts are fastened, no breakages should occur, due to "screw fall-out," provided that JIS standard nuts with a strength category equivalent to or better than that of the bolts are used.

Table 1 gives examples of the minimum length of fit when the shear fracture strength of ISO metric "coarse screw threads" and "fine screws threads" is greater than the tension breaking strength of the male screws. (Source: "Screw Fastening Theory and Calculations" by Akira Yamamoto, published in 1970 by Yokendo Ltd.)

Table1 Minimum length of fit

Table 1-(1) Minimum length of fit of ISO metric "coarse screw threads" (Unit: mm)

Nominal diameter (pitch) / Strength ratio*	M3 (0.5)	M4 (0.7)	M5 (0.8)	M6 (1.0)	M8 (1.25)	M10 (1.5)	M12 (1.75)	M16 (2.0)	M20 (2.5)	M24 (3.0)	M30 (3.5)
3	5.1	6.4	8.0	9.4	12.3	15.3	18.4	24.8	30.4	36.5	45.6
2.5	4.3	5.4	6.7	7.9	10.4	12.9	15.4	20.8	25.4	30.5	38.1
2	3.5	4.4	5.5	6.5	8.5	10.5	12.6	16.8	20.6	24.7	30.9
1.5	2.7	3.4	4.2	5.0	6.6	8.1	9.6	13.0	15.8	18.7	23.4
1	1.9	2.4	3.0	3.5	4.6	5.6	6.7	9.0	11.0	13.2	16.5
Smaller than 1	2.1	2.6	3.2	3.8	4.9	6.0	7.1	9.4	11.6	13.9	16.8

Table 1-(2) Minimum length of fit of ISO metric "fine screw threads" (Unit: mm)

Nominal diameter (pitch) / Strength ratio*	M8 (1.0)	M10 (1.25)	M12 (1.25)	M16 (1.5)	M20 (1.5)	M24 (2.0)	M30 (2.0)
3	13.4	16.2	20.4	27.0	34.8	40.1	51.3
2.5	11.4	13.6	17.2	22.6	29.0	33.8	42.6
2	9.1	11.1	13.7	18.1	23.4	27.1	34.5
1.5	7.0	8.5	10.4	13.8	17.8	20.6	26.1
1	4.8	5.9	7.2	9.4	12.0	13.9	17.7
Smaller than 1	5.0	6.2	7.4	9.8	12.2	14.4	17.7

* Strength ratio = Tensile strength of male screw (bolt)/tensile strength of female screw (nut)

To calculate the minimum number of screw-turning threads, divide these values by the respective thread pitch.
Table 2 gives examples of the numbers of these screw-turning threads for coarse screw threads with a strength ratio of 1, which are obtained from Table 1.

Table 2 Examples of numbers of screw-turning threads

Nominal diameter	M3	M4	M5	M6	M8	M10	M12	M16	M20	M24	M30
No. of screw-turning threads	3.8	3.4	3.7	3.5	3.6	3.7	3.8	4.5	4.4	4.4	4.7

In cases where, lightweight objects such as the covers of lighting fixtures are to be fastened using hand-turned screws, there is no need for the shear fracture strength of the screw threads to exceed the tension breaking strength of the male screws if the maximum axial force generated by the tightening force or by external forces is substantially less than the tension breaking strength of the male screws. Instead, it is sufficient to implement a design in which the maximum axial force is exceeded. For this reason, the minimum length of fit in Table 1 does not have to be satisfied in such cases. (Example: Burrings)

4 Prevention of dropping caused by loose screws

The following countermeasures shall be taken when, in screw fastening areas involving installation work in locations such as high places and walls, there is a danger of the product falling if the screws were to come loose.

1) Items made of rubber or other materials liable to permanent set or items with high elastic deformation shall not be sandwiched between surfaces and fastened. However, this condition shall not apply if the fastening area is not loosened by the permanent setting of such sandwiched items, such as with stepped screws.
2) The bearing surfaces of screw heads shall be configured as smooth flat surfaces to avoid the objects to be fastened from becoming permanently set. However, this condition shall not apply when the bearing surfaces of the screw are equipped with protrusions, etc., to prevent loosening or rotation.

[Comments]

If the fastening force (axial force of the screw) yielded by the screws when tightened is reduced for some reason after tightening, then the functions of the fastened object will deteriorate or be lost. For this reason, products shall be designed in such a way to prevent any looseness. Objects used in locations that are affected by severe vibration shall be provided with parts to prevent rotation -- typically, cotter pins, adhesives (screw-locking agents) or double nuts -- or be designed in such a way that the bonding surfaces are smoothed out with minimum surface roughness and with all microscopic unevenness eliminated as much as possible. However, care shall be taken since these measures may have no effect with some vibration patterns. When rubber is sandwiched to prevent air conditioner vibration, the permanent setting of the rubber will not lead to looseness of the screws because stepped screws are used.

5 Underhead lengths of screws

The ends of the male screws protruding from the female screws shall not touch other parts or objects, resulting in insufficient fastening or damage to other parts, etc.

[Comments]

Examples of the excessive length of male screws include the following cases:

1) In one case, the underhead length of the screws that were used where a pipe and shaft were coupled was excessive, resulting in the pipe not being adequately tightened to the shaft, and vibration and other factors occurring over a prolonged period causing an accident in which the pipe fell down.
2) In another case, the screws used to attach the cover of an embedded sealing block on the ceiling were too long. Therefore, when the hanging sealing cap was rotated, it became caught and failed to rotate to the prescribed position, causing the block to fall.

6 Construction of multi-function machined screws

If female screws and through holes are to be machined to provide multiple functions in the same cross section of the thread areas, the thickness of their walls shall be increased and the screws given a construction enabling them to satisfactorily withstand the fastening strength of the thread areas.

However, screws having a construction in which threads have been cut two-fold in the same cross section at right angles to the axial direction shall not be used for fastening with screws where products installed in locations such as high places and walls are to be supported.

[Comments]

When the inside of a bolt is to be used as a female screw, the danger is that the wall of the bolt between grooves on the outside male screw and the inside female screw will be become thinner, possibly resulting in the breakage or fracture of the bolt. Fig. 1 shows an example of a countermeasure designed to maintain the fastening strength of the thread area using a method that does not involve cutting the threads two-fold in the same cross section at right angles to the axial direction. Taking other countermeasures, such as increasing the wall thickness to maintain the strength, is also feasible.

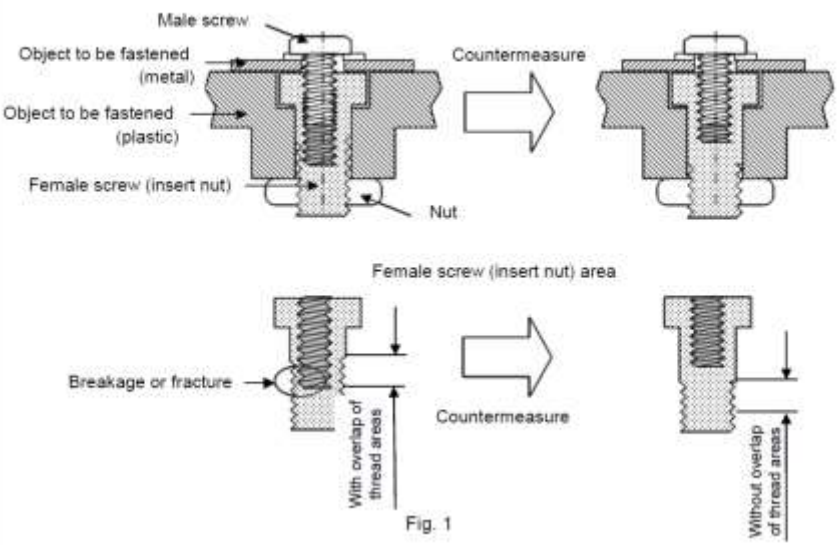


Fig. 1