



**INSTALLATION OPERATIONAL AND  
MAINTENANCE MANUAL FOR  
SWELECT HHV SOLAR PHOTOVOLTAICS PRIVATE LIMITED MODULES**



**CONTEXT**

<b>1. DISCLAIMER OF LIABILITY .....</b>	<b>6</b>
<b>2. SAFETY PRECAUTIONS.....</b>	<b>6</b>
<b>2.1. FIRE SAFETY.....</b>	<b>11</b>
<b>3. HANDLING, UNPACKING &amp; STORAGE .....</b>	<b>12</b>
<b>3.1. INSPECTION UPON RECEIPT.....</b>	<b>12</b>
<b>3.2 STORAGE.....</b>	<b>13</b>
<b>3.3 UNLOADING AND TRANSPORT.....</b>	<b>13</b>
<b>3.4 UNPACKING.....</b>	<b>14</b>
<b>4. ENVIRONMENTAL CONSIDERATIONS .....</b>	<b>18</b>
<b>4.1. CLIMATE CONDITION .....</b>	<b>18</b>
<b>4.2. ENVIRONMENTAL CONDITION .....</b>	<b>18</b>
<b>5. INSTALLATION CONDITION.....</b>	<b>19</b>
<b>5.1. SITE SELECTION.....</b>	<b>19</b>
<b>5.2. TILT ANGLE SELECTION.....</b>	<b>20</b>
<b>6. MOUNTING INSTRUCTIONS FOR MONOFACIAL AND BIFACIAL MODULE.....</b>	<b>21</b>
<b>6.1. MOUNTING METHODS .....</b>	<b>23</b>
<b>6.1.1. BOLT TYPE FIXING.....</b>	<b>23</b>
<b>6.1.2. CLAMP TYPE FIXING.....</b>	<b>24</b>
<b>6.1.3. MOUNTING WITH BOLTS 14 X 9 mm MOUNTING HOLES.....</b>	<b>27</b>
<b>6.1.4. MOUNTING WITH SINGLE-AXIS TRACKING SYSTEM .....</b>	<b>27</b>
<b>10 X 7 mm MOUNTING HOLES .....</b>	<b>27</b>
<b>6.1.5. MOUNTING WITH CLAMPS .....</b>	<b>28</b>
<b>6.2. PV MODULE GROUNDING.....</b>	<b>28</b>
<b>7. ELECTRICAL CONFIGURATION .....</b>	<b>30</b>
<b>7.1. ELECTRICAL WIRING .....</b>	<b>31</b>

<b>7.1.1. ADVANCED PID MITGATION .....</b>	<b>32</b>
<b>7.2. CABLE AND CONNECTOR MANAGEMENT.....</b>	<b>33</b>
<b>7.3. FUSE RATING .....</b>	<b>36</b>
<b>7.4. BYPASS DIODES .....</b>	<b>36</b>
<b>7.5. SELECTION OF INVERTER AND COMPATIBILITY .....</b>	<b>37</b>
<b>7.6. TECHNICAL SPECIFICATION.....</b>	<b>38</b>
<b>8. MAINTENANCE AND CARE .....</b>	<b>42</b>
<b>8.1. VISUAL INSPECTION OF MODULE .....</b>	<b>43</b>
<b>8.2. INSPECTION OF CONNECTORS AND CABLES .....</b>	<b>44</b>
<b>8.3. CLEANING INSTRUCTION .....</b>	<b>44</b>
<b>9. DISPOSAL AND PRODUCT LIFE CYCLE .....</b>	<b>47</b>
<b>10. WARNING.....</b>	<b>48</b>

	DOC.TITLE: <b>SOLAR PV MODULE INSTALLATION, OPERATIONAL AND MAINTENANCE MANUAL</b>	DOC TYPE: <b>WORK INSTRUCTION</b>	
	DOC. NO: <b>SHPV/WI-D&amp;D-INST.Manual/47</b>	Rev No: 10	Page No: 4

**LIST OF FIGURES**

**FIGURE 1 : UNLOADING OF THE MODULE USING FORKLIFT & CRANE..... 14**

**FIGURE 2 : METHOD A- UNPACKING OF MODULES USING MODULE PALLET..... 16**

**FIGURE 3: METHOD B - UNPACKING OF MODULES USING L STAND ..... 17**

**FIGURE 4: BACK SIDE OF THE BIFACIAL MODULE BACK SIDE OF BIFACIAL MODULE ..... 23**

**FIGURE 5: PV MODULE WITH MOUNTING HOLES (FOR REFERENCE) ..... 24**

**FIGURE 6: BOLT TYPE FIXING ..... 24**

**FIGURE 7: INSTALLATION WITH CLAMPS INTO 4 OUTER HOLES. BEAMS PERPENDICULAR TO LONG SIDES ..... 25**

**FIGURE 8: INSTALLATION WITH CLAMPS INTO 4 INNER HOLES. BEAMS PERPENDICULAR TO SHORTSIDES ..... 26**

**FIGURE 9: PV MODULES INSTALLES USING FRINGE CLAMPING METHOD ..... 26**

**FIGURE 10: PV MODULES INSTALLED USING MIDDLE CLAMPING METHOD ..... 26**

**FIGURE 11: PV MODULES RECOMMENDED GROUNDING ..... 29**

**FIGURE 12: PV MODULE GROUNDING ACCESSORIES ..... 30**

**FIGURE 13: PV MODULES CONNECTED IN SERIES AND PARALLEL..... 32**

**FIGURE 14: PV MODULES CONNECTORS ..... 35**

**FIGURE 15: IMPROPER PV MODULES MOUNTING AND CONNECTION..... 44**

**FIGURE 16: PV MODULES WARNINGS..... 49**

**LIST OF TABLES**

**TABLE 1: MODULE TYPE & CELL SIZE ..... 10**

**TABLE 2: ALBEDO GAIN FOR DIFFERENT SURFACE ..... 23**

**TABLE 3: BOLT SIZE AND ITS CORRESPONDING TORQUE VALUE ..... 27**

**TABLE 4: ADVANCED PID MITIGATION..... 33**

**TABLE 5: CABLES AND CONNECTOR MANAGEMENT..... 34**

**TABLE 6: CERTIFIED CONNECTORS MODEL AND MAKE ..... 36**

**TABLE 7: TECHNICAL SPECIFICATION FOR M10 PERC MODULES..... 38**

**TABLE 8: TECHNICAL SPECIFICATION FOR M10 PERC BIFACIAL MODULE ..... 39**

**TABLE 9: TECHNICAL SPECIFICATION FOR M10 PERC BLACK MODULES ..... 40**

**TABLE 10: TECHNICAL SPECIFICATION FOR M10 TOPCON BIFACIAL MODULES ..... 41**

**TABLE 11: LIST OF PPE MATRIX ..... 45**

**Thank You** for selecting **SWELECT HHV SOLAR PHOTOVOLTAIC (SHPV) Modules**

Please read and comprehend this manual completely before installing the Solar PV (SPV) Modules. In order to obtain a trouble-free operation, it is necessary to follow the instructions described in this manual. Any non-adherence to the instructions will make SHPV modules ineligible for warranty claims.

## 1. DISCLAIMER OF LIABILITY

- The usage of this manual, installation, and handling of SHPV modules are beyond SHPV's control. SHPV does not assume any responsibility against failure to follow instructions, resulting into any Loss, Damage, Injury, and Expenses due to improper Installation, Handling, Usage, and Maintenance.
- No responsibility is assumed by SHPV for any Infringement of IPR (Intellectual Property Rights), and other rights of third parties, which may result from use of the module. No license is guaranteed by implication or otherwise, under any patent rights.
- The information in this manual is based on SHPV's knowledge and experience, and is believed to be reliable, but such information including product specification (without limitations), and suggestions do not constitute a warranty, expressed or implied. SHPV reserves the rights to change the manual and module specification without prior notice.
- The term PV module or module mentioned in this manual refers to is the Mono-facial and Bi-facial solar modules.

## 2. SAFETY PRECAUTIONS

- SHPV modules are of Class II Application PV modules that generate electricity upon direct exposure to light and can produce electric shock. Use of insulated tools and gloves is recommended while working with modules under light. No metallic contact should be on the human body. Contact with electrically active parts of the module, such as terminals, can result in burns, sparks, and lethal shock.

*(Les modules SHPV sont des modules PV d'application de classe A qui génèrent de l'électricité lors d'une exposition directe à la lumière et peuvent produire un choc électrique. L'utilisation d'outils et de gants isolés est recommandée lorsque vous travaillez avec des modules sous la lumière. Aucun contact métallique ne doit se trouver sur le corps humain).*

- Hazardous voltage (IEC 61730: higher than 50V DC; EN 61730: higher than 120V), hazardous power applications (higher than 240W) where general contact access is anticipated (modules qualified for safety thorough EN IEC 61730-1 and -2 within this application class are considered to meet the requirements for safety class II).  
*(Tension dangereuse (CEI 61730: supérieure à 50 V CC; EN 61730: supérieure à 120 V), applications d'alimentation dangereuses (supérieures à 240 W) où un accès général aux contacts est prévu (modules qualifiés pour la sécurité conformément aux normes EN CEI 61730-1 et -2 dans ce cadre). la classe d'application sont considérées comme répondant aux exigences de la classe de sécurité II).*
- The objective of this manual is to provide the customer(s) clear instructions on how to mount the PV modules to ensure compliance with certification and regulatory requirements.  
*(L'objectif de ce manuel est de fournir au(x) client(s) des instructions claires sur la façon de monter les modules PV afin de garantir la conformité aux exigences de certification et réglementaires).*
- Further, you are advised to consult the local authorities (if there are any statutory requirements) before mounting the PV modules. Ensure that the mounting instructions described in this manual meet their requirements.  
*(De plus, il est conseillé de consulter les autorités locales (s'il existe des exigences légales) avant de monter les modules PV. Assurez-vous que les instructions de montage décrites dans ce manuel répondent à leurs exigences).*
- No one should stand on the front side, and back side of the PV module, as non-uniform localized pressure will cause damage to the solar cells inside the module.  
*(Personne ne doit se tenir à l'avant et à l'arrière du module photovoltaïque, car une pression localisée non uniforme endommagerait les cellules solaires à l'intérieur du module).*
- The front surface of the module is constructed with tempered glass, and hence it should be handled with utmost care. If the glass breaks, then human contact with the surface can lead to electric shock, particularly when the ambient condition is wet. Broken modules cannot be repaired, and it should be disposed properly, as per the electronic E- Waste disposal regulations in the year 2022.  
*(La surface avant du module est construite en verre trempé et doit donc être manipulée avec le plus*

*grand soin. Si le verre se brise, le contact humain avec la surface peut entraîner un choc électrique, en particulier lorsque les conditions ambiantes sont humides. Les modules cassés ne peuvent pas être réparés et doivent être éliminés correctement, conformément aux réglementations relatives à l'élimination des appareils électroniques).*

- Any loose connection in connectors of PV module can cause electrical arcing and can lead to fire hazard. Ensure that all the electrical connectors should be well protected against corrosion and soiling. Ensure that connectors are corrosion free, and clean, with absolutely no gaps between the contacts. Gaps can result in Electrical Arcing leading to Fire Hazards.

*(Toute connexion desserrée dans les connecteurs du module PV peut provoquer un arc électrique et conduire à un incendie. Assurez-vous que tous les connecteurs électriques soient bien protégés contre la corrosion et salissure. Assurez-vous que les connecteurs sont exempts de corrosion et nettoyés, sans aucun espace entre les contacts. Les lacunes peuvent entraîner des arcs électriques entraînant des risques d'incendie).*

- For personal safety, do not install / handle PV modules under adverse environmental conditions viz. gusty winds, wet frosted roof surfaces etc. Modules should always be dry while installing.

*(Pour votre sécurité personnelle, n'installez/ne manipulez pas de modules PV dans des conditions environnementales défavorables, à savoir. vents violents, surfaces de toit mouillées et givrées, etc. Les modules doivent toujours être secs lors de l'installation).*

- Ensure the polarity of the modules / strings are not reversed, considering other modules in the string.

*(Assurez-vous que la polarité des modules/chaînes n'est pas inversée, en tenant compte des autres modules de la chaîne).*

- Concentrating artificial sunlight on PV module is not allowed, as it will degrade its performance and life cycle.

*(La concentration de la lumière artificielle sur le module PV n'est pas autorisée, car cela dégraderait ses performances et son cycle de vie).*

- SHPV modules are certified for operating in installations at voltages below 1500Vdc. The maximum system voltage of 1500Vdc must be considered while taking into account the temperature ranges in the location of power plant. Mixing power classes in one string is not allowed and can be harmful.

Damages to modules due to such mixing can lead to invalidity of product warranty.

*(Les modules SHPV sont certifiés pour fonctionner dans des installations à des tensions inférieures à 1500 Vdc. La tension maximale du système de 1500 Vcc doit être prise en compte en tenant compte des plages de température à l'emplacement de la centrale électrique. Le mélange de classes de puissance dans une même chaîne n'est pas autorisé et peut être nocif. Les dommages aux modules dus à un tel mélange peuvent entraîner l'invalidité de la garantie du produit).*

- Do not damage or scratch the front or back surfaces of the module. Do not stand, walk, or jump on any module. The front glass can break, and localized pressure can cause micro-cracks in the solar cells, degrading performance and safety.

*(Ne pas endommager ni rayer les surfaces avant et arrière du module. Ne pas se tenir debout, marcher ou sauter sur un module. La vitre avant peut se briser et une pression localisée peut provoquer des microfissures dans les cellules solaires, dégradant ainsi les performances et la sécurité)*

- Do not punch or drill holes in the module frame, as this may cause corrosion, compromise structural integrity, and void the product warranty.

*(Ne percez pas et ne percez pas de trous dans le cadre du module, car cela pourrait provoquer de la corrosion, compromettre l'intégrité structurelle et annuler la garantie du produit)*

- Under normal conditions, a photovoltaic module is likely to experience conditions that produce more current and/or voltage than reported at standard test conditions. Accordingly, the values of Isc and Voc marked on this module should be multiplied by a factor of 1.25 when determining voltage ratings, conductor current ratings, fuse sizes, and size of controls connected to the PV output.

*(Dans des conditions normales, un module photovoltaïque est susceptible de produire un courant et/ou une tension supérieure à ceux enregistrés dans les conditions d'essai standard. Par conséquent, les valeurs Isc et Voc indiquées sur ce module doivent être multipliées par 1,25 pour déterminer les tensions nominales, les courants nominaux des conducteurs, la taille des fusibles et la taille des commandes connectées à la sortie photovoltaïque)*

- The module is considered to be in compliance with this standard only when the module is mounted

in the manner specified by the mounting instructions. A module with exposed conductive parts is considered to be in compliance with this standard only when it is electrically grounded in accordance with the manufacturer's instructions and the requirements of the National Electrical Code, ANSI/NFPA 70 (2014-2017).

*(Le module est considéré comme conforme à cette norme uniquement lorsqu'il est monté de la manière spécifiée dans les instructions de montage. Un module avec des parties conductrices exposées est considéré comme conforme à cette norme uniquement lorsqu'il est électriquement mis à la terre conformément aux instructions du fabricant et aux exigences du National Electrical Code, ANSI/NFPA 70 (2014-2017)).*

The details described in this manual are applicable for the photovoltaic modules of family type:

Cell Size	Module Type			
M10	SWM11BN0XXX,	SWM11BN2XXX,	SWM11BN4XXX,	SWM11BN6XXX,
	SWM11BN8XXX,	SWM11BT0XXX,	SWM11BT2XXX,	SWM11BT4XXX,
	SWM11BT6XXX,	SWM11BT8XXX,	SWM11BB0XXX,	SWM11BB2XXX,
	SWM11BB4XXX,	SWM11BB6XXX,	SWM11BB8XXX,	SWT15BG0XXX,
	SWT15BG2XXX,	SWT15BG4XXX,	SWT15BG6XXX,	SWT15BG8XXX
M10R	SWT15BG0XXX,	SWT15BG2XXX,	SWT15BG4XXX,	SWT15BG6XXX,
	SWT15BG8XXX,	SWT15BN0XXX,	SWT15BN2XXX,	SWT15BN4XXX,
	SWT15BN6XXX,	SWT15BN8XXX,	SWT15BT0XXX,	SWT15BT2XXX,
	SWT15BT4XXX,	SWT15BT6XXX,	SWT15BT8XXX	
G12R	SWT35BG0XXX,	SWT35BG2XXX,	SWT35BG4XXX	

TABLE 1: MODULE TYPE & CELL SIZE

**Note: The information provided in this manual is subject to revision without prior notice for continual improvement.**

*(Remarque: Les informations fournies dans ce manuel sont sujettes à révision sans préavis pour une amélioration continue).*

## 2.1. FIRE SAFETY

- The PV module is declared as non-explosion-protected equipment, and must not be installed near open flames, flammable materials and vapours.

*(Le module PV est déclaré comme équipement non protégé contre les explosions et ne doit pas être installé à proximité de flammes nues, de matériaux et de vapeurs inflammables).*

- SHPV Modules have a Class C fire resistance rating in accordance with UL 61730/ IEC 61730 certification. “The fire rating of this module is valid only when mounted in the manner specified in the mechanical mounting instructions”. 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 create hazards in the event of a fire.

*(Les modules SHPV ont un indice de résistance au feu de classe C conformément à la certification UL 61730/IEC 61730. “Le classement au feu de ce module n'est valide que lorsqu'il est monté de la manière spécifiée dans les instructions de montage mécanique”. Les installations sur le toit doivent être placées uniquement sur des revêtements de toit résistants au feu. Les constructions et installations de toiture peuvent affecter la sécurité incendie d'un bâtiment; une mauvaise installation peut créer des dangers en cas d'incendie).*

- Adhere strictly to national and local fire codes, such as the National Building Code (NBC) of India and the State Fire Services Acts. Ensure a clear access pathway around the solar array and a ridge setback.

*(Respecter scrupuleusement les codes nationaux et locaux de prévention des incendies, tels que le Code national du bâtiment (NBC) indien et les lois sur les services d'incendie des États. Prévoir un accès dégagé autour du panneau solaire et un retrait du faîte).*

- Additional devices such as ground fault indicators, fuses etc., may be required. All module frames must be properly grounded in accordance with local and national electrical codes (e.g., NEC, ANSI/NFPA 70).

*(Des dispositifs supplémentaires, tels que des indicateurs de défaut à la terre, des fusibles, etc., peuvent être nécessaires. Tous les châssis de modules doivent être correctement mis à la terre, conformément aux codes électriques locaux et nationaux (par exemple, NEC, ANSI/NFPA 70).*

- 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, SHPV modules should not be installed near highly inflammable liquids/gases, or locations with hazardous materials.

*(Une procédure d'installation non qualifiée, l'utilisation de pièces défectueuses/usées peut entraîner un risque électrique pendant le fonctionnement. Afin d'éviter tout risque d'incendie dans ce cas, les modules SHPV ne doivent pas être installés à proximité de liquides/gaz hautement inflammables ou d'emplacements contenant des matières dangereuses).*

- In the case of a fire, SHPV modules may produce dangerous voltage/surge 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 of the PV system during and after a fire until the necessary steps have been taken to mitigate the risk.

*(En cas d'incendie, les modules SHPV peuvent produire une tension/surintensité dangereuse, même s'ils ont été déconnectés de l'onduleur, ou ont été partiellement ou entièrement détruits, ou le câblage nu détruit. En cas d'incendie, informez l'équipe d'incendie/de sécurité des dangers particuliers liés au système photovoltaïque et restez à l'écart de tous les éléments du système photovoltaïque pendant et après un incendie jusqu'à ce que les mesures nécessaires aient été prises pour atténuer le risque).*

### 3. HANDLING, UNPACKING & STORAGE

Proper procedures during this stage are critical to prevent pre-installation damage such as micro-cracks, scratches, or frame deformation, which can compromise long-term performance and safety of the module.

#### 3.1. INSPECTION UPON RECEIPT

- Upon delivery, inspect the pallet packaging for any signs of damage (e.g., crushed corners, torn wrapping, impact marks).
- Verify that the product model number and quantity on the pallet match the shipping documents. Packing list pasted outside the box contains all details including the serial no of modules.

- Each module carries a unique serial number, always recording it during installation for future reference. In addition, a nameplate indicating the module's model name, electrical ratings, and safety characteristics is affixed to the back side of the module."
- Immediately report any discrepancies or damage to SHPV customer service with photographic evidence.

## 3.2 STORAGE

- Store pallets in a dry, cool, and well-ventilated indoor location to avoid direct sunlight and moisture. Outdoor storage is not recommended.
- If modules are forced to store in rainy atmosphere the entire stack must be covered with a water-impermeable tarpaulin and dual pallet system should be followed (i.e. A non-absorbent moisture barrier is mandatory between the ground and the wooden shipping pallet).
- Modules are stored in an uncontrolled environment, the storage time should be less than 1 month, and extra precautions should be taken to prevent connectors from being exposed to moisture or sunlight. Ensure adequate ventilation to prevent moisture buildup.
- Do not stack pallets more than two high. Stacking higher creates excessive weight on the bottom frames and modules, which can cause damage and voids the warranty. Store pallets on level, stable ground.
- Do not allow children and unauthorized people to be near the installation site or storage area of Modules.

## 3.3 UNLOADING AND TRANSPORT

- Modules should be unloaded using suitable mechanical equipment such as a Forklift or Hydra (crane) only as shown in Figure 1. Ensure proper lifting techniques and follow safety guidelines to prevent damage or injury.
- Always move the forklift or jack entering from the short side.
- In the process of loading and unloading, the forklift should be selected according to the size and weight of the goods.
- If the fork length is less than 3/4 of the size of the goods, extension sleeves should be fitted on the forks before the assembly is forked, in order to avoid the packing container dumping when moving the forklift.

- When the forklift is loaded with modules, the spacing between the two forks should be adjusted as required to ensure the load of the two forks is balanced without deflection.
- Ensure while loading the module using forklift the forklift arm should be covered with sponges (for e.g. preferably silicone, rubber, EPE) and minimum distance has to be maintained between forklift arm and module pallet to prevent the inside modules being damaged due to external force.
- When lifting the module with forklift ensure that it should not be lifted above 5 degrees.



*FIGURE 1 : UNLOADING OF THE MODULE USING FORKLIFT & CRANE*

**Attention in Loading and unloading with hoisting:**

- During unloading, the hoisting rope of the crane should be a longer nylon sling. Wire rope is not allowed.
- Before lifting, the length of the sling should be evenly distributed on both sides to avoid the case body tilting to one side during lifting, which causes the sling to be too tight and the assembly to explode.
- When lifting, the box should be kept balanced to avoid tilting.
- In order to minimize the impact of sling on the safety of goods in the process of hoisting, the box should be supported during loading and unloading. For example, wooden pallets, boards or other fixtures of the same width as the outer packing cases should be used on the upper part of the box to reduce the pressure of the contact position on the box.
- Do not use steel cables directly on the packaging, as this will crush the modules.
- During transport on-site, drive slowly and avoid sudden stops or bumps to prevent shock and vibration to the modules.

**3.4 UNPACKING**

- Unpack module pallet with care and follow the unpacking steps marked on the pallet. Be careful when unpacking, transporting and storing the modules.
- **Crucial Step:** Before removing any modules, ensure the remaining stack is stable. If necessary, lean the stack against a secure support structure (e.g., a wall, another pallet).
- Never leave a partially unpacked stack of modules freestanding. Unpacking of Module can be done in two methods refer to Figure 2 for Method A & Figure 3 for Method B.

**Method A: Unpacking of Modules using Module Box:**

- **Step 1:** Cut the Stretch Film around the module box. Remove the top cover on the box and then follow the sleeve of the box.
- **Step 2:** Leave the long side of the single box about 15~20 cm to solid support structure such as wall or another pallet of the same type (failure to do so would result in module breakage, and void of warranty).
- **Step 3:** Two workers hold the modules to protect them from falling. Two workers hold the modules to protect them from falling.
- **Step 4:** One of the workers cut the internal packing pet straps. The two workers then push the modules tenderly to lean them against the solid support and remove the modules from the first one outside to the last one inside in sequence.

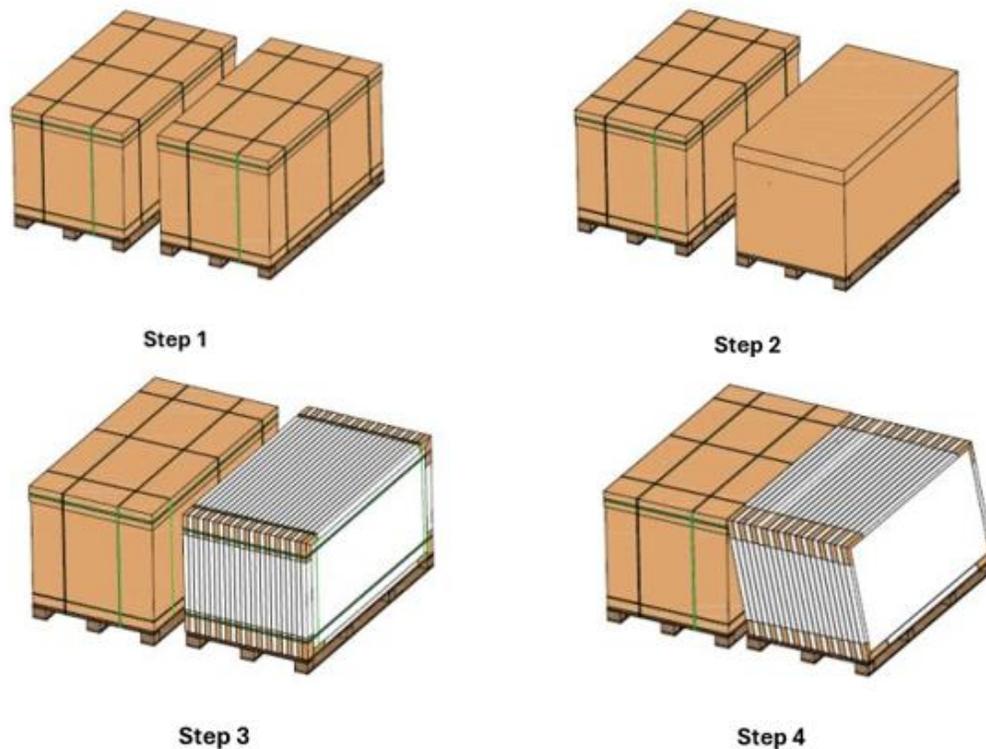
**Method B: Unpacking of Modules using L Type Stand: Recommended Method**

- **Step 1:** Cut the Stretch Film around the module box.
- **Step 2:** Remove the top cover on the box and then follow the sleeve of the box.
- **Step 3:** Place the stand supporter that is higher or wider than the module to avoid hitting and damaging the glass. And ensure the L stand should properly lock in between the pallet reapers.
- **Step 4:** Cut of all the vertical straps where there are 1 or 2 horizontal straps remaining, two people should gently push the module towards the stand supporter.
- **Step 5:** Cut off the remaining straps.
- **Step 6:** Take the modules out by following the instructions below.

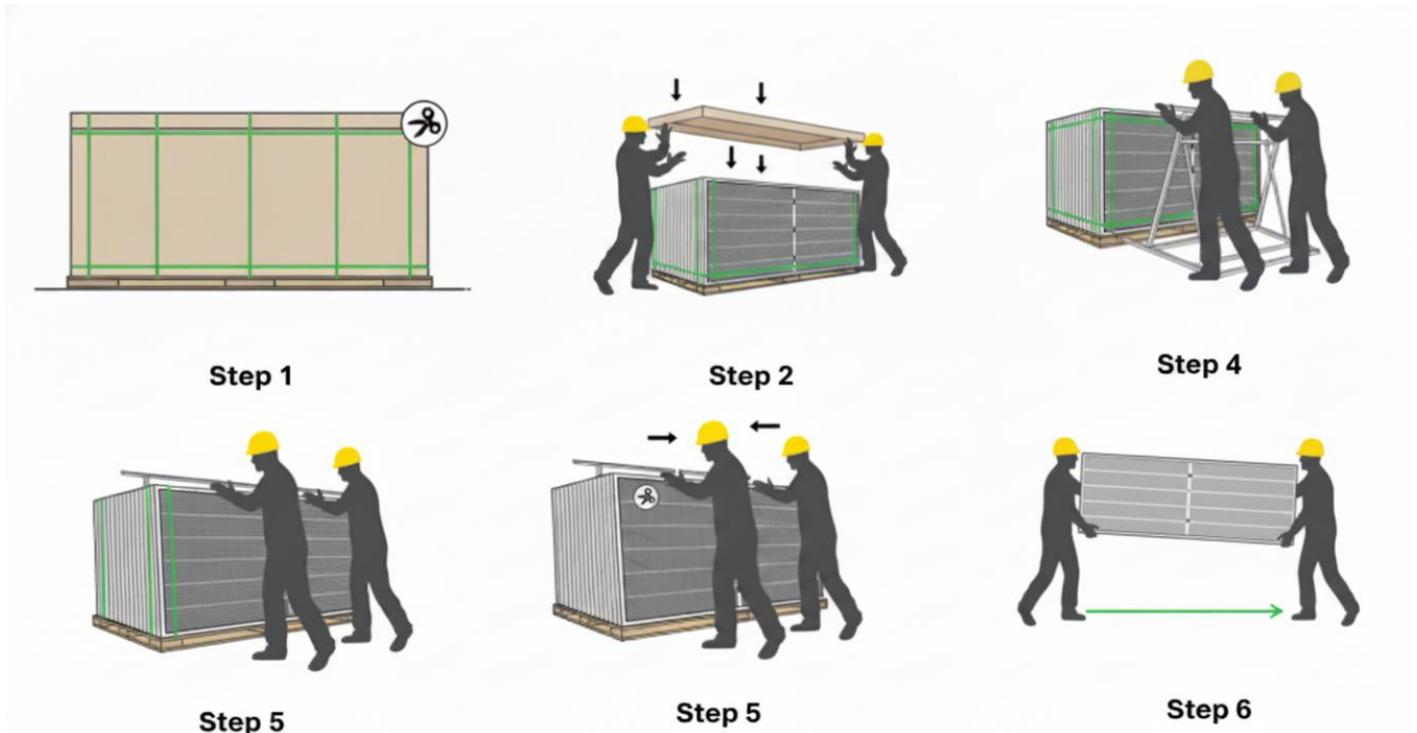
**Remove modules one by one, following the handling instructions below:**

- **Two-Person Lift:** Modules must always be carried by two people, one on each end, holding the module by its frame.

- **Vertical Orientation:** Carry modules in a vertical or near-vertical position. Carrying flat modules (horizontally) allows them to flex and sag under their own weight, which is a primary cause of cell micro-cracks.
- **No Single-Person Carry:** Never allow one person to lift or carry a module. This puts uneven stress on the frame and glass.
- **No Head Carrying:** Do not carry modules balanced on one person's head. This creates dangerous point loads.
- **Do Not Lift by Junction Box or Cables:** This can damage the junction box seals and strain cable connections, leading to water ingress and electrical faults.
- **Do not stack unboxed modules directly on top of each other:** Use cardboard or foam separators between each module if temporary stacking is necessary.



*FIGURE 2 : METHOD A- UNPACKING OF MODULES USING MODULE PALLET*



*FIGURE 3: METHOD B - UNPACKING OF MODULES USING L STAND*

- Care should be taken while placing the module on support structure so that it does not fall off.
- Do not place the modules directly on top of each other.
- Do not place excessive loads on the module or twist the module frame.
- Do not stand, step, walk and/or jump on the module.
- Do not drop or place objects on the modules (such as tools).
- Do not mark the modules with sharp instruments. Particular attention should be given to ensure that the module's back-sheet does not come in contact with Sharp objects, as scratches and holes will directly affect product safety.
- Do not change the wiring of bypass diodes.
- Keep all electrical contacts clean and dry.
- Do not keep the modules on the field with backside facing sun/upside-down.

## 4. ENVIRONMENTAL CONSIDERATIONS

### 4.1. CLIMATE CONDITION

- All SHPV Solar modules are tested for IEC 61215, IEC 61730-I & II, UL 1703, IEC 61701, IEC 62716, IEC 62804. The modules are qualified for safety through IEC 61730 and are considered to meet the requirements of Safety Class II.
- SHPV modules meet the requirements of European Standards, and a certificate of European Conformity (CE) is given as they are tested for Ammonia Fumes that may be present in Burns, Sheltering Cattle, Pigs, as well as sustainable for Installation in Humid (Coastal) areas with high Sandstorms. SHPV modules have passed Salt mist corrosion test (Severity VI), IEC 61701, with a salt concentration of 5% by weight. Galvanic corrosion can occur between the aluminium frame and ground mounting materials, if such materials are made of dissimilar metals.
- Stainless steel and Aluminium metal in direct contact is not recommended for seaside installations, so as to avoid metal corrosion.
- Do not install modules near naked flames or flammable materials.
- Do not expose modules to artificially concentrated light sources.
- Do not immerse modules in water or constantly expose modules to water (either fresh or salt) (i.e. from fountains, sea spray).
- Exposing modules to salt (i.e. marine environments) and sulphur (i.e. sulphur sources, volcanos) risks to module corrosion.
- To gain better output from rear side from bifacial modules, prefer albedo Table 2 while installing PV modules.

### 4.2. ENVIRONMENTAL CONDITION

- Ambient temperature: -40°C to +50°C.
- Storage temperature: -20°C to +50°C.
- Operating temperature: -40°C to +70°C (Module [T98]max (°C): 70°C).
- Humidity: ≤ 85% RH.
- Mechanical load pressure: 5400 Pa (112.8lb/ft<sup>2</sup>) on the front and 2400 Pa on the rear (50.12lb/ft<sup>2</sup>).

- Minimum Design Load (Pa): -1600 Pa, +3600 Pa.
- BIS: front 1000 W/m<sup>2</sup>, rear 300 W/m<sup>2</sup>.

**Note: The mechanical load bearing (Including wind and snow loads) of the module is based on the approved mounting methods. The professional system installer must be responsible for mechanical Load calculation according to the system design.**

**All the environmental condition of solar module specifications are based on the IEC 61215 & IEC 61730 testing.**

## 5. INSTALLATION CONDITION

### 5.1. SITE SELECTION

- SHPV modules should be installed in a location where they will receive maximum sunlight throughout the year.
- In the Northern Hemisphere, the module should typically face south, and in the Southern Hemisphere, the modules should typically face north. Modules facing 30° away from true South (or North) will lose approximately 10 to 15 percent of their power output. If the module faces 60° away from true South (or North), the power loss will be 20 to 30 percent.
- When choosing a site, avoid trees, buildings or obstructions, which could cast shadows on the modules, especially during the winter months where the arc traced by the sun is lowest, above the horizon. Shading causes loss of output, but the bypass diodes in the PV module will minimize any such significant losses.
- Shading can be minimized by having the distance between the obstruction and solar array more than thrice the height of obstruction.
- 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, it could have a direct impact on the power output.
- The installation place should be less than 1,000 m (3,280 ft) above sea level. Above 1,000 m are allowed only if the wind pressure load for a module is less than 2,400 N/m<sup>2</sup> (50.12 lb/ft<sup>2</sup>).
- Engage a certified and experienced installation team that understands the specific thermal and mechanical challenges of installing bifacial modules on metal roofs. Proper torquing of clamps and adherence to design specifications are critical for long-term reliability and safety.

- When installing as per IEC 61215 the maximum design load, a safety factor of 1.5 (Mechanical Design load = Design Loads x 1.5) needs to be considered in compliance with the requirements of the local laws and regulations.

## 5.2. TILT ANGLE SELECTION

- The tilt angle of the PV module is measured between the surface of the PV module and the horizontal ground surface. The PV module generates maximum output power when it faces the sun directly.
- For optimal annual energy production, orient modules towards the equator. The ideal tilt angle is typically equal to the site's latitude.
- Using the PVsyst software helps in determining the optimal tilt angle based on geographical location (latitude, longitude), Climatic data (irradiance, temperature etc.), System Type (fixed tilt or tracking) and Design Load (maximum annual yield, seasonal optimization etc.)
- If the tilt angle of the PV module is below 15 degrees, it is recommended to use two water drain clips in the bottom edge of the module frame.
- For standalone systems with batteries where the PV modules are attached to a permanent structure, the tilt angle of the PV modules should be selected to optimize the performance, based on seasonal load and sunlight. In general, if the PV output is adequate when irradiance is low (e.g., winter), then the angle chosen should be adequate during the rest of the year.
- For grid-connected installations where the PV modules are attached to a permanent structure, PV modules should be tilted so that the energy production from the PV modules will be maximized on an annual basis.
- Any slope of less than 1:2.4 (for example equals to slope of  $\arctan(1/2.4 \sim 22.6^\circ)$  is required to maintain the fire class rating; Modules are Class C Fire Rated.
- The System Fire Class Rating of a module in a roof mounted system should meet the local code requirements to achieve the specified System Fire Class Rating for a non-BIPV module.
- Any module mounting system has limitations on inclination required to maintain a specific System Fire Class Rating.

**Note: The connection of the module to the racking system can be created with clamps, with frame, or**

**an embedded system on the frame. If a different installation method is desired, please contact SHPV customer service or technical support team for consultation. Improperly mounted modules may be damaged.**

## **6. MOUNTING INSTRUCTIONS FOR MONOFACIAL AND BIFACIAL MODULE**

- PV modules can be installed by bolt type or fixed by clamp method.
- While mounting the PV module, if the frame has a transparent plastic film, this film must be removed from all sides of the frame before installing the modules.
- The module frame must not be modified in any way (e.g., drilling additional holes), as this will avoid the warranty.
- And corner cap fixed on four corners of the modules has to be removed.
- Avoid using mounting methods where drain holes are blocked.
- PV modules should not be installed in such a way that it will be immersed in water under any circumstances, and it should not be installed in a moving vehicle / vessel.
- For bolts type fixing corrosion resistive M6/M8 bolts to be used.

### **For mono-facial modules follow these instructions before installation:**

- Minimum clearance required between module edge and surface should also be considered according to the local regulation's requirements.
- SHPV recommends maintaining minimum distance between each PV module to be 10mm.
- For roof mounting the clearance of at least 115 mm has to be maintained between modules and the surface of the roof. For ground mounting the clearance of at least 300mm has to be maintained from the ground surfaces. If other mounting methods are employed this may affect the UL Listing or the fire class ratings.
- Use durable, rust-proof and ultraviolet resistant materials to fabricate the modules support structure and use such support structure that are already tested, certified and approved.

### **For bifacial modules follow these instructions before installation:**

- The bifacial modules have the potential to generate 10% to 30% extra electricity from the back. To get optimal generation from TOPCon Bifacial module SHPV recommended clearance from metal roof & ground should be > 300mm and gap between the module on all sides should be >

48mm. This greater standoff allows for a significant improvement in airflow, preventing the formation of localized hot spots at the top and bottom of the array and reducing the overall operating temperature of the modules.

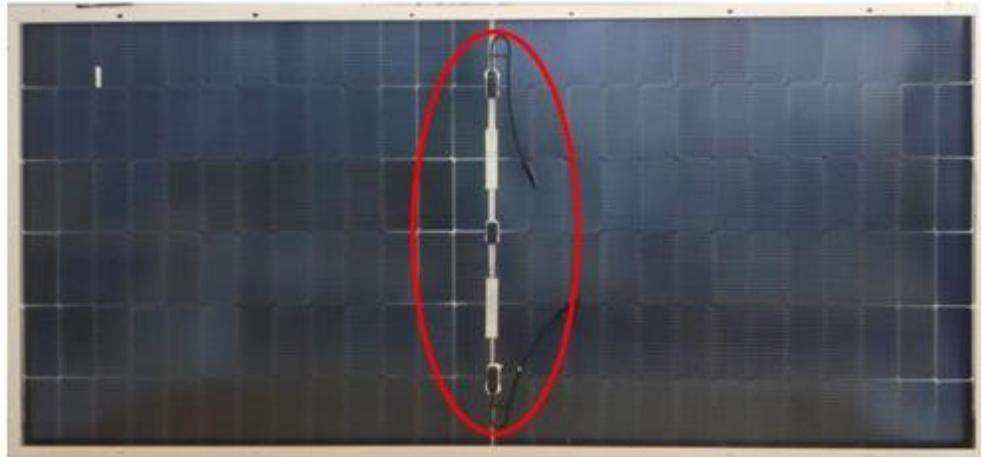
- Ensure mounting hardware does not obstruct airflow and is designed for bifacial modules, not reused from Mono-facial setups.
- Optimize Module Orientation: Consider a landscape orientation for the module rows. This may distribute thermal and mechanical stress more evenly across the length of the module, potentially reducing the extreme stress at the top and bottom edges seen in portrait configuration.
- Choose a High-Quality Racking System: Use racking and clamping systems designed for low-stress installation. Ensure the clamping torque is applied within the manufacturer's specified range to avoid creating micro-cracks or excessive mechanical pressure points, and the racking system shall be designed for mounting the bifacial modules.
- It is advised to secure two water drain clips per module to prevent dust accumulation at the edges and to avoid Hot Spots.
- Apply a cool roof coating (for e.g.: aluminum foil or white membrane) with a high solar reflective index (SRI) to the metal roof before installation. This will significantly reduce the amount of heat reflected onto the underside of the bifacial modules, lowering their operating temperature and mitigating the primary source of thermal stress. Recommended SRI is >90.
- While, mounting the bifacial module mount the Junction box to be back side of the module (i.e. towards the roof floor/ ground facing). Refer Figure 4.
- **Expected Bifacial Gain vs. Height & Albedo**

The following table provides typical power gain estimates based on mounting height and ground surface albedo. These are estimates, and actual performance will vary with site-specific conditions:

Mounting Height	Bifacial Gain (Grass - Albedo ~20%)	Bifacial Gain (Gravel - Albedo ~35%)	Bifacial Gain (White TPO Roof - Albedo ~80%)
0.5 meter	5 - 8%	9 - 12%	15 - 20%
1.0 meter	7 - 10%	11 - 15%	20 - 25%
1.5 meters	8 - 12%	13 - 17%	22 - 28%

	DOC.TITLE: <b>SOLAR PV MODULE INSTALLATION, OPERATIONAL AND MAINTENANCE MANUAL</b>	DOC TYPE: <b>WORK INSTRUCTION</b>	
	DOC. NO: <b>SHPV/WI-D&amp;D-INST.Manual/47</b>	Rev No: 10	Page No: 23

*TABLE 2: ALBEDO GAIN FOR DIFFERENT SURFACE*



*FIGURE 4: BACK SIDE OF THE BIFACIAL MODULE BACK SIDE OF BIFACIAL MODULE*

## 6.1. MOUNTING METHODS

### 6.1.1. BOLT TYPE FIXING

- The frame of each module has 8 mounting holes (Length x Width: 14mm x 9mm) and 4 Tracker mounting holes (Length x Width: 10 mm x 7 mm) used to secure modules to the support structure which is marked in the figure. The module frame must be attached to a mounting rail using M6/M8 corrosion-proof bolts together with spring washers and flat washers in eight symmetrical locations on the PV module. The applied torque value should be high enough to fix the modules steadily. The reference value for M6/M8 bolt is given in Table 3. As to special support system or special installation requirement, please reconfirm with the support system supplier for torque value. Please find the mounting information image in Figure 5 & Figure 6.

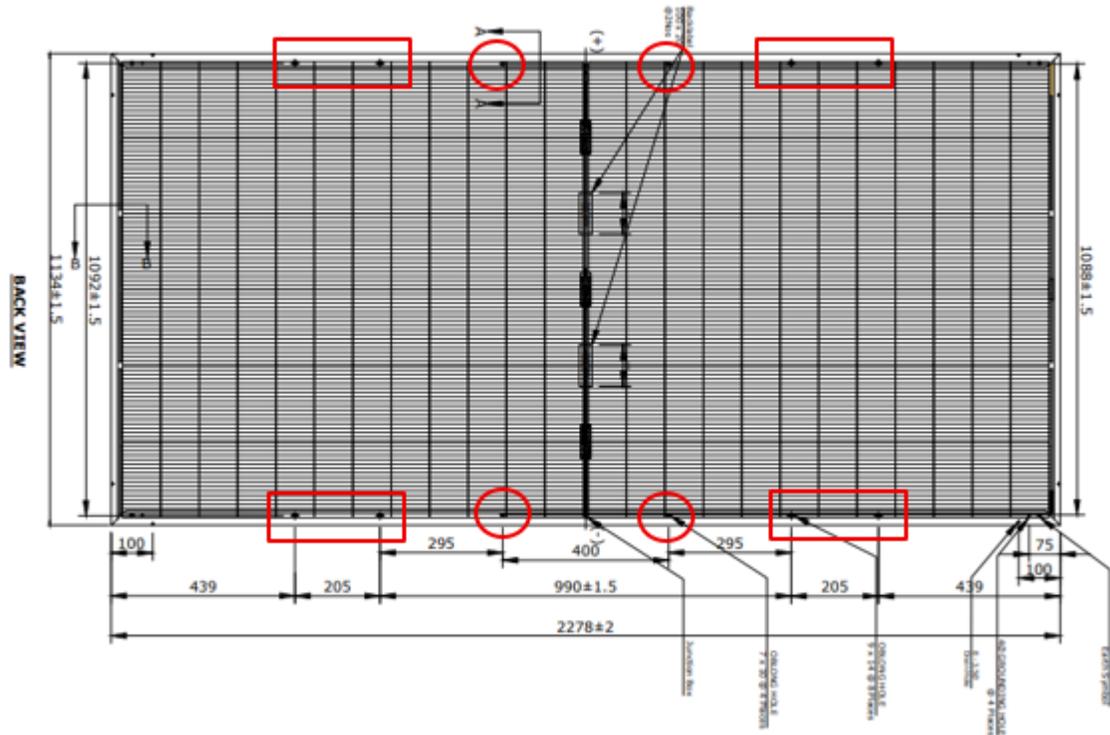


FIGURE 5: PV MODULE WITH MOUNTING HOLES (FOR REFERENCE)

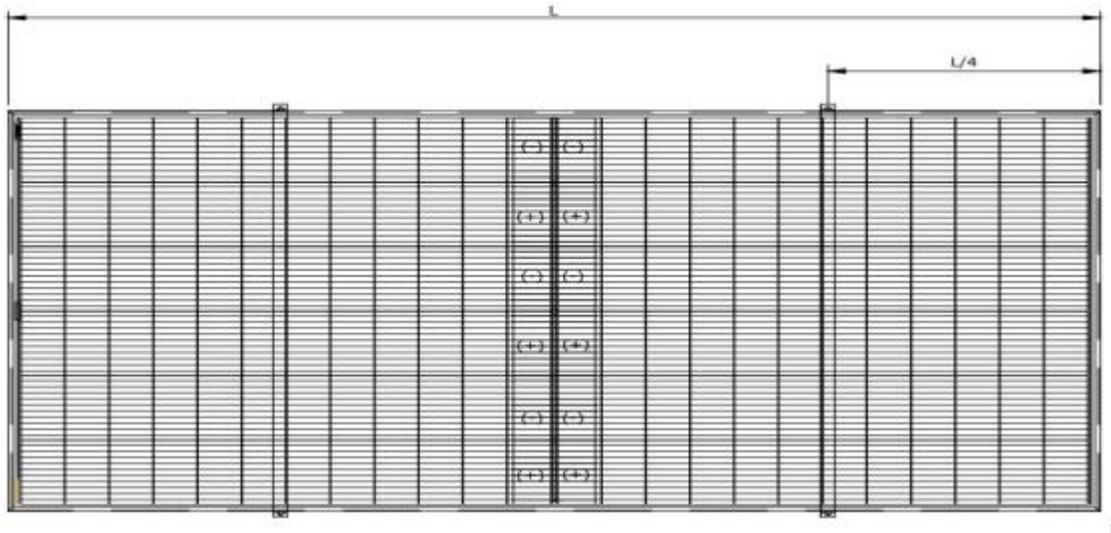


FIGURE 6: BOLT TYPE FIXING

### 6.1.2. CLAMP TYPE FIXING

- To fix the modules on the mounting rail using clamp mounting method, a minimum of 4 clamps need to be fixed as shown in Figure 7 & 8.
- SHPV recommends clamp mounting on long side of the module.
- Depending on the local wind and snow loads, if excessive pressure load is expected, additional clamps or support is required to ensure that the module can bear the load.

- The clamp must maintain an overlap of 10 mm with the frame of the module.
- SHPV has tested modules with a number of clamps and suggests to use clamps which has an EPDM or any other insulating washer.
- The clamps should never touch the glass and cause any breakage, and it should not cause any shadow effects on the module.
- The applied torque value should be big enough to fix the modules steadily (Please consult with the clamp or support structure supplier, for the specific torque value. For example: M6/M8 Screw torque reference value is given in table 03.
- The customer should not make any modification to the frame under any circumstances this will void the warranty.
- SHPV Solar modules are certified for 2400 Pa (50.12 lb./ft<sup>2</sup>) (Wind Load) and 5400 Pa (112.8 lb./ft<sup>2</sup>) (Snow Load) on the front side. Additional clamps can be used to ensure that the modules can bear the load.
- Refer the figure 9 & 10 for Fringe Type Module and Middle Module Installation.



*FIGURE 7: INSTALLATION WITH CLAMPS INTO 4 OUTER HOLES. BEAMS PERPENDICULAR TO LONG SIDES*



FIGURE 8: INSTALLATION WITH CLAMPS INTO 4 INNER HOLES. BEAMS PERPENDICULAR TO SHORTSIDES

**FRINGE MODULE INSTALLATION**

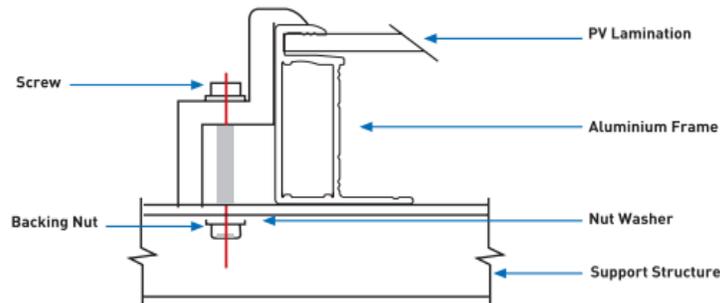


FIGURE 9: PV MODULES INSTALLED USING FRINGE CLAMPING METHOD

**MIDDLE MODULE INSTALLATION**

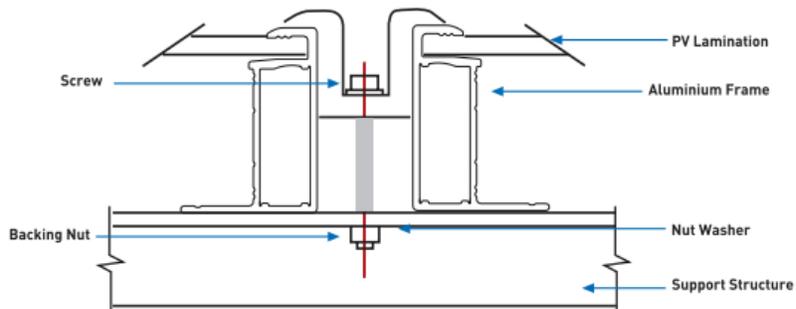


FIGURE 10: PV MODULES INSTALLED USING MIDDLE CLAMPING METHOD

Bolt Size	Condition	Material of Mating Thread	Recommended Torque
<b>M8</b>	Dry (Unlubricated)	Stainless Steel / Aluminum	16 - 20 Nm
<b>M8</b>	Lubricated	Stainless Steel / Aluminum	12 - 15 Nm
<b>M6</b>	Dry (Unlubricated)	Stainless Steel / Aluminum	9 - 12 Nm

*TABLE 3: BOLT SIZE AND ITS CORRESPONDING TORQUE VALUE*

### 6.1.3. MOUNTING WITH BOLTS 14 X 9 mm MOUNTING HOLES

- Modules can be attached using the mounting holes 14 X 9 mm on the back of the module frame, by fixing the module to the support rails with bolts. The frame of each module has 8 Nos. 14 X 9 mm mounting holes, ideally placed to optimize the load handling capability, and to secure the modules to the supporting structure.
- To maximize mounting longevity, SHPV strongly recommends the use of corrosion proof (stainless steel) attachment fixings. Secure the module in each mounting location with an M8 bolt and a flat washer, spring washer and nut and tighten to a torque of 16 to 20 Nm (140 to 180 lbf.in.). All parts in contact with the modules should use flat stainless-steel washers of minimum 1.5 mm thickness with an outer diameter of 20 to 24 mm (0.79 - 0.94 in).

### 6.1.4. MOUNTING WITH SINGLE-AXIS TRACKING SYSTEM

#### 10 X 7mm MOUNTING HOLES

- It is a Single axis Tracking System; the module is fixed on the axis by bolting long frames.
- The frame of each module has 4 Nos. 10 X 7 mm mounting holes with specific location.
- Modules in each fixing location are fixed with an M6 bolt, two flat washers, a spring washer and nut.
- If a different bolt similar to M6 is used, they need to be tightened to a torque of 16 Nm (140lbf.in).
- All parts in contact with the frame should use flat stainless-steel washers of minimum 1.5 mm thickness with an outer diameter of 16-20mm (0.63-0.79in).

- The bolt should be made of stainless steel or anti-corrosion material.
- Mechanical Load Pressure under this method: 30 lbs.ft<sup>2</sup> max from the front side & 30 lbs.ft<sup>2</sup> max from the rear according to UL 1703.

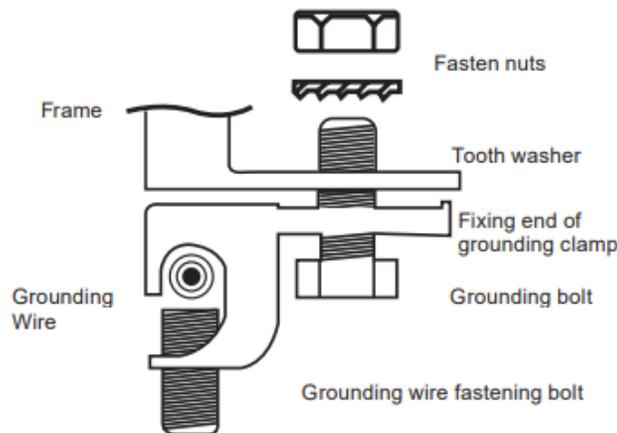
### 6.1.5. MOUNTING WITH CLAMPS

- SHPV has tested its modules with a number of clamps from different manufacturers, with a mounting bolt of at least M8.
- Use only standard solar mounting clamps made of anodized aluminum alloy 6005-T6, with compatible stainless-steel fasteners.
- The clamp must overlap the module frame by at least 7 mm but no more than 10 mm.
- Use minimum 4 clamps to attach modules to the mounting rails.
- Modules clamps should not come into contact with the front glass and must not deform the frame.
- Be sure to avoid shadowing effects on the solar cells from the module clamps.
- The module frame is not to be modified under any circumstances.
- When choosing this type of clamp-mounting method, use at least four clamps on each module, two clamps should be attached on each long side of the module (for portrait orientation).
- Depending on local wind and snow loads, additional clamps may be required to ensure that modules can bear the load.
- Applied torque should refer to mechanical design standard according to the bolt customer is using, for ex: M8 – refer the bolt torque value in given Table 3.

### 6.2. PV MODULE GROUNDING

- All modules have to be electrically grounded as per the National Electrical Code (USA) or in accordance with CSA C22.1, Safety Standard for Electrical Installations, Canadian Electrical Code, Part 1.
- Modules are provided with grounding holes at the back of the module frames, and the grounding symbol (embossed earth) has also been printed/marked near the hole for identification.
- The module must be grounded using grounding holes and suitable grounding conductors or wires which include copper, alloy, or any other material in accordance with the local electrical design and regulation.

- The ground conductor must be reliably grounded by a suitable ground electrode. And all the grounding hardware must be made of stainless steel.
- SHPV recommends using grounding wire with resistance that is less than 1 ohm.
- The electrical contact is made by penetrating the anodized coating of the aluminum frame. It is necessary to use tooth gasket or self-tapping screw for effective grounding.
- Bimetallic Lug is required for effective grounding.
- Every module must be grounded individually, only after all the modules in the system are connected properly.
- Bracket must be checked before the event of a thunderstorm; it is necessary to carry out spot check on the underground component.
- Grounding connections should be installed by a qualified electrician. Connect module frames together using adequate grounding cables: grounding wire size (4-16mm<sup>2</sup> AWG solid bare copper) should be selected.
- The Recommended Grounding method is given below in Figure 11 & 12.
- Anti-thunder measures must be taken for modules in series. Photovoltaic grounding and lightning protection must be implemented as per local government regulations.



*FIGURE 11: PV MODULES RECOMMENDED GROUNDING*



*FIGURE 12: PV MODULE GROUNDING ACCESSORIES*

## 7. ELECTRICAL CONFIGURATION

- All wiring should be performed by well-trained, qualified installers as per the local codes and regulations.
- It is recommended to connect only such number of modules in series, such that the system voltage should not exceed the rated value at any time of the year. The EPC should choose the appropriate electrical design based on the Inverter MPPT ratings, operating voltage, and the environmental conditions, considering the lowest temperature recorded at the site.
- PV modules can be connected in Series to increase the Operating Voltage (up to 1500Vdc). The positive connector of module is connected to the negative connector of another module, and a click sound should be heard. Click sound ensures proper connectivity between the two terminals. Similarly, PV modules can be connected in Parallel to increase the overall current (up to Fuse Rating; 30A) at the terminals.
- SHPV modules are provided with standard copper cables having 4 mm<sup>2</sup> cross-sectional area and are rated for 1500V/1000V (IEC and UL) maximum system voltage, 90° C, and UV resistant. Ensure that the cables are not exposed to waterlogging.
- The maximum voltage in the system should be lesser than the certified system voltage (typically 1500V) or the maximum input voltage of the inverter. Since  $V_{oc} \propto (1/T)$ , the open circuit voltage of the array needs to be calculated at the lowest ambient temperature recorded at the location of power plant.
- Below formula can be used for this calculation:

$$\text{System Voltage} = X * V_{oc} * [1 + ((T_{\alpha})V_{oc} (\%) \times (25 - T_{min}))]$$

Where, X - No: modules which are connected in series.

$V_{oc}$  - Open circuit voltage of each module (Refer to the Data Sheet).

$(T_{\alpha}) V_{oc}$  - Thermal coefficient of open circuit voltage for the module in Percentage.

$T_{min}$  - Minimum ambient temperature of the location of the plant.

- Outer cable diameter is maximum 7 mm and minimum is 5 mm.
- In field application it is recommended to use 4 mm<sup>2</sup> cables insulated for minimum of 90°C and designated as PV wire.
- Under normal conditions, a photovoltaic module is likely to experience conditions that produce higher current and/or voltage than reported at standard test conditions. Accordingly, the values of  $I_{sc}$  and  $V_{oc}$  marked on this PV module should be multiplied by a factor of 1.25 when determining component voltage ratings, conductor current ratings, and size of controls (e.g., inverter) connected to the PV output.
- **Note:** According to system design standards such as IEC 62548 (Photovoltaic (PV) arrays – Design requirements) and NEC 690 (National Electrical Code, USA), the following safety multipliers 1.25 must be applied when sizing system components.

## 7.1. ELECTRICAL WIRING

- The reported performance measurements are subject to ±5% uncertainty at Standard Test Condition STC/Bifacial Standard Test Condition for voltage, current and 0-3% power.
- According to IEC 60904-3 STC Condition: 1000 W/m<sup>2</sup>, (25±2) °C, AM 1.5.  
 BSTC Condition: (AM 1.5, T = 25 °C, Irradiance = 1000W/m<sup>2</sup> +  $\phi$ •135W/m<sup>2</sup>),  
 Rear Side Irradiance =  $\phi \times 135 \text{ W/m}^2$ ,  
 Where  $\phi$  = bi-faciality factor of the module (ratio of rear to front  $I_{sc}$ ).
- Maximum allowable system voltage for SHPV modules is 1500V, Class for protection against electrical shock, in accordance with Clause 4 of IEC 61730-1:2016 is CLASS II.
- When modules are in series connection, the string voltage is sum of individual modules in one string. When modules are in parallel connection, the current is sum of the individual string current. Modules with different electric performance models cannot be connected in one string. Please

Refer – Figure 13.

- SHPV recommends to avoid using Y Connectors, although a maximum of 2 strings per Y Connector could be connected in parallel, with appropriate string fuse for circuit protection.

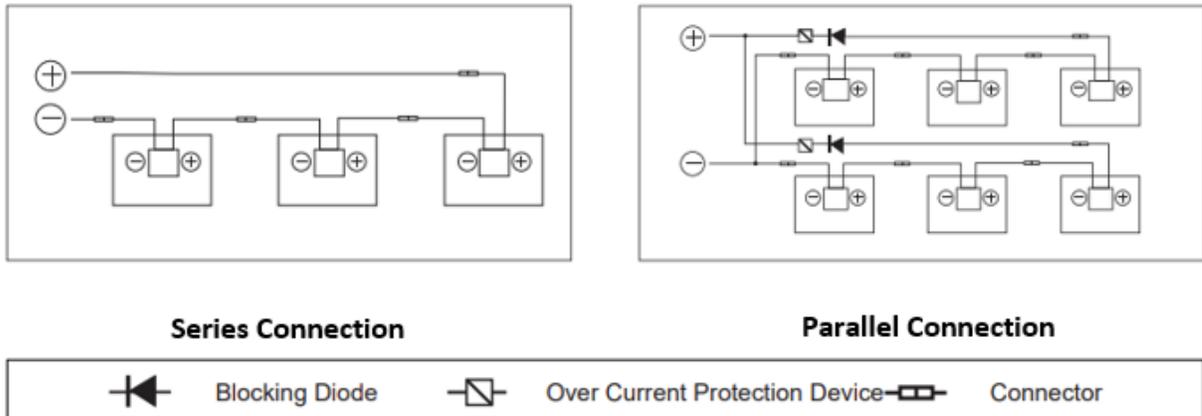


FIGURE 13: PV MODULES CONNECTED IN SERIES AND PARALLEL

### 7.1.1.ADVANCED PID MITGATION

- Potential Induced Degradation (PID) can cause significant power loss in PV systems, especially in hot and humid climates with high system voltages. It occurs when a high negative voltage potential exists between the cells and the grounded module frame, causing ion migration that degrades cell performance. Mitigating PID requires a combined approach at the module and system level.
- Module Level Prevention- Modules should be PID Free Modules according to IEC 62804 Standards.
- System-Level Mitigation (Installer/Designer's Responsibility): Even with PID-resistant modules, best practices in system design provide an extra layer of protection as listed in Table 04.

Mitigation Strategy	Description & Best Practice	Considerations
<b>Negative Pole Grounding</b>	This is the most common and method for transformer less inverters. By grounding the DC negative conductor, the voltage potential of the entire cell string is raised to be near or above ground potential, eliminating the negative bias that causes PID.	MUST be supported by the inverter. Check the inverter's installation manual to confirm if functional grounding of the negative pole is permitted. Improper grounding can damage the inverter and void its warranty.
<b>Inverter with Anti-PID / PID Recovery Function</b>	Many modern inverters offer a built-in Anti-PID feature. At night, the inverter applies a positive voltage bias to the PV array, which repels the harmful ions from the cells and effectively "recovers" any performance lost during the day.	This is an active, highly effective solution. It can be a key factor when selecting an inverter for large-scale plants in high-risk environments. It eliminates the need for physical grounding kits.
<b>Use of Galvanically Isolated (Transformer) Inverters</b>	Transformer-based inverters physically isolate the DC side from the AC side. This prevents the establishment of leakage current paths to ground, thereby inhibiting the PID mechanism.	This is an inherently PID-free design. However, these inverters are typically larger, heavier, and slightly less efficient than modern transformer less inverters.

TABLE 4: ADVANCED PID MITIGATION

## 7.2. CABLE AND CONNECTOR MANAGEMENT

Proper cable and connector management is critical for system safety, longevity, and performance. Hanging or poorly secured cables are a primary cause of ground faults, arc faults, and performance loss.

Technique	Description & Best Practice	Why It's Critical
<b>Use UV-Resistant Clips/Ties</b>	Secure cables to the module frame or racking using dedicated, UV-stable stainless-steel clips or high-quality polyamide zip ties. Standard plastic zip ties will degrade and fail.	Prevents cables from hanging, swinging in the wind, and abrading against the roof or racking, which can wear away insulation and cause faults.
<b>Create Drip Loops</b>	Before a connector, form a gentle downward loop with the cable. The lowest point of the loop must be below the connector itself.	Prevents rainwater from tracking down the cable and seeping into the connector seal over time, which causes corrosion and insulation faults.
<b>Maintain Bending Radius</b>	The minimum bending radius for the factory-supplied 4mm <sup>2</sup> cable is 42 mm (approximately 5-6 times the cable diameter). Do not create sharp bends.	Exceeding the minimum bend radius puts physical stress on the copper conductors and insulation, leading to premature failure and potential fire hazards.
<b>Protect from Sharp Edges</b>	Ensure cables are not pulled tight against sharp metal edges of the racking or module frame. Use edge guards or route cables through designated channels.	Protects the cable's outer jacket and inner insulation from being cut or abraded, which is a direct cause of ground faults.
<b>Bifacial Cable Routing</b>	Secure cables along the inner flange of the module frame whenever possible. Avoid draping cables across the rear side of the module.	Minimizes backside shading. Even a small, consistent shadow from a cable can reduce the bifacial energy gain and may lead to localized hot spots over time.

*TABLE 5: CABLES AND CONNECTOR MANAGEMENT*

- Protect unplugged connectors against moisture, dust and any environmental pollution. Only clean and dry plugged connectors fulfil their ingress protection (IP) class. Ensure that the connector caps are fastened before connecting the modules.

- Do not attempt to make 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.
- Faulty connections can result in arcs and electrical shock. Check all electrical connections are fastened and secure. Make sure all locking connectors are fully engaged and locked.
- Only compatible connectors can be mated, i.e., from the same vendor and model, which should be used. For approved connector make for each PV model as per IEC CDF kindly connect to SHPV technical team.

**Note: Please make sure to use specific Connector Crimping Tool**



FIGURE 14: PV MODULES CONNECTORS

- Modules equipped with PV wiring connectors that comply with the Standard, “Connectors for Use in Photovoltaic Systems, UL 6703”, shall have the specific, allowable, mating connector manufacturer(s) and model number(s) listed, as well as contact information and/or website of the PV connector manufacturer.
- Cables should always be fastened on module frames or on mounting rails, in order to avoid shading on module rear side.
- For Connector Manufacturer and Model please refer to Table 06 below.

Manufacturer	Model
Zhejiang Zhonghuan Sunter PV Technology Co., Ltd	PV-ZH202B
DhaSh PV Technologies Private Ltd	DS01
Stäubli Electrical Connectors AG	PVKST4-EVO2/xy_UR PVKBT4-EVO2/xy_UR
GENX PV India Private Limited	GXC-01

TABLE 6: CERTIFIED CONNECTORS MODEL AND MAKE

### 7.3. FUSE RATING

- Please rate the fuses for maximum Vdc and connected in each, non-grounded pole of the Solar Array. (If the system is a floating system, then fuses should be connected in both positive and negative poles). The maximum Fuse Rating connected in series with the array string is usually 30A. The fuse rating also corresponds to maximum reverse current that a module will be able to withstand. 30A Fuse per String is recommended.

**Note: The actual module specific fuse rating can be found on the module data sheet.**

- $1.5/K_f \cdot I_{sc} \leq I_n \leq \text{Max Series Fuse Rating (IEC standard)}$ .
- $1.56/K_f \cdot I_{sc} \leq I_n \leq \text{Max Series Fuse Rating (NEC standard)}$ .

Where,  $I_n$ - Fuse rated current [A].

$I_{sc}$  - Short circuit current of the module [A].

$K_f$  Temperature correction factor [-].

### 7.4. BYPASS DIODES

- Bypass diodes divert current from the cell strings in the event of partial shading.
- If hot spot occurs, the diode will come into operation to stop the main current from flowing through the hot spot cells in order to prevent module over-heated and performance loss.
- In case of any failure, diode replacement of Potted Junction Box is not possible. If the bypass diode

stops working, then the only way to correct the problem is to replace the complete Junction box with new one. To replace Junction Box SHPV recommends contacting the supplier.

- The junction boxes used with SHPV 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 overcurrent protection devices.

**Note: The Warranty Claim is Void if the replacement of Junction Box is not done under the presence of SHPV Personnel.**

## 7.5. SELECTION OF INVERTER AND COMPATIBILITY

- Connect the required quantity of modules, which corresponds to the Voltage specifications of the Inverters used in the system. SHPV recommends a maximum of 30 modules to be connected in series based on the Module's Maximum System Voltage.
- When installed as per IEC norms and regulations, SHPV modules normally do not need to be electrically connected to earth and can operate with either galvanically isolated (with transformers) and transformer less inverters.
- If the system is located in hot and very humid locations, then galvanically isolated Inverters with Transformers must be used and the negative pole of the array must be connected to earth. It is recommended to adopt inverter negatively- earthed-installation to avoid the PID effect.
- If a Transformer less Inverter is used in hot humid climatic locations, the Installer should ensure that the right active negative earthing kit is to be installed by consulting and having assurance from the Inverter supplier.

**Note: The Recommended Maximum Series/Parallel Module Configuration is subject to choose of Inverter (MPPT Range) and the Temperature Ranges recorded at the site.**

## 7.6. TECHNICAL SPECIFICATION

Type name or model no.	<b>SWM11BN8xxx</b> (xxx= 595-585 in step of 1)	<b>SWM11BN6xxx</b> (xxx= 550-540 in step of 1)	<b>SWM11BN2xxx</b> (xxx= 460-450 in step of 1)
Nominals short-circuit current at STC [A]	13.67 – 13.56	13.79 – 13.68	13.83 – 13.79
Nominal open-circuit voltage at STC [V]	55.02 – 54.58	50.25 – 49.82	41.74 – 41.30
Tolerance of rating at STC (P <sub>mpp</sub> / I <sub>sc</sub> / V <sub>oc</sub> ) [%]	0-3/±5/±5	0-3/±5/±5	0-3/±5/±5
Dimensions (L x W x H) [mm]	2465 x1134x35	2278x1134x35	1909 x1134x35
Module area [m <sup>2</sup> ]	2.81	2.58	2.16
Class (IEC 61730-1:2016)	Class II	Class II	Class II
Maximum system voltage [V <sub>DC</sub> ]	1500	1500	1500
Pollution degree	PD 1	PD 1	PD 1
Over-current protection rating [A]	25	25	25
Defined min. creepage distance [mm]	14.0	14.0	14.0
Defined min. clearance distance [mm]	14.0	14.0	14.0
Max. operational altitude [masl]	≤2000	≤2000	≤2000
Design load – downwards [Pa]	3600	3600	3600
Design load – upwards [Pa]	1600	1600	1600
Safety factors for mechanical load	1.5	1.5	1.5
Number of solar cells	156	144	120
Connection of cells (S, SP, PS)	SP	SP	SP
Number of diodes	3	3	3
Cells per diode	52	48	40
Temperature Coefficient for V <sub>oc</sub>	-0.2741		
Temperature Coefficient for I <sub>sc</sub>	0.0479		
Temperature Coefficient for P <sub>max</sub>	-0.3621		

TABLE 7: TECHNICAL SPECIFICATION FOR M10 PERC MODULES

Type name or model no.	SWM11BT8xxx (xxx= 595-585 in step of 1)	SWM11BT6xxx (xxx = 550-540, in steps of 1)	SWM11BT2xxx (xxx = 460-450, in steps of 1)
Nominals short-circuit current at STC [A]	13.67 – 13.56	13.79 – 13.68	13.83 – 13.79
Nominal open-circuit voltage at STC [V]	55.02 – 54.58	50.25 – 49.82	41.74 – 41.30
Tolerance of rating at STC (Pmpp / I <sub>sc</sub> / V <sub>oc</sub> ) [%]	±3/±10/±10	±3/±10/±10	±3/±10/±10
Nominal maximum output power at BNPI [W]	655 – 644	606 – 595	506 – 497
Nominals short-circuit current at BNPI [A]	15.04 – 14.92	15.17 – 15.05	15.26 – 15.17
Nominal open-circuit voltage at BNPI [V]	55.02 – 54.58	50.25 – 49.82	41.47 – 41.30
Tolerance of rating at BNPI (Pmpp / I <sub>sc</sub> / V <sub>oc</sub> ) [%]	±3/±10/±10	±3/±10/±10	±3/±10/±10
Bi-faciality coefficient	70 ± 5 %	70 ± 5 %	70 ± 5 %
Dimensions (L x W x H) [mm]	2465x1134x35	2278 x 1134 x 35	1909 x 1134 x 35
Module area [m <sup>2</sup> ]	2.81	2.58	2.16
Class (IEC 61730-1:2016)	Class II	Class II	Class II
Maximum system voltage [VDC]	1500	1500	1500
Pollution degree	PD 1	PD1	PD1
Qualified as cemented joint design	No	No	No
Over-current protection rating [A]	30.0	30	30
Defined min. creepage distance [mm]	14.0	14	14
Defined min. clearance distance [mm]	14.0	14	14
Max. operational altitude [masl]	≤2000	≤2000	≤2000
Design load – downwards [Pa]	3600	3600	3600
Design load – upwards [Pa]	1600	1600	1600
Safety factors for mechanical load	1.5	1.5	1.5
Number of solar cells	156	144	120
Connection of cells (S, SP, PS)	SP	SP	SP
Number of diodes	3	3	3
Cells per diode	52	48	40
Temperature Coefficient for V <sub>oc</sub>		-0.2741	
Temperature Coefficient for I <sub>sc</sub>		0.0479	
Temperature Coefficient for P <sub>max</sub>		-0.3621	

TABLE 8: TECHNICAL SPECIFICATION FOR M10 PERC BIFACIAL MODULE

Type name or model no.	SWM11BB8xxx (xxx= 590-580 in step of 1)	SWM11BB6xxx (xxx = 545 - 535, in steps of 1)	SWM11BB2xxx (xxx = 455-445, in steps of 1)
Nominal maximum output power at STC [W]	590-580 (in steps of 1)	545 - 535 (in step of 1W)	455-445 (in step of 1W)
Nominals short-circuit current at STC [A]	13.62 – 13.51	13.74 – 13.64	13.83 – 13.75
Nominal open-circuit voltage at STC [V]	54.80 – 54.36	50.04 – 49.61	41.52 – 41.08
Tolerance of rating at STC (P <sub>mp</sub> / I <sub>sc</sub> / V <sub>oc</sub> ) [%]	±3/±5/±5	±3/±5/±5	±3/±5/±5
Dimensions (L x W x H) [mm]	2465x1134x35	2278 x 1134 x 35	1909 x 1134 x 35
Module area [m <sup>2</sup> ]	2.81	2.58	2.16
Class (IEC 61730-1:2016)	Class II	Class II	Class II
Maximum system voltage [VDC]	1500	1500	1500
Pollution degree	PD 1	PD1	PD1
Qualified as cemented joint design	No	No	No
Over-current protection rating [A]	25.0	25	25
Defined min. creepage distance [mm]	14.0	14	14
Defined min. clearance distance [mm]	14.0	14	14
Max. operational altitude [masl]	≤2000	≤2000	≤2000
Design load – downwards [Pa]	3600	3600	3600
Design load – upwards [Pa]	1600	1600	1600
Safety factors for mechanical load	1.5	1.5	1.5
Number of solar cells	156	144	120
Connection of cells (S, SP, PS)	SP	SP	SP
Number of diodes	3	3	3
Cells per diode	52	48	40
Temperature Coefficient for V <sub>oc</sub>	-0.2741		
Temperature Coefficient for I <sub>sc</sub>	0.0479		
Temperature Coefficient for P <sub>max</sub>	-0.3621		

*TABLE 9: TECHNICAL SPECIFICATION FOR M10 PERC BLACK MODULES*

Type name or model no.	SWT15BG8xxx (xxx= 630- 595, in step of 1)	SWT15BG6xxx (xxx= 580- 550, in step of 1)	SWT15BG4xxx (xxx = 530-500, insteps of 1)	SWT15BG2xxx (xxx= 480- 450, in step of 1)	SWT15BG0xxx (xxx = 430-405, in steps of 1)
Nominals short-circuit current at STC [A]	14.27 – 13.85	14.28 – 13.92	14.43 – 14.07	14.30 – 13.94	13.97 – 13.67
Nominal open-circuit voltage at STC [V]	55.87 – 54.96	51.46 – 50.68	46.43 – 45.65	42.73 – 41.95	38.33 – 37.68
Tolerance of rating at STC (Pmpp / Isc / Voc) [%]	±3/±10/±10	±3/±10/±10	±3/±10/±10	±3/±10/±10	±3/±10/±10
Nominal maximum output power at BNPI [W]	693-654	638-605	583-550	528-495	473-445
Nominals short-circuit current at BNPI [A]	15.70 – 15.24	15.71 – 15.31	15.87 - 15.48	15.73 – 15.33	15.37- 15.04
Nominal open-circuit voltage at BNPI [V]	55.87 – 54.96	51.46 – 50.68	46.43 – 45.65	42.73 – 41.95	38.33 – 37.68
Tolerance of rating at BNPI (Pmpp / Isc / Voc) [%]	±3/±10/±10	±3/±10/±10	±3/±10/±10	±3/±10/±10	±3/±10/±10
Bi-faciality coefficient	80 ± 5 %	80 ± 5 %	80 ± 5 %	80 ± 5 %	80 ± 5 %
Dimensions (L x W x H) [mm]	2465 x1134x35	2278x1134x3 5	2094 x 1134 x35	1909 x1134x35	1722 x 1134 x 35
Module area [m <sup>2</sup> ]	2.80	2.58	2.37	2.16	1.95
Class (IEC 61730-1:2016)	Class II				
Maximum system voltage [VDC]	1500	1500	1500	1500	1500
Pollution degree	PD 1	PD 1	PD 1	PD1	PD1
Qualified as cemented joint design	No	No	No	No	No
Over-current protection rating [A]	30	30	30	30	30
Defined min. creepage distance [mm]	12.5	12.5	12.5	12.5	12.5
Defined min. clearance distance [mm]	12.5	12.5	12.5	12.5	12.5
Max. operational altitude [masl]	≤2000	≤2000	≤2000	≤2000	≤2000
Design load – downwards [Pa]	3600	3600	3600	3600	3600
Design load – upwards [Pa]	1600	1600	1600	1600	1600
Safety factors for mechanical load	1.5	1.5	1.5	1.5	1.5
Number of solar cells	156	144	132	132	108
Connection of cells (S, SP, PS)	SP	SP	SP	SP	SP
Number of diodes	3	3	3	3	3
Cells per diode	52	48	44	40	36
Temperature Coefficient for V <sub>oc</sub>	-0.216%/ C				
Temperature Coefficient for I <sub>sc</sub>	+0.041%/ C				
Temperature Coefficient for P <sub>max</sub>	-0.291%/ C				

TABLE 10: TECHNICAL SPECIFICATION FOR M10 TOPCON BIFACIAL MODULES

## 8. MAINTENANCE AND CARE

All solar module types described in this manual are designed to operate in outdoor conditions for long periods. However, it is recommended to follow the basic procedures that are described below in order to obtain the best performance from the solar photovoltaic modules.

- Well-designed PV Plant requires minimum maintenance but however with further maintenance the performance and the reliability of the system can be improved.
- To ensure optimal operation, fault detection, and preventive maintenance of a solar PV system, the performance of solar modules must be continuously monitored. This can be achieved through two primary levels of monitoring: Centralized monitoring via SCADA /String Level Monitoring.
- Check that the mounting structures are properly laid and the modules are held tightly and are in accordance with the mounting instructions given in Section 6.
- Ensure all the cable assembly is tight and no part of cable assembly will be exposed to water logging
- Do not open the junction box to change the diodes even if they are defective. Please contact the PV module manufacturer in case of known or suspected diode failure.
- Do not make modifications to any component of the PV module (diode, junction box, connectors or others).
- Regular maintenance is required to keep modules clear of dust, bird droppings, seeds, pollen, leaves, branches, dirt spots and snow.
- Periodically inspect the system to check the integrity of all wiring and supports.
- To protect against electric shock or injury, electrical or mechanical inspections and maintenance should be performed by qualified personnel only.
- Product should be recycled in useful renewable method after end of its life cycle SHPV is recommending the installers to clean the modules as explained in the below procedure.
- When there is a noticeable build-up of soiling deposits on the module surface, wash the PV array with water and a gentle cleaning implement (a sponge, or a non-conductive brush) during the cool part of the day. Dirt must never be scraped or rubbed away when dry, as this will cause micro-scratches.
- Ensure that any brushes or agitating tools are constructed with non-conductive materials to

minimize risk of electric shock and that they are not abrasive to the glass or the aluminium frame.

- The power output from the module is strongly influenced by the transparency of the Cover/front glass. Over a period of time dust could accumulate on the glass and reduce the solar light passing through the glass which in turn reduces the performance of the module. In order to restore the module performance, clean the glass with plain water. In most cases plain water is adequate. However, if there are any hard stains, it could be removed by gently wiping/mopping with soft cotton/sponge.
- Aluminum frames could get discolored due to bird droppings. It is recommended to use mild soap or detergent to clean the Aluminum surface.
- Wear gloves while cleaning, as sharp edges on the Aluminum frame can cause injury.
- While cleaning be careful not to drop any objects on the module surface. The module surface is made of glass and can get damaged easily. A damaged module increases the risk of electrical shock. Any damaged module must be immediately replaced by a new module.
- Periodic inspection of the mounting structure and electrical connections must be carried out, and any loose connections must be corrected immediately.
- Do not touch the surface of module with bare hands.
- Do not walk, stand or sit on the module while cleaning.
- Do not clean the module which has cracked glass or damaged cable.

## **8.1. VISUAL INSPECTION OF MODULE**

Check module cosmetic defects with naked eyes, especially:

- Module glass cracks.
- Corrosion at welding parts of the cell main grid (caused by moisture into the module due to damage of sealing materials during installation or transportation).
- Check whether there are traces of burning mark on the module back sheet.
- Check PV modules if any signs of aging include rodent damage, climate aging, connector's tightness, corrosion and grounding condition.
- Check if any sharp objects are in contact with PV modules' surface.
- Check if there are any obstacles shading the PV modules.
- Check if any loose or damage screws between the modules and mounting system. If so, adjust

and fix in time.

- Check if modules consist of defects like crack, delamination, Burn Mark and Discoloration etc.
- A thermal (infrared) camera can identify hot spots caused by cracked cells, soiling, or failed bypass diodes. It is recommended to perform a thermographic inspection during commissioning and every 2-3 years thereafter.

**Note:** Hot Spot is defined as a temperature differential greater than 30°C within a single PV module when exposed to an irradiance level of 1000 W/m<sup>2</sup>.

## 8.2. INSPECTION OF CONNECTORS AND CABLES

- Check the tightness of the connectors and cables.
- Check if there is any crack or gap of silicone near the junction box.
- Check whether the cable or other components are on top of the module, this may cause hot spot in the module.



*FIGURE 15: IMPROPER PV MODULES MOUNTING AND CONNECTION*

## 8.3. CLEANING INSTRUCTION

- The accumulation of dirt on solar modules is a primary cause of energy loss and decreased system performance.
- The frequency of cleaning is not a fixed schedule but should be determined by the rate of dust accumulation at the installation site. The frequency of cleaning solar modules is dependent on several environmental factors.
- Clean the modules when a noticeable layer of dirt, dust, pollen, bird droppings, or other debris is present. This is critical to ensure your system operates at its maximum efficiency.

- The module must not be covered by grass, animal droppings or other debris, otherwise it can cause decrease in power, hot spots, or combustion.
- It is recommended to inspect modules for cracks, damage cable joints and loose connections before cleaning of the modules. It is also recommended that personnel should wear appropriate Personal Protective Equipment (PPE) during cleaning.
- **Personal Protective Equipment (PPE):** matrix is essential for ensuring the safety of workers during the installation and cleaning of solar modules the recommended PPE for various tasks associated with solar module installation and maintenance is given in the table below.
- The specific PPE required can vary based on the job site risk assessment and local regulations ensure compliance with the latest local safety standards.
- **Cleaning Time:** The recommended time for cleaning modules is during low light conditions when production is lowest. The best time to clean modules is from dusk to dawn when the plant is not in operation and risk of electrical shock is minimum.
- The module should be cleaned when the irradiance is lower than 200 W/m<sup>2</sup>, suggested module cleaning time: In the summer, before 6 AM, and after 7 PM; In the winter before 7 AM, and after 6 PM.

Task	PPE Required
General Installation	Safety helmet, safety glasses, gloves, high-visibility vest, steel-toed boots.
Electrical Work	Insulated gloves, safety glasses, face shield.
Working at Heights	Safety harness, fall arrest system, helmet with chin strap.
Cleaning Modules	Electrically insulating gloves, non-conductive footwear, goggles.

*TABLE 11: LIST OF PPE MATRIX*

- **Type of water:** Reverse osmosis (RO) Water is an ideal option. If RO is not available, rainwater or tap water can be used.
- Tap water must be of low mineral content with total hardness less than 75mg/L. In case mineral content of water used is more than 75mg/L but less than 200mg/L, the water must be squeezed

off to prevent scale build up over module surface. A long handle commercially available 'squeeze' may be used.

- The PH of the water used for cleaning the module should be between 6 to 8.
- **Water Pressure:** Water pressure should not exceed 35 Bar at the nozzle. Use of high-pressure hoses for cleaning may exert excess pressure and damage the modules.
- **Water Temperature:** Temperature of water used for cleaning should be same as module temperature at the time of cleaning (difference should not be greater than 20°C at maximum. Cleaning should be carried out when the modules are cool to avoid thermal shock which can potentially cause cracks on the modules.
- **Removing Stubborn Marks:** To remove stubborn dirt such as birds dropping, dead insects, tar etc., use a soft sponge, micro-fiber cloth or a non-conductive non-abrasive brush. It is recommended to soak the dirt point with water/water jet for some time before using the sponge/brush. Rinse the module subsequently with plenty of water.
- While cleaning rear side of bifacial module, avoid any sharp objects that may cause damage or penetrate the base material other cleaning requirements are same as front side.
- Modules that are mounted flat (0 tilt angle) should be cleaned more often, as they will not self-clean as effectively as modules at a 10 tilt or greater.
- Do not use abrasive cleaners, de-greasers or any unauthorized chemical substance (e.g. oil, lubricant, pesticide, etc.) on the module.
- If grease is present, an environmental friendly cleaning agent may be used with caution.
- Do not use corrosive cleaning solutions containing hydrofluoric acid, alkali, acetone, or industrial alcohol.
- Only substances explicitly approved by SHPV are allowed to be used for cleaning modules.
- Noticeable dirt must be rubbed away by gentle cleaning implement (soft cloth, sponge or brush with soft bristles).
- Snow should be removed using a soft brush.
- While cleaning the dirt on the back sheet avoid any sharp object, which can damage the substrate material and cause a slit.
- **Module Safety Instructions:** Ensure brushes or agitating tools are non-abrasive and are

constructed with non- conductive materials to minimize risk of electric shock.

- However, it is advisable to perform periodic inspection of the modules for damage to glass, Backsheet, frame, junction box or external electrical / loose connections and corrosion by the authorized professional.
- Once a year, or as required as per site conditions, check that growing foliage has not caused module shading. Correct if this condition has occurred.
- Instead of weeding the plant manually by scythe, using professional weeding equipment with protective devices can reduce the probability of stone splashes on the module.
- As required, check that the system voltage and current output (or power output) is consistent with the expected output. Such a check will help to determine if array cleaning is needed, if there are loose or corroded connections, or if there is a component problem.

**Important Note:** All cleaning and maintenance operations are to be done by trained personnel only. If the modules are mounted on high roof or on an area which is at a specific height from the ground level, the people involved in cleaning operations must wear appropriate safety harnesses.

## 9. DISPOSAL AND PRODUCT LIFE CYCLE

- If the modules need to be disposed off, kindly contact the manufacturer, or it can be done in accordance with the local laws for landfills. In either case, customer is requested to intimate the manufacturer.
- Safe disposal of PV Modules suggests de-commissioning of the Modules, such that no harmful materials are released to the environment. At the end of the module's life cycle, the module and the various parts involved during manufacturing could be recycled. If the solar panels are not reused or recycled, there can be a significant wastage of raw materials.
- PV Modules are made of various components, and each component has different properties (seen with respect to hazardous/non-hazardous, recyclable/non-recyclable). Most common recycled components of the PV modules are glass (front cover), aluminium frame, busbar/ribbon and solar cells. Recycling these components do not pose any threat to the surroundings. The Ethylene Vinyl Acetate (EVA) Encapsulant, and Polyvinyl Fluoride Substrate are typically not recoverable, but can be removed through thermal process. Junction boxes can be removed from the module manually. Dispose the module as per E-Waste Local Regulation and policy of that region (i.e. E-Waste

Regulations of the Country 2022) and dispose modules through authorized E-Waste management agencies. Furthermore, few components can be recovered if the modules are defective, broken, or not needed by the customer. Some of these components are also used in electronic products. Therefore, Standard Recycling practices can be followed.

- “Meaning of crossed-out wheeled dustbin: Do not dispose of electrical appliances as unsorted municipal waste, use separate collection facilities. Contact your local government for information regarding the collection systems available. If electrical appliances are disposed of inland fills or dumps, hazardous substances can leak into the groundwater and get into the food chain, damaging your health and well-being. When replacing old appliances with new ones, the retailer is legally obligated to take back your old appliance for disposal at least free of charge.



## 10. WARNING

- While performing any type of electrical maintenance, the system should be isolated / shutdown and maintenance should be performed by well trained professionals. Any failure to follow instructions may results in lethal electric shocks, burns, other injuries and sometimes death. SHPV is not responsible for any type of accident in Power Plants using SHPV Modules.

*(Lors de l'exécution de tout type de maintenance électrique, le système doit être isolé/arrêté et la maintenance doit être effectuée par des professionnels bien formés. Tout non-respect des instructions peut entraîner des décharges électriques mortelles, des brûlures, d'autres blessures et parfois la mort. SHPV n'est responsable de tout type d'accident dans les centrales électriques utilisant des modules SHPV).*

- This documentation includes a statement advising that artificially concentrated sunlight shall not be directed onto the front or back face of the PV module (if not qualified for).

*(Cette documentation comprend une déclaration indiquant que la lumière du soleil artificiellement concentrée ne doit pas être dirigée sur la face avant ou arrière du module PV (s'il n'est pas qualifié pour cela).*



**WARNING**



- **DO NOT CONNECT OR DISCONNECT THE MODULES UNDER LOAD**
- **NEVER STAND OR STEP ON THE MODULES**

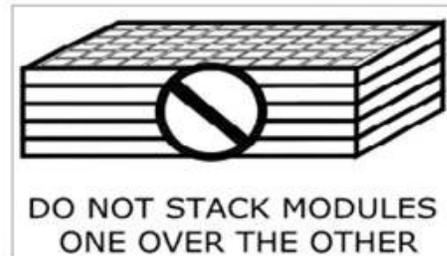
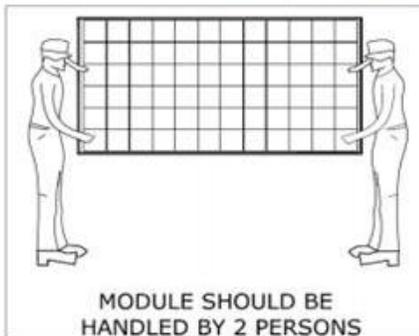


FIGURE 16: PV MODULES WARNINGS

### CONTACT DETAILS

#### **SWELECT HHV SOLAR PHOTOVOLTAICS PVT. LTD.**

NO. 169, 166, SEMBAGOUNDAN PUDUR,  
KUPPEPALAYAM VILLAGE, COIMBATORE,  
COIMBATORE NORTH TALUK, COIMBATORE DISTRICT,  
TAMIL NADU-641107.

Follow Us:



Installation Manual



E-mail: [info@swelectes.com](mailto:info@swelectes.com); Web: [www.swelectes.com](http://www.swelectes.com)