

## INSTALLATION MANUAL

### 1. Introduction

This manual contains information regarding the safe installation and handling of photovoltaic (PV) modules produced by AREPL. All the instructions given in this manual should be read carefully and understood before attempting to install the modules. If there are any questions, please contact us for further explanation.



The instructions and requirements of this manual refer to the following crystalline modules manufactured by AREPL.

#### **Polycrystalline and Monocrystalline:**

AREPL Modules DHOOP Series ranging from 250W to 370W

#### **1.1 Product identification**

**1.2** Each module can be identified by means of the following embedded information:

#### **Nameplate:**

It is located on the reverse side of the module. According to IEC 61215 and IEC 61730 directives it gives information about the main parameters of the module: Product Type, Maximum Power, Current at Maximum Power, Voltage at Maximum power, Open Circuit Voltage, Short Circuit Current, all as measured under Standard Test Conditions, weight, dimensions, Maximum System Voltage, etc.

#### **Serial number:**

Each individual module is identified by a unique serial number accompanied with a barcode. They are permanently inserted inside the laminate, under the front glass of the module, visible when viewed from the front of the module. There is only one unique serial number accompanied with one barcode on the module.

#### **1.3 Quality and Safety Standards**

AREPL photovoltaic modules meet all the requirements of the following official Standards in terms of Quality and Safety:

- IEC 61215: design qualification and type approval
- IEC 61730-1 and 2: photovoltaic module safety qualification
- ISO 9001: Quality management system for manufacture and sales of Photovoltaic Modules

- ISO 14001: Environmental friendly manufacturing practices
- ISO 18001 : OHSAS

#### **1.4 Limited warranty**

The warranty conditions applied to the module by AREPLare described in the document: “Limited Warranty for PV Modules” –the current version is available on our website at [www.agrawalrenewableenergy.com](http://www.agrawalrenewableenergy.com). Ignoring the instructions in this manual may give AREPLcause to invalidate the warranty where negligence can be proven(improper installation or use). Please contact us for any question about warranties.

Beyond the obligatory requirements imposed by AREPLfor installation and use of the modules covered by AREPLlimited Warranty, this manual carries out a series of recommendations in order to facilitate, optimize or increase security and effectiveness of themodule installation. In these cases in which AREPLis giving just suggestions and not specific obligations, different technical choices bythe installer may not cause the withdrawal of the warranty.

## **2. Safety**

AREPLPV modules have passed all the required safety tests according to the IEC EN 61730 Directive with Application Class Aand they are certified as Safety Class II.

### **2.1 General Safety**

- All PV modules should be installed according to all local and national applicable standards, codes andregulations.
- Installation should be performed only by qualified persons. Installers should assume the risk of all injury that might occur during installation including, without limitation, the risk of electric shock.
- All safety precautions specified even for the other components of the system should be checked andfollowed.
- Rooftop installations should be placed over fire resistant roof coverings only.
- Do not attempt to disassemble the modules, and do not remove any attached nameplates or components from the modules.
- Do not apply paint or adhesive to module top surface.
- Do not use mirrors or other magnifiers to artificially concentrate sunlight on the modules. Do not expose back sheet foilsdirectly to sunlight.



## 2.2 Handling Safety

- Do not exceed the maximum height of pallets stacked on top of each other. Maximum height is 2 pallets. Standard packaging for shipment in 40 ft. High-Cube Containers



- Do not damage or scratch the PV module surfaces.
- Do not use the junction boxes and the cables as a grip.
- Do not stand or step on module.
- Do not drop module or allow objects to fall on module.
- To avoid glass breakage, do not place any heavy objects on the module.
- Do not set the module down hard on any surface.
- Inappropriate transport and installation may break modules.

## 2.3 Installation Safety



- Installing solar PV systems requires specialized skills and knowledge.
- One individual module may generate DC voltages greater than 30 V when exposed to light of any intensity. Contact with a DC voltage of 30 V or more is potentially hazardous.
- To avoid electrical arcing, do not disconnect modules under load. Keep connectors dry and clean.
- PV modules will generate electricity whilst exposed to light. Generation will only stop when the PV module is either removed from light or covered with a dark opaque material. When working with modules without any cover, regard the safety regulations for live electrical equipment.
- Do not wear metallic rings, watchbands, ear, nose, lip rings or other metallic devices while installing or troubleshooting PV systems in order to avoid risk of electric shock.
- Use only insulated tools that are approved for working on electrical installations. Abide with the safety regulations for all other components used in the PV system, including wiring and cables, connectors, charging regulators, inverters, storage batteries and rechargeable batteries, etc.
- Use only equipment, connectors, wiring and support frames suitable for a solar electric system. Always use the same type of module within a particular PV system.
- Do not attempt to repair any part of the PV module.

### 3. Installation

#### 3.1 Design considerations

To maximize efficiency, PV modules should be installed in a location where they will receive the maximum amount of sunlight throughout the year. In the Northern Hemisphere modules should face the South, while in the Southern Hemisphere modules should face the North. Therefore, modules facing more than 30 degrees away from true South (or North) could lose approximately 10% to 30% of their power output (depending on the latitude of the installation site: the higher the latitude, the higher the loss).

It is recommended that where PV modules are connected in series they should be installed at same orientation and tilt angle.

Different orientations or angles may cause a loss of power output due to the change in sunlight exposure.

While designing the final layout of the modules in the PV system (on the ground or on the roof), we recommend the designer to keep suitable access space to allow easy maintenance and inspection works.

Ensure that AREPL PV modules are installed and stored in the following conditions:

- Operating ambient temperature: from -40°C to +85°C
- Storage temperature: from -40°C to +60°C
- Humidity: below 85 RH%



Provide adequate ventilation under a module for cooling. AREPL recommends 10 cm minimum air space between Module and mounting surface. AREPL recommends that PV modules are mounted at a minimum tilt angle of 10° with respect to the horizon, in order to facilitate the self-cleaning of their front glass from dirt during

ordinary raining. AREPL modules should not be mounted in mobile applications (except solar trackers) or in locations where aggressive substances such as salt or salt-water (beyond the prescriptions at paragraph 3.4) or any other type of corrosive agent could affect the performance and/or safety of the PV modules.

### **3.2 Mechanical installation**

Use always structures and materials specifically developed and certified for PV modules installation.

The minimum distance between two fixed modules for linear thermal expansion of the module frames should be 5 mm. Nevertheless, the recommended distance between two modules is 20 mm to allow wind circulation, in order to reduce pressure loads and improve module ventilation. The PV module should not be mounted in such a way that the drain holes of the module can become blocked.

AREPLPV modules are suitable for mechanical mounting both in portrait and landscape orientation. In choosing the orientation, please keep in mind the internal PV module by-pass diode configuration to ensure the optimum electrical behavior from any potential shading over the modules.

Galvanic corrosion can occur between the aluminum frame of the PV module and the mounting hardware if such hardware is composed of dissimilar metals, especially in harsh environments such as high humidity. In these cases, to prevent corrosion, neoprene tape, PVC washers or stainless steel washers should be placed between the PV module frame and the support structure.

Additionally, all module support structures used to support PV modules at correct tilt angles should be wind and snow load rated by appropriate local and civil Directives prior to installation.

**NOTICE:** Do not disassemble the PV module and do not remove, drill or modify the frame in any way, as this will invalidate the warranty. Please contact us if module mounting procedure is not clear.

#### **3.2.1. Installation using the frame mounting holes**

Modules must be securely fixed to the mounting structure using the four pre-drilled mounting holes (12 x 9 mm) for 60 cells modules and (14 X 9) for 72 cells modules placed in the long frame rails at 400 mm from the top and bottom frames. Use M8 stainless steel hardware, spring washers and flat washers with a torque of approximately 10 newton meter [Nm] for normal installation. Galvanized or hot dipped zinc plated hardware is also acceptable.

### 3.2.2. Installation using pressure clamps

Installation using pressure clamps may be executed along both sides of the module. The obligatory position of the clips along the frame depends on which side of the module is used for the installation as follows:

- Fixing on the long side: The clamps must be mounted along the frame at the position of the mounting hole, with a tolerance of 10% of the module total length to the edge of the frame.
- Fixing on the short side: The clamps must be mounted along the frame at the edges of the module, with a tolerance of 25% of the module total width to the middle of the frame.

**Note that on both sides of the module the pressure clamps always should be mounted in a symmetric position with respect to the center line for a proper load distribution.**



Clamps must be installed according to the manufacturer's specific instructions. Do not apply excessive pressure on the frame such that the frame deforms. AREPL recommends a torque of approximately 10 newton meter [Nm], but refer to the clamp manufacturer for specific hardware and torque requirements.

The clamps should have contact only with the module frame and, to avoid shadowing effects and possible damage, should not overlap onto or over the module glass.

Do not install the modules with pressure clamps mounted out of the specified areas, otherwise the module mechanical resistance may be affected.

### 3.2.3. Insertion systems

Insertion systems on the short sides of the module may be used with a limitation on the maximum load resistance of 2400 Pa. Insertion systems on the long side of the module are not affected by any limitation and may be used with a maximum of 5400 Pa for snow load.

When using insertion systems where the modules are installed sliding through the inner side of the rails, AREPL recommends the use of PVC frame protectors in order to prevent damage to the anodized surface of the frame.



### **3.2.4. Module load resistance**

Wind Load: 2400 Pa

Snow Load: 5400 Pa

According to IEC 61215 Directive, 2400 Pa corresponds to a wind pressure of 130 km/h (approximately +/-800 Pa) with a safety factor of 3 for gusty winds.

### **3.3 Electrical installation**

Modules electrically connected together in a series/parallel configuration generate DC electrical energy which may be converted to AC by means of a solar inverter. The resulting PV system may be therefore connected to the local utility grid system. As local utilities' policies and technical rules on connecting a renewable energy system to their power grids vary from region to region, consult a qualified system designer or integrator to design such a system to comply with the Directives. Permits are normally required for installing a PV system and the utility will formally approve and inspect the system before its connection to the grid can be accepted.

The PV system electrical installation should be executed in accordance with the respective National Electrical Code or applicable National Regulations.

Use only insulated tools that are approved for working on electrical installations. Abide by the safety regulations for all the components used in the system, including wiring and cables, connectors, charge regulators, inverters, storage batteries etc.

#### **3.3.1. General considerations**

Modules are fitted with two pre-assembled sunlight resistant cable leads, which are terminated with PV fast connectors. The positive(+) terminal has a female connector while the negative (-) terminal has a male connector. These cable leads and connectors must not be removed or cut off.

Several modules are connected in series and then in parallel to form a PV array, especially for applications with high operating voltage. When modules are connected in series, the total voltage of the resulting string is the sum of the individual voltages of the modules. Do not use different types of modules in the same circuit as this will cause mismatch, power loss and/or damage to the PV system.

When selecting the size of the cables that connect the module strings to the solar inverter, it is recommended to refer to the nameplate electrical parameters of the related module type.

For electrical design considerations, the values given in the module label or datasheet of the related model type should be multiplied by a factor of 1.25 for Short Circuit Current (Isc) and 1.10 for Open Circuit Voltage (Voc), when determining component voltage ratings, conductor current ratings, fuse sizes and the rest of electrical hardware connected to the module strings.

Nevertheless, consult rated local wiring regulations to determine system wire size, type, and temperature allowed for your installation.

### **3.3.2. Bypass diodes**

When a module is connected in series with other modules, partial shading can cause a reverse voltage across the shaded area of the module. The current generated is therefore forced through the shaded area by the other modules.

When a bypass diode is wired in parallel with the PV cell strings, such a forced current will flow through the diode and bypass the current generated by the non-shaded cells, thereby minimizing module heating, current losses, and damage to the module.

AREPLPV modules are fitted with internal bypass diodes wired inside the junction box to reduce the effects of partial shadings. Do not open the junction box to change the diodes even if they are defective. This should be done only by qualified personnel.

### **3.3.3. PV System Grounding**

AREPL modules are certified for Class A applications, Safety Class II, 1000Vdc Maximum System Voltage. Refer to respective National Electrical Code requirements and standards for safety-related grounding of racking system and/or module frames.

When executing the grounding of the module frames, AREPL recommends taking into account the following considerations:

- The long frame rails are equipped with pre-drilled grounding holes in their centre. These holes should be used only for grounding purposes and not for mounting purposes.
- Proper grounding is achieved by connecting the module frame(s) and structural members contiguously using a suitable grounding conductor. The grounding wire should be properly fastened to the module frame to assure good electrical contact. Use copper, copper alloy or any other conductive material accepted by the applicable National Electrical Regulation.



- Make electrical contact by penetrating the anodized coating of the aluminum frame. To break the anodized layer, AREPL suggests a stainless steel toothed washer to be inserted between the nut and the frame.
- When carrying out the grounding of the modules, the aluminum frame must not be in permanent direct contact with dissimilar Metals, this could result in a galvanic corrosion. Stainless steel flat washers may be inserted between frame and grounding lug.
- AREPL recommends the use of stainless steel grounding bolts or grounding lugs specifically designed for PV applications.

#### **4. Commissioning and maintenance**

Test all electrical and electronic components of the system before using it. Follow the instructions in the manuals supplied with the components and equipment. Commission and Maintenance works should only be performed by specialized and properly trained personnel.

##### **4.1 Commissioning**

Check the OpenCircuit Voltage of every string of modules connected in series with a digital multimeter. The measured overall values should correspond to the sum of the OpenCircuit Voltage of the individual modules.

Be aware that the measured overall voltage can be lower than expected, due to the normal decrease of OpenCircuit Voltage of the individual modules, caused by the temperature rising of solar cells or low irradiance. The rated voltage at STC will be found in the nameplate or technical datasheet of the module type used in the PV system.

In any case, the measured overall voltage should be never below 20% of the estimated one. Excessively low voltage is typically caused by improper connections at the terminals or defective bypass diodes. Please contact us if the problem cannot be resolved.

Once the commissioning has been executed, check the operating current through every series of the PV installation. It can be measured directly by a DC clamp meter. All measurements should be in the same value range, but they may vary from the maximum current measured at STC specified in the datasheet. The measured values are dependent on the solar inverter, but they should be proportional to the solar irradiance present at the moment.

## 4.2 Maintenance

AREPL recommends the following maintenance in order to ensure optimum performance of the module:

- Check the electrical and mechanical connections every six months to verify that they are clean, secure and undamaged;
- Check that mounting hardware, terminal screws and grounding components are tightly secured with no corrosion;
- Check that modules are not shaded by vegetation or any unwanted obstacles;
- Do not touch live parts of cables and connectors;
- Use appropriate safety equipment (insulated tools, insulating gloves, etc.) when handling modules;
- If any problem with the system or individual module arises, have them investigated by a competent specialist;
- Replacement modules must be the same type of those to be replaced;
- Modules generate high voltage when exposed to sunlight. Please cover the front surface of modules with an opaque non scratch material when repairing. Repairing works must be performed by specialized and properly trained personnel only;

**NOTICE: Follow the maintenance instructions for all components used in the system, such as support frames, charge regulators, inverters, batteries etc.**

### 4.2.1. Cleaning

Dirt and dust can accumulate on the glass surface of the PV module over time, particularly in low inclination installations. This can cause a general decrease of power output and also sedimentation on the lower edge of the modules due to dirt accumulation. AREPL recommends periodic cleaning of PV modules to ensure maximum power output, especially in regions with high quantity of dust in the air or low precipitations, as follows:

- Under most weather conditions, normal rainfall is enough to keep the PV module glass surface clean. Clean the glass surface of the module as necessary and consider that lower inclination requires more cleaning frequency;
- Always use water and a soft sponge or cloth for cleaning. A mild, non-abrasive cleaning agent can be used to remove stubborn dirt. High mineral content water is not recommended, as it may leave residual deposits on the module;
- AREPL modules may be equipped with anti-reflective coated glass. This technology provides AREPL modules with high transmittance and low reflectivity features, which

improves the module power output, reduces the dust and dirt deposition and produces verylow glare. To avoid any damage to this layer do not clean the modules with high pressure washers, steam or corrosive chemicals. Do not use abrasive sponges or aggressive tools that could scratch the module surface;

- To avoid a possible thermal shock clean the modules during early morning, when the module is still cold. This is speciallyrecommended in regions with hotter temperatures;
- In cold environments with snow do not try to remove the frozen snow or ice from the module scratching on the front glass.

Only soft snow can be removed gently with a soft brush in order to improve the production;

- Do not clean modules having broken glass or exposed wiring. This could cause a general electrical failure of the module and/orelectrical shock hazard.

#### **Disclaimer of liability**

The use of this manual and the conditions or methods of installation, operation, utilization and maintenance of PV product are beyond AREPL control. Therefore, AREPL will not accept any responsibility and expressly denies any liability damage, or expense arising out of or in any way connected with such installation, operation, utilization or maintenance.

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