



# INSTALLATION MANUAL

ENGLISH | Version 01 - 2012

## 1. Introduction

This manual contains information regarding the safe installation and handling of photovoltaic (PV) modules produced by Jiangxi LDK Solar Hi-Tech Co., Ltd. ("LDK Solar"). 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 LDK Solar Customer Engineering Service (CES) for further explanation. The instructions and requirements of this manual refer to the following crystalline modules manufactured by LDK Solar:

### Monocrystalline:

- LDK-xxxD-24(s) Family - from LDK-180D-24(s) to LDK-210D-24(s)
- LDK-xxxD-20 Family - from LDK-220D-20 to LDK-260D-20

### Polycrystalline:

- LDK-xxxP-24(s) Family - from LDK-160P-24(s) to LDK-200P-24(s)
- LDK-xxxP-20 Family - from LDK-210P-20 to LDK-250P-20
- LDK-xxxP-24 Family - from LDK-260P-24 to LDK-290P-24

### 1.1 Disclaimer of liability

The use of this manual and the conditions or methods of installation, operation, utilization and maintenance of PV product are beyond LDK Solar's control. Therefore, LDK Solar will not accept any responsibility and expressly denies any liability for loss, damage, or expense arising out of or in any way connected with such installation, operation, utilization or maintenance. No responsibility will be assumed by LDK Solar for any infringement of patents or other rights of third parties, which may result from use of the PV module. No license is granted by implication or otherwise under any patent or patent rights. The information in this manual is based on LDK Solar's knowledge and experience and it is believed to be reliable. Nevertheless, such information including product specification (without limitations) and suggestions do not constitute a warranty, expressed or implied. LDK Solar reserves the right to change the manual, the PV module, the specifications, or product information sheets without prior notice.

### 1.2 Product identification

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 EN 50380 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.

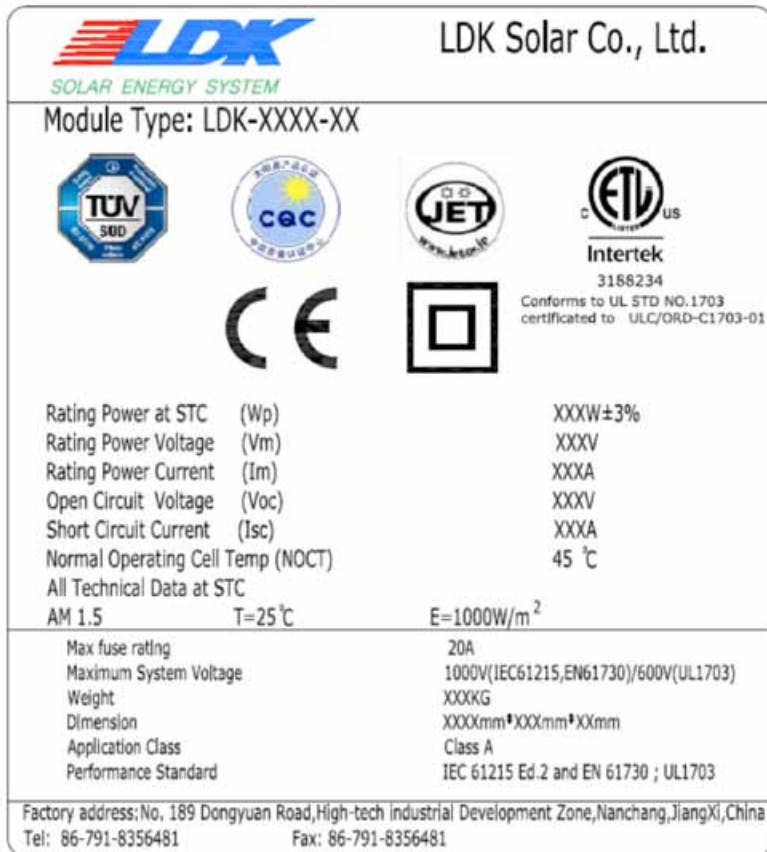


Figure 1: Example of a LDK module nameplate label

### 1.3 Quality and Safety Standards

LDK Solar 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
- UL1703 2002/03/15 Ed.3 Rev. 08/04/2008
- CEC Listed: modules are eligible for California rebates
- MCS: the Microgeneration Certification Scheme UK
- Canadian Standard for safety flat-plate Photovoltaic modules and panels
- PV CYCLE: voluntary module take back and recycling program
- ISO 9001: quality management system for manufacture and sales of Photovoltaic Modules

### 1.4 Limited warranty

The warranty conditions applied to the module by LDK Solar are described in the document: “Limited Warranty for PV Modules” – the current version is available on our website and takes precedence.

Ignoring the instructions in this manual may give LDK Solar cause to invalidate the warranty where negligence can be proven (improper installation or use). Please contact the Customer Engineering Service for any question about warranties.

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

## 2. Safety

LDK Solar PV modules have passed all the required safety tests according to the IEC EN 61730 Directive with Application Class A and they are certified as Safety Class II devices according to the IEC EN 61140 Directives. Fire safety has been rated as Class C, meeting all the requirements to be mounted on rooftops.

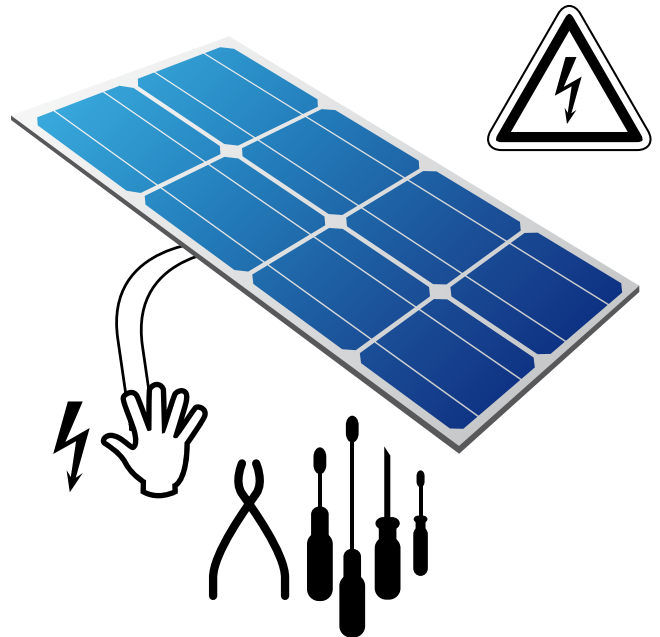
### 2.1 General Safety

- All PV modules should be installed according to all local and national applicable standards, codes and regulations.
- 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 and followed.
- 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 foils directly 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 maximise 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 LDK Solar 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%

When installing a module on a roof or building, ensure that it is securely fastened and prevented from falling as a consequence of wind, snow or other mechanical loads.

Provide adequate ventilation under a module for cooling. LDK Solar recommends 10 cm minimum air space between module and mounting surface.

LDK Solar 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.

LDK Solar 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.

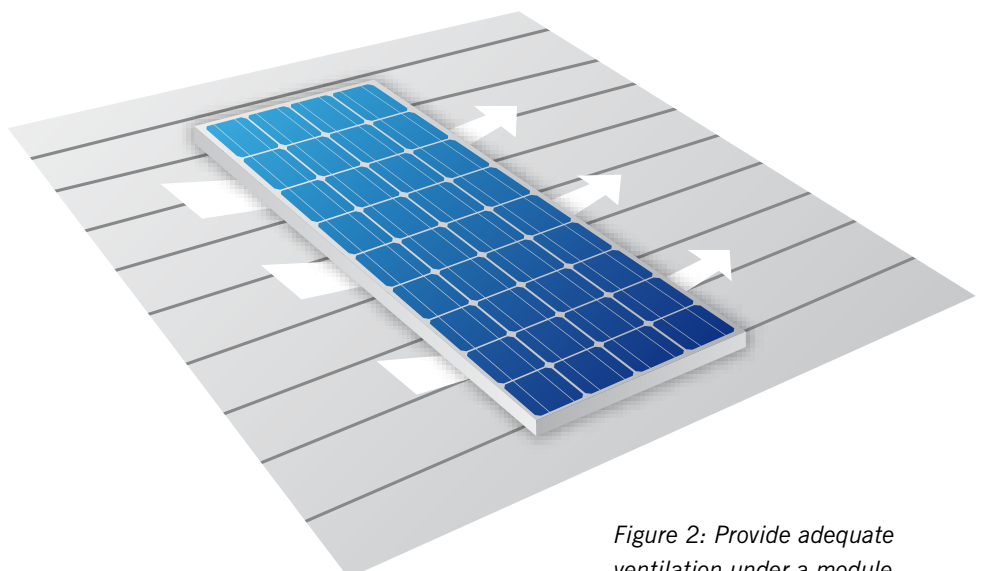


Figure 2: Provide adequate ventilation under a module

## 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.

LDK Solar PV 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 behaviour 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 the LDK Technical Service 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 (14 x 9 mm) placed in the long frame rails at 400 mm from the middle. Use M8 stainless steel hardware, spring washers and flat washers with a torque of approximately 10 newton metre [Nm] for normal installation. Galvanized or hot dipped zinc plated hardware is also acceptable.

Please refer to the drawings in Annex 1 for more information about the proper use of mounting holes and load resistance of all module types.

LDK Solar recommends the use of all eight mounting holes if excessive wind or snow loads are expected to affect the PV installation.



Figure 3: Frame holes mounting

### 3.2.2. Installation using pressure clamps

Installation using pressure clamps may be executed along both sides of the module frame according to instructions in Annex 1. 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. Refer to the drawings in Annex 1.**

Clamps must be installed according to the manufacturer's specific instructions. Do not apply excessive pressure on the frame such that the frame deforms. LDK Solar recommends a torque of approximately 10 newton metre [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.



Figure 4: Mounting clamps

### 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. See Annex 1 for more information.



Figure 5: Insertion system

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

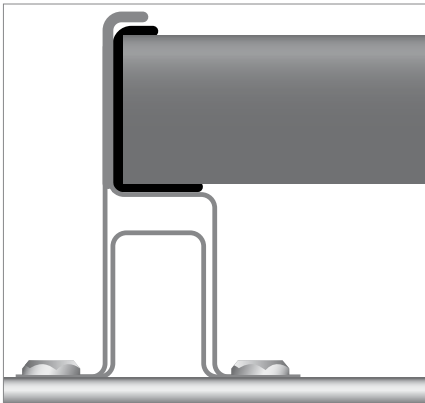


Figure 6: Frame protector

### 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.

**Note:** the information provided above could vary according to the mounting system and configuration as described in the Annex 1.



### 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.

LDK Solar PV 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.

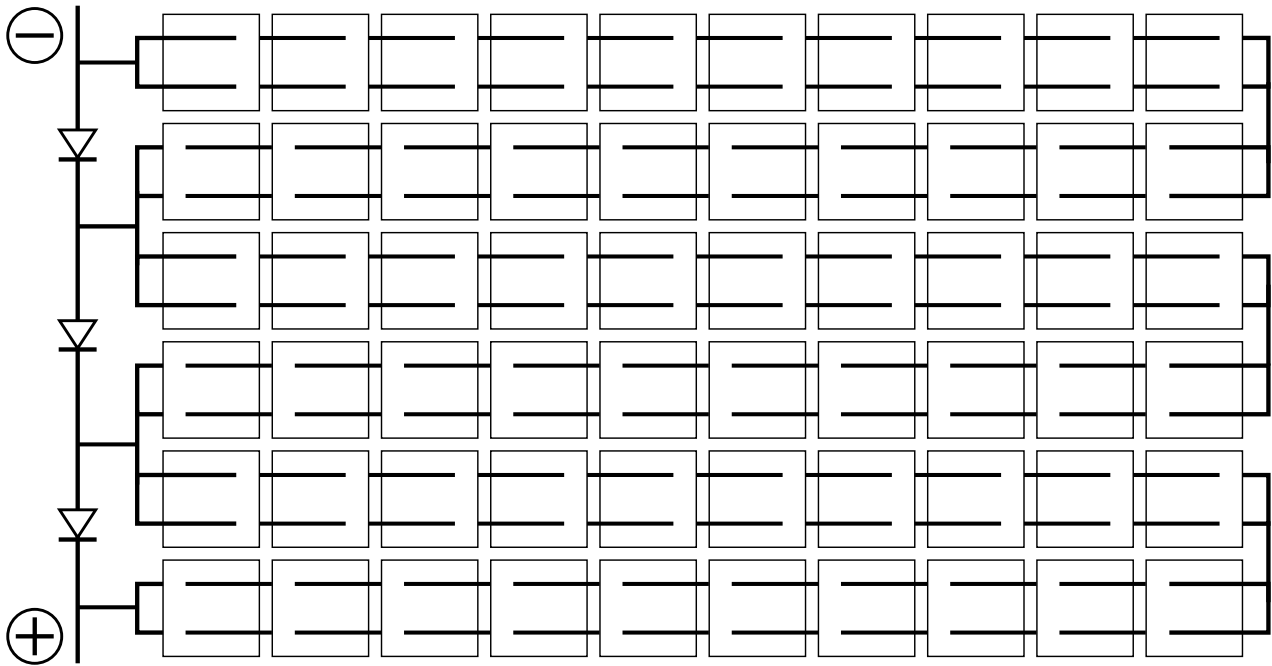


Figure 7: Bypass diodes and cells electrical circuit

### 3.3.3. PV System Grounding

LDK 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, LDK 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 aluminium frame. To break the anodized layer, LDK Solar suggests a stainless steel toothed washer to be inserted between the nut and the frame.
- When carrying out the grounding of the modules, the aluminium 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.
- LDK Solar recommends the use of stainless steel grounding bolts or grounding lugs specifically designed for PV applications.

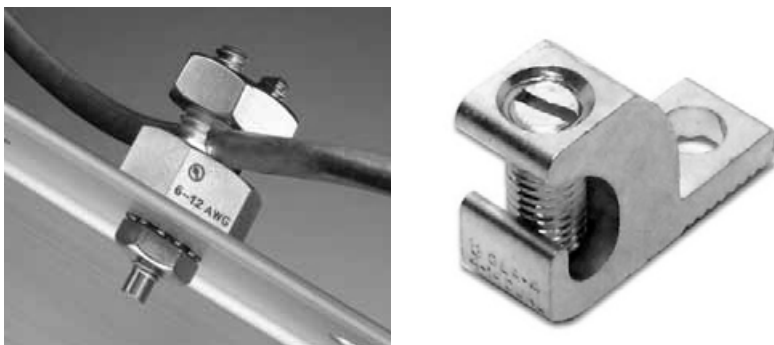


Figure 8: Grounding steel bolts

### 3.4 Saline environments

It is known that saline environments can accelerate the processes of electrical insulation losses and galvanic corrosion, especially when different metals with high electrochemical potential come into contact with each other. LDK Solar modules have passed the IEC 61701 salt-mist corrosion test with a severity level 5 according to IEC 60068-2-52 and therefore are suitable to be installed near marine environments under the following conditions:

- Modules must not be installed in direct contact with salt water, for example in offshore (e.g. platforms) and marine (e.g. piers, boats) applications;
- Modules installed in locations where the distance from salt water is below 500 m must fulfill the following requirements:
  - The modules must be mounted with a minimum tilt angle of 10° with respect to the horizon, to facilitate the self-cleaning of the salt residue from the module surface through naturally occurring rainfall;
  - When the modules are fixed using the 4 mounting slots, all the hardware (washers, screws and nuts) must be made of stainless steel;
  - To avoid possible galvanic corrosion between the aluminium frame and the support structure, PVC washers or neoprene tape must be inserted between the two metals;
  - When executing the grounding of module frames, stainless steel hardware must be used.

## 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.

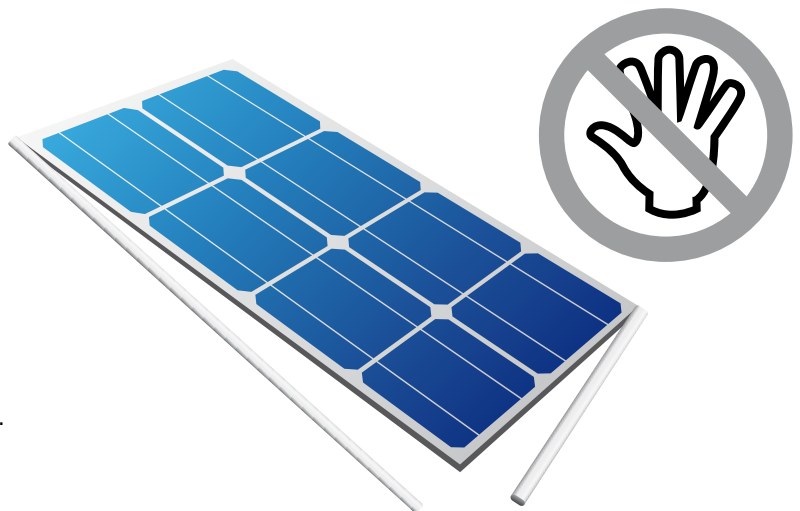
### 4.1 Commissioning

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 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 the LDK Solar Technical Service 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

LDK Solar 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. LDK Solar 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;
- LDK modules may be equipped with anti-reflective coated glass. This technology provides LDK modules with high transmittance and low reflectivity features, which improves the module power output, reduces the dust and dirt deposition and produces very low 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 specially recommended 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/or electrical shock hazard.

## 5. Module end-of-life

LDK Solar is a member of the PV CYCLE Association, a European non-for-profit association managing a fully operational collection and recycling scheme for end-of-life PV modules throughout Europe. LDK Solar membership in the Association guarantees that after the life span of the installation, all modules at their end-of-life (when they become waste) will be collected and recycled by a specialized authorized PV CYCLE operator. This ensures that the whole PV value-chain is environmentally friendly. PV CYCLE already meets the major requirements of the recast WEEE Directive and is currently working on making its collection and recycling services fully compliant. All the collecting and recycling services provided by PVCYCLE are free of charge for final users (except the costs for dismounting the modules).

**Please visit PV CYCLE web site for further information: <http://www.pvcycle.org/>**

### 6. Module specifications

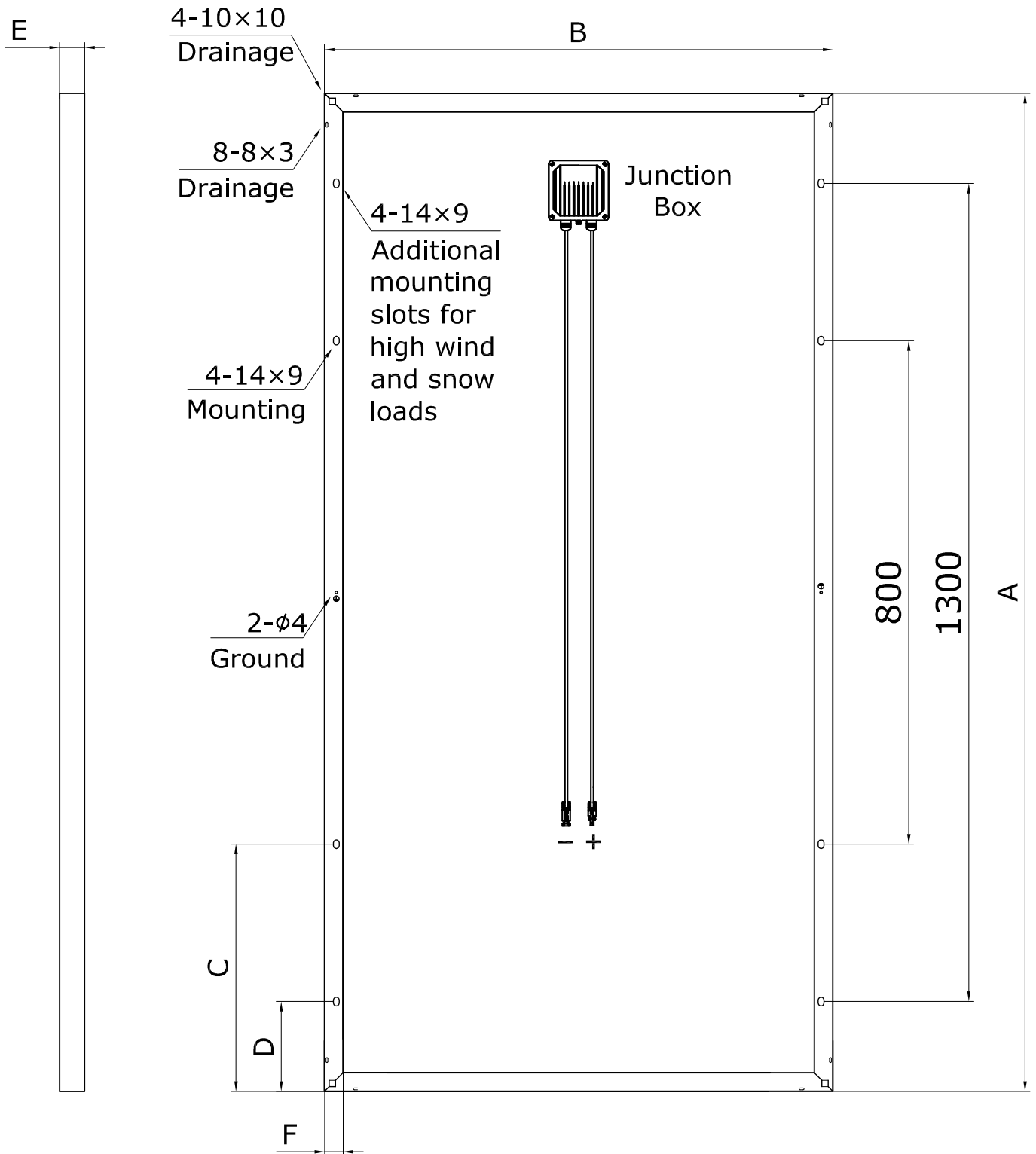


Figure 9: LDK module dimensions

**MODULE DIMENSIONS SUMMARY TABLE**

	LDK 180/210 D-24 (s)	LDK 160/200 P-24 (s)	LDK 220/260 D-20	LDK 210/250 P-20	LDK 260/290 P-24
<b>A</b>	1580	1580	1642	1642	1958
<b>B</b>	808	808	994	994	994
<b>C</b>	390	390	421	421	579
<b>D</b>	140	140	171	171	329
<b>E</b>	40	40	40	40	50
<b>F</b>	30	30	30	30	40
<b>Cable length [mm]</b>	950	950	1000	1000	1200
<b>Weight [kg]</b>	15.6	15.6	20	20	30.5
<b>Cell type</b>	Mono 125	Poly 125	Mono 156	Poly156	Poly156
<b>Number of Cells</b>	72	72	60	60	72
<b>Connectors</b>	MC4 or compatible				
<b>Max fuse rating</b>	20 A				

## 7. Technical Service Contact

### LDK Solar Hi-Tech (Nanchang) Co., Ltd

No. 999 Torch Boulevard,  
Nanchang, Jiangxi, 330096, China  
Tel: +86 791 8105313  
Fax: +86 791 8108260  
Email: [service@ldksolar.com](mailto:service@ldksolar.com)

### Europe:

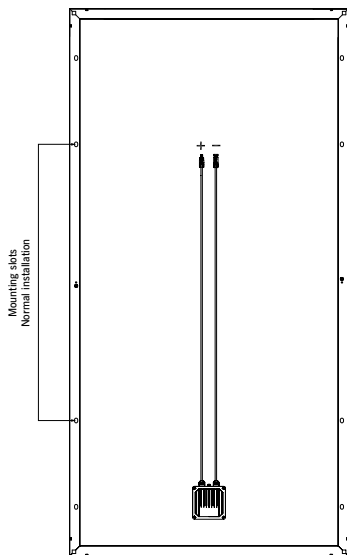
#### LDK Solar Tech, Europe, GmbH

Forsterstr. 70  
8044 Zurich, Switzerland  
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**ANNEX 1: MODULE INSTALLATION & LOAD GUIDE**

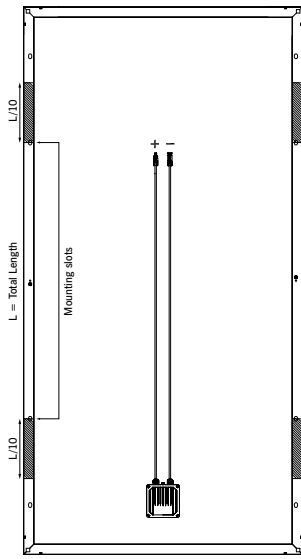
**System 1: Installation with mounting holes**



<b>All module types</b>
Snow load: 5400 Pa - Wind load : 2400 Pa
Normal Installation

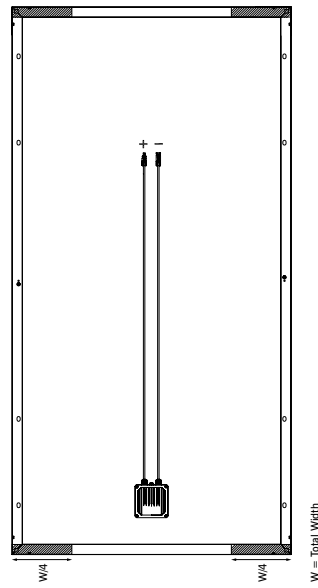
**System 2: Installation with pressure clips**

A – Clip System on large side:



<b>All module types</b>
Snow load: 5400 Pa - Wind load : 2400 Pa
Installation according to drawing specification

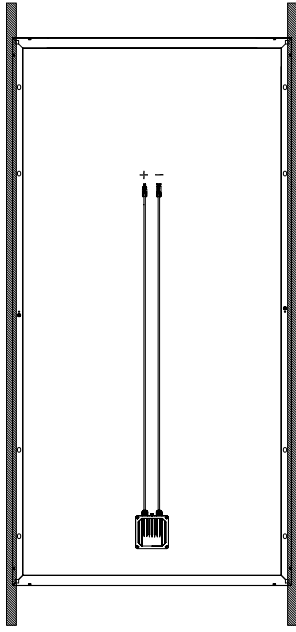
B – Clip System on short side:



<b>All module types</b>
Snow load: 2400 Pa - Wind load : 2400 Pa
Pressure clips on short side
Not allowed for 5400 Pa

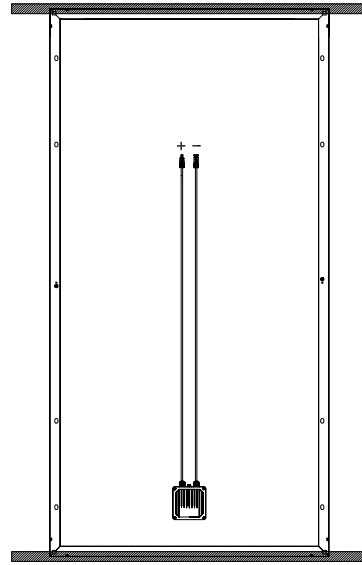
**System 3: Insertion Systems**

A – Insertion System on large side:



<b>All module types</b>
Snow load: 5400 Pa - Wind load : 2400 Pa
Insertion System on large side

B – Insertion System on short side:



<b>All module types</b>
Snow load: 2400 Pa - Wind load : 2400 Pa
Insertion System on short side
Not allowed for 5400 Pa

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