



LDK SOLAR

Module Installation Manual

According to IEC Standards



Photo Courtesy: LDK Solar Power Tech./ Location: Xinyu, China/ System Size: 2MW/ LDK factory rooftop application

SCALE, QUALITY, TECHNOLOGY and COST-COMPETITIVE

LDK Solar is one of the leading, fastest growing mono and poly crystalline module manufacturer and supplier in the world with 600MW today and 1.5GW module capacity at the end of 2010. At LDK Solar, we produce high-quality, high-efficiency and one of the most price-competitive modules to help our global customers achieve grid parity.

Who we are

Established only in 2005 in China (NYSE:LDK), LDK Solar is one of the leading, fast growing, vertically integrated manufacturer and supplier of Photovoltaic (PV) products in the world. Today, LDK Solar has more than 15,000 employees worldwide with manufacturing facilities in China and sales, marketing, and customer services offices in Asia, Europe and North America. We provide mono and poly crystalline wafers and modules to our customers worldwide.

Our Mission

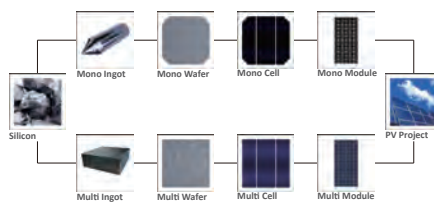
At LDK, our mission is to be recognized as the PV brand and preferred partner in the solar energy industry. To achieve this important mission, we focus on large scale, cost-effective manufacturing to provide price-competitive, high-quality, high-efficiency and environmentally friendly PV products to our customers worldwide. We are helping our customers to achieve grid parity and make solar energy affordable and accessible for everyone.

Our Business Model

There are only a few companies in the industry that have the ability to cover the entire PV value chain. LDK has successfully developed into a leader in the solar energy industry based on its strong vertically integrated business model; producing its own high-purity solar & semiconductor grade polysilicon,

mono and poly crystalline ingots, wafers, cells and modules in-house in China. Manufacturing of these products under one roof ensures that we can tightly control our materials and production quality, offering customers leading product durability and sustainable performance to come.

LDK Solar PV Value Chain



Vertically Integrated Photovoltaic Value Chain

LDK Solar Modules

At LDK Solar, we produce high-quality and high-efficiency mono and poly crystalline solar modules. Our monocrystalline series of modules range from 160Watt to 250Watt in power output and polycrystalline series of modules range from 160Watt to 280Watt. Our solar modules are clean, environmentally friendly and built to our customers' and end-users' specifications. Adapting our product range to meet market demands allows us to provide our customers with a broad range of on grid and off grid solutions for residential, commercial and industrial to utility scale applications around the world.

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About LDK Solar

Who we are

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Module Overview

LDK Solar Photovoltaic modules consist of a series of electrically interconnected crystalline silicon solar cells, which are permanently encapsulated between a tempered glass superstrate and substrate. The entire laminate is secured within an anodized aluminium frame for structural strength; easy of installation and to protect the cells from the most severe environmental conditions.

The following document refers to the following crystalline modules manufactured by LDK Solar;

Monocrystalline Modules:

LDK-160D-24 to LDK-190D-24
LDK-200D-20 to LDK-240D-20

Polycrystalline Modules:

LDK-160P-24 to LDK-180P-24
LDK-180P-18 to LDK-220P-18
LDK-200P-20 to LDK-240P-20
LDK-240P-24 to LDK-280P-24

Application Overview

LDK Solar modules are high-quality and high-efficiency, virtually maintenance-free, direct current (DC) power source, designed to operate most efficiently in sunlight. LDK Solar modules are ideal for residential, commercial, industrial, PV parks and designed to meet many other customer needs.

Introduction

Purpose of the Manual

The purpose of LDK Solar Photovoltaic modules manual contains information regarding the installation and safe handling of LDK Solar Co. Ltd photovoltaics module (hereafter is referred to as "module"). LDK Solar Co. Ltd hereafter is referred to as "LDK". All instructions must be read and clearly understood by the certified installer before the installation. If there are any questions, please contact LDK Solar customer technical service department for further instruction and explanation.

Installer should conform to all safety precautions in the guide and local codes when installing solar modules. In addition, before installing the system, contact local authorities to determine the necessary permitting, installation and inspection requirements. Keep this manual in a safe place for further reference (care and maintenance) and in case of sale or disposal of the modules.

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Disclaimer of Liability

Because the use of this manual and the conditions or methods of installation, operation, use and maintenance of photovoltaic (PV) product are beyond LDK Solar's control, LDK Solar does not accept responsibility and expressly disclaims liability for loss, damage, or expense arising out of or in any way connected with such installation, operation, use or maintenance.

No responsibility is assumed by LDK Solar for any infringement of patents or other rights of third parties, which may result from use of the PV product. 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 is believed to be reliable; but such information including product specification (without limitations) and suggestions do not constitute a warranty, express or implied. LDK Solar reserves the right to change the manual, the PV product, the specifications, or product information sheets without prior notice.

Product identification

Each module has labels on its rear side providing the following information:

Nameplate: describes the product type, rated power, rated current, rated voltage, open circuit voltage, short circuit current, all as measured under standard test conditions, weight, dimension etc. the maximum system voltage is shown on the nameplate.

Bar code: each individual module has a unique serial number. There is only one bar code on module. It is permanently attached to the interior of the module visible when viewing from the front of the module. This bar code is inserted at the beginning of laminating.



Figure 1: Example of LDK module label

Product Certifications

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



- IEC: IEC 61215, IEC 61730 (1&2), conformity to CE
- UL1703 2002/03/15 Ed:3 Rev:2004/06/30
- ULC/ORD-C1703-01 second edition 2001/01/01
- UL and Canadian standard for safety flat-plate
- ISO9001:2008 Quality Management System
- CEC Listed: Modules are eligible for California rebates
- PV Cycle: Voluntary module take back and recycling program

Product Limited Warranty

Module warranty conditions are described in the LDK Solar document: *LDK Solar Standard PV Module Warranty*.

Ignoring the instructions and considerations described herewith can be a cause by LDK Solar to invalidate the warranty in case of provable negligence. Please contact to the Technical Support Service for any question about warranties.

Safety Guidelines

General Safety Guidelines

- 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.
- Check and follow all safety precautions specified for other components of the system.
- Rooftop installations should be placed over fire resistant roofs 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.



Handling Safety Guidelines

- 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 module.



Installation Safety Guidelines

- Installing solar photovoltaic systems requires specialized skills and knowledge.
- One individual module may generate DC voltages greater than 30 volts when exposed to direct sunlight. Contact with a DC voltage of 30V or more is potentially hazardous.
- Do not disconnect under load.
- It is recommended to completely cover the module with an opaque material during installation to keep electricity from being generated.
- Do not wear metallic rings, watchbands, ear, nose, lip rings or other metallic devices while installing or troubleshooting photovoltaic systems.
- Use only insulated tools that are approved for working on electrical installations. Abide with the safety regulations for all other components used in the 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 photovoltaic system.
- Do not attempt to repair any part of the PV module.

Installation Guidelines

Design Considerations

LDK Solar 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 south, while in the Southern Hemisphere modules should face north. Therefore, modules facing more than 30 degrees away from true South (or North) will lose approximately from 10% to 30% of their power output.

LDK Solar PV modules connected in series should be installed at same orientation and angle. Different orientation or angles may cause a loss of power output due to the change in sunlight exposure. To develop the final distribution of the modules conforming the photovoltaic system, consider to keep suitable access to allow the maintenance and inspection works.

LDK Solar modules series must be installed in the following conditions:

Operating ambient temperature:	-40°C to +85°C
Storage temperature:	-40°C to +60°C
Humidity:	Below 85RH%
Wind pressure:	Below 112,78 lb / ft ² (2400Pa)
Snow pressure:	Below 112.78 lb / ft ² (5400Pa)

When installing a module on a roof or building, ensure that it is securely fastened and cannot fall as a result of wind or snow loads and provide adequate ventilation under a module for cooling (10cm minimum air space between module and mounting surface).

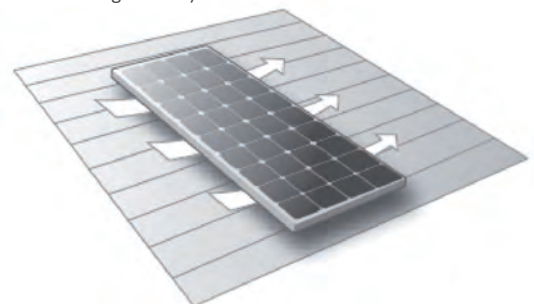


Figure 2: Provide adequate ventilation under a module

Mechanical Installation

To prevent Electrolysis Corrosion due to the anodized aluminum in the module frame, PVC or stainless steel washers can be placed between the PV module frame and 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 codes prior to installation.

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

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

The 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 shadings over the modules.

Note: It is not allowed to dismount, drill or modify the frame or any other part of the PV module. This may cause the loss of warranty. Please contact LDK Technical Service Contact if module mounting procedure is not clear

Frame Holes Mounting

Modules must be securely attached to the mounting structure using four mounting points(14mm*9mm). Use M8 stainless steel hardware, spring washers and flat washers with a torque of approximately 8 Newton-meters for normal installation. If additional wind or snow loads are anticipated for this installation, additional mounting points are also used. Refer to the drawing, below.

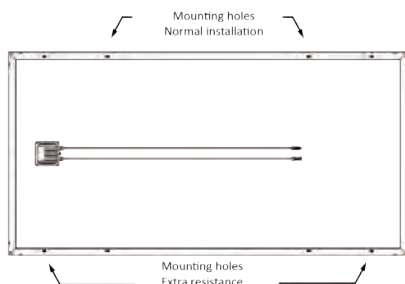


Figure 3: Module mounting holes

Pressure Clips Mounting

The modules should be fixed to the structure by pressure clips on the large side of the frame. The clips must be mounted at the position of the mounting hole, with a 10% of total length tolerance to the edge of the module. Note that always both sides should be mounted in a simetric position respect to the center. See figure 3.

The clips must only fix the modules by the contact with the frame. Do not allow contact between clip and glass. Do not mount the modules by pressure clips out of the specified area or on the small side of the module: Module mechanical resistance could be affected.

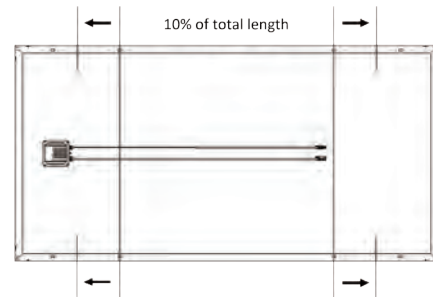


Figure 4: Clip mounting distance

The modules have been designed to resist a load of 2400Pa, (positive or negative load) due to wind effect, and 5400 Pa due to snow effect. This resistance value can decrease if modules are not mounted following the instructions above.

Electrical installation

The DC electrical energy generated by photovoltaic systems may also be converted to AC and connected to a utility grid system. As local utilities' policies on connecting renewable energy systems to their grids vary from region to region, consult a qualified system designer or integrator to design such a system. Permits are normally required for installing such a system and the utility must formally approve and inspect such a system before it can be accepted.

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

The electrical characteristics are within ± 5 percent of the indicated values of I_{sc} , V_{oc} , and P_{max} under standard test conditions (irradiance of 100mW/cm², AM 1.5 spectrums, and a cell temperature of 25°C (77°F))

General considerations

Several modules are connected in series and then in parallel to form a PV array, especially for application with a high operation voltage. If modules are connected in series, the total voltage is equal to the sum of individual voltages. Do not use different type of modules in the same circuit.

Modules are fitted with pre-assembled cable leads and safe plug & socket connectors to use for system electrical connections; these cable leads and connectors must not be removed or cut off

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

System Grounding

- All module frames and mounting racks must be properly grounded. The grounding wire must be properly fastened to the module frame to assure good electrical contact. Use the recommended type, or an equivalent, connector for this wire.
- If the support structure is made of metal, the surface of the structure must be electroplated and have excellent conductivity.
- Proper grounding is achieved by connecting the module frame(s) and structural members contiguously using a suitable grounding conductor
- The grounding conductor must then make a connection to earth using a

suitable earth ground electrode. We recommend the lay-in lug when grounding. The rack must also be grounded unless it is mechanically connected by nuts and bolts to the grounded PV modules.

Bypass diode and blocking diode

Partial shading of an individual module can cause a reverse voltage across the shaded PV module; the current is then forced through the shaded area by the other modules. When a bypass diode is wired in parallel with the series string, the forced current will flow through the diode and bypass the shaded PV module, thereby minimizing module heating and array current losses. LDK Solar Photovoltaic modules are fitted with internal bypass diodes within the junction box to reduce the effects of partial shadings.

In system utilizing a battery, blocking diodes are typically placed between the battery and the PV module output to prevent battery discharge at night. Blocking diodes must have a rated average forward current [IF(AV)] above maximum system current at highest module operating temperature and a rated repetitive peak reverse voltage [VRRM] above maximum system voltage at lowest module operating temperature.

Commission and maintenance

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

- Check the open-circuit voltage of every series module by a digital multimeter. The measured values should correspond to the sum of the open-circuit voltage of the individual module. You will find the rated voltage in the technical specifications of the type of the module used. If the measured value is significantly lower than the expected value, please proceed as described under "Troubleshooting an excessively low voltage".
- Check the short-circuit current of every series circuit. It can be measured directly by a digital multimeter connected in the two terminals of series circuit or module, or with any load such as PV illumination to make a rough measurement. Attention, the rated scale of the ammeter or the rated current of load should more than 1.25 times of the rated short-circuit current of series module. You will find the rated current in the technical specifications of the type of module used. The measured value can vary significantly, depending on weather conditions, the time of day and shading of the module.

Troubleshooting low voltages

Identify the commonly low voltage and excessively low voltage. Commonly the low voltage mentioned here is the decrease of open-circuit voltage of the module, which is caused by the temperature rising of solar cells or lower irradiance. 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 could not be resolved.



Maintenance

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

- Under most weather conditions, normal rainfall is sufficient to keep the PV module glass surface clean. Clean the glass surface of the module as necessary and consider that almost flat inclination should need extra cleaning.
- Always use water and a soft sponge or cloth for cleaning. A mild, non-abrasive cleaning agent can be used to remove stubborn dirt.
- Check the electrical and mechanical connections every six months to verify that they are clean, secure and undamaged
- If any problem arises, have them investigated by a competent specialist.
- Attention, observe the maintenance instructions for all components used in the system, such as support frames, charging regulators, inverters, batteries etc.

Module end-of-life

On February 2010, LDK Solar became a member of the Association PV CYCLE, an European association for voluntary take-back and recycling of photovoltaic modules.

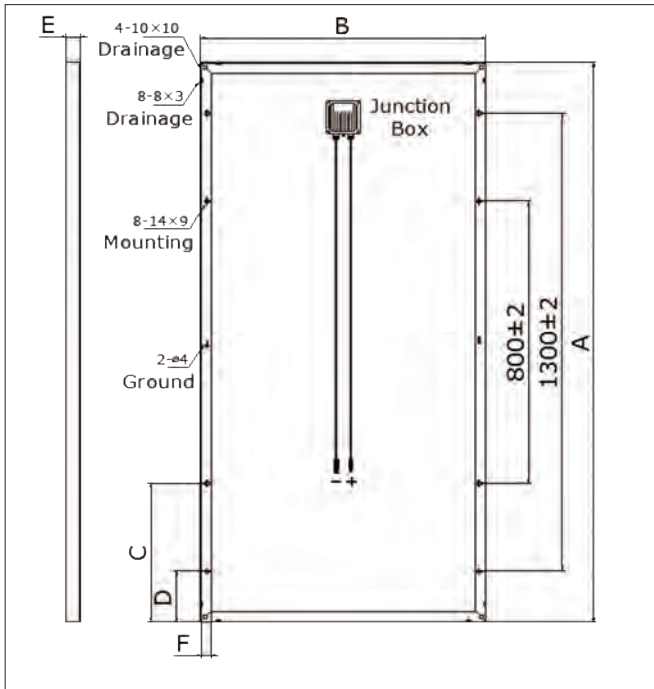
The LDK membership guarantees that after the life span of the installation, all modules will be collected and recycled by a specialized organization which ensures that all PV process is under environmental care. All the services are according to European Commission and free-charge for final users (except incidences during installation).

Please visit PV Cycle web site for further information:

<http://www.pvcycle.org/>

Module specifications

Technical Service Contact



LDK Solar Co. Ltd.
 Add: No. 1368 Wuzhong Road
 Wuzhong Economic Development Zone
 Suzhou City, Jiangsu Province, China
 Tel: + 86 512 822 516 66
 Fax: + 86 512 822 501 01
 Email: module.service@ldksolar.com
 Website: www.ldksolar.com

Series	P-18	P-20	P-24-5'	P-24-6'	D-20	D-24
A	1484	1642	1958	1586	1642	1586
B	994	994	994	808	994	808
C	342	421	579	393	421	393
D	92	171	329	143	171	143
E	40	40	50	40	40	40
F	30	30	40	30	30	30
Cable	1200					
Weight(kg)	18	20	30.5	15.6	20	15.6
Cell type	Multi 156*156	Multi 156*156	Multi 156*156	Multi 125*125	Mono 156*156	Mono 125*125
Num of Cells	54	60	72	72	60	72
Connector	MC4					

Note: All dimension values are in mm

Partner:

LDK SOLAR Co. Ltd.
NYSE: LDK

Web Site: www.ldksolar.com
Email: module.service@ldksolar.com