Installation Guide

for photovoltaic module of Shandong Linuo Photovoltaic Hi-tech Co.,Ltd

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● Purpose of this guide

This guide contains information regarding the installation and safe handling of photovoltaic modules made by Shandong Linuo Photovoltaic Hi-tech Co., Ltd (hereafter referred to as “modules”). Shandong Linuo Photovoltaic Hi-tech Co., Ltd hereafter is referred to as “Linuo Power”.

All instructions should be read and understood before installation commences. If there are any questions, please contact our sales department for further assistance. The installer should conform to all the safety precautions in the guide when installing the module. Local standards should also be followed in such installations.

Before installing a solar photovoltaic system, the installer should become familiar with the mechanical and electrical requirements for such a system. Keep this guide in a safe place for future reference (maintenance) and in case of disposal of the module.

● General

◇ Installation of solar photovoltaic systems may require specialized skills and knowledge. Installation should be performed only by qualified persons.

◇ All modules come with a permanently attached junction box. Linuo Power can provide customers with fitted cables for easy installation, if desired.

◇ The installer assumes all risk of injury that might occur during installation, including, but not limited to, the risk of electric shock.

◇ 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.

◇ When disconnecting wires connected to a photovoltaic module that is exposed to sunlight, an electric arc may result. Such arcs may cause burns, may start fires and may otherwise create problems. Therefore, be extremely careful.

◇ Do not disconnect under load.

◇ Photovoltaic solar modules change light energy to direct-current electrical energy. They are designed for outdoor use. Modules may be ground mounted, mounted on rooftops, vehicles or boats. Proper design of support structures are the responsibility of the system designer and installer.

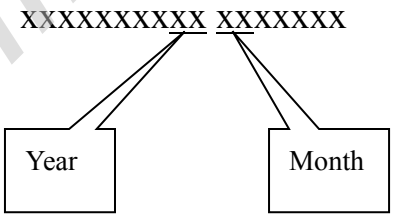
◇ Do not attempt to disassemble the module, and do not remove any attached nameplates or components.

◇ Do not apply paint or adhesive to the top surface of modules.

◇ Do not use mirrors or other magnification device to artificially concentrate sunlight onto the modules.

◇ When installing the system, abide with all local, regional and national statutory regulations. Obtain a building permit where necessary. Abide with any local and national regulations when mounting on vehicles or boats.

◇ The date of manufacture is shown in the label. Please read below to know how to find the date from the label



Date in the label “11101660110100001”, the date of manufacture is shown as “January 2011”.

◇ Do not remove any label. If the label is removed, the product warranty will no longer be honored by Linuo Power

● Safety precautions for installation of solar photovoltaic systems

◇ Solar modules produce electrical energy when light shines on their front surface. The DC voltage may exceed 30V. If modules are connected in series, the total voltage is equal to the sum of the individual module voltage. If modules are connected in parallel, the total current is equal to the sum of individual module current.

◇ Keep children well away from the system while transporting and installing mechanical and electrical components.

◇ Do not wear metallic rings, watchbands, ear, nose, lip rings or other metallic devices while installing or troubleshooting photovoltaic systems.

◇ Only use approved insulated tools for electrical installation work.

◇ 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 use in a solar electric system. Always use the same type of module within a particular photovoltaic system.

◇ Rated electrical characteristics are within ± 10 percent of the indicated values of $I_{sc,}$ $V_{oc,}$ and P_{max} under standard test conditions (irradiance of 1000W/m^2, AM 1.5 spectrums and a cell temperature of 25℃ (77 ℉).

◇ Under normal outdoor conditions, the module will produce current and voltages that are different than those listed in the data sheet. All values from the datasheet are from

standard test conditions. Accordingly, during system design, values of short-circuit current and open-circuit voltage When making decisions and component or system output related components rated voltage, current, fuse conductor size and controller such as size of components and the output parameters .when relevant reference kit marked the short circuit current and open-circuit voltage values, and It Should according to125% value design and installation.

● Mechanical Installation

➢ Selecting the location

◇ Select a suitable location for installation the module.

◇ We suggest that the module should be facing true south in northern latitudes and true north in southern latitudes. Module surface perpendicular with the sun's rays direction is the best choose, but if it is difficult to make the module surface face the true south or north, we suggest reduce azimuth of module during installation.

◇ For detailed information on the best elevation tilt angle for the installation, refer to standard solar photovoltaic installation guides or a reputable solar installer or systems integrator.

◇ The module should not be shaded at any time of the day.

◇ Do not use module near equipment or in locations where flammable gases can be generated or collected.

➢ Selecting the proper support frame

◇ Prepare modular assembly support frame to withstand local expected earthquake level, if there is a smaller title angle, pay more attention to the support frame to withstand wind pressure and snow pressure.

◇ The modular assembly support frame must be made of durable, corrosion-resistant and UV-resistant material.

◇ Always observe the instructions and safety precautions included with the support frame to be used with the module.

◇ Do not drill additional mounting holes in the glass surface of the module or in the frame of the module. Doing so will void the warranty.

◇ No attempt must be made to drill holes in the modules. To do so will void the warranty.

◇ Do not lift the module by grasping the module’s junction box or electrical leads.

◇ Do not stand or step on the module.

◇ Do not drop the module or allow objects to fall on the module.

◇ To avoid breakage of module glass, 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 the glass portion of the module.

➢ Module installation

◇ Select the height of the mounting system to prevent the lowest edge of the module from

being covered by snow for a long time in winter in areas that experience heavy snowfalls. In addition, assure the lowest portion of the module is placed high enough so that it is not shaded by plants or trees or damaged by sand and stone driven by wind.

◇ 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.

◇ Provide adequate ventilation under a module for cooling (minimum 10cm space between module and mounting surface).

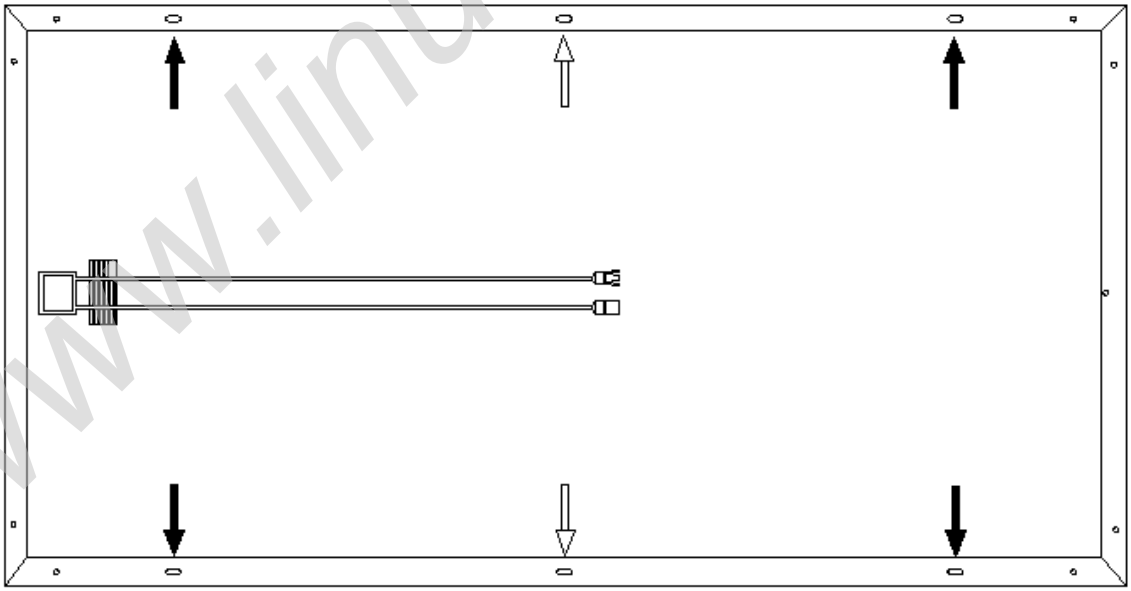
◇ When installing module on a roof, ensure that the roof construction is suitable. In addition, any roof penetration required to mount the module must be properly sealed to prevent leaks.

◇ In some cases, a special support frame may be necessary.

◇ The roof installation of solar modules may affect the fireproofing of the house construction. The modules are rated fire Class C, and are suitable for mounting over a class A roof. Do not install modules on a roof or building during strong winds in case of accidents.

◇ In example A, Modules can be mounted to the substructure (Example A) between different modules with middle clamp and mounted to the substructure with end clamp at the end of module array.

◇ In example B, Modules must be securely attached to the mounting structure using four mounting points for normal installation. If additional wind or snow loads are anticipated for this installation, additional mounting points are also used. For details please see the diagram below. Load calculations shall be done by the system designer or installer.

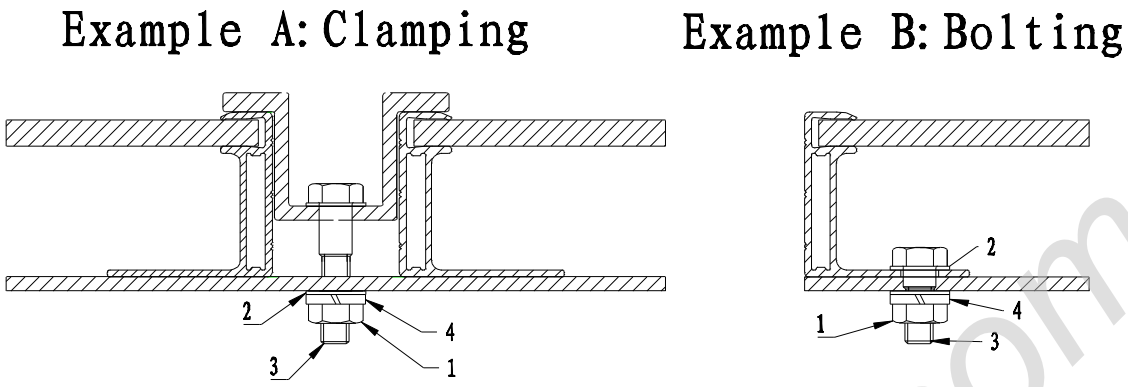


Mounting holes for normal installation

For high wind and snow-loads,these mounting holes must also be used

◇ The screw bolts and nuts should be of stainless steel.

Two installation way of modules：



1) Stainless steel serrated lock nut

2) Stainless steel washer

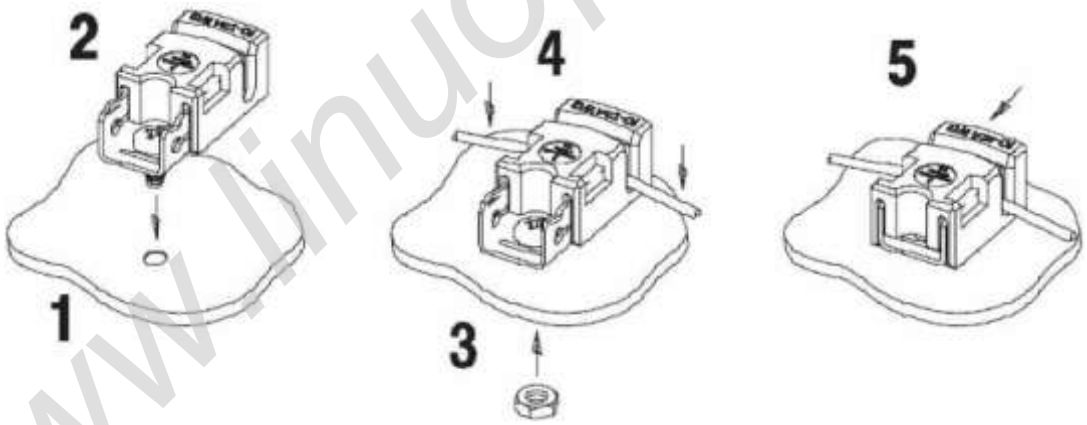
3) Stainless steel M6 bolt

4) Spring washer

In the examples shown, the tightening torque (using stainless steel M6 bolts) must be 8-10 Nm. Use the existing holes for securing the module; do not drill any additional holes (doing so would void the warranty). Use appropriate corrosion-proof fastening materials.

● Electrical Installation

➢ Grounding



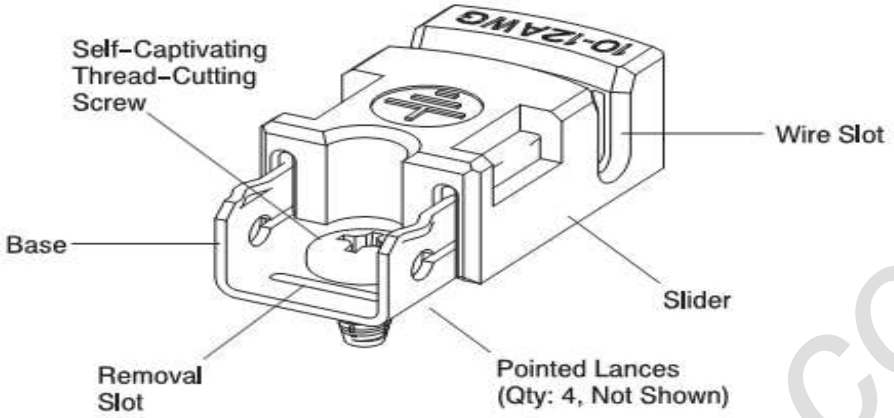
◇ According to National Electrical Code of (NEC), if the mounting position is in America, grounding should be carried out by attachment to the module or array frame.

◇ Details for wiring in accordance with the NEC in the Americas and IEC in Europe, the grounding method of the frame of arrays shall comply with the NEC, article 250.

◇ The module frame must be properly grounded (refer to NEC clause 250) in accordance with NEC. The grounding wire must be properly connected to the module frame to ensure good electrical contact. Use the recommended type, or an equivalent, connectors for this wire.

◇ For metal support frames, the surface of the frame must be electroplated and have excellent conductivity.

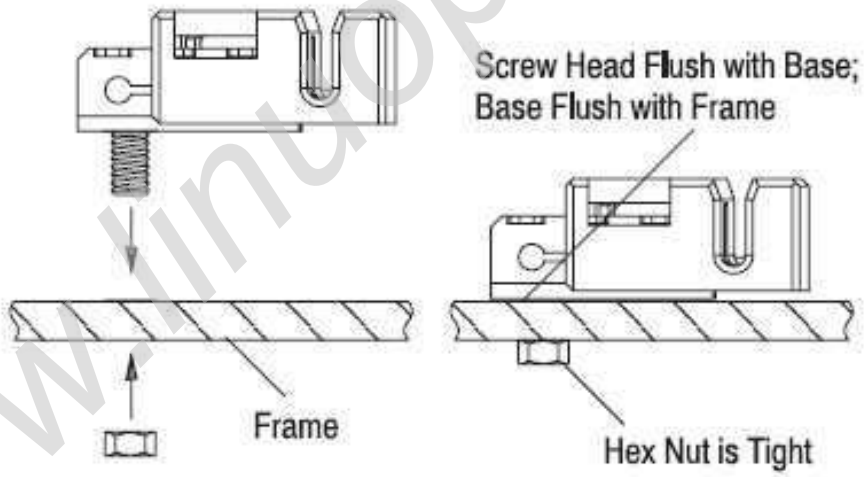
◇ We recommend the Ground Clips (rated for 1000Volts) when grounding.



◇ Mounting Grounding Clip to Frame

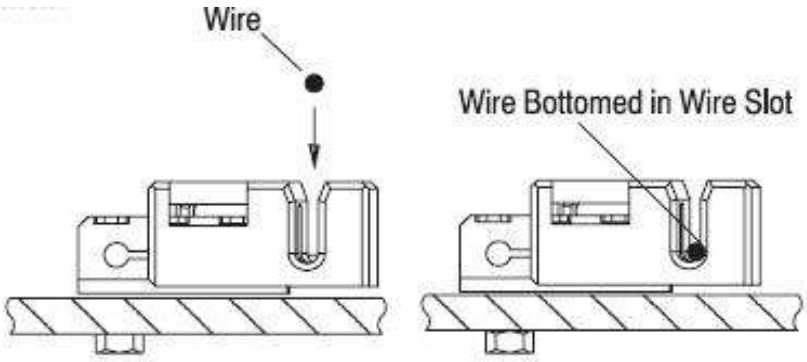
The grounding clip must be placed onto the frame of solar panels so that the screw straddles the pre-drilled hole. The head of the screw must be flush with the base and the base must be flush with the frame. Refer to Figure below. It is recommended that the screw be tightened to a torque of 2.3 and 2.8 Nm [20 and 25 in.-lbs].

◇ Appling screw and nut of hexagon style and installing the nut of hexagon style at the bottom of screw. The appropriate clamp is necessary for tightening the nut.



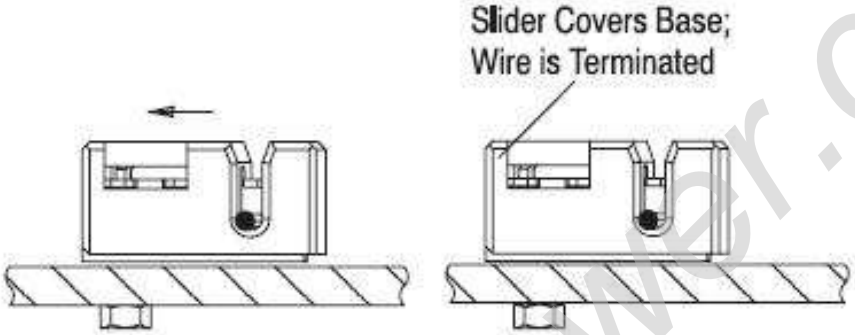
◇ Wire Placement

The wire must be bottomed in the wire slot (wire slot will cause the wire slight curve). Refer to the figure below.



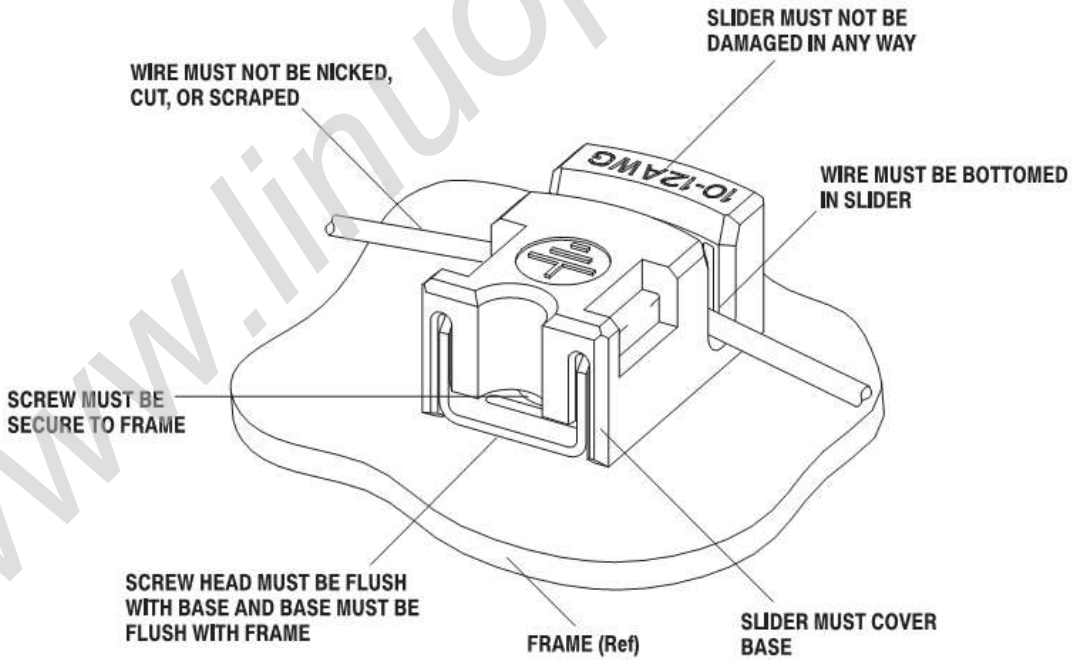
◇ Terminating the Wire

The slider must be engaged (slider covers the base). Refer to the figure below.



◇ Visual Effect

The figure below shows a Grounding Clip Assembly. This illustration should be used by production personnel to ensure a correctly applied product.



- **Testing, commissioning and troubleshooting**

◇ Test all electrical and electronic components of the system before using it. Follow the instructions in the guides supplied with the components and equipment.

◇ Check modules connected in series before they are connected to system. Check the open-circuit voltage of every series module by a digital multimeter (fluke 170 series are recommended). 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 (Fluke 170 series are recommended) 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 day and shading of the module.

➢ Blocking diodes and bypass diodes

◇ Blocking diodes prevent current from the battery to the module when no electricity is being generated. It is recommended to use blocking diodes when a charging regulator is not used. Your specialist dealer can advise you the suitable types.

◇ In systems, It Will occur hot spots effect when part of a module is shaded and the rest is exposed to the sun. These currents can cause the affected cells to get very hot and could even damage the module. To protect module from hot spots effect, by-pass diodes are used in module. All modules rated greater then 55 Watt have bypass diode already integrated in the junction box. In the unlikely event of diode failure, a replacement can easily be made.

◇ Protect yourself from electricity shocks while maintaining the solar power system.

➢ Off-Grid-connected electrical system

◇ Do not use modules of different configurations in the same system. The max number of module (N) = V（max system） / [Voc(at STC)].

◇ 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.

◇ For applications requiring high currents, several photovoltaic modules can be connected in parallel; the total current is equal to the sum of individual currents.

◇ Module is supplied with connectors to use for system electrical connections. Consult rated local wiring regulations to determine system wire size, type, and temperature.

◇ The cross section area of cable and the capacity of connector must be selected to suit the maximum system short circuit current, otherwise the cable and connector will be

overheated under large current. It is dangerous

◇ The junction box has a breather port. The breather port must be mounted facing down and can not be exposed to rain. Therefore, the junction box must be on the higher side \

◇ Protect yourself from electricity shocks while debuging or maintaining the solar power system.

● Maintenance Disclaimer of liability

◇ First, check all wiring connections to make sure it is not open-circuit or is not connection well.

◇ Check the open-circuit voltage of each module:

◇ Fully cover the modules with an opaque material.

◇ Disconnect the wiring at both terminals of the modules.

◇ Remove the opaque material from the module to be checked and measure the open-circuit voltage at its terminals.

◇ If the measured voltage is only half of the rated, this indicates a defective bypass diode. Refer to‘Testing and replacing bypass diodes’.

◇ In the case of not very low irradiance, if the voltage across the terminals differs from the rated value by more than 5 percent, this indicates a bad electrical connection.

◇ Protect yourself from electricity shocks while debuging or maintaining the solar power system.

➢ Maintenance

Linuo Power recommends the following maintenance measures in order to ensure optimum performance of the module:

◇ Clean the glass surface of the module when necessary. 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.

◇ In addition, the maintenance instructions for all other components used in the system, such as support frames, charging regulators, inverters, batteries etc. should be followed accordingly.

➢ 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 Linuo Power’s control, Linuo Power 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 Linuo Power 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 modification or otherwise under any patent or patent rights.
- ◇ The information in this manual is based on Linuo Power'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.
- ◇ Linuo Power reserves the right to change the manual, the specifications, or product data sheets without prior notice.

● EOHMS Element

- ◇ All the customers should be informed by Linuo Power Group and acquaint, according to this instruction that solar PV business belongs to the environmental protection scope. We use solar energy, which is clean and renewable, to achieve sustain and healthy growing of our human race.
- ◇ During the transportation, moving and installation, all the workers should wear appliances for labor protections to avoid sharp edges cutting or crashing injured.
- ◇ Linuo Power Group has successfully entered the PV Cycle Association for all the abandoned materials and modules recycling belonging to Linuo Power Group.