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UL Installation guide for Suntech Power photovoltaic module

Version UL081014



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Purpose of this guide

This guide contains information regarding the installation and safe handling of Suntech Power Co., Ltd photovoltaic module (hereafter is referred to as “module”). Suntech Power Co., Ltd hereafter is referred to as “Suntech”.

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

Before installing a solar photovoltaic system, the installer should become familiar with the mechanical and electrical requirement for such a system. Keep this guide in a safe place for future reference (care and maintenance) and in case of sale or disposal of the module at the end of its useful life.

- Installing 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 and #12 AWG wire terminated in Multicontact PV-KBT4 or PV-KST4 connectors. Suntech can provide customers with fitted cables for ease of installation, if desired.
- The installer should assume the risk of all injury that might occur during installation, including, without limitation, 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!
- 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 is the responsibility of the system designer and installer. Proper use of mounting holes is suggested in a following paragraph.
- Do not attempt to disassemble the module, and do not remove any attached nameplates or components.



- Do not apply paint or adhesive to module top surface.
- Do not use mirrors or other magnifiers to artificially concentrate sunlight on the module.



- 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.

Safety precaution for installing a solar photovoltaic system

- 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 voltages. If modules are connected in parallel, the total current is equal to the sum of individual module currents.
- Keep children well away from the system while transporting and installing mechanical and electrical components.
- 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 use in a solar electric systems. Always use the same type of module within a particular photovoltaic system.
- The electrical characteristics are within ± 10 percent of the indicated values of I_{sc} , V_{oc} , and P_{max} under standard test conditions (irradiance of $100\text{mW}/\text{cm}^2$, AM 1.5 spectrums, and a cell temperature of 25°C (77°F))
- Under normal outdoor conditions the module will produce current and voltages that are different than those listed in the data sheet. Data sheet values are values expected at standard test conditions. Accordingly, during system design, values of short-circuit current (I_{sc}) and open-circuit voltage (V_{oc}) marked on UL series modules should be multiplied by a factor of 1.25 when determining component voltage ratings, conductor ampacity, fuse sizes and size of controls connected to the module or system output.
- Refer to Section 690-8 of the National Electrical Code for an additional multiplying factor of 125 percent (80 percent derating) which may be applicable.

Product identification

Each module has three 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 for UL listed modules is 600 volts DC and is shown on the nameplate. Maximum fuse rating is also shown.
- "Pass": describe inspection date and security class.
- Bar code: each individual module has a unique serial number. The serial number has 18 digits. The 15th and the 16th digit are the week code, and the 17th and the 18th digit are the year code. For example, xxxxxxxxxxxxxx0106 means the module was made in the first week of 2006. 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.



Typical serial number barcode label

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

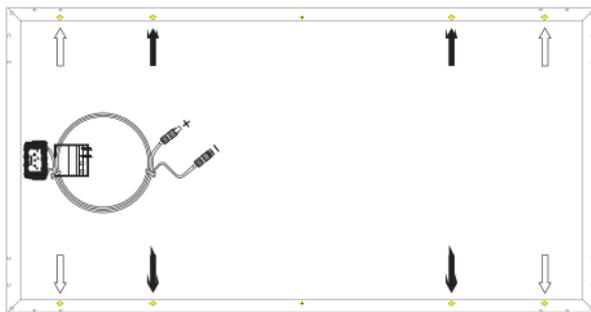
Mechanical Installation

• Selecting the location

- ▶ Select a suitable location for installation of the module.
- ▶ The module should be facing true south in northern latitudes and true north in southern latitudes for best power production.
- ▶ 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 locacollected.

• Selecting the proper support frame

- ▶ Always observe the instructions and safety precautions included with the support frame to be used with the module.
- ▶ No attempt must be made to drill holes in the glass surface of the module. To do so will void the warranty.
- ▶ Do not drill additional mounting holes in the frame of the module. Doing so will void the warranty.
- ▶ Modules must be securely attached to the mounting structure using four mounting points for normal installation. If additional wind or snowloads are anticipated for this installation, additional mounting points are also used. Refer to the drawing, below. Load calculations are left to the system designer or installer.



↑ Mounting holes for normal installation

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

Mechanical Installation

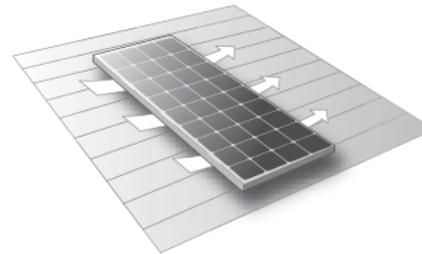
- ▶ The support module mounting structure must be made of durable, corrosion-resistant and UV-resistant material.

• Ground mount

- ▶ 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.

• Roof mount

- ▶ 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 (5cm minimum air 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.
- ▶ The National Electric Code requires the use of a properly sized GFDI on photovoltaic arrays installed on dwellings. Refer to the NEC for further information on earth ground fault breakers.
- ▶ When installing the module on a roof or building, do so in calm winds. Installing a module during strong winds may cause accidents.

Mechanical Installation

- **Pole mount**

- ▶ When installing a module on a pole, choose a pole and module mounting structure that will withstand anticipated winds for the area.



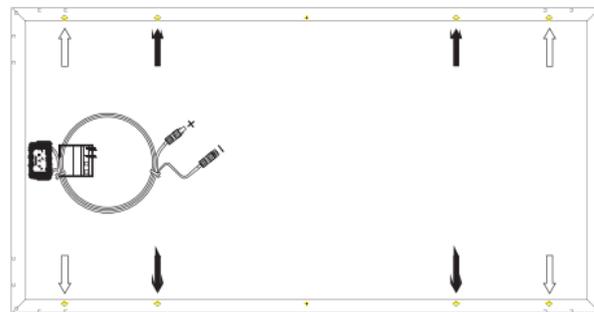
Ground mount

Roof mount

Pole mount

- **General installation**

- ▶ Module mounting must use the pre-drilled mounting holes in the frame.
- ▶ The most common mounting is achieved by mounting the module using the four symmetry points close to the inner side on module frame.
 - ▶ If excessive wind or snow loads are expected, all eight mounting holes must be used.
- ▶ Do not lift the module by grasping the module's junction box or electrical leads.
- ▶ 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 the glass of the module.



↑ Mounting holes for normal installation

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

Electrical Installation

- **Grid-connected electrical system**

- ▶ 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 to install such a system and the utility must formally approve and inspect such a system before it can be connected to the grid.

- **Grounding**

- ▶ The module frame must be properly grounded (refer to NEC clause 250). 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 frame is made of metal, the surface of the frame must be electroplated and have excellent conductivity.
- ▶ We recommend the lay-in lug (Cat. No. GBL4-DBT; rated for 600Volts; company: ILSCO; UL number is E34440) when grounding.

First strip 16mm insulating jacket from the end of the ground wire (4-14 STR.) carefully to avoid nicking or cutting conductors, insert the wire into the slot of the lug (see the picture), and screw down the slotted screw.

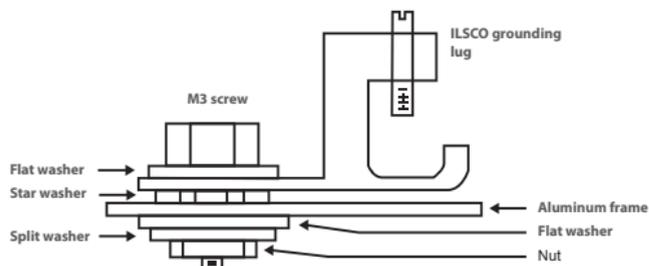
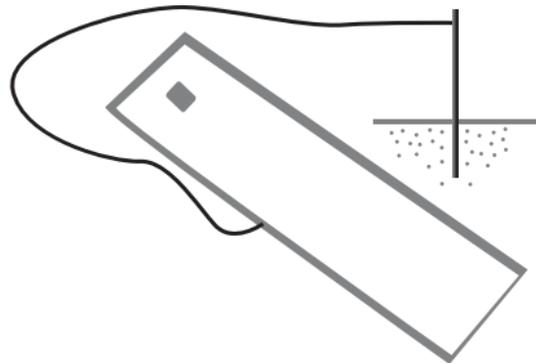


Insert ground wire here

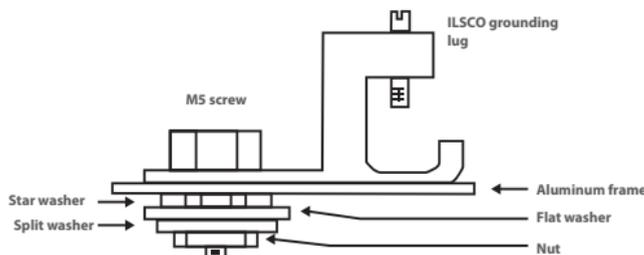


Electrical Installation

Next, assemble the recommended ILSCO grounding lug to the aluminum frame using stainless steel M3 or M5 screw and hardware as shown below. Note: there are two different size grounding holes, the smaller of which is being phased out. Further, buildup of hardware for mounting the grounding lug are the same—except for the M3 screw, an added flat washer is mounted directly under the M3 screw head. The star washer is fitted directly under the grounding lug and makes electrical contact by penetrating the anodized coating of the aluminum frame. The screw assembly is further fitted with a flat washer, then a split lock washer and finally a nut to secure the entire assembly, as shown. Recommended torque of M3 or M5 screw assembly is 0.8NM or 1.5 NM.



For module with $\Phi 4\text{mm}$ grounding holes

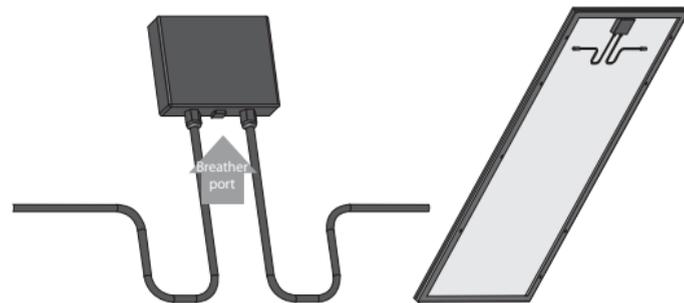


For module with $\Phi 5.1\text{mm}$ grounding holes

Electrical Installation

• General installation

- ▶ Do not use modules of different configurations in the same system.
- ▶ 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 Multicontact connectors (PV-KBT4 and PV-KST4) to use for system electrical connections. Use the National Electric Code to determine system wiring size (refer to NEC clause 310), type and temperature rating of conductors to be connected to the module's connectors. Wiring connected to the module's wiring should be #12 AWG (minimum) and must be temperature rated at 90°C (minimum).
- ▶ In Canada installation shall be in accordance with CSA C22.1, Safety Standard for Electrical Installations, Canadian Electrical Code, Part 1.
- ▶ 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. Refer to NEC for details.
- ▶ Module overcurrent protection, rated for DC use. Fuse ratings are as shown the enclosed tables of this Installation Guide.
- ▶ The junction box is fitted with 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 of the module when it is mounted.



Suntech recommends that all work in commissioning and maintenance of a system must be performed by a qualified solar PV technician!

- **Blocking diodes and bypass diode**

- ▶ Blocking diodes prevent current flowing 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 with regards to suitable types, such as Schottky diodes.
- ▶ In systems with more than two modules in series, high reverse current can flow through cells that are shaded partially or outright 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 such high reverse currents, by-pass diodes are used in module. All modules rated greater than 55 Watt have bypass diode already integrated in the junction box. In the unlikely event of diode failure, Suntech recommends a qualified service technician be employed to determine if diodes have failed and to make replacement.
- ▶ Protect yourself against electricity shocks while commissioning and maintaining the solar power system.

- **Testing, commissioning and troubleshooting**

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

- o Testing modules connected in series before they are connected to system.

To determine Voc and Isc in the following tests, the module(s) must be exposed to the sun and not connected to a load. Observe personal safety when making these measurements.

- ▶ Check the open-circuit voltage (Voc) of every series module using a digital multimeter (Fluke 170 series are recommended). The measured system Voc should correspond to the sum of the Vocs of the individual module. You will find the rated voltage in the technical specifications of the type of the module used and in the tables at the end of this Installation Guide. If the measured value is significantly lower than the expected value, proceed as described under "Troubleshooting an excessively low voltage".
- ▶ Determine the short-circuit current (Isc) of every series circuit. It can be measured directly by connecting the digital multimeter connected in the two terminals of series circuit or module, Attention, the rated scale of the ammeter or the rated current of load should more than 1.25 times than 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.

- o Troubleshooting low voltages

To identify the commonly low voltage and excessively low voltage, the commonly how 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.

- ▶ 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.

- **Maintenance**

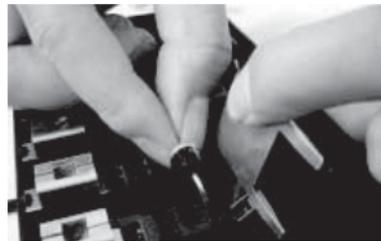
Suntech recommends the following maintenance in order to ensure optimum performance of the module:

- ▶ Clean the glass surface of the module as 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. Observe the maintenance instructions for all components used in the system, such as support frames, charging regulators, inverters, batteries, etc.

- **Testing and replacing bypass diodes**

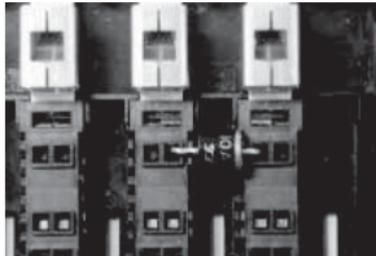
Removing the bypass diodes should be done only by a competent PV technician and after the module has been disconnected from the system.

- ▶ Place module face down on a soft, flat surface Insert a 3mm flat screwdriver into the slot on the junction box cover. (The cover has a sign of screwdriver). Gently pull up the four slots until the cover been opened.
- ▶ Insert the 3mm flat screwdriver into a hole alongside of diode and near one mounting hole of the diode, pry the screwdriver in the opposite direction of diode and gently pull the diode up until the lead comes free. Do the same in the other mounting hole of the diode, and repeat until the diode is free.

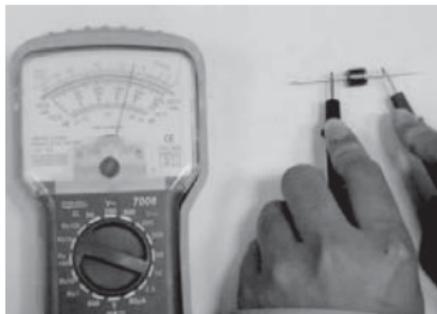


Commission and Maintenance

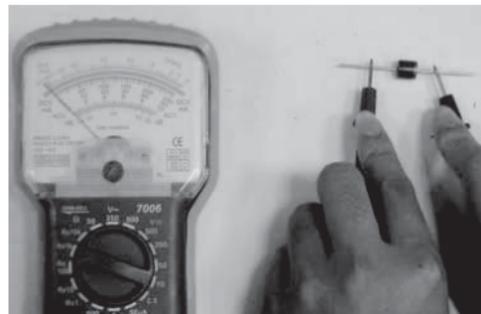
- Note the orientations of the polarity markings on the diodes.



- Check the resistance of the diodes by using the digital multimeter's ohms scale. Resistance should be low in one direction, then when leads are reversed on the diode's terminals the resistance should be high, as illustrated in the two pictures below. If a diode has a low resistance in both directions, it is probably shorted. If it has high resistance in both directions it is probably open. In either case it should be replaced.



Diode check: low resistance



Diode check: high resistance

- Replace a defective diode with a diode of the same type, and ensure that its polarity marking is oriented the same way as the original diode.
- Finally, check the open-circuit voltage (Voc) of the module, as described previously, and replace both covers.

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 Suntech's control, Suntech 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 Suntech 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 Suntech'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, expresses or implied. Suntech reserve the right to change the manual, the PV produce, the specifications, or product information sheets without prior notice.

/Ab-1 series – outer dimensions - 1580 × 808 × 35 mm

Model	Open Circuit Voltage (Voc) at STC,(V dc)	Rated Voltage (Vmax) at STC,(V dc)	Maximum System Voltage, (V dc)	Rated Current (Imax) at STC,(A dc)	Short Circuit Current (Isc) at STC,(A dc)	RatedMaximum Power (Pmax) at STC,(Watts)	Maximum Series Fuse, (A)
STP185-24/Ab-1	44.6	35.6	600	5.2	5.4	185	15
STP180-24/Ab-1	44.4	35.6	600	5.05	5.4	180	15
STP175-24/Ab-1	44.2	35.2	600	4.95	5.2	175	15
STP170-24/Ab-1	43.8	35.2	600	4.83	5.14	170	15
STP165-24/Ab-1	43.6	34.8	600	4.74	5.04	165	15
STP160-24/Ab-1	43.2	34.4	600	4.65	5	160	15
STP155-24/Ab-1	43.2	34.4	600	4.51	4.9	155	15
STP150-24/Ab-1	43.2	34.4	600	4.36	4.87	150	15
STP145-24/Ab-1	43	34	600	4.26	4.85	145	15
STP140-24/Ab-1	42.6	34	600	4.12	4.8	140	15

Disclaimer of liability

/Ab-1 series – outer dimensions - 1580 x 808 x 35 mm

Model	Open Circuit Voltage (Voc) at STC,(V dc)	Rated Voltage (Vmax) at STC,(V dc)	Maximum System Voltage, (V dc)	Rated Current (Imax) at STC,(A dc)	Short Circuit Current (Isc) at STC,(A dc)	Rated Maximum Power (Pmax) at STC,(Watts)	Maximum Series Fuse, (A)
STP185S-24/Ab-1	44.6	35.6	600	5.2	5.4	185	15
STP180S-24/Ab-1	44.4	35.6	600	5.05	5.4	180	15
STP175S-24/Ab-1	44.2	35.2	600	4.95	5.2	175	15
STP170S-24/Ab-1	43.8	35.2	600	4.83	5.14	170	15
STP165S-24/Ab-1	43.6	34.8	600	4.74	5.04	165	15
STP160S-24/Ab-1	43.2	34.4	600	4.65	5	160	15
STP155S-24/Ab-1	43.2	34.4	600	4.51	4.9	155	15
STP150S-24/Ab-1	43.2	34.4	600	4.36	4.87	150	15
STP145S-24/Ab-1	43	34	600	4.26	4.85	145	15
STP140S-24/Ab-1	42.6	34	600	4.12	4.8	140	15

/Bb-1 series – outer dimensions - 1195 x 541 x 30 mm

Model	Open Circuit Voltage (Voc) at STC,(V dc)	Rated Voltage (Vmax) at STC,(V dc)	Maximum System Voltage, (V dc)	Rated Current (Imax) at STC,(A dc)	Short Circuit Current (Isc) at STC,(A dc)	Rated Maximum Power (Pmax) at STC, (Watts)	Maximum Series Fuse, (A)
STP085-12/Bb-1	21.4	17.1	600	4.97	5.32	85	15
STP080-12/Bb-1	21.2	16.8	600	4.76	5.12	80	15
STP075-12/Bb-1	21	16.6	600	4.52	5.00	75	15
STP085S-12/Bb-1	21.9	17.6	600	4.83	5.14	85	15
STP080S-12/Bb-1	21.6	17.2	600	4.65	5.00	80	15
STP075S-12/Bb-1	21.6	17.2	600	4.36	4.87	75	15

Disclaimer of liability

/Ub-1 series – outer dimensions - 1482 x 992 x 35 mm

Model	Open Circuit Voltage (Voc) at STC,(V dc)	Rated Voltage (Vmax) at STC,(V dc)	Maximum System Voltage, (V dc)	Rated Current (Imax) at STC,(A dc)	Short Circuit Current (Isc) at STC,(A dc)	Rated Maximum Power (Pmax) at STC,(Watts)	Maximum Series Fuse, (A)
STP210-18/Ub-1	33.6	26.4	600	7.95	8.33	210	20
STP200-18/Ub-1	33.4	26.2	600	7.63	8.12	200	20
STP190-18/Ub-1	33	26	600	7.31	7.89	190	20
STP180-18/Ub-1	32.7	25.8	600	6.98	7.65	180	20
STP170-18/Ub-1	32.7	25.7	600	6.61	7.32	170	20
STP210S-18/Ub-1	33.6	26.4	600	7.95	8.33	210	20
STP200S-18/Ub-1	33.6	26.2	600	7.63	8.1	200	20
STP190S-18/Ub-1	33.2	26.2	600	7.25	7.84	190	20
STP180S-18/Ub-1	33.2	26	600	6.94	7.52	180	20
STP170S-18/Ub-1	33	25.8	600	6.59	7.26	170	20

Model	Open-Circuit Voltage (Voc) at STC (Vdc)	Rated Voltage (Vmax) at STV (Vdc)	Maximum System Voltage (Vdc)	Rated Current (Imax) at STC (Adc)	Short - Circuit Current (Isc) at STC (Adc)	Rated Maximum Power (Pmax) at STC (Watts)	Maximum Series Fuse (A)
STP280-24/Vb-1	44.8	35.2	600	7.95	8.33	280	20
STP270-24/Vb-1	44.5	35.0	600	7.71	8.20	270	20
STP260-24/Vb-1	44.0	34.8	600	7.47	8.09	260	20