



INSTALLATION MANUAL FOR KYOCERA PV MODULES

**KD140SX-UFU, KD145SX-UFU
KD150SX-UFU**

Please read this manual carefully before installing the modules.

6C-214549

1. INTRODUCTION

As the world leader in development and application of high technology ceramic/silica materials, Kyocera offers a wide range of highly efficient and reliable crystalline silicon solar photovoltaic (PV) power modules. Kyocera began to extensively research PV technology in 1975 and commenced manufacturing operations in 1978. Since then, Kyocera has supplied millions of cells and modules throughout the world. With years of experience and state-of-the-art technology, Kyocera provides the highest quality PV power modules in a range of sizes designed to meet the requirements of the most demanding energy and power users worldwide.

2. POWER MODULES

Kyocera PV module (hereinafter referred to as "the PV module") consist of a series of electrically interconnected crystalline silicon solar cells, which are permanently laminated within a pottant and encapsulated between a tempered glass cover plate and a back sheet. The entire laminate is secured within an anodized aluminum frame for structural strength, ease of installation, and to protect the cells from the most severe environmental conditions.

3. APPLICATIONS

The PV module is a reliable, virtually maintenance-free direct current (DC) power source, designed to operate at the highest level of efficiency. The PV module is ideal to remote homes, recreational vehicles, water pumps, telecommunication systems and many other applications either with or without using storage batteries.

4. WARNINGS & SAFETY

PV modules generate electricity when exposed to light. Arrays of many modules can cause lethal shock and burn hazards. Only authorized and trained personnel should have access to these modules. To reduce the risk of electrical shock or burns, modules may be covered with an opaque material during installation. Do not touch live terminals with bare hands. Use insulated tools for electrical connections. Do not use these modules with solar concentration.

WARNING

"SUITABLE FOR USE IN CLASS I, DIVISION 2, GROUPS A, B, C AND D HAZARDOUS LOCATIONS, OR NONHAZARDOUS LOCATIONS ONLY."

"WARNING - EXPLOSION HAZARD - DO NOT DISCONNECT EQUIPMENT WHILE THE CIRCUIT IS LIVE OR UNLESS THE AREA IS KNOWN TO BE FREE OF IGNITABLE CONCENTRATIONS."

"WARNING - EXPLOSION HAZARD - SUBSTITUTION OF ANY COMPONENT MAY IMPAIR SUITABILITY FOR CLASS I, DIVISION 2."

PERMIT

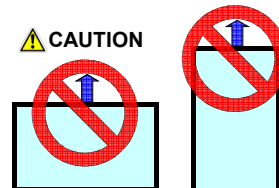
- Before installing your PV system, contact local authorities to determine the necessary permits, installation and inspection requirements.

INSTALLATION AND OPERATION

- The PV module is considered to be in compliance with UL1703 only when the PV module is mounted in the manner specified by the installation manual.
- Systems should be installed by qualified personnel only. The system involves electricity, and can be dangerous if the personnel are not familiar with the appropriate safety procedures.

- **Do not step on a PV module.**
- Although the PV modules are quite durable, the glass can be broken (and PV module will no longer work properly) if it is dropped or hit by tools or other objects.
- The module frame is made of anodized aluminum, and therefore corrosion can occur if the module is subject to a salt-water environment and/or is in contact with another type of metal (galvanic corrosion). Pay attention to the above and take appropriate measures to prevent corrosion when selecting the installation environment, material of support structure, and clamping method.
- The PV module frame(s) must be attached to a support structure by one of the methods described in Section 7, INSTALLING PV MODULES.
- Module support structures used to support the PV module(s) should be wind rated and approved by the appropriate local and civil codes prior to installation.
- Do not expose the back of the module to direct sunlight.
- In Canada installation shall be in accordance with CSA C22.1, Safety Standard for Electrical Installations, Canadian Electrical Code, Part 1.

- When handling the modules, **DO NOT HOLD THEM BY SUPPORTING ONLY ONE SIDE OF THE FRAME BECAUSE IT CAN CAUSE SEPARATION OF THE GLASS AND FRAME.**



- Do not touch the PV module with bare hands. The frame of the PV module may have sharp edges and may cause injury. Wear suitable gloves, such as leather gloves with padding in the palm and finger areas.

FIRE RATING

- In case of roof installation, the PV module assembly shall be mounted on a fire resistant roof covering rated for the application. The PV module is comprised of a glass front surface and polyethylene terephthalate (PET) backsheet and has a Class C fire rating.
- The fire rating of the PV module is valid only when mounted in the manner specified in the installation manual.

GROUNDING

- The PV module with exposed conductive parts is considered to be in compliance with UL1703 only when it is electrically grounded in accordance with the instructions presented below and the requirements of the National Electrical Code.
- Refer to "9.GROUNDING" section.

BATTERY

- When PV modules are used to charge batteries, the battery must be installed in a manner, which will ensure the performance of the system and the safety of its users. **Follow the battery manufacturer's safety guidelines concerning installation, operation and maintenance recommendations.** In general, the battery (or battery bank) should be kept away from people and animals. Select a battery site that is protected from sunlight, rain, snow, debris, and is well ventilated. Most batteries generate hydrogen gas when charging, which can be explosive. Do not light matches or create sparks near the battery bank. When a battery is installed outdoors, it should be placed in an insulated and ventilated battery case specifically designed for this purpose.

5. SITE SELECTION

In most applications, the PV modules should be installed in a location where they will receive maximum sunlight throughout the year. In the Northern Hemisphere, the modules should typically face south, and in the Southern Hemisphere, the modules should typically face north. Modules facing 30 degrees away from true South (or North) will lose approximately 10 to 15 percent of their power output. If the module faces 60 degrees away from true South (or North), the power loss will be 20 to 30 percent. Install the solar modules where they are not shaded by obstacles such as buildings and vegetation. Pay special attention to avoid partial shadowing of the solar modules by objects during the daytime.

6. MODULE TILT ANGLE

The PV modules produce more power when they are pointed directly at the sun. For stand alone installations PV modules should be tilted for optimum winter performance. As a general rule, if the system power production is adequate in the winter, it will be satisfactory during the rest of the year. PV module tilt angle is measured between PV modules and the ground. Refer to the recommended module tilt angle table for your site.

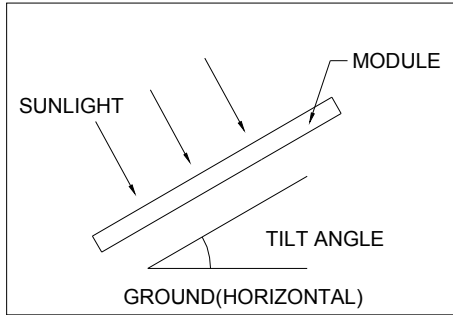


Figure 1. Module Tilt Angle

Table 1. Recommended Tilt Angles for Stand Alone Fixed Systems - Based on Winter Performance

SITE LATITUDE IN DEGREES	FIXED TILT ANGLE
0° TO 15°	15°
15° TO 25°	SAME AS LATITUDE
25° TO 30°	LATITUDE + 5°
30° TO 35°	LATITUDE + 10°
35° TO 40°	LATITUDE + 15°
40° +	LATITUDE + 20°

For grid tie installations where the solar modules are attached to a permanent structure, PV modules should be tilted at an angle equal to the site's latitude. This will typically result in the highest annual energy output.

7. INSTALLING PV MODULES

The minimum spacing of 2" (50mm) is required between the PV module and the mounting surface around the perimeter of PV module. The frame of each PV module has 0.35" (9mm) diameter mounting holes (Refer to Module Mounting Specifications). These are used for fixing PV modules to the supporting structure. PV module frames must be attached to a support structure using M8 (5/16") stainless steel screw in a minimum of four (4) places symmetrical on PV module. The stainless steel screw used for fixing the module frame should secure with an adequate torque. (usually, 19 N-m (14 ft-lb).) An example of a ground mounted structure is shown in Figure 2. The four holes close to the corners of the module are most often used for installation. Refer to the Mounting Specifications for the position of these holes. Clearance between PV module frame and the mounting surface may be required to prevent the junction box from touching the surface, and to circulate cooling air around the back of PV module. Spacing between PV modules must be a minimum of 1/8" (3.2 mm) to allow for thermal expansion. If the modules are to be installed on the roof or wall of a building, the stand-off method or the rack method is recommended.

When installing modules in a snowy area, an appropriate countermeasure has to be taken to prevent possible damage to the lower side frame by slipping snow (e.g. attach supporting parts to the lower side frame of modules). Any damage caused by snow or such countermeasures is not covered under warranty.

STAND-OFF METHOD: PV modules are supported parallel to the surface of the building wall or roof. Clearance between PV module frames and surface of the wall or roof is required to prevent PV module and / or wiring from damage.

The recommended stand-off height is 4.5" (about 115 mm). If other mounting means are employed, this may affect the Listing For Fire Class Ratings.

RACK METHOD: The supporting frame is used to mount PV modules at correct tilt angles. PV modules specified in this installation manual are not designed for Building Integrated Photovoltaic (B.I.P.V) application as part of a roof or wall. The mounting design may have an impact on the fire resistance.

OTHER: Other method(s) certified by a registered professional engineer, and in compliance with local codes.

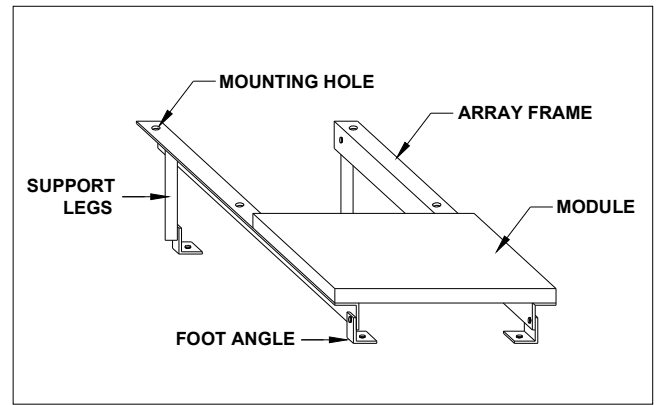


Figure 2. Basic Rack or Stand-off Mounting Structure

8. MODULE WIRING

As shown in Figure 3 Standard Wiring Examples, Kyocera PV modules utilize the Type "IM" junction box (see J-box details). This junction box, located on the back side of the module, is weatherproof and is designed to be used with standard wiring or conduit connections. A cable clamp with a minimum rating of IP65 must be used to maintain the weatherproof integrity of the junction box. Bypass diodes are preinstalled at factory.

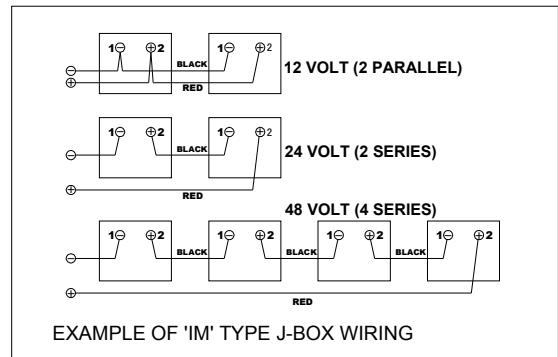


Figure 3. Standard Wiring Examples

To wire Kyocera PV modules:

- Determine the nominal system array voltage of your system. Each panel is equivalent to a 12 VDC nominal block. Standard array voltages 12, 24 and 48 volt are shown as examples in Figure 3.
- Open the "IM" box cover by loosening the screws in the cover.
- The wire used to interconnect PV modules may be single or two conductors, from 14AWG (2.08 mm²) up to 10AWG (5.26 mm²) gauge stranded copper wire, in a "SUNLIGHT RESISTANT" and insulated for 90°C minimum jacket cable. This cable is suitable for applications where wiring is exposed to the direct rays of the sun. The maximum and minimum outer diameters of the cable that may be used with the cable connector are 8 mm and 6 mm respectively (Figure 4).
- Using a flat blade screw driver, remove only the appropriate "KNOCK-OUTS" from the sides of the "IM" box.
- Route wires through the knock-outs and clamps refer to installation example (see Figure 5).
- Gently hand tighten the terminal screws with cross slot (Phillips -head) screwdriver. Do not over tighten, as the terminal can be damaged.
(Recommendation Torque : 1.5N-m (13.3 in-lb))
- The output wiring from the final module is generally run to a separate array junction box. In commercial system, this wiring from the array box to the next component (i.e. fuse box. or charge regulator, etc.) is generally run in conduit. The maximum electrical rating of an acceptable series fuse is 15 amperes.
- After checking that PV module wiring is correct, close all the junction boxes. Use a Phillips head screw driver to secure all screws on the junction box cover to ensure a waterproof seal.
- Refer to the cable clamp specifications for The PV modules. Refer to below for a cable clamp of our designation.
(Manufacturer / Part Number)
Cable Gland : LAPP / S2212 (NPT-1/2")
Nut : LAPP / 911371K (NPT-1/2")

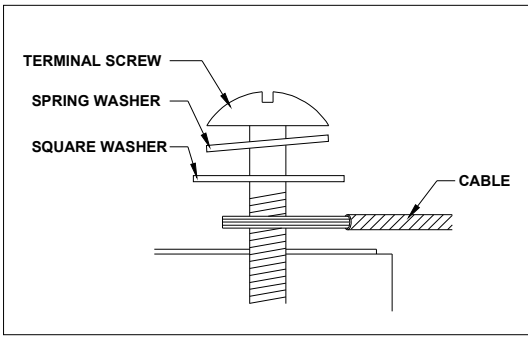


Figure 4. Ring or Spade Terminal Connectors

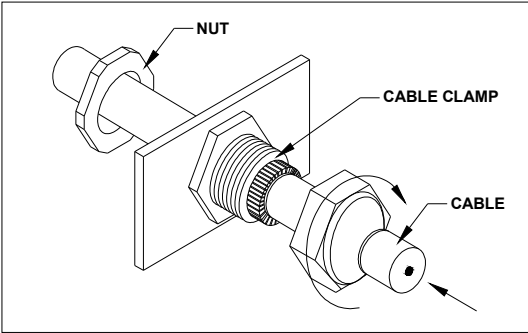


Figure 5. Installation Example of Cable Clamp

NOTE: DO NOT MAKE WIRING WORK WHILE PV MODULE IS EXPOSED TO THE LIGHT.

NOTE: MAXIMUM SYSTEM VOLTAGE IS 600VDC.

The PV modules and most PV system components have a maximum system voltage rating of 600 volts DC. Some grid-tie systems operate at or near this voltage rating. Like other polycrystalline solar modules, the open circuit voltage of the PV module increases as the ambient temperature decreases. Maximum System voltage is computed as the sum of the open-circuit voltage of the series-connected PV modules for the lowest expected ambient temperature. Refer to the National Electrical Code Article 690-7(a) for determining the maximum number of the PV modules that can be placed in series. Temperature coefficients, specific to the module of use, can be used to provide the most accurate prediction of module voltage under temperature extremes.

NOTE: Limit the maximum number of series connections of the PV modules so that the system voltage is 600V or less.

NOTE: Do not connect the modules in parallel without maximum over current protection.

NOTE: Under normal conditions, PV module is likely to experience conditions that produce more current and/or voltage than reported at standard test conditions. The requirements of the National Electrical Code (NEC) in Article 690 shall be followed to address these increased outputs. In installations not under the requirements of the NEC, the values of ISC and VOC marked on this module should be multiplied by a factor of 1.25 when determining component voltage ratings, conductor ampacities, overcurrent device ratings, and size of controls connected to the PV output.

9. GROUNDING

Before installation, consult the local codes and the authorities having jurisdiction to determine the necessary grounding requirements. When installing in the US market, attach all PV module frames to an earth ground in accordance with the National Electrical Code (NEC) Article 250. Proper grounding is achieved by connecting PV module frames and all metallic structural members contiguously to one another using a suitable grounding conductor. The grounding conductor shall be of copper, copper alloy or another material suitable for use as an electrical conductor per NEC. The grounding conductor must then make a connection to earth using a suitable earth grounding electrode. Ensure positive electrical contact through the anodizing on PV module frame extrusion by utilizing one of the following methods.

Attach the grounding conductor:

- (1) to one of the .35" (9mm) diameter holes marked "ground" using 5/16" stainless steel hardware. Wrap conductor around bolt. Tighten the screws with adequate torque (usually 132 in-lb). Avoid direct contact of copper ground conductor to aluminum frame.
- (2) to a ground lug (manufacture : ILSCO, model : GBL-4DBT). Tighten the screws with adequate torque (usually 62 in-lb). Use #10-32 stainless steel hardware to attach the lug to the module frame torque to 40 in-lb.

NOTE: A stainless steel star washer, having contact with anodized surface of the frame, must be employed to break through the anodized layer of the frame extrusion and electrically connect the grounding conductor to the conducting aluminum frame material.

NOTE: As a general rule, avoid direct contact of copper or copper alloy ground conductors with the aluminum frame to prevent galvanic corrosion. All ground bond securing hardware in contact with either the aluminum module frame and/or copper or copper alloy ground conductors must be stainless steel.

NOTE: Where common grounding hardware (nuts, bolts, star washers, spring-ring lock washers, flat washers and like that) is used to attach a listed grounding/bonding device, the attachment must be made in conformance with the grounding device manufacturer's instructions.

NOTE: Common hardware items such as nuts, bolts, star-washers, lock washers and the like have not been evaluated for electrical conductivity or for use as grounding devices and should be used only for maintaining mechanical connections and holding electrical grounding devices in the proper position for electrical conductivity. Such devices, where supplied with the module and evaluated through the requirement in UL 1703, may be used for grounding connections in accordance with the instructions provided with the module.

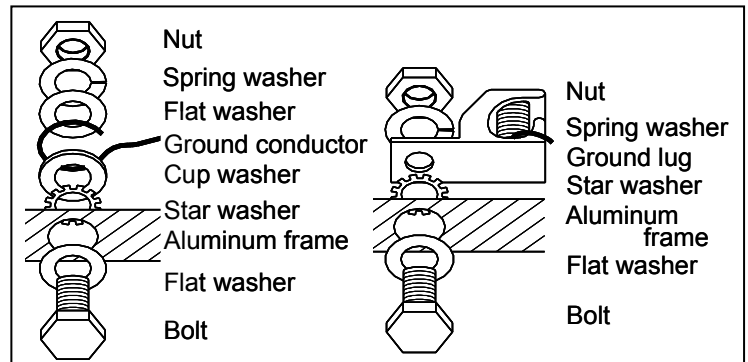


Figure 6. Installation Example of Grounding

10. BLOCKING DIODES

In systems utilizing a battery, blocking diodes are typically placed between the battery and PV module output to prevent battery from discharging at night. The PV modules is made of polycrystalline cells with high electrical "back flow" resistance to nighttime battery discharging. As a result, the PV modules do not contain a blocking diode when shipped from the factory. Most PV charge regulators and inverters incorporate a nighttime disconnect feature.

11. BYPASS DIODES

Partial shading of an individual module in a source circuit string (i.e. two or more modules connected in series) can cause a reverse voltage across the shaded cells within the module. Module output current is then forced through the shaded area by the remaining illuminated cells and other PV modules in series with the partially shaded module(s). The current forced through the shaded cells within the PV module(s) causes additional module heating and severe loss of power.

The purpose of bypass diodes is to provide a low-resistance current path around the shaded cells, thereby minimizing PV module heating and array current losses.

The PV modules employ bypass diodes that have:

- Rated Average Forward Current [$I_{F(AV)}$] **Above** maximum system current at highest PV module operating temperature.
- Rated Repetitive Peak Reverse Voltage [V_{RRM}] **Above** maximum system voltage at lowest PV module operating temperature.

12. MAINTENANCE

The PV module is designed for long life and requires very little maintenance. Under most weather conditions, normal rainfall is sufficient to keep the module glass surface clean. If dirt build-up becomes excessive, clean the glass surface only with a soft cloth using mild detergent and water. USE CAUTION WHEN CLEANING THE BACK SURFACE OF THE PV MODULE TO AVOID PENETRATING THE BACK SHEET. PV modules that are mounted flat (0° tilt angle) should be cleaned more often, as they will not "self clean" as effectively as modules mounted at a 15° tilt or greater. Once a year, check the tightness of terminal screws and the general condition of the wiring. Also, check to be sure that mounting hardware is tight. Loose connections may result in a damaged PV module or array.

KYOCERA Solar Group Sales Office

■ KYOCERA Corporation

Corporate Solar Energy Group
6 Takeda Tobadono-cho Fushimi-ku, Kyoto 612-8501, Japan
Phone : 81-75-604-3476
Fax : 81-75-604-3475
<http://www.kyocera.com/>

■ KYOCERA Solar, Inc.

8800 E. Raintree Drive, Suite 280, Scottsdale, AZ 85260, U.S.A.
Phone : 1-480-948-8003
Fax : 1-480-951-6329
<http://www.kyocerasolar.com/>

■ KYOCERA Solar Pty Ltd.

Level 3, 6-10 Talavera Road, North Ryde NSW 2113, Australia
Phone : 61-2-9870-3946
Fax : 61-2-9888-9673
<http://www.kyocerasolar.com.au/>

■ KYOCERA Solar do Brasil Ltda.

Av. das Américas, nº 20.007, Bl 02/ Sala 105 - Recreio dos Bandeirantes Ed.
Comercial Everglades Cep 22790-851 - Rio de Janeiro/ RJ – Brasil
Phone : 55-21-3724-3900
Fax : 55-21-3724-3911
<http://www.kyocerasolar.com.br>

13. SPECIFICATIONS

Under certain conditions, a photovoltaic module may produce more voltage and current than reported at Standard Test Conditions (STC). Refer to Section 690 of the National Electrical Code for guidance in series string sizing and choosing overcurrent protection.

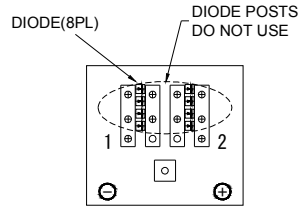
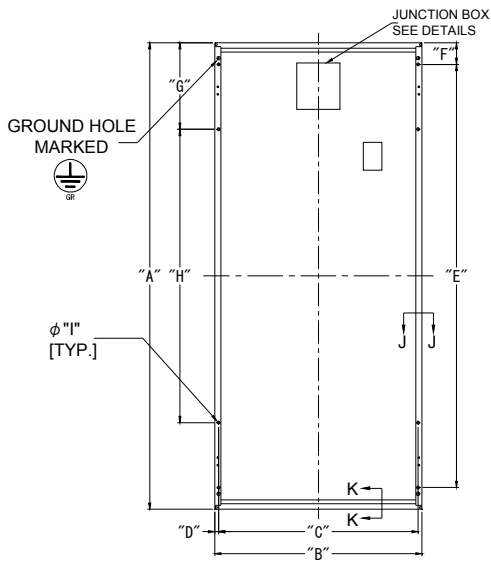
Table.2 Module Specification

Electrical Characteristics: @ STC			
Module Type	KD140SX-UFU	KD145SX-UFU	KD150SX-UFU
Pmax	140W	145W	150W
Voc	22.1V	22.3V	22.5V
Isc	8.68A	8.78A	8.87A
Vpm	17.7V	17.9V	18.2V
Ipm	7.91A	8.11A	8.25A
Factory installed Bypass Diode			
Number	8pcs.	8pcs.	8pcs.
Series Fuse Rating	15A	15A	15A
Thermal Characteristics: Temp. Coefficient			
Voc [V/°C] ([%/°C])	-8.00x10 ⁻² (-0.36)	-8.03x10 ⁻² (-0.36)	-8.10x10 ⁻² (-0.36)
Isc [A/°C] ([%/°C])	5.21x10 ⁻³ (6.0x10 ⁻²)	5.27x10 ⁻³ (6.0x10 ⁻²)	5.32x10 ⁻³ (6.0x10 ⁻²)
Vpm [V/°C] ([%/°C])	-9.22x10 ⁻² (-0.52)	-9.32x10 ⁻² (-0.52)	-9.41x10 ⁻² (-0.52)
Physical Characteristics:			
Length	59.06"(1500mm)	59.06"(1500mm)	59.06"(1500mm)
Width	26.30" (668mm)	26.30" (668mm)	26.30" (668mm)
Depth	1.81" (46mm)	1.81" (46mm)	1.81" (46mm)
Weight	27.6lb (12.5kg)	27.6lb (12.5kg)	27.6lb (12.5kg)
Mounting Hole	Diameter .35"(9mm), Quantity 4	Diameter .35"(9mm), Quantity 4	Diameter .35"(9mm), Quantity 4
Grounding Hole	Diameter .35"(9mm), Quantity 4	Diameter .35"(9mm), Quantity 4	Diameter .35"(9mm), Quantity 4
Application Class	Class A	Class A	Class A

NOTES

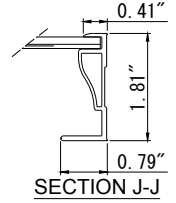
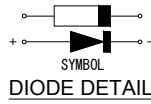
- (1) The electrical characteristics are within +/-10% of the installed values of Pmax, Isc and Voc under standard test conditions (irradiance of 1000W/m², AM 1.5 spectrum, and a cell temperature of 25 deg C).
- (2) See module specification sheet for most recent electrical characteristics.
- (3) See module drawing for mounting and grounding holes locations.

MODULE DIMENSIONS										
MODULE TYPE	DIM.A	DIM.B	DIM.C	DIM.D	DIM.E	DIM.F	DIM.G	DIM.H	DIM.I	J-BOX TYPE
KD140SX-UFU										
KD145SX-UFU	59.06"	26.30"	25.31"	0.49"	53.54"	2.76"	10.96"	37.13"	0.35"	IM
KD150SX-UFU										

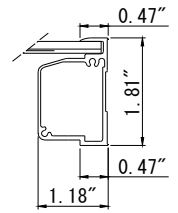


TYPE 'IM' J-BOX

TERMINAL DESIGNATIONS
1:NEGATIVE POST
2:POSITIVE POST



SECTION J-J



SECTION K-K

REVISION RECORD

December 28, 2015 The first edition