KYOCERA

INSTALLATION MANUAL
FOR KYOCERA PV MODULES

KD140SX-1YU

Please read this manual carefully before installing the modules.

6C-210471

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 modules 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

Kyocera PV module (hereinafter referred to as "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 for residential, commercial, or utility applications; grid-tie or off-grid applications and those with or without using storage batteries.

4. WARNINGS AND SAFETY PRECAUTION

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 for solar concentration.

PERMIT

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

INSTALLATION AND OPERATION

- 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 module is quite durable, the glass can be broken if it is dropped or hit by tools or other objects.
  This will render the PV module inoperable.
- Sunlight shall not be concentrated on the module.
- 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 attaches to a support structure by one of the methods described in Section 7, INSTALLING PV MODULES.
- Module support structures to be 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.
- Do not touch the PV module with bare hands. The frame of the PV module has sharp edges and many cause injury. Wear suitable gloves, such as leather gloves with padding in the palm and finger areas.

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

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, polyethylene terephthalate (PET) back sheet and has a Class C fire rating.

GROUNDING

- Refer to "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. When choosing a site, avoid trees, buildings or obstructions which could cast shadows on PV modules especially during winter season when the arc of the sun is lowest over the horizon.

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.

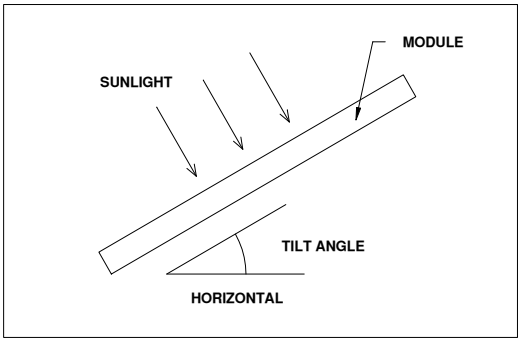

Figure 1. Module Tilt Angle

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 KD SERIES MODULES

A minimum spacing of 2" (50mm) is required between the PV module and the mounting surface around the perimeter of PV array. The frame of each module has .35" (9 mm) mounting holes (Refer to Module Mounting Specifications). These are used fixing PV modules to the supporting structure. 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 the module. A minimum of .13" (3.2mm) spacing must also be maintained between module frames to allow for thermal expansion. If the modules are to be installed on the roof or wall of a building, the standoff method or the rack method is recommended.

STAND-OFF METHOD: The PV modules are supported parallel to the surface of the building wall or roof. Clearance between the module frames and surface of the wall or roof is required to prevent 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) as part of a roof or wall application. 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.

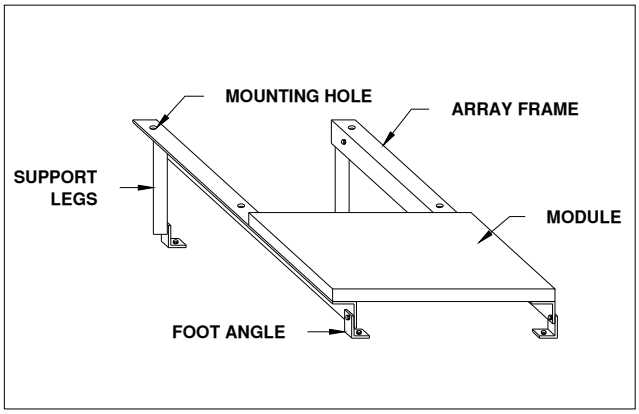

Figure 2. Basic Rack or Standoff Mounting Structure

8. MODULE WIRING

As shown in Figure 3 Standard Wiring Examples, the 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.

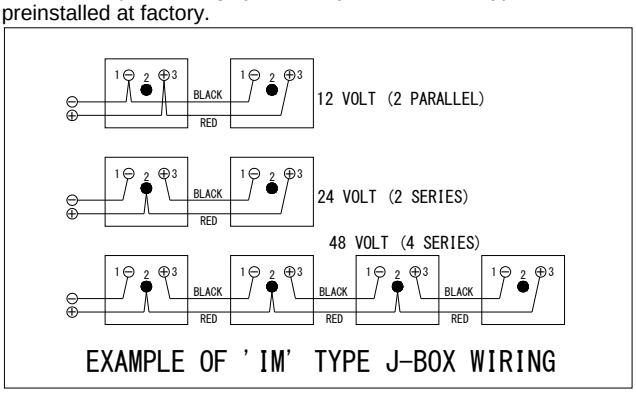

Figure 3. Standard Wiring Examples

To wire the PV modules:

A 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.

B. Open the "IM" box cover by loosening the screws in the cover.

C. The wire used to interconnect PV modules may be single or two conductors, from 14AWG (2.08 mm^2) up to 10AWG (5.26 mm^2) gauge stranded copper wire, in a "SUNLIGHT RESISTANT" 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).

D. Using a flat blade screwdriver, remove only the appropriate "KNOCK-OUTS" from the sides of the "IM" box.

E. Route wires through the knock-outs and clamps refer to installation example (see Figure 5).

F. Gently hand tighten the terminal screws with cross slot (Phillips -head) screwdriver. Do not over tighten, as the terminal can be damaged.
(Recommendation Torque : 1.1 foot-pounds (1.5 Newton-meters))

G. 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 6～15 amperes.

H. After checking that 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.

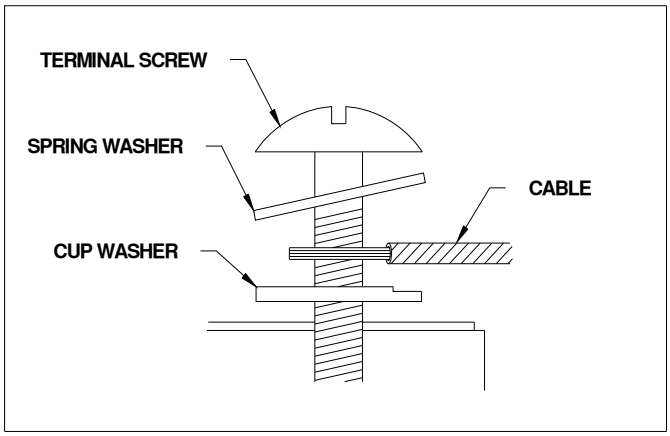

Figure 4. Ring or Spade Terminal Connectors

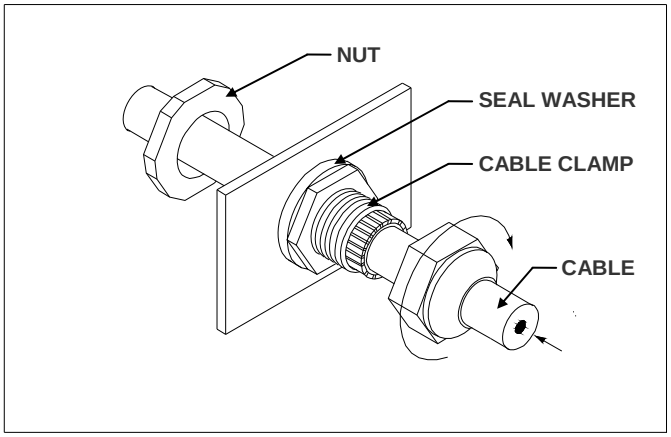

Figure 5. Installation Example of Cable Clamp

NOTE: MAXIMUM SYSTEM VOLTAGE IS 750VDC.
The PV modules and most PV system components have a maximum system voltage rating of 750 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. 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 connection of the PV

modules so that the system voltage is 750V or less.
NOTE: Under normal conditions, PV modules may produce more current and/or voltage than reported in the standard test conditions. Therefore, when voltage evaluations for components, capacity of conductors, size of fuses, and size of control systems connected to the module output are determined, multiply the values of short- circuit current (Isc) and open-circuit voltage (Voc) that are marked in PV modules by the factor of 1.25.

9. GROUNDING

Before installing, consult the local code authorities having jurisdiction to determine the necessary grounding requirements. Attach all PV module frames to the earth ground. Proper grounding is achieved by connecting PV module frame(s) and all metallic structural members continuously one to another using a suitable "grounding conductor". The grounding conductor, or strap, may be copper, copper alloy, or good conduct. Ensure positive electrical contact through the anodizing on PV module's frame by utilizing one of the following grounding methods. Attach the grounding conductor:

(1) to one of the 9 mm diameter holes marked 'ground' with a bolt and nut assembly that incorporates a bonding or external tooth washer, or a serrated screwhead.
(A bolt of 8mm in diameter is recommended.)
(2) to electrically conductive metal, such as that of a support structure, which has been bonded to the module frame through the use of 4 bonding or external tooth washers, a welded, soldered for brazed joint or other suitable means. A minimum torque of 6 foot-pounds (8 Newton-meters) must be applied to ensure a proper electrical connection through module frame anodizing.
(3) with two or more screws, or two full threads of a single screw engaging PV module frame metal.

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 are 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 inverter incorporate a nighttime disconnect feature, however.

11. BYPASS DIODES

Partial shading of an individual module in a source circuit string (i.e. two or more PV modules connected in series) can cause a reverse voltage across the shaded cells within PV module. PV 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 PV module(s). The current forced through the shaded cells within the PV module(s) causes additional PV module heating and serve 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.

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 PV 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 PV 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.

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13. SPECIFICATIONS

・ Under certain conditions, a photovoltaic module may produce more voltage and current than reported at Standard Test Conditions (STC).

Electrical Characteristics : @ STC	
Model Number	KD140SX-1YU
Rated Power, Watts (Pmax) (W)	140 ±5%
Open Circuit Voltage (Voc) (V)	22.1
Short Circuit Current (Isc) (A)	8.68
Voltage at Load (Vpm) (V)	17.7
Current at Load (Ipm) (A)	7.91
Maximum System Voc (V)	750
Factory installed Bypass Diode (pcs.)	8
Series Fuse Rating (A)	15
Thermal Characteristics :	
Temp. Coefficient of Voc (V / ℃)	-0.80×10^{-1}
Temp. Coefficient of Isc (A / ℃)	5.21×10^{-3}
Temp. Coefficient of Vpm (V / ℃)	-9.22×10^{-2}
Physical Characteristics :	
Length (mm)	1500
Width (mm)	668
Depth (mm)	46
Weight (kg)	12.5
Mounting Hole Diameter	9mm, Qty.4
Grounding Hole Diameter	9mm, Qty.4
Application Class	Class A

NOTES

(1) Standard Test Conditions of irradiance of 1000 W/m^2, spectrum of 1.5 air mass, and cell temperature of 25 deg C.

(2) See module drawing for mounting and grounding holes locations.