



INSTALLATION MANUAL

FOR THE

KC-SERIES

SOLAR PHOTOVOLTAIC POWER MODULES

Please read this manual carefully before installing the modules.

6C-203650-3

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. APPLICATIONS

KC series modules are a reliable, virtually maintenance-free direct current (DC) power source, designed to operate most efficiently in sunlight. KC series modules are ideal for powering remote homes, water pumps, utility grid-tie, telecommunication systems and many other applications either with or without the use of storage batteries.

3. WARNINGS + SAFETY

Solar 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 to avoid shocks or burns. Do not touch live terminals with bare hands. Use insulated tools for electrical connections.

PERMIT

- Before installing your solar system, contact local authorities to determine the necessary permit, 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 the module.

- Although KC series modules are quite rugged, the glass can be broken (and the module will no longer work properly) if it is dropped or hit by tools or other objects.
- 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 with contact to a rack of another type of metal. (Electrolysis Corrosion) If required, PVC or stainless steel washers can be placed between the solar module frame and support structure to prevent this type of corrosion.
- KC series module(s) frame must be attached to a support structure by one of the methods described in Section 6, Installing KC series module(s).
- Module support structures that are to be used to support KC series module(s) should be wind rated and approved for use by the appropriate local and civil codes prior to installation.

FIRE RATING

- KC series modules are comprised of a glass front surface, polyvinyl fluoride (PVF) backskin and possess a Class C fire rating.

GROUNDING

- Refer to "Grounding" section.

INSPECTION

- Follow the requirements of applicable local and national electrical codes.

BATTERY

- When solar modules are used to charge batteries, the battery must be installed in a manner, which will protect the performance of the system and the safety of its users. **Follow the battery manufacturer's guidelines concerning installation, operation and maintenance recommendations.** In general, the battery (or battery bank) should be away from the main flow of people and animal traffic. 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 the purpose.

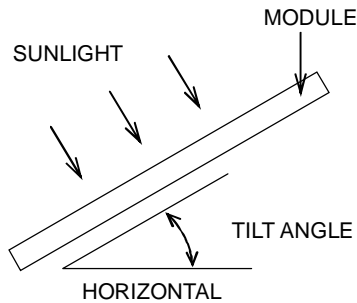
4. SITE SELECTION

In most applications, KC series 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 the solar modules especially

during the winter months when the arc of the sun is lowest over the horizon.

5. MODULE TILT ANGLE

KC series modules produce the most power when they are pointed directly at the sun. For stand alone installations the solar 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. The solar module tilt angle is measured between the solar modules and the ground. Refer to the recommended module tilt angle table for your site.



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, the solar modules should be tilted at an angle equal to the site's latitude. This will typically result in the highest annual energy output.

6. INSTALLING KC SERIES MODULES

KC series module may be installed in various applications utilizing a variety of support structure options and attachment methods. For optimal performance in all applications, clearance between the module frame and the mounting surface is required to allow cooler ambient air to circulate around the back of the module.

BUILDING ATTACHED: The modules are commonly 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 wiring damage and to allow air to circulate behind the module. Do not fully enclose the photovoltaic array, as solar modules perform best when cool in temperature. If other mounting means are

employed, this may affect the listing for Fire Class Ratings. **FREE STANDING:** The supporting structure is used to mount modules at correct tilt angles. The mounting design may have an impact on the fire resistance.

KC series module may be attached to a support structure by the following methods:

STANDARD: Utilizing ¼" or 6mm stainless steel hardware through the existing 0.28" diameter (7 mm) mounting holes in the module frame and then through KC series module mounting holes on the support structure. The stainless steel hardware used for securing the module frame should secure with an applied torque of 6 foot-pounds (8 Newton-meters). Refer to the Module Drawings for the position of the solar module mounting holes.

CLAMPING: Top or bottom clamping methods certified by a registered professional engineer, and in compliance with local codes.

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

7. MODULE WIRING

KC series modules come pre-wired and terminated ready for most building attached or free standing installations. Each module has two #10 AWG type USE-2/RHH/RHW-2 stranded sunlight resistant output cables each terminated with Multi-Contact® connectors. The positive (+) terminal has a female connector while the negative (-) terminal has a male connector. The module wiring is solely for series connections only, i.e. female (+) to male (-) interconnections. Series and parallel connections shall be made by use of two #10 AWG type XLP sunlight resistant output cables with male and female Multi-Contact® connectors.

NOTE: When making connections with Multi-Contact connectors, make sure the array is disabled. **DO NOT MAKE CONNECTIONS WHILE UNDER LOAD.** Module output connections are marked "Do not disconnect under load".

NOTE: MAXIMUM SYSTEM VOLTAGE 600 VDC.

KC series 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 KC series module increases as the ambient temperature decreases. Maximum System voltage is computed as the sum of the open-circuit voltage of the series-connected photovoltaic modules for the lowest expected ambient temperature. Refer to the National Electrical Code Article 690-7(a) for determining the maximum number of KC series 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.

8. GROUNDING

Before installing your solar system, contact local authorities to determine the necessary grounding. Attach all module frames to an earth ground in accordance with the National Electrical Code (NEC). Proper grounding is achieved by connecting the module frame(s) and structural members contiguously one to another using a suitable "grounding conductor". The grounding conductor, or strap, may be copper, copper alloy, or another material acceptable for use as an electrical conductor per NEC. The grounding conductor must then make a connection to earth using a suitable earth ground electrode. Ensure positive electrical contact through the anodizing on the module's frame by utilizing one of the following grounding methods. Attach the grounding conductor:

- (1) to one of the 0.28" diameter (7 mm) holes marked 'ground' with a bolt or screw assembly that incorporates a bonding or external tooth washer, or a serrated screwhead.
- (2) to electrically conductive metal, such as that of a support structure, which has been bonded to the module frame through a bonding or external tooth washer, or a welded, soldered or brazed joint or other suitable means.
- (3) with two or more screws, or two full threads of a single screw engaging the module frame metal.

9. BLOCKING DIODES

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

10. 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 solar modules in series with the partially shaded module(s). The current forced through the shaded cells within the module (or modules) causes additional module heating and severe loss of power. All KC series modules are supplied with factory installed (non user serviceable) bypass diodes.

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

The solar modules employ bypass diodes that have:

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

temperature.

11. MAINTENANCE

KC series modules are designed for long life and require 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 MODULE TO AVOID PENETRATING BACK SHEET.** 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 general condition of the wiring and check to be sure that mounting hardware is tight. Loose connections will result in a damaged module or array.

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12. SPECIFICATIONS

- Typical module production may result in a maximum power from 10% higher to 5% lower than Rated Power (Pmax). 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.

Kyocera KC Series Module Specification

Electrical Characteristics: @ STC							
Model Number	KC125GT	KC130GT	KC167GT	KC170GT	KC175GT	KC190GT	KC200GT
Rated Power, Watts (Pmax)	125	130	167	170	175	190	200
Open Circuit Voltage (Voc)	21.7	21.9	28.9	29.0	29.2	32.5	32.9
Short Circuit Current (Isc)	8.00	8.02	8.00	8.03	8.09	8.08	8.21
Voltage at Load (Vpm)	17.4	17.6	23.2	23.4	23.6	26.1	26.3
Current at Load (Ipm)	7.20	7.39	7.20	7.27	7.42	7.28	7.61
Maximum System Voc	600	600	600	600	600	600	600
Factory Installed Bypass Diode (Qty)	Yes (2)	Yes (2)	Yes (3)	Yes (3)	Yes (3)	Yes (3)	Yes (3)
Series Fuse Rating (Amps)	12	12	11	11	11	11	11
Thermal Characteristics:							
Temp. coefficient of Voc (V/°C)	-8.21×10^{-2}	-8.21×10^{-2}	-1.09×10^{-1}	-1.09×10^{-1}	-1.09×10^{-1}	-1.23×10^{-1}	-1.23×10^{-1}
Temp. coefficient of Isc (A/°C)	3.18×10^{-3}	3.18×10^{-3}	3.18×10^{-3}	3.18×10^{-3}	3.18×10^{-3}	3.18×10^{-3}	3.18×10^{-3}
Temp. coefficient of Vpm (V/°C)	-9.31×10^{-2}	-9.31×10^{-2}	-1.24×10^{-1}	-1.24×10^{-1}	-1.24×10^{-1}	-1.40×10^{-1}	-1.40×10^{-1}
Physical Characteristics:							
Model Number	KC125GT	KC130GT	KC167GT	KC170GT	KC175GT	KC190GT	KC200GT
Length, Inches (mm)	56.1(1425)	56.1(1425)	50.8 (1290)	50.8 (1290)	50.8 (1290)	56.1(1425)	56.1(1425)
Width, Inches (mm)	25.7(652)	25.7(652)	39.0 (990)	39.0 (990)	39.0 (990)	39.0(990)	39.0 (990)
Depth, Inches (mm)	1.42(36)	1.42(36)	1.42 (36)	1.42 (36)	1.42 (36)	1.42 (36)	1.42 (36)
Weight, Pounds (kg)	26.9(12.2)	26.9(12.2)	35.3 (16)	35.3 (16)	35.3 (16)	40.8 (18.5)	40.8 (18.5)
Mounting Hole Diameter inches (mm)	0.28"(7) Qty - 8	0.28"(7) Qty - 8	0.28" (7) Qty - 4	0.28" (7) Qty - 4	0.28" (7) Qty - 4	0.28"(7) Qty - 4	0.28"(7) Qty - 4
Grounding Hole Diameter inches (mm)	0.28"(7) Qty - 2	0.28"(7) Qty - 2	0.28" (7) Qty - 2	0.28" (7) Qty - 2	0.28" (7) Qty - 2	0.28"(7) Qty - 2	0.28"(7) Qty - 2

NOTES

- Standard Test Conditions of irradiance of 1000 W/m², spectrum of 1.5 air mass, and cell temperature of 25 deg C.
- Normal Operational Cell Temperature (NOCT) of 800 W/m², spectrum of 1.5 air mass, and cell temperature of 25 deg C.
- See module drawing for mounting and grounding hole locations.

