

# OPTIMUM Module Installation Manual



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# 1 INTRODUCTION

- Perlight Solar modules consist of a series of electrically interconnected crystalline silicon solar cells, which are permanently encapsulated between a tempered glass superstrate and substrate. 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.
- Perlight Solar modules are a highly reliable, virtually maintenance-free direct current (DC) power source, designed to operate most efficiently in sunlight. Perlight Solar series modules are ideal to power remote homes, recreational vehicles, water pumps, telecommunication systems and many other applications either with or without the use of storage batteries.
- this instruction is suitable for following types :

## PV Modules with 6" Mono-crystalline Silicon Solar Cells:

PLM-\*\*\*M-72 (\*\*\*=245W to 360W);  
PLM-\*\*\*MB-72 (\*\*\*=245W to 360W);  
PLM-\*\*\*MA-72 (\*\*\*=245W to 360W);  
PLM-\*\*\*M-66 (\*\*\*=215W to 330W);  
PLM-\*\*\*MB-66 (\*\*\*=215W to 330W);  
PLM-\*\*\*MA-66 (\*\*\*=215W to 330W);  
PLM-\*\*\*M-60 (\*\*\*=220W to 300W);  
PLM-\*\*\*MB-60 (\*\*\*=220W to 300W);  
PLM-\*\*\*MA-60 (\*\*\*=220W to 300W);  
PLM-\*\*\*M-54 (\*\*\*=185W to 270W);  
PLM-\*\*\*MB-54 (\*\*\*=185W to 270W);  
PLM-\*\*\*MA-54 (\*\*\*=185W to 270W);  
PLM-\*\*\*M-48 (\*\*\*=155W to 240W);  
PLM-\*\*\*MB-48 (\*\*\*=155W to 240W);  
PLM-\*\*\*MA-48 (\*\*\*=155W to 240W);

## PV Modules with 6" Poly-crystalline Silicon Solar Cells:

PLM-\*\*\*P-72 (\*\*\*=235W to 350W);

PLM-\*\*\*PB-72 (\*\*\*=235W to 350W);  
PLM-\*\*\*PA-72 (\*\*\*=235W to 350W);  
PLM-\*\*\*P-66 (\*\*\*=225W to 320W);  
PLM-\*\*\*PB-66 (\*\*\*=225W to 320W);  
PLM-\*\*\*PA-66 (\*\*\*=225W to 320W);  
PLM-\*\*\*P-60 (\*\*\*=195W to 295W);  
PLM-\*\*\*PB-60 (\*\*\*=195W to 295W);  
PLM-\*\*\*PA-60 (\*\*\*=195W to 295W);  
PLM-\*\*\*P-54 (\*\*\*=185W to 265W );  
PLM-\*\*\*PB-54 (\*\*\*=185W to 265W );  
PLM-\*\*\*PA-54 (\*\*\*=185W to 265W );  
PLM-\*\*\*P-48 (\*\*\*=165W to 235W );  
PLM-\*\*\*PB-48 (\*\*\*=165W to 235W );  
PLM-\*\*\*PA-48 (\*\*\*=165W to 235W );

#### PV Modules with 5" Mono-crystalline Silicon Solar Cells:

PLM-\*\*\*M-96 (\*\*\*=230W to 280W );  
  
PLM-\*\*\*MB-96 (\*\*\*=230W to 280W);  
PLM-\*\*\*MA-96 (\*\*\*=230W to 280W);  
PLM-\*\*\*M-72 (\*\*\*=160W to 210W );  
PLM-\*\*\*MB-72 (\*\*\*=160W to 210W);  
PLM-\*\*\*MA-72 (\*\*\*=160W to 210W);

## 2 PERMIT

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

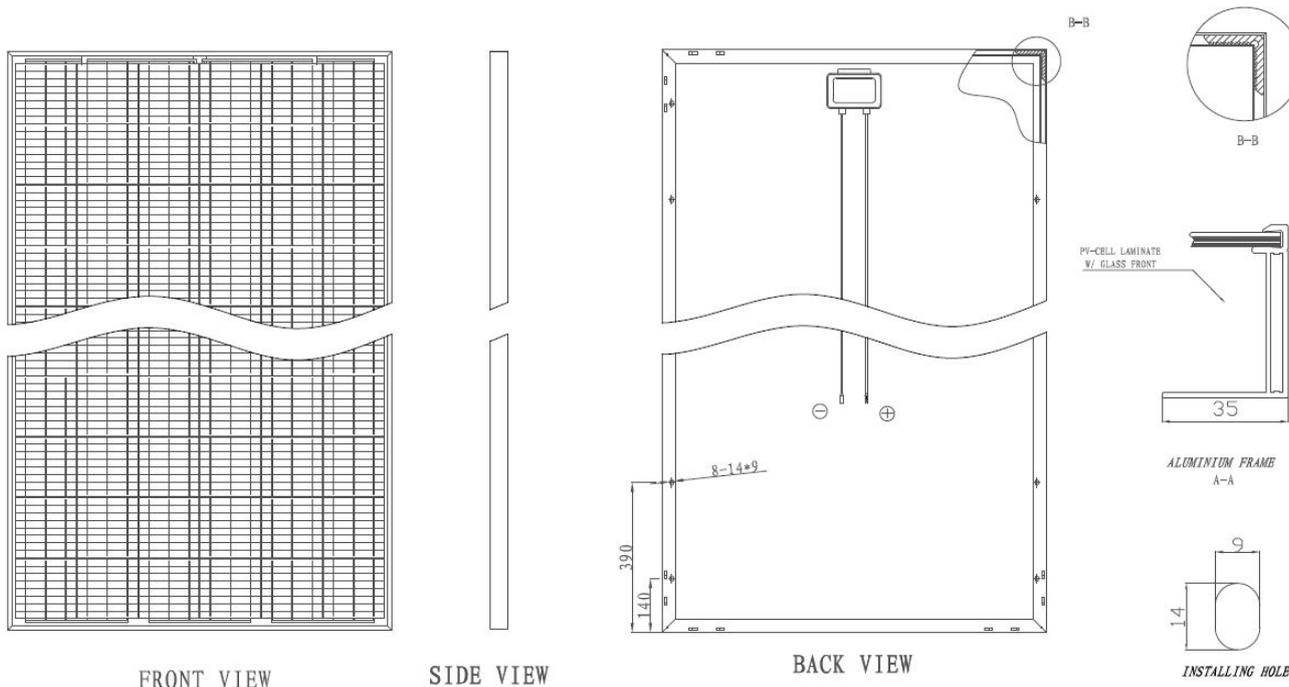
## 3 CLIMATE CONDITION

Install the Perligh Solar PLM-P220 series modules in the following conditions:

- Ambient temperature: -20°C to +40°C.
- Operating temperature: -40°C to +85°C.

- Storage temperature: -40°C to +40°C,
- Humidity: below 85RH%
- Wind pressure: below 50.12lb / ft<sup>2</sup> (2400Pa).
- Corrosion resistance: Except for corrosive salt area and sulfurous area.

## 4 STRUCTURE



## 5 SITE SELECTION

In most applications, Perlight Solar modules should be installed in a location where they will receive maximum sunlight throughout the year. In the Northern Hemisphere, the module 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 per cent 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.

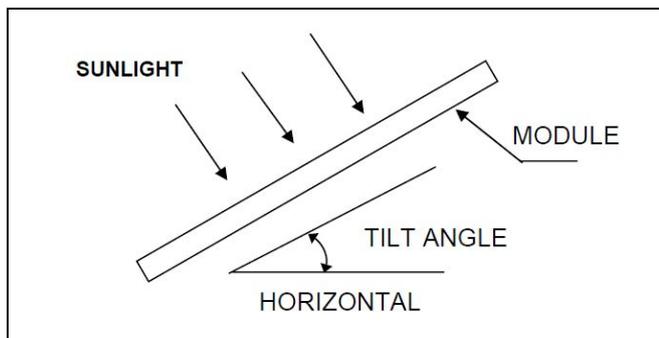
When choosing a site, avoid trees, buildings or obstructions, which could cast

shadows on the solar photovoltaic modules especially during the winter months when the arc of the sun is lowest over the horizon. Shading causes loss of output, even though the factory fitted bypass diodes of the PERLIGHT SOLAR module will minimize any such loss. Do not install the Perligh Solar module near naked flame or flammable materials. Do not install the Perligh Solar module in a location where it would be immersed in water or continually exposed to water from a sprinkler or fountain etc.

## 6 MODULE TILT ANGLE

Perligh Solar modules connected in series should be installed at same orientation and angle. Different orientation or angle may cause loss of output power due to difference of amount of sunlight exposed to the module.

Perligh Solar modules produce the most power when they are pointed directly at the sun. For installations where the Perligh Solar modules are attached to a permanent structure, the Perligh Solar modules should be tilted for optimum winter performance. As a rule, if the system power production is adequate in winter, it will be satisfactory during the rest of the year. The module tilt angle is measured between the solar modules and the ground (Figure.1). Optimal tilting of Perligh Solar module is almost the same as the latitude of installation location.



Degrees of Latitude	Tilting Angle
0° ~ 15°	15°
15° ~ 25°	Same as Latitude
25° ~ 30°	Latitude + 5°
30° ~ 35°	Latitude + 10°
35° ~ 40°	Latitude + 15°
40° +	Latitude + 20°

Chart 1: Installation angle

## 7 MOUNTING AND NOTES

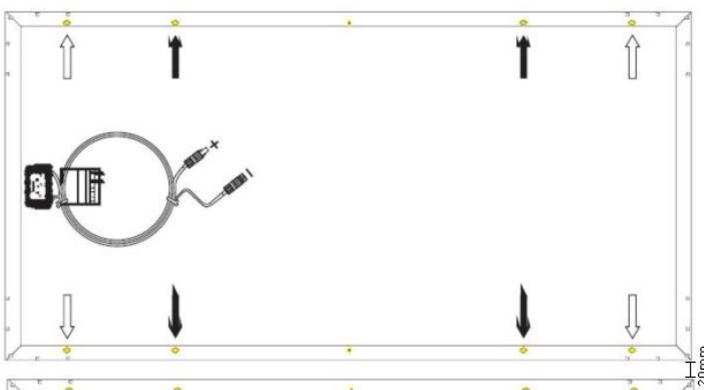
Systems should be installed by qualified personnel only. It involves electricity, and can be dangerous if the personnel are not familiar with the appropriate safety

procedures.

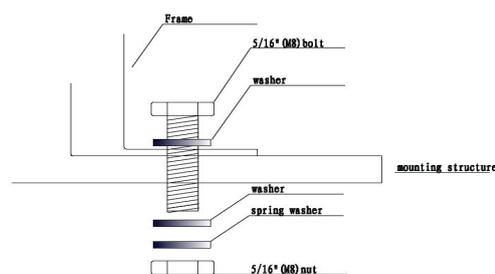
The module frame is made of anodized aluminum, and therefore corrosion can occur if the module is subject to a salt water environment with contact to a rack of another type of metal (Electrolysis Corrosion). If required, PVC or stainless steel washers can be placed between the Perlight Solar module frame and support structure to prevent this type of corrosion. Module support structures that are to be used to support PERLIGHT SOLAR modules at correct tilt angles should be wind and snow load rated for use by the appropriate local and civil codes prior to installation.

Perlight Solar modules can be mounted as following method:

- Using corrosion-proof screws (M8) on the existing installing holes in the module frame, see drawing 2.
- Using suitable module clamps on the module frame, see drawing 2.
- Using insertion systems.



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



(Drawing 2)

The frame of each module has 4 mounting holes (12mm\*9mm) used to secure the modules to supporting structure. The module frame must be attached to a supporting structure using M8 stainless steel hardware together with spring washers and flat washers in four places symmetrical on the Perlight Solar module. The applied torque is about 8 Newtonmeters.

The module clamps must not come into contact with the front glass and must not deform the frame. Avoid shadowing effects from the module clamps and the insertion systems. It is not permitted to modify the module frame under any circumstances. Recommended distance between 2 Solar modules is 5mm considering linear thermal expansion of the module frames.

Clearance between the module frame and 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.

The modules are not designed for integral mounting as part of a roof or wall. The mounting design may have an impact on the fire resistance. If the modules are to be installed on the roof or wall of a building, the fire resistance of roof covering or wall should be rated for the application. Here the standoff method or the rack method is recommended. The modules are supported parallel to 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. The recommended stand-off height is 115mm. Any slope less than 5in/ft (127mm/305mm) required to maintain a fire class rating. Do not mount PERLIGHT SOLAR module in such way that the drain holes of PERLIGHT SOLAR module are intended to block up.

Do not step on the module, although PERLIGHT SOLAR 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.

## 8 GROUNDING

All module frames and mounting racks must be properly grounded in accordance with the National Electrical Code. 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 other 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.

Attach a separate conductor to one of the 4mm diameter grounding holes marked 'GR' on the module frame with a bolt and nut that incorporates an external tooth washer. This is to ensure positive electrical contact with the frame. (Figure.2)

The rack must also be grounded unless they are mechanically connected by nuts and bolts to the grounded PERLIGHT SOLAR modules. The array frame shall be grounded in accordance with NEC Art250.

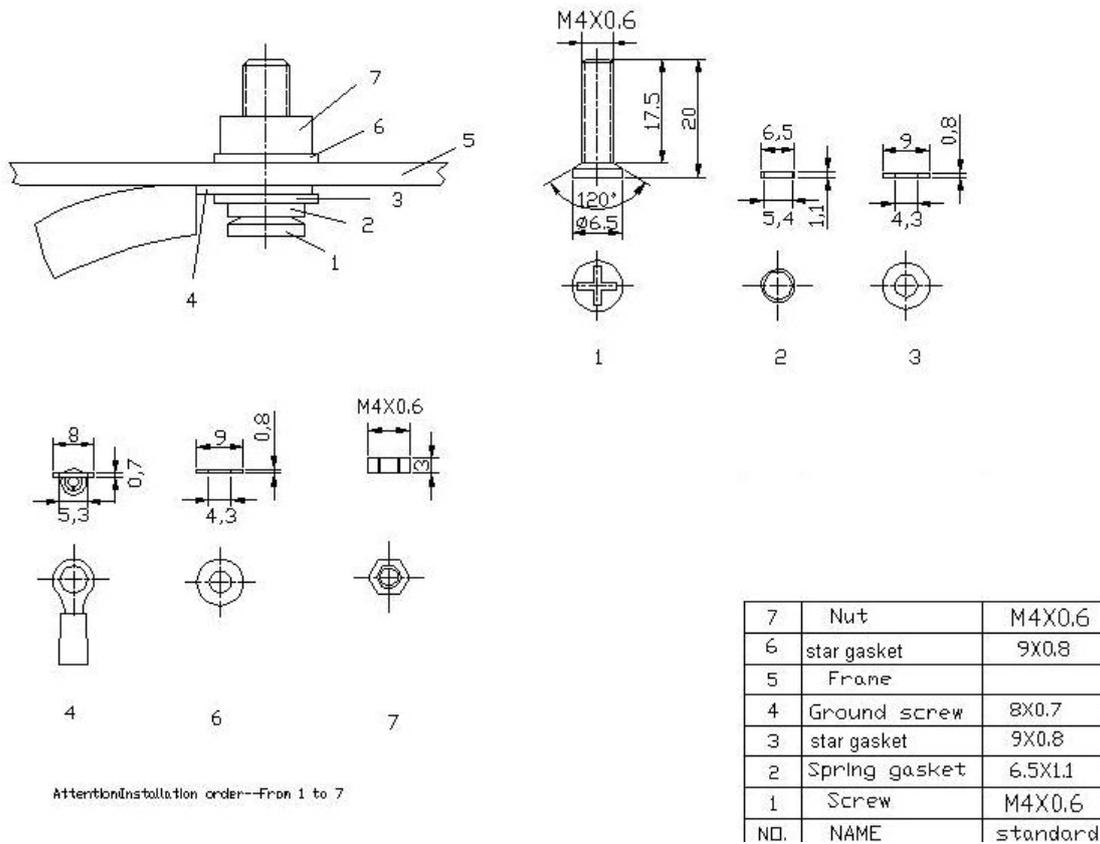


Chart2: grounding Guide

## 9 BYPASS DIODES AND BLOCKING DIODES

Partial shading of an individual module can cause a reverse voltage across the shaded PERLIGHT SOLAR module. Current is then forced through the shaded area by the other modules.

When a bypass diode is wired in parallel with the series string, the forced current will flow through the diode and bypass the shaded PERLIGHT SOLAR module, thereby minimizing module heating and array current losses.

In system utilizing a battery, blocking diodes are typically placed between the battery and the PERLIGHT SOLAR module output to prevent battery discharge at night.

Diodes that are used as blocking diodes must: Have a Rated Average Forward Current [IF(AV)] above maximum system current at highest module operating

temperature. Have a Rated Repetitive Peak Reverse Voltage [VRRM] above maximum system voltage at lowest module operating temperature.

## 10 WARNING AND NOTES

The PERLIGHT SOLAR modules generate electricity when exposed to light. Array 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 maybe 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.

Use appropriate methods to mount PERLIGHT SOLAR modules. Fall of modules from high place will cause death, injury or damage.

The PERLIGHT SOLAR module has a pair of male and female waterproof connectors. For a series electrical connection, connect positive (+) connector of first PERLIGHT SOLAR module to negative (-) connector of the following module.

Do not short the positive and the negative. Do not disconnect under load. Be sure connector no gap between the insulators. In case there is a gap, a fire and/or an electrical shock may occur.

Artificially concentrated sunlight shall not be directed on the PERLIGHT SOLAR module. The electrical characteristics are indicated value of Pmax under standard test conditions (Irradiance of 1000W/m<sup>2</sup>, AM 1.5 spectrum, and cell temperature of 25°C).

Under normal conditions, a solar photovoltaic module is likely to experience conditions that produce more current and/or voltage than reported at standard test conditions. Accordingly the value of Isc and Voc marked on this module should be multiplied by a factor of 1.25 when determining component voltage ratings, conductor current ratings, fuse sizes, and sizes of controls connected to the PERLIGHT SOLAR output. Refer to Section 690-8 of the National Electrical Code for an additional multiplying factor of 1.25 which may also be applicable.

The installation in Canada shall be in accordance with CSA C22.1, Safety Standard for Electrical Installations, Canadian Electrical Code, Part 1.

PV modules can be wired in series to increase voltage as shown in below figure. the maximum quantity in series is 21 pieces of modules. PV modules can be wired in parallel to in increase the current. The maximum PV modules in parallel are

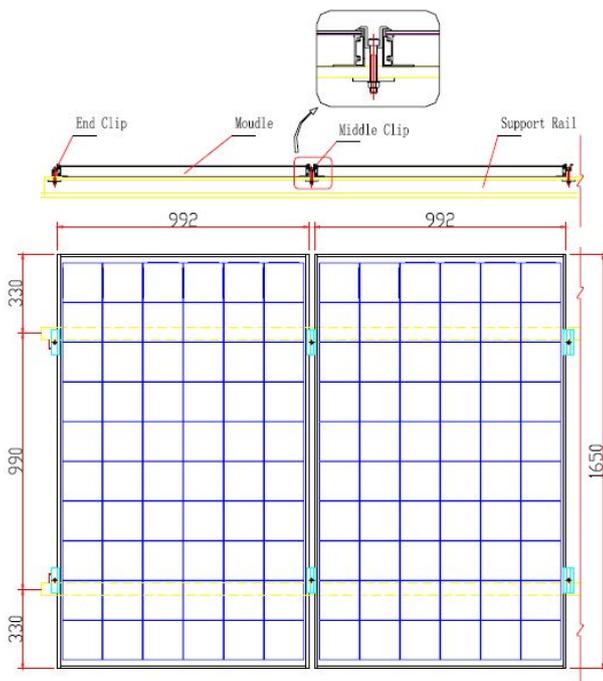
three groups of maximum PV modules in series.

## 11 MODULE WIRING

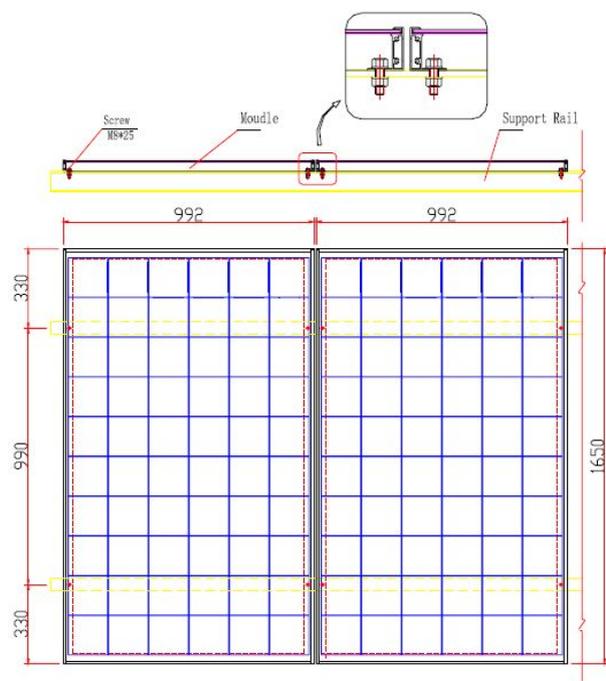
Each module has two TUV 2 PfG 1169 1×4mm<sup>2</sup>, L=900mm standard 90°C sunlight resistant output cables each terminated with plug & ply connectors. This cable is suitable for applications where wiring is exposed to the direct rays of the Sun. We recommend that all wiring and electrical connections comply with the National Electrical Code (NEC).

For field connections, use the minimum No. #12 AWG copper wires insulated for a minimum of 90°C and Sunlight resistant as well.

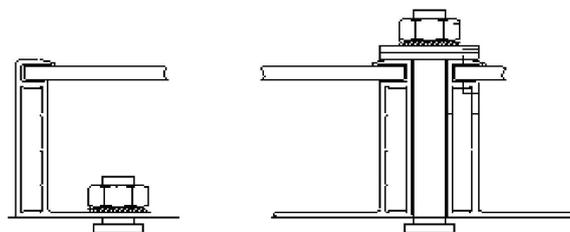
The minimum and maximum outer cable diameters of the cable are 5 to 7mm. Refer to table 1 for the maximum electrical rating of series fuse.



Mounting Drawing 1 (with clamping clips)



Mounting Drawing 2 (with screws)



## 12 MAINTENANCE

Under most weather conditions, normal rainfall is sufficient to keep the PERLIGHT SOLAR module glass surface clean. If dirt build-up becomes excessive, clean the glass only with a soft cloth using mild detergent and water. USE CAUTION WHEN CLEANING THE BACK SURFACE OF THE MODULE TO AVOID PENETRATING THE SUBSTRATE MATERIALS. PERLIGHT SOLAR 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 will result in damage for array.

Changed PERLIGHT SOLAR module must be the same kind and type. Do not touch live parts of cables and connectors. Use appropriate safety equipment (insulated tools, insulating gloves, etc.), when touching them.

Cover the front surface of the PERLIGHT SOLAR module by an opaque or other material when repairing. The PERLIGHT SOLAR modules when exposed to sunlight generate high voltage and are dangerous.

## 13 CLASS APPLICATION

The modules are qualified for application class A: Hazardous voltage (IEC 61730: higher than 50V DC; EN 61730: higher than 120V), hazardous power applications (higher than 240W) where general contact access is anticipated (Modules qualified for safety through EN IEC 61730-1 and -2 within this application class are considered to meet the requirements for Safety Class II).