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**Green Energy Power Module Installation Manual** 

# **Contents**

1 General Information	3
1.1 Overview	3
1.2 Warnings	3
2 Installation	6
2.1 Installation Safety	6
2.2 Installation Condition	7
2.2.1 Climate Condition	7
2.2.2 Site Selection	7
2.2.3 Tilt Angle Selection	7
2.3 Mechanical Installation Introduction	9
2.3.1 General Instructions	9
2.3.2 Mechanical Installation	9
2.3.3 MODULE Grounding	9
3 Wiring and Connections	12
4 Maintenance and Care	14
5 Electrical Specification	14
6 Disclaimer of Liability	14
7 Module specifications	15

### 1. General Information

#### 1.1 Overview

Thanks for choosing Green Energy Power modules. In order to ensure the PV modules are installed correctly, please read the following installation instructions carefully before modules are installed and used. Please remember that these products generate electricity and certain safety measures need to be taken to avoid danger. Make sure the module array is designed in such a way not to exceed the maximum system voltage of any system component such as connectors or inverters.

This module has a Class C Fire Rating (Canada) or Module Fire performance type 1 (United States of America) and must be installed over a roof which has appropriate fire resistance. Before mounting the module, please consult your local building department to determine approved roofing materials. The modules are qualified for application class A, and modules qualified for safety through UL 1703 within this application class are considered to meet the requirements of Safety Class II.

The Fire rating is Class C in Canada, but the Module Fire performance is type 1 in America with the specified construction in below table, when used with a listed mounting system that has been rated as a Class A System when installed with type 1 modules, is suitable to maintain the System Class A Fire Rating in America.

Module	Specific construction	Marking
All Module	Superstrate: 3.2 ~ 4.0 mm thick;  EVA: 0.25 ~ 0.8 mm thick;  Substrate: 0.3 mm ~ 0.46 mm thick;  Frame: Types "35mm by 35mm" or "35mm by  30mm" or "30mm by 30mm"	Module Fire Performance: Type 1

## 1.2 Warnings

- PV modules generate DC electrical energy when exposed to sunlight or other light sources. Active parts of modules such as terminals can result in burns, sparks and lethal shock.
- Artificially concentrated sunlight shall not be directed on the module or panel.
- Front protective glass is utilized on the module.
   Broken solar module glass is an electrical safety

hazard (may cause electric shock or fire). These modules cannot be repaired and should

- be replaced immediately.
- To reduce the risk of electrical shocks or burns, modules may be covered with an opaque material during installation to avoid injury.
- The fire rating of this module is valid only when mounted in the manner specified in the mechanical mounting instructions.
- The module is considered to be in compliance with UL1703 only when the module is mounted in the manner specified by the mounting instructions below.
- All installations must be performed in compliance with the National Electrical Code (NEC) and modules installed in Canada need to follow Canadian Electric Code (CEC).
- A 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.
- Any module without a frame (laminate) shall not be considered to comply with the requirements of UL1703 unless the module is mounted with hardware that has been tested and evaluated with the module under this standard or by a field Inspection certifying that the installed module complies with the requirements of UL1703.
- The installation work of the PV array can only be done under the protection of sunsheltering covers or sunshades and only qualified person can install or perform maintenance work on this module.
- Follow the battery manufacture's recommendations, if batteries are used with modules.
- Do not use this module to replace or partly replace roofs and walls of living buildings.
- Do not install modules where flammable gas may be present.
- Do not touch live terminals with bare hands. Use insulated tools for electrical connections.



Use insulated tools for electrical connection

- Do not remove any part installed by Green Energy Power or disassemble the module.
- All instructions should be read and understood before attempting to install, wire, operate and maintain the module.
- Don't lift up PV modules using the attached cables or the junction box.
- All PV systems must be grounded to earth. If there is no special regulation, please follow the National Electrical Code or other national code.
- 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 requirements in UL 1703, may be used for grounding connections in accordance with the instructions provided with the

module.

- Under normal conditions, a photovoltaic 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 value of Isc and Voc marked on the 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.
- Once the PV module has been shipped to the installation site, all of the parts should be unpacked properly with care.
- Do not stand or step on the PV module like below pictures show. This is prohibited and there is a risk of damage to the module and cause injury for you.





- Only PV modules with the same cell size should be connected in series.
- During transporting modules, please attempt to minimize shock or vibration to the module, as this may damage the module or lead to cell micro cracks.
- During all transportation situations, never drop the module from a vehicle, house or hands. This will damage the module.
- Do not clean the glass with chemicals. Only use tap water. Make sure the module surface temperature is cool to the touch. Cleaning modules with cool water when module surface temp is high may result in glass breakage.
- Do not disconnect any of the modules when under load.
- The recommended standoff height is 6 inches (15cm). If other mounting means are employed this may affect the UL Listing.
- When looking at PV modules with anti-reflection (AR) coating technology, it will be normal
  to see some cells with a slight color difference at different angles. Modules with LRF
  (light reflective film) and without LRF should not be built in the same array.
- Do not use modules in an environment with aliphatic, aromatic, phenols, ketones, halogenated substance or mineral oil, which may corrode the junction box by chemical attack.

### 2. Installation

## 2.1 Installation Safety

- Always wear protective head gear, insulated gloves and safety shoes (with rubber soles).
- Keep the PV module packed in the carton until installation.
- Do not touch the PV module unnecessarily during installation. The glass surface and the frame may be hot. There is a risk of burns and electric shock.
- Do not work in rain, snow or windy conditions.
- Due to the risk of electrical shock, do not perform any work if the terminals of the PV module are wet.
- Use insulated tools and do not use wet tools.
- When installing PV modules, do not drop any objects (e.g., PV modules or tools).
- Make sure flammable gases are not generated or present near the installation site.
- The modules are equipped with PV wiring connectors that comply with UL 6703, Standard for Connectors for use in Photovoltaic Systems. Connectors from other manufactures should not be mated with each other connectors.
- Insert module connectors fully and correctly. An audible "click" sound should be heard.
   This sounds confirms the connectors are fully seated. Check all connections.
- The module leads should be securely fastened to the module frame. Wire Management should be done in a way to avoid the connector from scratching or impacting the back sheet of the module.
- Do not touch the junction box and the end of the interconnect cables (connectors) with bare hands during installation or under sunlight, regardless if the PV module is connected to or disconnected from the system.
- Do not expose the PV module to excessive loads on the surface of the PV module or twist the frame.
- Do not hit or put excessive load on the glass or back sheet, this may break the cells or cause micro cracks.
- During installation or operation, don't use sharp tools to wipe the back sheet and glass.
   Scratches can appear on the module.
- Do not drill holes in the frame, it may cause corrosion of the frame and void the warranty.
- When installing modules on roof mounted structures, please try to follow the "from top to bottom" and/or "from left to right" principle, and don't step on the module. This will damage the module and would be dangerous for personal safety. For roof mounted applications, the assembly is to be mounted over a fire resistant roof covering rated for the application.
- All PV systems must be grounded to earth (Refer to 3. "Wiring and connection" for specific grounded).

#### 2.2 Installation Condition

#### 2.2.1 Climate Condition

Please install the modules in the following conditions:

- a) Operating temperature: within –40°C(-40°F) to 85°C (185°F).
- b) Humidity: < 85RH%.

#### \* Note:

The mechanical load bearing (including wind and snow loads) of the module is based on the approved mounting methods. The professional system installer must be responsible for mechanical load calculation according to the system design.

#### 2.2.2 Site Selection

In most applications, Green Energy Power 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 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 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 PV module will minimize any such loss.

Do not install the PV module near open flame or flammable materials.

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.

Do not install the PV module in a location where it would be immersed in water or continually exposed to water from a sprinkler or fountain etc.

## 2.2.3 Tilt Angle Selection

The tilt angle of the PV module is measured between the surface of the PV module and a horizontal ground surface (Figure 1). The PV module generates maximum output power when it faces the sun directly.

For standalone systems with batteries where the PV modules are attached to a permanent

structure, the tilt angle of the PV modules should be selected to optimize the performance based on seasonal load and sunlight. In general, if the PV output is adequate when irradiance is low (e.g., winter), then the angle chosen should be adequate during the rest of the year. For grid-connected installations where the PV modules are attached to a permanent structure, PV modules should be tilted so that the energy production from the PV modules will be maximized on an annual basis.

Only for UL listed products .The System Fire Class Rating of the module or panel in a mounting system in combination with a roof covering should complete the requirements to achieve the specified System Fire Class Rating for a non-BIPV module or panel.

Any module or panel mounting system have limitations on inclination required to maintain a specific System Fire Class Rating.

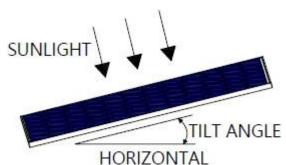


Figure1: PV module tilt angle

For bifacial modules, the suggested installation tilt angle and height is 30 degree and 1.2m, respectively. For different ground cover conditions, like snow, grass, desert, water surface, cement land and so on, the expectation generation energy gain varied from 4% to 24%, as shown in figure 2.

- i) The reflectivity of snow is 80-85%, generation energy will be increased by 17-24%.
- ii) The reflectivity of sand is 22-25%, generation energy will be increased by 7-14%.
- iii) The reflectivity of cement is 30-33 %, generation energy will be increased by 6-13%.
- iv) The reflectivity of grass is 10-20 %, generation energy will be increased by 6-8 %.
- v) The reflectivity of water is 2-5 %, generation energy will be increased by 4-7 %.

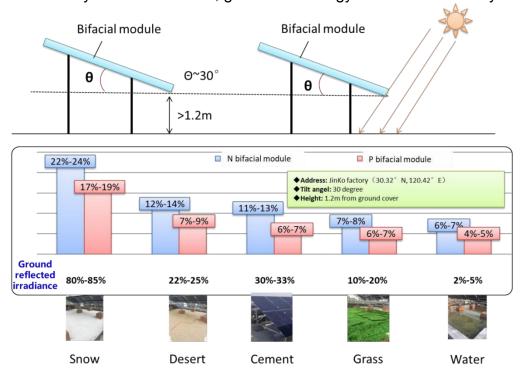


Figure 2: PV module installed on different ground covers

#### 2.3 Mechanical Installation Introduction

#### 2.3.1 General Instructions

The installation instructions described in this manual need to be followed, make sure that all local applicable standards and construction regulations are complied with as well.

In most applications, the PV modules should be installed in a location where they will receive maximum sunlight throughout the year.

MODULES should not be shaded, since this can lead to "hot spot", power loss even failure of the MODULE.

In the Northern Hemisphere, orient the MODULE to the south, and in the Southern Hemisphere, MODULE shall face the north. Determine the optimum setting angle according to the latitude of the installation site. Consult this information from a reputable installer or system integrator.

For stand-alone PV systems with batteries where MODULES are attached to a permanent structure, the tilt angle of the MODULE should be selected to optimize the performance based on seasonal load and sunlight. For grid-tired installations where the MODULES are attached to a permanent structure, MODULES should be tilted to maximize the energy generation on an annual basis.

MODULES can be clamped in place depending on the design of PV mounting structure. The mounting structure must be made from anti-corrosion material and able to withstand the required loads.

We recommend using our PV mounting structure for the ground or roof installations. Welcome to contact us at Jiangsu Green Energy Power Technology Co., Ltd; Fax No: +86 511 8853 2992; Service Line: +86 511 8812 9618 for details.

#### 2.3.2 Mechanical Installation

The MODULES may be installed in various applications utilizing a variety of mounting structures and attachment methods, and the structure should have enough strength to achieve mounting span. Generally, MODULES is able to be mounted using frame clamps. When using clamp mounting, the clamps (mid-clamp and end-clamp) must be designed for MODULE and have minimum dimensions in accordance with the instructions below and drawings provided. Clamps should be made of aluminum, stainless steel or other appropriate weatherproof and anti-corrosion materials. Moreover, the clamps should be within frame coverage width to avoid shading and MODULE damage. The MODULE warranty will be void if customer-designed clamps or third party mounting structures are improper or inadequate in regard to properties (material, strength etc.) or installation. To provide adequate ventilation, MODULES must be mounted such that there is a minimum clearance of 50mm between the

bottom of the module frame and roofing board/ground surface.

Please review the following descriptions and drawings carefully, not mounting the MODULES in accordance with these instructions may void your warranty.

Clamp Mounting: Firmly attached MODULES onto the mounting structure using clamps which will not be deformed by wind or snow load. Note that MODULES may be clamped only in the permitted clamping area on the long side of MODULE frame, never use clamps on the short side of MODULE frame. Make sure that clamps must not overlap the glass or shade the MODULE surface.

Make sure that the clamps must not overlap the glass or shade the module surface, and must be a minimum contact surface on the MODULE frame of 50mm. Refer to the following drawings and figures for detailed instructions. The torque of M8 bolt is 20N·m.

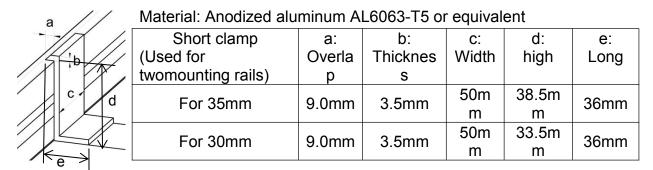


Figure 3: Referenced clamp specifications

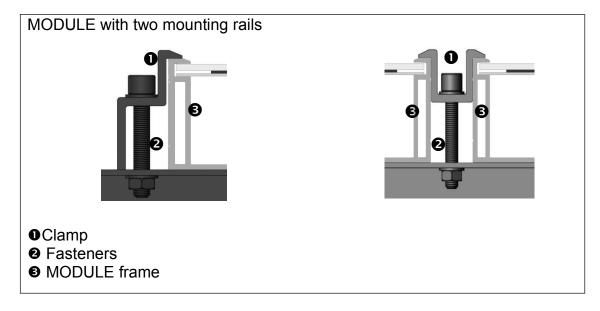


Figure 4: Referenced mounting method

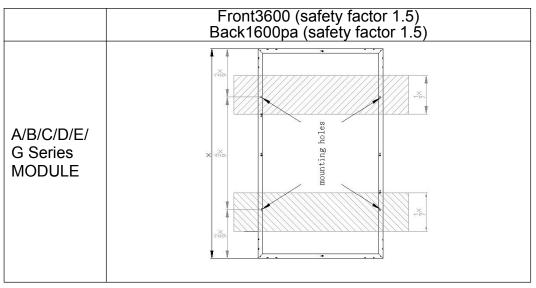


Figure 5: MODULE installed with clamp

### 2.3.3 MODULE Grounding

This guide is for MODULE frame grounding. If grounding is required, ensure that MODULE frames (metal exposed to touch) are always grounded. Installation for wiring and grounding method shall be in accordance with national, regional and local codes, standards and laws as well.

Each MODULE has a predrilled grounding hole in the frame for use. Proper grounding is achieved by connecting MODULE frames and all metallic structural parts continuously to one another using a suitable grounding conductor. This grounding conductor shall be made by copper, copper alloy or other appropriate materials. The grounding conductor must connect to earth using a proper earth grounding electrode. Ensure positive electrical contact through the anodizing layer on MODULE frame to be scored by using the following method. The torque of M4 bolt is 2.3N·m.

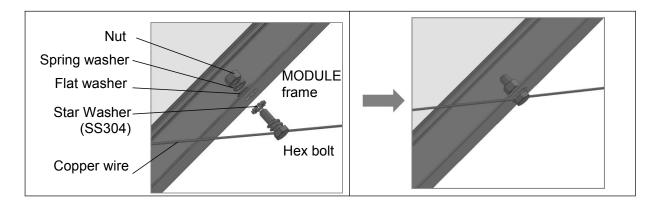


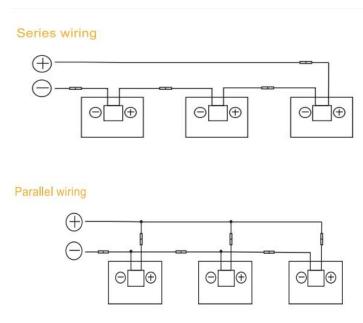
Figure 7: Grounding method

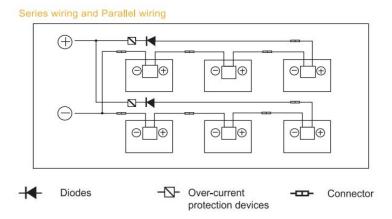
## 3. Wiring and Connection

- a) Before this procedure, please read the operation instructions of the PV system carefully. Connect the PV module connections in series or parallel, which is determined by the user sometimes configuration requirement for system power, current and voltage.
- b) PV modules connected in series should have similar current, and modules must not be connected together to create a voltage higher than the permitted system voltage. The maximum number of modules in series depends on system design, the type of inverter and environmental conditions.

The maximum number of modules that can be connected in series for each string must be calculated in accordance with the requirements of relevant regulations, and the value of its open circuit voltage under the lowest expected local temperature cannot exceed the maximum system voltage value specified by the module (according to the IEC 61730 safety test appraisal. The maximum system voltage of the modules is DCl500V and the value required by other DC electrical modules.

The open circuit voltage correction factor can be calculated according to the following formula: Cv.g=1-B woc(25-T). T is the lowest ambient temperature expected at the system installation location, B (%/ $^{\circ}$ C) is the selected module. The temperature coefficient of Voc (refer to the corresponding module parameter table). If a reverse current exceeding the maximum fuse current of the module may flow through the module, an over current protection device of equal specification must be used to protect the module. If the number in parallel is greater than 2 strings. There must be an over current protection device on each string of modules.





- c) The maximum fuse rating value in an array string can be found on the product label or in the product data sheet. The fuse rating value is also corresponding to the maximum reverse current that a module can withstand, i.e. when one string shaded then the other parallel strings of modules will be loaded by the shaded string and the current will pass through to create a current circuit. Based on the maximum series fuse rating of the module and local electrical codes and standards, make sure the modules strings in parallel are protected with the appropriate in-line string fusing.
- d) Connect the conductors from the PV array to the combiner box in accordance with the design and local codes and standards. The cross-sectional area and cable connector capacity must satisfy the maximum short-circuit of the PV system (for a single component, it is recommended the cross-sectional area of cables be 4mm² and the rated current of connectors be more than 10A, otherwise cables and connectors will become overheated from high current. Please note the temperature limit of the cables is 85°C.
- e) modules can be grounded using bolts. Attach the equipment grounding conductor to the module frame using the hole and hardware provided. Note that a stainless steel bolt is used between the ground wire and module frame as illustrated in following figure. A washer is used to avoid corrosion due to dissimilar metals. Tighten the screw securely. It is recommended that the applied torque is 1.7~2.0 ft-lbs (2.3 to 2.8 N\*m).

Module	Mour	Mounting hardware configuration								
Wodule	Hardware	Material	Size	Number provided						
	Bolt	Stainless steel	M4	2						
	Spring washer	Stainless steel	M4	2						
All	Nut	Stainless steel	M4	2						
Module	Star washer	Stainless steel	M4	2						
	Plain washer	Stainless steel	M4	4						

Table 7: The mounting part of the ground mounting hole

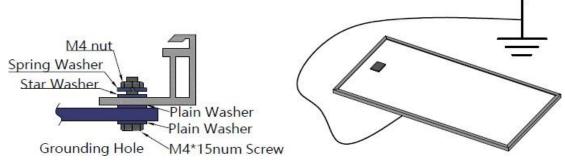


Figure 8: Ground installation of PV modules

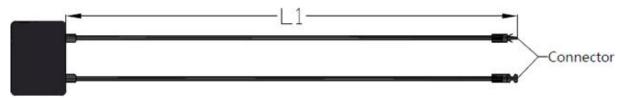
The use of bolt grounding device is not allowed unless the grounding device is UL1703 or UL2703 certified with Green Energy Power modules. Alternate grounding options built into the racking system are acceptable as long as they have been UL approved.

Model series	Grounding Clip						
woder series	Manufacturer	Туре					
Group 1 $\sim$ 16	Tyco Electronics Corp	1954381-1					

Table 8: The ground mounting Clip of PV modules

- f) The following UL Listed Ground Clamp in combination with the following model number PV modules can be used. Other third party grounding method can't be used unless the grounding device is UL2703 certified with Green Energy Power modules.
- g) Follow the requirements of applicable local and national electrical codes.
- h) These modules contain factory installed bypass diode. If these modules are incorrectly connected to each other, the bypass diodes, cable or junction box may be damaged.
- i) The module shall be wired in accordance with the NEC, the grounding method of the frame of arrays shall comply with the NEC, article 250
- j) CNL models shall be in accordance with CSA C22.1, Safety Standard for Electrical Installations, Canadian Electrical Code, Part 1.
- k) It is recommended that the M8 bolt be tightened to a torque of about  $16 \sim 20 \text{ N}^*\text{m}$ .
- I) The cable of the junction box is defined as L1, as showed below. For Green Energy Power standard module, L1 is 900/1200mm; and for customized module, L1 can be based on your condition, take the cable length into consideration before designing the wiring layout.
- m)Green Energy Power Solar requires the negative grounding of the inverter when a system is installed with standard (non-Eagle line) PV solar modules. Alternatively, a "charge-equalizing" device may be used to mitigate the effects of the Potential Induced Degradation (PID) phenomenon that can occur in specific environments that the array is installed in.

Figure 10: Junction box



#### 4. Maintenance and Care

- a) A build up of dust or dirt on the module(s) front glass will result in decreased energy output. Clean the module(s) preferably once annually if possible (depending on site conditions) using a soft dry or damp cloth, as necessary.
- b) Never use abrasive material under any circumstances.
- c) Examine the PV module(s) for signs of deterioration. Check all wiring for possible rodent damage, weathering and that all connections are tight and corrosion free. Check electrical leakage to ground.
- d) Check screws/bolts and mounting brackets are tight, adjust and tighten as necessary.
- e) Check the junction box and diodes as well. If you have any diodes problem, please contact Green Energy Power Solar.
- f) When cleaning the modules, it is not allowed to stand on the module.
- g) Never use chemicals when cleaning modules as this may affect the module warranty and energy output.

## 5. Electrical Specification

The module electrical ratings are measured under Standard Test Conditions, which are 1000W/m², irradiance with AM 1.5 spectrum and 25 deg C (77° F) ambient temperature. The module might produce more or less voltage or current than rated value in uncertainty condition. Tables below are electrical characteristics of PV products at STC and the tolerance of Isc, Voc, Vmp and Imp is ±10%.

# 6. Disclaimer of Liability

Because the use of the manual and the conditions or methods of installation, operation, use and maintenance of photovoltaic (PV) product are beyond Green Energy Power's control, Green Energy Power 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 Green Energy Power 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.

### 7. MODULE SPECIFICATIONS

The information in this manual is based on Green Energy Power'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. Green Energy Power reserves the right to change the installation manual, the PV product, the electrical specifications, or product information sheets without prior notice.All electrical data shall be shown as relative to standard test conditions(stc)(1000W/m²,(25±2) °C,AM1.5,according to IEC 60904-3).

### a) PERC:

Temperature coefficient for voltage at open -circuit:-0.304%/℃

Temperature coefficient for maximum power:-0.36%/°C

Temperature coefficient for short-circuit current:0.05%/℃

Model	Maximum power output (Pmax)	Optimum operation voltage (Vmp)	Optimum operation current (Imp)	Open circuit voltage (Voc)	Short circuit current (Isc)	Maximum system voltage (IEC)	Maximum series fuse rating (A)	Maximum series quantity	Maximum parallel quantity
	530	41.35	12.82	49.2±3%	13.71±3%	1500	25	24	1
CED AMA	535	41.5	12.9	49.35±3%	13.78±3%	1500	25	24	1
GEP-AfMc XXXMH	540	41.65	12.97	49.5±3%	13.85±3%	1500	25	24	1
	545	41.8	13.04	49.65±3%	13.92±3%	1500	25	24	1
	550	41.95	13.11	49.8±3%	13.99±3%	1500	25	24	1
	485	37.81	12.83	45.2±3%	13.72±3%	1500	25	26	1
05D 584	490	37.99	12.9	45.33±3%	13.79±3%	1500	25	26	1
GEP-EfMc XXXMH	495	38.17	12.97	45.45±3%	13.85±3%	1500	25	26	1
	500	38.35	13.04	45.59±3%	13.93±3%	1500	25	26	1
	505	38.53	13.11	45.72±3%	14±3%	1500	25	26	1
	440	34.71	12.68	41.5±3%	13.43±3%	1500	25	28	1
055.504	445	34.93	12.74	41.73±3%	13.49±3%	1500	25	28	1
GEP-BfMc XXXMH	450	35.16	12.8	41.96±3%	13.55±3%	1500	25	28	1
	455	35.38	12.86	42.18±3%	13.61±3%	1500	25	28	1
	460	35.6	12.92	42.4±3%	13.67±3%	1500	25	28	1
	390	30.79	12.67	36.69±3%	13.42±3%	1500	25	32	1
	395	31.03	12.73	36.93±3%	13.48±3%	1500	25	32	1
GEP-IfMc XXXMH	400	31.28	12.79	37.18±3%	13.54±3%	1500	25	32	1
	405	31.52	12.85	37.42±3%	13.60±3%	1500	25	32	1
	410	31.76	12.91	37.67±3%	13.66±3%	1500	25	31	1

Model	Maximum power output (Pmax)	Optimum operation voltage (Vmp)	Optimum operation current (Imp)	Open circuit voltage (Voc)	Short circuit current (Isc)	Maximum system voltage (IEC)	Maximum series fuse rating (A)	Maximum series quantity	Maximum parallel quantity
	530	41.35	12.82	49.2±3%	13.71±3%	1500	25	24	1
	535	41.5	12.9	49.35±3%	13.78±3%	1500	25	24	1
GEP-DfMc XXXMH	540	41.65	12.97	49.5±3%	13.85±3%	1500	25	24	1
	545	41.8	13.04	49.65±3%	13.92±3%	1500	25	24	1
	550	41.95	13.11	49.8±3%	13.99±3%	1500	25	24	1
	485	37.81	12.83	45.2±3%	13.72±3%	1500	25	26	1
	490	37.99	12.9	45.33±3%	13.79±3%	1500	25	26	1
GEP-GfMc XXXMH	495	38.17	12.97	45.45±3%	13.85±3%	1500	25	26	1
	500	38.35	13.04	45.59±3%	13.93±3%	1500	25	26	1
	505	38.53	13.11	45.72±3%	14±3%	1500	25	26	1
	440	34.71	12.68	41.5±3%	13.43±3%	1500	25	28	1
	445	34.93	12.74	41.73±3%	13.49±3%	1500	25	28	1
GEP-CfMc XXXMH	450	35.16	12.8	41.96±3%	13.55±3%	1500	25	28	1
	455	35.38	12.86	42.18±3%	13.61±3%	1500	25	28	1
	460	35.6	12.92	42.4±3%	13.67±3%	1500	25	28	1
	390	30.79	12.67	36.69±3%	13.42±3%	1500	25	32	1
	395	31.03	12.73	36.93±3%	13.48±3%	1500	25	32	1
GEP-JfMc XXXMH	400	31.28	12.79	37.18±3%	13.54±3%	1500	25	32	1
	405	31.52	12.85	37.42±3%	13.60±3%	1500	25	32	1
	410	31.76	12.91	37.67±3%	13.66±3%	1500	25	31	1
	430	40.6	10.6	48.4±3%	11.32±3%	1500	20	24	1
	435	40.8	10.67	48.6±3%	11.40±3%	1500	20	24	1
GEP-AfMb XXXMH	440	41.0	10.74	48.8±3%	11.47±3%	1500	20	24	1
	445	41.2	10.81	49.0±3%	11.54±3%	1500	20	24	1
	450	41.4	10.87	49.2±3%	11.61±3%	1500	20	24	1
	400	36.24	11.04	45.25±3%	11.73±3%	1500	20	26	1
GEP-EfMb	405	36.33	11.15	45.44±3%	11.84±3%	1500	20	26	1
XXXMH	410	36.42	11.26	45.62±3%	11.95±3%	1500	20	26	1
	415	36.51	11.37	45.81±3%	12.06±3%	1500	20	26	1

Model	Maximum power output (Pmax)	Optimum operation voltage (Vmp)	Optimum operation current (Imp)	Open circuit voltage (Voc)	Short circuit current (Isc)	Maximum system voltage (IEC)	Maximum series fuse rating (A)	Maximum parallel quantity	Maximum parallel quantity
	355	33.7	10.54	40.3±3%	11.28±3%	1500	20	29	1
OED DOM	360	33.9	10.62	40.5±3%	11.35±3%	1500	20	29	1
GEP-BfMb XXXMH	365	34.1	10.71	40.7±3%	11.42±3%	1500	20	29	1
	370	34.3	10.79	40.9±3%	11.49±3%	1500	20	29	1
	375	34.5	10.88	41.1±3%	11.56±3%	1500	20	29	1
	430	40.6	10.6	48.4±3%	11.32±3%	1500	20	24	1
	435	40.8	10.67	48.6±3%	11.40±3%	1500	20	24	1
GEP-DfMb XXXMH	440	41.0	10.74	48.8±3%	11.47±3%	1500	20	24	1
	445	41.2	10.81	49.0±3%	11.54±3%	1500	20	24	1
	450	41.4	10.87	49.2±3%	11.61±3%	1500	20	24	1
	400	36.24	11.04	45.25±3%	11.73±3%	1500	20	26	1
GEP-GfMb	405	36.33	11.15	45.44±3%	11.84±3%	1500	20	26	1
XXXMH	410	36.42	11.26	45.62±3%	11.95±3%	1500	20	26	1
	415	36.51	11.37	45.81±3%	12.06±3%	1500	20	26	1
	355	33.7	10.54	40.3±3%	11.28±3%	1500	20	29	1
	360	33.9	10.62	40.5±3%	11.35±3%	1500	20	29	1
GEP-CfMb XXXMH	365	34.1	10.71	40.7±3%	11.42±3%	1500	20	29	1
	370	34.3	10.79	40.9±3%	11.49±3%	1500	20	29	1
	375	34.5	10.88	41.1±3%	11.56±3%	1500	20	29	1

## b) N-TOPcon:

Temperature coefficient for voltage at open -circuit:-0.30%/°C Temperature coefficient for maximum power:-0.25%/°C Temperature coefficient for short-circuit current:0.046%/°C

Model	Maximum power output (Pmax)	Optimum operation voltage (Vmp)	Optimum operation current (Imp)	Open circuit voltage (Voc)	Short circuit current (Isc)	Maximum system voltage (IEC)	Maximum series fuse rating (A)	Maximum parallel quantity	Maximum parallel quantity
	410	31.13	13.17	37.73 ± 3%	13.91 ± 3%	1500	25	31	1
	415	31.32	13.25	37.92 ± 3%	13.99 ± 3%	1500	25	31	1
055.184	420	31.51	13.33	38.11 ± 3%	14.07 ± 3%	1500	25	31	1
GEP-IfMc XXXNH	425	31.70	13.41	38.30 ± 3%	14.15 ± 3%	1500	25	31	1
	430	31.88	13.49	38.49 ± 3%	14.23 ± 3%	1500	25	31	1
	435	32.07	13.57	38.68 ± 3%	14.31 ± 3%	1500	25	31	1
	440	32.26	13.65	38.87 ± 3%	14.39 ± 3%	1500	25	30	1
	410	31.13	13.17	37.73 ± 3%	13.91 ± 3%	1500	25	31	1
	415	31.32	13.25	37.92 ± 3%	13.99 ± 3%	1500	25	31	1
050 184	420	31.51	13.33	38.11 ± 3%	14.07 ± 3%	1500	25	31	1
GEP-IfMc XXXNHB	425	31.70	13.41	38.30 ± 3%	14.15 ± 3%	1500	25	31	1
	430	31.88	13.49	38.49 ± 3%	14.23 ± 3%	1500	25	31	1
	435	32.07	13.57	38.68 ± 3%	14.31 ± 3%	1500	25	31	1
	440	32.26	13.65	38.87 ± 3%	14.39 ± 3%	1500	25	30	1
	410	31.13	13.17	37.73 ± 3%	13.91 ± 3%	1500	30	31	2
	415	31.32	13.25	37.92 ± 3%	13.99 ± 3%	1500	30	31	2
055.04	420	31.51	13.33	38.11 ± 3%	14.07 ± 3%	1500	30	31	2
GEP-IfMc XXXNHT	425	31.70	13.41	38.30 ± 3%	14.15 ± 3%	1500	30	31	2
	430	31.88	13.49	38.49 ± 3%	14.23 ± 3%	1500	30	31	2
	435	32.07	13.57	38.68 ± 3%	14.31 ± 3%	1500	30	31	2
	440	32.26	13.65	38.87 ± 3%	14.39 ± 3%	1500	30	30	2

Model	Maximum power output (Pmax)	Optimum operation voltage (Vmp)	Optimum operation current (Imp)	Open circuit voltage (Voc)	Short circuit current (Isc)	Maximum system voltage (IEC)	Maximum series fuse rating (A)	Maximum parallel quantity	Maximum parallel quantity
	455	34.56	13.17	41.89 ± 3%	13.91 ± 3%	1500	25	28	1
	460	34.72	13.25	42.05 ± 3%	13.99 ± 3%	1500	25	28	1
	465	34.89	13.33	42.22 ± 3%	14.07 ± 3%	1500	25	28	1
GEP-BfMc	470	35.05	13.41	42.38 ± 3%	14.15 ± 3%	1500	25	28	1
XXXNH	475	35.21	13.49	42.54 ± 3%	14.23 ± 3%	1500	25	28	1
	480	35.38	13.57	42.71 ± 3%	14.31 ± 3%	1500	25	28	1
	485	35.54	13.65	42.87 ± 3%	14.39 ± 3%	1500	25	27	1
	490	35.71	13.73	43.04 ± 3%	14.47 ± 3%	1500	25	27	1
	455	34.56	13.17	41.89 ± 3%	13.91 ± 3%	1500	25	28	1
	460	34.72	13.25	42.05 ± 3%	13.99 ± 3%	1500	25	28	1
	465	34.89	13.33	42.22 ± 3%	14.07 ± 3%	1500	25	28	1
GEP-BfMc	470	35.05	13.41	42.38 ± 3%	14.15 ± 3%	1500	25	28	1
XXXNHB	475	35.21	13.49	42.54 ± 3%	14.23 ± 3%	1500	25	28	1
	480	35.38	13.57	42.71 ± 3%	14.31 ± 3%	1500	25	28	1
	485	35.54	13.65	42.87 ± 3%	14.39 ± 3%	1500	25	27	1
	490	35.71	13.73	43.04 ± 3%	14.47 ± 3%	1500	25	27	1
	455	34.56	13.17	41.89 ± 3%	13.91 ± 3%	1500	30	28	2
	460	34.72	13.25	42.05 ± 3%	13.99 ± 3%	1500	30	28	2
	465	34.89	13.33	42.22 ± 3%	14.07 ± 3%	1500	30	28	2
GEP-BfMc	470	35.05	13.41	42.38 ± 3%	14.15 ± 3%	1500	30	28	2
XXXNHT	475	35.21	13.49	42.54 ± 3%	14.23 ± 3%	1500	30	28	2
	480	35.38	13.57	42.71 ± 3%	14.31 ± 3%	1500	30	28	2
	485	35.54	13.65	42.87 ± 3%	14.39 ± 3%	1500	30	27	2
	490	35.71	13.73	43.04 ± 3%	14.47 ± 3%	1500	30	27	2
	510	38.97	13.09	47.11 ± 3%	13.83 ± 3%	1500	25	25	1
	515	39.11	13.17	47.28 ± 3%	13.91 ± 3%	1500	25	25	1
0=5 == :	520	39.25	13.25	47.45 ± 3%	13.99 ± 3%	1500	25	25	1
GEP-EfMc XXXNH	525	39.39	13.33	47.62 ± 3%	14.07 ± 3%	1500	25	25	1
	530	39.53	13.41	47.79 ± 3%	14.15 ± 3%	1500	25	25	1
	535	39.67	13.49	47.96 ± 3%	14.23 ± 3%	1500	25	25	1

Model	Maximum power output (Pmax)	Optimum operation voltage (Vmp)	Optimum operation current (Imp)	Open circuit voltage (Voc)	Short circuit current (Isc)	Maximum system voltage (IEC)	Maximum series fuse rating (A)	Maximum parallel quantity	Maximum parallel quantity
	540	39.81	13.57	48.13 ± 3%	14.31 ± 3%	1500	25	24	1
	510	38.97	13.09	47.11 ± 3%	13.83 ± 3%	1500	25	25	1
	515	39.11	13.17	47.28 ± 3%	13.91 ± 3%	1500	25	25	1
	520	39.25	13.25	47.45 ± 3%	13.99 ± 3%	1500	25	25	1
GEP-EfMc XXXNHB	525	39.39	13.33	47.62 ± 3%	14.07 ± 3%	1500	25	25	1
	530	39.53	13.41	47.79 ± 3%	14.15 ± 3%	1500	25	25	1
	535	39.67	13.49	47.96 ± 3%	14.23 ± 3%	1500	25	25	1
	540	39.81	13.57	48.13 ± 3%	14.31 ± 3%	1500	25	24	1
	510	38.97	13.09	47.11 ± 3%	13.83 ± 3%	1500	30	25	2
	515	39.11	13.17	47.28 ± 3%	13.91 ± 3%	1500	30	25	2
GEP-EfMc XXXNHT	520	39.25	13.25	47.45 ± 3%	13.99 ± 3%	1500	30	25	2
	525	39.39	13.33	47.62 ± 3%	14.07 ± 3%	1500	30	25	2
	530	39.53	13.41	47.79 ± 3%	14.15 ± 3%	1500	30	25	2
	535	39.67	13.49	47.96 ± 3%	14.23 ± 3%	1500	30	25	2
	540	39.81	13.57	48.13 ± 3%	14.31 ± 3%	1500	30	24	2
	550	41.47	13.27	50.18 ± 3%	13.99 ± 3%	1500	25	23	1
	555	41.62	13.34	50.32 ± 3%	14.07 ± 3%	1500	25	23	1
	560	41.77	13.41	50.46 ± 3%	14.15 ± 3%	1500	25	23	1
	565	41.92	13.48	50.60 ± 3%	14.23 ± 3%	1500	25	23	1
GEP-AfMc	570	42.07	13.55	50.74 ± 3%	14.31 ± 3%	1500	25	23	1
XXXNH	575	42.22	13.62	50.88 ± 3%	14.39 ± 3%	1500	25	23	1
	580	42.37	13.69	51.02 ± 3%	14.47 ± 3%	1500	25	23	1
	585	42.52	13.76	51.16 ± 3%	14.55 ± 3%	1500	25	23	1
	590	42.67	13.83	51.30 ± 3%	14.63 ± 3%	1500	25	23	1
	595	42.82	13.41	51.44 ± 3%	14.71 ± 3%	1500	25	23	1
	550	41.47	13.27	50.18 ± 3%	13.99 ± 3%	1500	25	23	1
	555	41.62	13.34	50.32 ± 3%	14.07 ± 3%	1500	25	23	1
	560	41.77	13.41	50.46 ± 3%	14.15 ± 3%	1500	25	23	1
	565	41.92	13.48	50.60 ± 3%	14.23 ± 3%	1500	25	23	1
GEP-AfMc	570	42.07	13.55	50.74 ± 3%	14.31 ± 3%	1500	25	23	1
XXXNHB	575	42.22	13.62	50.88 ± 3%	14.39 ± 3%	1500	25	23	1
	580	42.37	13.69	51.02 ± 3%	14.47 ± 3%	1500	25	23	1

Model	Maximum power output (Pmax)	Optimum operation voltage (Vmp)	Optimum operation current (Imp)	Open circuit voltage (Voc)	Short circuit current (Isc)	Maximum system voltage (IEC)	Maximum series fuse rating (A)	Maximum parallel quantity	Maximum parallel quantity
	585	42.52	13.76	51.16 ± 3%	14.55 ± 3%	1500	25	23	1
	590	42.67	13.83	51.30 ± 3%	14.63 ± 3%	1500	25	23	1
	595	42.82	13.41	51.44 ± 3%	14.71 ± 3%	1500	25	23	1
	550	41.47	13.27	50.18 ± 3%	13.99 ± 3%	1500	30	23	2
	555	41.62	13.34	50.32 ± 3%	14.07 ± 3%	1500	30	23	2
	560	41.77	13.41	50.46 ± 3%	14.15 ± 3%	1500	30	23	2
	565	41.92	13.48	50.60 ± 3%	14.23 ± 3%	1500	30	23	2
GEP-AfMc	570	42.07	13.55	50.74 ± 3%	14.31 ± 3%	1500	30	23	2
XXXNHT	575	42.22	13.62	50.88 ± 3%	14.39 ± 3%	1500	30	23	2
	580	42.37	13.69	51.02 ± 3%	14.47 ± 3%	1500	30	23	2
	585	42.52	13.76	51.16 ± 3%	14.55 ± 3%	1500	30	23	2
	590	42.67	13.83	51.30 ± 3%	14.63 ± 3%	1500	30	23	2
	595	42.82	13.41	51.44 ± 3%	14.71 ± 3%	1500	30	23	2
	610	35.80	17.04	42.50 ± 3%	17.88± 2%	1500	30	28	1
	615	36.01	17.08	42.70 ± 3%	17.92± 2%	1500	30	28	1
GEP-BfMd XXXNH	620	36.22	17.12	42.90 ± 3%	17.96± 2%	1500	30	27	1
	625	36.43	17.16	43.10 ± 3%	18.01± 2%	1500	30	27	1
	630	36.64	17.2	43.30 ± 3%	18.05± 2%	1500	30	27	1
	610	35.80	17.04	42.50 ± 3%	17.88± 2%	1500	30	28	1
	615	36.01	17.08	42.70 ± 3%	17.92± 2%	1500	30	28	1
GEP-BfMd XXXNHB	620	36.22	17.12	42.90 ± 3%	17.96± 2%	1500	30	27	1
	625	36.43	17.16	43.10 ± 3%	18.01± 2%	1500	30	27	1
	630	36.64	17.2	43.30 ± 3%	18.05± 2%	1500	30	27	1
	610	35.80	17.04	42.50 ± 3%	17.88± 2%	1500	35	28	1
	615	36.01	17.08	42.70 ± 3%	17.92± 2%	1500	35	28	1
GEP-BfMd XXXNHT	620	36.22	17.12	42.90 ± 3%	17.96± 2%	1500	35	27	1
	625	36.43	17.16	43.10 ± 3%	18.01± 2%	1500	35	27	1
	630	36.64	17.2	43.30 ± 3%	18.05± 2%	1500	35	27	1
	660	38.85	17.00	46.10± 3%	18.32 ± 3%	1500	30	26	1
	665	39.05	17.04	46.30± 3%	18.36 ± 3%	1500	30	25	1
	670	39.25	17.08	46.50± 3%	18.40 ± 3%	1500	30	25	1
GEP-EfMd XXXNH	675	39.45	17.12	46.70± 3%	18.44 ± 3%	1500	30	25	1

Model	Maximum power output (Pmax)	Optimum operation voltage (Vmp)	Optimum operation current (Imp)	Open circuit voltage (Voc)	Short circuit current (Isc)	Maximum system voltage (IEC)	Maximum series fuse rating (A)	Maximum parallel quantity	Maximum parallel quantity
	680	39.65	17.16	46.90 ± 3%	18.48 ± 3%	1500	30	25	1
	685	39.86	17.19	47.10 ± 3%	18.52 ± 3%	1500	30	25	1
	690	40.06	17.23	47.30 ± 3%	18.57 ± 3%	1500	30	25	1
	695	40.26	17.27	47.50 ± 3%	18.61 ± 3%	1500	30	25	1
	700	40.48	17.30	47.70 ± 3%	18.65 ± 3%	1500	30	25	1
	660	38.85	17.00	46.10± 3%	18.32 ± 3%	1500	30	26	1
	665	39.05	17.04	46.30± 3%	18.36 ± 3%	1500	30	25	1
	670	39.25	17.08	46.50± 3%	18.40 ± 3%	1500	30	25	1
	675	39.45	17.12	46.70± 3%	18.44 ± 3%	1500	30	25	1
GEP-EfMd	680	39.65	17.16	46.90 ± 3%	18.48 ± 3%	1500	30	25	1
XXXNHB	685	39.86	17.19	47.10 ± 3%	18.52 ± 3%	1500	30	25	1
	690	40.06	17.23	47.30 ± 3%	18.57 ± 3%	1500	30	25	1
	695	40.26	17.27	47.50 ± 3%	18.61 ± 3%	1500	30	25	1
	700	40.48	17.30	47.70 ± 3%	18.65 ± 3%	1500	30	25	1
	660	38.85	17.00	46.10± 3%	18.32 ± 3%	1500	35	26	1
	665	39.05	17.04	46.30± 3%	18.36 ± 3%	1500	35	25	1
	670	39.25	17.08	46.50± 3%	18.40 ± 3%	1500	35	25	1
	675	39.45	17.12	46.70± 3%	18.44 ± 3%	1500	35	25	1
GEP-EfMd XXXNHT	680	39.65	17.16	46.90 ± 3%	18.48 ± 3%	1500	35	25	1
	685	39.86	17.19	47.10 ± 3%	18.52 ± 3%	1500	35	25	1
	690	40.06	17.23	47.30 ± 3%	18.57 ± 3%	1500	35	25	1
	695	40.26	17.27	47.50 ± 3%	18.61 ± 3%	1500	35	25	1
	700	40.48	17.30	47.70 ± 3%	18.65 ± 3%	1500	35	25	1
	410	31.13	13.17	37.73 ± 3%	13.91 ± 3%	1500	30	31	2
	415	31.32	13.25	37.92 ± 3%	13.99 ± 3%	1500	30	31	2
	420	31.51	13.33	38.11 ± 3%	14.07 ± 3%	1500	30	31	2
GEP-JfMc XXXNH	425	31.70	13.41	38.30 ± 3%	14.15 ± 3%	1500	30	31	2
	430	31.88	13.49	38.49 ± 3%	14.23 ± 3%	1500	30	31	2
	435	32.07	13.57	38.68 ± 3%	14.31 ± 3%	1500	30	31	2
	440	32.26	13.65	38.87 ± 3%	14.39 ± 3%	1500	30	30	2

Model	Maximum power output (Pmax)	Optimum operation voltage (Vmp)	Optimum operation current (Imp)	Open circuit voltage (Voc)	Short circuit current (Isc)	Maximum system voltage (IEC)	Maximum series fuse rating (A)	Maximum parallel quantity	Maximum parallel quantity
GEP-CfMc	455	35.86	12.69	42.26± 2%	13.43± 2%	1500	30	30	2
	460	35.99	12.79	42.41± 2%	13.50± 2%	1500	30	30	2
	465	36.13	12.88	42.56± 2%	13.57± 2%	1500	30	30	2
	470	36.26	12.97	42.71± 2%	13.64± 2%	1500	30	30	2
XXXNH	475	36.40	13.05	42.86± 2%	13.71± 2%	1500	30	30	2
	480	36.54	13.14	43.01± 2%	13.78± 2%	1500	30	30	2
	485	36.68	13.23	43.16± 2%	13.85± 2%	1500	30	30	2
	490	36.80	13.32	43.31± 2%	13.92± 2%	1500	30	30	2
	510	38.97	13.09	47.11 ± 3%	13.83 ± 3%	1500	30	25	2
	515	39.11	13.17	47.28 ± 3%	13.91 ± 3%	1500	30	25	2
	520	39.25	13.25	47.45 ± 3%	13.99 ± 3%	1500	30	25	2
GEP-GfMc XXXNH	525	39.39	13.33	47.62 ± 3%	14.07 ± 3%	1500	30	25	2
	530	39.53	13.41	47.79 ± 3%	14.15 ± 3%	1500	30	25	2
	535	39.67	13.49	47.96 ± 3%	14.23 ± 3%	1500	30	25	2
	540	39.81	13.57	48.13 ± 3%	14.31 ± 3%	1500	30	24	2
	550	41.47	13.27	50.18 ± 3%	13.99 ± 3%	1500	30	23	2
	555	41.62	13.34	50.32 ± 3%	14.07 ± 3%	1500	30	23	2
	560	41.77	13.41	50.46 ± 3%	14.15 ± 3%	1500	30	23	2
	565	41.92	13.48	50.60 ± 3%	14.23 ± 3%	1500	30	23	2
GEP-DfMc	570	42.07	13.55	50.74 ± 3%	14.31 ± 3%	1500	30	23	2
XXXNH	575	42.22	13.62	50.88 ± 3%	14.39 ± 3%	1500	30	23	2
	580	42.37	13.69	51.02 ± 3%	14.47 ± 3%	1500	30	23	2
	585	42.52	13.76	51.16 ± 3%	14.55 ± 3%	1500	30	23	2
	590	42.67	13.83	51.30 ± 3%	14.63 ± 3%	1500	30	23	2
	595	42.82	13.41	51.44 ± 3%	14.71 ± 3%	1500	30	23	2
	610	35.80	17.04	42.50 ± 3%	17.88± 2%	610	35	35	1
	615	36.01	17.08	42.70 ± 3%	17.92± 2%	615	35	35	1
GEP-CfMd XXXNH	620	36.22	17.12	42.90 ± 3%	17.96± 2%	620	35	35	1
	625	36.43	17.16	43.10 ± 3%	18.01± 2%	625	35	35	1
	630	36.64	17.2	43.30 ± 3%	18.05± 2%	630	35	35	1

Model	Maximum power output (Pmax)	Optimum operation voltage (Vmp)	Optimum operation current (Imp)	Open circuit voltage (Voc)	Short circuit current (Isc)	Maximum system voltage (IEC)	Maximum series fuse rating (A)	Maximum parallel quantity	Maximum parallel quantity
GEP-GfMd XXXNH	660	38.85	17.00	46.10± 3%	18.32 ± 3%	1500	35	26	1
	665	39.05	17.04	46.30± 3%	18.36 ± 3%	1500	35	25	1
	670	39.25	17.08	46.50± 3%	18.40 ± 3%	1500	35	25	1
	675	39.45	17.12	46.70± 3%	18.44 ± 3%	1500	35	25	1
	680	39.65	17.16	46.90 ± 3%	18.48 ± 3%	1500	35	25	1
	685	39.86	17.19	47.10 ± 3%	18.52 ± 3%	1500	35	25	1
	690	40.06	17.23	47.30 ± 3%	18.57 ± 3%	1500	35	25	1
	695	40.26	17.27	47.50 ± 3%	18.61 ± 3%	1500	35	25	1
	700	40.48	17.30	47.70 ± 3%	18.65 ± 3%	1500	35	25	1
	600	45.39	13.22	54.95± 3%	13.97± 3%	1500	30	21	2
GEP- HfMcXXXNH	605	45.49	13.3	55.10± 3%	14.04± 3%	1500	30	21	2
	610	45.59	13.38	55.25± 3%	14.11± 3%	1500	30	21	2
	615	45.69	13.46	55.40± 3%	14.18± 3%	1500	30	21	2
	620	45.79	13.54	55.55± 3%	14.25± 3%	1500	30	21	2
	625	45.92	13.61	55.70± 3%	14.32± 3%	1500	30	21	2
	630	46.02	13.69	55.85± 3%	14.39± 3%	1500	30	21	2



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