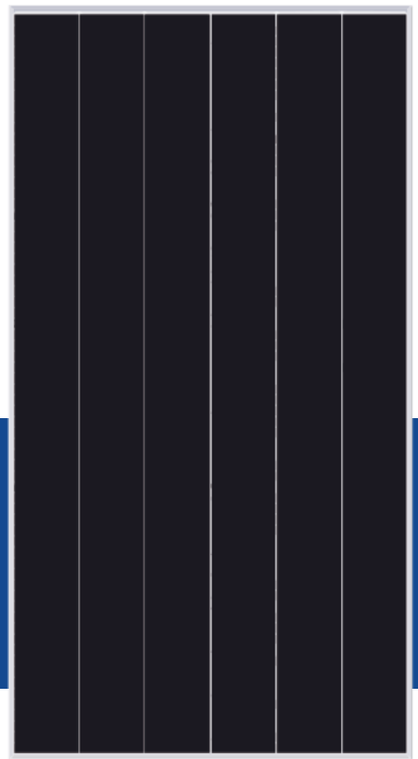
HYUNDAI SOLAR MODULE

DJ SERIES

G12 PERC Shingled

HiE-S635DJ HiE-S640DJ
HiE-S645DJ HiE-S650DJ



Shingled Technology

For Utility-Scale Applications

More Power Generation In Low Light

G12 PERC Shingled

G12 PERC Shingled Technology provides ultra-high efficiency with better performance in low irradiation. Maximizes installation capacity in limited space.

Mechanical Strength

Tempered glass and reinforced frame design withstand rigorous weather conditions such as heavy snow and strong wind.

Reliable Warranty

Global Brand with powerful financial strength provide reliable 25-year warranty.

UL / VDE Test Labs

Hyundai's R&D center is an accredited test laboratory of both UL and VDE.

Hyundai's Warranty Provisions

25 YEARS
- **25-Year Product Warranty**
  - On material and workmanship

30 YEARS
- **30-Year Performance Warranty**
  - Initial year: 98.0%
  - Linear warranty after second year: with 0.45%p annual degradation, 84.95% is guaranteed up to 30 years

About Hyundai Energy Solutions Co.,Ltd

Established in 1972, Hyundai Heavy Industries Group is one of the most trusted names in the heavy industries sector and is a Fortune 500 company. As a global leader and innovator, Hyundai Heavy Industries is committed to building a future growth engine by developing and investing heavily in the field of renewable energy.

As a core energy business entity of HHI, Hyundai Energy Solutions has strong pride in providing High-quality PV products to more than 3,000 customers worldwide.

Certification

HYUNDAI ENERGY SOLUTIONS

Electrical Characteristics

		Mono-Crystalline Module (HiE-S____DJ)			
		635	640	645	650
Nominal Output (Pmpp)	W	635	640	645	650
Open Circuit Voltage(Voc)	V	46.4	46.5	46.6	46.7
Short Circuit Voltage (Isc)	A	17.54	17.64	17.74	17.84
Voltage at Pmax (Vmpp)	V	38.5	38.6	38.7	38.8
Cuurent at Pmax (Impp)	A	16.49	16.58	16.68	16.77
Module Efficiency	%	20.4	20.6	20.8	20.9
Cell Type	-	PERC Mono-Crystalline Silicon Shingled			
Maximum System Voltage	V	1,500			
Temperature Coefficiency of Pmax	%/℃	-0.34			
Temperature Coefficiency of Voc	%/℃	-0.27			
Temperature Coefficiency of Isc	%/℃	0.04			

*All data at STC(Standard Test Conditions). Above data may be changed without prior notice.
*Tolerance of Pmax:0~+5W.
*Measuring uncertainty of power:±3%.
* Performance deviation of Voc [V], Isc [A], Vm[V] and Im[A]:±3%.

Mechanical Characteristics

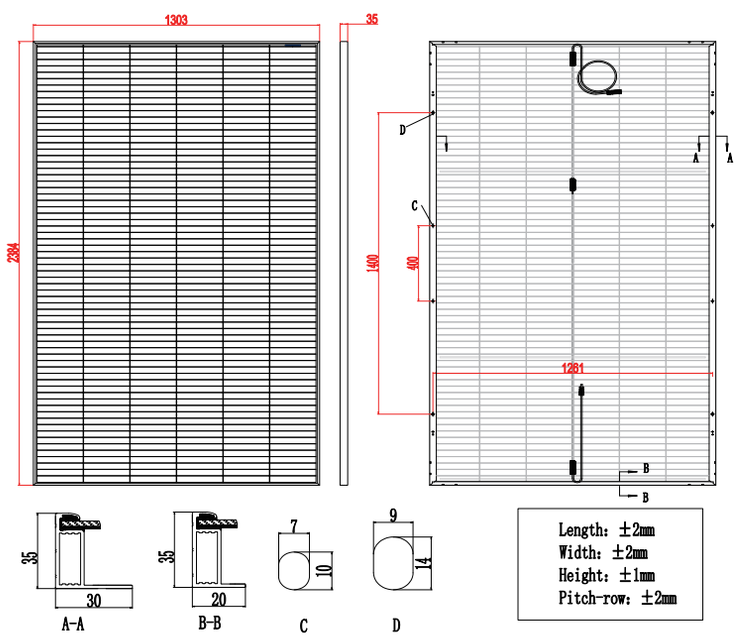
Dimensions	2,384 × 1,303 × 35mm (L × W × H)		
Weight	39kg		
Solar Cells	414 cells, PERC Mono-crystaline Shingled		
Output Cables	Length 1,200mm, 1×4mm²	Connector	Maker : Staublie PV-KST4-EVO2/xy_UR PV-KBT4-EVO
Junction Box	IP68, TUV&UL, Three Diodes		
Construction	Front Glass: Tempered glass, 2.0mm Encapsulation: EVA (Ethylene-Vingl-Acetate)		
Frame	Anodized Aluminum		

Installation Safety Guide

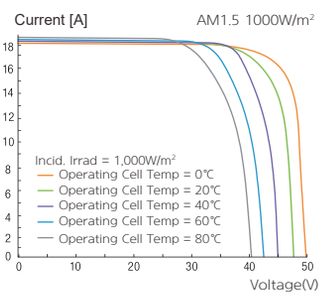
- Only qualified personnel should install or perform maintenance.
- Be aware of dangerous high DC voltage.
- Do not damage or scratch the rear surface of the module.
- Do not handle or install modules when they are wet.

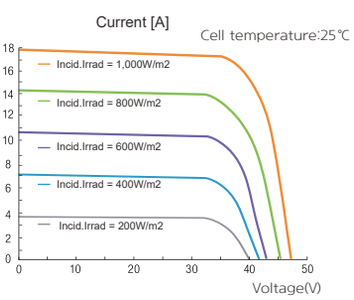
Nominal Operating Cell Temperature	42.3℃ (±2℃)
Operating Temperature	-40 ~ 85° C
Maximum System Voltage	DC 1,500
Fire Rating	Class C
Series Fuse Rating	30A
Maximum Surface Load Capacity	Front 5,400 Pa Rear 2,400 Pa

Module Diagram (Unit: mm)



I-V Curves





Manufactured in China

HYUNDAI ENERGY SOLUTIONS

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Printed Date : 12/2021

Hyundai Limited Warranty for PV Modules
("Limited Warranty")

Effective February 1, 2022

Customer Name	
Contract No.	
Date of Issue	
Project Name (If Applicable)	

The following warranty ("Limited Warranty") is provided by Hyundai Energy Solutions Co., Ltd. ("HYUNDAI") in regards to the photovoltaic modules ("MODULE(S)") supplied to the original end customer and subsequent owners at the original installation site (collectively referred to as "CUSTOMER"). The Warranties defined herein apply only to the MODULES which (a) are sold directly by HYUNDAI or through one of its authorized local distributors and (b) have a legible Hyundai Energy Solutions Co., Ltd. logo and product serial number. The start date for all of the following warranties is the earlier of either: (i) the date of installation; or (ii) the 90th day (natural day) after the delivery at the end-customer's site of the HYUNDAI MODULES("Warranty Start Date"). HYUNDAI reserves right to revise the terms of this Limited Warranty without prior notice.

This Limited Warranty shall apply to the following Products :

- HiE-SxxxUH (xxx = 445-480, in increment of 5)
- HiE-SxxxSI (xxx = 395-455, in increment of 5)
- HiE-SxxxUI (xxx = 420-455, in increment of 5)
- HiE-SxxxVI (xxx = 460-500, in increment of 5)
- HiE-SxxxUF (xxx = 370-400, in increment of 5)
- HiE-SxxxSG (xxx = 325-380, in increment of 5)
- HiE-SxxxUG (xxx = 350-380, in increment of 5)
- HiE-SxxxVG (xxx = 385-415, in increment of 5)
- HiE-SxxxKN (xxx = 535-550, in increment of 5)
- HiE-SxxxDJ (xxx = 635-650, in increment of 5)

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Head Distribution Centre:
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WALES, 2151 Australia
Tel. 0412-500-769
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1. Product Warranty

A. HYUNDAI warrants to the CUSTOMER that the MODULES supplied shall, for the duration of twenty-five (25) years from the Warranty Start Date ("Product Warranty Period"), be free from defects in materials and workmanship under normal application, installation, use, and service conditions.

If the MODULES fail to conform to this warranty during this Product Warranty Period, (a) HYUNDAI has the right to choose the net value of the defective MODULES or the current market MODULE price refunded to the CUSTOMER, the so-called defective MODULES of the net value of the MODULES purchased at the time on the basis of the first deduction of 16% depreciation, subsequent annual deductions 3.5% depreciation, depreciation is calculated from the date of the warranty, up to 25 years; (b) Free repair or replacement of defective MODULES, and to provide the initial sale of the delivery point of free delivery service, the MODULES and parts to be replaced are owned by HYUNDAI.

B. The remedies set forth in this clause shall be the sole and exclusive remedy available to the CUSTOMER for any product defect, and shall not be available beyond the Product Warranty Period for any reason whatsoever.

2. Performance Warranty

A. As for single glass MODULES:
HYUNDAI warrants to the CUSTOMER that for a period of one (1) year from Warranty Start Date the actual power output of the MODULES will be no less than 98.0% of the Nominal Power* at STC**, as specified on the date of sale in HYUNDAI's product datasheet. From the second year, the actual power output will decline annually by no more than 0.55%p for a period of remaining twenty-four (24) years, so that by the end of the twenty-five (25) year, an actual output of at least 84.8% of the Nominal Power* at STC**, as specified on the date of sale in HYUNDAI's product datasheet will be achieved.

B. As for double glass MODULES:
HYUNDAI warrants to the CUSTOMER that for a period of one (1) year from Warranty Start Date the actual power output of the MODULES will be no less than 98.0% of the Nominal Power* at STC**, as specified on the date of sale in HYUNDAI's product datasheet. From the second year, the actual power output will decline annually by no more than 0.45%p for a period of remaining twenty-nine (29) years, so that by the end of the thirty (30) year, an actual output of at least 84.95% of the Nominal Power* at STC**, as specified on the date of sale in HYUNDAI's product datasheet will be achieved

If the MODULES fail to reach the guaranteed power output levels set out above provided that such loss in power is verified by HYUNDAI, (a) HYUNDAI has the right to choose

the net value of the defective MODULES or the current market MODULE price refunded to the CUSTOMER, the so-called defective MODULES of the net value of the MODULES purchased at the time on the basis of the first deduction of 16% depreciation, subsequent annual deductions 3.5% depreciation, depreciation is calculated from the date of the warranty, single glass MODULES up to 25 years, double glass MODULES up to 30 years; (b) Free repair or replacement of defective MODULES, and to provide the initial sale of the delivery point of free delivery service, the MODULES and parts to be replaced are owned by HYUNDAI.

C. The remedies set forth in this clause shall be the sole and exclusive remedies provided for any performance deficiencies, and shall not be available beyond the aggregate specified Performance Warranty Periods for any reason whatsoever.

3. Exclusions and Limitations

A. A warranty claim under any of the foregoing Warranties must be filed within the applicable warranty period.

B. The Warranties do not apply to any MODULE, which in HYUNDAI's sole and absolute judgment, has been subjected to:

(a) Damage and/or failure caused by use on a mobile unit including, but not limited to, vehicles, vessels, etc.;
(b) Damage and/or failure caused by non-compliance with national and local electric codes;
(c) Damage and/or failure caused by installations not in conformance with the MODULE(S) specifications, installation manuals, operation manuals, or labels attached to the MODULE(S);
(d) Damage and/or failure caused by improper wiring, installation, or handling;
(e) Damage and/or failure caused by devices and/or parts other than the MODULE(S) or by mounting methods of such devices and/or parts;
(f) Damage and/or failure caused by improper or incorrectly performed maintenance, operation or modification;
(g) Damage and/or failure caused by removal from the original place of installment;
(h) Damage and/or failure caused by repairs not in accordance with HYUNDAI's instructions;
(i) Damage and/or failure caused by inappropriate handling during storage, packaging or transportation; without limitation including damage caused by improper treatment, overloading, electro-chemical or electrical influences, or any other circumstances that may arise through no fault of HYUNDAI;
(j) Damage and/or failure caused by external shock such as flying objects or external stress;
(k) Damage and/or failure caused by direct contact with environmental pollution such as soot, acid rain or industrial chemicals including ammonia;

(l) Damage and/or failure caused by direct contact with salt water;
(m) Damage and/or failure caused by natural forces (earthquakes, tornados, floods, lightning, hurricanes, heavy snow, hail, etc.) and fire, power failures, power surges or other unforeseen circumstances that are beyond HYUNDAI's control;
(n) Damage and/or failure caused by terrorist acts, riots, war or other man-made disasters;
(o) Damage and/or failure caused by external stains or scratches that do not affect output;
(p) Damage and/or failure caused by sound, vibration, rust, scratching, or discolorations that are the result of normal wear and tear, aging or continuous use; or
(q) Damage and/or failure caused by MODULE(S) installed in a location that exceeds operating conditions.
(r) Repair or modifications by someone other than an approved service technician of HYUNDAI.

D. The Product Warranty and Performance Warranties shall be applied exclusively of one another. HYUNDAI, at its sole option and in its sole discretion, will decide whether the cause of the claim is applicable to the Product Warranty or any of the Performance Warranties.

E. HYUNDAI will decide, at its sole and absolute option, whether to collect replaced MODULES or not. In the case HYUNDAI decides to collect all or some of the replaced MODULES, HYUNDAI will cover transportation (other than air transport) costs for returning the MODULES. In the case HYUNDAI decides not to collect any replaced MODULES, HYUNDAI will not cover any transportation costs for returning the MODULES. In any case, HYUNDAI will not cover any of the costs associated with the installation, removal, reinstallation, discarding or packaging of the MODULES. If the collected MODULES are found not to be covered under these Warranties at HYUNDAI's sole and absolute judgement, CUSTOMER is obliged to cover all associated costs mentioned above.

F. In the event that any model or make of MODULES for which a claim is made under either of the foregoing Warranties have been discontinued or materially altered, HYUNDAI reserves the right to replace the MODULES with any other module type that may be different in output, size, color or material.

G. Any repaired or replaced MODULES under these Warranties will hold only the remaining warranty period applicable to the original MODULES.

H. The Warranties provided under this Limited Warranty shall only extend to MODULES that have been installed within the sales area.

I. Our goods come with guarantees that cannot be excluded under the Australian Consumer Law. You are entitled to a replacement or refund for a major failure and compensation for any other reasonably foreseeable loss or damage. You are also entitled to have the

goods repaired or replaced if the goods fail to be of acceptable quality and the failure does not amount to a major failure.

4. Severability

If any court or competent authority finds any clauseor portion of any clause of this Limited Warranty invalid, illegal, or unenforceable, that portion will be deemed to be deleted only to the extent required, and the validity and enforceability of the rest of the Limited Warranty shall not be affected.

5. Assertion of Claims

The assertion of claims under this Limited Warranty presupposes that the Customer has (i) informed the authorized reseller/distributor of our Module(s) in writing of the alleged claim, or that; (ii) this written notification has been sent directly to HYUNDAI in the event that the authorized reseller/distributor no longer exists (e.g. due to discontinuance of business or bankruptcy). Any such assertion of claims must be accompanied by the original sales receipt as the proof of purchase and time of purchase of HYUNDAI Module(s). The assertion of the claim must occur within thirty (30) days (natural day) from the date that the defects occurred. The return of Module(s) may only occur after the written authorization of HYUNDAI has been given.

6. Force Majeure

HYUNDAI shall bear no responsibility or liability for the non-performance or delay of any duties or obligations arising out of this Limited Warranty due to natural disasters, industrial disputes, government regulations, civil riot or war, or any other event outside HYUNDAI's control that is not reasonably known or understood at the time of sale of the MODULES.

7. Liability

THE FOREGOING WARRANTIES AND REMEDIES ARE EXCLUSIVE AND IN LIEU OF ALL OTHER WARRANTIES, REPRESENTATIONS, OR CONDITIONS, EXPRESS OR IMPLIED, EITHER IN FACT OR BY OPERATION OF LAW, STATUTORY OR OTHERWISE, INCLUDING WARRANTIES OR CONDITIONS OF MERCHANTABILITY, NONINFRINGEMENT, AND FITNESS FOR A PARTICULAR PURPOSE. HYUNDAI NEITHER ASSUMES NOR AUTHORIZES ANY OTHER PERSON TO ASSUME FOR IT ANY OTHER LIABILITY IN CONNECTION WITH THE SALE, INSTALLATION, MAINTENANCE, OR USE OF THE GOODS. HYUNDAI SHALL BEAR NO RESPONSIBILITY OR LIABILITY WHATSOEVER FOR ANY DAMAGE OR INJURY TO PERSONS OR PROPERTY, OR FOR ANY OTHER LOSS OR INJURY RESULTING FROM ANY CAUSE WHATSOEVER ARISING OUT OF OR RELATED TO THE NEGLIGENT USE, MISUSE OR NEGLIGENT INSTALLATION OF THE MODULES. UNDER NO CIRCUMSTANCES SHALL HYUNDAI BE LIABLE FOR

DAMAGES IN EXCESS OF THE PURCHASE PRICE OF THE APPLICABLE MODULE(S), NOR FOR ANY INCIDENTAL, CONSEQUENTIAL OR SPECIAL DAMAGES, HOWSOEVER CAUSED. LOSS OF USE, LOSS OF PROFITS, LOSS OF PRODUCTION AND LOSS OF REVENUES ARE SPECIFICALLY EXCLUDED.

*"**Nominal Power**" is the power in watt peak that a MODULE generates in its maximum power point. **"**STC(Standard Test Conditions)**"is as follows: (a) light spectrum of AM 1.5, (b) an irradiation of 1,000 W/m^2 and (c) a cell temperature of 25 ℃. The measurements must be carried out at HYUNDAI or an independent test institute agreed to by HYUNDAI in advance, in accordance with IEC60904 as tested at the junction box connectors per the calibration and testing standards of HYUNDAI. These measurements will be considered valid at the production date of the MODULES with an equipment tolerance of ±3%. HYUNDAI's calibration standards shall be in compliance with the standards applied by international institutions accredited for this purpose.

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HES INSTALLATION MANUAL (IEC)

Issued on Apr. 18th, 2022

1. General Information

· This Installation manual contains information regarding the installation and the safe handling method of the photovoltaic shingled module (hereafter referred to as "**module**") supplied by Hyundai Energy Solutions Co., Ltd. (hereafter referred to as "**HES**") which is as follows,

· HiE-SxxxDJ: 414 pieces, 635-650W, 1500V / HiE-SxxxDI: 408 pieces, 625-650W, 1500V

· HiE-SxxxDM: 390 pieces, 600-620W, 1500V / HiE-SxxxDN: 345 pieces, 530-550W, 1500V

· HiE-SxxxDG: 340 pieces, 520-540W, 1500V / HiE-SxxxDL: 325 pieces, 500-515W, 1500V

· System users and installers should read and understand this manual before handling, installing the module. Please contact Customer Support department or our local representatives for more detailed information.

· Before installing solar photovoltaic systems, mechanical and electrical requirements for the total system should be checked as well. Keep this manual in a safe place for future reference.

· The installer should consider every safety precautions specified in this manual and local codes when installing a module.

· HES modules are tested and certified for installation worldwide. Different regions may have different regulations for solar PV installations. In this manual, hereafter "IEC only" is used to refer to regions where IEC standard applies, e.g. Europe, Middle East, most of Asia Pacific countries; "UL only" is used to refer to regions where UL standard applies, e.g. United States, Canada; all other references are global.

1.1 NOTICE

· Installing solar photovoltaic systems requires specialized skills and knowledge. Thus, before installation, wiring, and operation of photovoltaic modules, system users and installer should understand and conform to this manual.

· Installation and wiring should only be performed and supervised by qualified persons.

· Each module has a junction box for permanent cable connection. HES can provide customers with fitted cables for easy installation. Installers should secure the safe installation status including all electrical hazards.

1.2 DANGER

- Installers should secure the installation status, without limitation, including the risk of electric shock.
- Backsheet of PV module should be kept safe from any damage or scratch to prevent mechanical or electric shock.
- Do not disassemble or remove any part of a PV module. Such actions may cause electric shock, fire or damage.
- Keep safety regulations for all components used in the system, including wiring and cables, connectors, charging regulators, inverters, storage batteries and rechargeable batteries, etc.

1.3 WARNING

- Before installation, recommend preventing the module from exposure to direct sunlight or other light source. (If modules are exposed directly to sunlight without connection, each module generates over DC 30V, which is potentially hazardous.)
- Modules are heavy. Be sure to have more than two persons with anti-slip gloves on carry each PV module. Do not throw and drop PV modules.
- Do not sit, stand, step, walk and/or jump on the module, including the frames.
- Do not drop or place objects on the modules. Do not place excessive loads on the modules or twist the module frame.
- All installation equipment and PV modules must be kept in dry condition during installation.
- Check the current and the voltage before connecting the line. There is potential hazard in case of higher voltage in series connection and higher current in parallel connection.
- All PV modules must be earthed by using earth device. Safety check for all other parts of systems should be finished before installation to prevent any electric hazard.
- Do not use any damaged PV module, where it may cause fire, electric shock or injury.
- Do not focus light on a PV module, where it may cause fire and damage.
- Do not touch live parts of wires, cables, connectors, or junction boxes, in order to prevent electric shock and injury. Be sure the circuit breaker is off if it's applicable. Always use appropriate safety equipment. (Insulated tools, insulating gloves, etc.)

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· Do not re-arrange bypass diodes, where it may cause electric shock and injury.

· Do not disconnect the cable when the load to module is engaged.

· Check applied Class for module after installing the module.

· Do not remove any labels.

1.4 ⚠ CAUTION

· In order to prevent any performance drop, damage, or incapability, do not use paint and adhesive material to the module surface.

· Do not leave modules in places where flammable gases can be generated or collected.

· Do not leave un-fixed and unsafe PV modules unattended.

· Do not wear metallic rings, watchbands, ear, nose, lip rings or other metallic devices while installing photovoltaic systems.

· Installers should be careful of module's sharp parts(ex: the edges of module)

1.5 General Safety

The following requirements should be kept during installation and inspection.

· Check the inspection requirements by authorized personnel.

· When installing the system, abide by all local, regional and national statutory regulations.

· System designer and installers should secure safe installation of PV modules. All installation must be conformed to all fire safety regulations. Additional structures can be applied for installation. If additional equipment is applied, it is necessary to check the fuse status, earth error and system isolation.

· Do not use different types of PV module in a same module array.

· Abide by the safety regulations for all other components within the total system.

2. Transportation, Storage and Unpacking

· Modules are packaged vertically. They should also be vertical during transportation.

· Check tension of banding tapes before transportation. Be cautious of abnormal shock for vehicles and modules which might cause module damage and cell crack during transportation. Store the modules safely in a dry and cool environment.

· Do not stack or move more than two packages of modules which are stacked vertically.

· Workers are recommended to keep some distance from the package when one worker cuts banding

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tapes. Don't lift the package after removing banding tapes.

· After unpacking, please visually check if there is no problem on modules. Install modules and components without any defect.

· When carrying modules, do not hold cables or junction box. Carry by holding frames with two hands.

· Carry one module at one time.

3. Installation Environment

3.1 General

· Before installing and operating HES PV system, installer and operator should follow the requirements specified in this manual.

· Do not drill additional holes in the frame of the modules. This additional hole will void the warranty. Refer to the mounting profile in Picture 1.

· Secure the module using mounting holes provided and stainless corrosion resistant material. Locking washers should be used for long-term security.

· Appropriate materials should be used for mounting structure in order to prevent the module frame, mounting structure from corrosion.

· When installing the system, it is necessary to avoid any shade caused by buildings or trees nearby.

· For more information about the installation, please contact HES or local representatives for more detailed information.

3.2 Notes on Installation

· Space between PV module frames and installation objects is necessary for cooling air circulation. Do not seal this space. Minimum 50mm of standoff height is necessary.

· The minimum distance between two fixed modules for linear thermal expansion of the module frame supports should be 10 mm. Nevertheless, the recommended distance between two modules is 30 mm to allow wind circulation, in order to reduce pressure loads and improve module ventilation.

· The minimum distance between a module frame and a sidewall of clamp for linear thermal expansion of the module frame supports should be 1.5 mm, in order to reduce pressure loads.

· All the junctions on the conductive connection must be fixed. Metal containing iron in the conductive connection should be made with stainless steel or be treated against corrosion by anodizing, spray-painting, or galvanization to prevent rusting and corrosion.

· Modules that feature antireflective coated glass are prone to visible finger print marks if touched on the front glass surface. HES recommends handing modules with gloves or limiting touching of the front

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surface. Any finger print marks resulting from installation will naturally disappear over time or can be reduced by following the washing guidelines in Section 6.2.

· Do not install PV modules horizontally. Horizontal installation can cause performance drop of PV modules. HES recommends mounting modules at a 10° tilt or greater.

3.3 Installation Site

PV modules will be operated under General Operation Condition (GOC). Do not install PV module at site beyond General Operation Conditions or under specific condition.

1) General Site Conditions

The site condition for the sea level and wind load should be matched the following requirements.

(1) Sea level of site : Below 1,000 m (3,280 ft)

(2) Maximum Instantaneous wind Speed (design load, safety factor = 1.5)

· Below 3,600Pa or 2,400Pa on the front module surface

· Below 1,600Pa on the back module surface

※ If the wind strength is not over than 1,600Pa (1,600 N/m^2, 163.3 kg/m^2, 33.3 lb/ft^2), the installation site over 1,000m (3,280ft) above sea level is permitted.

※ Installations under the condition of wind strength specified above are allowed only when the methods of installations comply with Module Installation Instruction (Appendix 1.)

2) Specific Site Condition

The following actual site condition should be checked for adequate installations.

· Hail, heavy snow, and sand are to be considered as important factors related to module damage and power output decline.

· HES recommend installing lightning rods in lightning-expected areas and SPD (Surge Protection Device) for surge.

· Air pollution, chemical gas, acid rain, and smoke are important factors to be considered.

· Do not use PV modules in place of normal roofing.

· PV modules are not recommended to be installed where salt-mist will hit directly. HES PV modules have passed IEC61701 salt-mist, but galvanic corrosion can occur between the aluminum frame of the modules and mounting or grounding hardware if such hardware is comprised of dissimilar metals. Tongwei modules can be installed at seaside locations 50m to 500m from the sea, but the modules

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should be protected against corrosion. For locations ⩾500m from the sea, it is low risk with salt-mist corrosion, only annual preventive maintenance is required. When PV modules are installed within 7km from a body of salt water, the installer should check for salt damage at the proposed install location and implement salt-mist corrosion preventive measures, which are not scratching the corrosion-resistant coating of the modules and mounting system, installing modules at a minimum tilt of 10 degrees.

- PV modules shall not be immersed in water and shall not be continually exposure to water from a sprinkler, fountain, etc.
- PV modules shall not be installed in sulfurous area near sulfurous volcano and sulfurous spring.
- If PV modules are installed near factory or plant area, they can be polluted by fumes and the pollution may not be cleaned. Thus the installer should consider and check the installation area and the distance from factory or plant area.
- If PV modules are installed in damp environments, the installer should check the installation area to see if there is a possibility that moss grows in PV modules.
- In a harsh, hot, and humid environment, HES recommends using (-) grounding to inverters.
- Do not install PV modules indoors or on moving objects.

4. Installation

- Generally modules are fixed using mounting holes or clamp hardware.
- Each module must be securely fixed at a minimum of 4 – 8 points on two each side of long frame.
- The mounting design must be certified by a registered professional engineer. The mounting design and procedures shall comply with local electrical and building codes.
- Mounting hardware is not provided by HES.
- Mounting hardware like those in Picture 1 & 2 is highly recommended by clamping or bolt & nut mounting (Torque level: 16 N·m for bolting method, 8 N·m for clamping). The material of bolts and nuts are recommended as stainless steel.
- Area of module frame fastened by each clamp shall be no less than 400 mm^2. *(clamp length ≥50mm, the clamped width of module frame shall be in this area: 9-11mm)*
- Detailed mounting method is described in ‘module installation instruction’ in the Appendix 1.

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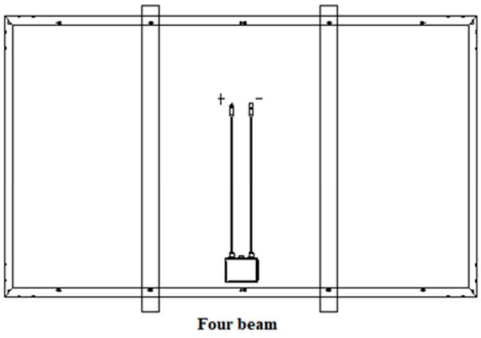
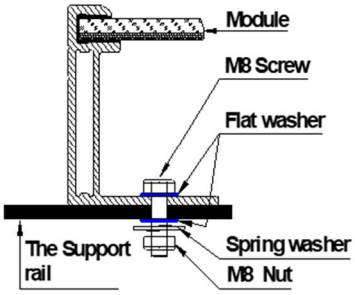
Mounting holes location	Screw bolts fasten method	Recommend accessories		
		Part name	material	Dimension
		Screw	Stainless steel	M8× 16mm
		Spring washer	Stainless steel	M8
		Flat washer	Stainless steel	100*25mm
		Nut	Stainless steel	M8
		Bolt beam: width * height * length 40mm*40mm* > 2000mm		

Picture 1. Installation Method using stainless steel bolt & nut

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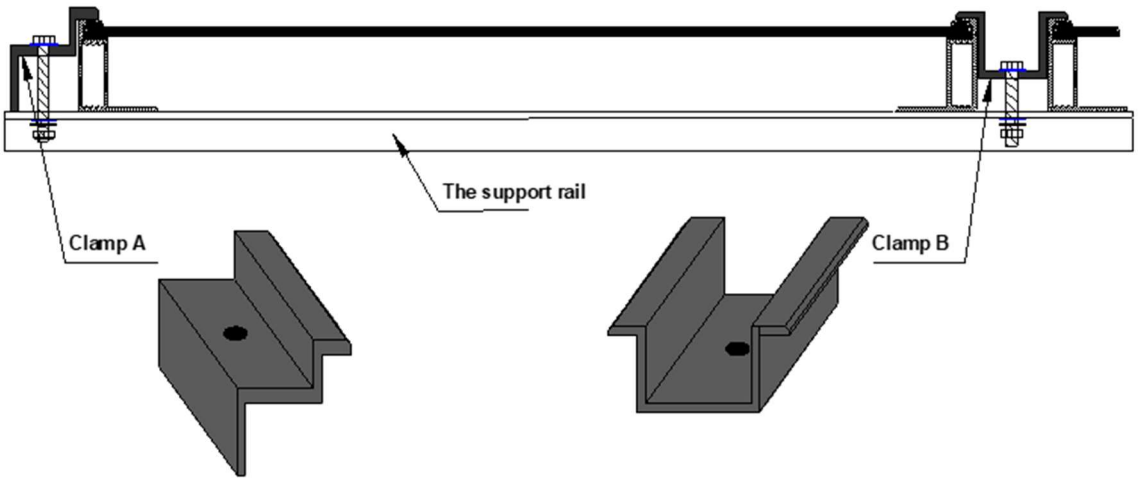

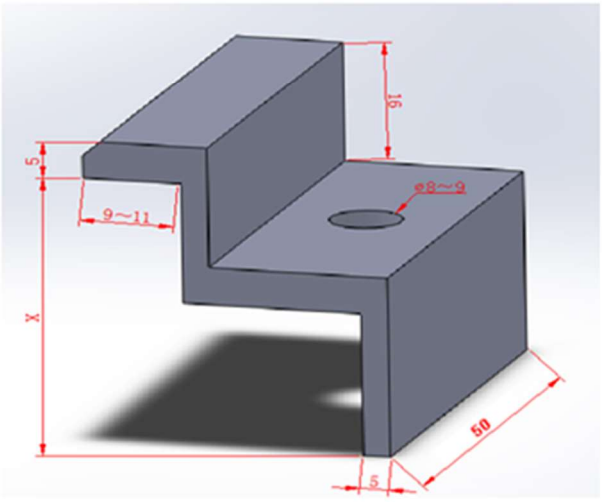

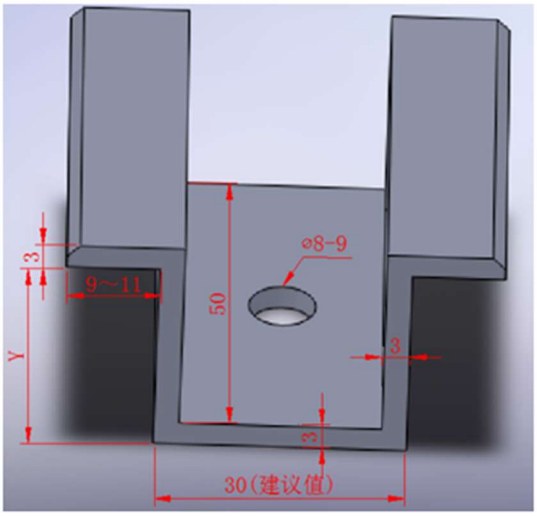

Fixture A: Fixture for edge module

For the 30 frame, the recommended value of X is 29mm

For the 35 frame, the recommended value of X is 34mm

For the 40 frame, the recommended value of X is 39mm

Fixture B: Fixture for intermediate modules

For the 30 frame, the recommended value of X is 20mm

For the 35 frame, the recommended value of X is 25mm

For the 40 frame, the recommended value of X is 30mm

Picture 2. Mounting Hardware (Clamp)

5. Wiring

5.1 General

· All wiring should be matched with acceptable regional and local electrical codes.

· All wiring work should be done by certified and authorized engineers.

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· All wiring should be connected safely in order to prevent any hazard.

· All PV modules for one serial connection must be identical in terms of output and in types.

· Do not connect PV modules directly in parallel without the combine box.

5.2 Module Wiring

· System voltage should not exceed the maximum system voltage of module.

· The maximum number of modules in parallel connection depends on inverter's capacity.

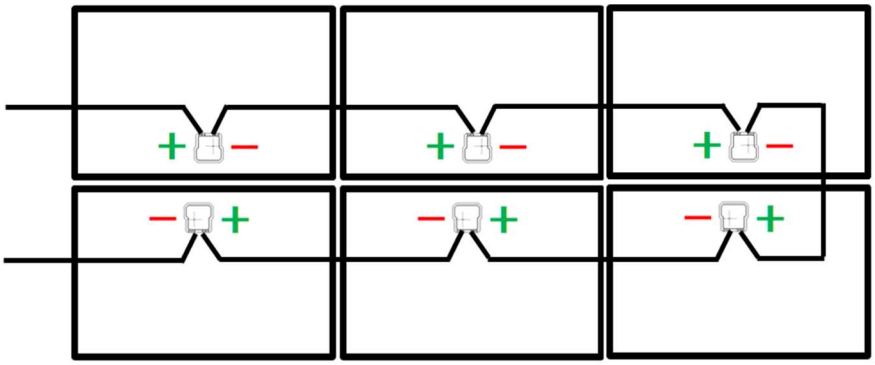
· PV modules are not designed to be connected to load directly. Therefore, a proper inverter must be connected.

· Bypass diodes are installed on the modules at the factory. Wrong connection may cause damage to the bypass diodes, cable and junction box.

- The value of Isc and Voc marked on modules should be multiplied by 1.25 when determining module voltage ratings, conductor current ratings, fuse size and the size of controls to the PV output

5.3 Array Wiring

'Array' is defined as a module arrangement with combined electrical connection. The array must be insulated to resist against the possible maximum open-circuit voltage. Also, solar irradiation-proof copper wires must be used for array wiring. Installers must check the local electrical specifications. In order to prevent cable drooping, installers should fix cable using wire or duct.

Horizontal Installation (Double row, The junction box is inside)	

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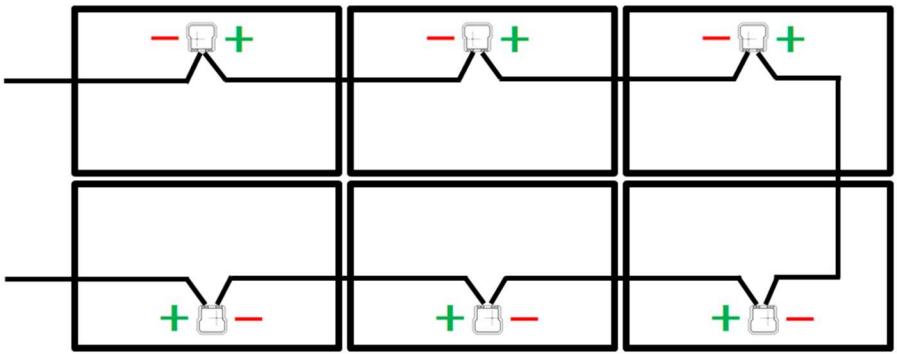
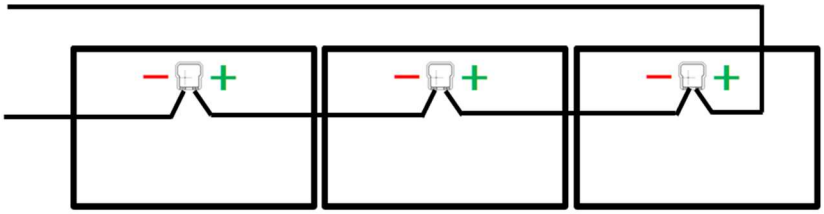
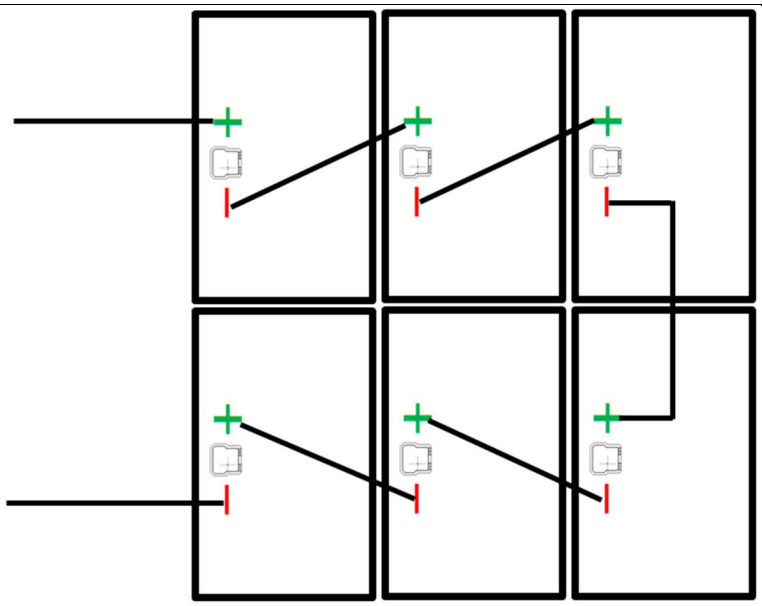
Horizontal Installation (Double row, The junction box is outside)	
Horizontal Installation (Single row)	
Vertical Installation (Double row)	

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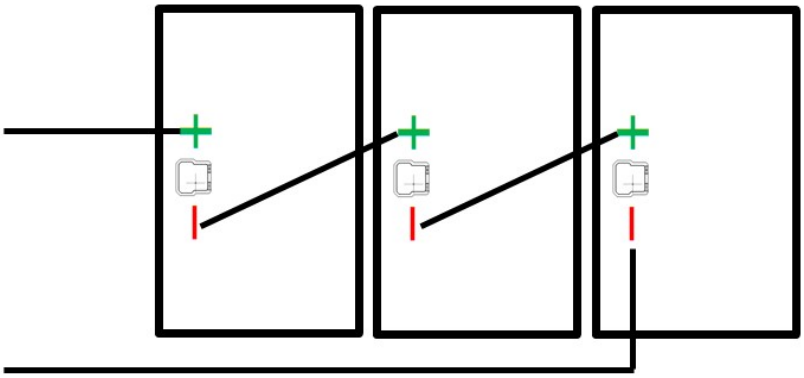
Vertical Installation (Single row)	

5.4 Earth Ground Wiring

To prevent electric shock and fire, an earthing must be done on the frames of PV modules and array. The array frame must be earthed according to local codes.

There is an earthing hole in the module frame; by using these holes, an earth conductor and the module frame must be connected and earthed. Use 12 AWG copper wire for the grounding wire. (See picture 3)

Common grounding hardware (nuts, bolts, star washers, split-ring lock washer, flat washers and the like) is used to attach a listed grounding/bonding device. The attachment must be made in conformance with the grounding device manufacturer's instructions.

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 device, 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.

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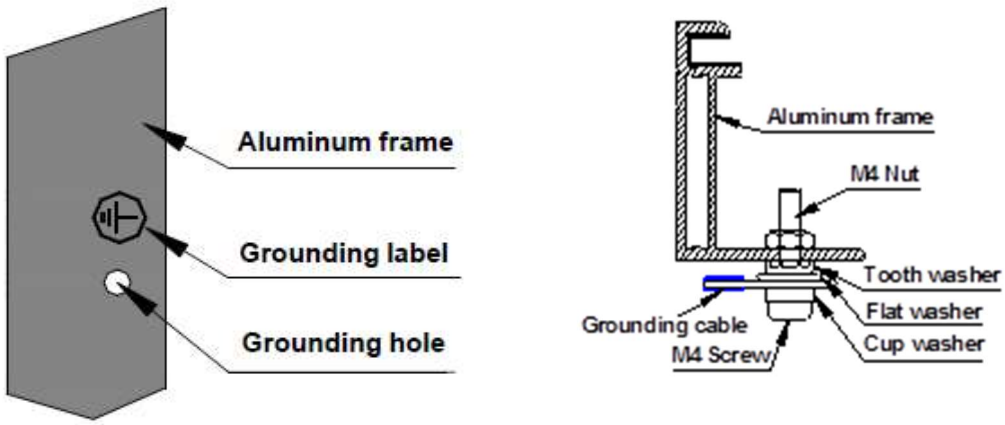

Picture 3. Grounding Hardware(Torque level: 2-3 N·m)

5.5 Module Terminations

The installer should connect cables using the same cable connector equipped in each PV module. For more information about electrical connection, contact an authorized engineer of HES. HES does not give warranty for the case of using connectors which are not approved by HES.

5.6 Junction Box & Terminals

A PV module has the plus and minus connectors and a junction box with bypass diodes. On the junction box, the polarity is clearly marked.

1) Protection Degree : IP67
2) Temperature Range : -40°C ~ +90°C
3) Wire Size : 4.0mm^2 (AWG 12)
4) The cable must not be bent or crushed on the direct exit of the cable screw joint. A minimum bending radius 43mm must be maintained. The cable must be routed in a way that tensile stress on the conductor or connections is prevented. (Picture 4)

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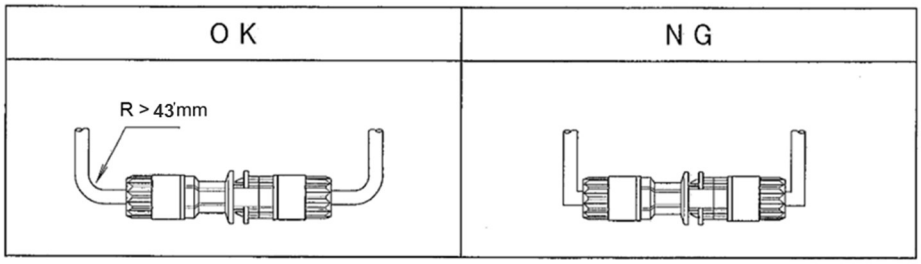
Picture 4.



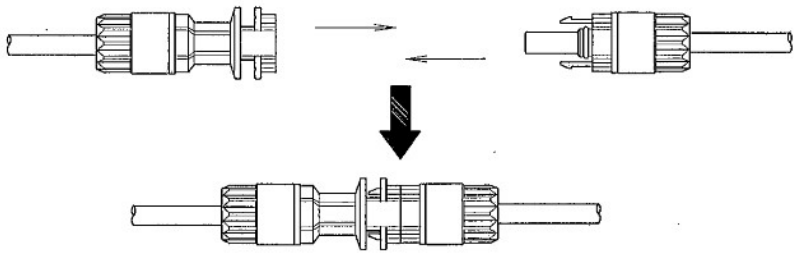
Cable Routing

5) When connect connectors, insert connector until locking hook catches the holder and clicks. Pull each connector gently and make sure connectors are not disconnected. (Picture 5)

6) Do not give between the connector and cable a strong pull (over 10kg).

7) Do not apply external stress to the body of connector. Do not place the connectors in water.

8) When same series modules with different connectors are installed together, make sure those two connectors are compatible.



Picture 5. Connect connectors

9) If the connectors need to be disconnected, installer should use the exclusive tool to disconnect them after safety measure such as cut-off of connection band.

10) Connected cables and connectors should be fixed.

11) Action against contamination or corrosion should be enacted on disconnected connectors.

5.7 Conduit

For conduit application, it is necessary to follow the regulation for outdoor installation of conduit. All fixing parts should be protected from any damage and moisture.

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5.8 Diode

When there is partial shade on a PV module, reverse-voltage can occur inside PV module. In order to protect this phenomenon, the diodes are normally installed in the Junction Box. HES PV modules are equipped with bypass diodes. If installer wishes to change into other diodes, the installer should inform an authorized engineer of HES.

Junction box set 1				
Junction box	SUZHOU UKT NEW ENERGY TECHNOLOGY CO., LTD	JB12x (x=S1)	Rated Voltage = 1500VDC Rated Current = 30A Number of diodes: 3	Certificate no.: R 50377301
Adhesive (junction box)	Suzhou TONSAN Adhesive Ltd.	1527	-	-
	Shanghai Huitian New Chemical Co., Ltd.	HT906Z	-	-
	Jiangsu Tianchen Silicon Materials Co., Ltd.	HT8258	-	-
	Hangzhou Zhijiang Silicone Chemicals Co., Ltd.	JS-606	-	Tested with PV modules
	GUANGZHOU BAIYUN CHEMICAL INDUSTRY CO., LTD.	SMG533	-	-
Potting material	Jiangsu Tianchen Silicon Materials Co., Ltd.	HT6360	-	-
	Goloho Chemical Industrial Ltd.	GOLOHO-313-AB	-	-
	Hangzhou Zhijiang Silicone Chemicals Co., Ltd.	JS-1184	-	Tested with PV modules
	Beijing Tonsan New Material Technology Co., Ltd.	1521	-	-
	GUANGZHOU BAIYUN CHEMICAL INDUSTRY CO., LTD.	SKF323	-	-
	Shanghai Huitian New Material Co., Ltd.	5299W-S	-	-
	Suzhou TONSAN Adhesive Ltd.	1533	-	-
Bypass diodes	SUZHOU UKT NEW ENERGY TECHNOLOGY CO., LTD	UKTH5045-12/ TM3045-30	Tj max = 200°C	-
Cable	Ningbo Kibor Wire & Cable Co., Ltd.	H1Z2Z2-K 1x4.0mm²	Rated Voltage = 1500VDC	Certificate no.: R 50302047

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Object	Manufacturer	Type	Technical Data	Remark
	Wuxi Xinhongye Wire & Cable Co., LTd.	H1Z2Z2-K 1x4.0mm²	Rated Voltage = 1500VDC (1x4.0mm²)	Certificate no.: R 50311889
	Trina Solar Co., Ltd.	62930 IEC 131 1X4.0mm² HALOGEN FREE LOW SMOKE	Rated Voltage = 1500VDC	Certificate no.: R 50451199
	Trina Solar Co., Ltd.	H1Z2Z2-K 1X4.0mm²	Rated Voltage = 1500VDC	Certificate no.: R 50426462
	Changshu JHOSIN Communication Technology Co., Ltd.	62930 IEC 131 1X4.0mm² HALOGEN FREE LOW SMOKE	Rated Voltage = 1500VDC	Certificate no.: R 50413335
Connectors	SUZHOU UKT NEW ENERGY TECHNOLOGY CO., LTD	PV-CO02-xy	Rated Voltage = 1500VDC Rated Current = 45A	Certificate no.: R 50390097
	Jiangxi Jinko PV Material Co., Ltd.	PV-JK03M-2	Rated Voltage = 1500VDC Rated Current = 30A	Certificate no.: R 50318165
	Staubli Electrical Connectors AG	PV-KST4-EVO 2/xy_UR PV-KBT4-EVO 2/xy_UR	Rated Voltage = 1500VDC Rated Current = 45A	Certificate no.: R 60127169
	Trina Solar Co., Ltd.	TS4-xz (z=2)	Rated Voltage = 1500VDC Rated Current = 41A	Certificate no.: R 50385924
	Trina Solar Co., Ltd.	TS4	Rated Voltage = 1500VDC Rated Current = 41A	Certificate no.: R 50401767
Junction box set 2				
Junction box	QC Solar (Suzhou) Corporation	3Qxy(x=2, y=1)	Rated Voltage = 1500VDC Rated Current = 30A Number of diodes: 3	Certificate no.: R 50476363
Adhesive (junction box)	Suzhou TONSAN Adhesive Ltd.	1527	-	-
	Shanghai Huitian New Material Co., Ltd.	HT906Z	-	-
	GUANGZHOU BAIYUN CHEMICAL INDUSTRY CO., LTD	SMG533	-	-
	Jiangsu Tianchen New Material Co., Ltd.	HT-8258	-	-
Potting material	Suzhou TONSAN Adhesive Ltd.	1521	-	-
	Suzhou TONSAN Adhesive Ltd.	1533	-	-
	Shanghai Huitian New Material Co., Ltd.	5299W-S	-	-
Bypass diodes	QC Solar (Suzhou) Corporation	QCMK5045	Tj max = 200°C	-

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Object	Manufacturer	Type	Technical Data	Remark
Cable	QC Solar (Suzhou) Corporation	H1Z2Z2-K 1x4.0mm²	Rated Voltage = 1500VDC	Certificate no.: R 50348871
	QC Solar (Suzhou) Corporation	62930 IEC 131 1x4.0 / 6.0mm² HALOGEN FREE LOW SMOKE	Rated Voltage = 1500VDC	Certificate no.: R 50447239
Connectors	QC Solar (Suzhou) Corporation	QC4.10-cd	Rated Voltage = 1500VDC Rated Current = 41A	Certificate no.: R 50353779
	Staubli Electrical Connectors AG	PV-KST4-EVO 2/xy_UR (male) PV-KBT4-EVO 2/xy_UR (female)	Rated Voltage = 1500VDC Rated Current = 45A	Certificate no.: R 60127169
	Amphenol Technology (Shenzhen) Co., Ltd.	UTXCFabcde; UTXCMabcde (a=A, b=4, c=A to Z, e=Blank or A or Z)	Rated Voltage = 1500VDC Rated Current = 35A	Certificate no.: R 50340393
Junction box set 3				
Junction box	Jiangxi Jinko PV Material Co., Ltd.	PV-JK09Lxy (x=2, y=2)	Rated Voltage = 1500VDC Rated Current = 30A Number of diodes: 3	Certificate no.: R 50354415
Adhesive (junction box)	Jiangsu Tianchen New Materials Co., Ltd	HT-8258	-	-
	JIANGSU MINGHAO NEW MATERIAL SCI-TECH CORPORATION	MH-3668	-	-
	Shanghai Huitian New Material Co., Ltd.	HT906Z	-	-
Potting material	Shanghai Huitian New Chemical Materials Co., Ltd	5299W-S	-	-
	Jiangsu Tianchen New Materials Co., Ltd	HT-6360A / HT-6360B	-	-
	JIANGSU MINGHAO NEW MATERIAL SCI-TECH CORPORATION	MH-3667	-	-
	Shanghai Huitian New Chemical Materials Co., Ltd.	HT5299W-S (black)	-	-
	TONSAN ADHESIVE INC	1521	-	-
	Hangzhou Zhijiang Silicone Chemicals Co., Ltd.	JS-1184	-	-
Bypass diodes	Jiangxi Jinko PV Material Co., Ltd.	TPA6050-T	Tj max=200℃	-
Cable	Ningbo Kibor Wire&Cable Co., Ltd.	H1Z2Z2-K 1x4.0mm²	Max. Voltage=1500V	Certificate no. R 50302047

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Object	Manufacturer	Type	Technical Data	Remark
	Jiangxi Jinko PV Material Co., Ltd.	H1Z2Z2-K 1x4.0mm²	Max. Voltage=1500V	Certificate no. R 50319823
	Jiangxi Jinko PV Material Co., Ltd.	H1Z2Z2-K 1x4.0mm²	Max. Voltage=1500V	Certificate no. R 50334783
	Jiangxi Jinko PV Material Co., Ltd.	H1Z2Z2-K 1x4.0mm²	Max. Voltage=1500V	Certificate no. R 50347607
	Jiangxi Hejia Technology Co., Ltd.	H1Z2Z2-K 1x4.0mm²	Max. Voltage=1500V	Certificate no. R 50346833
	YushanXinzhan Industrial Co., Ltd.	H1Z2Z2-K 1x4.0mm²	Max. Voltage=1500V	Certificate no. R 50345549
	Jiangxi Jinko PV Material Co., Ltd.	H1Z2Z2-K 1x4.0mm²	Max. Voltage=1500V	Certificate no. R 50367004
	DONGGUAN XINBEISEN WIRE AND CABLE CO LTD	H1Z2Z2-K 1x4.0mm²	Max. Voltage=1500V	Certificate no. R 50355846
	Jiangxi Jinko PV Material Co., Ltd.	H1Z2Z2-K 1x4.0mm²	Max. Voltage=1500V	Certificate no. R 50380780
	Suzhou Baohing Electric Wire & Cable Co., Ltd.	H1Z2Z2-K 1x4.0mm²	Max. Voltage=1500V	Certificate no. R 50310426
	Jiangxi Jinko PV Material Co., Ltd.	H1Z2Z2-K 1x4.0mm²	Max. Voltage=1500V	Certificate no. R 50380522
	Jiangxi Han Guang Cable Co., Ltd.	H1Z2Z2-K 1x4.0mm²	Max. Voltage=1500V	Certificate no. R 50390363
	Jiangxi Jinko PV Material Co., Ltd.	H1Z2Z2-K 1x4.0mm²	Max. Voltage=1500V	Certificate no. R 50393550
	Jiangxi Hejia Technology Co., Ltd.	H1Z2Z2-K 1x6.0…25mm²	Max. Voltage=1500V 1x6mm²	Certificate no. R 50346833
	Suzhou Baohing Electric Wire&Cable Co., Ltd.	62930 IEC 131 1x1.5…35mm²	Max. Voltage=1500V 1x4mm², 1x6mm²	Certificate no. R 50464210
	Ningbo Kibor Wire&Cable Co., Ltd.	62930 IEC 131 1x1.5…10mm²	Max. Voltage=1500V 1x4mm², 1x6mm²	Certificate no. R 50413678
	Wuxi Xinhongye Wire & Cable Co., Ltd	H1Z2Z2-K 1x1.5…35mm²	Max. Voltage=1500V 1x4mm², 1x6mm²	Certificate no. R 50311889
	Wuxi Xinhongye Wire & Cable Co., Ltd	62930 IEC 131 1x1.5…35mm²	Max. Voltage=1500V 1x4mm², 1x6mm²	Certificate no. R 50439595
	Jiangxi Jinko PV Material Co., Ltd.	H1Z2Z2-K 1x2.5…35mm²	Max. Voltage=1500V 1x4mm², 1x6mm²	Certificate no. R 50463891
	SUZHOU YONGHAO CABLE CO., LTD.	H1Z2Z2-K 1x2.5…35mm²	Max. Voltage=1500V 1x4mm², 1x6mm²	Certificate no. R 50379270
	SUZHOU YONGHAO CABLE CO., LTD.	62930 IEC 131 1x2.5…35mm²	Max. Voltage=1500V 1x4mm², 1x6mm²	Certificate no. R 50401233
	RUIXU INDUSTRY CO., LTD.	H1Z2Z2-K 1x2.5…10mm²	Max. Voltage=1500V 1x4mm², 1x6mm²	Certificate no. R 50479665

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Object	Manufacturer	Type	Technical Data	Remark
	RUIXU INDUSTRY CO., LTD.	62930 IEC 131 1x2.5…10mm²	Max. Voltage=1500V 1x4mm², 1x6mm²	Certificate no. R 50467836
	Jiangxi Jinko PV Materials Co., Ltd.	H1Z2Z2-K 1x2.5…10mm²	Max. Voltage=1500V 1x4mm², 1x6mm²	Certificate no. R 50479666
	Jiangxi Jinko PV Materials Co., Ltd.	62930 IEC 131 1x2.5…10mm²	Max. Voltage=1500V 1x4mm², 1x6mm²	Certificate no. R 50479664
Connectors	Staubli Electrical Connectors AG	PV-KST4-EVO2/xy_UR; (male) PV-KBT4-EVO2/xy_UR (female)	Rated Voltage=1500V Rated Current=45A for 4mm²	Certificate no. R 60127169
	Jiangxi Jinko PV Material Co., Ltd.	PV-JK03M/xy (Plug+Socket)(x=2,y =B)	Rated Voltage=1500V Rated Current=45A for 4mm²	Certificate no. R 50318165
	Jiangxi Jinko PV Material Co., Ltd.	PV-JK03M1/xy (Plug+Socket)(x=2,y =B)	Rated Voltage=1500V Rated Current=45A for 4mm²	Certificate no. R 50318165
	Jiangxi Jinko PV Material Co., Ltd.	PV-JK03M2/xy (Plug+Socket)(x=2,y =B)	Rated Voltage=1500V Rated Current=45A for 4mm²	Certificate no. R 50318165
Junction box set 4				
Junction box	Zhejiang Jiaming Tianheyuan Photovoltaics Technology Co., Ltd.	JM37xy (x=A, y=C)	Rated Voltage = 1500VDC Rated Current = 30A Number of diodes: 3	Certificate no.: R 50494552
Adhesive (junction box)	Beijing Tonsan New Material Technology Co., Ltd.	TS1527	-	-
	Shanghai Huitian New Chemical Material Co., Ltd.	HT906Z	-	-
	Momentive	TSE382-(W/B/C)	-	-
Potting material	Beijing Tonsan New Material Technology Co., Ltd.	1521	-	-
	Huitian New Chemical Material Co., Ltd.	5299W-S	-	-
Bypass diodes	Zhejiang Jiaming Tianheyuan Photovoltaics Technology Co., Ltd.	MK5050	Tj max = 200°C	-
Cable	Zhejiang Jiaming Tianheyuan Photovoltaics Technology Co., Ltd.	H1Z2Z2-K 1x4.0mm²	Rated Voltage = 1500VDC	Certificate no.: R 50334928
Connectors	Zhejiang Jiaming Tianheyuan Photovoltaics Technology Co., Ltd.	PV-JM601A	Rated Current = 30A	Certificate no.: R 50332967
	Staubli Electrical Connectors AG	PV-KST4-EVO2/xy_UR (male); PV-KBT4-EVO2/xy_UR (female)	Rated Current = 45A (4mm²)	Certificate no.: R 60127169

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Object	Manufacturer	Type	Technical Data	Remark
	Zhejiang Jiaming Tianheyuan Photovoltaics Technology Co., Ltd.	PV-JM608	Rated Current = 30A	Certificate no.: R 50374980
	Amphenol Technology (Shenzhen) Co., Ltd.	H4Cabcdef(c=4)(b=B, M or N)	Rated Current = 35A	Certificate no.: R 50388083
Junction box set 5				
Junction box	Zhejiang Zhonghuan Sunter PV Technology Co., Ltd.	PV-ZH011C-3K PV-ZH011C-3H	Rated Voltage = 1500VDC Rated Current = 30A Number of diodes: 3	Certificate no.: B 082630 0026 Rev. 00
Adhesive (junction box)	BEIJING TONSAN New Material Technology Co., LTD.	TS1527	-	-
	Shanghai Huitian New Chemical Material Co., Ltd.	HT906Z	-	-
	Goloho Chemical Industry Ltd.	GOLOHO-63	-	-
	Jiangsu Tiancheng Silicon Co., LTD.	TS-688	-	-
	Jiangsu Tianshun new Material Technology Co., Ltd	TS6568	-	-
	HangZhou Zhijiang Silicone Chemicals CO.,LTD	JS606	-	-
	Jiangsu CREVO Science&Technology Co., Ltd	CV709	-	-
	Jiangsu CREVO Science&Technology Co., Ltd	CREVO709	-	-
	Tonsan Adhesive,Inc	1527	-	-
	Sika India Pvt. Ltd.	Sika AS 60 CN	-	-
	DOW CORNING	PV804	-	-
	Jiangsu Tianchen silisonIcon material Co., Ltd	HT-8258	-	-
	Guangzhou Baiyun Chemical Industry Co., Ltd	SMG533	-	-
Potting material	Huitian New Chemical Material Co., Ltd.	5299W-S	-	-
	BEIJING TONSAN New Material Technology Co., LTD.	1533	-	-
	BEIJING TONSAN New Material Technology Co., LTD.	1521	-	-
	Jiangsu CREVO Science&Technology Co., Ltd	CV315	-	-

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Object	Manufacturer	Type	Technical Data	Remark
	Hangzhou Zhijiang Silicone Co., Ltd.	JS-1184	-	-
	DOW Corning Corporation	PV-7326	-	-
	JIANGSU TIANCHEN SILICON MATERIALS CO.,LTD	HT-6360A/B	-	
Bypass diodes	Zhejiang Zhonghuan Sunter PV Technology Co., Ltd.	SKT5045F	Tj max = 200°C	-
Cable	Zhejiang Zhonghuan Sunter PV Technology Co., Ltd.	H1Z2Z2-K 1x4.0mm²	Rated Voltage = 1500VDC	Certificate no.: R 50330654
	Zhejiang Zhonghuan Sunter PV Technology Co., Ltd.	H1Z2Z2-K 1x6.0mm²	Rated Voltage = 1500VDC	Certificate no.: R 50330654
	Zhejiang Zhonghuan Sunter PV Technology Co., Ltd.	62930 IEC 131 1x6.0mm²	Rated Voltage = 1500VDC	Certificate no.: R 50436635
	Zhejiang Zhonghuan Sunter PV Technology Co., Ltd.	62930 IEC 131 1x4.0mm²	Rated Voltage = 1500VDC	Certificate no.: R 50436635
Connectors	Zhejiang Zhonghuan Sunter PV Technology Co., Ltd.	PV-ZH202B	Rated Voltage = 1500VDC Rated Current = 40A	Certificate no.: R 50350557
	Multi-Contact AG Basel	MC4-EVO2	Rated Voltage = 1500VDC Rated Current = 45A	Certificate no.: R 60127169
Junction box set 6				
Junction box	Zhejiang Renhe Photovoltaic Technology Co., Ltd.	FT60xy (x=1 or 2, y =B or D)	Rated Voltage = 1500VDC Rated Current = 30A for (x=2), 32A for (x=1) Number of diodes: 3	Certificate no.: R 50497914
Adhesive (junction box)	TONSAN ADHESIVE INC.	TS1527	-	-
	Shanghai Huitian New Chemical Material Co., Ltd.	HT906Z	-	-
	DOW CORNING	PV8101F	-	-
	Jiangsu MingHao New Mstar Technology Ltd.	MH-3668	-	-
	Goloho Chemical Industrial Co., Ltd.	GOLOHO63	-	-
	JIANGSU TIANSHENG NEW MATERIALS SCIENCE AND TECHNOLOGY CO.,LTD.	TS-688	-	-
	DOW CORNING	PV-804	-	-
	DOW CORNING	PV-8007	-	-
	Momentive Performance Materials	RTV 3642	-	-
	Hangzhou Zhijiang Silicone Chemicals CO., LTD.	JS-606	-	-

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Object	Manufacturer	Type	Technical Data	Remark
	Chengdu Guibao Science and Technology Co., Ltd.	888A	-	-
	LIYANG KANGDAWEI INDUSTRIAL CO.,LTD	KDW1536	-	-
	Otto Hermann GmbH	Novasil SP 5728/S-CA2105	-	-
	Jiangsu tiancheng New materials PLC.	HT8258	-	-
	Jiangsu Crevo Science & Technology Co., Ltd.	CV709	-	-
	Guangzhou Baiyun Chemical Industry Co., Ltd.	SMG533	-	-
Potting material	Shanghai Huitian New Chemical Material Co., Ltd.	5299W-S	-	-
	TONSAN ADHESIVE, INC	TS1521	-	-
	TONSAN ADHESIVE, INC	TS1533	-	-
Bypass diodes	Zhejiang Renhe Photovoltaic Technology Co., Ltd. OEM: ChangZhou Star Sea Electronics Co., Ltd.	RMK4560D (for FT60xy (x=1))	Tj max = 200°C	-
	Zhejiang Renhe Photovoltaic Technology Co., Ltd. OEM: ChangZhou Star Sea Electronics Co., Ltd.	RMK4555D (for FT60xy (x=2))	Tj max = 200°C	-
Cable	Zhejiang Renhe Photovoltaic Technology Co., Ltd.	H1Z2Z2-K 1x4.0mm^2	Rated Voltage = 1500VDC	Certificate no.: R 50318681
	Trina Solar Co., Ltd.	H1Z2Z2-K 1x4.0mm^2	Rated Voltage = 1500VDC	Certificate no.: R 50426462
	Trina Solar Co., Ltd.	62930 IEC 131 1x4.0mm^2	Rated Voltage = 1500VDC	Certificate no.: R 50451199
	Zhejiang Renhe Photovoltaic Technology Co., Ltd.	62930 IEC 131 1x4.0mm^2	Rated Voltage = 1500VDC	Certificate no.: R 50452023
Connectors	Zhejiang Renhe Photovoltaic Technology Co., Ltd.	05-8	Rated Voltage = 1500VDC Rated Current = 30A	Certificate no.: R 50334688
	Amphenol Technology (Shenzhen) Co.,Ltd.	UTXCFabcd; UTXCMabcd	Rated Voltage = 1500VDC Rated Current = 35A	Certificate no.: R 50340393
	Staubli Electrical Connectors AG	PV-KST4-EVO 2/xy_UR; PV-KBT4-EVO 2/xy_UR	Rated Voltage = 1500VDC Rated Current = 45A (4mm^2)	Certificate no.: R 60127169
	Tyco Electronics (Shanghai) Co., Ltd.	PV4-S1yx (y=F or M; x=4.0)	Rated Voltage = 1500VDC Rated Current = 40A (x=4.0)	Certificate no.: R 50372137
	Trina Solar CO., Ltd.	TS4-xz(x=1, z=2)	Rated Voltage = 1500VDC Rated Current = 41A (4mm^2)	Certificate no.: R 50385924

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Object	Manufacturer	Type	Technical Data	Remark
	Phoenix Contact GmbH & Co.KG	PV-CF-C-2,5-4-SETxxxx; PV-CM-C-2,5-4-SETxxxx	Rated Voltage = 1500VDC Rated Current = 30A (4mm²)	Certificate no.: R 60126961
	Zhejiang Renhe Photovoltaic Technology Co., Ltd.	RHC2xyzu	Rated Voltage = 1500VDC Rated Current = 35A (4mm²)	Certificate no.: R 50473621

6. Electrical Installations

6.1 General With Regard to Electrical Installation

6.1.1 Under normal outdoor conditions, a module is likely to produce different current and voltage than the values measured under STC in the specification of HES solar's module. Therefore, when determining the parameters (for example, nominal voltage, conductor capacity, fuse capacity and controller capacity, etc.) related to the power output of the PV system, the values of short-circuit current and open circuit voltage of the modules should be multiplied by a factor of 125% during design and installation.

6.1.2 Try to use the modules with the same configuration in the same PV system. If the modules are connected in series, the total voltage is the sum of voltages of all the modules. The maximum voltage of string does not exceed the maximum system voltage of the modules (the maximum system voltage of HES solar's modules is 1500V), the maximum number of modules that can be connected in a series string must be calculated in accordance with applicable regulations, make sure the open circuit voltage of string does not exceed the maximum system voltage of the modules and the other electrical DC components required at the minimum temperature at the PV system location. Using the following formula:

System voltage=N*Voc*[1+λvoc (25-Tmin)]

N number of modules in series

Voc open circuit voltage at STC (refer to product label or data sheet)

λvoc Thermal coefficient of Voc of each module (refer to product data sheet)

Tmin Minimum ambient temperature at the PV system location

6.1.3 If the PV system requires the installation of high current, several PV modules can be connected in parallel, and total current is the sum of current of all the modules. The maximum parallel number of the modules N= Imax (fuse rating) /Isc,

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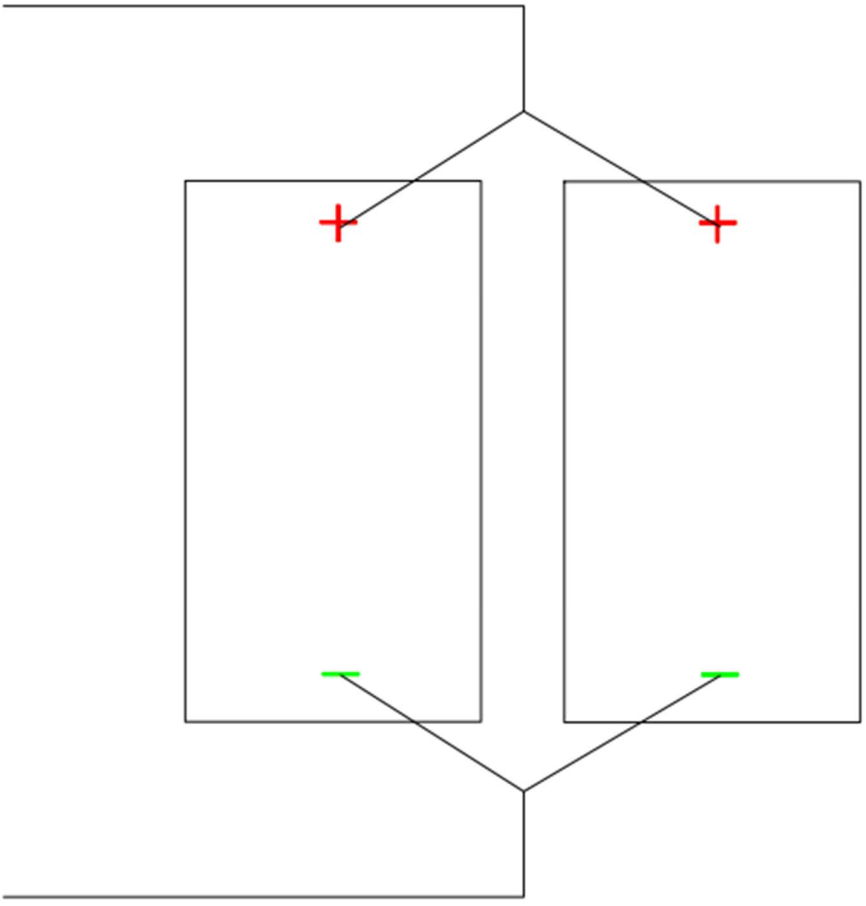
6.1.4 An over-current protection device with appropriately rated must be used when reverse current could exceed the value of the maximum fuse rating of the module, an over-current protection devices is required for each series string if more than two series strings are connected in parallel.

6.1.5 When installing the module, place the end with the junction box up and try to avoid the rain.

6.1.6 Do not carry out installation in rainy weather, because humidity will void the insulation protection, Thus cause safety accidents.

Parallel connection	

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7. Operation and Maintenance

It is required to perform regular inspection and maintenance of the modules, especially within warranty scope. It is the user's responsibility to report to the supplier regarding the damages found.

7.1 Cautions

- Do not conduct electrical work such as opening junction boxes or separation of connectors without a qualified expert.
- Before electrical work, remove any metal material from body and wear protection equipment for insulation.
- To minimize output decline, remove any substance near the PV modules such as grass, moss, and vine.
- Any chemical which is not approved by HES shall not contact PV modules.

7.2 Cleaning

- Recommend maintaining module glass surface clean as possible to improve module power efficiency and long life.
- HES 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.
- For AR coating HES modules utilize special materials to increase energy harvest. Always use clean gloves when handling the module, never touch the glass with bare hands.
- If dirt build-up becomes excessive, clean the glass surface with room temperature water and soft materials without potential risks of scratch. Do not use water with high pressure for cleaning. Do not use harsh cleaning materials such as scouring powder, steel wool, scrapers, blades, or other sharp instruments to clean the glass surface of the module. Use of such materials or cleaning will invalidate the product warranty.
- Do not clean the backside of the module. If backside cleaning is necessary, please contact local representatives for more detailed information.
- PV modules will be "self-clean" as effectively as modules mounted at a 15° tilt or greater.

7.3 Visual Inspection of Modules

- Inspect the modules visually to find whether there are appearance defects, the following need to be paid more attention especially:

  1) Whether the glass is broken

  2) Corrosion along the cells' bus-bar

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3) Whether there is burning vestige on the Backsheet.

7.4 Inspection of connector and Cable

In order to ensure proper operation of the system, please check all wiring connections and the condition of the wire insulation periodically.

8. Disposal

· Users shall dispose of modules according to local disposal regulations.

· Contact HES for more detailed information related to disposal and recycling.

9. Disclaimer of Liability

1) HES do not have any responsibility and liability for clause as below.

- Loss, damage, injury or expense resulting from improper installation, handling or use. The installation techniques, handling and use of this product are beyond company control.
- Infringement of any third party's patent or right that is caused by using HES modules.
- Loss, damage, injury or expense resulting from any factor that is unsuspected the module was produced or shipped.

2) HES reserves the rights for any change the technical specification including the PV production, the specifications, or the product information sheets without prior notice.

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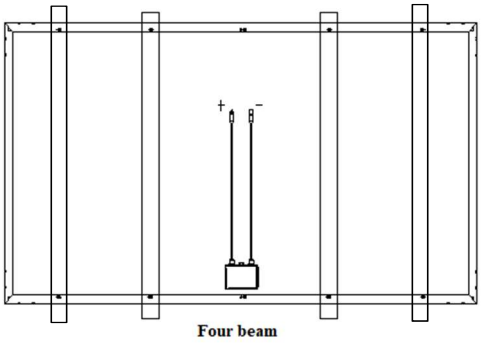
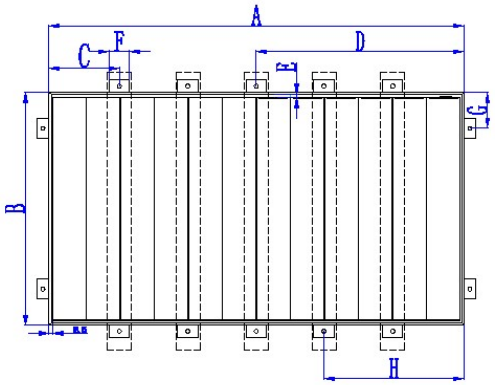
Appendix 1) Module Installation Instruction (Front / Back Design Load, Safety factor = 1.5)

<table>
<tr><th colspan="2">Method</th><th>DJ / DI / DM / DN / DG / DL</th></tr>
<tr><td>Bolting</td><td>on
Long Bar</td><td> 

8 Bolts : 3600/1600 Pa</td></tr>
<tr><td>Clamping

■:Clamping area

※ Min. Clamp Width: 50mm</td><td>on
Long Bar</td><td> 

<table>
<tr><th>Type</th><th>A/mm</th><th>B/mm</th><th>C/mm</th><th>D/mm</th><th>E/mm</th><th>F/mm</th><th>G/mm</th><th>H/mm</th></tr>
<tr><td>DG</td><td>2355</td><td>1090</td><td>425±50</td><td>/</td><td>9～11</td><td>≥50</td><td>/</td><td>570±50</td></tr>
<tr><td>DI</td><td>2355</td><td>1303</td><td>425±50</td><td>/</td><td>9～11</td><td>≥50</td><td>/</td><td>570±50</td></tr>
<tr><td>DL</td><td>2253</td><td>1096</td><td>405±50</td><td>/</td><td>9～11</td><td>≥50</td><td>/</td><td>545±50</td></tr>
<tr><td>DN</td><td>2384</td><td>1096</td><td>430±50</td><td>/</td><td>9～11</td><td>≥50</td><td>/</td><td>575±50</td></tr>
<tr><td>DM</td><td>2253</td><td>1303</td><td>405±50</td><td>/</td><td>9～11</td><td>≥50</td><td>/</td><td>545±50</td></tr>
<tr><td>DJ</td><td>2384</td><td>1303</td><td>430±50</td><td>/</td><td>9～11</td><td>≥50</td><td>/</td><td>575±50</td></tr>
</table>
Design load 3600/1600Pa or 2400/1600Pa</td></tr>
</table>

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Appendix 2) Module Electrical Performance

· **Electrical Characteristics : HiE-SxxxDJ**

Item	HiE-SxxxDJ (xxx: Maximum Power Value)			
Maximum Power at STC(Pmax) [W]	650	645	640	635
Voltage at Pmax (Vmpp) [V]	38.8	38.7	38.6	38.5
Current at Pmax (Impp) [A]	16.77	16.68	16.58	16.49
Open circuit voltage (Voc) [V]	46.7	46.6	46.5	46.4
Short circuit current (Isc) [A]	17.84	17.74	17.64	17.54
Module efficiency [%]	20.9	20.8	20.6	20.4
Maximum Series Fuse Rating [A]	30			
Temp. coefficient of Pmpp [%/K]	-0.34			
Temp. coefficient of Voc [%/K]	-0.27			
Temp. coefficient of Isc [%/K]	0.04			
Output tolerance [W]	+5 / 0			
Maximum system voltage [Vdc]	IEC 1,500			
Cell quantity in series [pcs]	414			
Bypass diodes [pcs]	3			
Cell Type	Mono-crystalline Silicon Cell			
Application & Safety Class	Class A & Class II			
Fire rating	Class C (IEC)			

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· **Electrical Characteristics : HiE-SxxxDI**

Item	HiE-SxxxDI (xxx: Maximum Power Value)					
Maximum Power at STC(Pmax) [W]	650	645	640	635	630	625
Voltage at Pmax (Vmpp) [V]	38.3	38.3	38.2	38.1	38.0	37.9
Current at Pmax (Impp) [A]	16.95	16.86	16.76	16.67	16.57	16.48
Open circuit voltage (Voc) [V]	46.2	46.1	46.0	45.9	45.8	45.7
Short circuit current (Isc) [A]	18.03	17.93	17.83	17.73	17.63	17.53
Module efficiency [%]	21.2	21.0	20.9	20.7	20.5	20.4
Maximum Series Fuse Rating [A]	30					
Temp. coefficient of Pmpp [%/K]	-0.36					
Temp. coefficient of Voc [%/K]	-0.28					
Temp. coefficient of Isc [%/K]	0.04					
Output tolerance [W]	+5 / 0					
Maximum system voltage [Vdc]	IEC 1,500					
Cell quantity in series [pcs]	408					
Bypass diodes [pcs]	3					
Cell Type	Mono-crystalline Silicon Cell					
Application & Safety Class	Class A & Class II					
Fire rating	Class C (IEC)					

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· **Electrical Characteristics : HiE-SxxxDM**

Item	**HiE-SxxxDM** (xxx: Maximum Power Value)				
Maximum Power at STC(Pmax) [W]	620	615	610	605	600
Voltage at Pmax (Vmpp) [V]	36.7	36.6	36.5	36.4	36.4
Current at Pmax (Impp) [A]	16.90	16.80	16.70	16.60	16.47
Open circuit voltage (Voc) [V]	44.2	44.1	44.0	43.9	43.9
Short circuit current (Isc) [A]	17.98	17.87	17.77	17.66	17.52
Module efficiency [%]	21.1	20.9	20.8	20.6	20.4
Maximum Series Fuse Rating [A]	30				
Temp. coefficient of Pmpp [%/K]	-0.36				
Temp. coefficient of Voc [%/K]	-0.28				
Temp. coefficient of Isc [%/K]	0.04				
Output tolerance [W]	+5 / 0				
Maximum system voltage [Vdc]	IEC 1,500				
Cell quantity in series [pcs]	390				
Bypass diodes [pcs]	3				
Cell Type	Mono-crystalline Silicon Cell				
Application & Safety Class	Class A & Class II				
Fire rating	Class C (IEC)				

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· **Electrical Characteristics : HiE-SxxxDN**

Item	**HiE-SxxxDN** (xxx: Maximum Power Value)				
Maximum Power at STC(Pmax) [W]	550	545	540	535	530
Voltage at Pmax (Vmpp) [V]	39.1	39.0	38.9	38.8	38.8
Current at Pmax (Impp) [A]	14.07	13.97	13.87	13.77	13.67
Open circuit voltage (Voc) [V]	47.1	47.0	46.9	46.8	46.7
Short circuit current (Isc) [A]	14.97	14.86	14.76	14.65	14.55
Module efficiency [%]	21.0	20.9	20.7	20.5	20.3
Maximum Series Fuse Rating [A]	30				
Temp. coefficient of Pmpp [%/K]	-0.36				
Temp. coefficient of Voc [%/K]	-0.28				
Temp. coefficient of Isc [%/K]	0.04				
Output tolerance [W]	+5 / 0				
Maximum system voltage [Vdc]	IEC 1,500				
Cell quantity in series [pcs]	345				
Bypass diodes [pcs]	3				
Cell Type	Mono-crystalline Silicon Cell				
Application & Safety Class	Class A & Class II				
Fire rating	Class C (IEC)				

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· **Electrical Characteristics : HiE-SxxxDG**

Item	**HiE-SxxxDG** (xxx: Maximum Power Value)				
Maximum Power at STC(Pmax) [W]	540	535	530	525	520
Voltage at Pmax (Vmpp) [V]	38.3	38.3	38.2	38.1	38.0
Current at Pmax (Impp) [A]	14.08	13.98	13.88	13.78	13.68
Open circuit voltage (Voc) [V]	46.2	46.1	46.0	45.9	45.8
Short circuit current (Isc) [A]	14.98	14.87	14.77	14.66	14.55
Module efficiency [%]	20.9	20.7	20.5	20.3	20.1
Maximum Series Fuse Rating [A]	30				
Temp. coefficient of Pmpp [%/K]	-0.36				
Temp. coefficient of Voc [%/K]	-0.28				
Temp. coefficient of Isc [%/K]	0.04				
Output tolerance [W]	+5 / 0				
Maximum system voltage [Vdc]	IEC 1,500				
Cell quantity in series [pcs]	340				
Bypass diodes [pcs]	3				
Cell Type	Mono-crystalline Silicon Cell				
Application & Safety Class	Class A & Class II				
Fire rating	Class C (IEC)				

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· **Electrical Characteristics : HiE-SxxxDL**

Item	**HiE-SxxxDL** (xxx: Maximum Power Value)			
Maximum Power at STC(Pmax) [W]	515	510	505	500
Voltage at Pmax (Vmpp) [V]	36.8	36.7	36.6	36.5
Current at Pmax (Impp) [A]	14.01	13.90	13.80	13.69
Open circuit voltage (Voc) [V]	44.3	44.2	44.1	44.0
Short circuit current (Isc) [A]	14.90	14.79	14.68	14.57
Module efficiency [%]	20.9	20.7	20.5	20.2
Maximum Series Fuse Rating [A]	30			
Temp. coefficient of Pmpp [%/K]	-0.36			
Temp. coefficient of Voc [%/K]	-0.28			
Temp. coefficient of Isc [%/K]	0.04			
Output tolerance [W]	+5 / 0			
Maximum system voltage [Vdc]	IEC 1,500			
Cell quantity in series [pcs]	325			
Bypass diodes [pcs]	3			
Cell Type	Mono-crystalline Silicon Cell			
Application & Safety Class	Class A & Class II			
Fire rating	Class C (IEC)			

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