HD Plus 1000VA / 2000VA

WITH SOLAR CHARGE CONTROLLER

INSTALLATION AND OPERATION MANUAL

SAFETY INSTRUCTIONS

Before using the product, please read carefully the warning messages and instructions on labels and user manual of this product and other components connected to the product.

The product is designed to be connected with lead-acid battery only. Do not connect the product with other types of batteries.

In the event flooded batteries are used, regular maintenance on the battery shall be performed.

The product is design for indoor installation. Please do not expose the product to direct sunlight, rainfall, or snow.

Before performing any maintenance on the product, please disconnect all power sources (AC mains, batteries, solar panel) to avoid the risk of electrical shock.

Do not attempt to disassemble or repair the product. Only authorized personnel is allowed to perform repair.

While performing maintenance or cleaning (especially on the batteries where hazardous liquid might be touched), it's recommended to wear necessary personal protections (e.g. gloves and goggle)

The product and external batteries shall not be installed anywhere near smoke, spark, and flame.

In the event a generator with auto-start function is connected with the product, before performing maintenance or cleaning.

SCOPE OF WARRANTY

The product comes with a standard 1-year warranty. This warranty includes all defects of design, components and manufacturing. The Warranty is void and does not cover any defects or damages caused by in any of the following circumstances:

- Seal on the product is broken
- The product has been misused, neglected, or abused
- Improper transportation and delivery
- The product has been used or stored in conditions outside its electrical or environmental specifications
- The product has been used for purposes other than for which it was designed
- The product has been used outside its stated specifications, operating parameters and application
- Acts of third parties, atmospheric discharges, excess voltage, chemical influences, natural wear and tear and for loss and damage in transit
- Improper testing, operation, maintenance, adjustment, repair, or any modification of any kind not authorized in writing by the supplier
- The product has been connected to other equipment with which it is not compatible
- Use and application beyond the definition in this manual
- Application beyond the scope of applicable safety standards or grid codes
- Acts of nature such as lighting, fire, storm, flood, vandalism and etc.

The right to repair and/or replace the defective product is at the supplier's sole discretion. Any warranty claim shall be asserted in writing to the supplier within 5 working days after notice of product failure. The supplier is not responsible for damages beyond the scope of this warranty.

TABLE OF CONTENT

1. PRODUCT OVERVIEW

This is a DC-to-AC inverter with integrated solar battery charger, which can be used as a long run-time UPS (Uninterruptible Power Supply), an energy-saving solution or an automotive inverter (hereinafter referred to as "**inverter**").

The inverter accepts input power source from AC mains (utility), battery, and PV (solar) string and switches between various operation modes automatically depending on the operational conditions.

When used as an UPS, battery or PV (solar) string act as back-up power source to supply loads during the outage of AC mains.

When used as an energy-saving device, the PV (solar) string can be set as priority to supply the loads without consuming the power from AC mains, as long as sufficient sunlight is present.

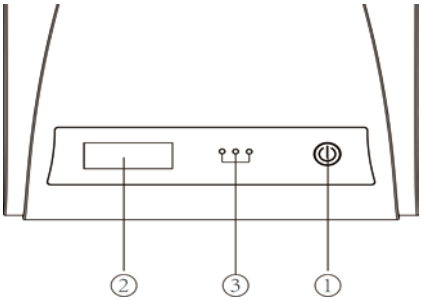
The battery can be charged by both AC mains and PV (solar) string with intelligent charging control.

Key features:

- Automatic line-to-battery switchover
- Built-in enhanced AC charger
- Built-in solar charger controller up to 40A
- Selectable Input voltage ranges/AC charging current/ AC or solar charger priority
- High efficient DC-to-AC conversion with minimized energy loss
- Rack design & wall-mounted design for flexible installation
- Intelligent 3-stage charger control for efficient charging and preventing overcharge
- Auto restart upon AC recovery
- User-friendly LCD and LED indications
- Multiple protections: low battery alarm, low battery shutdown, over charger protection, overload protection, over temperature protection, short circuit protection

1.1 Product Outlook

Front Panel

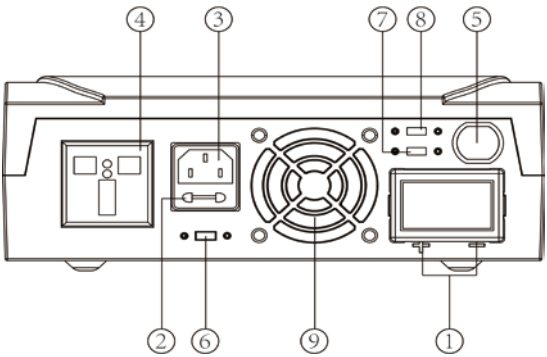


① Power ON/OFF button

② LCD

③ LED indicators

Rear Panel



① Battery Input

② AC input fuse

③ AC input receptacle

④ AC output receptacle

⑤ PV Input

⑥ AC input voltage range selector (refer to section 2.6)

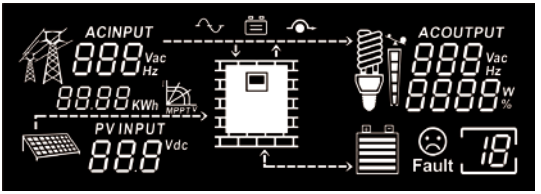
⑦ PV/Utility priority choice switch (refer to section 3.2)

⑧ Charge current choice switch (for 1000VA model only)

⑨ DC FAN

LCD Display

LCD displays the power flow and input/output readings in a visualized graphic design which allows the user to understand the operation status easily. The backlight of LCD remains on whenever the inverter is working (including Standby Charging Mode and Fault Mode).



Icon	Description
	This icon is showed when AC input presents. Input voltage level can be told by the numeric reading.
	This icon is showed when PV (solar) system presents. Input voltage level can be told by the numeric reading.
	This icon is showed total PV generating capacity.
	Level of remaining battery capacity
	Inverter is operated under over-loading condition
	The icon and level bar indicates the loading level (0~100%)
	Line Mode is enabled
	Backup Mode is enabled
	Standby Charging Mode is enabled
	This icon is showed when there is a fault event. The number is the fault code which can be referred to specific fault event (please refer to Section “Troubleshooting”).

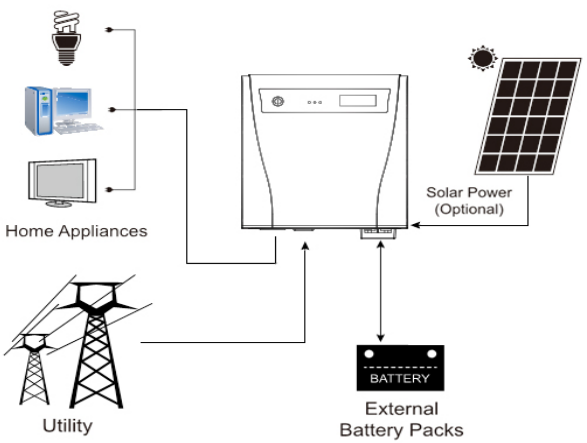
LED Indicators

The operation mode of the inverter can be easily told by LED indicators. Please see the table below for details.

LED	Behavior	Description
Green	On	Line Mode, battery is being charged but nearly full
	Blinks once every 2 second	Line Mode, battery is being charged and not full
	Blinks twice every 5 second	Standby Charging Mode
Yellow	On	Backup Mode
Red	On	Fault event
	Blinks every 0.5 second	Overloading

1.2 Typical Application

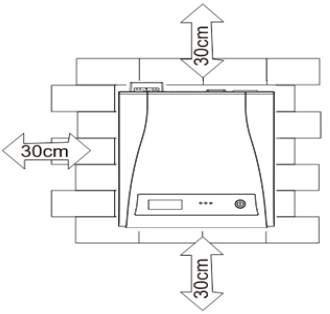
A typical application diagram for home and office applications is as shown below. The inverter can accept AC input from AC mains, and is capable of supply various loads such as fluorescent lamp, fan, and TV.



2. INSTALLATION

2.1 Safety Clearance

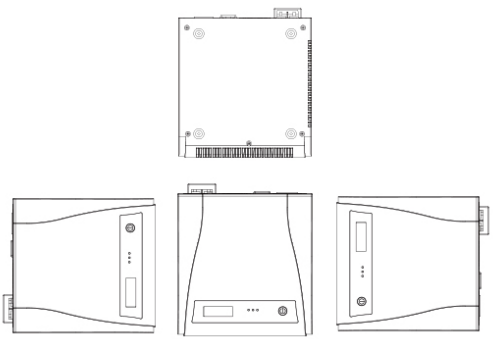
The minimum clearance to the wall shall be larger than 30cm in order to ensure proper ventilation.
In the event the ambient temperature is high, it's recommended to increase the distance of safety clearance to improve the heat dissipation.



2.2 Mounting Inverter on the Wall

The inverter is designed to either be placed on horizontal surface or be mounted on the wall with various ways (as shown below). When mounting the inverter on the wall,

1) The wall shall be solid and strong enough to carry the inverter;
2) The location of installation shall allow the user to read the LCD easily;
3) Two screws shall be firstly fixed on the wall (distance as shown below) so that the inverter can be hung on the screws, recommended screw size is M4*50~65mm.
4) After mounting the inverter, make sure it's firmly mounted and won't easily fall off in the event of unexpected earthquake or vibration.



2.3 Batteries

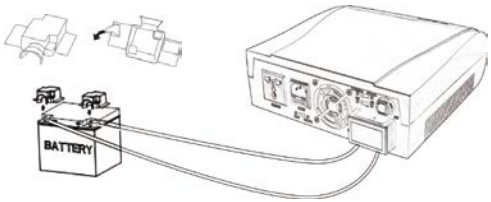
Determine the size of battery

The inverter is designed with pre-set charging current and voltage. Given a fixed charging current, under-sized batteries may shorten the battery life while over-sized batteries may result in unreasonable recharging time.

It's recommended the batteries capacity shall be no less than 100Ah.

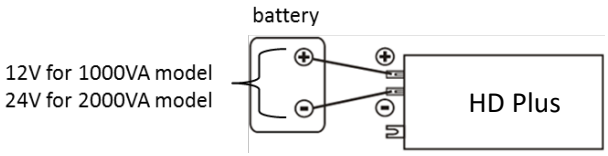
Connect the battery cables

- The gauge of battery cables shall be no less than 6 AWG with 105˚C rating.
- No matter how the batteries are connected (in series or in parallel), make sure the cables' terminal voltage is consistent with the inverter's specification (12V for 1000VA model and 24V for 2000VA model).
- It's recommended to cover the battery terminals during the connection.
- Check the polarity of cables before connecting to the inverter.
    - Connect the battery cables to the inverter's battery terminals as shown below.



Connect with single battery

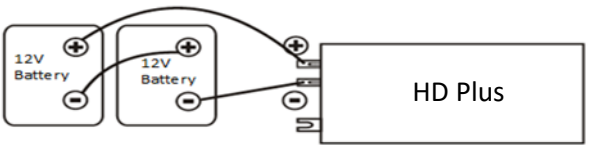
Make sure the battery voltage meets the inverter's specification (12V for 1000VA model and 24V for 2000VA model)



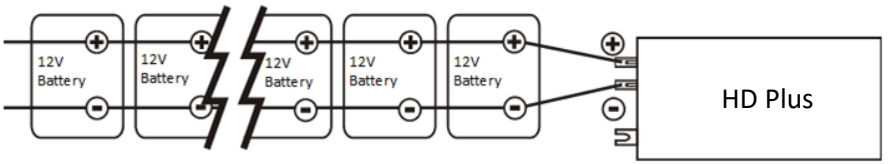
Connect with multiple batteries

While connecting multiple batteries, use the same brand/type for all batteries. Do not mix the battery bank with different brand/type of batteries.

The user may connect the batteries in series in order to double the voltage connected to inverter. The diagram below illustrate how to connect two 12V batteries in series to make up 24V (for 2000VA model)



The user may connect the batteries in parallel in order to increase the total battery capacity without changing the battery voltage. The example below shows parallel connection of multiple 12V batteries. While the total capacity is times by the number of battery, the terminal voltage remains 12V.



Charging Current Setting Switch (available on 1000VA model only):

The user of 1000VA model may set the charging current of the charger powered by AC input (not the solar battery charger) to either 15A or 20A, depending on the capacity of batteries. The larger the battery size, the larger charging current is needed in order to have reasonable recharging time. However too large charging current could damage the batteries. Please consult your battery supplier for suitable setting of charging current.

Recommendation:

- When Battery capacity≤150AH, please select charger current as 15A
- When battery capacity>150AH, please select charger current as 20A

2.4 PV (solar) string

Selection of PV panel

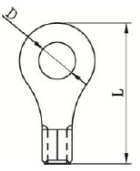
PV string is a connection of PV panels whose output voltage and current vary under different illumination. And just like battery, the PV panel can be connected in either series or parallel as per needed. Please consult the supplier of PV panel so that the operational voltage and current fall within the allowed range of the inverter as set out in the specification.

Please do not use PV panel which requires one terminal connected to ground (e.g. thin-film panel).

Connect the PV strings

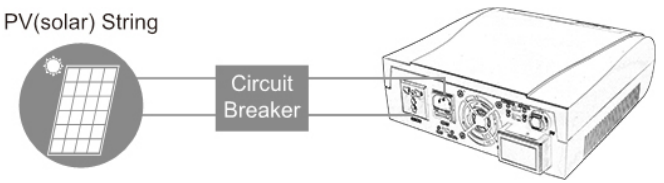
As the PV string generates power as long as illumination exists, a circuit breaker shall be installed between the PV string and inverter so that the power from PV string can be switched off when needed (e.g. regular maintenance).

To ensure better contact and reliability, ring terminal shall be fit on the cables from PV string before connecting to the inverter. The recommended size of ring terminal is



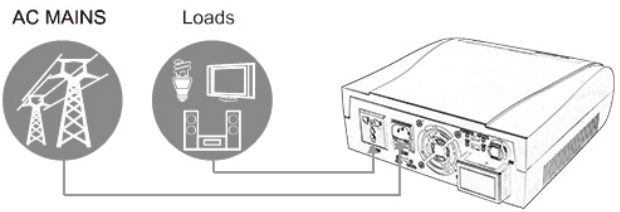
Model	Rated Current	Wire Gauge	Ring Terminal		
			Cable mm^2	Dimensions	
				D(mm)	L(mm)
1KVA/2KVA	40A	1*10AWG	5.16	5.3	19.8

Connect the cables from PV string to PV input terminals as shown below. Please check the polarity before connection.



2.5 Connect AC Input Cables and Loads

Connect the AC input cables and loads to the receptacles as shown below.



2.6 AC Input Voltage Range Selector

A. “NARROW” setting:

Set the selector to “NARROW” when connected with loads which are more sensitive on voltage range. With this setting, the inverter is more sensitive to the voltage disturbance on the AC input and the input voltage range is set at 170~280VAC while output voltage follows input voltage.

B. “WIDE” setting:

Set the selector to “WIDE” when connected with loads which are less sensitive on voltage range (e.g. light bulb, fan, fluorescent tube, or TV). With this setting, the inverter’s input voltage range is extended to 90~280VAC while output voltage follows input voltage.

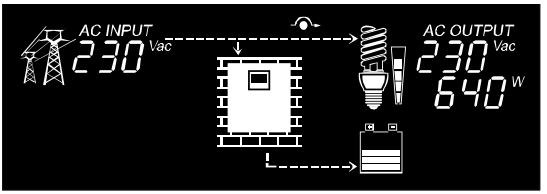
Please note that the inverter’s transfer time switching from Line Mode to Backup Mode gets longer as the input voltage gets low. Under the circumstance, connecting the inverter with loads which are sensitive to transfer time (e.g. computer) might result in power interruption.

3. OPERATION

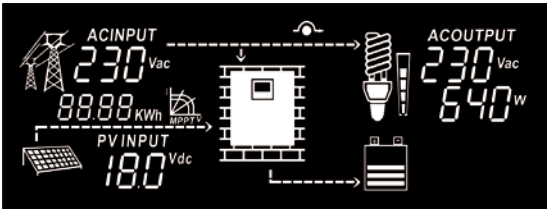
After connecting batteries, AC input cables, and loads, the inverter is now ready to work.

3.1 Standby Charging Mode

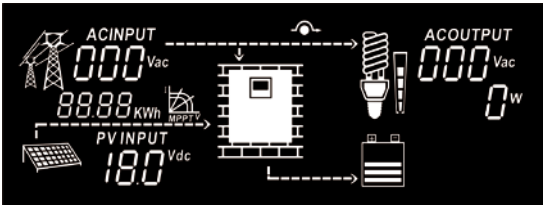
The battery can be charged without switching on the inverter, and such operation is called Standby Charging Mode. When AC input cable and battery is connected, the inverter will enter into Standby Charging Mode and LCD will be turned on with the following display.



If PV string is also connected with enough voltage, the display will be as shown below to indicate the power flow from PV string.



Even if AC input is absent, PV power can still charge the battery and the display will be as shown below.



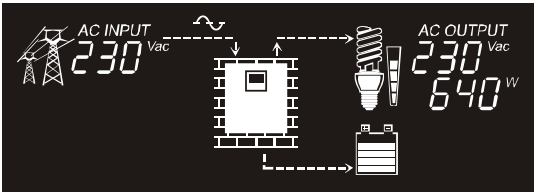
3.2 Operation Modes (after powered on)

Press the Power ON/OFF button to power on the inverter and the inverter will automatically enter into either of the operation mode according to the condition of AC input and PV input as shown in the table below,

	PV Power present	Less PV Power	No PV Power
AC Input Power Present	LINE MODE 2		LINE MODE 1
AC Input Power Absent	BACKUP MODE 3	BACKUP MODE 2	BACKUP MODE 1

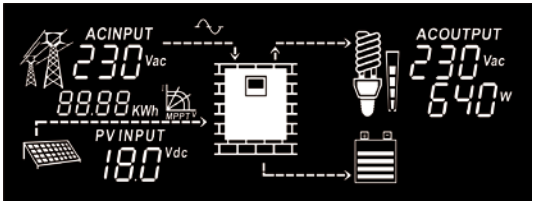
LINE MODE 1

AC input power is present but there is no PV power (e.g. night time). Load is supplied by AC input power directly.



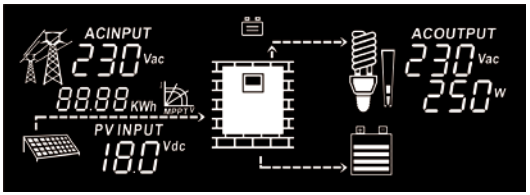
LINE MODE 2

Both AC input and PV input are present. Load is supplied by either AC input or PV input depending on the priority switch's setting.



Priority Setting Switch

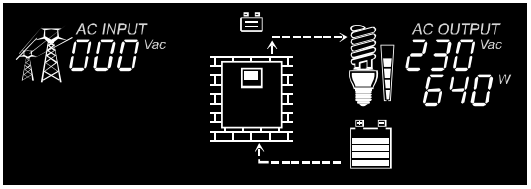
In LINE MODE 2, if priority setting switch is set to give PV priority and PV power is also strong enough to support load, the AC input will not



be consumed even though it is present. This is deemed an energy-saving operation.

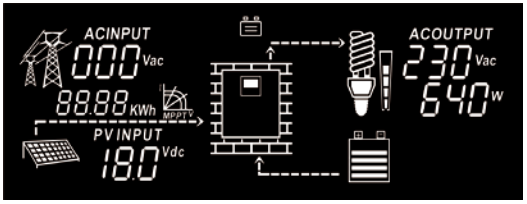
BACKUP MODE 1

Both AC input and PV input are absent. The backup power to load comes only from battery. The backup time is determined by the capacity of battery.



BACKUP MODE 2

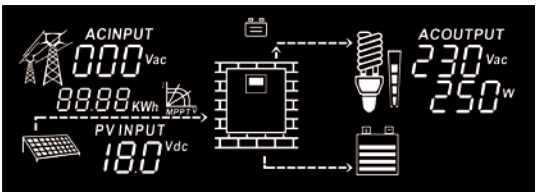
AC input is absent and PV power is not enough to support loads completely. The insufficient power is covered by battery.



The larger the PV power, the less consumption from battery and therefore the longer backup time.

BACKUP MODE 3

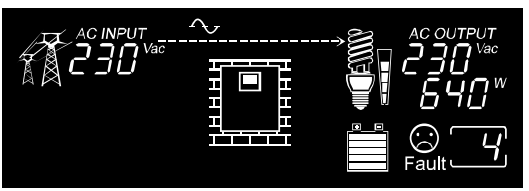
AC input is absent and PV power is strong enough to not only support the load but also charge the battery.



As long as the PV power persists, the load can be powered continuously without consuming power from battery.

3.3 Fault Mode

Inverter enters into Fault Mode when there is a fault event. The fault icon will be shown with a fault code. Please refer to fault code table in “Trouble shooting” section.



4. SPECIFICATION

MODEL		HD Plus1000-12	HD Plus2000-24
CAPACITY	VA/W	1000VA/720W	2000VA/1300W
NOMINAL BATTERY VOLTAGE		$12V_{DC}$	$24V_{DC}$
LINE MODE			
INPUT	Nominal Voltage	$230V_{AC}$	
	Voltage Range	$170\text{-}280V_{AC}$ (Narrow Range)	
		$90\text{-}280V_{AC}$ (Wide Range)	
	Normal voltage	50Hz or 60Hz	
OUTPUT	Voltage	$230V_{AC}$	
	Frequency	Following the Utility	
	Output Waveform	Following the Utility	
EFFICIENCY		>95% (full R load, battery full charged)	
TRANSFER TIME		15ms Typical, 40ms Max.	
BACKUP MODE			
OUTPUT	Voltage	230VAC (+10% / -18%)	
	Frequency	50Hz or 60Hz (Auto detection)	
	Output Waveform	Modified Sine-wave	
EFFICIENCY		>80%	
OVERLOAD PROTECTION		1min@>110%, 20s@>120%, 0s@>150%	
PROTECTION		Discharge, over-charged, over-loading, over-temperature, short-circuit protection	
BATTERY CHARGER (powered by AC)			
CHARGING ALGORITHM		3-step charging	
AC CHARGING MODE		15 Amp or 20Amp Selectable	10Amp
FLOATING CHARGING VOLTAGE		13.7V	27.4V
OVERCHARGING VOLTAGE		16V	32V
SOLAR BATTERY CHARGER			
MAX. INPUT POWER		450W	900W
CHARGING CURRENT		40Amp	
NOMINAL BATERY VOLTAGE		12V	24V
OPTIMAL WORK VOLTAGE RANGE		15V~18V	30V~36V
MAX. PV INPUT VOLTAGE		55V	
MAX. PV INPUT CURRENT		40 Amp	

GENERAL			
PHYSICAL	Dimension (D x W x H)	275mm*226mm*85mm	
	Net Weight (kg)	2.50	2.47
ENVIRONMENT	Operating Environment	0- 50°C, 5%-90 % relative humidity (non-condensing)	
	Storage Environment	-15°C to 55°C, 5% to 95% humidity (non-condensing)	
	Noise Level	Less than 50dB	

5. TROUBLE SHOOTING

Problem	Possible Cause	Remedial Action
No LCD display	Battery voltage is low	Re-charge the battery and check if the battery cables are well-connected
	Battery is defective	Replace the batteries
	Power button is not pressed	Press and hold the power button
Mains are normal but works in backup mode	AC input is absent	Check the connection of AC input
Backup time is short	Overloading	Disconnect non-critical loads
	Battery voltage is too low	Re-charge battery for at least 8 hours
Alarm buzzer beeps continuously	Inverter entered into fault mode. The buzzer beeps continuously for one minute, and then beeps according to the table below.	1. Refer to table below to identify the fault 2. Record and report the fault to service representative for further assistance

Alarm Behavior Table

Fault Description	Line Mode		Backup Mode		Fault Code
	No. of Beeps	AC Output	No. of Beeps	AC Output	
Overload 1 (V_{out} <195V)	/	/	0	OFF	0
Output RMS voltage low	/	/	2	OFF	2
Over temperature/Short-circuited	/	/	3	OFF	3
Fan locked	4	ON	4	OFF	4
Battery voltage high	5	ON	/	/	5
Overload 2 (V_{out} ≧195V; P_{out} > 80% rated half-wave load)	6	ON	6	OFF	6
AC output abnormal	/	/	7	OFF	7
Output voltage RMS high	/	/	8	OFF	8
Peak output voltage high	/	/	8	OFF	8
Utility connection error	9	OFF	9	OFF	9
PV current high	1BP/s	ON	1BP/s	ON	11
Solar charger over-temperature	1BP/s	ON	1BP/s	ON	12
Battery voltage high for Solar charger	1BP/s	ON	1BP/s	OFF	13
PV over-voltage	1BP/s	ON	1BP/s	ON	14
NTC opened	1BP/s	ON	1BP/s	ON	15
Solar charger MOSFETs /Relay damaged	1BP/s	/	1BP/s	/	16

Note: please contact your service representative in the event the alarm behavior is not included in the table above.

APPENDIX A How to Select and Configure PV Panels

The following parameters can be found in each PV panel's specification:

- P_{max}: Max output power (W)
- V_{oc}: open-circuit voltage (V)
- I_{sc}: short-circuit current (A)
- V_{mp}: max power voltage (V)
- I_{mp}: max power current (A)

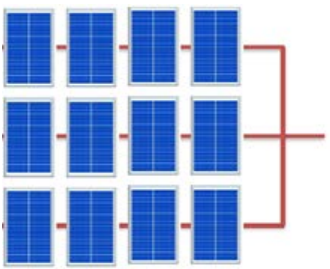
PV panels can be connected in series or parallel in order to obtain the desired output voltage and current which meets the inverter's allowed range.

When connecting PV panels in series, the max voltage and current of the string is

$V_{string} = V_1+V_2+V_3+V_4...$

$I_{string} = I_1=I_2=I_3=I_4...$

When connecting the above PV string in parallel, the max voltage and current of the total string is



$V_{total} = V_{string1}=V_{string2}=V_{string3}=V_{string4}...$

$I_{total} = I_{string1}+I_{string2}+I_{string3}+I_{string4}...$

In either case, the total output power is $P_{total} = P_{panel}$ X Number of PV panel

The guideline to select and configure PV string is

- P_{total} shall be equal or slightly larger than the max. capacity of solar battery charger (450W for 1000VA model and 900W for 2000VA model). Surplus capacity of PV string does not help the solar charger's capacity and only result in higher installation cost.
- Total V_{mp} of the string shall be within the operating voltage range of solar battery charger (15~18V for 1000VA model and 30~36V for 2000VA model are recommended).

- Total I_{mp} of the string shall be less than the max. charging current of the solar battery charger (40A for both 1000VA and 2000VA model)
- Total V_{oc} of the string shall be less than the max. PV input voltage of the solar battery charger (55V for both 1000VA and 2000VA model).
- Total I_{sc} of the string shall be less than the max. PV input current of the solar battery charger (40A for both 1000VA and 2000VA model).

Example 1 - How to connect 1000VA model to PV panels with the following parameters?

- P_{max}: 80W
- V_{oc}: 21.6V
- I_{sc}: 5.17A
- V_{mp}: 17.2V
- I_{mp}: 4.65A

(1) The max. PV input power for 1000VA model is 450W,

450W / 80W = 5.6⇒ max. 5 PV panels shall be connected.

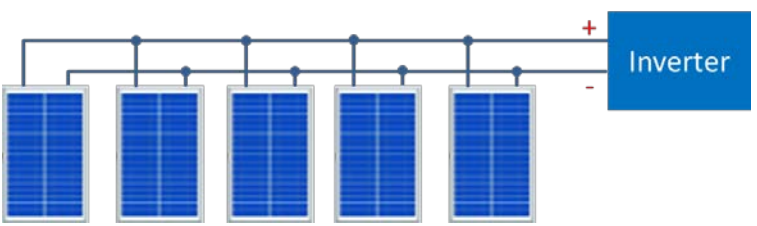
(2) Operating Voltage Range is 15~18V,

18V/17.2V = 1.04 ⇒ max. number of PV panel in series is 1.

(3) Max. charging current is 40A,

40A/5.17A = 7.7 ⇒ max. number of PV panel in parallel is 7.

(4) Taking (1)~(3) into consideration, the optimized configuration is 5 PV panels in parallel, as shown below



(5) Check again the V_{oc} and I_{sc} of PV string,

V_{oc} of string is 21.6V < 55V (Max. PV Input Voltage) ⇒ OK

I_{sc} of string is 5 x 5.17A = 25.9A < 40A (Max. PV Input Current) ⇒ OK

Example 2 - How to connect 2000VA model to PV panels with the following parameters?

- P_{max}: 120W
- V_{mp}: 17.45V
- V_{oc}: 21.7V
- I_{mp}: 7.01A
- I_{sc}: 8.76A

(1) The max. PV input power for 2000VA model is 900W,

900W / 120W = 7.5 ⇒ max. 7 PV panels shall be connected.

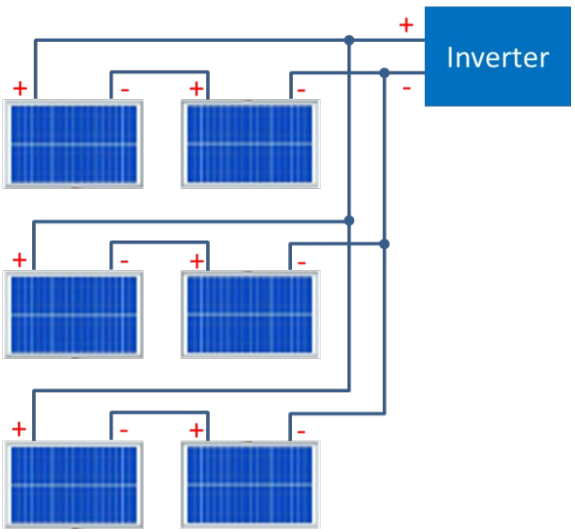
(2) Operating Voltage Range is 30~36V,

36V/17.45V = 2.1 ⇒ max. number of PV panel in series is 2.

(3) Max. charging current is 40A,

40A/7.01A = 5.7 ⇒ max. number of PV panel in parallel is 5.

(4) Taking (1)~(3) into consideration, the optimized configuration is 2 PV panels in series as a string, and 3 strings in parallel (as shown below).



(5) Check again the V_{oc} and I_{sc} of PV string,

V_{oc} of string is 2 x 21.7V = 43.4V < 55V (Max. PV Input Voltage) ⇒ OK

I_{sc} of string is 3 x 8.76A = 26.3A < 40A (Max. PV Input Current) ⇒ OK

DISPOSAL

In the event the product reaches the end of its service life, please contact the local dealer for disposal instructions.

The product must not be disposed of with the household waste.

Disposal of the product at the end of its service life shall be done in accordance with applicable disposal regulations for electronic waste.