Energy Storage Lithium Iron Battery System

378VDC/280AH (105KWH)

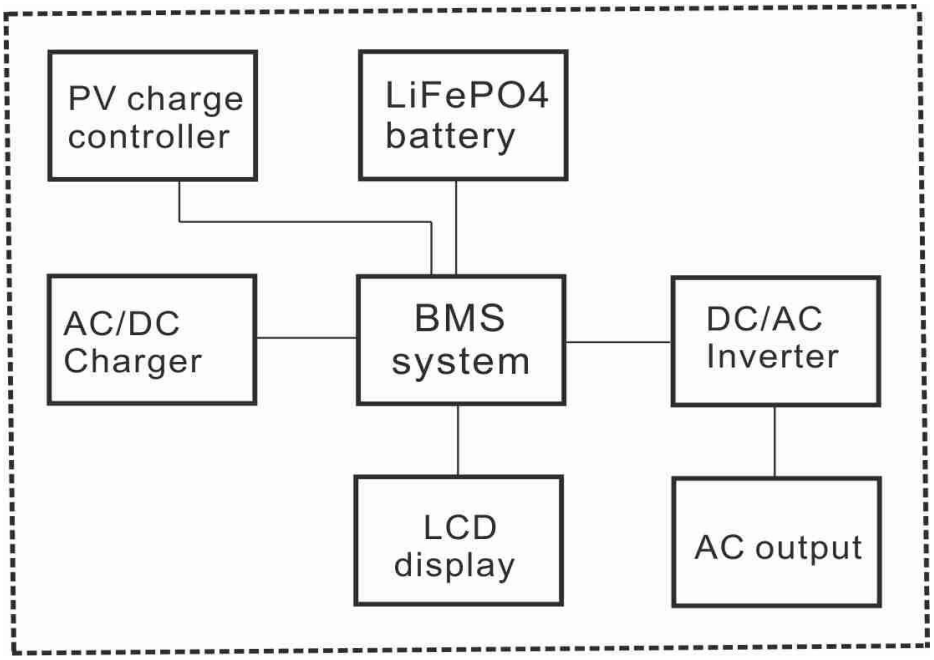
Operation Instruction

Zhejiang Sandi Electric Co., Ltd

1、Product Description

ESS lithium battery system is composed of lithium battery modules, BMS system, PV charge controller, AC/DC Charger, central control unit CCU, temperature detector, integrated structure and other parts; the solar panels in the system are battery storage and power for output; BMS module completes the detection and control of voltage, current, temperature, SOC, SOH and charging and discharging related parameters of power battery pack; PV controller and inverter realize bidirectional AC/DC function to meet the charging and discharging conversion demand of power battery pack; each detector is used to monitor the ambient temperature in real time to ensure the safety of the system.

2、System composition



2、Product Features

1. Standardized components, modular architecture, easy for expansion
2. High energy density, small footprint, short construction period, strong environmental adaptability
3. Battery module within the layered stack design, with more than 10 years of long design life
4. Long Cycle Life LiFePO4 Lithium ion Battery system from 20KWH—500KWH optional
5. The use of international advanced Mitsubishi IPM module and intelligent power module, with high power fast adjustment capability
6. BMS battery management system with SOC automatic calibration and high current active balance function, combined with the perfect operation control and management strategies to achieve accurate and efficient management
7. The combination of software and hardware protection, with alarm protection and automatic diagnostic functions, improve the protection strategy to ensure safe and efficient operation of the system
8. Product communicates with the monitoring platform in real time through RS232, CAN communication interface, and reports various records in time to ensure real-time monitoring of the

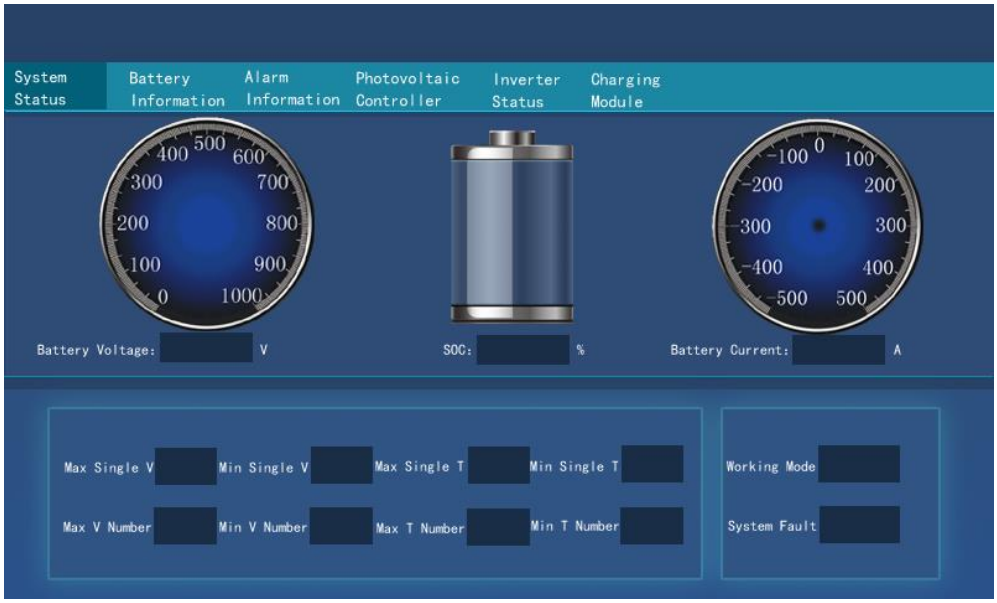
battery pack of the monitoring platform

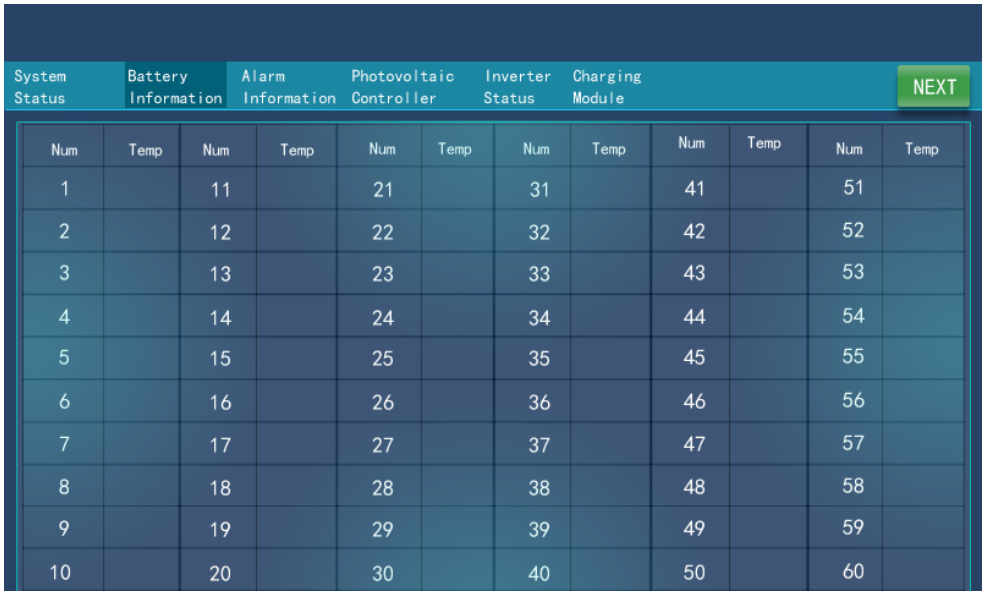
9. PV charge controller adopts three charging stages (buck charging, equalize charging and float charging) which can maximize the utilization of PV modules and batteries

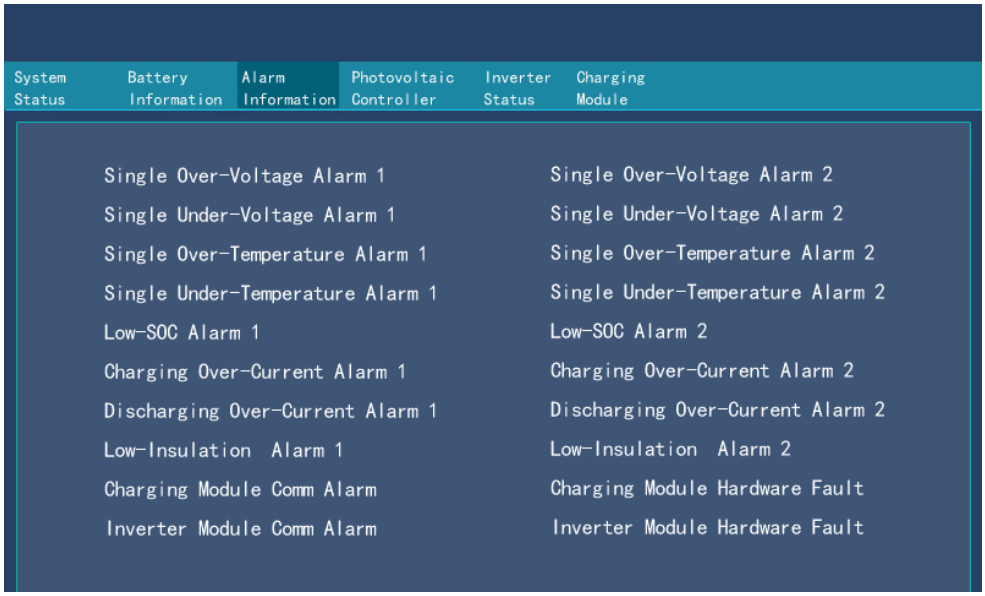
10. Colorful LCD display all module working information and status

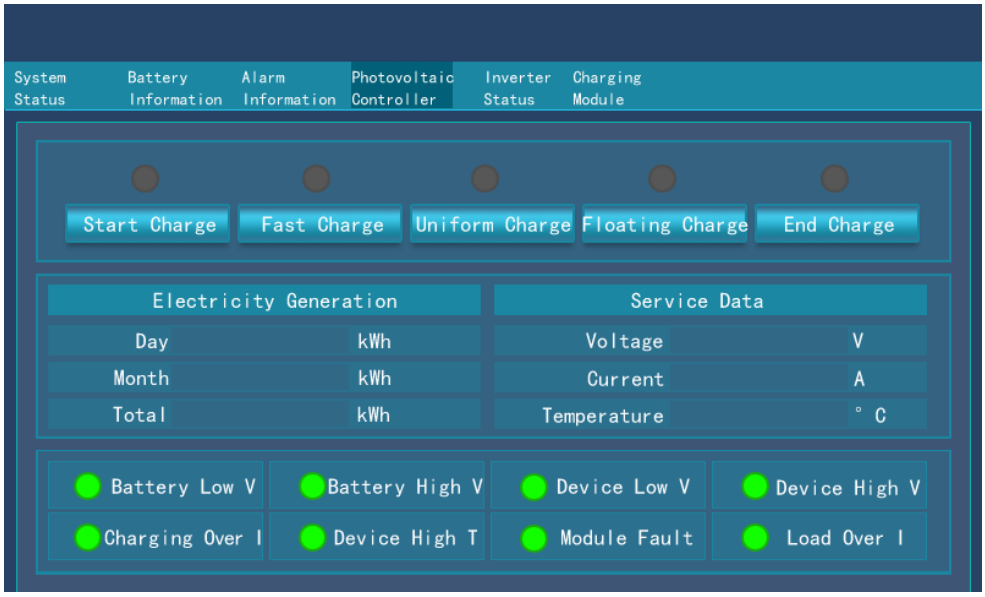
3、Product Image:

4、BMS LCD display introduction




System Status
Battery Information
Alarm Information
Photovoltaic Controller
Inverter Status
Charging Module
NEXT
Num Temp Num Temp Num Temp Num Temp Num Temp Num Temp
1 11 21 31 41 51
2 12 22 32 42 52
3 13 23 33 43 53
4 14 24 34 44 54
5 15 25 35 45 55
6 16 26 36 46 56
7 17 27 37 47 57
8 18 28 38 48 58
9 19 29 39 49 59
10 20 30 40 50 60

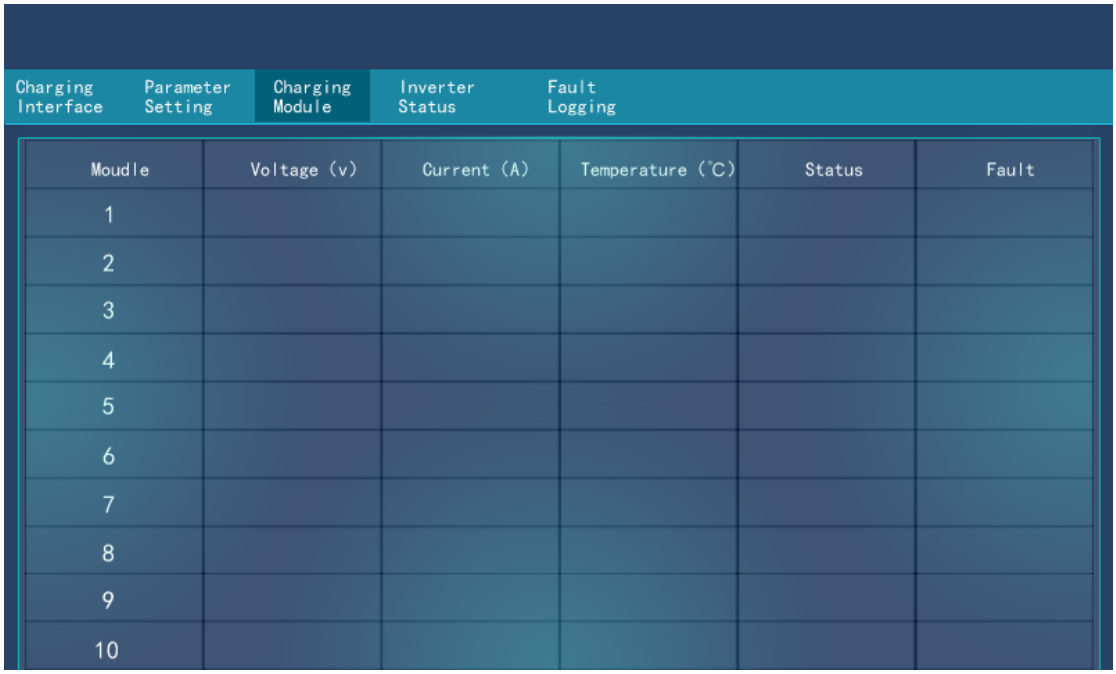

System Status
Battery Information
Alarm Information
Photovoltaic Controller
Inverter Status
Charging Module
Single Over-Voltage Alarm 1
Single Under-Voltage Alarm 1
Single Over-Temperature Alarm 1
Single Under-Temperature Alarm 1
Low-SOC Alarm 1
Charging Over-Current Alarm 1
Discharging Over-Current Alarm 1
Low-Insulation Alarm 1
Charging Module Comm Alarm
Inverter Module Comm Alarm
Single Over-Voltage Alarm 2
Single Under-Voltage Alarm 2
Single Over-Temperature Alarm 2
Single Under-Temperature Alarm 2
Low-SOC Alarm 2
Charging Over-Current Alarm 2
Discharging Over-Current Alarm 2
Low-Insulation Alarm 2
Charging Module Hardware Fault
Inverter Module Hardware Fault


System Status
Battery Information
Alarm Information
Photovoltaic Controller
Inverter Status
Charging Module
Start Charge
Fast Charge
Uniform Charge
Floating Charge
End Charge
Electricity Generation
Day kWh
Month kWh
Total kWh
Service Data
Voltage V
Current A
Temperature ° C
Battery Low V
Battery High V
Device Low V
Device High V
Charging Over I
Device High T
Module Fault
Load Over I


System Status
Battery Information
Alarm Information
Photovoltaic Controller
Inverter Status
Charging Module
DC Voltage: V
A-phase Voltage: V
A-phase Current: A
B-phase Voltage: V
B-phase Current: A
C-phase Voltage: V
C-phase Current: A
Reservation of Start and Stop Time (24-hour system) :
Start Inverter Output: hour min
Stop Inverter Output: hour min
NO Order(0)/Order(1):
SAVE
Life Time:
Bypass Voltage:
Capacity:
Equipment Status:
START
STOP


Charging Interface
Parameter Settings
Charging Module
Inverter Status
Fault Logging
Charging Voltage: V
Charging Current: A
Charging Power: Kw
Charging Time: min
Battery Vol: V
Capacity: Kwh
System Fault:
RUN
STOP
RESET


Charging Interface
Parameter Settings
Charging Module
Inverter Status
Fault Logging
Floating V: V Floating I: A
Uniform V: V Uniform I: A
CHN (0) /ENG (1) :
Manual (0) /Auto (1) :
Sandi (0) /Bangzhao (1) :
Reservation of Charging Time (24-hour system) :
Start: hour min
END : hour min
RETURN
SAVE
1
2
3
4
5
6
7
8
9
0
CLEAR
OK



5. Operation of solar controller

5.1 Instruction of HMC

Key	Instruction
	Menu key
	Back
	Menu choose
	Value increase
	Menu choose
	Value decrease
	Confirm
	Moving cursor

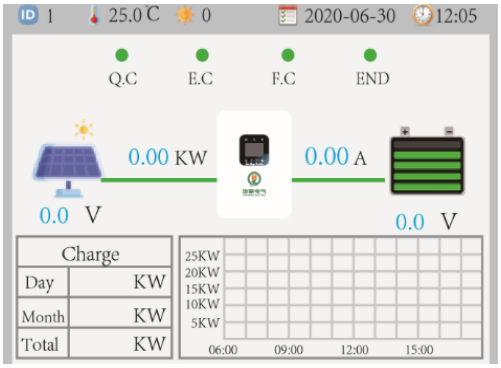
LED indicator	LED Status	Instruction
Charging indicator	Light off	No charging
	Flash	Charging
Warning indicator	Light off	No failure
	Flash	Failure (buzzer alarm)
DC Indicator, only effective if controller has DC output function)	Light off	No DC output
	Light on	DC output

Note: In night time, there is no sunshine, the controller doesn't charge, so the charging indicator will flash but the buzzer doesn't alarm, the warning code shows solar panel under low voltage, this is normal status, don't worry.

5.2 Operation interface

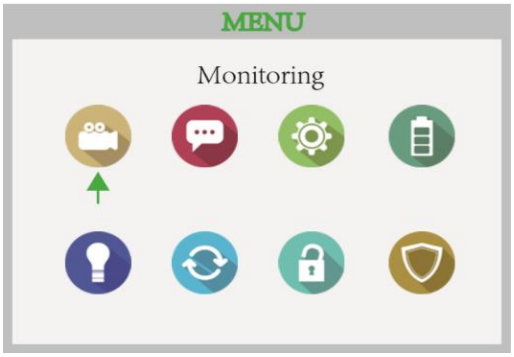
If there is no operation in 3 minutes, the controller will enter into Monitoring interface automatically

5.2.1 Monitoring interface



5.2.2 Main Menu interface

At the monitoring interface, please press the menu key enter to main menu interface as following



➢ Instruction of each symbol

Monitoring

Equipment information

Equipment setting

Charging setting

DC output setting

Password setting

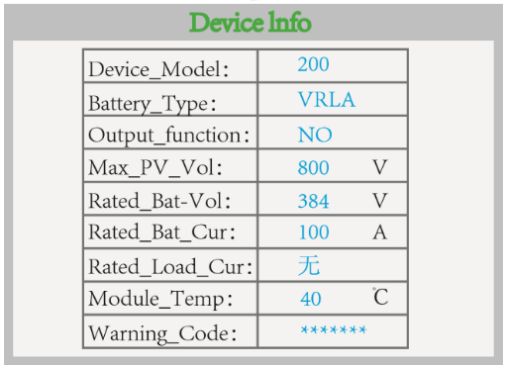
Recovery to factory setting

High Level setting

Cursor

5.2.3 Equipment information

At the main menu interface, press ⌃ or ⌄ key to move the cursor, when the cursor direct to Equipment information symbol, press ↵ key enter into the Equipment information interface as following



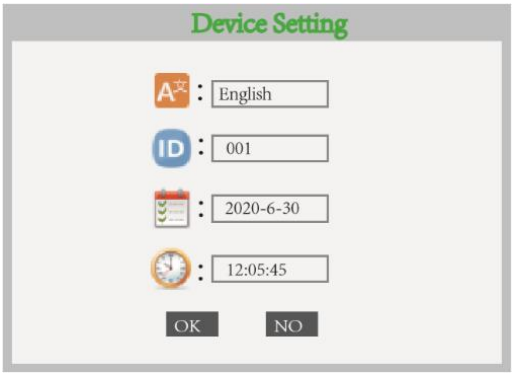
Please refer to the warning code as following

➢**0000 0001:** battery over discharge
➢**0000 0010:** battery over charge
➢**0000 0100:** solar panel output voltage low than battery voltage
➢**0000 1000:** solar panel output voltage more than the "Max_PV_Vol" value
➢**0001 0000:** the charging current more than "rated_Bat_Cur" value
➢**0010 0000:** the inside temperature of controller more than the "Module_Temp" value
➢**0100 0000:** IGBT power module is damaged
➢**1000 0000:** the DC output current more than "Rated_Load_Cur" value

Please kindly noted if the warning code shows IGBT power module is damaged and this couldn't be recovery by itself, please disconnect the controller from all equipment immediately, including battery, solar panel, DC load and so on. And send it back to us for repairing.

5.2.4 Equipment setting

At the main menu interface, press ⌃ or ⌄ key to move the cursor, when the cursor direct to Equipment setting symbol, press the ↵ key enter to equipment setting interface as following

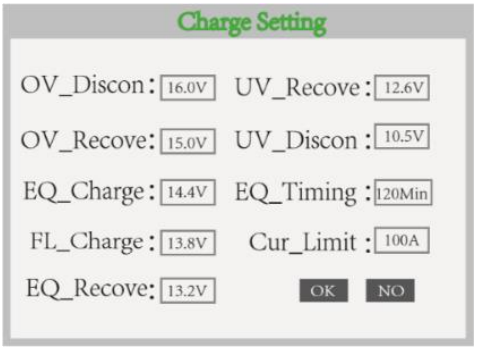


Press the ↵ or ☰ key to move the blue back light, you can press ⌃ or ⌄ key to change the parameter when it is blue back light. When the "OK" is blue back light, if you want to save the changing, press ↵ key to save the changing. If you don't want to save the changing, press ⌄ key to move the blue back light to "NO", then press ↵ key to give up the changing, it will return to main menu interface immediately.

5.2.5 Charging setting

At the main menu interface, press ⌃ or ⌄ key to move the cursor, when the cursor direct to charging setting symbol, press the ↵ key enter to charging parameter setting interface as following

Note: The initial password is 1234. Please care about the parameters setting. Wrong working parameters will damage battery permanently.



At this interface, press ↵ or ☰ key to move the blue back light. User can change the parameter by pressing ⌃ or ⌄ key when it is blue back light. When the "OK" is blue back light, if you want to save the changing, you can press ↵ key to save it, if you don't want to save the changing, you can press ⌄ key moving the blue back light to "NO", then press ↵ key to give

up the changing, and it will exit to main menu immediately

Instruction of each parameter

- **OV_Discon:** Over voltage disconnect
- **OV_Recove:** Over voltage reconnect
- **EQ_Charge:** Equalize charging
- **FL_Charge:** Float charging
- **EQ_Recove:** Recovery to fast charging
- **UV_Recove:** Under voltage reconnect
- **UV_Discon:** Under voltage disconnect
- **EQ_Timing:** Equalize charging time
- **Cur_Limit:** Limiting charging current

In order to keep the system safe, please strictly to the following logics:

- All the charging parameters (except equalize charging time and limiting charging current) must among the range of 0.75~1.42 times of rated voltage of battery system. For example, if the rated voltage of battery system is 240V, all the charging parameters must be in the range of 180V~340.8V
- Over voltage disconnect > Over voltage reconnect > equalize voltage > float voltage > equalize recovery voltage > over discharge reconnect> rated system voltage > over discharge disconnect

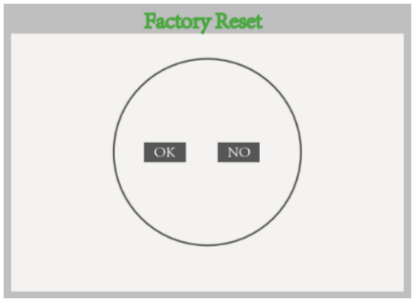
5.2.6 DC output setting (this only suitable for DC output function)

Only the solar controller has DC output function, you can set the parameters. The initial password for interview this interface is 1234.

At this interface, press ☰ or ↵ key to move the blue back light, and change the parameter by pressing ∧ or ∨ key when it is blue back light, you can set lots of DC output model through setting the time of different stage

5.2.7 Recovery to factory setting

The initial password for interview this interface is 1234.



At this interface, press ^ or v key to move the blue back light, and press ↵ key to save or give up the factory reset

5.2.8 Password setting

The initial password for interview this interface is 1234. Please kindly noted that once you change the password, it will invalidate the initial password immediately, please remember the new password well.

At this interface, press ≡ or ↵ key to move the blue back light, and change the number by pressing ^ or v key when it is blue back light. When the "OK" is blue back light, if you want to save the changing, you can press ↵ key to save it, if you don't want to save the changing, you can press v key moving the blue back light to "NO", then press ↵ key to give up the changing, and it will exit to main menu immediately

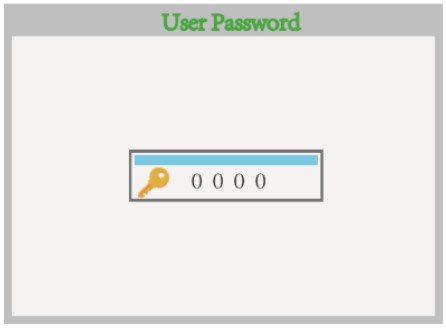
Instruction of each parameter

5.2.9 High level setting

This is for factory testing and it is not for anyone!

5.2.10 Password interface

The following is the password interface for any setting interface



At this interface, press ≡ or ↵ key to move the blue back light, and change the number by pressing ↵ or ^ key when it is blue back light. When the blue back light at last number, press v will enter to next step, if the password is right, it will enter to next interface. If the password is wrong, it will point out password error and exit to main menu interface.

6. Troubleshooting & Maintenance

6.1 Instruction of buzzer alarm

When the buzzer alarms, it indicates an abnormal status in the system, and it will stop buzzing when the abnormal status is fixed

6.2 Troubleshooting

6.2.1 Warning code: 0000 0001 (buzzer beep)

6.2.1.1 Instruction: Battery is under voltage

6.2.1.2 Reason: battery is over discharged

6.2.1.3 Solution

- Please check whether the over discharging protection function of inverter in the system is still useful
- Please check whether there is other DC load connect to battery directly
- Please check whether the solar controller charging or not when it is good sunshine

6.2.2 Warning code: 0000 0010 (buzzer beep)

6.2.2.1 Instruction: battery is over voltage

6.2.2.2 Reason: there is other power source charging battery or battery is old

6.2.2.3 Solution

- Please check whether the connection is still tightly
- Please check whether there is other power source charging battery
- Please check the controller still has charging current

6.2.2 Warning code: 0000 0100 (buzzer doesn't beep)

6.2.2.1 Instruction: the PV arrays don't have voltage

6.2.2.2 Reason: There is no voltage from PV arrays to solar controller

6.2.2.3 Solution:

- If it is night time or there is no sunshine, it is normal
- If there is good sunshine, please check whether the connection is right, and also check whether the breaker between PV Arrays and controller is turn on

6.2.3 Warning code: 0000 1000 (buzzer beep)

6.2.3.1 Instruction: PV arrays output voltage is over the controller's max. input voltage ability

6.2.3.2Reason: there are too many solar panels in series connection

6.2.3.3 Solution:

- Please reduce the series connection quantity of solar panel

6.2.4 Warning code: 0001 0000 (buzzer beep)

6.2.4.1 Instruction: over charging

6.2.4.2Reason: the charging current is over controller's ability

6.2.4.3 Solution

- Please restart the controller and check whether it could be solved
- Please reduce the solar panel quantity

6.2.5 Warning code: 0010 0000 (buzzer beep)

6.2.5.1 Instruction: over temperature

6.2.5.2Reason: the inside temperature high than the module temperature

6.2.5.3 Solution

- Please check whether the air inlet and outlet of the controller are blocked
- Please check whether the installation environment temperature is too high
- Please check whether the installation space is closed and the air is in circulation

6.2.6 Warning code: 0100 0000 (buzzer beep)

6.2.6.1 Instruction: IGBT power module is failure

6.2.6.2 Reason: Lighting or other reason

6.2.6.3 Solution: please disconnect the controller from other equipment immediately and send it back to factory for repairing

6.2.7 Warning code: 1000 0000 (buzzer beep)

6.2.7.1 Instruction: DC output is over current

6.2.7.2 Reason: the DC load power high than controller's rated output power

6.2.7.3 Solution: Please reduce the power of DC loads

6.3 General fault description

If the controller appears with the following phenomenon, we provide the solution. If it still exists after you follow the solution method, please contact us for advice

Fault	Reason	Solution
The controller doesn't work for first time	1.Battery voltage is too low 2.Reverse connection	1.Replace new batteries 2.Please check and adjust the connections
The controller doesn't charge when there is good sunshine	The connection of PV arrays is open circuit	Please check if the connection between PV arrays are right and reliable
Small charging current	1.The sunshine is not good 2.Battery under float charging or it is near to full charge	1.Please re-check when the sunshine is good 2.Normal

6.4 Technical Parameters

Model	SDC378V-50A	
Rated system voltage	378V	
Max. charging current	50A	
Max. input solar power	18.9KW	
Max. input voltage	750V	
Input group for solar panel	1 group	
Equalize charging voltage	407.1V	These parameters can be adjusted according to demands of different type battery
Over voltage disconnect	424.8V	
Over voltage reconnect	418.9V	
Equalize recovery voltage	394.2V	
Equalize charging time	120 minutes	
Display	Colorful LCD screen + Touching keys	
Display language	English	
Terminal type	TC series barrier terminal	
Elevation	≤3000M, should reduce power if the elevation high than 3000M	
Storage temperature	-25°C +55°C	
IP (Ingress protection)	IP32	
Dimension	420*342*175mm	
Net weight	11.5KG	

7. Operation of AC/DC Charger

7.1 Functional details

1. Hot plug

Plug technology is applied to the charging module to provide convenience for installation and maintenance. The access of the charging module to the system shall not disturb the output voltage of the system.

2. Advanced current sharing technology

Under constant voltage working mode, the charging modules can share current automatically within 10S, with degree of unbalance less than ±0.5A.

3. Control of input limited power

Refer to Fig. 1-8 for the relation between the output power and input voltage of the charging module. When the input voltage is within 220 Vac ~ 280 Vac (return difference is less than 5V), the module can output the maximum power of 7 KW; when the input voltage is within 90 Vac ~ 220 Vac, the module can still work normally under limited power mode.

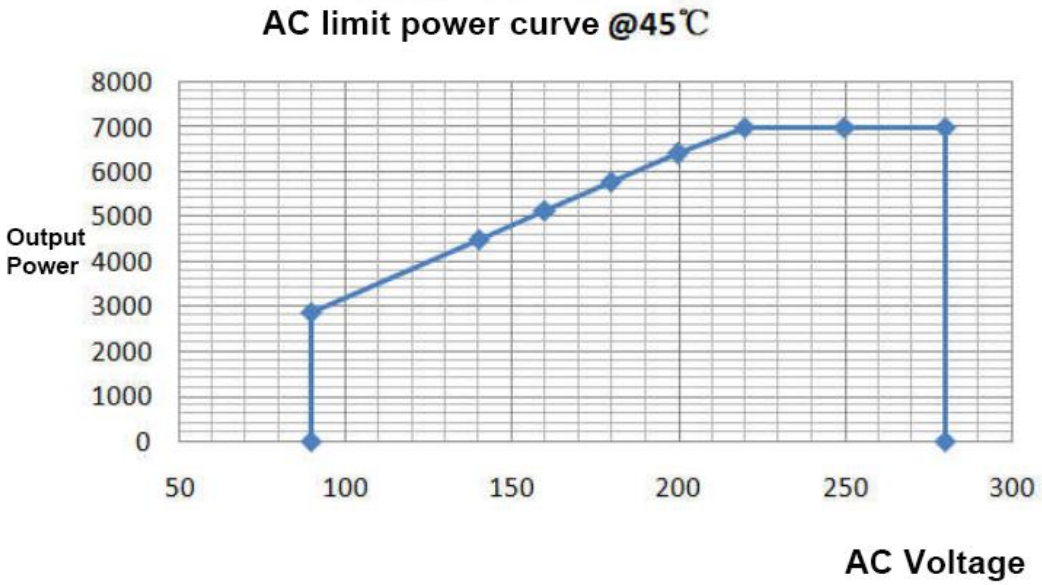


Fig. 1-8 Relation curve between the output power and the input voltage of three-phase AC input mode

4. Control of output constant power

When there is a rated input voltage, the output power of the module is 7KW. Refer to Fig. 1-9 for the relation between the output voltage and the output current of the module.

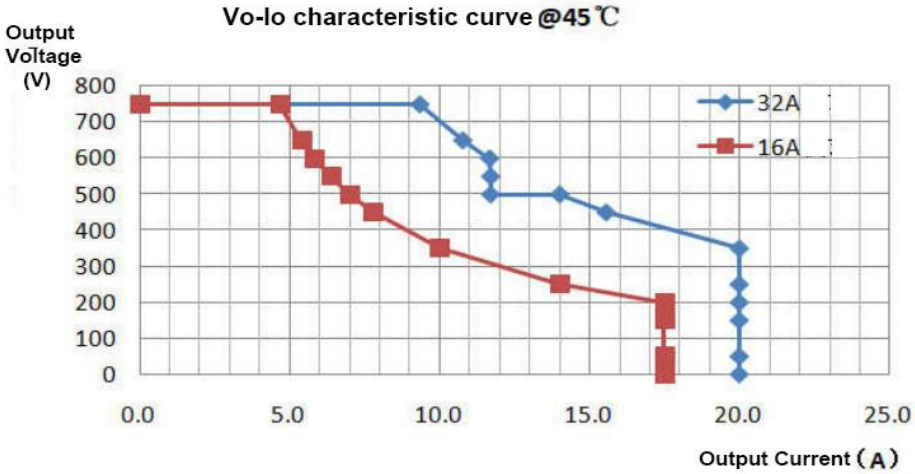


Fig. 1-9 Relation curve between the output voltage and the output current of the module

7.2 The charging module adopts two working modes:

7.2.1) The module receives monitoring instructions and works in 32A mode or 16A mode (with different power limits).

7.2.2) Outputs 150-750V. When there is no required voltage, the power-on defaults to work in the low-voltage section. When the actual output of the module is higher than 525V, the module automatically switches to the high-voltage section. When the demand is lower than 500V, it will automatically switch back to the low-voltage section to work. When the output of the module changes from high voltage to low voltage, the output of the module will drop briefly across the switching point; when the output of the module changes from low voltage to high voltage, there is

no drop in the output of the module when it crosses the switching point. When the switching point is crossed, the power output is as above Graph curve way.

7.2.2 Temperature limited power

Under 55°C ambient temperature, the module can output full power of 7kW;

Over 55°C ambient temperature, the module shall be used by derating with the power Linearly .

Under 65°C ambient temperature, the allowable output power of the module is 3,500 W.

Under 75°C ambient temperature, the output power of the module is reduced to 0.

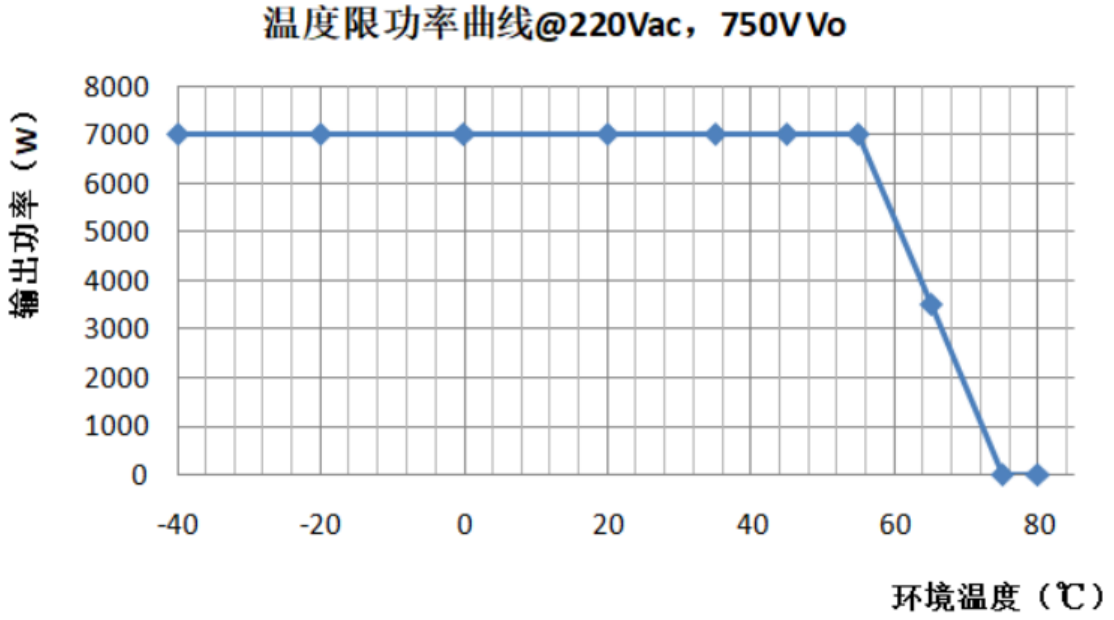


Fig. 1-10 Relation Curve between Max output power and ambient temperature

7.2.3 Regulation of output current limiting point

The module has stepless current limiting function. Through the external monitoring module, the current limiting point of the module is adjustable in the range of 0~20A. When the output voltage is between 150Vdc～750Vdc,

When, the current limiting accuracy of the module is ±0.3A.

7.2.4 Regulation of output voltage

The output voltage of the module can be regulated constantly through the external monitoring module, with regulation range of 150Vdc ~ 750Vdc and minimum regulation step of 0.1 Vdc.

7.2.5 Fan control

The built-in processor of the module can regulate the speed of the fan according to the internal temperature and output current of the module.

7.2.6 Protection of input overvoltage/ voltage shortage

The input of the module is a single-phase AC voltage. When the input voltage is lower than 90Vac or greater than 280Vac, the module will stop working and no output.

When an overvoltage or undervoltage alarm occurs, the module will report the alarm information to the monitoring module; when the input voltage returns to the normal range, the alarm disappears and the module recovers Return to normal working condition.

7.2.7 Output overvoltage protection

Manual intervention is required after overvoltage protection to boot.

The software overvoltage protection point can be set through the monitoring module, the setting range is 150Vdc～778Vdc, and the factory default value is 778Vdc.

Manual intervention method: The module can be reset through the monitoring module, or the module can be reset by re-powering after the AC power failure.

6.2.8 Over-temperature protection

The environmental over-temperature protection point is 80°C. When the DC panel has a temperature over 85°C, the module will stop working; when the DC panel has a temperature below 75°C, the module will automatically work again.

6.2.9 Protection of internal bus fault

When the internal bus voltage of the module is beyond the overvoltage/ voltage shortage protection point, the module will be powered off automatically. At this time, there is no output from the module and the fault indicator light is on.

6.2.10 Short circuit protection

In case of short circuit of the module, it will be subjected to protective shutdown and the red indicator light of the panel is on, and this condition will be transmitted to the monitor of the "module fault".

6.2.11 Interruption of background communication

After module communication interruption, the protection indicator light will flash and the module will be subject to shutdown protection. When the communication is recovered, the protection indicator light recovers to normal state and the module works again.

6.2.12 Protection against fan fault

In case of module communication interruption over 8S, the module will be subject to shutdown protection, without voltage output and the protection indicator light will flash. After fault removal, the module will work automatically again.

6.2.13 Monitoring performance

The charging module is equipped with CAN bus. It can also be converted to RS232 via the protocol converter, and the RS485 protocol communicates with the external monitoring module.

Refer to Table 1-2 for the list of the monitoring information.

Command / Signal Issued by the Monitoring Module of the Charger System	Charging Module Information Collected by the Monitoring Module of the Charger System
Module start-up/ shutdown Setting of function of output current slow rise Regulation of the current limiting point of charging module Regulation of the output voltage of charging module	Input voltage, output voltage and output current Current limiting point and temperature of charging module DC output overvoltage point DC switch state Fault alarm and protection alarm Temperature limited power and input limited power AC power failure Current unbalance Address

7.3 Technical Parameters

Category	Name	Parameter
Environmental conditions	Operating temperature	-40°C ~ +75°C, derating is required when the temperature is above 55°C.
	Storage temperature	-40°C ~ +70°C
	Relative humidity	≤95%RH, No condensation
	Cooling way	Forced air cooling
	Altitude	2000m, derating is required when the altitude is above 2000 m
AC input	Input phase	Single phase L/N or L1/L2 + PE
	Voltage rage	100-280Vac
	Rated voltage	220Vac
	Power factor	0.99
	Frequency range	45Hz~65Hz
DC output	Output power	21KW@voltage >350Vdc
	Voltage range	150-750Vdc
	Current range	0 ~ 60A
	Rated current	28A@750V(Set current limit point, current limit point 1.0 is 9A, converted into current limit point according to actual current demand)
	Steady voltage precision	<±0.5%
	Steady current precision	≤±1%(rated range of 20% ~ 100% for output load)
	Load regulation rate	≤±0.5%
	Startup overshoot	≤±3%
Power factor and THD	Power factor	≥0.95 Full-load output power of @20%~50%
		≥0.98 Full-load output power of @50%~100%
		≥0.99 Full-load output power, input nominal voltage and frequency of @100%
	THD	≤5% Full-load output power of @50%~100%
Noise index	Peak-to-peak value noise	≤1% (150~750V, 0~20MHz)
Others	Safety requirements	C lassA , Meet the requiremnt of NB/T 33001-1-2010,NB/T 33008-1-2013
	Efficiency	≥94.5%, @750V, 50%~100% load current, under rated input voltage
	Instant impulse current upon startup	<20A
	Temperature Coefficient(1/°C)	≤±0.01%
	Startup duration (select the startup mode through the monitoring module)	Normal startup mode: the time delay from AC power-on to module output is ≤ 8s.
		Output delayed startup: The startup duration can be set through the monitoring module, with default output startup duration of 3~8s.
	Noise	≤65dB(A) (1m away)
	Earthing resistance	Earthing resistance ≤ 0.1Ω, bearable current ≥ 25A
	Leakage current	Leakage current≤3.5mA

	Surge protection	Meets IEEE C62 41-1991 Class B3 rating, 6kV/3kA (1.2/50μs impulse voltage and 8/20μs inrush current mixed wave)
	Insulation resistor	The insulation resistance of DC part and AC part to housing and the AC part to the DC part shall be ≥ 10MΩ.
Mechanical parameters	Size	87Mm (H) ×177.5mm (W) ×385mm (D)
	Weight	≤15kg

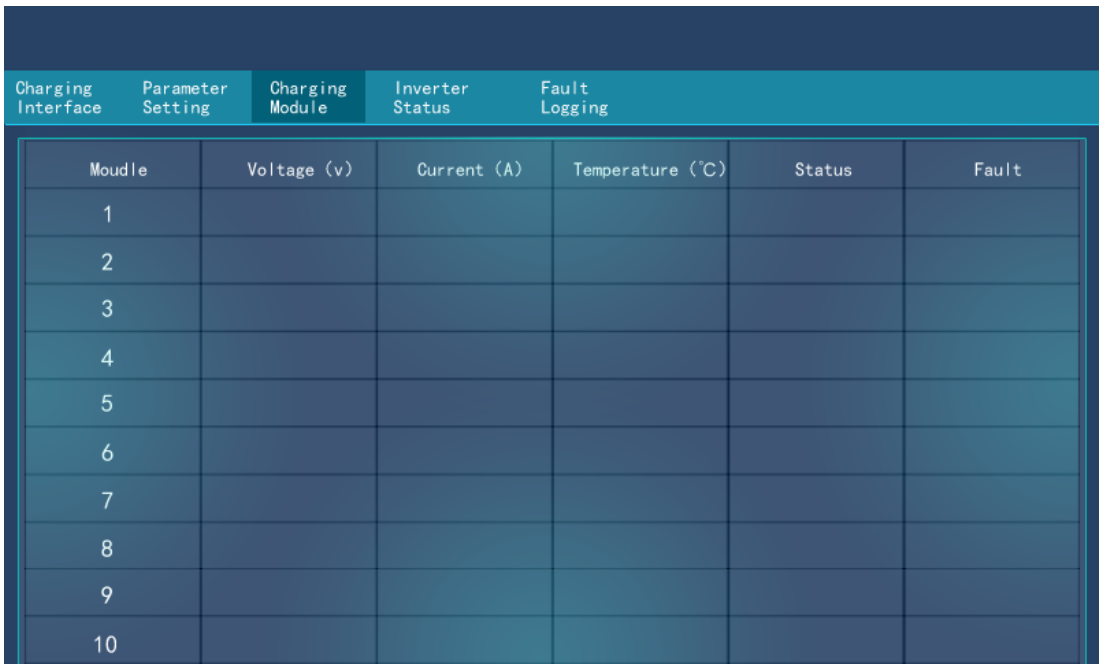
7.4 Fault Phenomenon and Troubleshooting Suggestions

Abnormality	Related Alarm	Cause Analysis		Treatment Suggestions
Operation indicator light (green) off	Module communication interruption	No input and output voltage		Ensure there is input and output voltage
	No alarm	Reverse connection of input power supply or disconnection of input fuse		Re-connect the input power supply or replace the fuse with another input fuse with the same capacity
Protection indicator light (yellow) on	Module protection	The module is subjected to over-temperature protection. Main causes include:	Fan blocking	Remove the object blocking the operation of the fan
			Obstructed air duct:	Remove the obstacle at the air inlet
			Too high environmental temperature	Lower the environmental temperature
			Not insert the charging module fully in place	Re-insert the charging module
	Unbalanced module current	The average current of the module is more than 3A.		Check whether there is normal communication for the charging module and whether the communication line is connected normally. If there is normal communication but there is still abnormity in the system, the charging module shall be replaced.
	Module protection	PFC output overvoltage protection		Change the position of the abnormal charging module and the normal charging module. If the abnormal charging module still fails to work, the charging module shall be replaced.
	Module protection	AC input voltage beyond the normal range		Ensure that the AC input voltage is within the normal range.
Protection indicator light (yellow) flashing	Module communication interruption	Module communication interruption		Check the connection of the communication line
Fault indicator light (red) on	Module fault	Module overvoltage or output short circuit		Pull out the charging module and restart it. In case of fault protection again, the charging module shall be replaced.
Fault indicator light (red) flashing	Fan fault	Fan fault		Replace the fan

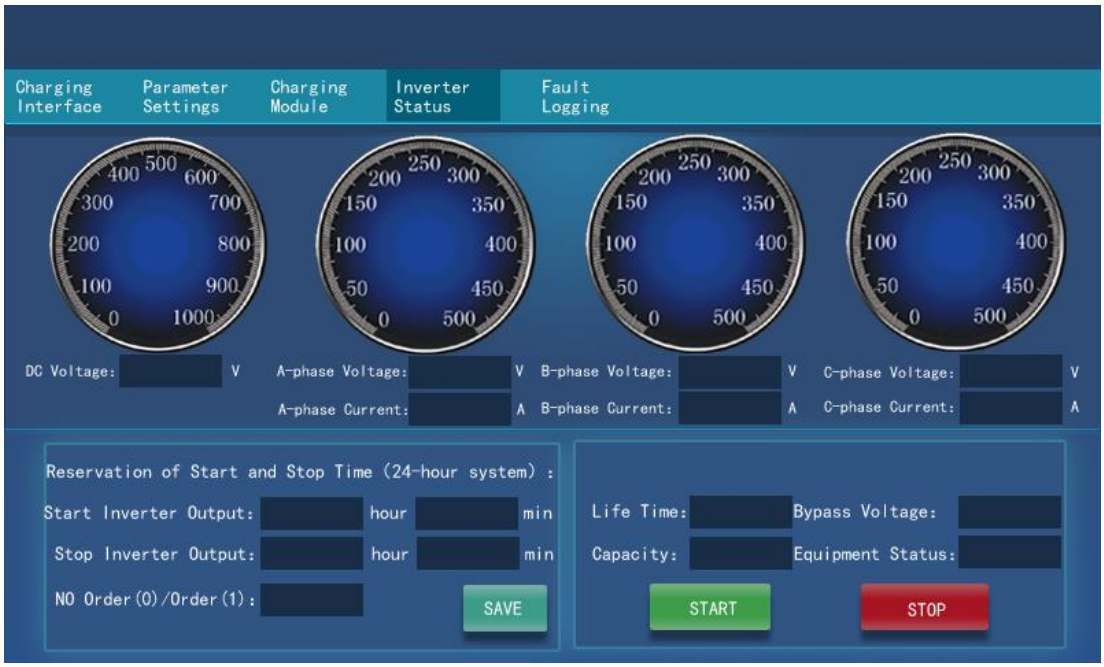
7.5. LCD Panel Operating Instructions

Parameter settings

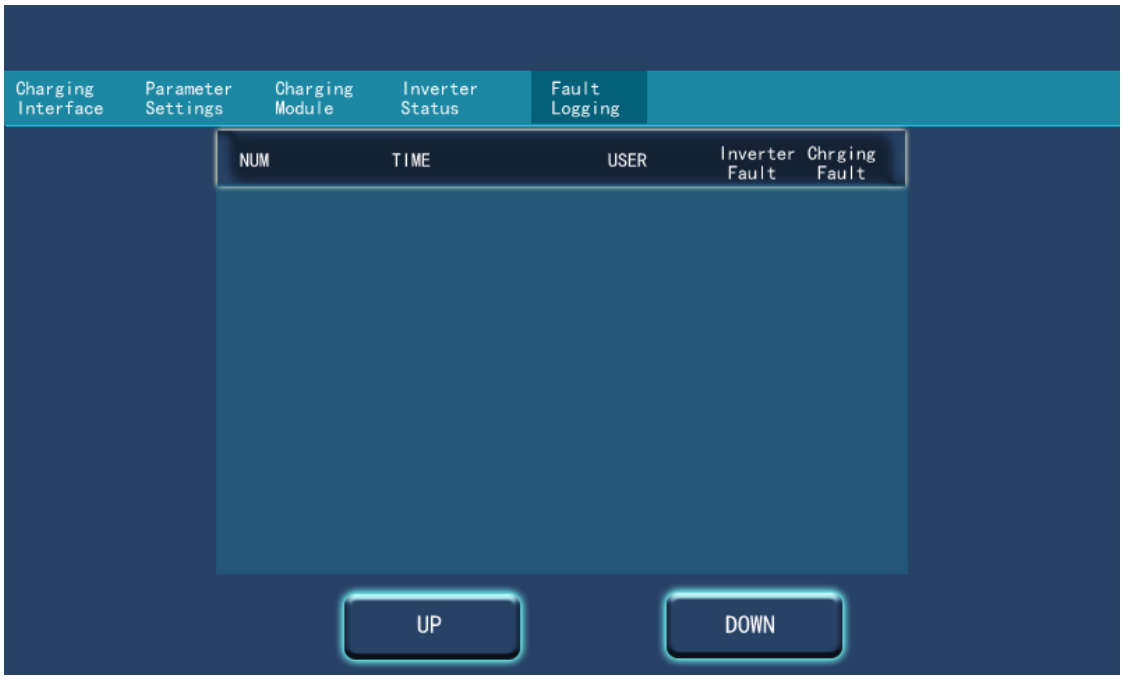
Charging Module



Inverter status



Fault logging



8. General Specifications of Lithium cell

8.1 Abbreviation Definitions

C_1 —— the rated capacity (in ampere-hours) of the cell for a one-hour discharge.

I_1 —— a current corresponding to the one-hour discharge capacity (in ampere-hours), which is equal to, in numeral, the C_1.

In the following specification 1 I_1 (A) = 280A.

SOC —— the state of charge.

DOD —— the depth of discharge.

8.2 General Specifications

	Item	Specification
1	Cell Type	Lithium -ion power cell
2	Cell Model	LP71173280-280Ah
3	Nominal Capacity☆	280Ah(The NEW BATTERY)
4	Nominal Voltage☆	3.2V (118pcs in series)@378VDC
5	AC-impedance(1000Hz)☆	0.12±0.05mΩ
6	Weight	5302±100g
7	Maximum Charge Current at Room Temperature	1.0*I*1（Continuous） 2*I*1 (60s)
	Charging Voltage	3.65V
8	Maximum Discharge Current at Room Temperature	1.0*I*1（Continuous） 2*I*1 (60s)

	Discharge End Voltage	2.5V （＞0℃）、2.0V(≤0℃)
9	Max Operating Temperature Range	
	Charge	0℃～65℃
	Discharge	-35℃～65℃
10	Optimal Operating Temperature Range	
	Charge	15℃～35℃
	Discharge	15℃～35℃
11	Storage Temperature	
	1 month	-30℃~ 45℃
	6 months	-20℃～35℃
*Cells should be stored at 20%SOC-40%SOC or the voltage is between 3.275V and 3.305V.		

8.3. Appearance and Dimension

Appearance and Dimension refer to the attached drawing 1.

8.4. Characteristics

8.4.1 Test Condition

Cells should be tested within a month after purchase and the charge-discharge times of the test cells should be less than 5. Unless noted otherwise, all tests will be conducted at standard temperature which is (25±2)℃ and standard humidity which is (65±20)%. The room temperature mentioned in this specification means (25±2)℃.

8..4.2 Test Equipment

a) Voltmeter Inner impedance>1000Ω per volt.

b) Slide caliper The slide caliper should have a minimum scale of 0.02mm.

c) Impedance meter The impedance meter should be operated at AC 1kHz.

d) Electronic Scale The electronic scale should have a minimum scale of 0.001g.

8.4.3 Test Process and Specification

8.4.3.1 Charge Method

Cells are charged with Constant Current and Constant Voltage (CC/CV) method at room temperature. The constant current is $1/3I_1$ (A) and the constant voltage is 3.65V. Charge shall be terminated when the charge current has tapered to 0.05 I_1 (A), then store cells for 1h.

8.4.3.2Test Item and Specification

Test item and specification should refer to table 2.

Number	Item	Test profile	Specification
1	Appearance and Dimension	1.Eyeballing` 2.Test cells' dimension with slide caliper	No Deep Scratch, No Transformation, No leakage,
2	Weight	Electronic Scale	5302±100g
3	Open Circuit Voltage☆	Measure the open circuit voltage within 1h after charging cells per 4.3.2.	OCV≥3.35V
4	Nominal discharge capacity☆	Discharge cells at a 1.0 I_1(A) current to 2.5V within 1h after charging cells per 4.3.2. Record the capacity. The cycle can repeat 5 times, when the capacity difference of 3 times continuously are less than 3%, the test can be terminated. Tack the average of last 3 discharge capacity.	1.0 $I1$ Capacity ≥272Ah （The NEW BATTERY）
5	Maximum charge current at Room Temperature	Continuous: Charge cells per 4.3.2. Discharge cells to 2.5V at a 1.0 I_1 (A) current. And record the capacity. Charge cells to 3.65V at a n I_1 (A) current, and then charge cells at constant voltage (3.65V) until the current has tapered to 0.05 I_1 (A). ("n" is an integer) 50%SOC: Charge cells per 4.3.2. Discharge cells 30min at a 1.0 I_1 (A) current. Charge cells to 3.65V in a n I_1 (A) current. ("n" is an integer)	1.0 $I1$ (A)(Continuous); 2.0 $I1$ (A)(60s,50%SOC);
6	Maximum discharge current at Room Temperature	Continuous: Discharge cells at a 1.0 I_1 (A) current to 2.5V after charge cells per 4.3.2. And record the capacity. Charge cells per 4.3.2. Discharge cells in a n I_1 (A) current to 2.5V. ("n" is an integer). 50%SOC: Discharge cells at a 1.0 I_1 (A) current for 30min after charging cells per 4.3.2. Discharge cells to 2.5 V at a n I_1 (A) current. ("n" is an integer)	1.0 $I1$ (A)(Continuous); 2.0 $I1$ (A)(60s,50%SOC);
7	Cycle Life at Room Temperature☆	Charge cells per 4.3.2. Discharge cells to 2.5V at a constant current of 1.0 I_1 (A). Discharge capacity shall be measured after 3500 cycles. Cells should be clamping during cycling.	3500thDischarge Capacity ≥80% Nominal Capacity (200th Discharge Capacity ≥97% Nominal Capacity or 500th Discharge Capacity ≥93% Nominal Capacity or 1000th Discharge Capacity ≥90% Nominal Capacity）
8	Cycle Life at High Temperature☆	Charge cells per 4.3.2. Discharge cells to 2.5V at a constant current of 1.0 I_1 (A). Discharge capacity shall be measured after 2000 cycles. Cells should be clamping during cycling.	2000th Discharge Capacity ≥80% Nominal Capacity (200th Discharge Capacity ≥93% Nominal Capacity or 500th Discharge Capacity ≥88% Nominal Capacity）
9	Charge Retention☆	After charging per 4.3.2, store the testing cells for 30 days at the environment temperature of (25±2)℃, then discharge the cells to 2.5V at a 1.0 I_1 (A) current. Record the discharge capacity. Charge cells per 4.3.2. Discharge the cells to 2.5V at a 1.0 I_1 (A)current. Record the recovery capacity. After charging per 4.3.2, store the testing cells at (45±2)℃ for 30 days, then discharge the cells to 2.5V at a 1.0 I_1 (A) current. Record the discharge capacity. Charge cells per 4.3.2. Discharge the cells to 2.5V at a 1.0 I_1 (A)current. Record the recovery capacity.	Capacity Retention ≥96.5% （25℃） Capacity Recovery ≥95% （45℃）

10	Characteristics at high temperature	Cells shall be charged per 4.3.2 and store for 5h at （55±2）℃, then discharge to 2.5V at 1.0 I_1 (A) and measure the capacity.	Residual capacity≥97% of Nominal capacity
11	Characteristics at low temperature	Cells shall be charged per 4.3.2 and store for 24h at （-20±2）℃, then discharge to 2.0V at 1/3 I_1 (A) and measure the capacity。	Residual capacity≥70% of Nominal capacity
12	Short-circuit Test★	Cells, charged per 4.3.2, with thermocouples, shall be short circuited 10 minutes in fuming cupboard by connecting the positive and negative terminals through the external wires. And the resistance of external wires will be less than 5mΩ. Observe 1h.	No Explosion, No Fire
13	Overcharge Test★	After charged per 4.3.2, test cells (with thermocouple) shall be overcharged with a sort of method below: 1st Method: Charge test cells at 1 I_1 (A), and stop test when the voltage reached 1.5 times of end voltage. Observe 1h. 2nd Method: Charge test cells at 1 I_1 (A), then stop the test when the charge time reached 1h. Observe 1h.	No Explosion, No Fire
14	Over Discharge test★	Cell shall be charged per 4.3.2. Discharge cells at a 1 I_1 (A) current for and stop the test when the discharge time reached 90 min. Observe 1h.	No Explosion, No Fire, No leakage
15	Thermal Test★	Cell shall be charged per 4.3.2. Put cells (with thermocouple) into the oven, then close the door of it The oven temperature shall be raised at a rate of 5℃±2℃/min to a temperature of （130±2）℃, the cells shall remain at this temperature for 30min. Then, stop the test and observe 1h.	No Explosion, No Fire
16	Crush Test★	After charged per 4.3.2, crush the cells vertically at the speed of (5±1) mm/s until cells'deformation reach to 30% or the voltage tapered to 0V, or the press reach to 200kN. Observe 1h.	No Explosion, No Fire
17	Drop Test★	Charge cells per 4.3.2. Then drop cells from a height of 1.5m to the concrete ground. Cells shall be dropped with the terminals down.	No Explosion, No Fire, No leakage

8.5 Caution

8.5.1 Charge

a) NO over-charge，the charge voltage should not be over 3.65V.

b) NO reverse charging

c) The charge temperature range is 0℃~ 65℃. The charge must be stopped when any part of the cell reach to 65℃.

d) Optimal charge temperature range is 15℃ ~35℃。Do not charge for a long time in the

temperature less than 15℃.

8.5.2 Discharge

a) No short circuit

b) The end of discharge voltage must be over 2.0V.

c) The discharge temperature range is -35℃~ 65℃. The discharge must be stopped when any part of the cell reach to 65℃.

d) Optimal discharge temperature range is 15 ℃~ 35℃. Do not discharge for a long time in the temperature more than 35℃

8.5.3 Put cells away from children.

8.5.4 Storage and Usage

a) For any short time storage (in one month), cell should be in a clean and dry area（humidity ≤65% RH） and at -30℃ ~+45℃ at 20~40%SOC .

b) For any long time storage (in 6 month), cell should be in a clean and dry area（humidity ≤65% RH） and at -20℃ ~+35℃ at 20~40%SOC.

c）During the course of storage or usage, keep the cells upright .

9. Warning

9.1 Avoid overheat in any circumstances.Don't modify or disassemble the battery. It will be dangerous, and may cause ignition, heating, leakage or explosion.

9.2 Don't put cells in overheat circumstances or disposed in fire ,don't put cells under the sunshine.

9.3 Don't short-circuit positive(+) and negative(-) terminals. Keep away from metal or other conductive materials. Jumbling the batteries of direct contact with positive(+) and negative(-) terminals or other conductive materials may cause short-circuit and may even cause fire and explosion.

9.4 Don't reverse the positive (+) and negative (-) terminals.

9.5 Don't put cells in water or other conductive liquids or let cells absorb amoisture.

9.6 Don't impact cells excessively.

9.7 Don't solder the battery directly. Excessive heating may cause deformation of the battery components such as the gasket, which may lead to the battery swelling,leakage, explosion,or ignition.

9.8 Don't use abnormal cell which has damages by shipping stress, drop, short or something else, and which gives off electrolyte odor.

9.9 Don't contact cans directly or with other conductive materails during the using process.

9.10 Keep away form static circumstances during storage and using.

9.11 Don't use cells together with other one-shot batteries and secondary batteries. Don't use cells together with different packages, types and brands.

9.12 Stop using and process the cells accordingly when the following circumstances happened: getting hot sharply, smelling, changing colors, deformation or others.

9.13 If there is leaked electrolyte from batteries, please scrub it away with fresh water to avoid any skin discomfort.

10. Shipping

10.1 During transportation, keep the battery from acutely vibration, impacting, insolation, drenching.

10.2 The delivery battery should be at 10%~50% SOC charged state.

11. Others

If customers need to use or operating cells beyond the specified range of this file, please contact Zhejiang Sandi Electric Co., Ltd. Manufacturer will not be responsible for trouble caused by using cells beyond the specified range of this file.

Manufacturer will not be responsible for trouble occurred by matching electric circuit, cell pack and charger.