NPFC Series	Narada®

Product Manual
48NPFC100 Lithium Battery Pack

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This manual is used to introduce the 48NPFC100 lithium battery pack. Please read this manual before installing the battery pack and follow the instructions during the installation.

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1. Safety operation guide for lithium batteries

Warning: 48NPFC100 is a 48V voltage DC system operated by authorized personnel only.

Before Connecting

1) After unpacking, check the products and packing list first to see if there is anything damaged or missing.
2) Before installation, disconnect the external power supply of the battery and ensure that the battery is powered off;
3) Correct wiring, do not mistake the positive and negative cables, ensure that there is no short circuit with external equipment；
4) Do not directly connect the battery to the AC power supply;
5) The battery system is properly grounded. The grounding resistance must be less than 50 mΩ;
6) Ensure battery system electrical parameters are compatible with related equipment；
7) Keep the battery away from fire and water.

In use

1) If the battery is to be moved or repaired, the power must be cut off and the battery completely shut down;
2) Do not connect batteries of different types;
3) Do not work with a faulty or incompatible switching power supply;
4) Do not remove the battery;
5) In case of fire, please use the lithium battery extinguishing device that meets the national requirements;
6) Do not open, repair or disassemble the battery without authorization.

Reminder

1) Read the user manual carefully before installation；
2) This product is only suitable for -48V communication switching power supply system, do not use for other occasions；
3) Do not turn on the system switch when the product is not in use, so as to avoid the consumption of lithium battery；
4) If the battery is stored for a long time, it must be charged once every 3 months, and the SOC should not be less than 90% each time；
5) The battery must be recharged within 12 hours after the low voltage protection is triggered；
6) The output dc voltage of the battery exceeds 48V. Pay attention to personal safety when using the battery；
7) Disconnect all battery terminals before maintenance；

2. Product Introduction

48NPFC100 lithium battery pack is an advanced product developed according to the requirements of new backup power supply for communication operators under the new trend of communication. It has the characteristics of integration, miniaturization, light weight, intelligence, standardization and environmental protection. It can be widely used in macro base station, transmission station, indoor distribution station, integrated base station, marginal station, micro cellular station, outdoor micro station, WLAN equipment, radio frequency stretching, distributed power supply and other communication fields.

2.1 Product Appearance

Note： Because the product is constantly updated, this picture is for reference only。

2.2 Product Feature

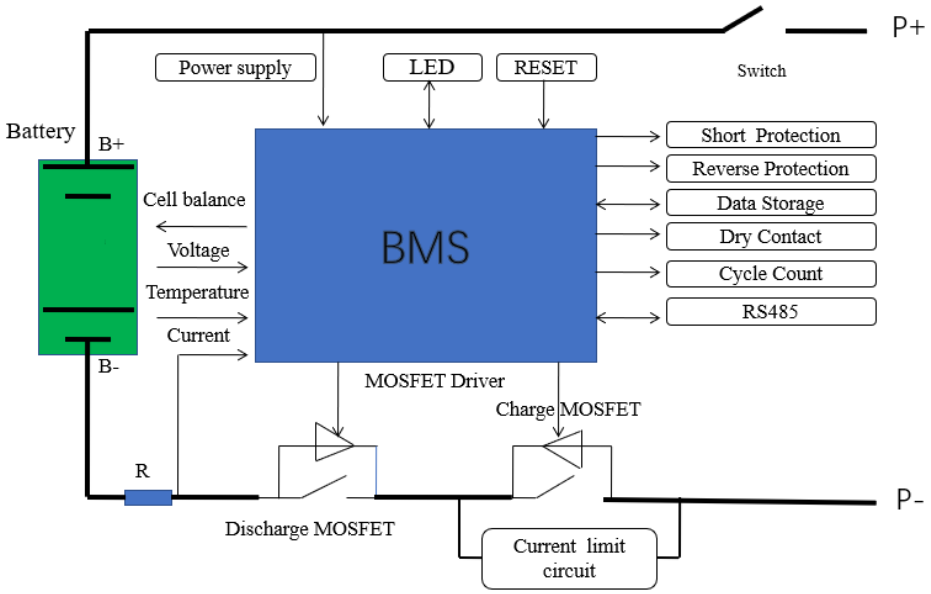
- New type of lithium iron phosphate battery, safe and reliable, long cycle life and replacement.
- Group cycle life up to more than 2000 times, longer service life under floating charging working conditions
- Raw materials and production, use process green environmental protection
- The specification of single cell is 3.2V/100Ah, use the technique of laser welding to be connected firmly.
- single battery equipped with safety valve of two-level protection, safe and reliable.
- High energy density, stable discharge platform, greatly reduce the rate of base station withdrawal.
- Integrated design: 15 cells battery modules + BMS + 19-inch standard cabinet or universal chassis with seismic iron frame.
- Cabinet embedded installation dimensions, and adapt to seismic iron frame floor installation.

- Small size, light weight, greatly reduce the station floor area and reduce the building floor bearing requirements.
- Modular design, according to the actual need of multiple parallel to expand capacity
- Support high-rate charge and discharge, high efficiency, to achieve small capacity configuration to achieve large current discharge.
- Strong adaptability to the environment, wide working temperature range, base station cannot configure air conditioning or improve the constant temperature of air conditioning, greatly reduce the site construction cost and electricity cost.
- Adopt intelligent gap charge and discharge function, effectively reduce the base station electricity cost.
- All-round alarm protection (overcharge, over discharge, short circuit, overload, overcurrent, high temperature, low temperature, balance, and sleep).
- Intelligent design, can be through the moving loop monitoring system remote communication.
- With RS232 upstream interface and dual RS485 cascade interface, RS485 can be well connected with the computer software and other devices for customer's operation, RS232 is not for customer.
- Centralized LED indicator light, such as SOC LED, Alarm LED, RUN LED.
- Front panel front-end operation and maintenance, convenient and quick.
- It has good electromagnetic compatibility and can be compatible with standard communication rectifier equipment.
- Using laser printing on the cell shell to produce the identification code.
- The 4-channel battery temperature collection cables adopt glue, which is firmly and evenly fixed.
- The power cables and the voltage collection signal cables are firmly fixed with cable ties, and have clear marks.

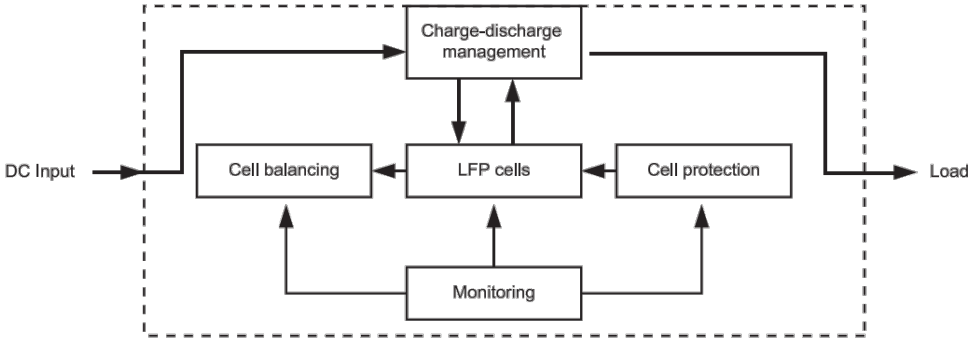
2.3 Working principle and working state of the product

It mainly provides -48VDC backup power supply for communication equipment. The product consists of 15 cells of 3.2V/100Ah lithium iron phosphate batteries in series and BMS, which are connected to the positive and negative battery ports of the communication switch power supply through the total positive and negative power ports on the front panel. When the mains is normal, the switching power supply will supply power to the communication equipment and charge the product at the same time. When the mains is disconnected, the power supply is uninterrupted until the mains is restored or the battery management system over discharge protection and the power supply is cut off

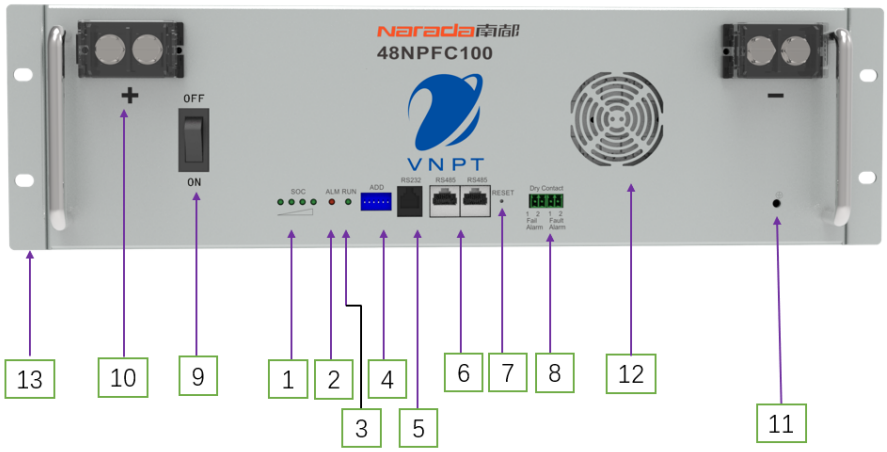
Schematic diagram of product system：



Work Diagram



2.4 This section describes the chassis panel



No	Name	Description
1	SOC LED	Indicator for capacity
2	ALM LED	Indicator for alarms
3	RUN LED	Indicator for running status
4	ADD	Address of communication
5	RS232	Firmware update
6	RS485*2	Communication port
7	Reset	Recover original state
8	Dry Contact*2	Dry contact indicators
9	Switch	ON/OFF power switch
10	Battery Output	Terminals for battery output
11	GND	Ground screw
12	Fan	Cool BMS down
13	Handle	Push and pull battery

Panel interface description:

1) SOC: SOC is short for state of charge. There are four green LED lights in front panel indicating SOC. Each SOC LED light represents 25% of rated capacity

●	●	●	●	SOC
☼	☼	☼	☼	75% ~ 100%
☼	☼	☼	○	50% ~ 75%
☼	☼	○	○	25% ~ 50%
☼	○	○	○	0% ~ 25%

Note: ☼ mean light on, ○ mean light off

2) ALM: There is one red LED light in front panel indicating alarms.

Flash Status	Running Status of Battery
Flash 1	Activation state, but neither charge nor discharge
Flash 2	Charging state
Continue light	Discharging state
Extinguish	Dormant state

3) RUN: There is one green LED light in front panel indicate the running status.

Flash Status	Running Status of Battery
Flash 1	Activation state, but neither charge nor discharge
Flash 2	Charging state
Continue light	Discharging state
Extinguish	Dormant state

Flash Introduction of LED indicator for Alarm LED and RUN LED

Flash Status	ON	OFF
Flash 1	0.25s	3.75s
Flash 2	0.5s	0.5s
Flash 3	0.5s	1.5s

4) ADD Dipswitch: ADD is applicable to modules connected in parallel. ADD consists of six binary bits.

Instructions for ADD Dialing				Module No.	Binary Code
1	2	3	4		
OFF	OFF	OFF	OFF	Default ADD	0000
ON	OFF	OFF	OFF	PACK 1	0001
OFF	ON	OFF	OFF	PACK 2	0010
ON	ON	OFF	OFF	PACK 3	0011
OFF	ON	OFF	OFF	PACK 4	0100
ON	OFF	ON	OFF	PACK 5	0101
OFF	ON	ON	OFF	PACK 6	0110
ON	ON	ON	OFF	PACK 7	0111
OFF	OFF	OFF	ON	PACK 8	1000

Default 0000	PACK 1 0001	PACK 2 0010	PACK 3 0011	PACK 4 0100
				
	PACK 5 0101	PACK 6 0110	PACK 7 0111	PACK 8 1000
				

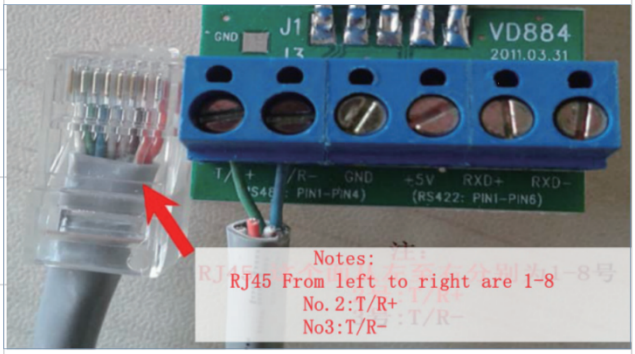
Note: Counting of ADD must begin from 0001, without interruption, or parallel communication cannot be available

5) RS232: RS232 communication port just for software upgrade now.

RJ11 Pins	Definition	Sketch
1	NC	
2	SWCLK	
3	BMS transmit; Computer receiver	
4	BMS receiver; Computer transmit	
5	GND	
6	SWDIO	

2 RXD Receive data - From battery to computer
3 TXD Deliver data - From computer to battery
5 GND – Signal ground

6) RS485: It is adopting RS485 series port communication pattern to upload data. Contents of data transmit include BMS parameters, battery running status, alarms, etc. Communication of modules connected in parallel is available through RS485.

RJ45 Pins	Definition	Sketch
1	GND	
2	RS485_A	
3	RS485_B	
4,5,6,7,8	No connection	

7) RESET: Press RESET button when abnormity occurs to assure stability of battery performance.

Button	Sleep	Press the button for 3 seconds and release it. The BMS will sleep and the LED indicator will light up for 0.5 seconds from "RUN".
	Activation	Press the button and release it after 1S, the BMS will be activated, and the LED indicator will light up for 0.5 seconds from "L1".
	Reset	Press the button and release it after 10S. The BMS will be reset. The LED light will be on successively from "L1" for 0.5 seconds.

8) Dry contact: Failure Alarm: indicate BMS or battery fail including but not limited to charge and discharge MOS fail, cell voltage under 0.5V, NTC disconnect, and so on.

9) Power switch: When turn-off, battery get into sleep mode, and cut-off output, the alarm output also will be stopped.

10) Battery Output: Positive terminal*2 and Negative terminal*2 distributed at two sides of front panel.

11) GND: Connect earth by flexible cable above GREEN Sheathed, UL94-V0, gauge of the grounding wire should be equal to or greater than the gauge of the battery return wire.

12) Fan: Cool BMS down.

13) Handle: The handle is used to push and pull the battery easily from battery cabinet. Not recommend use handle to handing the battery.

2.5 Product Technical Parameters

⚠ Before installation and use of the product, set the parameters of the switching power supply strictly according to the requirements. The parameters that have been set of the product should not be changed at will, otherwise, the service performance of the product will be seriously affected.

Basic Parameters:

Specifications	48NPFC100
Type of battery	Laminated lithium iron phosphate/LFP battery
Nominal Voltage	48V
Nominal Capacity	100Ah
Nominal energy	4800Wh
Cell Specification	3.2V/100Ah
Cell model	FE100A
Cell shell	Prismatic, Aluminum case
Cell Manufacturer	Zhejiang Narada Power Source Co., Ltd

Specifications	48NPFC100
Battery pack manufacturer	Zhejiang Narada Power Source Co., Ltd
Origin	Hangzhou, Zhejiang
Combination	15 single cells + BMS + Rack or iron frame general purpose chassis
Battery pack Size	Width 442.5 × Depth 441 × Height 133(mm)
Weight	39.0Kg±2%
Weight energy density of battery pack	120 (Wh/kg)
Energy density of cell	161 Wh/kg
Operating voltage range	40.5-54.0 VDC
Charge temperature	0～60℃
Discharge temperature	-20～60℃
Operating Temperature	0～60℃
Storage temperature	0～40℃
Environmental humidity	5% ~ 95%
Working altitude	2000m (from 1000m to 2000m, the working temperature decreases by 1 ℃ for every 200m increase in altitude)
Working atmospheric pressure	70kpa-106kpa
Noise	< 5db
Self-discharge rate / month	≤3% (+25℃)
IP rate	IP20

Charging Technical Parameters：

Specifications	48NPFC100
Charging mode	Balanced charge, intermittent charge, continuous float charge
Pack equalized charge voltage range	53.25V～54.0V (Normal 53.3V)
Pack charge voltage	53.3V
Cell equalized charge voltage range	3.55V～3.60V (Normal 3.55V)
Pack float charge voltage range	51.0V～52.5V (Normal 52.5V)
Cell float charge voltage range	3.40V～3.6V (Normal 3.6V)
Charge current range	0A～100A (Normal 10A～20A)
Max charge current	100A
Charge overcurrent alarm range	>=80A
Charge overcurrent protection range	>= 105A
Charge overcurrent protection recovery	＜70A
Battery current limit	10A
Cell overvoltage alarm	3.60V
Cell overvoltage alarm recovery	3.50V

Specifications	48NPFC100
Cell overvoltage protection	3.65V
Cell overvoltage protection recovery	3.35V
Cell overvoltage detection delay time	500ms-3000ms
Charge overcurrent detection delay time	500ms-2500ms
Pack overvoltage alarm	54.5V
Pack overvoltage alarm recovery	53.2V
Pack overvoltage protection	56V
Pack overvoltage protection recovery	50.2V
Pack overvoltage detection delay time	500ms-2500ms

Discharge technical parameters：

Specifications	48NPFC100
Discharge current	0A ~ 100A
Max discharge current	100A
Discharge overcurrent alarm	80A
Discharge overcurrent alarm recovery	70A
Discharge overcurrent protection	>=105A
Discharge overcurrent protection recovery	charge recovery
Cell under voltage alarm	2.80V
Cell under voltage alarm recovery	3.1V
Cell under voltage protection	2.50V
Cell under voltage protection recovery	charge recovery
Cell under voltage detection delay time	1000ms-2500ms
Discharge overcurrent detection delay time	1000ms-2500ms
Pack voltage under voltage alarm	45.0V
Battery pack voltage at 80%DOD: For DC low voltage alarm	46.0V
Pack under voltage alarm recovery	50V
Battery pack voltage at 90-95%DOD: For Load low voltage disconnect-LLVD	45.0V
Pack voltage under voltage protection/Battery pack voltage at 95-100%DOD: Battery low voltage disconnect-BLVD	43.2V
Pack under voltage protection recovery	charge recovery
Pack under voltage detection delay time	500ms-2500ms
Low power alarm	10% SOC
Low power alarm recovery	15% SOC

Other technical parameters

Specifications	48NPFC100
Equalized open voltage	3.34V
Balanced open voltage difference	30mV
equalized current	40-100mA
Short circuit protection current	360-400A
Short circuit protection delay	≤500us
Short circuit protection recovery mode	Load disconnected, or charge recovery
BMS operating current	≤40mA
BMS sleep current	≤500μA
Storage capacity	＞50%
Over temperature alarm	55℃
Over temperature alarm recovery	45℃
Over temperature protection	70℃
Over temperature protection delay	60℃
Low temperature alarm	0℃
Low Temperature alarm recovery	10℃
Low temperature protection	0℃
Low temperature protection recovery	5℃
Cell resolution voltage	0.5%
Pack resolution voltage	0.6%
Voltage display accuracy	2%
Current display accuracy	2%
SOC display accuracy	5%
SOH display accuracy	≤10%
Temperature display accuracy	±2℃
Temperature collection number	6 channels (4 batteries, 1 environment, 1 MOS)
Communication interface	RS232, RS485
Cascade communication	2 channel RS485, RJ45 interface
Failure rate (test time ≥9 months)	≤2%
Warranty	Determined by specific project, default value is 3 years

3. Product Installation

Reminder

1) Please study this manual before installation.
2) Please inspect the package before unboxing, if any destroy with appearance, contact with the supplier as soon as possible.
3) This device shall be installed and operated by professionals.
4) Batteries shall not be placed in direct sunshine or close to heat source.
5) Batteries shall be installed in place with good ventilation to assure enough heat dissipation.
6) Batteries shall be placed in are with clean ambient and low humidity.
7) Heavy weight shall not be placed on any cable.
8) Ensure that the communication protocols of the rectifier and battery match. Narada will not be responsible for the debugging failure caused by the mismatch of communication protocols.

Product Size:

3.1 Equipment and tools

The following equipment and tools are required to install the product:

laptop

screwdriver

screwdriver

wire stripper

crimping pliers

multimeter

clamp meter

diagonal pliers

insulated rubber tape

steel tap

⚠Note:

Use appropriate insulation tools to prevent accidental electric shock or short circuit. If no insulating tool is available, use insulating tape to cover the entire exposed metal surface of the existing tool except the end.

It is recommended to wear the following safety items when operating the battery pack:

insulating gloves

goggle

safety shoe

3.2 Clean

Dust and iron filings must be removed before installing and operation to ensure the cleanliness of the product and the environment.

3.3 Installation specification

1) At least two people shall operate on the construction site.
2) First check whether the outer packing box of the product is damaged and whether the product specification and model are accurate.
3) After unpacking, check whether the materials are complete and intact according to the packing list.
4) This product should be handled with care when taken out to avoid collision, scraping, falling and other damages affecting the use.
5) Metal installation tools must be insulated before use to prevent short circuit of battery due to accidental conditions such as tool drop during operation.
6) Before installation, check whether the wiring bar and bus bar are clean.
7) Before installation, check that the diameter of the connecting cable used can meet the maximum current requirements of equipment operation.
8) The wiring layout shall be reasonable, neat and orderly, and moisture-proof and anti-corrosion measures shall be taken.
9) Ensure that the wiring is correct and the grounding wire shall be reliably grounded.
10) After installation, the wiring fixing and product fixing bolts shall be checked one by one for tightness and reliability.
11) Turn off the power switch of the product when the mains power is not connected after installation.
12) Before the formal opening, the product shall be powered up to avoid damage to the product due to over discharge.

3.4 Standard cabinet installation and parallel connection method

Battery modules of NPFC series are applicable to installation in cabinets and wall-hanging.

1) Insert battery module into cabinet, and fix two handles of battery module with cabinet rack using 4pcs M6 screws.

2) Wall-hanging installation also can be adopted, fix two handles of battery module with triangle rack on the wall using 4pcs M6 screws.

Schematic diagram of 48NPFC100 wiring bar:

1) Connect earth by flexible cable above GREEN-YELLOW Sheathed, UL94-V0, gauge of the grounding wire should be equal to or greater than the gauge of the battery return wire, .no less than 6AWG, connection through 2-hole 0.75 in center spacing, on right side of cabinet back.

2) Connect '+' of battery output with positive copper bar of power plant, and '-' with negative copper bar or power switch. If multi battery modules will be connected in parallel, please take note of follows:

   - ♦ The battery modules connected no more than 10 in parallel.
   - ♦ The minimum spacing between batteries is 10mm.

3) Connect '+' of battery output of each battery module with positive copper bar of power plant, and '-' with negative copper bar of power plant or power switch separately.

4) Length of cable between battery module and power plant shall be less than 2.0m. To make sure similar voltage drop of cable for each battery, length of all positive and negative cables should be the same.

5) Color for cable between '+' and positive bar is suggested as RED, and cable between '-' and negative as BLACK.

6) When installation is accomplished, battery module is in dormant state. Once power on for the power plant and battery module, battery will go into normal running status, and discharge/charge can be available.

7) If there is only one battery module in operation, communication between battery module and computer can be available through RS485.

8) If there are more than one battery modules in operation, parallel communication also can be available using RS485 * RS485 port.

9) The last battery in each rack has an empty RS485 port, its need to be connected with a cable with RJ45 terminals to avoid interference with communication. The other end of the cable should be covered with insulating tape.

10) RS232 communication port just for software debugging by supplier.

11) Dry contact should be connected when battery connected in electric circuit.

12) Dummy load cannot be larger maximum discharge current of each battery model according to the datasheet, and BLVD is larger than 43.2V.

13) Voltage drop on cable between battery module and power plant shall be less than 0.5V. Method of calculation for cross sectional area of cable is shown as below.

$A=\Sigma I \times L/(K \times \triangle U)$

In the above formula, A is across sectional area of wire (mm2), ΣI is the total current (A), L is length of cable, △U is the permit voltage drop on cable (V), and K is electrical conductivity of wire. For example, for copper, K = 57.

Illustration diagram of 48V/900Ah in parallel for real scenario:

4. Application

4.1 Application steps

1) After the product is installed, turn on the "Switch" on the front panel, and the product will enter the standby working state. The operation light flashes and the capacity light indicates the remaining capacity.

2) When the communication switching power supply is loaded, the battery enters the charging working state, the running light is always on, and the capacity light indicates the current capacity; When the battery pack is fully charged, the capacity light is fully on, and then the battery pack turns into standby working state, and the operation light flashes.

3) In case of main power failure, the product gets the discharge working state without delay to provide backup power support for communication equipment. The operation light flashes and the capacity light indicates the current capacity; If the mains power is restored halfway, the battery pack will turn into the charging state; Otherwise, when the battery pack is discharged to the over discharge protection, it will automatically cut off the output and turn into the sleep working state.

4.2 Sleep mode and wake-up function

1) The product has the sleep function. When any of the following conditions is met, the system enters the low power consumption mode:

   a. Single or overall, over discharge protection is not released within 30 seconds;

   b. Press the key for 3 seconds and release the hand;

   c. The minimum cell voltage is lower than the sleep voltage, and the duration reaches the sleep delay time (no communication, no protection, no balance and no current at the same time);

   d. The standby time exceeds default 24 hours (no communication, no charge and discharge, no mains power);

   e. Forced shutdown by upper computer software.

   f. Before entering sleep, ensure that no charger is connected, otherwise it will not be able to enter the low power consumption mode.

2) The product has wake-up function after sleeping. When the system is in low-power mode and meets any of the following conditions, the system will exit the low-power mode and enter the normal operation mode:

   a. Connect the charger-machine, and the output voltage of the charger shall be greater than 48V;

   b. Press the key 3S and release the hand;

c. Access the communication line and start the upper computer software (because the over discharge protection enters the sleep state, this method cannot wake up the protection board);

Remarks: *after single or overall, over discharge protection, enter the low power consumption mode, wake up regularly every 4 hours, and turn on the charge discharge MOS. If it can be charged, it will exit the sleep state and enter normal charging; If the automatic wake-up fails to charge for 10 consecutive times, it will no longer wake up automatically. When the system is defined as that the recovery voltage is not reached after 2 days / 48h standby (standby time setting value) after the end of charging, it is forced to resume charging until the end of recharging.*

4.3 Charging

⚠This series of products can meet three charging modes: balanced charging, intermittent charging and continuous online floating charging.

1) Equalizing charging mode

a. This charging method is suitable for installation in stations with relatively large switching power supply configuration power and more module redundancy. It is charged in the way of constant current and time, and the charging speed is fast. BMS provides a passive balanced charging function during charging, which is used to correct the voltage dispersion caused by the difference of cells in series of a battery pack, avoid the deterioration or even damage of battery pack performance caused by overcharge or overcharge of individual cell, and make all cells' voltage within a certain reasonable range.

b. The product adopts intermittent equalization mode, that is to control the number of equalizing cells, and the equalizing cells open and close the equalizing circuit according to a certain proportion of time.

   ① Under the charging state, the cells with balanced opening sections are discharged at the same time, and the voltage acquisition accuracy will be affected. The intermittent equalization mode can be used to adjust the time proportion, so as to sample at the interval when the equalization is closed, so as to ensure the accuracy of voltage acquisition.

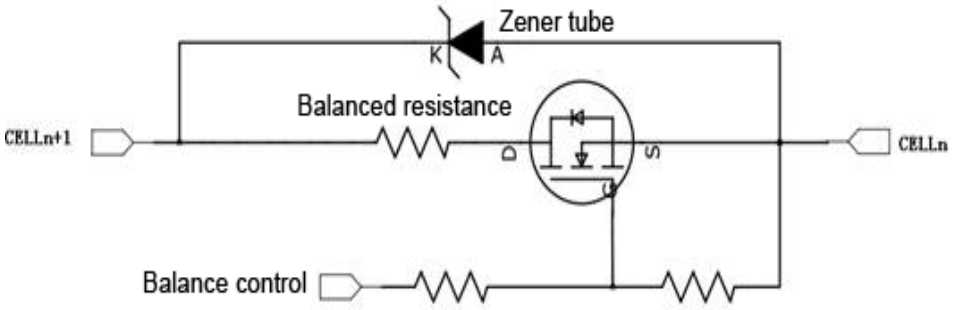
   ② Intermittent equalization is adopted, and the temperature rise can be effectively controlled by controlling the number and time of equalization opening to ensure the reliability of equalization.

   ③ Intermittent helps maintain battery consistency.

   ④ Equalization principle: when the detection chip detects that the cell cell n + 1 meets the equalization on condition, the equalization control pin outputs the high

level relative to the cell to turn on the equalization MOS, release the power of the cell cell n + 1 through the equalization resistance, slow down the charging speed of the cell ln + 1 and balance the voltage of each section. Since the system adopts the passive power consumption equalization mode, considering the system reliability, the number of equalization cells and intermittent equalization on mode are adopted.

Schematic diagram of equalization circuit:



c. When all the following conditions are met, the cell equalization function meeting the conditions is turned on:

① The battery pack is charged;

② The maximum cell voltage is higher than the balanced opening voltage(Normal 3.50V, configurable);

③ The maximum pressure difference between cells exceeds the balanced opening pressure difference (20 mV, configurable);

d. When all the following conditions are met, the cell equalization function meeting the conditions is turned off:

① The battery pack is not charged;

② The highest cell voltage is lower than the balanced starting voltage;

③ The maximum pressure difference between cells is lower than the balanced opening pressure difference;

2) Float-charging mode

The battery need not adopt this charge mode, follow “Equalizing charging mode”.

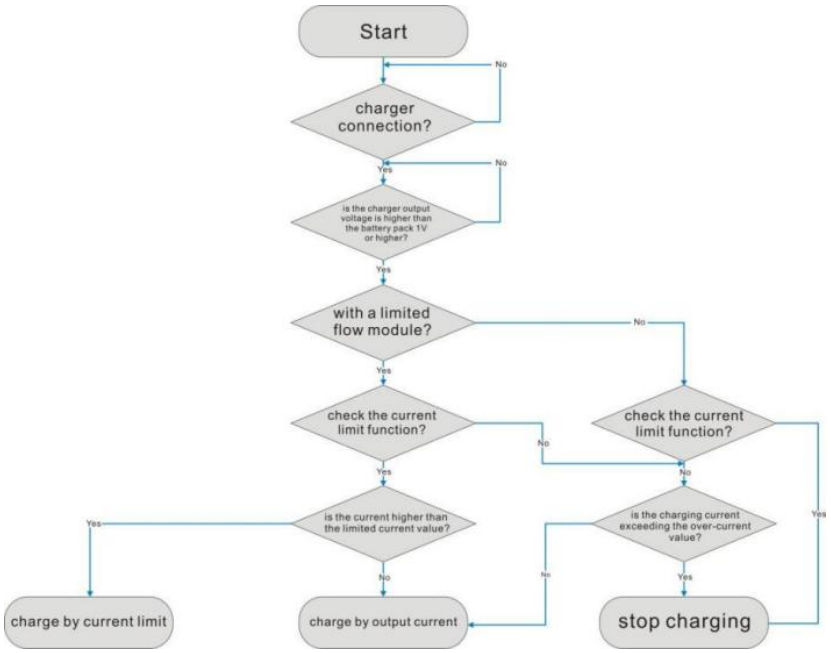
3) Charging current limiting function

This product has the charging current limiting function. BMS is configured with Max.10A charging current limiting module. After the charging current limiting board is configured, the function can be turned off or on the upper computer, and the function is turned on by default. After the charging current limiting module is opened, the CHARGING MOS tube of The BMS

is turned off. If the output current of the switching power supply is lower than the current limiting value, the charge is charged according to the output current of the switching power supply; if the output current of the switching power supply is higher than the current limiting value, the charge process is charged according to the current limiting value.

If the charging current limiting module is not open a current limiting function, BMS charging MOS tube is open, switch power supply by charging MOS tube, the charging current value is the switching power supply output current, up to a maximum of 100A charging current (1.0 C), when the charging current exceed the current threshold of 1.0C (reach 105A), the BMS shut off charging MOS stops charging.

Schematic diagram of the flow limiting module:



4.4 Product storage record function

BMS has a storage and recording function, which can separately record the protection and alarm and recovery categories and the occurrence time. The recording content includes the fault category and the cell voltage when the fault occurs, the total voltage, the charge/discharge capacity, the charge/discharge current, and the temperature. In addition to the normal recording of protection, alarm and recovery information, it can be set to record battery pack parameters within a certain period of time: cell voltage, total voltage, charge/discharge capacity, charge/discharge current, temperature, etc.

The storage capacity is not less than 800 records. The storage period and time interval can be set. The storage content adopts the principle of first-in-first-out. The storage content is measured by BMS, and the software reads and exports and stores it as an excel file.

	B	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z	AA	AB
1	ADDR	PACK_BAR	Time	CELL1	CELL2	CELL3	CELL4	CELL5	CELL6	CELL7	CELL8	CELL9	CELL10	CELL11	CELL12	CELL13	CELL14	CELL15	CELL_MAX	CELL_MIN	CELL_SUM	Current	Full_Cap	Surplus_All	Chg_All
2	1	14810Z212021-05-		3.18	3.177	3.177	3.178	3.185	3.186	3.182	3.171	3.184	3.182	3.172	3.177	3.174	3.175	3.185	3.186	3.171	47.68	-50.22	108.74	22.4	0
3	1	14810Z212021-05-		3.18	3.177	3.177	3.178	3.185	3.187	3.182	3.171	3.184	3.183	3.172	3.176	3.174	3.175	3.185	3.187	3.171	47.68	-50.19	108.74	22.39	0
4	1	14810Z212021-05-		3.18	3.177	3.177	3.178	3.185	3.186	3.182	3.171	3.184	3.182	3.172	3.176	3.174	3.175	3.185	3.186	3.171	47.68	-50.21	108.74	22.37	0
5	1	14810Z212021-05-		3.18	3.177	3.177	3.178	3.185	3.186	3.182	3.171	3.184	3.182	3.172	3.176	3.174	3.175	3.185	3.186	3.171	47.68	-50.23	108.74	22.36	0
6	1	14810Z212021-05-		3.18	3.177	3.177	3.178	3.185	3.186	3.181	3.171	3.184	3.182	3.172	3.176	3.174	3.175	3.185	3.186	3.171	47.68	-50.2	108.74	22.35	0
7	1	14810Z212021-05-		3.18	3.177	3.177	3.178	3.185	3.186	3.182	3.171	3.184	3.182	3.172	3.176	3.174	3.175	3.185	3.186	3.171	47.68	-50.23	108.74	22.34	0
8	1	14810Z212021-05-		3.18	3.177	3.177	3.178	3.186	3.186	3.182	3.171	3.184	3.182	3.172	3.176	3.174	3.175	3.185	3.186	3.171	47.68	-50.24	108.74	22.32	0
9	1	14810Z212021-05-		3.18	3.177	3.177	3.178	3.185	3.186	3.182	3.171	3.184	3.182	3.172	3.176	3.174	3.175	3.185	3.186	3.171	47.68	-50.21	108.74	22.31	0
10	1	14810Z212021-05-		3.18	3.177	3.177	3.178	3.185	3.186	3.181	3.171	3.183	3.182	3.172	3.176	3.174	3.175	3.185	3.186	3.171	47.68	-50.21	108.74	22.3	0
11	1	14810Z212021-05-		3.18	3.177	3.177	3.178	3.185	3.186	3.181	3.171	3.184	3.182	3.172	3.176	3.174	3.175	3.185	3.186	3.171	47.68	-50.21	108.74	22.29	0
12	1	14810Z212021-05-		3.179	3.177	3.177	3.178	3.185	3.186	3.181	3.171	3.184	3.182	3.172	3.176	3.174	3.175	3.185	3.186	3.171	47.68	-50.23	108.74	22.28	0
13	1	14810Z212021-05-		3.179	3.177	3.177	3.178	3.185	3.186	3.181	3.171	3.183	3.182	3.172	3.176	3.174	3.175	3.185	3.186	3.171	47.68	-50.27	108.74	22.27	0

EXCEL export data screenshot

The number of charge/discharge cycles is calculated according to the following algorithm:

① The lithium battery pack has a cycle from over-discharge protection to over-charge protection;

② When the discharge power of the lithium battery pack reaches 80% of the nominal capacity, it is a cycle;

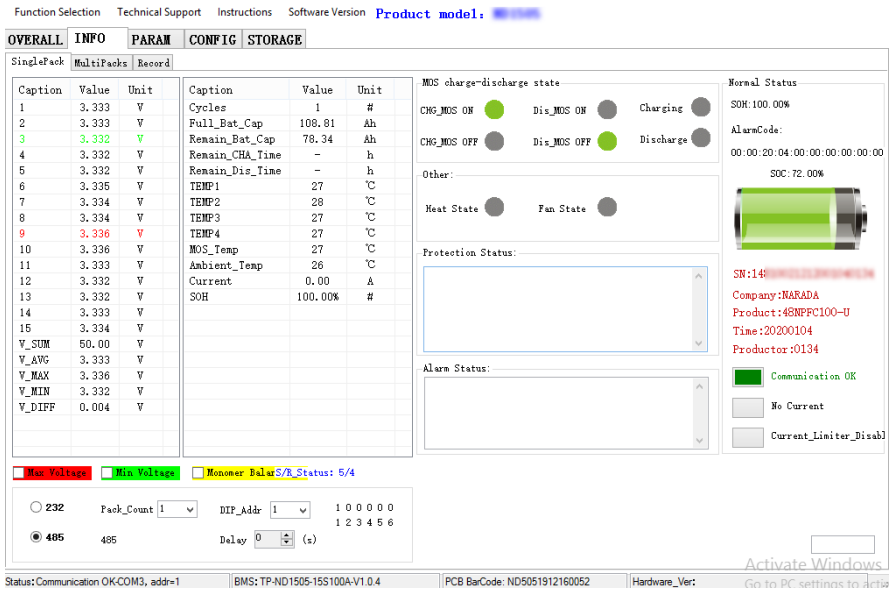
When a cycle is generated, it is automatically saved in the internal memory of the BMS and can be read by the computer UI software.

4.5 Product monitor functions

The product is equipped with RS485 cascade interface to meet relevant communication protocols, it also provides software protocol and access to the power environment monitoring system of the station, which can greatly reduce the daily maintenance work.

The product has the following real-time monitoring functions:

Contents: battery pack capacity (SOC), battery pack voltage, single battery voltage, ambient temperature, battery cell temperature, MOS temperature, battery pack charging current, battery pack discharge current, battery pack health state (SOH)



Software interface

4.6 Safety protection and Alarm function

The safety protection function is divided into two forms: active protection (software protection) and passive protection (hardware protection), and the safety protection and recovery parameters can be set in the upper computer, which means, they have certain redundancy.

1) Protection and recovery function for excessive total charging voltage

The battery pack has the function of protection and recovery of excessive total charging voltage. When the total voltage reaches the set value of excessive total voltage alarm during charging, BMS considers that the charging overvoltage alarm state occurs and gives an alarm, but does not affect the normal charging function; When the total voltage rises to the set value of total voltage protection, BMS considers that the charging overvoltage state occurs, cuts off the charging circuit and gives an alarm to ensure the safety performance of the battery pack, but does not affect the normal discharge function. When the total voltage decreases to the recovery set value, the battery pack returns to the normal charging working state. This function can be set to close and open through the upper computer software.

2) Protection and recovery function of low total discharge voltage

The battery pack has the protection and recovery function of low total discharge voltage. When the total voltage reaches the set value of low total voltage alarm during discharge, BMS considers that the low discharge alarm state occurs and gives an alarm, but does not affect the normal discharge function; When the total voltage drops to the set value of total voltage protection, BMS considers that the total discharge voltage is too low, cuts off the discharge circuit and gives an alarm to ensure the safety performance of the battery pack, but does not affect the normal charging function; BMS enters the sleep state. When the switching power supply resumes charging and the total voltage rises to the recovery set value, BMS considers that the battery pack discharge is too low, the protection state has been released, and the battery pack returns to the normal working state. This function can be set to close and open through the upper computer software.

3) Over voltage protection and recovery function of single battery

The battery pack has the protection and recovery function of single battery over voltage. When cell battery voltage reaches the set value of over voltage alarm during charging, BMS considers that the alarm state of single battery over voltage occurs and alarms, but does not affect the normal charging function; When the unit voltage rises to the set value of unit voltage over high protection, BMS considers that the unit charging voltage is too high, cuts off the charging circuit and gives an alarm to ensure the safety performance of the battery pack, but does not affect the normal discharge function; When the unit voltage drops to the recovery set value, BMS considers that the protection state of overcharging of the unit voltage has been released, and the battery pack returns to the normal working state.

4) Low voltage protection and recovery function of single battery

The battery pack has the function of protection and recovery of low voltage of single battery. When cell voltage reaches the set value of low voltage alarm during discharge, BMS considers that the low voltage alarm state of single battery occurs and alarms, but does not affect the normal discharge function; When the unit voltage drops to the low unit voltage protection setting value, BMS considers that the low unit discharge voltage occurs, cuts off the discharge circuit and gives an alarm to ensure the safety performance of the battery pack, but does not affect the normal charging function; BMS enters the sleep state. When the switching power supply resumes charging and the cell voltage rises to the recovery set value, BMS considers that the cell voltage discharge is too low, the protection state has been released, and the battery pack returns to the normal working state.

5) Short circuit protection

The battery pack has short-circuited protection function. After a short circuit occurs at the output end of the battery pack, That is, when the discharge current exceeds the short-circuit protection current (greater than 3C), BMS considers that the short-circuit state occurs, cuts off the circuit and gives an alarm to ensure the safety performance of the battery pack and will not affect other equipment in the station; charging and discharging action is prohibited in this state; after the external short-circuit is cancelled, BMS considers that the short-circuit state has been removed and the battery pack automatically returns to normal working state (it can also be reset manually to restore the normal working state).

6) Discharge overcurrent (load) protection and recovery function

The battery pack has the function of discharge overcurrent (load) protection and recovery. When the discharge current exceeds the set value of overcurrent (load) alarm, BMS considers that the discharge overcurrent alarm state occurs and gives an alarm, but does not affect the normal discharge function. When the discharge current exceeds the overcurrent When the (on load) protection set value, BMS considers that the discharge overcurrent protection state occurs, cuts off the discharge circuit and gives an alarm to ensure the safety performance of the battery pack; after the overload is cancelled or the discharge current drops to the set value, the battery pack will return to the normal discharge working state. This function can be set to close and open through the upper computer software.

7) Charging over-current protection

The battery pack has charging overcurrent protection function. When the charging current reaches the charging current overcurrent alarm set value, BMS considers that the charging overcurrent alarm state occurs and alarms, but does not affect the normal charging function. When the charging current reaches the set value of charging overcurrent protection, BMS considers that the charging overcurrent protection state occurs, cuts off the charging circuit and gives an alarm to ensure the safety performance of the battery pack, then quickly switch the main circuit to another circuit of limited-current to realize the continuously charge.

When the charging current drops to the recovery value of charging overcurrent protection, BMS considers that charge state of the limited current has been released and the battery pack should return to the normal charging working state. This function can be set to close and open through the upper computer software.

8) Over temperature protection and recovery function

The battery pack has the function of charge and discharge over temperature protection and recovery. When the temperature reaches the set value of over temperature alarm, BMS considers that the over temperature alarm state occurs, but does not affect the normal charge and discharge function. When the temperature reaches the set value of overtemperature protection, BMS considers that the overtemperature protection state occurs, cuts off the circuit and gives an alarm to ensure the safety performance of the battery pack; When the temperature drops to the recovery value of overtemperature protection, BMS considers that the overtemperature protection state has been released and the battery pack returns to the normal charge and discharge working state.

9) Low temperature protection and recovery function

The battery pack has the function of low-temperature protection and recovery of charge and discharge. When the temperature reaches the set value of low-temperature alarm, BMS considers that the low-temperature alarm state occurs, but does not affect the normal charge and discharge function. When the temperature reaches the set value of low-temperature protection, BMS considers that the low-temperature protection state occurs, cuts off the circuit and gives an alarm to ensure the safety performance of the battery pack; When the temperature rises to the recovery value of low-temperature protection, BMS considers that the low-temperature protection state has been released and the battery pack returns to the normal charge and discharge working state.

5. Maintenance

5.1 Handling and placement

1) The operation must be carried out by qualified and authorized personnel.

2) Due to the heavy weight of the battery system, please handle with care

5.2 Common faults and Solutions

Troubles	Troubleshooting	Solutions
Battery cannot discharge	Protection against under-voltage	System failure
	Protection against over-temperature or under-temperature (cell temperature is lower than -20°C or higher than 70°C)	Regulate cell temperature in the range of -20°C to 70°C for discharge
	Battery output is short circuit	Relieve short circuit and charge battery
	Protection against over current	Remove some unimportant load and charge battery
	System failure	Shutdown system and call maintenance service
RS485 communication failure	Battery is fully charged. Normal charge management	Do not need to solve
	Protection against over voltage	Inform that the battery is fully charged and the BMS has cut off the power to avoid any battery over charge. Do not need to solve
	Protection against over-temperature or under temperature (cell temperature is lower than -10°C or higher than 70°C)	Regulate cell temperature in the range of 0°C to 55°C for charge
	System failure	Shutdown system and call maintenance service
All LED indicators on	System failure	Shutdown system Call for maintenance service
Communication failure	Fault of communication cable	Check ports and wiring
	Halt of System communication management	Press RESET button
	System failure	Shutdown system Call for maintenance service

5.3 routine maintenance

 Danger: battery maintenance must be performed by qualified and authorized personnel.

 Danger: some maintenance items must shut down the system at the beginning

1) The battery shall be recharged every three months if in long time storage.
2) Please clean the dust by the dust collector when dust is accumulated on vent.
3) Please use clean and dry cloth/fabric to clean up the cabinet, if need further cleaning, please use neutral cleanser. Alcohol or ammonia synthesis is forbidden.
4) Carrying shall be handled gently, prevent from severe compact.
5) Prevent battery from splashing liquid.
6) Suggest inspect the tighten of output screw every two years.

5.4 Inspection and maintenance

Proper maintenance will prolong the life of a battery and will aid in assuring that it can satisfy its design requirements. A good battery maintenance program will serve as a valuable aid in determining the need for battery replacement. The users must consider their application and reliability needs if maintenance procedures, other than those recommended in this document, are used. Battery maintenance should be performed by personnel knowledgeable of batteries and the safety precautions involved.

6. Packing list

6.1 Label

The product label is affixed to the outer cover of the battery, and it is not easy to fall off within the operating temperature range of the battery. The label displays the customer-specified logo, product name, nominal voltage, capacity, equalizing voltage, current, floating voltage, production date, manufacturer and other specified requirements.

The product serial number label is affixed to the battery cover, and it is not easy to fall off within the battery operating temperature range. The product serial number is displayed on the label.

Battery Specification	Battery Specification
Product Name	Lithium Battery Module
Model	48NPFC100 （15S）
Nominal Capacity/Voltage	100AH/48V
Boost Charge Voltage	53.5V
Charge Current Limit	10A
Full Charge Voltage	54.0V
Max. Work Current	100A
Manufacturer	NARADA

6.2 Packing list

No.	Product	Specifications	Unit	Quantity
1	Lithium Battery	48V100Ah	set	1
2	Product Manual		copy	1
3	Certificate		copy	1
4	Cabinet screws	M6	set	4
5	Module to module communication cable	0.7m	pcs	1
6	Flexible Power cable	red, 150cm, 1x25mm2	pcs	1
7	Flexible Power cable	blue, 150cm, 1x25mm2	pcs	1

Remarks: *construction accessories shall be configured according to actual conditions.*