

Narada[®]

LITHIUM IRON PHOSPHATE BATTERY

NPFC Series

(LiFePO₄ Battery Module for Telecom)

OPERATION MANUAL

Version 9.0

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Safety and Warning

Chapter Notes

The NPFC series LiFePO₄ battery system installation, operation, maintenance should follow important recommendations in this manual:

- ⬇ The equipment shall be installed by the professional trained staff.
- ⬇ Battery maintenance should be carried out by the experienced professionals and aware of the preventive measures on the potential harm of the battery.
- ⬇ Note: Be care of the risk of electric shock for large current in case of battery short circuit, pay attention to the following points during operation
 - Remove watches, rings or other metal objects
 - Use tools with insulated handles
 - Do not place tools or metal objects on the battery
- ⬇ Do not direct access to the battery system to the mains grid power outlet.
- ⬇ Do not put the battery system into fire, do not use or storage the battery near to the high temperature source.
- ⬇ Do not use liquid or other objects placed into the battery system.
- ⬇ Do not open or cut the battery, not hit, throw or step on the battery.
- ⬇ Using special communication between battery module and power plant to charge battery
- ⬇ Be sure to subject to charge and discharge parameters setting in this manual.
- ⬇ The output interface of the system is still voltage when grid power cut, avoid electric shock or short circuit when operation.
- ⬇ Please check if the box is damaged. If damaged, please immediately notify the supplier
- ⬇ If you find leaking liquid or white powder residue on product, prohibit operation.

Please take care of the following marks

				
Warning	Electricity danger	Protecting your eyes	Watch Short-circuits	With adults custody
				
Read the manual	Fire forbidden	Circle used	Do not put batteries into dustbin	The product has passed the UL authentication

Product Introduction

Chapter One/01

Product Features

NPFC series battery system is 48V system for communications back-up type LiFePO₄ (lithium iron phosphate) battery products, the system uses the advanced LiFePO₄ battery technology with the benefit of long cycle life, small size, light weight, safety and environmental protection, and has a strong environmental adaptability, it is idea for harsh outdoor environments.

The system also integrates a smart battery management and monitoring module, support for remote centralized monitoring and remote battery management and maintenance, to meet the requirements of unattended. Therefore, the NPFC system can fully meet the backup power supply requirements of the access network equipment, mobile communications equipment, transmission equipment, micro base stations and microwave communication equipment.

Main application

- ⬇ Network Telecommunication Facilities
- ⬇ OSP
- ⬇ Terminal of FTTX
- ⬇ Access network system
- ⬇ Indoor distribution system
- ⬇ Telecom BTS
- ⬇ Integrated outdoor power cabinet
- ⬇ UPS
- ⬇ Internet data center (IDC)
- ⬇ Solar energy
- ⬇ Common Bonding Network (CBN) and or Isolated Bonding Network (IBN)

Dimension

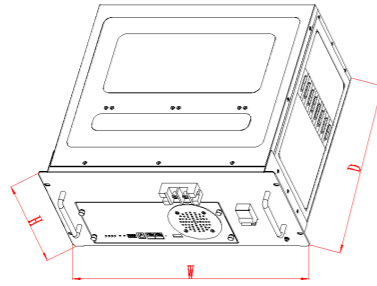


Fig.1-1 Structural Drawing of NPFC Series Batteries (48NPFC100 as example)

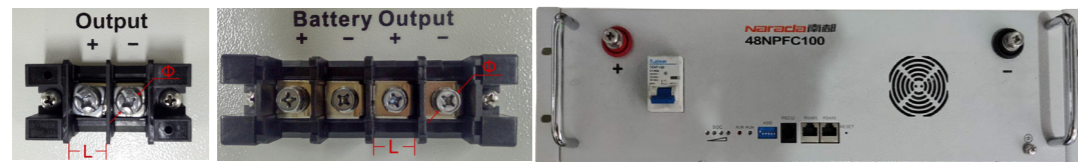


Fig.1-2 Battery Output Terminal

Table 1-1 Battery Model & Dimension of NPFC Series

Battery Model ^①	Typical Weight (kg)	Dimensions(mm)			Battery Output Terminal	
		Width (No ear)	Height	Depth	L	Φ
48NPFC10	7.3	442	44	243	10mm	M4
48NPFC20	13.4	442	88	243	10mm	M4
48NPFC50	28.5	442.5	132.5	400	13mm	M6
48NPFC80 (3U)	39.0	442.5	132.5	400	13mm	M6
48NPFC100 (5U 19")	45.5	442.5	222	400	13mm	M6
48NPFC100 (3U 23")	48.0	522.5	132.5	420	13mm	M6
48NPFC100 (3U 19")	38.5	442.5	133	400	/	M8
48NPFC160	70.0	465.9	222	480	13mm	M8
48NPFC200	80.0	465.9	222	480	13mm	M8

Note:

1. Battery Model: Battery models listed in the datasheet are standard products. Narada can also supply customized design in cell, BMS and dimensions for various application scenarios.

2. Terminal Torque: M4, 2~3 N·m; M6, 7~8 N·m; M8, 9~10 N·m;

Layout

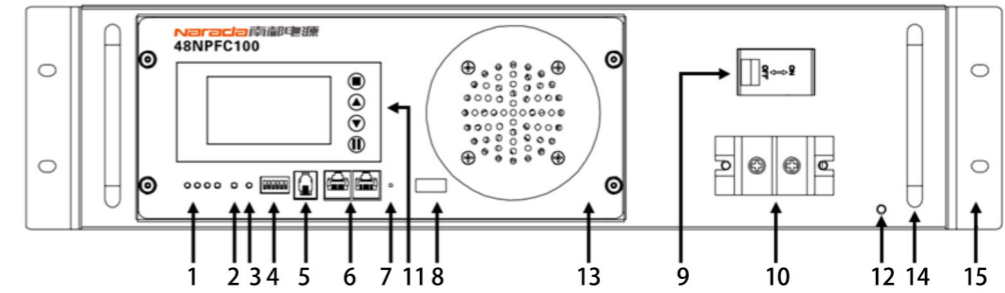


Fig. 1-3 Layout of Front Panel for NPFC Series Batteries

(Received product may not have all parts above, this instruction is as an example)

Table 1-2 Instruction for Layout of Front Panel

No.	Marks	Functions	Detailed Information
1	SOC	Indicators for capacity	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. Detailed information is shown in Annexed Table 1.1.
2	ALM	Indicator for alarms	There is one red LED light in front panel indicating alarms. Detailed information is shown in Annexed Table 1.3.
3	RUN	Indicator for running status	There is one green LED light in front panel indicating running status. Detailed information is shown in Annexed Table 1.2.
4	ADD Dip switch	Address of communication	ADD is applicable to modules connected in parallel. ADD consists of six binary bits. Detailed information is shown in Annex 2.

5	RS232	communication port	RS232 communication port just for software upgrade now.
6	RS485	communication port	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.
7	RESET	Reset button	Press RESET button when abnormality occurs to assure stability of battery performance.
8	Dry contact	Dry contact	Dry contact 1: battery cell fail (the cell voltage is lower than 2.5V, or the voltage difference is more than 800mv) Dry contact 2: BMS fail (charge/discharge MOSFET fail, or 940 fail, or NTC fail).
9	Power switch	ON/OFF switch	When turn-off, battery get into sleep mode, and cut-off output, the alarm output also will be stopped.
10	Battery Output	Terminals for battery output	Using terminals with four or two cores. Polarities are +, -, +, - from left to right. The two '+' and '-' are equal relatively. Detailed information is shown in Fig. 1-2.
11	LCD (optional)	Display battery information	Detailed information is shown in Annexed Table 3.
12	GND	Ground screw	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.
13	Removable Panel (optional)	Removable Panel	Battery BMS can be removable and replace easily through this.
14	Handle	handle	The handle is used to push and pull the battery easily from battery cabinet. Not recommend use handle to handing the battery.
15	Side mounting	Wall-hanging installation	The side mounting is used to wall-hanging installation battery. Also use the ear to handle the battery.

Working Principle

The NPFC battery system mainly includes Lithium battery pack, battery protection, cell balancing unit, monitoring module and charge-discharge management module for optional. Its schematic diagram shown in Figure 1-4

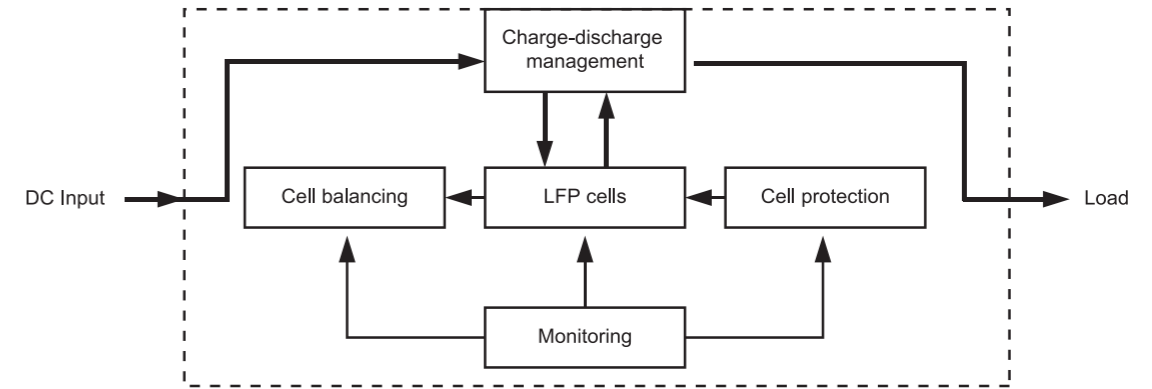


Fig. 1-4 Schematic Diagram

LFP cells	Chemical power, energy storage and power supply components.
Cell protection	Protect LFP cells against overcharge, over discharge, over current, over temperature, short circuit
Cell balancing	Equalization LFP cells for cells unbalanced
Monitoring	Support centralized monitoring system (optional according to customer requirements)

NPFC battery working principle:

DC power input rectifier after filter, DC divided two circuits, one circuit directly supply the load, another circuit charge lithium battery. When grid power on, the system supplies the loads and charging inside lithium batteries; When grid power failure, lithium inside system supply DC power to the load, to ensure uninterrupted power supply as power system.

Battery Management System (BMS)

Smart BMS technology is adopted for battery modules of NPFC series to assure smart automatic management for batteries. Features of BMS are shown as below:

- There is a centralized monitoring unit in BMS. Functions such as remote measurement, remote communication, remote controlling are available. Battery modules can be controlled remotely by staffs in control center. NPFC series are in line with the requirements of the development of modern communications technology.
- It is combined by technologies of power source and computer. Parameters and status of rectifiers and AC/DC distributions can be detected and controlled.
- Excellent electromagnetic compatibility. BMS used for battery modules of NPFC series can comply with the outdoor power plants during operation, no interfere with each other.
- BMS can provide protections against overcharge, over-discharge, over-temperature, over current, short circuit, etc., to assure reliable safety and operation life.
- With patented cell balancing technology, BMS provide high efficiency for cell balancing and prolong system operate life.
- Configuration flexibility, support parallel connection expansion

Technical Characteristic

Chapter Two/02

Discharge performance

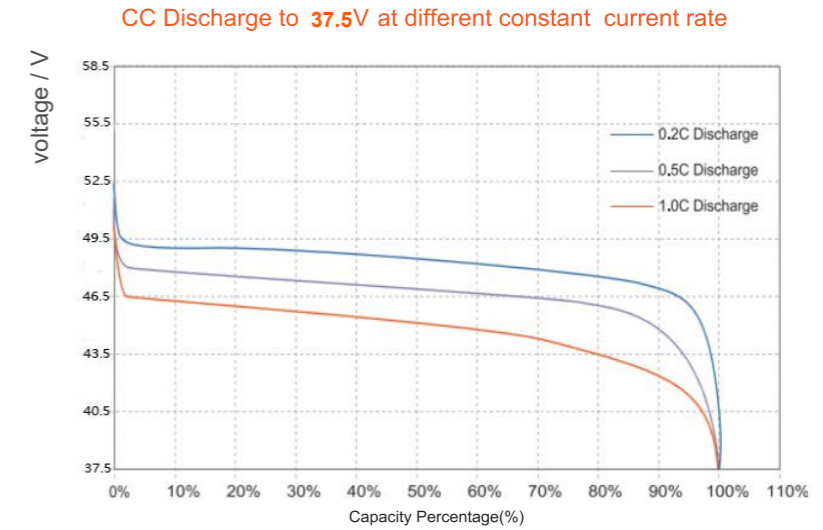


Fig.2-1 Discharge curve at different constant current of NPFC series

Charge performance

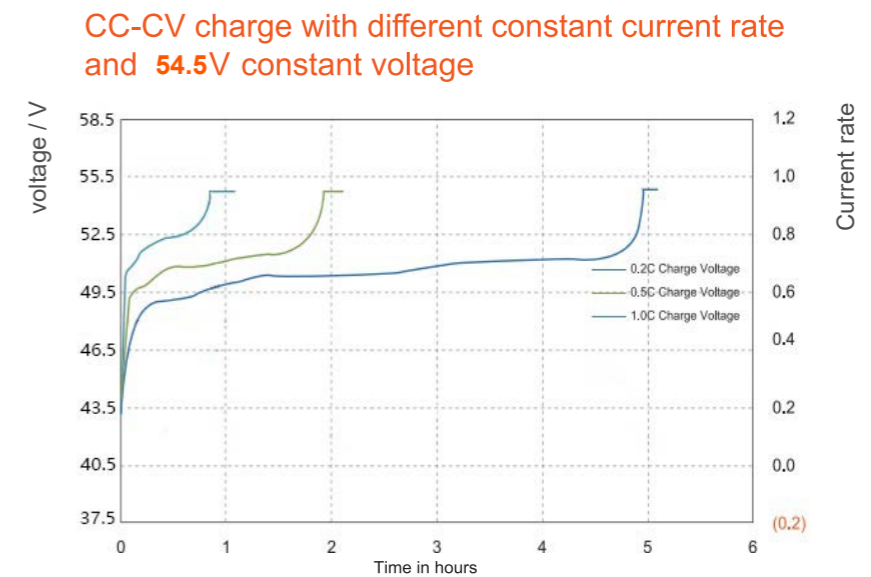


Fig.2-2 Charge curve at different current limitation of NPFC series

Operation

Chapter Three/03

Parameter settings

Lead-acid batteries can be replaced by lithium battery of NPFC series if power is matched. Table 3-1 is new parameter settings of power plant for lithium battery.

Table 3-1 Parameter Settings of Power Plant for NPFC Series Batteries

No.	Parameters	Units	Defaults
1	Float charge voltage	V	54.0
2	Equalization charge voltage	V	NA or 54.1
3	Standard charge current	A	0.2C
4	Charge current limitation	A	0.5C ~ 1.0C
5	Equalization charge interval	day	NA
6	Equalization charge duration	H	NA
7	Condition to equalization charge	A	NA
8	Condition to float charge	A	0.05C
9	Recovered LLVD voltage	V	50.0
10	LLVD	V	47.0
11	BLVD	V	43.2
12	Temperature compensation for float charge	-mV/°C	NA
13	Temperature compensation for equalization charge	-mV/°C	NA

Note:

1. Equalization charge is requested to switch off for NPFC series batteries.
2. Rectifier parameter shall be set according to specific site requirement based on battery units used.
3. If the battery connected more than 2 in parallel, the max. charge current recommend 0.5C.

Operation Condition

Table 3-2 Requirements for Operation Environment

Temperature Range (°C)	Discharge	-20 ~ +60
	Charge	0 ~ +60
	Storage	0 ~ +40
Recommended Temperature(°C)	Discharge	+15 ~ +35
	Charge	+15 ~ +35
	Storage	+15 ~ +30
Humidity		5% ~ 95%

Storage and Installation

Chapter Four/04

Storage

- Storage temperature range: 0°C to 40°C.
- Storage battery should be at 50%-80%SOC.
- Recharge charge before using to recover capacity loss of self-discharge during storage and transport.
- Recharge battery during long-term storage for self-discharge. Recharge program as follow table:

Storage temperature	Recharge interval	Single Module Recharge Procedure
0°C-30°C	Every 6 months	1) Charge with 0.2C to 100%SOC 2) Discharge with 0.2C to 0%SOC
30°C-40°C	Every 3 months	3) Charge with 0.2C per module for 4 hours

- Storage battery over 40°C or under 0°C will reduce battery life,
- Storage battery in dry and low temperature, well ventilated place
- Battery performance degradation after long-term storage, please shorten shelf time as possible as you can.

Installation

Unboxing & Inspection

- Please study this manual before installation.
- Please inspect the package before unboxing, if any destroy with appearance, contact with the supplier as soon as possible.
- This device shall be installed and operated by professionals.

Preparation for Installation

- Batteries shall not be placed in direct sunshine or close to heat source.
- Batteries shall be installed in place with good ventilation to assure enough heat dissipation.
- Batteries shall be placed in are with clean ambient and low humidity.
- Heavy weight shall not be placed on any cable.
- Following are the tools possibly but not limited be use for installation:



Tool items (possibly but not limited)

Installation of Battery Modules

1. Installation and fixation

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

■ cabinet installation

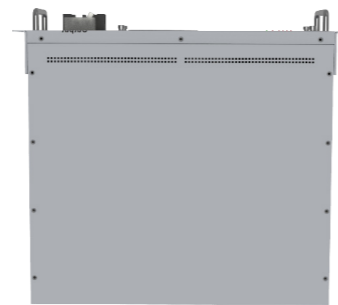
Insert battery module into cabinet, and fix two handles of battery module with cabinet rack using 4pcs M6 screws.

■ Wall-hanging installation

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



Preferred



Alternate



Forbidden (Except for 48NPFC10, 48NPFC20, 48NPFC100-19)



2. Ground connection

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, .no less than 6AWG, connection through 2-hole 0.75in center spacing, on right side of cabinet back.

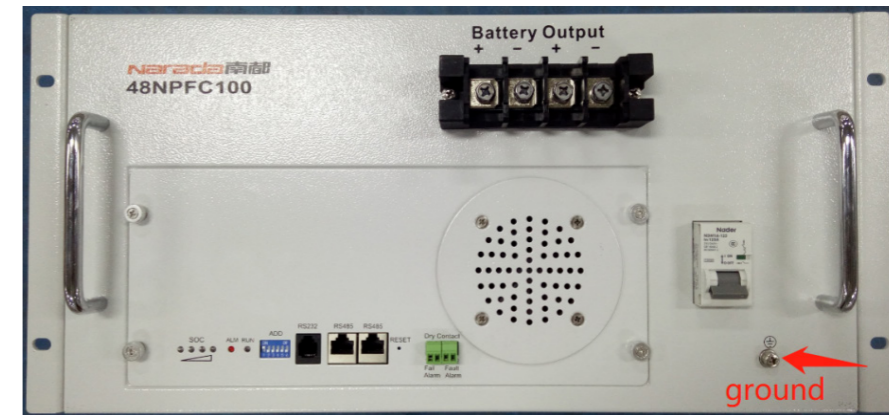


Fig. 4-1 Ground connection for NPFC Series Batteries

3. Battery output connection

- 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:
 - 1) The battery modules connected no more than 8 in parallel.
 - 2) 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.
- Color for cable between '+' and positive bar is suggested as RED, and cable between '-' and negative as BLACK.
- The picture of paralleling connection for NPFC Series Batteries see Fig. 4-2. There is a tray under each battery to support the battery.



Fig. 4-2 Layout of paralleling connection for NPFC Series Batteries

4. Power on for battery module

- 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.
- Parameter settings for lithium battery modules in power plant are shown in Table 3-1.

5. RS232/RS485 communication connection

- If there is only one battery module in operation, communication between battery module and computer can be available through RS485.
- If there are more than one battery modules in operation, parallel communication can be available using RS485.
- The last battery in each rack have an empty RS485 port for CAN cable terminal resistor. The other end of communication cable, use the electric tape to seal it.
- RS232 communication port just for software upgrade.
- Communication protocols for RS485 are shown in Annex 3.
- Dry contact should be connected when battery connected in electric circuit.

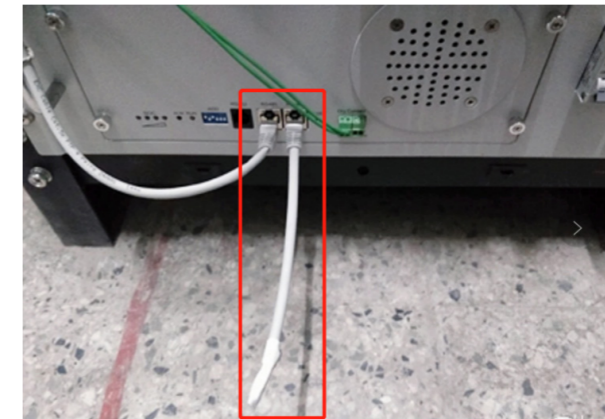


Fig. 4-3 How to handle the empty RS485 port for NPFC Series Batteries

6. Discharge with dummy load

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

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

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

Maintenance

Chapter Five/05

General

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.

NPFC series lithium batteries can be used at an altitude of less than 5000 meters. If the altitude more than 5000 meters, it will affect the battery performance and life due to the decrease of air pressure and temperature.

- The battery shall be recharged every three months if in long time storage
- Please clean the dust by the dust collector when dust is accumulated on vent
- 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.
- Carrying shall be handled gently, prevent from severe compact
- Prevent battery from splashing liquid
- Suggest inspect the tighten of output screw every two years

Troubleshooting and Solutions

Table 5-1 Troubleshooting and Solutions

Troubles	Troubleshooting	Solutions
Battery cannot discharge	Protection against under-voltage	Charge battery
	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
Battery cannot charge	System failure	Shutdown system and call maintenance service
	Battery is fully charged. Normal charge management	Do not need to solve
	Protection against over voltage	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
All LED indicators on	System failure	Shutdown system Call for maintenance service
	System failure	Shutdown system and call maintenance service
Communication failure	Fault of communication cable	Inspect communication cable
	Halt of System communication management	Press RESET button
	System failure	Shutdown system Call for maintenance service

Different flash status of LED indicators represents corresponding running status or alarms. Detailed information is shown Annex 1.

Note: The improvement of product and technology, and the possible of battery specification and appearance changes, Narada hold the right of final explanation!

Annex 1-Instructions for LED Flash

Annex Table 1.1 – SOC LED Indicators Description

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

Note: ☀ mean light on, ○ mean light off

Annex Table 1.2 – RUN Indicators Description

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

Annex Table 1.3 – ALM Indicators Description

Flash Status	Alarm Information of Battery
Extinguish	Minor Alarm(Various Alarm Status)
Flash 2	Fail(Various fail)
Flash 3	Major Alarm(Various protection status)
Extinguish	Normal, no alarm

Annex Table 1.4 – Flash Instruction of LED Indicators

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

Annex 2 – Instructions for ADD Dip Switch

ADD Dip Switch is applicable to modules connected in parallel. ADD consists of four binary bits

Annex Table 2.1 – Instruction for Addresses of Communication

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

Annex Table 2.2 – Instruction of ADD for Parallel Communication

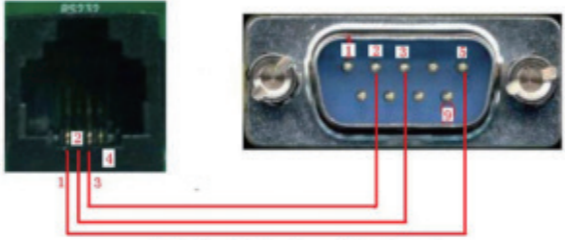


Note: Counting of ADD must begin from 0001, without interruption, or parallel communication cannot be available

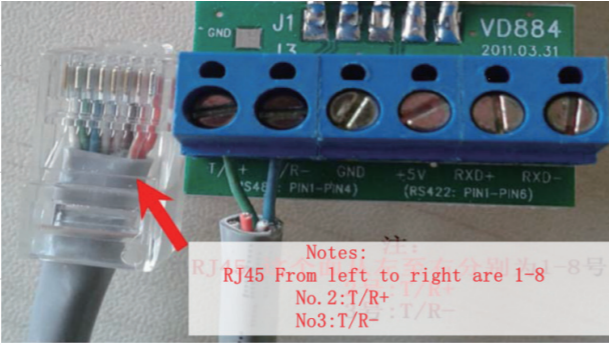
Annex 3 – Communication Protocol for RS232 and RS485

There is one RS232 port in front panel for software upgrade, and one RS485 port in front panel for communication between battery and PC, also for communication between battery modules connected in parallel.

Annex Table 3.1 – RJ11 Pins Assignment (RS232)

RJ11 Pins	Definition	Sketch
1	GND	 <p>2 RXD Receive data - From battery to computer 3 TXD Deliver data - From computer to battery 5 GND – Signal ground</p>
2	Pack receipt, computer delivery	
3	Pack delivery, computer receipt	
4	No connection	

Annex Table 3.2 – RJ45 Pins Assignment (RS485)

RJ45 Pins	Definition	Sketch
1	GND	 <p>Notes: RJ45 From left to right are 1-8 No. 2:T/R+ No3:T/R-</p>
2	RS485_A	
3	RS485_B	
4,5,6,7,8	No connection	

Annex 4 – LCD Menu Instruction

Press “MENU” to enter the following interface
Welcome
Battery manage system

Press “MENU” next
Press “MENU” to enter the following interface
Battery parameters query
Battery status
Battery parameter settings
Version Information

The “Battery Parameters” subdirectory

- Voltage: xxxx V
- Current: xxxx A (charge:+, discharge:-)

The “Battery Temperature” Subdirectory

- Temperature01:xx°C
- Temperature02:xx°C
- Temperature03:xx°C
- Temperature04:xx°C
- PCB Temperature: xx°C
- Environment Temperature: xx°C

The “Cell Voltages” Subdirectory

- Cell01: xxxx mV
- Cell02: xxxx mV
- Cell03: xxxx mV
- Cell04: xxxx mV
- Cell05: xxxx mV
- Cell06: xxxx mV
- Cell07: xxxx mV
- Cell08: xxxx mV
- Cell09: xxxx mV
- Cell10: xxxx mV
- Cell11: xxxx mV
- Cell12: xxxx mV
- Cell13: xxxx mV
- Cell14: xxxx mV
- Cell15: xxxx mV
- Cell16: xxxx mV
- SOC: xxxx%
- Nominal Capacity: xxxx Ah

The “Battery parameter settings” Subdirectory Non-manufacturers cannot enter
10 NPFC series LiFePO₄ Battery System for Telecommunication Operation manual V1.0

The “Version Information” Subdirectory

- “BMS version” Subdirectory
- BMS software version
- BMS hardware version

The ‘Battery Status’ Subdirectory

- Status: IDLE/CHARGE/DISCHARGE
- “Alarm status” Subdirectory
- Overvoltage alarm YES/NO
- Under voltage alarm YES/NO
- Over temperature YES/NO
- Under voltage alarm YES/NO
- Under capacity alarm YES/NO
- Difference voltage YES/NO
- Overcurrent YES/NO
- Charger Reverse alarm YES/NO
- “Protection status” Subdirectory
- Overvoltage protect YES/NO
- Under voltage protect YES/NO
- Over temperature protect YES/NO
- Under temperature protect YES/NO
- Over current protect YES/NO
- Short current protect YES/NO
- “Fail alarm” Subdirectory
- Sampling line: OK/ERROR
- Charge MOSFET: OK/ERROR
- Discharge MOSFET: OK/ERROR
- Sampling chip: OK/ERROR
- Short current times: xxxx
- Temperature protect times: xxxx
- Over protect times: xxxx
- Over current times: xxxx
- Under voltage times: xxxx

- The “LCD version” Subdirectory
- LCD software version:
- LCD hardware version:

After-sale Services

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