Narada LITHIUM IRON PHOSPHATE BATTERY

FEN4850

(Outdoor Battery for Telecom-5G)

INSTALLATION & OPERATIONS MANUAL

Version 3.1

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Safety and Warning

The FEN4850 - IP65 battery system installation, operation and maintenance should follow the important recommendations in this manual.

- The equipment shall be installed by professionally trained staff.
- Battery maintenance should be carried out by experienced professionals and a be aware of the preventive measures to avoid the potential dangers of mis-handling the battery.
- Note: Be careful of the risks of electric shock for large currents in case of battery short circuit. Pay attention to the following points during operation:
  - Remove watches, rings, or other metal objects from body
  - Use insulated tools
  - Do not place tools or metal objects on the battery
  - Do not connect direct access of the battery system to the main grid power outlet (AC)
- Please check that the shipping box is not damaged. If the battery appears damaged, please notify the supplier immediately.
- Do not put the battery system into a fire, do not use or store the battery near high temperature sources.
- Do not use liquid or other cleaning objects placed onto the battery system.
- Do not open or cut the battery, do not strike, throw or step on the battery.
- Use the special communication cable between the battery module and power plant to charge battery. Order the cables through MPINarada. (see annex 3)
- Be sure to follow the charge and discharge parameter settings in this manual.
- The terminals of the battery are live voltage, even when grid power removed or interrupted. Avoid electric shock or short circuit when operating the battery in this condition (Grid Power off).
- If you find leaking liquid or white powder residue on product, prohibit operation. Disconnect Immediately and contact vendor support.

Please be aware of the following.

				
Handle with Care	Read Manual Carefully	Warning	Electrical Danger	Wear Eye Safety PPE
				
Short Circuit Danger	UL Canada / USA Listed	Do Not Expose to Fire	Recycle used Batteries and Packaging	Do Not Dispose of Batteries in Garbage. Send for Recycling

Product Introduction

Product Features

The FEN4850 Lithium Iron Phosphate (LFP) battery is a safe and reliable for micro-station backup power system, which can meet the backup power supply requirements of 5G micro stations, network equipment, communication equipment, and transmission equipment. It can be mounted on a pole or the side of a cabinet and building structure.

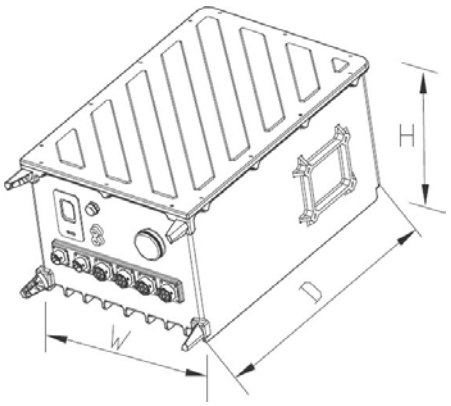
This battery module is able to adapt to a variety of 48V telecom power systems. It has many characteristics, such as flexible configuration, modular design, IP65 waterproof, outdoor pole installation, remote monitoring capability and multi-group system parallel communication function, internal heating system for low temperature use, intelligent battery management technology with protection functions such as voltage, current and temperature, high energy density, long life, high charge and discharge rate, etc.

Main Applications

- Outdoor distribution system
- Telecom Micro-Station Radio Towers
- Powering Equipment Cabinets to free up space
- Powering small cells Network equipment,
- Communication equipment,
- Transmission Equipment

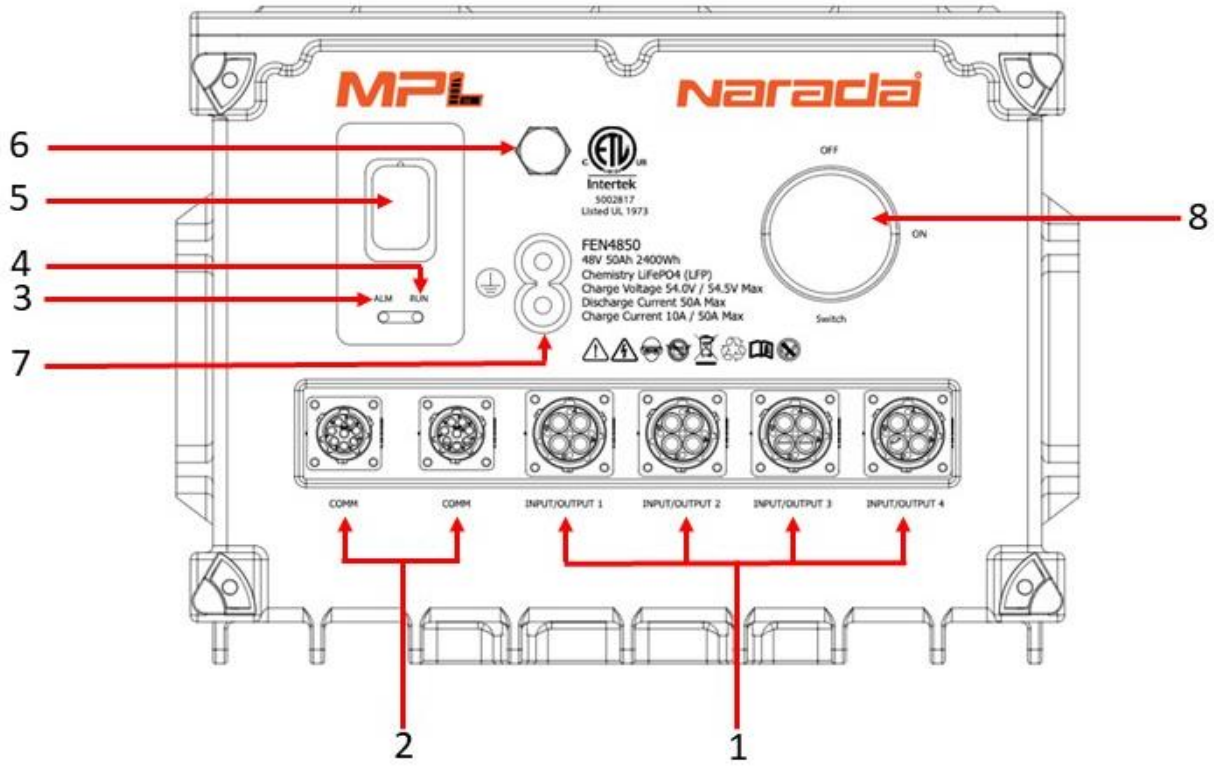
Dimensions

Structural Drawing of FEN4850 Batteries



Battery Model	Weight (Kg))	Dimensions (mm))			Battery Output Terminal Φ
		Width	Height	Depth	
FFEN4850	34	310	222	448	Plug Type

Layout of Battery Panel



Layout of Front Panel for FEN4850 Batteries
(Received product may not have all parts above, this instruction is as an example)

Layout of the Front Panel

No.	Marks	Function	Detailed Information
1	Input/ Output	Power Terminals	FEN4850 battery has 4 power input and output ports, each port can input and output power independently, use part no. FEN4850 CBLDCPow Cable. See Annex 3.1
2	COMM	Communication	Use the Part Number FEN4850 CBLComPC to connect to the BMS Parameters and view battery details and data downloads. See Annex 3.1
3	ALM	Indicator for Alarms	There is one red LED light in front panel indicating that battery is in alarm status. Detailed information is shown in Annexed Table 1.2.
4	RUN	Indicator for Running Status	There is one green LED light in front panel indicating running status. Detailed information is shown in Annexed Table 1.1.
6	Safety valve	Pressure Relief Valve	In case of safety problems, the pressure relief valve can release the pressure inside the battery to ensure the safety of the battery. Replace Battery if the relief valve has opened.
7	GND	Battery Ground	Connect a flexible green sheath ground cable. The ground wire should be equal to or greater than the battery return wires.
8	Power Switch	Key Switch	The FEN4850 battery can be turned on and off by using the key switch. The key can be pulled out and inserted in either the on and off state. NOTE: 2 keys are provided. If additional keys are required, they can be ordered from MPINarada
5	Wi-Fi	Wi-Fi Antenna	NOTE: This feature is currently disabled for security purposes.

Working Principle

The FEN4850 battery system mainly includes the Lithium battery packs, battery protection, cell balancing unit, monitoring module and charge-discharge management module.

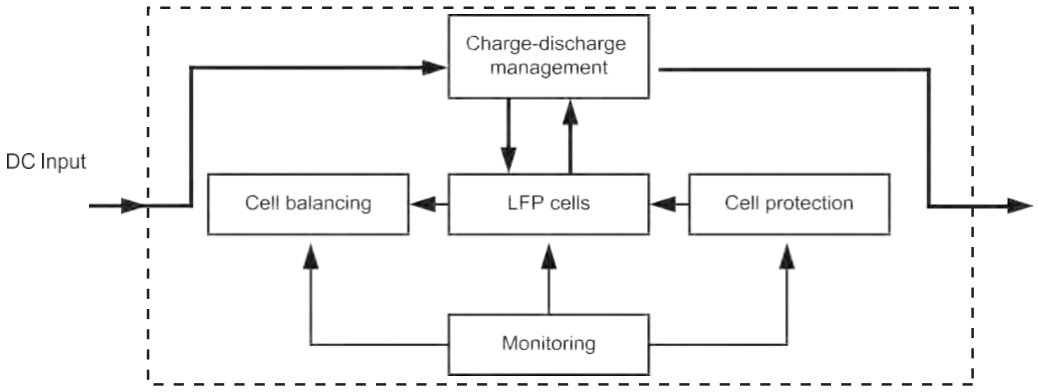


Fig. 1-4 Schematic Diagram

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)

FEN4850 Battery Working Principle

DC power input is divided into two circuits. One circuit directly supplies the load, another circuit charges the lithium battery. When grid power is on, the system supplies the loads and charges the lithium batteries; When there is a grid power failure, the lithium cells inside the battery supplies DC power to the load, to ensure uninterrupted power supply to equipment.

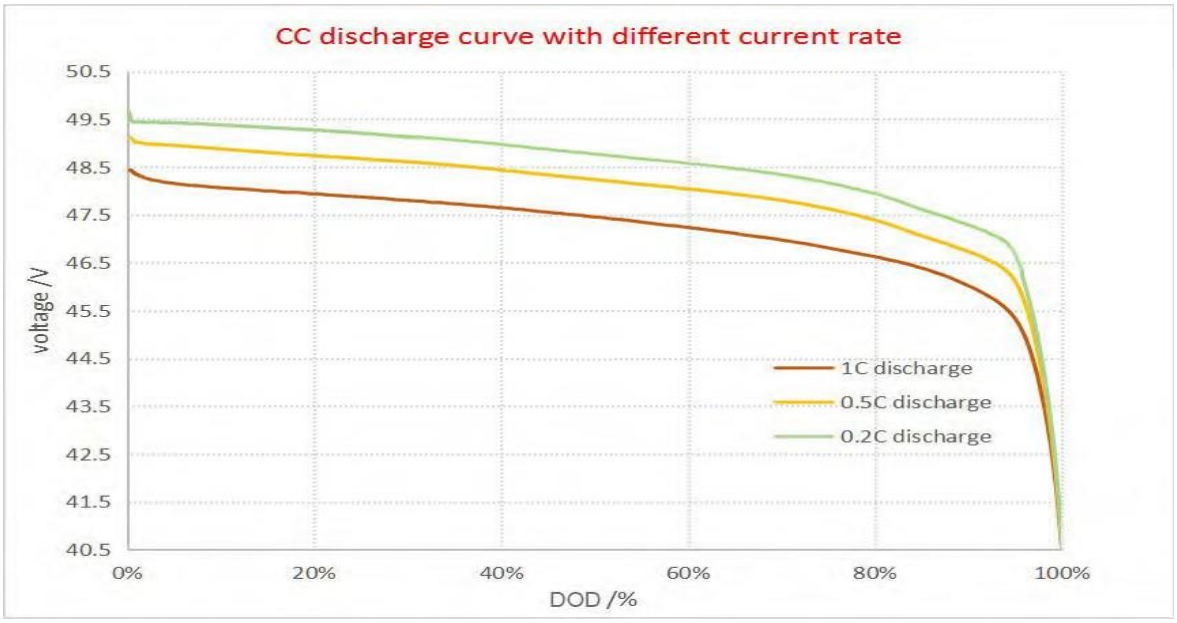
Battery Management System (BMS

- Battery modules can be monitored remotely by operations staff in the control center. FEN4850 batteries are compatible with the requirements of modern communications technology.
- Excellent electromagnetic compatibility. BMS used for the battery modules of FEN4850 battery complies with the outdoor power plants during operation, with no interference with each other.
- The BMS provides protections against overcharge, over-discharge, over-temperature, over current, short circuit, etc., to assure reliable safety and operation life.
- The BMS provides high efficiency for cell balancing and prolonging system operate life.
- Configuration flexibility, supports expansion of up to 4- FEN4850 modules in parallel.

Technical Characteristic

Discharge Performance

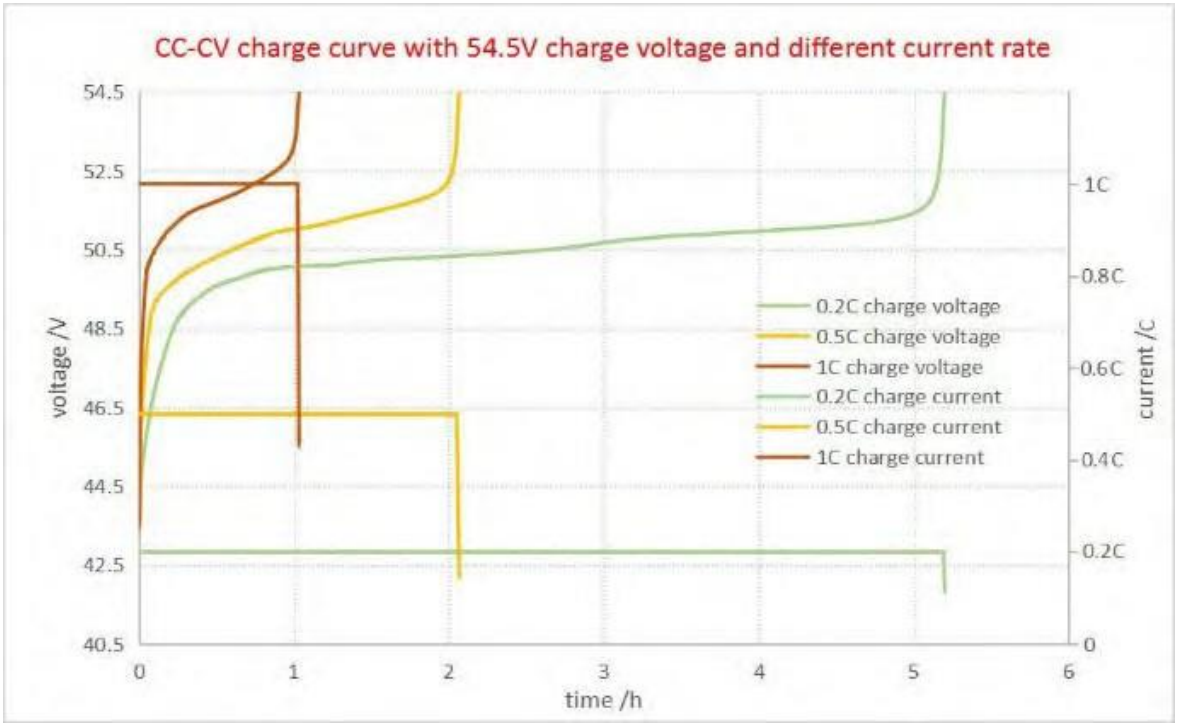
CC Discharge to 40.5V at different constant current rate



Discharge curve at different constant current of FEN4850 battery

Charge Performance

CC-CV Charge with different constant current rate and 54 plus or minus .5V constant voltage



Charge curve at different current limitation of FEN4850 battery

Operation

Parameter Settings

Parameter Settings of Power Plant for FEN4850 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	0.5~1.0C
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	Low Voltage Disconnect (LVD)	V	40.5
11	Battery Low Voltage Disconnect (BLVD)	V	43.2
12	Temperature compensation for float charge	-mV/°C	NA
13	Temperature compensation for equalization charge	-mV/°C	NA

Note:

Equalization Charge and Temperature Compensation is not required for Lithium Iron Phosphate (LFP) batteries.

Rectifier parameter shall be set based on number of batteries in parallel.
If the batteries connected, by more than 2 in parallel, the maximum charge current recommended is 0.5C.

Operating Conditions

Table 3-2 Requirements for Operation Environment

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

Storage

- Storage temperature range: 0°C to 40°C.
- Storage of battery should be at 50%-80% SOC.
- Recharge battery after storage and before using, to recover capacity loss from self-discharge during the storage period and transport.
- Battery should be recharged during long-term storage, to recover capacity loss from self-discharge based on the following recommendations

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 3. Charge with 0.2C per module for 4 hours
30°C-40°C	Every 3 months	

- Storing the battery at over 40°C or under 0°C temperatures will reduce battery life.
- Store the battery in a dry, low temperature, well ventilated location.
- Battery performance degrades after long-term storage, shorten the storage shelf time as much as possible.
- The battery should be placed strictly in the following positions:

Normal Position

Not Recommended

Installation Instructions

Unboxing & Inspection:

- Review this manual before attempting to un-box the battery and installation.
- Inspect the package before un-boxing, if any damage with appearance, contact the supplier as soon as possible.
- This device shall be installed and operated by industry professionals familiar with telecom standards for handling power equipment.

Preparation for Installation:

- Batteries shall not be placed near heat sources.
- Batteries shall be installed in place with good ventilation.
- Batteries shall be placed in a clean area for preparation.
- Battery is heavy, do not place on top of other equipment such as test sets and cables.
- Wear Safety Glasses
- Following are the tools required for installation:




Installation of Battery

Installing the Handle and Corner Guard

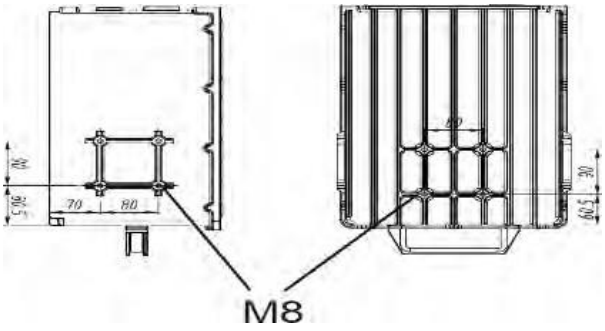
Install the handle and corner protector on the battery with the mounting bolt provided. The corner guards are to facilitate the transportation of the battery and protect the battery terminals from being damaged when the battery in the unfortunate event it is dropped. Dropping the battery without the corner guards could cause a short circuit, and other dangers.

Installation of Mounting Bracket

Preparing the FEN48590 Battery for Mounting the Bracket.
Contact MPINarada for assistance to purchase the Pole / Wall Bracket.

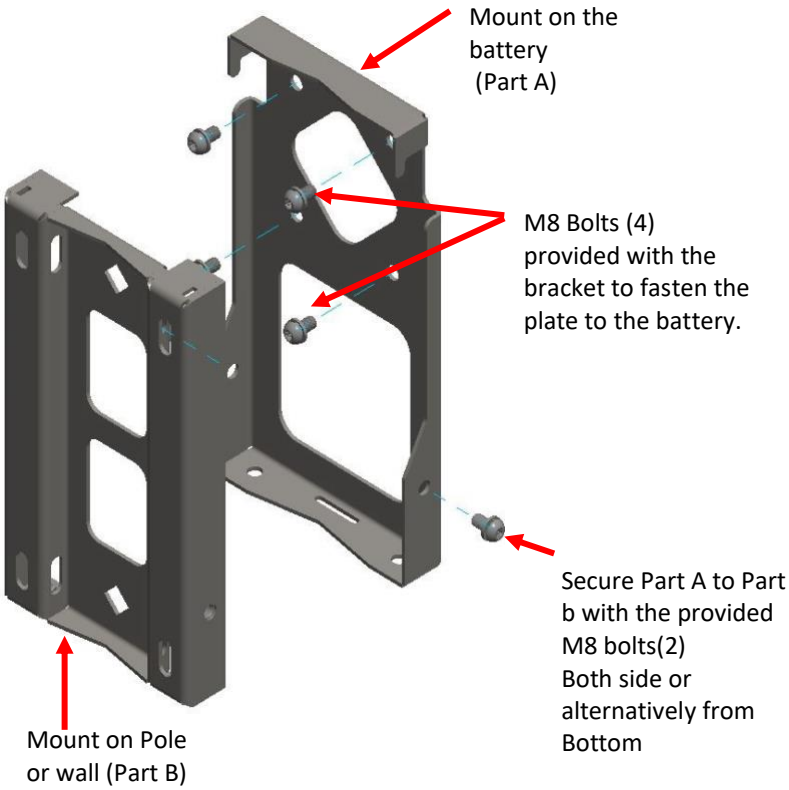
Battery can be mounted as shown below

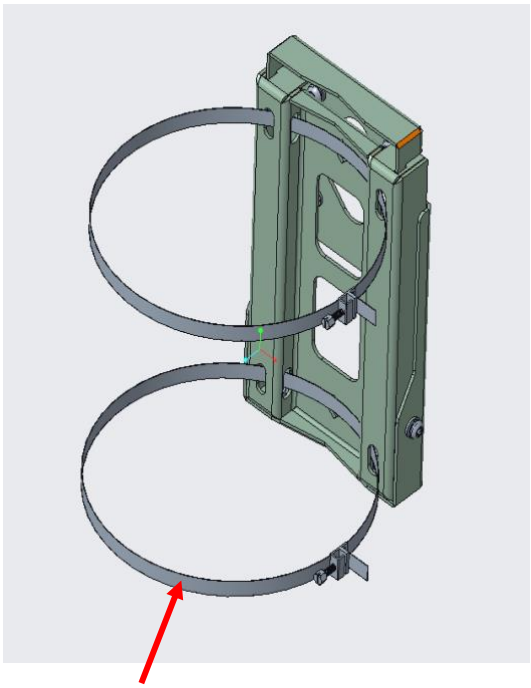
Mounting Bracket Battery Support



Mounting holes: (Depth: 10mm)

Pole / Wall Mount Bracket





Installing The FEN4850 on Pole or Wall

Install and fix the mounting bracket (Part A) to the battery using supplied M8 Bolts. Ensure they are tight. Install and fix the Pole / Wall plate (Part B) to the selected structure. Installation company to use appropriate fasteners for type of structure. Once the Brackets (Part A and B) are installed, hook Part A with Battery onto the Part B Mount installed on structure. Once installed and securely mated, secure Parts A and B brackets with the provided M8 bolts (2) at the side of the Battery (Part A) both sides. Then add an appropriately sized bolt or worm drive strap to fir the circumference of the pole. Recommend a ½" to ¾" wide bolt or worm drive clamp.
The strap needs to be fed through the holes on the bracket (as shown) and tightened around the pole.

Note: That this strap is user supplied based on circumference of pole that the FEN4850 will be mounted on.

NOTE:

- Due to the heavy weight of the battery, safety protection should be taken during installation to avoid personal injury if the battery were to accidentally fall. Consider having two people to install the FEN4850 battery properly.
- The installation with the brackets must be secured tightly, and the battery ports must face the ground.
- Although the FEN4850 battery has an IP65 protection level and has a lightning protection configuration, it is still necessary to take protective measures such as lightning protection for the installation pole. If using a metallic pole, it should be sufficiently grounded.
- The FEN4850 battery can be installed in two ways: back mounting and side mounting.

Ground Connection

- Connect ground 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. The FEN4850 battery has 2 grounding bolts (M6).

Communications Connection

- Connect the battery to the device/ PC through the communications cable ordered. (See Annex 3)
- FEN4850-CBLComPC or FEN4850-CBLComRec)
- If there is more than one battery module in operation, parallel communication can be available using RS485 equipped cable. (See Annex 3 for this cable FEN4850-CBLMod).
- Communication protocols for RS485 are shown in Annex 3.

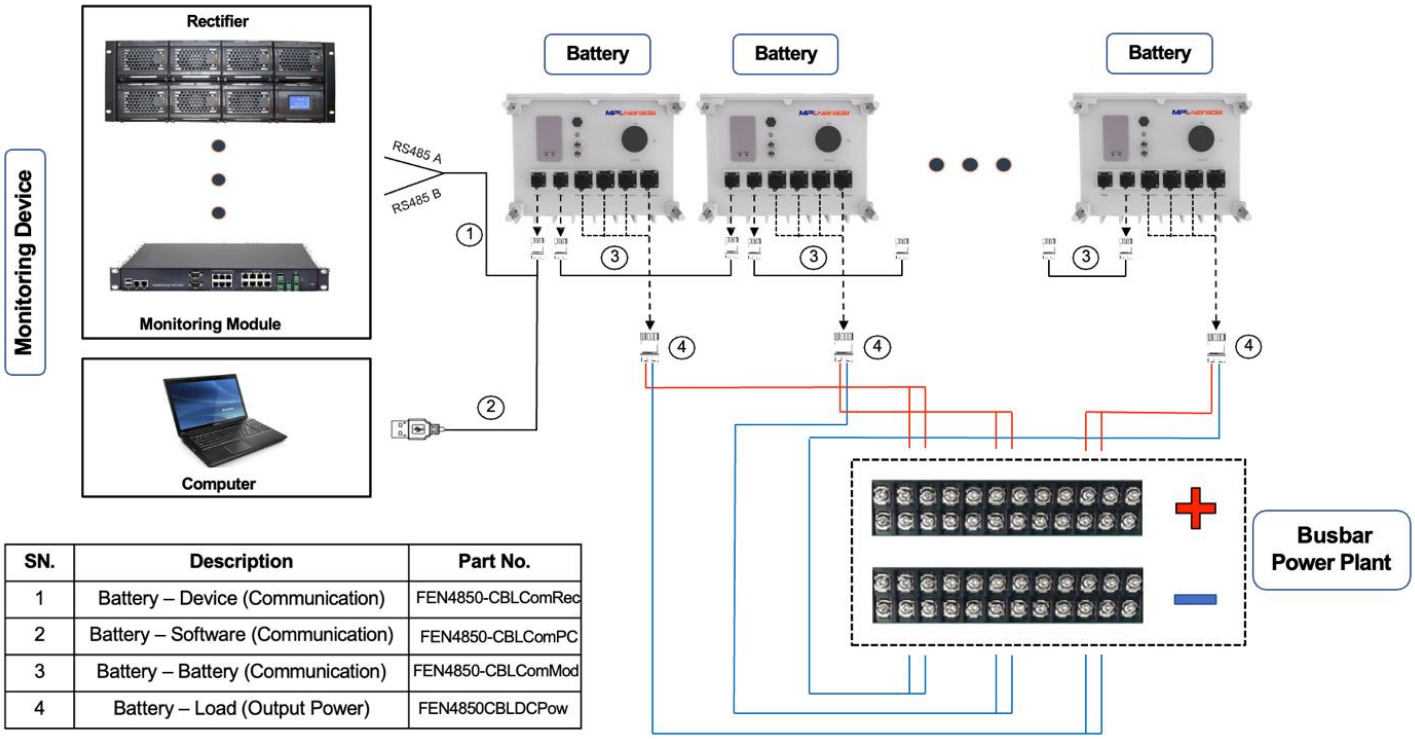
Battery On / Output Connection

- Connect the battery and the device to busbar through the power cable ordered (see Annex 3). See also the diagram on Page 14.
- The red of the power cable is the positive, and the black is the negative. (See Annex 3) Note that the 2 reds are terminated
- together and the 2 blacks are terminated together on their respective buss.
- The 2- 10AWG wires are paralleled, (2 reds together and 2 blacks together) to arrive at almost a 6AWG equivalent. This is enough for 45amp discharge and charge.
- If multiple battery modules will be connected in parallel, please take note of the following:
- The battery modules connected cannot be more than 4 in parallel. See diagram on page 13.
- Connect '+' of battery output of each battery module with positive copper bar of power plant, and '-' with
- negative copper busbar of power plant.
- Length of cable between battery module and the power plant shall be less than 2.0m. To make sure similar
- voltage drop of cable for each battery. The length of all positive and negative cables should be the same.

Power On for Battery Module

- When installation is completed, the battery module is in dormant state. Turn on the Key Switch to wake up battery.
- Battery will go into normal running status, and discharge/charge will be available.
- Parameter settings for lithium battery modules in power plant are shown in Table 3-1.
- After the battery is turned on, the key should be removed close the key switch protective cover to ensure that the IP protection level of the battery is IP65. Keep the key properly stored in a safe place to avoid losing the key. The battery cannot be turned off and on without the key. Note that 2 keys are provided when shipped.

Typical FEN4850 Installation to Power Plant



SN.	Description	Part No.
1	Battery – Device (Communication)	FEN4850-CBLComRec
2	Battery – Software (Communication)	FEN4850-CBLComPC
3	Battery – Battery (Communication)	FEN4850-CBLComMod
4	Battery – Load (Output Power)	FEN4850CBLDCPow

Maintenance

General

- Proper maintenance will prolong the life of the FEN4850 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 the application and reliability needs of their maintenance procedures used, other than those recommended in this document.
- Battery maintenance should be performed by personnel knowledgeable and experienced with working on batteries and all safety precautions.
- FEN4850 batteries can be used at up to an altitude of 5000 meters. If the altitude is more than 5000 meters, it will affect
- the battery performance and life due to the decrease of air pressure and temperature.
- Use clean and dry cloth/fabric to clean up the cabinet, if need further cleaning is needed, only use a neutral cleanser. DO NOT USE Alcohol or Ammonia products to clean the cabinet.
- when carrying the FEN4850, it should be handled gently to prevent any damage from severe impact or dropping.
- Avoid splashing any corrosive liquids onto the battery when working near the battery.
- Inspect/tighten the mounting bracket and connectors every year.

Troubleshooting

Issue	Troubleshooting	Solutions
Battery Cannot Discharge	Protection against under-voltage	Charge battery
	Protection against over temperature or under temperature (Cell temperature is lower than -30°C or higher than 70°C)	Regulate cell temperature in the range of -20°C to 65°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	Service
Battery Cannot Charge	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 -0°C or higher than 65°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	Inspect communication cable
	Halt of System communication management	Restart Key Switch
	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.

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Annex 1 - Instructions for LED Flash

Annex Table 1.1 – RUN Indicators Description

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

Annex Table 1.2 – ALM Indicators Description

Flash Status	Alarm Information of Battery - RED
No Light	Normal, no alarm
Flash 2	Minor Alarm
Flash 3	Major Alarm
Continuous	Fail

Annex Table 1.3 – Flash Instruction of LED Indicators

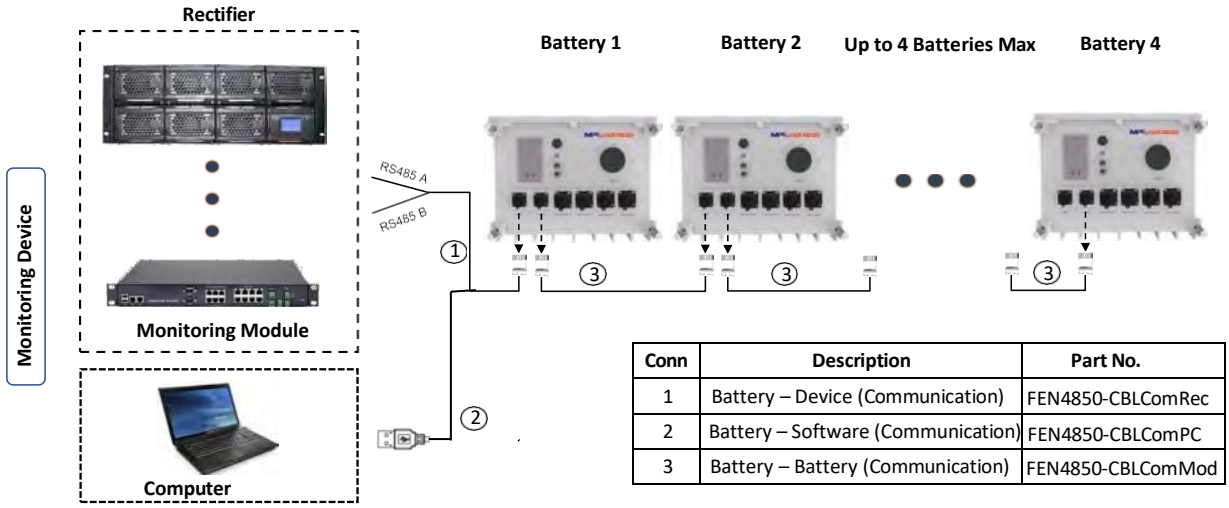
Flash Status	ON	OFF
Flash 1	0.25s	3.75s
Flash 2	0.5s	0.5s
Flash 3	0.5s	1.5s

Annex 2 Instruction for Parallel Communication Connections

- FEN4850 battery packs are automatically assigned addresses through Modbus for parallel communication, and RS485 interface (FEN4850-CBLComPC) realizes communication with PC or other intelligent terminals with the FEN4850- CBLComRec cable. The bus interface of multiple batteries in parallel is shown in the figure below.

- Parallel communication supports up to 4 batteries maximum.

Typical FEN4850 Installation for Monitoring



Conn	Description	Part No.
1	Battery – Device (Communication)	FEN4850-CBLComRec
2	Battery – Software (Communication)	FEN4850-CBLComPC
3	Battery – Battery (Communication)	FEN4850-CBLComMod

Instructions for Parallel Communication of FEN4850 battery

- The pins of power port and communication port of FEN4850 battery are marked.
- See Annex 3 for the detailed information the cables.
- To connect the first battery to the laptop for on-site monitoring and access to BMS Data, use FEN4850-CBLComPC.
- If multiple FEN4850 batteries are to be on same site/ location and they are to be monitored remotely, then the batteries should be interconnected with the Communications Cable FEN4850-CBLComMod is required.
- One cable for each additional FEN4850. The first battery is then connected to the Rectifier Controller using FEN4850-CBLComRec.
- The MODBUS Table is available from MPINarada Support for programing the user's monitoring software.

Annex 3 – Communications and Power Cables

The Power and Communications Cables are not provided in the shipment of the FEN4850. and need to be ordered separately. Please verify your requirement with your Sales contact.

The pins of power port and the communication cable ports of FEN4850 battery are marked, and the Port has anti-mis-connection settings. When the corresponding pin is wrong, the connection line and terminal cannot be connected.

Annex Table 3.1 REQUIRED Cables

Communication Port and Cable from Laptop and FEN4850

Part Number: FEN4850-CBLComPC

The Communications to laptop cable is to set up the Battery functions and view the BMS Parameters.

Power Port and Cable

Part Number: FEN4850-CBLDCPow

The Power Cable is needed to charge and discharge battery. It should be ordered with the FEN4850 Battery. The 2 red leads are terminated together onto the Positive Bus and the 2 black leads are terminated together on the Negative bus. Customer to add termination connectors to suit their installation and buss connection.

Annex Table 3.2 OPTIONAL Cables

(depending on customer design and requirements)

Communications Cable from FEN4850 to Rectifier Ports
Part Number: FEN4850 CBLComRec

If the customer plans to monitor remotely with their own monitoring software through the rectifier controller they will need this communications cable.

Customer to add termination connectors to suit their installation and buss connection

Communication Port and Cable
Part Number: FEN4850-CBLComMod

Used when connecting 2 or more FEN4850 for monitoring, this cable is required, (no more than 4 in parallel) Need 1 cable for each battery. (See Annex 2 for layout)

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FEN4850 Anti-theft Option (Tilt sensor) Instructions

Overview

NOTE: The default state of the tilt sensor when the battery is shipped is <u>OFF</u>.

<u>Tilt Sensor - Anti-Theft Feature Description</u>

The tilt sensor is a sensitive vibration sensor that has been added to the battery. After the battery moves, the tilt sensor generates a signal and transmits it to the BMS. The BMS receives and analyzes whether the movement meets the conditions for locking the battery. If the condition is met, the battery will be locked, otherwise, the battery will work normally.

The following instructions are for activating the Anti-Theft Feature, if desired.

Caution:

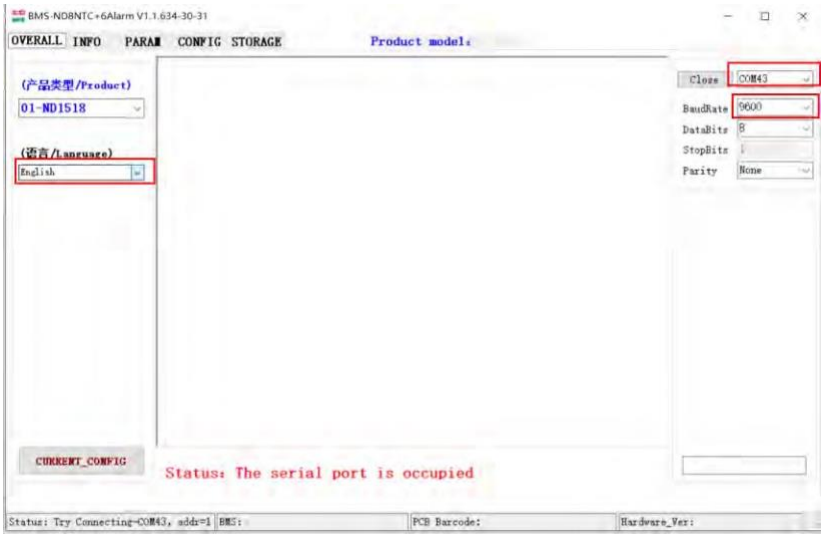
If this feature is to be activated, ensure that the FEN4850 is installed and secured in its final working position. Failure to secure the battery before activating the Anti-Theft, could trigger the sensor and lock the battery from charging or discharging.

To Turn On the Anti-theft function (tilt sensor)

The default state of the tilt sensor when the battery is shipped is off. If it is desired to turn on the tilt sensor, it will need to be set it through the battery BMS software.

(1) Turn the key to the off position, then connect the FEN4850 battery with Communication Port and Cable to Laptop.

(2) Turn on the key of battery, then open the software to communicate the battery.



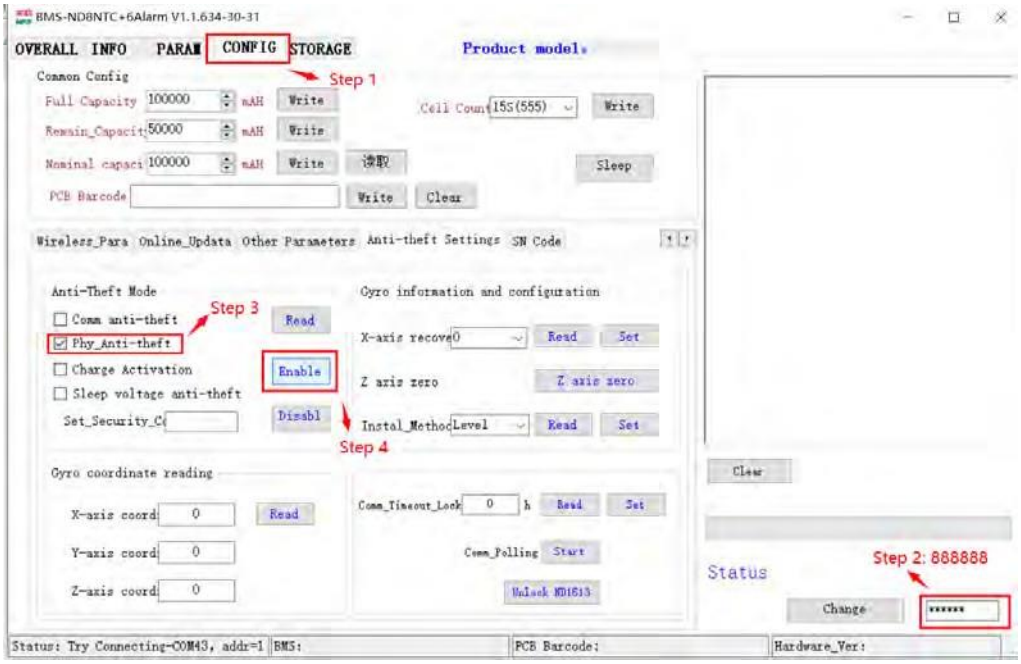
Note: Please choose language and “COM” port that match the USB.

(3) Select the "CONFIG" page (Step 1) of the software,

Step 2 - Enter the unlock password "888888" in the lower right corner,)

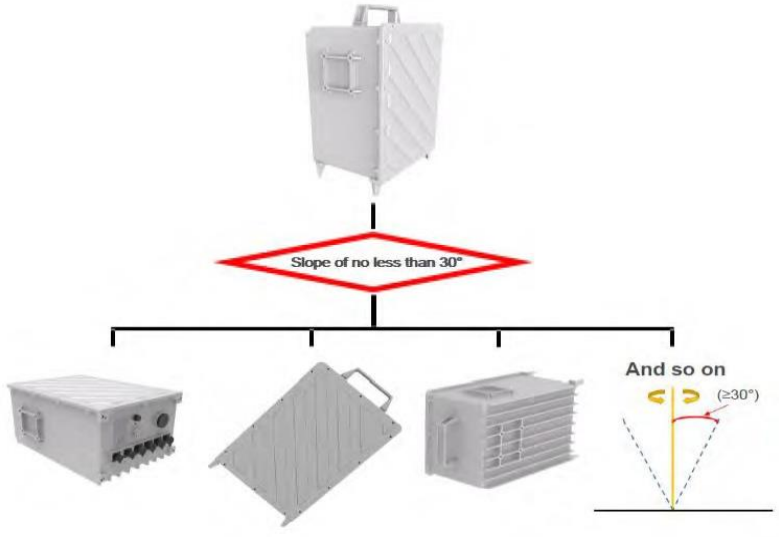
Step 3 - then click the "Anti-Theft Mode" Setting and ✓ Physical anti-theft,

Step 4 - then click the Enable button, the tilt sensor will be turned on, and the software will prompt that the physical anti-theft setting is successful.



Trigger (Lock) condition

When the battery's tilt angle moves more than 30°in the horizontal/vertical direction, the tilt sensor will generate a signal and send it to the BMS. After receiving this signal, the BMS will lock the battery. At this time, the battery can only be charged and cannot be discharged.

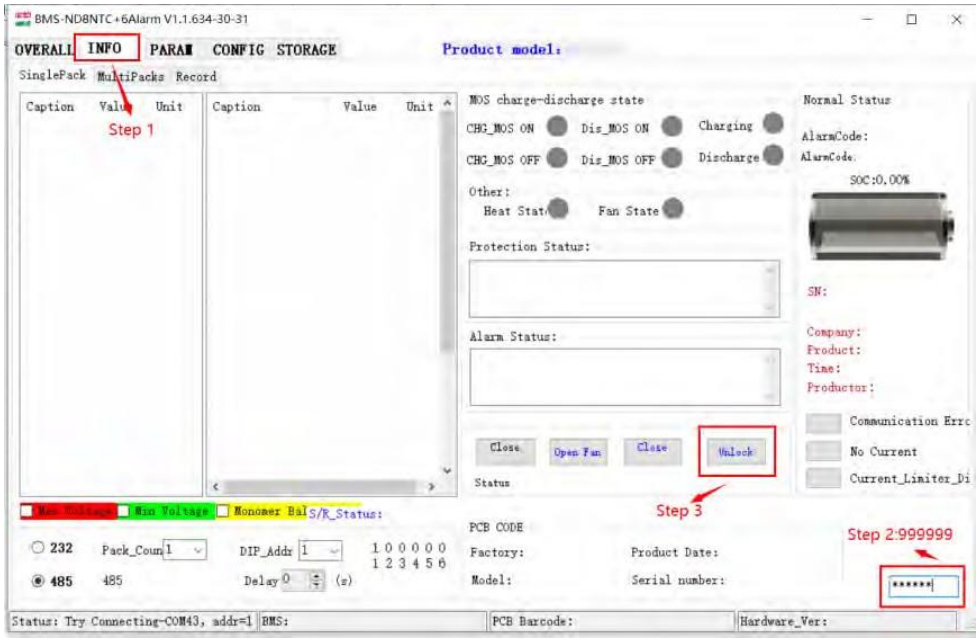


To Unlock the Anti-Theft Feature after it has been turned on.

Step 1 - Select the "info" page of the software,

Step 2 - enter the unlocking password "999999" in the lower right corner,

Step 3 - and then click "unlock" to complete the unlocking process.



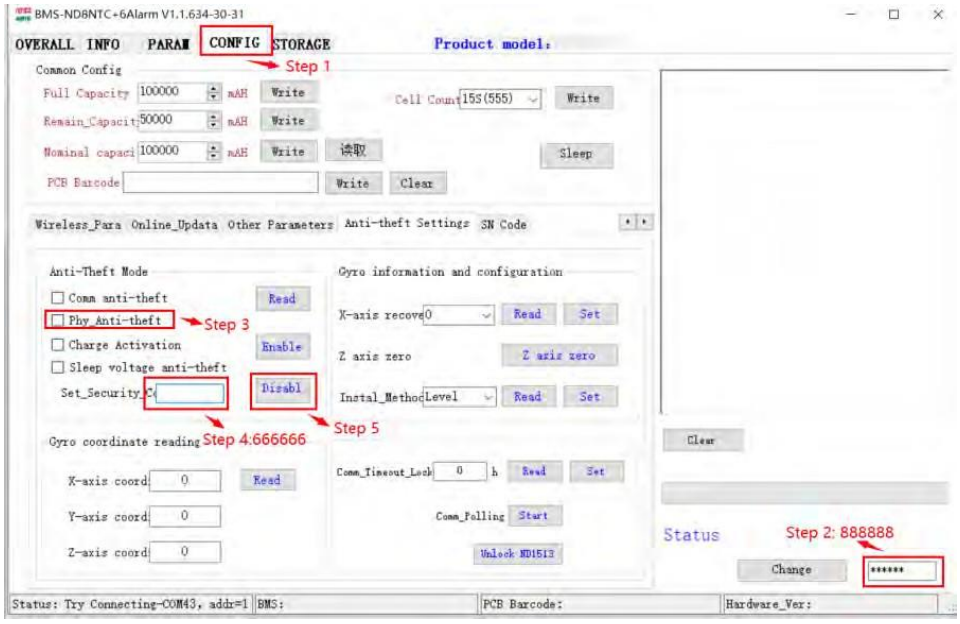
Step 1 - Select the "CONFIG" page of the software,

Step 2 - enter the unlock password "888888" in the lower right corner,

Step 3 - then click the "Anti-Theft Settings" item,

Step 4 - enter the password "666666" at "Set Security",

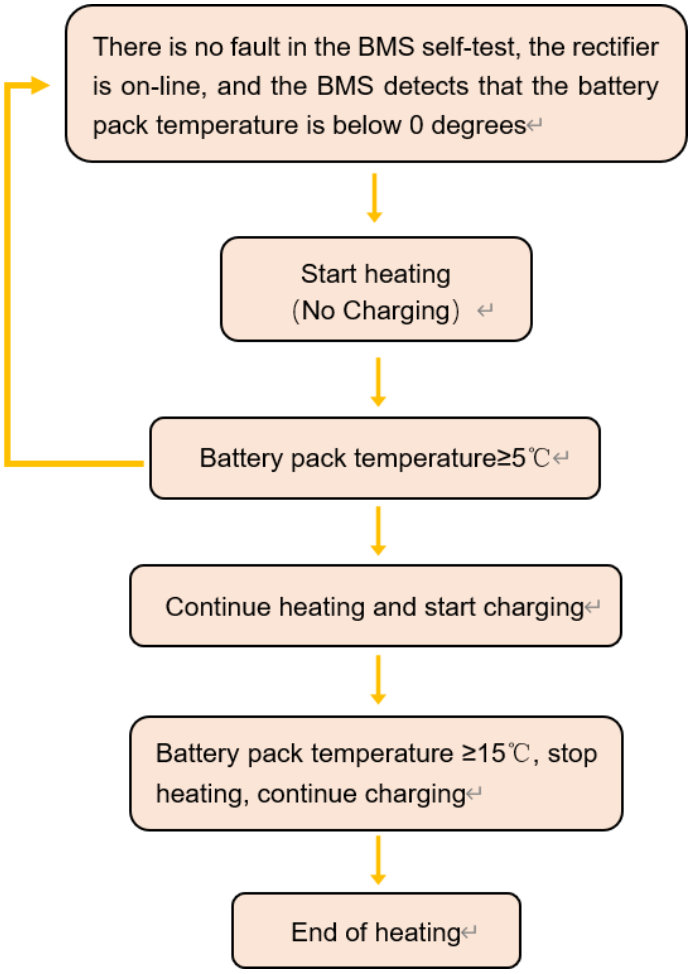
Step 5 - and then click the "Disable" button (Step 4) to complete the anti-theft function (Tilt sensor).



Note: If the anti-theft function is turned off when the battery is locked, the battery lock will still exist, and the battery needs to be unlocked with the key to return to normal.

Annex 5 – Heating Introduction

The FEN4850 battery has a low temperature heating function. When the ambient temperature is too low, the battery will automatically heat up.



Note:

1. The minimum temperature is greater than 15°C degrees to stop heating.

2. Stop heating when the minimum temperature is higher than 15°C, or the maximum cell temperature is greater than 30 degrees or at full power.

3. When the minimum temperature is higher than 15°C or the cell temperature difference is greater than 15°C, stop heating.

4. The normal rated power of the whole heating module is 230W.

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