Narada®

LITHIUM IRON PHOSPHATE BATTERY

NPFC/MPLhE Series

INSTALLATION, OPERATIONS and MAINTENANCE MANUAL

VERSION 1.0

Updated July 6, 2023, for LED Flash Status

(LiFePO$_4$ Battery Module for Telecom)

Contents

Operations Manual

Product Introduction

Narada MPL series of Lithium Iron Phosphate (LFP) 48V / 51.2V Batteries are a safe and reliable product for equipment site backup power systems, which can meet the reserve power supply requirements of network equipment, communication equipment, and transmission equipment. They are stackable in 19" / 23" for either 2 post racks, 4 post racks and cabinet configuration.

These battery modules can adapt to a variety of 48V / 51.2V telecom power systems. It has many characteristics, such as flexible configuration, modular design, remote monitoring capability and multi-group system parallel communication function, intelligent battery management technology with protection functions such as voltage, current and temperature, high energy density, long life, high charge, and discharge rate, etc.

MPL-LFP chemistry makes it one of the safest technologies, suitable for high and low-temperature operation and high discharge rates. These LFP batteries are ideal for telecom growth and as a replacement for VRLA.

Main Applications

- Telecom Micro Stations
- Radio and Cellular Towers
- Equipment Cabinets
- Network Equipment in Central Offices
- Transmission Equipment
- Variety of Communications equipment.

Features

- Simple installation and load/charge system integration.
- Advanced intelligent lithium battery management system (BMS) technology
- Configuration flexibility, and support for parallel connection.

Compliance

- UL1642, Standard for Lithium Batteries
- UL2054, Standard for Household and Commercial Batteries
- EN 61000-6-1:2007, Electromagnetic compatibility (EMC)
- EN 61000-6-3:2007+A1:2011, Electromagnetic compatibility (EMC)
- IEC 62133:2012, Battery Safety Testing
- UL1973
- UN 38.3

48NPFC100

48MPLhE100-16S

48NPFC200

DIMENSIONS

Model	V	Capacity (Ah)	Max Discharge (A)	Width		Depth		Height		Rack Units	Weight		Terminal Bolt
				mm	in	mm	in	mm	in		kg	lbs.	
48NPFC100	48	100	100	442	17.4	400	15.8	133.5	5.26	3U	38.5	84.9	M6
48MPLhE100-16S	51.2	100	100	442	17.4	440	17.3	133.5	5.26	3U	41.5	91.5	M6
48NPFC200	48	200	100	442	17.4	480	18.9	122	8.74	5U	71.5	157.6	M6

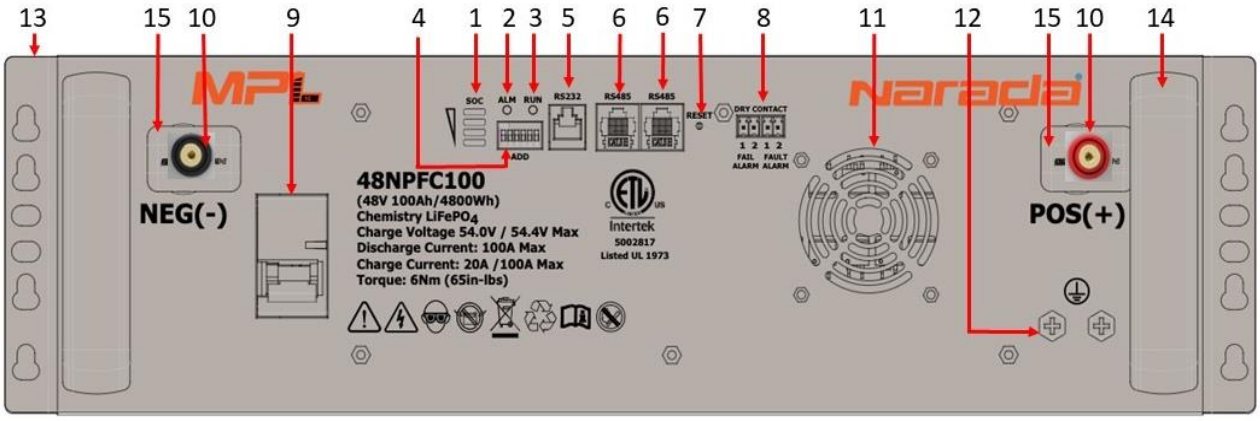
Terminal Bolt for

48NPFC100, 48MPLhE100-16 and NPFC200

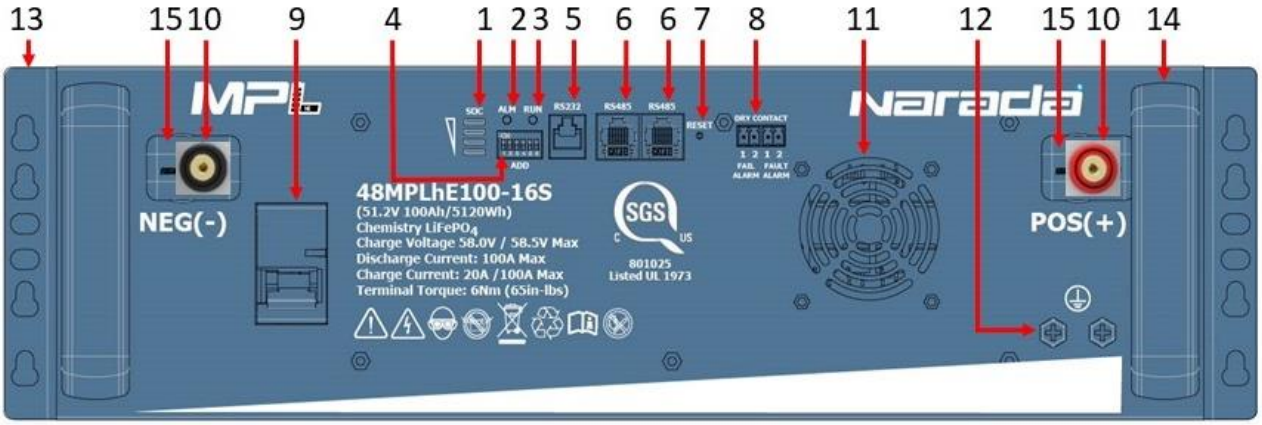
Torque for M6 = **6** Nm **or 65in**

Front Panel Layout

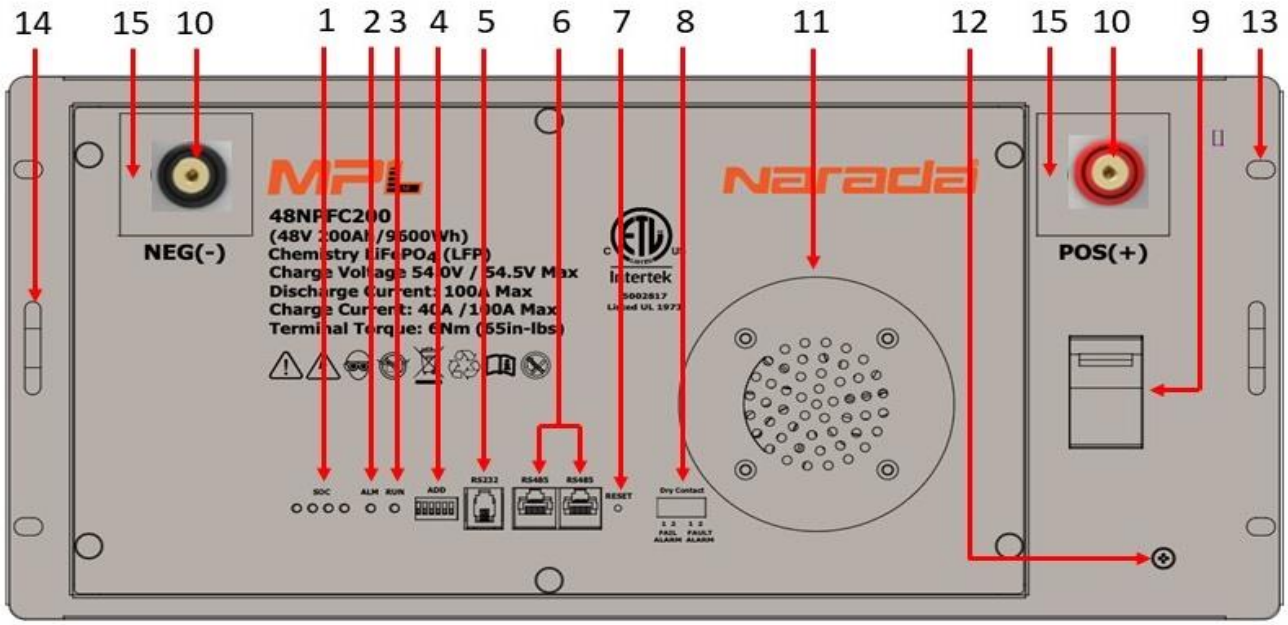
Front Panel Layout for 48NPFC100



Panel Layout for 48MPLhe100 Front Panel Layout for 48NPFC200



Front Panel Layout for 48NPFC200



Front Panel Layout Description

No	Battery Marking	Function	Description
1	SOC	Capacity Indicator	There are 4 green lights stacked and each one indicates 25% State of Charge. 4 lights = 100%
2	ALM	Alarm Indicator	There is one red LED on the Front Panel. If this light is lit, it indicates an alarm status. Detailed information is in Annex 1.2
3	RUN	Running Status	There is one Green LED on the Front Panel indicating running status. Detailed information is in Annex 1.2
4	ADD	Com Address	These are DIP Switch settings. For a single battery installation, the DIP Switch Setting no 1 is in the raised position. If additional batteries are installed in parallel, each one has its own setting to identify it. See the ADD Com Address table below.
5	RS232	Com Port	This com port is used to upload upgrades, changes to the Parameter settings, Alarm, battery running status etc. Customer will not need to use this port without MPINarada support.
6	RS485	Com Ports	These 2 comports are used for Monitoring the BMS system. The one port, on the first battery is the direct connect to the laptop or to Power controller if remote monitoring is set up. The second port is used when there is more than one battery in parallel and the port is connected to the next battery using its RS485 port. Please see pictures later in this manual
7	RESET	Reset Slot	The reset is used when the battery is behaving abnormally or to force it into sleep mode. Use a small Pin type device to put it into the opening and press the reset.
8	DRY CONTACT	Wiring Connection	These connections are used for basic remote alarms. The “Failure Alarm” can be used to capture and send a notification for Battery Fail, charge / discharge MOS fail, cell voltage under 0.5V, NTC disconnect etc. The “Fault Alarm” can be used to capture output short circuit, charge/ discharge over temperature and Charge Discharge over current.
9	Breaker	Power Breaker On/ Off	Power ON (Switch in up position) means the battery is now functioning and power is present on the Positive and Negative terminals. Power OFF means there is no power present on the Positive and Negative Terminals. The BMS will still be active, and the SOC lights will remain on. The run light should be off.
10	NEG – POS +	Power Connection	The power connections are used to connect the battery to the Positive / Negative Buss of the power plant. Always ensure the proper polarity is maintained. Use the proper PPE and insulated tools when making these connections. The M6 bolts are provided with battery.
11	FAN	Cooling	This fan operates when required to cool as required. If an optimal temperature of 25C (or lower) is maintained, the fan will experience minimal operation. If the fan fails, contact MPINarada to have the battery replaced. It is not field serviceable.
12	GND	Grounding	The battery must be grounded to earth ground for safety.
13	Mounting Bracket	Mount to Rack / Cabinet	The battery will come with the 19” bracket pre-installed. The 23” battery bracket comes with the battery as well and it needed, needs to be installed by removing the 19” bracket. For the 48NPFC200 there is an addition bracket available and must be ordered and shipped separately
14	Handles	Handling in Rack	Handles are used for sliding the battery in and out of the rack. They should not be used for transporting the battery from one location to another.
15	Battery Terminal Caps	Power Terminal Covers	Black Terminal Cover for Negative Power Post Red Terminal Cover for Positive Power Post

STORAGE

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	

- Storage of Battery should be 50% - 80% SOC
- Storage Temp range is 0°C to 40°C
- Storing the battery in temperatures over 40°C or under 0°C will reduce battery life
- Store the batteries in dry and low temperature and well-ventilated location
- Battery performance degradation after long-term storage, keep shelf time as short as possible before installation
- Recharge the battery after storage and before use, to recover the 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 above recommendations

PROCESS TO CHARGE BATTERIES IN STORAGE

1. Obtain a 60V variable power supply.

Caution: The Voltage and Amp settings should be performed based on the Variable Power Supply instructions. Ensure to use proper PPE to perform the following:

2. Set the Voltage of the power supply to 54V.
3. Set the Amp setting for 0.2C of the battery. Depending on how many batteries are to be charged in parallel, set the Amps in +0.2C increments for each battery in parallel. For example, 48NPFC100 >
    a) 1 battery: set amps to 20, 2 batteries: set amps to 40, continue to adjust the number of batteries and amp value based on the limit of the Variable Power supply. Lower than.2C is ok.
4. Turn off the Power supply, Turn off the Battery Breaker
5. Connect the positive (Red) lead from the power supply to the Positive (Red) terminal of the battery.
6. Connect the negative (Black) lead of the power supply to the Negative (Black) terminal of the battery.
7. Turn on the battery (Breaker up) first, then turn on the power switch of the power supply.
8. Battery should start charging, the power supply reading should show the voltage level of the battery and will increase as the charging progresses.
9. Charge the battery until SOC-led lights read 100% (4 lights).
10. Once Battery is fully charged.
    a) turn off the power supply first
    b) turn off the battery (breaker down) next.
    Remove the Black Lead from the Negative (Black) terminal on the battery first.
11. Remove the Red Lead from the Positive (Red) terminal on the battery.
12. Repeat these instructions for each battery to be recharged.

WORKING PRINCIPLE

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

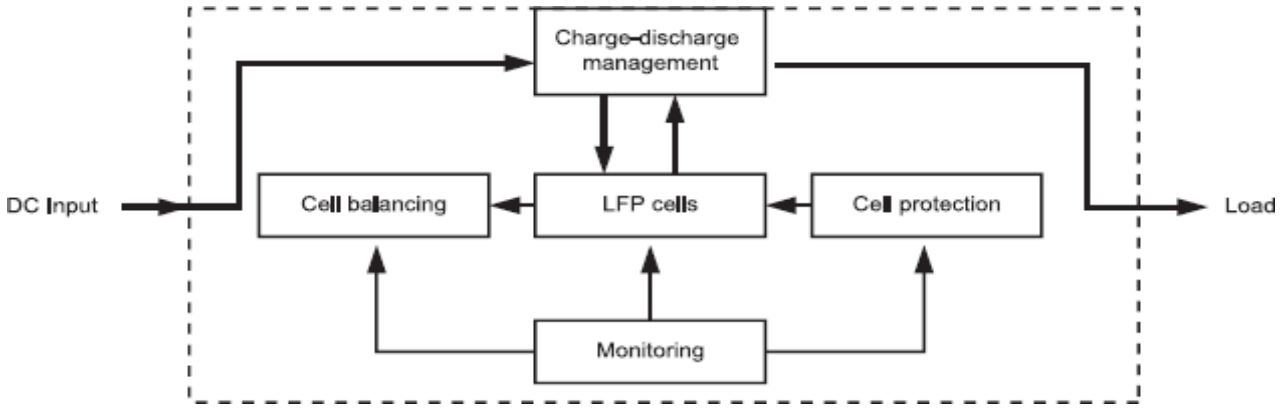


Fig. 1-4 Schematic Diagram

LFP Cells	Battery cells provide the stored energy.
Cell Protection	Protects LFP cells against overcharge, over discharge, over current, over temperature, short circuit.
Cell Balancing	The battery adjusts cell voltages to make sure they are matched closely.
Monitoring	Support centralized monitoring system (optional according to customer requirements)

NPFC Battery Working Principle

DC power input from the rectifier, the DC is divided into two circuits, one circuit directly supplies the load, and another circuit charges the lithium battery cells.
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 supply the DC power to the load, to ensure uninterrupted power to equipment.

Battery Management System (BMS)

- Smart BMS technology is adopted for the battery modules of the NPFC / MPLhE to ensure automatic battery management.
- There is a centralized monitoring unit in the BMS. Functions such as remote measurement, remote communication and remote controlling are available when connected to compatible equipment such as the power plant. Battery units can be controlled remotely by operations staff in the control center. NPFC/MPLhE batteries are compatible with the requirements of modern communications technology development.
- It is combined with the technologies of using a battery and computer. Parameters and status of rectifiers and AC/DC distributions can be detected and controlled.
- Excellent electromagnetic compatibility. BMS is used for the battery modules of NPFC / MPLhE batteries and with no interference with each other.
- The BMS protects against overcharge, over-discharge, over-temperature, over current, short circuit, etc., to assure reliable safety and operation life.
- With patented cell balancing technology, the BMS provides high efficiency for cell balancing and prolonging system operating life.
- Configuration flexibility supports parallel connection expansion.

TECHNICAL CHARACTERISTICS

DISCHARGE PERFORMANCE

CC Discharge to 40.5V at different constant current rate

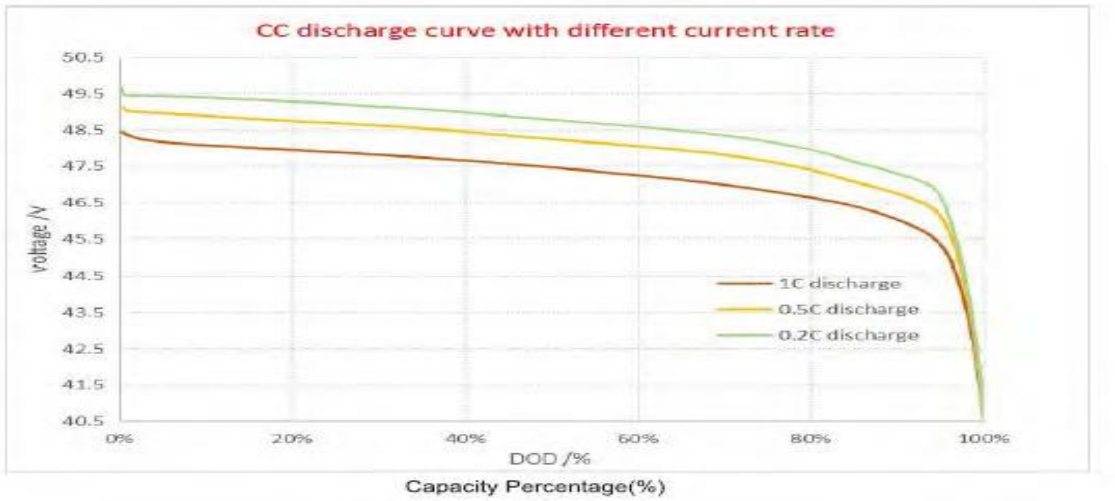


Fig.2-1 Discharge curve at different constant currents of NPFC / MPLhE series

CHARGE PERFORMANCE

CC-CV Charge with different constant current rates and 54.5V constant voltage

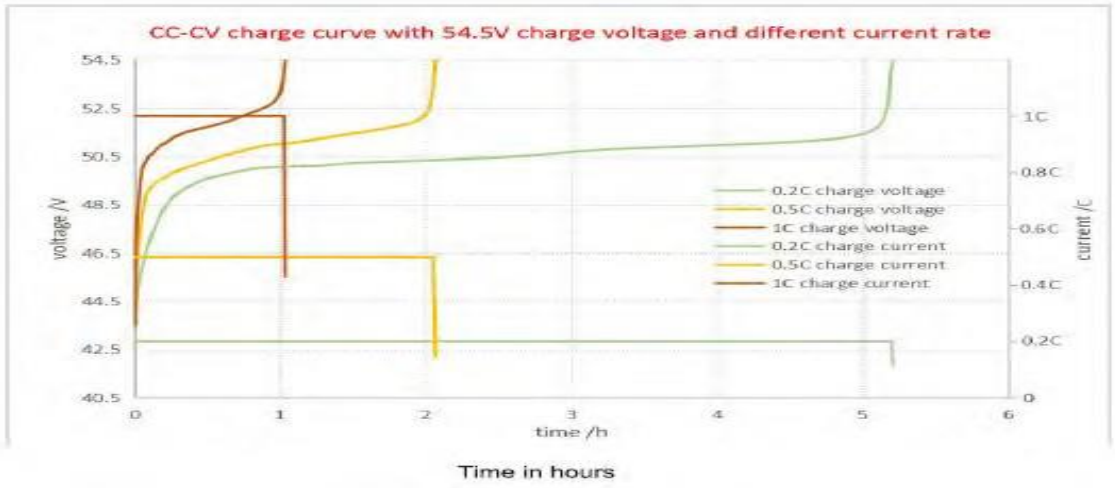


Fig.2-2 Charge curve at the different current limitations of NPFC / MPLhE series

OPERATING PARAMETERS

Battery Charging Parameters

Model	Capacity (Ah)	Nominal Charge Current (A)	Charge Current Limitation (A)
48NPFC100	100	20	100
MPLhE100-16S	100	20	100
48NPFC200	200	40	100

BMS/Battery Operating Parameters

Parameters	Units	Value
Charge voltage 4 8 N PFC100 48NPFC200	V	54 ±0.5
48MPLhE100-16s.	V	57.5 ±0.5
Equalization charge voltage	V	NA
Nominal charge current	A	0.2C
Charge current limitation	A	0.5C ~ 1.0C
No Equalization Required	day	NA
LVBD (Low voltage battery disconnect)		
48NPFC100 48NPFC200	V	54 ±0.5
48MPLhE100-16s	V	57.5 ±0.5

Parallel Operation Based on Discharge Rate (C)

48NPFC100	0.5C< C ≤1C, P≤4	0.2C< C ≤0.5C, P≤8	C ≤0.2C, P≤16
48MPLhE100-16S	0.5C< C ≤1C, P≤4	0.2C< C ≤0.5C, P≤8	C ≤0.2C, P≤16
48NPFC200	0.33C< C ≤0.66C, P≤4	C≤0.33C, P≤6	0.2C< C ≤0.2C, P≤10

There are slight differences in internal impedance between parallel batteries which affect how the load current is shared between the batteries. This limits the number of batteries that should be used in parallel at different loads. The table above shows guidance for the load vs number of parallel batteries. Exceptions can be made for some load profiles with short-duration currents above these limits. Please consult with MPI for sizing outside this guidance. Long discharging below 5 amps per battery may cause inaccuracy in the SOC calculation, for this reason, the number of batteries should be compared to the discharge rate to keep the current above 5 amps.

Operating Temperature Environment Limits

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

An equalization charge is not required for Lithium Iron Phosphate (LFP) batteries.

Rectifier parameters shall be set according to specific site requirements based on the battery units used.

If the batteries are connected, by more than 2 in parallel, the maximum charge current limitation recommended is 0.5C.

NPFC series lithium batteries can be used up to an altitude of 5000 meters (about 3.11 mi). If the altitude is more than 5000 meters (about 3.11 mi), it will affect the battery performance and life due to the decrease of air pressure and temperature.

INSTALLATION MANUAL

SAFETY AND WARNING

The NPFC Family of batteries for installation, operation and maintenance should follow the important recommendations in the manual.

COMPLETELY read the Installation and Operations Manual before starting.

Contact MPINarada if you have any questions before starting.

The NPFC series $LiFePO_4$ battery system installation, operation, and maintenance should follow important recommendations in this manual:

- The equipment shall be installed by professionally trained staff.
- Battery maintenance should be carried out by experienced professionals.
- Be aware of the preventive measures to avoid the potential dangers of mishandling the battery.
- Note: Be careful of the risks of electric shock for large currents in case of a battery short circuit., Pay attention to the following points during operation:
    - Remove watches, rings, or other metal objects from the body.
    - Use insulated tools.
    - Do not place tools or metal objects on the battery.
    - Do not connect 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, and do not use or store the battery near hot 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.
- 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 is removed or interrupted. Avoid electric shock or short circuits when operating the battery in this condition (Grid Power off). Use the battery terminal covers for this safety.
- If you find leaking liquid or white powder residue on the product, prohibit operation. Disconnect Immediately and contact vendor support.

Please be aware of the following markings and their meaning.

				
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**

INSTALLATION

Unboxing & Inspection

- Please read this manual before installation.
- Please inspect the package before unboxing, if any damage is noted contact the supplier as soon as possible.
- This device shall be installed and operated by professionals.
- Make sure you keep the additional brackets and M6 Bolts, they will be needed as part of the installation into the racks or cabinets.

Preparation for Installation

- Batteries shall not be placed in direct sunshine or close to a heat source.
- Batteries shall be installed in place with good ventilation to assure enough heat dissipation.
- Batteries shall be placed in areas with clean ambient and low humidity.
- The following are the tools required to be used for installation: Where applicable tools used should be insulated.




Once the battery module has been unpacked and no physical damage is apparent, then turn on the battery by moving the breaker switch to the on position. The State of Charge (SOC) and the Run light should turn green.

If this does not happen, it is possible the battery is in sleep mode and needs to be put on charge before using it. (See page 7 for the recharge process for the battery in storage)

Pressing the reset button may also activate (wake up) the battery module. See Annex 4 for reset instructions.

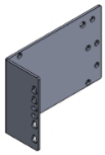
Installation of Battery Modules

Battery Module Brackets

(See Annex 6 for Bracket Part Numbers)

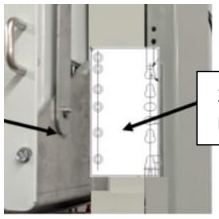
Battery modules of the NPFC series are designed for horizontal installation in cabinets or racks.

- The 48NPFC100, 48MPLhE100-16 and 48NPFC200 battery modules come with the 19" L bracket pre-installed.
- For the 48NPFC100 and 48MPLhE100-16, the 23" L brackets are packaged in the battery module box for use in the 23" rack configuration.
- For the 48NPFC200 front mount brackets need to be used with a shelf to support the battery.
- The 48NPFC200 mid-Mount bracket is included.
- These batteries can also be installed on a customer-provided rack/cabinet shelf.



23" L bracket NPFC100 mid mount

23" Bracket extender for NPFC200 front mount



23" Mid-mount Extender Plate

19" Mid-Mount Bracket with support for NPFC200. Shown above is also a 23" extender.

The L Brackets for 48NPFC100 and 48MPLhE100-16S can be removed and turned/rotated 180^0 for mid-mount installation.

After selecting the bracket configuration desired;

Mount the appropriate bracket onto the battery and insert and secure the battery module into a cabinet or rack horizontally and fix the two battery mounting brackets (left and right) to the cabinet or rack posts using appropriate bolts for locking into the rack or cabinet. Batteries can be inserted in any order, but it is recommended to start at the bottom to allow for future growth and allow for a lower center of gravity.

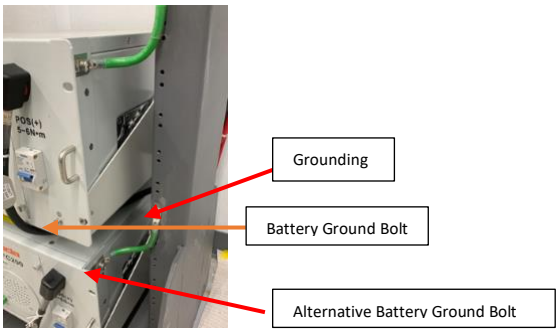
Example of a complete set of batteries in a cabinet.

The minimum spacing between batteries is 10mm (about 0.39 in).

Ground Connection

After mounting the battery module onto the rack/cabinet, connect the battery to the ground by flexible cable GREEN Sheathed, gauge of the grounding wire should be equal to or greater than the gauge of the battery return wire, no less than 6AWG, and connection to ground bolt on the front of the battery module. If preferred, on the right side of the cabinet (as shown)

NOTE: the rack or cabinet should be grounded to the building ground to have an effective grounding system for the batteries.



Ground connection for NPFC Series Batteries

Cable Preparation for Connections – Cable

(Use stranded cable for maximum installation flexibility)

DO NOT make any final connections until later in the instructions.

- Cable lengths should all be equal for all batteries. This will ensure that the discharge power drawn for each battery will be equally shared between the number of batteries installed.
- The length of the cable between the battery module and the power plant busbar shall be no longer than 2.5m / 8.2 Ft.
- Use the NEC (National Electrical Code) for cable size selection for the allowable cable ampacities. Cut your Red (Positive Cables) and Black (Negative Cables).
- The 48NPFC100, 48NPFC100-16S and the NPFC200 all have a maximum discharge rate of 100 amps.
- For ease of battery module testing and or replacement, consider adding quick connect / battery disconnect connectors on the power cable (not supplied by MPINarada). Ensure that they are installed securely and that the connections are sized to the cable conductor being used. (See picture below)
- Run the Negative (black) cable and Positive (red) cable on the side of the rack up to their respective Busbars.
- Lace or tie wrap the cables together and to the rack, post to keep them organized.

Cable Lugs

Battery connections and protections at the busbar are like VRLA battery installations.

Make sure the battery breaker is "OFF" and remains off until final connections are completed.

Use only UL / ULC-approved Lugs.

Recommended for the battery terminal connection: Flared (or Belled entry) Barrel Lug with Inspection Window. Use manufacturers recommended crimp pressure and crimping die for the selected lug. This is important to ensure a proper and secure cable-to-lug connection. Improper lug compression could lead to a high resistance connection over time. On the battery terminal connection, the Torque for the M6 bolt is 6 Nm or 65 in-lbs.

Recommended for Bus-Bar cable connection: Flared Long Barrel Lug, preferably a 2-hole connection. Use manufacturers recommended crimp pressure and crimping die for the selected lug. This is important to ensure a proper and secure cable-to-lug connection. Improper lug compression could lead to a high resistance connection over time. Torque the cable mounting lug (or Belled entry lug) as per the lug manufacturer's recommendations.

Battery Termination Lug

Bus-Bar Termination Lug

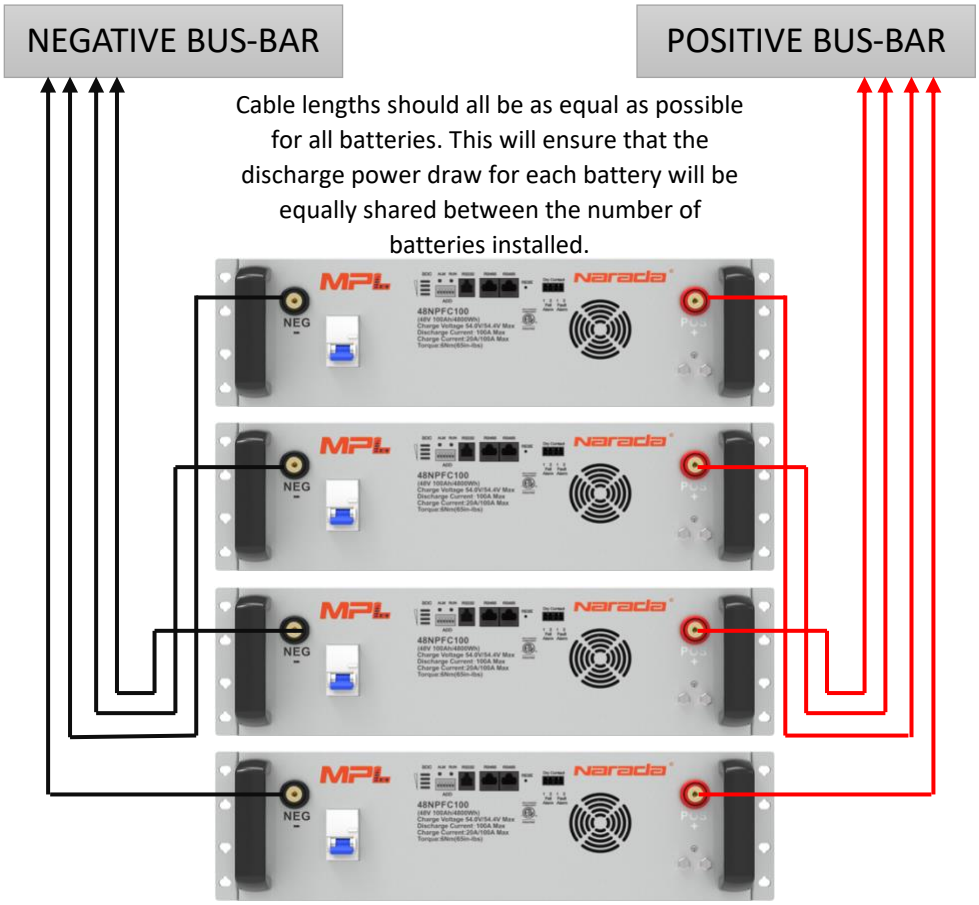
After securely connecting the lugs on the battery terminals, replace the terminal caps to avoid potential accidental shorting of the terminals and for personal safety.

Final Connections

Battery Cable Installation

- **Note: Ensure Battery Breaker is "off" and Power Feed to Bus-Bars is isolated if possible.**
- Do Not Connect Cables to the "Live" Power Plant Bus-Bar until cleared by the Operations team.
- If multi-battery modules will be connected in parallel, please take note of follows:
- No more than 8 battery modules connected in parallel in the rack or cabinet.
- Connect the '-' negative of the battery output cable with the negative busbar of the power plant, and then connect the "+ " positive of the battery output cable with the positive copper bar of the power plant, separately for each LFP battery in the rack or cabinet.

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

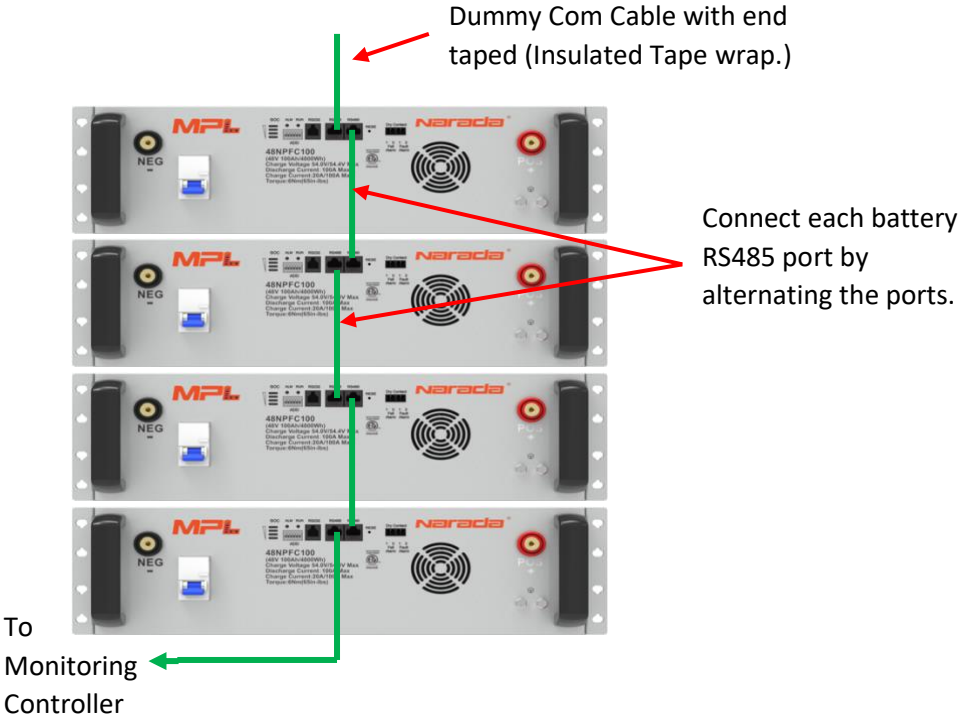


Power on for Battery Module

- When the installation is completed, the battery module is in a dormant state. Once power is turned on from the power plant and the battery module (breaker on), the battery will go into normal running status, and discharge/charge can be available. Note: to protect from potential in-rush, turn the battery on, only after power plant Busbars have been energized.
- Turn the Battery off and connect a multimeter (VDC setting) to the positive and negative battery terminals, respecting the polarity. Turn on the Battery. Check that voltage is between 48VDC and 54VDC (between 51.2 VDC and 58VDC for the 48MPLhE100-16) and that the red ALM LED is not on for more than 30 seconds.
- If the DC power main is not energized, keep the battery turned off until after the main power busbar has been energized.
- Once DC main power is activated, turn on the battery and allow it to fully charge.

RS485 Communication Connection

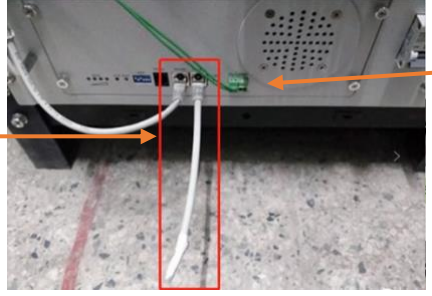
- If there is only one battery module in operation, communication between the battery module and the computer is through the RS485. The dip Setting is 1 on (up) and 2,3,4,5,6 is off (down)
- If there is more than one battery module in operation, communication is done using RS485 between battery modules. See Annex 2 below for Dip Switch settings for each Battery.



- The last battery in each rack has an empty RS485 port, it needs to be connected with a cable with RJ45 terminals to avoid interference with communication. (Dummy Com Cable) The other end of the cable should be covered with insulating tape. (See picture below) No need for a resistor.

How to handle the empty RS485 port for NPFC Series Batteries and view of dry contacts

Dummy Com Cable with insulating tape on end.



RS232 Port

- The RS232 port is reserved for factory use.

Dry Contacts

Dry Contact Port Assignment	***Dry Contact Port 1 (Pin1 & Pin2):*** Cell failure (cell voltage is too low, lower than n*1.7V, n =number of cells), voltage difference is too large (greater than 800mv.
	Dry Contact Port 2 (Pin3 & Pin4): BMS failure (charging / discharging MOS damage, 940 damage, NTC disconnection)

- Dry contact should be connected after the battery is connected.
- Dry contacts, if required, should be wired out to the Power Plant communications/alarm ports.
- The maximum load capacity of dry contact is: 30V/1A

MAINTENANCE

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.

- The battery shall be recharged every three months if in storage.
- Clean the dust with a medium-powered vacuum when accumulated on the vent.
- Use clean and dry cloth/fabric to clean up the cabinet, if need further cleaning, please use a neutral cleaner (such as cleaning wipes). Alcohol or ammonia is forbidden.
- Carrying shall be handled gently, to prevent severe contact.
- Prevent any liquids from being splashed onto the battery.
- Inspect and re-torque the M6 bolts to 6 Nm or 65 in-lbs. on the battery power terminals every two years.

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
	System failure	Shutdown system and call maintenance 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 -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	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 in Annex 1.

ANNEX 1 – INSTRUCTIONS FOR LED FLASH

Annex Table 1.1 – SOC LED Indicators Description

				SOC
●	●	●	●	75% - 100%
●	●	●	◎	50% - 75%
●	●	◎	◎	25% - 50%
●	◎	◎	◎	0% - 25%

Note: ● signifies light on, ◎ signifies light off

ANNEX TABLE 1.2 – RUN INDICATORS DESCRIPTION

Battery Status	Narada Default Setting Normal/ ALM/ Protect	RUN ●	ALM ●	Battery LED ● ● ● ●	Explanation
Breaker OFF	Sleep Mode	OFF	OFF	OFF	
Standby	Normal	Flash 1	OFF	According to the battery SOC indicator 1 GREEN = 0% -25% 2 GREEN = 25% - 50% 3 GREEN = 50% - 75% 4 GREEN = 75% - 100%	If Temperature Alarm , then ALM LED = Flash 3 When SOC is too low ALM is OFF
	ALM	Flash 1	OFF		
Charge	Normal	Flash 2	OFF		
	ALM (without Temperature)	Flash 2	OFF		If Temp alarm the ALM = Flash 3
	Overcharge Protection	Flash 1	OFF		
	Over Temp Protection, Under Temp Protection, Over Current Protection	Flash 1	Flash 2		
	Charge Current Limit	ON	ON		
Discharge	Normal	ON	OFF		
	Alarm (excluding discharge overcurrent alarm)	ON	Flash 3		Special Case description; If discharge over current alarm the ALM = OFF
	Over discharge Protection	Flash 1	OFF		
	Over Temp Protection Under Tempo Protection Over Current Protection Short Circuit Protection	Flash 1	Flash 2		
Invalid	Fault	OFF	ON	OFF	Faults refer tto Hardware faults such as BMS Voltage sampling device, charging MOS damage, temperature sensor disconnection etc.

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 – INSTRUCTIONS FOR ADD DIP SWITCH

ADD Dip Switch applies to modules connected in parallel. ADD consists of four binary bits and Maximum quantity of batteries in parallel is 16.

Annexed Table 2.1 – Instruction for Addresses of Communication

Instructions for ADD Dialing				Module No.	Binary Code	Remarks
1	2	3	4			
OFF	OFF	OFF	OFF	Pack 1	0000	Master PACK, supports RS232
ON	OFF	OFF	OFF	Pack 2	0001	Expansion PACK
OFF	ON	OFF	OFF	Pack 3	0010	Expansion PACK
ON	ON	OFF	OFF	Pack 4	0011	Expansion PACK
OFF	ON	OFF	OFF	Pack 5	0100	Expansion PACK
ON	OFF	ON	OFF	Pack 6	0101	Expansion PACK
OFF	ON	ON	OFF	Pack 7	0110	Expansion PACK
ON	ON	ON	OFF	Pack 8	0111	Expansion PACK
OFF	OFF	OFF	ON	Pack 9	1000	Expansion PACK
ON	OFF	OFF	ON	Pack 10	1001	Expansion PACK
OFF	ON	OFF	ON	Pack 11	1010	Expansion PACK
ON	ON	OFF	ON	Pack 12	1011	Expansion PACK
OFF	OFF	ON	ON	Pack 13	1100	Expansion PACK
ON	OFF	ON	ON	Pack 14	1101	Expansion PACK
OFF	ON	ON	ON	Pack 15	1110	Expansion PACK
ON	ON	ON	ON	Pack 16	1111	Expansion PACK

Annexed Table 2.2 – Instruction of ADD for Parallel Communication.

Please also review BMS PC Software Manual available from MPINarada Support

PACK 1 0000 ADD	PACK 2 0001 ADD	PACK 3 0010 ADD	PACK 4 0011 ADD	PACK 5 0100 ADD	PACK 6 0101 ADD	PACK 7 0110 ADD	PACK 8 0111 ADD
PACK 9 1000 ADD	PACK 10 1001 ADD	PACK 11 1010 ADD	PACK 12 1011 ADD	PACK 13 1100 ADD	PACK 14 1101 ADD	PACK 15 1110 ADD	PACK 16 1111 ADD

NOTE: Counting of ADD shall begin from 0000, without interruption, or parallel communication cannot be available

ANNEX 3 – COMMUNICATION PROTOCOL FOR RS232 AND RS485

There is one RS485 port in the front panel for communication between battery and PC, and one RS485 for communication between battery modules connected in parallel.

Cable Part Number - NPFC-COM-RS485 for the above batteries can be purchased from MPINarada. This cable comes in 2 parts. Connect the cables at DB9.

Contact MPINarada for the latest laptop config file and BMS read software.

The BMS Parameters can be viewed either through laptops or with customer provided remote monitoring software.

The BMS Modbus table to program remote monitoring software is available from MPINarada support.

See Annex 5 for the BMS Parameter Table.

ANNEX 4 – INSTRUCTION for the RESET BUTTON

Annex Table 4.1 – Definition of Reset Button

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.

ANNEX 5 - BMS Parameter Table

Item	Parameter	Value	Unit	Recovery	Remark
Alarm	Cell Overvoltage Start	3.6	V		
	Cell Overvoltage Delay	1±0.5	s		
	Cell Overvoltage Stop	3.5	V		
	Cell Undervoltage Start	2.8	V		
	Cell Undervoltage Delay	1±0.5	s		
	Cell Undervoltage Stop	3.1	V		
	Pack Overvoltage Start	54.5	V		
	Pack Overvoltage Delay	1±0.5	s		
	PackOvervoltage Stop	53.2	V		
	Pack Undervoltage Start	45	V		
	Pack Undervoltage Delay	1±0.5	s		
	PackUndervoltage Stop	50	V		
	Charging Overcurrent Start	80	A		80/50
	Charging Overcurrent Delay	1±0.5	s		
	Charging Overcurrent Stop	70	A		70/40
	Disharging Overcurrent Start	80	A		80/51
	Disharging Overcurrent Delay	1±0.5	s		
	Disharging Overcurrent Stop	70	A		70/41
	Cell Overtemper Start	55	℃		
	Cell Overtemper Delay	4	S		
	Cell Overtemper Stop	45	℃		
	Cell Undertemper Start	0	℃		
	Cell Undertemper Delay	4	S		
	Cell Undertemper Stop	10	℃		
	Ambient OverTem Start	55	℃		
	Ambient OverTem Delay	4	S		
	Ambient OverTemStop	45	℃		
	Ambient UnderTem Start	0	℃		
	Ambient UnderTem Delay	4	S		
	Ambient UnderTem Stop	10	℃		
	Capacity Low Start	10	%		
	Capacity Low Stop	15	%		
	Voltage Difference Start	800	mV		
	Voltage Difference Stop	500	mV		
Protect	Cell Overvoltage Start	3.8	V		
	Cell Overvoltage Delay	1±0.5	s		
	Cell Overvoltage Stop	3.34	V		
	Cell Undervoltage Start	2.5	V		
	Cell Undervoltage Delay	1±0.5	s		
	Cell Undervoltage Stop	/	/	Charging	
	Pack Overvoltage Start	56	V		
	Pack Overvoltage Delay	1±0.5	s		
	PackOvervoltage Stop	54.5	V		
	Pack Undervoltage Start	40.5	V		
	Pack Undervoltage Delay	1±0.5	s		
	PackUndervoltage Stop	/	/	Charging	
	Charging Overcurrent-1 Start	105±5	A		105±5/90±5/55±5
	Charging Overcurrent-1 Delay	1±0.5	s		
	Disharging Overcurrent-1 Start	105±5	A		105±5/90±5/55±5
	Disharging Overcurrent-1 Delay	1±0.5	s		
	Charging Overcurrent-2 Start	120±5	A		120±5/100±5/90±5
	Charging Overcurrent-2 Delay	1±0.5	s		
	Disharging Overcurrent-2 Start	120±5	A		120±5/100±5/90±5
	Disharging Overcurrent-2 Delay	1±0.5	s		
	Charging OverTem Start	70±3	℃		

ANNEX 6 - Com Cable and Bracket Part Numbers

NPFC Cables	Description
NPFC-CBL-U-RJ	Communication Cable - USB to RJ45
NPFC-COM-RS485	Communication Cable - RS485-USB
NPFC100 Brackets	
NPFC100-3RU19UB-L	48NPFC100-3RU-19 Universal Mount Left Side Brackets
NPFC100-3RU19UB-R	48NPFC100-3RU-19 Universal Mount Right Side Brackets
NPFC100-3RU23UB-L	48NPFC100-3RU-23 Universal Mount Left Side Brackets
NPFC100-3RU23UB-R	48NPFC100-3RU-23 Universal Mount Right Side Brackets
MPLHE100 – 16 Brackets (Blue)	
MPLhE100-3RU19UB-L	48MPLhE100-3RU-19 Universal Mount Left Side Brackets
MPLhE100-3RU19UB-R	48MPLhE100-3RU-19 Universal Mount Right Side Brackets
MPLhE100-3RU23UB-L	48MPLhE100-3RU-23 Universal Mount Left Side Brackets
MPLhE100-3RU23UB-R	48MPLhE100-3RU-23 Universal Mount Right Side Brackets
NPFC200 Brackets	
NPFC200-L1901	48NPFC200 19" Rack Mount L Bracket
NPFC200-R1901	48NPFC200 19" Rack Mount R Bracket
NPFC3RU-1923L	NPFC 3RU 19-23 Universal Extension Plate Left
NPFC3RU-1923R	NPFC 3RU 19-23 Universal Extension Plate Right
NPFC200-TSBRK	48NPFC200 Top Support Bracket
NPFC200-19MPK-U	NPFC200 Battery Mounting Support Kit US: (2x) #12-24 x 0.5" Hex Head Flange Bolt (M5 Alt) (2x) 1 /4-20 Serrated Flange Head Nut (M6 Alt) (1x) Right Mounting Bracket (1x) Left Mounting Bracket (1x) Top Support Bracket

NOTES:

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