RFN-S16A200-17A Product datasheet

V1.00

Formulate:	Refinergy	**Date:**	June-16-2022
Verify:	Joey	**Date:**	June-16-2022
Approve:		**Date:**	June-16-2022

Shenzhen Refinergy Technology CO.,Ltd

Optional module	Specification	YES/N0
LCD	2.8 inch 12864 resolution	Y
Current limiting	10A	Y
Wireless module	BLE module	N
CANBUS	CAN+485	Y

Accessories list			
NO	Name	Model description	PCS
1	BMS board	RFN-S16A200-04A without SOC LED and dip switch	1
2	Voltage temperature sampling cable1	HY2.0 7P-UL1430 24AWG length 850mm +1PCS NTC,T1	1
3	Voltage temperature sampling cable2	HY2.0 6P-UL1430 24AWG length 850mm +1PCS NTC,T2	1
4	Voltage temperature sampling cable3	HY2.0 7P-UL1430 24AWG length 850mm+1PCS NTC,T3	1
5	Voltage temperature sampling cable4	HY2.0 6P-UL1430 24AWG length 850mm+1PCS NTC,T4	1
6	B+ Power cable	3.5MM Banana connector Female(male shell female needle) 16AWG UL3135 L=500MM+OT2-3 Drawing number_W0003-A0	1
7	Screw	Button-head bolt group M5*10	6
8	Communication adapter cable 1	HY2.0*5P UL1569 24AWG double-headed same black white L=500MM(BMS internal communication cable)	1
9	Communication adapter cable 2	HY2.0*5P UL1569 24AWG double-headed same red black yellow white orange L=500MM(INV communication cable)	2
10	Communication adapter cable 3	HY2.0*10P UL1569 24AWG double-headed same black white L=500MM(Dip switch cable)	1
11	LED adapter cable	HY2.0*10P UL1569 24AWG double-headed same red black L=500MM(Power indicator cable)	2
12	Weak current switch cable	HY2.0*2P UL1569 24AWG single head L=500MM	1
13	Communication adapter board	Communication adapter board RFN-MB004 with green LED 6+2	1

Version Revision History

Version	Revision	Revise/Create	Date
V1.00	DRAFT	Joey	Jun-16-2022

Table of Contents

1. Introduction

The BMS system is specifically designed for 48V products such as home energy storage, data center backup power and mobile energy storage. It provides real-time monitoring of battery voltage, current, temperature, and BMS system fault information, offering customers a complete and reliable control and protection system. The system also includes intelligent charging balance, energy estimation, RS485 communication, CAN communication, RS232 communication, LED display, power button switch and optional features such as data storage, current limiting, intelligent heating film control, and system parallel connection. It can be widely applied in indoor and outdoor base stations, home energy storage, and other backup power systems.

2. Solution Advantages

●Maintain a high level of functional safety and provide multiple reliable diagnostic protection functions.

●Deeply optimize to meet market demands, abandoning redundant designs for a more streamlined and precise solution.

●Integrated design, offering high integration solutions.

●Meet the high cost-effectiveness and performance balance requirements of industrial and home energy storage systems.

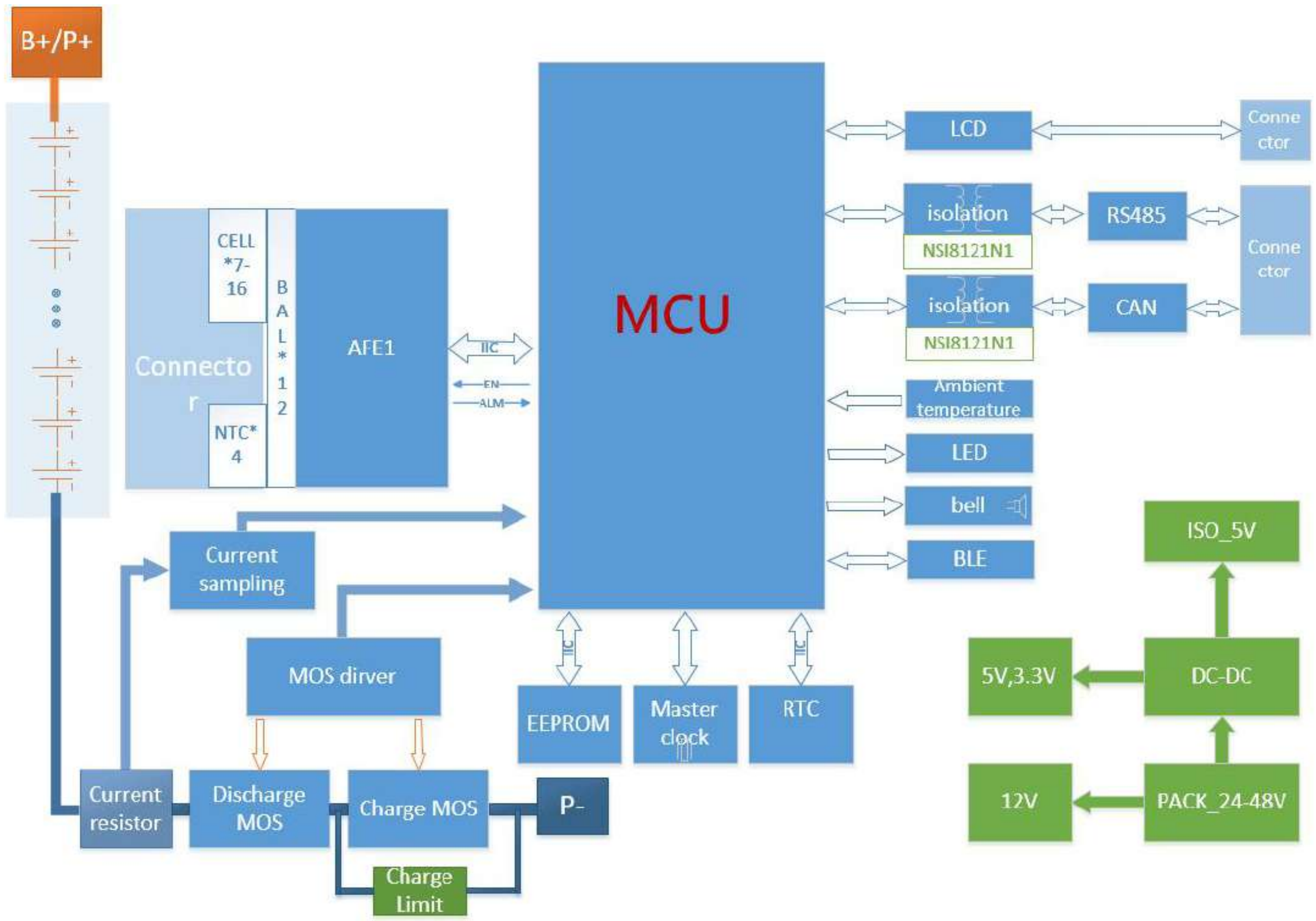
3. Functional Characteristics

- Suitable for LiFePO4, polymer, ternary and other material battery cells.
- Alarm and protection functions for cell over-voltage, under-voltage, discharge over-current, over-temperature, low temperature, charging over-current, over-temperature, low temperature, low SOC, short circuit.
- Equipped with cell balance function.
- Accurate estimation of cell capacity with a precision of up to 5%.
- Optional dry contact port cooperate with inverters.
- Optional heating control interface.
- Optional LED power and fault status indication function.
- PC GUI Software control functions, allowing flexible configuration of various protection

parameters, protection time, capacity, balance, and storage settings.

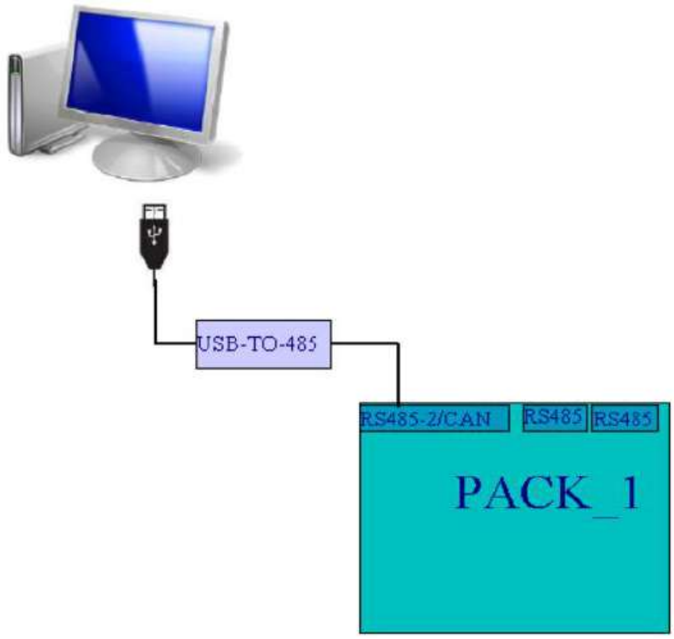
- RS485 communication interface for isolated communication, compliant with YD/T1363.3 communication standard, parallel communication can be realized by 4-bit dip switch.
- Optional CAN communication interface for isolated communication. Parallel communication can be realized by 4-bit dip switch.
- Optional current limiting module for safety and more reliable parallel module function.

4. Schematic Block Diagram

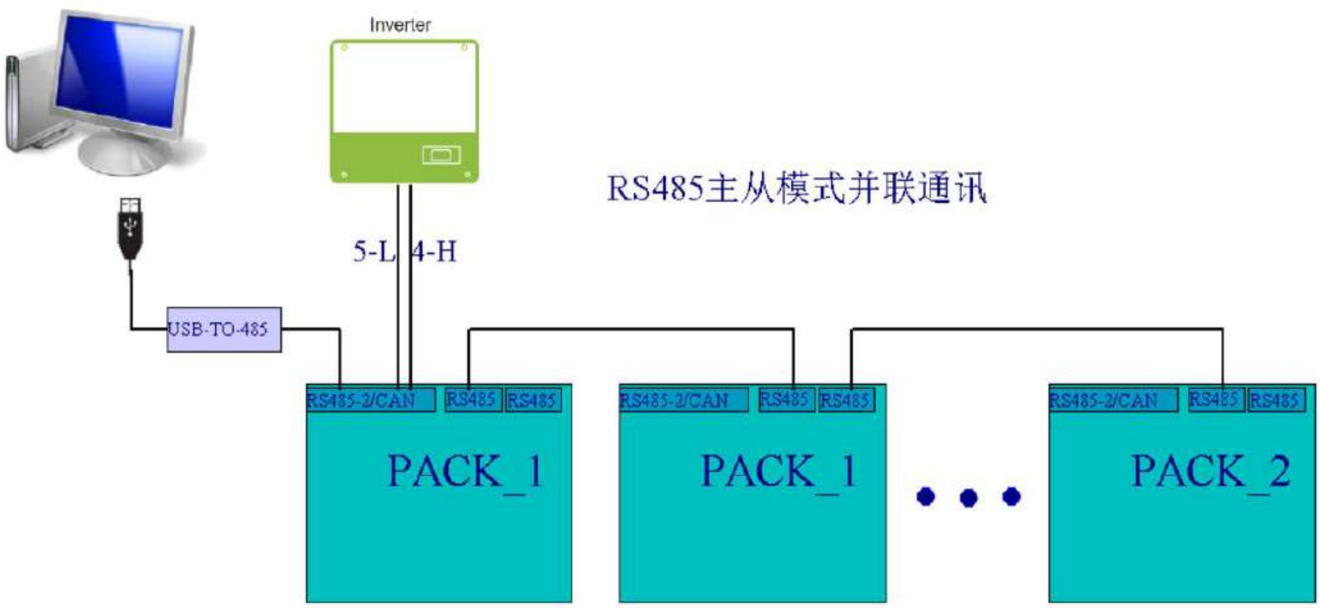


5. Communication Application

- 485-2 Standalone mode communication



- 485-2 as a host, CAN and inverter, 485-1 master-slave mode parallel communication



6. Electrical Characteristics

6.1 Basic parameter settings

(Note: The following parameters are applicable to the LiFePO4 system and shall be tested at 25℃ unless otherwise specified)

NO	Item		Factory default parameters	Yes/NO	Remark
1	Cell over-charge protection	Warning voltage	3600mV	Y	
		Protection voltage 1	3700mV	Y	
		Protection voltage 2	3800mV	Y	
		Protection delay 1	1.0S	Y	
		Protection delay 2	1.0S	Y	
	Cell over-voltage protection release	Release voltage	3500mV	Y	
		Discharging release	Discharging>1000mA		
		Capacity release	SOC<96%	Y	
2	Cell over-discharge protection	Warning voltage	2850mV	Y	
		Protection voltage 1	2750mV	Y	
		Protection voltage 2	2600 mV	Y	
		Protection delay 1	1.0S	Y	
		Protection delay 2	1.0S	Y	
	Cell over-discharge protection release	Release voltage	3100mV	Y	
		Charging release	Charging >1000mA		
		Protection delay	3.0S	Y	
3	Pack over-charge protection	Warning voltage	57.6V	Y	
		Protection voltage	59.2V	Y	
		Protection delay	1.0S	Y	
	Pack over-voltage protection release	Release voltage	56V	Y	
		Capacity release	SOC<96%	Y	
		Discharging release	Discharging>1000mA		
	Pack over-discharge Protection	Warning voltage	45.6V	Y	
		Protection voltage	44V	Y	
		Protection delay	1.0S	Y	
	Pack over-discharge release	Release voltage	49.6V	Y	
		Charging release	Charging>1000mA		
4	Charging over-current protection	Warning current	205A	Y	The status will be locked and no longer released automatically if it appears 3 times
		Protection current	210A	Y	
		Charging release	1.0S	Y	
	Charging over-current	Automatic release	Automatic release in 30S	Y	

	protection release	Discharging release	Discharging>1000mA		and need to release by discharging
5	Discharge over-current warning current	Warning current	205A	Y	The status will be locked and no longer released automatically if it appears 3 times and need to release by charging
	Discharge over-current protection 1	Over-current protection 1	210A	Y	

	Discharge over-current protection 2	Over- current protection 2	300A	Y	The status will be locked and no longer released automatically if it appears 3 times and need to release by charging
	Discharge over-current delay	Protection delay 1	3S	Y	
		Protection delay 2	160ms	Y	
	Discharge over-current release	Automatic release	Automatic release In 30S	Y	
		Charging release	Discharging>1000mA		
6	Short circuit protection	Protection current	460A	Y	
		Protection delay	100uS	Y	
		Protection release	Automatic release In 30S	Y	
			Charging>1000mA		
7	Temperature protection	MOS over-temperature warning protection	90℃	Y	
		MOS over-temperature protection	115℃	Y	
		MOS protection release temperature	80℃	Y	
		Charging low temperature warning	5℃	Y	
		Charging low temperature protection	0℃	Y	
		Charging low temperature protection release	5℃	Y	
		Charging over-temperature warning	50℃	Y	
		Charging over-temperature protection	55℃	Y	
		Charging over-temperature	50℃	Y	

		protection release			
		Discharging low temperature warning	-10℃	Y	
		Discharging low temperature protection	-20℃	Y	
		Discharging low temperature protection release	-10℃	Y	
		Discharging over-voltage warning	50℃	Y	
		Discharging over-voltage protection	60℃	Y	
		Discharging over-voltage protection release	55℃	Y	
8	Current consumption	Operation self-consumption current	≤25mA		
		Power off current	≤300uA		
9	Cell balance function	Balance opening voltage	3400mV	Y	
		Power on differential pressure	30mV	Y	
		Power off differential pressure	20mV	Y	
10	Capacity default Settings	Low battery alarm level	SOC＜10%	Y	
		Full capacity setting	[0-655]Ah	Y	
11	Hardware limiting setting	Starting voltage mV	3650	Y	It will starts if any of the conditions are met
		Starting current mA	210000	Y	

7. LED Instructions

7.1 LED working status indication

Requirement description: 8 indicator LED for the battery, including warning, running and 6 capacity indicators, function description as below：

Status		LED capacity (From low to high)						ALM	RUN	Instruction
Power off	Capacity	1	2	3	4	5	6	7	8	All off
Charging	1%-5% Capacity	★							★	The indicator LED(1^6)start from low to high in flowing water status
	6%-15% Capacity	●	★						★	The indicator LED(2^6)start from low to high in flowing water status
	16%-25% Capacity	●	●	★					★	The indicator LED(3^6)start from low to high in flowing water status
	26%-50% Capacity	●	●	●	★				★	The indicator LED(4^6)start from low to high in flowing water status
	51%-75% Capacity	●	●	●	●	★			★	The indicator LED(5^6)start from low to high in flowing water status
	76%-99% Capacity	●	●	●	●	●	★		★	The indicator LED(6^6) start in sparkling status
	100% Capacity	●	●	●	●	●	●		★	Charging finished
Discharging	1%-5% Capacity	●							★	
	6%-15% Capacity	●	●						★	
	16%-25% Capacity	●	●	●					★	
	26%-50% Capacity	●	●	●	●				★	
	51%-75% Capacity	●	●	●	●	●			★	
	76%-100% Capacity	●	●	●	●	●	●		★	
	0% Capacity	★						★	★	ALM★Low power warning default 10%
Parallel standby mode	1%-5% Capacity	●							★	
	6%-15% Capacity	●	●						★	
	16%-25% Capacity	●	●	●					★	The main loop is not closed
	26%-50% Capacity	●	●	●	●				★	The main loop is not closed
	51%-75% Capacity	●	●	●	●	●			★	The main loop is not closed
	76%-100%Capacity	●	●	●	●	●	●		★	The main loop is not closed

Warning	Low power warning	/	/	/	/	/	/	★	★	Based on SOC indication
	Under-voltage warning			/	/	/	/	★	★	Including cell and pack under-voltage base on current SOC indication
	Over-voltage warning	/	/	/	/	/	/		★	Including cell and pack under-voltage
	Over-charging warning	/	/	/	/	/	/	★	★	Based on SOC indication
	Over-discharging warning	/	/	/	/	/	/	★	★	Based on SOC indication
	Charging low temperature warning	/	/	/	/	/	/	★	★	Based on SOC indication
	Charging over-temperature warning	/	/	/	/	/	/	★	★	Based on SOC indication
	Discharging low temperature warning	/	/	/	/	/	/	★	★	Based on SOC indication
	Discharging over-temperature warning	/	/	/	/	/	/	★	★	Based on SOC indication
	MOS over-voltage warning	/	/	/	/	/	/	★	★	Based on SOC indication
	Fan fault warning	/	/	/	/	/	/	★	★	Based on SOC indication
	Cell imbalance warning	/	/	/	/	/	/	★	★	Based on SOC indication
Protection	Under-voltage protection	/	/	●				●	★	Including cell and pack under-voltage
	Over-voltage protection	/	/	/	/	/	/		★	Including cell and pack under-voltage base on current SOC indication

Protection	Charging over-current protection	/	/		●			●	★	
	Discharging over-current protection	/	/			●		●	★	
	Charging low temperature protection	/	/	●	●			●	★	
	Charging over-temperature	/	/	●		●		●	★	

	protection									
	Discharging low temperature protection	/	/	●			●	●	★	
	Discharging over-temperature protection	/	/		●	●		●	★	
	MOS over-temperature protection	/	/		●		●	●	★	
	Discharge short circuit protection	/	/	●	●		●	●	★	
Failure	Charging MOS failure error							●		
	Discharging MOS failure error	/	/		●			●		
	Voltage front-end sampling fault	/	/			●		●		
	Voltage front-end disconnected fault	/	/				●	●		
	Temperature front-end fault	/	/	●	●			●		
	Temperature front-end disconnected fault	/	/	●		●		●		
	Current front-end sampling fault	/	/	●			●	●		
	Cell imbalance fault	/	/		●	●		●		
	Parameter configuration error fault	/	/		●		●	●		
	Parallel device fault	/	/			●	●	●		
	Pre-charge circuit fault	/	/	●	●	●		●		
	Communication fault	/	/	●	●		●	●		
	Charger fault	/	/	●		●	●	●		
	Fault stacking			●	●	●	●	●		Two or more faults occur at the same time

Note: ●means continuous light, ★means sparkling light, the flashing frequency of the indicator LED is 1Hz.

8. Buzzer Instructions

- Buzzer sound once per 1s when fault;
- Buzzer sound once per 2s when protection;
- Buzzer sound once per 3s when alarm;
- Buzzer function can be used or disabled by the PC GUI Software, factory default NC.

9. Button Instructions

- Without self-locking button, long press 3s to turn on or off.
- When the BMS is in sleep mode, press the button for 3S and release, it will be activated and the LED indicator lights will be turned on from "RUN" in sequence for 0.5s.
- When the BMS is activated, press the button for 3S and release, it will be in sleep mode, the LED indicator lights will be turned on from the lowest power in sequence for 0.5s. Press the button for 6S and release, it will be reset and the LED indicator lights will be turned on for 1.5s at the same time.
- The BMS still retains the parameters and functions set by the PC GUI Software after being reset, it can be achieved by "restoring default values" from the PC GUI Software if the initial parameters need to be restored, but the relevant operation records and stored data still remain unchanged(such as power consumption, cycle times, protection records, etc).

10. Sleep and Wake up

10.1 Sleep

The system switches to low power mode either of the following conditions are met.

1) Cell or pack over-discharge protection is not released within 30s.
2) Press the button for 3s and release it.
3) The minimum cell voltage is lower than the sleep set voltage (default voltage 3000mV) and the duration reaches the sleep delay time (default voltage 1 minute) (no communication, no protection, no balance and no current at the same time).
4) Standby time more than 24 hours (no communication, no charge-discharge and no utility power)
5) Forced power off through PC GUI Software.

Note: Make sure that no charger is connected before switch to sleep mode or the low power mode will not be switched.

10.2 Wake up

The system will exit low power mode and switch to the normal mode either of the following conditions are met when system is in low power mode.

1） Connect The charger and the output voltage must be greater than 48V.

2） Press the button for 3S and release it.

3） Connect the cable and turn on the PC GUI Software(The BMS can not be waked up and will switch to sleep mode due to over-release protection)

Note: The system switches to low power mode after the cell or pack over-discharge protection, it wakes up every 4 hours and activates the charging/discharging MOSFET, it will exits the sleep mode and keep charging normally if charger is connected, it will no longer automatically wake up if automatic wake-up fails to charge for 10 consecutive times. When the system is defined as charging completed, it will forcibly resume charging until charging is completed again if the recovery voltage is not reached after 2 days/48 hours (standby time setting).

11. Communication Instructions

11.1 RS232 Communication

The BMS can communicate with the PC GUI Software through RS232 interface and monitor various information including battery voltage, current, temperature, status, SOC, SOH and battery production information,etc, the default baud rate is 9600bps.

11.2 RS485 Communication

The master pack (address is 0) can communicate with the slave pack through the RS485 interface during parallel communication, it can check the information of the master pack and each slave packs through the PC GUI Software, the default baud rate is 9600bps.

11.3 CAN Communication

The master pack (address is 0) can communicate with the slave pack through the CAN interface during parallel communication, it can check the information of the master pack and each slave packs through the PC GUI Software, the default baud rate is 500kbps.

12. Dip Switch Setting

Customer can choose whether to use the dip switch, if the dip switch is not used, the system will automatically detect whether other device is existed and select the device with min address as a host by address allocation.

12.1 Refer to below table1-2 of dip switch definition.

Table1 The 1 #-4 # bit dial indicate the slave device address(Applies to slave settings)

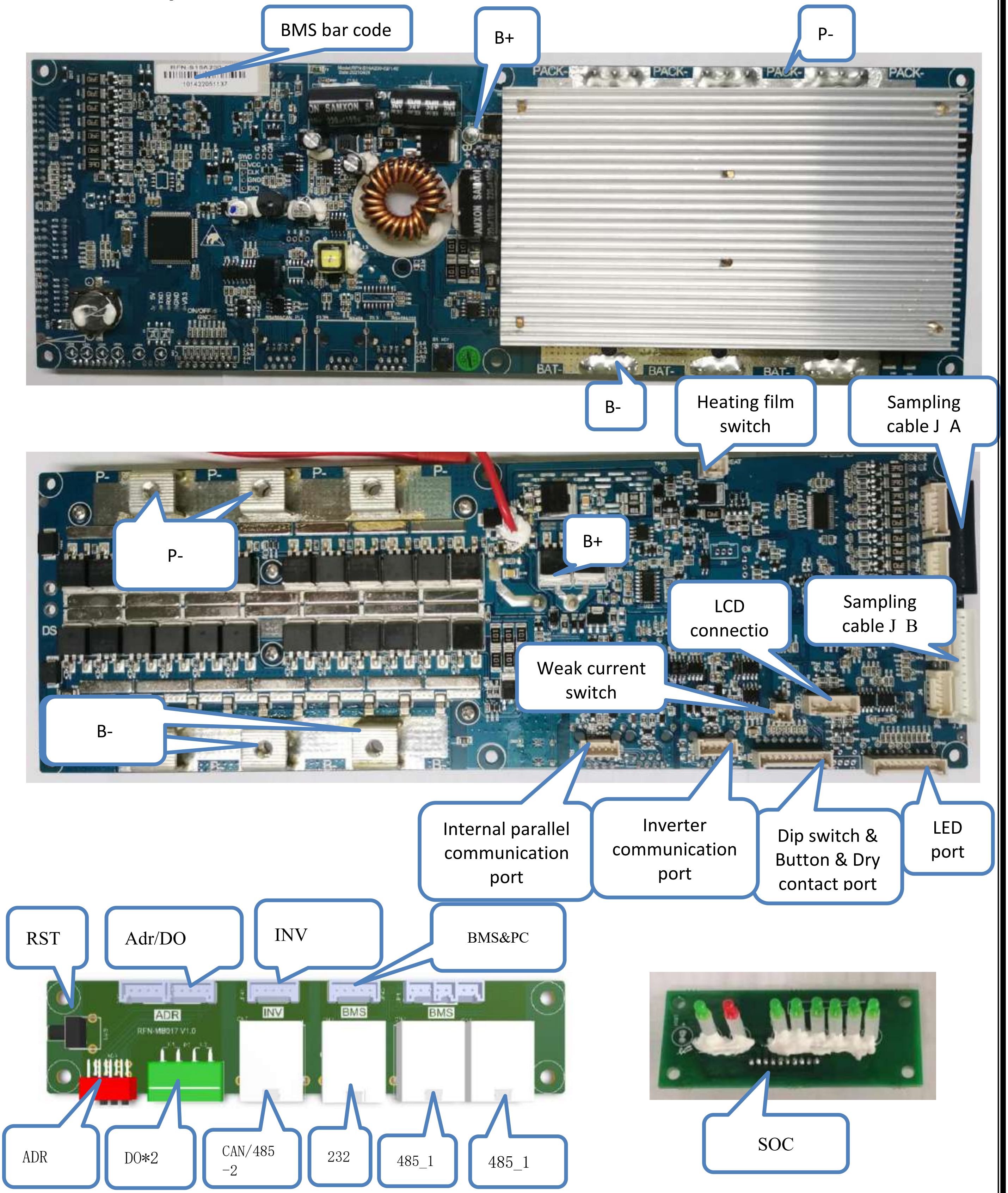
Address	1#	2#	3#	4#		5#--8#	
0	OFF	OFF	OFF	OFF		OFF	No cascade connection, standalone mode
1	ON	OFF	OFF	OFF		OFF	Device address 1
2	OFF	ON	OFF	OFF		OFF	Device address 2
3	ON	ON	OFF	OFF		OFF	Device address 3
4	OFF	OFF	ON	OFF		OFF	Device address 4
5	ON	OFF	ON	OFF		OFF	Device address 5
6	OFF	ON	ON	OFF		OFF	Device address 6
7	ON	ON	ON	OFF		OFF	Device address 7
8	OFF	OFF	OFF	ON		OFF	Device address 8
9	ON	OFF	OFF	ON		OFF	Device address 9
10	OFF	ON	OFF	ON		OFF	Device address 10
11	ON	ON	OFF	ON		OFF	Device address 11
12	OFF	OFF	ON	ON		OFF	Device address 12
13	ON	OFF	ON	ON		OFF	Device address 13
14	OFF	ON	ON	ON		OFF	Device address 14
15	ON	ON	ON	ON		OFF	Device address 15

Table 2 The 5#--8# bit dial indicate the slave device address(Applies to master settings)

Address	5#--8#		5#	6#	7#	8#	Parallel quantity
1	OFF		OFF	OFF	OFF	OFF	No parallel

2	OFF		ON	OFF	OFF	OFF	2 pack parallel
3	OFF		OFF	ON	OFF	OFF	3 pack parallel
4	OFF		ON	ON	OFF	OFF	4 pack parallel
5	OFF		OFF	OFF	ON	OFF	5 pack parallel
6	OFF		ON	OFF	ON	OFF	6 pack parallel
7	OFF		OFF	ON	ON	OFF	7 pack parallel
8	OFF		ON	ON	ON	OFF	8 pack parallel
9	OFF		OFF	OFF	OFF	ON	9 pack parallel
10	OFF		ON	OFF	OFF	ON	10 pack parallel
11	OFF		OFF	ON	OFF	ON	11 pack parallel
12	OFF		ON	ON	OFF	ON	12 pack parallel
13	OFF		OFF	OFF	ON	ON	13 pack parallel
14	OFF		ON	OFF	ON	ON	14 pack parallel
15	OFF		OFF	ON	ON	ON	15 pack parallel

13. BMS Physical Structure



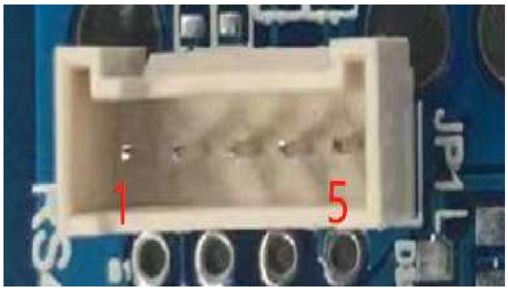
Main PCBA inch: L*W*H=300*100*32mm

14. Interface Definition

14.1 Communication interface diagram

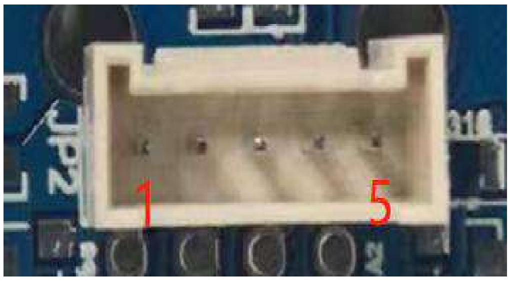
(1) BMS Internal grid connection&Monitoring

RS485_1--use HY2.0 5P vertical JP1 socket	
Pin	Instruction
1	RS485-B1
2	RS485-A1
3	GND
4	RS232-RXD
5	RS232-TXD

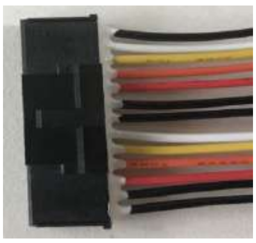


(2) BMS and inverter communication port

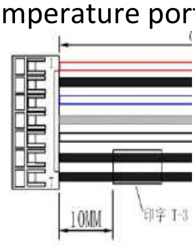
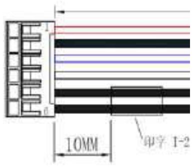
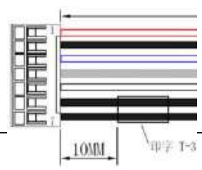
CAN/RS485-2--use HY2.0 5P vertical JP2 socket	
Pin	Instruction
1	RS485-B2
2	RS485-A2
3	GND
4	CANH
5	CANL

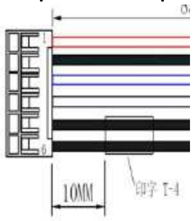


14.2 Electrical interface definition

Interface	Instruction	
B+	Cell pack positive electrode is used to power the BMS, the power positive port P+ is connected to the cell positive electrode directly.	
B-	Cell pack negative electrode.	
P-	Battery pack negative electrode which is both charging negative electrode and discharging negative electrode(Charging and discharging at the same port)	
Voltage temperature port J_A	J_A-13	CELL1-
	J_A-12	CELL1+
	J_A-11	CELL2+
	J_A-10	CELL3+
	J_A-9	CELL4+
	J_A-8	NTC1+
	J_A-7	NTC1-
	J_A-6	CELL5+

	J_A-5	CELL6+
	J_A-4	CELL7+
	J_A-3	CELL8+
	J_A-2	NTC2+
	J_A-1	NTC2-
Voltage temperature port J_B 	J_B-13	CELL9-
	J_B-12	CELL9+
	J_B-11	CELL10+
	J_B-10	CELL11+
	J_B-9	CELL12+
	J_B-8	NTC3+
	J_B-7	NTC3-
	J_B-6	CELL13+
	J_B-5	CELL14+
	J_B-4	CELL15+
	J_B-3	CELL16+(Short connect with CELL15+ if it is 15S)
	J_B-2	NTC4+
	J_B-1	NTC4-

Interface	Instruction	
Voltage temperature port 1 	CON1-7	NTC1-
	CON1-6	NTC1+
	CON1-5	CELL1-
	CON1-4	CELL1+
	CON1-3	CELL2+
	CON1-2	CELL3+
	CON1-1	CELL4+
Voltage temperature port 2 	CON2-6	NTC2-
	CON2-5	NTC2+
	CON2-4	CELL5+
	CON2-3	CELL6+
	CON2-2	CELL7+
	CON2-1	CELL8+
Voltage temperature port 3 	CON3-7	NTC3-
	CON3-6	NTC3+
	CON3-5	CELL9-(can connect to CELL8+)
	CON3-4	CELL9+
	CON3-3	CELL10+

	CON3-2	CELL11+
	CON3-1	CELL12+
Voltage temperature port 4 	CON4-6	NTC4-
	CON4-5	NTC4+
	CON4-4	CELL13+
	CON4-3	CELL14+
	CON4-2	CELL15+
	CON4-1	CELL16+(NC or connect to the 15th cells together if the 16th cells NC)

14.3 Dry contact port definition

None

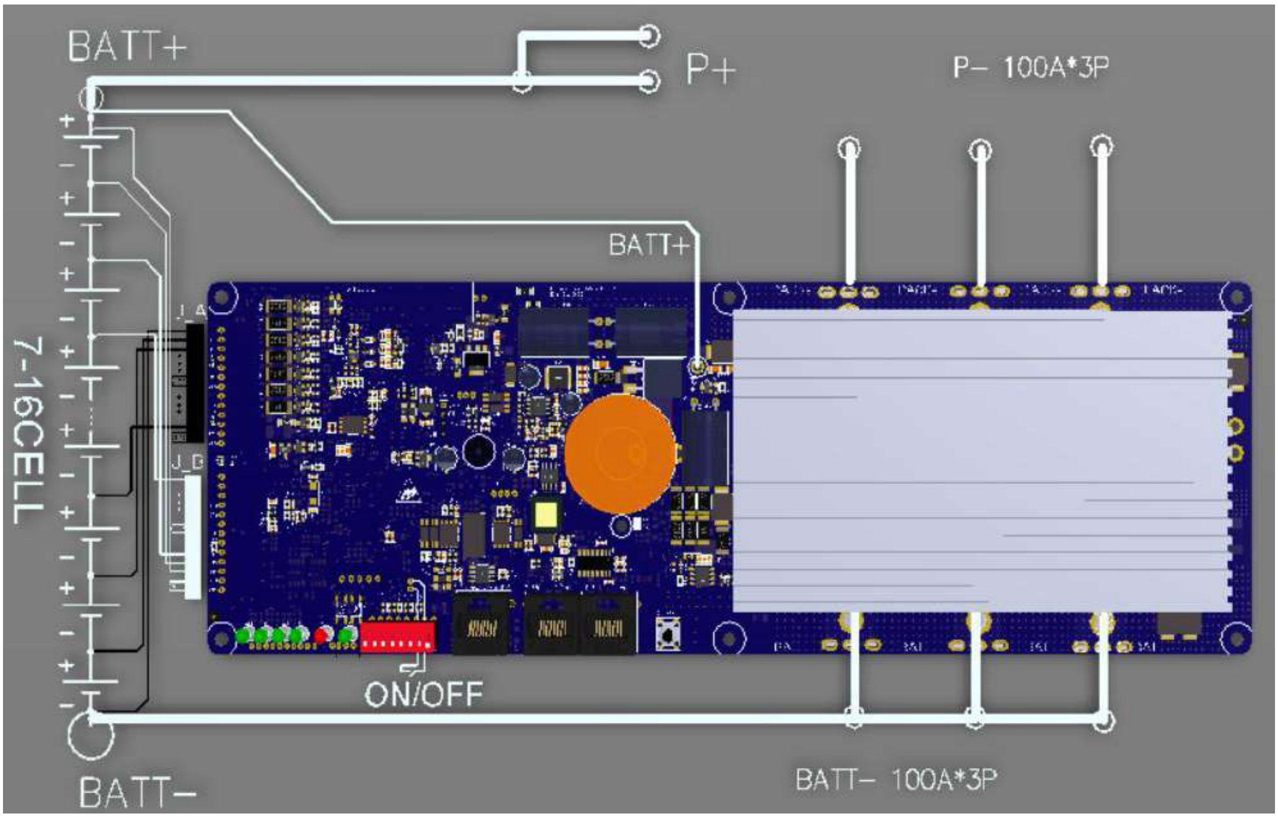
14.4 Weak current switch（power switch）definition

P6A HY2.0 2P   Remark: Default enabled function and can be closed through PC GUI Software.

14.5 Heating film switch definition

J5 XHB2.54-2P   Remark: output current limiting 2A,48V 100W heating film is recommended.

15. Installation Instructions



There are strict requirements for the sequence when power on the BMS. Connect B-, P-, B+, P+ first and then plug the sampling connector(NO1, 2, 3, 4) from B0 to B15/16 in sequence, it will be activated by charging or automatic activated after power on. Load and charging must be added after all the cables are connected and installed.

If you need to power off the BMS, remove the charger or load first, then remove the sampling cable from B16/B15 to B0 in sequence, remove B+, P+, B-, P- at last.

Caution:

1.Need to both cut off the B+ cable and remove the sampling connector(NO 4, 3, 2, 1) immediately when the BMS is powered on.

2.16S and 15S connect description：if user needs to temporarily change the serials(only 15S and 16S)

J_B-4	CELL15+
J_B-3	CELL16+（Short connect with CELL15+ if it is 15S）

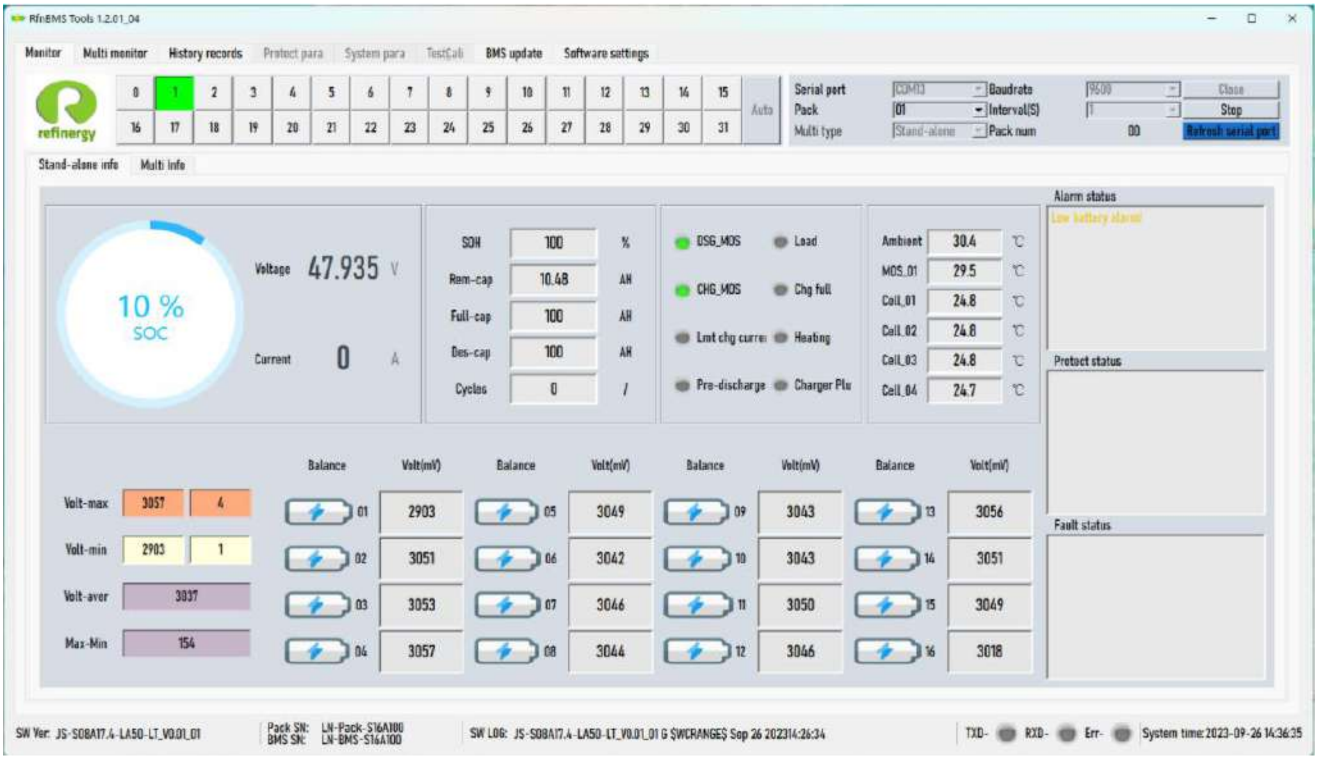
The system parameter configuration cell serials should be written into the corresponding value.

The protection parameter configuration pack under-voltage should be written into the corresponding value.

3.In order to keep the the BMS default current calibration consistently after assembling the pack, it is necessary to strictly control the wire lock position of the B- and P- terminal, for current 200A we need to lock three wires of the same length and thickness, then gather them into one wire.

16. PC GUI Software

We provide free PC software support, the monitoring platform can directly communicate with BMS through RS232/RS485 interface and obtain the latest battery voltage, current, temperature status, SOC&SOH information. The host PC can obtain the battery information of each pack automatically when the option is set to FF. The remote control and parameter settings is only effective to the master pack.



17. Notice

- Reverse or improper connection is not allowed while welding the battery leads. The BMS may be damaged if there is any incorrect connect and need to be retested before it can be used.
- Avoid any direct contact between the BMS and the cell surface to prevent damage to the cell during assembly. The assembly must be firm and reliable.
- The BMS may be damaged if wire leads, soldering iron and soldering tin touch the components on the BMS.
- Pay attention to anti-static, moisture-proof and water-proof when power on.
- Please follow the design parameters and usage conditions strictly when power on, the BMS may be damaged if there is any exceed data values of this specification.
- Please check whether the cables are correctly connected if there is no voltage output or inability to charge when initial power on during assembly.
- PC GUI Software Communication Caution: In order to connect RS485-1 corresponding to JP1 for testing through PC GUI Software, the address dip switch must be set to 2-15 (switch to slave mode) If other ports are connected first, need to wait for 30s to exit the master mode or the RS485-1 can not communicate with the PC GUI Software.