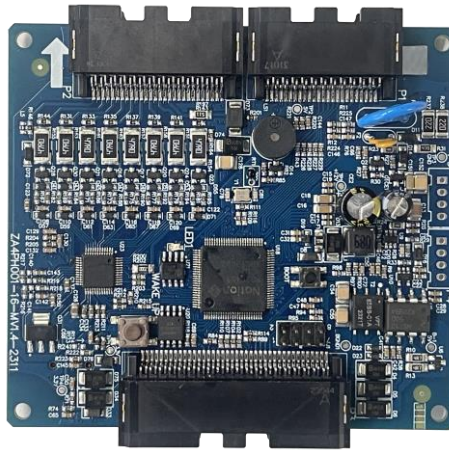
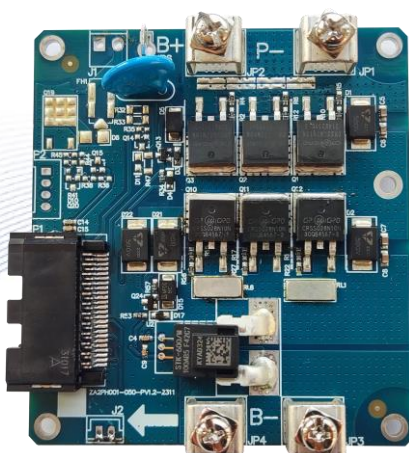


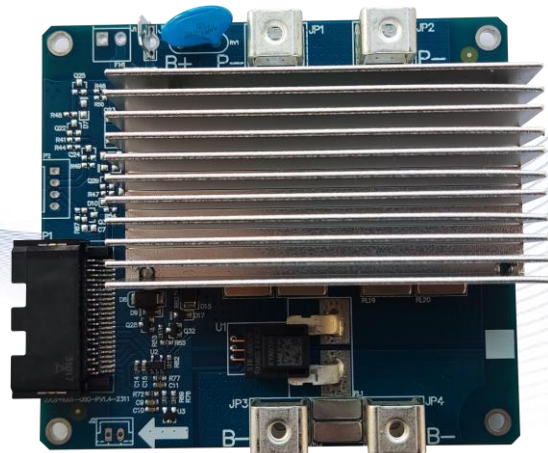
HPA100-16 SERIES LITHIUM BATTERY PROTECTION BOARD USER MANUAL



Physical Image of HPA100-16 Control Board



Physical Image of HPA100-16-050 Power Board



Physical Image of HPA100-16-080 Power Board

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Table – 1 Software Version

Date	Version	Note
2024-01-03	1.0	Original release.

Table – 2 Notation Clarification

Sign	Instruction
 NOTE	Highlights an essential element of a procedure to ensure correctness.
 CAUTION!	Indicates a procedure or practice, which, if not strictly observed, could result in damage or destruction of equipment.
 WARNING!	Indicates a procedure or practice, which could result in injury to personnel or loss of life if not followed correctly.

Glossary and List of Abbreviations

BMS: Battery Management System

AFE: Analog Front End

1 OVERVIEW

HPA100-16 series split-type lithium battery protection board is a significant part of low-voltage lithium battery module, mainly used as backup power supply for 7~16 strings lithium battery base station communication, AGV power lithium battery pack, household energy storage and other systems. It can monitor the working status (voltage, current, temperature, etc.) of battery pack to alarm and protect the over/under voltage, over current, over temperature, reverse connection, etc. It can also provide the balanced protection function to extend the service life for battery cell, and realize the data monitoring, parameter configuration and firmware upgrade via RS485, CANBUS and other interfaces.

2 NAMING CONVENTIONS

2.1 NAMING CONVENTIONS

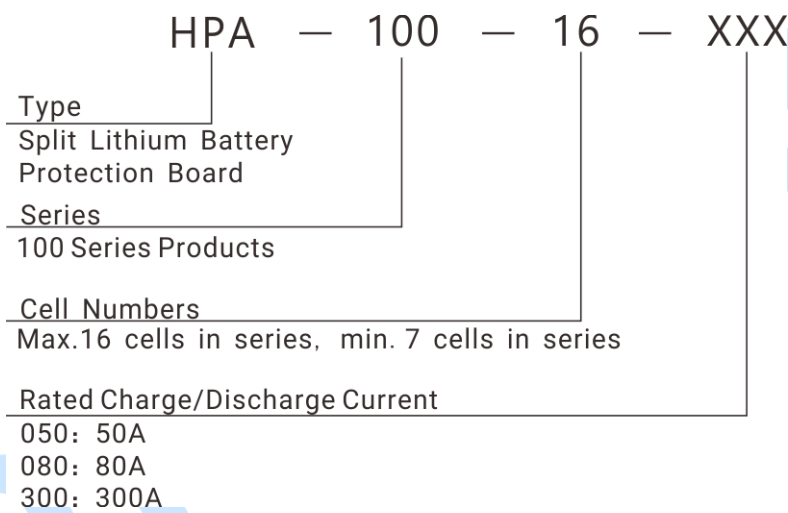


Fig.1 – Naming Conventions

2.2 MODEL COMPARISON

Table 3 – Model Comparison

Model	HPA100-16-050	HPA100-16-080	HPA100-16-300
Rated Charge/Discharge Current	50A	80A	300A
Charge/Discharge Switch Device	Built-in MOS	Built-in MOS	External Relay
External Diverter	No	No	Yes
Cell Capacity	≤50Ah	≤100Ah	Match with relay
Heating Function	Yes	Yes	No
Short Circuit Protection	Yes	Yes	No
Current Limiting	Yes	Yes	No

3 PERFORMANCE AND CHARACTERISTICS

- The stable and reliable AFE chip is adopted to realize the voltage detection of the cells, which supports the voltage detection of 7~16 strings of cells;
- 4 channels of cell temperature detection are supported, and the temperature sensor type is NTC 10K-3950;
- 1 MOS field-effect transistor temperature sampling function, 1 ambient temperature sampling function;
- Alarm and protection functions of over/under voltage, over current, over temperature, reverse connection, etc.;
- Battery loop charge and discharge control;
- With 1# isolated CANBUS interface, 1# isolated RS485 interface, 1# non-isolated and parallel connected RS485 interface, max.15 modules cascade communication are supported;
- 2 Aux. input ports;
- 4 Low side switches (HPA100-16-300);
- It has sleep and wakeup functions for low power consumption;
- Passive balance function, and the max. balanced current is 77mA;
- RTC display and event log functions, which can circularly record 1000 groups of warning, protection, fault and other alarms when they occur and eliminate the records;
- The black box function can record 3 groups of protection and fault events. Each group records 60 pieces of data 50s before and 10s after an event occurs;
- The power is supplied by battery module;
- With buzzer alarm function;
- With heating function, which is used for battery module heating;
- The maximum capacity load of the pre-charging circuit is 30000uF, and specific value is subject to the actual measurement of the system;
- The firmware is upgraded via RS485 interface.

Table 4 –Technical Index

Item	Contents
Working Voltage	Battery supply: 17VDC~64VDC
Overall Power Consumption	Normal working: $\leq 1.2W$; the max.: $\leq 2.6W$, Wake-up: $\leq 15mW$
Cell Voltage Collection	Range: (0~5000)mV Resolution: 1mV Accuracy: $\pm 5mV$
Temperature Collection	Range: $-40^{\circ}C \sim +150^{\circ}C$ Resolution: $1^{\circ}C$ Accuracy: $\pm 1^{\circ}C$ Temp. Sensor Type: NTC 10K-3950
Current Collection	HPA100-16-50, Range: $-50A \sim +50A$, Resolution: 0.1A, Accuracy: 1%FS (Full Range)
	HPA100-16-80, Range: $-80A \sim +80A$, Resolution: 0.01A, Accuracy: 1%FS (Full Range)
	HPA100-16-300, Range: $-300A \sim +300A$, Resolution: 0.01A, Accuracy: 1%FS (Full Range)
SOC Accuracy	$\pm 5\%$
CAN Interface	1#, 250kbps, isolation
RS485 Interface	2#, 9600bps, RS485-1 isolation, RS485-2 non-isolation
Cell Heating Output Power	Max.2A, voltage supplied by P+, P-
Low Side Switch 1-4	3A DC12V, DC power supply active output (HPA100-16-300)
EMC Standard	GB/T 34131-2023
Case Dimensions	Control Board: 95mmx89.8mmx23mm
	HPA100-16-50: 88mmx82.8mmx23.5mm
	HPA100-16-80: 102.8mmx90mmx31mm
	HPA100-16-300: 74.5mmx60mmx23mm
Panel Cutout	Control Board: 87mmx77mm
	HPA100-16-50: 80mmx72mm
	HPA100-16-80: 92mmx82mm
	HPA100-16-300: 64mmx52mm
Working Temperature	$(-40 \sim +70)^{\circ}C$
Working Humidity	$(20 \sim 93)\%RH$
Storage Temperature	$(-40 \sim +80)^{\circ}C$
Weight	253.7 g (HPA100-16-80 Control Board, HPA100-16-80 Power Board) 142.2g (HPA100-16-50 Control Board, HPA100-16-50 Power Board)

5 BUZZER ACTION

Table 5 – Description of Buzzer Action

Enable Status	Action Description
Disable	The buzzer does not sound.
Enable	The buzzer will sound for 1s when you power on the device for the first time or wake up from sleep mode.
	The buzzer will sound for 0.3s when in hibernation.
	When in warning, sounds for 2s and rest for 0.5s; in protection, sounds for twice per second; in fault protection, sounds for 5 times per second; after the short circuit protection is locked for 3 times, the buzzer does not sound.
Note: The buzzer functions can be set to enable or disable through PC, and the factory default is disabled.	

6 SLEEP MODE/WAKEUP KEYS DESCRIPTION

When BMS is in sleep mode, long press the sleep/wakeup key for more than 1s, then release the key after the buzzer changing from sounding to not sounding, then BMS enters the running mode.

When BMS is in running mode, long press sleep/wakeup key for 3~6s, then release the key after the buzzer sounding for once, BMS enters the sleep mode.

7 SLEEP/WAKEUP DESCRIPTION

System will enter the sleep mode if any of the following conditions are met:

- (1) The single cell or the total voltage over discharge protection is not removed after a delay of 30s;
- (2) Long press and hold the keys for 3~6s;
- (3) System without any operation for more than 24 hours and no communication & charger connection;
- (4) Sleep by PC software;
- (5) System without any operation, and the min. single cell voltage is lower than the sleep voltage, and the duration reaches the sleep delay time without communication and charger connection.

System will enter the running mode if any of the following conditions are met:

- (1) Connect to charger, the output voltage of charger will be greater than 36V;
- (2) Long press and hold the key for more than 1s;

8 PARAMETER SETTING

8.1 CONTENTS AND RANGES OF PARAMETER SETTING

Table 6 – Contents and Ranges of Parameter Setting

No.	Item	Range	Default	Description
Module Setting				
1	Password	(0-65534)	1234	
2	RS485_1Comm Baud Rate	(0-2)	0	0: 9600bit/s 1: 19200bit/s 2: 115200bit/s
3	RS485_1 Comm Stop Bit	(0-1)	0	0: 1bit 1: 2 bits
4	RS485_1Parity Check Bit	(0-2)	0	0: No parity 1: Odd 2: Even
5	RS485_2 Comm Baud Rate	(0-2)	0	0: 9600bit/s 1: 19200bit/s 2: 115200bit/s
6	RS485_2 Comm Stop Bit	(0-1)	0	0: 1bit 1: 2 bits
7	RS485_2 Parity Check Bit	(0-2)	0	0: No parity 1: Odd 2: Even
8	CAN Comm Baud Rate	Not Selectable	250kbps	
9	Buzzer Mute	(0-1)	0	0: Disable 1: Enable
10	Inverter Type	(0-50)	0	0: Not used 1: JYHY-01 2: JYHY-02 3: JYHY-03 4: JYHY-04 5: JYHY-05 6~50: Reserved
Battery Module				
1	System Nominal Capacity	(1-600.0)AH	100.0	
2	System Total Capacity	(1-600.0)AH	100.0	
3	Rated Charging Current	(1.0-500.0)A	100.0	
4	Rated Discharging Current	(1.0-500.0)A	100.0	
5	Balance Start Voltage	(2000-5000)mV	3450	
6	Balance Start Voltage Difference	(0-1000)mV	50	
7	Sleep Voltage for Single Cell	(2000-5000)mV	2500	
8	Sleep Delay for Single Cell	(0-120)min	5	
9	Full Charging Voltage	(20.0-70.0)V	57.6	
10	Full Cut-off Current	(50-10000)mA	2000	

No.	Item		Range	Default	Description	
11	Intermittent Charging SOC		(50-100)%	95		
12	Charging Active Current Limiting Value		(0-200.0)%	100.0		
13	Cells Number		(7~16 Strings)	16 Strings	7~16 strings are selectable.	
Protection Parameter Setting						
1	Single Cell Over Voltage Protection	Protection Setting	Warning Enable	(0-1)	1	0: Disable 1: Enable
2			Warning Threshold	(2000-5000)mV	3550	Return voltage difference is 10mV.
3			Protection Threshold	(2000-5000)mV	3650	
4			Protection Delay	(0-60.0) s	3.0	
5		Return Condition	Return Volt.	(2000-5000)mV	3450	When the cell voltage is less than or equal to the setting threshold, the protection returns; or when SOC is less than or equal to the setting threshold, the protection returns; or when the discharging current is greater than or equal to the threshold, the protection returns.
6			Return SOC	(0-100)%	90	
7			Return Current	(0-50.0)A	1.0	
8	Total Cell Over Voltage Protection	Protection Setting	Warning Enable	(0-1)	1	0: Disable 1: Enable
9			Warn	(20.0-70.0)V	56.0	
10			Protection	(20.0-70.0)V	57.6	
11		Return Condition	Delay	(0-60.0)s	3.0	
12			Return	(20.0-70.0)V	54.4	When total voltage is less than or equal to the setting
13			Return SOC	(0-100)%	90	

No.	Item			Range	Default	Description
14	ecti on	ditio n	Return Current	(0-50.0)A	1.0	threshold, the protection returns; or when SOC is less than or equal to the setting threshold, the protection returns; or when discharging current is greater than or equal to the setting threshold, the protection returns.
15	Sing le Cell Und er Volt . Prot ecti on	Prot ecti on Sett ing	Warning Enable	(0-1)	1	0: Disable 1: Enable
16			Warn	(2000-5000)mV	2700	
17			Protection	(2000-5000)mV	2600	When under voltage protection lasts for 30s and still cannot be recovered, the unit enters the low-power mode and returns when charging voltage signal is detected.
18			Protection Delay	(0-60.0)s	1.0	
19	ecti on	Ret urn Con ditio n	Return	(2000-5000)mV	2950	The protection returns when the lowest voltage is greater than or equal to the setting threshold.
20	Tot al Cell Und er Volt . Prot ecti on	Prot ecti on Sett ing	Warning Enable	(0-1)	1	0: Disable 1: Enable
21			Warn	(20.0-70.0)V	44.0	
22			Protection	(20.0-70.0)V	42.4	When under voltage protection lasts for 30s and still cannot be recovered, the unit enters the low-power mode and returns when charging voltage signal is detected.
23			Delay	(0-60.0)s	2.0	
24	Prot ecti on	Ret urn Con ditio n	Return	(20.0-70.0)V	48.0	The protection returns when total voltage is greater than or equal to the setting threshold.

No.	Item			Range	Default	Description
25	Charging Over Current Protection	Protection Setting	Warning Enable	(0-1)	1	0: Disable 1: Enable
26			Warn	(0.1-150.0)%	102.5	
27			Protection	(0.1-150.0)%	105	The status will be locked after 3 consecutive occurrences, it will not be automatically unlocked. It will be automatically unlocked after 1 minute.
28			Delay	(0-60.0)s	2.0	
29	Protection	Return Condition	Return Current	(0-50.0)A	1.0	The protection returns when discharging current is greater than the setting threshold.
30	Discharging Over Current Protection	Protection Setting	Warning Enable	(0-1)	1	0: Disable 1: Enable
31			Warn	(0.1-300.0)%	102.5	
32			Protection 1	(0.1-300.0)%	105	The status will be locked after 3 consecutive occurrences, it will not be automatically unlocked. It will be automatically unlocked after 1 minute. It will be unlocked when charging current is greater than the setting threshold.
33			Delay	(0-60.0)s	0.1	
34			Protection 2	(0.1-300.0)%	112.5	The status will be locked after 3 consecutive occurrences, it will not be automatically unlocked. It will be automatically unlocked after 1 minute. It will be unlocked when charging current is greater than the setting threshold.
35		Delay	(0-60.0)s	0.1		
36		Return Condition	Return Current	(0-50.0)A	1.0	The protection returns when charging current is greater than the setting threshold.

No.	Item		Range	Default	Description	
37	Short-Circuit Protection		Delay	(100-1000)us	300	The status will be locked after 3 consecutive occurrences, it will not be automatically unlocked. It will be unlocked when charging voltage signal is detected or load is removed.
38	MOS High Temp. Protection	Protection Setting	Warning Enable	(0-1)	1	Note: HPA100-16-300 has no this setting.
39			Warn	(-40-120) °C	95	
40			Protection	(-40-120) °C	115	
41	Low Ambient Temp. Protection	Return Condition	Return	(-40-120) °C	85	The protection returns when MOS temperature is less than or equal to the setting threshold.
42			Warning Enable	(0-1)	1	
43			Warn	(-40-120) °C	-10	
44	High Ambient Temp. Protection	Return Condition	Protection	(-40-120) °C	-20	
45			Return	(-40-120) °C	0	
46			Warning Enable	(0-1)	1	
47	High Ambient Temp. Protection	Return Condition	Warn	(-40-120) °C	60	
48			Protection	(-40-120) °C	70	
49			Return	(-40-120) °C	50	
50	High Charging	Protection Setting	Warning Enable	(0-1)	1	
51			Warn	(-40-120) °C	50	
52			Protection	(-40-120) °C	65	

No.	Item			Range	Default	Description
53	Temp. Protection	Return Condition	Return	(-40-120) °C	55	The protection returns when the charging temperature is less than or equal to the setting threshold.
54	Low Charging Temp.	Protection Setting	Warning Enable	(0-1)	1	
55			Warn	(-40-120) °C	0	
56			Protection	(-40-120) °C	-10	
57	Temp. Protection	Return Condition	Return	(-40-120) °C	-1	The protection returns when the charging temperature is greater than or equal to the setting threshold.
58	High Discharging Temp. Protection	Protection Setting	Warning Enable	(0-1)	1	
59			Warn	(-40-120) °C	50	
60			Protection	(-40-120) °C	65	
61			Return	(-40-120) °C	60	The protection returns when the discharging temperature is less than or equal to the setting threshold.
62	Low Discharging Temp. Protection	Protection Setting	Warning Enable	(0-1)	1	
63			Warn	(-40-120) °C	0	
64			Protection	(-40-120) °C	-20	
65			Return	(-40-120) °C	-10	The protection returns when the discharging temperature is greater than or equal to the setting threshold.
66	Low Power Warning		Warning Threshold	(0-100)%	5	No warning when charging.

9 TERMINAL DEFINITION AND CASE DIMENSIONS

9.1 TERMINAL DEFINITION

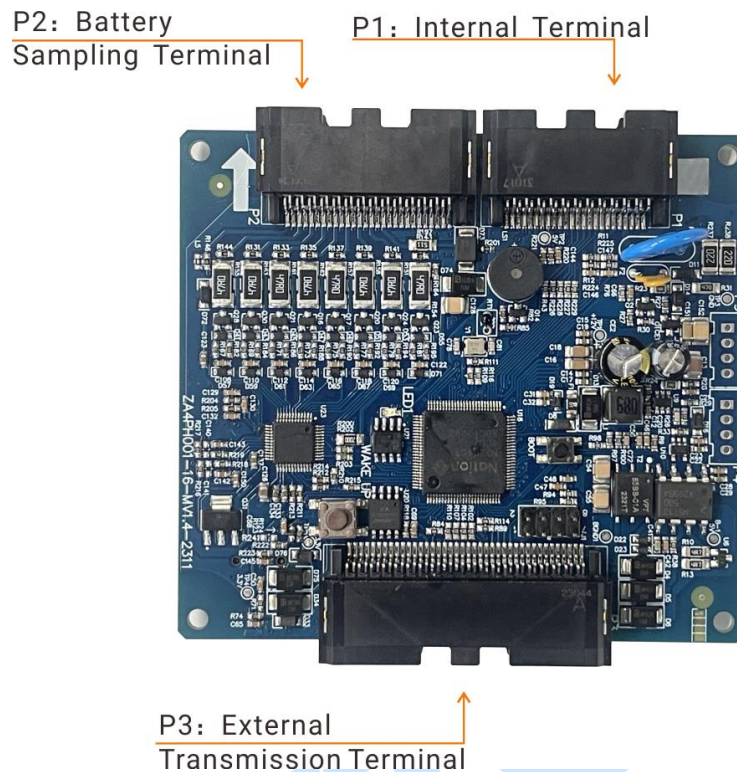


Fig.2 – HPA100-16 Physical Image

Table 7 – Internal Terminals of HPA100-16

No.	Definition	No.	Definition
1	PreChg_MOS	13	CHG_MOS
2	MOS_BT	14	DSG_MOS
3	Current1	15	GND
4	GND	16	+5.0V
5	SC	17	NC
6	POW_OFF	18	GND
7	RELAY_O_2	19	RELAY_O_1
8	RELAY_O_4	20	RELAY_O_3
9	GND	21	P_ID1
10	NC	22	P_ID2
11	P+	23	B+
12	P-	24	NC

Table 8 – Battery Sampling Terminals of HPA100-16

No.	Definition	No.	Definition
1	BV_1	15	BV_0
2	BV_3	16	BV_2
3	BV_5	17	BV_4
4	BV_7	18	BV_6
5	BV_9	19	BV_8
6	BV_11	20	BV_10
7	BV_13	21	BV_12
8	BV_15	22	BV_14
9	NC	23	BV_16
10	NC	24	NC
11	AFE_GND	25	NTC1-10k
12	AFE_GND	26	NTC2-10k
13	AFE_GND	27	NTC3-10k
14	AFE_GND	28	NTC4-10k

Table 9 – Battery Sampling Terminal Functions of HPA100-16

No.	Definition	Functions
HPA100-16 Battery Sampling Terminals		
1	BV_1	Battery Positive 1
2	BV_3	Battery Positive 3
3	BV_5	Battery Positive 5
4	BV_7	Battery Positive 7
5	BV_9	Battery Positive 9
6	BV_11	Battery Positive 11
7	BV_13	Battery Positive 13
8	BV_15	Battery Positive 15
15	BV_0	Battery Negative 1
16	BV_2	Battery Negative 2
17	BV_4	Battery Negative 4
18	BV_6	Battery Negative 6
19	BV_8	Battery Negative 8
20	BV_10	Battery Negative 10
21	BV_12	Battery Negative 12
22	BV_14	Battery Negative 14
23	BV_16	Battery Negative 16
11	AFE_GND	Temperature Detection 1 Negative
12	AFE_GND	Temperature Detection 2 Negative
13	AFE_GND	Temperature Detection 3 Negative
14	AFE_GND	Temperature Detection 4 Negative
15	NTC1-10k	Temperature Detection 1 Positive
16	NTC2-10k	Temperature Detection 2 Positive

No.	Definition	Functions
17	NTC3-10k	Temperature Detection 3 Positive
18	NTC4-10k	Temperature Detection 4 Positive

Table 10 – DI & Communication Terminals of HPA100-16

No.	Definition	No.	Definition
1	CAN_L	21	CAN_H
2	NC	22	NC
3	RS485_1B	23	RS485_1A
4	NC	24	NC
5	RS485_2B	25	RS485_2A
6	NC	26	NC
7	NC	27	NC
8	NC	28	NC
9	NC	29	NC
10	NC	30	NC
11	NC	31	NC
12	NC	32	NC
13	NC	33	NC
14	NC	34	NC
15	NC	35	INPUT1_1
16	NC	36	INPUT1_2
17	Power_Switch	37	GND
18	INPUT2	38	GND
19	NC	39	GND
20	NC	40	NC

Table 11– DI & Communication Terminal Functions of HPA100-16

No.	Definition	Functions
HPA100-16 DI& Communication Terminals		
1	CAN_L	Isolated CAN, used to communicate with external device.
21	CAN_H	
17	Power_Switch	According to the user requirements, power switch is enabled by PC configuration, using rocker switch to connect to Terminal 17 and Terminal 37 (No.38 & No.39).
37	GND	
35	INPUT1_1	Aux. input port 1 (connect to battery positive or charger output negative side is active).
36	INPUT1_2	Common port of Aux. input port 1 (externally connect to battery negative or charger output negative side).
18	INPUT2	Aux. input 2 (connect to battery negative is active).
38	GND	Common port of Aux. input 2 (Connect to battery negative internally).
5	RS485_2B	Non-isolated 485 interface, using PCS, charging pile to communicate.
25	RS485_2A	
23	RS485_1A	Isolated 485 interface, used to communicate with PC.

No.	Definition	Functions
3	RS485_1B	
39	GND	

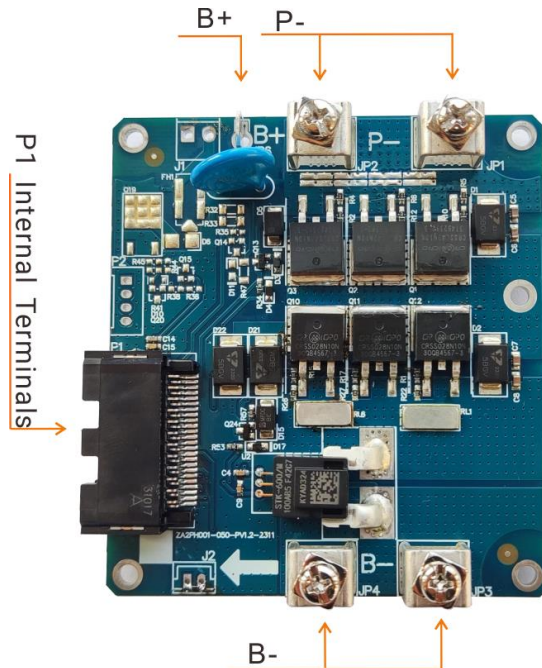


Fig.3 – Physical Image of HPA100-16-050

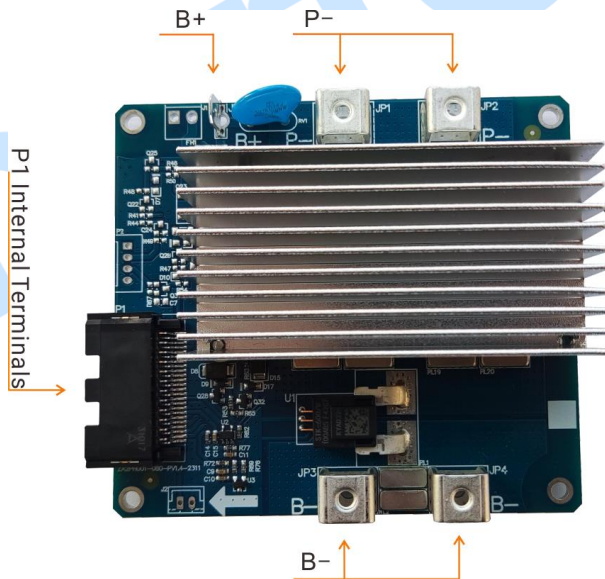
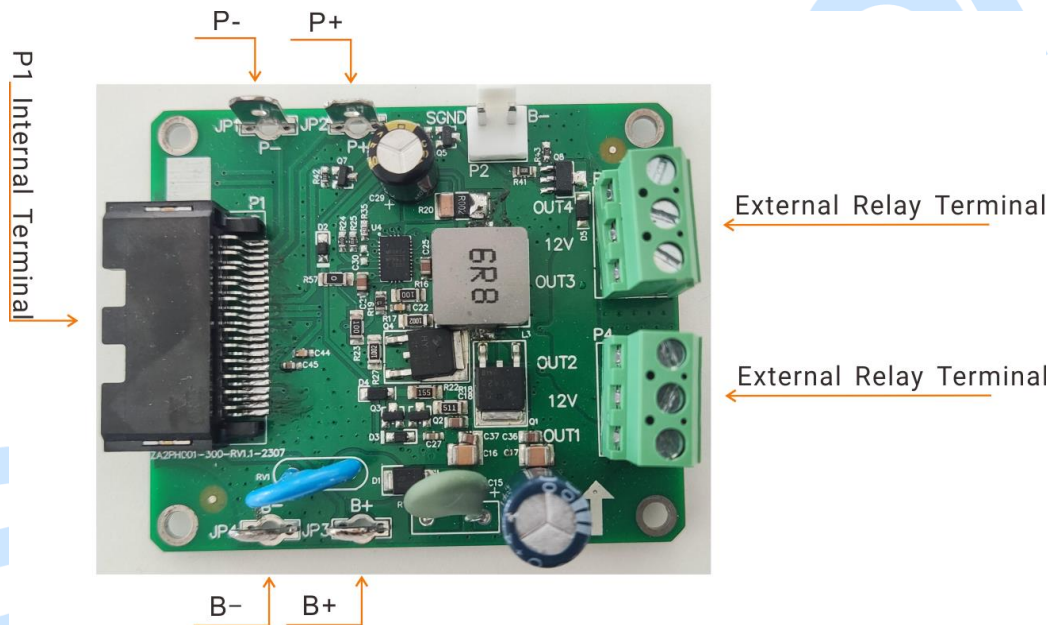


Fig.4 – Physical Image of HPA100-16-080

Table 12– Internal Terminals of HPA100-16-050/080

No.	Definition	No.	Definition
1	PreChg_MOS	13	CHG_MOS
2	MOS_BT	14	DSG_MOS
3	Current1	15	GND
4	GND	16	+5.0V
5	Over_Current	17	NC
6	NC	18	NC
7	NC	19	NC
8	NC	20	NC
9	GND	21	P_ID1
10	NC	22	P_ID2
11	P+	23	B+
12	P-	24	NC

Note: P- terminal: M4x8 screw; B-terminal: M4x8 screw; B+: red cable lug


Fig.5 – Physical Image of HPA100-16-300
Table 13– Internal Terminals of HPA100-16-300

No.	Definition	No.	Definition
1	NC	13	NC
2	Current2	14	NC
3	Current1	15	GND
4	GND	16	+5.0V
5	NC	17	GND
6	NC	18	NC
7	RELAY_O_2	19	RELAY_O_1
8	RELAY_O_4	20	RELAY_O_3
9	GND	21	GND
10	NC	22	GND
11	P+	23	B+

No.	Definition	No.	Definition
12	P-	24	NC

Note: P- blue cable lug; P+ red cable lug; B+ red cable lug; B- blue cable lug

9.2 CASE DIMENSIONS

Unit: mm

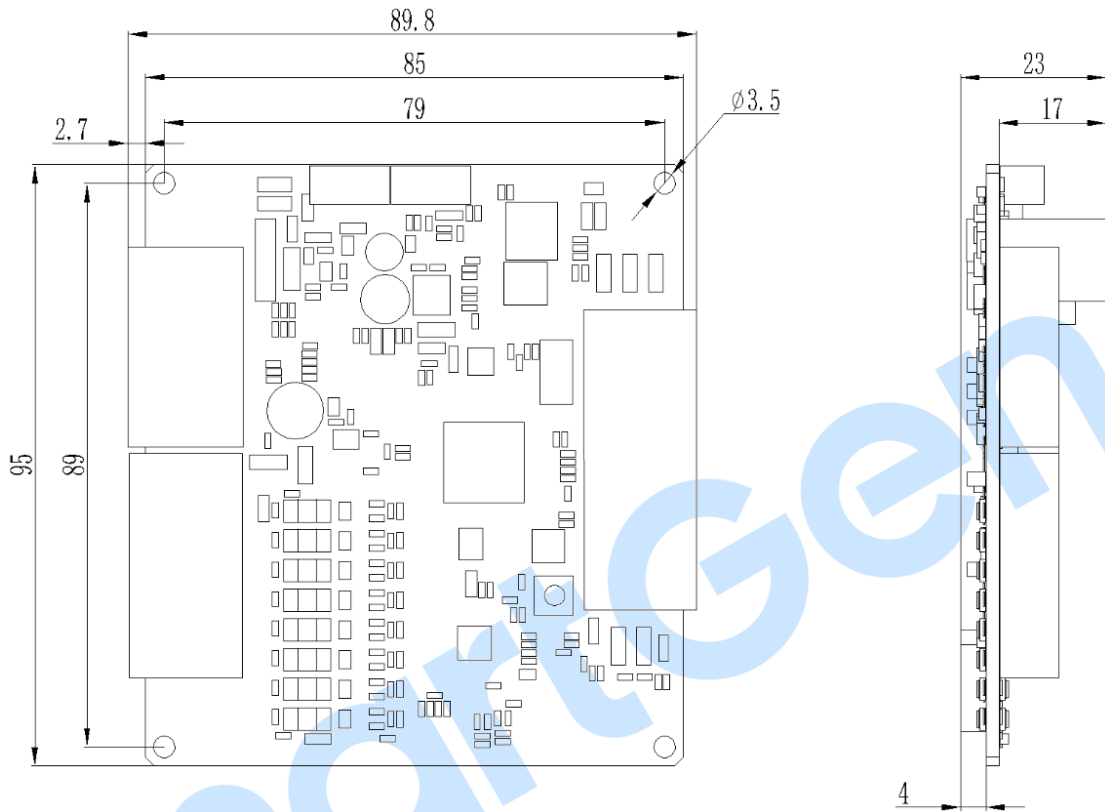


Fig.6 – Case Dimensions of HPA100-16

Unit: mm

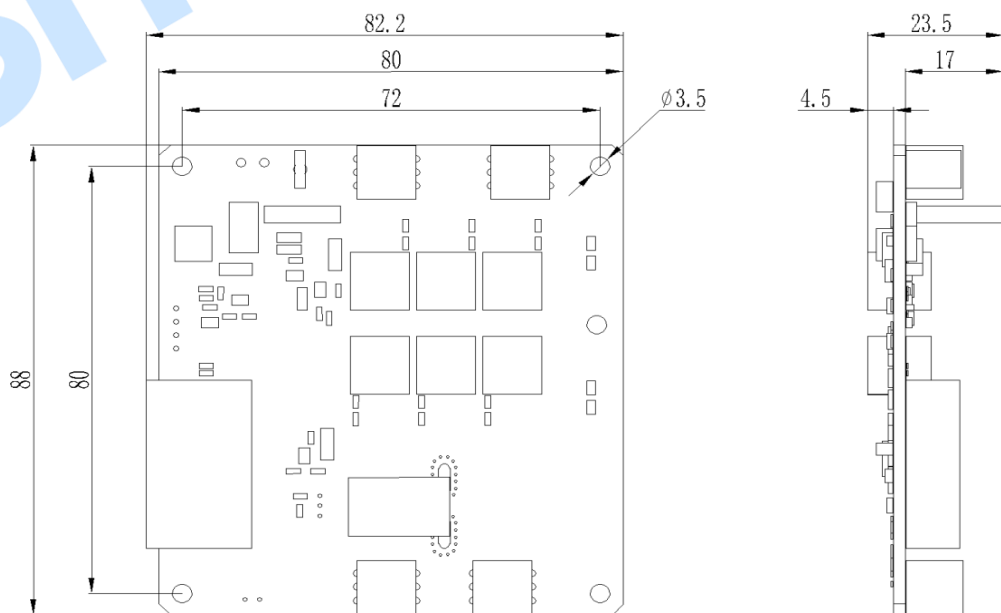


Fig.7 – Case Dimensions of HPA100-16-050

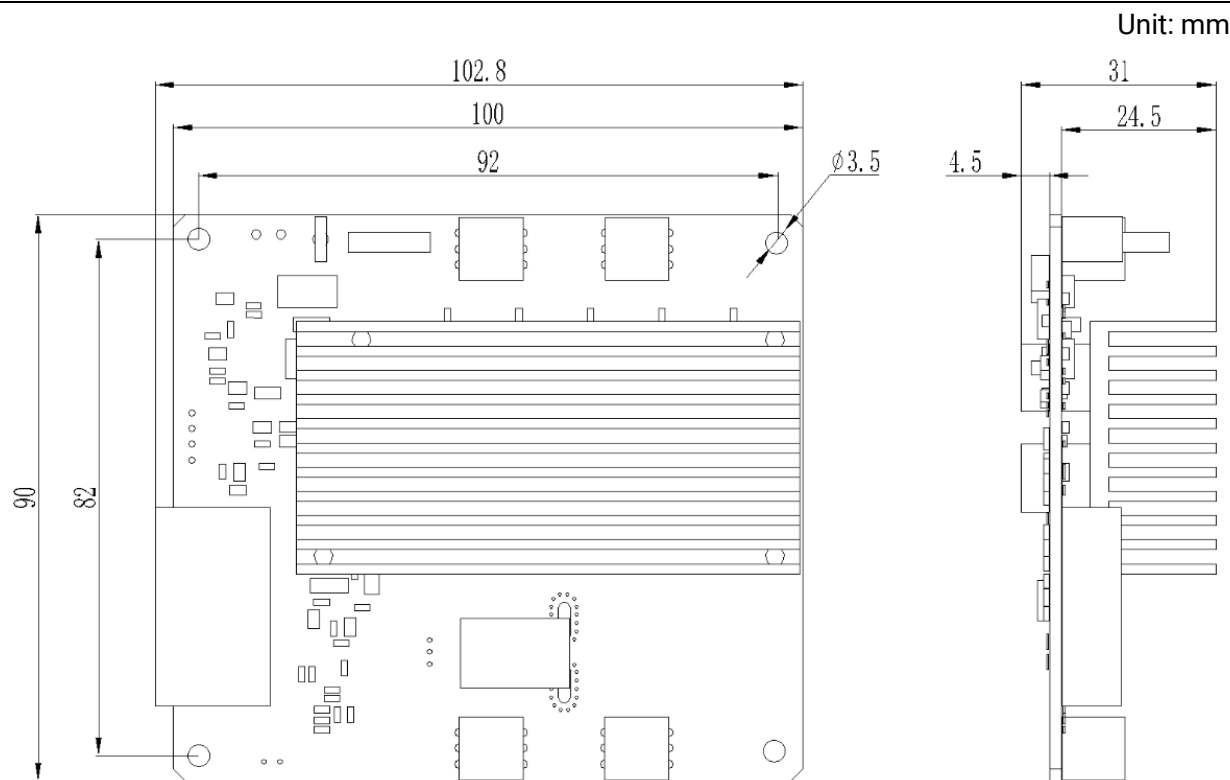


Fig.8 – Case Dimensions of HPA100-16-080

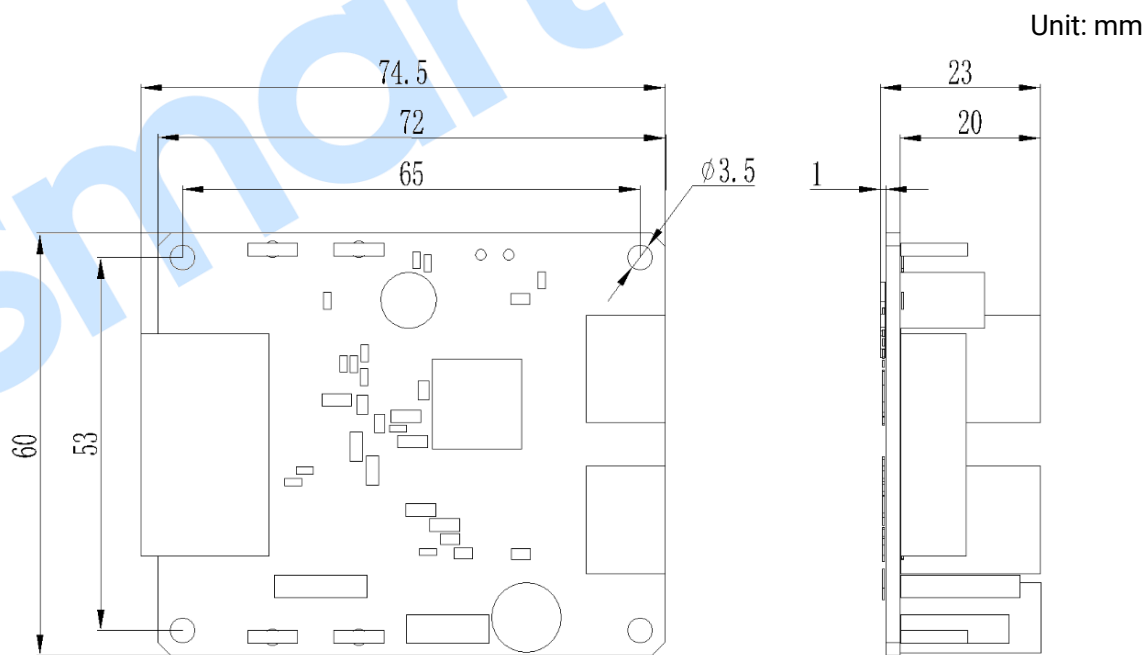


Fig.9 – Case Dimensions of HPA100-16-300

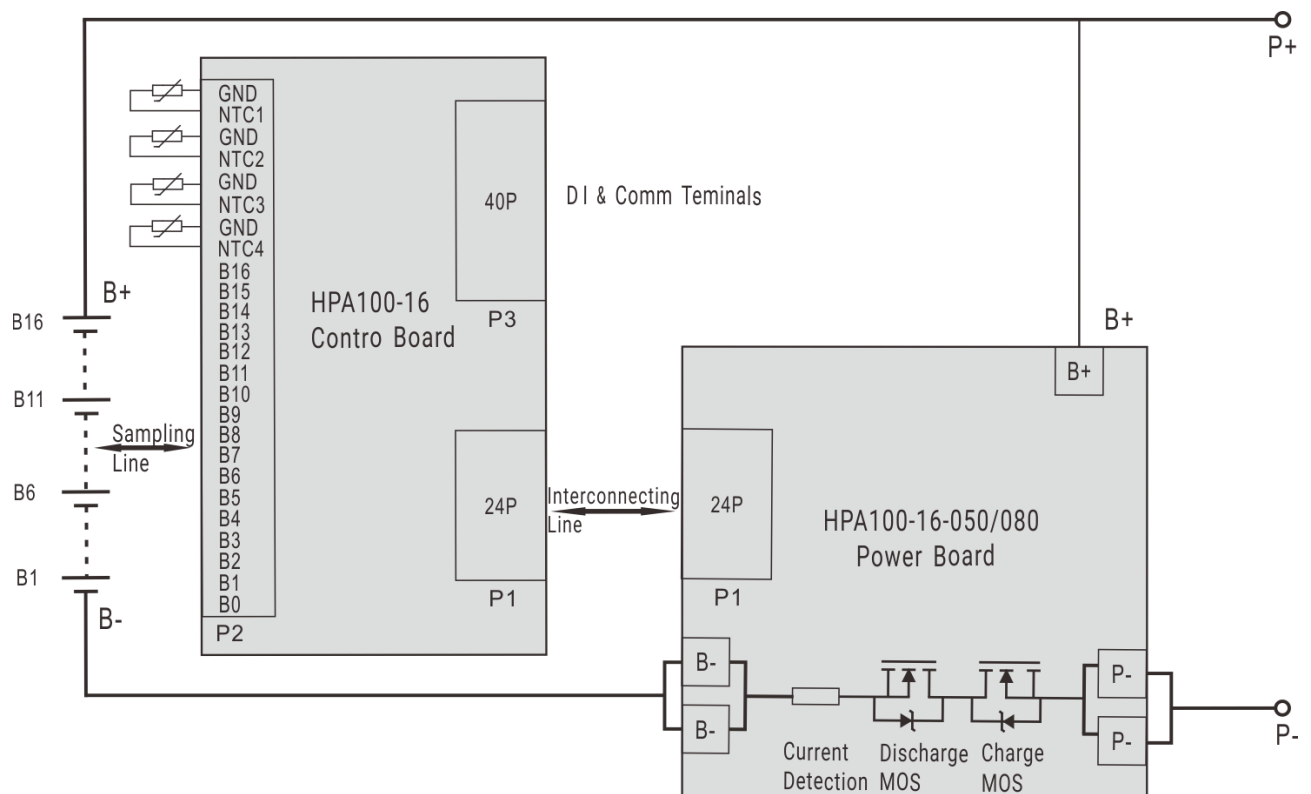


Fig.10 – Application Diagram of HPA100-16-050/080

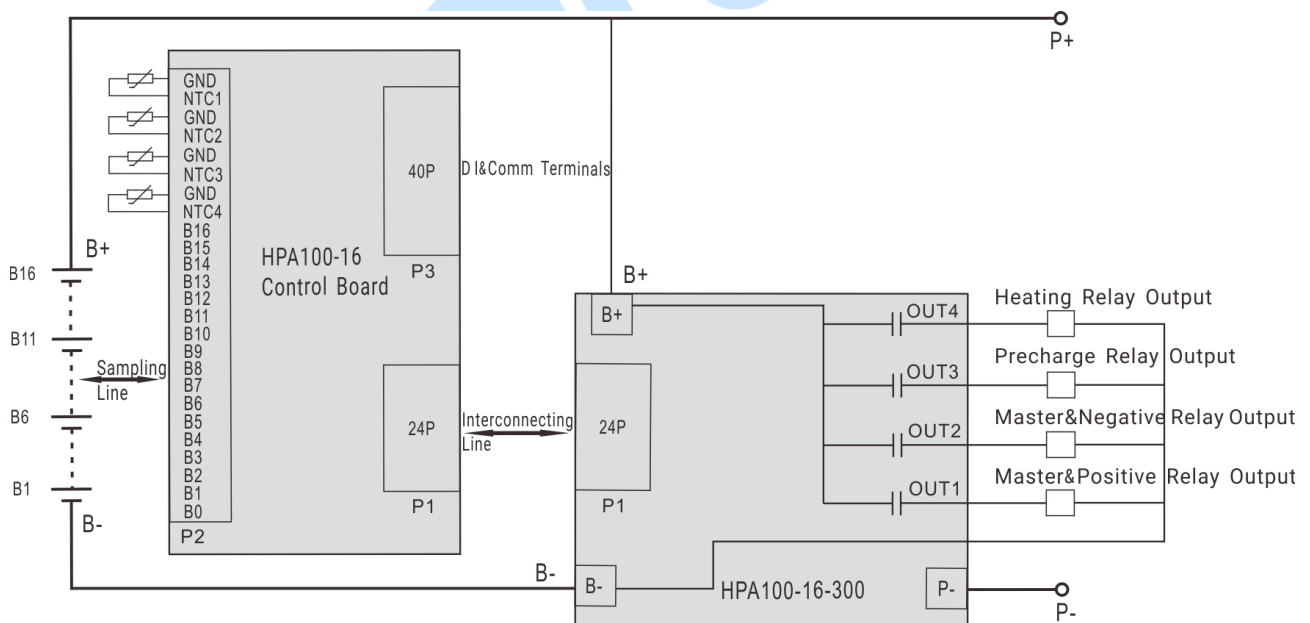


Fig.11 – Application Diagram of HPA100-16-300

Table 14 – Trouble Shooting

Fault Symptom		Possible Measurement
Protection board no response when power on		Check the wirings of protection board.
Communication Failure	CAN Communication Fault	Check the wirings; Check if the wirings between CAN_H and CAN_L are reversely connected; A 120Ω resistor is recommended to connect between CAN_H and CAN_L.
	485 Communication Fault	Check the wirings; Check ID setting; Check if the wirings between RS485_A and RS485_B are reversely connected; Check if PC communication baud rate and parity bit are correct; A 120Ω resistor is recommended to connect between A&B of RS485.
Abnormal battery voltage and temperature data		Check the wirings; Check the connector is tightly inserted;