B-BOX system safety performance introduction

1 Standard reference

IEC 60950-1:2005 (Second Edition) + Am 1:2009 + Am 2:2013

EN 60950-1/A12:2011

IEC 62619

2 Design proposal
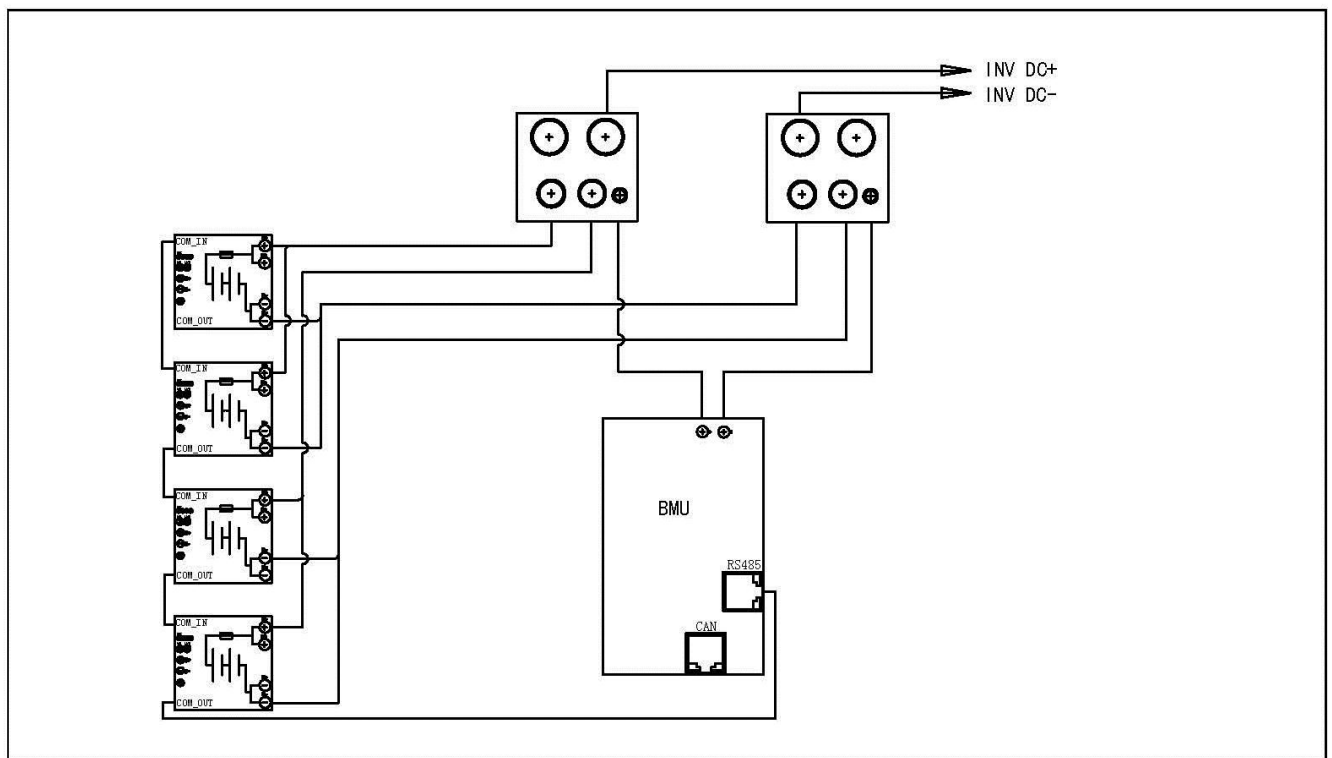
2.1 Topological graph

Figure 1 System schematic diagram

Description:the system consist of four B-PLUS 2.5(U3A1-50P-A) batteries(covers 3/2/1 B-PLUS 2.5(U3A1-50P-A) battery)、,BMU（Read information of B-PLUS 2.5(U3A1-50P-A) and control current to inverter）)

2.2 Grounded design

B-PLUS 2.5(U3A1-50P-A) battery connect to GND busbar, ,at last, the PE busbar connect to ground directly.

2.3 Safety protection

    2.3.1   There is a lock on the front door to forbid electronic component connect with human body.

    2.3.2   Every B-PLUS 2.5 contain FUSE(with UL248 and ISO 8820-5 certification)

    2.3.3   System have complete electrical protection list in below table:

Item	Parameter

Over voltage protection	59V
Lack voltage protection	43.2V
Over current protection when charging	50A*N
Over current protection when discharging	60A*N
High temperature protection when charging	60℃
High temperature protection when discharging	60℃
Low temperature protection when charging	-10℃
Low temperature protection when discharging	-20℃
Short circuit protection	Y
Reverse connect protection	Y
Parallel connect short circuit protection	Y

3 Protect function of B-plus2.5

Protect function relized by BMS –battery management system.

BMS as an important component had effect on battery protection and monitor. In long-term process of using, the consistence difference of battery pack may causes voltage difference and SOC difference from cell. The cell hold higher SOC may be easily to fully charged, and cell keep on lower SOC may cause over discharge then lead to cell failure.

Over charge/discharge will cause a series of problems such as resistance increasing, lithium ion separated, power degradation etc. so as to decrease efficiency of charge/discharge, shorten the cycle life and cause potential risk, altogether, the BMS avoid over charge/discharge of the battery pack or cell unit to make battery used better.

Detail BMS protect function list:

No.	Sub-circuit module	Description
1	Safety protection electric circuit	• Anti-EMI/conduction/radiation design; • Anti electrostatic design, anti electrical surge design.
2	Power starting circuit	The circuit realizes power supply from the battery and external power, turning on/off BMS systematic function by hand, transposition starting protection, DC/DC power down and turn off by itself.
3	Power supply circuit	Convert IC, LDO circuit via DC-DC to input 30V~72V, and output isolated/non-isolated power supply voltage such as 3.3V, 5V, 12V, 25V etc.
4	cell voltage inspection circuit	Sampling of single cell by discreting components and integrating IC. Examine samples by inputting MCU ADC.
5	Temperature Inspection circuit	Inspect the practical temperature of cell via the temperature sensor on it. Set the temperature number as the voltage number and examine samples by inputting MCU ADC.

6	Balance Control Circuit	Adopt different equalization resistance according to different capacity. When charging, start return circuit of the single cell and adjust the voltage when it's overcharged.
7	Current Inspection Circuit	Collect charge/discharge current via current sensor and convert it to voltage data. Examine sampls by inputting MCU ADC.
8	Hardware protection circuit	Realize quick hardware response and protection of charge/discharge overcurrent and short circuit.
9	Discharge Control Circuit	Respond to the discharge control of MCU software and hardware circuit; realize timely on/off of discharge return circuit and normal discharge function and protection function of battery.
10	Charge Control Circuit	Respond to the discharge control of MCU software and hardware circuit; Realize timely on/off of charge return circuit and normal charge function and protection function of battery.
11	PACK voltage inspection circuit	Realize the inspection of PACK and battery total voltage.
12	Heater Control Circuit(**Reserved)**	Realize the control on heater and inspect the effectiveness of the control.
13	LED display circuit	Display the capacity, running status and warning etc.
14	Communication Circuit	RS485 communication mode report the battery status to control equipment such as PC, PMU etc. Or report battery warning abnormality via dry contact.
15	MCU	Take ADC samples to voltage, current and temperature, receive logical judge signal, output logical control signal communication, report voltage, current and temperature data. It's the CPU of smart control plan.

BYD Lithium battery Co.,ltd

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