# 苏州普厉特智能科技有限公司
Suzhou Preta Intelligence and Technology Co., Ltd.

# Hbowa-UTL-418

## Energy Storage System Specification

| Version | Date | Changes |
|---|---|---|
| V1.0 | 2024/09/12 | First Release |
| V1.1 | 2025/03/06 | Modify the DC system parameters in Table 2 |
| V1.2 | 2025/03/15 | Updated series of diagrams for the internal diagram of the energy storage system in Figure 2 and the schematic diagram of the DC system in Figure 4 |
| | | |

# Content

# Figure

# Table

# 1. General Introduction

## 1.1. Confidentiality

This product specification document is intended solely for personnel involved in this project. It may not be transferred to other individuals without prior authorization.

## 1.2. Purpose of the Document

This product is developed by Suzhou Preta Intelligence and Technology Co., Ltd. The document describes the product's performance metrics, including basic functions, interfaces, key parameters, safety performance, and related statements.

This document provides specifications and parameters for the product. If any deficiencies are identified by the contracting parties, they shall notify the company's R&D department for review and updates.

Suzhou Preta Intelligence and Technology Co., Ltd. reserves the right to update and clarify this document.

## 1.3. Definitions and Abbreviations

BMS：Battery Management System

BAU：Battery Array management Unit

BCU：Battery Cluster management Unit

BMU：battery Module management Unit

TMS：Thermal Management System

FSS：Fire Suppression System

BOL：Beginning of Life

EOL：End of Life

RTE：Round-Trip Efficiency

LC：Local Controller

## 1.4. Compliance with Standards

Meets the following criteria

| | |
|---|---|
| UN38.3 | Lithium metal and lithium-ion batteries |
| NFPA 68 | Standard on Explosion Protection by Deflagration Venting |
| NFPA 69 | Standard on Explosion Prevention Systems |

| | |
|---|---|
| NFPA 70E | Standard for electrical safety in the workplace |
| NFPA 855 | Standard for the installation of stationary energy storage systems |
| IEEE 1584 | IEEE Guide for Performing Arc-Flash Hazard Calculations |
| IEEE 693 | IEEE Recommended Practice for Seismic Design of Substations |
| UL 9540A | Standard for safety test method for Evaluating Thermal Runaway Fire Propagation in Battery Energy Storage Systems |
| UL 9540 | Standard for safety energy storage systems and equipment |
| UL 1973 | Standard for safety batteries for use in stationary and motive auxiliary power applications |
| UL 471 | Commercial Refrigerators and Freezers |
| UL 1778 | Standard for safety uninterruptible power systems |
| UL 489 | Molded-case circuit breakers, molded-case switches, and circuit-breaker enclosures |
| UL 1077 | Supplementary protectors for use in electrical equipment |
| UL 98 | Standard for safety enclosed and dead-front switches |
| UL 62368-1 | Standard for safety Audio/Video, Information and Communication Technology Equipment-Part 1: Safety Requirements |
| IEC 62619 | Secondary cells and batteries containing alkaline or other non-acid Electrolytes-Safety requirements for secondary lithium cells and batteries for use in industrial applications |
| IEC 62477-1 | Safety requirements for power electronic converter systems and equipment -Part 1: general |
| IEC 60664-1 | Insulation coordination for equipment within low-voltage supply systems – Part 1: Principles, requirements and tests |
| IEC 61000-6-2 | Electromagnetic compatibility (EMC) – Part 6-2: Generic standards Immunity standard for industrial environments |
| IEC 61000-6-4 | Electromagnetic compatibility (EMC) – Part 6: Generic standards Section 4: Emission standard for industrial environments |
| IEC 60730 | Software safety requirements for automatic embedded control systems |
| IEC 62040 | Uninterruptible power systems (UPS) – Part 3: Method of specifying the performance and test requirements |

# 2. Technical Specifications

## 2.1. Applications

The Hbowa-UTL-418 energy storage battery system is designed with independent auxiliary power distribution, liquid cooling, alarm, fire suppression, and automated control systems for safety assurance. It features simple operation and convenient wiring. Composed of Suzhou Preta Intelligence and Technology Co., Ltd.'s 314Ah battery cells, the system delivers high energy density, long cycle life, high efficiency, and adaptability to low-temperature and high-altitude environments. In smart grid energy storage applications, it effectively regulates power resources, balances day-night and seasonal electricity demand variations, optimizes supply-demand gaps, ensures grid stability, and serves as a critical enabler for renewable energy integration and intelligent grid management.

## 2.2. Product Advantages

The Hbowa-UTL-418 energy storage system offers the following advantages:

1) **Standardized Design**：It can be loaded into 20HC high-cabin containers, which meets shipping standards, and also adopts the PACK pre-installation system to save transportation and on-site installation costs.
2) **Convenient Interfaces**：Centralized DC/AC/communication cable areas simplify installation.
3) **High Integration**：System-level integration achieves an area energy density exceeding 247 kWh/m².
4) **Adaptive Thermal Management**：Intelligent temperature control automatically adjusts to battery conditions, extending lifespan. High-efficiency liquid cooling further reduces auxiliary energy consumption.
5) **Backup Power Support**：The low-voltage auxiliary system operates for 2 hours after main power loss.
6) **Humidity Self-Regulation**：Built-in dehumidification maintains optimal humidity, prevents condensation, and enhances corrosion resistance.
7) **Ultimate Safety**：Multi-level protection: Cell pressure relief valves prevent combustible gas accumulation.；Aerosol fire suppression devices in battery boxes and cabinets suppress thermal runaway.；Explosion vent panels on cabinet tops mitigate gas-induced explosions.；UL94-V0 fire-resistant insulation layers block heat propagation.
8) **Cells**：LiFePO4 (LFP) chemistry with gel-based flame-retardant electrolyte minimizes combustion risks.
9) **PACK**：Aerogel insulation blocks thermal runaway. Fuse protection design reduces short-circuit hazards.
10) **RACK**：

- Fuse，Contactor and Isolating Switch Protection, a multi-level protection linkage mechanism minimizes risks of overcharge, over-discharge, and short circuits.
- Emergency Stop and Lightning Protection: Further enhances system safety.
- Multi-level Fire Detection Design：

  Temperature Detectors: Monitor cabinet temperature to detect anomalies.

  Smoke Detectors: Measure smoke density to identify potential fires.

  Audible/Visual Alarms: Trigger warnings based on signals from temperature and smoke detectors.

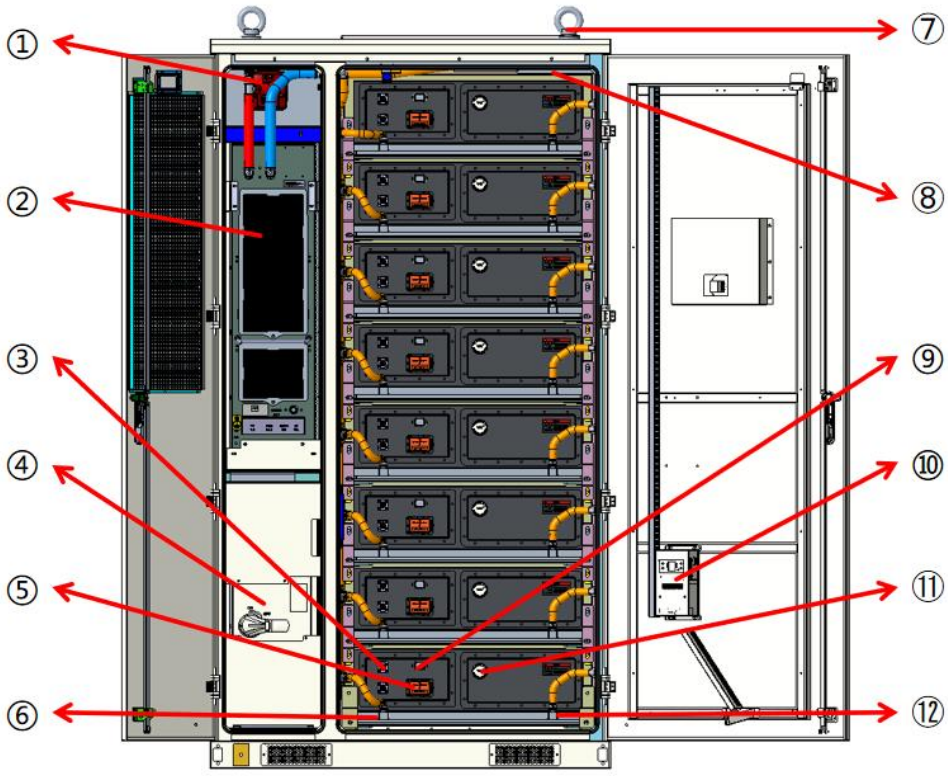
  Aerosol Fire Suppression: Deploys automatically to prevent fire spread.

### 2.2.1. Product Overview

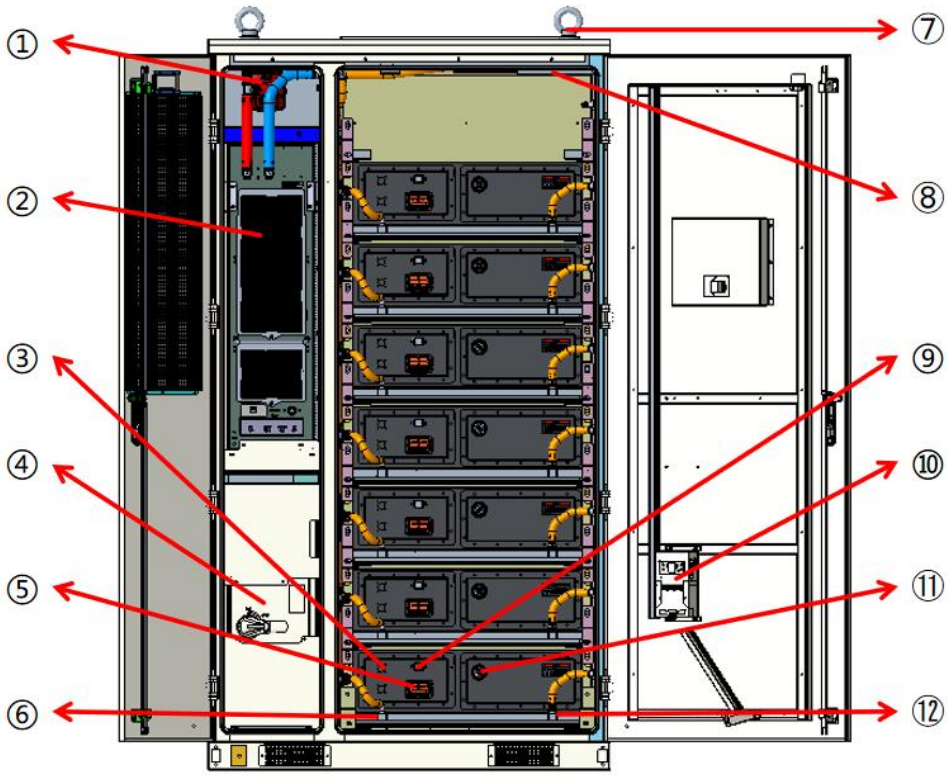
The Hbowa-UTL-418 energy storage system is composed of a fire suppression system, thermal management system, and battery management system (BMS). Its external appearance is illustrated in the figure below:

Figure 1 Hbowa-UTL Series Energy Storage System External Appearance Diagram

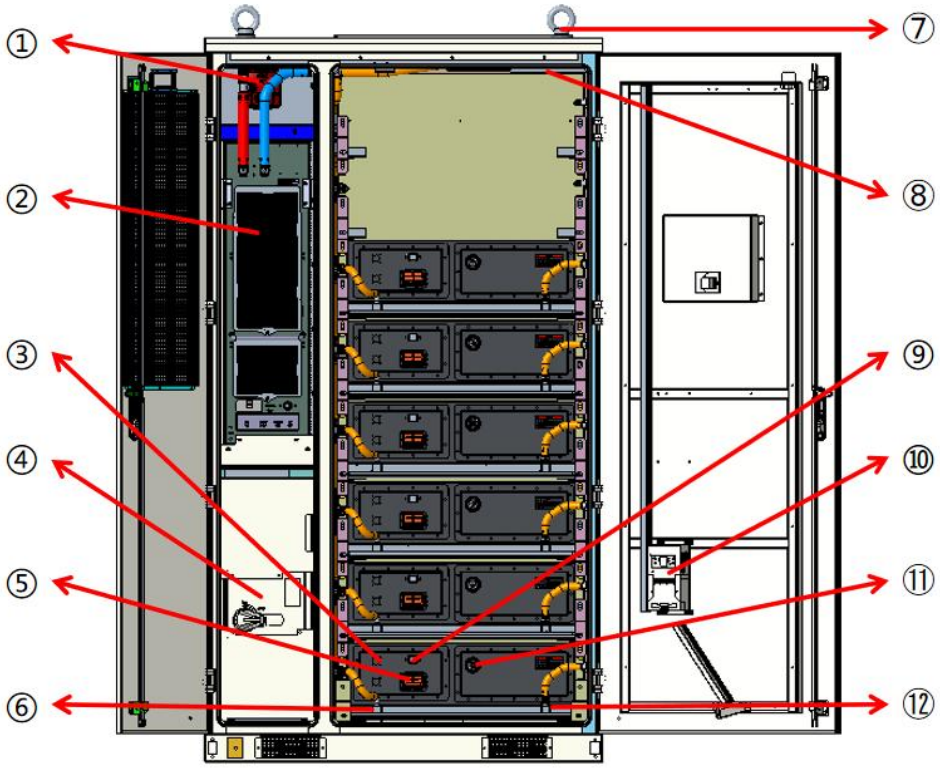
(For Reference Only)



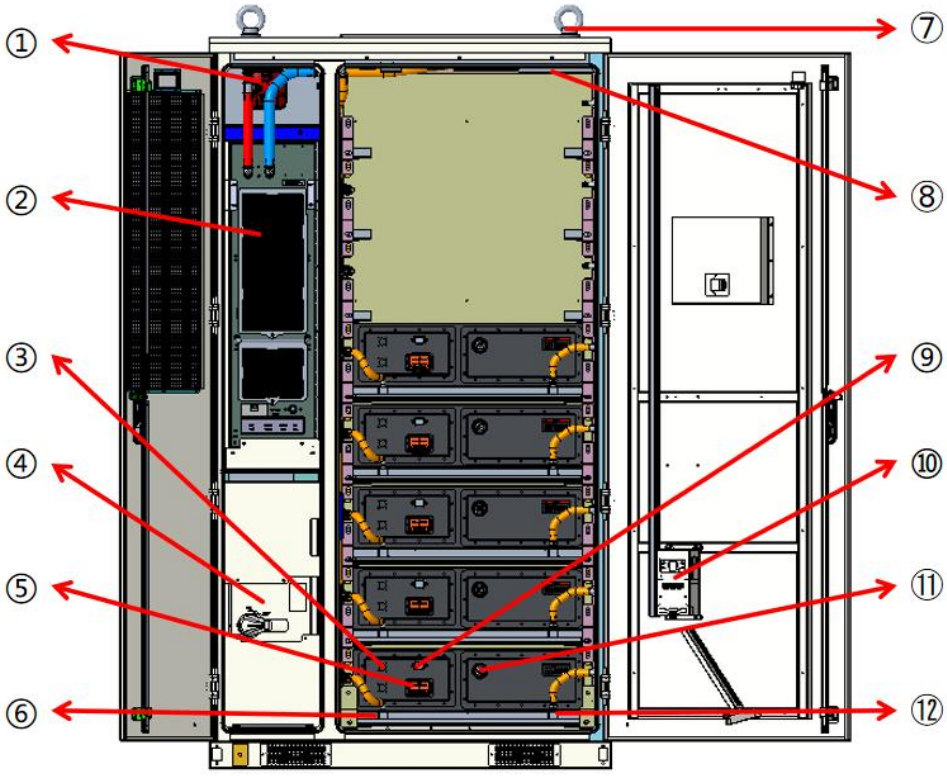

Hbowa-UTL-418



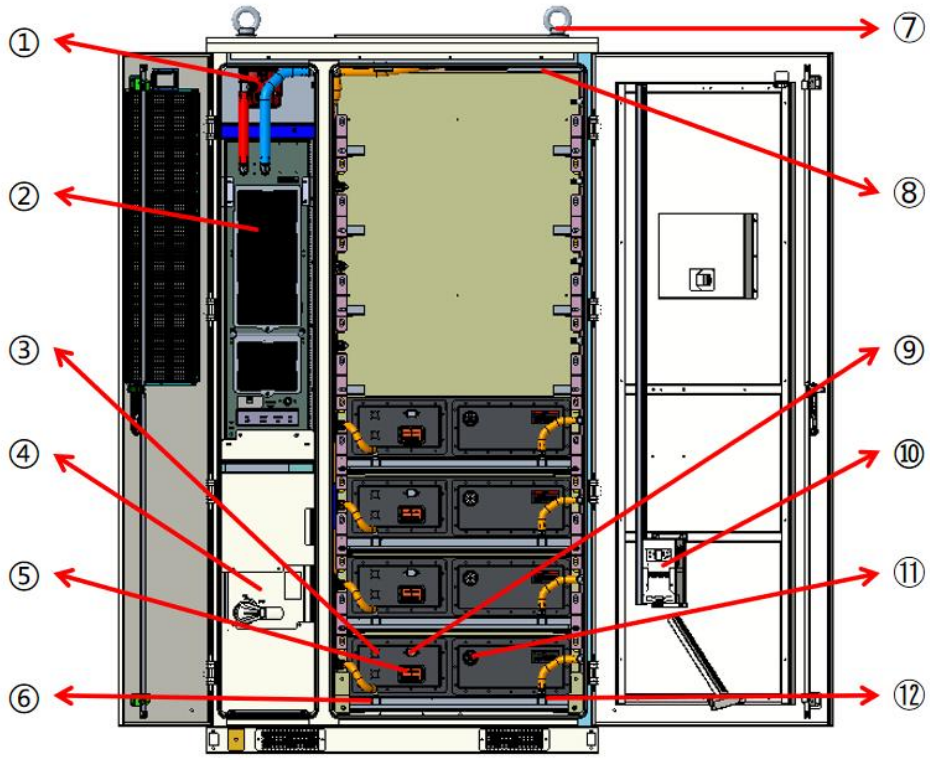

Hbowa-UTL-366



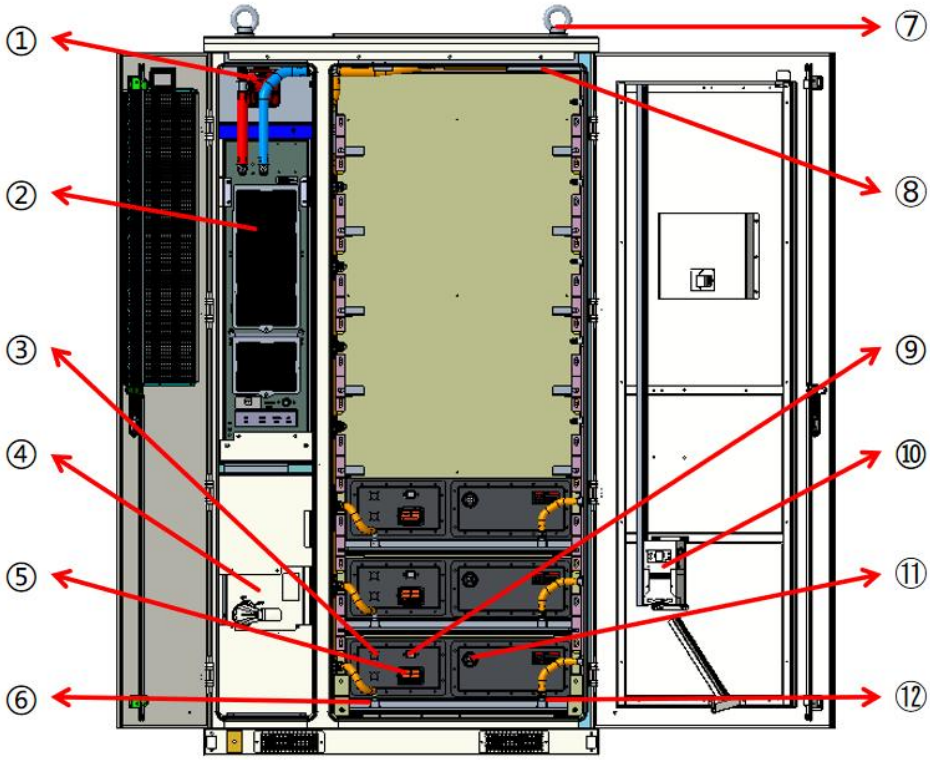

Hbowa-UTL-314




Hbowa-UTL-261




Hbowa-UTL-209




Hbowa-UTL-157

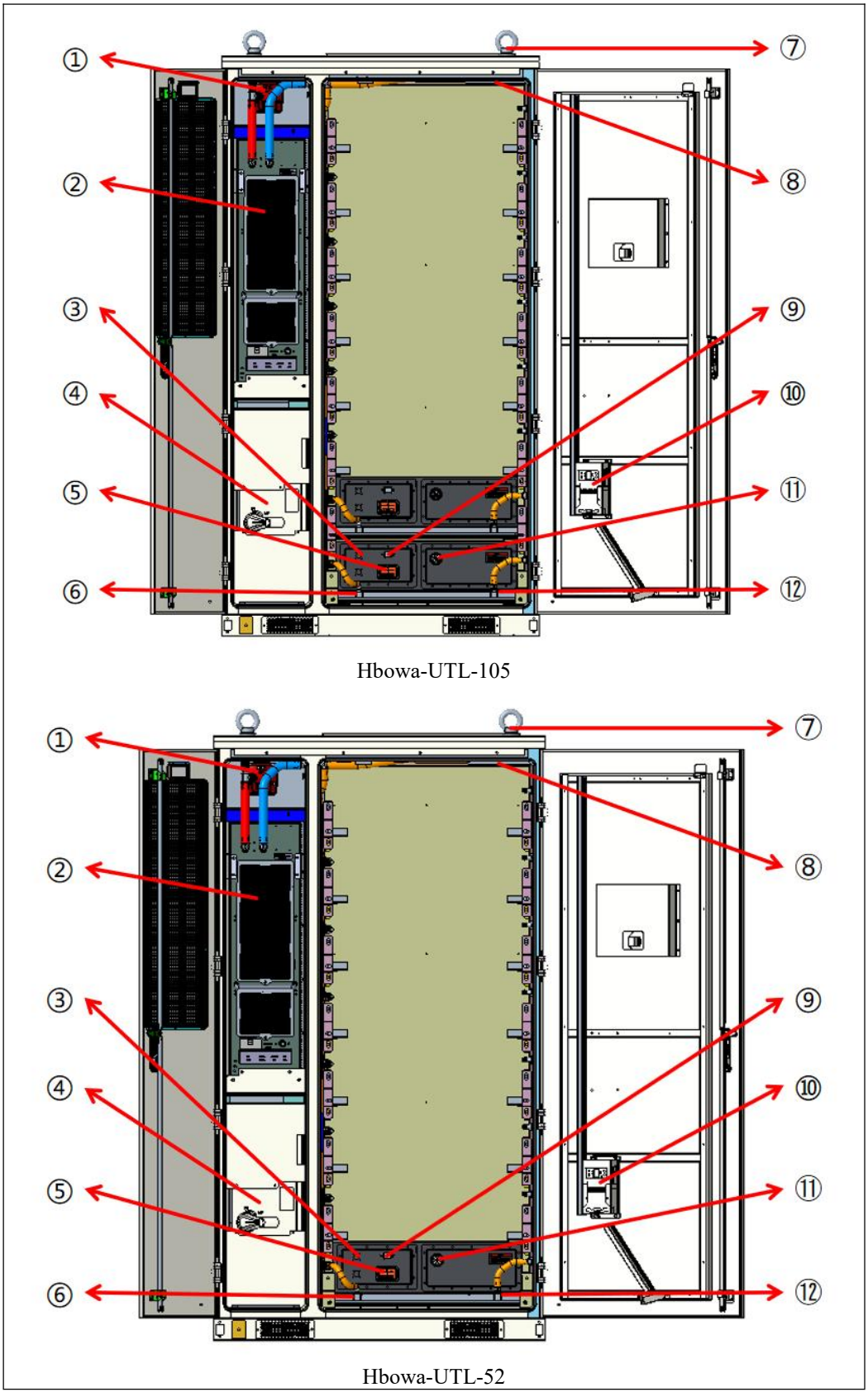



Figure 2 Hbowa-UTLSeries: Energy Storage System Internal Diagrams (For Reference Only)

Table 1 Hbowa-UTL-418ESS Configuration

| Component | Name | Component | Name |
|---|---|---|---|
| 1 | Fire Alarm Audible/Visual Alarms | 7 | Lifting Ring |
| 2 | Liquid Cooling Unit | 8 | Gas Fire Suppression System (Optional) |
| 3 | Power Connector | 9 | Communication Plug |
| 4 | High-Voltage Control Box | 10 | Dehumidifier |
| 5 | MSD | 11 | Pressure Relief Valve |
| 6 | Hot Water Outlet | 12 | Cold Water Inlet |

### 2.2.2. DC System

The system utilizes Great Power's 314Ah battery cells, with 52 cells forming one PACK, and 1–8 PACKs constituting one RACK. The battery serves as the core of the energy storage system, enabling energy storage and release.

### 2.2.3. Battery Management System (BMS)

The BMS employs an automotive-grade three-tier architecture. By monitoring voltage, current, and temperature, it manages battery energy, performs diagnostics, and analyzes faults to ensure the safe and stable operation of the energy storage system.

### 2.2.4. Thermal Management System

The temperature control system consists of a high-performance liquid cooling unit, liquid cooling pipelines, and liquid cooling plates integrated into each battery module. Through heat transfer, it achieves battery heat dissipation and temperature uniformity, effectively maintaining the entire system within an optimal temperature range. This ensures the batteries operate under ideal conditions, extending the system's lifespan.

### 2.2.5. Dehumidification System

A dehumidifier regulates humidity inside the container to prevent corrosion of materials caused by excessive moisture.

### 2.2.6. Fire Suppression System

The fire suppression system combines smoke detectors, temperature detectors, audible/visual

alarms, and aerosol fire suppression to mitigate fire risks. Through the combined linkage of fire extinguishing agents and explosion prevention systems, it provides effective protection for the energy storage system.

# 3. System Specifications

This section details the Hbowa-UTL-418 energy storage system, including DC system parameters, auxiliary power parameters, communication interfaces, and mechanical/environmental specifications.

## 3.1. DC System Parameters

Table 2 DC System Parameters

| Project Name | Hbowa-UTL-52 | Hbowa-UTL-105 | Hbowa-UTL-157 | Hbowa-UTL-209 | Hbowa-UTL-261 | Hbowa-UTL-314 | Hbowa-UTL-366 | Hbowa-UTL-418 | Remark |
|---|---|---|---|---|---|---|---|---|---|
| Model | SLL03C2-D1P52S1R1-A01 | SLL03C2-D1P52S1R2-A01 | SLL03C2-D1P52S1R3-A01 | SLL03C2-D1P52S1R4-A01 | SLL03C2-D1P52S1R5-A01 | SLL03C2-D1P52S1R6-A01 | SLL03C2-D1P52S1R7-A01 | SLL03C2-D1P52S1R8-A01 | |
| Power Number | ≤0.5P/0.5C | | | | | | | | |
| System Configuration | 1P52S | 1P104S | 1P156S | 1P208S | 1P260S | 1P312S | 1P364S | 1P416S | |
| Rated Capacity (Ah) | 314 | | | | | | | | Voltage Range：2.5V~3.65V/cell |
| Rated Energy (kWh) | 52.25 | 104.5 | 156.75 | 209.00 | 261.25 | 313.5 | 365.75 | 418.00 | |
| Usable Energy (kWh) | 50.66 | 101.32 | 151.97 | 202.63 | 253.29 | 303.95 | 354.6 | 405.26 | |
| Rated Voltage (Vd.c.) | 166.4 | 332.8 | 499.2 | 665.6 | 832.0 | 998.4 | 1164.8 | 1331.2 | 3.2V/cell |
| Operating Voltage Range (V) | 145.6 ~ 184.6 | 291.2 ~ 369.2 | 436.8 ~ 553.8 | 582.4 ~ 738.4 | 728 ~ 923 | 873.6 ~ 1107.6 | 1019.2 ~ 1292.2 | 1164.8 ~ 1476.8 | Per Cell 2.80～3.55 |
| Maximum Operating Voltage Range (Vd.c.) | 135.2 ~ 187.2 | 270.4 ~ 374.4 | 405.6 ~ 561.6 | 540.8 ~ 748.8 | 676 ~ 936 | 811.2 ~ 1123.2 | 946.4 ~ 1310.4 | 1081.6 ~ 1497.6 | Per Cell 2.6~3.6 |

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Rated Power (KW) | 26.13 | 52.25 | 78.38 | 104.5 | 130.63 | 156.75 | 182.88 | 209 | |
| Maximum Power (KW) | 33.96 | 67.93 | 101.89 | 135.85 | 169.81 | 203.78 | 237.74 | 271.7 | |
| Maximum Charge Current (A) | 193 | | | | | | | | 25±5℃, 5min |
| Maximum Discharge Current (A) | 193 | | | | | | | | 25±5℃, 5min |
| Rated Charge Current (A) | 157 | | | | | | | | 0.5C |
| Rated Discharge Current (A) | 157 | | | | | | | | 0.5C |
| Maximum Depth of Discharge | 0~100% | | | | | | | | Recommend 5%~95%SOC |
| Round-Trip Efficiency | 93.5% | | | | | | | | ≤0.5P |

## 3.2. Auxiliary Power Supply Parameters and Communication

Table 3 Auxiliary Power Supply Specifications

| NO. | Item | Specification | Remarks |
|---|---|---|---|
| 1 | Voltage Range（V a.c) | 220V±10%，50Hz<br>277V，60Hz | UPS only powers low-voltage communication equipment (LC & BMS), included in auxiliary power |
| 2 | Power Consumption（W） | ≤4000 | Includes liquid cooling system, at 220V power supply |
| 3 | Operating Noise（dB） | ≤75 | |
| 4 | Communication Protocol | CAN、Modbus-TCP | |

### 3.3. Mechanical and Environmental Parameters

Table 4 Mechanical and Environmental Parameters

| NO. | Item | | Specification | Remarks |
|---|---|---|---|---|
| 1 | Outdoor Cabinet Dimensions (mm) | | D1300*W1300*H2373.5 | Excluding lifting hooks |
| 2 | Weight（T） | | 8packs≈3.93<br>7packs≈3.57<br>6packs≈3.19<br>5packs≈2.85<br>4packs≈2.49<br>3packs≈2.13<br>2packs≈1.78<br>1packs≈1.41 | |
| 3 | IP Rating | Battery compartment | IP55 | |
| 4 | | Electrical compartment | IP20 | |
| 5 | | High-voltage box | IP55 | |
| 6 | | Liquid cooling unit | IP26 | |
| 7 | Color | | RAL 7035 | |
| 8 | Operating Ambient Temperature(℃) | | 25±5 | |
| 9 | Storage Ambient Temperature (℃) | | -35~+55 | |
| 10 | Altitude（m） | | ≤2000 | Customizable for 2000m~4500m |
| 11 | Relative Humidity（RH） | | 0~85% | No condensation |

# 4. System Principle

### 4.1. Auxiliary Power System

The auxiliary power system of the Hbowa-UTL-418 energy storage system is mainly used to supply power to conventional auxiliary equipment inside the cabinet and the liquid cooling unit. It also includes backup power for devices such as UPS, dehumidifier, water immersion sensor, detectors, audible and visual alarm system, and BMS system, with the UPS supporting no less than 2 hours of backup power.

Schematic Diagram: (Refer to the figure below)

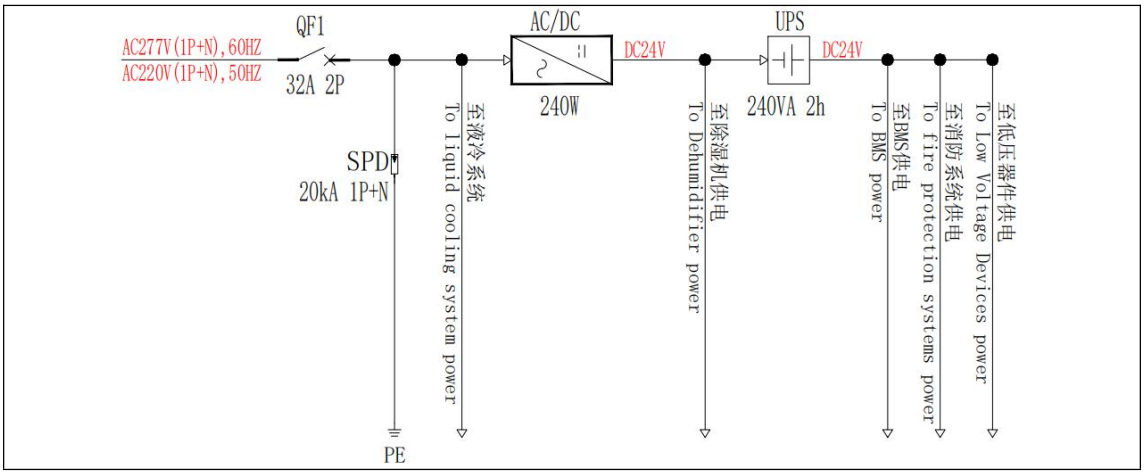
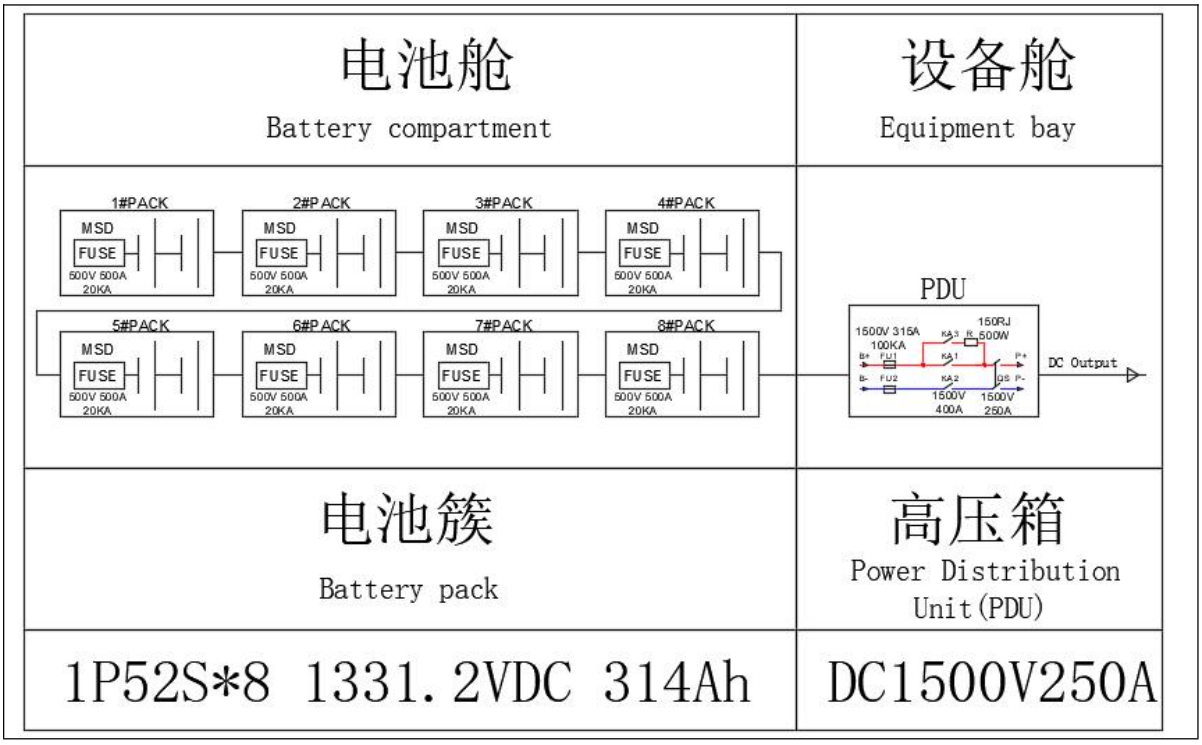


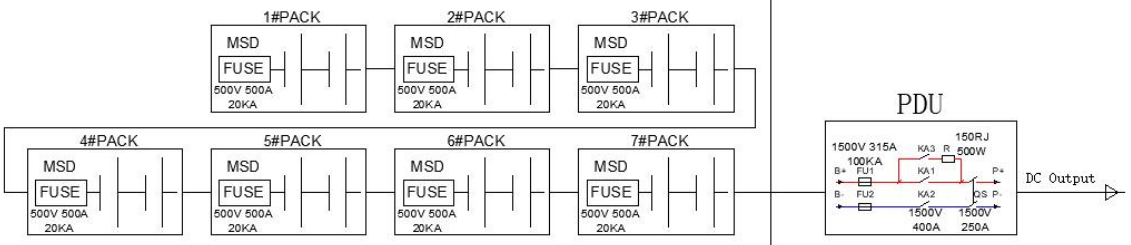

Figure 3 Auxiliary Power Schematic Diagram

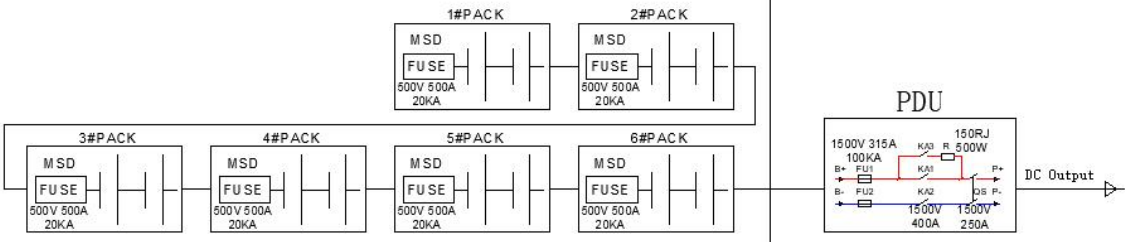
## 4.2. DC System

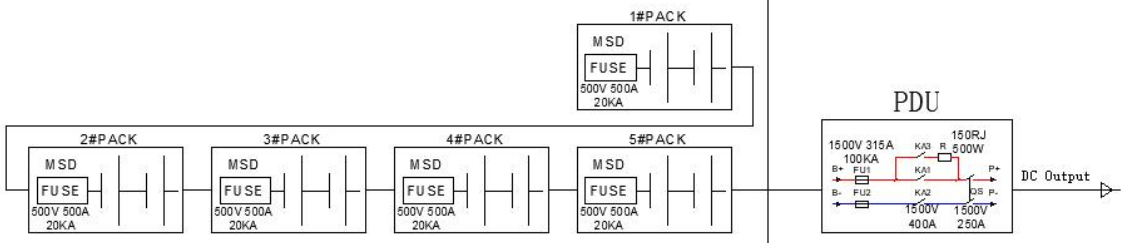
The DC system of the Hbowa-UTL-418 energy storage system consists of 1 battery stack, structured as follows:1 High-Voltage Box (HV Box) per stack, 1 Battery Cluster managed by each HV Box, 8 PACKs per cluster, 52 battery cells per PACK (using Great Power's 314Ah $LiFePO_4$ cells)

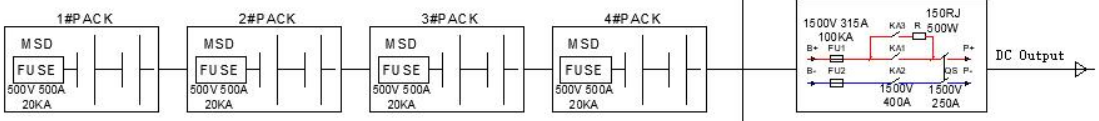
Schematic Diagram:

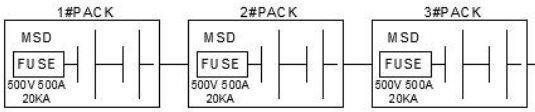
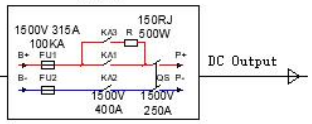


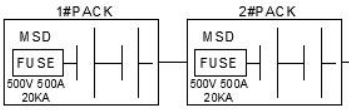
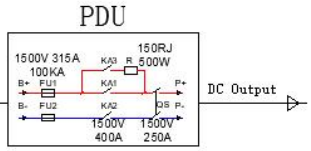
| 电池舱<br>Battery compartment | 设备舱<br>Equipment bay |
|---|---|
|  | |
| 电池簇<br>Battery pack | 高压箱<br>Power Distribution Unit(PDU) |
| 1P52S*7 1164.8VDC 314Ah | DC1500V250A |

| 电池舱<br>Battery compartment | 设备舱<br>Equipment bay |
|---|---|
|  | |
| 电池簇<br>Battery pack | 高压箱<br>Power Distribution Unit(PDU) |
| 1P52S*6 998.4VDC 314Ah | DC1500V250A |

| 电池舱<br>Battery compartment | 设备舱<br>Equipment bay |
| --- | --- |
|  | |
| 电池簇<br>Battery pack | 高压箱<br>Power Distribution Unit(PDU) |
| 1P52S*5 832VDC 314Ah | DC1500V250A |

| 电池舱<br>Battery compartment | 设备舱<br>Equipment bay |
| --- | --- |
|  | |
| 电池簇<br>Battery pack | 高压箱<br>Power Distribution Unit(PDU) |
| 1P52S*4 665.6VDC 314Ah | DC1500V250A |

| 电池舱<br>Battery compartment | 设备舱<br>Equipment bay |
| --- | --- |
|  |  |
| 电池簇<br>Battery pack | 高压箱<br>Power Distribution Unit(PDU) |
| 1P52S*3 499.2VDC 314Ah | DC1500V250A |

| 电池舱<br>Battery compartment | 设备舱<br>Equipment bay |
| --- | --- |
|  |  |
| 电池簇<br>Battery pack | 高压箱<br>Power Distribution Unit(PDU) |
| 1P52S*2 332.8VDC 314Ah | DC1500V250A |

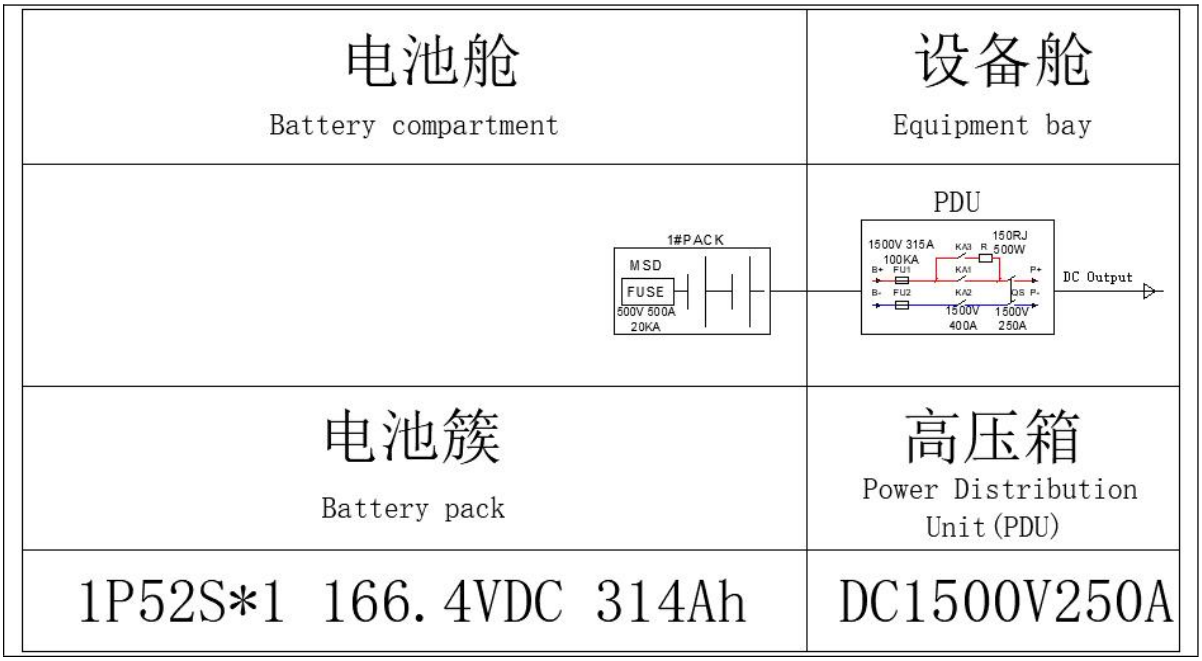



Figure 4 DC System Schematic Diagram

### 4.3. Communication Topology Principle

The Hbowa-UTL-418 energy storage system adopts standard communication protocols and an automotive-grade three-level architecture,where the BMU uploads battery system information from within the energy storage system to the BCU. The BCU also collects information from the fire protection system, thermal management system, dehumidification system, I/O, etc., and uploads it to the BAU.The BAU centrally manages all BCUs.

The communication schematic diagram is as follows:

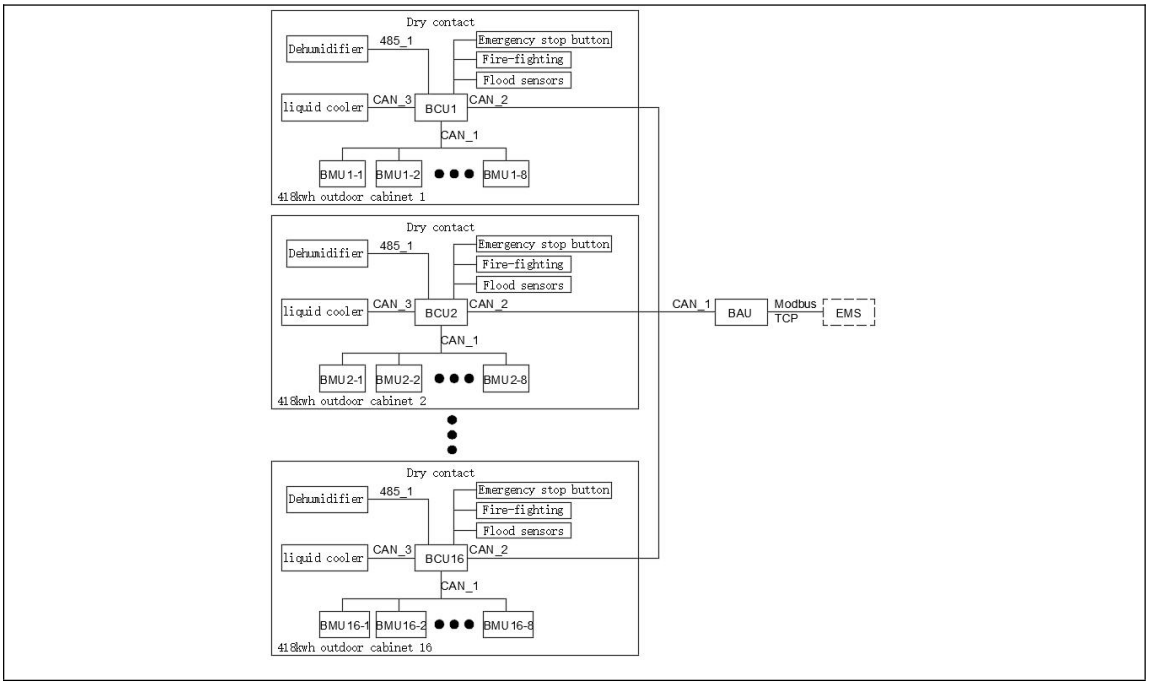



Figure 5 Communication Diagram

## 4.4. Interface Diagram

### 4.4.1. AC Power/Communication Interface Diagram

The high-voltage compartments (J3, J4, J5, J6, P+ and P-) in the electrical compartment of the Hbowa-UTL-418 energy storage system are the terminals for the client side. They are mainly composed of interfaces such as the parallel communication ports (J3, J4), external communication (J5), AC input (J6), and power terminals (P+, P-).

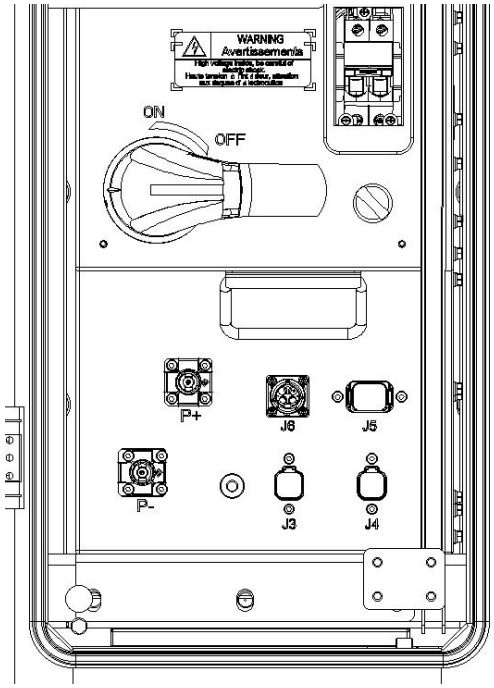
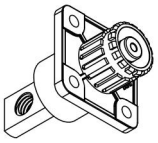
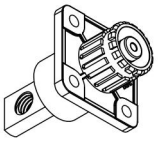
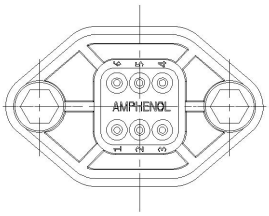
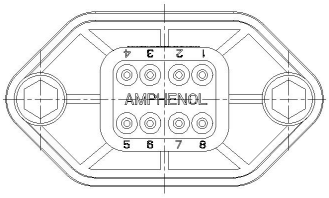
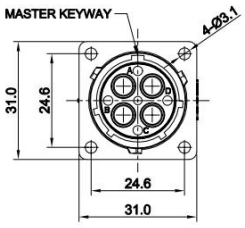



Figure 6 Interface Diagram

Table 5 Terminal Model and Specifications

| Plug Model | Socket Diagram | Plug Model | Port Definition | | Remarks |
|---|---|---|---|---|---|
| PSR8CBM5A-8MM |  | PSRP8C50L | / | | /P+ |
| PSR8ABM5A-8MM |  | PSRP8A50L | / | | /P- |
| AT04-6P-PM05GRN |  | AT06-6S-EC01GRN | 1:CAN2H<br>2:CAN2L<br>3:CAN2G | 4:NC<br>5:NC<br>6:NC | J3/4 |

| | | | | | |
|---|---|---|---|---|---|
| AT04-08PC<br>-PM05GEC |  | AT06-08S<br>C-EC01 | 1:CAN3H<br>2:CAN3L<br>3:CAN3G<br>4:485-2A | 5:485-2B<br>6:485-2G<br>7:NC<br>8:NC | J5 |
| RTS016N4<br>S03 |  | RTS6BS16<br>N4PHEC | A: AC-L<br>B: AC-N<br>C:NC<br>D：NC | | J6 |

# 5. Design Parameter

## 5.1. DC System

### 5.1.1. Battery Cell

The Hbowa-UTL-418 energy storage system utilizes 314Ah battery cells, renowned for their safety and reliability, widely applied in utility-scale and commercial/industrial energy storage scenarios. With high safety performance, these cells have passed rigorous certifications including UL, IEC, UN, and RoHS. The detailed parameters are shown in the following table:

Table 6 Battery Cell Parameters

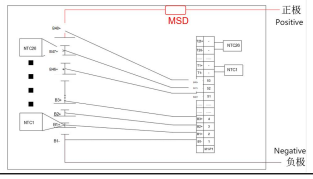
| NO. | Name | Specification | Remarks |
|---|---|---|---|
| 1 | Model | GSP71173204F | |
| 2 | Nominal Capacity(Ah) | 314 | |
| 3 | Nominal Energy(Wh) | 1004.8 | |
| 4 | Nominal Voltage(V) | 3.2 | |
| 5 | Voltage Range(V) | 2.5~3.65@T > 0℃<br>2.0~3.65@T≤0℃ | |
| 6 | Charge Temperature (℃) | 0~60 | |
| 7 | Discharge Temperature（℃） | -30~60 | |
| 8 | Storage Temperature (℃) | -40~60 | Recommended-10℃~35℃ |
| 9 | Cycle Life | ≥8000@70% | |

| NO. | Name | Specification | Remarks |
|---|---|---|---|
| 10 | Operating Altitude(m) | ≤5000 | |
| 11 | Applications | Generation-side storage、Grid-side storage, Commercial & Industrial storage | |
| 12 | Certifications | GB/T36276、UL1973、UL9540A、IEC62619 UN38.3、RoHS、Reach | |

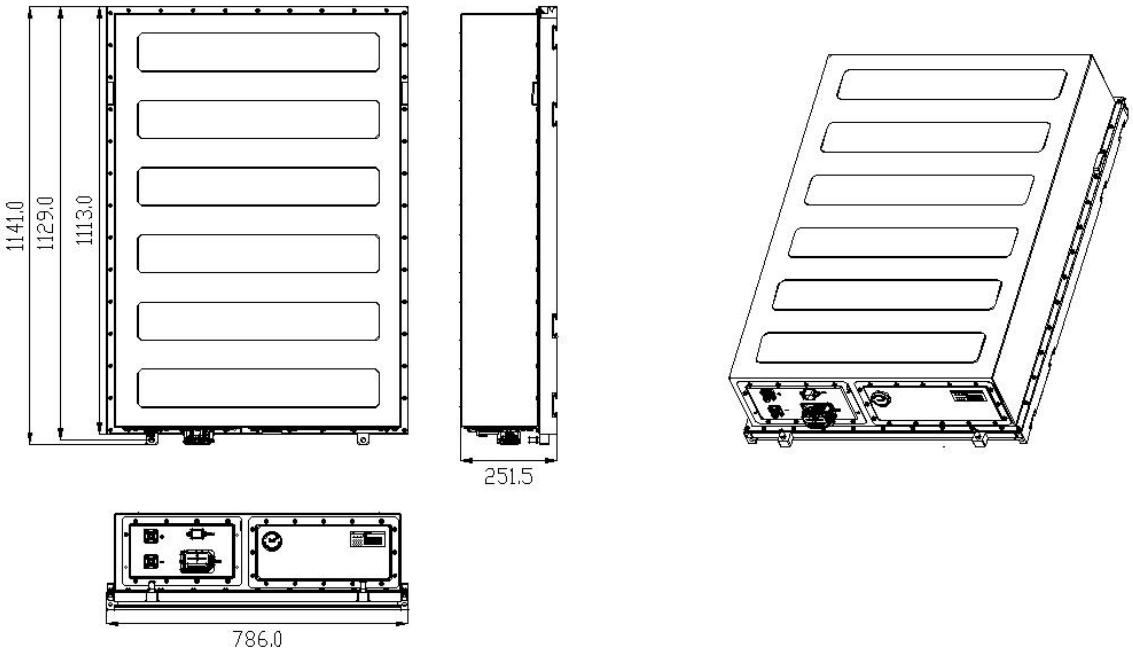
### 5.1.2. Battery Pack

The battery pack contains 4 modules. Each module consists of 13 cells connected in series. Each module is monitored by 6 or 7 temperature sensors (NTC). Each module has 14 voltage measurement points (one per cell).

Table 7 Battery Pack Parameters

| NO. | Item | Specification | Remarks |
|---|---|---|---|
| 1 | Product Model | PLL03C2-D1P52S-A01 | |
| 2 | Configuration | 1P52S | |
| 3 | Rated Energy（kWh） | 52.25 | |
| 4 | Rated Voltage（V d.c） | 166.4 | |
| 6 | Recommended Voltage Range (V d.c) | 145.6~184.6 | 2.8V~3.55V/cell |
| 6 | Maximum Voltage Range (V d.c) | 135.2～187.2 | 2.6V~3.60V/cell |
| 7 | Rated Charge Current（A） | 157 | 0.5C |
| 8 | Maximum Charge Current（A） | 193 | ≤5min |
| 9 | Rated Discharge Current（A） | 157 | 0.5C |
| 10 | Maximum Discharge Current (A) | 193 | ≤5min |
| 11 | Communication Protocol | CAN | |
| 12 | Dimensions (mm) | D1141*W786*H251.5 | Depth excludes connector size |
| 13 | Battery Enclosure Wiring Diagram |  | Temperature sensor quantity is customizable based on application requirements. |

| NO. | Item | Specification | Remarks |
|---|---|---|---|




Schematic Diagram

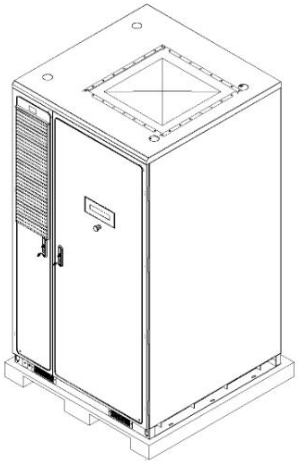
### 5.1.3. System Cabinet

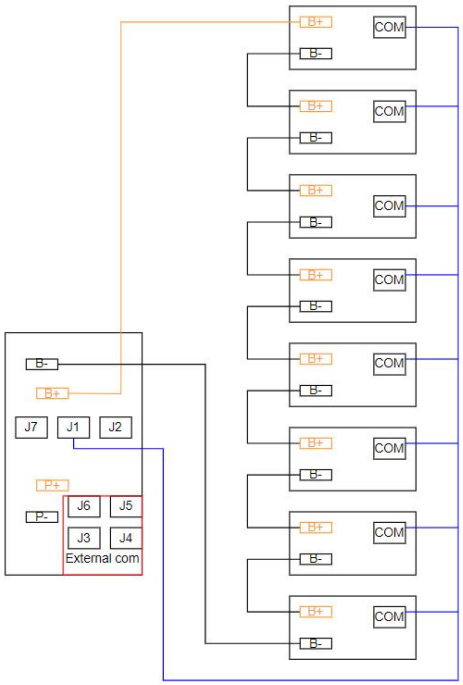
A single-column battery rack comprises one complete battery cluster, including one high-voltage cabinet, one liquid cooling unit, and associated wiring harnesses to form an integrated system. The design employs standardized modular components with high interchangeability, allowing the rack to accommodate varying numbers of modules. System capacity can be flexibly adjusted through module addition or removal to meet expansion or reduction requirements. The battery cluster specifications are detailed in Table 8：

Table 8 Battery cluster specifications

| NO. | Item | Specification | Remark |
|---|---|---|---|
| 1 | Product Model | Hbowa-UTL-418 | |
| 2 | Configuration | 1P416S | |
| 3 | Rated Energy（kWh） | 417.996 | |
| 6 | Rated Energy（V d.c） | 1331.2 | |
| 7 | Rated Voltage（V d.c） | 1081.6~1497.6 | 2.6V~3.60V/cell |
| 8 | Recommended Voltage Range（V d.c） | 1164.8~1476.8 | 2.8V~3.55V/cell |
| 9 | Rated Charge Current（A） | 157 | |

| | | | |
|---|---|---|---|
| 10 | Maximum Charge Current (A) | 193 | ≤5min |
| 11 | Rated Discharge Current (A) | 157 | |
| 12 | Maximum Discharge Current（A） | 193 | ≤5min |
| 13 | Communication | CAN | |
| 14 | System Auxiliary Power Consumption | ≤4000W | Including water cooling system,<br>220Vac AC power supply |
| 15 | Cabinet External Dimensions | D1300*W1300*H2373.5 | |






Schematic Diagram

## 5.2. Battery Management System

The DC system in the Hbowa-UTL-418 energy storage system consists of 1 battery cluster, with each cluster comprising 8 battery packs. Accordingly, the battery management system adopts a two-tier architecture, where each secondary tier manages 8 battery packs.

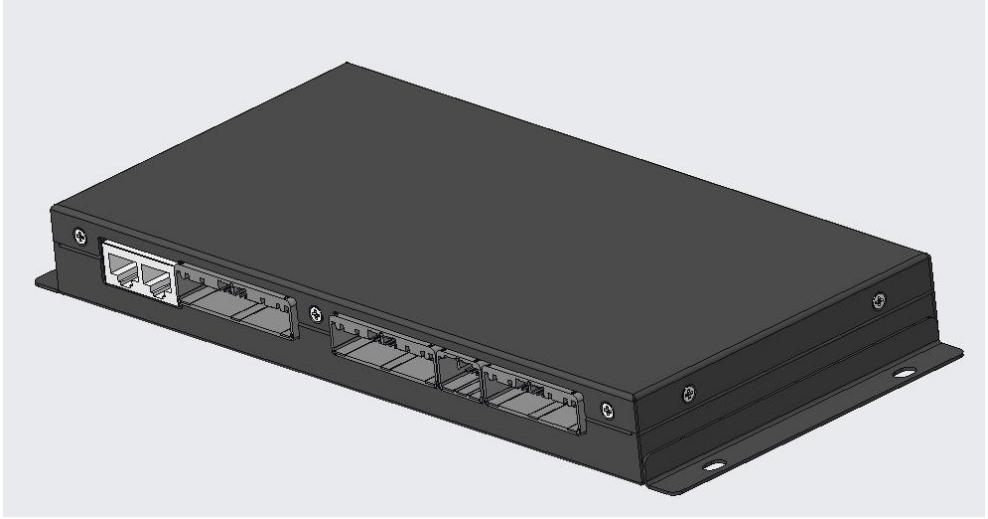
### 5.2.1. Cluster Control Unit (BCU)

The module manages battery clusters within the energy storage system and is typically installed in the high-voltage control cabinet of each battery cluster. It is primarily responsible for collecting cluster voltage and current measurements, aggregating individual cell voltage and temperature data within the cluster, calculating cluster status parameters such as SOC/SOH, executing equalization strategies,

performing battery fault diagnosis, and implementing localized protection and relay control functions based on fault information. The BCU features a CAN communication interface for data exchange with the BMU and BAU. Equipped with insulation monitoring capabilities, the BCU performs cell-level SOC/SOH calculations and provides redundant CAN interfaces, RS-485, and Ethernet ports for external communication. As the core component of the energy storage battery management system, the BCU serves as critical equipment to ensure safe, reliable, and efficient operation of the energy storage system. The hardware specifications are shown in the following table:

Table 9 Cluster Control Unit BCU Parameters

| NO. | Item | | Specification | Remarks |
|---|---|---|---|---|
| 1 | Model Number | | QT-SBCU-3131 | |
| 2 | Input Voltage(V d.c) | | 24 | |
| 3 | Power Consumption（W） | | ≤4W@24V | |
| 4 | Voltage Measurement（V d.c) | | 0~1500 | Accuracy ±5% |
| 5 | Current Measurement Accuracy | | ±0.5% | |
| 6 | Operrating Temperature（℃） | | -40~+85℃ | |
| 7 | Communicati on Interface | LAN | 2 ports | |
| 8 | | CAN | 3 ports | |
| 9 | | RS485 | 2 ports | |
| 10 | I/O interface | DI | 4 ports | |
| 11 | | DO | 2 ports | |
| 12 | | Configurable DI/DO | 4 ports | |
| 13 | Dimensions L*W*D（mm） | | 276*125*29.8 | |

| NO. | Item | Specification | Remarks |
|---|---|---|---|
|  Schematic Diagram | | | |

### 5.2.2. Slave Control BMU

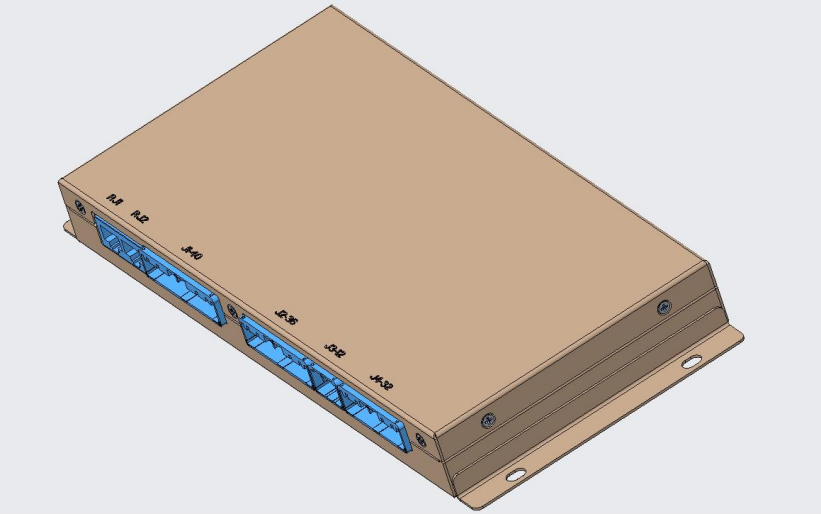
The slave control BMU provides real-time monitoring of individual cell voltages and temperatures while incorporating thermal management and balancing capabilities. It forms a highly flexible cluster battery management system when connected to the master control unit QT-SBCU-3131 via CAN bus. Designed to support up to 56 series-connected cells and 32 temperature detection channels

The BMU performs cell-level SOC/SOH calculations and generates alarms for various abnormal conditions including overvoltage, undervoltage, overtemperature, and communication failures. The unit also features diagnostic functions for detecting disconnections in voltage and temperature sensing harnesses.

Table 10 Passive Balancing Slave BMU

| NO. | Item | | Specification | Remake |
|---|---|---|---|---|
| 1 | Model Number | | QT-SBMU-56T32F0 | |
| 2 | Input Voltage(V d.c) | | 12/24 | |
| 3 | Power Consumption（W） | | ≤1 | |
| 4 | Voltage Measurement | Channels | 56 | |
| 5 | | Range (V d.c) | 0~5 | ±5mV |
| 6 | Temperature Measurement | Channels | 32 | ±1℃@-10℃~70℃<br>±2℃@other range |
| 7 | | Range（℃） | -40~120 | |
| 8 | Balancing Current（mA） | | 100 | |
| 9 | Communication | | CAN | |

| NO. | Item | Specification | Remake |
|---|---|---|---|
| 10 | Dimensions L*W*D（mm） | 260*110*26 | |
| 11 | Operating Temperature（℃） | -40~75 | |
| 12 | Relative Humidity（RH） | 5~95% | |
| 13 | Weight（g） | 149 | |
| 14 | Oprating Altitude（m） | ≤5000 | |



## 5.3. Thermal Management System

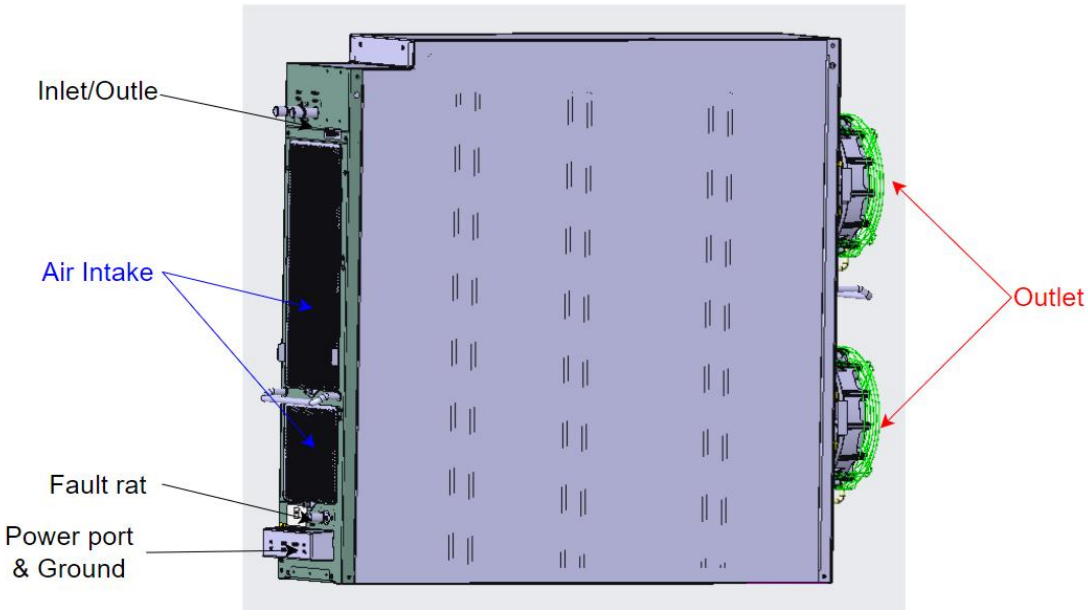
The thermal management system of the Hbowa-UTL-418 energy storage system is designed to maintain the battery system within an optimal operating temperature range, ensuring batteries operate at their ideal temperature during charging, discharging, and idle states to extend service life.

This system comprises a high-capacity liquid cooling unit, liquid cooling pipelines, and cooling plates integrated into each battery pack, forming a complete liquid cooling circulation system. Through heat transfer principles, it effectively dissipates heat and maintains temperature uniformity across all battery cells, precisely controlling temperature rise and differentials within the entire system. The key hardware parameters of the liquid cooling unit are as follows:

Table 11 Liquid Cooling Unit Parameters

| NO. | Item | Technical Specification | Remarks |
|---|---|---|---|
| 1 | Model | BTMS-80-ES | |
| 2 | Rated Cooling Capacity (KW) | 5 | Ambient temp：45℃,<br>Water temp：18℃ |
| 3 | Rated Heating Capacity (KW) | 2.5 | Water temp：20℃ |
| 4 | Voltage Range（V a.c) | 175~276 | |

| | | | |
|---|---|---|---|
| 5 | Frequency（Hz） | 50 | |
| 6 | Cooling Power Consumption（KW） | 4.5 | |
| 7 | Heating Power Consumption（KW） | 3.5 | |
| 8 | Self-Circulation Power (KW) | 0.3 | |
| 9 | Refrigerant Type | R410a | |
| 10 | Flow Rate（L/min） | 50 | @90kpa，18℃water temp |
| 11 | Noise Level（dBA） | ≤75 | |
| 12 | Communication Protocol | CAN 2.0B | Baud rate: 500kbps |
| 13 | Dimensions L*W*H (mm) | 1202.15*267*1107 | |
| 14 | Operating Temperature (℃) | -30~60 | |
| 15 | Max. Altitude（m） | ≤4000 | |
| 16 | IP Rating | IP×6（Electrical components） | |




Schematic Diagram

The thermal management system primarily consists of a compressor, heat exchanger, condenser, solenoid valves, water pump, heater, and battery pack cooling plates. The system schematic is shown below:

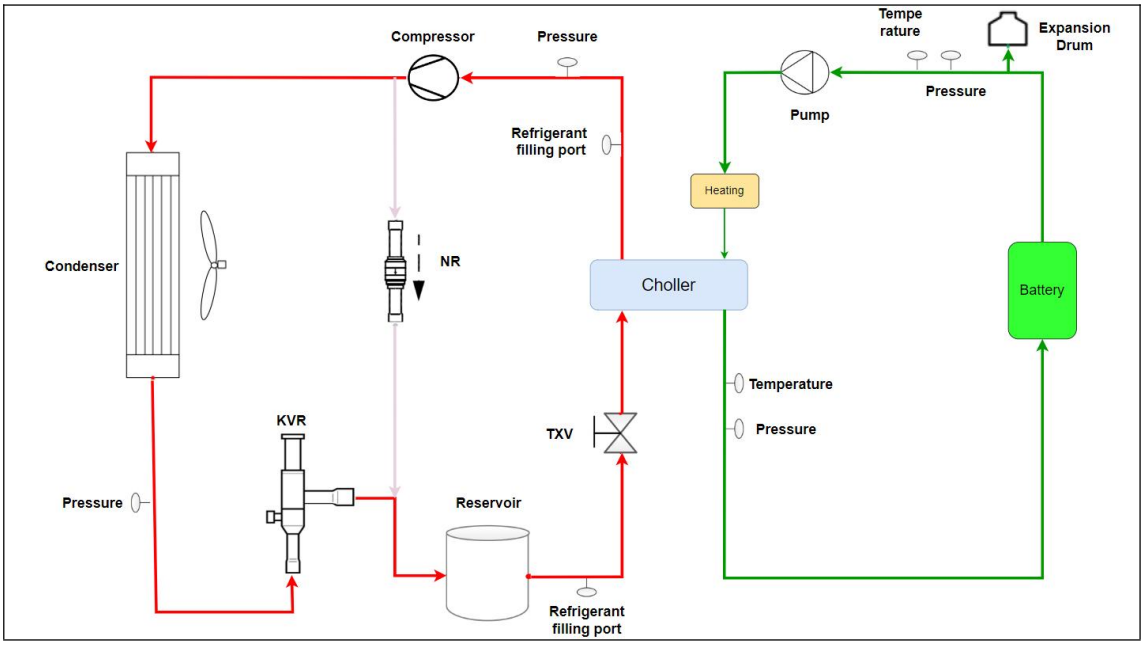



Figure 7 Thermal Management System Schematic Diagram

**Compressor:** Compresses low-temperature, low-pressure gaseous refrigerant into high-temperature, high-pressure state, providing the driving force for the refrigeration cycle.

**Heat Exchanger：**Transfers heat from hot to cold fluids through thermal conduction/convection to achieve cooling.

**Condenser：** Converts high-temperature, high-pressure gaseous refrigerant from the compressor into low-temperature, high-pressure liquid refrigerant.

**Solenoid Valves：** Precisely regulate refrigerant flow direction and volume to maintain system temperature within optimal operating range.

**Water Pump：** Circulates coolant throughout the system.

**Heater：** Provides active heating for the coolant when required.

**Battery Cooling Plates：**Directly contact battery cells, transferring heat to the coolant via thermal conduction for precise temperature control.

The Hbowa-UTL-418 energy storage system utilizes a liquid cooling pipeline architecture for thermal regulation. The system configuration is illustrated in the following schematic diagram:

Figure 8 Liquid Cooling Pipeline Schematic Diagram

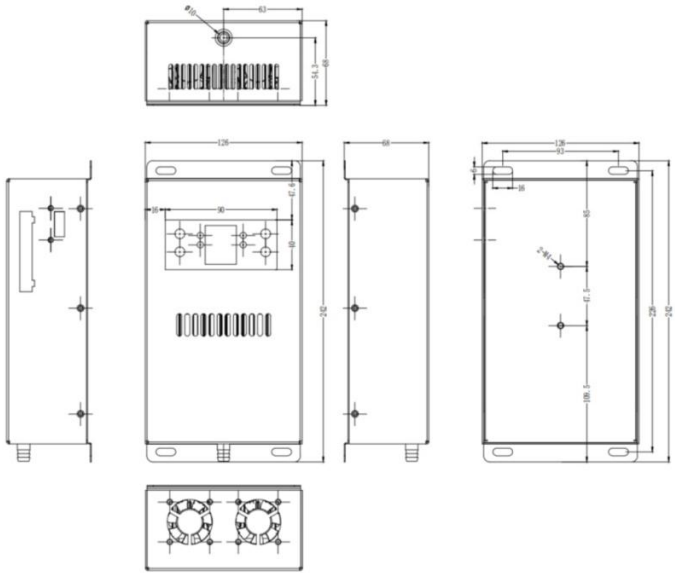
The liquid cooling pipelines serve as the main channels connecting to the liquid cooling unit, ensuring smooth inflow and outflow of coolant to maintain optimal thermal regulation.

## 5.4. Dehumidification System

The Hbowa-UTL-418 energy storage system's battery compartment is equipped with an integrated semiconductor-based dehumidification system. Utilizing Peltier cooling technology, the system actively draws humid air from the compartment into the dehumidification duct through fan circulation. As the air passes through the semiconductor cooling modules, moisture condenses into water droplets, which are then discharged through drainage tubing, achieving highly effective humidity control. This process simultaneously reduces both relative and absolute humidity levels without significantly raising ambient temperature, thereby avoiding thermal stress effects. By fundamentally minimizing moisture-related risks, the system effectively prevents equipment aging, insulation degradation, and structural corrosion within the battery compartment, ensuring safe and reliable operation of the energy storage system.

Table 12 Dehumidifier Specifications

| NO. | Item | Specification | Remark |
|---|---|---|---|
| 1 | Model | SDUL-60D | |
| 2 | Rated Voltage(V d.c) | 24 | |
| 3 | Dehumidification Power (W) | 60 | |
| 4 | Dehumidification Efficiency（mL/day） | ≥480 | ±10mL |
| 5 | Humidity Range（RH） | 20%~95% | ±3%RH |
| 6 | Temperature Detection Range（℃） | -25~95 | ±1%℃ |
| 7 | Communication Protocol | RS485 | |
| 8 | Dimensions L*W*H (mm) | 242*126*68 | |



Schematic Diagram

The semiconductor dehumidification device is composed of a power supply system, a supply air system, semiconductor cooling plates and a drainage pipeline.

Power Supply System：Provides stable electrical energy to ensure normal operation of the dehumidification unit

Air Delivery System：Utilizes fans to draw moist air into the internal air ducts.

Semiconductor Cooling Modules：Cools the humid air below its dew point to induce condensation.

Condensed water droplets flow by gravity into collection channels

Drainage System：Channels collected condensate out of the battery compartment

The operational schematic of the system is illustrated below:：

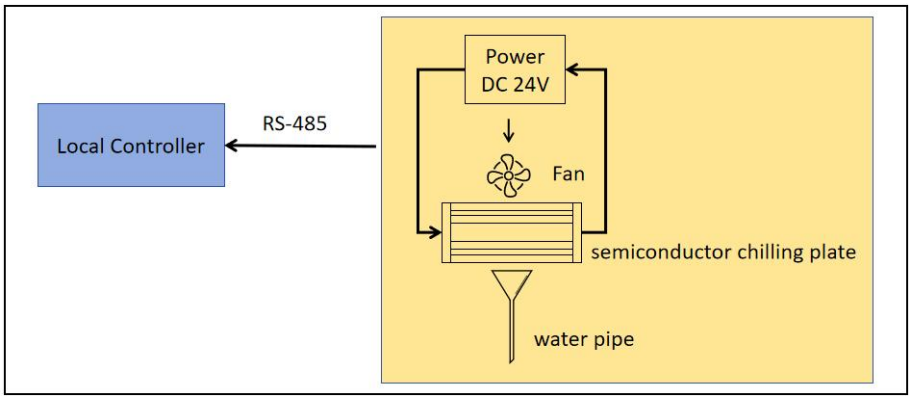



Figure 9 Dehumidifier Working Principle Diagram

## 5.5. Fire Protection System

The Hbowa-UTL-418 energy storage system incorporates a multi-level fire protection system comprising PACK-level and cluster-level fire suppression.

PACK-Level Protection：Aerosol fire suppression provides protection for the battery compartment through both BMU electrical triggering and thermal temperature triggering, with one aerosol fire suppression unit installed per PACK and a total of 8 units per cluster for fire extinguishing.

Cluster-level fire protection: Upon activation of the smoke detector, an audible and visual alarm will be triggered and feedback will be sent to the BCU; if both the smoke detector and temperature sensor are triggered simultaneously, the cluster-level aerosol fire suppression system will activate to extinguish the fire.

The fire protection system control logic diagram is as follows:

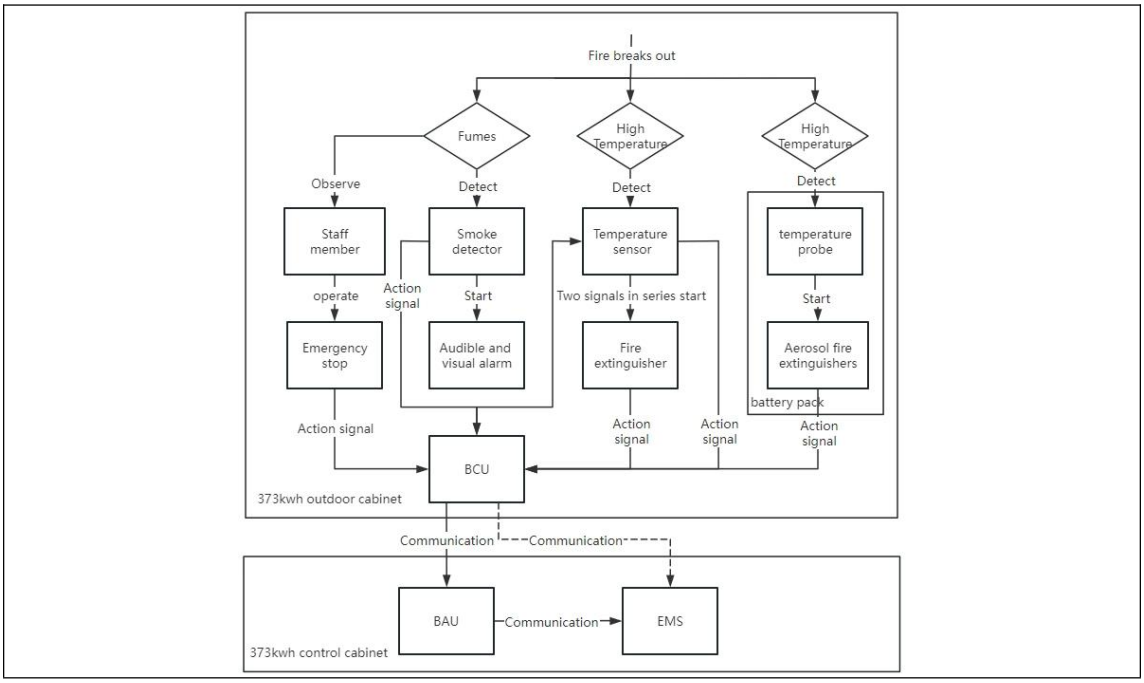



Figure 10 Fire Protection Logic Diagram

## 5.6.Lightning Surge Protection System

The Surge Protective Device (SPD) effectively absorbs transient overvoltage and overcurrent in power systems. As a critical component of internal lightning protection, the SPD achieves equipment protection through graded discharge of lightning current.

The SPD installed in the outdoor cabinet is a Type 2 surge protection device (lightning impulse current: 8/20 μs). The customer must independently configure a Type 1 surge protection device (lightning impulse current: 10/350 μs) at the AC input side of the outdoor cabinet.

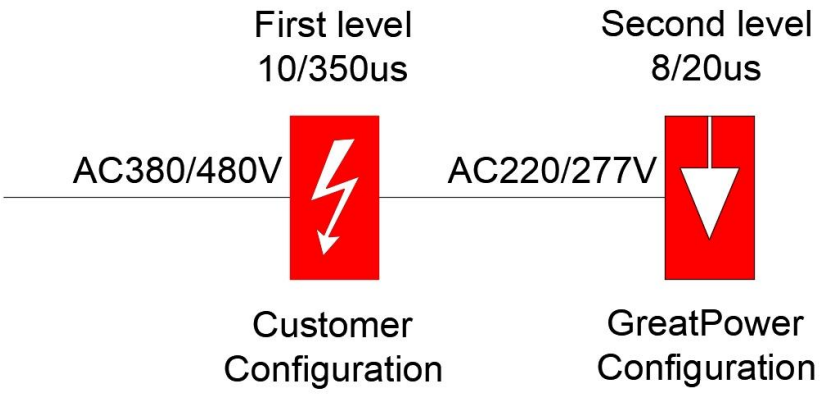



Figure 11 Surge Protective Device Configuration Diagram

# 6. Application Scenarios

## 6.1. PCS Matching

The Hbowa-UTL-418 energy storage system offers different PCS connection methods based on fuse compatibility. For a 0.5P system, two PCS connection configurations are available, while a 0.25P system supports one PCS connection method.

### 6.1.1. DC 0.5P System

When operating in 1MW PCS boost-integrated cabinet mode (equipped with a single 1MW PCS unit), the following connection method can be adopted: DC busbar consolidation at the PCS.

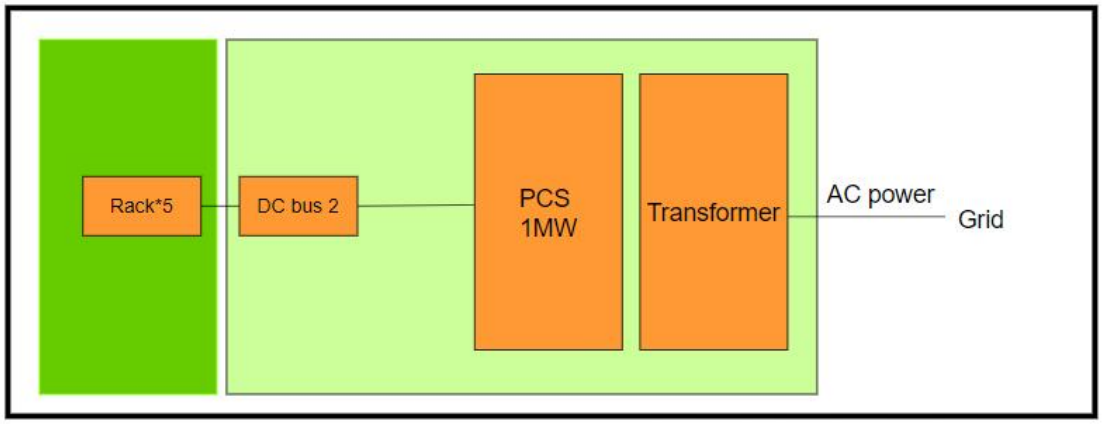



Figure 12 0.5P/1MW System1PCS Connection Method

When operating in 1.25MW PCS boost-integrated cabinet mode (equipped with a single 1.25MW PCS unit), the following connection method can be adopted: DC busbar consolidation at the PCS.

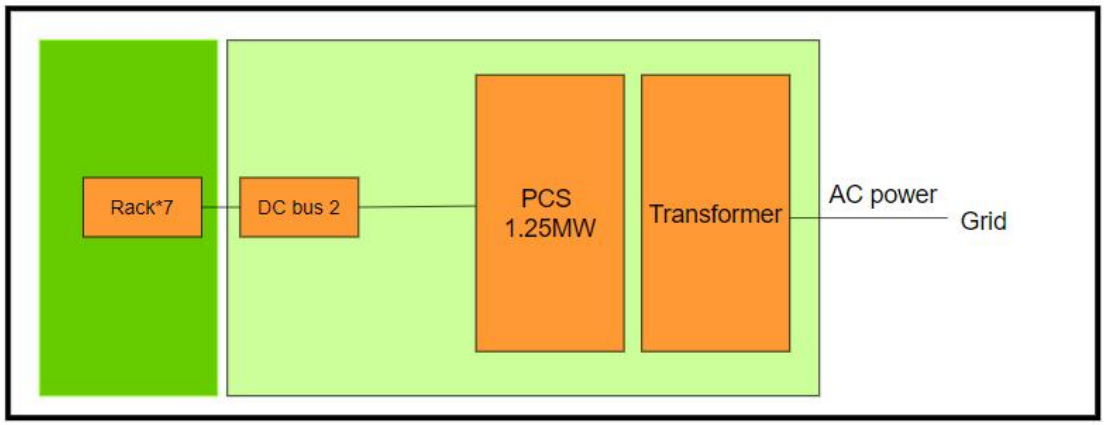



Figure 13 0.5P/1.25MWSystem 1 PCS Connection Method

For the 1.25MW PCS boost-integrated cabinet configuration (equipped with a single 1.25MW PCS unit), the system adopts the following connection method: DC busbar consolidation at the PCS.

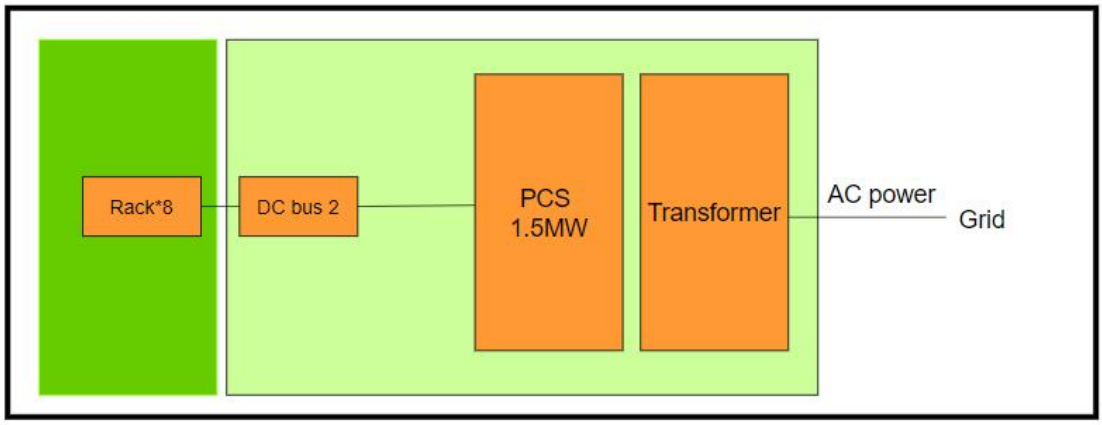



Figure 14 0.5P/1.5MW System 1 PCS Connection Method

1.75MW PCS Boost-Integrated Cabinet Configuration, containing one 1.75MW PCS unit. Connection Method: DC busbar consolidation at the PCS

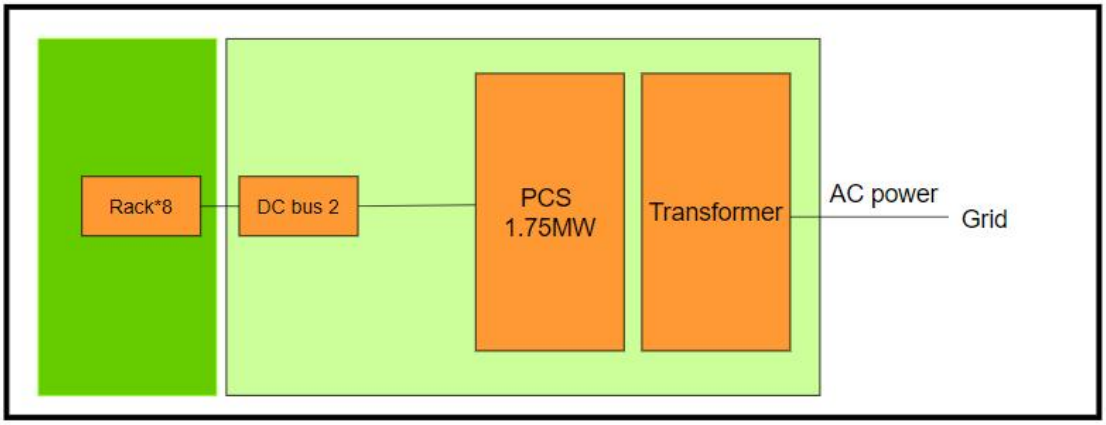



Figure 15 0.5P/1.75MWSystem 1PCS Connection Method

### 6.1.2. DC 0.25P System

When selecting a 1.75MW PCS boost-integrated cabinet configuration containing one 1.75MW PCS unit, the following connection method can be adopted: one PCS corresponds to one energy storage system, one energy storage system has 10 clusters, and the DC busbars of each energy storage system are consolidated at the PCS.

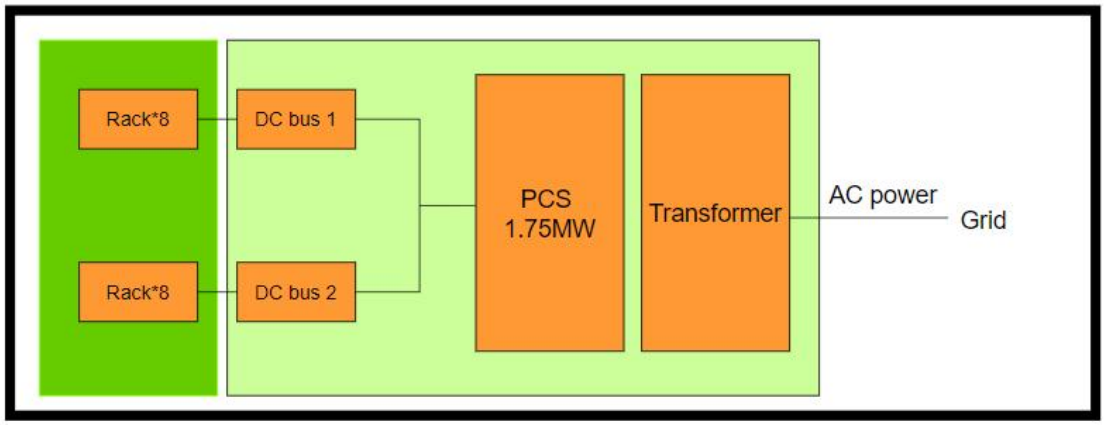



Figure 16 0.25P 1PCS Connection Methord

### 6.1.3. Precautions

1) Ensure proper connection of DC cables to the positive and negative terminals on the PCS side.
2) Verify that the DC side of the PCS includes a pre-charging circuit.
3) Confirm that the DC side of the PCS is equipped with a main circuit switch.
4) Ensure the DC side of the PCS has a DC SPD
5) Verify the AC side of the PCS is protected by an AC SPD.
6) Confirm that the fuse on the PCS DC side has a faster breaking time than the energy storage system's fuse during a short circuit.PCS
7) The PCS must include an insulation monitoring device on the DC side. Before closing the DC contactor, the BMS monitors the insulation status of the battery clusters. After the DC contactor is closed, the BMS disables its insulation detection, and the PCS assumes responsibility for insulation monitoring on the DC busbar.
8) When the energy storage system operates at a low SOC and cannot be promptly charged by the grid while requiring short-term storage, ensure the PCS is disconnected from the energy storage system to prevent over-discharge.
9) Both the energy storage container and the PCS boost-integrated cabinet must be grounded locally, with their grounding conductors connected to the same grounding grid.

## 6.2. Fuse Protection

The internal high-voltage box and PACK of the energy storage system are equipped with fuses as shown below:

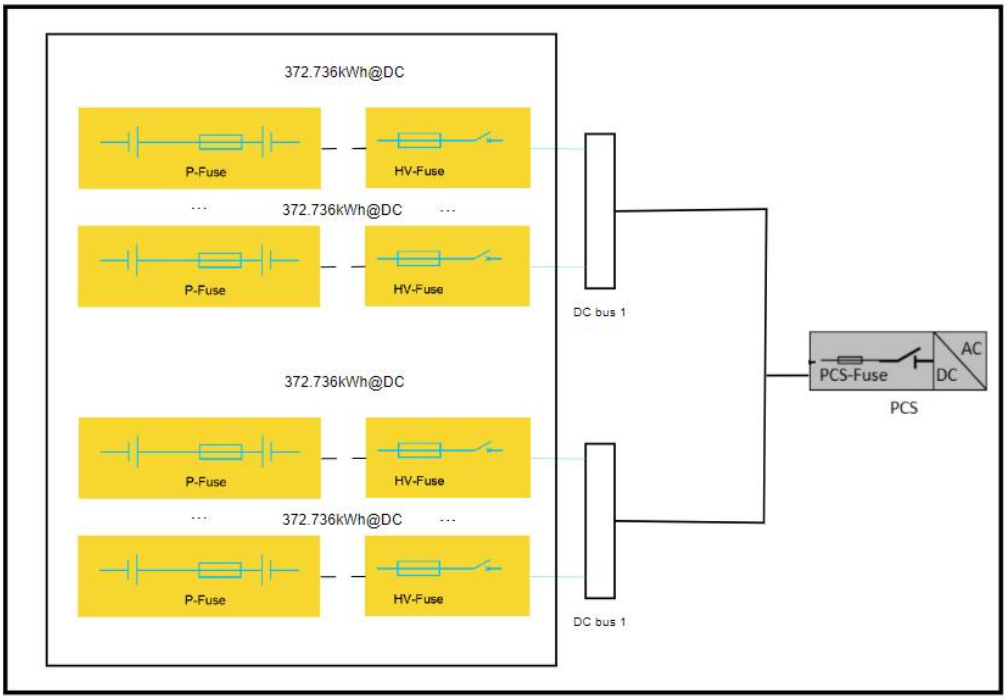



Figure 17 Internal fuse protection

P-Fuse：PACK intergrated with MSD fuse，for Pack-level short-circuit protection.

HV-Fuse：HV-box internal fuse,for cluster-level short-circuit protection.

PCS-Fuse：PCS DC input fuse,PCS DC busbars short-circuit faults protection

In accordance with the principle of three-stage fuse protection, the fuse breaking time required between them is: PCS-Fuse < HV-Fuse < P-Fuse。

HV-Fuse fuse voltage used is 1500VDC,Max. breaking capacity：250kA。

Theoretical calculation of short-circuit currents for individual outdoor cabinets > 10.36kA，also due to the battery data volume limitations after BAU parallel connection, then the DC side parallel connection can not exceed 16 clusters in parallel.

## 6.3. External communication

Hbowa-UTL-418 outdoor cabinets communicate with outdoor cabinets using CAN, using a T-bus network to transfer information to the BAU, which can communicate with the EMS via RS485. The communication configuration is as follows.

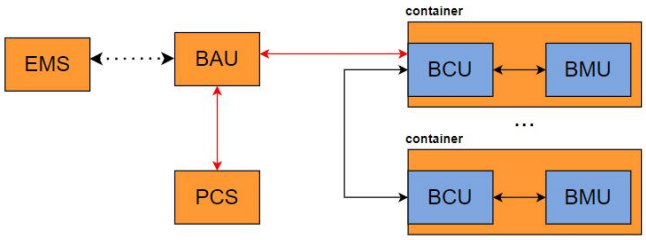



Figure 18 Communication Architecture

## 6.4. DC cabinet layout

Front, top and side views of the energy storage system Hbowa-UTL-418, see user manual for detailed installation information.

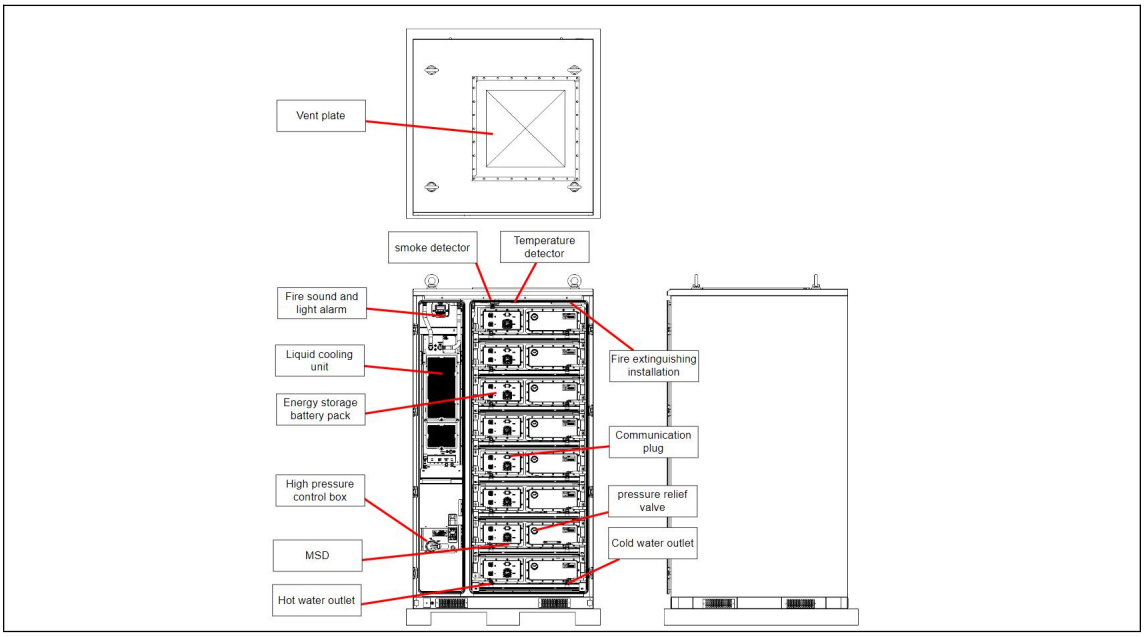



Figure 19 DC Cabinet overview

### 6.4.1. Multi-Stack Layout

The DC cabinet can be arranged in a decentralised manner, as shown in the diagram below. One side of the layout is without walls and can be scaled up or down in distance according to UL9540A.

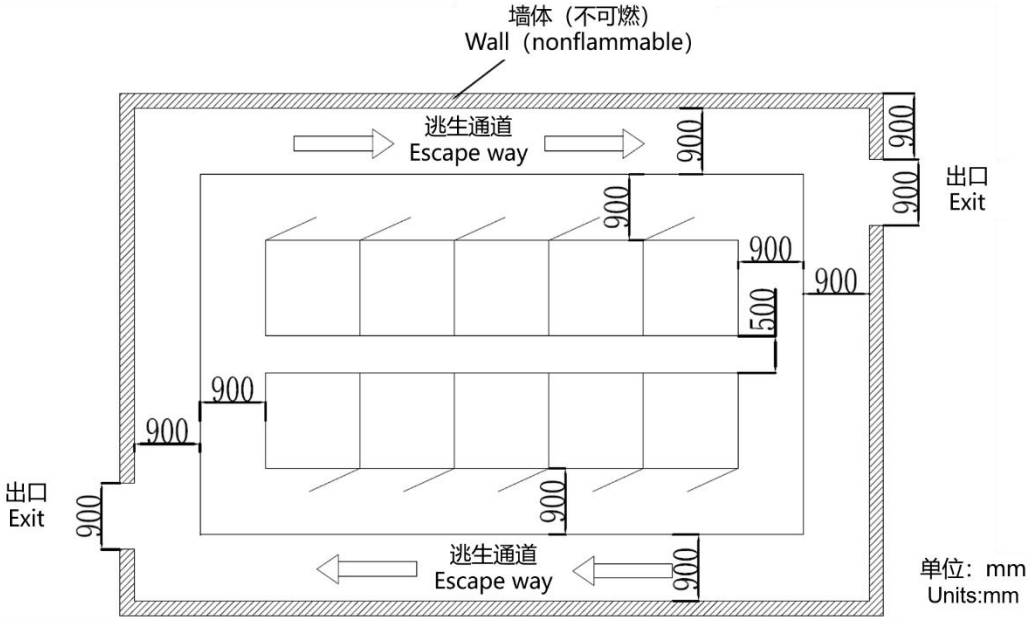



Figure 20 Multi-stack Layout（Reference only）

### 6.4.2. Single-stack layout

The DC Cabinets can be arranged in a decentralised manner, as shown in the diagram below. One side of the layout is without walls and can be scaled up or down in distance according to UL9540A.

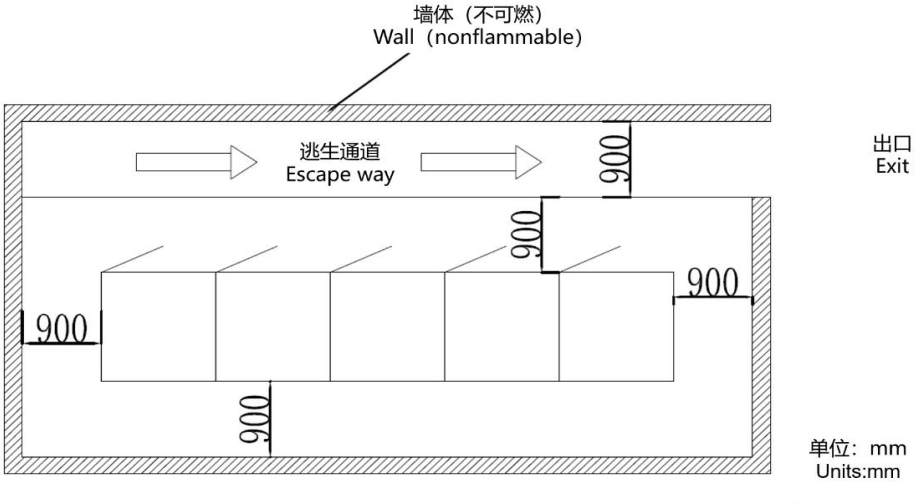



Figure 21 Single-stack Layout（Reference only）

# 7. Storage and application requirements

## 7.1. Transport storage requirements

1) The product should be carefully and gently placed during transport to avoid collision and knocking, and it is strictly prohibited to put it together with corrosive items such as acid and alkali.

2)The products are not allowed to be tilted, collapsed and other bad during normal consignment or placement.

3)After the client receives the arriving products, the storage inspection should be completed within 15 days, with specific reference to the inspection specification negotiated by both parties.

4) When storing the products, they should be placed in a warehouse with air circulation, relative humidity not greater than 95%, temperature within the range of -20~35°C, altitude <4000m, waterproof, anti-corrosive and dust-proof, and the SOC should be kept at 20%~50%.

5) If the battery products are stored for more than 6 months, it is recommended that customers carry out a charge/discharge maintenance to adjust the SOC to 20%~50% to reduce the capacity loss of the prefabricated cabin caused by storage.

## 7.2. Product application requirements

The customer should ensure that the following application conditions relating to the product are strictly observed.

1) The customer must use the products in pairs according to the product batch, and not mix different batches without obtaining consent.

2) The customer shall use the product in strict accordance with the contents of this specification, and the customer shall ensure that the user of the product shall use the product in accordance with the contents of this specification, e.g.: the range of operating ambient temperature: -30 ~ 55°C. If the product does not meet the parameters of the product, the quality of the product shall not be affected.

Otherwise, PretaPower will not be responsible for any product parameter discrepancies, quality problems, failures and any losses.

3)Prohibit the product from overcharging/overdischarging, otherwise it may cause overheating of the cells in the battery cluster and fire accidents.

4)The product should be protected from mechanical vibration, collision and pressure shock during use, otherwise the product may be short-circuited internally, generating high temperature and fire. The products are potentially dangerous and must be operated and maintained with appropriate protective measures, otherwise PretaPower shall be exempted from liability.

5)In order to avoid affecting the performance of the product, the customer may not modify the design and framework of the battery management system without authorisation, otherwise the direct causality

quality problems or quality accidents shall be exempted from the responsibility of PretaPower.

6) The customer should keep complete monitoring data of the system or battery cell operation in the product, which can be used as a reference for product quality responsibility, otherwise PretaPower will not bear the responsibility of product quality guarantee.

7) When the capacity of the product in use is less than or equal to 65% of the nominal capacity, the customer should stop using the product, otherwise PretaPower will not be responsible for any parameter inconsistency, quality problems, core failure and any loss.

# 8. Other Agreement

1) The customer is obliged to keep the content of this specification confidential, and the customer shall not disclose it to any third party without authorisation, as specified in the confidentiality agreement signed by both parties.

2) Acceptance, warranty, after-sales service and technical service shall be subject to the agreement of the business contract between the two parties.

# 9. The End

The content and technical specifications described in this document are the result of substantial research, design, and validation by PretaPower. Any updates or revisions to the document will be communicated as necessary to ensure the information remains accurate and current.

The Hbowa-UTL-418 energy storage system has been designed with a focus on safety, efficiency, and reliability, adhering to the highest industry standards.

For further details or inquiries regarding the product, please contact our technical support team or visit our website.

苏州普厉特智能科技有限公司
Suzhou Preta Intelligence and Technology Co., Ltd.

Official Website:https://www.pretapower.com

E-mail: info@pretapower.com