

Zhejiang Jinko Energy Storage Co., LTD

Product Design Scheme

SunGiga 261kWh AIO Cabinet

IEC Version



| Author/Updater | Approval: Guoqiang.Huang | | |
|----------------|--------------------------|-----------|------------|
| | Version | Signature | Date |
| Kimi | V1.0 | | 2025.04.22 |
| Kimi | V1.1 | | 2025.07.08 |
| Songfeng.hou | V1.2 | | 2025.11.11 |
| Songfeng.hou | V1.3 | | 2026.01.28 |
| | | | |

Contents

| | | |
|-----|------------------------------------|----|
| 1. | Overview | 1 |
| 2. | Definition | 1 |
| 3. | System Scheme | 1 |
| 3.1 | System Introduction..... | 1 |
| 3.2 | Design Features | 3 |
| 3.3 | Battery System | 4 |
| 3.4 | PCS | 6 |
| 3.5 | BMS..... | 8 |
| 3.6 | Liquid Cooling System..... | 9 |
| 3.7 | Firefighting System..... | 11 |
| 3.8 | Cabinet and Auxiliary Systems..... | 16 |

1. Overview

This technical document is the product design scheme for the 261kWh liquid-cooled energy storage outdoor cabinet for the IEC version. The system is primarily composed of the rack+ PCS. It includes the battery system, liquid cooling system, firefighting system, BMS and PCS.

2. Definition

| NO. | Item | Definition |
|-----|--------------|--|
| 1 | Battery cell | Cell |
| 2 | Battery pack | 1P52S Liquid-cooled battery pack |
| 3 | Battery rack | Battery system composed of 5 battery packs |
| 4 | BMU | Battery Management Unit |
| 5 | BCU | Battery Control Unit |
| 6 | SCU | System Control Unit |
| 7 | PCS | Power Conversion System |

3. System Scheme

3.1 System Introduction

The 261kWh IEC project liquid-cooled outdoor cabinet is a single energy storage unit, which consists of 5 liquid-cooled battery packs, 1 liquid cooling unit, and 1 PCS. Each liquid-cooled pack is made up of 52 battery cells connected in series, with a rated capacity of 314Ah per cell. The PCS includes sensors for data collection and protective and control electrical components, which are used to manage and protect the operating status of the entire battery rack. The system adopts a layered design with separate compartments for the liquid cooling compartment, battery compartment, and electrical compartment, facilitating installation and maintenance.

The system technical parameters are shown in Table 1, and the system single-line diagram is shown in Figure 2.

Table 1 Technical Parameters

| Parameter | Value |
|-------------------------------|--|
| Product Model | JKS-261KLAA-125PLAB |
| Rated Energy | 261kWh |
| Maximum Charge/Discharge Rate | 0.5P |
| Configuration Method | 1P260S |
| Nominal Voltage | 832V |
| Voltage Range | 728~936V |
| Operating Ambient Temperature | -30℃~55℃ |
| Operating Ambient Humidity | ≤95% Relative Humidity, no condensation |
| Average Noise Level | ≤75dB(A) @1m |
| Altitude | ≤3000m |
| IP Rating | IP55 |
| Corrosion Protection Class | C3 |
| Cooling Method | Liquid Cooling |
| Fire Protection | Smoke detector + Temperature sensor + H ₂ Detector + CO Detector + Audible and visual alarm +Explosion-proof intake ventilation+ Explosion-proof exhaust ventilation + Aerosol extinguisher |
| Dimensions (W×D×H) | 1100*1400*2400mm |
| Weight | ≈2.85T |
| Design Life | 15 years |



Figure 1 AIO Cabinet

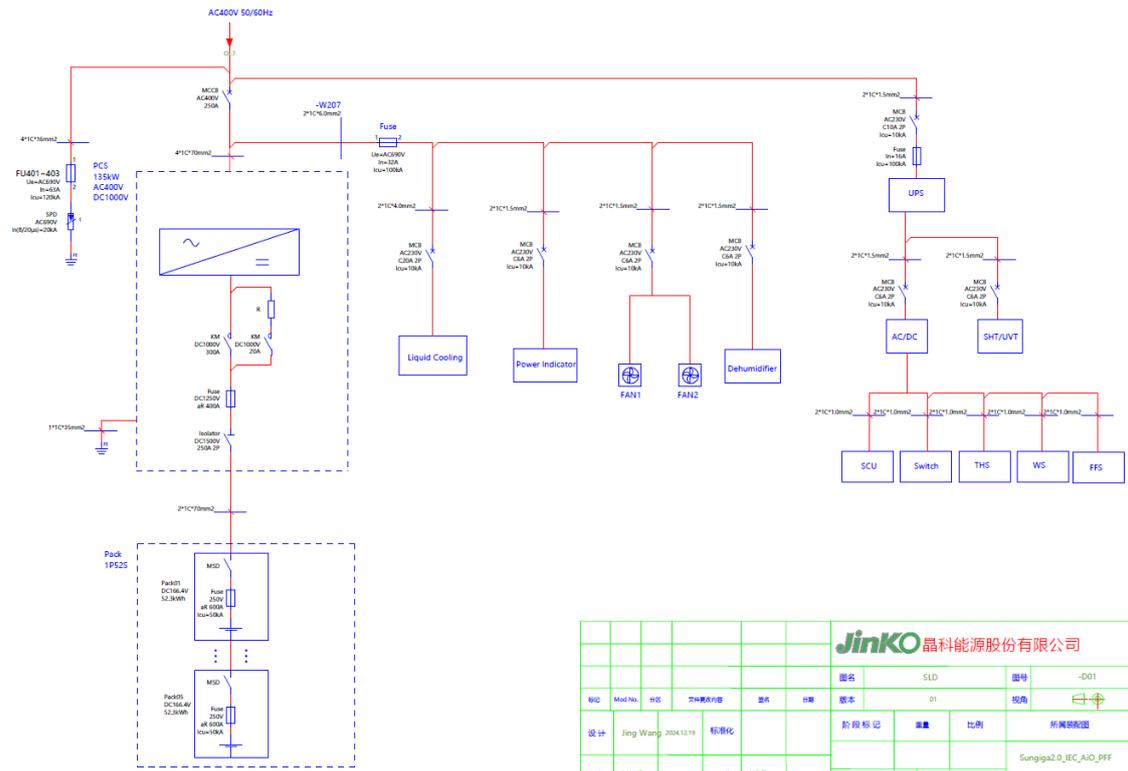


Figure 2 Single Line Diagram

3.2 Design Features

- 1) Adopting LFP battery cells specifically designed for energy storage, which feature high energy density and long cycle life;
- 2) The battery system employs a standardized modular design, allowing for flexible expansion and convenient maintenance and inspection of the system;
- 3) The liquid cooling system features multi-mode, refined thermal management control, which enhances system efficiency and lifespan while reducing auxiliary power consumption;
- 4) The battery pack uses an efficient connection process to achieve high reliability, low impedance, and high consistency in the power connections of the battery modules;
- 5) A high-strength structural design is employed to ensure the safety of the battery system during long-distance transportation and under extreme conditions, such as earthquakes;
- 6) The BMS adopts a three-tier architecture. Through communication with the liquid cooling system, temperature and humidity systems, and other auxiliary systems, the BMS monitors the operating status of each subsystem within the integrated cabinet, aggregates and processes data from the subsystems for upload, and provides multi-level fault alarms;

- 7) The outdoor cabinet is equipped with an aerosol gas fire extinguishing system, as well as smoke and temperature sensors, water ingress sensors, and audible and visual alarms;
- 8) The integrated design effectively meets the primary application scenarios of current peak-valley arbitrage for commercial and industrial use in the markets. The integrated solution has low transportation and deployment costs and is easy to install and commission on-site;
- 9) The AC/DC integrated cabinet features compartmentalized layout, with separate routing for high-voltage and low-voltage lines as well as signal cables. Strong and weak electrical secondary circuits are laid separately, and each power terminal is connected to only one wire, minimizing electromagnetic interference to the greatest extent;
- 10) A UPS is configured, with redundant power supply design to ensure that the control system, signalling system, and fire protection system can operate normally for a short period in the event of an AC power outage.

3.3 Battery System

3.3.1 Cell

This solution adopts 314Ah lithium iron phosphate prismatic aluminium-case cells. The detailed specifications are shown in Table 2.

Table 2 Cell Specifications

| No. | Parameter | Value | Notes |
|-----|---------------------------------|---|--------------------------|
| 1 | Rated Charge/Discharge Rate | 0.5P/0.5C | |
| 2 | Rated Charge/Discharge Power | 0.5P | |
| 3 | Rated Charge/Discharge Energy | 1004.8Wh | |
| 4 | Rated Charge/Discharge Capacity | 314Ah | |
| 5 | Nominal Voltage | 3.2V | |
| 6 | Dimensions (L×W×H) | (71.70±0.5)×(174.04±0.5)×(207.11±0.5)mm | |
| 7 | Weight | 5.65±0.2kg | |
| 8 | Operating Voltage Range | 2.8~3.6V | Maximum range: 2.5~3.65V |

| | | | |
|----|---|---|--|
| 11 | Cell Alarm Temperature | 55°C | |
| 12 | Cell Protection Temperature | 60°C | |
| 13 | Maximum Continuous Charge/Discharge Current | 314A | |
| 14 | Permissible Operating Temperature Range | Charging: 0°C~60°C Discharging: -30°C~60°C | |
| 15 | Permissible Storage Temperature Range | -30~60°C | |



Figure 3 314Ah Cell

3.3.2 Pack

The battery pack features a liquid-cooled design and is composed of 52 series-connected 314Ah cells. The detailed specifications are shown in Table 3. The pack has 28 temperature sampling points and 52 voltage sampling points for the cells.

Table 3 Pack Specifications

| No. | Parameter | Value |
|-----|--|--------------|
| 1 | Configuration Method | 1P52S |
| 2 | Nominal Voltage | 166.4V |
| 3 | Nominal Capacity | 314Ah |
| 5 | Maximum Charge/Discharge Rate | 0.5P |
| 6 | Nominal Energy | 52.2 kWh |
| 8 | Operating Voltage Range | 145.6-187.2V |
| 9 | Continuous Discharge Power | 26.1kW |
| 13 | Insulation Resistance between Battery Module and Enclosure | ≥1000Ω/V |
| 14 | Insulation Performance | ≥1000Ω/V |

| | | |
|----|------------------|---|
| 16 | Ambient Humidity | ≤95% Relative Humidity, no condensation |
| 17 | Cooling Method | Liquid cooling |
| 18 | Protection Level | IP67 |



Figure 4 1P52S liquid-cooled pack

3.3.1 Rack

The battery rack is composed of 5 liquid-cooled packs connected in series. The detailed specifications are shown in Table 4.

Table 4 Rack specifications

| No. | Parameter | Value | Notes |
|-----|---------------------------------|---|-------|
| 1 | Battery Configuration Method | 1P260S | |
| 2 | Rated Charge/Discharge Rate | 0.5P/0.5C | |
| 3 | Rated Charge/Discharge Power | 130.5kW | |
| 4 | Rated Charge/Discharge Energy | 261kWh | |
| 5 | Rated Charge/Discharge Capacity | 314Ah | |
| 6 | Nominal Voltage | 832V | |
| 7 | Cooling Method | Liquid Cooling (50% Ethylene Glycol Water Solution) | |

3.4 PCS

The PCS is a power circuit management unit and AC/DC conversion unit specifically designed for energy storage systems. It is equipped with disconnect switches, contactors, fuses, circulating current control circuits, current sensors, and other components internally. These enable the PCS to perform functions such as voltage and current collection for the battery rack, control and

protection of the battery rack circuit through contactors, and AC/DC conversion.

The PCS is a conversion device between the power grid and the battery, capable of charging and discharging the battery. The bidirectional energy storage converter supports both grid-connected and off-grid operating modes. It can support at least the same 12 units in parallel for grid-connected operation and the same 12 units in parallel for off-grid operation. The PCS utilizes third-generation semiconductor (silicon carbide) technology, which offers higher charge and discharge efficiency compared to the IGBT technology. The PCS and the Sungiga supports constant voltage, constant power, and constant current control, with individual management for each battery rack, facilitating maintenance. The main parameters are as follows:

Table 5 PCS specifications

| No. | Parameter | Value | Notes |
|--------------------------------------|-----------------------------------|---------------------|-------|
| AC Parameters | | | |
| 1 | Rated AC Power | 135kVA | |
| 2 | Reactive Power Range | -135~135kvar | |
| 3 | AC Overload Capability | 148.5kVA | |
| 4 | Power Supply System | 3W+N+PE | |
| DC Parameters | | | |
| 5 | Maximum DC Power | 148.5kW | |
| 6 | DC Voltage Range | 600-1000V (@400Vac) | |
| 7 | Rated DC Current | 188A | |
| 8 | Voltage Regulation Accuracy | ≤±1% | |
| 9 | Current Regulation Accuracy | ≤±1% | |
| Grid-Connected Operating Mode | | | |
| 10 | Permissible Grid Voltage | 400 (-15~15%) Vac | |
| 11 | Permissible Grid Frequency | 50/60Hz (±5Hz) | |
| 12 | Rated Current | 195A | |
| 13 | Total Current Harmonic Distortion | ≤3% | |
| 14 | Voltage Ripple Factor | ≤1% | |
| 15 | Power Factor | 0.99/-1~1 | |
| System Parameters | | | |
| 16 | Efficiency | ≥98% (full load) | |
| 17 | Dimensions | 720*265*960 | |

| No. | Parameter | Value | Notes |
|-----|---------------------------------|--|-------|
| 18 | Weight | 100KG | |
| 19 | Noise Level | <75dB | |
| 20 | Protection Level | IP65 | |
| 21 | Permissible Ambient Temperature | -30~60°C (no derating below 50°C) | |
| 22 | Cooling Method | Air-cooled | |
| 23 | Permissible Relative Humidity | 0~100% (no condensation) | |
| 24 | Altitude | ≤3000m (derating above 3000m) | |
| 25 | Communication Interface | RS485, Ethernet, CAN | |
| 26 | Communication Protocol | Modbus TCP/RTU, CAN2.0, IEC104, IEC61850 | |
| 27 | Certification | CE | |

3.5 BMS

The BMS in this design solution adopts a three-tier architecture. The first tier is the pack-level BMU, which is located within each battery pack and is responsible for individual cell voltage and temperature collection, as well as cell balancing functions. The cell-level information (cell voltage, cell temperature, cell SOC, cell SOH, and balancing status, etc.) is transmitted upward by the BMU for data reporting. The second tier is the rack-level BCU, located in the electrical compartment. It aggregates and processes the data uploaded by the BMU and is responsible for total voltage and current collection of the battery rack, as well as contactor control. The third tier is the SCU, which aggregates and processes the battery information uploaded by the BCU. It features display, parameter setting, fault alarm, data recording, and other functions.

The communication between the first and second tier BMS uses CAN bus; the communication between the second and third tier BMS uses LAN. The SCU communicates with the EMS via a switch, using LAN + Modbus protocols. Communication with the cloud platform is through 4G wireless communication (Adjustments can be made according to the actual requirements), using the standard MQTT protocol.

The block diagram of the BMS is shown as follows.

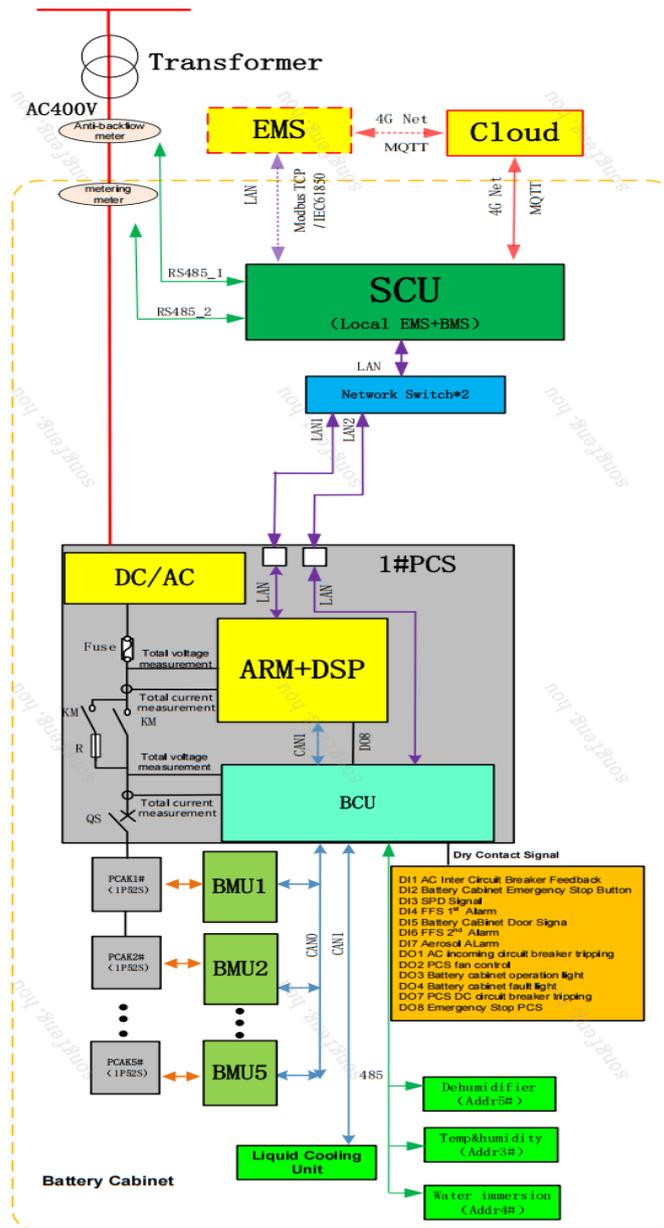


Figure 5 BMS Diagram

3.6 Liquid Cooling System

The battery thermal management system in this project employs a liquid cooling system, which consists of a liquid cooling unit, supply and return liquid piping, and battery liquid cooling plates. It also adopts a multi-mode, refined thermal management control logic to ensure system temperature and temperature differences, thereby enhancing system consistency and lifespan. The cabinet is composed of five 1P52S packs. Considering system heat leakage and efficiency, a liquid cooling unit with a cooling capacity of no less than 3kW (at 40°C) is selected.

The main design parameters of the liquid cooling system are shown in the following table:

Table 6 Liquid cooling system specifications

| Parameter | Value |
|----------------------------------|---------------------------------------|
| Size Limitation | ≤W700×D900×H245 (mm) |
| Maximum Power | 2.34kW |
| Standby Power | ≤20W |
| Self-Circulation Power | 0.1kW |
| Cooling Capacity | 3kW (L45°C/W18°C) |
| Cooling Power/Current | 1.5kW (L45°C/W18°C) |
| Heating Capacity | 2kW |
| Heating Power | 2.2kW |
| Coolant | 50% Ethylene Glycol Water Solution |
| Refrigerant | R410a/R134a |
| Ambient Temperature Range | -30°C~+55°C |
| Relative Humidity | Not exceeding 95% (20°C) |
| Maximum Altitude at Place of Use | ≤3000m |
| Noise Level | ≤75dB |
| IP Rating | IPX5 (for electrical control cabinet) |
| Power Supply | 1/PE AC 220-240V 50/60Hz |
| Communication Interface | CAN |
| Net Weight | ≤75 Kg |

The liquid cooling unit is equipped with a touch control screen, which allows for real-time monitoring of the water-cooling system's operating status and modification of relevant parameters. The software features real-time display of temperature and pressure data, as well as historical data query functions. It also provides operational status and alarm display for the main components. The liquid cooling unit and the battery arrangement space are designed with a completely independent structural layout to enhance system safety. The liquid cooling pipes use shaped flexible hoses that combine insulation, dew prevention, and exhaust functions. The internal flow channels of the battery liquid cooling plates are designed through full-condition thermal flow simulation analysis, adopting

a non-uniform flow channel design to ensure uniform flow distribution and eliminate fluid dead zones. The system uses temperature and temperature difference criteria at various levels to implement fine-grained temperature zone control, intelligently switching operating modes to reduce auxiliary power consumption and improve system efficiency while ensuring system temperature and temperature differences.

The working modes of the liquid cooling unit include:

Automatic Control Mode: Automatically adjusts the cooling and heating power based on the cell temperature;

Cooling Mode: Flow rate ≥ 25 LPM (when connected to system load), controls the outlet liquid temperature at 22°C (adjustable between 15~30°C);

Heating Mode: Flow rate ≥ 25 LPM (when connected to system load), controls the outlet liquid temperature at 30°C (adjustable between 15~30°C);

Standby Mode: The system is shut down (cooling, heating, and pump);

Self-Circulation Mode: Only the water pump operates.

3.7 Firefighting System

The FFS comprises an automatic fire alarm system integrated with the aerosol fire-suppression system.

Fire-protection equipment, in various specifications, mainly includes aerosol extinguishing devices, smoke detectors, heat detectors, combustible-gas detectors (H, CO), explosion-proof intake& exhaust ventilation systems, audibleandvisible fire alarms and water-based fire protection.

The fire-detection system consists of smoke and heat detectors equipped with volt-free (dry-contact) outputs; both detector types can transmit independent signals to the BMS.

When any single detector is activated, the audible/visible alarm is triggered and a dry-contact signal is fed back to the BMS.

When both smoke and heat detectors are activated (second-stage alarm), the BMS will simultaneously isolate its AC&DC high-voltage bus to ensure safety.

The combustible-gas detection system comprises Hand CO detectors, also with dry-contact outputs.

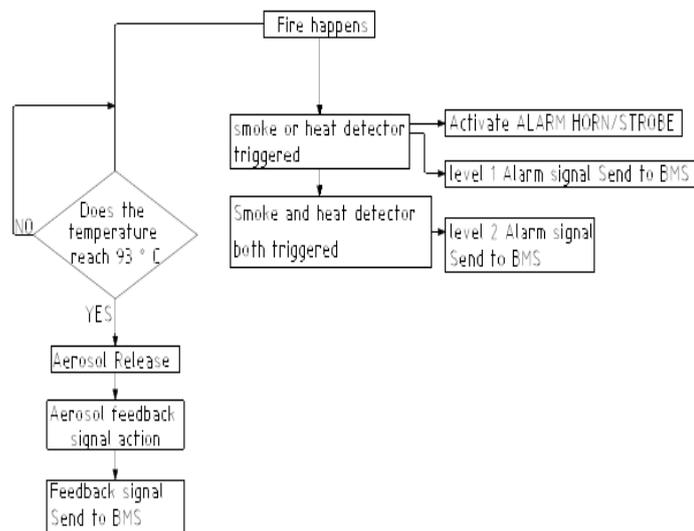
If the combustible-gas concentration in the protected zone reaches the low-alarm threshold, the detection system actuates and sends a control signal to the ventilation system, opening the explosion-proof intake&exhaust valves for forced ventilation.

When both smoke and heat detectors reach their threshold and output a second-stage alarm, the ventilation system shuts down the fans and motorized louvers, and the BMS receives the alarm signal.

When the aerosol nozzle inside the battery cabinet detects that the ambient temperature reaches 93°C, it will automatically release the aerosol extinguishing agent to extinguish the fire and send an activation signal of the aerosol heat-sensitive detector to the BMS.

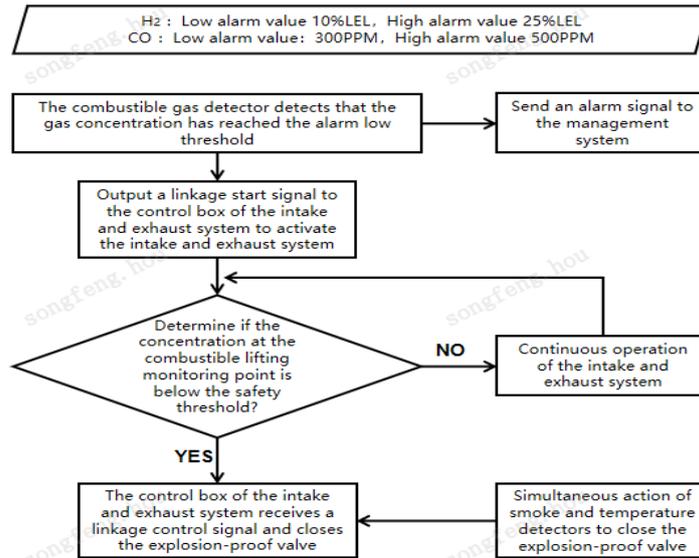
Cabinets equipped with a water-based fire-suppression function feature a water-fire interface that allows external connection to water pipes and valves. In the event of an emergency fire inside the cabinet, the external valve can be opened to activate the internal water-spray system and bring the fire under control.

Note: Fire-protection functions vary with configuration.



Logic Diagram of the fire safety system

Figure 6 FFS flowchart



Control logic diagram of intake and exhaust system

Figure 7 Ventilation and exhaust system control logic diagram

● Smoke decetor:

Main parameters are as follows:

| Parameter | Value |
|-----------------------|------------------------|
| Operating Voltage | DC9~33V |
| Static Current | 30~50 μ A@24V |
| Alarm Voltage | 6~28V |
| LED Alarm Current | 4mA |
| Operating Temperature | -20℃ ~ 60℃ |
| Sensitivity | 0.15db/m |
| Humidity | ≤95%RH, non-condensing |
| Height | 50mm |
| Diameter | 100mm |



Figure 8 Smoke detector

● Temperature Sensor

The temperature sensor can detect the ambient temperature and trigger the detector alarm when the ambient temperature exceeds the preset limit temperature threshold.

Main parameters are as follows:

| Parameter | Value |
|-----------|-------|
|-----------|-------|

| | |
|-----------------------|------------------------|
| Operating Voltage | DC9~33V |
| Maximum Alarm Current | 52mA |
| Alarm Temperature | 65°C |
| Hold Voltage | 6V |
| Hold Current | 10mA |
| Operating Temperature | -20°C ~ 60°C |
| Humidity | ≤95%RH, non-condensing |
| IP Rating | IP54 |
| Height | 50mm |
| Diameter | 100mm |



Figure 9 Heat detector

- Aerosol extinguisher

The working principle of the condensed aerosol fire-extinguishing mechanism is to remove the active chemical substances involved in the flame chain reaction. Upon activation, FPC (a patented solid compound) immediately begins a chemical reaction, producing condensed dry aerosol within seconds. The condensed dry aerosol efficiently disrupts the chain reaction of the flame when it comes into contact with it.

Main parameters are as follows:

| Parameter | Value |
|------------------------|--------------------------|
| Activation Mode | Thermal activation, 93°C |
| Min. Pulse Current | 0.8A |
| Min. Pulse Voltage | 1.5V |
| Min. Pulse Duration | 0.5S |
| Aerosol Discharge Time | 5~10S |
| Operating Temperature | -54°C ~ 100°C |
| Diameter | 84mm |
| Height | 295mm |



FP-500S

Figure 10 Aerosol extinguisher

- Explosion-proof intake&exhaust valves

Explosion-proof exhaust valves

| Parameter | Value |
|----------------------------|-----------------------|
| Start the trip | 30mm |
| Exhaust area after opening | >20300mm ² |
| Turn on speed | 4.0mm/s |
| Voltage | 24V |
| Maximum power | 137.4±4W |
| Protection level | IP66 |
| Fan air volume CFM | 783.3 |

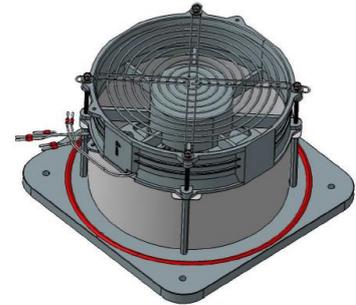


Figure 11 Explosion-proof exhaust valves

Explosion-proof intake valves

| Parameter | Value |
|--|-----------------------|
| Start the trip | 30mm |
| Exhaust area after opening | >20300mm ² |
| Turn on speed | 4.0mm/s |
| Operating temperature | -30°C~70°C |
| Voltage | 24V |
| The maximum power of the electric push rod | 3W |
| Protection level | IP66 |
| Fan air volume CFM | 783.3 |

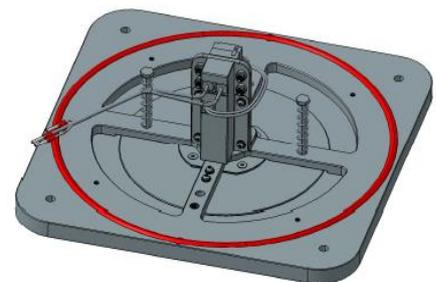


Figure 12 Explosion-proof intake valves

- Gas Detector(CO detector&H2 detector)

The gas detector can monitor the concentration of combustible gas and feed the data back to the ventilation system. Both a hydrogen detector and a carbon monoxide detector are installed inside the cabinet.

| Parameter | Value |
|-----------------------|--|
| Operating Voltage | DC9~33V |
| Maximum Alarm Current | 52mA |
| Alarm Temperature | 65°C |
| Operating Voltage | 10-30Vdc |
| Power Requirements | 3W MAX |
| Humidity | 90%RH |
| IP Rating | IP65 |
| Height | 50mm |
| Diameter | 156*166*109mm |
| Gas Ranges Available | Carbon Monoxide(CO) : 0-25,50, 100,200,250,300,1000,2000 ppm. Hydrogen(H2):0-100%LEL or 0-200,2000ppm |



Figure 13 Gas detector

- Horn Strobe

| Parameter | Value |
|--------------------|---|
| Voltage | 17-60V DC |
| Current @ 0.5Hz | 25.1mA |
| Current @ 1Hz | 45.1mA |
| Flash Colour | White |
| Body Colour | Red |
| Sound Output | 94 -97dBA |
| Ingress Protection | IP33C (Deep base) IP21C (Shallow base) |



Figure 14 Horn Strobe

3.8 Cabinet and Auxiliary Systems

The cabinet dimensions are 1100×1400×2400 mm (length × width × height), and it contains 5

packs, 1 PCS, a fire protection system, a liquid cooling system, and other components. To facilitate the construction, commissioning, maintenance, and inspection of the battery system, a single-sided maintenance layout is used. The layout is shown in the figure below:

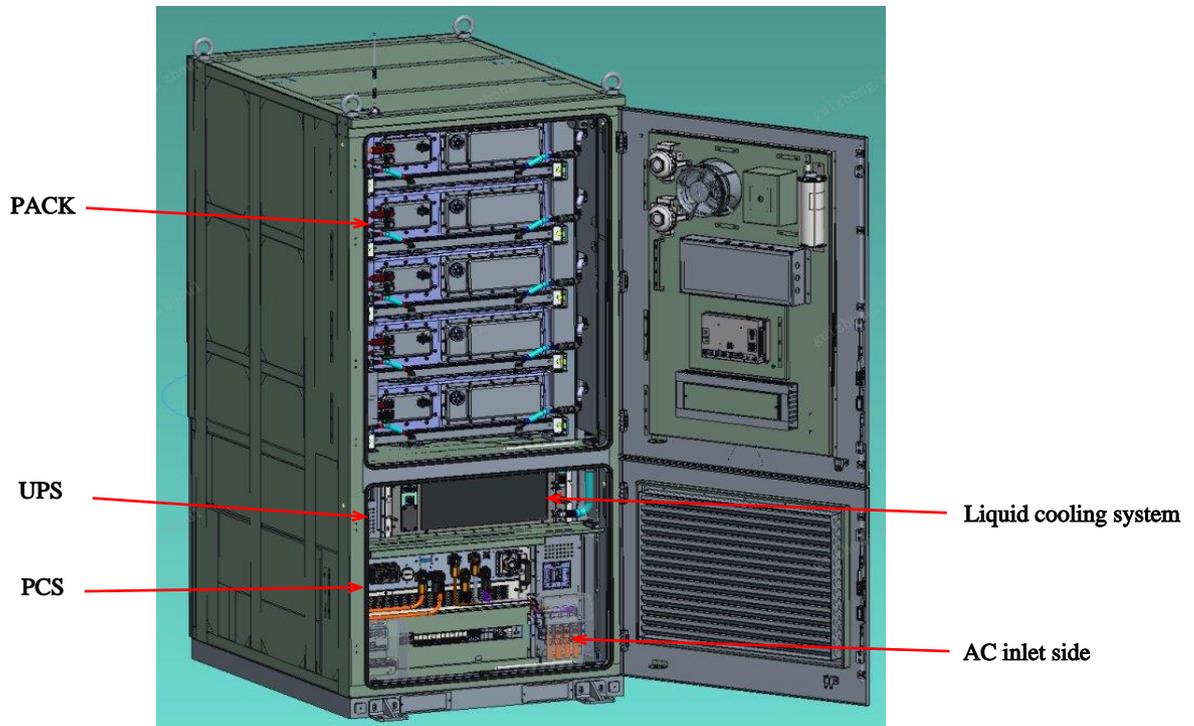


Figure 1 5 Front view of the cabinet

A grounding copper bar is installed inside the integrated cabinet for the PE (Protective Earth) grounding of the equipment within the cabinet.

The cabinet is equipped with water ingress sensors and temperature and humidity sensors to monitor the operating environment in real time. It also enables alarm linkage with other subsystems, meeting the requirements for safe operation and inspection management.

The following page is intentionally left blank.

| Item | Description | Specification | Qty |
|---------------------------|---|--|----------|
| | Jinko Sungiga G2 All-in-one BESS | Rated capacity 261kWh/135kW, including items and parameters indicated from 1.1 to 3.5 | 8 |
| Battery Parameters | | | |
| 1.1 | Battery rack | Rated capacity: 261kWh | 1 |
| | | LFP 314Ah Cell; Module 1P52S, 5 packs | |
| | | Charge/Discharge rate: 0.5C | |
| 1.2 | Liquid Cooling System & Components | Pumps, heat ex-changer, HVAC and pipelines etc. | 1 |
| PCS Parameters | | | |
| 2.1 | PCS | Rated AC Power: 135kVA | 1 |
| | | Max Voltage: 1000V | |
| | | AC Output: 400V/50 (60) Hz | |
| | | Three phase four wire | |
| | | Cooling Method: Air-Cooling | |
| System Parameters | | | |
| 3.1 | Enclosure & Accessories | Dimensions(L*W*H):1100×1400×2400mm, IP55/C3 | 1 |
| 3.2 | Fire Suppression System & Components | Aerosol FFS | 1 |
| 3.3 | Operation Ambient Temperature | -30°C~55°C, >50°C derating | N/A |
| 3.4 | Operation Relative Humidity | <95%RH, no condensing | N/A |
| 3.5 | Weight | ≈2.85T | N/A |

Note:

1. Jinko Sungiga G2 supports only manual on-grid/off-grid switching. Automatic, fast or seamless switching requires additional equipment to be purchased separately.
2. The scope of EMS function should be detailed specified before the contract signing stage.
3. Detailed technical information including project information checklist, electrical drawing, and all required documents shall be drafted and sent to Jinko for technical evaluation before project signing.
4. Any after-sale issue due to the deviation or not-confirmation with the pre-commissioning checklist will not be in Jinko scope.