



User Manual

HV48100 SE

LiFePO4 Energy Storage Battery



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About This Document

This document describes the installation, electrical connections, commission, and troubleshooting of HV48100 SE High Voltage Energy Storage System (hereinafter referred as ESS). Before installing and operating the ESS, read this document carefully to understand the safety information as well as functions and features of the ESS.

This document is intended for:

- Technical support engineers
- Hardware installation engineers
- Commissioning engineers
- Maintenance engineers

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1 SAFETY PRECAUTIONS

Statement

Before transporting, storing, installing, operating, using, and/or maintaining the equipment, read this document, strictly follow the instructions provided herein, and follow all the safety instructions on the equipment and in this document. In this document, "equipment" refers to the products, software, components, spare parts, and/or services related to this document; "the Company" refers to the manufacturer (producer), seller, and/or service provider of the equipment; "you" refers to the entity that transports, stores, installs, operates, uses, and/or maintains the equipment.

The Danger, Warning, Caution, and Notice statements described in this document do not cover all the safety precautions. You also need to comply with relevant international, national, or regional standards and industry practices. The Company shall not be liable for any consequences that may arise due to violations of safety requirements or safety standards concerning the design, production, and usage of the equipment.

The equipment shall be used in an environment that meets the design specifications. Otherwise, the equipment may be faulty, malfunctioning, or damaged, which is not covered under the warranty. The Company shall not be liable for any property loss, personal injury, or even death caused thereby.

Comply with applicable laws, regulations, standards, and specifications during transportation, storage, installation, operation, use, and maintenance.

Do not perform reverse engineering, decompilation, disassembly, adaptation, implantation, or other derivative operations on the equipment software. Do not study the internal implementation logic of the equipment, obtain the source code of the equipment software, violate intellectual property rights, or disclose any of the performance test results of the equipment software.

The Company shall not be liable for any of the following circumstances or their consequences:

- The equipment is damaged due to force majeure such as earthquakes, floods, volcanic eruptions, debris flows, lightning strikes, fires, wars, armed conflicts, typhoons, hurricanes, tornadoes, and other extreme weather conditions.
- The equipment is operated beyond the conditions specified in this document.
- The equipment is installed or used in environments that do not comply with international, national, or regional standards.
- The equipment is installed or used by unqualified personnel.
- You fail to follow the operation instructions and safety precautions on the

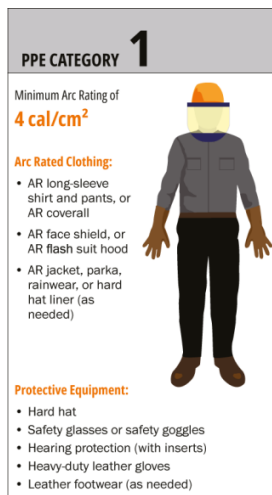
product and in the document.

- You remove or modify the product or modify the software code without authorization.
- You or a third party authorized by you cause the equipment damage during transportation.
- The equipment is damaged due to storage conditions that do not meet the requirements specified in the product document.
- You fail to prepare materials and tools that comply with local laws, regulations, and related standards.
- The equipment is damaged due to your or a third party's negligence, intentional breach, gross negligence, or improper operations, or other reasons not related to the Company.

1.1 Personal Safety

Danger

- Ensure that power is off during installation. Do not install or remove a cable with power on.
- Transient contact between the core of the cable and the conductor will cause electric arcs, sparks, fire or explosion, which may result in personal injury.
- Non-standard and improper operations on the energized equipment may cause fire, electric shocks, or explosion, resulting in property damage, personal injury, or even death.
- Select the appropriate PPE category per NFPA 70E based on the arc rating ($\geq 4\text{cal/cm}^2$)



- Before operations, remove conductive objects such as watches, bracelets, bangles, rings, and necklaces to prevent electric shocks.
- During operations, use dedicated insulated tools to prevent electric shocks or short circuits. The dielectric withstanding voltage level must comply with local laws, regulations, standards, and specifications.
- During operations, wear personal protective equipment such as protective clothing, insulated shoes, goggles, safety helmets, and insulated gloves.

1.1.1 General Requirements

- Do not stop protective devices. Pay attention to the warnings, cautions, and related precautionary measures in this document and on the equipment.
- If there is a likelihood of personal injury or equipment damage during operations, immediately stop, report the case to the supervisor, and take feasible protective measures.
- Do not power on the equipment before it is installed or confirmed by professionals.
- Do not touch the power supply equipment directly or with conductors such as damp objects. Before touching any conductor surface or terminal, measure the voltage at the contact point to ensure that there is no risk of electric shock.
- Do not touch operating equipment because the enclosure is hot.
- In the case of a fire, immediately leave the building or the equipment area and activate the fire alarm or call emergency services. Do not enter the affected building or equipment area under any circumstances.

1.1.2 Personnel Requirements

- Only professionals and trained personnel are allowed to operate the equipment.
 - a) Professionals: personnel who are familiar with the working principles and structure of the equipment, trained or experienced in equipment operations and are clear of the sources and degree of various potential hazards in equipment installation, operation, maintenance.
 - b) Trained personnel: personnel who are trained in technology and safety, have required experience, are aware of possible hazards on themselves in certain operations, and are able to take protective measures to minimize the hazards on themselves and other people.
- Personnel who plan to install or maintain the equipment must receive adequate training, be able to correctly perform all operations, and understand all necessary safety precautions and local relevant standards.

- Only qualified professionals or trained personnel are allowed to install, operate, and maintain the equipment.
- Only qualified professionals are allowed to remove safety facilities and inspect the equipment. Personnel who will perform special tasks such as electrical operations, working at heights, and operations of special equipment must possess the required local qualifications.
- Only certified high-voltage electricians are allowed to operate equipment.
- Only authorized professionals are allowed to replace the equipment or components (including software).
- Only personnel who need to work on the equipment are allowed to access the equipment.

1.2 Electrical Safety

Danger

- Before connecting cables, ensure that the equipment is intact. Otherwise, electric shocks or fire may occur.
- Non-standard and improper operations may result in fire or electric shocks.
- Prevent foreign matter from entering the equipment during operations. Otherwise, equipment damage, load power derating, power failure, or personal injury may occur.

Warning

For the equipment that needs to be grounded, install the ground cable first when installing the equipment and remove the ground cable last when removing the equipment.

1.2.1 General Requirements

- Follow the procedures described in the document for installation, operation, and maintenance. Do not reconstruct or alter the equipment, add components, or change the installation sequence without permission.
- Obtain approval from the national or local electric utility company before connecting the equipment to the grid.
- Observe the power plant safety regulations, such as the operation and work ticket mechanisms.
- Install temporary fences or warning ropes and hang "No Entry" signs around the operation area to keep unauthorized personnel away from the area.
- Before installing or removing power cables, turn off the switches of the equipment and its upstream and downstream switches.
- If any liquid is detected inside the equipment, disconnect the power supply

immediately and do not use the equipment.

- Before performing operations on the equipment, check that all tools meet the requirements and record the tools. After the operations are complete, collect all the tools to prevent them from being left inside the equipment.
- Before installing power cables, check that cable labels are correct and cable terminals are insulated.
- When installing the equipment, use a torque tool of a proper measurement range to tighten the screws. When using a wrench to tighten the screws, ensure that the wrench does not tilt, and the torque error does not exceed 10% of the specified value.
- Ensure that bolts are tightened with a torque tool and marked in red and blue after double-checking. Installation personnel mark tightened bolts in blue. Quality inspection personnel confirm that the bolts are tightened and then mark them in red. (The marks must cross the edges of the bolts.)
- After the installation is complete, ensure that protective cases, insulation tubes, and other necessary items for all electrical components are in position to avoid electric shocks.
- If the equipment has multiple inputs, disconnect all the inputs before operating the equipment.
- Before maintaining a downstream electrical or power distribution device, turn off the output switch on the power supply equipment.
- During equipment maintenance, attach "Do not switch on" labels near the upstream and downstream switches or circuit breakers as well as warning signs to prevent accidental connection. The equipment can be powered on only after troubleshooting is complete.
- If fault diagnosis and troubleshooting need to be performed after power-off, take the following safety measures: Disconnect the power supply. Check whether the equipment is live. Install a ground cable. Hang warning signs and set up fences.
- Check equipment connections periodically, ensuring that all screws are securely tightened.
- Only qualified professionals can replace a damaged cable.
- Do not scrawl, damage, or block any labels or nameplates on the equipment. Promptly replace labels that have worn out.
- Do not use solvents such as water, alcohol, or oil to clean electrical components inside or outside of the equipment.

1.2.2 Grounding

- Ensure that the grounding impedance of the equipment complies with local electrical standards.
- Ensure that the equipment is connected permanently to the protective ground. Before operating the equipment, check its electrical connection to ensure that it is reliably grounded.
- Do not work on the equipment in the absence of a properly installed ground conductor.
- Do not damage the ground conductor.
- Ground the protective ground terminal on the equipment enclosure before connecting the power supply; otherwise, electric shock as a result of touch current may occur.

1.2.3 Cabling Requirements

- When selecting, installing, and routing cables, follow local safety regulations and rules.
- When routing power cables, ensure that there is no coiling or twisting. Do not join or weld power cables. If necessary, use a longer cable.
- Ensure that all cables are properly connected and insulated and meet specifications.
- Ensure that the slots and holes for routing cables are free from sharp edges, and that the positions where cables are routed through pipes or cable holes are equipped with cushion materials to prevent the cables from being damaged by sharp edges or burrs.
- If a cable is routed into the cabinet from the top, bend the cable in a U shape outside the cabinet and then route it into the cabinet.
- Ensure that cables of the same type are bound together neatly and straight and that the cable sheath is intact. When routing cables of different types, ensure that they are at least 30 mm away from each other.
- When cable connection is completed or paused for a short period of time, seal the cable holes with sealing putty immediately to prevent small animals or moisture from entering.
- Secure buried cables using cable supports and cable clips. Ensure that the cables in the backfill area are in close contact with the ground to prevent cable deformation or damage during backfilling.
- If the external conditions (such as the cable layout or ambient temperature) change, verify the cable usage in accordance with the IEC-60364-5-52 or local

laws and regulations. For example, check that the current-carrying capacity meets requirements.

- When routing cables, reserve at least 30 mm clearance between the cables and heat generating components or areas. This prevents deterioration or damage to the cable insulation layer.
- When the temperature is low, violent impact or vibration may damage the plastic cable sheathing. To ensure safety, comply with the following requirements:
- Cables can be laid or installed only when the temperature is higher than 0°C. Handle cables with caution, especially at a low temperature.
- Cables stored at subzero temperatures must be stored at room temperature for at least 24 hours before they are laid out.
- Do not perform any improper operations, for example, dropping cables directly from a vehicle. Otherwise, the cable performance may deteriorate due to cable damage, which affects the current-carrying capacity and temperature rise.

1.3 Environment Requirements

Danger

- Do not expose the equipment to flammable or explosive gas or smoke. Do not perform any operation on the equipment in such environments.
- Do not store any flammable or explosive materials in the equipment area.
- Do not place the equipment near heat sources or fire sources, such as smoke, candles, heaters, or other heating devices. Overheat may damage the equipment or cause a fire.

Warning

Install the equipment in an area far away from liquids. Do not install it under areas prone to condensation, such as under water pipes and air exhaust vents, or areas prone to water leakage, such as air conditioner vents, ventilation vents, or feeder windows of the equipment room. Ensure that no liquid enters the equipment to prevent faults or short circuits.

To prevent damage or fire due to high temperature, ensure that the ventilation vents or heat dissipation systems are not obstructed or covered by other objects while the equipment is running.

1.3.1 General Requirements

- Ensure that the equipment is stored in a clean, dry, and well-ventilated area with proper temperature and humidity and is protected from dust and condensation.

- Keep the installation and operating environments of the equipment within the allowed ranges. Otherwise, its performance and safety will be compromised.
- Do not install, use, or operate outdoor equipment and cables (including but not limited to moving equipment, operating equipment and cables, inserting connectors to or removing connectors from signal ports connected to outdoor facilities, working at heights, performing outdoor installation, and opening doors) in harsh weather conditions such as lightning, rain, snow, and level 6 or stronger wind.
- Do not install the equipment in an environment with dust, smoke, volatile or corrosive gases, infrared and other radiations, organic solvents, or salty air.
- Do not install the equipment in an environment with conductive metal or magnetic dust.
- Do not install the equipment in an area conducive to the growth of microorganisms such as fungus or mildew.
- Do not install the equipment in an area with strong vibration, noise, or electromagnetic interference.
- Ensure that the site complies with local laws, regulations, and related standards.
- Ensure that the ground in the installation environment is solid, free from spongy or soft soil, and not prone to subsidence. The site must not be located at a low-lying land prone to water or snow accumulation, and the horizontal level of the site must be above the highest water level of that area in history.
- Do not install the equipment in a position that may be submerged in water.
- If the equipment is installed in a place with abundant vegetation, in addition to routine weeding, harden the ground underneath the equipment using cement or gravel.

1.4 Battery Safety

Danger

- Do not connect the positive and negative poles of a battery together. Otherwise, the battery may be short-circuited. Battery short circuits can generate high instantaneous current and releases a large amount of energy, which may cause battery leakage, smoke, flammable gas release, thermal runaway, fire or explosion. To avoid battery short circuits, do not maintain batteries with power on.
- Do not expose batteries at high temperatures or around heat sources, such as scorching sunlight, fire sources, transformers, and heaters. Battery overheating may cause leakage, smoke, flammable gas release, thermal runaway, fire or explosion.

- Protect batteries from mechanical vibration, falling, collision, punctures, and strong impact. Otherwise, the batteries may be damaged or catch fire.
- To avoid leakage, smoke, flammable gas release, thermal runaway, fire or explosion, do not disassemble, alter, or damage batteries, for example, insert foreign objects into batteries, squeeze batteries, or immerse batteries in water or other liquids.
- Do not touch battery terminals with other metal objects, which may cause heat or electrolyte leakage.
- There is a risk of fire or explosion if the model of the battery in use or used for replacement is incorrect. Use a battery of the model recommended by the manufacturer.
- Battery electrolyte is toxic and volatile. Do not get contact with leaked liquids or inhale gases in the case of battery leakage or odor. In such cases, stay away from the battery and contact professionals immediately. Professionals must wear safety goggles, rubber gloves, gas masks, and protective clothing, power off the equipment, remove the battery, and contact technical engineers.
- A battery is an enclosed system and will not release any gases under normal operations. If a battery is improperly treated, for example, burnt, needle-pricked, squeezed, struck by lightning, overcharged, or subject to other adverse conditions that may cause battery thermal runaway, the battery may be damaged or an abnormal chemical reaction may occur inside the battery, resulting in electrolyte leakage or production of gases such as CO and H₂. To prevent fire or device corrosion, ensure that flammable gas is properly exhausted.
- The gas generated by a burning battery may irritate your eyes, skin, and throat. Take protective measures promptly.

Warning

- Install batteries in a dry area. Do not install them under areas prone to water leakage, such as air conditioner vents, ventilation vents, feeder windows of the equipment room, or water pipes. Ensure that no liquid enters the equipment to prevent faults or short circuits.
- Before installing and commissioning batteries, prepare firefighting facilities, such as fire sand and carbon dioxide fire extinguishers, according to construction standards and regulations. Before putting into operation, ensure that firefighting facilities that comply with local laws and regulations are installed.
- Before unpacking, storage, and transportation, ensure that the packing cases are intact and the batteries are correctly placed according to the labels on the

packing cases. Do not place a battery upside down or vertically, lay it on one side, or tilt it. Stack the batteries according to the stacking requirements on the packing cases. Ensure that the batteries do not fall or get damaged. Otherwise, they will need to be scrapped.

- After unpacking batteries, place them in the required direction. Do not place a battery upside down or vertically, lay it on one side, tilt it, or stack it. Ensure that the batteries do not fall or get damaged. Otherwise, they will need to be scrapped.
- Tighten the screws on copper bars or cables to the torque specified in this document. Periodically confirm whether the screws are tightened, check for rust, corrosion, or other foreign objects, and clean them up if any. Loose screw connections will result in excessive voltage drops and batteries may catch fire when the current is high.
- After batteries are discharged, charge them in time to avoid damage due to over discharge.
- Statement
- The Company shall not be liable for any damage or other consequences to the batteries it provides due to the following reasons:
 - Batteries are damaged due to force majeure such as earthquakes, floods, volcanic eruptions, debris flows, lightning strikes, fires, wars, armed conflicts, typhoons, hurricanes, tornadoes, and other extreme weather conditions.
 - Batteries are damaged because the onsite equipment operating environment or external power parameters do not meet the environment requirements for normal operation, for example, the actual operating temperature of batteries is too high or too low, or the power grid is unstable and experiences outages frequently.
 - Batteries are damaged, fall, leak, or crack due to improper operations or incorrect connection.
 - After being installed and connected to the system, the batteries are not powered on in time due to your reasons, which causes damage to the batteries due to over discharge.
 - Batteries are damaged because they are not accepted in time due to your reasons.
 - You set battery operating parameters incorrectly.
 - You use batteries of different types together, causing acceleration of capacity attenuation. For example, you use our batteries together with batteries of other vendors or with batteries of different rated capacity.

- You maintain batteries improperly, causing frequent over discharge; you expand the load capacity without notifying us; or you have not fully charged the batteries for a long time.
- You do not perform battery maintenance based on the operation guide, such as failure to check battery terminals regularly.
- Batteries are damaged because you do not store them in accordance with storage requirements (for example, in an environment that is damp or prone to rain).
- Batteries are not charged as required during storage due to your reasons, resulting in capacity loss or other irreversible damages to the batteries.
- Batteries are damaged due to your or a third party's reasons, for example, relocating or reinstalling the batteries without complying with the Company's requirements.
- You change the battery use scenarios without notifying the Company.
- You connect extra loads to the batteries.
- The battery storage period has exceeded the upper limit.
- The battery warranty period has expired. You are advised not to use a battery whose warranty period has expired, as this poses safety risks.

1.4.1 General Requirements

- Before installing, operating, and maintaining batteries, read the battery instructions and comply with its requirements. The safety precautions specified in this document are highly important and require special attention.
- Use batteries within the specified temperature range. When the ambient temperature of the batteries is lower than the allowed range, do not charge the batteries to prevent internal short circuits caused during low-temperature charging.
- Before unpacking batteries, check whether the packaging is intact. Do not use batteries with damaged packaging. If any damage is found, notify the carrier and manufacturer immediately.
- Install batteries within 24 hours after unpacking. If the batteries cannot be installed in time, put them in the original packaging and place them in a dry indoor environment without corrosive gases. Power on the ESS within 24 hours after installation. The process from unpacking batteries to powering on the system must be completed within 72 hours. During routine maintenance, ensure that the power-off time does not exceed 24 hours.
- Do not use a damaged battery (such as damage caused when a battery is dropped, bumped, bulged, or dented on the enclosure), because the damage

may cause electrolyte leakage or flammable gas release. In the case of electrolyte leakage or structural deformation, contact the installer or professional O&M personnel immediately to remove or replace the battery. Do not store the damaged battery near other devices or flammable materials and keep it away from non-professionals.

- Before working on a battery, ensure that there is no irritant or scorched smell around the battery.
- When installing batteries, do not place installation tools, metal parts, or sundries on the batteries. After the installation is complete, clean up the objects on the batteries and the surrounding area.
- Do not install battery packs on rainy, snowy, or foggy days. Otherwise, the battery packs may be corroded by moisture or rain.
- If batteries are exposed to water accidentally, do not install them. Instead, transport the batteries to a safe isolation point and dispose of them in a timely manner.
- Before installing battery packs, check whether they are abnormal. A battery pack is deemed abnormal when any of the following symptoms occurs:
 - The enclosure of the battery pack is obviously deformed or damaged.
 - The voltage between the positive and negative electrodes of the battery pack is far below the specified range.
- Check whether the positive and negative battery terminals are grounded unexpectedly. If so, disconnect the battery terminals from the ground.
- Do not perform welding or grinding work around batteries to prevent fire caused by electric sparks or arcs.
- If batteries are left unused for a long period of time, store and charge them according to the battery requirements.
- Do not charge or discharge batteries by using a device that does not comply with local laws and regulations.
- Keep the battery loop disconnected during installation and maintenance.
- Monitor damaged batteries during storage for signs of smoke, flame electrolyte leakage, or heat.
- If a battery is faulty, its surface temperature may be high. Do not touch the battery to avoid scalds.
- Do not stand on, lean on, or sit on the top of the equipment.
- In backup power scenarios, do not use the batteries for the following situations:
 - a. Medical devices substantially important to human life
 - b. Control equipment such as trains and elevators, as this may cause personal injury

- c. Computer systems of social and public importance
- d. Locations near medical devices
- e. Other devices similar to those described above

1.4.2 Short-Circuit Protection

- When installing and maintaining batteries, wrap the exposed cable terminals on the batteries with insulation tape.
- Avoid foreign objects (such as conductive objects, screws, and liquids) from entering a battery, as this may cause short circuits.

Recycling

- Dispose of waste batteries in accordance with local laws and regulations. Do not dispose of batteries as household waste. Improper disposal of batteries may result in environmental pollution or an explosion.
- If a battery leaks or is damaged, contact technical support or a battery recycling company for disposal.
- If batteries are out of service life, contact a battery recycling company for disposal.
- Do not expose waste batteries to high temperatures or direct sunlight.
- Do not place waste batteries in environments with high humidity or corrosive substances.
- Do not use faulty batteries. Contact a battery recycling company to scrap them as soon as possible to avoid environmental pollution.

Precaution

- Please read this manual carefully before installation and any operation.
- Charge the battery every 6 months to keep battery SOC > 90% if long term storage.
- Battery must be charged within 12 hours when low voltage alarm triggered.
- Each Battery module has an output voltage of over 48V. It is vital to pay attention to personal safety in any case when operating.
- All battery terminals must be disconnected before maintenance.
- Please contact with Pytes or its dealer within 24 hours if there is anything abnormal.
- Battery being damaged directly or indirectly by above cases will result in warranty failure.

1.5 Emergency Handling

1.5.1 Leakage Handling

- Electrolyte is corrosive and can cause irritation and chemical burns. If you come into direct contact with the battery electrolyte, do as follows:
- Inhalation: Evacuate from contaminated areas, get fresh air immediately, and seek immediate medical attention.
- Eye contact: Immediately wash your eyes with water for at least 15 minutes, do not rub your eyes, and seek immediate medical attention.
- Skin contact: Wash the affected areas immediately with soap and water and seek immediate medical attention.
- Intake: Seek immediate medical attention.

2 PRODUCT DESCRIPTION

The HV48100 SE is the second-generation high-voltage battery storage system based on lithium iron phosphate (LFP). It is equipped with integrated fans and a heating film, enabling operation across a wider range of environmental conditions. As one of Pytes' new energy storage products, it works with PCS, inverters, UPS, etc., and applies to scenarios such as solar storage, micro-grids, and off-grid systems — offering long cycle life, compact design, easy installation, and wide compatibility. In addition, we have specially designed the HV48100 SE outdoor cabinet, which integrates a fire suppression system and an air conditioning system to meet the requirements of various applications. HV48100 SE is equipped with built-in battery management system (BMS) to manage and monitor voltage, current and temperature etc. of cells. The more important, its BMS is designed for balancing charging and discharging to prolong battery cycle life.

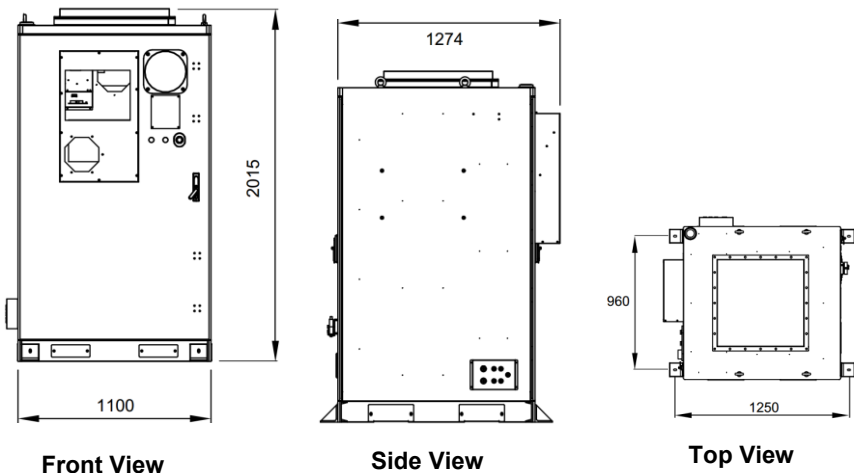


Figure 1: Enclosure Dimensions (Top, Front, Side Views)

2.1 Features

- Non-Toxic, Pollution Free and Environment Friendly
- Safe and Long Cycle Life
- Multi Protection Including over Charging/Discharging, over-Current and High/Low Temperature by Battery management system (BMS)
- Charge/Discharging State self-Management and Cell Voltage Capacity Balancing
- Flexible Configuration with Wide compatibility with Various PCS
- More Reliable and Little System Noise with natural cooling

- Operation Temperature: -20~50°C / -4~122°F.
- Excellent Discharge Performance and Cycle Life
- Compact, Light Weight, Modular Design. Easy Installation, Maintenance and Replacement

2.2 Components

Exterior View:

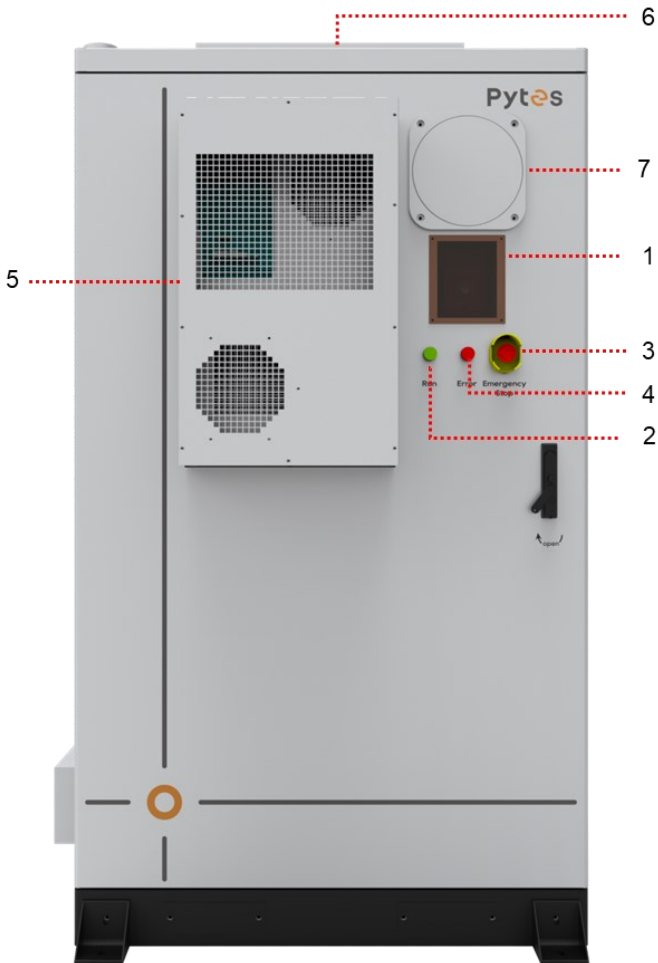


Figure 2: HV48100 SE Components (door closed)

No.	Item
1	Sound and Light Alarm
2	System Operation Indicator Light
3	Emergency Stop Button
4	System Fault Indicator
5	Air Conditioner
6	Explosion vent
7	Explosion-proof fan

Interior View:

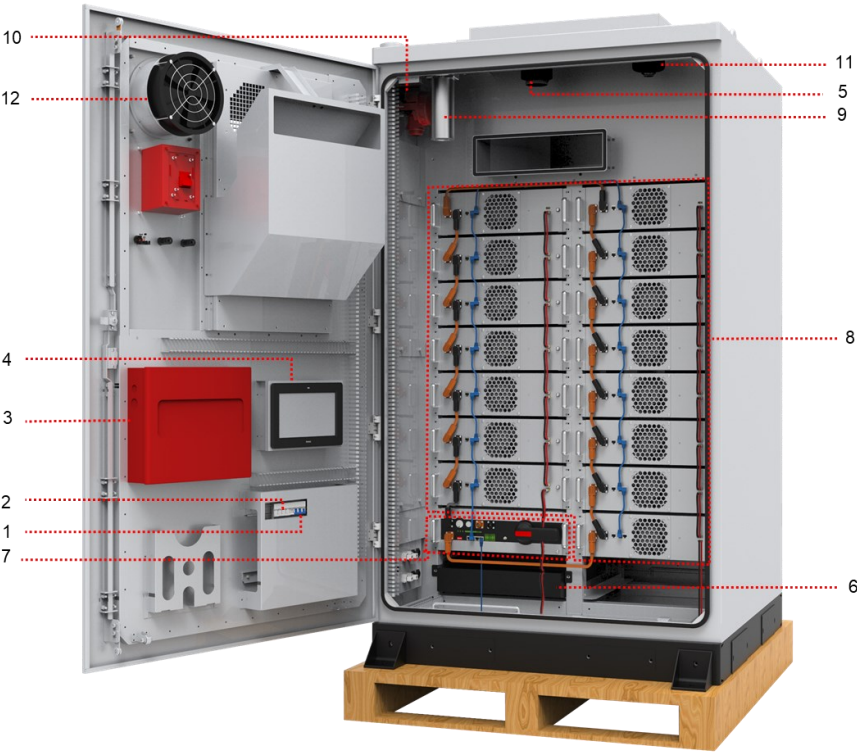


Figure 3: HV48100 SE Components (interior view)

Note: This document uses the 1P14S system as an example. The actual structure of a model may vary.

No.	Item
1	QF2: To connect and cut off the fan/heater power supply of control system
2	QF1: To connect and cut off the power supply of control system
3	Fire Extinguishing Control Panel
4	BAU: To view system information
5	Heat Detector
6	UPS: When the fire is triggered or the mains power is cut off, power is supplied to the fire protection system
7	Battery Control Unit
8	Battery Module Unit
9	Aerosol Device
10	Combustible gas detectors
11	Smoke Detector
12	Explosion-proof fan

2.2.1 HV48100 SE BCU (Battery Control Unit)

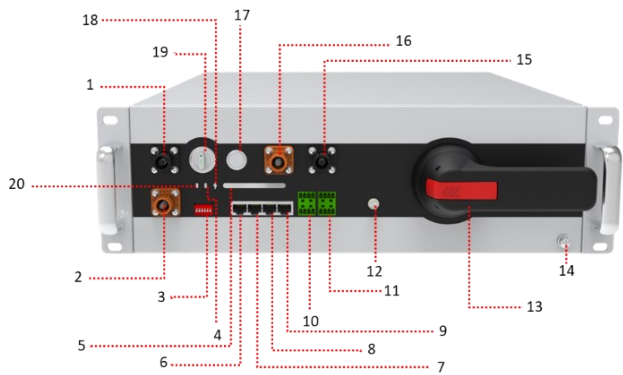


Figure 4: HV48100 SE Battery Control Unit

1	Battery Input Power (Negative)	To connect battery negative terminal.
2	Battery Input Power (Positive)	To connect battery positive terminal.
3	DIP Switch	Set DIP for different inverter
4	RUN Indicator (MCU)	System running indication
5	Battery SOC indicator	Indicate Battery SOC level
6	Console Port	RJ45 port, following RS232 protocol.

7	Battery Communication Port	To connect with battery module. RJ45 port, following CAN protocol.
8	RS485 Port	RJ45 communication port
9	CAN Port	CAN communication port
10	Dry Contact - 1	Reserved.
11	Dry Contact - 2	Reserved.
12	Antenna Port	To connect WiFi Antenna.
13	Isolation Switch	To cut off with external device.
14	Grounding Port	To connect grounding cable
15	DC Output Power (Negative)	To connect inverter negative terminal.
16	DC Output Power (Positive)	To connect inverter positive terminal.
17	Soft Switch	Start the system
18	Battery charging/discharging indicator	Battery Charging/discharging
19	DC Power Button	Switch on/off battery power.
20	Alarm Indicator	Indicate alarm

2.2.2 Battery HV48100 SE BMU (Battery Module Unit)

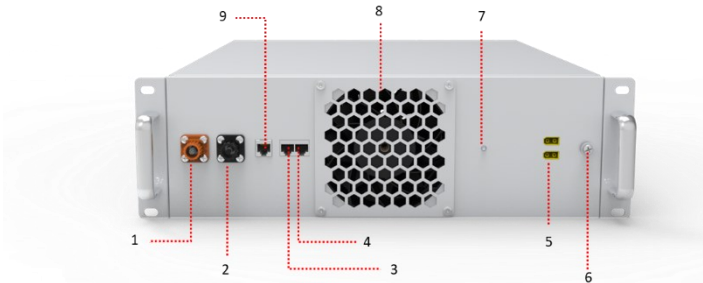


Figure 5: HV48100 SE Battery Module Unit

1	Battery Power Terminal (Positive)	To connect with Battery in series.
2	Battery Power Terminal (Negative)	To connect with Battery in series.
3	Link 0 Port	To connect with battery module. RJ45 port, following CAN protocol.
4	Link 1 Port	
5	Fan Power Terminal	To power the fan
6	Grounding Port	To connect grounding cable
7	RUN indicator	To show running condition.
8	Fan	For cooling
9	Console Port	RJ45 port, following RS232 protocol.

2.2.3 BAU (Battery Array Unit)

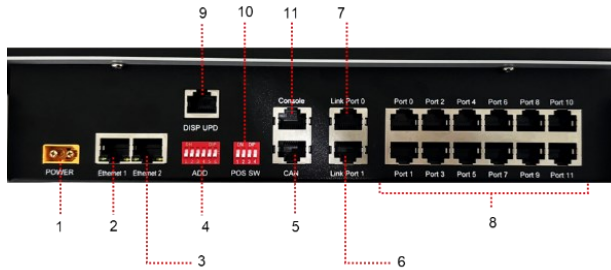


Figure 6: BAU Interface

1	Power	To power the BAU
2	Ethernet 1	To Connect with Internet Modem
3	Ethernet 2	To Connect with Internet Modem
4	ADD	Set DIP for different inverter
5	CAN port	CAN communication port
6	Link 0	To Connect Multiple BAU. RJ45 port, following CAN protocol.
7	Link 1	
8	Port 0 ~ Port 11	Connect multiple battery arrays (BCU to BAU)
9	DISP USD	-
10	POS SW	Select terminal resistance, to master control other BAU (CAN2), or communicate with PCS or inverter (CAN3)
11	Console Port	RJ45 port, following RS232 protocol.

2.2.4 Air Conditioner

2.2.4.1 Introduction

The outdoor cabinet air conditioner designed to provide precise temperature and humidity control for electrical enclosures in harsh environments. This unit ensures optimal thermal management for critical equipment housed in outdoor cabinets, such as power distribution systems, battery energy storage systems (BESS), and communication infrastructure.

Key Features:

- **Robust Construction:** IP55-rated enclosure with multi-process anti-corrosion treatment, suitable for extreme temperatures (-40°C to +55°C).
- **High Reliability:** Designed for 24/7 operation with a lifespan exceeding 10 years.
- **Smart Monitoring:** RS485 interface with MODBUS protocol for remote

monitoring and control.

- **Energy Efficiency:** Uses eco-friendly R134a refrigerant (RoHS compliant) with a cooling capacity of 2000W.
- **Easy Maintenance:** Front-access design and LCD menu for simplified servicing and parameter adjustments.

2.2.4.2 Technical Parameters

Category	Specification
Physical Dimensions	746 × 446 × 200 mm (H×W×D)
Weight	35 kg
Installation	Door-mounted
Cooling Capacity	2000W @ 35°C ambient

Category	Specification
Heating Capacity	1050W
Power Input (Cooling)	850W–1000W / 3.8A–4.5A @ 230V AC
Operating Voltage	187–254V AC, 50/60Hz
Noise Level	≤65 dB(A)
Protection Rating	IP55
Refrigerant	R134a (RoHS compliant)
Communication	RS485 (MODBUS protocol)
Operating Temperature	-40°C to +55°C
Storage Temperature	-50°C to +70°C

2.2.5 UPS (1KVA–2KVA)

2.2.5.1 Introduction

The double-conversion online UPS designed for critical power protection in rack/tower configurations. It ensures uninterrupted power supply (UPS) with high efficiency, pure sine wave output, and advanced battery management, making it ideal for data centers, telecom systems, medical equipment, and industrial applications.

Key Features:

- **True Online Double-Conversion:** Zero transfer time during outages; output voltage regulation <1%.
- **High Efficiency:** Up to 91% efficiency in AC mode; ECO mode for energy savings.
- **Hot-Swappable Batteries:** Easy maintenance without downtime.

- Smart Monitoring: 2.8" touch LCD for real-time status, programmable outlets, and remote management via RS-232/USB/SNMP.
- Robust Protection: MOV surge suppression, adjustable charging current (up to 8A), and low THDI.
- Flexible Voltage/Frequency: Supports 50Hz/60Hz conversion and wide input voltage ranges (55–300VAC).

Models Covered:

1KVA (1000W), 1.5KVA (1500W), 2KVA (2000W).

2.2.5.2 Technical Parameters

Category	Specifications
Input	
Voltage Range	55–150VAC ($\pm 5\%$) or 110–300VAC ($\pm 5\%$) @ 50% load
Frequency Range	40–70Hz
Power Factor	≥ 0.99
Output	
Voltage	100–240VAC (selectable)
Regulation (Battery Mode)	$\pm 1\%$
Waveform	Pure sine wave
Transfer Time	0ms (AC to battery); 4ms (inverter to bypass)
Battery	
Type	12V/7Ah or 9Ah (varies by model)
Recharge Time	3 hours to 95% capacity @ 2A charging current
Efficiency	
AC Mode	$\geq 89\%$ (1KVA) / $\geq 91\%$ (3KVA)
ECO Mode	$\geq 86\%$ (1KVA) / $\geq 90\%$ (3KVA)
Physical	
Dimensions (D×W×H)	410–630 × 438 × 88mm (varies by model)
Weight (with battery)	11.6–27.5kg
Environmental	
Operating Temperature	0–40°C
Humidity	20–90% RH (non-condensing)
Noise Level	<50dB (1KVA) / <55dB (3KVA) @ 1m

2.3 Fire suppression system

2.3.1 Introduction

HV48100 SE cabinet is equipped with a comprehensive thermal runaway mitigation and fire protection system.

This includes aerogel cell separation to limit fire thermal propagation, a dual-redundant aerosol-based fire suppression system for rapid fire suppression, and passive deflagration ventilation to manage overpressure events. Designed to detect and respond to thermal hazards at both the battery pack and cabinet levels, this system ensures maximum safety and risk containment.

2.3.2 Working Logic

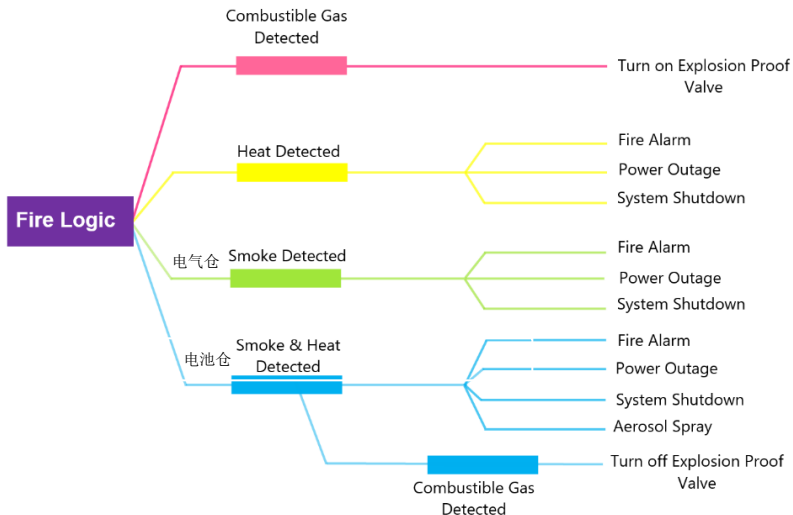


Figure 7: Fire logic of HV48100 SE

- Combustible gas detector triggered: the gas detector sends a signal to the BAU and triggers the corresponding control, and the explosion-proof fan is started;
- Smoke or heat detector triggered: the fire controller sends a signal to the BAU and triggers the corresponding control, and the sound and light alarm is activated and system shutdown power outage
- Smoke and heat detector triggered: the fire controller sends a signal to the BAU and triggers the corresponding control, aerosol spraying, system shutdown power outage and the sound and light alarm starts;
- Smoke, heat and Combustible detector triggered: the above logic is implemented, but the explosion-proof fan is turned off.

Note: The sound and light alarm will be on BAU displays the alarm on the screen and records the history.

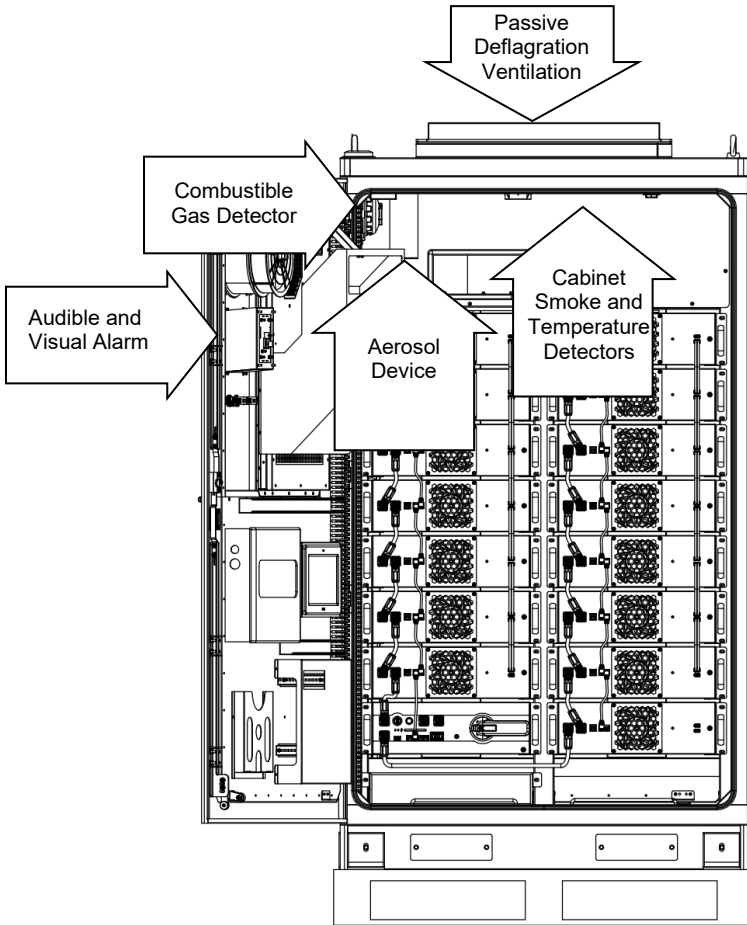


Figure 8: Fire suppression system

If HV48100 SE cabinet contains flammable gases at a concentration high enough to explode, and a spark inside ignites it, the resulting explosion will cause the cabinet's explosion vent to open. The vent is a safety feature designed to release pressure from the explosion, helping to prevent the cabinet from rupturing or causing more severe damage.

Note: – Explosion Vent Hazard: The explosion vent opens violently in the direction marked on the cabinet. Never block, cover, or place any object in front of the vent or within its discharge zone. If the vent activates, evacuate immediately from the fan-shaped area in front of the vent. Do not approach, reset, or seal the vent until authorized personnel have declared the area safe.

2.4 System Topology

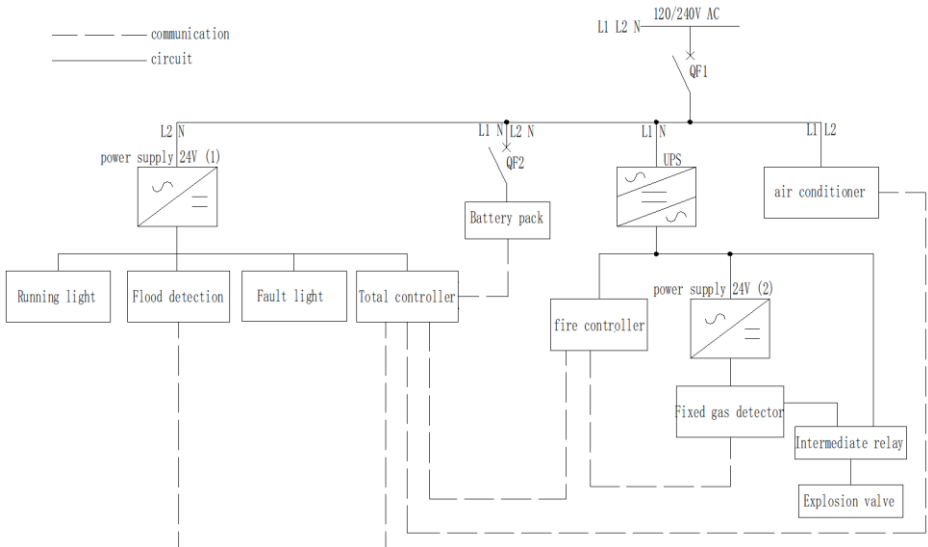


Figure 9: System Topology

2.5 Label Description

American Version

2.5.1 Battery Control Unit

Pytes			
Product: Rechargeable Li-ion Battery System		Protection Class: Class I	Product: Système de Batterie Li-ion Rechargeable
Rated Capacity: 100Ah		Rated/Maximum Current: 50A	Classe de Protection: Class I
Short-circuit Current: 2200A@8ms		Ingress Protection Code: IP20	Courant Nominal/Maximal: 50A
			Courant de court-circuit: 2200A@8ms
			Indice de Protection: IP20

2.5.2 Battery Module

Pytes

Battery Model	HV48100 SE BMU
Batteries Cell Type	LFP Battery
Operating Voltage Range	47.5V~57.6V
Nominal Voltage	51.2V
Rated Energy	5.12kWh
Rated Capacity	100Ah
Rated Charge/Discharge Current	50A
Maximum Charge/Discharge Current	50A
Protective Class	Class I
Ingress Protection Code	IP20

CAUTION!

IFpP54/150/120[(8S)2S]E/-10+50/95

- ◆ Do not dispose of batteries in a fire, as they may explode.
- ◆ Do not open or mutilate batteries. The released electrolyte is harmful to the skin and eyes and may be toxic.
- ◆ Batteries can present a risk of electric shock or burns from high short-circuit currents.
- ◆ Failed batteries can reach temperatures exceeding safe touch thresholds for surfaces.

S/N:

Date:

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Modèle de Batterie	HV48100 SE BMU
Type de Cellule de La Batterie	Batterie LFP
Plage de Tension de Fonctionnement	47.5V~57.6V
Tension Nominale	51.2V
Énergie Nominale	5.12kWh
Capacité Nominale	100Ah
Courant Nominal de Charge/Décharge	50A
Courant Maximal de Charge/Décharge	50A
Classe de Protection	Class I
Indice de Protection	IP20

ATTENTION!

IFpP54/150/120[(8S)2S]E/-10+50/95

- ◆ Ne jetez pas les batteries au feu, car elles pourraient exploser.
- ◆ Ne pas ouvrir ni endommager les batteries. L'électrolyte libéré est corrosif pour la peau et les yeux, et peut présenter une toxicité.
- ◆ Les batteries peuvent présenter un risque d'électrocution ou de brûlures dues aux courants intenses de court-circuit.
- ◆ Les batteries défectueuses peuvent atteindre des températures dépassant les seuils de sécurité thermique pour le contact cutané.

MADE IN CHINA (Fabriqué en Chine)
Shanghai PYTES Energy Co., Ltd.
No.3492, Jinqian Road, Fengxian District, Shanghai, 201406, China
(N° 3492, Route Jin Qian, Quartier de Fengxian, Shanghai, 201406, Chine)
www.pytesusa.com
pytesusa@pytesgroup.com

3 TRANSPORTATION AND STORAGE

3.1 Transportation Requirements

Danger

Load or unload batteries with caution. Otherwise, the batteries may be short circuited or damaged (such as leakage and crack), catch fire, or explode.

Warning

- Do not move a battery by holding its terminals, bolts, or cables. Otherwise, the battery may be damaged.
- Keep batteries in the correct direction during transportation. They must not be placed upside down or tilted, and must be protected against falling, mechanical impact, rains, snows, and falling into water during transportation.
- Before unpacking, storage, and transportation, ensure that the packing cases are intact, and the batteries are correctly placed according to the labels on the packing cases. Do not place a battery upside down or vertically, lay it on one side, or tilt it.
- Stack the batteries according to the stacking requirements on the packing cases.
- Ensure that the batteries do not fall or get damaged. Otherwise, they will need to be scrapped.
- Battery module is pre-charged to 50% SOC or custom required before shipment. The remaining capacity will be determined by storage time and condition before installation on the scene.
 - a. The battery modules meet UN38.3 standard.
 - b. Comply with laws towards dangerous goods transportation, in particular, the revised ADR (European Convention on the International Carriage of Dangerous Goods by Road).

3.1.1 Forklift

- For transporting large equipment while still in its original packaging, a forklift must be used to lift the cabinet from the base prior to movement.
- When operating the forklift, ensure the forks are positioned centrally beneath the cabinet to maintain balance and prevent tipping. The equipment must be securely fastened to the forklift using appropriate restraints before transport, and a designated supervisor should monitor the movement at all times.
- The cabinet's tilt angle must remain within specified limits: with packaging intact, the tilt angle (α) must not exceed 15°; once the packaging has been removed, the tilt angle (α) must not exceed 10°.

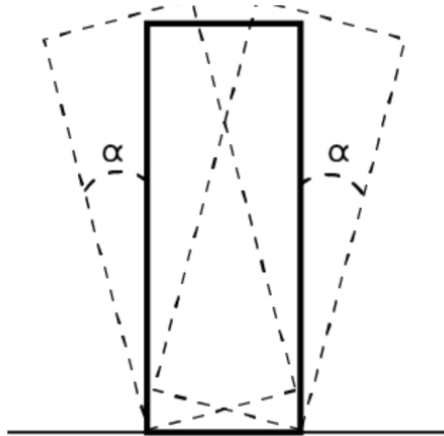


Figure 10: Cabinet's tilt angle

- The forklift shall have a rated capacity of 2 tons.
- The fork tines shall be no shorter than 1,200 mm.
- Lifting and lowering must be carried out slowly and smoothly.
- The cabinet may only be placed on a level, obstacle-free surface free of bumps or debris.

3.1.2 Overhead Hoisting

- All personnel involved in lifting operations must be properly trained and hold valid certifications prior to carrying out any hoisting activities.
- The ground or foundation at the lifting site must be verified to ensure it can safely support the crane's load-bearing requirements.
- The hoisting area shall be clearly cordoned off and equipped with temporary warning signage to restrict unauthorized access.
- Access beneath the crane boom or suspended load is strictly prohibited during lifting operations.
- Slings and wire ropes must not be dragged, snagged, or subjected to impact; striking them with hard objects is strictly forbidden.
- The included angle between any two slings must not exceed 90°.

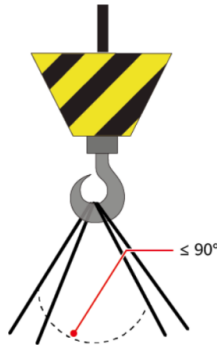


Figure 11: Angle between any two slings of forklift

3.2 Storage Requirements

Warning

- Ensure that batteries are stored in a dry, clean, and ventilated indoor environment that is free from sources of strong infrared or other radiations, organic solvents, corrosive gases, and conductive metal dust. Do not expose batteries to direct sunlight or rain and keep them far away from sources of heat and ignition.
- If a battery is faulty (with scorch, leakage, bulge, or water intrusion), move it to a dangerous goods warehouse for separate storage. The distance between the battery and any combustible materials must be at least 3m. The battery must be scrapped as soon as possible.
- Place batteries correctly according to the signs on the packing case during storage. Do not place batteries upside down, lay them on one side, or tilt them. Stack batteries in accordance with the stacking requirements on the packing cases.
- Store batteries in a separate place. Do not store batteries together with other devices. Do not stack batteries too high. If a large number of batteries are stored onsite, the site should be equipped.

CAUTION

Batteries should be used soon after being deployed onsite. Batteries that have been stored for an extended period should be charged periodically. Otherwise, they may be damaged.

- **Recharge During Storage:** To ensure the long-term health of all backup power sources within the ESS during storage, the following specific recharge intervals

must be strictly observed:

- a. Main battery modules (BMU): Recharge every 3 to 6 months to maintain SOC above 90%.
- b. UPS internal battery: Recharge every 3 to 6 months to prevent deep discharge and capacity loss. Always perform a full recharge.
- c. Fire extinguishing control panel backup battery: Recharge every 1 to 2 months to ensure it remains fully functional in case of an emergency during storage. Ensure that the battery is recharged to its full capacity each time.
- Failure to follow these intervals may result in battery degradation, failure, and voiding of the warranty.
- The storage environment must comply with local regulations and standards.
- The storage environment must be clean and dry. The product must be protected against rain and water.
- The air must not contain corrosive or flammable gases.
- The storage environment requirements are as follows:
 - a. Storage Temperature: Within
 - 1month: $-20^{\circ}\text{C}\sim 50^{\circ}\text{C}$ ($-4^{\circ}\text{F}\sim 122^{\circ}\text{F}$);
 - 1-3months: $-10^{\circ}\text{C}\sim 40^{\circ}\text{C}$ ($14^{\circ}\text{F}\sim 104^{\circ}\text{F}$);
 - 3-12months: $>0^{\circ}\text{C}\sim 30^{\circ}\text{C}$ ($32^{\circ}\text{F}\sim 86^{\circ}\text{F}$)
 - b. Relative humidity: 5% to 80%
 - c. Altitude: < 4000m
- If equipment except battery packs has been stored for more than two years, it must be checked and tested by professionals before use.
- Proof that the product is stored according to the requirements must be available, such as temperature and humidity log data, storage environment photos, and inspection reports.
- Ensure that batteries are delivered based on the "first in, first out" rule. Ensure that the storage duration starts from the latest charge time marked on the battery packing case and that the latest charge time is updated after every charge.

4 SYSTEM INSTALLATION

4.1 Pre-installation Checks

4.1.1 Checking the Outer Packing

Before unpacking the battery, check the outer packing for damage, such as holes and cracks, and check the battery model. If any damage is found or the battery model is not what you requested, do not unpack the product and contact your dealer as soon as possible.

4.1.2 Checking Deliverables

After unpacking the battery, check that the deliverables are intact and complete, and free from any obvious damage. If any item is missing or damaged, contact your dealer. For details about the number of deliverables delivered with the battery, see below Packing list.

Category	Storage Requirement
Cabinet	For equipment stored for more than six months, conduct a comprehensive inspection of both external condition and internal wiring, followed by system re-energization to perform charge and discharge testing. This verification shall be carried out at six-month intervals to ensure proper functionality. Prior to shut down after testing, confirm that the battery state of charge (SOC) is maintained at no less than 90% for storage. Following on-site installation, ensure that the bottom cable entry points are properly sealed using fire-resistant materials to maintain safety and compliance.
Power Cable & Communication Cable	Enclose the items in PE bags, then pack them into cartons for protected indoor storage.
BMU / BCU	The batteries shall be stored indoors in cartons, with ambient humidity maintained below 65%. In conditions of elevated external humidity, doors and windows must be kept tightly closed to prevent moisture ingress. Carton stacking and storage requirements: 1. Cartons shall be elevated on wooden pallets or frames, positioned at least 250 mm above the floor and no less than 100 mm from surrounding walls. 2. Adequate spacing shall be maintained between cartons to allow for proper air circulation and moisture dissipation. 3. Ventilation equipment, such as fans, shall be installed to promote airflow and reduce humidity accumulation.

4.1.2 Packing list

Category	Item	Description	Qty
HV48100 SE Cabinet	Controller Battery(lead)	12V 7.0Ah, Fire Alarm Host Battery	2
	Hexagon socket head cap screw, spring washer and flat washer assembly	M6×12, machine screw, cylindrical head, flat tail, 304 A2-70, natural color, to fix main control, secondary control	60
	3-core male connector	3-core male connector, AC Power input waterproof interface	1
	Expansion screw	M10×60mm, screw rod type, to fix Cabinet on Ground	4
	Hexagon socket head cap screw, spring washer and flat washer assembly	M12×25, machine screw, cylindrical head, flat tail, A2-70, natural color, to fix inverter or inverter bracket on cabinet	4
	HV48100 SE BMU Dual-row cascade communication cable	Cat6 shielded twisted pair 8-core flexible wire, 645mm, blue, RJ45 90° elbow, cascade communication cable to connect both columns	1
	HV48100 SE Dual-row series cable	UL10269-4AWG, 660mm, orange, Amphenol negative 5.7 plug 30° + Amphenol positive 5.7 plug 20°, Series connection power cable	1
	HV48100 SE Dual-row positive connection cable	UL10269-4AWG, 800mm, orange, Amphenol positive 5.7 plug 20° (×2), Power cable from BCU to last BMU	1
	RJ45 plug	Waterproof Standard RJ45 plug, cabinet output communication waterproof interface	2
Battery Control Unit [1]	Cascade Communication Cable	184mm, RJ45*2, Cascade communication	1
	External Dry Contact Connection Cable	22AWG, 30mm, Black, Transmits on/off signal	1
	Battery Power Cable-Negative	4AWG, 155mm, Black, Amphenol terminal*2, Cable to connect BCU to BMU	1
	Output Power Cable-Positive	6AWG, 4000mm, Orange, BCU to inverter external power cable	1
	Output Power Cable-Negative	6AWG, 4000mm, Black, BCU to inverter external power cable	1
	Ground Cable	UL1015, 10AWG, 250mm, Grounding protection	1
Battery Module Unit [2]	Cascade Communication Cable	163mm, RJ45*2, Inter-module cascade communication	1
	Temperature Control Power Cable	12AWG - 184mm - Black/Red, Powers built-in heating pad inside module	1
	Battery Serial Power Cable	UL10269/4AWG/160mm, Amphenol 5.7mm Terminals, Positive + Negative. series connection power cables	1
	Earthing Cable	UL1015, 150mm, 10AWG, SC6-6*2, BMU chassis ground protection	1

[1][2] Note: The quantities shown in the table above reflect the standard accessories for a single BCU and a single BMU. As your system may contain multiple units, please adjust the totals based on your specific configuration:

1. Total BCU accessories = (Accessories per BCU) × (Number of BCUs)
2. Total BMU accessories = (Accessories per BMU) × (Number of BMUs)

4.2 Preparing tools and instruments

4.2.1 Tools

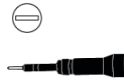
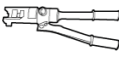
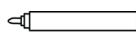
			
Phillips Insulated Torque Screwdriver	Insulated torque socket wrenches (incl. extensions)	Insulated torque screwdriver	Art knife
			
wire stripper	hydraulic press	Multimeter (DC voltage range ≥ 15000V DC)	steel tape measure
			
adjustable wrench	hammer	Combination Sleeve	Open-end torque wrench
			
level (device determine horizontal)	forklift trucks	(permanent) marker (pen)	Infrared thermometer
			
Terminal Crimping Pliers	Extra-large range clamp-on ammeter	network wiring pliers	Ratcheting Crimping Pliers
			
High-voltage insulated gloves	safety goggles	safety helmets	safety footwear

Figure 12: Required Installation Tools

Note:

- a. Use insulated tools to avoid electric shock or short circuits risks.

- b. Alternatively, cover the entire exposing metal surface of tools with insulating tape if insulated tools are not available.
- c. Select the appropriate PPE category per NFPA 70E based on the arc rating (4 cal/cm^2),

4.2.2 Fire-extinguisher System

HV48100 SE has built in fire suppression system. External Fire-extinguisher system should be determined in accordance with local fire code requirements.

Note: Refer to local requirements for using and maintenance.

Note: The system installation must be installed in compliance with all applicable local and national electrical, fire and building codes, like the National Electric Code (NEC), NFPA in the USA and the Canadian Electric Code (CEC) in Canada.

Always consult the AHJ or relevant regulatory bodies to ensure full compliance before installation.

4.3 Determining the Installation Position

4.3.1 Installation Environment Requirements

Warning

- HV48100 SE is IP55. It is designed to be installed in an outdoor location.
- HV48100 SE is high voltage DC system, it must be operated by qualified and authorized person only.

Cleaning

The battery system is equipped with high voltage connectors. Cleaning conditions will affect isolation characteristic of the system. Before system installation and operation, dust and iron scurf must be cleaned. An anti-dust environment is recommended. Turn off the system to clean if it's over operation conditions.

4.3.1.1 Operation Temperature

- system operation temperature: $-20 \sim 50^{\circ}\text{C}$ / $-4 \sim 122^{\circ}\text{F}$;
- Optimum range: $18^{\circ}\text{C} \sim 28^{\circ}\text{C}$.

Warning

Out of operation temperature will lead to battery system over / low temperature alarm or protection, which reduces battery cycle life.

4.3.1.2 Grounding System

- a. Make sure the system is well grounded before installation.
- b. The resistance of the grounding system must $\leq 100\text{m}\Omega$

4.3.1.3 Installation Angle Requirement

The battery can be ground-mounted only.

Do not install the battery at forward tilted, back tilted, side tilted, horizontal, or upside-down positions.

4.3.2 Installation Position Requirements

Install the battery on a level, solid brick-concrete ground or foundation. If other types of grounds are used, they must be made of fire-retardant materials and meet the load-bearing requirements of the equipment.

4.3.2.1 Foundation Requirement:

1. The energy storage system must be installed on concrete foundation other noncombustible surfaces. The mounting plane must be level, firm, and flat with sufficient bearing capacity; depressions or tilting are prohibited.
2. For hard ground surfaces, a foundation plinth shall be built with its top surface 300 mm above the surrounding ground level. For complete dimensions, refer to Figure below.
3. For soft ground surfaces, a foundation shall be built extending 1000 mm below ground level, with its top surface 300 mm above ground level. For complete dimensions, refer to Figure below.

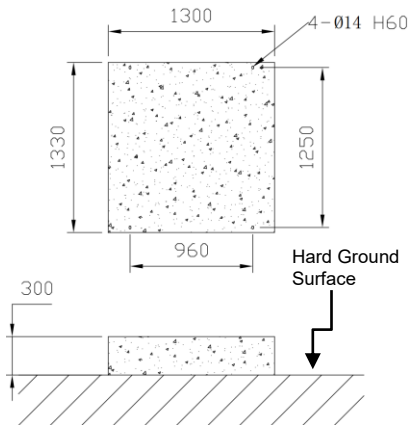


Figure 13: Hard ground foundation plot

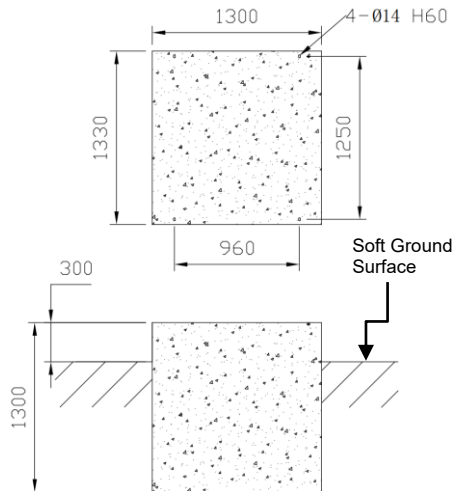


Figure14: Soft ground foundation plot

4.3.2.2 Product Fixation:

The energy storage cabinet should be fixed to a concrete floor, expansion screws should be used to fix the cabinet to the holes in the floor. The method of fixing the energy storage cabinet is shown in Figure. The following steps need to be followed to fix the energy storage integrated cabinet.

1. Select the appropriate tool to transport the energy storage cabinet to the mounting location and align with mounting structure. Drill the holes (4-Φ14

- H60) Number of holes: 4, diameter of hole: 14mm, Depth of hole: 60mm
2. Fix the energy storage cabinet on the foundation with M10×60 expansion screws, or fix it on the steel base with M10×60 bolts through the waist hole of the base. Torque (35 N.m.)

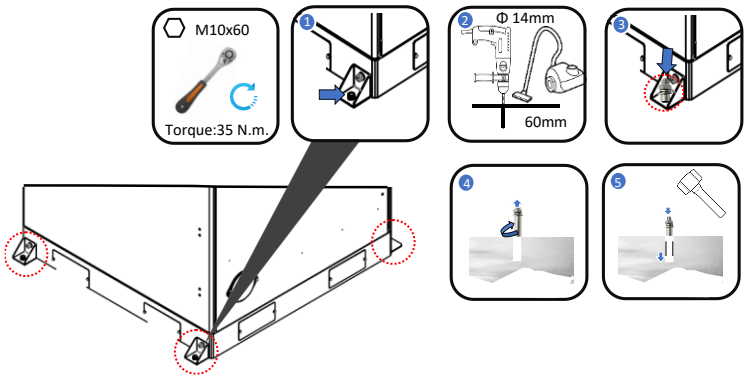


Figure 15: Installation Diagram of System Foundation

4.3.2.3 Space requirements

The Energy Storage Integration Cabinet must be installed at a sufficient distance from walls and other equipment to meet the requirements for the narrowest access aisles, evacuation routes, and ventilation.

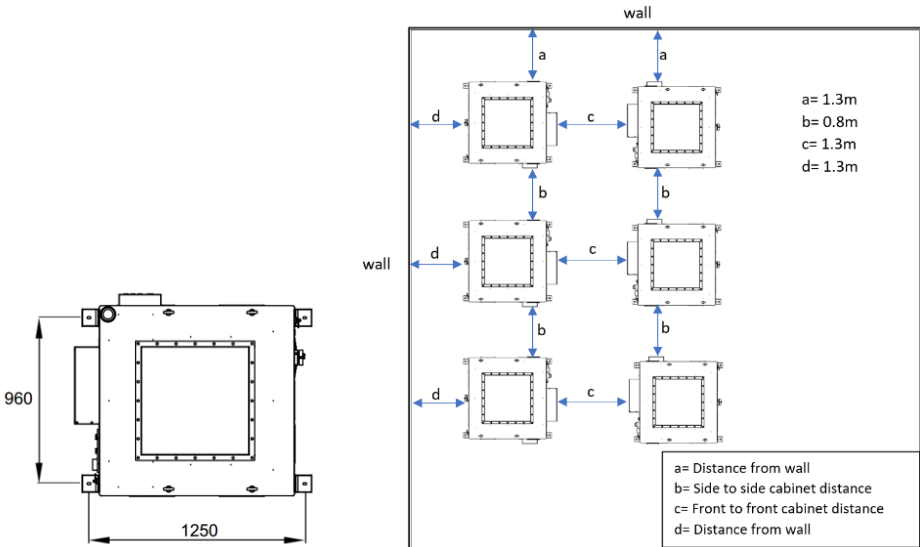


Figure 16: System Installation Space Requirements Chart

This subsection requires minimum space requirements for proper operation of the Energy Storage Integration Cabinet. If site conditions permit, it is recommended that greater spacing be selected to ensure reliable and efficient operation of the Energy Storage Integration Cabinet. This is shown in Figure below.

4.4 Equipment Installation

4.4.1 Battery module & Battery control unit installation

With One BCU

Step 1: First place a Battery module into cabinet slot at the top right corner, tighten 4 screws of mounting ear to fix the battery module on cabinet. Then other BMU will be placed at top left corner in cabinet slot.

Step 2: Repeat Step1 to install all remaining battery modules in order from right to left and top to bottom.

Step 3: Place Battery control unit into cabinet slot in left column in the last BMU row or under the last BMU row based on available slot and different number of BMUs (Always place BCU in left column), tighten 4 screws of mounting ear to fix the battery control unit on cabinet.

With Two BCU

Step1: First place a Battery module into cabinet slot at the top left corner slot, tighten 4 screws of mounting ear to fix the battery module on cabinet. Then other BMU will be placed below it and tighten screws.

Step 2: Repeat Step1 to install all remaining battery modules (up to 6 or 7BMUs) in order from top to bottom.

Step 3: Place Battery control unit (BCU1) into cabinet slot under the last BMU, tighten4 screws of mounting ear to fix the battery control unit on cabinet.

Step 4: Repeat the step1 and2 for the right-side column, first place BMU at top right corner slot then follow top to bottom order to install all BMUs (up to6 or 7).

Step 5: Place battery control unit (BCU2) into cabinet slot under the last BMU, tighten the screws

Note: Single battery module is ≥ 43 kg. Be careful during whole procedure of handling and removal.

Note: The cabinet filled with battery modules can be between 920kg ~ 1139kg (2029lb ~ 2511lb), based on different configuration. Be cautious during whole procedure of handling and removal.

BMU7	BMU8
BMU6	BMU9
BMU5	BMU10
BMU4	BMU11
BMU3	BMU12
BMU2	BMU13
BMU1	BMU14
BCU	BMU15
UPS	Empty

HV48100 SE BMU placements with one BCU (ex. 1p14s)

BMU7	BMU7
BMU6	BMU6
BMU5	BMU5
BMU4	BMU4
BMU3	BMU3
BMU2	BMU2
BMU1	BMU1
BCU 1	BCU 2
UPS	Empty

HV48100 SE BMU placements with two BCU (ex. 2p7s)

Figure 17: Cabinet HV48100 SE BMU placement with single and multiple BCU

5 ELECTRICAL CONNECTION

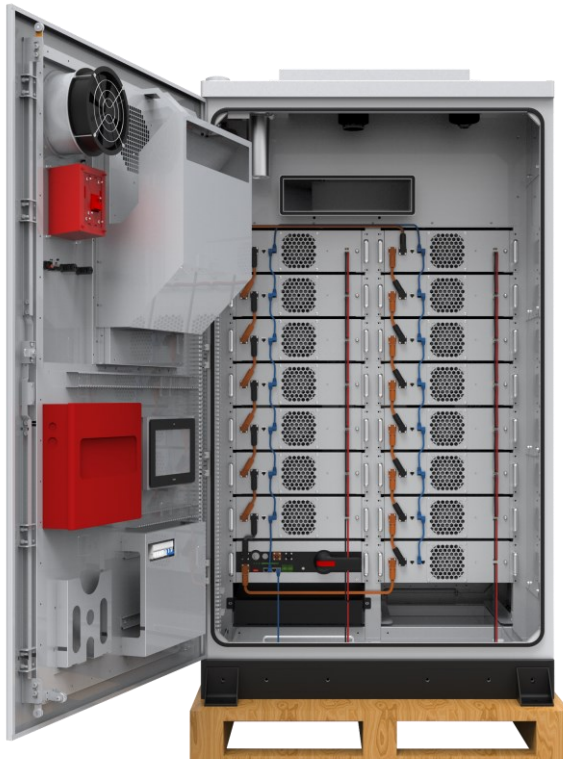


Figure 18: HV48100 SE internal Connections

5.1 Internal Connections of the Battery

5.1.1 Installing Ground Cable Precautions

Danger

- Ensure that the PE Cable is securely connected. Otherwise, electric shocks may occur.
- It is recommended that silica gel or paint be used around the ground terminal after PE cable is connected.

Connect the PE cable to the cabinet grounding point and then to local ground point. The ground point is located at the input/output ports which is at bottom of the cabinet right side.

Note: The system grounding is achieved by cabinet grounding through metal surface direct touching of battery module, control module and rack/cabinet, if other cabinet is used, please make sure each battery is grounded.

It is recommended to paint over the outside of the grounding terminal after installation for protection.



Figure 19: HV48100 SE external grounding connection

5.1.2 Installing Internal Communication Cables

With One BCU

Step 1: Connect all the batteries like a daisy chain from link port 1 to link port 0, starting from BMU1(which is just above BCU) to the last BMU in the left column, follow bottom to top sequence.

Step 2: Connect Link 1 port of top left BMU to the Link 0 port of top right BMU.

Step 3: From top right BMU to the last BMU (in right column) connect Link 1 port to Link 0port, follow top to bottom sequence.

Step 4: Connect Battery communication port of BCU with Link 0 port of the first Battery Module (BMU1).

Note: Communication cable of all Battery modules (BMU1...BMU15) will be connected in daisy chain from link 1 to link 0.



Figure 20: Communication cable connections

Step 5: Confirm the communication cable from "CAN" port of BCU to "Port 0" on BAU is already connected.



Figure 21: BAU interface

Step 6: Confirm the communication cable from "CAN" port of BAU to the COM 1 port on the bottom left of the HV48100 SE cabinet is already connected.

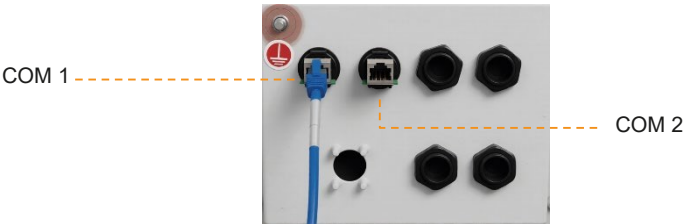


Figure 22: HV48100 SE Cabinet - Internal Cable Feed-Through (Bottom Left)

Step 7: Serial connect Dry Contact IN 1+ to IN 1- on HV48100 SE BCU.



Figure 23: HV48100 SE BCU dry contact

With Two BCU

Step 1: Connect the short communication cable between Link 1 port of the first battery (BMU 1) which is just above the BCU 1 to the Link 0 Port of the second battery above it.

Step 2: Repeat the step 1 and follow same order (from bottom to top link 1 to link 0) up to 6 or 7 BMUs.

Step 3: Connect Battery communication port of BCU 1 with Link 0 port of the first Battery Module (BMU 1) in same column.

Note: Last Battery (ex. BMU 7 etc.) Link 1 Port will be empty.

Step 4: Repeat step 1 and step 2 for BMUs above BCU 2, from bottom to top Link1 to link 0. And connect battery communication port of BCU 2 with its same column BMU 1(Just above BCU 2).

Step 5: Connect the communication cable from "CAN" port of BCU1 to "Port 0" on BAU. Connect the communication cable from "CAN" port of BCU2 to "Port 1" on BAU. **Step 6:** Connect the communication cable from "CAN" port of BAU to the COM 1 port on the bottom left of the HV48100 SE cabinet.

Step 7: Serial connect Dry Contact IN 1+ to IN 1- on each HV48100 SE BCU. Shown above in figure.

5.1.2 Installing Internal DC Power Cables

With One BCU

Step 1: Connect the first battery's positive terminal (B+) to the second battery's negative terminal (B-) using a short power cable. Continue this same bottom-to-top pattern in the left column until you reach BMU 7.

Step 2: Next, connect BMU 7's positive terminal to BMU 8's negative terminal in the top row. Then continue connecting top-to-bottom in the right column until you reach the last BMU.

Step 3: Run a positive battery power cable from the last battery's positive terminal (B+) to the positive terminal (B+) of the BCU.

Step 4: Finally, connect the first battery's negative terminal (B-) to the negative terminal (B-) of the BCU using a negative power cable.

Step 5: Connect heating film and BMU fan power cable connections in daisy chain order from bottom to top in each column. Connect the bottom BMU in both columns with cabinet auxiliary power supply.

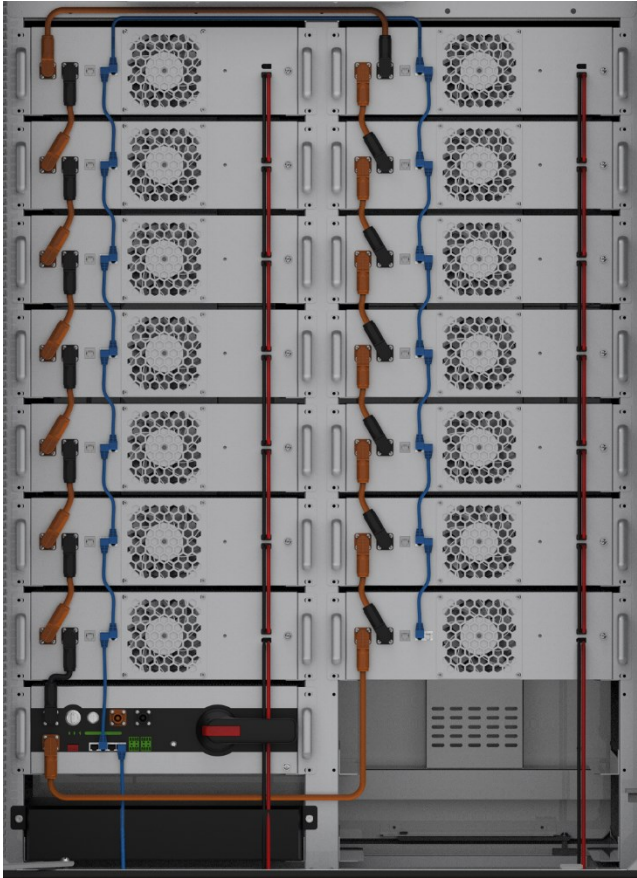


Figure 24: HV48100 SE (1P14S) electrical connections

With Two BCU

Step 1: Connect the first battery Positive terminal(B+) with second battery Negative terminal (B-) with short power cable, follow bottom to top sequence

Step 2: Repeat Step 1 for left column in order from (BMU 1 to BMU 7) connect all battery modules in series above BCU 1.

Step 3: Repeat Step 1 for right column in order from (BMU 1 to BMU 7) connect all battery modules in series above BCU 2

Step 4: Connect the Positive terminal (B+) of BCU 1 with the last battery Positive terminal (B+) with a Positive battery power cable. Connect the negative terminal (B-) of BCU 1 with first battery negative terminal (B-) with negative power cable

Step 5: Repeat the step 4 for BCU 2 and its battery modules

Step 6: Connect heating film and BMU fan power cable connections in daisy chain order from bottom to top in each column. Connect the bottom BMU in both columns with cabinet auxiliary power supply.

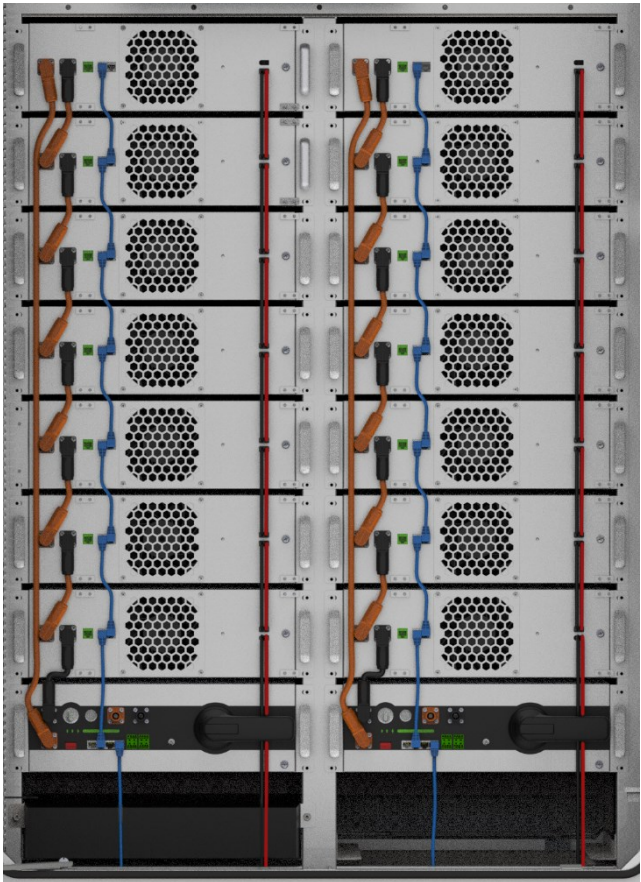
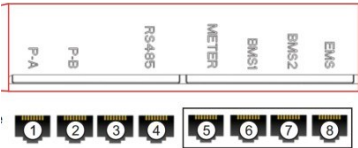


Figure 25: HV48100 SE (2P7S) electrical connections

5.2 External Electrical Connections of the Battery



Bottom-Side Port View

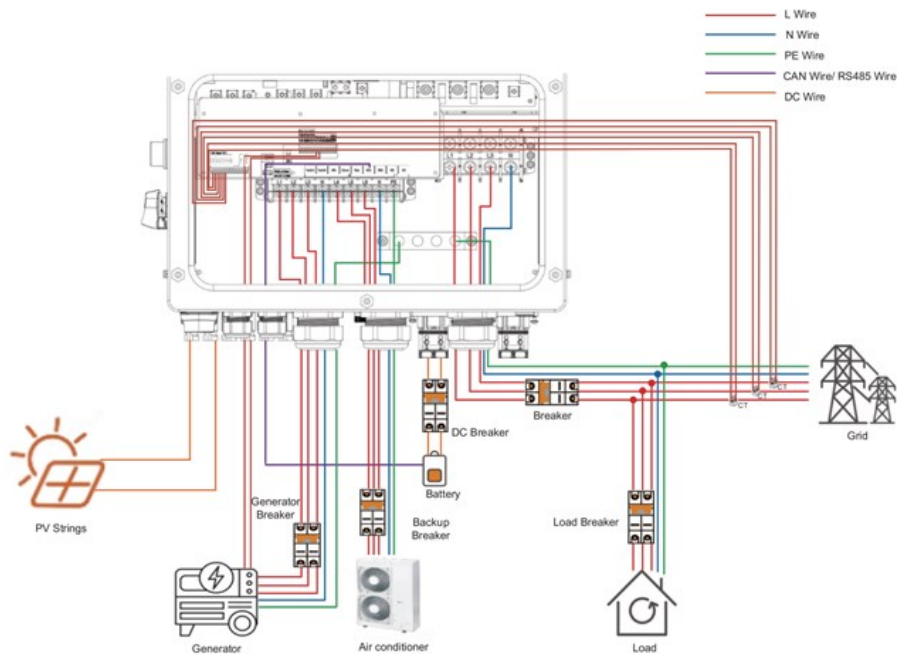


Figure 26: HV48100 SE Battery and Inverter Connection

Note: This diagram uses the Solis inverter as an example. For other inverter models, please refer to the corresponding inverter user manual.

5.2.1 Installing an External BMS Cable

Step 1: Install the waterproof connector on one end (from cabinet to the inverter) of the communication cable

Step 2: Connect the external terminal of the COM1 port (located at the bottom left of the HV48100 SE cabinet) to the inverter's BMS/CAN port.

No.	CAN	RS485	RS232
1			
2			
3			TX
4	CAN_H		GND
5	CAN_L		
6			RX

7		485_A	
8		485_B	

Note: Different Inverter will have different Communication protocol and Pin layout, consult installer for right one

5.2.2 DIP Switch Setting

a. With One BCU (1P12S & 1P15S)

All the DIP switch on BCU should be in down position.



b. With two BCU (2P6S & 2P7S)

All the DIP switch on BCU1 should be in down position.

First DIP switch should be up on BCU2 all the other DIP switches should be in down position.



Note: If using HV48100 SE without cabinet then DIP switch on BCU should be according to inverter.

c. BAU Dip Switch

Set the DIP switch on BAU for communication protocol address pairing to inverter.

DIP switch Address

Code Bit						PCS
1	2	3	4	5	6	
1	0	0	0	1	0	Sol-Ark
0	1	0	0	0	0	Deye
0	1	0	1	0	0	Solis
0	0	1	0	0	0	Growatt
0	0	1	1	0	0	Luxpower

Notes: code bits 1, 2, 3, 4, 5, 6 in the schematic represent DIP switches from left to right facing front panel. Dialing up = "1", Dialing down = "0".

5.2.3 Installing External DC Power Cable

Step 1: Open Cable glands on the bottom right of HV48100 SE cabinet. Pass the

external power cables through the (size: M22x1.5) cable feed and through the cable gland to the inverter.

Step 2: (Optional but recommended) Install a conduit on the external side of the gland for additional mechanical protection and environmental sealing.

Note (Recommendation): Use a flexible PVC or metal conduit with an appropriate inner diameter (≥ 14 mm) to fit over the cables and securely attach to the gland's external thread or conduit adapter.

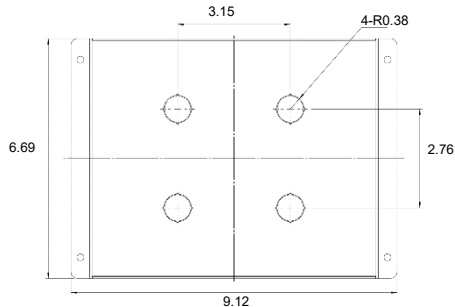


Figure 27: Knock out holes on the conduit entry plate

Follow the steps below to connect the BCU (Battery Control Unit) to the inverter:

Note (Recommended): Install a DC circuit breaker between battery and inverter.

Step 3: Connect Negative External power terminal (P-) of BCU with inverter Negative Battery terminal (-).

Step 4: Connect Positive External power terminal (P+) of BCU with inverter Positive Battery terminal (+).

Step 5: Install the external protective cover on each Battery Management Unit (BMU), ensuring all mounting points are secured.

Note: External Protective cover of BMU is an optional accessory. Ignore Step 5 if you don't have

5.3 External Power Terminal

5.3.1 AC Auxiliary Power Source Configuration:

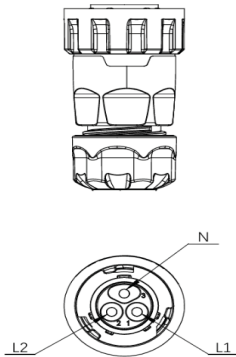
The cabinet's main power supply must be sourced from the load side of the PCS (the hybrid inverter). If the system uses 240V split-phase power, it can be connected directly to the cabinet; if it uses 480V three-phase power, an additional transformer is required to provide auxiliary power.

HV48100 SE cabinet external power terminal is based on electricity standards for

America.

Mains power input demand

Mains power wiring definition:



Mains power input demand

Voltage	240V (Split phase) 208V (Three phase, L1-L2 208V, L1-N, L2-N 120V)
Maximum Auxiliary Load Power	5kW

Figure 28: External Power terminals for American Standard

5.3.2 Transformer for Off Grid Installation

If there is no 240Vac source on the site, a 480V/ 208Vz (depends on the Inverter AC output) transformer to converter the power from inverter load panel to 240Vac is needed. If the system requires grid-connected/stand-alone switching and operates in stand-alone mode, the cabinet’s power supply must be connected to the load side of the PCS.

If the system is only grid-connected and does not require stand-alone operation, connection to the PCS load side is not necessary. If you need transformer, please contact Pytes.

Here is the required specification of the transformer if you prefer to source yourself:

- Transformer total capacity: 6kVA
- Input: 120/208 V or 277/480 V (depending on the inverter AC output)
- Output: L1(0 V), N (120 V), L2(240 V)
 - a. L1-N: AC 120 V / 2.3 kVA
 - b. L2-N: AC 120 V / 1.7 kVA
 - c. L1-L2: AC 240 V / 2 kVA

5.4 Cabinet Parallel Installation

This section describes the parallel installation of HV48100 battery cabinets connected

to single or multiple inverters, including DC power combining via HV C01, multi-inverter/multi-cabinet deployment, and safety rules compliant with North American electrical codes (NEC NFPA 70, UL 1741, UL 9540).

5.4.1 General Parallel Rules

- Maximum parallel cabinets per system: 4

Note: Maximum 4 BCU communication to a master BAU; for system with 1 BCU maximum is 4 cabinets, for system with 2 BCU maximum is 2 cabinets.

- All parallel cabinets must be same model (HV48100 SE), same BMU quantity, and identical software configuration
- Before parallel connection: fully charge all cabinets; inter-cluster voltage difference < 10 V
- Busbars and main cables must be sized for total parallel current with proper overcurrent protection

5.4.2 DC Power Combining with HV C01(Optional)

When multiple HV48100 cabinets connect to one inverter, use the HV C01 DC combiner box for safe DC power aggregation and protection. For standard HV48100 parallel configuration: use DC breaker rated for system voltage and 125% of maximum continuous current.

Note: Contact Pytes technical support for instructions of parallel multiple cabinets

5.4.3 Multiple Inverters & Multiple Cabinets

For systems with multiple inverters and multiple HV48100 cabinets:

- Assign one dedicated battery cluster to each inverter.
- Keep same nominal capacity for battery clusters connected to different inverters for balanced performance.
- Each cluster uses its own HV C01 combiner and protection
- Separate DC paths between clusters; no cross-connection between inverter DC inputs
- BAU manages only its own battery cluster; do not share BAU across inverters
- Wiring Topology
- Each inverter ↔ dedicated battery cluster ↔ dedicated HV C01
- Star-type DC bus connection to minimize voltage imbalance
- Equal-length cables for all parallel branches
- Proper grounding and bonding per NEC

5.4.4 Special Configurations

For non-standard layouts:

- Mixed capacity
- Non-1:1 inverter-to-cluster ratio
- Custom communication or power topology
- Integration with third-party equipment

Note: Contact Pytes technical support and the inverter manufacturer for joint evaluation and approval before installation. Unauthorized custom configurations may cause safety hazards and void warranty.

5.4.5 Safety & Compliance (North America)

- All work must comply with NEC (NFPA 70), UL 1741, UL 9540, and local codes
- Use listed DC breakers, cables, and connectors
- Provide clear labeling for DC inputs/outputs, disconnect devices, and battery cabinets
- Ensure proper isolation, overcurrent, and short-circuit protection
- Qualified personnel only for installation and commissioning

5.5 AC Surge Protection Recommendation

WARNING

ELECTRIC SHOCK HAZARD

- Add AC surge protection.
- Inadequate protection against AC transient surges from the inverter may result in dangerously high voltage on communication, DC, or AC conductors, damaging the system and posing safety hazards.

Failure to follow this instruction may result in death or serious injury.

5.5.1 AC Surge Protection Recommendation

To protect against transient surges, install a third-party Surge Protective Device (SPD) (UL TYPE 4CA) for 277/480 V AC, 3P Wye with a 40kA (I_{max} 40kA - I_n 20kA) Surge Current Rating at the source of the inverter's AC input conductors if the cabinet auxiliary AC supply is sourced from an unprotected system. Refer to the inverter's installation manual to verify surge protection requirements. If the inverter does not provide adequate built-in surge protection, an external SPD rated for 277/480 V AC, 3P Wye must be installed to ensure system reliability and protection.

(Example part: DS44S-400/G, Citel America Inc. Surge Protective Devices (SPDs))

6 SYSTEM START UP AND COMMISSION

6.1 Verification Before Power-On

Check items and acceptance criteria:

No.	Check Item	Acceptance Criteria
1	Battery installation	The installation is correct and reliable.
2	Cables Routing	Cables are routed properly as required by the customer.
3	Cable tie	Cable ties are evenly distributed, and no burr exists.
4	Grounding	The PE cable is connected correctly, securely, and reliably.
5	Switch	The DC switch and all switches connected to the battery are OFF.
6	Cable connection	The AC output power cable, DC input power cable, battery cable, and signal cables are connected correctly, securely, and reliably.
7	Unused terminal and port	Unused terminals and ports are locked by watertight caps.
8	Installation environment	The installation space is proper, and the installation environment is clean and tidy.

Danger

Wear personal protective equipment and use dedicated insulated tools to avoid electric shocks or short circuits.

Warning

- During Power-on procedure, power off the batteries immediately if any fault is detected. Rectify the fault before proceeding with the procedure.
- After batteries are used for system commissioning or batteries have discharged, charge the batteries in time. Otherwise, batteries may be damaged due to over discharge.
- Battery over discharge and damage may occur if batteries with low SOC are stored. Batteries should be recharged in a timely manner.

6.2 Turn on Procedure:

1. Long-press the left most button on the UPS until the screen's right side displays 110-120V, then release. The UPS startup is successful.



Figure 29: UPS Interface

2. Wait until the fire alarm control panel sounds its buzzer before connecting the backup power (lead-acid battery).
3. Turn the "Enable Access" key clockwise to enter control mode, and then click "Reset" on the panel.



Figure 30: Fire Alarm Control Panel Interface

Note: After a reset, the reset is considered successful when fire alarm control panel's buzzer stops sounding.

4. After the reset is complete, simply turn the enable access key to the left to return it to its default position.
5. Turn the "Enable Access" key clockwise to enter control mode, and then click "Reset" on the panel.
6. Connect the serial cable of the lead acid battery of alarm panel
7. Turn on the BAU by pressing the button on top right side.
8. Turn on the Battery:

Step 1: Close the external disconnectors between the inverter and the battery.

Step 2: Turn on Isolation switch on BCU.

Step 3: Turn on Power knob on BCU, indicator lights on the knob switch turn to green.

Step 4: Short press the SW button on BCU, the RUN light will flash. All BMUs will start up.

9. Turn on the inverter. Refer to the specific inverter integration guide to set up communication with the battery.
10. Refer to the inverter user manual to program the rest of setting of the inverter.
11. Verify that AC output of the inverter is active.
12. Close the QF1 and QF2 breaker

Notice: Before the equipment is put into operation for the first time, ensure that the parameters are set correctly by professional personnel. Incorrect parameter settings may result in noncompliance with local grid connection requirements and affect the normal operations of the equipment.

6.3 System Commissioning

1. After battery turn on, before` turning on the breaker between the battery and inverter, the BAU and BMU need to be updated to the latest firmware. (Please contact Pytes)
2. After firmware update, turn on the breaker between the inverter and battery, turn on the inverter, turn on the DC&AC breaker on the inverter side according the inverter manual
3. Set and confirm the inverter and battery are in Confirm Closed-Loop Communication according to Pytes Inverter Battery integration manual.
4. Confirm there is no alarm on inverter and battery.
5. Turn on the DC&AC breaker on the inverter side according the inverter manual
6. To confirm if the battery can be normally charged and discharged
7. Full Charge and Discharge Cycle: Perform a complete charge and
8. discharge cycle of the battery under monitored conditions.

Product Registration: Register the product after installation to activate the warranty and for ongoing support.

Note: For complete commissioning steps refer to HV48100 SE commissioning plan.

7 SYSTEM SHUTDOWN AND DECOMMISSION

Danger

- Wear personal protective equipment and use dedicated insulated tools to avoid electric shocks or short circuits.
- Do not smoke or have an open flame around batteries.
- Do not use wet cloth to clean exposed copper bars or other conductive parts.
- Do not use water or any solvent to clean batteries.

Warning

- Do not maintain batteries with power on. To power off the batteries before performing operations such as checking and tightening screw torques, explain the risks to the customer, obtain the customer's written consent, and take effective preventive measures.
- After batteries are discharged, charge them in time to avoid damage due to over discharge.
- Before moving or reconnecting the equipment, disconnect the mains and batteries and wait for five minutes until the equipment powers off. Before maintaining the equipment, check that no hazardous voltages remain in the DC bus or components to be maintained by using a multimeter.

CAUTION

- Do not connect two or more cables to the positive or negative power port of a battery in parallel.
- Stay away from the equipment when preparing cables to prevent cable scraps from entering the equipment. Cable scraps may cause sparks and result in personal injury and equipment damage.

7.1 Shutdown Procedure:

1. Disconnect the PV DC switch, the utility grid, and any other external power sources from the inverter, ensuring that all circuit breakers are in the off position. Verify that the inverter is in standby mode.
2. Disconnect the circuit breaker between the inverter and the battery (if present).
3. Shut down the BCU and BMU.

Step1: Short Press the BCU SW button, wait all BCU and BMU RUN lights turn off.

Step2: Rotate the BCU power switch to the "Off" position.

Step3: Rotate the BCU isolation switch to the "Off" position.

4. Disconnect the QF1 and QF2 breakers in the cabinet.
5. Press and hold the UPS OFF button to shut down the UPS.
6. Disconnect the series connection between the two batteries in the alarm panel.
7. Disconnect the AC breaker of the Auxiliary Power Supply.

CAUTION

- Do not turn off the External power switch during system running.
- Before battery module replacement service, charge/discharge the replaced battery to same voltage as the other modules in the system. Otherwise, it will take a long time for the system to balance the module.

7.2 Emergency Shutdown Procedure

Note: In the event of an emergency, follow these steps to shut down the system safely.

Step 1: Press the Emergency Stop Button. This immediately de-energizes the cabinet by disengaging the integrated contacts in the BCU, cutting power to the DC circuits, and preventing further power flow through the system.

Step 2: Turn Off AC Power at the Source. After activating the Emergency Stop, shut off the external AC source circuit to fully isolate the system. This provides an additional layer of safety, ensuring the system is completely disconnected from all external power inputs.

7.3 System Decommissions

Important Safety & Pre-Decommission Notes

Before starting the decommissioning procedure, ensure the following:

- The system is in a safe, non-emergency state, and all work is performed by qualified personnel in accordance with local safety standards (e.g., IEC 62446, NFPA 70E).
- Confirm no active faults or alarms are present, and notify the site operator/owner of the shutdown and decommissioning plan.
- Wear appropriate personal protective equipment (PPE): insulated gloves, safety glasses, and non-conductive footwear.
- Allow sufficient time for the system to discharge residual voltage after disconnection.
- Follow lockout/tagout (LOTO) procedures where applicable to prevent accidental re-energization.

7.3.1 Decommission Steps:

Step 1: Isolate external power: Open all disconnect switches to cut off electrical connection to the Power Conversion Equipment (inverter/grid).

Step 2: Shut down batteries: Power off each battery module using its ON/OFF button.

Step 3: Press the leftmost button on the UPS to turn it off

Step 4: Open QF1 main incoming circuit breaker, then disconnect the alarm panel battery connection.

Step 5: Verify zero voltage: Use a multimeter to confirm no voltage remains at battery terminals on inverter

Step 6: Disconnect all cables: Remove battery power cables and CAT6/higher communication cables from the inverter and batteries.

Step 7: Remove wiring accessories (if applicable): Disassemble the conduit box, including conduits, cable glands, and grommets.

Step 8: Detach the battery: Unscrew the battery from the wall-mount adapter, then carefully remove it using two/three-person lift or mechanical aid.

Step 9: Final removal & disposal: Take down the wall-mount bracket, then recycle or dispose of all components per local regulations.

8 SYSTEM MAINTENANCE

Danger

- Wear personal protective equipment and use dedicated insulated tools to avoid electric shocks or short circuits.
- Do not smoke or have an open flame around batteries.
- Do not use wet cloth to clean exposed copper bars or other conductive parts.
- Do not use water or any solvent to clean batteries.

Warning

- Do not maintain batteries with power on. To power off the batteries before performing operations such as checking and tightening screw torques, explain the risks to the customer, obtain the customer's written consent, and take effective preventive measures.
- After batteries are discharged, charge them in time to avoid damage due to over discharge.
- Before moving or reconnecting the equipment, disconnect the mains and batteries and wait for five minutes until the equipment powers off. Before maintaining the equipment, check that no hazardous voltages remain in the DC bus or components to be maintained by using a multimeter.

CAUTION

- Do not turn off the External power switch during system running.
- Before battery module replacement service, charge/discharge the replaced battery to same voltage as the other modules in the system. Otherwise, it will take a long time for the system to balance the module.

8.1 Routine Maintenance

Precautions For Maintenance of Main Contactor:

During system operation at 50A max current:

- a. No-load operation only: Open/close the main contactor without load.
- b. Pre-action requirement: Reduce charging/discharging equipment power to 0 before: contactor activation.
- c. After the main contactor has completed energy storage system normal charging and discharging cutoff operations under 142.5V~864V, 50 A working conditions, its contact: system will gradually enter the performance decay period. To ensure the reliability and safety of the continuous operation of the equipment, it is recommended that users take the initiative to arrange for preventive replacement according to the life cycle parameters provided by the manufacturer, combined with the actual number of cut-off operations, after

reaching the specified frequency of operation.

System Cleanliness

Check item	Check method	Maintenance interval
System cleanliness	Check periodically that cabinet are free from obstacles and dust.	Once every 6 to 12 months
System running status	• Check that the battery is not damaged or deformed. • Check that the battery parameters are correctly set when the battery is running.	Once every 6 months
Electrical Connection	• Check that cables are secured. • Check that cables are intact, and that in particular, the parts touching the metallic surface are not scratched. • Check that unused DC input terminals, battery terminals, and other ports are locked by caps.	The first inspection is 6 months after the initial commissioning. From then on, the interval can be 6 to 12 months.
Grounding reliability	Check that ground cables are securely connected.	The first inspection is 6 months after the initial commissioning. From then on, the interval can be 6 to 12 months.

8.2 Maintenance of Main Components:

8.2.1 Air Conditioner

8.2.1.1 Maintenance Routine Checks:

1. Monthly Inspections:

- Clean air filters and vents to prevent dust buildup.
- Verify condenser/evaporator coils are unobstructed.
- Check for abnormal noises or vibrations.

2. Annual Servicing:

- Inspect refrigerant levels and piping for leaks.
- Test electrical connections for tightness and corrosion.
- Calibrate sensors and alarms via the LCD interface.

Troubleshooting:

Issue	Possible Cause	Solution
No cooling	Power loss / Faulty compressor	Check power supply; reset unit.
High noise	Loose components / Dirty fan	Tighten mounts; clean fan blades.
Communication failure	RS485 wiring issue	Verify connections and baud rate.

8.2.2 UPS

8.2.2.1 Maintenance Routine Checks:

1. Monthly:

- Inspect battery terminals for corrosion; clean if necessary.
- Verify LCD display for warnings (e.g., low battery, overload).
- Test UPS operation by simulating a power outage (unplug input).

2. Battery Care:

- Replace batteries every 3–5 years or when capacity drops below 80%.
- Avoid deep discharges; recharge immediately after outages.

3. Firmware Updates:

- Check manufacturer's website for firmware upgrades via USB/RS-232.

Troubleshooting:

Issue	Possible Cause	Solution
UPS not powering loads	Dead battery / Faulty inverter	Check battery connections; reset.
Frequent switch to battery	High input voltage fluctuations	Stabilize input power source.
Overload alarm	Exceeded wattage capacity	Reduce connected load.

8.3 Replacement of Main Component

Danger

- HV48100 SE is a high voltage DC system, operated by qualified and authorized person only.
- The power cables and plugs always carry high voltage DC power from serial connect- ed battery modules.
- Be cautious to handle the power plugs

8.3.1 Replacement of Battery Module

Step 1: Use a charger to charge the new battery module and existing modules, both to full (SOC 100%);

Step 2: Turn off the power of whole system. Make sure there's no power at P+ or P- terminals.

Step 3: Pull out the Plugs of Power Cable +/- and communication cables.

Step 4: Dismantle the 4 screws from front panel of battery module.

Step 5: Handle the battery module out of the rack and put it in place.

Step 6: Install the new battery module and connect the cables.

Step 7: Power on the system.

8.4 Battery Storage and Recharge

Storage temperature should be as follow:

Short Period: ambient temperature at -20°C ~ 50°C for less than 1 month

Long Period: ambient temperature at 0 ~ 35°C for more than 1-month, relative humidity <65% and no corrosive gas. It is recommended to discharge and charge the battery every 3 months. The longest discharge and charge interval shall not exceed 6 months and SOC is charged to not less than 90% of each charging.

CAUTION

If above instructions are not followed for long term storage, battery cycle life will significantly reduce.

8.5 SOC Calibration Trigger Logic

If the battery operates solely within a middle SOC range (e.g., 20–80%), coulomb counter can experience drift, leading to SOC reading inaccuracies. To ensure optimal performance and accurate SOC readings, a manual calibration should be performed under the following conditions:

- A calibration is required every 30 days if the battery's operational Depth of Discharge (DoD) remains predominantly shallow (e.g., cycling only within 20–80%).
- Perform the procedure once every month if the system does not naturally reach 97–100% SOC during a charging cycle.

Steps to Manually Perform SOC Calibration

1. Adjust the battery system's protection parameters: Set the lower SOC protection limit to 3% and the upper SOC protection limit to 100%.
2. Deep Discharge: Allow the system to discharge power until it reaches the 3% SOC lower limit.
3. Rest Period (Critical): Once the 3% SOC is reached, let the system rest for 1 hour. Do not change any power commands or connect any loads.
4. Full Recharge: After the 1-hour rest, command the system to charge until it reaches the 100% SOC upper limit.
5. Rest Period (Critical): When charging is complete and 100% SOC is reached, let the system rest for another 1 hour without changing any power commands.
6. The SOC calibration is now complete. The system may be returned to its normal operational mode.

For safe and effective maintenance of the system, maintenance personnel must carefully read and observe the following safety requirements.

1. Maintenance personnel must hold an electrician's license issued by the local safety supervision authority and successfully complete professional training before operation.

2. Observe related safety precautions, use necessary tools, and wear personal protective equipment.
3. Do not wear jewelry or metal accessories such as watches.
4. Do not touch the positive and negative high-voltage terminals of the ESS with hands at the same time.
5. Turn off all HV and LV switches before maintaining the ESS.
6. Do not clean the ESS with water directly. Use a vacuum cleaner if necessary.
7. Connect and disconnect cables by following the standard operation procedure. Do not connect or disconnect any cables forcefully or brutally.
8. Put away the tools and materials in time after maintenance. Check that no metal objects are left inside or on top of the equipment.
9. If there is any question about the operation and maintenance of the equipment, please contact Pytes Customer Service. Unauthorized operation is prohibited.

8.6 Cell Balancing (Float Charging)

To slowly bring all cells to a full and equalized state of charge (typically 100% SOC) using a low current, constant voltage. This can help passive balancing circuits in the BMS to equalize cell voltages, especially after system installation or after a long period of shallow cycling.

Prerequisites

- a. The battery system is safely connected and all safety checks completed.
- b. Ambient temperature is within the battery's operating range (e.g., 15–30°C for LiFePO₄).
- c. You have access to the system's charger or inverter/charger with adjustable parameters.
- d. Personal protective equipment (insulated gloves, safety glasses) is worn.

8.6.1 Step by Step Procedure:

Step1: Set the charging source to Float Voltage.

For a LiFePO₄ battery, the float voltage should be set to the Pytes recommended value 3.375 V to 3.40 V per cell (e.g., 54.0 V to 54.4 V per BMU). Do not use the standard bulk/absorption voltage.

Number of BMU = 5

Float Voltage = $54 \times 5 = 270\text{V}$

Step 2: Limit the charge current to a low value.

Set the maximum charging current to $\leq 0.05C$ (5% of the battery's rated capacity). For example:

- a. 100 Ah battery $\rightarrow \leq 5 \text{ A}$
- b. 200 Ah battery $\rightarrow \leq 10 \text{ A}$

Step 3: Initiate the float charge.

Start the inverter. The voltage will rise to the float setting. The current will start at the set limit and gradually decrease as the battery approaches the float voltage.

Step 4: Monitor the process.

Check every 2–3 hours that:

- a. Voltage remains stable at the float setpoint.
- b. Current is slowly declining (not increasing).
- c. No cell exceeds the maximum allowed voltage (e.g., 3.40 V).
- d. No overtemperature alarms occur.

Step 5: Maintain float for 12 hours.

Allow the charger to hold the battery at the float voltage for a full 12 hours. During this period, the BMS's passive balancers will bleed charge from higher-voltage cells, allowing lower cells to catch up.

Step 6: Terminate the float charge.

After 12 hours, stop the charging process by turning off the charger or switching the system back to normal operating mode (e.g., bulk/absorption disabled).

Step 7: Let the battery rest (optional but recommended).

Allow the battery to rest for 30–60 minutes before performing a discharge test or returning to normal operation. This lets cell voltages settle.

After the Float Charge

- a. The battery should now be at approximately 100% SOC with well-balanced cell voltages (difference < 20 mV typical).
- b. You may proceed with a standard SOC calibration (deep discharge to low SOC, then full charge).
- c. For systems that do not normally reach 100% SOC, a monthly low-current float charge of 6–12 hours can help maintain cell balance.

Cautions

- Do not use float charge as a substitute for SOC calibration (deep discharge + full charge). Float charging alone does not reset the BMS coulomb counter; it only helps with cell balancing.
- Excessive float charging (days or weeks) is not recommended for LiFePO_4 and may accelerate aging. 12 hours is generally safe but should not be repeated more often than necessary (e.g., once every 1–3 months if balancing is poor).

9 EMERGENCY HANDLING

9.1 Batteries Leaking

Danger

- The leaked electrolyte is a colorless viscous liquid that may evaporate rapidly and is flammable, turning into white salt residues. The electrolyte has a pungent smell and is corrosive, irritating to eyes and skin. Avoid contacting with it.
- When handling chemical leakage incidents, professional maintenance personnel and firefighters must wear necessary protective equipment such as air-purifying respirator and other PPE.
- For household members, if battery leakage occurs, you are advised to follow the following steps:
 - a. Stop the ESS immediately and set the battery power control module (DCDC) switch to OFF. Turn off the AC circuit breaker of the inverter and set the inverter DC switch to OFF.
 - b. Indoor installation scenario: Indoor personnel should quickly evacuate, open the doors, windows, and ventilation devices of the room, and turn off indoor fire sources during the evacuation. Outdoor installation scenario: Notify outdoor personnel to stay away from the site and set up a warning sign to isolate the area.
 - c. After evacuating to a safe area, notify professional maintenance personnel or firefighters to handle the emergency.
- Avoid contact with electrolytes or released gases. In the case of contact, take the following measures:
 - a. Inhalation: Evacuate from contaminated areas, get fresh air immediately, and seek immediate medical attention.
 - b. Eye contact: Immediately wash your eyes with water for at least 15 minutes, do not rub your eyes and seek immediate medical attention.
 - c. Skin contact: Wash the affected areas immediately with soap and water and seek immediate medical attention.
 - d. Intake: Seek immediate medical attention.

9.2 Catching Fire

Danger

- In case of smoke or fire, if there is a large amount of smoke in the battery storage room, do not open the door to prevent explosion risks and toxic gas inhalation.
- If a lithium battery catches fire, flammable and toxic gases will be released.

Therefore, during the extinguishing process, all firefighters must wear a full set of protective suits, including flame retardant/fireproof clothing, air-purifying respirator or breathing apparatus, firefighter helmet and mask, and insulated shoes.

- A lithium battery fire may last for several hours. After it is extinguished, the fire may be reignited by the heat generated from residual ingredients due to internal cell damage. After an open flame is extinguished, continue spraying water to cool the batteries. Wait until the battery temperature drops to the room temperature $\pm 10^{\circ}\text{C}$ and monitor for 24 hours to ensure that there is no sign of temperature rise before removing the batteries. Move the removed batteries to a safe place (an open and safe outdoor place is recommended).

9.2.1 Procedure

1. If batteries emit smoke or catch fires, notify all household members to evacuate immediately.
2. After evacuating to a safe outdoor area (20 m away is recommended), call the fire department immediately. While waiting for the fire rescue, contact the installer and Pytes technical support.
3. Firefighters arrive at the site and extinguish the fire.
4. After the fire is extinguished, set up a warning sign to isolate the area and spray water to reduce the battery temperature to the room temperature $\pm 10^{\circ}\text{C}$. (You can use an infrared thermometer or thermal imager.)
5. Observe the batteries for 24 hours and ensure that there is no sign of temperature rise before removing the batteries. (Only professionals are allowed to remove the batteries.)
6. After removing the batteries, move them to a safe place (an open and safe outdoor place is recommended), place them in the fire sand box or salt water. These operations must be performed by professionals who must take insulation measures, such as wearing insulated gloves, insulated shoes, and personal protective equipment (PPE).
7. After the battery fire is extinguished, if there is no potential risk onsite, the battery must be handled and recycled by professionals in accordance with local laws and regulations.

9.3 Soaking

If the battery pack is wet or submerged in water, cut off all power switches on inverter side, no further access. Contact Pytes or an authorized dealer for technical support.

9.4 Battery Falling or Strong Impact

Danger

- If a battery is dropped or violently impacted during installation, it may become faulty and cannot be used. Using a faulty battery will cause safety risks such as cell leakage and electric shock.
- If a battery has obvious damage or abnormal odor, smoke, or fire occurs, evacuate the personnel immediately, call emergency services, and contact the professionals. The professionals can use fire extinguishing facilities to extinguish the fire under safety protection.
- If the appearance is not deformed or damaged, and there is no obvious abnormal odor, smoke, or fire, contact the professionals to transfer the battery to an open and safe place, or contact a recycling company for disposal.

9.5 Electric Shock Handling

In Case of Electric Shock

- a. Immediately disconnect power (if it is safe to do so). Safely reach the E-stop button, trigger the system's emergency shutdown procedure, and cut off power to the affected equipment. Do not touch the victim directly if they are still in contact with a live electrical source.
- b. Call emergency medical services. Seek immediate medical attention for the individual affected.
- c. Do not touch the victim with bare hands. If the power cannot be disconnected, use a non-conductive object (such as a wooden pole) to separate the victim from the electrical source. Ensure your own safety first.

10 TECHNICAL SPECIFICATIONS

Battery Module (BMU)							
Chemistry	Lithium Iron Phosphate (LFP)						
Nominal Energy	5.12 kWh						
Nominal Voltage	51.2 V						
Operating Voltage	47.5 V ~ 57.6 V						
Nominal Capacity	100 Ah						
Weight	99 lb / 45 kg						
System							
BMU Internal Configuration ¹	5S2P	6S2P	7S2P	12S1P	13S1P	14S1P	15S1P
Rated Energy	51.20 kWh	61.44 kWh	71.68 kWh	61.44 kWh	66.56 kWh	71.68 kWh	76.80 kWh
Rated Power	25.60 kW	30.72 kW	35.84 kW	30.72 kW	33.28 kW	35.84 kW	38.40 kW
Operating Voltage	237.5 V ~ 288 V	285 V ~ 345.6 V	332.5 V ~ 403.2 V	570 V ~ 691.2 V	617.5 V ~ 748.8 V	665 V ~ 806.4 V	712.5 V ~ 864 V
Charge/Discharge Current	50 A*2			50 A			
General							
Dimensions (W x D x H)	43.31 x 50.16 x 79.33 inch/1100 x 1274 x 2015 mm						
Approximate weight	2029 lb / 920 kg	2234 lb / 1013 kg	2439 lb / 1106 kg	2203 lb / 999 kg	2306 lb / 1046 kg	2408 lb / 1092 kg	2511 lb / 1139 kg
Communication	CAN / RS485/ RS232 / Dry Contact / WIFI						
Ingress Protection Rating	IP55						
Anti-Corrosion Grade	C4-M						
Cycle Life ²	6000 cycles						
Warranty ³	System: 3 Years ⁴ Battery module: 10 Years						
Battery Module Internal Heating Film							
Rated Input Voltage	110Vac @ 60 Hz						
Rated Power	176 W						
Control Temperature	On: ≤50 °F / 10 °C Off: ≥59 °F / 15 °C						
Environmental							
Operating Temperature	-4 °F ~ 131 °F / -20 °C ~ 55 °C						
Operating Altitude	≤ 9843 ft / 3000 m						
Relative Humidity	5% ~ 80 % non-condensing						
Fire Suppression System							
Level 1: Detection & Ventilation	Hazardous gas detection activates ventilation system						
Level 2: Aerosol Suppression	Heat and smoke detection activates aerosol fire suppression system						
Level 3: Pressure Relief	The explosion relief valve opens automatically if internal pressure exceeds safe limits						
Level 4: Fire Hose Connection Port	Equipped with a fire hose connection port for firefighter hose attachment						
HVAC							
Max. Cooling Capacity	2300 W (L3S)						
Max. Heating Capacity	1050 W						
Ingress Protection Rating	IP55						
Compliance							
Certifications	UL 9540 Ed.3 (2023), UL 9540A, UL 1973, UN 38.3						
Code Compliance	NFPA 68 / 69 / 855						
Listings	CEC, SGIP, OGPc						

¹ Flexible Configuration Number of connectable BMUs per Battery Control Unit (BCU) ranges from 3 to 15. Voltage Range: 47.5 V x (3 ~ 15) ~ 57.6 V x (3 ~ 15). The HV48100SE has 16 available positions for BMU and BCU. The maximum configuration per HV48100 SE cabinet is 15S1P / 7S2P.

² Operating conditions: 77°F / 25°C, 0.5C @ 90% DOD, rest @ 70% (EOL).

³ Warranty: 3 years for the cabinet system (excludes the BMU and BCU), 10 years or 6000 cycles for the battery (whichever comes first).

⁴ Optional 2 year warranty extension available for purchase.



11 SYSTEM DEBUG

Debug steps	Content
Preparation.	It is forbidden to turn on loads before turn on HV48100 SE. Remarks: Follow instruction manuals of other equipment for turn on process other than HV48100 SE.
System Function	Function Debug: Communication: Check communication between HV48100 SE and devices, if it's normal or alarm. Power Conversion System: Before conjoint, it is a must that PCS or Inverter System runs normally and parameters meet HV48100 SE requirement. System Operation: Charge/Discharge, charging stop, discharging stop, current limiting, etc. Caution: Set up all parameters of PCS and EMS before turn on HV48100 SE.
Monitor Function	Connect to console terminal of main control to check whether data of HV48100 SE normally displays on the monitor system.
Operation Trial	After the system debugged, run the system a period with low load for trial operation, to test the high voltage DC system fits to requirement.

11.1 Troubleshooting

Danger

- HV48100 SE is a high voltage DC system, operated by qualified and authorized person only.
- Before checking the failure, make sure all cable connections and switches are in correct condition and the system can be turned on normally.

No.	Problem	Possible Reasons	Solution
1	Turn on the BMS. The Status LED lights in red. All battery module status LED Lights in green.	• This battery string is under protection. It is possible Over Current Protection or Failure Protection. • No external communication with upper controller.	• Through the monitor or maintenance software check the battery cell, battery module has alarm or not. • Check communication with upper controller and communication cable wiring. • Reversed connection is seriously danger!

2	The BMS's Status LED is lighting red, and some the battery module's status LED is lighting green, but some is lighting red.	This battery string is under protection. It is possible Over Current, Over Voltage, Low Voltage, Over Temperature, Low Temperature or Failure Protection.	Use the monitor or maintenance software to check the battery cell, battery module has protection and failure or not.
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11.2 Debugging

11.2.1 LED Indicator Instructions

Battery status	Normal/Alarm/Protection	ALM	RUN	Capacity LED						Description
		●	●	●	●	●	●	●	●	
Shut down	/	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	All off
Power-on	Normal	ON	ON	ON	ON	ON	ON	ON	ON	All lights will be on for 1 second at the same time.
Standby	Normal	OFF	Blink 1	OFF	OFF	OFF	OFF	OFF	OFF	Standby
	Alarm	Blink 3	OFF	OFF	OFF	OFF	OFF	OFF	OFF	Low Voltage
Charging	Normal	OFF	Light	Based on Capacity						
	Alarm	Blink 3	Light							
	Protection	Light	OFF	OFF	OFF	OFF	OFF	OFF	OFF	Protection triggered, charging stops
Discharge	Normal	OFF	Blink 3	Based on Capacity						
	Alarm	Blink 3	Blink 3							
	Protection	Light	OFF	OFF	OFF	OFF	OFF	OFF	OFF	Protection triggered, discharging stops

Note: The blinking descriptions: Blink 1 "0.3s on/3.7s off"; Blink 2 "0.5s on /0.5s off"; Blink 3 "0.5s on / 1.5s off"; Blink 4 "0.7s on / 9.3s off"

12 REGULATORY COMPLIANCE

This product complies with the essential requirements of the European Union.

CE Declaration (Radio Equipment Directive 2014/53/EU)

<https://www.pytesess.com/public/upload/20251030/9d78f34b6ae60e597414a564c86504ad.pdf>

For the latest compliance documentation, please visit the link above

Warranty Card

Customer Information			
Contact Name			
Phone Number		Email	
Address			
Product Information			
Battery Model		Inverter Brand/Model	
Battery Quantity		Inverter Quantity	
Purchase Date		Inverter Using Time	
Serial Number		on/off Grid	
Installer Information			
Installer Name		Installation Date	
Problem Description			
Photos of Battery Wiring			
Photos of Inverter Wiring and Panels			



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