EN

INSTALLATION GUIDE

AND USER MANUAL

L3 SERIES LIMITLESS LITHIUM™

L3 HVR

READ THE INSTRUCTIONS COMPLETELY BEFORE OPERATING THE EQUIPMENT

While a best effort is made to ensure all specifications and descriptions contained in this document are accurate at the time of publication, Sol-Ark reserves the right to make product modifications at any time without advance notice.

For the latest Sol-Ark product and installation documents, visit: www.sol-ark.com

For errors, omissions, or suggestions, contact support@sol-ark.com

For complete product specifications and information on relevant product listings and certifications, refer to the Product Datasheet available at www.sol-ark.com

DISCLAIMER

UNLESS SPECIFICALLY AGREED TO IN WRITING:

Sol-Ark assumes no responsibility or liability for any damages, property loss, personal injury, or any adverse consequences resulting from improper use and installation of the product or the failure to adhere to the guidelines provided in this document. Users are expressly advised to follow the instructions and guidelines outlined in the documentation accompanying the product. Sol-Ark shall not be liable for any damages or losses incurred due to deviations from recommended usage, installation, or maintenance procedures. By using the product, users acknowledge their understanding of these disclaimers and agree to use the product at their own risk. Sol-Ark reserves the right to update or modify product information, specifications, and guidelines without prior notice.

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This manual is only for the **L3 Series Limitless Lithium™ Outdoor Battery Energy Storage System**.

For support, contact:

(USA) +1 (972) 575-8875 ext. (2)

support@sol-ark.com

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IMPORTANT INSTRUCTIONS

This manual provides crucial information for the installation and operation of the L3 Series Limitless Lithium™ Battery Energy Storage System. Qualified and authorized personnel are required to conduct the installation and maintenance procedures adhering to all safety standards and system requirements outlined in this document.

This manual is applicable to countries that comply with the certification requirements. Standards and legal requirements of other countries might differ from the specifications outlined in this manual.

To secure the full product warranty, the L3 system must be registered by completing the warranty verification process and sending the information to Sol-Ark.

SYMBOLS THAT APPEAR IN THIS DOCUMENT

WARNING: This symbol indicates information that, if ignored, could cause serious injury, equipment damage, or death.

CAUTION: This symbol indicates information that, if ignored, could result in minor injury or equipment damage.

NOTE: This symbol indicates relevant information that is not related to hazardous situations.

NOTICES

ATTENTION: Read all instructions and cautionary markings in this document and on the equipment before installing the L3 HVR. Failure to do so may result in equipment damage, electric shock, serious injury, or loss of life. Failing to follow any of these instructions may also void the warranty.

All installations must conform to the laws, regulations, codes and standards applicable in the jurisdiction of installation. Before starting an installation, consult a local building or electrical inspector for current requirements. Local codes may vary but are adopted and enforced to promote safe electrical installations. A permit may be needed to do electrical work, and some codes may require an inspection of the electrical work.

When installed in the US electrical installations are required to follow the National Electrical Code (ANSI/NFPA 70) adopted by their local AHJ (Authority Having Jurisdiction) including any local amendments.

General

WARNING: Risk of electric shock. Risk of fire. Only qualified electrical personnel should install, troubleshoot, service, or replace the equipment.

WARNING: Risk of electric shock. Apply appropriate personal protective equipment (PPE) and follow safe electrical work practices during installation and service. Turn off all power supplying this equipment before working on or inside equipment. Always use a properly rated voltage sensing device to confirm power is off. Replace all devices, covers, and doors before turning on power to the equipment.

WARNING: Inspect the equipment for damage before installing. Do not install the equipment if it has been damaged in any way.

WARNING: Do not insert foreign objects into any part of the equipment.

WARNING: Do not expose the equipment or any of its components to direct flame.

WARNING: Do not attempt to open, disassemble, repair, tamper with, or modify the equipment other than what is permitted in this manual. The equipment contains no user-serviceable parts. Contact the installer who installed the equipment for any repairs.

WARNING: Do not connect life-support systems, other medical equipment, or any other use where product failure could lead to injury to persons or loss of life.

CAUTION: Do not use solvents to clean the equipment or expose the equipment to flammable or harsh chemicals or vapors. Do not allow petroleum-based paints, solvents, or sprays to contact nonmetallic parts of the equipment.

CAUTION: Do not use parts or accessories other than those specified for use with the equipment.

Installation and Use

WARNING: Risk of electric shock. Risk of fire. Only use electrical system components approved for dry locations.

WARNING: Risk of electric shock. Risk of fire. Ensure that all wiring is correct and that none of the wires are pinched or damaged.

WARNING: Risk of electric shock. Risk of fire. Before making any connections verify that the DC disconnect(s) are in the off position. Double check all wiring before applying power.

WARNING: Risk of electric shock. Improper servicing of the equipment or its components may result in a risk of shock or fire. To reduce these risks, disconnect all wiring before attempting any maintenance or cleaning.

WARNING: Risk of electric shock. Always de-energize the equipment before servicing.

WARNING: Risk of electric shock. Do not use equipment in a manner not specified by the manufacturer. Doing so may cause injury or loss of life, or damage to equipment.

NOTE: This device complies with part 15 of the FCC Rules. Operation is subject to the following two conditions: (1) This device may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesired operation. Changes or modifications not

expressly approved by the party responsible for compliance could void the user's authority to operate the equipment.

Environmental Conditions

WARNING: This equipment is intended for operation in an environment having a minimum temperature of -20°C (-4°F) and a maximum temperature of 50°C (122°F).

WARNING: Install the equipment in a location that prevents damage from flooding. Ensure that no water sources are above or near the equipment, including downspouts, sprinklers, or faucets.

NOTICES: Transportation and Handling

WARNING: To protect the equipment and its components from damage when transporting, handle with care. To help prevent damage, leave all equipment in its shipping packaging until it is ready to be installed.

WARNING: Risk of physical injury or death. The battery rack is not designed for transportation with modules installed. Do not attempt to lift a fully installed rack using any lifting device.

WARNING: Risk of physical injury or death. Vehicles used to transport Lithium-ion batteries must comply with all DOT transportation regulations surrounding Class 9 hazardous freight.

WARNING: Risk of physical injury or death. Use caution when using lifting equipment to move battery modules and components.

WARNING: Risk of physical injury or death. Boxed battery modules stacks should not exceed 8 units.

WARNING: Risk of physical injury or death. Each battery module weighs 44 kg (97lbs). Use appropriate transport and lifting equipment for safe handling and transport.

WARNING: Risk of physical injury or death.

Product Recycling

Due to the considerable size, the L3 HVR series battery storage system requires special handling to be recycled properly. For more information on locating recycling resources in your area, please visit our website at sol-ark.com/recycling.

Proper recycling is crucial for lithium storage batteries. It keeps hazardous waste out of landfills and allows reusable materials like lithium and other metals to be recovered and repurposed. As the owner of the system, you are responsible for ensuring proper end-of-life recycling takes place through a certified lithium battery recycling program.

You must not attempt disposal via normal waste collection or abandon the battery at a public facility. Please reference our website or call us for more details as soon as you know your energy storage system has reached its end of usable life

Requirements for Installation Personnel

All work MUST comply with local code, regulations, and industry standards. The installation of the L3 system can only be completed by qualified persons with appropriate qualifications as determined by the local AHJ.

1. L3 Series: At a First Glance

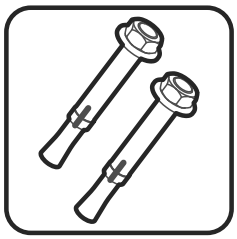
INSPECT SHIPMENT

The box should include all items shown in the component guide. If there are damaged or missing parts, immediately call Sol-Ark customer support at +1 (972) 575-8875 Ext. 2.

COMPONENT GUIDE

The L3 HVR battery energy storage system includes the following components:

A



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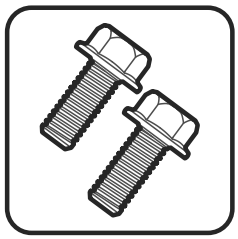

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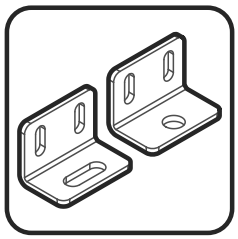

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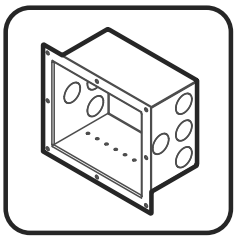

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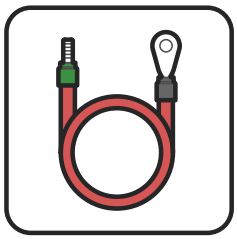

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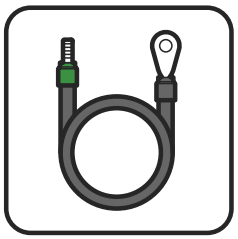

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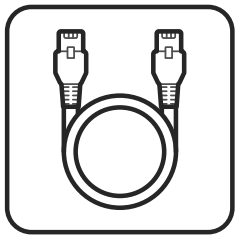

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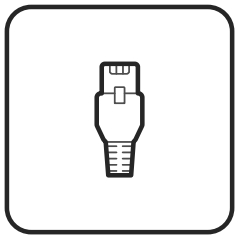

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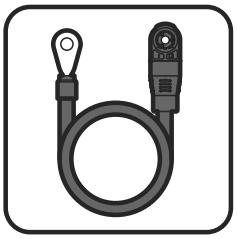

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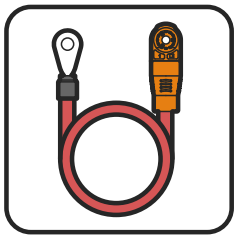

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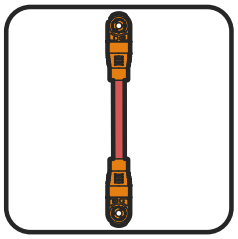

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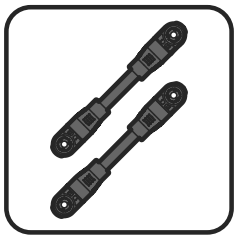

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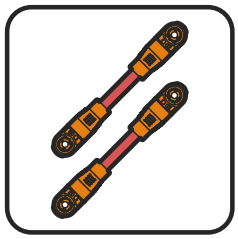

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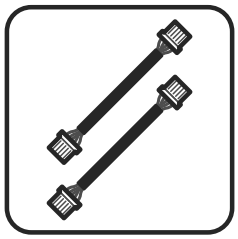

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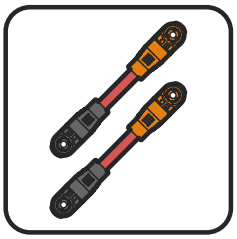
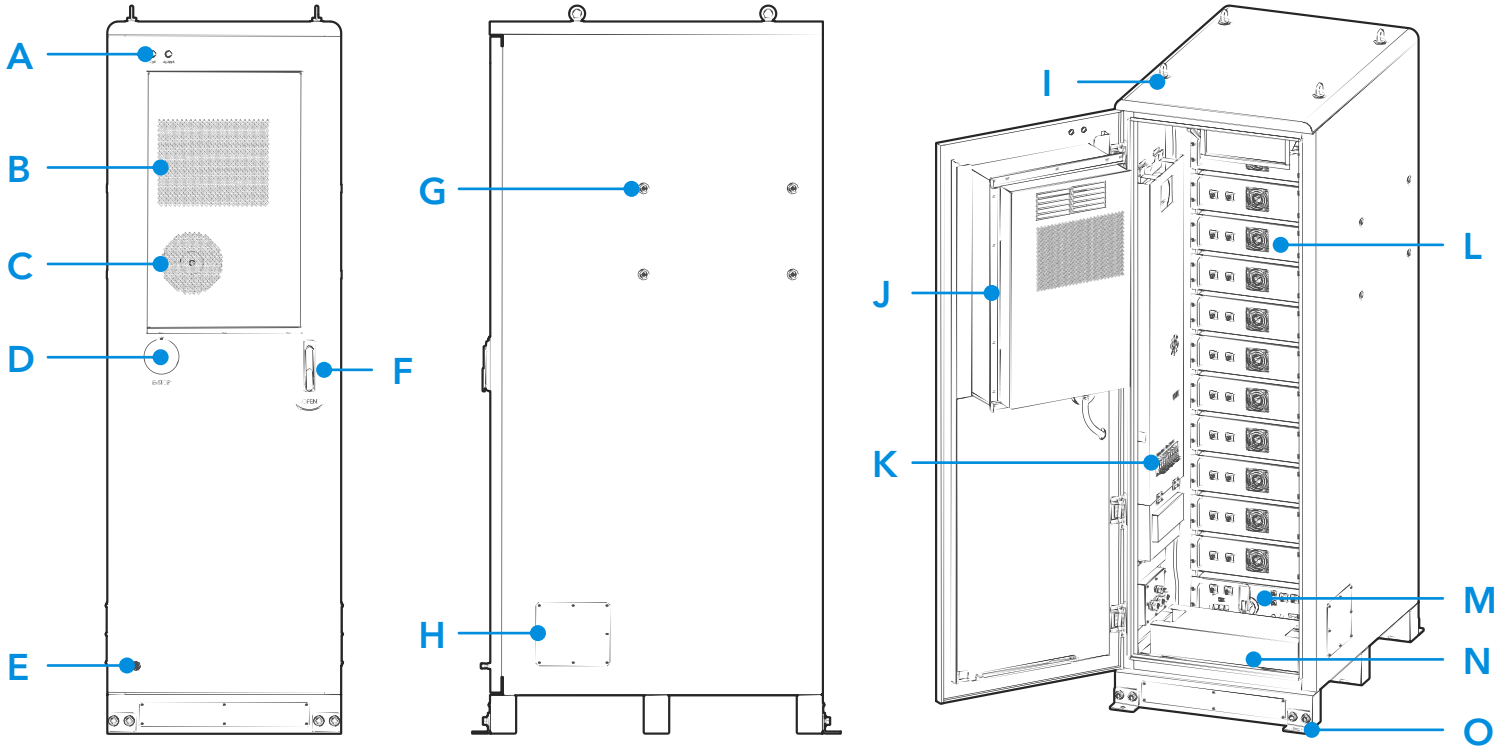


Q

Component	Description	Quantity
A	Masonry Expansion bolt M12x80mm **(not used)**	4
B	M10x25 mm Bolts for Mounting Feet	8
C	Mounting Feet (2 hole & 2 slotted)	4
D	R/L Cabinet Conduit Entry Knockout Box	2
E	9.8ft (300cm) P+ Inverter cable (red)	2
F	9.8ft (300cm) P- Inverter (black)	2
G	BMU-to-Battery Module Communication cable	1
H	16ft (500cm) Cabinet-to-Cabinet Ethernet Communication cable	1
I	PCS Communication Port - 120Ω Terminating Resistor	1
J	BMU-to-busbar P- cable (black)	1
K	BMU-to-Busbar P+ cable (red)	1
L	BMU-to-Battery Module B+ cable	1
M	*Parallel Connection* - Battery Module B- cable (black)	6
N	*Parallel Connection* - Battery Module B+ cable (red)	6
O	*Series Connection* - 4.3in (110mm) Battery Module Communication cable	11
P	*Series Connection* - 8.5in (215mm) Mattery Module Power Cable	11
Q	Manual Service Disconnect (MSD) Plug for Battery Negative	1

1.1 General Description



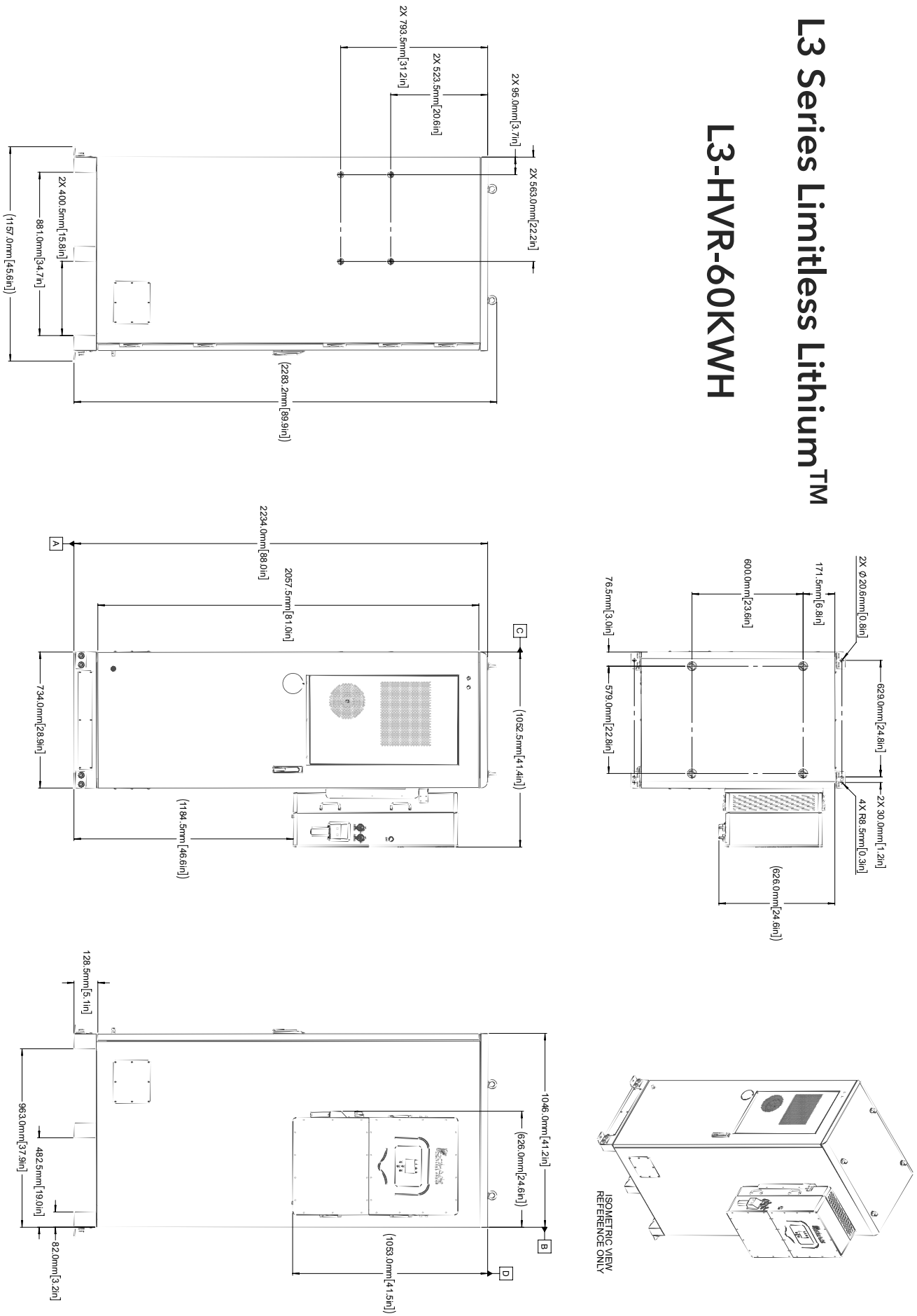
Component	Name
A	Indicator Lights (ON & ALARM)
B	HVAC Unit Air Outlet
C	HVAC Unit Air Intake
D	Emergency Stop Button (shuts down battery output)
E	HVAC Condensate Drain Outlet
F	Keyed Cabinet Door Handle
G	Inverter Carrier Mounting Holes
H	R/L side Condit Entry Cover
I	Lifting Points
J	HVAC Unit (heating/cooling)
K	Auxiliary Power Input Terminals and Internal Systems Breakers
L	12x L3 HVR-5.1kWh Battery Modules
M	1x L3 HVR BMS-750V - Battery Management Unit (BMU)
N	Safety Cover for Built-in DC busbar
O	Cabinet Mounting Feet

L3 HVR FASTENER TORQUE TABLE

⚠ *Do not use impact drivers to tighten any fasteners on the cabinet or inverter*

Connection	Torque [ft-lb or in-lb]	Torque [Nm]
M10 - Mounting Feet Bolts	37ft-lb	51 N-m
M6 - Internal Busbar +/- Connections	7.7 ft-lb	10.5N-m
M10 - Ext. Grounding Screws	37ft-lb	51N-m
M12 - Inverter Mounting Carrier Bolts	74 ft-lb	100 N-m
M4 - Inverter to Carrier Socket Screws	12 in-lb	1.37N-m

1.2 Specifications



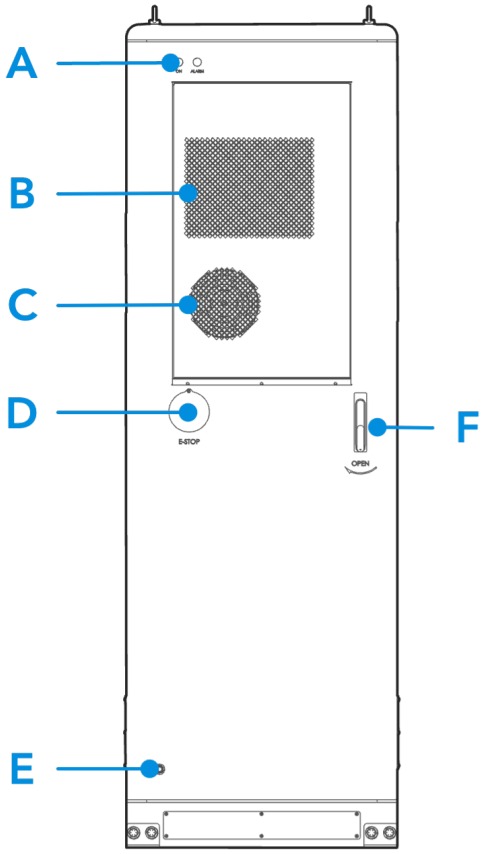
DATASHEET

L3 SERIES LIMITLESS LITHIUM™ L3-HVR-60

Battery Energy Storage System

Battery Model Name:	L3 HVR-60	L3 HVR-60
ESS Model Name:	L3 HVR-60KWH-30K	L3 HVR-60KWH-60K
Sol-Ark Product SKU:	L3-HVR-60KWH	L3-HVR-60KWH
System Data		
Compatible Inverter	Sol-Ark 30K-3P-208V-N	Sol-Ark 60K-3P-480V-N
Environmental Rating	Outdoor	
Cell Chemistry	Lithium Iron Phosphate	
Battery Cabinet Capacity	61.44 kWh	
System Usable Energy [1]	55.30 kWh	
Built-In DC Disconnect Rating	200A	
Internal Fuse Rating	160A	
Max Battery Cabinets Per Inverter	6	
Maximum Inverters Per System	6	
Recommend Depth of Discharge	90%	
Roundtrip Efficiency (DC Charge/Discharge)	94% (25C, 0.5C)	
System Nominal Voltage	307V	614.4V
System Operating Voltage	294V – 336V	588V–672V
Charge/Discharge Current [2]		
• Recommend	100A	50A
• Nominal/Continuous	100A	
• Peak Discharge (2 min @ 25°C)	125A	
Mechanical Specifications		
Product Dimensions (WxDxH)	76x107x226 cm (30x42x89 in)	
Net Weight	950 kg (2,095lbs)	
Mounting Type	Outdoor Enclosure	
Material and Finish	Steel – Corrosion Resistant Powder Coat	
Operating Temperature [3]	-20°C – 50°C (14°F – 122°F)	
Humidity	5%–85% RH	
Operating Altitude [4]	3000m (9,843 ft)	
Storage Conditions [5]	-4°F – 95°F up to 85% RH (non-condensing) – State of Charge (SOC) 30%	
Ingress Rating	IP55 (NEMA 3R)	
Noise Level @ 1m	75 dBA at 30°C (86°F)	
Seismic Zone	Up to Category F	
Communication Ports	CAN2.0/RS485	
Battery Module Specifications		
Battery Module Configuration	6s2p	12s1p
Battery Module Energy	5.12kWh	
Battery Module Nominal Voltage	51.2V	
Battery Module Nominal Capacity	100Ah	
Warranty and Certification		
Performance Warranty [6]	10 years or 196MWh Throughput	
Product Warranty	10 Years	
Certifications	UL1973, UL9540, UL9540a, UN38.3, FCC, Prop 65	

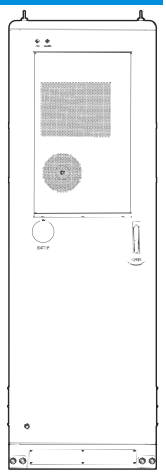
1. DC usable energy, test conditions: 90% DOD, 0.3C charge and discharge at 25°C. Usable system energy may vary due to system configuration parameters.
2. Output current is affected by battery temperature and SOC.
3. Temperature is based on the average cell temperature as measured by the BMS. Battery charging is disabled below 0°C (32°F). Derating occurs above 45°C (113°F). For HVR model, operating temperature range only applies if using included climate controls. See Sol-Ark technical sales for planning outdoor sites.
4. Battery will operate at a maximum of 1C charge/discharge up to 2000m, above 2000m maximum output is derated to 0.8C, contact Sol-Ark for details.
5. Storage temperature of the battery with no charge or discharge.
6. Operating Conditions 77°F±7°F 0.5C/0.5C, EOL (End of Life) 70% retained capacity.



HVAC Unit Specifications	
HVAC Unit Model Name:	DY-CNA20-BP (US)
Rated Input Voltage:	208Vac or 240Vac
Rated Frequency:	60 Hz
Max. Cooling Capacity:	7,165 BTU/hr
Max. Heating Capacity:	5,630 BTU/hr
Rated Power Input (Cooling):	900 W
Rated Power Input (Heating):	1,700 W
Rated Input Current (Cooling):	4.15 A
Rated Heating Current (Heating):	7.9 A
Max. Auxiliary Input Power (Wac):	1,800
Max. Auxiliary Input Current (Aac):	8.3
Max. Suction Pressure:	392 psi (2.7 Mpa)
Max. Discharge Pressure:	232 psi (1.6 Mpa)
Max. Air Flow Volume:	370 cfm (630 m^3/h)
Ingress Protection Rating:	IP55
Refrigerant Type:	R134a/330g
Dimensions (W x H x D):	478 x 796 x 306 mm (18.8 x 31.3 x 12 in)
Unit Net Weight:	48.5 kg (107 lb)

2. Installation

System Description



The L3 HVR Series Limitless Lithium™ is a high-performance lithium-ion battery system designed for outdoor energy storage applications. It offers reliable and efficient power solutions for time-of-use management, peak shaving, backup power, and micro-grid integration. The L3 HV-60 model features a gross capacity of 61.44 kWh per cabinet with the ability to be stacked up to 36 units allowing for 2.2MWh of total storage capacity, making it suitable for various energy storage requirements.

Advanced Battery Management System (BMS)

The HVR Series is equipped with a sophisticated automotive-grade contactor-based BMS. This advanced system continuously monitors and manages the voltage, current, and temperature of all battery modules and cells, ensuring optimal performance and safety.

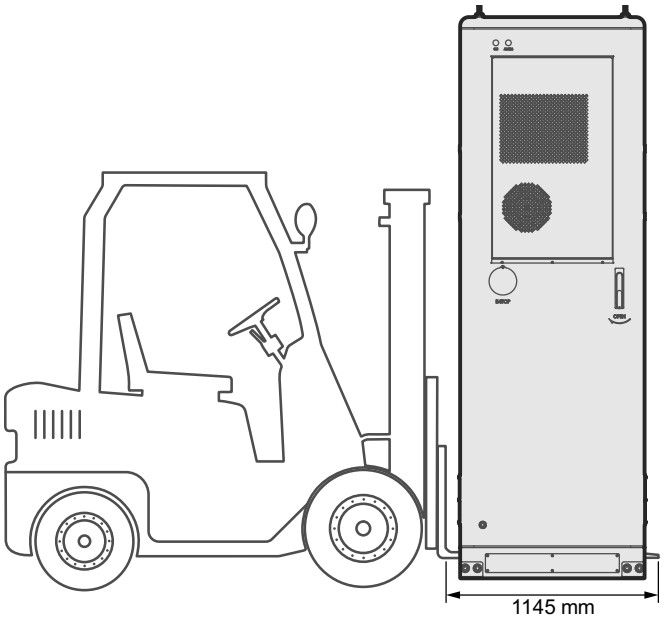
Comprehensive Fire Safety Features

Safety is a top priority in the design of the L3 HVR Series. The system incorporates built-in aerosol fire suppression systems in both the cabinet and battery modules. Additionally, it features smoke, heat, and CO2 detection mechanisms, providing multiple layers of protection against fire hazards.

2.1 Transportation and Lifting

Forklift

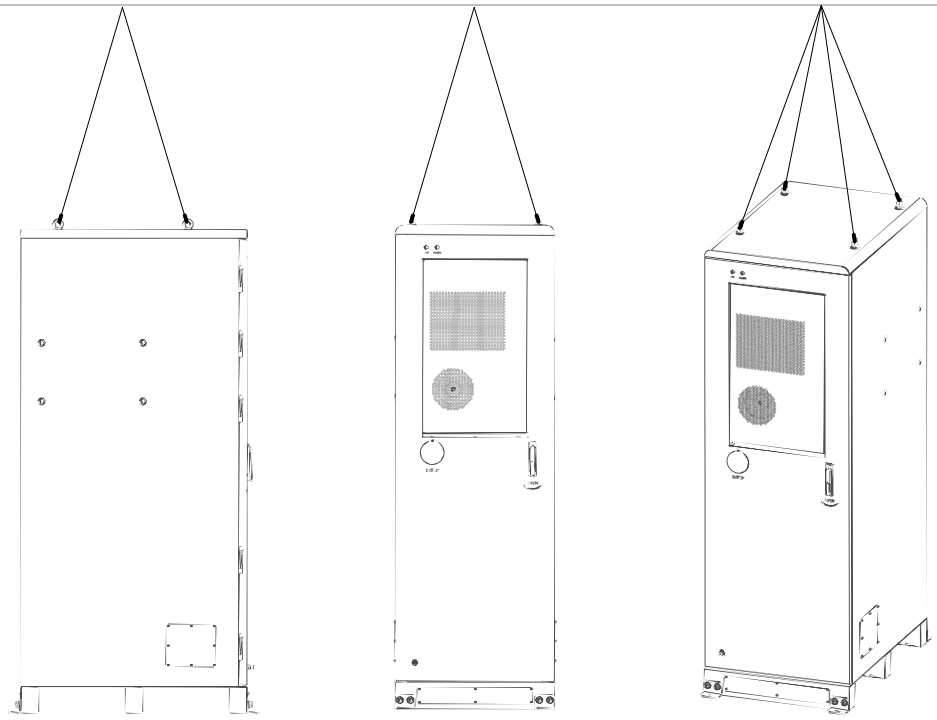
If the installation site has a flat surface level, you can use an outdoor rated forklift for transport provided it has a rated load capacity of more than **1500 kg (3300 lbs)** and its fork length meets the requirements shown in the illustration below. The bottom of the L3 HVR cabinet has special openings designed for forklift transport.



Overhead Hoisting

When hoisting, a 25-ton crane with a lifting arm between 126 to 133 feet (38.5 to 40.5 m) in length should be used. The following requirements must be met when lifting the L3 HVR:

- All safety requirements must be met.
- A professional instructor is needed in the whole hoisting process.
- The strength of the sling used should be able to withstand the weight of the devices.
- Ensure that all sling connections are safe and reliable, and that the lengths of the slings connected to the corner fittings are equal.
- The length of the sling can be adjusted appropriately according to the actual requirements of the site.
- During the lifting process, the devices must be stable and not skewed.
- Please lift the devices from the bottom.
- Take all necessary auxiliary measures to ensure the safe and smooth lifting of the devices.



2.2 Site Preperation

Basic Installation Requirements

The battery energy storage system must be installed on a level, solid foundation capable of safely bearing the total weight of the system when fully loaded with battery modules.

- The installation location must provide adequate clear space around the system for ventilation, cooling, maintenance access, and clearances in accordance with this documentation and the National Electrical Code®, Art. 110.26 or other local requirements for energy storage systems.
- Fully enclosed or indoor installations will require additional ventilation and/or fire protection systems per local codes.

Outdoor Installations Requirements

- The foundation should be constructed with proper drainage sloping away from the foundation to prevent pooling of water near the cabinet base.
- The foundation pad must extend at least 24 in beyond the footprint of the system on all sides.
- Must be located away from potential flood zones, drainage areas, or other areas prone to standing water.
- Shaded locations are preferable to reduce cooling load.
- The area should have adequate fencing and lighting as required by local building and mechanical code or other requirements for energy storage systems.

Foundation Details:

1. Single Cabinet Foundation Detail

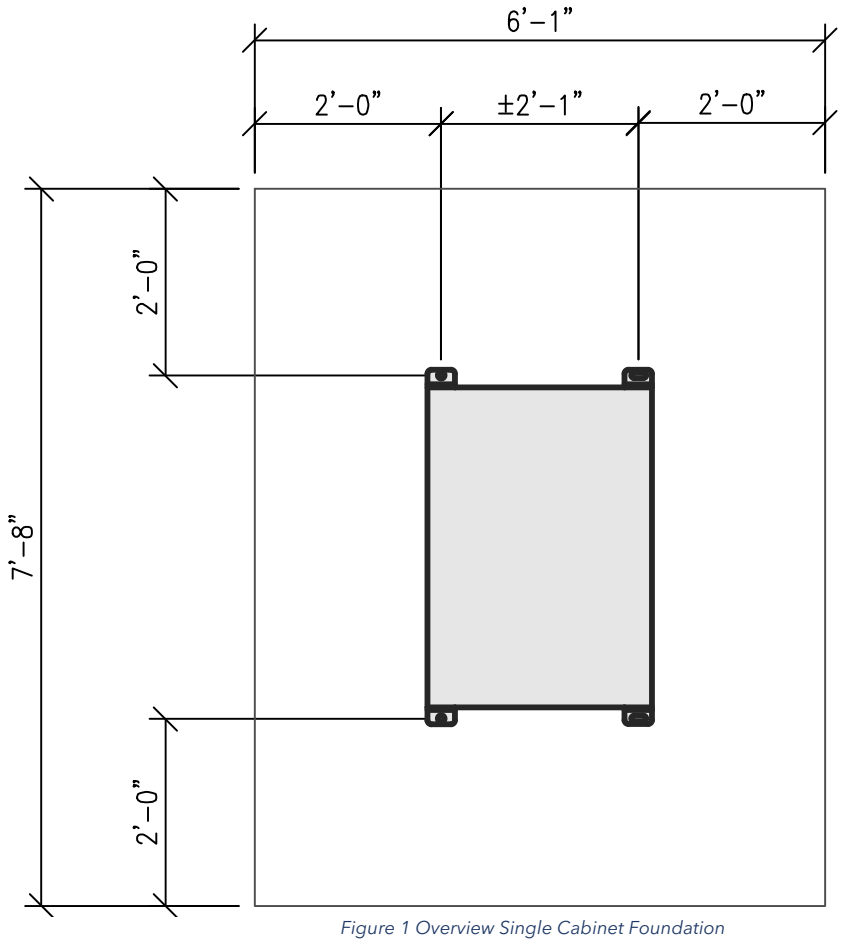


Figure 1 Overview Single Cabinet Foundation

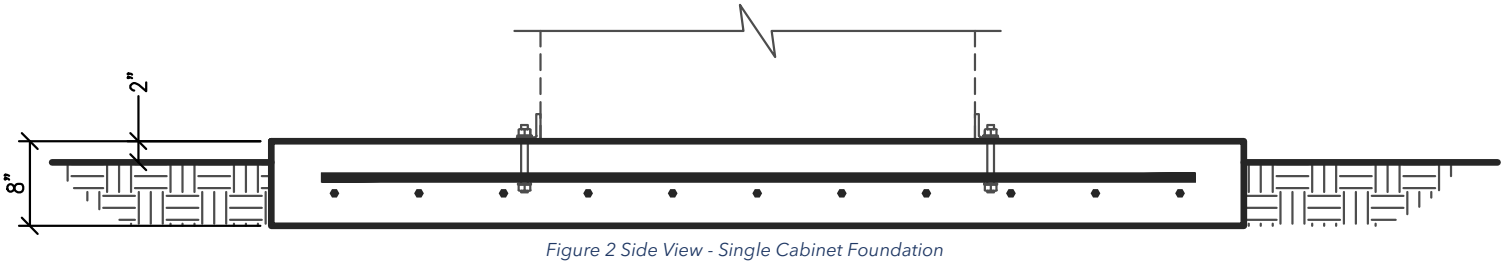


Figure 2 Side View - Single Cabinet Foundation

2. Multi-Cabinet Foundation Detail (Option A)

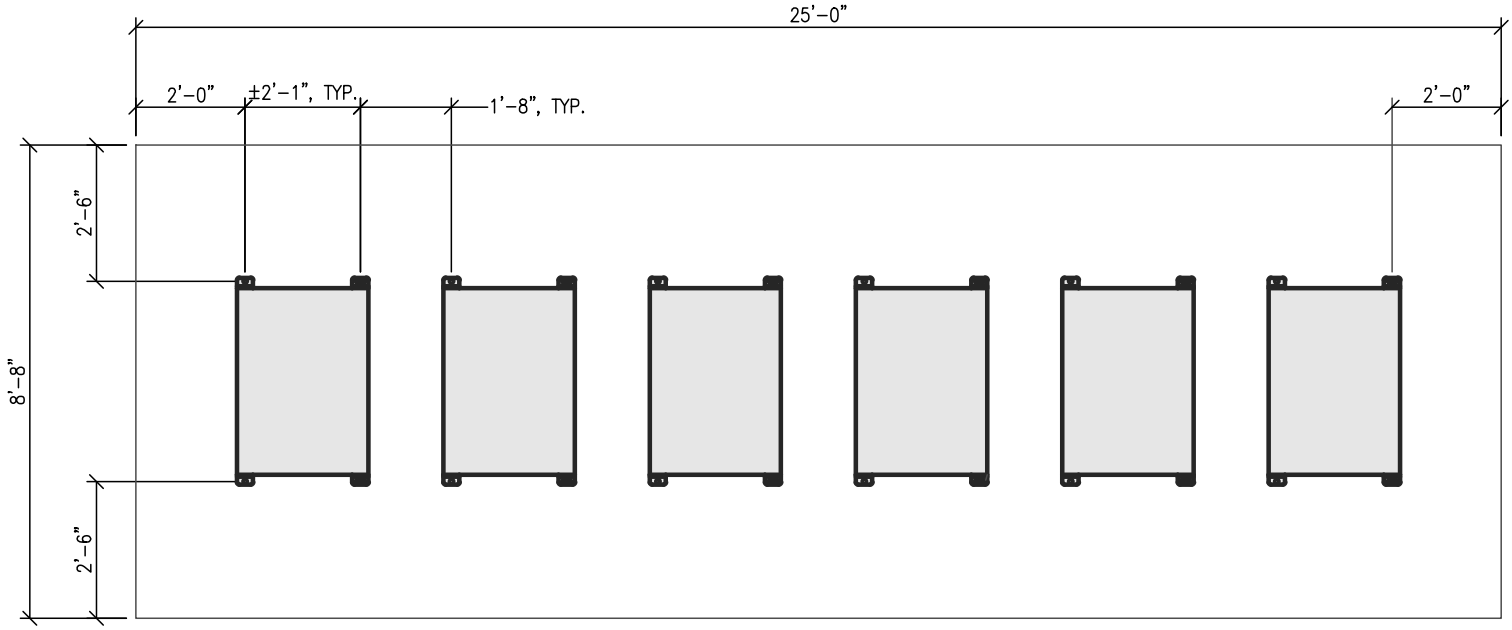


Figure 3 Six Cabinet - Foundation Overview (Option 1)

3. Multi-Cabinet Foundation Detail (Option B)

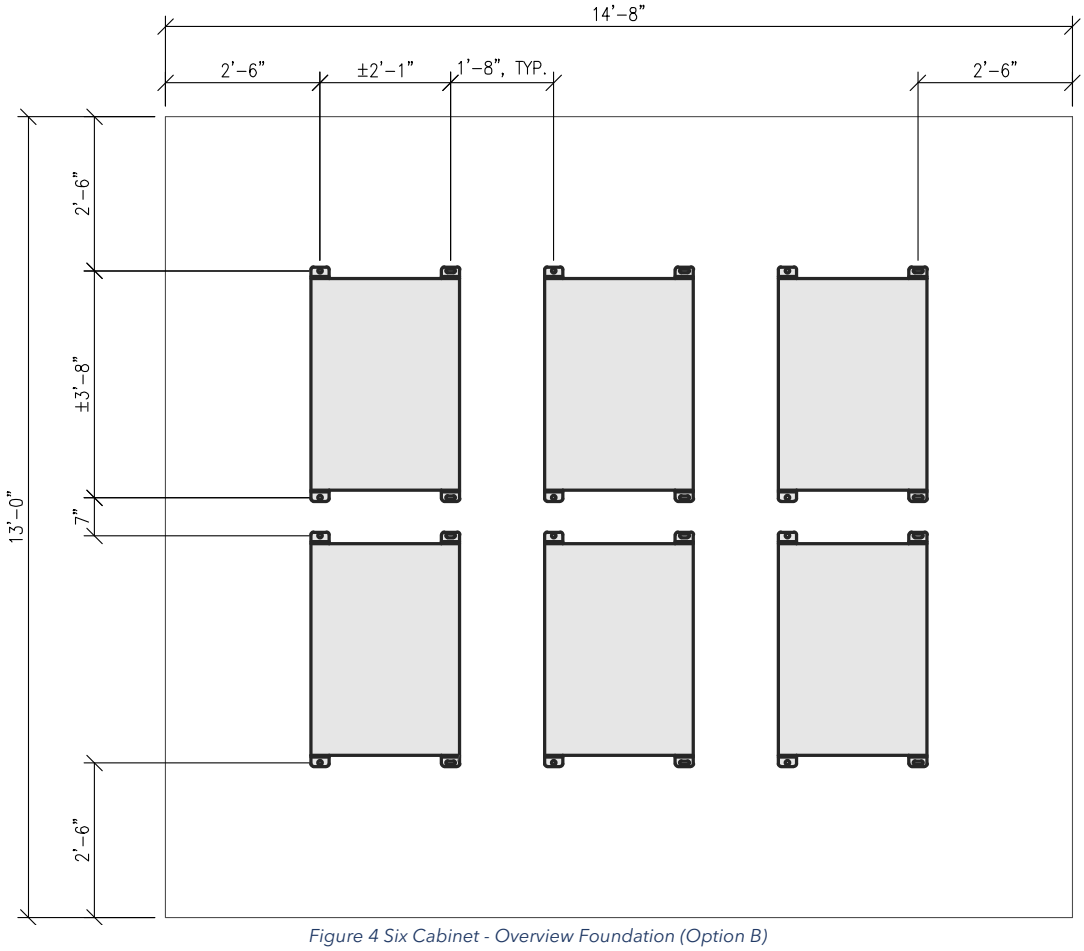


Figure 4 Six Cabinet - Overview Foundation (Option B)

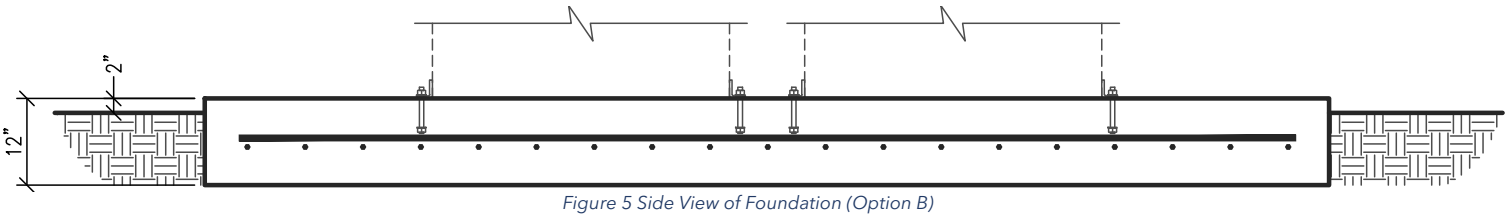
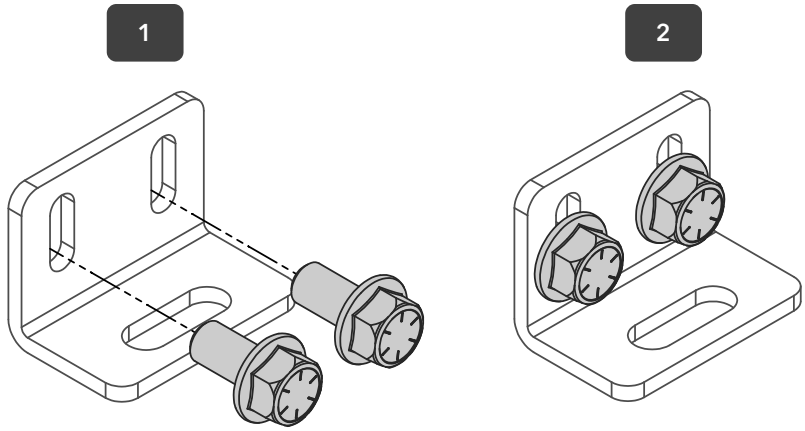


Figure 5 Side View of Foundation (Option B)

2.3 Mechanical Assembly

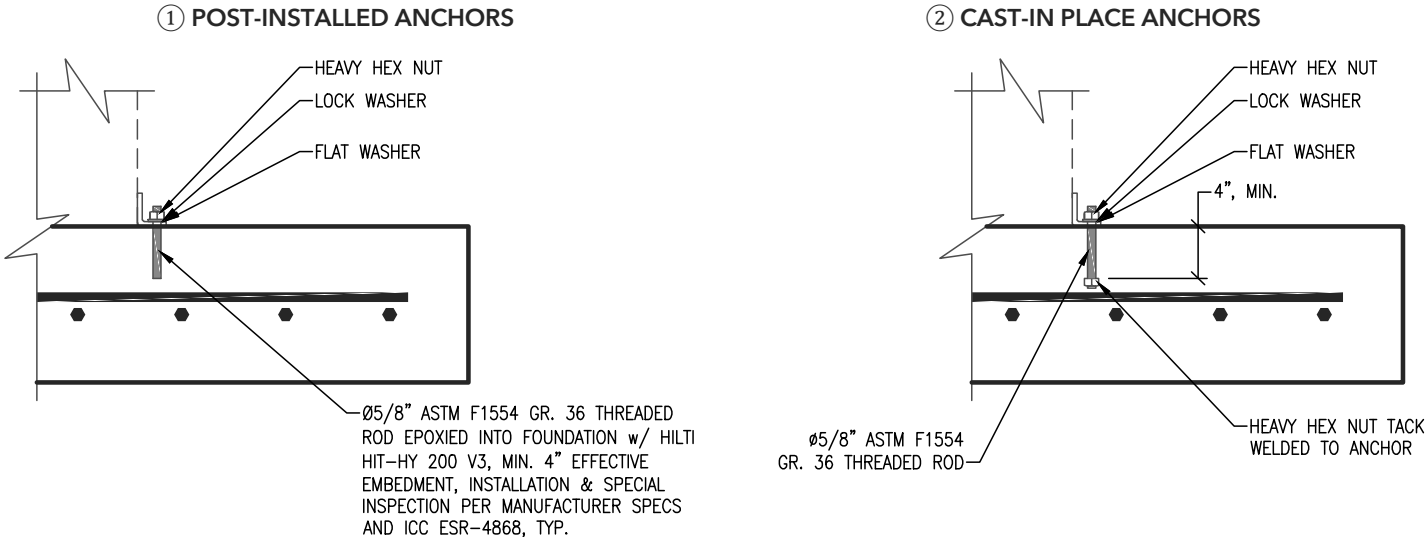
1. Install the Mounting Feet

After lifting the cabinet into its final location, attach the included L-shaped mounting feet to the cabinet using the provided bolts (M10x30mm) **[Step 1]** and tighten to **37ft-lb** (51 N-m) **[Step 2]** as shown in the figure below:



2. Anchor the Cabinet to the Foundation

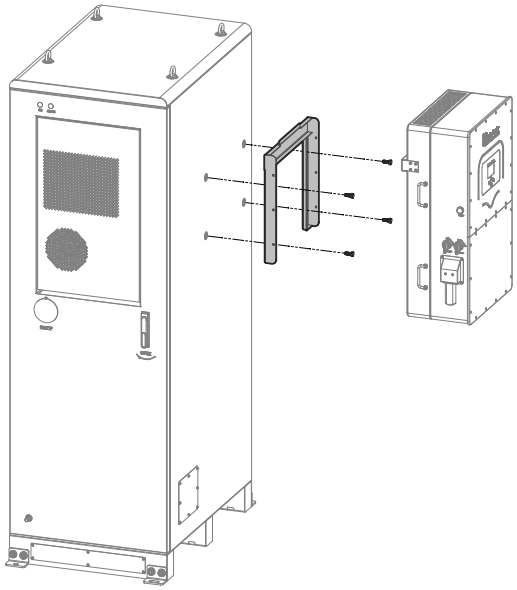
The cabinet mounting feet should be secured to the concrete foundation using one of the two methods shown in the figures below or using a method with equivalent strength as determined by a licensed design professional.

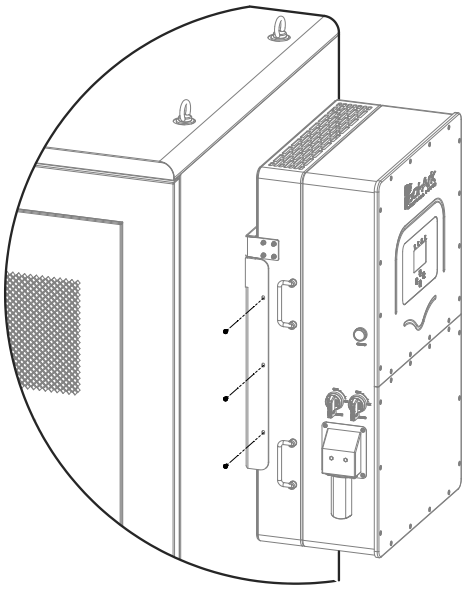


Inverter Mounting

3. Method A – Direct installation of the inverter

A. If installing the inverter directly to the L3 HVR cabinet use the following method:
B. Remove the M12 bolts on the cabinet exterior using a 12mm wrench and install the inverter mounting carrier onto the wall of the cabinet as shown in the left figure. Tighten to a torque of 74 ft-lb (100N-m).
C. Lift the inverter on the carrier, then secure the inverter to the mounting carrier with six (6) of the M4x12mm socket head screws provided. Tighten to a torque of 12 in-lb (1.37N-m).





4. Method B – External installation of the inverter

A. Use screws or anchors suitable for the mounting surface and capable of supporting the weight of the inverter **176lb** (80kg).
   a. *For Concrete or Masonry Mounting:* Use a minimum of **four** (4) M12x60mm expanding anchors (not included).
   b. *For Wood Frame Mounting:* Use a minimum of **four** (4) 1/2in lag screws with flat washers (not included), making sure to anchor into at least 2 framing members.
   c. *For Metal Framing Mounting:* Use a minimum of **four** (4) 1/4in self-tapping metal screws with flat washers (not included).
   d. In the case a different anchorage method is required, calculate the number of anchor points needed to properly hold the weight of the equipment.
B. Secure the inverter to the mounting carrier with six (6) of the M4x12mm socket head screws provided, then tighten to a torque of **12 in-lb** (1.37N-m).

2.4 Seismic Installation Guidelines

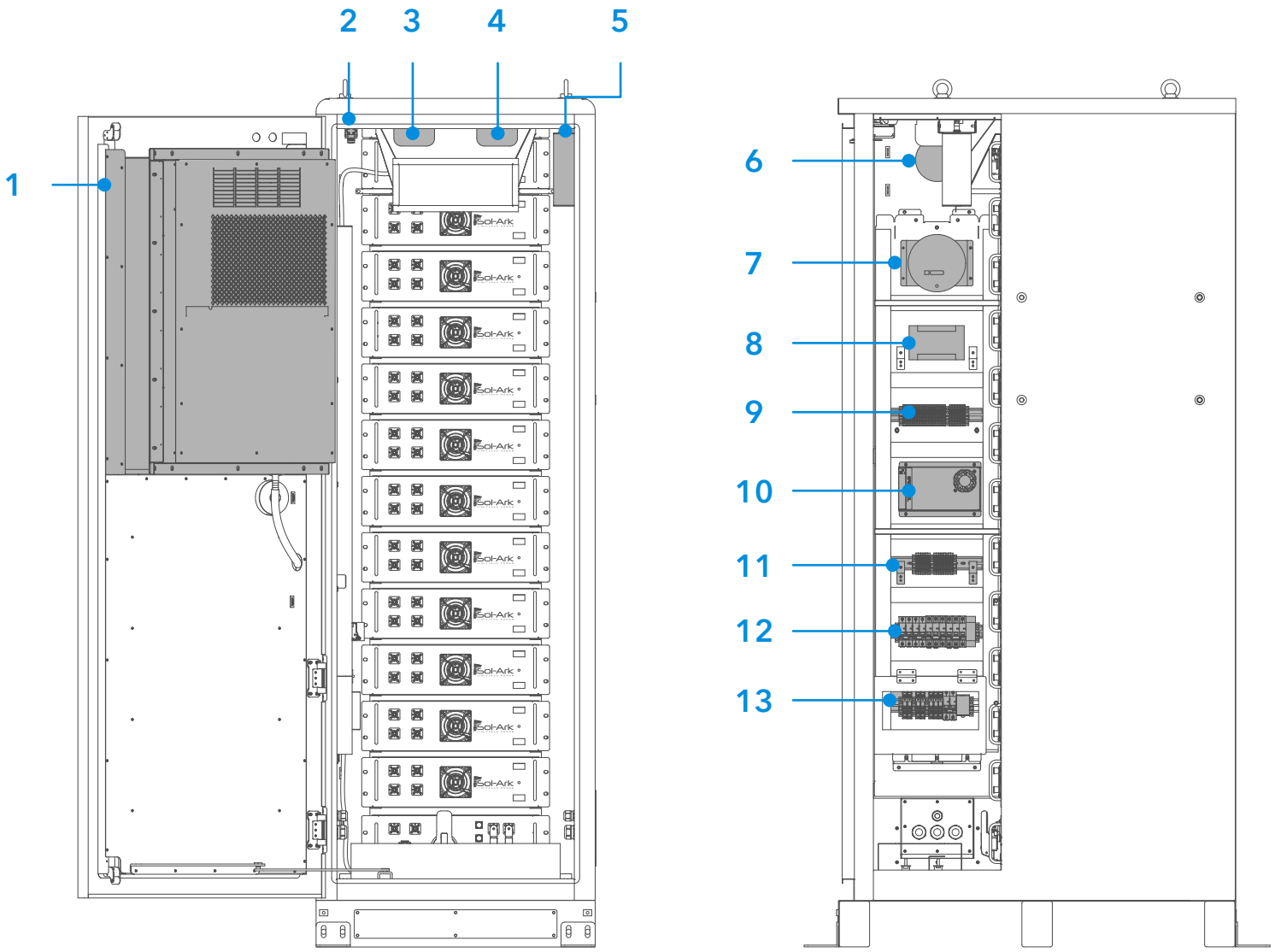
When installing the L3 HVR cabinet, it is important to follow all attachment and bracing requirements outlined in this manual to ensure structural integrity during a seismic event. The installation contractor should consult their local AHJ or licensed design professional regarding specific installation requirements for their site or area.

· **DO NOT USE** concrete screws (e.g. Tapcon) or wedge/expanding anchors to attach the Sol-Ark cabinet to a concrete foundation. The supplied cabinet mounting feet must be secured to the foundation according to the installation methods in Section 2.3.

After completing the cabinet assembly, the total weight of the battery energy storage system is 950 kg (2,095 lbs).

For information on pre-engineered stamped designs for use in Category E seismic areas and above
Please reach out to Sol-Ark at: support@sol-ark.com or +1 (972) 575-8875, Ex. 2.

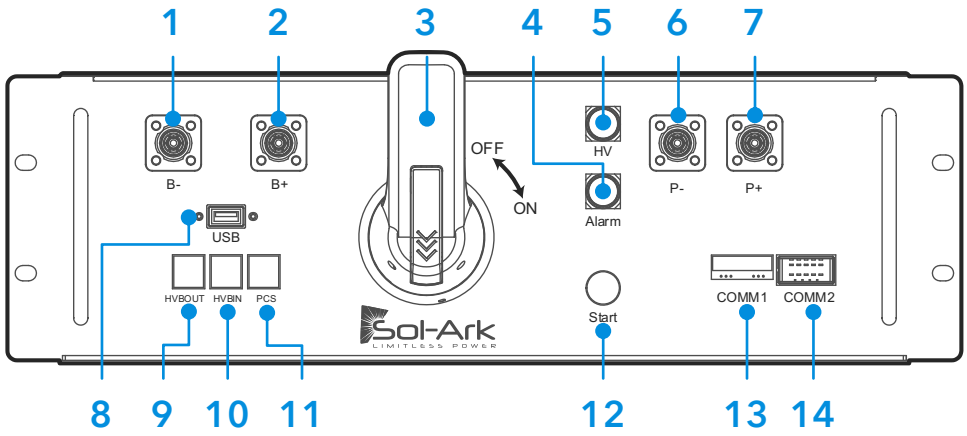
2.5 System Overview



No.	Name	Description
1	HVAC System	Heating and cooling for the battery cabinet
2	Door Limit Switch	Safety interlock to detect if door is open.
3	Smoke detector	Smoke detection with audible alarm
4	Heat detector	Heat detection with audible alarm
5	Aerosol fire extinguishing device	Aerosol suppression agent is deployed in the event of significant heat or smoke
6	Exhaust Fan	Prevents the buildup of hazardous gas during a thermal event
7	CO2/Combustible Gas Sensor	Detect hazardous gases to activate fire suppression system and ventilation.
8	Integrated System Controller	Manages sensor inputs and activates fire or ventilation systems
9	Signal and 24V Power Distribution	Sensor power and signal distribution.
10	24V Power Supply	Power supply unit for HVAC, indicators, and other support systems in the cabinet.
11	I/O and Power Distribution	Terminal block to supply power and signals throughout the cabinet.
12	Cabinet Circuit Breakers	Breakers/disconnects for cabinet power circuits (Main, BMS, HVAC)
13	Auxiliary Input Wiring Area	Input terminals for AC auxiliary power feed

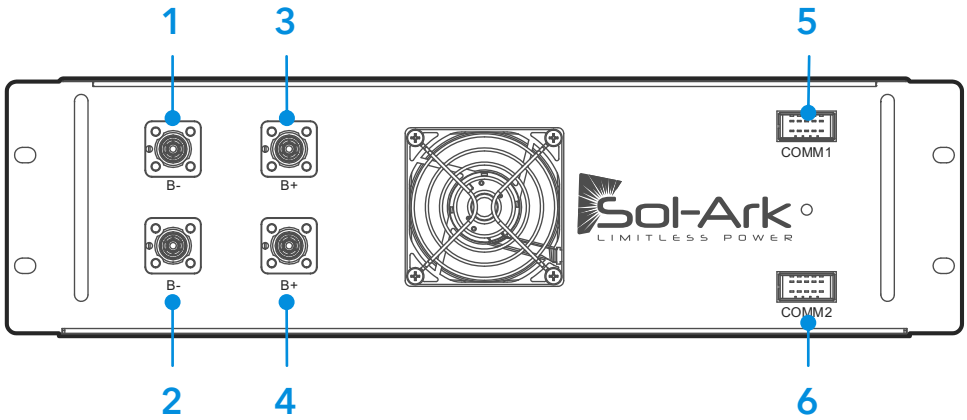
2.6 Battery Overview

1. BMU (Battery Management Unit)



No.	Name	Description
1	B-	Battery Pack Negative (-) Input
2	B+	Battery Pack Positive (+) Input
3	DC Disconnect	200A dual pole DC disconnect for the battery output (P+/P-)
4	ALARM Indicator	System fault indicator (red).
5	HV Indicator	High Voltage present indicator (yellow).
6	P-	Inverter Negative (-) Output
7	P+	Inverter Positive (+) Output
8	USB	USB2.0 port for data logging or firmware updates
9	HVBOUT	Communication output port to next L3 cabinet BMU. [OUTPUT]
10	HVBIN	Communication input port for previous L3 cabinet BMU [INPUT]
11	PCS	RJ45 port for battery to inverter closed-loop communication [OUTPUT]
12	START	Power switch for 12V BMU power supply
13	COMM1	BMU control and diagnostics communication port
14	COMM2	Inter-battery communication port for the first battery module [INPUT]

2. Battery Module



No.	Name	Description
1, 2	B-	Module Negative (-) Output
3, 4	B+	Module Positive (-) Output
5	COMM1	Communication port to next battery module.
6	COMM2	Communication port for previous battery module or BMU.

2.7 Electrical Installation

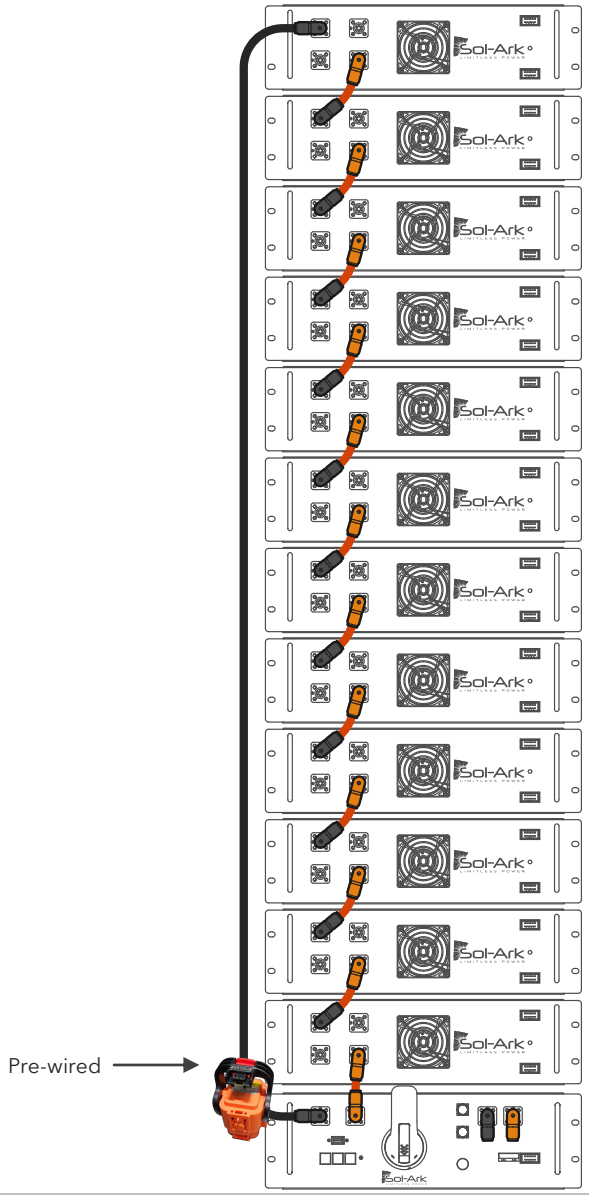
DC Battery Wiring

High Voltage risk of electric shock. Always de-energize the equipment before servicing.

*Before wiring the system, ensure the DC disconnect switch of the BMU is turned **OFF** and the MSD is **disconnected**.*

1. Sol-Ark 60K-3P-480V - (12s1p Wiring)

A. Install the 220 mm battery conductor from the positive Amphenol battery connector **(B+)** of the BMU to the positive Amphenol battery connector **(B+)** of the closest battery module (last module from top to bottom).
B. Install the 200 mm battery conductors from module to module. Ensure connection in series from the negative Amphenol battery connector **(B-)** of the first battery module to positive Amphenol battery connector **(B+)** of the subsequent battery module.
C. Connect the remaining battery conductors in the same manner.
D. Install a long battery conductor from the last battery module (first module from top to bottom) to the BMU. This is done by linking the negative Amphenol battery connector **(B-)** of the last module to the remaining unconnected negative Amphenol battery connector **(B-)** of the BMU.
E. Connect the grounding wire from the BMU to any available hole in the top crossbeam of the battery rack. Safely fasten it in position using M4 and M6 screws, respectively.
F. Connect the cabinet ground points (as marked), either inside or outside the cabinet, to the equipment grounding conductor for the battery system.

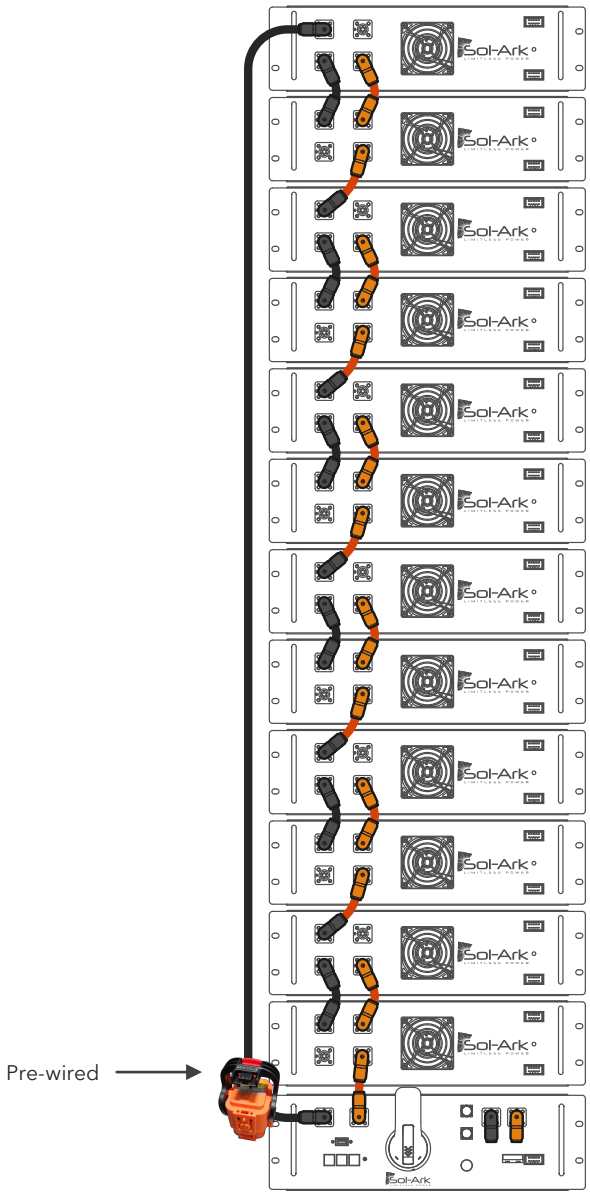


High Voltage risk of electric shock. Always de-energize the equipment before servicing.

*Before wiring the system, ensure the DC disconnect switch of the BMU is turned **OFF** and the MSD is **disconnected**.*

2. Sol-Ark 30K-3P-208V – (6s2p Wiring)

A. Install the 220 mm battery conductor from the positive Amphenol battery connector **(B+)** of the BMU to the positive Amphenol battery connector **(B+)** of the closest battery module (last module from top to bottom).
B. Install the 200 mm battery conductors from module to module. Ensure connection in series from the negative Amphenol battery connector **(B-)** of the first battery module to positive Amphenol battery connector **(B+)** of the subsequent battery module.
C. Connect the remaining battery conductors in the manner.
D. Install a long battery conductor from the last battery module (first module from top to bottom) to the BMU. This is done by linking the negative Amphenol battery connector **(B-)** of the last module to the remaining unconnected negative Amphenol battery connector **(B-)** of the BMU.
E. Connect the grounding wire from the BMU to any available hole in the top crossbeam of the battery rack. Safely fasten it in position using M4 and M6 screws, respectively.
F. Connect the cabinet ground points (as marked), either inside or outside the cabinet, to the equipment grounding conductor for the battery system.



Communications Wiring

3. Module-Module Communication

A. Connect one end to the **BCOM** communication port of the BMU. Subsequently, connect the other end to the **BCOM IN** communication port of the first module (the first module is the one directly above the BMU).
B. Locate 11 pieces of the 110mm (4.3in) inter-battery communication cables that daisy chain the battery modules together.
C. Connect one end to the **BCOM OUT** communication port of the first battery module. Connect the other end to the **BCOM IN** communication port of the subsequent battery module.
D. Connect all remaining 110mm (4.3in) communication cables for the rest of the battery modules following as shown in Figure 6.

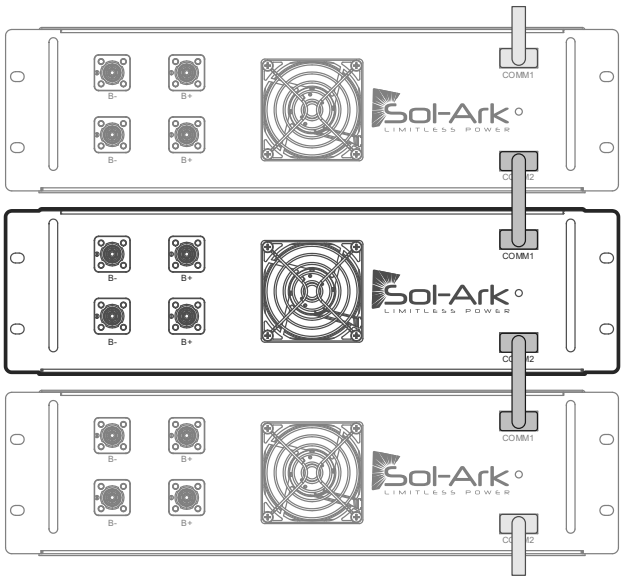


Figure 6 Inter-Module Communication Wiring

4. BMU Communications Ports

A. The BMU has a pre-installed ethernet cable starting from the **PCS** port of the BMU going to **SPD1** (surge protection device) inside the cabinet wiring area. To complete the wiring for closed loop battery-to-inverter communication run a user supplied, CAT5e or better, ethernet cable from the output of the **SPD1** to the **BMS1** port of the inverter.
B. See section 2.9 "BESS and Inverter Wiring" for more BMU wiring details.

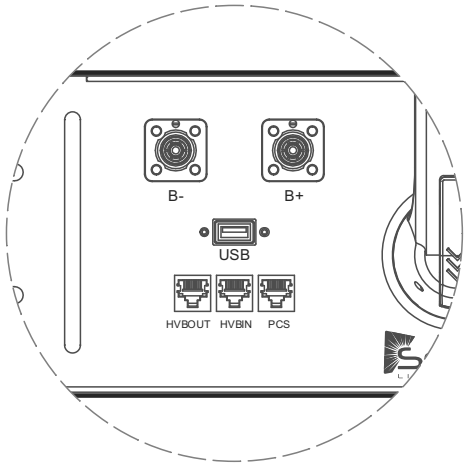


Figure 7 Battery Module Communication Ports

Pin	HV OUT
1	BMS_CANL
2	BMS_CANH
3	DI+
4	DI-
5	--
6	--
7	--
8	--

HV IN
BMS_CANL
BMS_CANH
DI+
DI-
--
--
--
--

PCS
485B-
485A+
--
PCANH
PCANL
--
485A+
485B-

2.8 Auxiliary Power and Communications Wiring

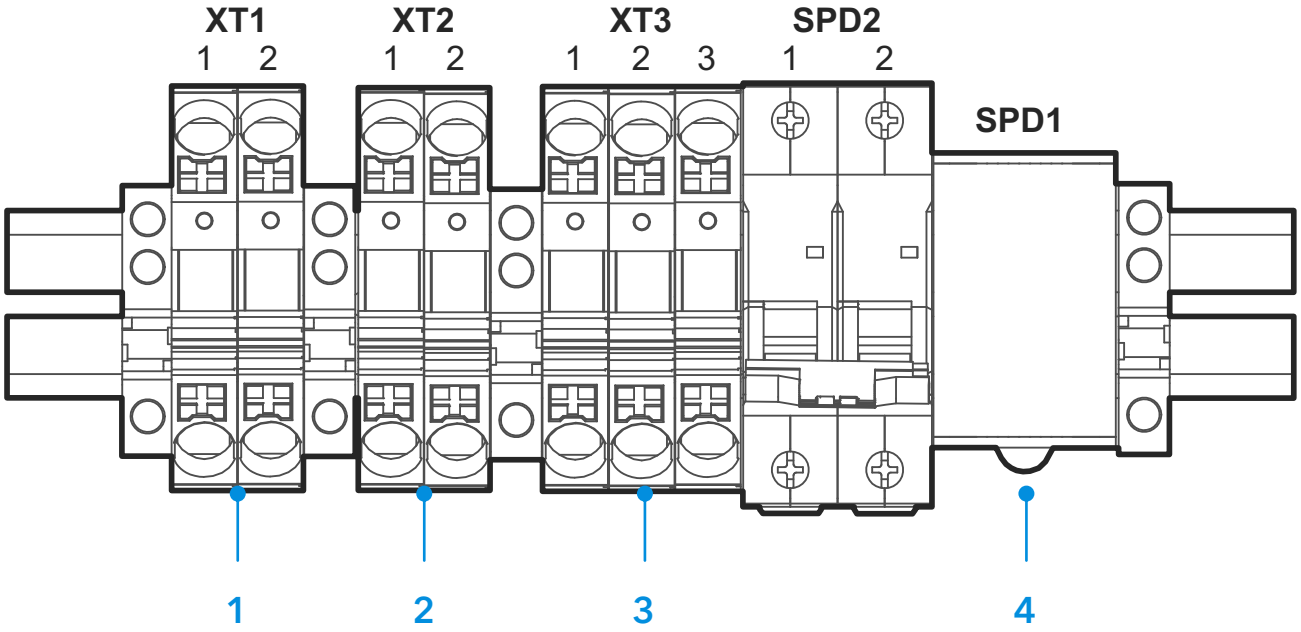


Figure 8 Auxiliary Wiring Terminal Block

No.	Name	Description
1	XT1	Live wire L1 terminal (208V_{AC} or 240V_{AC})L1 Input Terminal (3P-208V or Split Phase 240$V_{AC\ L\text{-}L}$)
2	XT2	Live wire L2 terminal (208V_{AC} or 240V_{AC})L2 Input Terminal (3P-208V or Split Phase 240$V_{AC\ L\text{-}L}$)
3	XT3	Equipment Grounding Terminal
4	SPD1	Battery to PCS Ethernet Surge Protection

- The auxiliary input supplies power to the cabinet's support systems such as the HVAC unit, sensors (smoke, heat, liquid), and indicator lights.
- When using a 60K-3P-480V inverter which natively supplies 277/480Vac output, the installation contractor will need to provide a 208 Vac or 240Vac power source to the XT1 and XT2 terminals to avoid damaging the cabinet. If required, one or more step-down transformer(s) with a rating of no less than 3kVa (per cabinet) should be used to provide a 208V or 240V supply voltage to their respective cabinet(s).
- ⚠ Failure to follow these instructions could result in **permanent damage** to the battery cabinet.

Connection Requirements

⚠ *Use Only 75°C Rated Copper (CU) Stranded or Solid Core Wire. Fine stranded wire must use a ferrule.*

Port	# of Cabinets	Min. Terminal Wire Size
XT1, XT2	1	12 AWG
	2-3	10 AWG
	4-5	8 AWG
	6	6 AWG
XT3	1 - 6	10 AWG (with 60A OCPD)
SPD1	1 - 6	RJ45 - CAT5e or better

2.9 BESS and Inverter Wiring

A. Begin wiring of the battery by first removing the inner and outer cover, as shown in the **Figure 6**, using a Phillips screwdriver.

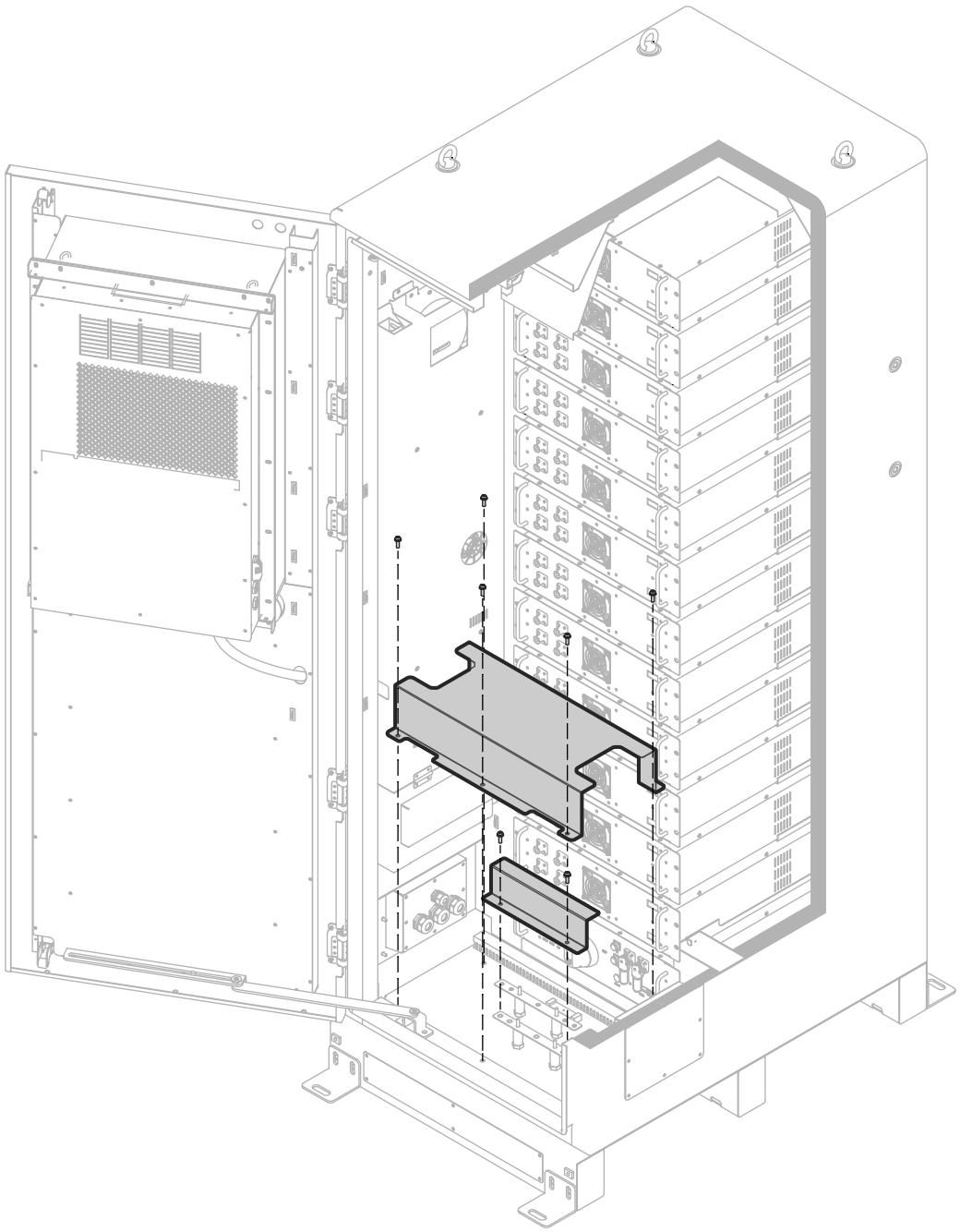


Figure 9 Removal of the bus bar wiring area cover

B. Using the included Pushlok-to-ring terminal cables connect each cable to their respective PCS+ and PCS- ports of the battery as shown by **(A)** of Figure 7.
C. Using the same cables, connect the ring terminal side to the positive and negative battery busbar as shown by **(A)** of Figure 7.
D. Connect the included 9.8ft (300cm) red cable from the positive busbar to the positive terminal of the inverter as shown by **(B)** of Figure 7.
E. Connect the included 9.8ft (300cm) black cable from the negative busbar to the negative terminal of the inverter as shown by **(B)** of Figure 7.
F. Plug in the **MSD** (Manual Service Disconnect) in the bottom left corner of the Battery Bank.
G. Secure the MSD by rotating down the black handle to a horizontal position.
    a. The MSD will complete the circuit, allowing for proper operation of the L3 HVR.
    b. Before performing any maintenance procedure disconnect the MSD device to prevent electric shock.

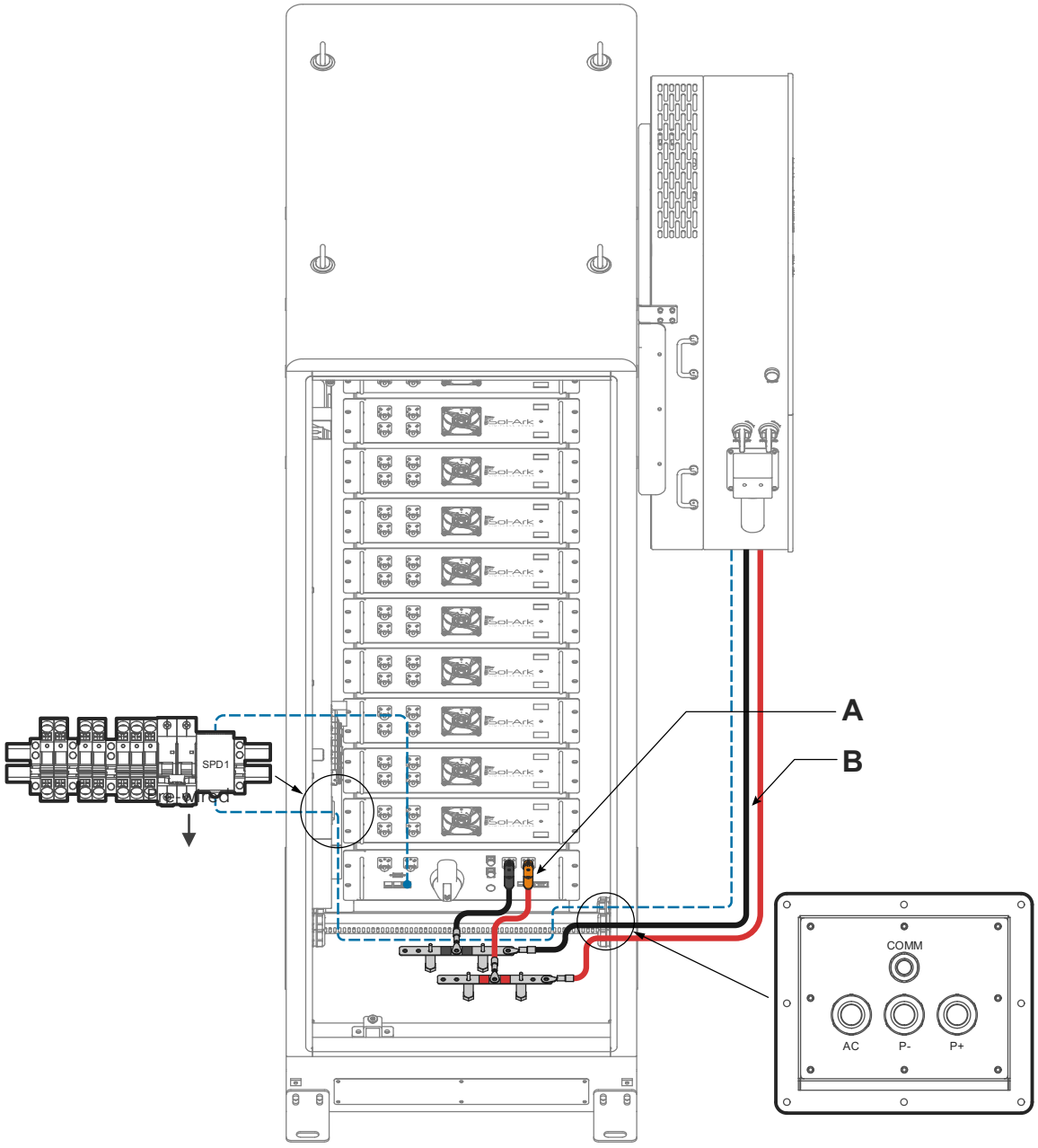


Figure 10 Wiring of the cabinet to the inverter

*Please note that 2x 9.8ft (300cm) cables are included in the shipment for the **"B"** connection shown above (battery busbar to Sol-Ark inverter).*

2.10 Multi-Unit Wiring

A. To parallel the L3 HVR battery with another unit, connect the previous L3 HVR's **positive** and **negative** busbars to the subsequent L3 HVR's busbar by using field supplied wiring, sized in accordance with the NEC, and in conduit or raceway suitable for wet locations to maintain the cabinets ingress protection rating.
B. Using CAT5e or better ethernet cable connect the master battery **HVBOUT** port to the **HVBIN** port of the next battery in the multi-unit system.
C. On the last battery in the stack install the 120Ohm RJ45 terminator into the **HVBOUT** port.

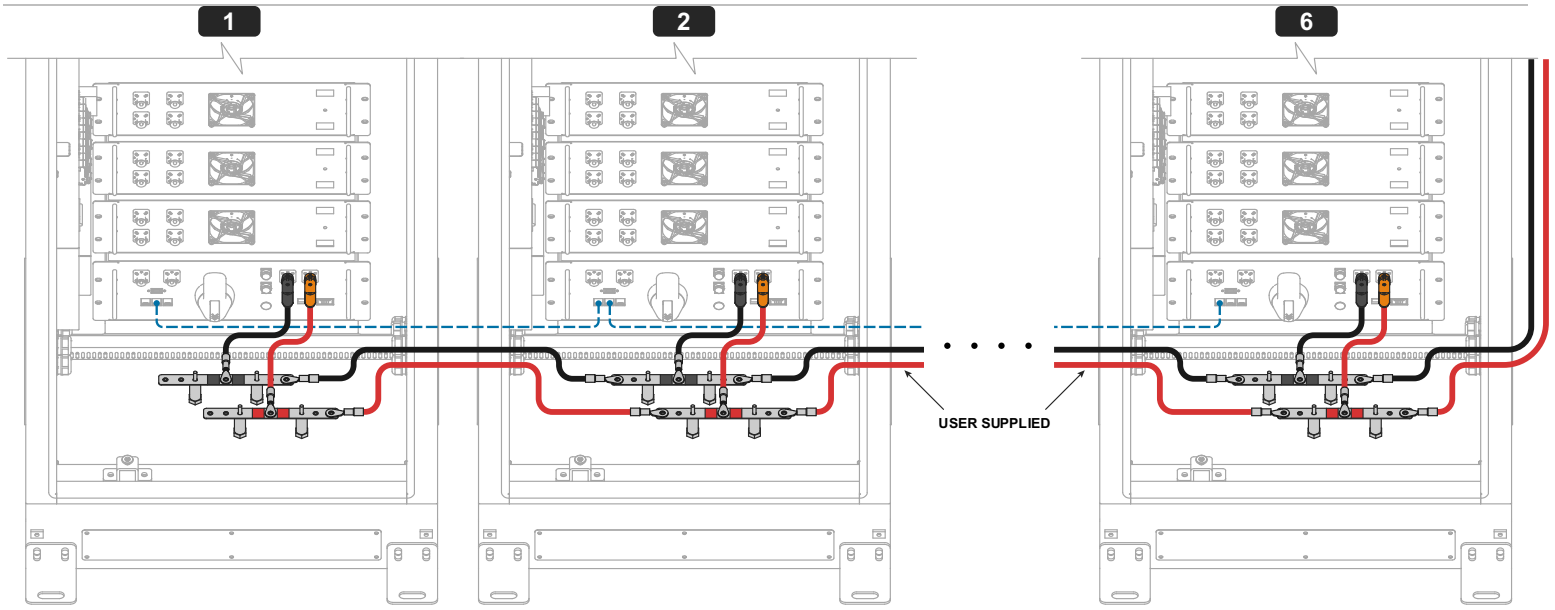


Figure 11 Illustration of wiring for a multi-cabinet system.

2.11 System Startup and Comissioning

⚠ *Follow proper safety measures when powering-up and testing the system*

1. Verify voltage of battery modules

A. ℹ The nominal voltage of battery module is 51.2V.
B. Measure and verify proper DC voltage between the B+ and B- connectors of the first battery module.
C. Repeat the measurement across **ALL** battery modules to confirm consistent voltage levels.
D. ⚠ Once all battery modules have been verified, measure and verify proper **high voltage** level between the B- connector of the first battery module and B- connector of the last battery module.
E. Reattach the connectors and ensure all conductors are properly installed.

2. Powering On the L3 HVR

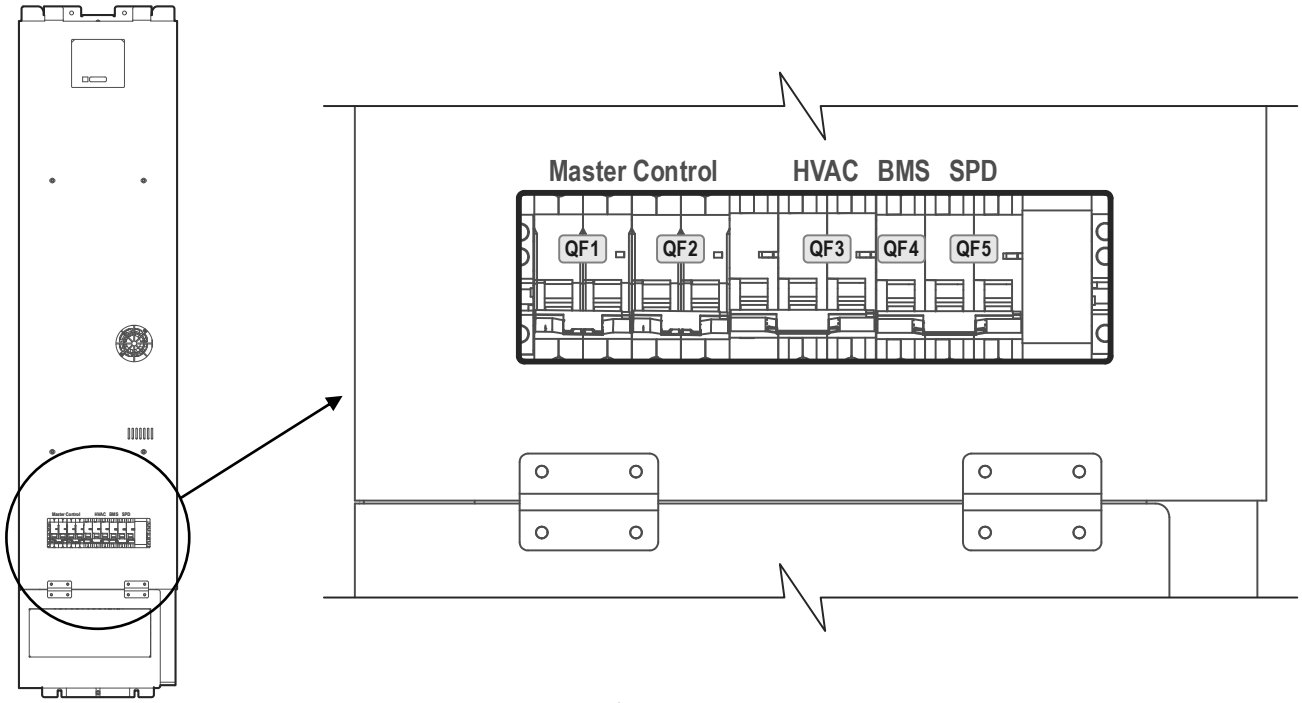


Figure 12 Location of the Control Systems Breakers

Name	Description
QF1	Main Breaker
QF2	Auxiliary Power Supply
QF3	HVAC
QF4	BMS Power Supply
QF5	Surge Protection Device 2

1. During initial commissioning, make sure the MSD is properly installed following depiction in the figure below.

Figure 13 MSD Installation Steps

2. Ensure the Surge Protection Device 2 breaker - **QF5** is ON. ⚠ SPD2 Should always stay ON.

3. Turn ON the Main Breaker – **QF1**.
4. Turn ON the Auxiliary PSU breaker – **QF2**.
5. Rotate the **DC disconnect** handle clockwise to the ON position, the DC disconnect switch will click and latch in place.
6. NOTE: The DC disconnect features a built-in locking tab that can be used to lock out the disconnect in the **OFF** position for service and maintenance.

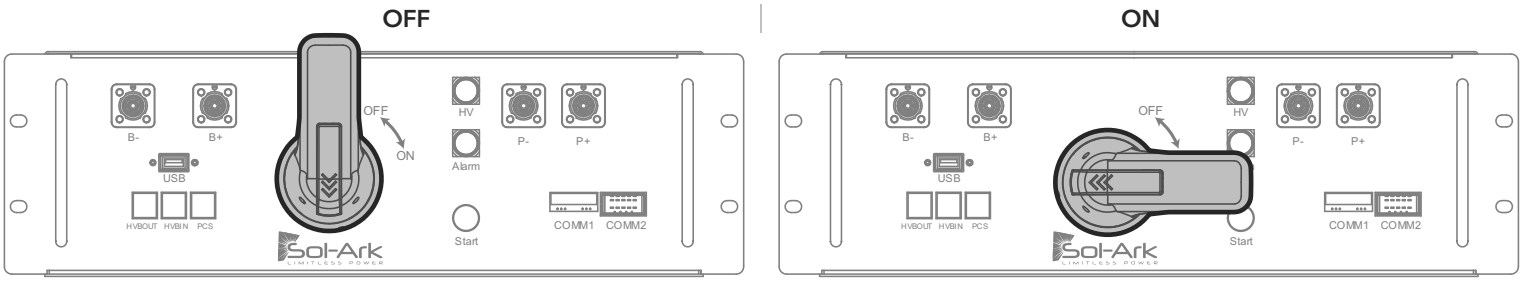


Figure 14 Operation of the BMU DC Disconnect

7. PRESS the **START** button of the BMU to the ON position.
8. Turn ON the BMS PSU breaker – **QF4**.
9. Turn ON the HVAC breaker – **QF3**.
10. Reverse the steps to turn OFF the unit. ⚠ SPD2 Should always stay ON.

2.12 System Power Cycle Sequence

If required during troubleshooting or maintenance use the following sequence to cycle power to the HVR cabinet systems.

⚠ ***DO NOT** attempt a power cycle with the inverter under full load.*

1. Turn OFF the HVAC breaker – **QF3**.
2. Turn OFF the BMS PSU breaker – **QF4**.
3. PRESS the **START** button of the BMU to the OFF position.
4. Rotate the **DC disconnect** handle counterclockwise to the OFF position.
5. Turn OFF the Auxiliary PSU breaker – **QF2**.
6. Turn OFF the Main Breaker – **QF1**.
7. Verify proper connectivity among **ALL** battery module connectors, the BMU, and the inverter within the L3 system.
8. Follow the Power ON sequence from the previous section to turn **ON** the L3 system.

3. Operation and Maintenance

3.1 Maintenance of the L3 System

> ⚠ *Before any disassembly or maintenance, ensure that L3 system is powered off and appropriate lock-out-tag-out procedures have been followed. Failure to do so could result in injury or death.*

For safe operation, it is essential to thoroughly inspect all components of the L3 system, including but not limited to system conductors, connectors, wiring between modules, BMU, and ground. The following maintenance tasks and inspections should be carried out by a qualified professional:

> ℹ *To clean any part of the battery enclosure, BMU, or modules, use a damp cloth to wipe down any surfaces, no harsh solvents or cleaning products should be used. Ensure that the battery connections remain free from any moisture.*

Maintenance Schedule

Task	Frequency	Procedure
Exterior - Visual Mechanical Inspection	12 months	Refer to Maintenance Appendix A
Interior - Visual Mechanical Inspection	12 months	Refer to Maintenance Appendix A
Inspect Cabinet Ventilation Ports Operation	6 months	Refer to Maintenance Appendix A
Verify Battery Equipment Grounding	12 months	Refer to Maintenance Appendix A
Replace HVAC Intake Air Filter	6 to 12 months	Refer to Maintenance Appendix A
Inspect HVAC Condensate Drain	6 to 12 months	Refer to Maintenance Appendix A

3.2 Fire Suppression System

The L3 HVR series features an integrated aerosol-based fire suppression system at the battery module and cabinet level. In the rare event of a thermal runaway, the aerosol canister would rapidly deploy, filling the battery module interior with non-toxic agent to suppress any potential fire before spreading. This unique, industry-leading safety capability from Sol-Ark ensures maximum protection for commercial and industrial users.

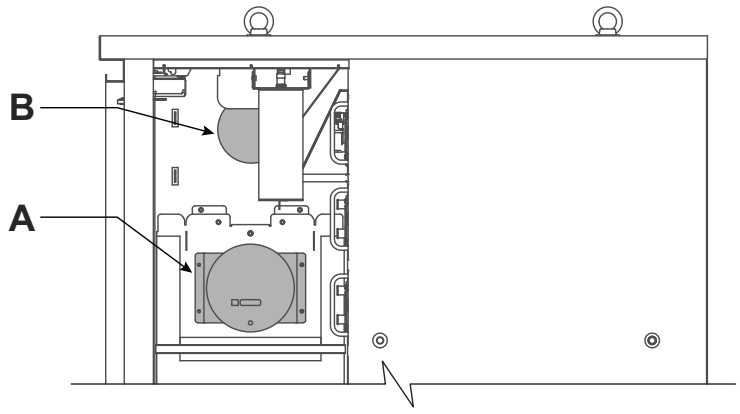
Module Level: Contained in each module is a 12-gram aerosol agent canister, this proprietary system activates automatically when heat inside the module reaches potentially unsafe levels due to thermal runaway or external fires (185°C ±10°C).

Cabinet Level: Inside each cabinet a larger 300-gram aerosol canister is located in the top right corner. This unit is electronically activated based on signals from the fire detection sensors inside the cabinet (smoke, heat, and CO2/gas) these will detect abnormal operating conditions and deploy the aerosol filling the inside of the cabinet.

Both suppression canisters have a warranted 10-year service life under normal conditions. However, it is important to avoid subjecting the canister to external impacts and corrosive or wet environments which could damage the units and impair their operation.

Deflagration Protection

When the CO2/hazardous gas detector **"A"** senses flammable gas in the cabinet, the exhaust fan **"B"** will turn on to exhaust flammable gases outside the cabinet.



3.3 BMS Firmware Update Process

1. The USB port of the BMU allows for the upgrading firmware and logging battery data.
2. To update the firmware first format a USB 2.0 drive as FAT32, no larger than 8GB in size.
3. Place the upgrade file provided by Sol-Ark in the root directory of the USB drive.
4. Turn on the battery and insert the USB flash disk after the blue indicator is on.
5. After the blue light indicator flashes and turns off, pull out the USB drive to complete the upgrade. Do not turn off the battery during the process.
6. After the blue light indicator of the battery lights up again, verify the version number using the BMS diagnostic software or via the information displayed on the inverter.

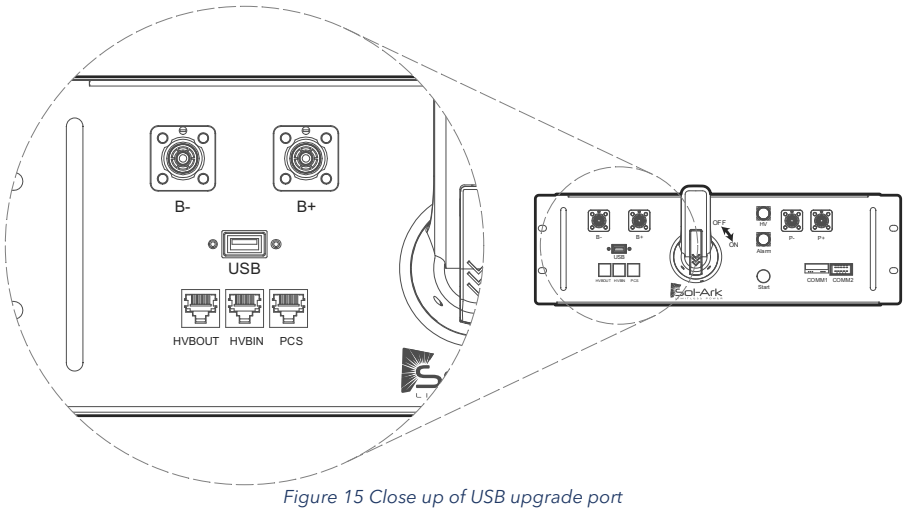


Figure 15 Close up of USB upgrade port

3.4 Long Term Battery Storage

When storing the assembled battery system for periods longer than 2 weeks it is recommended that the following steps be performed.

- To maximize battery lifespan, maintain storage temperature between 13°C – 30°C (55°F – 86°F).
- Power on and cycle the battery at least once every 6 months to maintain the SOC within 30-50%.
- To minimize BMU self-discharge power down the cabinet systems following the procedures in **Section 2.11**
- In addition, disconnect the orange MSD from the battery. This interrupts the power supply to the BMU, preventing battery discharge from the BMU.

4. Error Codes

4.1 Description of System Faults

FAULT	Potential Fault Cause
OT (Over Temperature)	BMS negative connector overtemperature
	BMS positive connector overtemperature
	Pre-charge resistor overtemperature level-2 alarm
	Heating film overtemperature level-2 alarm
	Charge overtemperature level-2 alarm
	Discharge overtemperature level-2 alarm
UT (Under Temperature)	Charge under temperature level-2 alarm
	Discharge under temperature level-2 alarm
OC (Over Current)	Charge overcurrent level-2 alarm
	Discharge overcurrent level-2 alarm
DV (Differential Voltage)	Excessive differential voltage level-2 alarm
DT (Differential Temperature)	Excessive differential temperature level-2 alarm
OV (Over Voltage)	Total charge voltage too high
	Cell overvoltage level 2 alarm
UV (Under Voltage)	Charge voltage too low
	Total discharge voltage too low
	Cell undervoltage level-2 alarm
OF (Other Fault)	Abnormal numbers of BMU
	BMU lost
	RTC clock fault
	Current module fault
	SCHG total voltage acquisition fault
	Abnormal RS485 communication
	RS485 communication failure
	PCS-CAN BUS communication failure
	Repeated BMS address fault
	Repeated BMU address fault
	Abnormal power supply voltage
	Heating relay adhesion
	SOC too low
	SOC too high
	Fuse Blown
	Charge Relay Welded
	Discharge Relay Welded
	Master Positive Relay Welded
	Temperature Acquisition Failure
	Cell voltage acquisition fault
	Inter battery communication failure
	Pre-charge failure
	Insulation level 2 alarm
	External total voltage acquisition fault
	Internal total voltage acquisition fault
	Current acquisition fault
	Limit protection
	EEPROM failure
ISO	Insulation level 2

4.2 Common Causes

FAULT TYPE	COMMON CAUSE
Charge over-current alarm	More than 105A for 2s; more than 125A for 5s; or more than 140A for 2s; If the battery is operating below 5°C (41°F) then: 52.5A for 2s; more than 62.5A for 5s; or more than 70A for 2s;
Charge over-current protection	
Discharge over-current alarm	
Discharge over-current protection	
Charge overtemperature alarm	Exceeding the parameter set value and set time (>45°C , 2s)
Charge overtemperature protection	Exceeding the parameter set value and set time (>50°C, 2s)
Discharge overtemperature alarm	Exceeding the parameter set value and set time (>50°C , 2s)
Discharge overtemperature protection	Exceeding the parameter set value and set time (>55°C , 2s)
Charge under temperature alarm	Exceeding the parameter set value and set time (<5°C , 2s)
Charge under temperature protection	Exceeding the parameter set value and set time (<0°C , 2s)
Discharge under temperature alarm	Exceeding the parameter set value and set time (<-10°C , 2s)
Discharge under temperature protection	Exceeding the parameter set value and set time (<-20°C, 2s)
Excessive differential voltage alarm	Exceeding the parameter set value and set time (>500mv, 2s)
Excessive differential voltage protection	Exceeding the parameter set value and set time (>800mv, 2s)
Excessive differential temperature alarm	Exceeding the parameter set value and set time (>10°C, 2s)
Excessive differential temperature protection	Exceeding the parameter set value and set time (>15°C, 2s)
Cell overvoltage alarm	To maintain consistency, cut off the charging immediately when the full charge calibration rated voltage of 3.6V is reached. When the voltage drops to 3.35V, restart it with the turned-off red light indicator. All protective red light indicators are always on!
Cell overvoltage protection	
Cell undervoltage alarm	
Cell undervoltage protection	
Pre-charge resistor overtemperature alarm	Exceeding the parameter set value and set time (>55°C, 2s)
Pre-charge resistor overtemperature protection	Exceeding the parameter set value and set time (>65°C, 2s)
Insulation level 1	Exceeding the parameter set value and set time
Insulation level 2	Exceeding the parameter set value and set time
Heating film overtemperature alarm	Exceeding the parameter set value and set time (>75°C, 2s)
Heating film overtemperature protection	Exceeding the parameter set value and set time (>80°C, 2s)
BMS connector overtemperature alarm	Exceeding the parameter set value and set time
BMS connector overtemperature protection	Exceeding the parameter set value and set time
BMU connector overtemperature alarm	Exceeding the parameter set value and set time
BMU connector overtemperature protection	Exceeding the parameter set value and set time
Power loop overtemperature alarm	Exceeding the parameter set value and set time
Power loop overtemperature protection	Exceeding the parameter set value and set time
SOC too low	Exceeding the parameter set value and set time
Total voltage too high alarm	Exceeding the parameter set value and set time
Total voltage too high protection	Exceeding the parameter set value and set time
Total voltage too low alarm	Exceeding the parameter set value and set time
Total voltage too low protection	Exceeding the parameter set value and set time
Discharge relay adhesion	Relay feedback information state adhesion
Charge Relay Welded	Relay feedback information state adhesion
Heating Relay Welded	High voltage is detected after disconnecting the heating relay
Limit protection	Exceeding the parameter set value and set time
Abnormal power supply voltage	Exceeding the parameter set value and set time
Master positive Relay Welded	Relay feedback information state adhesion
Fuse Blown	No high voltage is detected after the relay is closed
Repeated BMU address fault	BMU with the same number
INTER-CAN BUS communication failure	Loss of communication between BMS
PCS-CAN BUS communication failure	The heartbeat message of the inverter has been not received for a long time
RS485 communication failure	Inverter RS485 access is not received for a long time
Abnormal RS485 communication	C
External total voltage acquisition fault	/
Internal total voltage acquisition fault	The difference between the acquired internal total voltage and the accumulated internal total voltage exceeding the set value
SCHG total voltage acquisition fault	/
Cell voltage acquisition fault	The cell voltage acquired is 0
Temperature acquisition failure	The temperature acquired is -40℃
Current acquisition fault	/
Current module fault	Abnormal Hall current/reference voltage
EEPROM storage failure	EEPROM write failure during self-test
RTC clock fault	The external RTC failed to enable the charging function
Pre-charge failure	Pre-charge timeout
Charging voltage too low	The minimum cell voltage is lower than the set value
BMU lost	BMU message not received for a long time
Abnormal number of BMU	The number of BMU addresses is different from the number of set parameters

For more information, please contact us at: support@sol-ark.com or support phone: +1 (972) 575-8875, Ex. 2