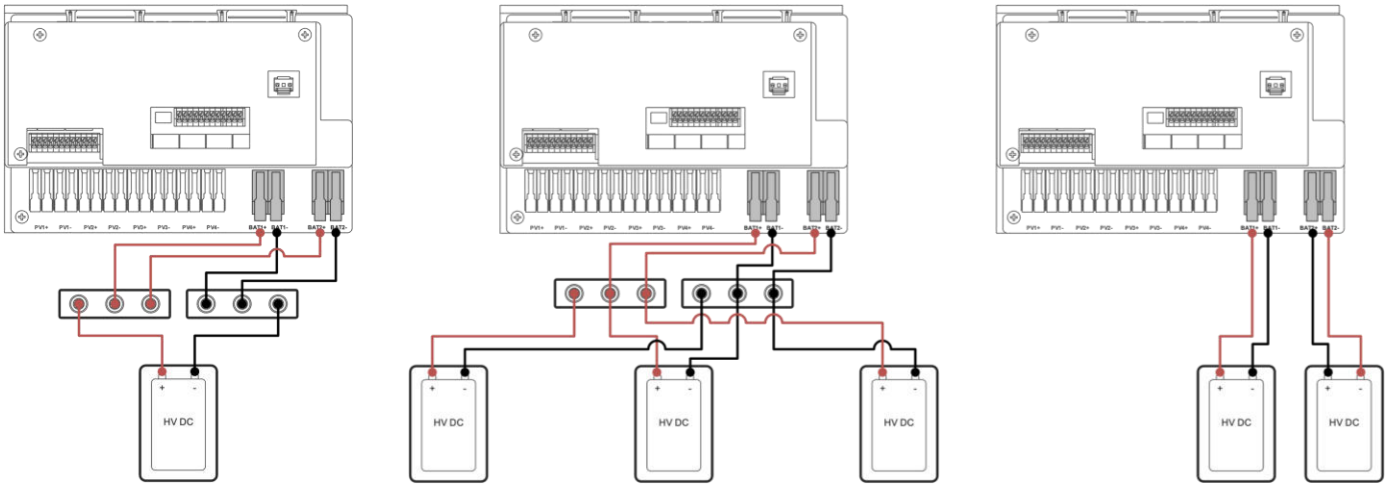
Application Note

High Voltage Batteries: Combining Methods and Equipment

Overview

The Sol-Ark 30K-3P-208V and 60K-3P-480V Commercial inverters feature dual high-voltage (HV) battery inputs, with each input terminal supporting up to 50 A continuous current. When using both terminals, the system can support up to 100 A of total charge/discharge capacity.

These two terminals also allow connection of up to two HV batteries without an external combiner solution as shown in Figure 1c. If more than two batteries need to be installed per inverter, as shown in Figures 1a and 1b, appropriate overcurrent protection and combining equipment is required.



a. Single battery (1C/battery) b. Multi-battery bank c. Dual battery 0.5C/battery

Figure 1: Battery Connection Configurations

Note: To ensure that the L3 HV-40/60 and L3 HVR-60 batteries comply with warranty requirements while maintaining a charging and discharging rate of 0.5C, it's necessary to use a minimum of two battery units when operating the 30K or 60K inverter at its maximum charge and discharge rating of 100 A.

Exception: When using the 30K inverter with the L3 HVR-60 battery, only one battery unit is required.

While the 30K-3P-208V and 60K-3P-480V support a wide voltage operating range, the continuous inverter output power requires a minimum of 300 V_{DC} input on the 30K and 600 V_{DC} on the 60K.

Copyright © 2026 Sol-Ark LLC

Operating Voltage Range	
30K-3P-208V	160-500 V_{DC}
60K-3P-480V	160-700 V_{DC}
Min. Input Voltage at Rated Power	
30K-3P-208V	300 V_{DC}
60K-3P-480V	600 V_{DC}

Safety and Code Compliance

To ensure safe and NEC-compliant operation, properly rated disconnecting means, overcurrent protection devices (OCPDs), and combiners suitable for HV battery banks must be utilized.

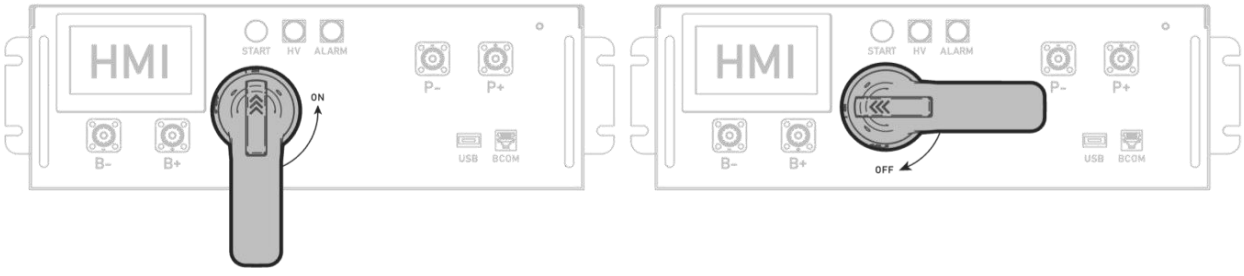
According to Article 706.15(A) of the National Electrical Code (2023 ed.), ESS systems are required to have a way to disconnect:

Means shall be provided to disconnect the ESS from all wiring systems, including other power systems, utilization equipment, and its associated premises wiring.

This section also describes the allowable location of the disconnecting means:

- Located within the ESS
- Located within sight and within 3 m (10 ft) from the ESS
- Where not located within sight of the ESS, the disconnecting means, or the enclosure providing access to the disconnecting means, shall be capable of being locked in accordance with 110.25

As shown below, all models of the L3 Limitless Lithium series BESS would comply with this requirement due to the inclusion of an integral, dual-pole, lockable disconnect (Figure 2) within the Battery Control Unit (BCU). This device disconnects both the positive and negative battery output conductors of the battery system.



OFF ON

Figure 2: DC Disconnect Operation on the L3 HV BCU

L3 Series Equipment Overview

L3 HV – Indoor Series	
Models	L3 HV-40 and L3 HV-60
OCPD	160 A fuse integrated into the Battery Control Unit (BCU)
Disconnect	200 A-rated dual-pole disconnect switch (integrated into the BCU)

L3 HVR – Outdoor Series	
Models	L3 HVR-60
OCPD	160 A fuse integrated into the Battery Control Unit (BCU)
Disconnect	200 A-rated dual-pole disconnect switch (integrated into the BCU)

Other Battery Partners

Battery OCPD and disconnect switch configurations are highly product dependent, and other battery providers may have their own disconnect requirements that are outside the scope of this application note.

Additional External Disconnects

While both the L3 HV and L3 HVR batteries include a built-in disconnecting means, additional disconnects could be required depending on the exact installation conditions of your project or local jurisdictional requirements. When utilizing external disconnects, it is important to select a device carefully, as many standard electrical safety switches, fuses, and breakers are not rated to interrupt a high-voltage DC source. Proper device listing is specifically addressed in Art. 706.31(C) of the 2023 NEC as shown:

"Overcurrent protective devices, either fuses or circuit breakers, used in any dc portion of an ESS shall be listed for dc and shall have the appropriate voltage, current, and interrupting ratings for the application."

For example, the Square D 60 A safety switch shown in Figure 3 is rated for only 250 V_{DC}, which is below the operating range of even the L3 HV-40 (500 V_{DC} max). Many pieces of equipment rated for 600 V_{AC} are rated lower when used in DC applications; they might also have a lower maximum operating current or fault current (SCCR or AIC) compared to their AC duty rating. Because of this, it is important to consult the product cutsheet or reach out to the equipment manufacturer directly to confirm the suitability of the equipment selected.

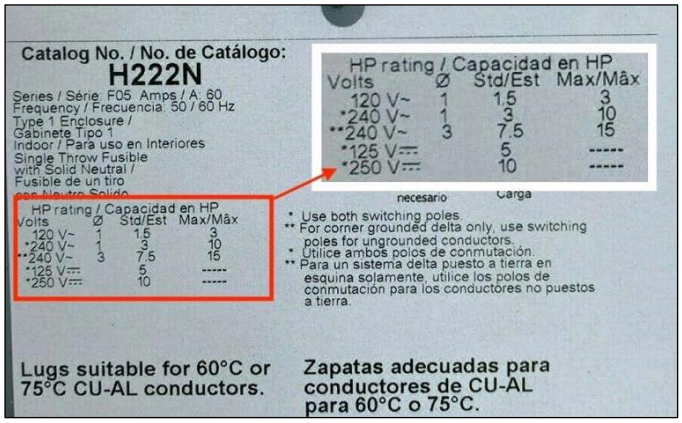


Figure 3: Safety Switch Rating Label – Detail



Figure 4: Fuse Rating Label showing a 125 V_{DC} rating

It's also important to verify whether the equipment you plan to use is UL-listed or recognized to the appropriate standards for that product class.

For example, circuit breakers must be listed as either UL 489 or UL 1077 devices. UL 489-listed breakers are allowed to protect feeders or multiple branch circuit devices, such as a main breaker in a panel board.

By contrast, UL 1077 devices are only acceptable for providing supplementary protection where there is generally already a UL 489 branch circuit protection device ahead of it (such as a resettable fuse in an HVAC unit).

As a rough guideline, you can only use UL 1077-listed breakers to protect circuits inside equipment which does not supply circuits that exit that equipment. Therefore, you would be required to use a UL 489-listed breaker to protect the DC conductors leaving each battery cabinet or rack.

Limiting Battery Fault Current

When sizing overcurrent protection devices (fuses or breakers), it's also important to consider the fault current rating (kAIC), in addition to the trip rating (A), of the devices used.

As designed, each L3 HV or HVR battery unit has a fault current contribution of 4,200 A_{DC}/1.47 ms. This means that each parallel unit combined on the DC side increases the fault current contribution of the total system. This is important because most busbars or power distribution blocks, according to UL 508 Table SB4.1, have a short-circuit current rating (SCCR) of 10 kA unless otherwise listed and marked.

Table SB4.1
Assumed maximum short circuit current rating for unmarked components
Table SB4.1 revised, effective date to be determined

Component	Short circuit current rating, kA
Bus bars	10
Circuit breaker (including GFCI type)	5
Current meters	a
Current shunt	10
Fuseholder	10

Figure 5: UL 508 Table SB4.1

To ensure safe operation with more than two L3 HV or HVR units in parallel, you must install an appropriate current-limiting overcurrent protection device on each battery output circuit. This will limit the available fault current present at the busbar.

According to the NEC Art. 100, current-limiting fuses are defined as:

"A device that, when interrupting currents in its current-limiting range, reduces the current flowing in the faulted circuit to a magnitude substantially less than that obtainable in the same circuit if the device were replaced with a solid conductor having comparable impedance."

This means that a current-limiting fuse must open rapidly and without self-destructing within one-half cycle or approximately 8 ms when subjected to a low-impedance fault such as a short circuit. To select an appropriate device, the fault current let-through potential of fuses or breakers is listed in the manufacturer's time-current curves, often called a *trip curve* in the industry.

As a rule of thumb, for a trip time on the order of 1 to 5 ms, most circuit breakers allow a fault current let-through of 4 to 6 times the device's rated trip current.

For example, assuming a 100 A-rated breaker, this would represent 400-600 A of fault current before the breaker opens to clear the fault condition.

Overcurrent Protection Device (OCPD) Sizing

It's important to size the wiring and OCPD connected to the battery output according to the anticipated current required from each battery at full load. This requires considering NEC Art. 240 (Overcurrent Protection) and Art. 706.30, which applies specifically to energy storage systems.

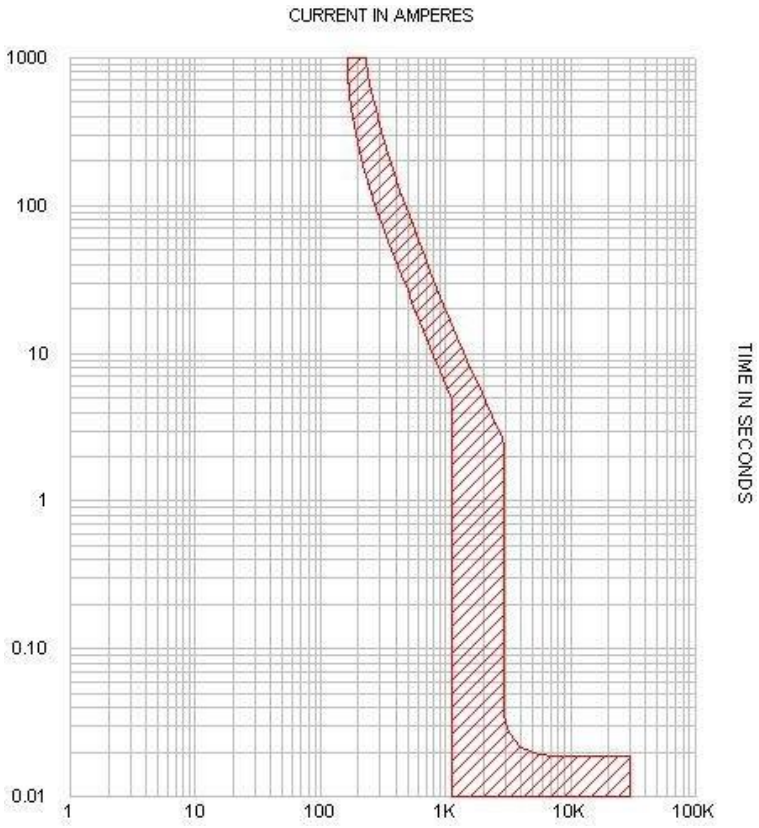


Figure 6: Illustrative Time versus Current Curve

Example – Single Inverter System

As a starting point, determine the maximum current value required for the battery circuit, defined by Art. 706.30(A)(1) through (5). For the 30K and 60K inverters, the inverter input circuit current specified in option (3) would apply:

"The maximum current shall be the continuous inverter input current rating when the inverter is producing rated power at the lowest input voltage."

As an example, using a 30K inverter paired with an L3 HV-40 battery operating at full power, this value would be 93.75 A (30,000 W / 320 V = 93.75 A). However, since each inverter has two battery ports rated at only 50 A, you would require two separate circuits rated for half of this value (46.87 A) to reach the total overall power input.

According to 706.30(B) for battery circuits, you are required to provide an OCPD sized 125% larger (unless listed for 100% use) than the current calculated by 706.30(A) or in this example 46.87 A x 125% = 58.6 A. This corresponds to a 60 A OCPD per battery output, based on Table 240.6(A).

Parallel Systems

It's important to note that as more batteries are added in parallel, the current required by each battery to the inverter decreases. This can reduce the size of the OCPD and conductor required for each battery when operating under a full load.

In a system consisting of six batteries and a single 30K inverter, the current required from each battery would be one-sixth of the total value (93.75 A) or 15.6 A. The required OCPD in this case would be only 20 A after 125% upsizing. This reduction has the benefit of allowing for more equipment options, such as the fuses used for DC PV strings, which typically range up to 30 A.

Commercially Available Products

The following product recommendations are for informational purposes only. Before using any products, it's important to validate the product's ratings and to carefully read and follow the manufacturer's instructions and usage guidelines.

The product options listed below represent a starting point for combining and fusing battery circuits. While these offer a solid foundation, additional assembly or components may be required, depending on your specific application or project needs.

600 V Rated (30K Inverter Only)

Manufacturer	Model Number/Name	Category	Links
Edison	EPDB104, EPDB512	Power Distribution Block	Catalog
Edison	HPB Series	Power Distribution Block	Catalog
Midnite	MNPV6	Fused Combiner	Catalog

1,000 V Rated (60K or 30K)

Manufacturer	Model Number/Name	Category	Links
Littelfuse	LFXV15 Series	Fuse and Holder	Catalog
Midnite	MNTS	Midget Class Fuse Holder	Catalog
Littelfuse	SPF Series	Midget Class Fuses	Datasheet
Projoy	PEBS-S Series	Breaker	Catalog
Midnite	MNPV10-1000	Fused Combiner	Catalog
Midnite	MNPV4-1000	Fused Combiner	Catalog
ILSCO	LDAU-16-500	Power Distribution Block	Catalog

Document Revision History

Rev.	Date	Authors	Description of Changes
1	2024	Liam O'Brien Michael Miller	Document created.
2	September 10, 2026	Itzel Sanchez	Clarified the C-rate note to meet L3 HV and HVR battery warranty requirements. Operating voltage range updated for the Sol-Ark 60K inverter to 160-700 V_{DC}. Standardized terminology for BMU, BCU, and BMS (BMU was previously referred to as BCU).