

Battery Racks for 400kW–1 MW UPS Systems

Assembly and Installation Manual

This manual provides information pertaining to the assembly, loading, and wiring of those APC battery racks designed to support the following Symmetra[®] MW UPS systems:

- 400 kW
- 600 kW
- 800 kW
- 1 MW

The basic components of each rack consist of frames, cross braces, support rails, and assembly hardware. Refer to “Parts List” on page 7.

Read these instructions carefully, and observe all safety warnings and other precautions before assembling racks or installing batteries. Should you require any assembly supervision, service, parts, accessories or maintenance, call the appropriate APC number (refer to rear of document).



Battery Rack Assembly and Installation Manual

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Safety

Safety warnings



- Only **QUALIFIED ELECTRICIANS** may perform this installation! Battery installation must be performed in accordance with all applicable codes!
- Observe all **WARNING** and **CAUTION** notices! Failure to do so may result in **SERIOUS INJURY** or **DEATH**!



- Disconnect charging source(s) **BEFORE** connecting or disconnecting battery terminals!
- Some battery terminals and other components remain **LIVE** even when the system is switched off! **LETHAL VOLTAGES** may still be present when the rack is non-operational, or when breakers are in the **OFF** position!
- **USE EXTREME CAUTION** when making terminal connections! **DO NOT** allow cables to touch anything except the intended terminal!
- **INSULATED TOOLS** and proper **INSULATING MATERIALS** (rubber floor stands, rubber mats, gloves, protective clothing, etc.) should be used when connecting battery cables!

Safety precautions



- Assemble racks in accordance with the instructions contained in this document **WITHOUT DEVIATION**.
- For installations where grounding is required for IEC and/or local codes, see instructions for **RACK GROUNDING**.
- Refer to local ordinances that pertain to battery installation and storage.
- Handle, transport, and properly dispose of or recycle batteries in accordance with regulations.
- Lead-acid batteries contain hazardous, toxic materials. **DO NOT** dispose of batteries in a fire—they may explode!
- Do not open, alter, or mutilate batteries! Released electrolyte is harmful to the skin and eyes, and may be toxic.
- Batteries should always be replaced with the same number and type as previously used.
- Batteries must remain in a climate-controlled environment having a temperature range of 22° to 25° C [72° to 77° F] and a relative humidity of 0% to 95%, non-condensing. Failure to adhere to these guidelines could adversely affect the performance of your batteries, as well as your battery warranty.

Additional considerations



- **Observe all requirements and limitations pertaining to floor loading!**
- **Remove watches, rings, and other metal objects from your body.**
- **DO NOT lay tools or metal parts on top of batteries!**
- **To avoid static build-up, service personnel should contact ground prior to working on batteries!**
- **DO NOT operate battery breakers without first referring to this manual!**

Specifications

Rack/battery options

The racks are deployed in multiples of two, with each rack housing one battery string. A maximum of eight racks (battery strings) can be used to support a single Symmetra MW UPS. The total number of strings deployed depends on the customer's requirements for run-time. The racks can accommodate either Power or Fiamm battery types.



Note

Refer to “APC Warranty on Batteries” on page 57.

The following product SKUs reflect the currently available rack/battery options.

Rack SKU	Battery Type (Model)	Assembly	Qty	Wiring Style	Cable Size (ref)*
SYR400k1000HxR-2CP	Power (TC-12150)	16 rails	2	E	120 mm ² (#4/0)
SYR400k1000HxR-2CF	Fiamm (12SLB130)	16 rails	2	E	120 mm ² (#4/0)

*Cobra cable rated for 150°C

Weights and dimensions

Each assembled rack measures 1778mm (H) x 1047mm (W) x 797mm (D) [70” x 41.2” x 31.4”]. For each two-rack combination, the width doubles to 2094mm [82.4”]. The weight of individual racks, battery types, and a fully loaded TWO-rack system is presented below.

Rack SKU	Weight Per Rack	Battery Type	Weight Per Batt	Total Wgt
SYR400k1000HxR-2CP	156 kg	Power (TC-12150)	45 kg	3192 kg
SYR400k1000HxR-2CF	156 kg	Fiamm (12SLB130)	42 kg	3000 kg

Shipping and Receiving

Shipping

Rack assemblies are shipped in corrugated boxes. Battery cables, battery boots, terminal blocks, and labels are also included in the shipment. Each pallet can support a maximum of two (2) units. Boxes are shrink-wrapped to the pallet for added stability.

Batteries are shipped separately, and shrink wrapped to their pallet as well.



Receiving

Check for damages.

1. Upon receipt, inspect the boxes for obvious signs of rough handling.
2. Remove shrink wrap, open boxes, and conduct an internal inspection of the equipment.
Keep boxes on pallet for transportation to installation site.
3. Record any damages and call the carrier immediately to allow their personnel to conduct an equipment inspection.
 - *DO NOT contact APC first—notify the carrier instead. Otherwise, APC may be unable to assist in recovering the realized amount of the claim.*
 - *All damage claims should be as specific as possible. Information pertaining to the shipment should appear on the shipping label and related paperwork.*
 - *BE SURE to request a copy of the carrier's inspection report!*

Check for discrepancies. Make certain the shipment has arrived in its entirety. Compare information from the shipping label/parts list against what has been received. If any part is missing or might have been damaged prior to shipping, contact APC immediately.

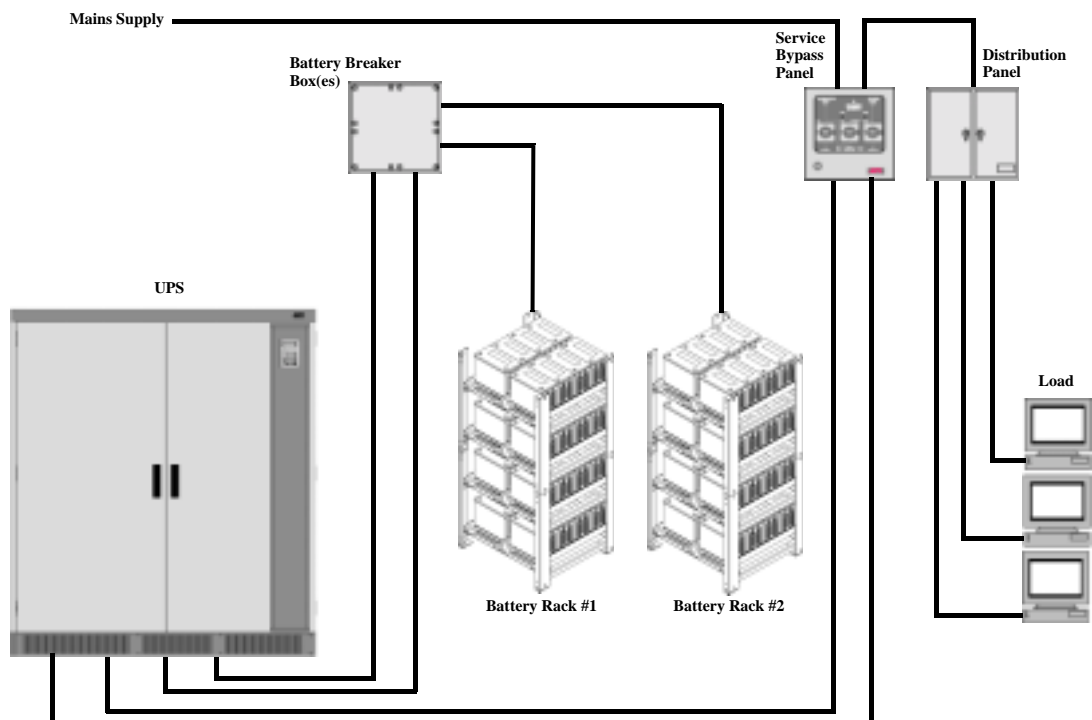
Placement

Positioning

The racks should ideally be positioned so that the batteries can easily be connected to the appropriate breaker in the battery breaker box(es). The graphic below shows a typical UPS system, and how the battery racks fit into the overall system.



If any or all of the racks are positioned apart from the battery breakers, sidecars should be employed to achieve connectivity. Sidecars are discussed in detail in “Appendix C: Employing Sidecars” on page 44.



Handling

The rack assemblies are relatively heavy (weighing 156 kg [344 lbs] each), so use a forklift or pallet-jack to transport boxes (on their pallets!) to the installation site. Upon arrival, re-open the boxes and remove the assembly equipment. Organize the parts in an area as close as possible to the rack’s final installation position.



If a rack must be moved or repositioned following assembly (and battery loading), DO NOT lift (with forklift or pallet-jack) from the front! This could cause batteries to slide off and might result in rack damage as well! Always lift from the side of the rack, if possible.

Installation Site

Installation considerations

The installation site should adhere to the following requirements:

- There should be ample room for performing rack assembly, battery installation, maintenance, and possible battery replacement.
- Aisle spacing should be in accordance with applicable code requirements.
- Racks should be set on a firm and reasonably level surface. Shimming up to a maximum of 6 mm [0.25 in.] may be used to level corner posts both front-to-back and side-to-side.
- Consider all requirements and restrictions with respect to floor loading.
- Batteries must remain in a climate-controlled environment having a temperature range of 22° to 25° C [72° to 77° F] and a relative humidity of 0% to 95%, non-condensing.
- Batteries should not be exposed to excessive moisture, construction dirt, corrosive elements, and other contaminants.

Installation equipment

Prior to assembling racks, ensure availability of the following tools and equipment:

- Open end/box wrenches (SAE dimensions)
- Ratchet set w/sockets (SAE dimension)—3/8"
- Torque wrench
- Standard, Phillips, and torx-head screwdrivers
- Concrete drill (for floor anchoring, if applicable)
- Voltmeter
- Ohmmeter (for ground testing)
- Floor shims (user supplied)
- Battery lifting device (rated)
- Step ladder or stepping stool
- Tape measure
- Chalk line
- T-square
- Level
- Felt tip marker
- Protective boot (to cover cable lugs)

Torque specifications

STANDARD BOLT				BATTERY TERMINAL		
Bolt Diameter		Torque		Battery Type	Torque	
mm	inches	Nm	in-lbs	Brand	Nm	in-lbs
6	1/4	7	60	Power	7.9	70
10	3/8	27	240	Fiamm	11.3	100
12	1/2	68	600			

Parts List

This section provides a listing of parts needed to assemble each battery rack. Do not proceed with this installation until all parts are in your possession.

Description	APC P/N	Qty
Top Side Subassembly	870-1657A	2
Bottom Side Subassembly	870-1658A	2
Battery Rail	870-1696	16
Cross Bar (rack)	870-3698	8
Rear Cross Brace	870-3697	4
M12 x 35 Bolt	803-1235	14
M12 Nut	803-1200	14
12mm Lockwasher	812-0038	14
12mm Washer	812-0039	28
1/4-20 Spring Nut	812-0040	32
1/4-20 x 3/4" Socket Flathead Screw	812-0037	32
3/8-16 x 1" Bolt	812-0723	16
3/8 KEPS Nut	812-3101	16
3/8 Washer	812-2030	32
M6 Flange Nut	803-2406	1
M6 Serrated Washer	811-0604	1
Number Sheet Label	885-1617	1
Warning Label		4
CE Rating Label	885-1618	1

Battery Cabling

Batteries are arranged in the rack in accordance with Wiring Style E. The wiring diagrams for this style are detailed in “Appendix A: Battery Wiring Style E” on page 35.

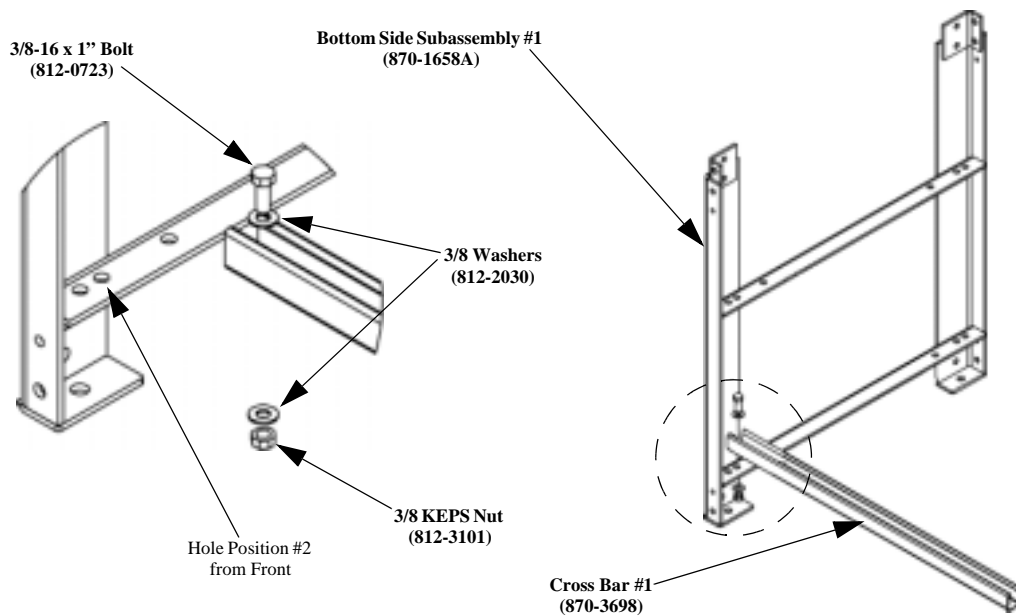
The (included) battery cabling kit was designed to suit the specific requirements of your product SKU. The cable references for this kit are provided in “Appendix B: Battery Cabling Kits” on page 43. If your kit is missing cables, contact APC immediately. Do not proceed with this installation until all parts are in your possession.

Rack Assembly

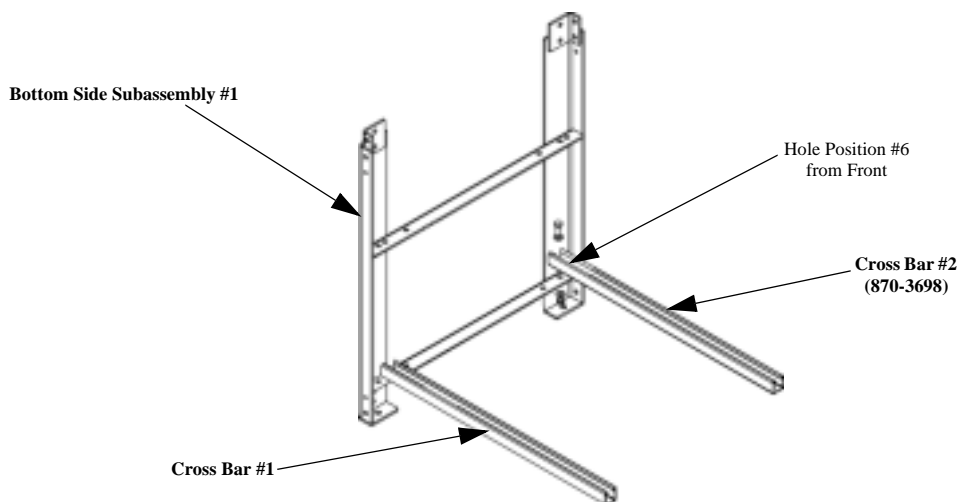
Assembling the bottom section

The bottom section of the rack will contain shelves #3 and #4.

1. Bolt Cross Bar #1 to Bottom Side Subassembly #1 at hole position #2 (from front) on the LOWER horizontal support of the Subassembly. Use (1) 3/8-16 x 1" bolt and related hardware: (2) 3/8 washers and (1) 3/8 KEPS nut.



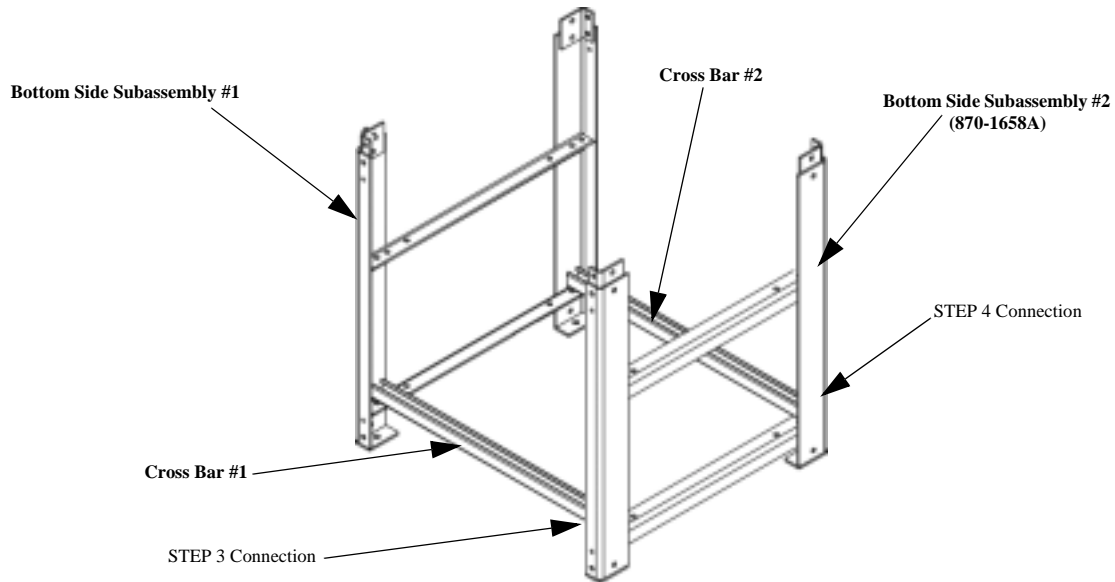
2. Bolt Cross Bar #2 to Bottom Side Subassembly #1 at hole position #6 (from front) on the LOWER horizontal support of the Subassembly. Use (1) 3/8-16 x 1" bolt and related hardware: (2) 3/8 washers and (1) 3/8 KEPS nut.



3. Bolt Cross Bar #1 to Bottom Side Subassembly #2 at its opposite hole position #2 (from front).
Use (1) 3/8-16 x 1" bolt and related hardware: (2) 3/8 washers and (1) 3/8 KEPS nut.

Refer to graphic in step 4 below.

4. Bolt Cross Bar #2 to Bottom Side Subassembly #2 at its opposite hole position #6 (from front).
Use (1) 3/8-16 x 1" bolt and related hardware: (2) 3/8 washers and (1) 3/8 KEPS nut.



5. Use a T-square to ensure exact right angles between Cross Bars and horizontal supports at all four corners of the rack before proceeding.

6. Bolt Cross Bar #3 to Bottom Side Subassembly #1 at hole position #2 (from front) on the UPPER horizontal support of the Subassembly. Use (1) 3/8-16 x 1" bolt and related hardware: (2) 3/8 washers and (1) 3/8 KEPS nut.

Refer to graphic in step 9 below.

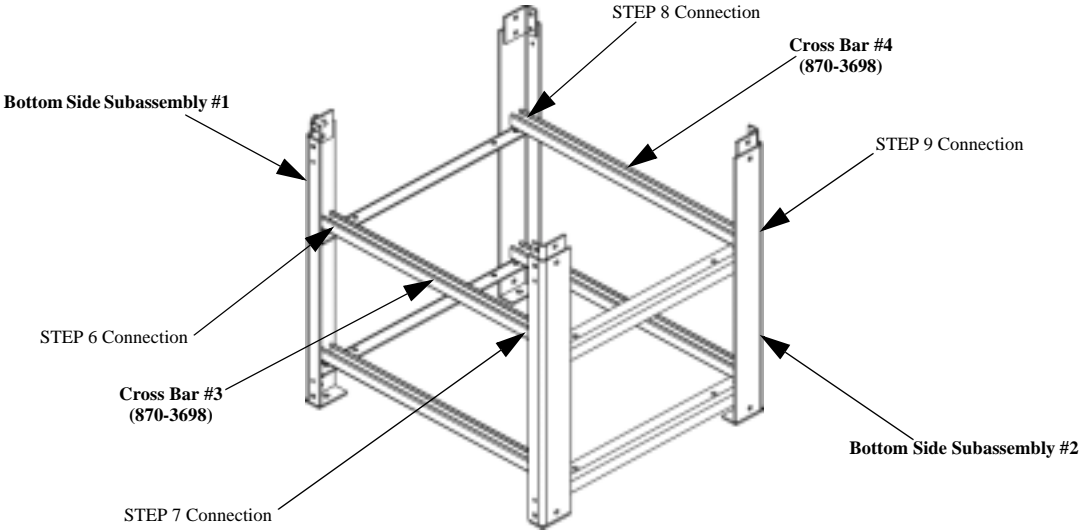
7. Bolt Cross Bar #3 to Bottom Side Subassembly #2 at its opposite hole position #2 (from front).
Use (1) 3/8-16 x 1" bolt and related hardware: (2) 3/8 washers and (1) 3/8 KEPS nut.

Refer to graphic in step 9 below

8. Bolt Cross Bar #4 to Bottom Side Subassembly #1 at hole position #6 (from front) on the UPPER horizontal support of the Subassembly. Use (1) 3/8-16 x 1" bolt and related hardware: (2) 3/8 washers and (1) 3/8 KEPS nut.

Refer to graphic in step 9 below.

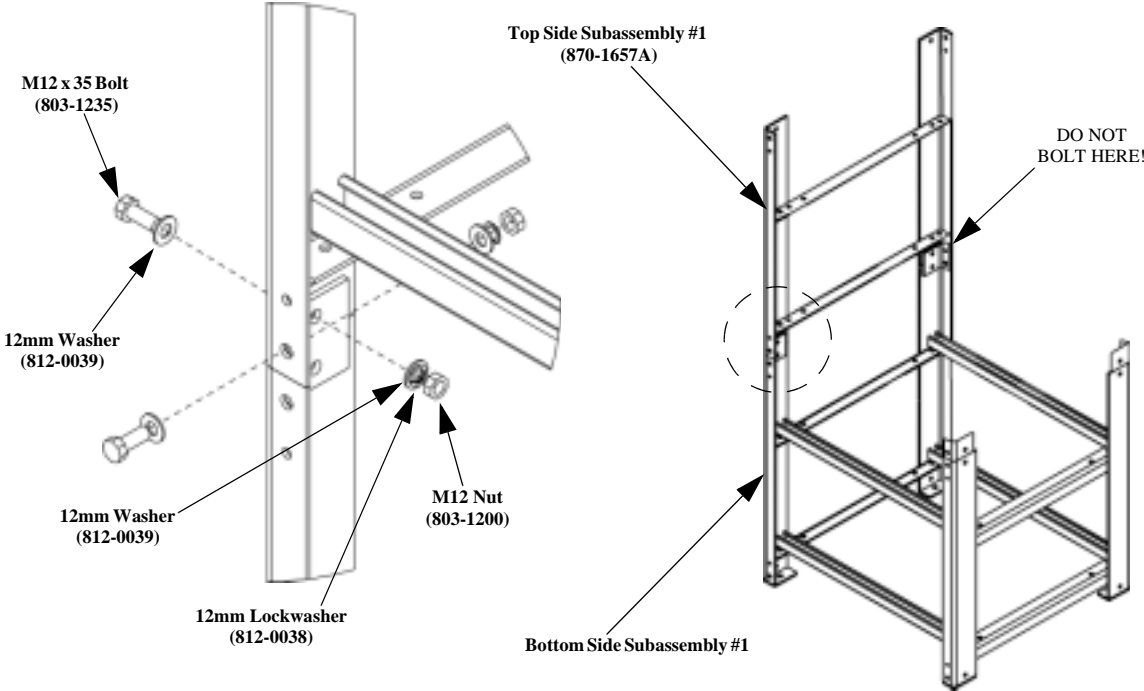
- 9. Bolt Cross Bar #4 to Bottom Side Subassembly #2 at its opposite hole position #6 (from front). Use (1) 3/8-16 x 1" bolt and related hardware: (2) 3/8 washers and (1) 3/8 KEPS nut.



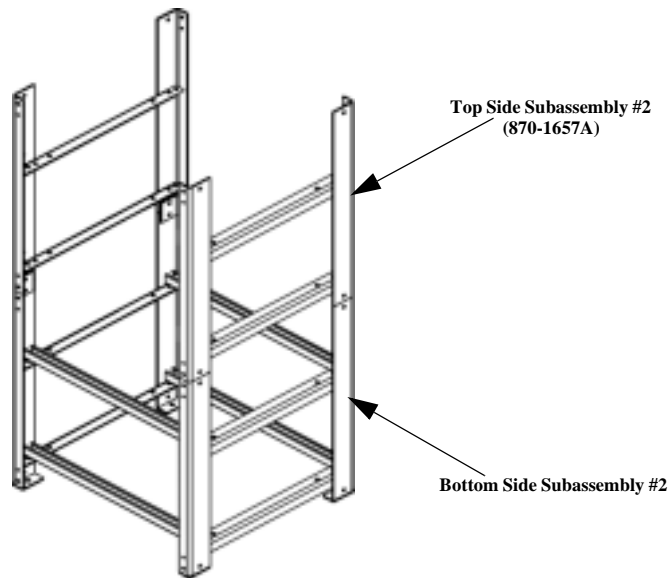
Assembling the top section

The top section of the rack will contain shelves #1 and #2.

- 1. Bolt Top Side Subassembly #1 onto Bottom Side Subassembly #1 at designated hole positions. Use (3) M12 x 35 bolts and related hardware: (6) 12mm washers, (3) 12mm lockwashers and (3) M12 nuts. DO NOT bolt the REAR hole at this time!



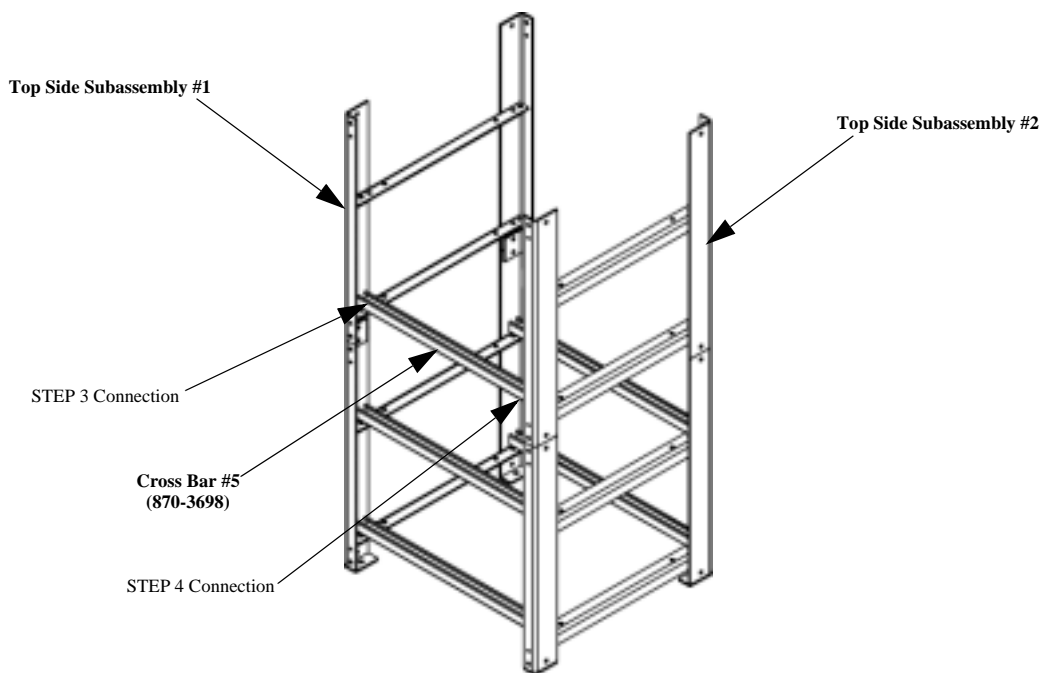
2. Bolt Top Side Subassembly #2 onto Bottom Side Subassembly #2 at same basic hole positions specified in step 1 above. Use (3) M12 x 35 bolts and related hardware: (6) 12mm washers, (3) 12mm lockwashers and (3) M12 nuts. Again, DO NOT bolt REAR hole!



3. Bolt Cross Bar #5 to Top Side Subassembly #1 at hole position #2 (from front) on the LOWER horizontal support of the Subassembly. Use (1) 3/8-16 x 1" bolt and related hardware: (2) 3/8 washers and (1) 3/8 KEPS nut.

Refer to graphic in step 4 below.

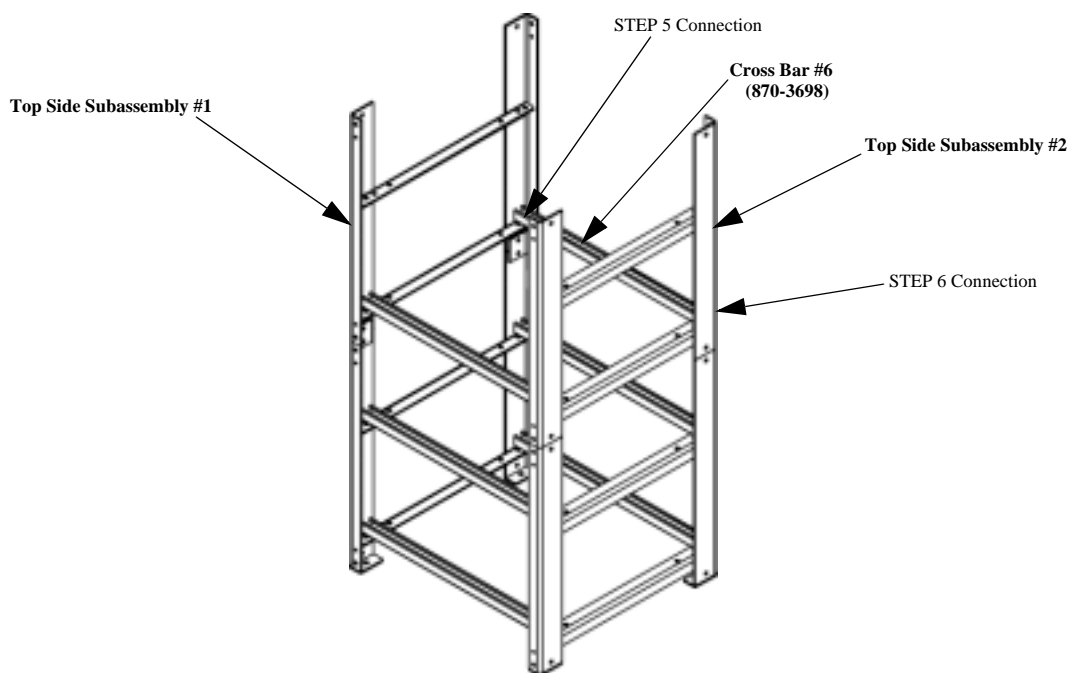
4. Bolt Cross Bar #5 to Top Side Subassembly #2 at its opposite hole position #2 (from front). Use (1) 3/8-16 x 1" bolt and related hardware: (2) 3/8 washers and (1) 3/8 KEPS nut.



5. Bolt Cross Bar #6 to Top Side Subassembly #1 at hole position #6 (from front) on the LOWER horizontal support of the Subassembly. Use (1) 3/8-16 x 1" bolt and related hardware: (2) 3/8 washers and (1) 3/8 KEPS nut.

Refer to graphic in step 6 below.

6. Bolt Cross Bar #6 to Top Side Subassembly #2 at its opposite hole position #6 (from front). Use (1) 3/8-16 x 1" bolt and related hardware: (2) 3/8 washers and (1) 3/8 KEPS nut.



7. Bolt Cross Bar #7 to Top Side Subassembly #1 at hole position #2 (from front) on the UPPER horizontal support of the Subassembly. Use (1) 3/8-16 x 1" bolt and related hardware: (2) 3/8 washers and (1) 3/8 KEPS nut.

Refer to graphic in step 10 below.

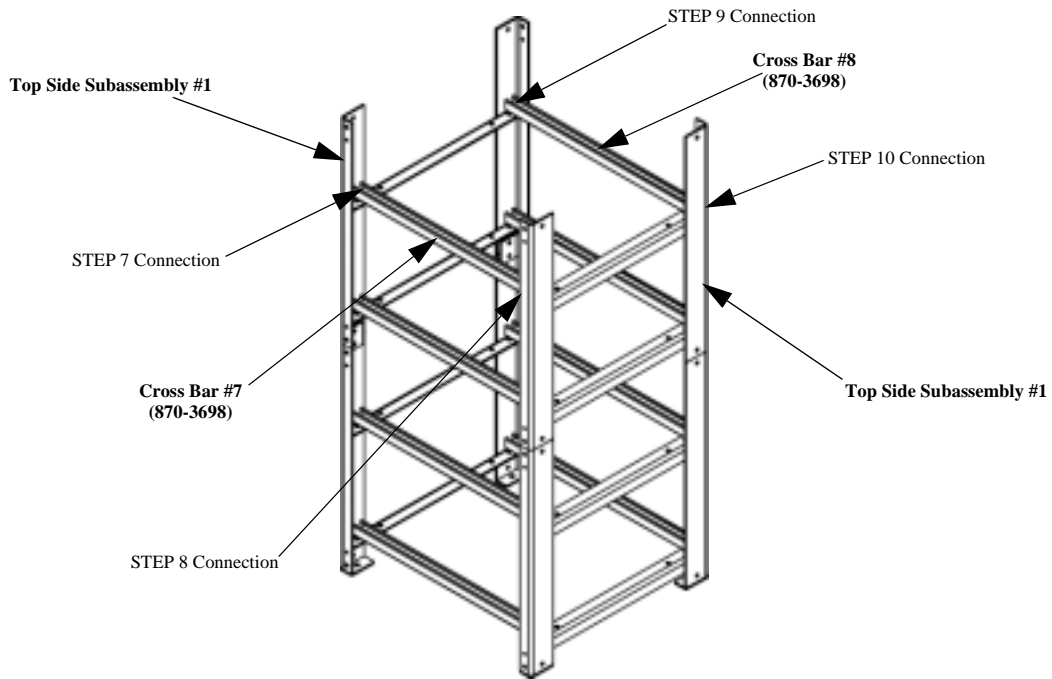
8. Bolt Cross Bar #7 to Top Side Subassembly #2 at its opposite hole position #2 (from front). Use (1) 3/8-16 x 1" bolt and related hardware: (2) 3/8 washers and (1) 3/8 KEPS nut.

Refer to graphic in step 10 below.

9. Bolt Cross Bar #8 to Top Side Subassembly #1 at hole position #6 (from front) on the UPPER horizontal support of the Subassembly. Use (1) 3/8-16 x 1" bolt and related hardware: (2) 3/8 washers and (1) 3/8 KEPS nut.

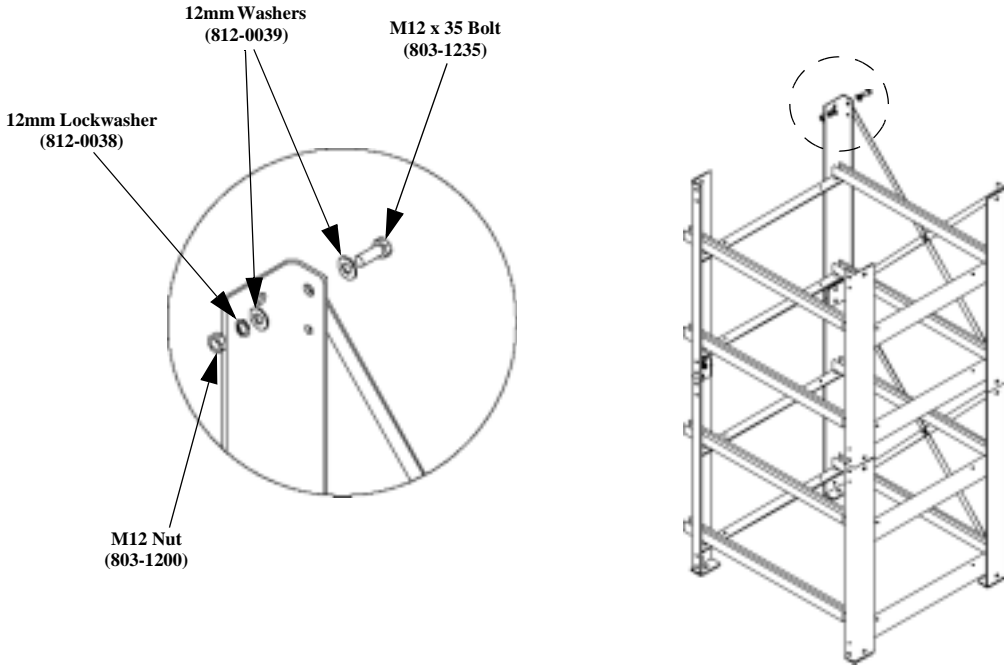
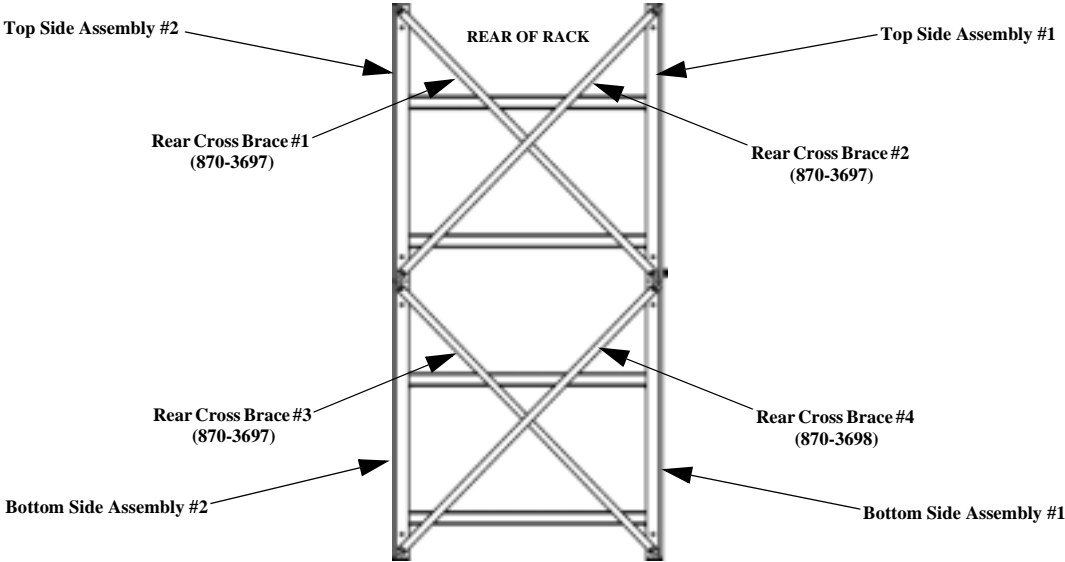
Refer to graphic in step 10 below.

10. Bolt Cross Bar #8 to Top Side Subassembly #2 at its opposite hole position #6 (from front). Use (1) 3/8-16 x 1" bolt and related hardware: (2) 3/8 washers and (1) 3/8 KEPS nut.



Stabilizing the rack

Bolt (4) Rear Cross Braces to rack at designated hole positions. Use (8) M12 x 35 bolts and related hardware: (16) 12mm washers, (8) 12mm lockwashers and (8) M12 nuts. Note that lower bolts on Brace #1 and Brace #2 also connect the Top Side Assemblies to the Bottom Side Assemblies.

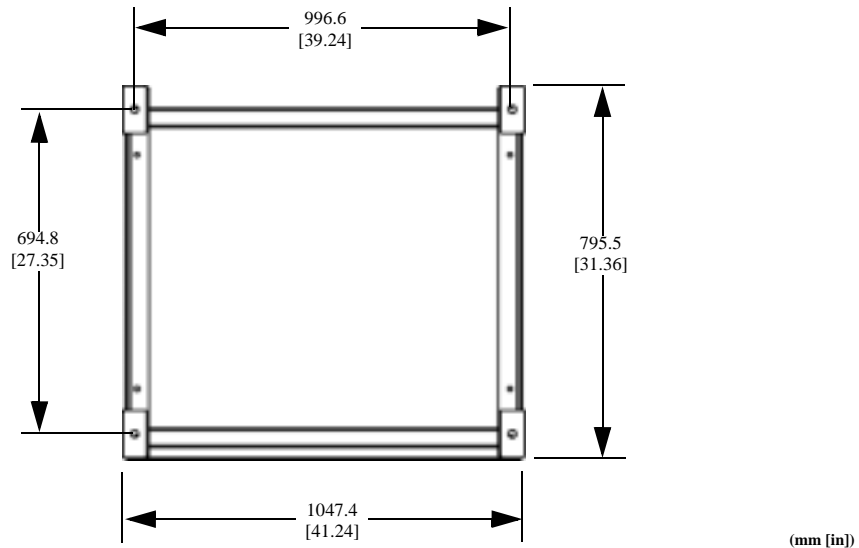


Anchoring the rack (optional)

For added stability, any or all of the racks can optionally be bolted to a concrete floor.

To anchor the rack, chalk mark four (4) pre-cut holes (at the base of the assembly) in the facility floor, drill, and apply anchoring hardware (not supplied).

Graphic provides accurate dimensional data between hole locations.



Numbering the batteries

Each battery is numbered from 1 to 64 because batteries are ultimately wired together in numerical sequence.

Apply a “numerical” sticker from supplied Labels to the top of each battery to designate its position in the wiring scheme.

Place a numbered sticker on all 64 of your batteries at this time.

Accessing your wiring diagrams

Wiring diagrams applicable to your rack SKU should be used as points of reference when loading and connecting batteries.

Refer to “Appendix A: Battery Wiring Style E” on page 35 throughout the process of loading and wiring your batteries.

Positioning rails on shelves

Apply your Battery Type (Power or Fiamm) to the Rail Spacing Matrix below to determine initial positioning of rails. Take into consideration that this information represents “suggested” starting points for placing rails. Make adjustments as necessary.

Battery Type	Wiring Style	Rails/Shelf	Left Corner Post to 1st Rail		Space Between Facing Rails		Center Space	
			mm	in	mm	in	mm	in
Power	E	4	50	2.00	345	13.50	235	9.25
Fiamm	E	4	50	2.00	405	16.00	110	4.25

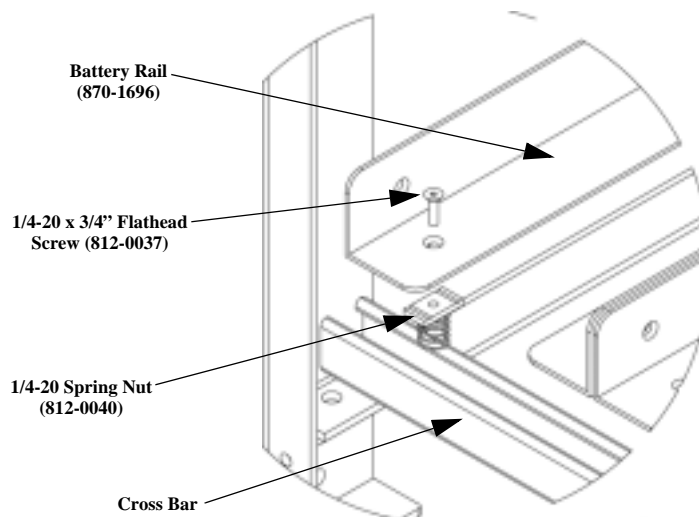
Addressing the bottom shelf

To maintain structural integrity, batteries are loaded from bottom-to-top in the rack.

1. Position Battery Rails on BOTTOM shelf Cross Bars according to spacing requirements obtained from the Rail Spacing Matrix chart above. Measure with ruler or tape to ensure proper spacing, and later make adjustments as necessary.

Each “set” of two (2) rails should face inward to enable their facing edges to support batteries. Refer to graphic in step 2 below.

2. Screw Battery Rails into BOTTOM shelf Cross Bars using 1/4-20 x 3/4” flathead screws and 1/4-20 spring nuts. Each battery rail requires two screws and two spring nuts (one screw and spring nut is applied to each cross bar).



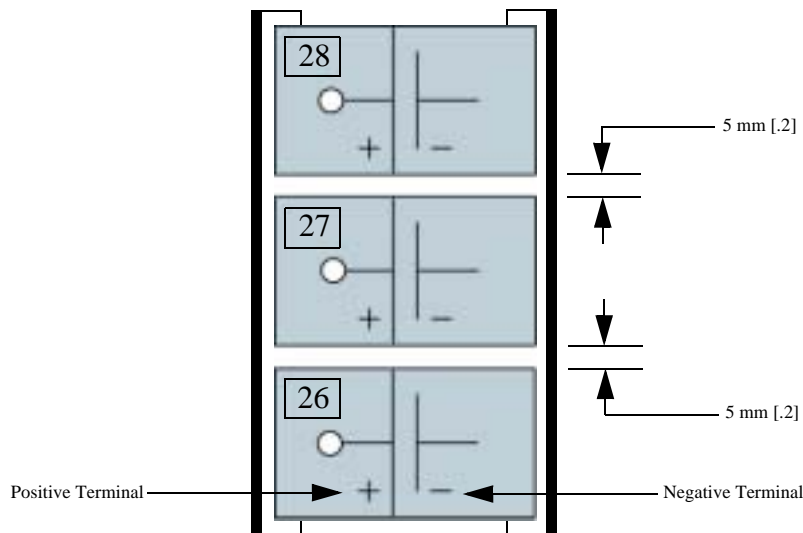
- Using a rated lifting device, load batteries onto BOTTOM shelf rails in accordance with your wiring diagram for that shelf. Take note of where each numbered battery should be placed, and the proper positioning of its positive and negative terminals.



Note

- Because batteries are loaded from bottom-to-top in the rack, the higher-numbered batteries are placed on the lower shelves.
- Prior to loading batteries, use a voltmeter to ensure each battery contains its required 12V. DO NOT load any battery with an insufficient voltage!

Leave a minimum space of 5 mm (.2 in) between batteries in the same row.



Wiring the batteries

All of the batteries loaded onto a given shelf must be connected (wired) in numerical sequence before starting assembly of the next shelf. These connections consist of battery-to-battery and row-to-row wiring.



Warning

Review “Safety” on page 1 for safety warnings and caution notices. Take heed of all safety information before proceeding with battery connections. Failure to comply could result in serious injury or death!

- Connect all batteries in the same row (those on the same rails) using the supplied battery-to-battery cable.
 - Refer to your wiring diagrams for proper cabling and termination points.
 - Refer to instructions for “Applying cable boots” on page 19, “Connecting to batteries” on page 20, and “Covering battery connections” on page 21.



Note

- Prior to connecting batteries, use a voltmeter to check the voltage between those terminals being connected. Any reading other than zero is unacceptable.
- After connecting each row, use voltmeter to measure the collective voltage. Reading should approximate number of batteries in row times 12V.

2. Working left to right (from front of rack), connect the last battery in the first row to the first battery in the second row using the supplied row-to-row cable.
 - Refer to your wiring diagrams for proper cabling and termination points.
 - Refer to instructions for “Applying cable boots” on this page, “Connecting to batteries” on page 20, and “Covering battery connections” on page 21.



Note

- **Prior to connecting batteries, use a voltmeter to check the voltage between those terminals being connected. Any reading other than zero is unacceptable.**
- **After connecting the entire shelf, use voltmeter to measure the collective voltage. Reading should approximate number of batteries on shelf times 12V.**

Applying cable boots. Before wiring batteries, slide both cable ends through a cable boot.

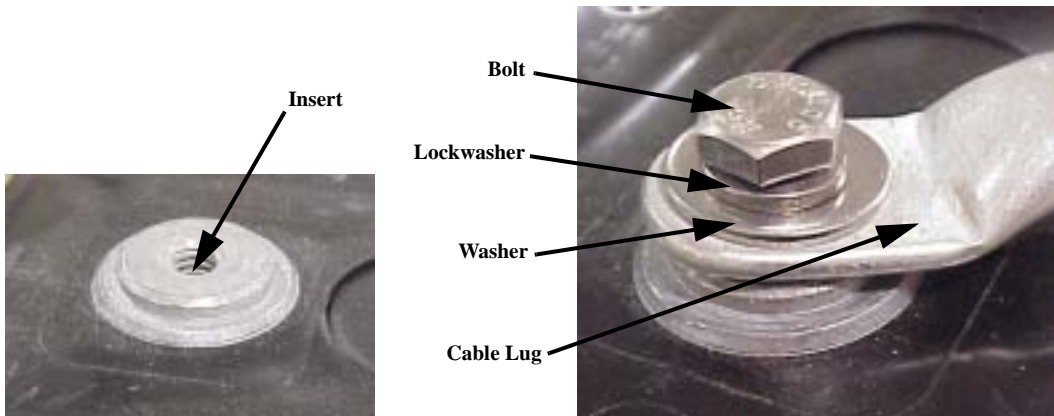


Connecting to batteries. There are three types of battery terminals for connecting cables: 1) Stud terminal, 2) Insert terminal, and 3) L (or I) terminal. The application of hardware for making the connection varies according to the type of terminal. Refer to “Torque specifications” on page 6.

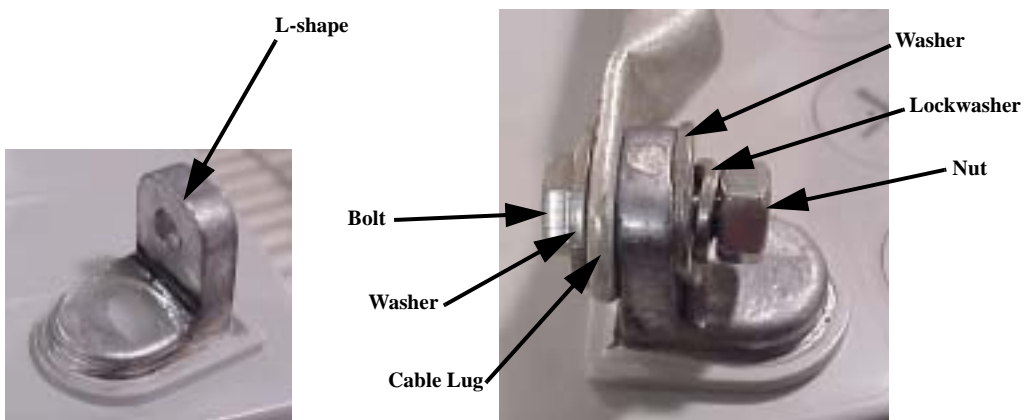
• **Stud Terminal**



• **Insert Terminal**



• **L or I Terminal**



Covering battery connections. After each lug has been connected to its battery terminal, snap the boot down over the lug/terminal.



Addressing the third shelf

The THIRD shelf is addressed only after bottom shelf batteries have been loaded and wired.

1. Position Battery Rails on THIRD shelf Cross Bars according to spacing requirements obtained from the Rail Spacing Matrix on page 17. Measure with ruler or tape to ensure proper spacing, and later make adjustments as necessary.

Refer to step 1 on page 17 for similar procedure.

2. Screw Battery Rails into THIRD shelf Cross Bars using 1/4-20 x 3/4" flathead screws and 1/4-20 spring nuts. Each battery rail requires two screws and two spring nuts (one screw and spring nut is applied to each cross bar).

Refer to step 2 on page 17 for similar procedure.

3. Using a rated lifting device, load batteries onto THIRD shelf rails in accordance with your wiring diagram. Take note of where each numbered battery should be placed, and the proper positioning of its positive and negative terminals.

Refer to step 3 on page 18 for similar procedure.

4. Make all specified THIRD shelf battery-to-battery and row-to-row connections.

Refer to "Wiring the batteries" on page 18.

Addressing the second shelf

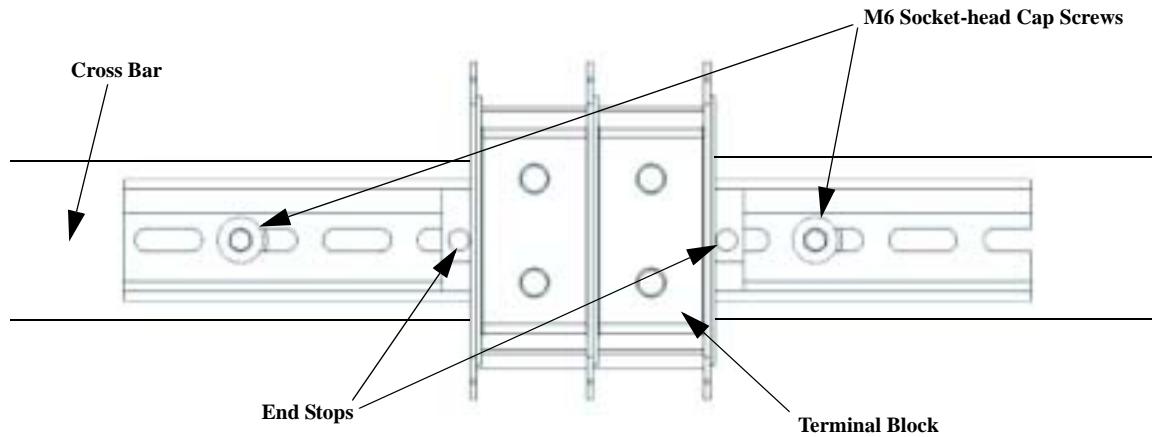
The SECOND shelf is addressed only after third shelf batteries have been loaded and wired.

1. Position Battery Rails on SECOND shelf Cross Bars according to spacing requirements obtained from the Rail Spacing Matrix on page 17. Measure with ruler or tape to ensure proper spacing, and later make adjustments as necessary.

Refer to step 1 on page 17 for similar procedure.

2. Screw (1) Terminal Block Assembly to the SECOND shelf Cross Bar at the front of the rack. Secure to cross bar with the (2) supplied M6 socket-head cap screws and flange nuts.

Select a location on the bar that does not conflict with battery or rail placement. The end stops can be loosened to allow the block to move left or right on its assembly.



3. Screw Battery Rails into SECOND shelf Cross Bars using 1/4-20 x 3/4" flathead screws and 1/4-20 spring nuts. Each battery rail requires two screws and two spring nuts (one screw and spring nut is applied to each cross bar).

Refer to step 2 on page 17 for similar procedure.

4. Using a rated lifting device, load batteries onto SECOND shelf rails in accordance with your wiring diagram. Take note of where each numbered battery should be placed, and the proper positioning of its positive and negative terminals.

Refer to step 3 on page 18 for similar procedure.

5. Make all specified SECOND shelf battery-to-battery and row-to-row connections.

Refer to "Wiring the batteries" on page 18.

Addressing the top shelf

The TOP shelf is addressed only after second shelf batteries have been loaded and wired.

1. Position Battery Rails on TOP shelf Cross Bars according to spacing requirements obtained from the Rail Spacing Matrix on page 17. Measure with ruler or tape to ensure proper spacing, and later make adjustments as necessary.

Refer to step 1 on page 17 for similar procedure.

2. Screw Battery Rails into TOP shelf Cross Bars using 1/4-20 x 3/4" flathead screws and 1/4-20 spring nuts. Each battery rail requires two screws and two spring nuts (one screw and spring nut is applied to each cross bar).

Refer to step 2 on page 17 for similar procedure.

- Using a rated lifting device, load batteries onto TOP shelf rails in accordance with your wiring diagram. Take note of where each numbered battery should be placed, and the proper positioning of its positive and negative terminals.

Refer to step 3 on page 18 for similar procedure.

- Make all specified TOP shelf battery-to-battery and row-to-row connections.

Refer to “Wiring the batteries” on page 18.

Shelf-to-shelf wiring

Shelf-to-shelf wiring takes place after ALL of the shelves in your rack have been fully assembled and their batteries wired together in numerical sequence. Start with the top shelf and work down.



Warning

Review “Safety” on page 1 for safety warnings and caution notices. Take heed of all safety information before proceeding with battery connections. Failure to comply could result in serious injury or death!

Using the supplied shelf-to-shelf cable, connect the HIGHEST-numbered battery on the TOP shelf to the LOWEST-numbered battery on the SECOND shelf. Then connect the highest-numbered battery on the second shelf to the lowest-numbered battery on the third shelf. Finally, connect the highest-numbered battery on the third shelf to the lowest-numbered battery on the fourth shelf.



Note

Prior to connecting batteries, use a voltmeter to check the voltage between those terminals being connected. Any reading other than zero is unacceptable.

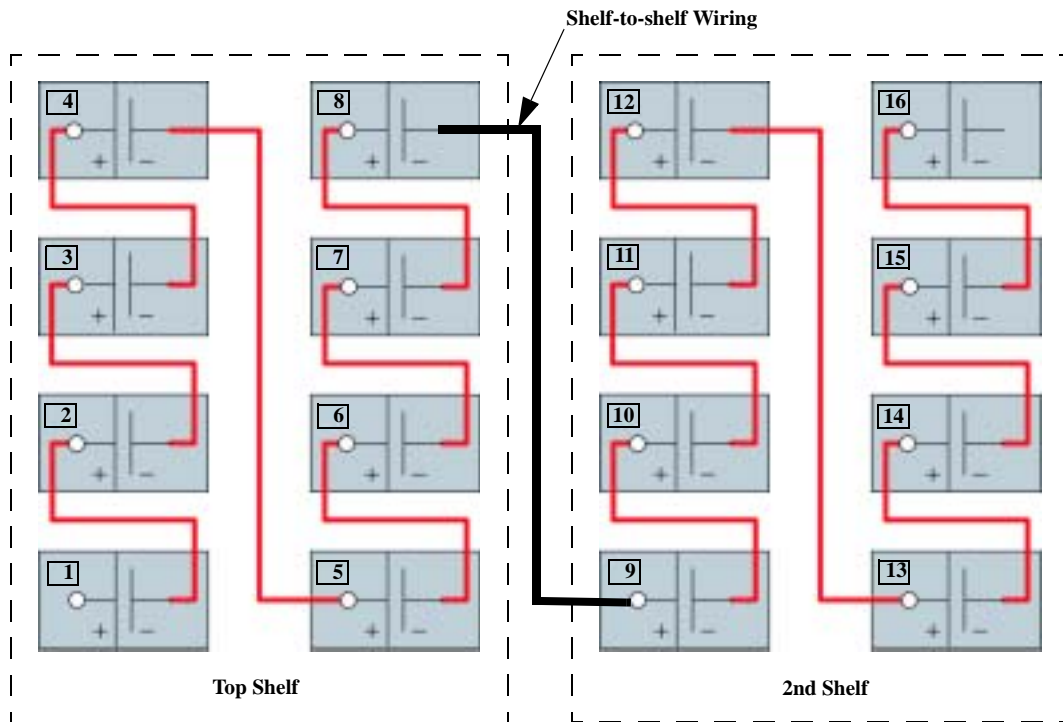
Follow these steps for each shelf-to-shelf connection:

- Refer to your wiring diagrams for proper cabling and termination points.
- Before making connections, apply two (2) cable boots.
- Connect one cable end to the open negative (-) terminal on the last battery in the upper shelf. Snap cable boot over the connected lug/terminal.
- Apply a “protective” boot (not supplied) to the other cable end, then snake the cable downward through (space in) centrally located rails.



Boot Your Cable!!!

5. Remove protective boot and connect this same cable end to the open positive (+) terminal on the first battery in the lower shelf. Snap cable boot over connected lug/terminal.



Assembling the second rack

The battery racks must be deployed in multiples of two.

Repeat all previous steps to assemble, load, and wire the second battery rack.

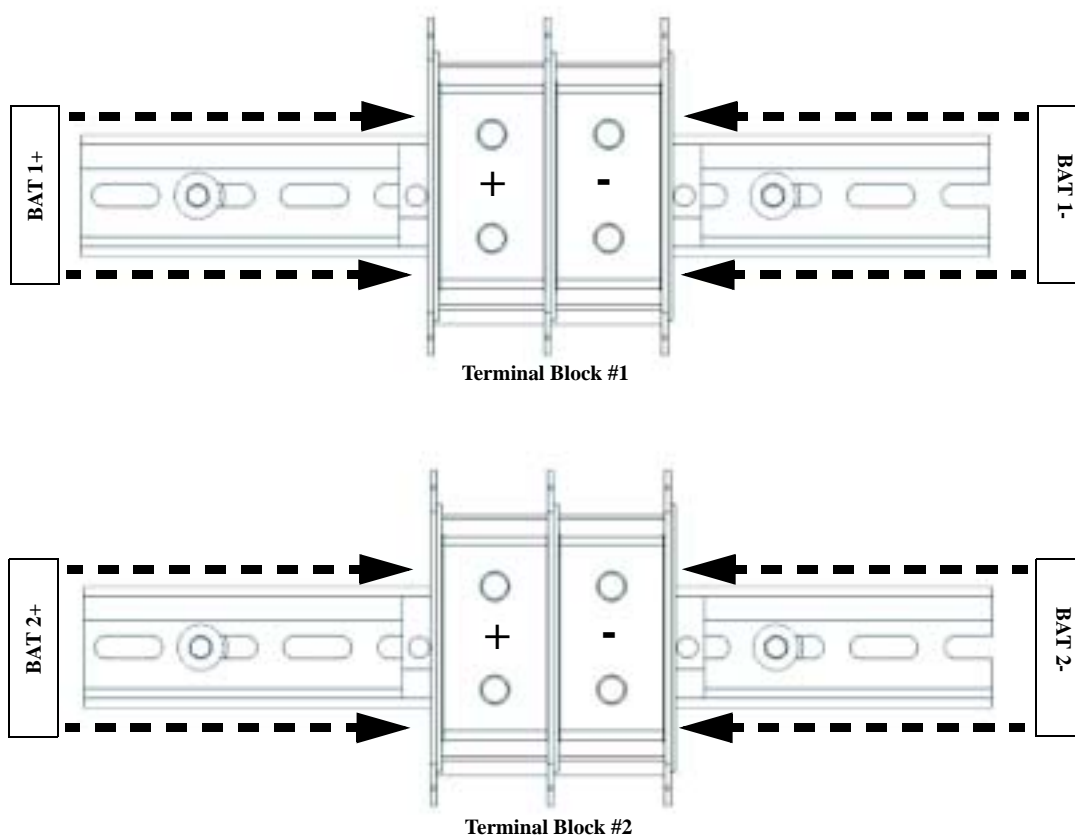
The first rack (Rack #1) contains the BAT 1 string (batteries #1-32), and the second rack (Rack #2) contains the BAT 2 string (batteries #33-64).

Labelling the terminal blocks

Each rack is equipped with (1) terminal block assembly. The left (+) and right (-) segments of each terminal block must be appropriately labelled.

1. Remove the snap-off cover from the front face of each terminal block.
2. Apply two “terminal block” stickers from supplied labels to the partitions on the sides of each terminal block.

Apply the BAT 1+ (on the left) and BAT 1- (on the right) stickers to the Rack #1 terminal block (Terminal Block #1), and the BAT 2+ (on the left) and BAT 2- (on the right) stickers to the Rack #2 terminal block (Terminal Block #2).



Employing sidecars to support separated racks

When battery racks are situated apart from their respective battery breakers, sidecars should be employed to enhance connectivity between the batteries and the breakers.



Note

If racks are NOT separated and sidecars are NOT used, proceed to the next section below. If racks ARE separated and sidecars ARE used, disregard the next section and proceed instead to “Appendix C: Employing Sidecars” on page 44.

Connecting terminal blocks to battery breakers

To minimize risk, *terminal block-to-battery breaker* connections are made prior to *battery-to-terminal block* connections. TOP entry of 120 mm² [#4/0] cable (not supplied) is recommended for all connections specified in this section. Each terminal block assembly contains preset hardware for securing cable lugs.



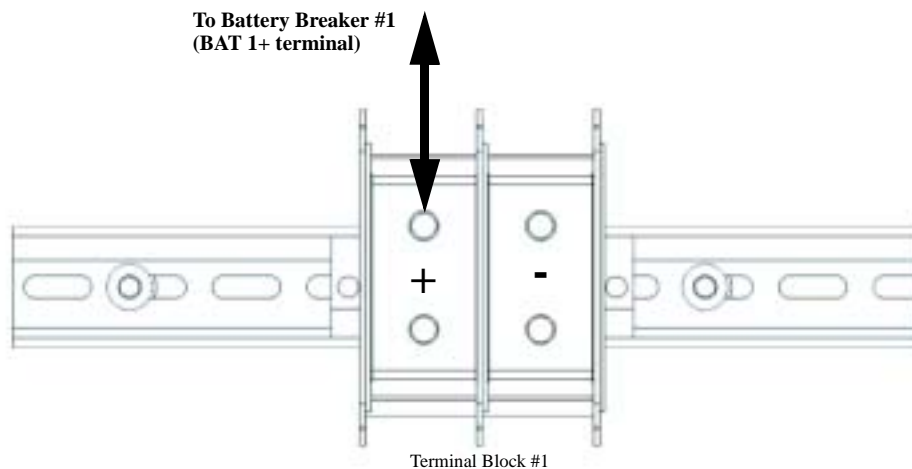
Be certain battery breakers are in the open (or OFF) position before making connections to them.



All external cable must comply with European and local electrical code.

- 1. Using one (1) 120 mm² [#4/0] cable, connect the appropriate (top or bottom) BAT 1+ terminal in Terminal Block #1 to the BAT 1+ terminal in Battery Breaker #1.**

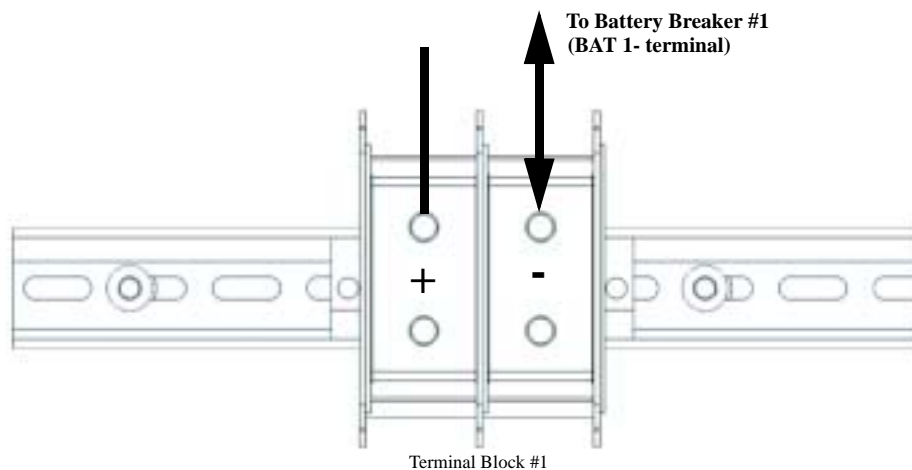
At Terminal Block #1: If using top cable entry, connect to top terminal (as shown) of the BAT 1+ segment on left. Otherwise, connect to bottom terminal. Secure lug to stud with preset washer and nut. To relieve strain, zip tie cable to the shelf directly above the terminal block.



At Battery Breaker #1: Refer to the battery breaker's wiring diagram for the proper BAT 1+ lug landing on the other end of this cable.

- Using one (1) 120 mm² [#4/0] cable, connect the appropriate (top or bottom) BAT 1- terminal in Terminal Block #1 to the BAT 1- terminal in Battery Breaker #1.

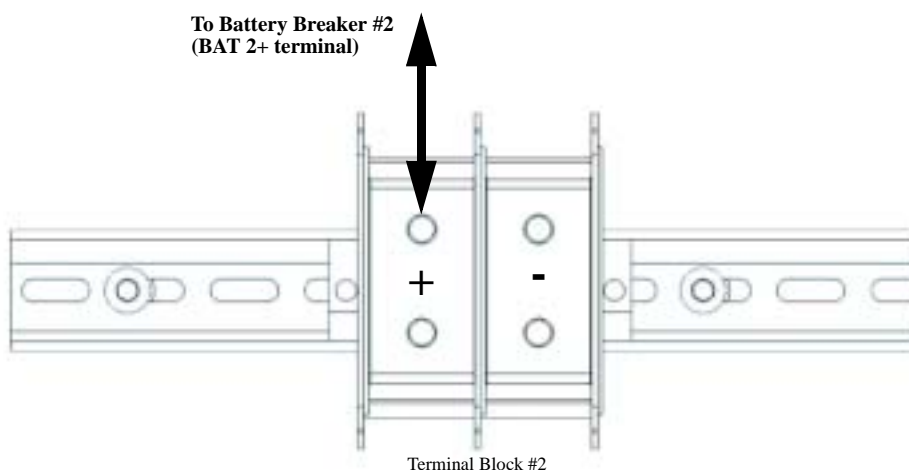
At Terminal Block #1: If using top cable entry, connect to top terminal (as shown) of the BAT 1- segment on right. Otherwise, connect to bottom terminal. Secure lug to stud with preset washer and nut. To relieve strain, zip tie cable to the shelf directly above the terminal block.



At Battery Breaker #1: Refer to the battery breaker’s wiring diagram for the proper BAT 1- lug landing on the other end of this cable.

- Using one (1) 120 mm² [#4/0] cable, connect the appropriate (top or bottom) BAT 2+ terminal in Terminal Block #2 to the BAT 2+ terminal in Battery Breaker #2.

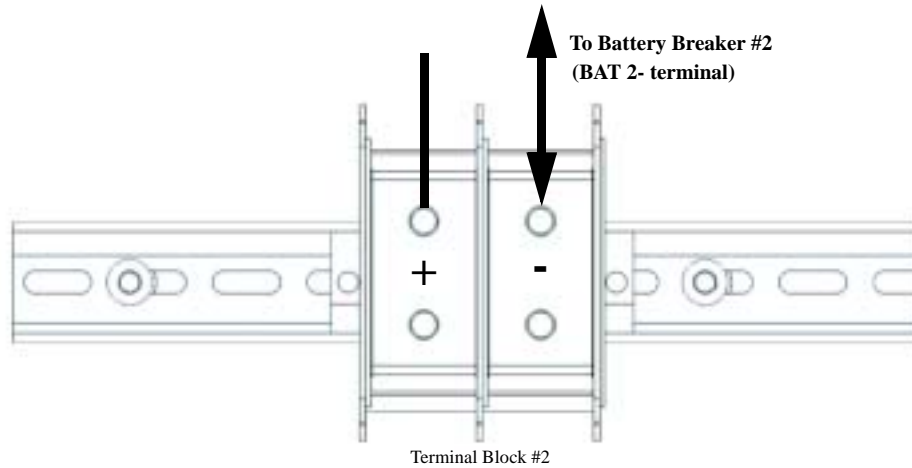
At Terminal Block #2: If using top cable entry, connect to top terminal (as shown) of the BAT 2+ segment on left. Otherwise, connect to bottom terminal. Secure lug to stud with preset washer and nut. To relieve strain, zip tie cable to the shelf directly above the terminal block.



At Battery Breaker #2: Refer to the battery breaker’s wiring diagram for the proper BAT 2+ lug landing on the other end of this cable.

4. Using one (1) 120 mm² [#4/0] cable, connect the appropriate (top or bottom) BAT 2-terminal in Terminal Block #2 to the BAT 2- terminal in Battery Breaker #2.

At Terminal Block #2: If using top cable entry, connect to top terminal (as shown) of the BAT 2- segment on right. Otherwise, connect to bottom terminal. Secure lug to stud with preset washer and nut. To relieve strain, zip tie cable to the shelf directly above the terminal block.



At Battery Breaker #2: Refer to the battery breaker’s wiring diagram for the proper BAT 2- lug landing on the other end of this cable.

Connecting terminal blocks to batteries

To minimize risk, connections between terminal blocks and batteries should be made FROM the terminal blocks TO the batteries. 120 mm² [#4/0] cable is supplied for all connections specified in this section. Each terminal block assembly contains preset hardware for securing cable lugs.



Warning

Review “Safety” on page 1 for safety warnings and caution notices. Take heed of all safety information before proceeding with battery connections. Failure to comply could result in serious injury or death!



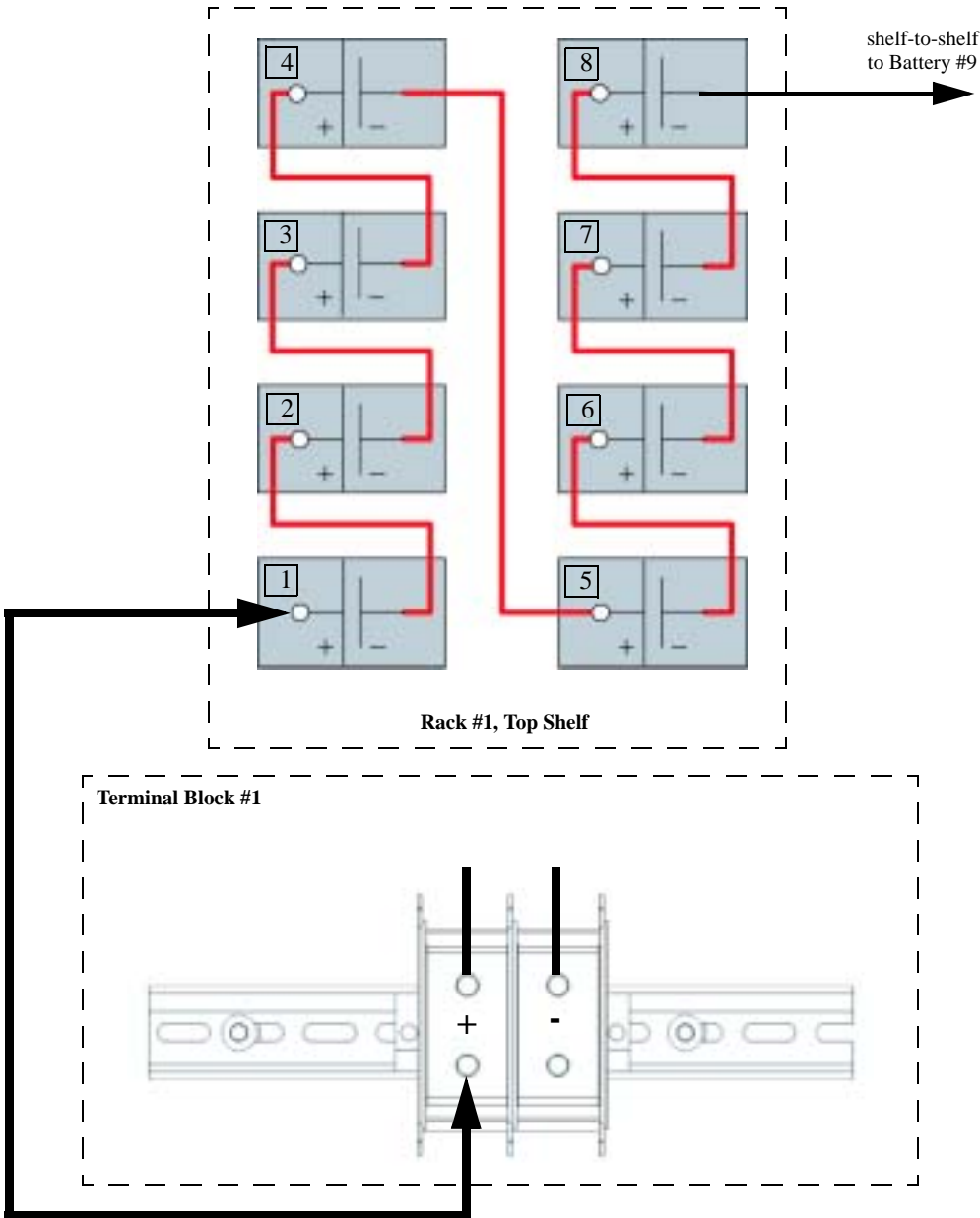
Note

Prior to making connections, use a voltmeter to measure collective voltage of the BAT 1 (#1-32) and BAT 2 (#33-64) strings. Readings should approximate the number of batteries in each string times 12V (or about 386V per string).

1. Using specified cable, connect the open BAT 1+ terminal in Terminal Block #1 to the open positive (+) terminal on Battery #1. Before making connections, apply ONE cable boot. If lug sizes are different, apply boot to the cable end with the SMALLER lug.

At Terminal Block #1: Connect the lug on the cable end WITHOUT the boot to the open BAT 1+ terminal. Secure lug to stud with preset washer and nut. Snake cable end WITH the boot between centrally located rails until it reaches Battery #1.

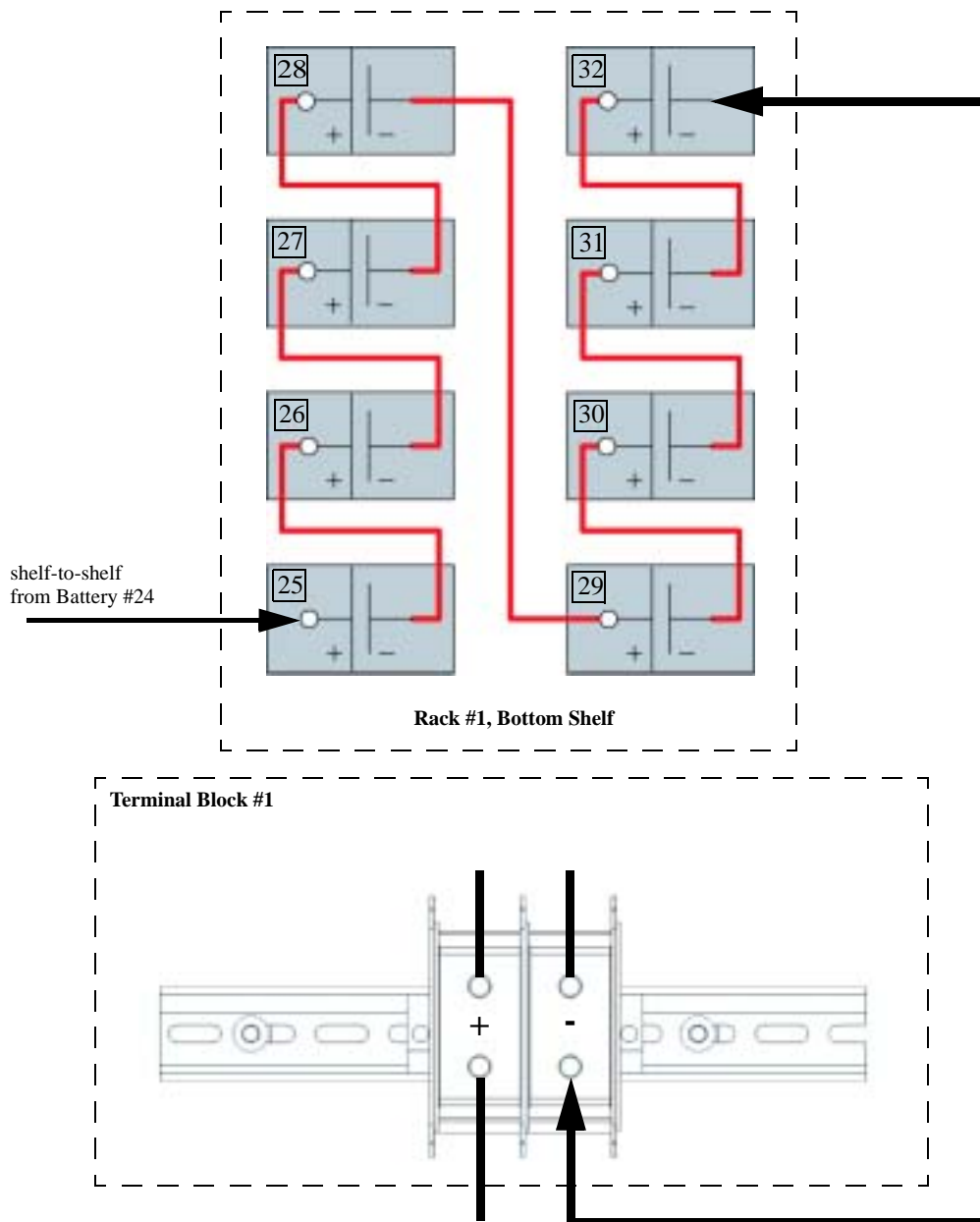
At Battery #1: Connect the lug on the cable end WITH the boot to the open positive (+) terminal on Battery #1. Snap the boot over the connected lug/terminal. Use zip ties as needed to relieve cable strain.



- Using specified cable, connect the open BAT 1- terminal in Terminal Block #1 to the open negative (-) terminal on Battery #32. Before making connections, apply ONE cable boot. If lug sizes are different, apply boot to the cable end with the SMALLER lug.

At Terminal Block #1: Connect the lug on the cable end WITHOUT the boot to the open BAT 1- terminal. Secure lug to stud with preset washer and nut. Snake cable end WITH the boot between centrally located rails until it reaches Battery #32.

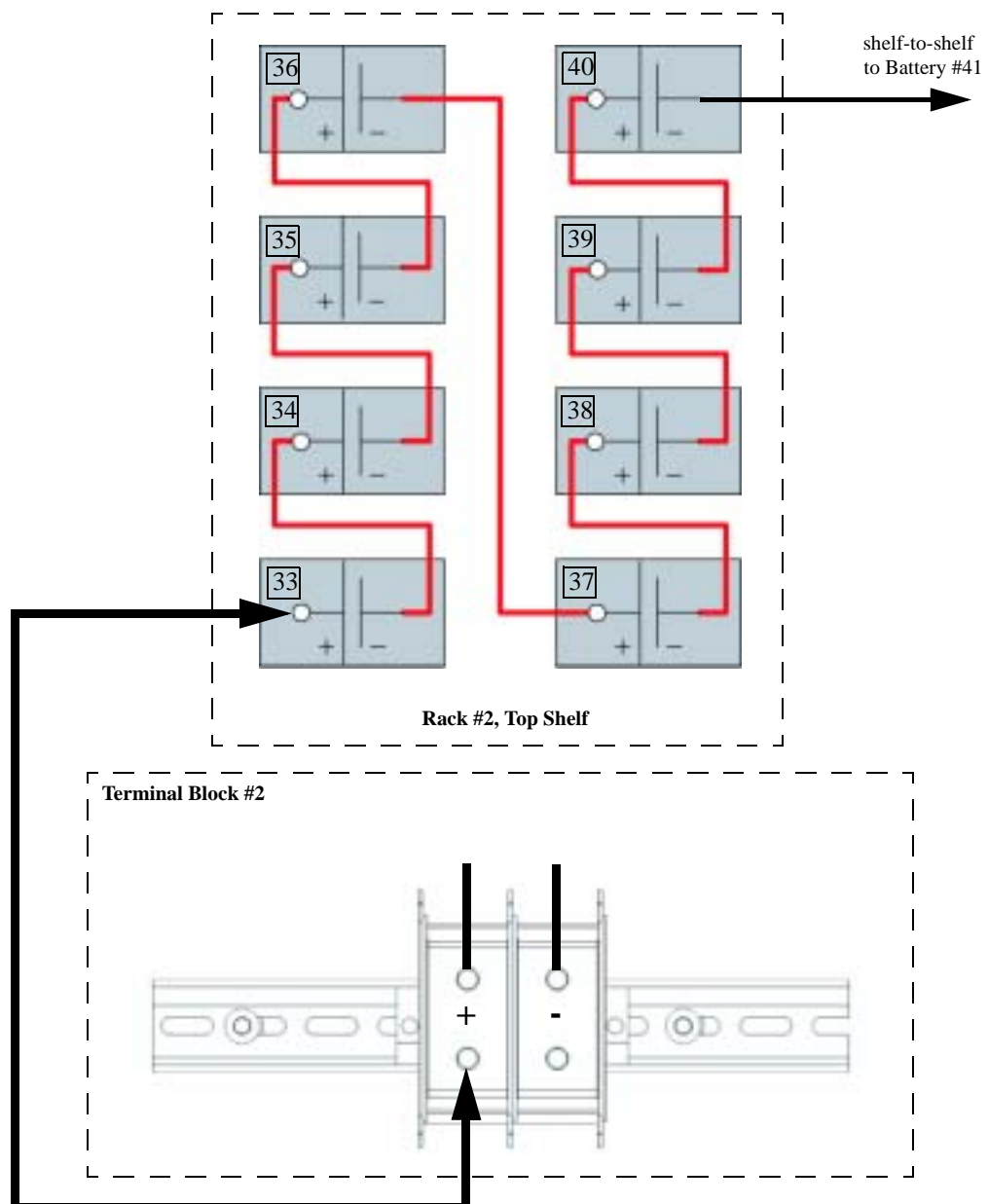
At Battery #32: Connect the lug on the cable end WITH the boot to the open negative (-) terminal on Battery #32. Snap the boot over the connected lug/terminal. Use zip ties as needed to relieve cable strain.



3. Using specified cable, connect the open BAT 2+ terminal in Terminal Block #2 to the open positive (+) terminal on Battery #33. Before making connections, apply ONE cable boot. If lug sizes are different, apply boot to the cable end with the SMALLER lug.

At Terminal Block #2: Connect the lug on the cable end WITHOUT the boot to the open BAT 2+ terminal. Secure lug to stud with preset washer and nut. Snake cable end WITH the boot between centrally located rails until it reaches Battery #33.

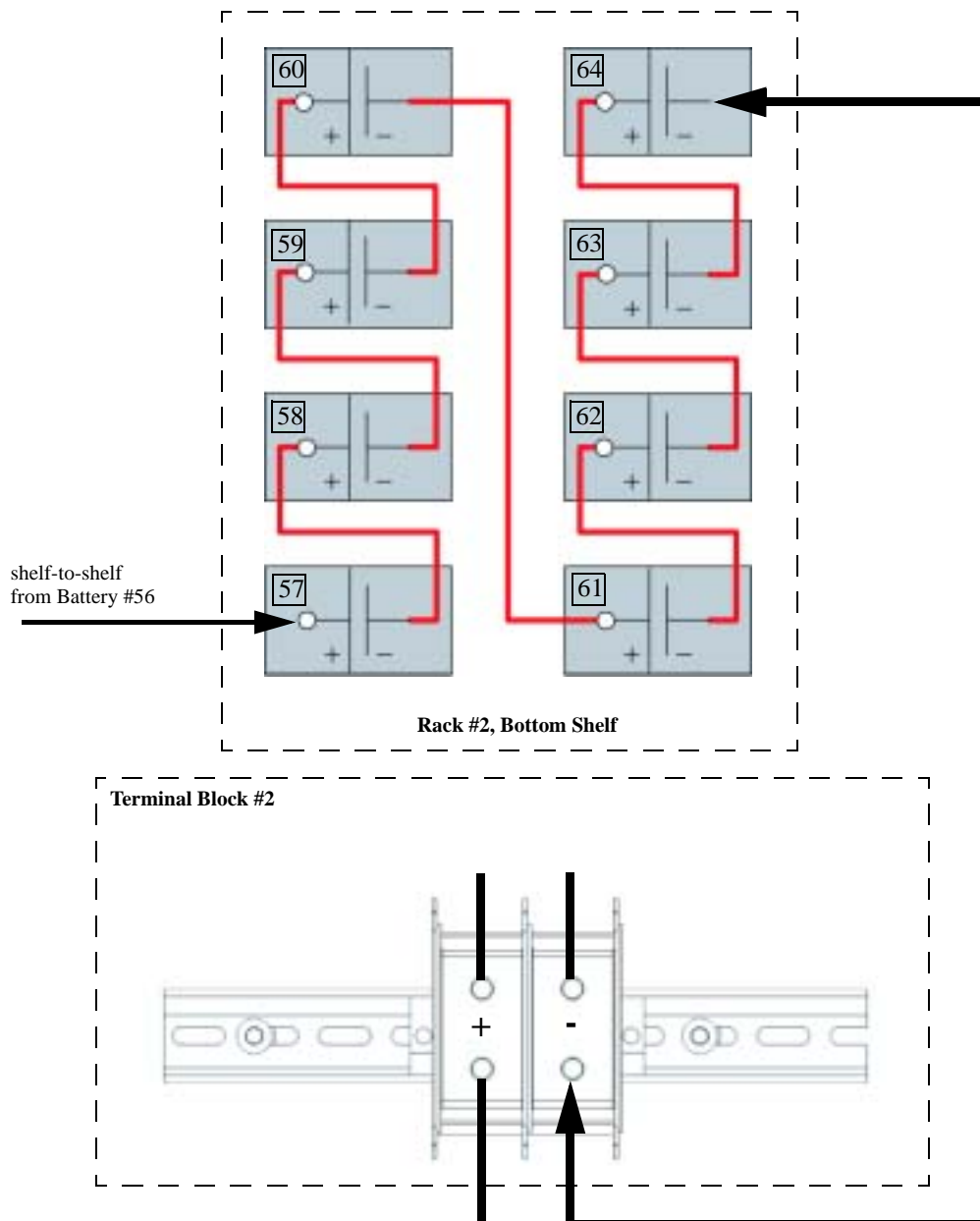
At Battery #33: Connect the lug on the cable end WITH the boot to the open positive (+) terminal on Battery #33. Snap the boot over the connected lug/terminal. Use zip ties as needed to relieve cable strain.



- 4. Using specified cable, connect the open BAT 2- terminal in Terminal Block #2 to the open negative (-) terminal on Battery #64.** Before making connections, apply ONE cable boot. If lug sizes are different, apply boot to the cable end with the SMALLER lug.

At Terminal Block #2: Connect the lug on the cable end WITHOUT the boot to the open BAT 2- terminal. Secure lug to stud with preset washer and nut. Snake cable end WITH the boot between centrally located rails until it reaches Battery #64.

At Battery #64: Connect the lug on the cable end WITH the boot to the open negative (-) terminal on Battery #64. Snap the boot over the connected lug/terminal. Use zip ties as needed to relieve cable strain.



Reattaching terminal block covers

Reattach the snap-off cover to the front face of each terminal block.

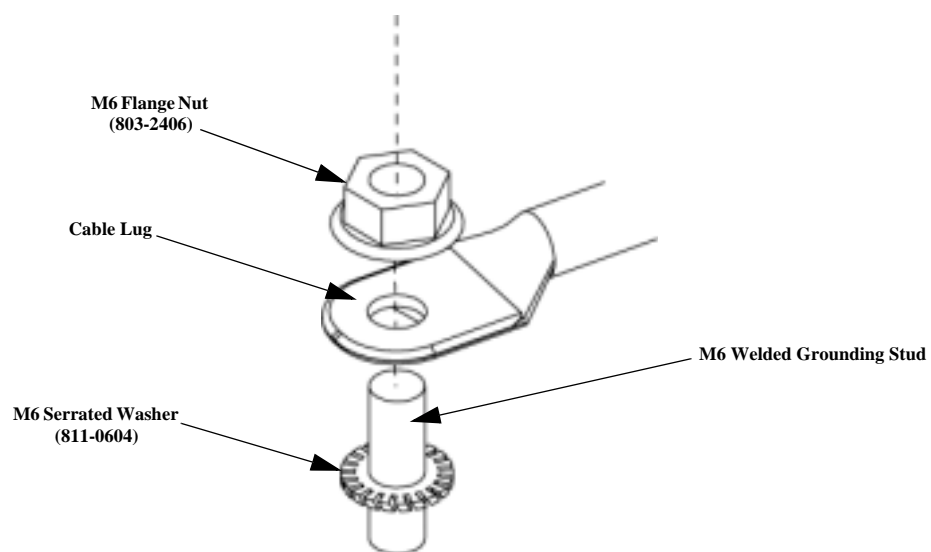
Applying warning labels

Labels must be applied to the more visible areas of the racks to warn of the dangers associated with live batteries.

1. Apply supplied “Warning” Labels to the front-facing Cross Bar on each shelf in the battery racks.
2. Apply supplied “CE Rating” Label (p/n 885-1618) to a highly visible area in the vicinity of the battery installation.

Grounding the racks

Connect an external grounding cable (not supplied) to a grounding stud located in one of the rack’s Bottom Side Subassemblies. Secure the cable to the stud by applying hardware as follows: Serrated washer, Cable lug, Flange nut.

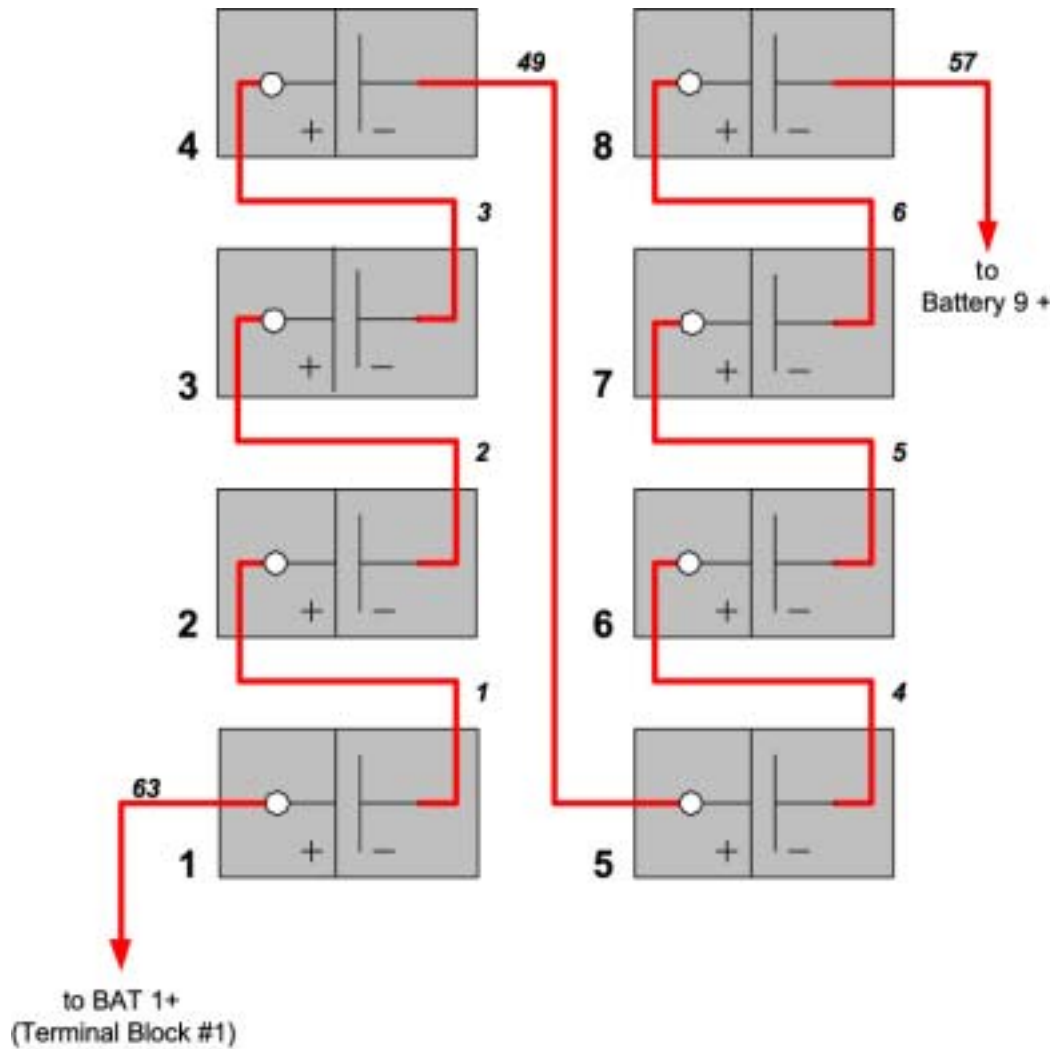


Glossary

AH	Ampere-hour	in-lbs	Inch-pounds
APC	American Power Conversion	kg	Kilogram
battery rails	Adjustable rails that rest on cross bars and hold batteries	lb	Pound
BOM	Bill of Materials	mm	Millimeter
C	Centigrade (degrees)	Ohmmeter	Instrument used to indicate resistance (in ohms)
cross bars	Bars between subassemblies that support battery rails	p/n	Part number
cross braces	Rack stabilizing braces between subassemblies	shims	Metal spacers used to level rack due to uneven flooring
electrolyte	A non-metallic electrical conductor	subassembly	A component part comprised of other parts
F	Fahrenheit (degrees)	torque	Tightening measure applied to nuts and bolts
frame	Main support structure of battery rack	UPS	Uninterruptible Power Supply
IEC	International Electric Code		

Appendix A: Battery Wiring Style E

Style E, rack #1, shelf #1 (top)

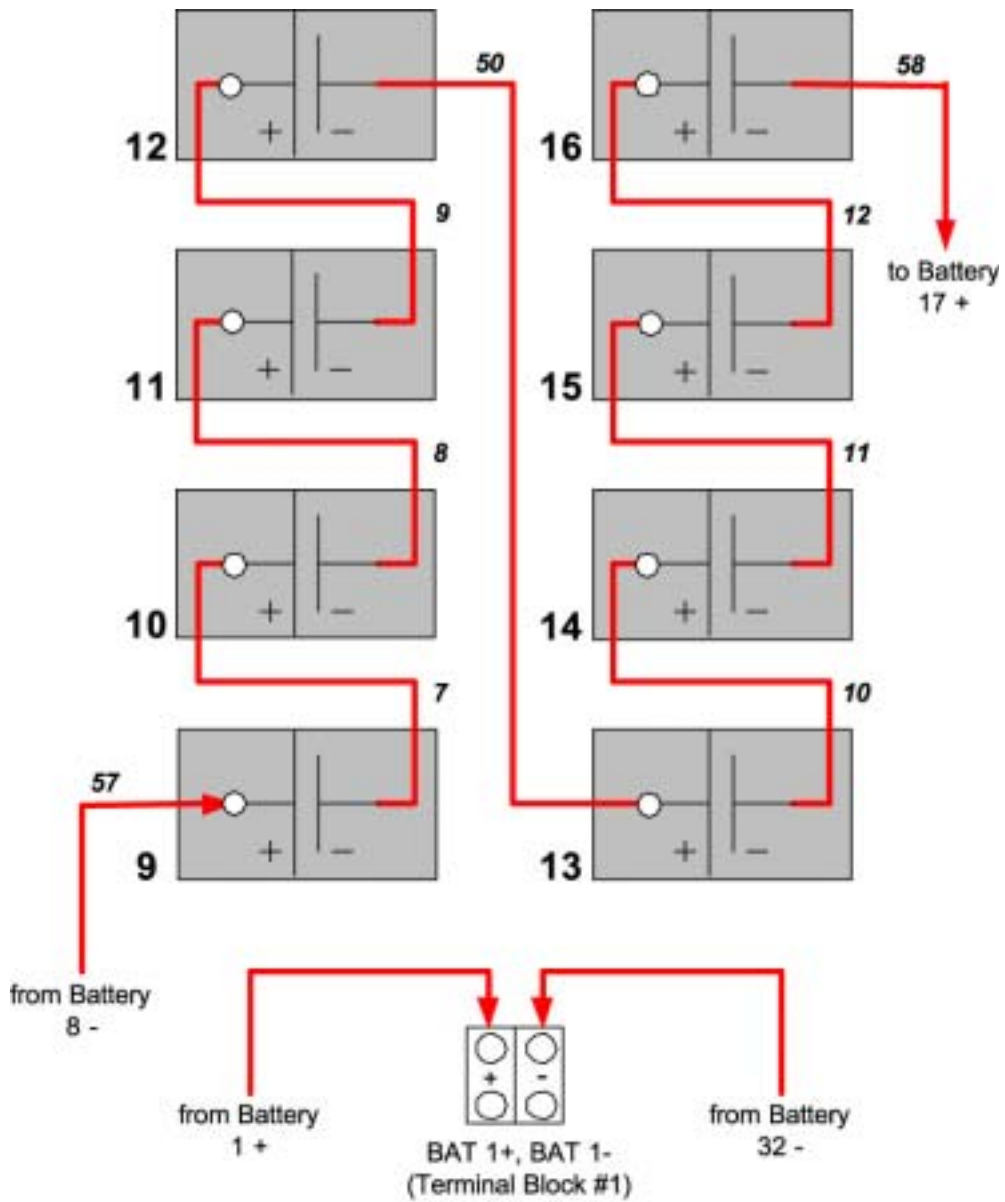


Front of Battery Rack

The following connections must be made to the TOP shelf in Rack #1:

- Battery-to-battery: cables 1-6
- Row-to-row: cable 49
- Shelf-to-shelf: cable 57
- Battery-to-terminal block: cable 63

Style E, rack #1, shelf #2

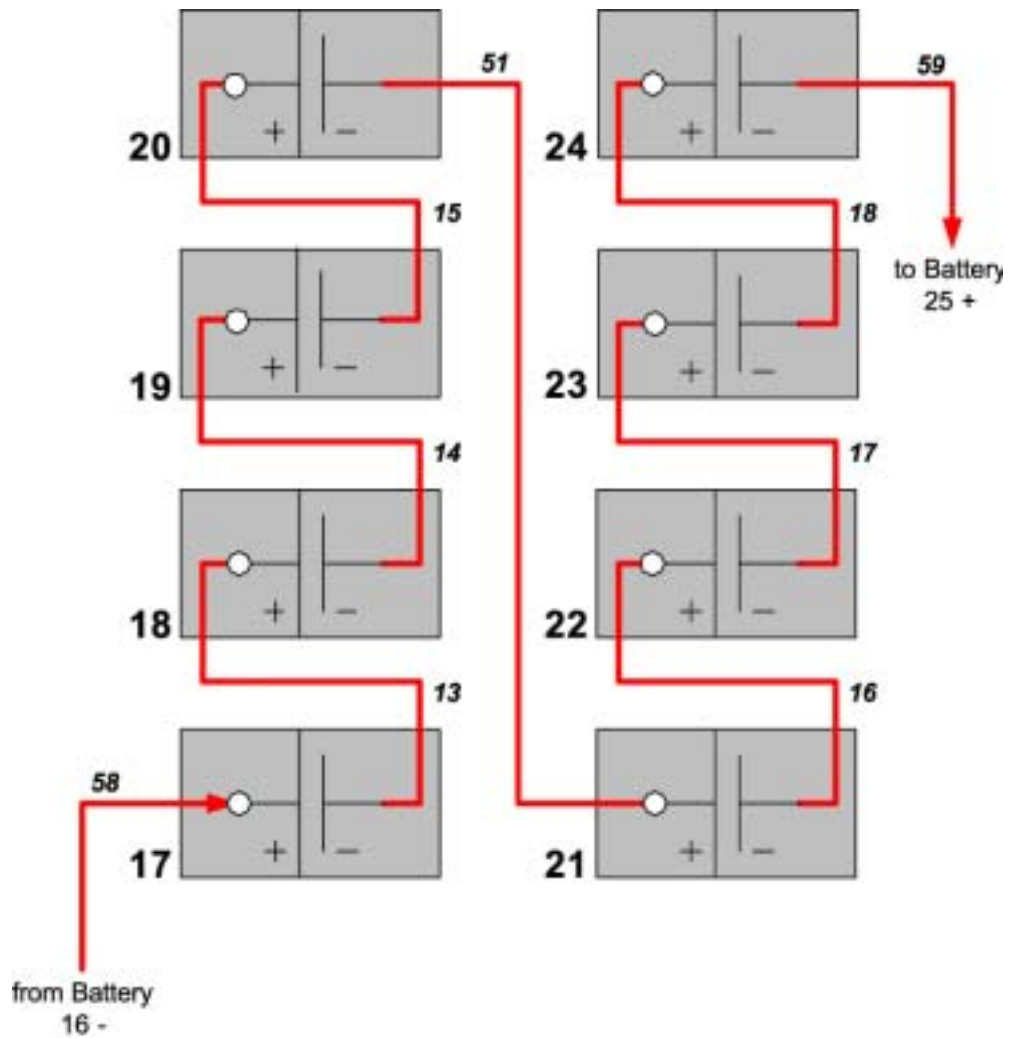


Front of Battery Rack

The following connections must be made to the SECOND shelf in Rack #1:

- Battery-to-battery: cables 7-12
- Row-to-row: cable 50
- Shelf-to-shelf: cable 58
- Battery-to-terminal block: none

Style E, rack #1, shelf #3

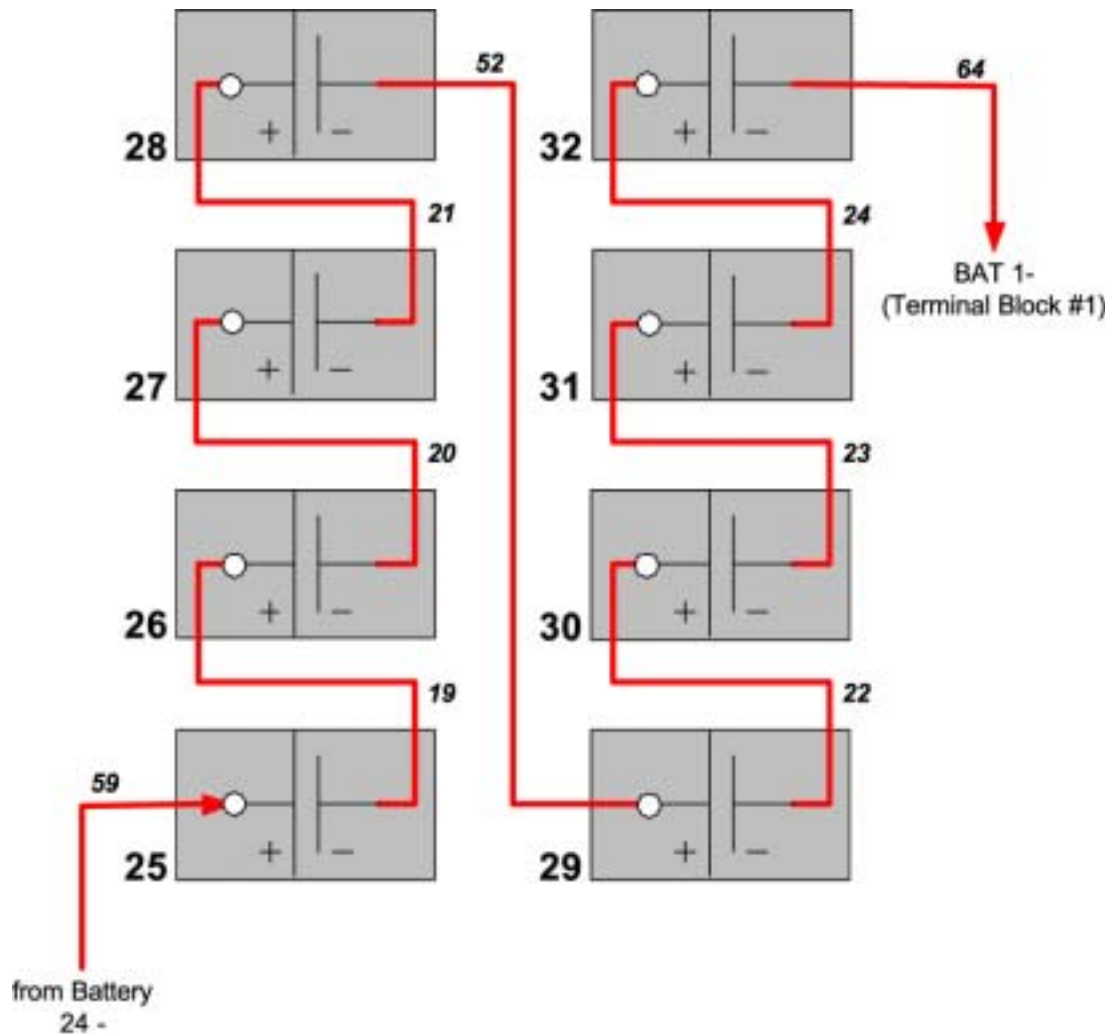


Front of Battery Rack

The following connections must be made to the THIRD shelf in Rack #1:

- Battery-to-battery: cables 13-18
- Row-to-row: cable 51
- Shelf-to-shelf: cable 59
- Battery-to-terminal block: none

Style E, rack #1, shelf #4 (bottom)

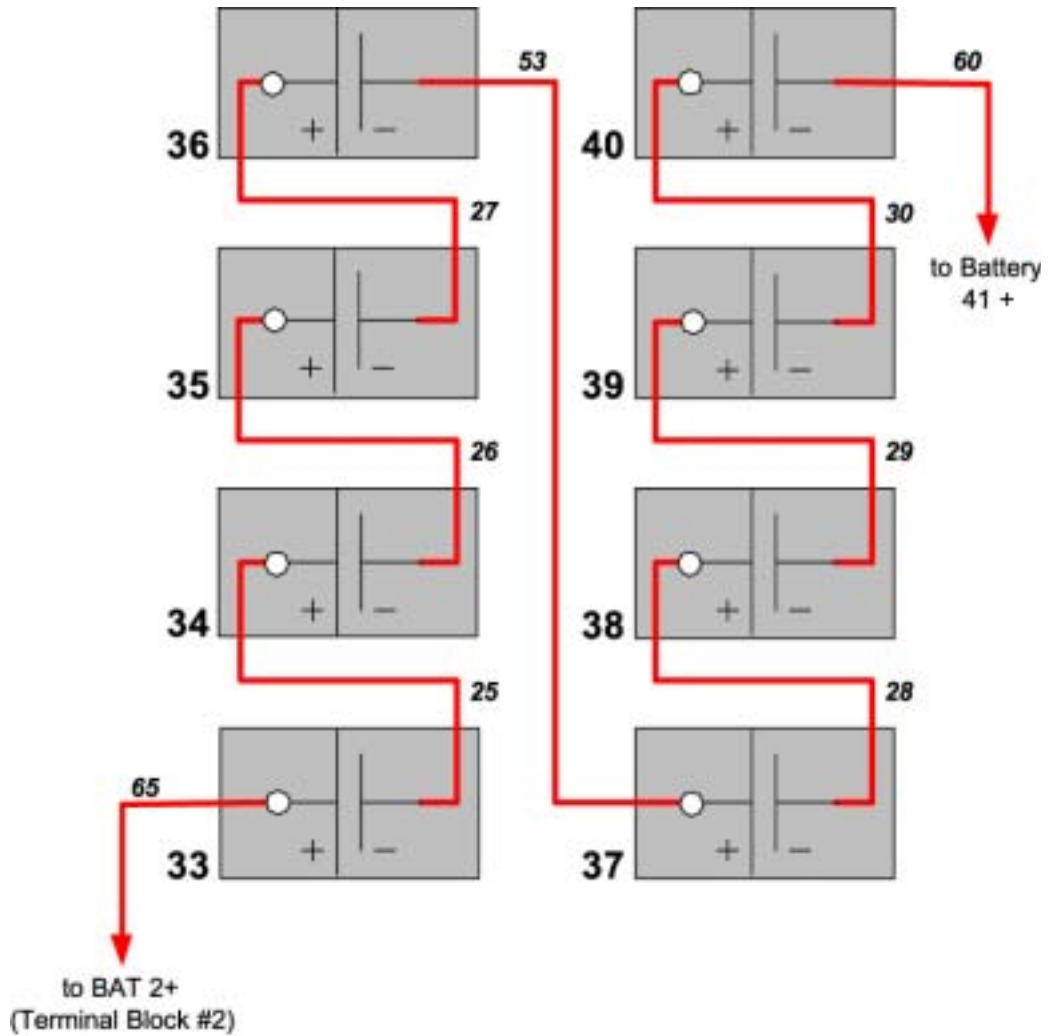


Front of Battery Rack

The following connections must be made to the BOTTOM shelf in Rack #1:

- Battery-to-battery: cables 19-24
- Row-to-row: cable 52
- Shelf-to-shelf: none (accepts cable 59)
- Battery-to-terminal block: cable 64

Style E, rack #2, shelf #1 (top)

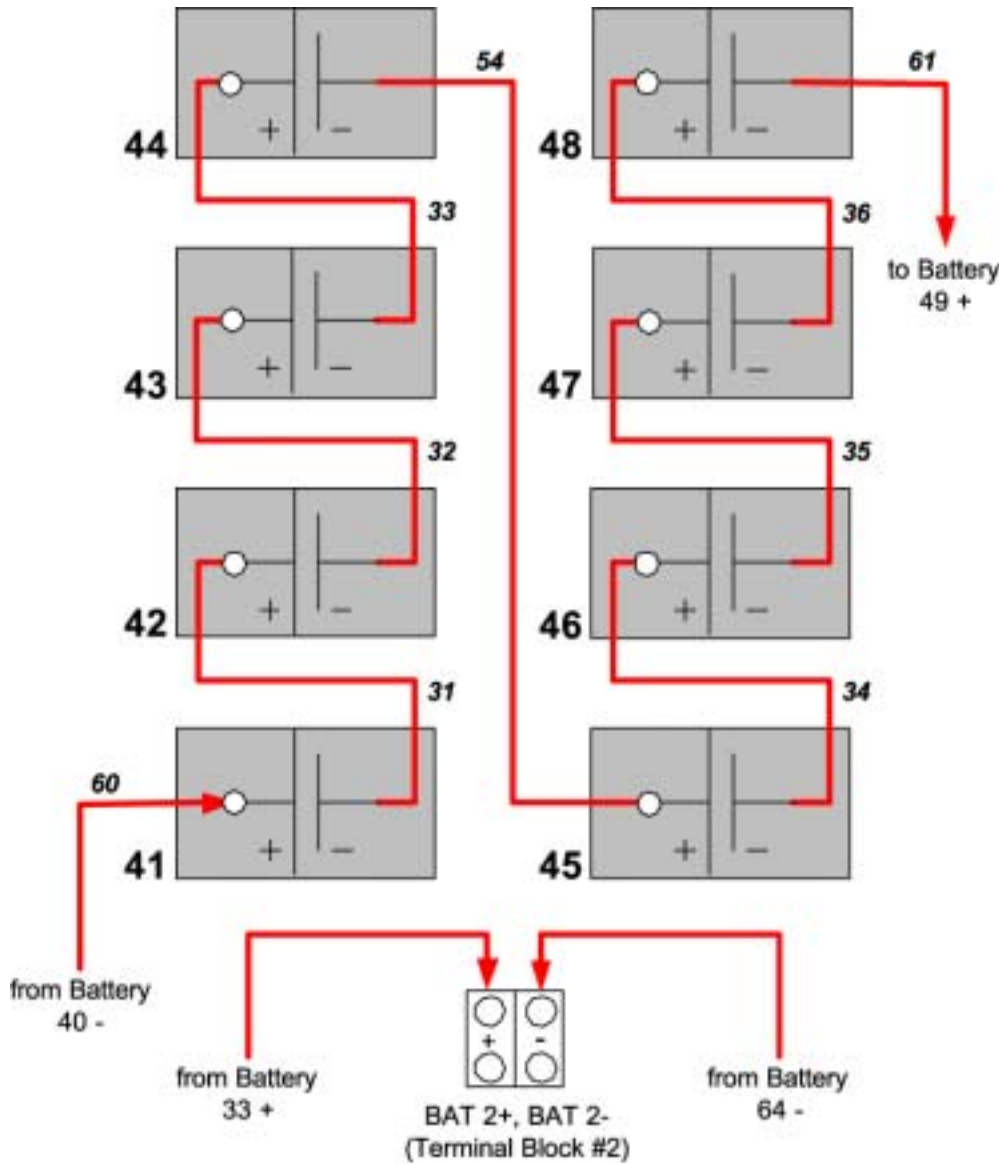


Front of Battery Rack

The following connections must be made to the TOP shelf in Rack #2:

- Battery-to-battery: cables 25-30
- Row-to-row: cable 53
- Shelf-to-shelf: cable 60
- Battery-to-terminal block: cable 65

Style E, rack #2, shelf #2

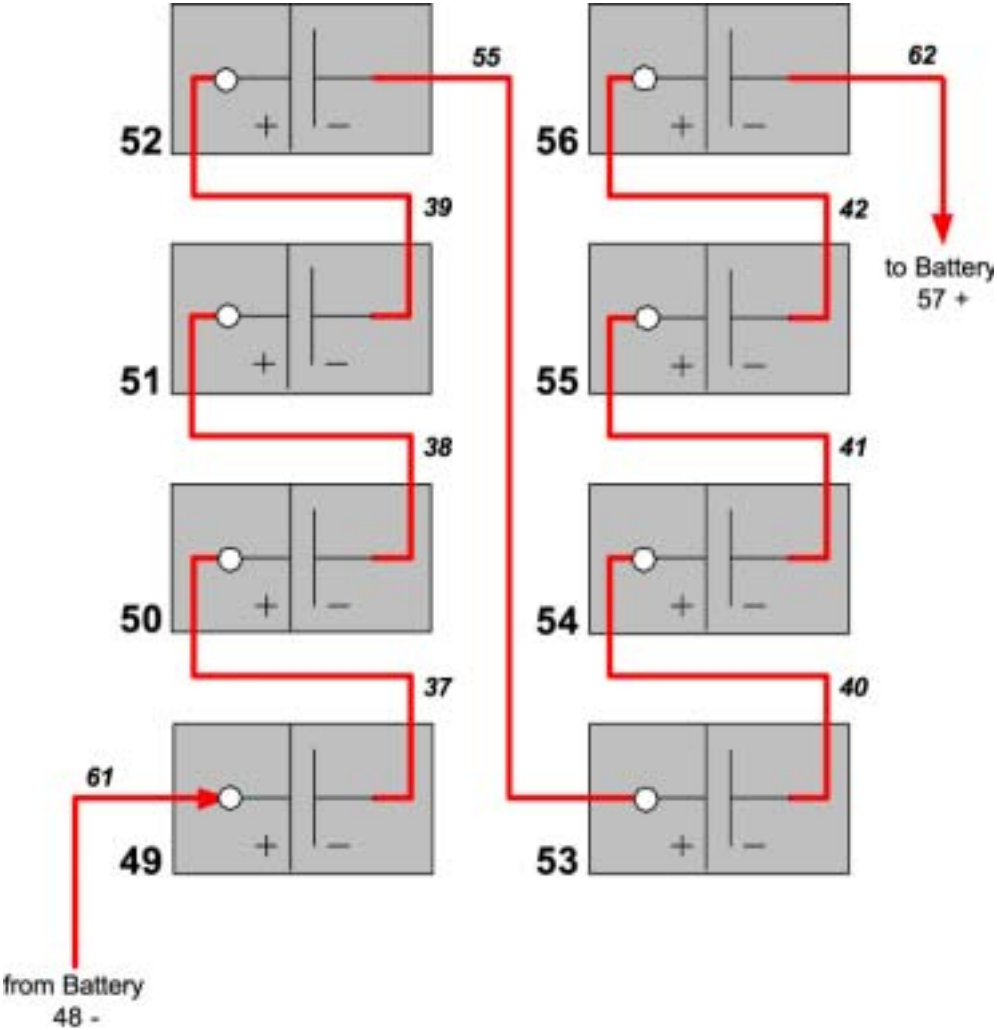


Front of Battery Rack

The following connections must be made to the SECOND shelf in Rack #2:

- Battery-to-battery: cables 31-36
- Row-to-row: cable 54
- Shelf-to-shelf: cable 61
- Battery-to-terminal block: none

Style E, rack #2, shelf #3

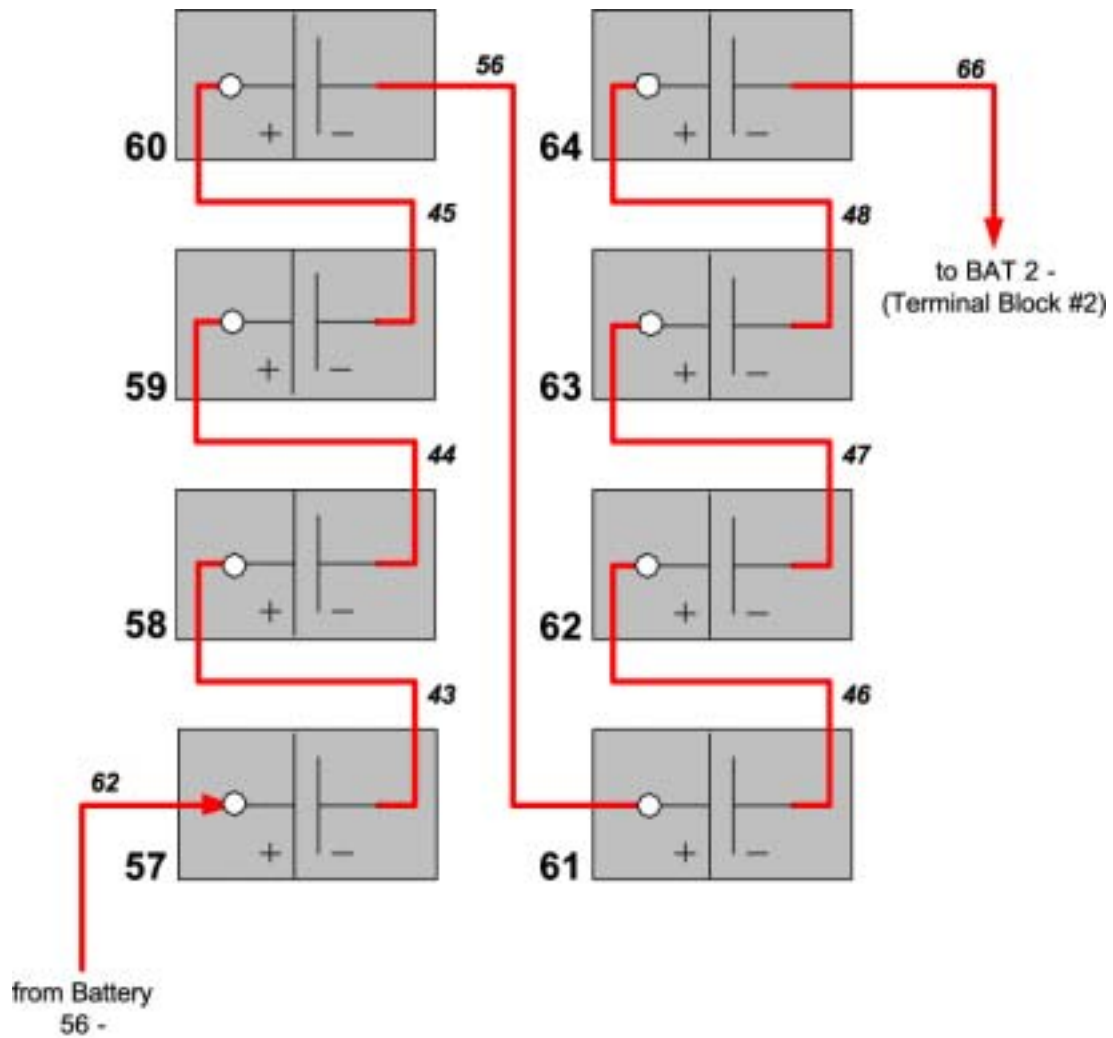


Front of Battery Rack

The following connections must be made to the THIRD shelf in Rack #2:

- Battery-to-battery: cables 37-42
- Row-to-row: cable 55
- Shelf-to-shelf: cable 62
- Battery-to-terminal block: none

Style E, rack #2, shelf #4 (bottom)



Front of Battery Rack

The following connections must be made to the BOTTOM shelf in Rack #2:

- Battery-to-battery: cables 43-48
- Row-to-row: cable 56
- Shelf-to-shelf: none (accepts cable 62)
- Battery-to-terminal block: cable 66

Appendix B: Battery Cabling Kits

References for Power battery cables:

Product SKU: SYR400k1000HxR

Ref Des	Qty	Use	Length	P/n
1-48	48	Battery-to-Battery	356 mm	0W01883
49-56	8	Row-to-Row	914 mm	0W02422
57-62	6	Shelf-to-Shelf	1422 mm	0W01881
63-66	4	Battery-to-Terminal	1219 mm	0W02394

References for Fiamm battery cables:

Product SKU: SYR400k1000HxR

Ref Des	Qty	Use	Length	P/n
1-48	48	Battery-to-Battery	914 mm	0W02422
49-56	8	Row-to-Row	914 mm	0W02422
57-62	6	Shelf-to-Shelf	1422 mm	0W01881
63-66	4	Battery-to-Terminal	1219 mm	0W02394

Appendix C: Employing Sidecars

Sidecar overview

Battery racks can be situated in one or more locations separate and apart from the battery breakers. In these instances, a sidecar should be employed at each separated location to prevent distance from compromising electrical connectivity. Sidecars permit use of larger output cables to alleviate the problem of power degradation.

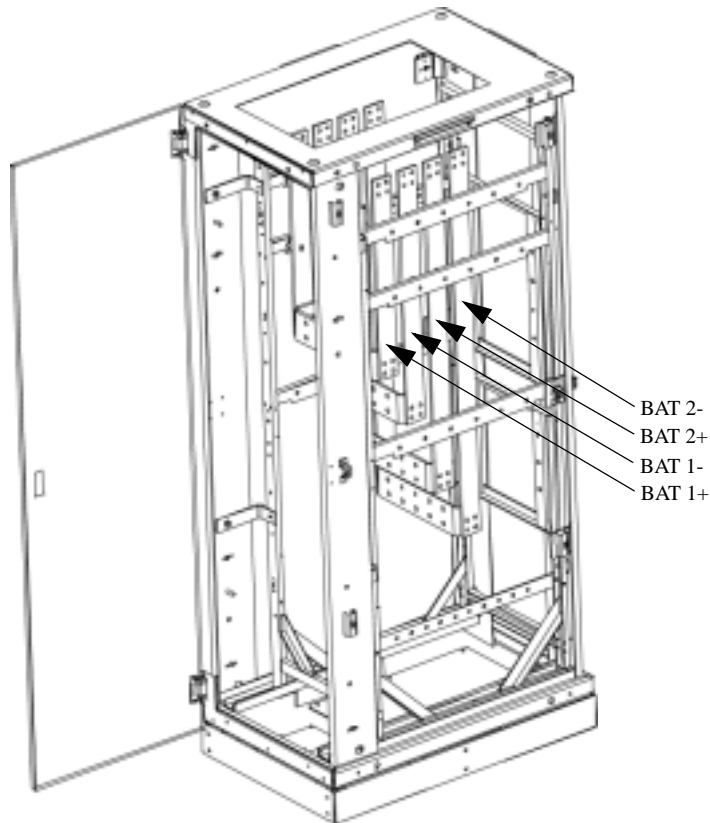


Note

Separated sidecars must be grouped in multiples of two (2, 4, 6, 8, etc.).

Sidecar enclosures measure approximately 585 mm (W) x 914 mm (D) x 2032 mm (H) [23" x 36" x 80"] and weigh approximately 227 kg [500 lb].

Each sidecar contains four distinct U-shaped busbar sets (with landing holes) for connecting a) inputs FROM the battery racks, and b) outputs TO the battery breakers. Each U-shaped set consists of two vertical **input** bars and one horizontal **output** bar. The horizontal bars are “staggered” (in terms of height and depth) to avoid congestion when connecting the larger output cables to them. The sets are designated as follows from front-to-back: BAT 1+, BAT 1-, BAT 2+, and BAT 2-.

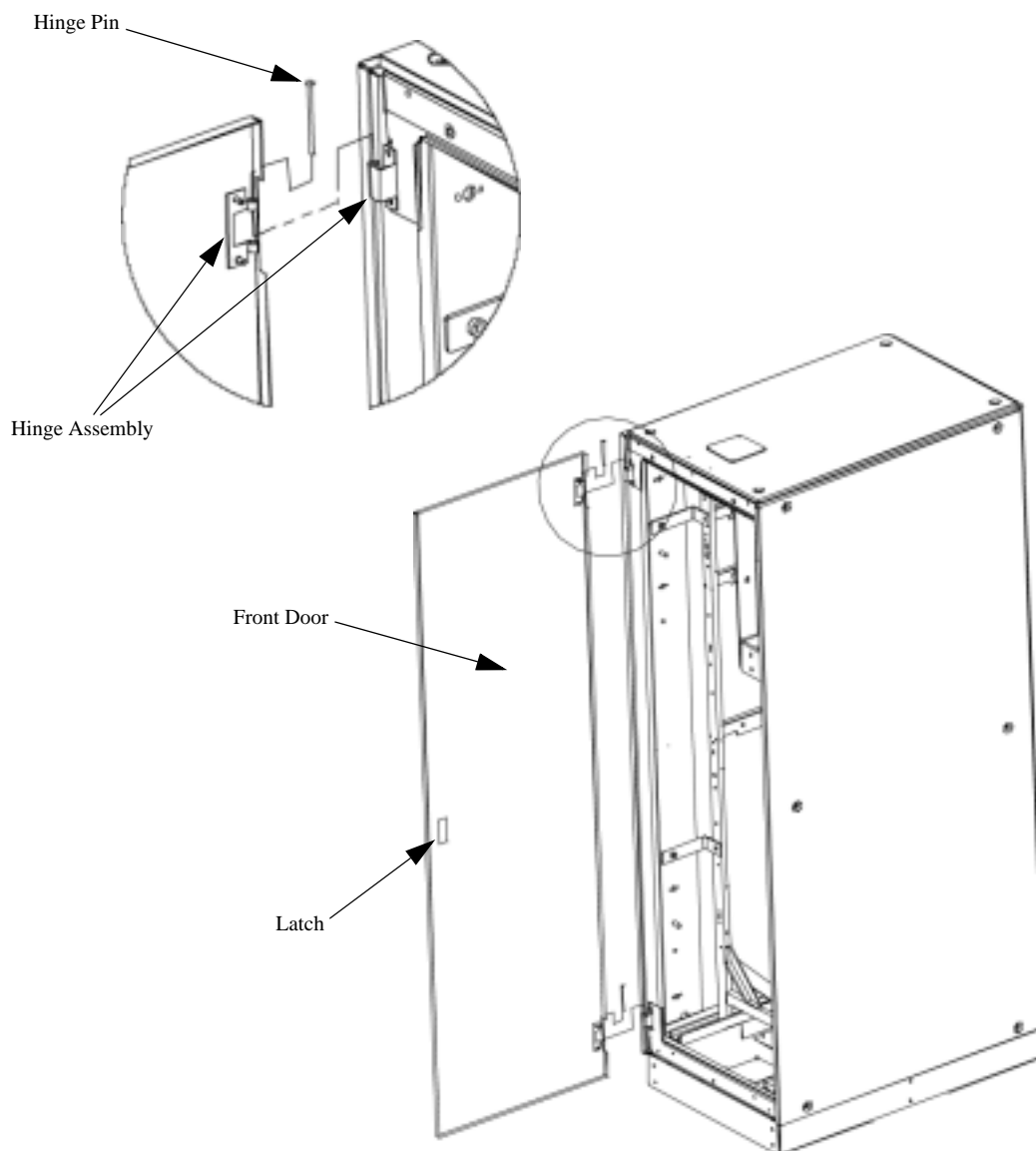


Positioning and accessing the sidecar

The sidecar is typically positioned alongside one of the separated racks it supports, and ideally should be positioned closest (of all units in the group) to the battery breakers.

Sidecars offer full front access to all of their internal components. The sidecar's front door is secured by a key lock (keys are included). Open the front door by first releasing and then twisting the latch a quarter-turn to the left. The door can be removed completely by releasing its two hinge pins.

While the sidecar offers both top and bottom cable entry, TOP is recommended. A torx-head screwdriver is needed to remove the four (4) corner screws securing the top plate to the enclosure, or (if using bottom entry) the six (6) perimeter screws securing the bottom plate.



Connecting terminal blocks to sidecars

To minimize risk, *terminal block-to-sidecar* connections are made prior to *sidecar-to-battery breaker* connections and *battery-to-terminal block* connections. TOP entry of 120 mm² [#4/0] cable (not supplied) is recommended for all connections specified in this section. Each terminal block assembly contains preset hardware for securing cable lugs.

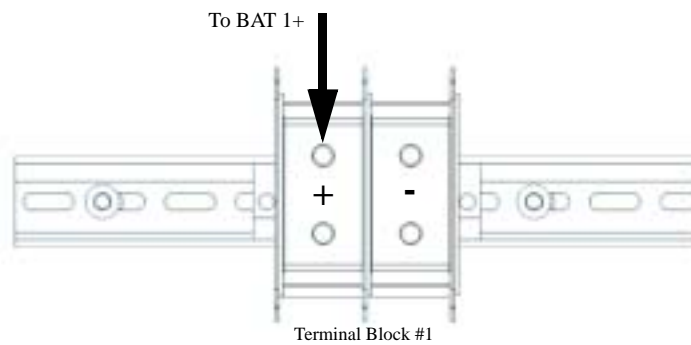


Note

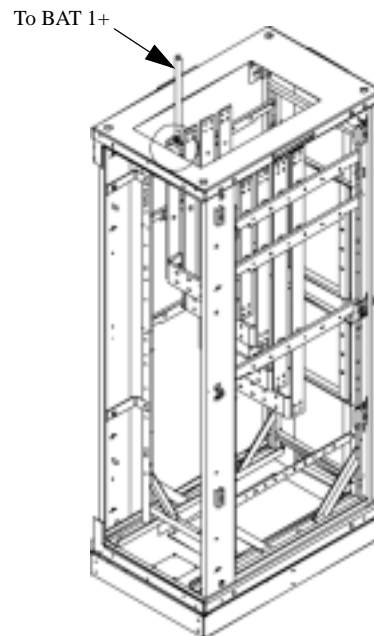
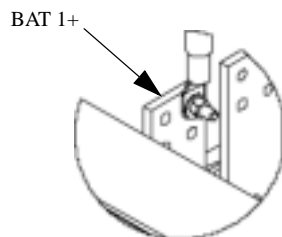
All external cable must comply with European and local electrical code.

- 1. Using one (1) 120 mm² [#4/0] cable, connect the BAT 1+ terminal in Terminal Block #1 to either of the two BAT 1+ vertical bars in the Sidecar.**

At Terminal Block #1: If using top cable entry, connect to top terminal (as shown) of the BAT 1+ segment on left. Otherwise, connect to bottom terminal. Secure lug to stud with preset washer and nut. To relieve strain, zip tie cable to the shelf directly above the terminal block.

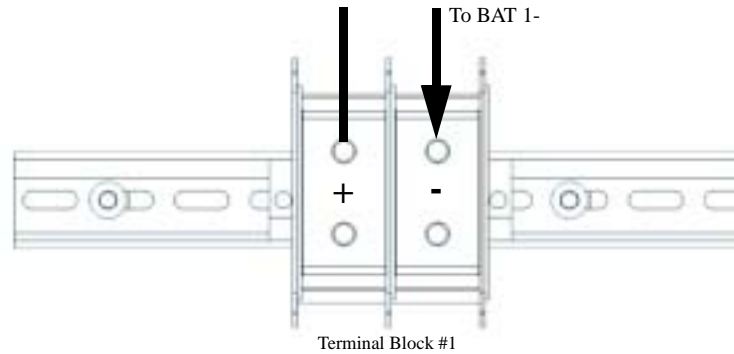


At the Sidecar: Connect other cable end to one of the single-hole landings atop either of the BAT 1+ vertical bars. Secure lug to landing with M10 [3/8"] bolt, washer, lock washer, and hex nut (hardware is not supplied).

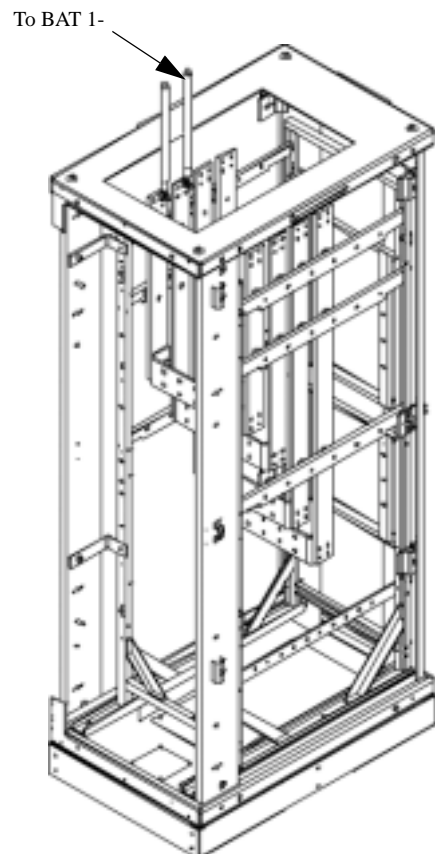


- Using one (1) 120 mm² [#4/0] cable, connect the BAT 1- terminal in Terminal Block #1 to either of the two BAT 1- vertical bars in the Sidecar.

At Terminal Block #1: If using top cable entry, connect to top terminal (as shown) of the BAT 1- segment on right. Otherwise, connect to bottom terminal. Secure lug to stud with preset washer and nut. To relieve strain, zip tie cable to the shelf directly above the terminal block.

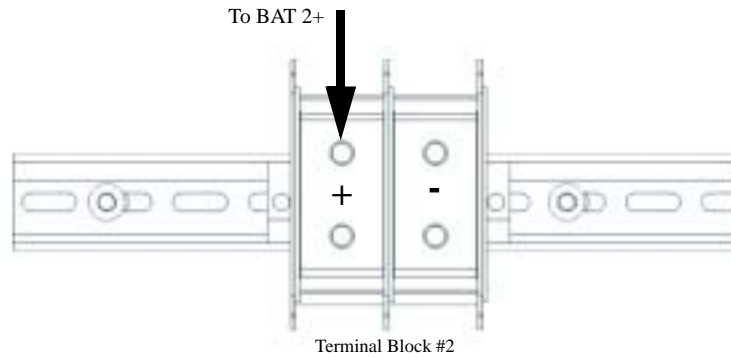


At the Sidecar: Connect other cable end to one of the single-hole landings atop either of the BAT 1- vertical bars. Secure lug to landing with M10 [3/8"] bolt, washer, lock washer, and hex nut (hardware is not supplied).

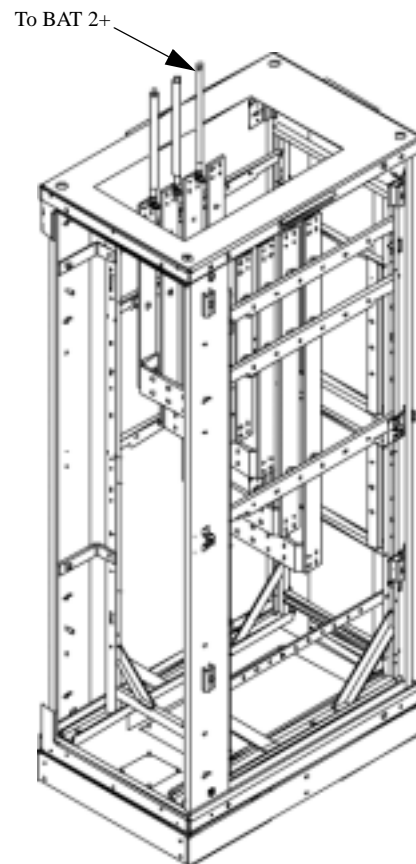


3. Using one (1) 120 mm² [#4/0] cable, connect the BAT 2+ terminal in Terminal Block #2 to either of the two BAT 2+ vertical bars in the Sidecar.

At Terminal Block #2: If using top cable entry, connect to top terminal (as shown) of the BAT 2+ segment on left. Otherwise, connect to bottom terminal. Secure lug to stud with preset washer and nut. To relieve strain, zip tie cable to the shelf directly above the terminal block.

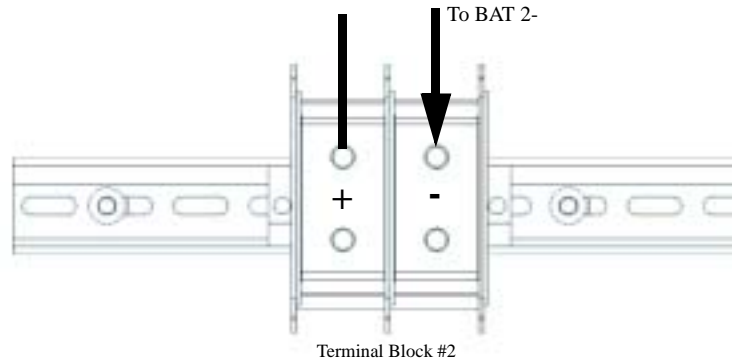


At the Sidecar: Connect other cable end to one of the single-hole landings atop either of the BAT 2+ vertical bars. Secure lug to landing with M10 [3/8"] bolt, washer, lock washer, and hex nut (hardware is not supplied).

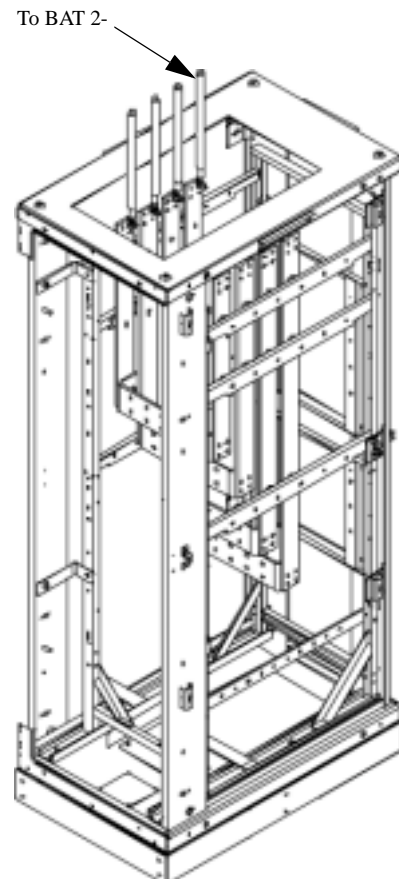


4. Using one (1) 120 mm² [#4/0] cable, connect the BAT 2- terminal in Terminal Block #2 to either of the two BAT 2- vertical bars in the Sidecar.

At Terminal Block #2: If using top cable entry, connect to top terminal (as shown) of the BAT 2- segment on right. Otherwise, connect to bottom terminal. Secure lug to stud with preset washer and nut. To relieve strain, zip tie cable to the shelf directly above the terminal block.



At the Sidecar: Connect other cable end to one of the single-hole landings atop either of the BAT 2- vertical bars. Secure lug to landing with M10 [3/8"] bolt, washer, lock washer, and hex nut (hardware is not supplied).



5. To connect additional racks to this same sidecar, repeat steps 1-4, while using different landing holes on the sidecar's vertical bars.

Connecting sidecars to battery breakers

To minimize risk, *sidecar-to-battery breaker* connections are made prior to *battery-to-terminal block* connections. TOP entry of 253 mm² [500 MCM] cable (not supplied) is recommended for all connections specified in this section. To avoid cable congestion, the sidecar connections are made from back-to-front in the enclosure.



Be certain battery breakers are in the open (or OFF) position before making connections to them.

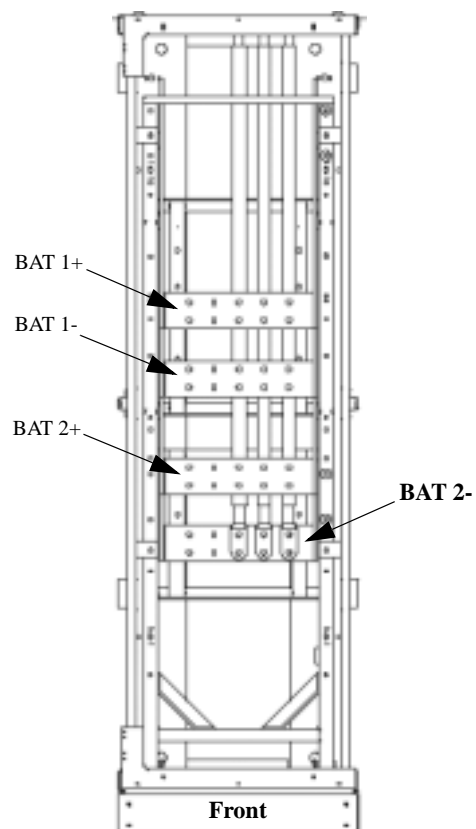
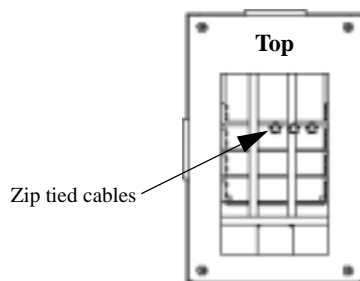


All external cable must comply with European and local electrical code. If using conduit, BAT 1 (+ and -) and BAT 2 (+ and -) cables must be run separately.

- 1. Using three (3) 253 mm² [500 MCM] cables, connect the BAT 2- horizontal bar in the Sidecar to the specified BAT 2- bus in Battery Breaker #2.**

At the Sidecar:

- Make connections to the three (3) two-hole landings nearest the RIGHT side of the BAT 2- horizontal bar (refer to right graphic). If using top cable entry, connect with lugs pointing down. Otherwise, connect with lugs pointing up. Secure the three (3) lugs to their landings with six (6) M12 [1/2"] bolts, washers, lock washers, and hex nuts. Hardware not supplied.
- If using top cable entry, reduce strain by zip tying cables to supports at top of frame (refer to below graphic). Zips not supplied.

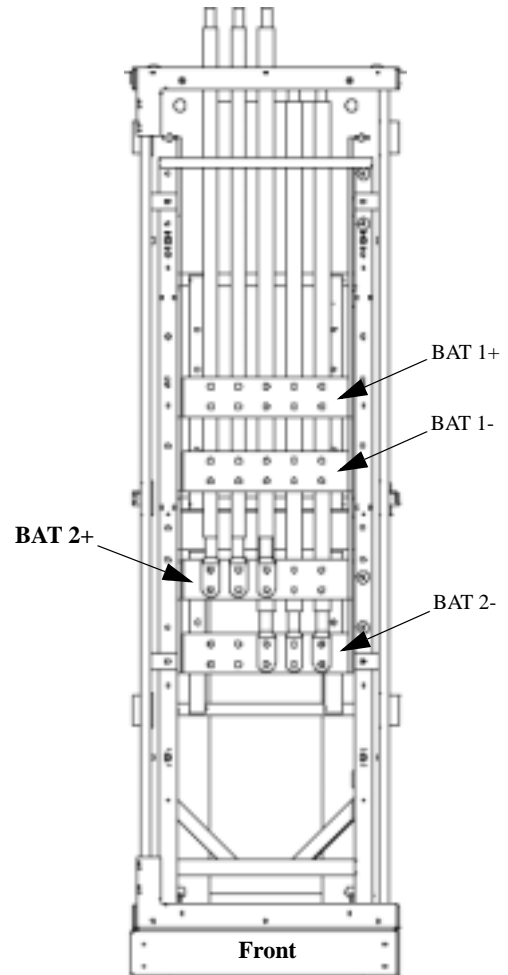
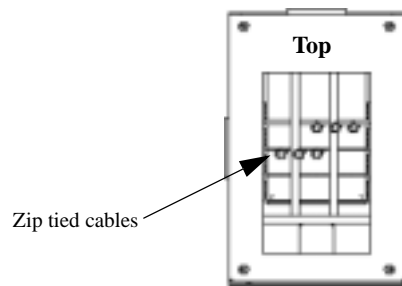


At Battery Breaker #2: Refer to the battery breaker's wiring diagram for the proper BAT 2- lug landings on the other end of these three (3) cables.

2. Using three (3) 253 mm² [500 MCM] cables, connect the BAT 2+ horizontal bar in the Sidecar to the specified BAT 2+ bus in Battery Breaker #2.

At the Sidecar:

- a. Make connections to the three (3) two-hole landings nearest the LEFT side of the BAT 2+ horizontal bar (refer to right graphic). If using top cable entry, connect with lugs pointing down. Otherwise, connect with lugs pointing up. Secure the three (3) lugs to their landings with six (6) M12 [1/2"] bolts, washers, lock washers, and hex nuts. Hardware not supplied
- b. If using top cable entry, reduce strain by zip tying cables to supports at top of frame (refer to below graphic). Zips not supplied.

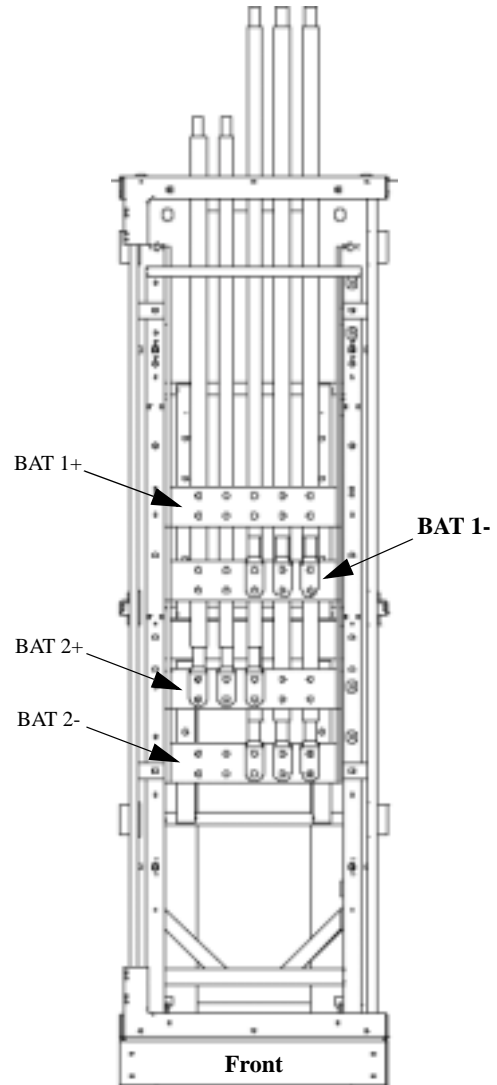
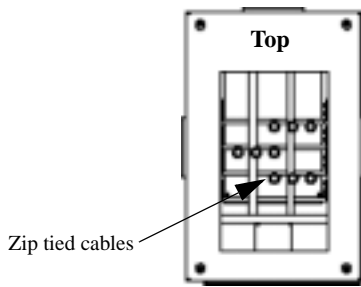


At Battery Breaker #2: Refer to the battery breaker's wiring diagram for the proper BAT 2+ lug landings on the other end of these three (3) cables.

3. Using three (3) 253 mm² [500 MCM] cables, connect the BAT 1- horizontal bar in the Sidecar to the specified BAT 1- bus in Battery Breaker #1.

At the Sidecar:

- a. Make connections to the three (3) two-hole landings nearest the RIGHT side of the BAT 1- horizontal bar (refer to right graphic). If using top cable entry, connect with lugs pointing down. Otherwise, connect with lugs pointing up. Secure the three (3) lugs to their landings with six (6) M12 [1/2"] bolts, washers, lock washers, and hex nuts. Hardware not supplied.
- b. If using top cable entry, reduce strain by zip tying cables to supports at top of frame (refer to below graphic). Zips not supplied.

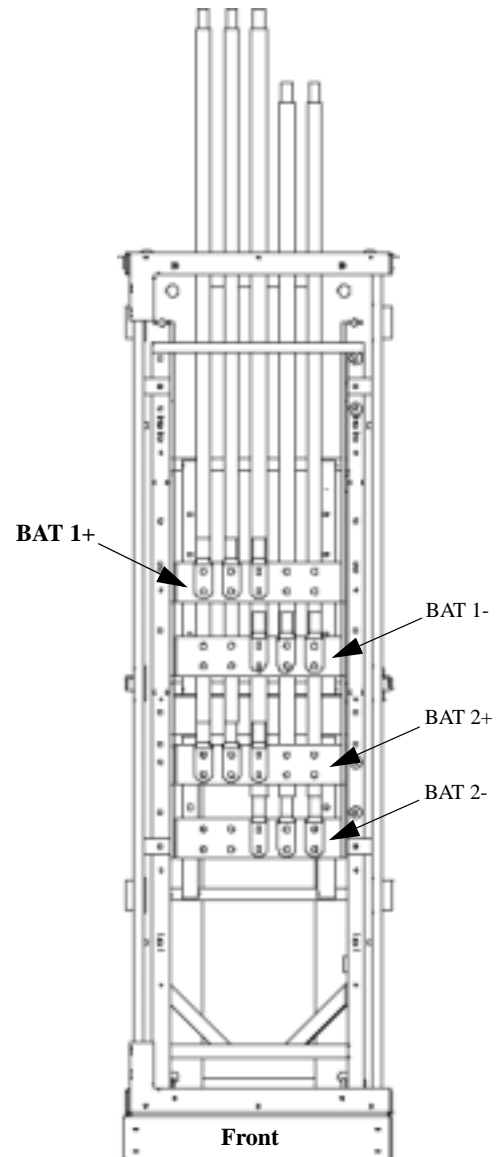
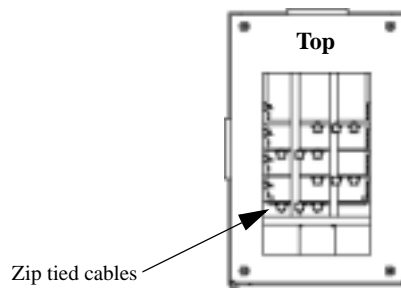


At Battery Breaker #1: Refer to the battery breaker's wiring diagram for the proper BAT 1- lug landings on the other end of these three (3) cables.

4. Using three (3) 253 mm² [500 MCM] cables, connect the BAT 1+ horizontal bar in the Sidecar to the specified BAT 1+ bus in Battery Breaker #1.

At the Sidecar:

- a. Make connections to the three (3) two-hole landings nearest the LEFT side of the BAT 1+ horizontal bar (refer to right graphic). If using top cable entry, connect with lugs pointing down. Otherwise, connect with lugs pointing up. Secure the three (3) lugs to their landings with six (6) M12 [1/2"] bolts, washers, lock washers, and hex nuts. Hardware not supplied.
- b. If using top cable entry, reduce strain by zip tying cables to supports at top of frame (refer to below graphic). Zips not supplied.



At Battery Breaker #1: Refer to the battery breaker's wiring diagram for the proper BAT 1+ lug landings on the other end of these three (3) cables.



Continue the rack assembly process, starting with "Connecting terminal blocks to batteries" on page 28.

Note

APC Warranty on Batteries

APC warrants that its supplied High-Rate series of Valve Regulated Lead Acid batteries will be free of defects in material and workmanship for a period of one (1) year from date of shipment. This amounts to the same basic warranty that is being offered by the leading battery manufacturers. Additional coverage can be procured through purchase of an extended warranty. Call your APC representative for information concerning the various types of extended warranties available.

Battery functionality is typically impacted by age and environmental conditions, and therefore certain requirements must be met by the end-user pursuant to this warranty. Failure to adhere to the following conditions may put the warranty at risk.

APC-supplied batteries must always be kept in a climate-controlled environment, and should be re-charged at a minimum of every three (3) months in situations where no automatic charging takes place. The battery environment must be free of excessive moisture, construction dirt, corrosive elements, or other contaminants. The temperature range must be maintained at 22° to 25° C / 72° to 77° F for batteries in an operating environment, and 0° to 25° C / 32° to 77° F for batteries in a storage environment. The relative humidity must be maintained at 0 to 95%, non-condensing.

APC must be notified immediately upon suspicion of possible battery defects, and be subsequently given authority to inspect any sites containing potentially defective batteries. If APC determines its supplied batteries to be defective due to material or workmanship, APC will repair or replace those batteries at its option, F.O.B. factory, without charge. Should battery repair or replacement occur as a result of this warranty, the warranty period will be pro-rated accordingly.

APC shall not be liable under this warranty if its testing and examination disclose that the alleged defect in the product does not exist or was caused by the purchaser's, or any third person's misuse, negligence, improper installation or testing, unauthorized attempts to repair or modify, or any other cause beyond the range of the intended use, or by accident, fire, lightning, or other hazard.

There are no warranties, express or implied, by operation of law or otherwise, of products sold or furnished under this agreement or in connection herewith. APC disclaims all implied warranties of merchantability, satisfaction, and fitness for a particular purpose. APC's express warranties will not be enlarged, diminished, or affected by and no obligation of liability will arise out of, APC's rendering of technical or other advice or service in connection with the products. The foregoing warranties and remedies are exclusive and in lieu of all other warranties and remedies. APC's warranties run only to purchaser and are not extended to any third parties.

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