



# NetSure™ -48 VDC Power System

Installation Instructions (Section 6025), Revision X

Specification Number: 582136800

Model Number: 502NGFB

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## ADMONISHMENTS USED IN THIS DOCUMENT



**DANGER!** Warns of a hazard the reader *will* be exposed to that will *likely* result in death or serious injury if not avoided. (ANSI, OSHA)



**WARNING!** Warns of a potential hazard the reader *may* be exposed to that *could* result in death or serious injury if not avoided. This admonition is not used for situations that pose a risk only to equipment, software, data, or service. (ANSI)



**CAUTION!** Warns of a potential hazard the reader *may* be exposed to that *could* result in minor or moderate injury if not avoided. (ANSI, OSHA) This admonition is not used for situations that pose a risk only to equipment, data, or service, even if such use appears to be permitted in some of the applicable standards. (OSHA)



**ALERT!** Alerts the reader to an action that *must be avoided* in order to protect equipment, software, data, or service. (ISO)



**ALERT!** Alerts the reader to an action that *must be performed* in order to prevent equipment damage, software corruption, data loss, or service interruption. (ISO)



**FIRE SAFETY!** Informs the reader of fire safety information, reminders, precautions, or policies, or of the locations of fire-fighting and fire-safety equipment. (ISO)



**SAFETY!** Informs the reader of general safety information, reminders, precautions, or policies not related to a particular source of hazard or to fire safety. (ISO, ANSI, OSHA)

# IMPORTANT SAFETY INSTRUCTIONS

## General Safety



**DANGER!** YOU MUST FOLLOW APPROVED SAFETY PROCEDURES.

Performing the following procedures may expose you to hazards. These procedures should be performed by qualified technicians familiar with the hazards associated with this type of equipment. These hazards may include shock, energy, and/or burns. To avoid these hazards:

- a) The tasks should be performed in the order indicated.
- b) Remove watches, rings, and other metal objects.
- c) Prior to contacting any uninsulated surface or termination, use a voltmeter to verify that no voltage or the expected voltage is present.
- d) Wear eye protection.
- e) Use double insulated tools appropriately rated for the work to be performed.

## Voltages

### AC Input Voltages



**DANGER!** This system operates from AC voltage capable of producing fatal electrical shock. AC input power must be completely disconnected from the branch circuits wiring used to provide power to the system before any AC electrical connections are made. DO NOT apply AC power to the system until all electrical connections have been completed and checked.

### DC Input/Output Voltages



**DANGER!** This system produces DC Power and may require battery to be connected to it. Although the DC voltage is not hazardously high, the rectifiers and/or battery can deliver large amounts of current. Exercise extreme caution not to inadvertently contact or have any tool inadvertently contact a battery or output terminal or exposed wire connected to a battery or output terminal. NEVER allow a metal object, such as a tool, to contact more than one termination or battery terminal at a time, or to simultaneously contact a termination or battery terminal and a grounded object. Even a momentary short circuit can cause sparking, explosion, and injury.

## Battery



**WARNING!** Correct polarity must be observed when connecting battery leads.



**WARNING!** Special safety precautions are required for procedures involving handling, installing, and servicing batteries. Observe all battery safety precautions in this manual and in the battery instruction manual. These precautions should be followed implicitly at all times.



**WARNING!** A battery can present a risk of electrical shock and high short circuit current. Servicing of batteries should be performed or supervised only by properly trained and qualified personnel knowledgeable about batteries and the required precautions.

The following precautions should be observed when working on batteries:

- Remove watches, rings, and other metal objects.
- Eye protection should be worn to prevent injury from accidental electrical arcs.
- Use certified and well maintained insulated tools. Use double insulated tools appropriately rated for the work to be performed. Ensure that wrenches with more than one working end have only one end exposed.
- Dispose of used batteries according to the instructions provided with the batteries. Do not dispose of batteries in a fire. They may explode.

ALWAYS FOLLOW THE BATTERY MANUFACTURER'S RECOMMENDATIONS AND SAFETY INSTRUCTIONS.



**CAUTION!** Performing maintenance and/or troubleshooting procedures may interrupt power to the loads, if battery reserve is not sufficient.

## Handling Equipment Containing Static Sensitive Components



**ALERT!** Installation or removal of equipment containing static sensitive components requires careful handling. Before handling any equipment containing static sensitive components, read and follow the instructions contained on the Static Warning Page.

## STATIC WARNING



This equipment contains static sensitive components. The warnings listed below must be observed to prevent damage to these components. Disregarding any of these warnings may result in personal injury or damage to the equipment.

1. Strictly adhere to the procedures provided in this document.
2. Before touching any equipment containing static sensitive components, discharge all static electricity from yourself by wearing a wrist strap grounded through a one megohm resistor. Some wrist straps, such as Vertiv Energy Systems' Part Number 631810600, have a built-in one megohm resistor; no external resistor is necessary. Read and follow wrist strap manufacturer's instructions outlining use of a specific wrist strap.
3. Do not touch traces or components on equipment containing static sensitive components. Handle equipment containing static sensitive components only by the edges that do not have connector pads.
4. After removing equipment containing static sensitive components, place the equipment only on conductive or anti-static material such as conductive foam, conductive plastic, or aluminum foil. Do not use ordinary Styrofoam™ or ordinary plastic.
5. Store and ship equipment containing static sensitive components only in static shielding containers.
6. If necessary to repair equipment containing static sensitive components, wear an appropriately grounded wrist strap, work on a conductive surface, use a grounded soldering iron, and use grounded test equipment.



# CUSTOMER DOCUMENTATION PACKAGE

This document (Section 6025) provides *Installation Instructions* for NetSure™ Power System Model 502NGFB, Spec. No. 582136800.

The complete Customer Documentation Package consists of...

## **System Installation Manual**

- Power System Installation Instructions: Section 6025

## **System User Manual**

- Power System User Instructions: Section 6026
- Rectifier Instructions: UM1R482000e
- Power System “System Application Guide”: SAG582136800
- Engineering Drawings

## **Controller User Manual**


- NCU Controller User Instructions: UM1M830BNA
- ACU+ Controller User Instructions: UM1M820BNA
- SCU+ Controller User Instructions: UM1M521BNA

For factory settings of all configurable Controller parameters, refer to the Configuration Drawing (C-drawing) supplied with your Power System.

# INSTALLATION ACCEPTANCE CHECKLIST

Provided below is an Installation Acceptance Checklist. This checklist helps ensure proper installation and initial operation of the system. As the procedures presented in this document are completed, check the appropriate box on this list. If the procedure is not required to be performed for your installation site, also check the box in this list to indicate that the procedure was read. When installation is done, ensure that each block in this list has been checked. Some of these procedures may have been factory performed for you.

 **NOTE!** The system is not powered up until the end of this checklist.

 **NOTE!** Some of these procedures may have been performed at the factory for you.

## **Installing the System**

- Relay Racks (if required) Secured to Floor
- Shelf(s) Secured to Relay Rack or Cabinet

## **Making Electrical Connections**

- Relay Rack Frame Grounding Connection Made
- Shelf(s) Frame Grounding Connection Made
- Control Bus (CAN BUS) Interconnections Made (List 1-4)
- External Interface Connections Made
- AC Input and AC Input Equipment Grounding Connections Made
- Bulk DC Output Connections Made (List 1-8)
- Load Connections Made (1-Row and 2-Row Distribution Cabinets)
- CO Ground Connection Made
- Battery Connections Made (1-Row and 2-Row Distribution Cabinets)
- External Interface Connections Made
  - Digital Inputs
  - Relay Outputs
  - Temperature Probes
- Remote Shunt Connections Made (For 58213680005 to 58213680008 only)
- Batteries Installed and Connected in an optional Battery Tray (if furnished)
- Optional External Battery Disconnect Unit Connections Made
- Ethernet Connection Made (if required)

### **Installing Rectifier Modules**

- Rectifier Modules Installed

### **Initially Starting the System**

- System Started, Configured, and Checked

### **Expanding the Power System**

- Expansion Shelves Installed
- SM-TEMP Installed

# INSTALLING THE SYSTEM

## General Requirements

- This product is intended only for installation in a Restricted Access Location on or above a non-combustible surface.
- This product must be located in a Controlled Environment with access to Crafts persons only.
- This product is intended for installation in Network Telecommunication Facilities (CO, vault, hut, or other environmentally controlled electronic equipment enclosure).
- This product is intended to be connected to the common bonding network in a Network Telecommunication Facility (CO, vault, hut, or other environmentally controlled electronic equipment enclosure).
- The DC return connection to this system can remain isolated from system frame and chassis (DC-I).
- The installer should be familiar with the installation requirements and techniques to be used in securing the relay rack(s) to the floor.
- Typical industry standards recommend minimum aisle space clearance of 2'6" for the front of the relay rack(s) and 2' for the rear of the relay rack(s).
- The installer should be familiar with the installation requirements and techniques to be used in securing the Shelf(s) to a relay rack or cabinet.
- Rectifier and mounting shelf ventilating openings must not be blocked and temperature of air entering rectifiers must not exceed rated Operating Ambient Temperature Range found in SAG582136800.

## Securing the Relay Rack(s) to the Floor (if furnished)

Secure the relay rack(s) to the floor per site requirements. Refer to the General Requirements section at the beginning of this section.

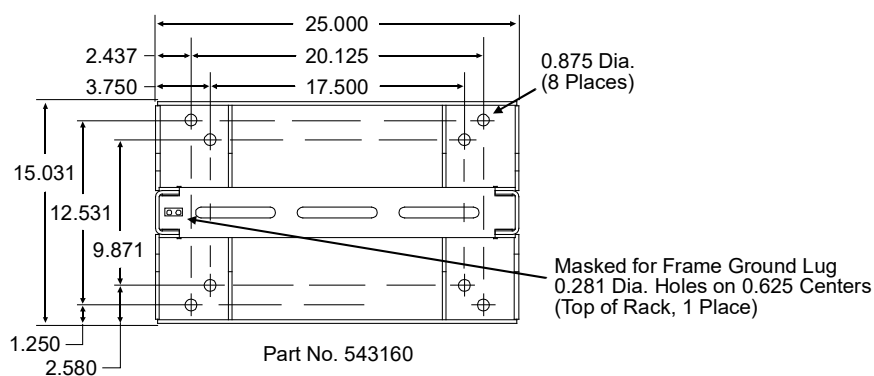
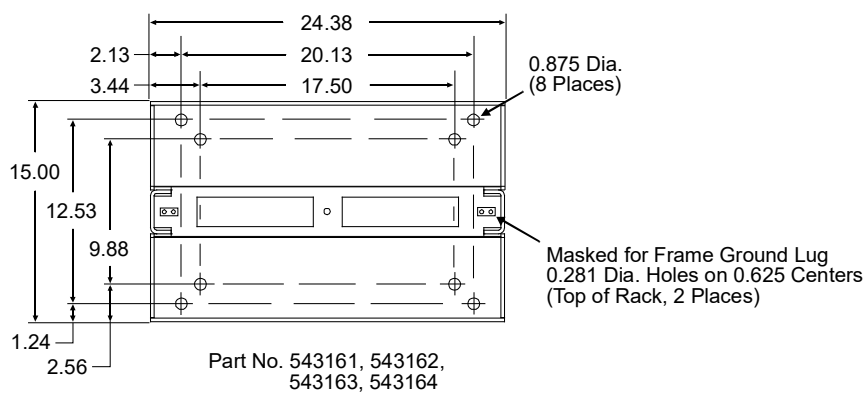
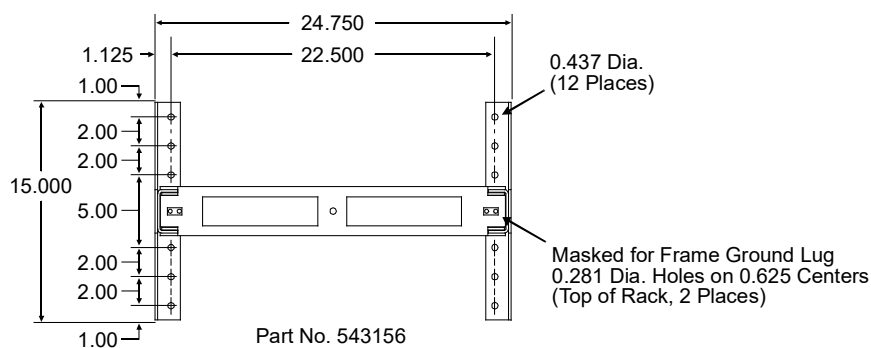
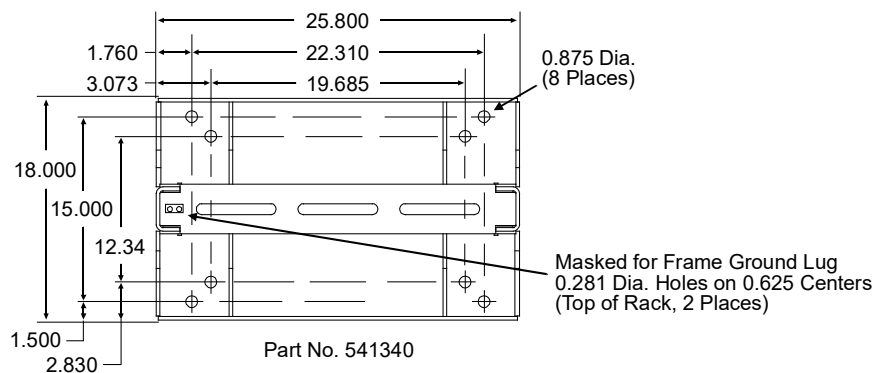
## Ventilation Requirements

Refer to the General Requirements section at the beginning of this section.

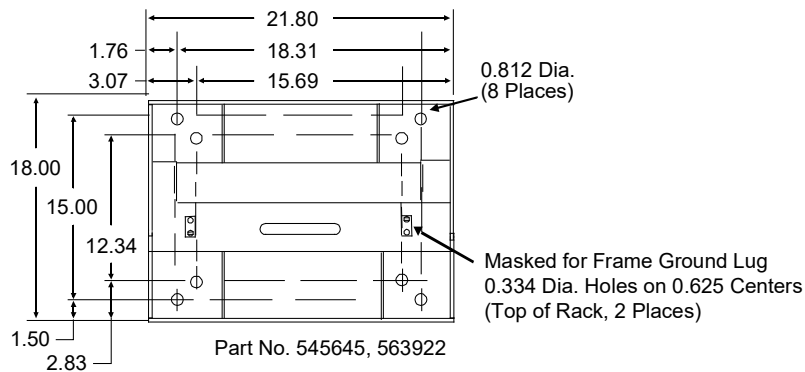
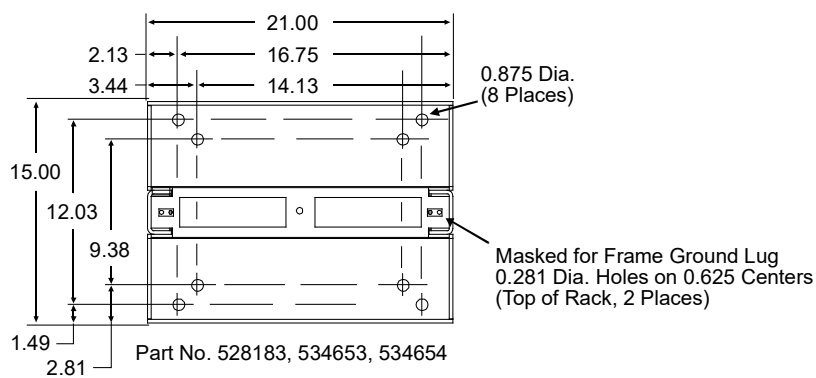
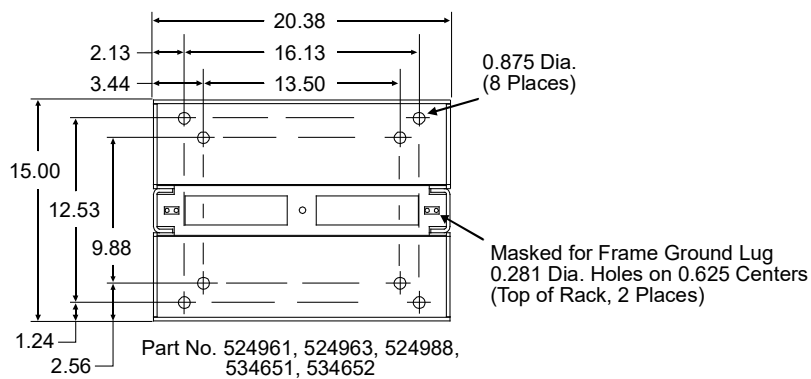
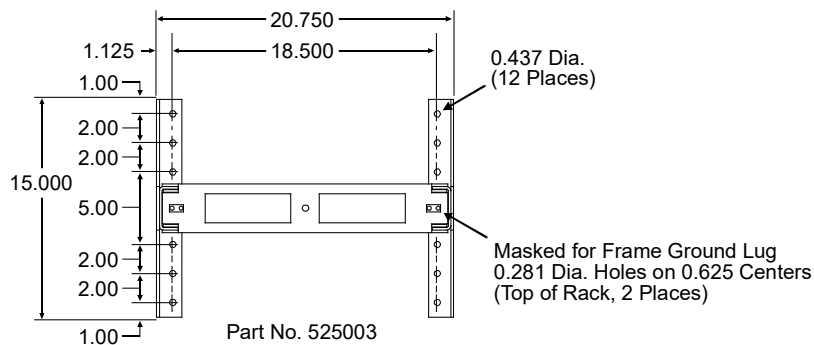
## Relay Rack Floor Mounting Dimensions

Refer to **Figure 1** and **Figure 2** for relay rack floor mounting dimension.

**Figure 1:** Relay Rack Floor Mounting Dimensions - 23" (dimensions are in inches)



**Figure 2:** Relay Rack Floor Mounting Dimensions - 19" (dimensions are in inches)





## Changing Orientation of Load Return Busbars (2-Row Distribution Cabinets)

In all 2-row Distribution Cabinets, the installer can rotate the Load Return busbars from the factory default horizontal orientation (for wiring through the cabinet rear) to a vertical orientation (for wiring through the cabinet top.)

 **NOTE!** List MV is factory configured for a vertical orientation (for wiring through the cabinet top.).

This procedure requires removal of the top cover and access from the top. Therefore, the procedure should be performed prior to mounting the cabinet in a location that inhibits top access.

 **CAUTION!** When performing any step in this procedure that requires removal or installation of hardware, use caution to ensure no hardware is dropped and left inside the cabinet; otherwise service interruption or equipment damage may result.

 **NOTE!** When performing any step in this procedure that requires removal of existing hardware, retain all hardware for use in subsequent steps.

### **Procedure**

1. Open the front door of the Distribution Cabinet. To do so, loosen the two captive fasteners on the door, then pivot the door outward.
2. Remove the top cover from the Distribution Cabinet. To do so, remove the six (6) screws that secure it.
3. Refer to **Figure 3**. Remove the hardware securing one of the busbars. Reposition the busbar, and reinstall the hardware. Torque hardware to the values shown in the figure.
4. Repeat step 3 for the second busbar.
5. The top cover can be installed now or after all electrical connections have been completed.

**Figure 3:** Rotating the Load Return Busbars in a 2-Row Distribution Cabinets

**Assembly Order for Each Busbar:**

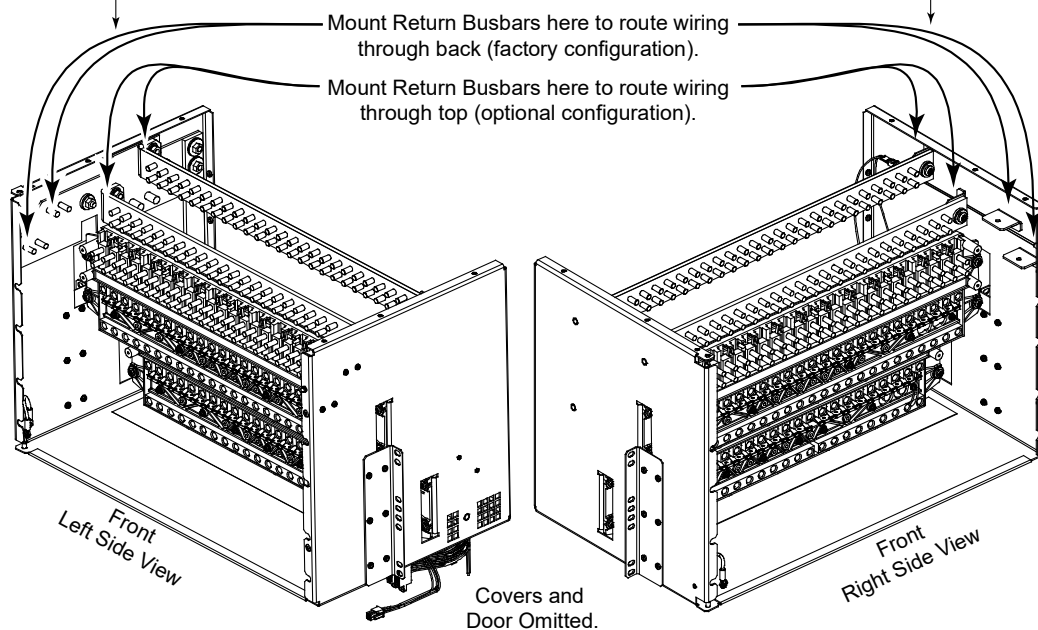
- Studs
- Return Busbar
- 1/4" Flat Washer, P/N 214200700 (2 places)
- 1/4" Lock Washer, P/N 215111100 (2 places)
- 1/4" Hex Nut, P/N 228557100 (2 places)
- Torque to 75 in.-lbs.

Ensure collar on insulator extends through busbar.

Ensure collar on insulator extends through washer.

**Assembly Order for Each Busbar:**

- Cabinet bracket
- Insulator, P/N 520764 (longer collar)
- Return Busbar
- Insulator, P/N 520763 (shorter collar)
- 3/8" Flat Washer, P/N 214112100
- 1/4-20 x 3/4" Screw, P/N 218708500
- Torque to 84 in.-lbs.





## Securing the Power System to a Relay Rack or Cabinet

### General

The Power System is designed to mount in a standard 19" or 23" wide relay rack or cabinet frame having 1" or 1-3/4" multiple drillings. Refer to SAG582136800 for overall dimensions and a list of available relay racks.



**NOTE!** Refer to the General Requirements section at the beginning of this section for Ventilation Requirements.



**NOTE!** For List 1-4 only, multiple Power Shelves must be stacked one above the other with no space between the shelves (for the Controller CAN bus cable interconnection).

### Procedure

1. Secure mounting angles to relay rack or cabinet at every available screw location on each side. Use a grounding washer on each screw. Proper orientation of grounding washers enables teeth to dig into paint for a secure ground connection. Tighten screws to 70 in.-lbs.



**NOTE!** Compliance with Telcordia GR-1089-CORE requires that prior to mounting the Power System to the equipment rack:

- All paint must be removed from the front surface of each equipment rack rail where it mates with a system mounting bracket, so that good metal-to-metal contact can be established between the system and rack.
- The system-to-rack mating surfaces must be cleaned.
- Electrical anti-oxidizing compound must be applied to the system-to-rack mating surfaces.

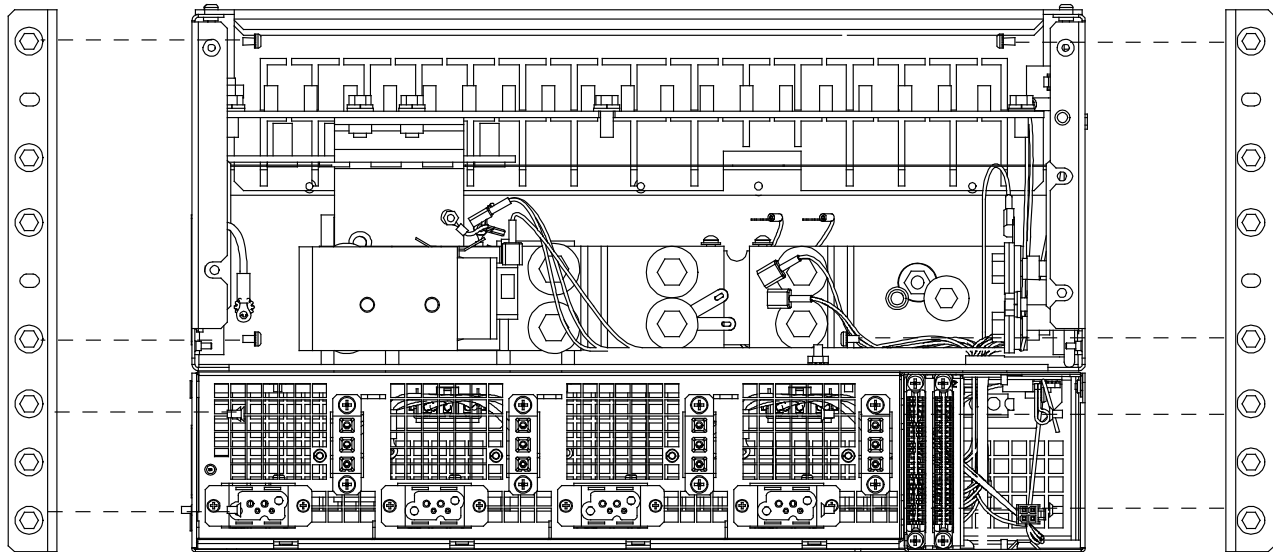
### Using Optional Knurr Data Cabinet Flush Mounting Bracket Kit P/N 556346

Optional Knurr Data Cabinet Flush Mounting Bracket Kit P/N 556346 consists of two brackets and hardware for mounting a List 10 power shelf and a List FA, FB, FC, GA, GB, or GC distribution shelf into a 19" wide rack of a Knurr data cabinet (one set of brackets mounts both shelves).

### Procedure

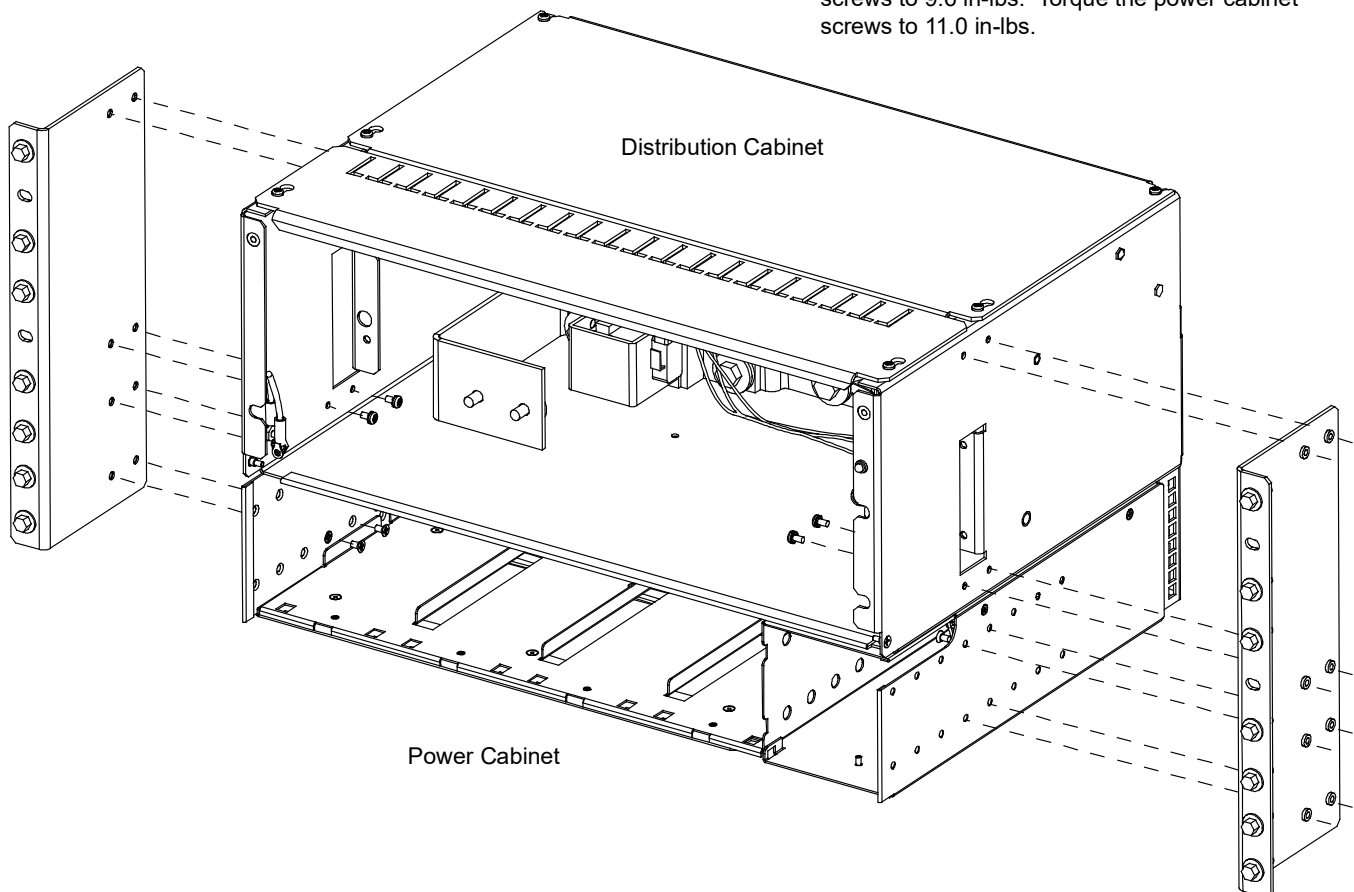
1. Secure the mounting brackets provided with P/N 556346 to the List 10 power shelf and a List FA, FB, FC, GA, GB, or GC distribution shelf per **Figure 4**. Refer to **Figure 4** for torque values.
2. Secure the power shelf with distribution cabinet to the Knurr data cabinet rack using the hardware provided with P/N 556346. Torque to 85.5 in.-lbs.

**Figure 4:** Installing Optional Knurr Data Cabinet Flush Mounting Bracket Kit P/N 556346



Components removed in illustration for clarity only.

Secure mounting brackets to cabinets with provided screws from the inside of the cabinets. Torque the distribution cabinet screws to 9.6 in-lbs. Torque the power cabinet screws to 11.0 in-lbs.



## Securing the System Horizontally to a Wall with P/N 552537 or P/N 552535 Kit (if furnished)

An optional wall mount bracket kit (P/N 552537 for 19" system and P/N 552535 for 23" system) is available for horizontal wall mounting of the system.



**NOTE!** Refer to "General Requirements" on page 4 for mounting restrictions and ventilation requirements.

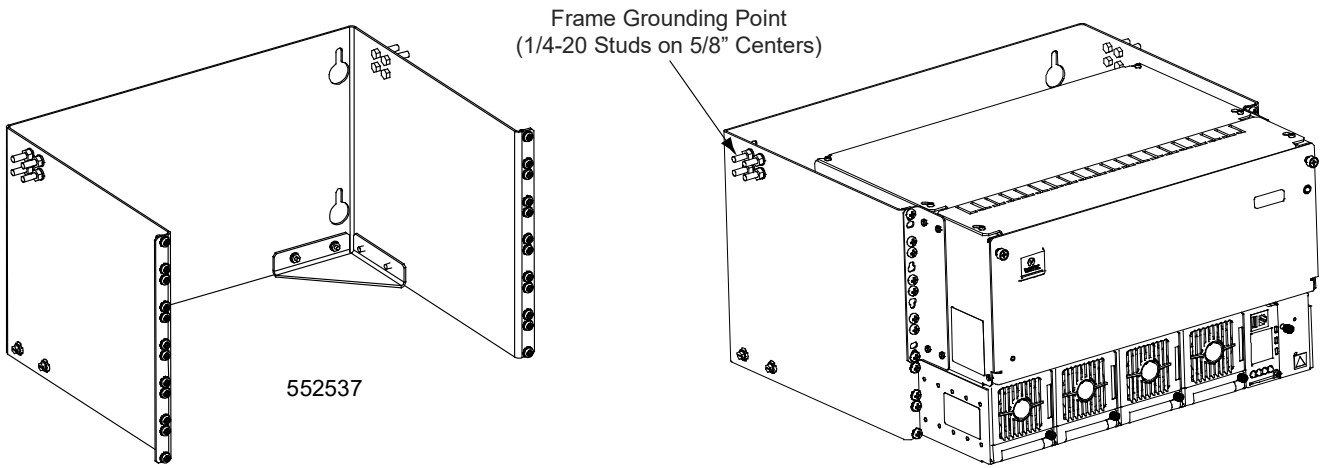


**NOTE!** Refer to **Figure 5** or **Figure 6** when performing this procedure.

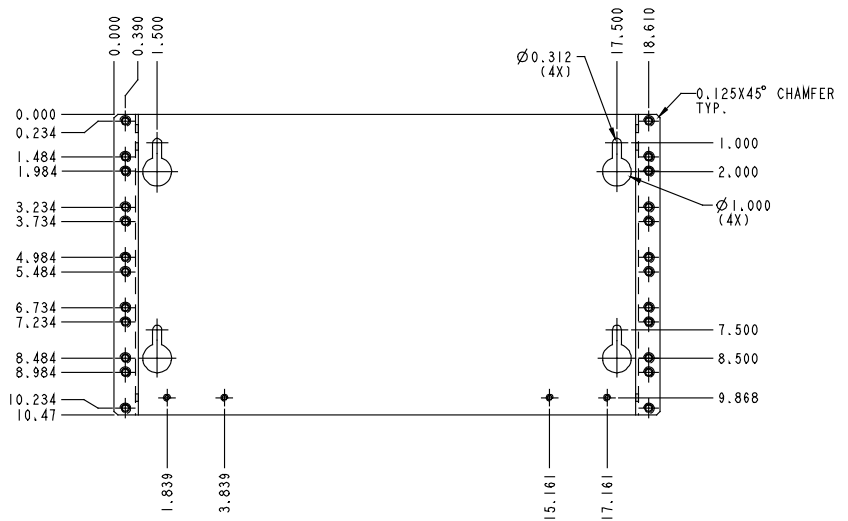
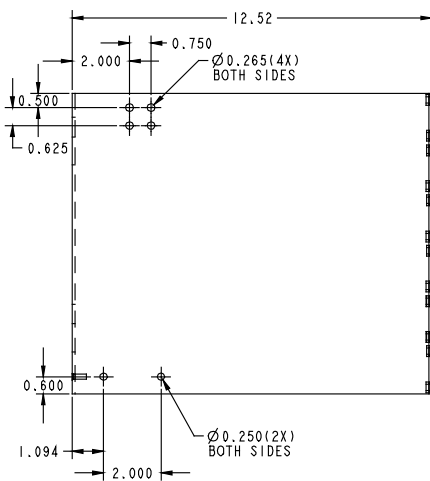
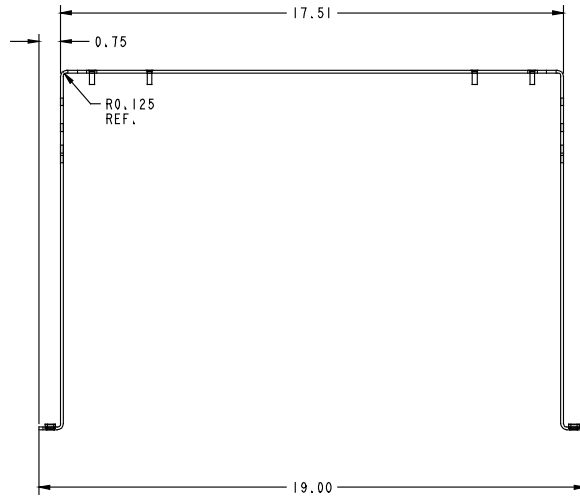
### **Procedure**

3. The installer must provide fasteners for securing the system to a wall or other horizontal surface. Ensure that the wall and fastening technique are suitable for supporting the weight of the system. Refer to System Application Guide SAG582136800 for system weight and additional dimensions.
4. Prepare the wall for customer-furnished fasteners. Secure the wall bracket to the wall.
5. Attach the system to the wall bracket using the standard mounting technique. See "Securing the Power System to a Relay Rack or Cabinet" on page 9.

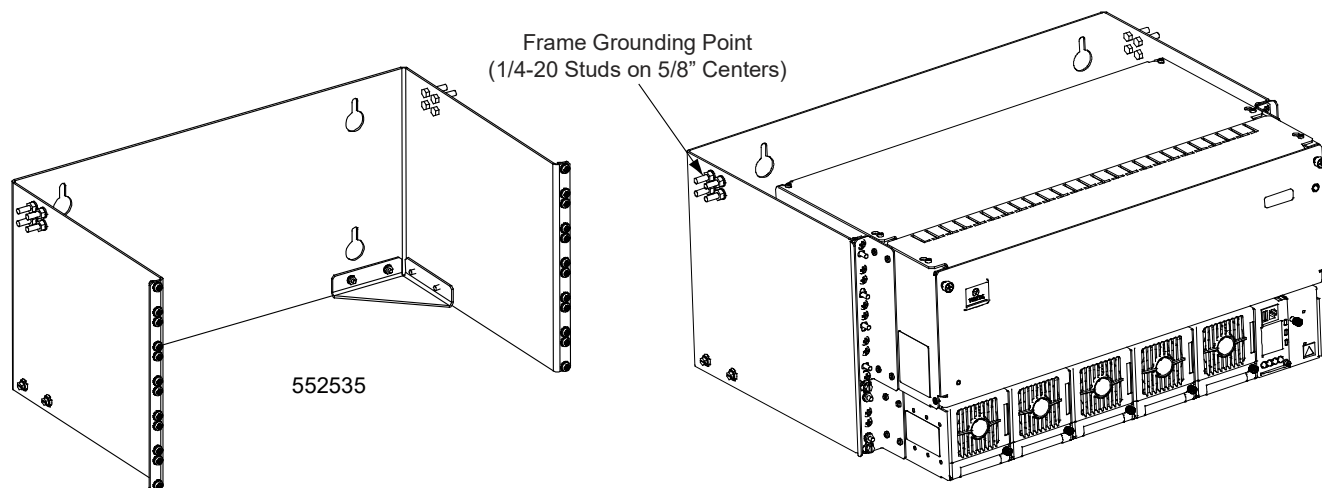
**Figure 5:** Horizontal Wall Mounting with P/N 552537



- Notes:
1. All dimensions are in inches, unless otherwise specified.
  2. Installer to furnish hardware for fastening bracket to wall.

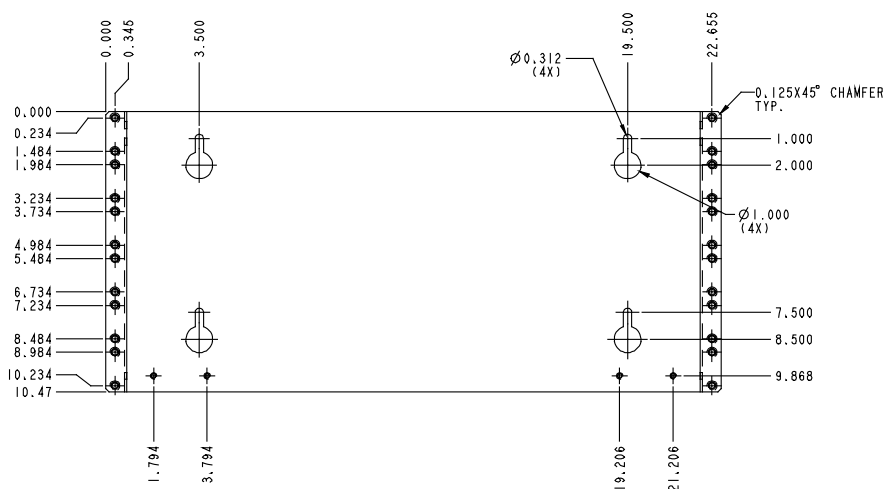
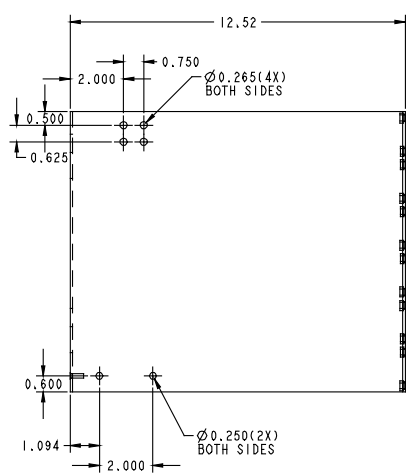
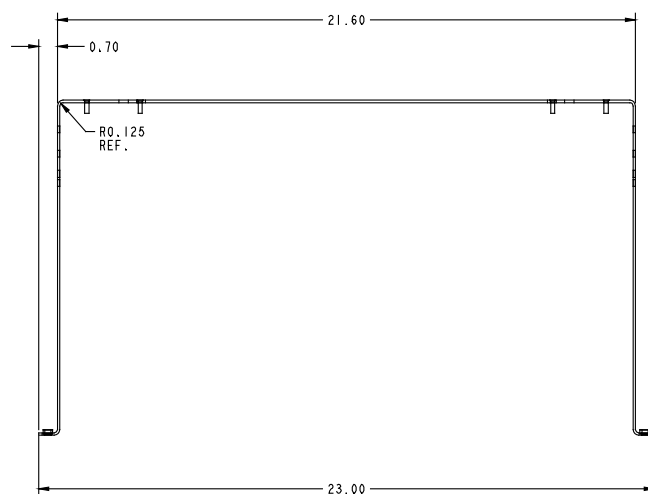


**Figure 6:** Horizontal Wall Mounting with P/N 552535



**Notes:**

1. All dimensions are in inches, unless otherwise specified.
2. Installer to furnish hardware for fastening bracket to wall.



## Installing Distribution Devices

### In Distribution Cabinet



**NOTE!** This procedure may have already been performed at the factory.

Install distribution devices in the Distribution Cabinet in the order described in this procedure.



**CAUTION! Single Row Distribution Assembly:** In a +40 °C ambient, 100 A circuit breakers can be used without a space provided the continuous current in each device does not exceed 64 A. Overcurrent protective devices greater than 100 A shall have an empty mounting position between it and any other overcurrent protective device.

At or above +65 °C, the maximum size overcurrent device used shall be 70 A. Devices rated at 70 A or less shall have an empty mounting position between it and any other overcurrent protective device.”

**Two Row Distribution Assembly:** In a +40 °C ambient, 100 A circuit breakers can be used without a space provided the continuous current in each device does not exceed 64 A. 100 A fuses, 150 A and 250A circuit breakers do not require a space adjacent to it.

At or above +65°C, the maximum size circuit breaker used shall be 125 A. The maximum size fuse used shall be 70 A. Devices rated at 50 A or greater shall have an empty mounting position between it and any other overcurrent protective device.

### Procedure

1. Open the front door of the Distribution Cabinet. To do so, loosen the two captive fasteners on the door, then pivot the door outward.
2. If installing one or more GMT Fuse Assemblies (Part No. 545333 or 549017), install starting at the left side of the cabinet, working toward the right. Refer to **Figure 7** or **Figure 8** for details. Note that each GMT Fuse Assembly occupies two distribution positions.
3. Install the circuit breakers or TPS/TLS-type fuseholders from right to left, starting with the highest capacity and working to the lowest capacity. Refer to **Figure 9** for details.
4. Record device current ratings on the label provided on the Distribution Cabinet front door.
5. For TPS/TLS fuseholders only, verify that a 0.18 amp alarm fuse is present in each fuseholder, and that a plastic safety cover is installed on this fuse.
6. If one or more optional GMT Fuse Assemblies was installed, for each assembly:
  - Install an appropriately sized GMT-type fuse in each fuse mounting position as required. If dummy fuses are present, first remove the dummy fuse.

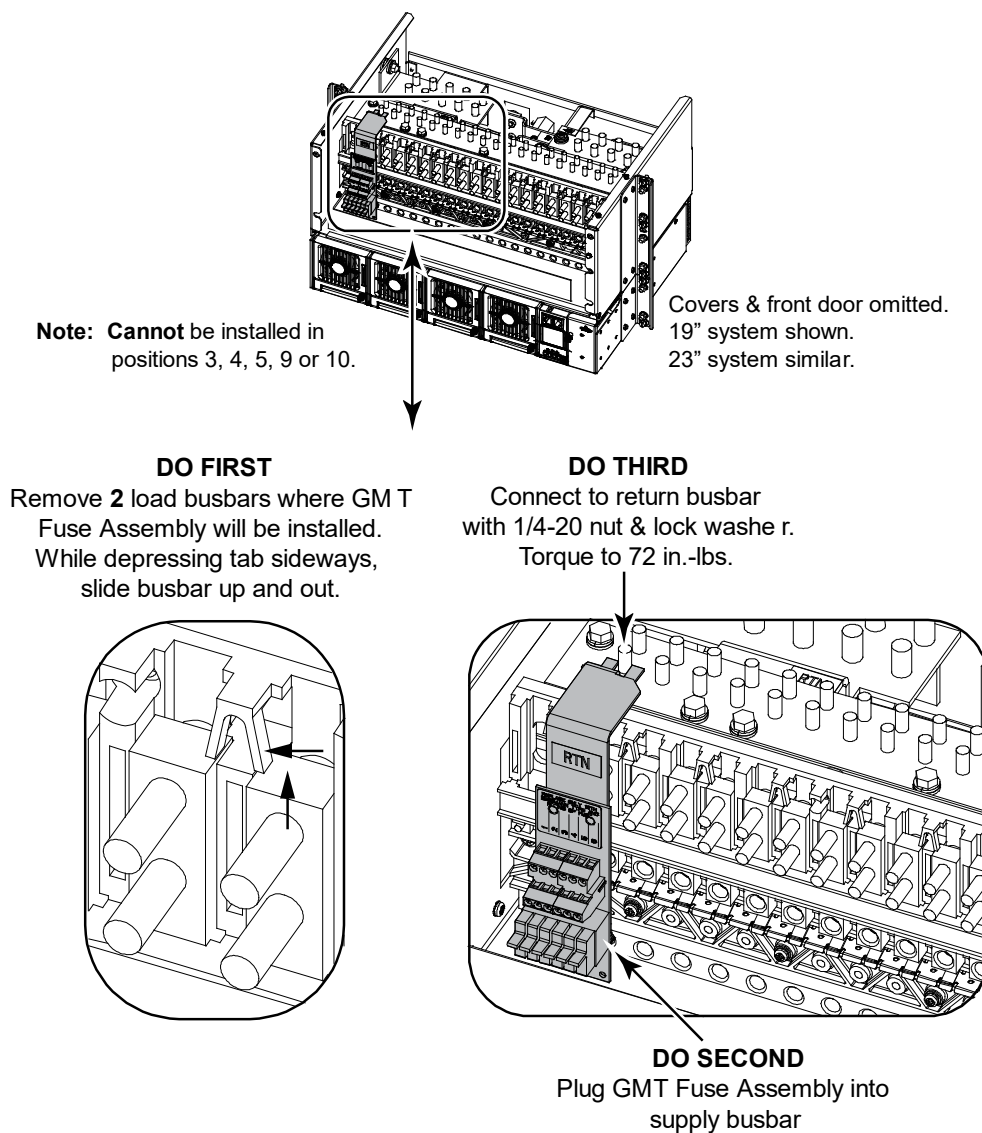


**CAUTION!** At 40°C ambient, GMT fuses greater than 10A SHALL have an empty mounting position between it and any other fuse. At 65°C ambient, GMT fuses greater than 5A SHALL have an empty mounting position between it and any other fuse. The maximum fuse size permitted at +65°C is 10A.

- Verify that a plastic safety cover is installed on each GMT fuse.
- Verify that dummy fuses are installed in all unused fuse positions.

- The front door of the Distribution Cabinet will be closed after all wiring connections have been completed.

**Figure 7:** Installing Optional GMT Fuse Assembly, Part No. 545333, in 1-Row Distribution Cabinet



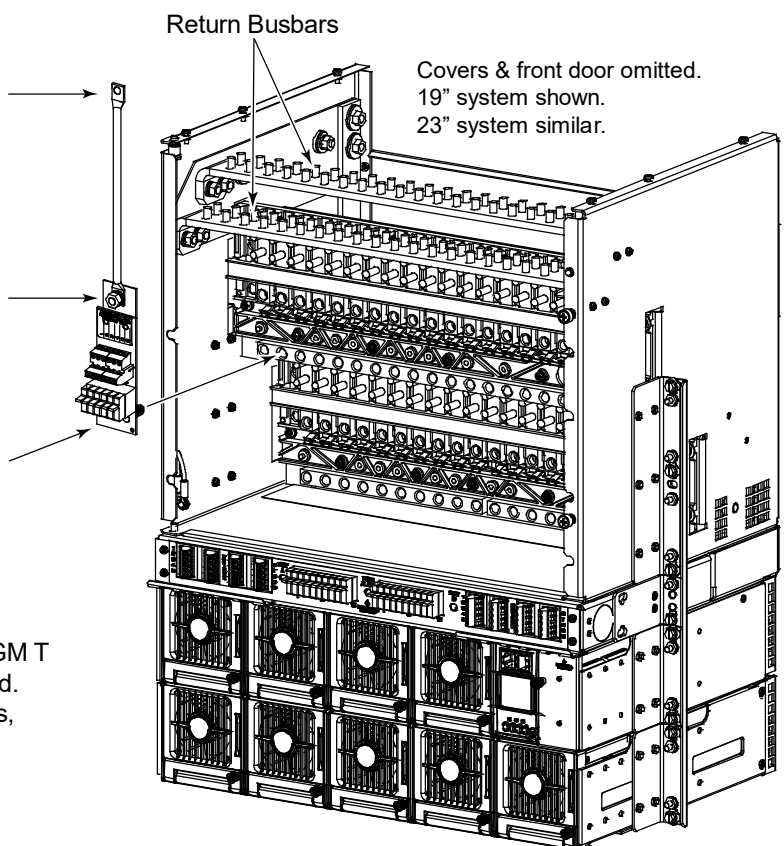
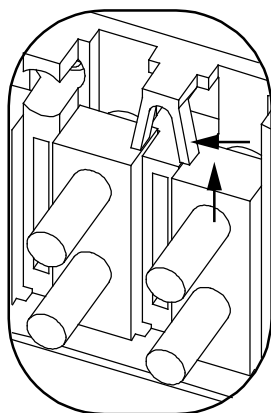
**Figure 8:** Installing Optional GMT Fuse Assembly, Part No. 549017, in 2-Row Distribution Cabinet

**DO FOURTH**  
Route jumper to Return busbar.  
Connect end to Return busbar.  
Use 1/4-20 nut, lockwasher & flat washer. Torque to 72 in.-lbs.

**DO THIRD**  
Connect jumper to GMT Fuse Assembly. Use 1/4-20 nut, lock washer & flat washer. Torque to 72 in.-lbs.

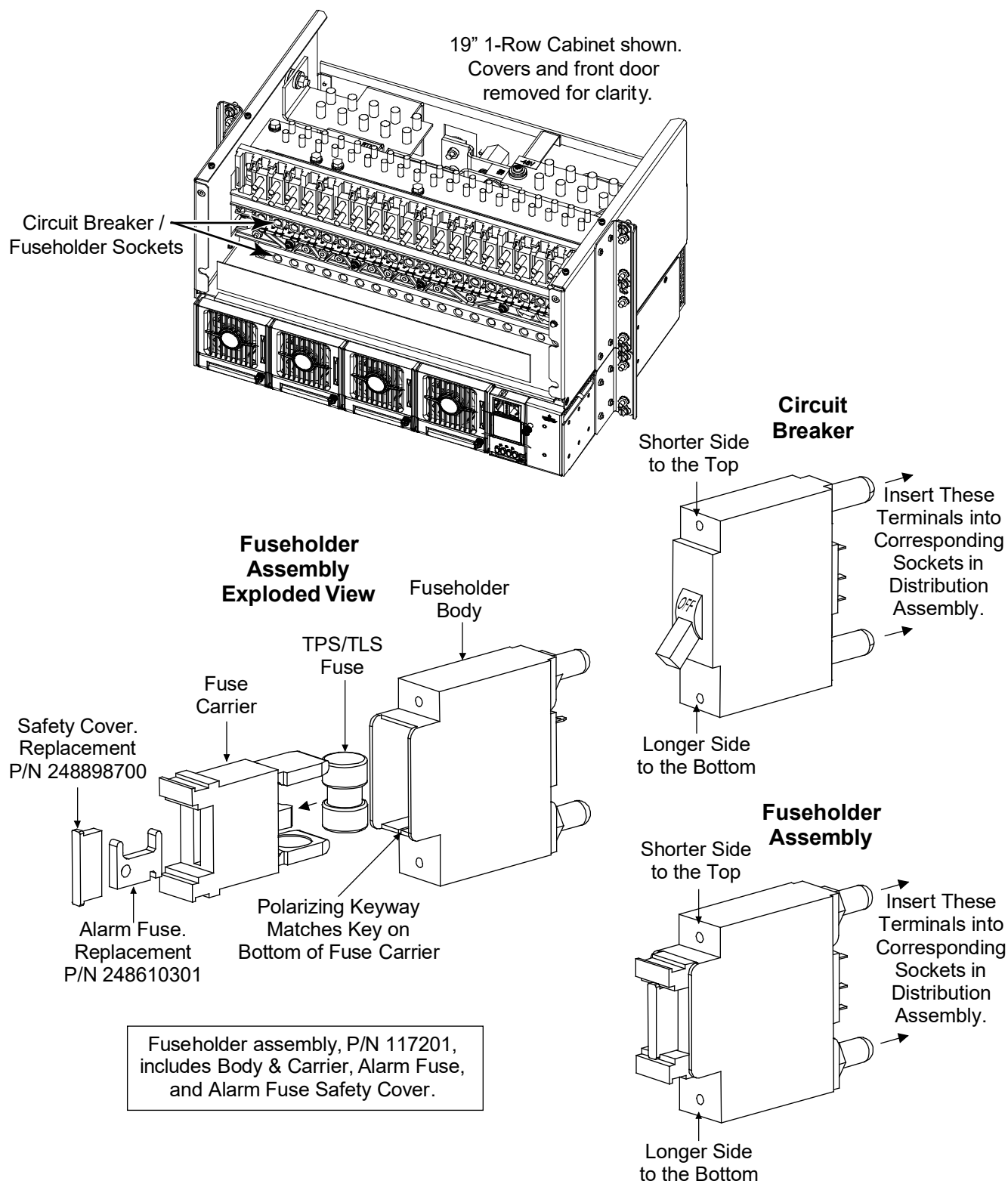
**DO SECOND**  
Plug GMT Fuse Assembly into supply busbar

**DO FIRST**  
Remove 2 load busbars where GMT Fuse Assembly will be installed.  
While depressing tab sideways, slide busbar up and out.





**Figure 9:** Installing Distribution Devices



### In List KG



**NOTE!** Refer to **Figure 10**.

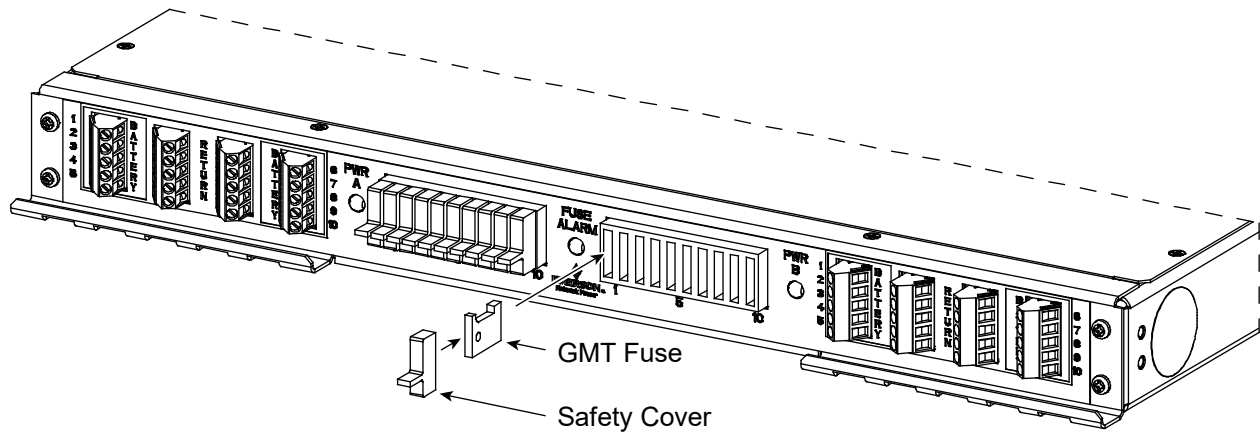
1. Install distribution fuses. Use only Bussmann GMT type of the rating required for your application.



**CAUTION!** A fuse with a rating of greater than 10 amperes SHALL HAVE an empty mounting position between it and any other fuse.

2. If your installation requires dummy fuses in all unused fuse positions, install the dummy fuses (factory provided).
3. Ensure that fuse safety covers are installed on each fuse.

**Figure 10:** Installing GMT Load Distribution Fuses (List KG)



# MAKING ELECTRICAL CONNECTIONS

## Important Safety Instructions



**DANGER!** Adhere to the “Important Safety Instructions” presented at the front of this document.

## Wiring Considerations

For recommended wire sizes, crimp lugs, branch circuit protection, alarm relay contact ratings, and general wiring information and restrictions; refer to System Application Guide SAG582136800. The SAG is located in the separate *User Manual*.

Refer to drawing 031110100 for lug crimping information. Refer to drawings 031110200 and 031110300 for additional lug information. These are located in the *Installation Manual*.

All wiring and branch circuit protection should follow the current edition of the American National Standards Institute (ANSI) approved National Fire Protection Association's (NFPA) National Electrical Code (NEC), and applicable local codes. For operation in countries where the NEC is not recognized, follow applicable codes.

## Relay Rack Frame Grounding Connection

For relay rack grounding requirements, refer to the current edition of the American National Standards Institute (ANSI) approved National Fire Protection Association's (NFPA) National Electrical Code (NEC), applicable local codes, and your specific site requirements.

### Procedure

1. Attach a customer grounding network lead to the equipment mounting rack(s) per site requirements. Holes are provided on the top of each relay rack for installing a lead with a two-hole lug that has 1/4" bolt clearance holes on 5/8" centers. When using 1/4-inch hardware, recommended torque is 84 in.-lbs. when a standard flat washer and lock washer are used.

## Frame Grounding Connection

For Power Shelf and Distribution Cabinet grounding requirements, refer to the current edition of the American National Standards Institute (ANSI) approved National Fire Protection Association's (NFPA) National Electrical Code (NEC), applicable local codes, and your specific site requirements.

### Procedure

1. The frame grounding connection to the Power Shelf and Distribution Cabinet is made by using grounding washers with the mounting hardware used to secure the shelf to the relay rack or cabinet. Refer to the previous procedure “Securing the Power System to a Relay Rack or Cabinet”. Ensure that the relay rack or cabinet is properly grounded.



**NOTE!** The DC Return connection to this system can remain isolated from system frame and chassis (DC-I).

## AC Input and AC Input Equipment


### Grounding Connections

Follow the Admonishments listed at the beginning of this section when making AC input connections.

 **NOTE!** Refer to SAG582136800 for AC Input Cable Assemblies/Line Cords and recommended branch circuit protection.

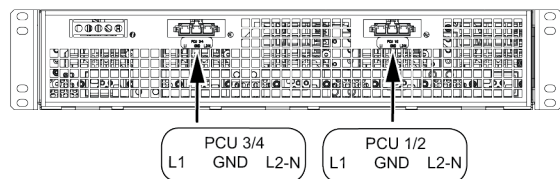
Each system requires multiple AC input branch circuits. Each AC input branch circuit feeds one (1) or two (2) rectifiers.

AC input connections are made using the AC Input Cable Assemblies/Line Cords ordered with the system. These are connected to the plug-in AC input connectors located on the system. Connect the other end of the AC Input Cable Assemblies/Line Cords to a properly wired AC outlet or distribution box. Refer to **Figure 11**.

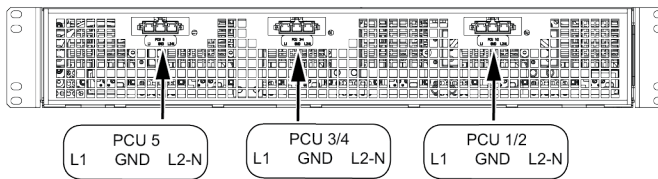
 **NOTE!** Support the AC cables by securing to the relay rack or other supports to prevent excessive strain on the shelf connectors.

**Figure 11: AC Input Connections, All Lists (cont'd on next page)**

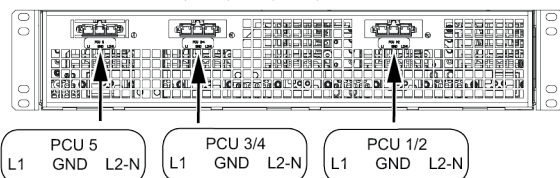
**19" Main Shelf in  
List 1, 10, 11, 16, 20, 21 and 26**



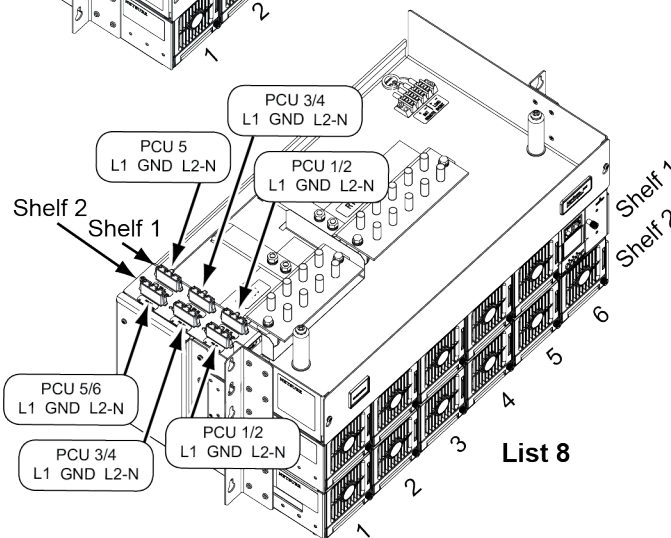
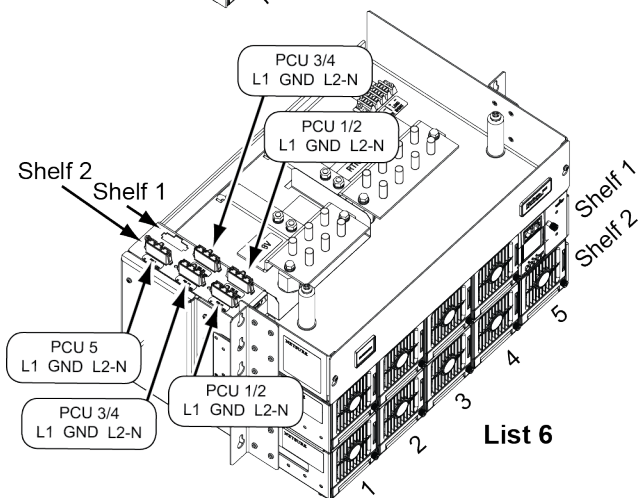
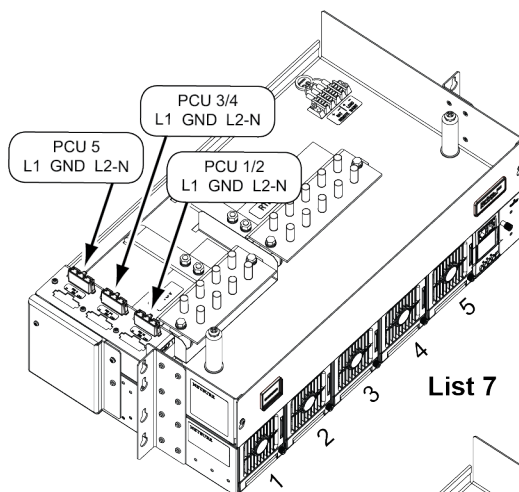
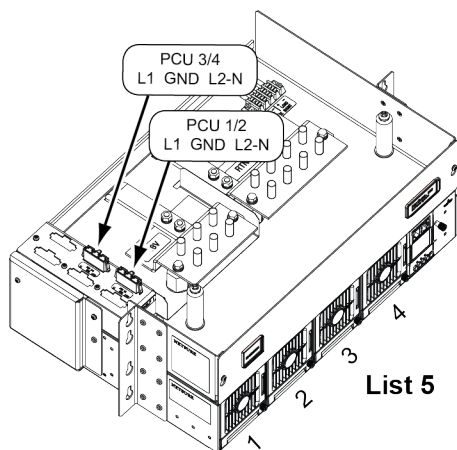
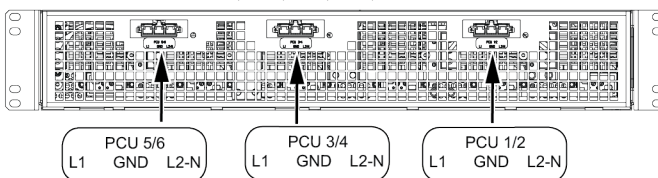
**23" Main Shelf in  
List 3, 12, 13, 17, 22, 23 and 27**



**19" Expansion Shelf(s) in  
List 2, 11, 14, 16, 21 and 26**



**23" Expansion Shelf(s) in  
List 4, 13, 15, 17, 23 and 27**

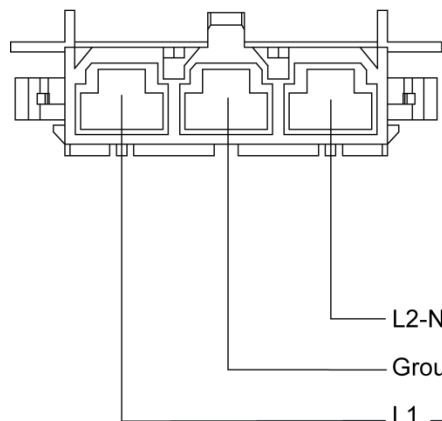


**For All Lists See Detail A**

**Figure 11:** AC Input Connections, All Lists (cont'd from previous page)

## Detail A

**AC Input Connector**  
(Cabinet Rear or Top View)

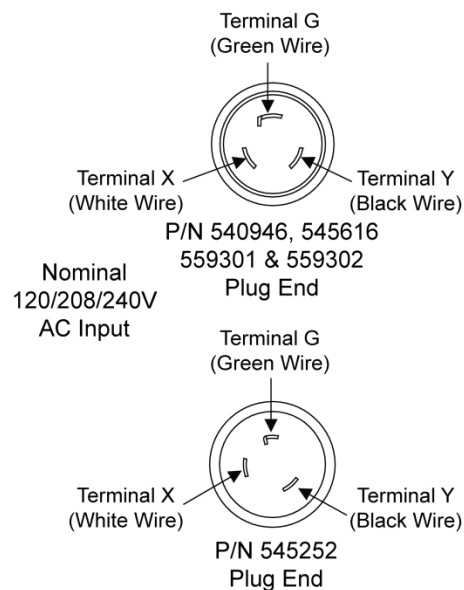


AC input connections are made using the ordered AC Input Cable Assemblies / Line Cords.

AC Input Cable Assembly	AC Input Line Cords
P/N 535232	P/N 540946
P/N 553202	P/N 545252
	P/N 545616
	P/N 559301
	P/N 559302

L2-N ——— Blue\* ——— White\*  
 Ground — Green/Yellow\* — Green\*  
 L1 ——— Brown\* ——— Black\*

\* color of AC Input Cable Assembly/Line Cord Lead.



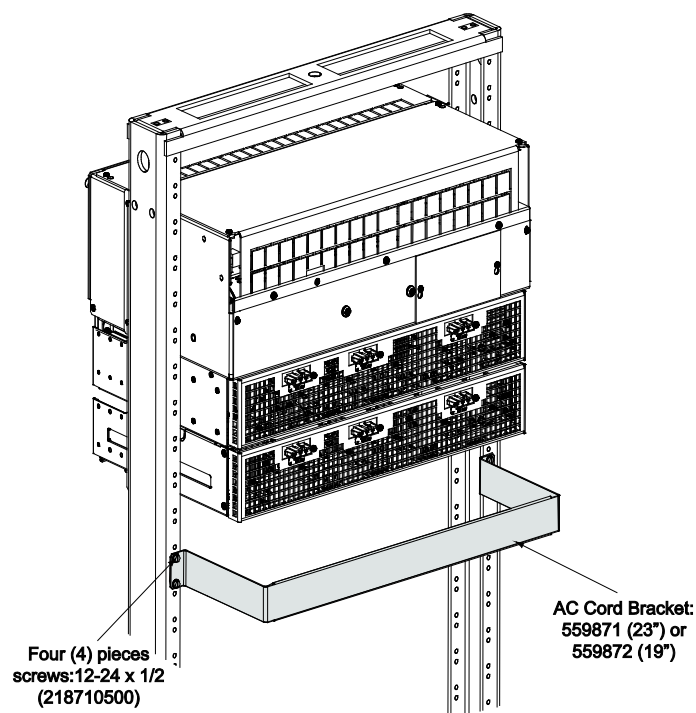
## Attaching Brackets and AC Cords

There are optional AC cord brackets available that allow the AC cords to be supported. Below are the steps for attaching the brackets and tying the AC cords to the brackets. Skip to Step #3 if your power system comes with the brackets already attached.

### Procedure

1. Locate the position to mount the bracket on the back side of the relay rack. The bracket should be 1RU below the power shelf. See **Figure 12**.

**Figure 12:** AC Cord Bracket Location.



2. Attach bracket to rear of relay rack with supplied hardware.
3. Attach AC cords to bracket with ty-raps or lacing with sufficient slack in the cord as to not stress the AC Molex connectors on the back of the shelf. See **Figure 13**.

**Figure 13:** AC Cords Attached to Bracket with Lacing.





## External Interface Connections


### IB2 (Controller Interface Board) Connections

The IB2 (Controller Interface Board) provides connection points for digital inputs, programmable relay outputs, and temperature probes. Refer to **Figure 14** for the location of the IB2 Board and its connectors. Refer to **Table 1** and **Table 2** for pin-out information.

If required to access these connection points, loosen the captive fastener on the front of the IB2 Board, and slide the assembly partially out of the shelf.

 **NOTE!** Two sets of Alarm Cables are available (see SAG582136800 for part numbers). One set for the Digital Inputs and another set for the Relay Outputs. Refer to **Table 1** and **Table 2** for color scheme. If the Relay Outputs Alarm Cable or Digital Inputs Alarm Cable is ordered, one half is factory connected in the shelf. The other half has a mating connector on one end and is un-terminated on the other end.

 **CAUTION!** All conductors in this harness may be connected within the cabinet. Shorting or grounding of unused conductors may result in service interruption or equipment damage. Therefore insulate all conductor ends not being used in your application.

 **NOTE!** Each Temperature Probe assembly consists of two pieces. If probes are ordered with the Power System, one piece is factory connected in the shelf. The other piece contains the Temperature Probe and a mating connector.

### Digital Inputs and Programmable Relay Outputs

Digital input and relay output leads are connected to screw-type terminal blocks located on the IB2. Recommended torque for these connections is 2.2 in-lbs. Refer to **Figure 14** for the location of the IB2 Board and its connectors. Refer to **Table 1** and **Table 2** for pin-out information.

#### Digital Inputs

Connect up to eight (8) digital inputs to the IB2. Note that you must supply both paths for the digital input (either a positive or negative signal and the opposite polarity return path). Observe proper polarity. Refer to **Figure 14** for the location of the IB2 Board and its connectors. Refer to **Table 1** for pin-out information. Note that some of these inputs are factory connected, as listed in **Table 1**.

The digital inputs can be programmed to provide an alarm when the signal is applied (HIGH) or removed (LOW). Refer to the Controller User Manual for programming information.

Digital Input Ratings: Refer to the following.

- a) Maximum Voltage Rating: 60V DC.
- b) Active High: > 19V DC.
- c) Active Low: < 1V DC.

The digital inputs may be preprogrammed for specific functions. Refer to the configuration drawing (C-drawing) supplied with your system for your system's specific configuration.




### **External Battery Disconnect Circuit Breaker Alarm Input**

Connect the alarm lead from an optional External Battery Disconnect Unit or the battery disconnect circuit breaker on an optional Battery Tray to the Negative (–) side of Digital Input #2 (terminal 3 of connector J3). – 48VDC is applied to the alarm lead when the circuit breaker is in the OFF position. Refer to **Figure 15**.

### **Programmable Relay Outputs**

The IB2 provides eight (8) programmable alarm relays with dry Form-C contacts. Connect up to eight (8) relay outputs to the IB2. Refer to **Figure 14** for the location of the IB2 Board and its connectors. Refer to **Table 2** for pin-out information.

 **NOTE!** The relay assigned to the “Major Summary” alarm (SCU+) or “Critical Summary” alarm (NCU or ACU+) (relay 1 by default) will operate in the “Fail Safe Mode”. “Fail Safe Mode” means Relay 1 is de-energized during an alarm condition, opening the contacts between the C and NO terminals, and closing the contacts between the C and NC terminals.

*The remaining 7 relays energize during an alarm condition, closing the contacts between the C and NO terminals, and opening the contacts between the C and NC terminals.*

Refer to **Table 2** if you are using the default relay assignments. A blank column in the table is also provided if you want to document a custom configuration.

Refer to the Controller User Manual for programming information.

Relay Ratings: Refer to the following.

- a) Steady State: 0.5 A @ 60V DC; 1.0 A @ 30V DC.
- b) Peak: 3 A @ 30V DC.

The relays may be preprogrammed for specific functions. Refer to the configuration drawing (C-drawing) supplied with your system for your system’s specific configuration.

### **Temperature Probes**

Two temperature probes can be connected to this system to provide Battery Charge Temperature Compensation and/or monitor ambient temperature. Each probe plugs into the IB2 Controller Interface Board. The battery charge temperature compensation feature allows the controller to automatically increase or decrease the output voltage of the system to maintain battery float current as battery temperature decreases or increases, respectively. Battery life can be extended when an optimum charge voltage to the battery with respect to temperature is maintained.


In the NCU and ACU+, each probe can be programmed to monitor ambient temperature or battery temperature. A temperature probe set as a battery probe can also be designated to be used for the battery charge temperature compensation feature, or the battery charge temperature compensation feature can be programmed to use the average or highest value of all battery temperature probes. A temperature probe set as a battery probe can also be used for controlling against battery thermal runaway (BTRM feature).

Each Temperature Probe consists of two pieces. One piece is factory installed to the shelf and the other is shipped loose. Locate and install the shipped loose piece to the piece factory installed in the shelf. A temperature probe programmed to monitor battery temperature should be mounted on the top or side of a battery cell. A temperature probe used for battery charge temperature compensation or BTRM (Battery Thermal Runaway Management) should also be mounted on the top or side of a battery cell to sense battery temperature. A temperature probe programmed to monitor ambient temperature should be mounted in a convenient location, away from direct sources of heat or cold. To mount, peel the backing from the self-

adhesive surface, and affix the probe to a clean, dry surface. Note that temperature probes with a mounting tab are also available (see SAG582136800).


**Table 1:** Programmable Digital Inputs (Factory Default)

Programmable Digital Input	Pin No.		Digital Input Cable Color Scheme	Custom Digital Input Cable P/N 559963 Color Scheme	Dedicated to...
1	J3-2	+	Internal Wiring	--	Internal Load Circuit Breaker / Fuse Alarm
	J3-1	-	Internal Wiring	--	
2	J3-4	+	Internal Wiring	--	Internal Battery Circuit Breaker Alarm
	J3-3	-	Internal Wiring	--	
3	J3-6	+	Internal Wiring	--	External Breaker / Fuse Alarm
	J3-5	-	Internal Wiring	--	
4	J4-2	+	W-S	Slate	User Defined
	J4-1	-	S-W	-48 VDC	
5	J4-4	+	W-BR	Brown	User Defined
	J4-3	-	BR-W	-48 VDC	
6	J4-6	+	W-G	Violet	User Defined
	J4-5	-	G-W	-48 VDC	
7	J5-2	+	W-O	Orange	User Defined
	J5-1	-	O-W	-48 VDC	
8	J5-4	+	W-BL	--	Emergency Stop
	J5-3	-	BL-W	--	
--	J5-5		Not Used	--	Not Used
--	J5-6			--	


 **CAUTION!** All conductors in this harness may be connected within the cabinet. Shorting or grounding of unused conductors may result in service interruption or equipment damage. Therefore insulate all conductor ends not being used in your application.

**Table 2:** Relay Outputs (Factory Default)

Programmable Relay Output	IB2 Pin No.	Alarm Cable Color Scheme	Alarms Assigned to this Relay (Default)	Alarms Assigned to this Relay (Custom)
1*	NO	J6-5	W-BL	SCU+: Any Major Alarm NCU or ACU+: Any Critical Alarm
	COM	J6-3	BL-W	
	NC	J6-1	W-O	
2	NO	J6-6	O-W	SCU+: Any Minor Alarm NCU or ACU+: Any Major Alarm
	COM	J6-4	W-G	
	NC	J6-2	G-W	
3	NO	J7-5	W-BR	DC Volt High #1
	COM	J7-3	BR-W	
	NC	J7-1	W-S	
4	NO	J7-6	S-W	Batt Discharge DC Volt Low #1
	COM	J7-4	R-BL	
	NC	J7-2	BL-R	
5	NO	J8-5	R-O	DC Volt Low #2
	COM	J8-3	O-R	
	NC	J8-1	R-G	
6	NO	J8-6	G-R	AC Failure
	COM	J8-4	R-BR	
	NC	J8-2	BR-R	
7	NO	J9-5	R-S	Fuse Alarm
	COM	J9-3	S-R	
	NC	J9-1	BK-BL	
8	NO	J9-6	BL-BK	Load Share Alarm Rect Not Respond Rect HVSD Rect AC Fail Rect Failure Rect Protect Rect Fan Fail Rect Derated Rect Temp Alarm
	COM	J9-4	BK-O	
	NC	J9-2	O-BK	

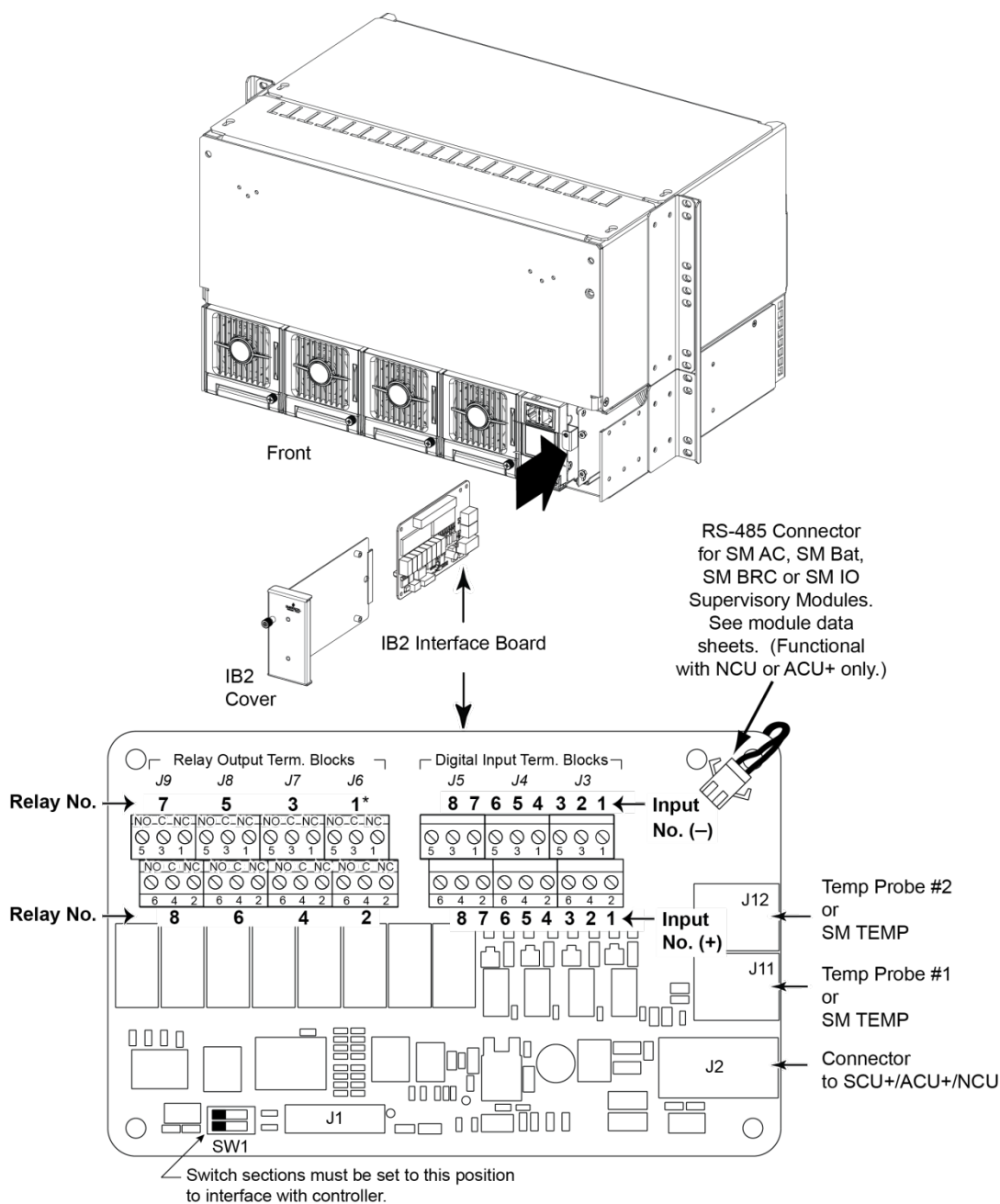
 **NOTE!** The Controller relay assigned to “Critical Summary” (NCU or ACU+) alarm or “Major Summary” (SCU+) alarm (relay 1 by default) will operate in the “Fail Safe Mode”. “Fail Safe Mode” means Relay 1 is de-energized during an alarm condition, opening the contacts between the C and NO terminals, and closing the contacts between the C and NC terminals.

The 7 remaining Controller relays energize during an alarm condition, closing the contacts between the C and NO terminals, and opening the contacts between the C and NC terminals.

 **CAUTION!** All conductors in this harness may be connected within the cabinet. Shorting or grounding of unused conductors may result in service interruption or equipment damage. Therefore insulate all conductor ends not being used in your application.

**Figure 14:** External Interface Connections to IB2 Interface Board

**NOTE!** A custom digital input cable and internal wiring kit is available, P/N 559963. This kit is factory installed only. (Provides -48 VDC pre-wired to the negative side of digital inputs #4 through #7 and a 10' alarm cable factory wired to the positive side of digital inputs #4 through #7.)

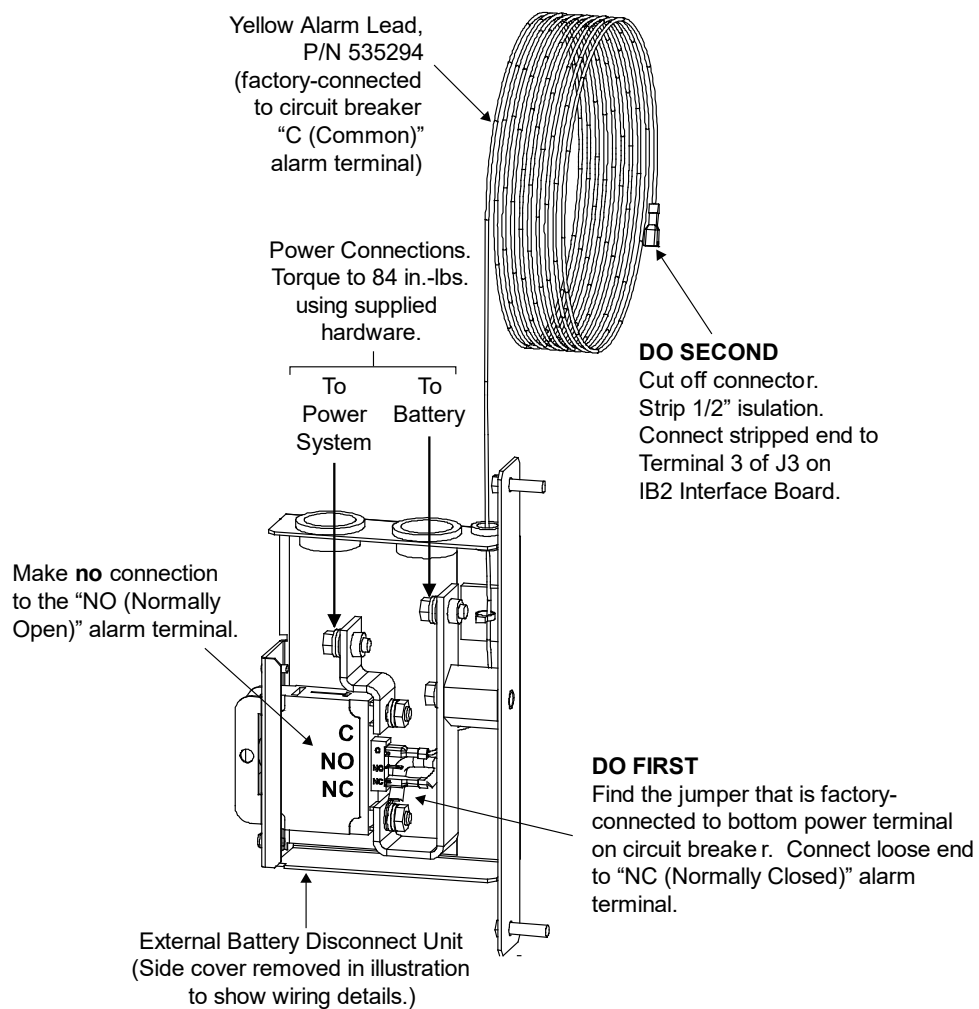


\* The Controller relay assigned to "Critical Summary" (NCU or ACU+) or "Major Summary" (SCU+) alarm (relay 1 by default) will operate in the "Fail Safe Mode". "Fail Safe Mode" means Relay 1 is de-energized during an alarm condition, opening the contacts between the C and NO terminals, and closing the contacts between the C and NC terminals. The remaining seven (7) relays energize during an alarm condition, closing the contacts between the C and NO terminals, and opening the contacts between the C and NC terminals.

A factory-connected jumper supplies +BAT (battery Return) to the positive (+) side of Digital Input #2. If List KG is provided, a factory-connected jumper supplies +BAT (battery Return) to the positive (+) side of Digital Input #3.

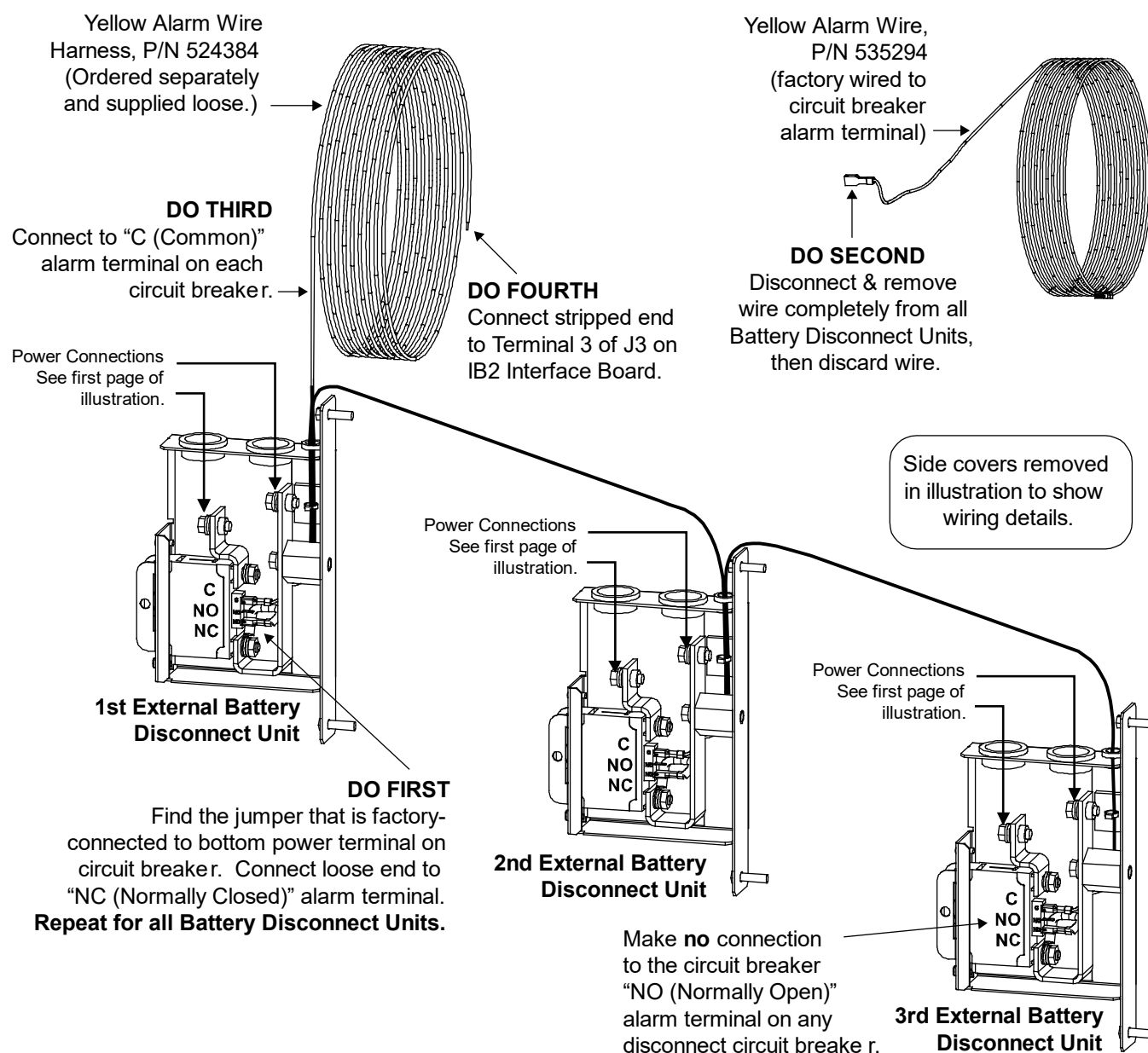
**Figure 15:** External Interface Connections to External Battery Disconnect Unit(s) (cont'd on next page)

### Alarm Wiring to a Single External Battery Disconnect Unit



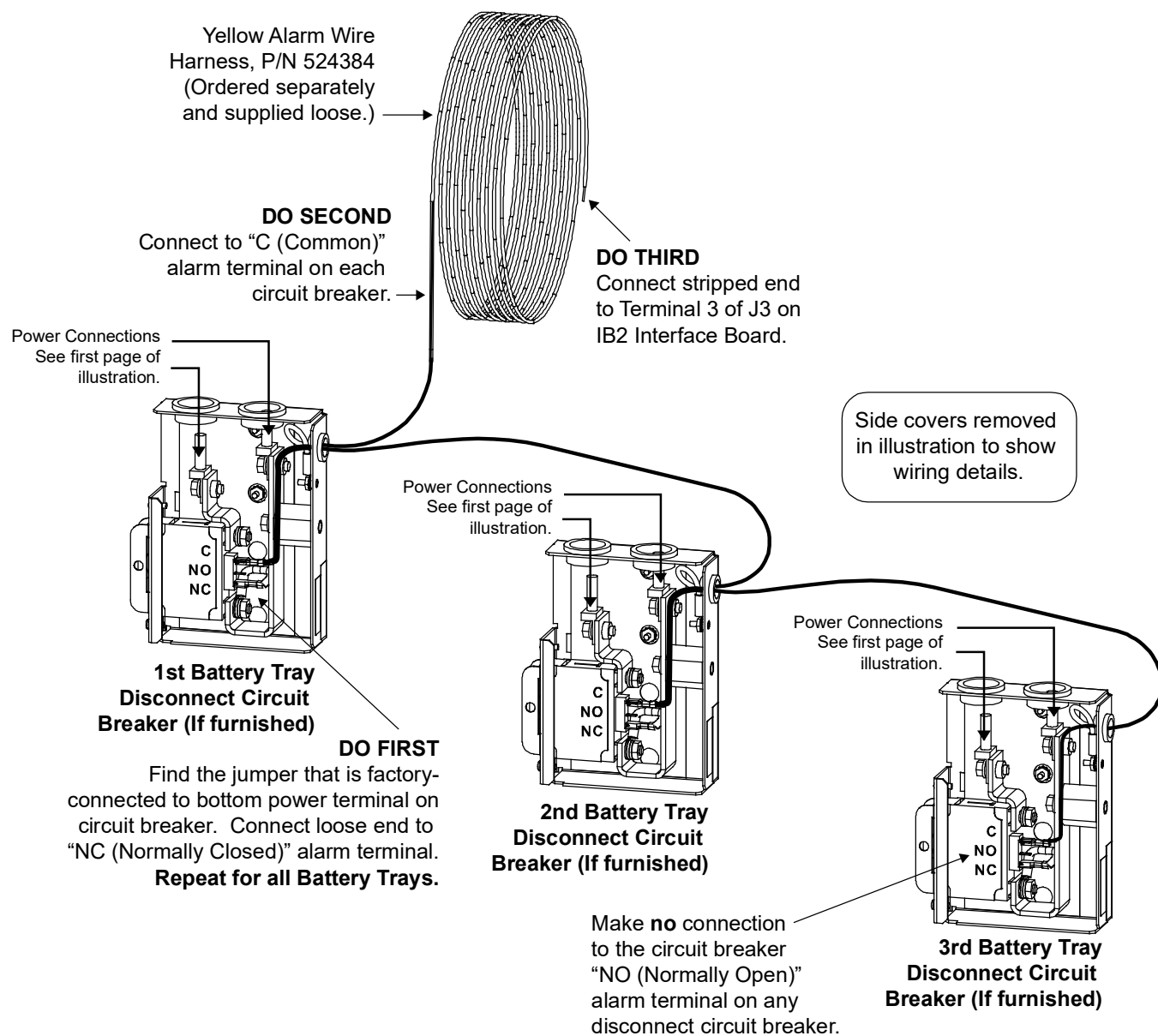
**Figure 15:** External Interface Connections to External Battery Disconnect Unit(s) (cont'd from previous page and on next page)

### Alarm Wiring to (2) or (3) External Battery Disconnect Units



**Figure 15:** External Interface Connections to Disconnect Circuit Breakers on Battery Tray(s) (cont'd from previous page)

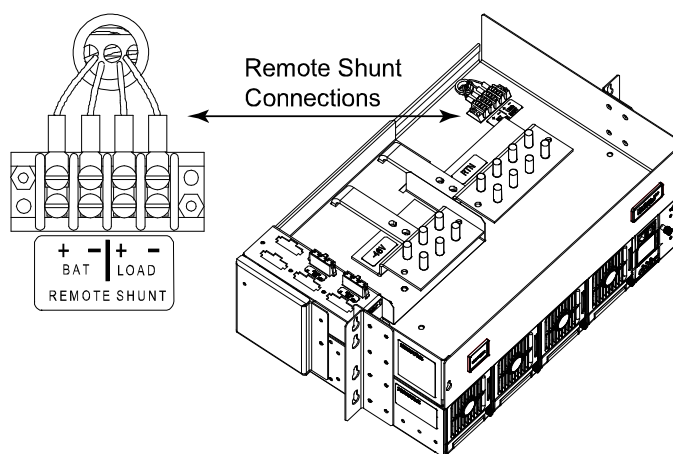
**Alarm Wiring to Battery Disconnect Circuit Breakers when (1) to (3) Battery Trays are Used (Factory-connected if ordered with system)**



### Remote Shunts Connections (Lists 5-8 Only)

A screw-type terminal block is provided for connection of one external battery shunt and one external load remote shunt. Recommended torque is 7 in.-lbs. Refer to **Table 3** and **Figure 16**.

**Figure 16:** Remote Shunt Connections (Lists 5-8 only)



**Table 3:** Power Conductor Requirements for External Shunts

Nominal Input Voltage	40°C Ambient			65°C Ambient		
	Max. Output Current (Amps)	90°C Cable Size	Max. Length at 0.4V Drop (Ft.)	65°C Output Current (Amps)	90°C Cable Size	Max. Length at 0.4V Drop (Ft.)
208/240VAC						
List 5	166.6	2 AWG	12.3	133.3	1/0 AWG	24.5
List 6	374.9	250 kcmil	20.6	300	350 kcmil	36.1
List 7	208.3	1/0 AWG	15.7	166.6	2/0 AWG	24.7
List 8	400	250 kcmil	19.3	366.6	500 kcmil	42.2
120VAC						
List 5	105.1	4 AWG	12.3	84.1	2 AWG	24.4
List 6	236.6	1/0 AWG	13.8	189.3	3/0 AWG	27.4
List 7	131.4	2 AWG	15.5	105.2	2 AWG	19.5
List 8	289.2	4/0 AWG	22.7	231.4	4/0 AWG	28.3

**Notes:**

1. The shunt(s) connected to these terminals must be connected to the output cables of this plant within these maximum distances for the cable sizes used.
2. Wire sizes are based on recommendations of the American National Standards Institute (ANSI) approved National Fire Protection Association's (NFPA) National Electrical Code (NEC). Table 310-17 for wire rated at 90°C conductor temperature operating in ambient temperatures of 40°C and 65°C was used.




## Connecting the SM-TEMP Module to the Controller’s CAN Bus (if required)

Refer to “Installing the SM-TEMP Temperature Concentrator Module” on page 86.

## Ethernet Connection


 **NOTE!** If the Web Interface is not being used with this system, skip this procedure.

The controller provides a Web Interface via an Ethernet connection to a TCP/IP network. An RJ-45 10BaseT jack is provided on the front of the controller for connection into a customer’s network running TCP/IP. This jack has a standard Ethernet pin configuration scheme, twisted pair. Refer to **Figure 17** for port location of controller, and **Table 4** for pin outs. Use shielded Ethernet cable (grounded at both ends). Note that the RJ-45 jack in the controller is connected to chassis ground.

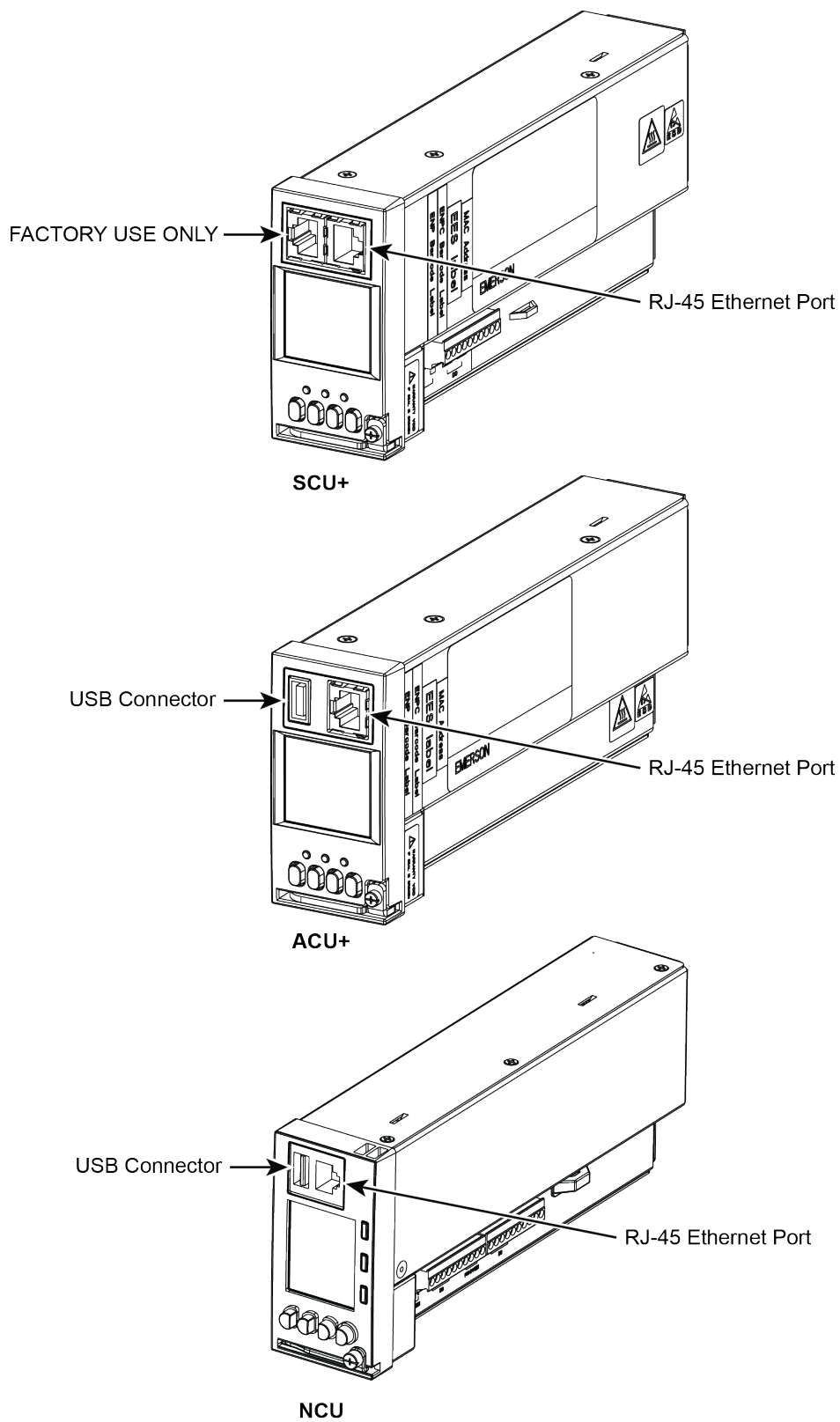
 **WARNING!** The intra-building port(s) of the equipment or subassembly is suitable for connection to intra-building or unexposed wiring or cabling only. The intra-building port(s) of the equipment or subassembly **MUST NOT** be metallically connected to the interfaces that connect to the OSP or its wiring. These interfaces are designed for use as intra-building interfaces only (Type 2 or Type 4 ports as described in GR-1089-CORE, Issue 4) and require isolation from the exposed OSP cabling. The addition of Primary Protectors is not sufficient protection in order to connect these interfaces metallically to OSP wiring.

**Table 4:** Controller RJ-45 Ethernet Port Pin Configuration

Port Pin Number	Name	Definition
1	Tx+	Write Signal +
2	Tx-	Write Signal -
3	Rx+	Read Signal +
4	--	no connection
5	--	no connection
6	Rx-	Read Signal -
7	--	no connection
8	--	no connection

 **NOTE!** You can access the Web pages of the Power System locally by using a “crossover” cable connected directly between your PC and the controller.

**Figure 17:** Controller RJ-45 Ethernet Port



## Control Bus (CAN Bus) Interconnections (List 1-4)

If one or more List 2 expansion shelves are being installed with a List 1 main shelf, or if one or more List 4 expansion shelves are being installed with a List 3 main shelf, a control bus (CAN bus) interconnection must be made between shelves. Refer “Expanding the Power System” on page 81 for a procedure.

## Bulk DC Output Connections (Lists 1-8)



**DANGER!** Ensure correct polarity when connecting DC output leads.

Follow the Admonishments listed at the beginning of this section when making DC output connections.

**582136800 List 1-4 Systems:** Bus bars with 3/8” clearance holes on 1" centers are provided for installation of customer provided DC output cables terminated in two-hole lugs. Refer to **Figure 18**.



**NOTE!** Customer wiring must connect the DC outputs of the main shelf and all expansion shelves in a system in parallel. When paralleling the outputs of multiple shelves, the wiring from all shelves should be of the same gauge and similar length.

**582136800 List 5-8 Systems:** 3/8-16 studs on 1" centers are provided for installation of customer supplied DC output cables terminated in two-hole lugs. Refer to **Figure 18**.

Observe proper polarity when connecting leads.

When lugs are secured using 3/8 inch hardware, recommended torque is 180 in.-lbs. when a Belleville lock washer is used, and 300 in.-lbs. when a standard flat washer and lock washer are used.

### **C.O. Ground Connection (List 5-8)**

For Lists 5-8, 3/8-16 studs on 1" centers are provided on the Return busbar for C.O. Ground wiring. Refer the detail illustrations in **Figure 18** for location.

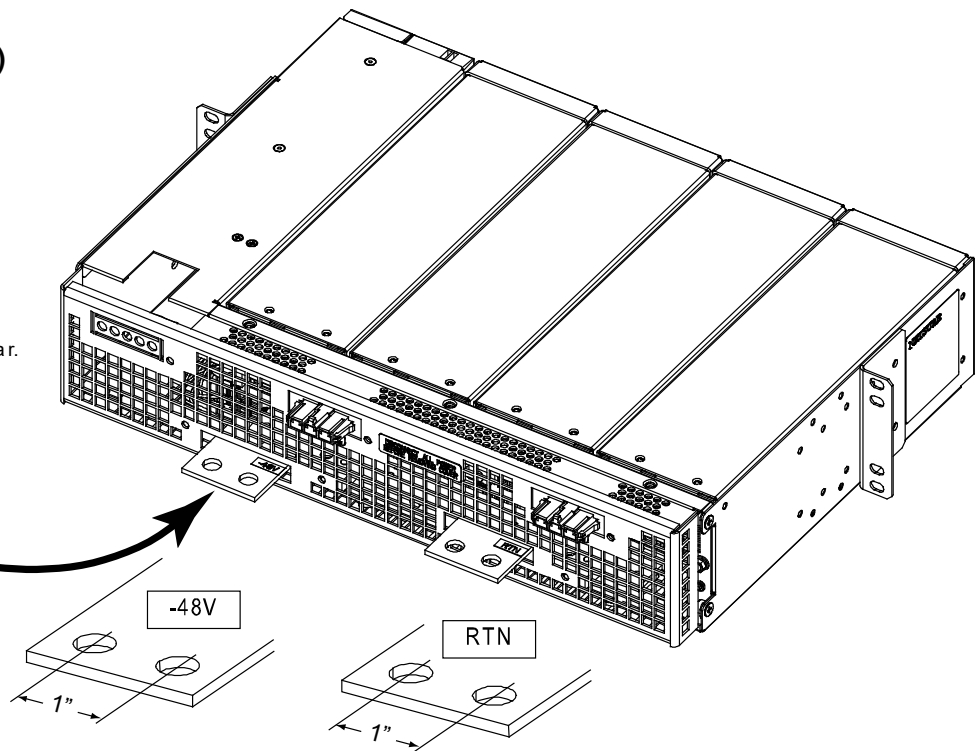
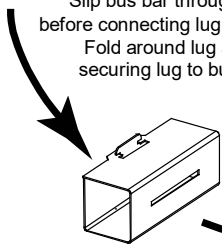
**Figure 18:** Bulk DC Output Connections, List 1-8 (Cont'd. on next page)

**DC Output  
List 1-4 (List 1 Shown)**

**Two (2) DC Output Lug  
Insulating Shields**



Slip bus bar through slot  
before connecting lug to busbar.  
Fold around lug after  
securing lug to busbar.

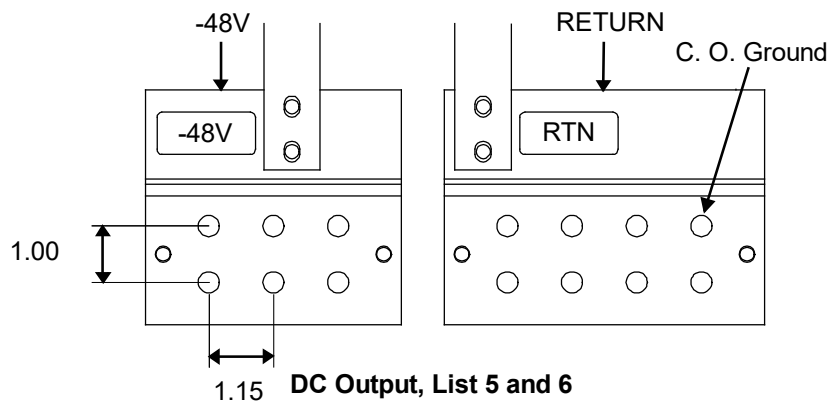
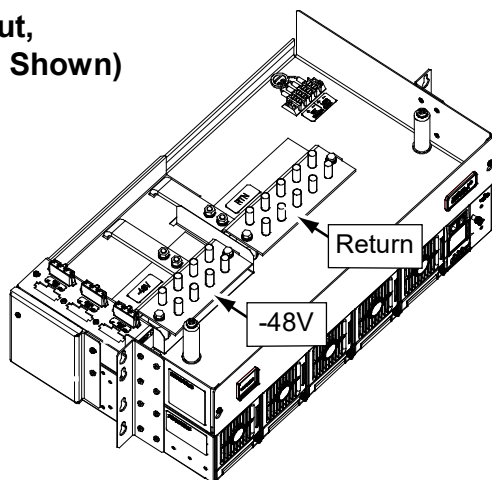


**DC Output Busbars**

Clearance Holes for 3/8" Bolts  
for Installation of Customer-Furnished  
Two-hole Lugs

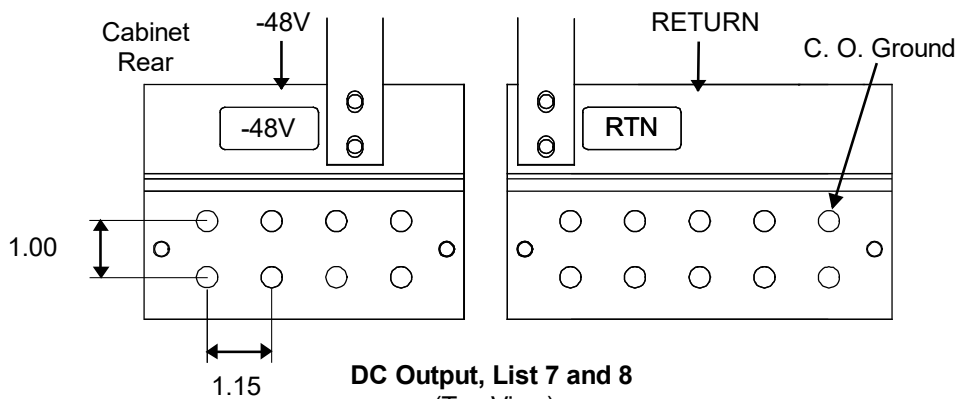
**Figure 18:** Bulk DC Output Connections, List 1-8 (Cont'd. from previous page)

**DC Output,  
List 5-8 (List 7 Shown)**



**DC Output, List 5 and 6  
(Top View)**

3/8-16 threaded studs for installation of customer-furnished two-hole lugs.  
Torque to 300 in.-lbs. with standard flat & lock washers.



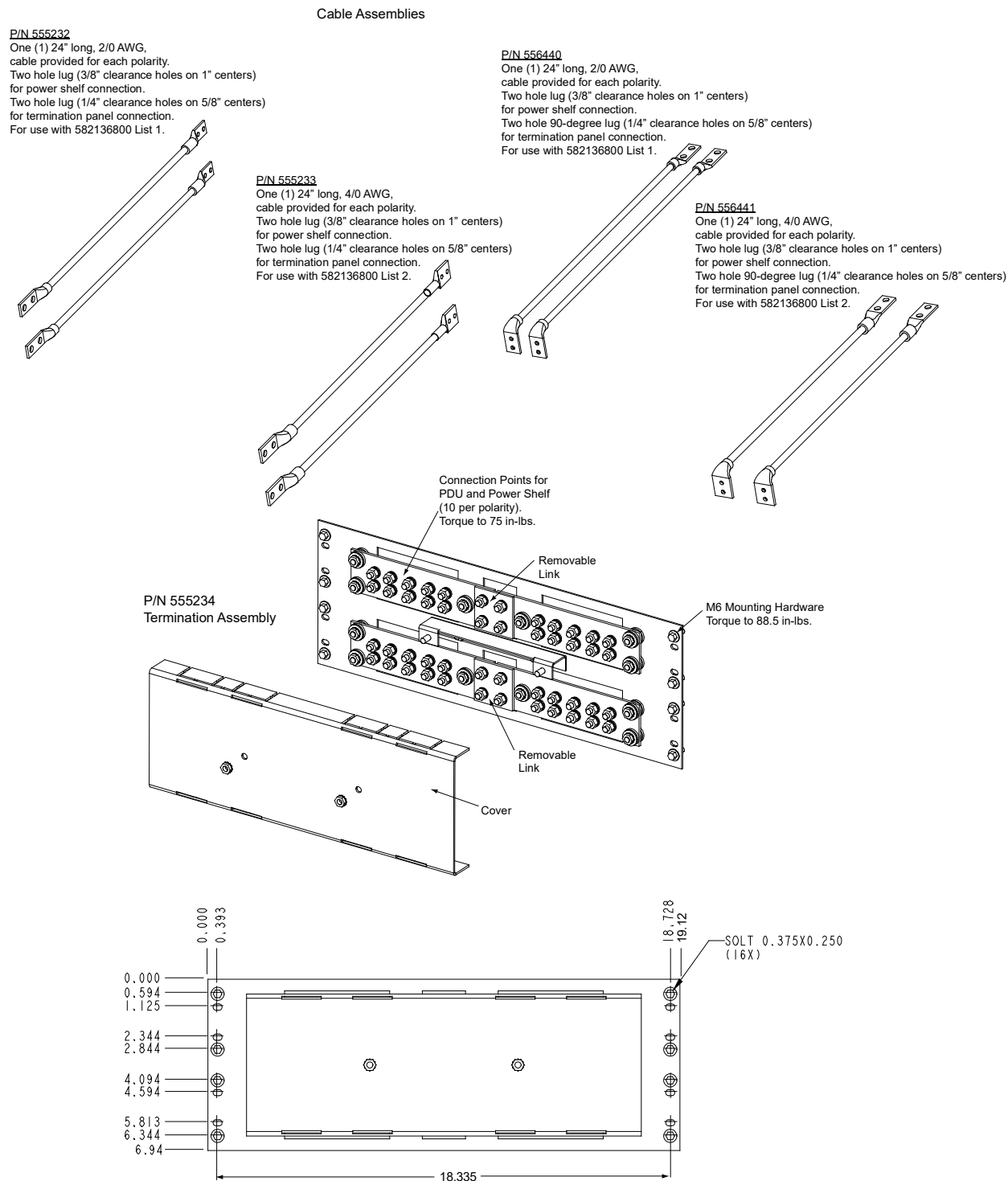
**DC Output, List 7 and 8  
(Top View)**

3/8-16 threaded studs for installation of customer-furnished two-hole lugs.  
Torque to 300 in.-lbs. with standard flat & lock washers.

## Connections to Termination Panel Kit P/N 555234

Refer to **Figure 19** and connect the cables order with the kit between the rectifier shelf and the termination panel mounted on a Knurr data cabinet.

**Figure 19:** Connections to Termination Panel Kit P/N 555234



## Load, C.O. Ground and Battery Connections to All Distribution Cabinets

### Accessing Electrical Connections (All Distribution Cabinets)

1. Open the front door of the Distribution Cabinet. To do so, loosen the two captive fasteners on the door, then pivot the door outward.
2. For 1-Row Distribution Cabinets only, remove both top cover(s) from the cabinet. To do so, for each cover loosen but do not remove the screws located on the top of the cover. Slide the cover to the front until the screw heads clear the slots in the cover. Then remove the cover.

### Load Connections (All Distribution Cabinets)

#### Wire Routing



**NOTE!** Refer to System Application Guide SAG582136800 for recommended wire sizes and crimp lugs. Refer to drawing 031110100 for lug crimping information. Refer to drawings 031110200 and 031110300 for additional lug information.

**One-Row Cabinets (Bullet Device Positions):** Load leads can be brought into the cabinet from the top, or from the back if right-angle adapters are used. Load Return leads must be brought into the cabinet from the back. Connections for both are accessible through the front of the cabinet.

**Two-Row Cabinets (Bullet Device Positions):** Load leads can be brought into the cabinet through the top, or through the back if right-angle adapters are used. Load Return leads can be brought into the cabinet through the back (factory configuration, except List MV), or through the top if the Load Return busbars have been rotated (List MV is factory configured for top access). Connections for both are accessible through the front of the cabinet.

The top covers of two-row cabinets provide cutouts for wiring from each distribution position and for the battery conductors. Use wire cutters to remove as required. Remove only the cutouts required for your installation. Route wires through these openings into the cabinet.

**Plug-in GMT Fuse Assemblies (All Cabinets):** Load and Load Return wiring can be brought into the cabinet through the top or back as required. Connections for both are accessible through the front of the cabinet.

#### Connections to Bullet Device Positions

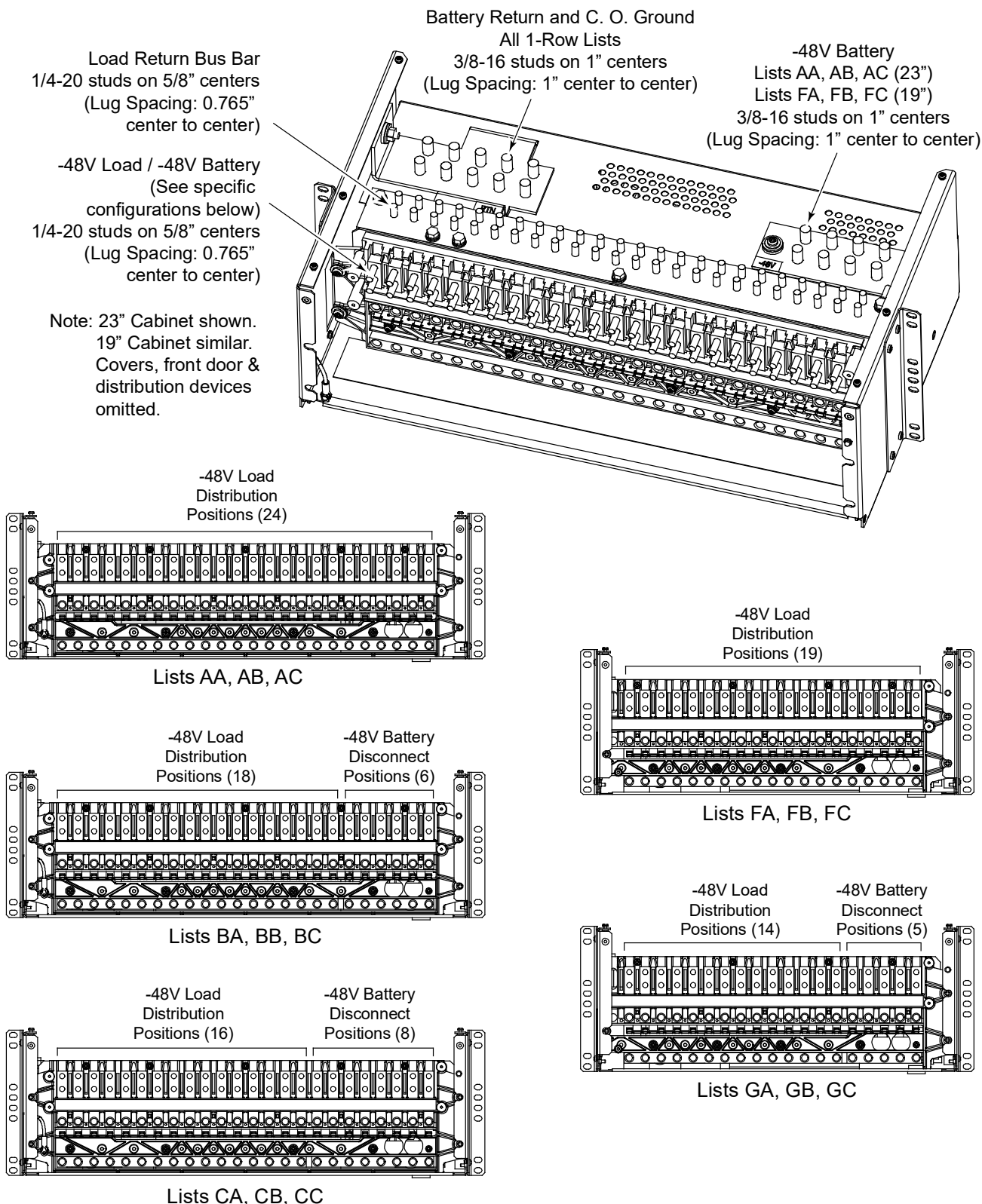
For Load and Load Return connections, 1/4-20 studs on 5/8" centers are provided. Installer must terminate wires with appropriate lugs. Refer to **Figure 20**, **Figure 21**, or **Figure 22** when making the following connections. Maximum size of wire to be connected to a single position is 2 AWG.



**WARNING!** Do not reverse polarity when making load or battery connections. Reversing polarity will cause equipment damage.

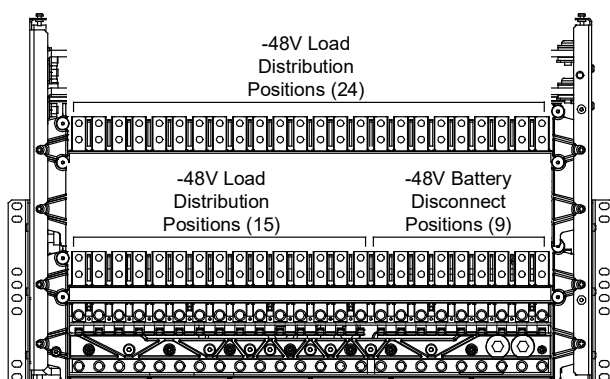
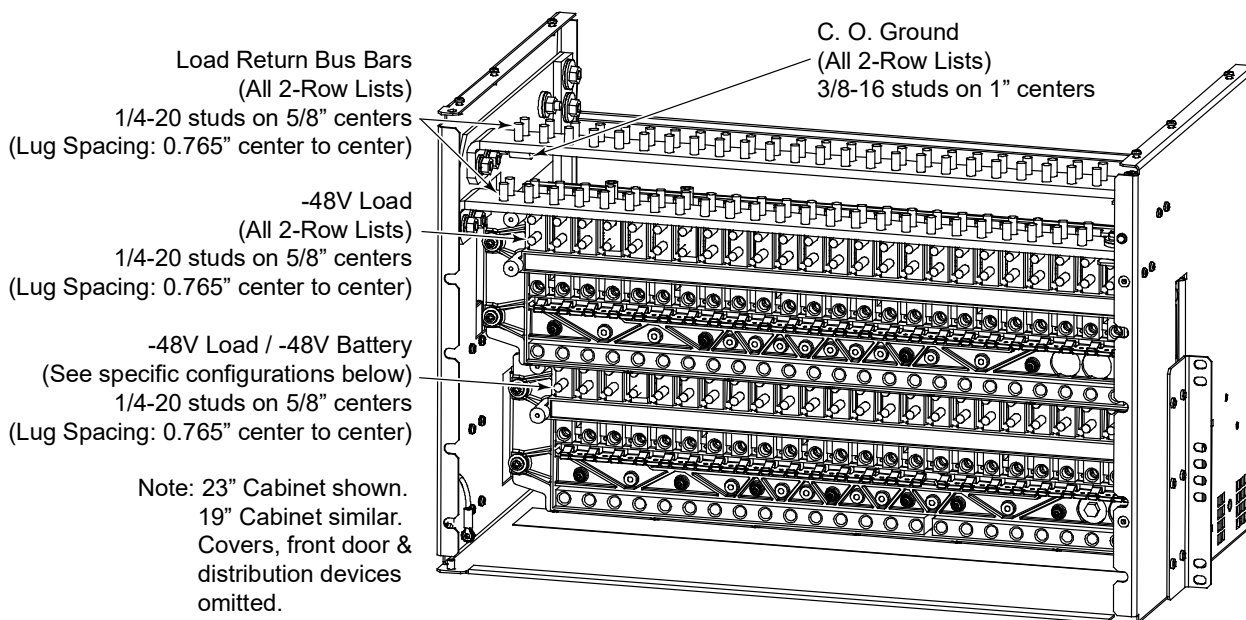
1. **Load:** Connect Load conductors to the bullet device mounting positions. Recommended torque for 1/4-20 hardware is 84 In. Lbs. when using standard flat and lock washers.
2. **Load Return:** Connect Load Return conductors to the Load Return busbar. Recommended torque for 1/4-20 hardware is 84 In. Lbs. when using standard flat and lock washers.

**Figure 20:** DC Load, C.O. Ground and Battery Connections (1-Row Distribution Cabinets)

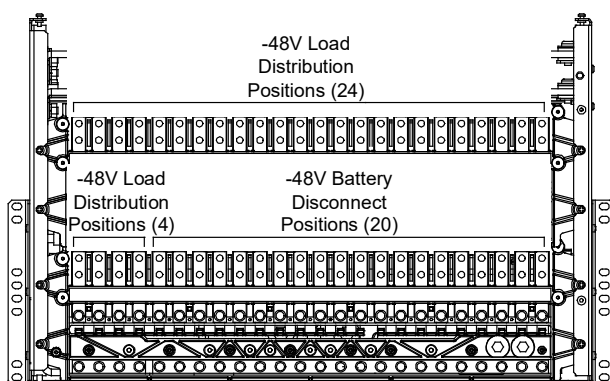




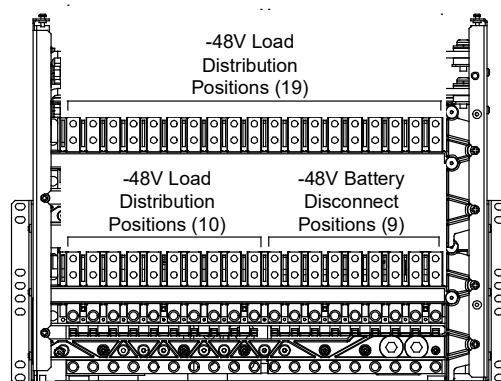
**Figure 21:** List MA-MD, NA-ND, RA-RD DC Load, C.O. Ground and Battery Connections (2-Row Distribution Cabinets)



Lists MA, MB, MC, MD



Lists NA, NB, NC, ND

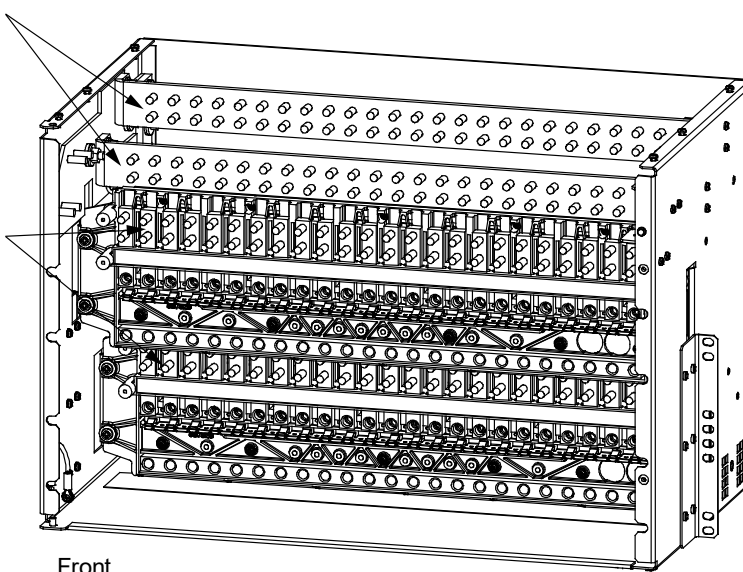


Lists RA, RB, RC, RD

**Figure 22:** List MV DC Load, C.O. Ground and Battery Connections (2-Row Distribution Cabinet)

Load Return Busbars  
(Qty. 48 Lug Positions)  
1/4-20 studs on 5/8" centers  
(Lug Spacing: 0.765" center to center)

-48V Load  
(Qty. 48 Breaker and Lug Positions)  
1/4-20 studs on 5/8" centers  
(Lug Spacing: 0.765" center to center)

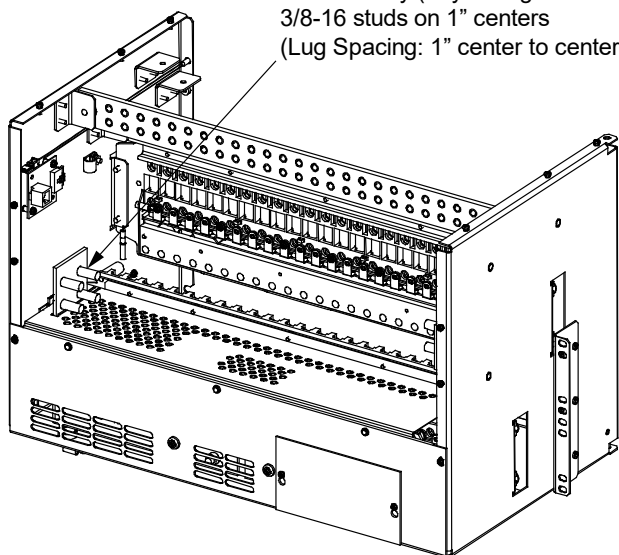


Front

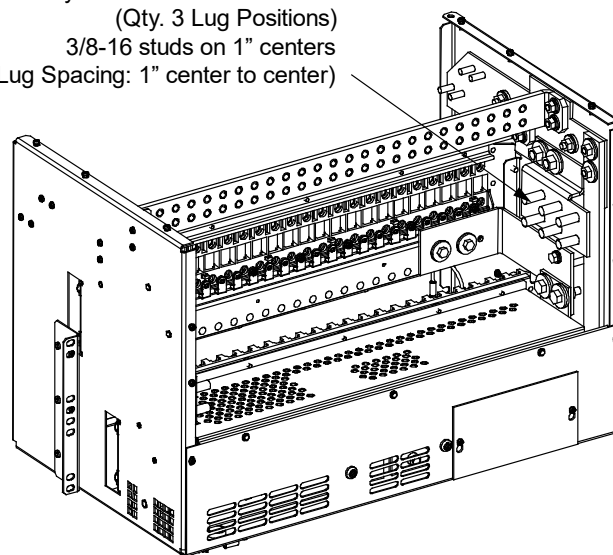
**Note:** Covers, front door & distribution devices omitted.

-48V Battery (Qty. 2 Lug Positions)  
3/8-16 studs on 1" centers  
(Lug Spacing: 1" center to center)

Battery Return and C.O. Ground  
(Qty. 3 Lug Positions)  
3/8-16 studs on 1" centers  
(Lug Spacing: 1" center to center)



Rear



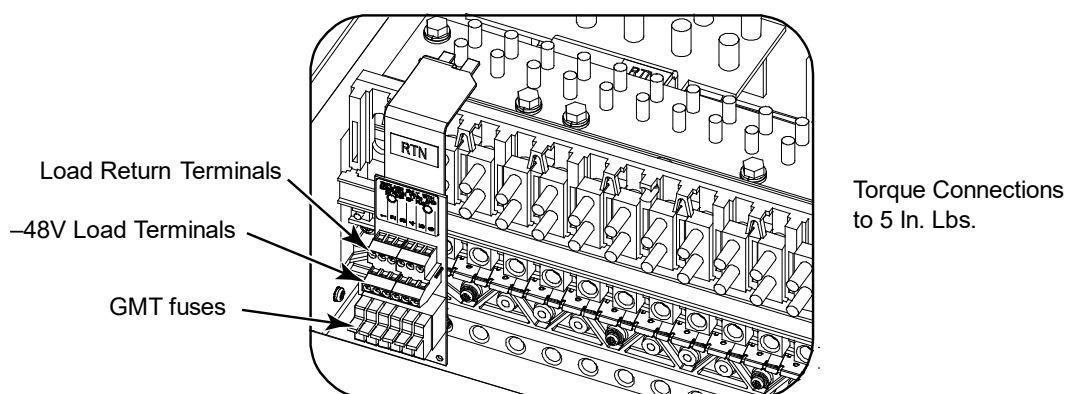
Rear

### **Connections to Optional GMT Fuse Assemblies, Part No. 545333 and 549017**

If Part No. 545333 or 549017 GMT Fuse Assemblies are present, connect load and load return leads to terminal blocks on the assembly.

Observe correct polarity as shown in **Figure 23** when connecting leads. Tighten screws as specified in the figure.

**Figure 23:** Load Connections to GMT Fuse Assembly (Part No. 545333 Shown. Connections to Part No. 549017 Identical)



### **C.O. Ground Connection (All Distribution Cabinets)**

For all 1-row and 2-row Distribution Cabinets, 3/8-16 studs on 1" centers are provided on the Return busbar for C.O. Ground wiring. Connect a lug-terminated C.O. ground lead at the location shown in **Figure 20**, **Figure 21**, or **Figure 22**. Recommended torque for 3/8-16 hardware is 300 In. Lbs. when using standard flat and lock washers.

### **Battery Connections (All Distribution Cabinets)**

**! DANGER!** Although battery voltage is not hazardously high, the battery can deliver large amounts of current. Exercise extreme caution not to inadvertently contact or have any tool inadvertently contact a battery terminal or exposed wire connected to a battery terminal. NEVER allow a metal object, such as a tool, to contact more than one termination at a time or to simultaneously contact a termination and a grounded object. Even a momentary short circuit can cause explosion and injury. Remove watches, rings, or other jewelry before connecting battery leads. Make the DC (battery) connections last. Make all other electrical connections without DC input power applied to the system.

**! DANGER!** Ensure correct polarity when connecting battery leads.

Make battery connections within the Distribution Cabinet as follows.

### **To Battery Busbars (Lists AA, AB, AC, FA, FB, FC, MV only)**

Battery and battery return leads terminated in two-hole lugs are connected to threaded studs located inside the Distribution Cabinet. Battery leads are brought into the rear or top of the shelf and are accessible from the front of the shelf. Refer to **Figure 20** or **Figure 22**. Observe proper polarity when connecting leads. Recommended torque for 3/8-16 hardware is 300 In. Lbs. when using standard flat and lock washers.

### **To Bullet Nose-Type Battery Disconnect Positions**

Battery and battery return leads terminated in two-hole lugs are connected to Disconnect positions and the Return bar as shown in **Figure 20** or **Figure 21**. Observe proper polarity when connecting leads. Recommended torque for 1/4-20 hardware is 84 In. Lbs. when using standard flat and lock washers.

### **Closing the Distribution Cabinet**

1. **One-Row Cabinets Only:** The top covers provide cutouts for wiring from each distribution position and for the battery conductors. Use wire cutters to remove as required. Remove only the cutouts required for your installation.
2. **One-Row Cabinets Only:** Install the top cover(s) on the Distribution Cabinet as follows: For both covers, place the cover in position while guiding wiring into the openings where cutouts were removed. Position the cover so that the mounting screw heads pass through the slots in the cover. Slide the cover towards the rear. Tighten the screws.
3. **All Cabinets:** Close the cabinet front access door and secure by tightening the two captive fasteners.

### **Load Connections to List KG GMT Load Distribution Fuse Panel**



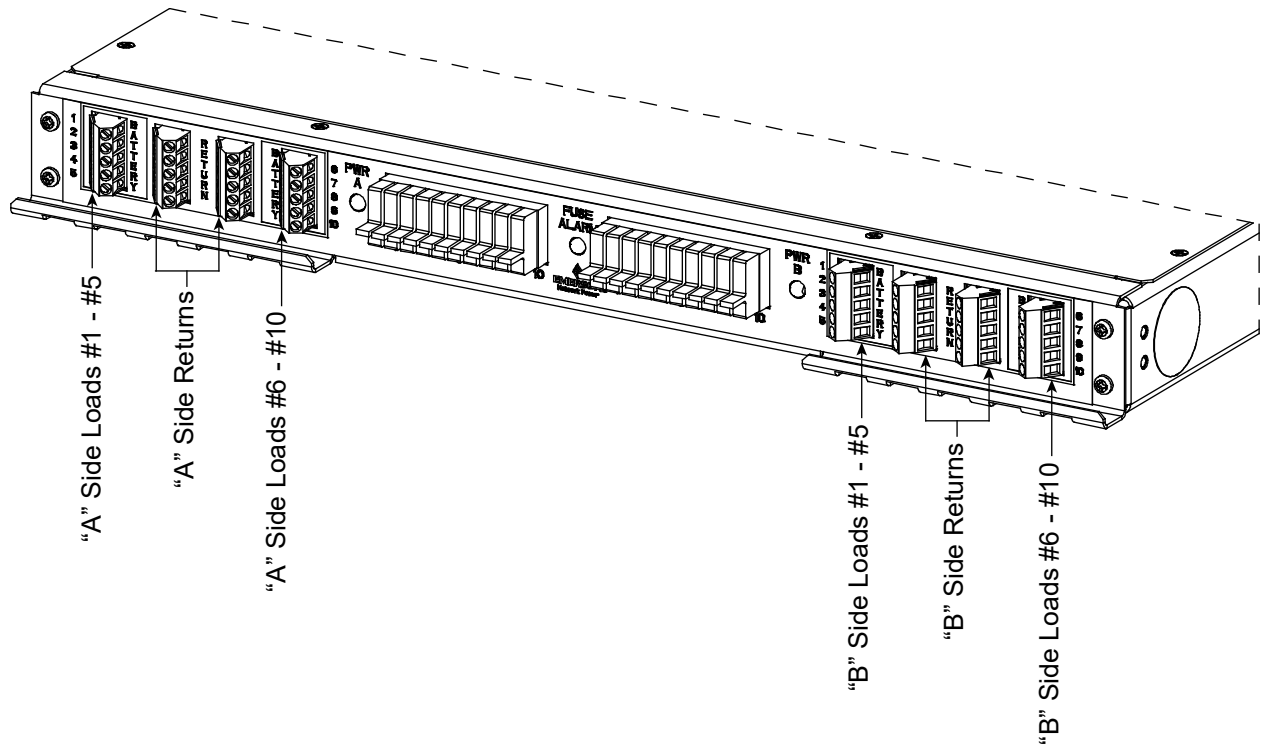
**WARNING!** Check for correct polarity before making connections.

Load and Load Return connections are made to the terminal blocks located on the front of the assembly. These terminal blocks provide screw compression type terminals, which accept a wire size in the range of 26 to 14 AWG. Refer to **Figure 24**. Recommended torque is 5.0 in.-lbs.



**NOTE!** "A" Side and "B" Side inputs are strapped in this power system.

**Figure 24:** Load Connections (List KG)



## Installing and Connecting Batteries in an Optional Battery Tray (if furnished)

### Important Safety Instructions



**WARNING!** Correct polarity must be observed when connecting battery leads.



**WARNING!** Special safety precautions are required for procedures involving handling, installing, and servicing batteries. Observe all battery safety precautions in this manual and in the battery instruction manual. These precautions should be followed implicitly at all times.



**WARNING!** A battery can present a risk of electrical shock and high short circuit current. Servicing of batteries should be performed or supervised only by properly trained and qualified personnel knowledgeable about batteries and the required precautions.

The following precautions should be observed when working on batteries:

- Remove watches, rings, and other metal objects.
- Eye protection should be worn to prevent injury from accidental electrical arcs.
- Use certified and well maintained insulated tools. Use double insulated tools appropriately rated for the work to be performed. Ensure that wrenches with more than one working end have only one end exposed.
- Do not lay tools or metal parts on top of batteries.
- Disconnect charging source prior to connecting or disconnecting battery terminals.
- Risk of explosion if battery is replaced with an incorrect type or if polarity is reversed. When replacing batteries, replace with the same manufacturer and type, or equivalent.
- Dispose of used batteries according to the instructions provided with the batteries. Do not dispose of batteries in a fire. They may explode.
- ALWAYS FOLLOW THE BATTERY MANUFACTURER'S RECOMMENDATIONS AND SAFETY INSTRUCTIONS.

In addition to the hazard of electric shock, gas produced by batteries can be explosive and sulfuric acid can cause severe burns. Do not open or mutilate batteries. Released electrolyte is harmful to the skin and eyes, and is toxic. If electrolyte comes into contact with skin, the affected area should be washed immediately with large amounts of water.



**DANGER! This equipment may be used in conjunction with lead-acid batteries. Working near lead-acid batteries is dangerous!**

- Batteries contain sulfuric acid.
- Batteries generate explosive gases during normal operation. Systems containing batteries should never be installed in an airtight room or space. Only install in a ventilated environment.
- Batteries are an energy source that can produce high amounts of electrical current.

FOR THESE REASONS, IT IS OF CRITICAL IMPORTANCE THAT YOU READ THESE INSTRUCTIONS AND FOLLOW THEM EXACTLY.

WHEN WORKING WITH LEAD-ACID BATTERIES:

- Wear complete protection for eyes, face, hands, and clothing. Examples are safety goggles or face shield, a rubber apron and gloves.
- If battery acid enters your eye, immediately flush your eye with running cold water for at least 15 minutes. Get medical attention immediately.
- If battery acid contacts skin or clothing, wash immediately with soap and water.

### **Battery Manufacturer Information**


Refer to SAG582136800 for specifications and manufacturers of the batteries to be installed in this power system.

### **Procedure**


Tray P/N 528496 is used in the following procedure. The procedure for all other available trays is similar.

 **NOTE!** Refer to **Figure 25** as this procedure is performed.


1. **If Battery Trays are Equipped With Circuit Breakers:** Turn OFF the Battery Disconnect circuit breakers located on all battery trays. Refer to **Figure 25** for locations.
2. Remove the Battery Retention Bracket as shown in **Figure 25**. To do so, remove the four 1/4-20 x 5/8" bolts and associated washers.
3. Slide batteries into the tray, with the battery terminals toward the front. Slide batteries into the tray as far as they will go.


 **NOTE!** The Battery Retention Bracket can be oriented two ways to accommodate batteries of different lengths. A correctly oriented bracket will fit snugly against the batteries. If your batteries require the alternate bracket orientation shown in Detail A of **Figure 25**, remove and reinstall the bullet-shaped spacers (trays P/N 528496 and 540842 only) as shown in Detail A before performing the next step.

4. Reinstall the Battery Retention Bracket. Secure with the hardware removed in a previous step. Refer to **Figure 25** for washer location.

 **NOTE!** The spacers on the bracket are used to accommodate the various sizes of batteries available. Install or remove the spacers as required so that the batteries are tight in the battery tray.

5. Connect three links supplied by the battery manufacturer between pairs of battery terminals as shown in **Figure 25**. Use hardware furnished by the battery manufacturer. Torque hardware to battery manufacturer's recommendations.
6. Ensure the battery cable ends in all trays are insulated with sleeving before performing the next step.

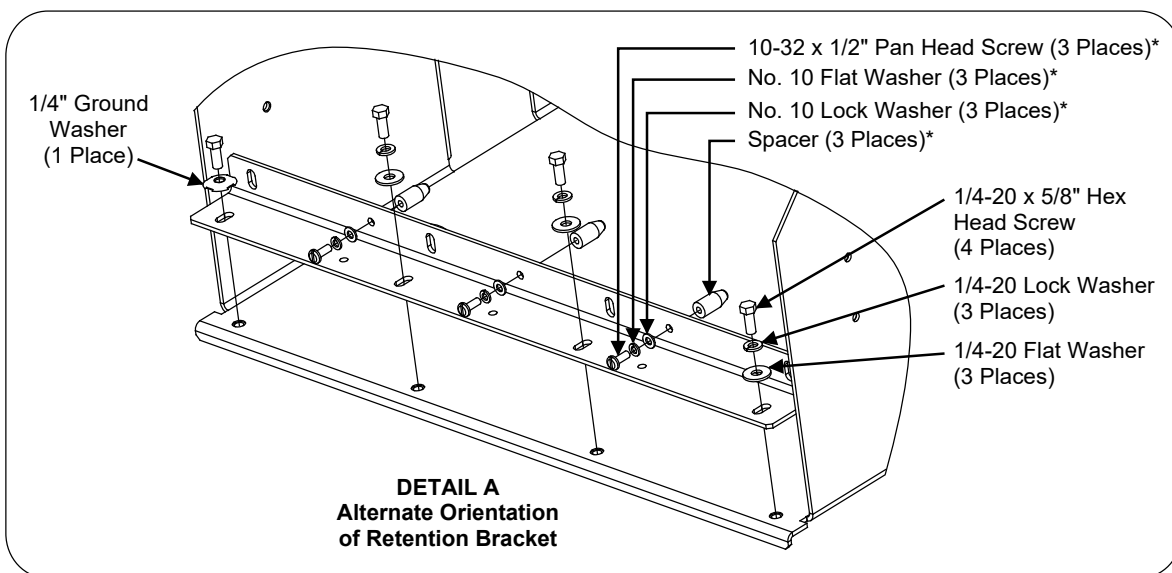
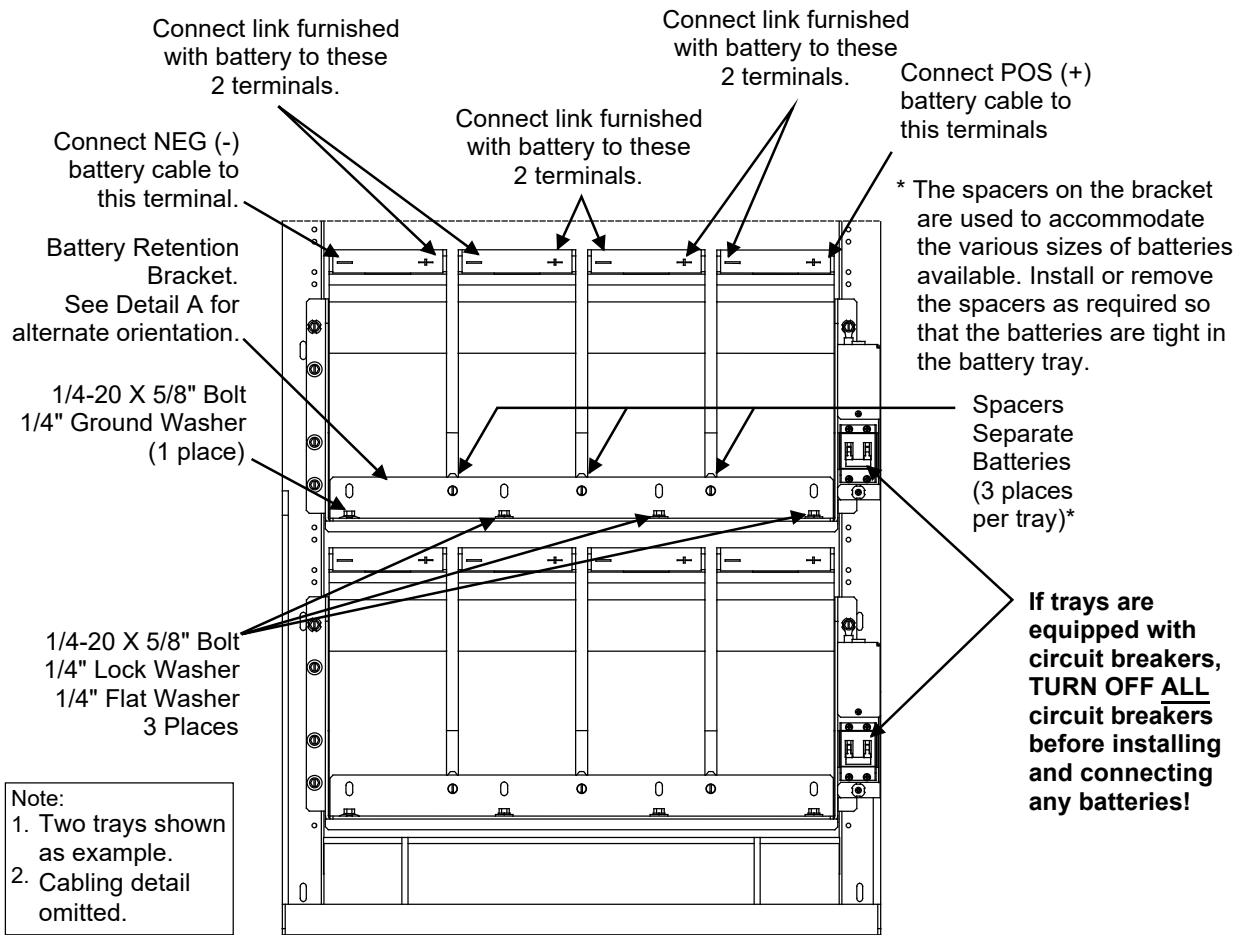
 **DANGER!** In multiple-tray installations, when batteries in one tray are connected, the battery cables in all trays will be energized. Remove sleeving from and connect one cable at a time. Do not allow cable end to contact the battery tray or equipment rack.

 **WARNING!** In the next step, observe correct polarity. Connect only cable labeled "+" to battery terminal labeled "+". Likewise, connect only cable labeled "-" to battery terminal labeled "-".

7. Connect the cables found in the battery tray to the battery terminals, “+” to “+” and “-” to “-”. Observe correct polarity. Refer to **Figure 25**. Secure with kit-furnished hardware as shown. Torque hardware to battery manufacturer’s recommendations.
8. Repeat steps 1 through 7 for any remaining battery trays.
9. **If Battery Trays Are Equipped With Circuit Breakers:** To connect the batteries to the Power System, turn ON the Battery Disconnect circuit breakers located on all battery trays.



**Figure 25: Battery Installation Details (Optional Battery Tray)**



# INSTALLING THE RECTIFIER MODULES

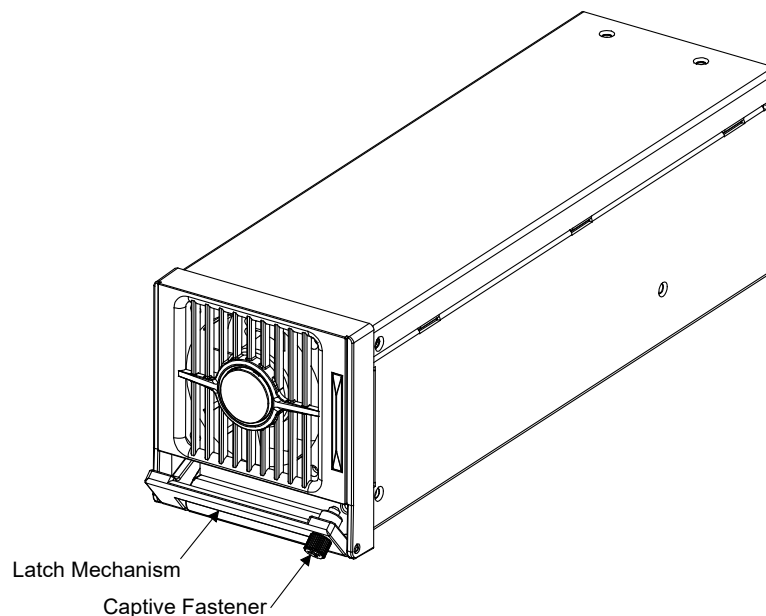
The Rectifier Module is hot swappable. It can be installed with the system operating.

Refer to **Figure 26** as this procedure is performed.

## **Procedure**

1. Place the Rectifier Module into an unoccupied mounting slot without sliding it in completely.
2. Loosen the captive fastener securing the top of the latch mechanism to the front of the Rectifier Module. Pull the top of the latch mechanism away from the Rectifier Module (this will retract the latch mechanism located on the underside of the Rectifier Module).
3. Push the Rectifier Module completely into the shelf. Push the top of the latch mechanism into the front panel of the Rectifier Module, and secure by tightening the captive fastener. This locks the Rectifier Module securely to the shelf.
4. Repeat the above steps for each Rectifier Module being installed in the system.
5. After the Rectifier Modules are physically installed in the mounting shelf(s), they are ready for operation immediately after power is supplied to them.
6. If blank cover panels are provided, install in any unused rectifier mounting slots.

**Figure 26:** Latch Mechanism on the Rectifier Module



# INITIALLY STARTING THE SYSTEM

## Initially Starting, Configuring, and Checking System Operation when E/W NCU

### Initial Startup Preparation

- Ensure that all blocks except the last one in the “Installation Acceptance Checklist” on page 2 have been checked.
- Refer to the separate NCU User Manual supplied with your Power System for complete Controller operating information.
- Refer to the Configuration Drawing (C-drawing) supplied with your Power System for settings of adjustable parameters.

### Initially Starting the System

#### Procedure

1. Apply DC input power to the system by closing the DC disconnect(s) or protective device(s) that supplies battery power to the system, if furnished.
2. Apply AC input power to the system by closing the external AC disconnects or protective devices that supplies power to the shelf(s).

Note that the system requires multiple AC input branch circuits.

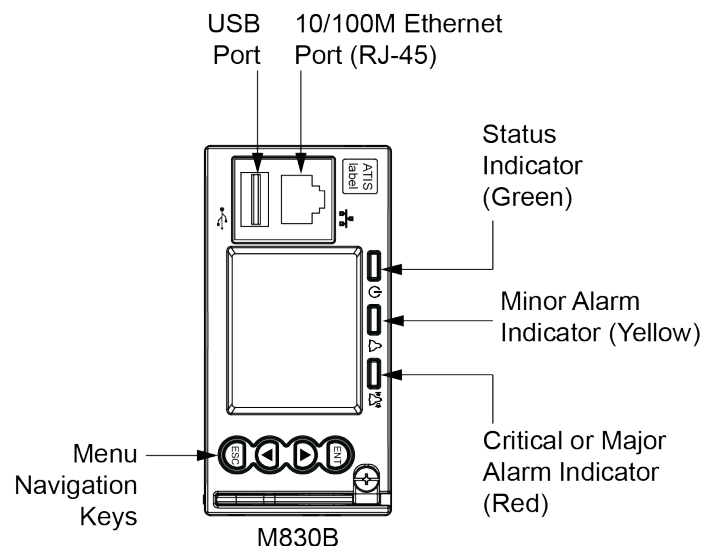
The rectifiers start and supply power to the loads.

3. Place each distribution circuit breaker (if furnished) to the ON position.

### NCU Controller Initialization

Refer to **Figure 27** for locations of the NCU local indicators and navigation keys.

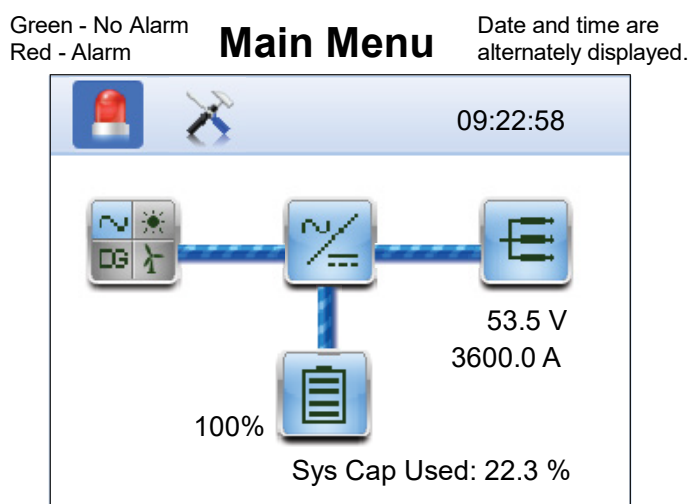
**Figure 27:** NCU Local Indicators and Navigation Keys



## Procedure

**NOTE!** The initialization routine takes several minutes. During that time various alarm indicators may illuminate on the NCU front panel and an audible alarm may sound. Disregard all alarms. An audible alarm can be silenced at any time by momentarily depressing the **ENT** key on the NCU Controller.

1. After the NCU is powered on, the display shows the “Emerson Network Power” screen. The controller is initializing.
2. When initialization is complete, the language screen appears. Press the up or down arrow key to select the desired language. Press the **ENT** key to confirm the selection.
3. The Main Menu displays.




Graphics	Menu Name	Description
	Alarm (Green - No Alarm) (Red - Alarm)	View active alarms and alarm history.
	Settings	Gain access to the NCU Controller's settings menus.
	Input Power	View AC, Solar, DG, and Wind related information.
	Module	View rectifier /converter related information.
	DC	View DC equipments related information.
	Battery	View battery related information.

Press the UP and DOWN keys to highlight the desired Menu graphic in the Main Menu.


Press the ENT key to enter the selected menu.


4. System information is displayed in multiple screens. Press the ESC key to view other system information. Press the down arrow key to view the next screen. Press the ESC key to return to the Main Menu.

- From the Main Menu, press the UP and DOWN keys to highlight the desired Menu graphic in the Main Menu. Press the ENT key to enter the selected menu.

 **NOTE!** Repeatedly press the “ESC” key to return in reverse order level by level from any submenu until the Main Menu appears.

- Verify and set the NCU controller as required for your application. Refer to the separate NCU User Manual for procedures. Refer also to “NCU Start Wizard” on page 53.

 **NOTE!** One Row Distribution Panels: Any LVD is on LVD2.  
Two Row Distribution Panels: Any single LVD is on LVD2 and when there are (2) LVD’s then LVBD is on LVD2 and LVLD is on LVD1.

 **NOTE!** When setting total rectifier current limit, the set point to each unit is the total set point divided by the number of units. For example, if the system contains five rectifiers and the current limit is set to 150 amps then each rectifier has a current limit set point of 30 amps. If one or more rectifiers are removed or fail it will take several seconds for the individual set points to the remaining rectifiers to be reset. In the example given, if one rectifier is removed the current limit set point will drop to 120 amps (30 amps times four remaining rectifiers) until the controller can send updated set points to the remaining rectifiers. This takes a couple communication cycles (several seconds) after which each rectifier would have a new set point of 37.5 amps for a total of 150 amps. The total current limit of the rectifiers should not be set such that the loss of the redundant rectifiers will cause this temporary set point to drop below the actual maximum expected load. If batteries are used on the rectifier output, the batteries should support the load until the current limit set points can be re-established due to loss of a rectifier.

### NCU Start Wizard

For initial startup, you can perform the Start Wizard from the local keypad and display to enter basic programmable parameters in one session. Refer to the “Start Wizard” section in the NCU Instructions (UM1M830BNA).

### Verifying the Configuration File

Your NCU was programmed with a configuration file that sets all adjustable parameters. The version number of the configuration file can be found on the configuration drawing (C-drawing) that is supplied with your power system documentation, and on a label located on the NCU. You can verify that the correct configuration file has been loaded into your NCU by performing the following procedure.

#### **Procedure**

- With the Main Menu displayed, press **ESC**. A screen displays the NCU name, serial number, IP number, software version, hardware version, and configuration version number.
- Press the **DOWN** key. A screen displays the NCU file system and MAC address.
- Press **ESC** to return to the Main Menu.

### Checking Basic System Settings

Navigate through the controller menus and submenus to check system settings. You can adjust any parameter as required. Note that these settings can also be checked (and changed if required) via the WEB Interface. Refer also to “NCU Start Wizard” on page 53.



**NOTE!** Repeatedly press the “ESC” key to return in reverse order level by level from any submenu until the Main Menu appears.

### **Procedure**

1. **To Select a Sub-Menu:**  
Press the UP and DOWN keys to highlight the desired sub-menu. Press the ENT key to enter the selected sub-menu.
2. **To Select a User:**  
To select a User, use the UP and DOWN keys to move the cursor to the Select User field. Press ENT. Use the UP and DOWN keys to select a User previously programmed into the NCU. Press ENT to select the User. Note that only Users programmed into the NCU are shown. Users are programmed via the Web Interface. The default User is admin.
3. **To Enter a Password:**  
If a password screen opens, a password must be entered to allow the User to make adjustments. To enter a password, use the UP and DOWN keys to move the cursor to the Enter Password field. Press ENT. Use the UP and DOWN keys to choose a character. Press ENT to accept and move to the next character. Continue this process until all characters are entered. Press ENT again to accept the password. The default password is 640275.
4. **To Change a Parameter:**  
Press the UP and DOWN keys to move up and down the list of parameters. Press ENT to select the parameter. Press the UP and DOWN keys to change the parameter. Press ENT to make the change. Press ESC to cancel the change.

### **Checking System Status**

#### **Procedure**

1. Observe the status of the indicators located on the Rectifier Modules and NCU. If the system is operating normally, the status of these is as shown in **Table 6**.

**Table 5:** Status and Alarm Indicators

Component	Indicator	Normal State
Rectifier Modules	Power (Green)	On
	Protection (Yellow)	Off
	Alarm (Red)	Off
NCU	Status (Green)	On
	Minor (Yellow)	Off
	Critical or Major Alarm (Red)	Off

## Configuring the NCU Identification of Rectifiers and Assigning which Input Feed is Connected to the Rectifiers

When rectifiers are all installed prior to applying power and starting the system, the order in which the NCU identifies the rectifiers is by serial number (lowest serial number is Rect 1, next lowest is Rect 2, etc.). If you prefer the NCU to identify the rectifiers by position in the system, perform the following procedure.

Upon power up, the NCU arbitrarily assigns Feed AC1, AC2, or AC3 to each rectifier. This assignment is used to display rectifier AC input feed voltage(s). The User may reassign the feed to each rectifier per your specific installation by following the procedure below.

### Local Menu Navigation:


None.

### Web Menu Navigation:

Refer to the NCU Instructions (UM1M830BNA) for detailed instructions.


## NCU Alarm Relay Check

The following procedures can be used to verify operation of the external alarm relays in a Power System equipped with an NCU with the factory default configuration. Note that alarm relays on an NCU with a custom configuration may operate differently.

 **NOTE!** There are two methods to check alarm relays. The first is by actually causing an alarm. The second is by using the NCU alarm relay check function. The first method is used in the following procedures. Refer to the NCU User Instructions (UM1M830BNA) for instructions using the NCU alarm relay check function.

## Checking the AC Fail Alarm

### Procedure

 **NOTE!** Battery must be connected during this procedure.

1. Verify system is operating and no alarms are present.
2. Verify the NCU displays the Main screen. If not, press ESC repeatedly to return to the Main screen.
3. Open the external AC disconnect(s) or protective device(s) that supply power to all of the rectifier modules.
  - a) **Requirement:** An audible alarm sounds. Alarm will be silenced in Requirement d.
  - b) **Requirement:** On subject rectifier module(s), the “Protection” indicator goes from off to yellow. After approximately 30 seconds, the green “Power” and yellow “Protection” indicators go off.
  - c) **Requirement:** NCU “Critical/Major” alarm indicator goes from off to red.
  - d) **Requirement:** NCU displays “Rect AC Fail” alarm.

To see the specific alarm(s), navigate to the Alarm Menu and press **ENT**. The Active Alarm screen lists two critical alarms. “Power System CAN Comm Fail Critical” is displayed. Scroll down by pressing the down arrow key. “Rect Mains Failure Critical” is displayed.

- e) **Requirement:** External “AC Fail” (Relay 6) and “Critical” (Relay 1) alarms activate.
4. Return external AC disconnect(s) or protective device(s) to the ON position.

- a) **Requirement:** “Power” indicator on subject rectifier modules goes from off to green.



**NOTE!** A “Rect Group All Rect No Response” alarm may activate briefly.

- b) **Requirement:** NCU “Critical/Major” alarm indicator goes from red to off.
- c) **Requirement:** Press ESC repeatedly to return to the Main screen. NCU displays “No Alarm”.
- d) **Requirement:** All external alarms deactivate.

## **Checking Rectifier Alarm**

### **Procedure**

1. Verify system is operating and no alarms are present.
2. Verify the NCU displays the Main screen. If not, press ESC repeatedly to return to the Main screen.
3. Pull one Rectifier Module half way out of the shelf. To do this, first loosen the captive fastener securing the top of the latch mechanism to the front of the Rectifier Module. Pull the top of the latch mechanism away from the Rectifier Module (this will retract the latch mechanism located on the underside of the Rectifier Module). Refer to **Figure 26** for latch mechanism illustration.

- a) **Requirement:** An audible alarm sounds. Alarm will be silenced in Requirement c.
- b) **Requirement:** NCU “Critical/Major” alarm indicator goes from off to red.
- c) **Requirement:** NCU displays “Alarm”.

To see the specific alarm(s), navigate to the Alarm Menu and press **ENT**. The “Active Alarm” screen lists one major alarm. “Rect (###) Comm Fail Major” is displayed.

- d) **Requirement:** External “Rectifier” (Relay 8) and “Major” (Relay 2) alarms activate.



**NOTE!** If the system is equipped with only one rectifier, skip step 4.

4. Pull a second Rectifier Module half way out of the shelf, as described in Step 3.
  - a) **Requirement:** An audible alarm sounds. The alarm will cancel in Requirement c.
  - b) **Requirement:** NCU “Critical/Major” alarm indicator stays red.
  - c) **Requirement:** Press ESC repeatedly to return to the Main screen. NCU displays “Alarm”.

To see the specific alarm(s), navigate to the Alarm Menu and press **ENT**. The Active Alarm screen lists one critical and two major alarms. “Rect Group Multi-Rect Fail Critical” is displayed. Use arrow keys to scroll through the list of alarms. “Rect ### Comm Fail Major” is displayed for each removed rectifier.

- d) **Requirement:** External “Rectifier” (Relay 8) and “Major” (Relay 2) alarms remains in alarm state and “Critical” (Relay 1) alarm activates.



5. Reinstall the rectifier module(s). Refer to *Installing the Rectifier Modules* at the beginning of this section.
  - a) **Requirement:** “Power” indicator on subject rectifier(s) goes from off to green.
  - b) **Requirement:** NCU “Critical/Major” alarm indicator goes from red to off.
  - c) **Requirement:** Press ESC repeatedly to return to the Main screen. NCU displays “No Alarm”.
  - d) **Requirement:** All external alarms deactivate.

### **Checking System Over Voltage Alarm 1 and Over Voltage Alarm 2**

1. Verify system is operating and no alarms are present.
2. Verify the NCU displays the Main screen. If not, press ESC repeatedly to return to the Main screen.
3. Record the system voltage displayed on the NCU Main screen.
4. Navigate to the Settings Menu.
5. With the Settings menu screen displayed, navigate to “**Over Voltage 1**”. Main Menu / Settings Icon / Other Settings / Over Voltage 1. Record the displayed voltage setpoint.
6. Press the Enter (ENT) key; then use the “▲” or “▼” keys to adjust the “Over Voltage 1” value to two volts below the system voltage recorded in step 3. Press ENT.
  - a) **Requirement:** An audible alarm sounds. The alarm will be silenced in Requirement c.
  - b) **Requirement:** NCU “Critical/Major” alarm indicator goes from off to red.
  - c) **Requirement:** Press ESC repeatedly to return to the Main screen. NCU displays “Alarm”.

To see the specific alarm(s), navigate to the Alarm Menu and press **ENT**. The Active Alarm screen lists one critical alarm. “**Power System Over Voltage 1 Critical**” is displayed.

- d) **Requirement:** External “DC Over Voltage 1” (Relay 3) and “Critical” (Relay 1) alarms activate.
7. Without readjusting the “Over Voltage 1” setpoint, navigate to “**Over Voltage 2**”. Main Menu / Settings Icon / Other Settings / Over Voltage 2. Record the displayed voltage setpoint.
8. Press the Enter (ENT) key; then use the “▲” or “▼” keys to adjust the “Over Voltage 2” value to one volt below the system voltage recorded in step 3. Press ENT.
  - a) **Requirement:** An audible alarm sounds. Alarm will be silenced in Requirement d.
  - b) **Requirement:** NCU “Critical/Major” alarm indicator stays red.
  - c) **Requirement:** Press ESC repeatedly to return to the Main screen. NCU displays “Alarm”.

To see the specific alarm(s), navigate to the Alarm Menu and press **ENT**. The Active Alarm screen lists two critical alarms. “**Power System Over Voltage 2 Critical**” is displayed. Use arrow keys to scroll through the list of alarms. “**Power System Over Voltage 1 Critical**” is displayed.

- d) **Requirement:** External “DC Over Voltage 1” (Relay 3) alarm and “Critical” (Relay 1) alarm remain active.
9. Navigate to “**Over Voltage 2**”. Main Menu / Settings Icon / Other Settings / Over Voltage 2.

10. Press ENT; then use the “▲” or “▼” keys to adjust the “Over Voltage 2” setting to the value recorded in step 7. Press ENT.



**NOTE!** Over Voltage 2 alarm will retire. The audible alarm will be silenced in the next step.

11. Use the “▲” or “▼” keys to scroll up to “Over Voltage 1”.
12. Press ENT; then use the “▲” or “▼” keys to adjust the “Over Voltage 1” setting to the value recorded in step 5. Press ENT.
  - a) **Requirement:** NCU “Critical/Major” alarm indicator goes from red to off.
  - b) **Requirement:** Press ESC repeatedly to return to the Main screen. NCU displays “No Alarm”.
  - c) **Requirement:** All external alarms deactivate.

### **Checking System Under Voltage Alarm 1 and Under Voltage Alarm 2**

1. Verify system is operating and no alarms are present.
2. Verify the NCU displays the Main screen. If not, press ESC repeatedly to return to the Main screen.
3. Record the system voltage displayed on the NCU Main screen.
4. Navigate to the Settings Menu.
5. With the Settings Menu screen displayed, navigate to “Under Voltage 1”. Main Menu / Settings Icon / Other Settings / Under Voltage 1. Record the displayed voltage setpoint
6. Press the Enter (ENT) key; then use the “▲” or “▼” keys to adjust the “Under Voltage 1” value to two volts above the system voltage recorded in step 3. Press ENT.
  - a) **Requirement:** An audible alarm sounds. The alarm will be silenced in Requirement c.
  - b) **Requirement:** NCU “Critical/Major” alarm indicator goes from off to red.
  - c) **Requirement:** Press ESC repeatedly to return to the Main screen. NCU displays “Alarm”.

To see the specific alarm(s), navigate to the Alarm Menu and press ENT. The Active Alarm screen lists one critical alarm. “Power System Under Voltage 1 Critical” is displayed.
- d) **Requirement:** External “DC Under Voltage 1” (Relay 4) and “Critical” (Relay 1) alarms activate.
7. Without readjusting the “Under Voltage 1” setpoint, navigate to “Under Voltage 2”. Main Menu / Settings Icon / Other Settings / Under Voltage 2. Record the displayed voltage setpoint.
8. Press the Enter (ENT) key; then use the “▲” or “▼” keys to adjust the “Under Voltage 2” value to one volt above the system voltage recorded in step 3. Press ENT.
  - a) **Requirement:** An audible alarm sounds. Alarm will be silenced in Requirement c.
  - b) **Requirement:** NCU “Critical/Major” alarm indicator stays red.
  - c) **Requirement:** Press ESC repeatedly to return to the Main screen. NCU displays “Alarm”.

To see the specific alarm(s), navigate to the Alarm Menu and press ENT. The Active Alarm screen

lists two critical alarms. “Power System Under Voltage 2 Critical” is displayed. Use arrow keys to scroll through the list of alarms. “Power System Under Voltage 1 Critical” is displayed.

- d) **Requirement:** External “DC Under Voltage 2” (Relay 5) alarm activates, “DC Under Voltage 1” (Relay 4) alarm resets, and “Critical” (Relay 1) alarm remains active.

9. Navigate to “Under Voltage 2”.

10. Press ENT; then use the “▲” or “▼” keys to adjust the “Under Voltage 2” setting to the value recorded in step 7. Press ENT.



**NOTE!** Low Voltage 2 alarm will retire. The audible alarm will be silenced in the next step.

11. Use the “▲” or “▼” keys to scroll up to “Under Voltage 1”.

12. Press ENT; then use the “▲” or “▼” keys to adjust the “Under Voltage 1” setting to the value recorded in step 5. Press ENT.

- a) **Requirement:** NCU “Critical/Major” alarm indicator goes from red to off.

- b) **Requirement:** Press ESC repeatedly to return to the Main screen. NCU displays “No Alarm”.

- c) **Requirement:** All external alarms deactivate.

### **Checking Circuit Breaker/Fuse Alarm**

1. Verify system is operating and no alarms are present.

2. Verify the NCU displays the Main screen. If not, press ESC repeatedly to return to the Main screen.

3. Open the front door of the Distribution Unit at the right-hand side of the shelf.



**NOTE!** The following procedure is to be used only with circuit breakers that provide an alarm indication when manually placed to the OFF (open) position (black handle). Electrical trip alarm circuit breakers (white handle) cannot be easily tested in the field.

4. Do one of the following: (1) Remove a good fuse or a dummy fuse from a GMT fuse position, and replace it with a blown fuse, or (2) Place the handle (if black) of a load circuit breaker in the OFF (open) position.

- a) **Requirement:** An audible alarm sounds. The alarm will be silenced in Requirement c.

- b) **Requirement:** NCU “Critical/Major” alarm indicator goes from off to red.

- c) **Requirement:** NCU displays “Alarm”.

To see the specific alarm(s), navigate to the Alarm Menu and press ENT. The Active Alarm screen lists one critical alarm. “Power System Load Fuse Brkr Critical” is displayed.

- d) **Requirement:** External “Fuse/Circuit Breaker Alarm” (Relay 7) and “Critical” (Relay 1) alarms activate.

5. Do one of the following: (1) Replace the blown GMT fuse with a known good fuse (or a dummy fuse), or (2) place the handle of the circuit breaker in the ON (closed) position.
  - a) **Requirement:** NCU “Critical/Major” alarm indicator goes from red to off.
  - b) **Requirement:** Press ESC repeatedly to return to the Main screen. NCU displays “No Alarm”.
  - c) **Requirement:** All external alarms deactivate.

### Final Steps

1. If any NCU Controller configuration settings were changed, refer to the NCU User Instructions (UM1M820BNA) and save a copy of the configuration file. This file can be used to restore the NCU Controller settings, if required, at a later date.
2. Verify the Distribution Cabinet door is closed and secured.
3. Verify all Rectifier Modules and the NCU are fully seated, latched, and the latch handle screws secured.
4. Verify there are no external alarms, and the local indicators are as shown in **Table 5**.

## Initially Starting, Configuring, and Checking System Operation when E/W ACU+

### Initial Startup Preparation

- Ensure that all blocks except the last one in the “Installation Acceptance Checklist” on page 2 have been checked.
- Refer to the separate ACU+ User Manual supplied with your Power System for complete Controller operating information.
- Refer to the Configuration Drawing (C-drawing) supplied with your Power System for settings of adjustable parameters.

### Initially Starting the System

#### Procedure

1. Apply DC input power to the system by closing the DC disconnect(s) or protective device(s) that supplies battery power to the system, if furnished.
2. Apply AC input power to the system by closing the external AC disconnects or protective devices that supplies power to the shelf(s).

Note that the system requires multiple AC input branch circuits.

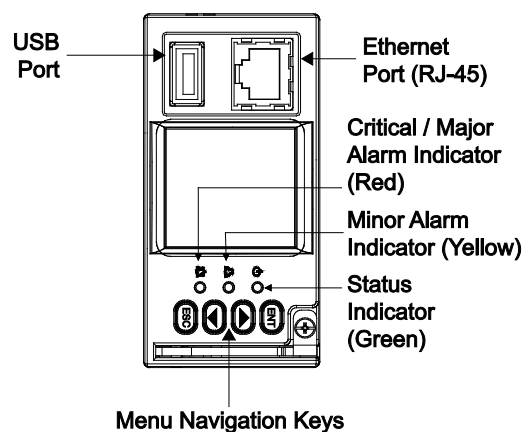
The rectifiers start and supply power to the loads.

3. Place each distribution circuit breaker (if furnished) to the ON position.

### ACU+ Initialization

Refer to **Figure 28** for locations of the ACU+ local indicators and navigation keys.

**Figure 28:** ACU+ Local Indicators and Navigation Keys



#### Procedure



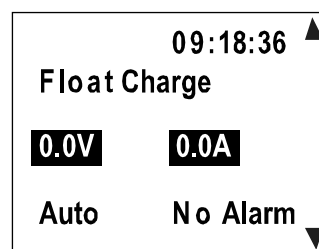
**NOTE!** The initialization routine takes several minutes. During that time various alarm indicators may illuminate on the ACU+ front panel and an audible alarm may sound. Disregard all alarms. An audible alarm can be silenced at any time by momentarily depressing the ENT key on the ACU+.

1. After the ACU+ is powered on, the display alternates between the “Emerson Network Power” screen and a screen displaying “Advanced Control Unit Plus Version \*\*\*\*\* Starting...”
2. Next, the language screen appears.

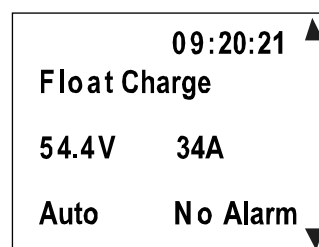


Press the “▲” or “▼” key to select the desired language. Press the **ENT** key to confirm the selection. If no key is pressed within 10 seconds, the ACU+ selects the displayed language automatically.

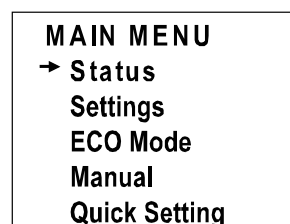
3. As initialization continues, the Main screen is displayed, but with zero volts. **Initialization is not complete.**




4. When initialization is complete, the Main screen displays voltage and current normally, and no alarms are active.




5. System information is displayed in multiple screens. Repetitively press the “▲” or “▼” key to view other system information screens one by one.
6. From the Main screen, press **ENT** to go to the “Main Menu” screen.



7. From the Main Menu, select a submenu by repetitively pressing the “▲” or “▼” key on the screen. The selected submenu will be indicated by the cursor. Press **ENT** to open the submenu.

 **NOTE!** Repeatedly press the “ESC” key to return in reverse order level by level from any submenu until the Main screen appears.


8. Verify and set the ACU+ controller as required for your application. Refer to the separate ACU+ User Manual for procedures.

 **NOTE!** One Row Distribution Panels: Any LVD is on LVD2.  
Two Row Distribution Panels: Any single LVD is on LVD2 and when there are (2) LVD’s then LVBD is on LVD2 and LVLD is on LVD1.

### Verifying the Configuration File

Your ACU+ was programmed with a configuration file that presets all adjustable parameters. The version number of the configuration file can be found on the Configuration Drawing (C-drawing) that is supplied with your Power System documentation, and on a label located on the ACU+. You can verify that the correct configuration file has been loaded into your ACU+ by performing the following procedure.


#### Procedure

 **NOTE!** When viewing any of the following screens, if a key is not depressed within approximately 10 seconds the ACU+ will automatically return to the Main screen.

1. With the Main screen displayed, press ESC. A screen displays the serial number and software version.
2. Press ENT. A screen displays the hardware version and MAC address.
3. Press ENT. A screen displays the configuration version number.
4. Press ESC, or wait approximately 10 seconds, to return to the Main screen.

### Checking Basic System Settings

Navigate through the controller menus and submenus to check system settings. You can adjust any parameter as required. Note that these settings can also be checked (and changed if required) via the WEB Interface.

 **NOTE!** Repeatedly press the “ESC” key to return in reverse order level by level from any submenu until the Main screen appears.

#### Procedure

1. **To Select a Sub-Menu:**  
Press the UP or DOWN arrow keys to move the cursor up and down the list of sub-menus in the menu screen (selects the sub-menu), then press ENT to enter the selected sub-menu.
2. **To Select a User:**  
To select a User, use the UP or DOWN arrow keys to move the cursor to the Select User field. Press ENT. Use the UP and DOWN keys to select a User previously programmed into the ACU+. Press ENT to select the User. Note that only Users programmed into the ACU+ are shown. Users are programmed via the Web Interface. The default User is admin.
3. **To Enter a Password:**  
If a password screen opens, a password must be entered to allow the User to make adjustments. To enter a password, use the UP and DOWN keys to move the cursor to the Enter Password field. Press ENT. Use the UP and DOWN keys to choose a character. Press ENT to accept and move to the next character. Continue this process until all characters are entered. Press ENT again to accept the password. The default password is 1.

4. **To Change a Parameter:**

Press the up or down arrow keys to move the cursor up and down the list of parameters in the menu screen (selects the parameter to change), then press ENT to change the selected parameter. The parameter field highlights. Press the up or down arrow keys to change the parameter value. Press ENT to confirm the change.

## Checking System Status

### Procedure

1. Observe the status of the indicators located on the Rectifier Modules and ACU+. If the system is operating normally, the status of these is as shown in **Table 6**.

**Table 6:** Status and Alarm Indicators

Component	Indicator	Normal State
Rectifier Modules	Power (Green)	On
	Protection (Yellow)	Off
	Alarm (Red)	Off
ACU+	Status (Green)	On
	Minor (Yellow)	Off
	Critical or Major Alarm (Red)	Off

## Configuring the ACU+ Identification of Rectifiers and Assigning which Input Phase is Connected to Each Rectifier

When rectifiers are all installed prior to applying power and starting the system, the order in which the ACU+ identifies the rectifiers is by serial number (lowest serial number is Rect 1, next lowest is Rect 2, etc.). If you prefer the ACU+ to identify the rectifiers by position in the system, perform the following procedure.


Upon power up, the ACU+ arbitrarily assigns Phase A, B, or C to each rectifier. This assignment is used to display rectifier AC input phase voltage(s). The User may reassign the phase to each rectifier per your specific installation by following the procedure below. (*Note: This power system is single phase only.*)

### Procedure

1. With the Main screen displayed, press ENT to go to the Main Menu. Navigate to and select “Settings” (ENT).
2. If a password screen opens, a password must be entered to allow the User to make adjustments. If a password was previously entered and has not yet timed out, skip this step and proceed to step 3). Otherwise, to enter a password, with the cursor at the User Name field (default is “Admin”), press the down arrow key to move cursor down to the password line. Press ENT. “0” is highlighted. Press the up arrow key once to change the “0” to “1” (default password is “1”), then press ENT twice. (Note: If you have been assigned a unique User Name and password, follow this procedure to enter these.)




3. With the Settings menu screen displayed, navigate to and select “Rectifier” (ENT).
4. Navigate to “Rect #” (# is used here to represent the rectifier identification number). Press ENT. The rectifier # menu screen is displayed, and the green LED on one rectifier starts flashing. This is the rectifier currently identified by the ACU+ as rectifier #. (If this is not the rectifier you want, press ESC to return to rectifier menu screen and select a different rectifier.)
5. If you wish to change the Rectifier IDs, navigate to and select “Rectifier ID”. Press ENT. Use the up or down keys to change the ACU+ identification number for the flashing rectifier. Press ENT.
6. If you wish to change the Rectifier Phase Assignment, navigate to and select “Rect Phase”. Press ENT. Use the up or down keys to change the phase connected to the flashing rectifier. Press ENT.
7. Press ESC to return to rectifier menu screen.
8. Navigate to and select the next rectifier.
9. Repeat steps 4) through 7) for each of the remaining rectifiers in the system.
10. When you have finished selecting identification numbers for all rectifiers, repeatedly press ESC to return to the Main Menu.
11. Navigate to and select “Manual” (ENT) / “Rectifier” (ENT) / “All Rect Ctrl” (ENT).
12. Navigate to “Confirm ID/PH”. Press ENT. “Yes” highlights.
13. Press ENT to select the operation. Press ENT again to confirm.

 **NOTE!** Check your number to be sure it is correct. If there were conflicts in your numbering, those conflicts will be given the next sequential available number.

14. Return to the Main screen by repeatedly pressing ESC (escape).ACU+ Alarm Relay Check.

### **ACU+ Alarm Relay Check**

The following procedures can be used to verify operation of the external alarm relays in a Power System equipped with an ACU+ with the factory default configuration. Note that alarm relays on an ACU+ with a custom configuration may operate differently.

 **NOTE!** There are two methods to check alarm relays. The first is by actually causing an alarm. The second is by using the ACU+ alarm relay check function. The first method is used in the following procedures. Refer to the ACU+ User Instructions (UM1M820BNA) for instructions using the ACU+ alarm relay check function.

### **Checking the AC Fail Alarm**

#### **Procedure**

 **NOTE!** Battery must be connected during this procedure.

1. Verify system is operating and no alarms are present.
2. Verify the ACU+ displays the Main screen. If not, press ESC repeatedly to return to the Main screen.
3. Open the external AC disconnect(s) or protective device(s) that supply power to all of the rectifier modules.
  - a) **Requirement:** An audible alarm sounds. Alarm will be silenced in Requirement d.
  - b) **Requirement:** On subject rectifier module(s), the “Protection” indicator goes from off to yellow. After approximately 30 seconds, the green “Power” and yellow “Protection” indicators go off.
  - c) **Requirement:** ACU+ “Critical/Major” alarm indicator goes from off to red.
  - d) **Requirement:** ACU+ displays “**Rect AC Fail**” alarm.

To see the specific alarm(s), press **ENT** to display the Main Menu. Navigate as follows: “**Status**” (ENT), “**Active Alarm**” (ENT). The Active Alarm screen lists two critical alarms. Press ENT. “**Power System CAN Comm Fail Critical**” is displayed. Scroll down by pressing the left (down) arrow key. “**Rect Mains Failure Critical**” is displayed.

- e) **Requirement:** External “AC Fail” (Relay 6) and “Critical” (Relay 1) alarms activate.
4. Return external AC disconnect(s) or protective device(s) to the ON position.
  - a) **Requirement:** “Power” indicator on subject rectifier modules goes from off to green.



**NOTE!** A “Rect Group All Rect No Response” alarm may activate briefly.

- b) **Requirement:** ACU+ “Critical/Major” alarm indicator goes from red to off.
- c) **Requirement:** Press ESC repeatedly to return to the Main screen. ACU+ displays “**No Alarm**”.
- d) **Requirement:** All external alarms deactivate.

## **Checking Rectifier Alarm**

### **Procedure**

1. Verify system is operating and no alarms are present.
2. Verify the ACU+ displays the Main screen. If not, press ESC repeatedly to return to the Main screen.
3. Pull one Rectifier Module half way out of the shelf. To do this, first loosen the captive fastener securing the top of the latch mechanism to the front of the Rectifier Module. Pull the top of the latch mechanism away from the Rectifier Module (this will retract the latch mechanism located on the underside of the Rectifier Module). Refer to **Figure 26** for latch mechanism illustration.
  - a) **Requirement:** An audible alarm sounds. Alarm will be silenced in Requirement c.
  - b) **Requirement:** ACU+ “Critical/Major” alarm indicator goes from off to red.
  - c) **Requirement:** ACU+ displays “**Alarm**”.

To see the specific alarm, press **ENT** to display the Main Menu. Navigate as follows: “**Status**” (ENT), “**Active Alarm**” (ENT). The “Active Alarm” screen lists one major alarm. Press ENT. “**Rect (###) Comm Fail Major**” is displayed.

- d) **Requirement:** External “Rectifier” (Relay 8) and “Major” (Relay 2) alarms activate.



**NOTE!** If the system is equipped with only one rectifier, skip step 4.

4. Pull a second Rectifier Module half way out of the shelf, as described in Step 3.
  - a) **Requirement:** An audible alarm sounds. The alarm will cancel in Requirement c.
  - b) **Requirement:** ACU+ “Critical/Major” alarm indicator stays red.
  - c) **Requirement:** Press ESC repeatedly to return to the Main screen. ACU+ displays “Alarm”.

To see the specific alarm, press **ENT** to display the Main Menu. Navigate as follows: “**Status**” (ENT), “**Active Alarm**” (ENT). The Active Alarm screen lists one critical and two major alarms. Press ENT. **Rect Group Multi-Rect Fail Critical**” is displayed. Use arrow keys to scroll through the list of alarms. “**Rect ### Comm Fail Major**” is displayed for each removed rectifier.

- d) **Requirement:** External “Rectifier” (Relay 8) and “Major” (Relay 2) alarms remains in alarm state and “Critical” (Relay 1) alarm activates.
5. Reinstall the rectifier module(s). Refer to *Installing the Rectifier Modules* at the beginning of this section.
  - a) **Requirement:** “Power” indicator on subject rectifier(s) goes from off to green.
  - b) **Requirement:** ACU+ “Critical/Major” alarm indicator goes from red to off.
  - c) **Requirement:** Press ESC repeatedly to return to the Main screen. ACU+ displays “No Alarm”.
  - d) **Requirement:** All external alarms deactivate.

### **Checking System Over Voltage Alarm 1 and Over Voltage Alarm 2**

1. Verify system is operating and no alarms are present.
2. Verify the ACU+ displays the Main screen. If not, press ESC repeatedly to return to the Main screen.
3. Record the system voltage displayed on the ACU+ Main screen.
4. Press ENT to go to the Main Menu. Select “**Settings**” (ENT).
5. If a password screen opens, a password must be entered to allow user to make adjustments. If the password was previously entered and has not yet timed out, skip this step and proceed to step 6. Otherwise, to enter the password, with the cursor at the user name (default is “Admin”), press the “▼” key to move cursor down to the password line. Press ENT. “0” is displayed. Press the “▲” key once to change the “0” to “1” (default password is “1”); then press ENT twice. (*Note: If you have been assigned a unique user name and password, follow this procedure to enter your personal information.*)
6. With the Settings menu screen displayed, navigate to “**Power System**” (ENT) / “**General**” (ENT) / “**Over Voltage 1**”. Record the displayed voltage setpoint.
7. Press the Enter (ENT) key; then use the “▲” or “▼” keys to adjust the “Over Voltage 1” value to two volts below the system voltage recorded in step 3. Press ENT.
  - a) **Requirement:** An audible alarm sounds. The alarm will be silenced in Requirement c.
  - b) **Requirement:** ACU+ “Critical/Major” alarm indicator goes from off to red.

- c) **Requirement:** Press ESC repeatedly to return to the Main screen. ACU+ displays “Alarm”.

To see the specific alarm, press **ENT** to display the Main Menu. Navigate as follows: “**Status**” (ENT), “**Active Alarm**” (ENT). The Active Alarm screen lists one critical alarm. Press ENT. “**Power System Over Voltage 1 Critical**” is displayed.

- d) **Requirement:** External “DC Over Voltage 1” (Relay 3) and “Critical” (Relay 1) alarms activate.

8. Without readjusting the “Over Voltage 1” setpoint, press the ESC key repeatedly to return to the Main Menu. Then navigate as follows: **Settings** (ENT) / “**Power System**” (ENT) / “**General**” (ENT) / **Over Voltage 2**. Record the displayed voltage setpoint.

9. Press the Enter (ENT) key; then use the “▲” or “▼” keys to adjust the “Over Voltage 2” value to one volt below the system voltage recorded in step 3. Press ENT.

- a) **Requirement:** An audible alarm sounds. Alarm will be silenced in Requirement d.

- b) **Requirement:** ACU+ “Critical/Major” alarm indicator stays red.

- c) **Requirement:** Press ESC repeatedly to return to the Main screen. ACU+ displays “Alarm”.

To see the specific alarm, press **ENT** to display the Main Menu. Navigate as follows: “**Status**” (ENT), “**Active Alarm**” (ENT). The Active Alarm screen lists two critical alarms. Press ENT. “**Power System Over Voltage 2 Critical**” is displayed. Use arrow keys to scroll through the list of alarms. “**Power System Over Voltage 1 Critical**” is displayed.

- d) **Requirement:** External “DC Over Voltage 1” (Relay 3) alarm and “Critical” (Relay 1) alarm remain active.

10. Press ESC repeatedly to return to the Main Menu. Navigate to “**Settings**” (ENT) / “**Power System**” (ENT) / “**General**” (ENT) / “**Over Voltage 2**”.

11. Press ENT; then use the “▲” or “▼” keys to adjust the “Over Voltage 2” setting to the value recorded in step 8. Press ENT.



**NOTE!** Over Voltage 2 alarm will retire. The audible alarm will be silenced in the next step.

12. Use the “▲” or “▼” keys to scroll up to “**Over Voltage 1**”.

13. Press ENT; then use the “▲” or “▼” keys to adjust the “Over Voltage 1” setting to the value recorded in step 6. Press ENT.

- a) **Requirement:** ACU+ “Critical/Major” alarm indicator goes from red to off.

- b) **Requirement:** Press ESC repeatedly to return to the Main screen. ACU+ displays “No Alarm”.

- c) **Requirement:** All external alarms deactivate.

### **Checking System Under Voltage Alarm 1 and Under Voltage Alarm 2**

1. Verify system is operating and no alarms are present.
2. Verify the ACU+ displays the Main screen. If not, press ESC repeatedly to return to the Main screen.
3. Record the system voltage displayed on the ACU+ Main screen.
4. Press ENT to go to the Main Menu. Select “**Settings**” (ENT).

5. If a password screen opens, a password must be entered to allow user to make adjustments. If the password was previously entered and has not yet timed out, skip this step and proceed to step 6. Otherwise, to enter the password, with the cursor at the user name (default is “Admin”), press the “▼” key to move cursor down to the password line. Press ENT. “0” is displayed. Press the “▲” key once to change the “0” to “1” (default password is “1”); then press ENT twice.



**NOTE!** If you have been assigned a unique user name and password, follow this procedure to enter your personal information.

6. With the Settings menu screen displayed, navigate to “**Power System**” (ENT) / “**General**” (ENT) / “**Under Voltage 1**”. Record the displayed voltage setpoint.
7. Press the Enter (ENT) key; then use the “▲” or “▼” keys to adjust the “Under Voltage 1” value to two volts above the system voltage recorded in step 3. Press ENT.
  - a) **Requirement:** An audible alarm sounds. The alarm will be silenced in Requirement c.
  - b) **Requirement:** ACU+ “Critical/Major” alarm indicator goes from off to red.
  - c) **Requirement:** Press ESC repeatedly to return to the Main screen. ACU+ displays “**Alarm**”.

To see the specific alarm, press **ENT** to display the Main Menu. Navigate as follows: “**Status**” (ENT), “**Active Alarm**” (ENT). The Active Alarm screen lists one critical alarm. Press ENT. “**Power System Under Voltage 1 Critical**” is displayed.

- d) **Requirement:** External “DC Under Voltage 1” (Relay 4) and “Critical” (Relay 1) alarms activate.
8. Without readjusting the “Under Voltage 1” setpoint, press the ESC key repeatedly to return to the Main Menu. Then navigate as follows: **Settings** (ENT) / “**Power System**” (ENT) / “**General**” (ENT) / **Under Voltage 2**. Record the displayed voltage setpoint.
9. Press the Enter (ENT) key; then use the “▲” or “▼” keys to adjust the “Under Voltage 2” value to one volt above the system voltage recorded in step 3. Press ENT.
  - a) **Requirement:** An audible alarm sounds. Alarm will be silenced in Requirement c.
  - b) **Requirement:** ACU+ “Critical/Major” alarm indicator stays red.
  - c) **Requirement:** Press ESC repeatedly to return to the Main screen. ACU+ displays “**Alarm**”.

To see the specific alarm, press **ENT** to display the Main Menu. Navigate as follows: “**Status**” (ENT), “**Active Alarm**” (ENT). The Active Alarm screen lists two critical alarms. Press ENT. “**Power System Under Voltage 2 Critical**” is displayed. Use arrow keys to scroll through the list of alarms. “**Power System Under Voltage 1 Critical**” is displayed.


- d) **Requirement:** External “DC Under Voltage 2” (Relay 5) alarm activates, “DC Under Voltage 1” (Relay 4) alarm resets, and “Critical” (Relay 1) alarm remains active.
10. Press ESC repeatedly to return to the Main Menu. Navigate to “**Settings**” (ENT) / “**Power System**” (ENT) / “**General**” (ENT) / “**Under Voltage 2**”.
11. Press ENT; then use the “▲” or “▼” keys to adjust the “Under Voltage 2” setting to the value recorded in step 8. Press ENT.

 **NOTE!** Low Voltage 2 alarm will retire. The audible alarm will be silenced in the next step.

12. Use the “▲” or “▼” keys to scroll up to “Under Voltage 1”.
13. Press ENT; then use the “▲” or “▼” keys to adjust the “Under Voltage 1” setting to the value recorded in step 6. Press ENT.
  - a) **Requirement:** ACU+ “Critical/Major” alarm indicator goes from red to off.
  - b) **Requirement:** Press ESC repeatedly to return to the Main screen. ACU+ displays “No Alarm”.
  - c) **Requirement:** All external alarms deactivate.

### **Checking Circuit Breaker/Fuse Alarm**

1. Verify system is operating and no alarms are present.
2. Verify the ACU+ displays the Main screen. If not, press ESC repeatedly to return to the Main screen.
3. Open the front door of the Distribution Unit at the right-hand side of the shelf.

 **NOTE!** The following procedure is to be used only with circuit breakers that provide an alarm indication when manually placed to the OFF (open) position (black handle). Electrical trip alarm circuit breakers (white handle) cannot be easily tested in the field.

4. Do one of the following: (1) Remove a good fuse or a dummy fuse from a GMT fuse position, and replace it with a blown fuse, or (2) Place the handle (if black) of a load circuit breaker in the OFF (open) position.
  - a) **Requirement:** An audible alarm sounds. The alarm will be silenced in Requirement c.
  - b) **Requirement:** ACU+ “Critical/Major” alarm indicator goes from off to red.
  - c) **Requirement:** ACU+ displays “Alarm”.

To see the specific alarm, press ENT to display the Main Menu. Navigate as follows: “Status” (ENT), “Active Alarm” (ENT). The Active Alarm screen lists one critical alarm. Press ENT. “Power System Load Fuse Brkr Critical” is displayed.

- d) **Requirement:** External “Fuse/Circuit Breaker Alarm” (Relay 7) and “Critical” (Relay 1) alarms activate.
5. Do one of the following: (1) Replace the blown GMT fuse with a known good fuse (or a dummy fuse), or (2) place the handle of the circuit breaker in the ON (closed) position.
  - a) **Requirement:** ACU+ “Critical/Major” alarm indicator goes from red to off.
  - b) **Requirement:** Press ESC repeatedly to return to the Main screen. ACU+ displays “No Alarm”.
  - c) **Requirement:** All external alarms deactivate.

### Final Steps

1. If any ACU+ Controller configuration settings were changed, refer to the ACU+ User Instructions (UM1M820BNA) and save a copy of the configuration file. This file can be used to restore the ACU+ Controller settings, if required, at a later date.
2. Verify the Distribution Cabinet door is closed and secured.
3. Verify all Rectifier Modules and the ACU+ are fully seated, latched, and the latch handle screws secured.
4. Verify there are no external alarms, and the local indicators are as shown in **Table 6**.

## Initially Starting, Configuring, and Checking System Operation when E/W SCU+

### Initial Startup Preparation

- Ensure that all blocks except the last one in the “Installation Acceptance Checklist” on page 2 have been checked.
- Refer to the separate SCU+ User Manual supplied with your Power System for complete Controller operating information.
- Refer to the Configuration Drawing (C-drawing) supplied with your Power System for settings of adjustable parameters.

### Initially Starting the System

#### Procedure

1. Apply DC input power to the system by closing the external DC disconnect(s) or protective device(s) that supplies battery power to the system, if furnished.

Close the system’s internal battery disconnect circuit breakers.

2. Apply AC input power to the system by closing the external AC disconnects or protective devices that supplies power to the shelf(s).

Note that the shelf requires two (2) AC input branch circuits.

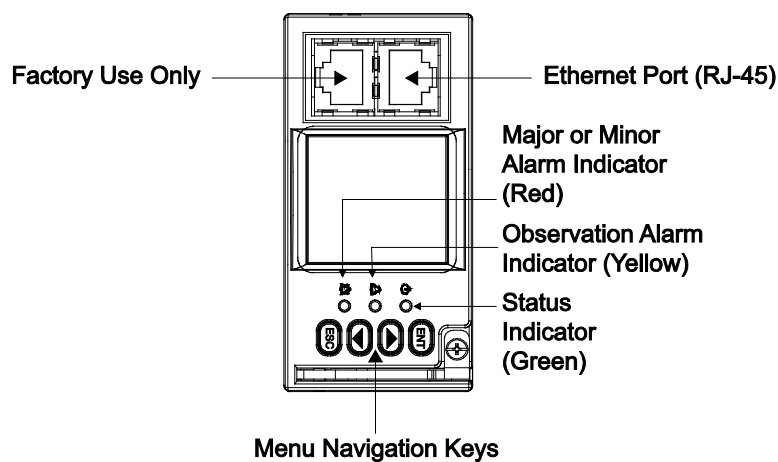
The rectifiers start and supply power to the loads.

3. Place each distribution circuit breaker (if furnished) to the ON position.

### SCU+ Initialization

Refer to **Figure 29** for locations of the SCU+ local indicators and navigation keys.

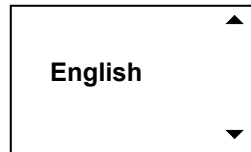
**Figure 29:** SCU+ Local Indicators and Navigation Keys





## Procedure

1. After the SCU+ is powered on, the language screen appears.

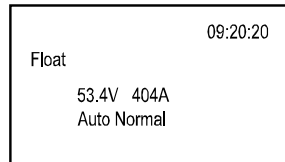


Press the “▲” or “▼” key to select the desired language. Press the **ENT** key to confirm the selection. If no key is pressed within 10 seconds, the SCU+ selects the displayed language automatically.

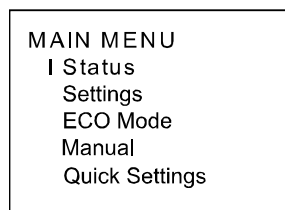
2. The SCU+ displays ‘Wait . . .’ as it performs an initialization routine. The SCU+ has a ‘System Type’ parameter that was pre-programmed for your specific system. This setting determines the initial configuration of the SCU+ parameters such as output voltage and alarm levels.



3. Once initialized, the Main screen is displayed.



4. System information is displayed in multiple screens. Repetitively press the “▲” or “▼” key to view other system information screens one by one.
5. From the Main screen, press **ENT** to go to the “Main Menu” screen.



6. From the Main Menu, select a submenu by repetitively pressing the “▲” or “▼” key on the screen. The selected submenu will be indicated by the cursor. Press **ENT** to open the submenu.



**NOTE!** Repeatedly press the “ESC” key to return in reverse order level by level from any submenu until the Main screen appears.

7. Verify and set the SCU+ controller as required for your application. Refer to the separate SCU+ *User Manual* for procedures.



**NOTE!** One Row Distribution Panels: Any LVD is on LVD2.

Two Row Distribution Panels: Any single LVD is on LVD2 and when there are (2) LVD's then LVBD is on LVD2 and LVLD is on LVD1.

### Verifying the Configuration File

Your SCU+ was programmed with a configuration file that sets all adjustable parameters. The version number of the configuration file can be found on the Configuration Drawing (C-drawing) that is supplied with your Power System documentation, and on a label located on the SCU+. You can verify that the correct configuration file has been loaded into your SCU+ by performing the following procedure.

#### Procedure

1. With the Main screen displayed, press ESC. A screen displays the software version and configuration version number.
2. Press ESC to return to the Main screen.

### Checking System Status

#### Procedure

1. Observe the status of the indicators located on the Rectifier Modules and SCU+. If the system is operating normally, the status of these is as shown in **Table 7**.

**Table 7:** Status and Alarm Indicators

Component	Indicator	Normal State
Rectifier Modules	Power (Green)	On
	Protection (Yellow)	Off
	Alarm (Red)	Off
SCU+	Status (Green)	On
	Observation (Yellow)	Off
	Major or Minor Alarm (Red)	Off

### Configuring the SCU+ Identification of Rectifier Modules

When Rectifier Modules are all installed prior to applying power to the system, the order in which the SCU+ identifies the Rectifier Modules is by serial number (lowest serial number is Rect 1, next lowest is Rect 2, etc.).

If you prefer the SCU+ to identify the Rectifier Modules by position in the shelf (for example, 1-3 from left to right), perform the following procedure.

#### Procedure

1. With the Main screen displayed, press ENT to go to the Main Menu. Navigate to and select “Settings” (ENT).
2. If a password screen opens, a password must be entered to allow user to make adjustments. If the password was previously entered and has not yet timed out, skip this step and proceed to step 3.

Otherwise, to enter the password, press the right (up) arrow key repeatedly until “3” is displayed (default password is “3”); then press ENT. (**Note:** *If you have been assigned a unique user name and password, follow this procedure to enter your personal information.*)


3. With the Settings menu screen displayed, navigate to and select “Rectifier” (ENT).
4. Navigate to “R-Posi #” (# is used here to represent the rectifier identification number). Press ENT. The rectifier position number is highlighted, and the green LED on one rectifier starts flashing. This is the rectifier currently identified by the SCU+ as rectifier #.
5. Use the up or down keys to change the position number for the flashing rectifier. Press ENT. The position number of the next rectifier is highlighted, and the green LED on that rectifier starts flashing.
6. Repeat Step 5 for all remaining rectifiers in the system.
7. When you have finished selecting identification numbers for the last rectifier, repeatedly press ESC to return to the Main Menu.

### SCU+ Alarm Relay Check

The following procedures can be used to verify operation of the external alarm relays in a Power System equipped with an SCU+ with the factory default configuration. Note that alarm relays on an SCU+ with a custom configuration may operate differently.

#### Checking the AC Fail Alarm

##### Procedure

 **NOTE!** *Battery must be connected during this procedure.*

1. Verify system is operating and no alarms are present.
2. Open the external AC disconnect(s) or protective device(s) that supply power to all of the rectifier modules.
  - a) **Requirement:** An audible alarm sounds. Alarm will be silenced in Requirement d.
  - b) **Requirement:** “Power” indicator on subject rectifier modules goes from green to off.
  - c) **Requirement:** SCU+ “Major/Minor” alarm indicator goes from off to red.
  - d) **Requirement:** SCU+ displays “**Alarm**”. Then the Alarm screen displays automatically. “**Mains Failure Major Alarm**” is displayed.
  - e) **Requirement:** External “AC Fail” (Relay 6) and “Major” (Relay 1) alarms activate.
3. Return external AC disconnect(s) or protective device(s) to the ON position.
  - a) **Requirement:** “Power” indicator on subject rectifier modules goes from off to green.
  - b) **Requirement:** SCU “Major/Minor” alarm indicator goes from red to off.
  - c) **Requirement:** Press ESC repeatedly to return to the Main screen. SCU+ displays “**Normal**”.
  - d) **Requirement:** All external alarms deactivate.

## **Checking Rectifier Alarm**

### **Procedure**

1. Verify system is operating and no alarms are present.
2. Pull one Rectifier Module half way out of any shelf. To do this, first loosen the captive fastener securing the top of the latch mechanism to the front of the Rectifier Module. Pull the top of the latch mechanism away from the Rectifier Module (this will retract the latch mechanism located on the underside of the Rectifier Module). Refer to **Figure 26** for latch mechanism illustration.
  - a) **Requirement:** An audible alarm sounds.
  - b) **Requirement:** SCU+ “Major/Minor” alarm indicator goes from off to red.
  - c) **Requirement:** SCU+ displays “**Alarm**”. Then the Alarm screen displays automatically. “**Rect ## Comm Fail Minor Alarm**” is displayed.
  - d) **Requirement:** External “Rectifier” (Relay 8) and “Minor” (Relay 2) alarms activate.
3. Pull a second Rectifier Module half way out of any shelf, as described in Step 2.
  - a) **Requirement:** An audible alarm sounds. You can press ENT to cancel.
  - b) **Requirement:** SCU+ “Major/Minor” alarm indicator stays red.
  - c) **Requirement:** There are three alarms. SCU+ displays “**Multi Rect Alarm Major**”. Press left arrow once. SCU+ displays “**Rect ## Comm Fail Minor**”. Press left arrow once. Press left arrow once more. SCU+ displays “**Rect ## Comm Fail Minor**”.
  - d) **Requirement:** External “Rectifier” (Relay 8) alarm remains in alarm state and “Major” (Relay 1) alarm activates.
4. Reinstall both rectifier modules. Refer to *Installing the Rectifier Modules* at the beginning of this section.
  - a) **Requirement:** “Power” indicator on subject rectifier(s) goes from off to green.
  - b) **Requirement:** SCU+ “Critical/Major” alarm indicator goes from red to off.
  - c) **Requirement:** Press ESC repeatedly to return to the Main screen. SCU+ displays “**Normal**”.
  - d) **Requirement:** All external alarms deactivate.

## **Checking System High Voltage Alarm 1 and High Voltage Alarm 2**

1. Verify system is operating and no alarms are present.
2. Record the system voltage displayed on the SCU+ Main screen.
3. Press ENT to go to the Main Menu. Select “**Settings**” (ENT).
4. If a password screen opens, a password must be entered to allow user to make adjustments. If the password was previously entered and has not yet timed out, skip this step and proceed to step 5. Otherwise, to enter the password, press the right (up) arrow key repeatedly until “3” is displayed (default password is “3”); then press ENT.



**NOTE!** *If you have been assigned a unique user name and password, follow this procedure to enter your personal information.*

5. With the Settings menu screen displayed, navigate to “DC” (ENT) / “Over Volt 1”. Record the displayed voltage setpoint.
6. Press the Enter (ENT) key; then use the arrow keys to adjust the “Over Voltage 1” value to two volts below the system voltage recorded in step 2. Press ENT.
  - a) **Requirement:** An audible alarm sounds. The alarm will be silenced in Requirement c.
  - b) **Requirement:** SCU+ “Major/Minor” alarm indicator goes from off to red.
  - c) **Requirement:** Press ESC repeatedly to return to the Main screen. SCU+ displays “Alarm”.

To see the specific alarm, press **ENT** to display the Main Menu. Navigate as follows: “**Status**” (ENT), “**Active Alarm**” (ENT), “**DC Over Volt 1 Major**”.

- d) **Requirement:** External “DC Over Voltage 1” (Relay 3) and “Major” (Relay 1) alarms activate.
7. Without readjusting the “Over Voltage 1” setpoint, press the ESC key repeatedly to return to the Main screen. Then navigate as follows: **Settings** (ENT) / **DC** (ENT) / **Over Volt2**. Record the displayed voltage setpoint.
8. Press the Enter (ENT) key; then use the arrow keys to adjust the “Over Voltage 2” value to one volt below the system voltage recorded in step 2. Press ENT.

- a) **Requirement:** An audible alarm sounds. Alarm will be silenced in Requirement d.
- b) **Requirement:** The “DC Over Volt 1” alarm retires.
- c) **Requirement:** SCU+ “Major/Minor” alarm indicator stays red.
- d) **Requirement:** Press ESC repeatedly to return to the Main screen. SCU+ displays “Alarm”.

To see the specific alarm, press **ENT** to display the Main Menu. Navigate as follows: “**Status**” (ENT), “**Active Alarm**” (ENT), “**DC Over Volt 2 Major**”.

- e) **Requirement:** External “DC Over Volt 1” (Relay 3) alarm resets, and “Major” (Relay 1) alarm remains active.
9. Press ESC repeatedly to return to the Main screen. Navigate to “**Settings**” (ENT) / “**DC**” (ENT) / “**Over Volt 2**”.
10. Press ENT; then use the arrow keys to adjust the “Over Voltage 2” setting to the value recorded in step 7. Press ENT.



**NOTE!** High Voltage 2 alarm will retire and High Voltage 1 alarm will activate. The audible alarm will be silenced in the next step.

11. Use arrow keys to scroll up to “**Over Volt 1**”.
12. Press ENT; then use the arrow keys to adjust the “Over Voltage 1” setting to the value recorded in step 5. Press ENT.
  - a) **Requirement:** SCU+ “Major/Minor” alarm indicator goes from red to off.
  - b) **Requirement:** Press ESC repeatedly to return to the Main screen. SCU+ displays “**Normal**”.

- c) **Requirement:** All external alarms deactivate.

### **Checking System Low Voltage Alarm 1 and Low Voltage Alarm 2**

1. Verify system is operating and no alarms are present.
2. Record the system voltage displayed on the SCU+ Main screen.
3. Press ENT to go to the Main Menu. Select “**Settings**” (ENT).
4. If a password screen opens, a password must be entered to allow user to make adjustments. If the password was previously entered and has not yet timed out, skip this step and proceed to step 5. Otherwise, to enter the password, press the right (up) arrow key repeatedly until “3” is displayed (default password is “3”); then press ENT. (*Note: If you have been assigned a unique user name and password, follow this procedure to enter your personal information.*)
5. With the Settings menu screen displayed, navigate to “**DC**” (ENT) / “**Under V1**”. Record the displayed voltage setpoint.
6. Press the Enter (ENT) key; then use the arrow keys to adjust the “Under Voltage 1” value to two volts above the system voltage recorded in step 2. Press ENT.

- a) **Requirement:** An audible alarm sounds. The alarm will be silenced in Requirement c.
- b) **Requirement:** SCU+ “Major/Minor” alarm indicator goes from off to red.
- c) **Requirement:** Press ESC repeatedly to return to the Main screen. SCU+ displays “**Alarm**”.

To see the specific alarm, press **ENT** to display the Main Menu. Navigate as follows: “**Status**” (ENT), “**Active Alarm**” (ENT), “**DC Under V1 Major**”.


- d) **Requirement:** External “DC Under Voltage 1” (Relay 4) and “Major” (Relay 1) alarms activate.
7. Without readjusting the “Under Voltage 1” setpoint, press the ESC key repeatedly to return to the Main screen. Then navigate as follows: **Settings** (ENT) / **DC** (ENT) / **Under V2**. Record the displayed voltage setpoint.
8. Press the Enter (ENT) key; then use the arrow keys to adjust the “Under Voltage 2” value to one volt above the system voltage recorded in step 2. Press ENT.

- a) **Requirement:** An audible alarm sounds. Alarm will be silenced in Requirement d.
- b) **Requirement:** The “DC Under V1” alarm retires.
- c) **Requirement:** SCU+ “Major/Minor” alarm indicator stays red.
- d) **Requirement:** Press ESC repeatedly to return to the Main screen. SCU+ displays “**Alarm**”.

To see the specific alarm, press **ENT** to display the Main Menu. Navigate as follows: “**Status**” (ENT), “**Active Alarm**” (ENT), “**DC Under V2 Major**”.

- e) **Requirement:** External “DC Under V1” (Relay 4) alarm resets, “DC Under V2” (Relay 5) alarm activates and “Major” (Relay 1) alarm remains active.
9. Press ESC repeatedly to return to the Main screen. Navigate to “**Settings**” (ENT) / “**DC**” (ENT) / “**Under V2**”.


10. Press ENT; then use the arrow keys to adjust the “Under Voltage 2” setting to the value recorded in step 7. Press ENT.

 **NOTE!** *Low Voltage 2 alarm will retire and Low Voltage 1 alarm will activate. The audible alarm will be silenced in the next step.*

11. Use arrow keys to scroll up to “**Under V1**”.
12. Press ENT; then use the arrow keys to adjust the “Under Voltage 1” setting to the value recorded in step 5. Press ENT.
  - a) **Requirement:** SCU+ “Major/Minor” alarm indicator goes from red to off.
  - b) **Requirement:** Press ESC repeatedly to return to the Main screen. SCU+ displays “**Normal**”.
  - c) **Requirement:** All external alarms deactivate.

### **Checking Circuit Breaker/Fuse Alarm**

1. Verify system is operating and no alarms are present.
2. Open the front door of the Distribution Cabinet by loosening the two captive fasteners and pivoting the door outward.

 **NOTE!** *The following procedure is to be used only with circuit breakers that provide an alarm indication when manually placed to the OFF (open) position (black handle). Electrical trip alarm circuit breakers (white handle) cannot be easily tested in the field.*

3. Place the handle (if black) of a circuit breaker in the OFF (open) position.
  - a) **Requirement:** The alarm indicator at the right side of the Distribution Cabinet front panel goes from off to red.
  - b) **Requirement:** SCU+ “Major/Minor” alarm indicator goes from off to red.
  - c) **Requirement:** SCU+ displays “**Alarm**”.

To see the specific alarm, press **ENT** to display the Main Menu. Navigate as follows: “**Status**” (ENT), “**Active Alarm**” (ENT), “**Load Fuse Brkr Major**”.

- d) **Requirement:** External “Fuse/Circuit Breaker Alarm” (Relay 7) and “Major” (Relay 1) alarms activate
4. Place the handle of the circuit breaker in the ON (closed) position.
  - a) **Requirement:** The alarm indicator at the right side of the Distribution Cabinet front panel goes from red to off.
  - b) **Requirement:** SCU “Major/Minor” alarm indicator goes from red to off.
  - c) **Requirement:** Press ESC repeatedly to return to the Main screen. SCU+ displays “**Normal**”.
  - d) **Requirement:** All external alarms deactivate.
5. Close the front door of the Distribution Cabinet and secure by tightening the two captive fasteners.

### Final Steps

1. Verify the Distribution Cabinet door is closed and secured.
2. Verify all Rectifier Modules and the SCU+ are fully seated, latched, and the latch handle screws secured.
3. Verify there are no external alarms, and the local indicators are as shown in **Table 7**.




# EXPANDING THE POWER SYSTEM

## Adding Expansion Shelves


The current capacity of this Power System may be increased through the addition of expansion shelves. List 2 expansion shelves can be used with a List 1, while List 4 expansion shelves can be used with List 3. Similarly, one (1) List 14 expansion shelf can be installed in a List 10, 11, 16, 20, 21 or 26, while one (1) List 15 expansion shelf can be installed in a List 12, 13, 17, 22, 23 or 27. Refer to System Application Guide SAG582136800 for restrictions regarding the maximum number of shelves in a system.

Refer to the procedure below to install an expansion shelf in the Power System.


### Procedure

 **DANGER!** All sources of AC and DC power must be completely disconnected from the Power System before performing this installation procedure.

Refer to **Figure 30** while performing this procedure.

 **NOTE!** For List 1-4 only, before performing the next step, disconnect all wiring from the DC Output busbars on the rear of the bottom shelf in the Power System.

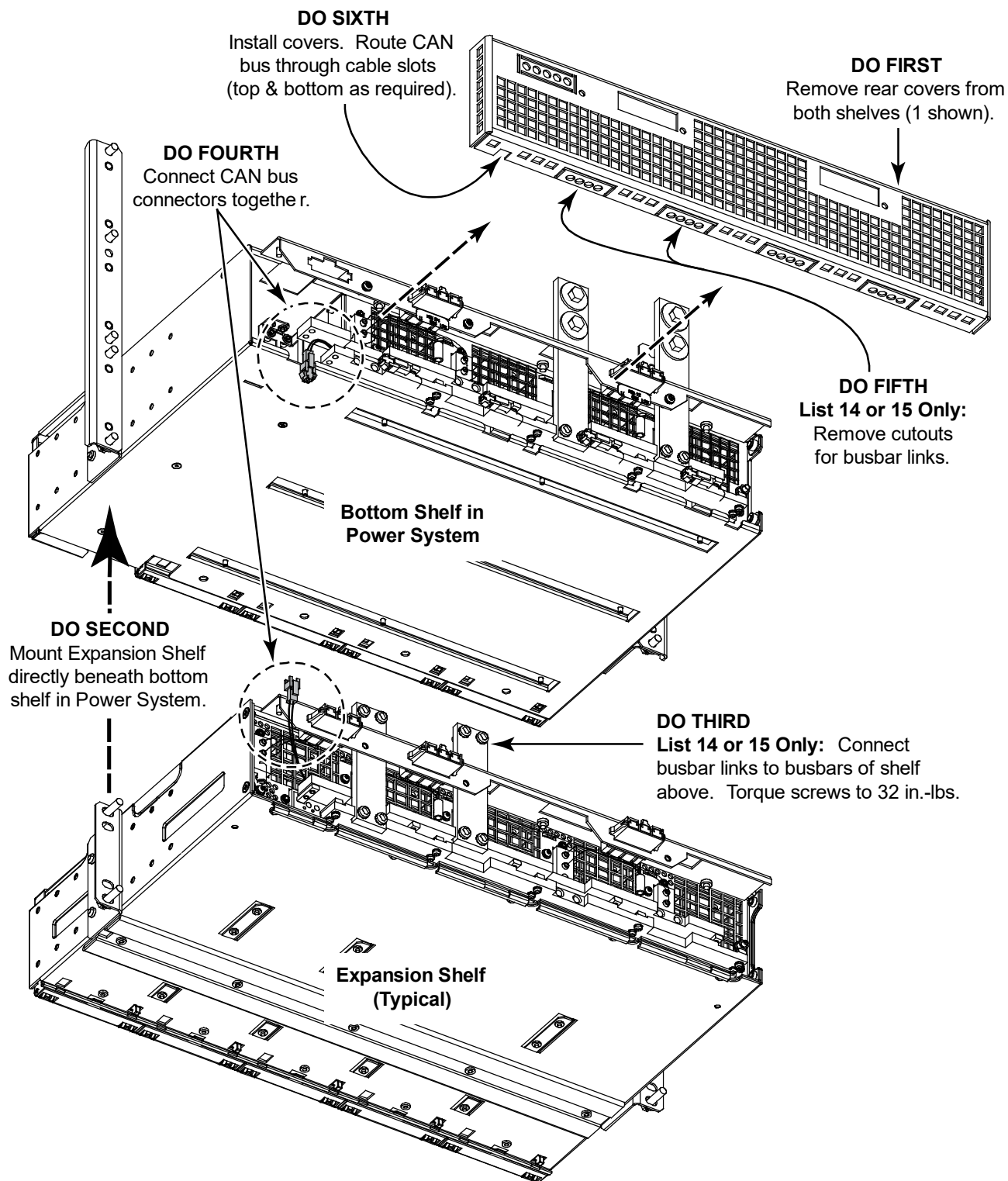
1. Remove the rear covers of the expansion shelf and the bottom shelf in the Power System. To do so, remove the screws adjacent to each AC connector.
2. The expansion shelf must be mounted immediately beneath the bottom shelf of the Power System, with no vertical space between. Secure mounting angles to relay rack or cabinet rails at two screw locations on each side. Use a grounding washer on each screw. Proper orientation of grounding washers enables teeth to dig into paint for a secure ground connection. Tighten each screw to 70 in.-lbs.
3. **List 14 or 15 Only:** Connect the vertical busbar links that extend above the shelf to the horizontal busbars of the shelf above. Use furnished fasteners (M5-0.8 x 12mm Torx-head SEMS). Tighten each fastener to 32 in.-lbs.

 **NOTE!** To properly align screw holes in the busbars, it may be necessary to first loosen the SEMS that secure the vertical busbar links to the expansion shelf. If so, these should also be tightened to 32 in.-lbs.

4. Locate the small 2-pin CAN bus connector at the back of the expansion shelf on the left-hand side. Connect to the mating connector of the shelf above.
5. **List 14 or 15 Only:** Remove cutouts from the rear cover of shelf above the expansion shelf to accommodate busbar links.
6. Reinstall the rear covers on the shelves. Carefully route the CAN bus cables through the cable slots in the top and bottom of each cover, as shown in the figure.
7. **List 1-4 Only:** If additional expansion shelves are being installed, repeat the previous steps for each.
8. **List 1-4 Only:** Make DC output connections to the expansion shelf(s). **Observe correct polarity.** Refer to “Bulk DC Output Connections (Lists 1-8)” on page 35.
9. **List 1-4 Only:** Reconnect DC output wiring to the shelf from which it was previously removed. **Observe correct polarity.** Refer to “Bulk DC Output Connections (Lists 1-8)” on page 35.

10. Make AC input connections to the expansion shelf(s). Refer to “AC Input and AC Input Equipment Grounding Connections” on page 20.
11. Install rectifier modules and blank cover panels. Refer to “Installing the Rectifier Modules” on page 50.
12. Apply AC power to the shelf(s) to start the rectifier modules. This completes the installation procedure.

**Figure 30:** Typical Expansion Shelf Installation (List 10 and 14 Shown)



## **Connecting a Device or System to the NCU or ACU+ CAN Bus (List 10 - List 27)**

A supporting device or system may be connected to the NCU or ACU+ CAN Port. Refer to **Figure 31** for location. Refer also to the external device's or system's instruction manual.

### **General Procedure**

1. Remove the CAN termination plug from the NCU or ACU+ Controller's CAN port. Connect the device or system to the NCU or ACU+ Controller's CAN port. Refer to **Figure 31** for pin-outs. Refer also to the external device's or system's instruction manual.

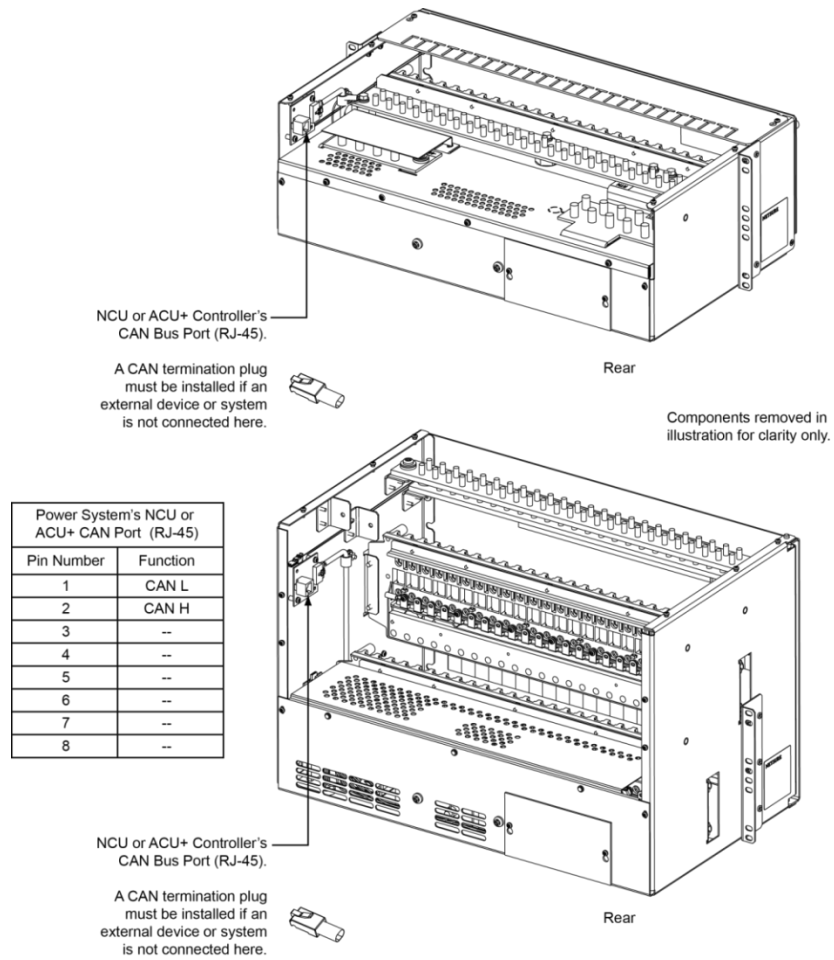
### **Optional SM-TEMP Module Procedure**

The analog output of the SM-TEMP Module may be connected to an NCU or ACU+ temperature port input. In lieu of connecting the analog output of the SM-TEMP module to an NCU or ACU+ temperature port input, the SM-TEMP module can simply be connected at the end of the NCU or ACU+ CAN Bus (requires ACU+ version 3.02 or later). Refer to the SM-TEMP Module Instructions (UM547490) for details. See also "Installing the SM-TEMP Temperature Concentrator Module" on page 86.

### **Connecting the SM-TEMP Module to the Controller's CAN Bus**

1. Remove the CAN termination plug from the NCU or ACU+ Controller's CAN port. Connect the SM-TEMP Module CAN terminals to the NCU or ACU+ Controller's CAN port. Refer to **Figure 31**. Ensure the last SM-TEMP Module (or if only one) has a CAN termination strap as shown in the SM-TEMP Module Instructions (UM547490).

**Figure 31:** NCU or ACU+ CAN Port



## Installing the SM-TEMP Temperature Concentrator Module

The analog output of the SM-TEMP module may be connected to an NCU, ACU+, or SCU+ temperature port input.

In lieu of connecting the analog output of the SM-TEMP module to an NCU or ACU+ temperature port input, the SM-TEMP module can simply be connected at the end of the NCU or ACU+ CAN bus (requires ACU+ version 3.02 or later).

Refer to the SM-TEMP Module Instructions (UM547490) for details.

### Procedure

1. Refer to the SM-TEMP Module Installation and User instructions (UM547490) to install and connect the SM-TEMP module.
2. Follow one of the steps detailed next to connect the SM-TEMP module to the power system.
  - a) NCU, ACU+, or SCU+: Connect the analog output of the SM-TEMP module to the NCU, ACU+, or SCU+ controller's interface board temperature port. Refer to **Figure 32**.

OR

- b) NCU or ACU+ (List 10 - List 27): Remove the CAN termination plug from the NCU or ACU+ Controller's CAN port. Connect the SM-TEMP Module CAN terminals to the NCU or ACU+ Controller's CAN port. Ensure the last SM-TEMP Module (or if only one) has a CAN termination strap as shown in the SM-TEMP Module Instructions (UM547490). Refer to **Figure 33**. Refer to **Table 8** for pin-outs.

OR

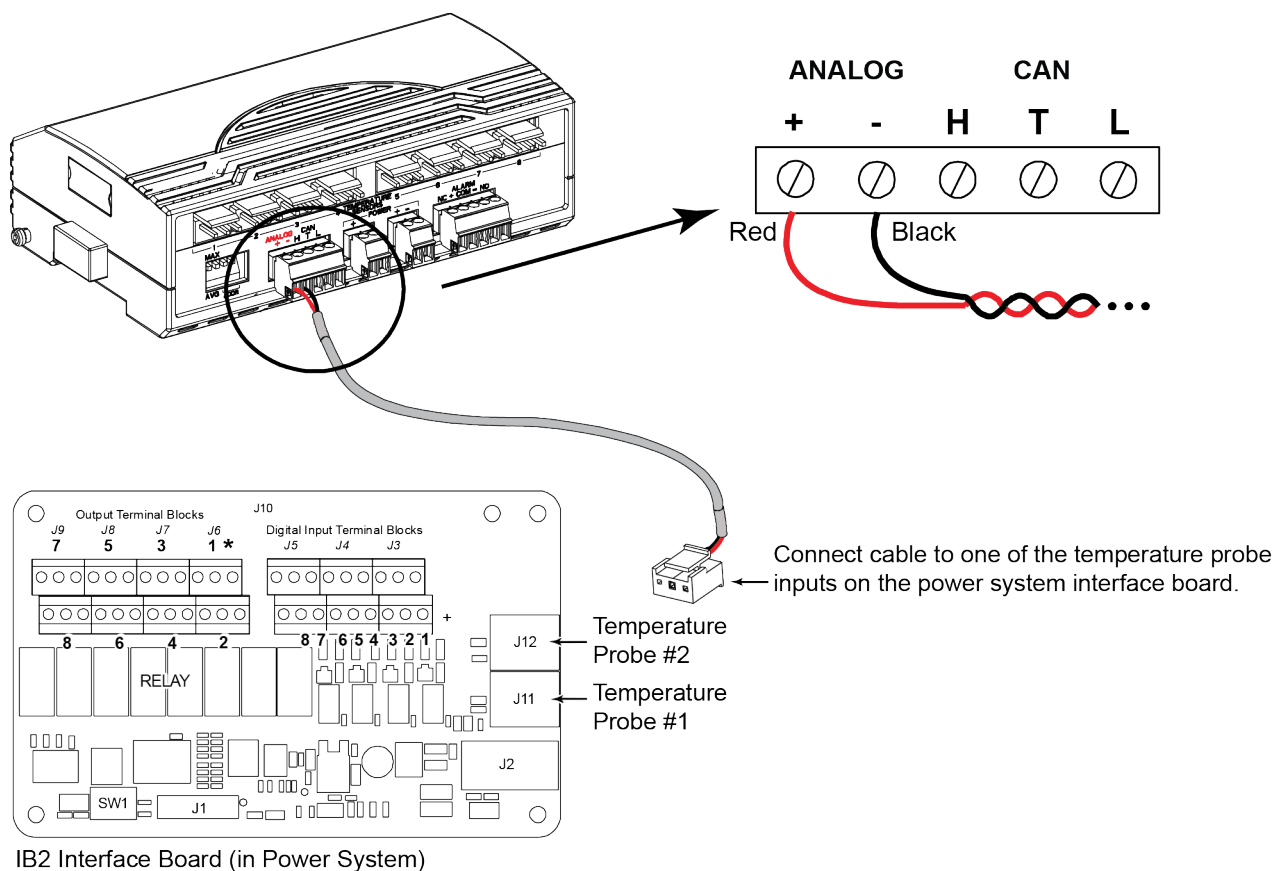
- c) NCU or ACU+ (List 10 - List 27): Remove the CAN termination plug from the CAN connector on the bottom most shelf. Connect the SM-TEMP Module CAN terminals to the CAN connector on the bottom most shelf using cable P/N 559932. Ensure the last SM-TEMP Module (or if only one) has a CAN termination strap as shown in the SM-TEMP Module Instructions (UM547490). Refer to **Figure 34**.

**Table 8:** CAN Connections

Power System's CAN Port Pin Number	SM-TEMP Module's CAN Port Pin Number
1 (CAN L)	TB1-5 (CAN L)
2 (CAN H)	TB1-3 (CAN H)
3	--
4	--
5	--
6	--
7	--
8	--

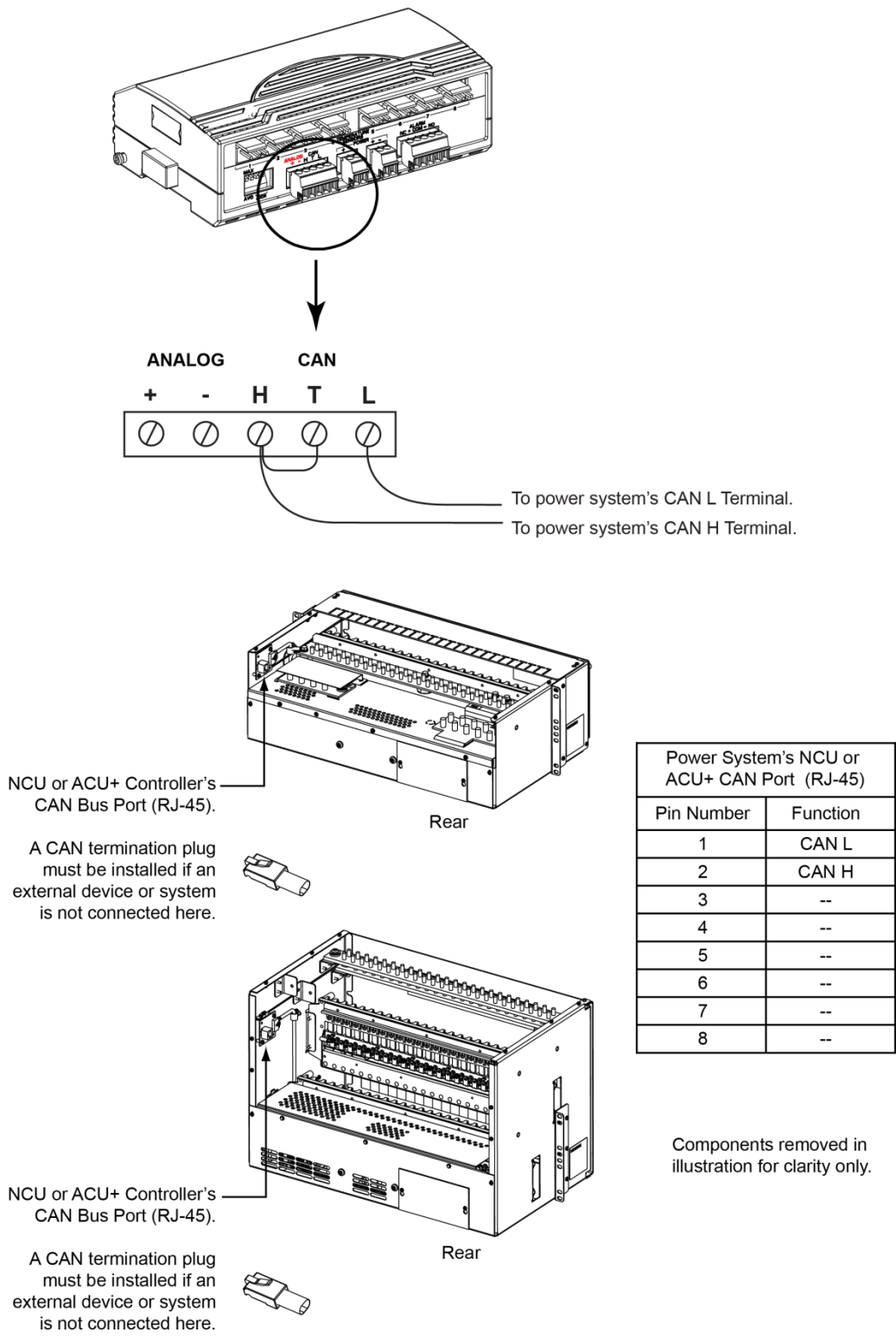
**Figure 32:** Connecting the SM-TEMP Module's Analog Output to the NCU, ACU+, or SCU+ Controller's Temperature Sensor Port

**Connecting the SM-TEMP Module's Analog Output to the NCU, ACU+, or SCU+ Controller's Temperature Sensor Port**



**Figure 33:** Connecting the SM-TEMP Module's CAN Terminals to the NCU or ACU+ CAN Bus (List 10 - List 27)

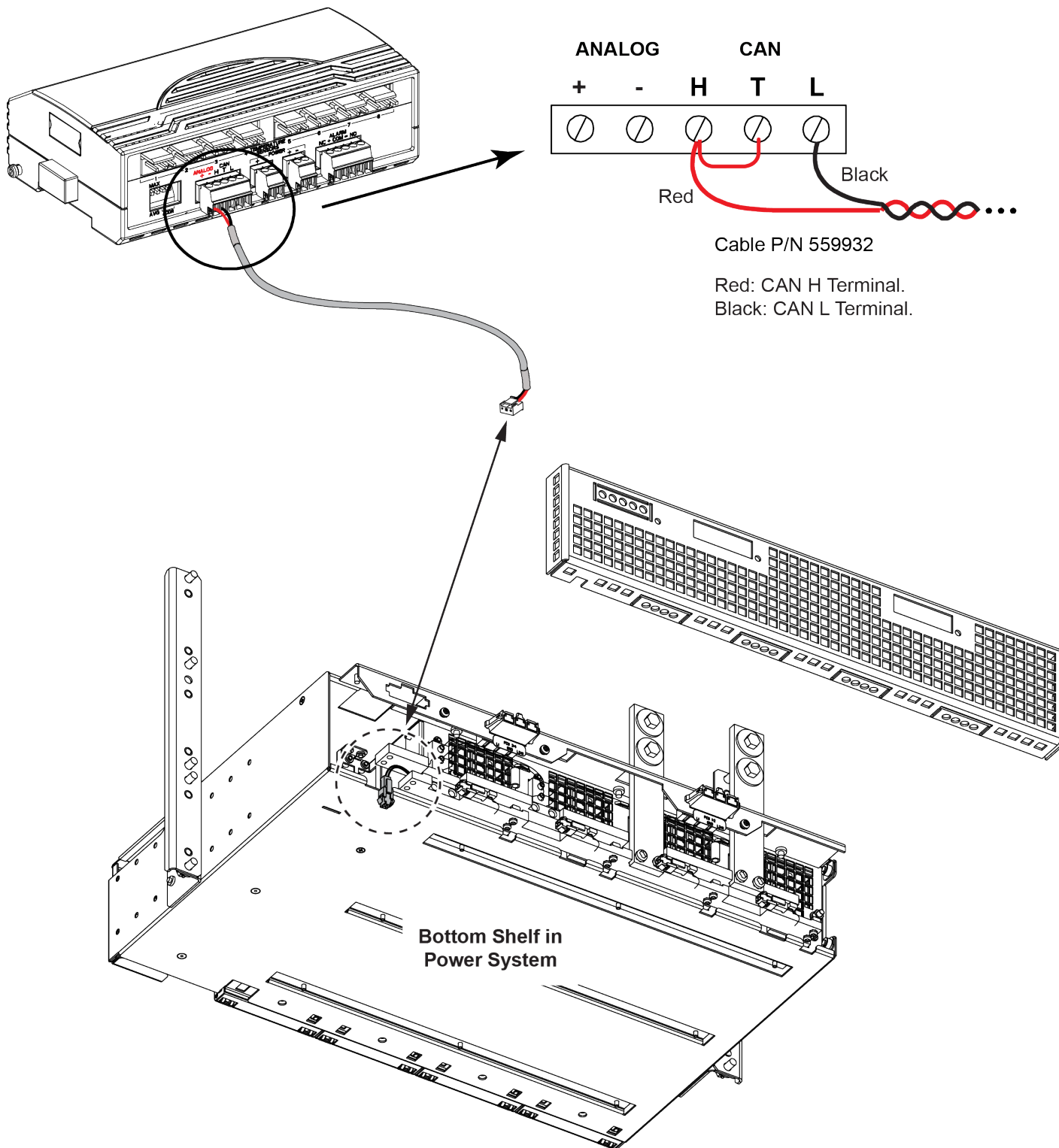
**Connecting the SM-TEMP Module's CAN Terminals to the NCU or ACU+ CAN Bus (List 10 - 27)**





**Figure 34:** Connecting the SM-TEMP Module's CAN Terminals to the NCU or ACU+ CAN Bus (List 1 - List 8)

**Connecting the SM-TEMP Module's CAN Terminals to the NCU or ACU+ CAN Bus (List 1 - List 8)**

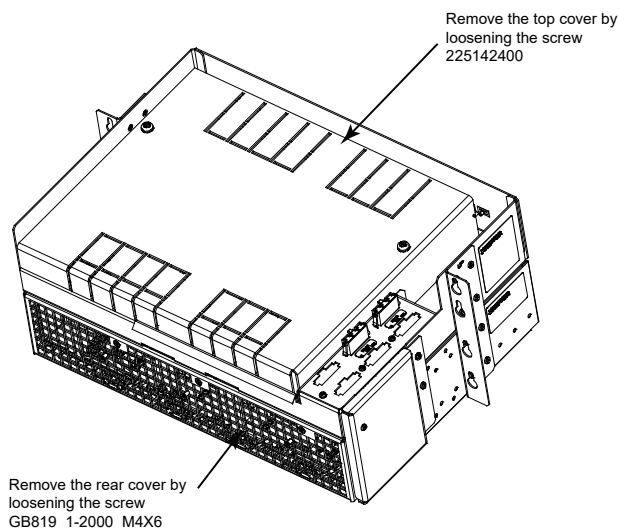


## Installing the Expansion CAN Cable 562465 (List 05 - List 08)

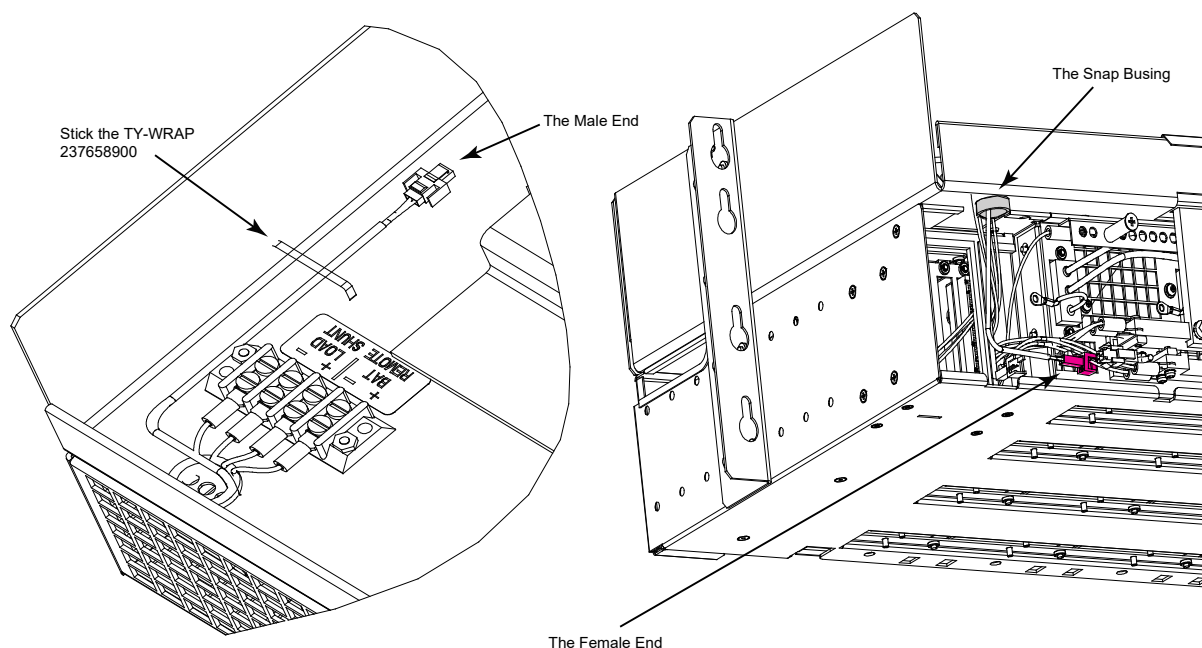
This cable will be used by the customer to connect a temperature compensation module to the system. One end of the cable must connect to the bottom shelf in a system and the other end to the temp comp cable 559932.

### General Procedure

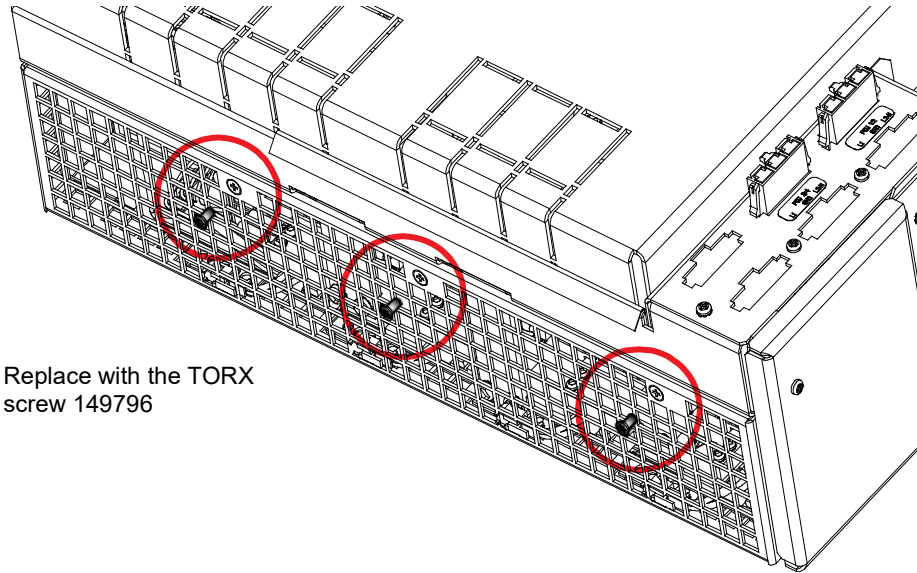
1. Remove the top cover and the rear cover.



2. Stick the TY-WRAP 237658900 of 562465, making the female end of 562465 thru the snap busing connect to the bottom shelf, and the male end to the temp comp cable 559932.



3. Re-install the top cover and the rear cover, but should be noted for re-installing the rear cover must be use the TORX screw 149796 replace the screw GB819\_1-2000\_M4X6.



Replace with the TORX  
screw 149796

**Item Specifics:**

Screw, Torx, M4-0.7 X 8mm, ROHS compliant

*Driver Bit:* Torx T-20

*Head Cap Type:* Torx 6-Lobe, Torx Countersunk Flat Head

*Fastener Type:* Machine Screw

