Lucent Technologies
Bell Labs Innovations

# *EPS 4802A*
# *Battery Plant*

Product Manual
Select Code 167-793-100
Comcode 108373291
Issue 2
June 1999

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**Notice:**
Every effort was made to ensure that the information in this document was complete and accurate at the time of printing. However, information is subject to change.

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# 1 Introduction

## -48-volt Economical Power Solution

The -48V, 220A Economical Power Solution (EPS) is an extremely flexible power system designed for indoor applications where space conservation is critical.

The EPS architecture integrates two rectifiers, a smart controller, dc distribution including 12 circuit breakers and a low-voltage disconnect contactor, and two strings of batteries to produce 4000W of power in a single six-foot high, 19-inch wide bay.

The system can be expanded up to 12,000W capacity by adding a supplementary bay with up to four more rectifiers and two more battery strings.

### *Applications*

Lucent Technologies developed the -48V EPS plant to supply power for Global System for Mobile Communications (GSM) equipment. Other applications include large transmission sites and microwave transmission sites.

### *Architecture and Configurations*

All the components of the basic EPS plant are built into a single frame, a six-foot high, 19-inch wide ETSI bay. This frame contains two RM2000 Series rectifiers, mounted in a PS3000 Series power shelf. This shelf incorporates the plant's ac input, which is single phase 170-264 Vac at 50Hz to 60Hz.

The shelf also houses the plant's SC312 controller, which monitors the state of the power system, performs battery management, reports on system status, and indicates LED alarms. Alarms report fault conditions at system, rectifier and battery levels. This controller is installed in a slot at the right side of the shelf in the first power (primary or master) shelf. All other

shelves (secondary or slave) have a simpler controller card, the Slave Aggregation Module (SAM), installed in the same slot.

DC distribution includes a panel with two to 12 DIN circuit breakers ranging up to 63A single pole or 3 x 63A triple pole, and a low-voltage disconnect contactor to prevent battery damage from deep discharges.

Batteries are arranged on four shelves; the initial plant will accept one or two strings of batteries. The plant is compatible with valve-regulated batteries. The standard battery shelf option includes Unigy I™ batteries.

**Note:** Unigy I™ is a registered trademark of East Penn Manufacturing Co., Inc. Supplied under contract to Lucent Technologies.

Eliminates the need for pre-system engineering and testing associated with piece-part assembly:

- Incremental growth minimizes initial system size and allows upgrades as demand increases
- Minimizes need for costly power cables and connectors
- Saves space and reduces time for installation and maintenance

Continuous performance:

- Hot swappable parts allow system maintenance without service interruption
- Load sharing enables balanced rectifier performance
- N+1 redundant rectifiers

Easy system management:

- SC312 controller handles centralized plant control, monitoring, and power alarm reporting

Upgradable:

- RM2000 rectifier rated at 2000 watts; system output upgradable to 12,000 watts with supplementary bay

Versatile:

- Operates with or without backup batteries
- Compatible with a wide range of input voltages

***Features***

EPS 4802A Battery Plant

- Modular front- and rear-access architecture in initial and supplementary bays
- Two plug-in rectifiers per shelf, up to three shelves per plant
- Maximum plant output 220A
- Hot-insertable components
- Accepts up to two strings of batteries per bay
- Seven office alarms and one pass-through alarm
- Remote monitoring capabilities with optional Sparton™ unit

## *Customer Training*

Lucent Technologies offers customer training on many Power Systems products. For information call 1-972-284-2163. This number is answered from 8:00 a.m. until 4:30 p.m., Central Time Zone (Zone 6), Monday through Friday.

## *Customer Service*

For customers in the United States, Canada, Puerto Rico, and the US Virgin Islands, call 1-800-THE-1PWR (1-800-843-1797). Services provided through this contact include initiating the spare parts procurement process for out of service emergencies, ordering Lucent Technologies documents, and providing other product and service information.

For other customers worldwide, call 001-972-840-0382. This number is answered from 8:00 a.m. until 4:30 p.m., Central Time Zone (Zone 6), Monday through Friday.

## *Technical Support*

Technical support for Lucent Technologies customers is available around the world during the normal product warranty

period and also while specific contractual agreements extend this service.

For customers in the United States, Canada, Puerto Rico, and the US Virgin Islands, call 1-800-CAL-RTAC (1-800-225-7822) to contact a product specialist to answer your technical questions and assist in troubleshooting problems.

For other customers worldwide, contact your local field support center or your sales representative to discuss your specific needs.

## *Product Repair and Return*

Repair and return service is provided for Lucent Technologies customers around the world.

For customers in the United States, Canada, Puerto Rico, and the US Virgin Islands, call 1-800-255-1402 for information on returning of products for repair.

For other customers worldwide, contact your sales representative to discuss your particular circumstances.

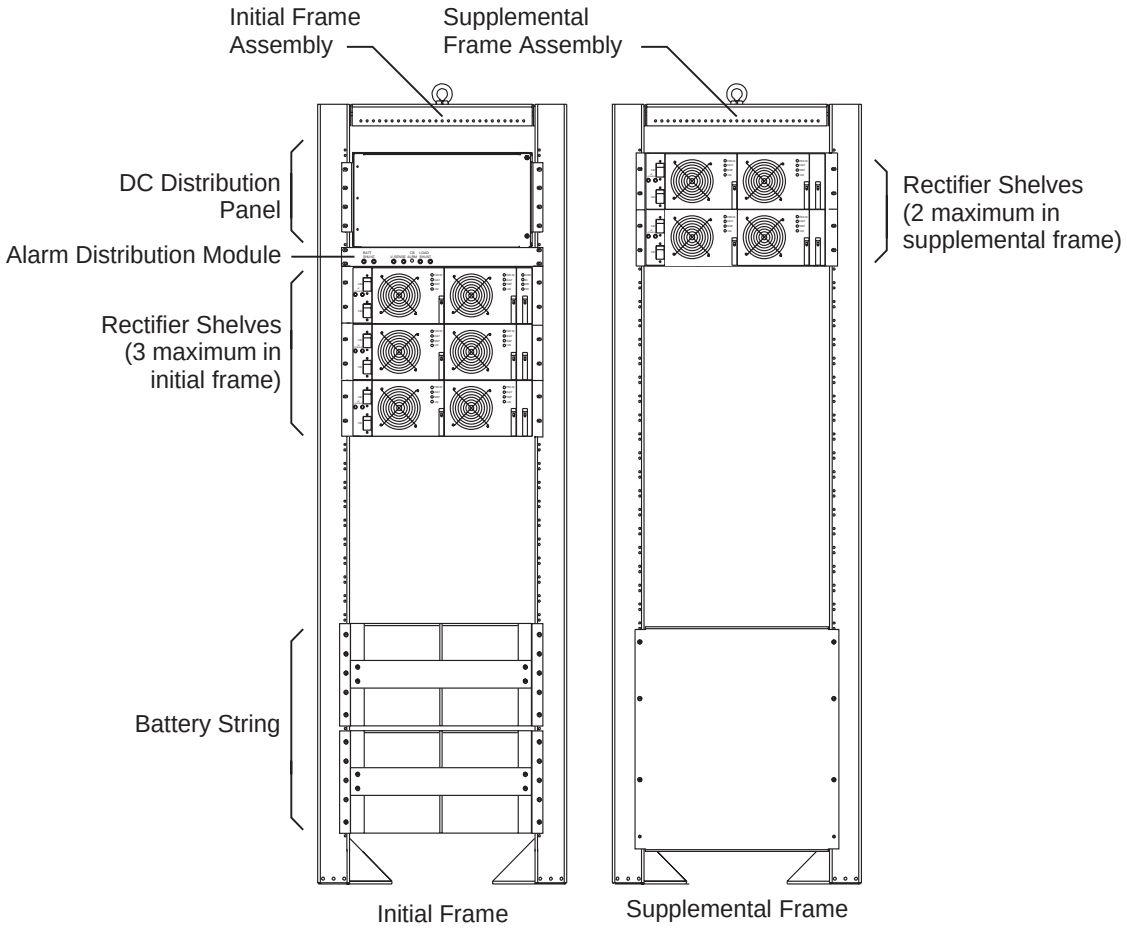
## *Warranty Service*

For domestic warranty service, contact your Warranty Service Manager (WSM). For international warranty service, contact your sales representative.

## *On-Line Power Systems Product Manuals*

For Lucent Technologies users logging in from inside the corporate firewall, the address of the "Power Systems On-Line Product Manuals" page is *http://www.cic.lucent.com/lineage.html*.

For customers logging in from outside the firewall, the address is *http://www.lucent8.com/lineage.html*. The annual subscription fee for access to this site is $25. To obtain a password, follow the instructions on-line or call 1-888-Lucent8 (1-888-582-3688). When prompted for an order number, enter or say "167-790-010."




This figure shows rectifier shelves in all possible positions. A fully configured EPS4802 system supports a maximum of three rectifier shelves between both initial and supplemental frames.

An initial frame equipped with three rectifier shelves (shown) can hold one battery string. An initial frame equipped with one or two rectifier shelves can hold two battery strings.

***Figure 1-1: EPS 4802A initial and supplemental frames***

# 2 Product Description

## Overview

Figure 2-1 is a block diagram of the -48-volt EPS plant. Primary and secondary shelf assemblies house and interconnect power modules, the control unit, and the distribution panel. The alarm distribution module allows external monitoring of office alarms and contains test jacks to measure plant output voltage, load current and battery current. Figure 2-1 shows the interconnections and signal flow among the components.

### *Control Unit*

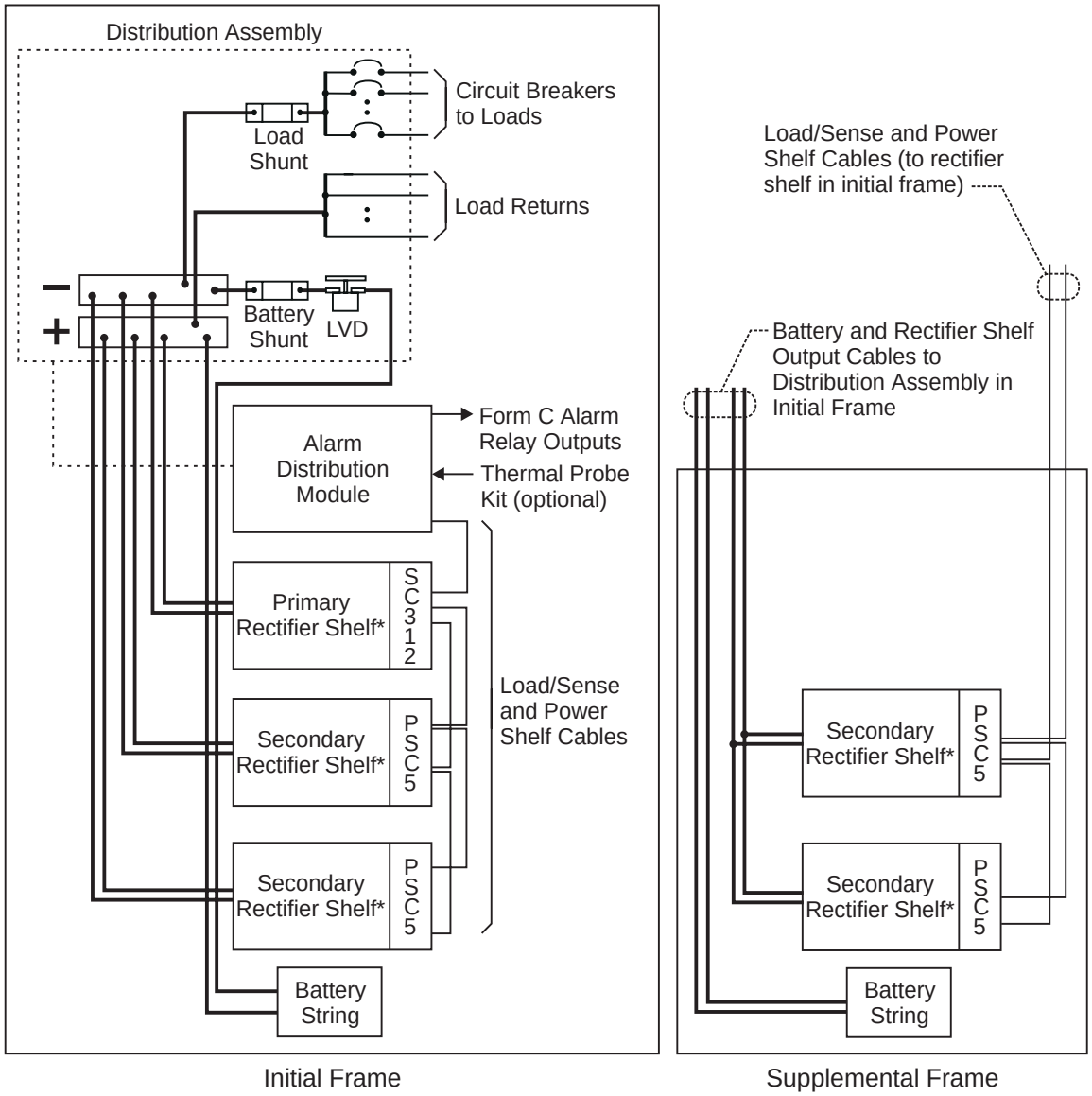
The SC312 Controller is designed to monitor up to six rectifiers mounted in a maximum of three shelves, and the battery strings which are floated on the output bus of the rectifiers.

Information on system status is provided via seven Form-C alarm relays. Four LEDs on the controller's faceplate give visual indications of the power system status. The controller connects with an alarm distribution module mounted in the initial bay to provide all office alarms.

The controller is mounted in a slot at the right side of the first or primary shelf of the system. One or two secondary or slave shelves may be mounted in the initial or in a supplemental bay. These shelves have a much simpler card, the Slave Aggregation Module (SAM), in the same position. Ribbon cables connect the slave shelves to the master shelf.

### *Rectifiers*

Output bus power is supplied by RM2000HA rectifiers, which provide a maximum of 54.5Vdc power to the bus.




* The EPS4802 Battery Plant can accomodate a maximum of three rectifier shelves between both initial and supplemental frames: up to three in the initial frame, and up to two in a supplemental frame.

***Figure 2-1: Block Diagram of the EPS 4802A Plant***

***Rectifier Shelves*** Two rectifiers are mounted in each PS3000A2 shelf. Each shelf contains an ac module at the far left of the shelf. This module contains two ac line filters and two 2-pole magnetic circuit breakers, one for each rectifier. Two RM2000HA rectifiers occupy the center of the shelf. A slot at the far right side of the shelf accepts either the SC312 Controller (in the first shelf or

master shelf) or the PSC5 Slave Aggregation Module (in each of the secondary or slave shelves).

The topmost shelf in the first bay is always the primary (master) shelf. Alarm signals between the slave shelves and the master shelf are carried by ribbon cable connected to backplane connectors.

The primary shelf is configured for local sense of output voltage. The secondary power shelves are configured for remote sense of output voltage.

Blank filler panels close off unused rectifier slots of the shelves. These panels aid against shock and vibration and improve the appearance of the shelves.

### *DC Distribution Panel*

The load output distribution panel is located at the top of the primary bay.

The panel houses the following components:

- 2 to 12 DIN style circuit breakers (ordered separately)
- low voltage disconnect (LVD) contactor
- connection for up to four strings of 100AH Unigy I™ batteries, with provisions to connect up to eight strings using back-to-back lugs
- two 300A, 50mV current shunts to measure battery current and load current
- battery temperature sensor which accepts signals from thermal sensors for temperature compensation

### *Battery Backup Strings*

The EPS 4802A plant is equipped with Unigy 1 Gel (12GVR100) valve regulated lead acid batteries. The battery strings are connected to a low voltage disconnect (LVD) contactor in the distribution panel. The LVD contactor is common to all battery strings and will disconnect all batteries from the bus when they are discharged beyond a threshold.

Thermal management of the batteries is provided by a slope-step temperature compensation feature in the SC312 controller.

***Reserve Time*** Fully charged battery strings typically will support the plant load for the period shown in Table 2-A. Actual performance will vary with temperature, age, and maintenance.

**Table 2-A: Typical Reserve Capacity With UnigyI™ Gel Type (12GVR-100) Batteries**

| Load (watts) | Number of strings in parallel | | | |
|---|---|---|---|---|
| | 1 | 2 | 3 | 4 |
| 2000 | 1 hour 30 minutes | 3 hours 45 minutes | 6 hours 15 minutes | 8 hours 15 minutes |
| 4000 | 45 minutes | 1 hour 30 minutes | 2 hours 45 minutes | 3 hours 45 minutes |
| 6000 | - | - | 1 hour 45 minutes | 2 hours 15 minutes |
| 8000 | - | - | 1 hour 15 minutes | 1 hour 30 minutes |
| 10,000 | - | - | 1 hour | 1 hour 15 minutes |

## *Power System Controller*

The SC312 controller monitors and reports on rectifier status, connects to a user interface, provides thermal management for battery strings, and generates appropriate alarms. Two circuit cards are used: the SC312 controller card itself, mounted in the primary power shelf, and PSC5 slave aggregation module (SAM) cards mounted in each secondary (slave) shelves.

***Office Alarms*** Alarm conditions in rectifiers and batteries are reported both by LED indicators on the front panel of the controller card and by Form-C relay contact closures, allowing alarms to be reported remotely. Table 2-B summarizes the available alarms.

**Table 2-B: EPS 4802A Plant Alarms**

| Alarms | Alarm Identification | LED | Conditions[1] |
|---|---|---|---|
| System level | PMJ (Power Major) | Red | more than one Rectifier Fail alarm (RFA)<br>more than one AC Fail alarm (ACF)<br>BD (Battery On Discharge)<br>OS (open string)<br>CB (load circuit breaker open)<br>battery PMJ (alrm from 210E)<br>battery temperature >72°C |

**Table 2-B: EPS 4802A Plant Alarms**

| Alarms | Alarm Identification | LED | Conditions[1] |
|---|---|---|---|
| System level | PMN (Power Minor) | Yellow | One RFA<br>One ACF<br>controller fuse failure<br>battery temperature >53°C<br>missing slave aggregation module<br>failed battery thermal probe<br>missing module (rectifier) in shelf |
| System level | CB (circuit breaker open) | PMJ (Red)<br>CB (on ADM) | One or more DC circuit breakers is open or fuse in the controller card is open |
| System level | ACF (AC Fail) | PMN<br><br>PMJ | Rectifier has a PFW[2] but no FAULT[2]<br><br>Two or more rectifiers have ACF |
| System level | OS (Open String) | PMJ | Battery contactor is open and battery is disconnected |
| System level | Aux. Alarm | | Customer configurable pass-through alarm |
| Battery level | BD (Battery on Discharge) | BD | Battery voltage is below 51V (regardless of whether the batteries are being discharged or recharged); PMJ is also present<br><br>If no ACF is present, batteries are being charged. |
| Rectifier level | RFA (Rectifier Fail Alarm) | PMN<br><br>PMJ | One rectifier has failed<br><br>Two or more rectifiers have failed |

1. All alarm outputs go to an open state when the controller is removed from the battery plant.
2. Indicates active LOW alarm signals.

### Circuit Breaker Open (CB) alarm

Whenever a load circuit breaker trips, the controller issues a CB alarm. Since this condition means that part of the load is unpowered, the controller reports this as a Power Major alarm (PMJ).

### Battery On Discharge (BD) alarm

The batteries supply power to the load in the event of ac failure. During this discharge, battery voltage falls below float voltage. At a customer selected threshold, a Battery On Discharge (BD) alarm is issued. The threshold (48V, 50V, or 51V) is selected by setting a DIP switch. Activation of alarm also triggers a PMJ alarm.

### Open String (OS) alarm

If a battery string is disconnected from the output bus, as in the

case of a Low Voltage Disconnect, the controller generates an Open String (OS) alarm. This also triggers a PMJ alarm.

**AC Failure (ACF) alarm**
If the ac input to at least one rectifier is missing or has dropped below the minimum input ac voltage, the controller generates an AC Failure (ACF) alarm. This triggers a PMN alarm. If two or more ACF signals are present, the controller issues a PMJ alarm.

**Rectifier Failure (RFA) alarm**
If a rectifier fails to perform to specification, the controller issues a Rectifier Failure (RFA) alarm. This also triggers a PMN alarm. If two or more RFA alarms are present, the controller issues a PMJ alarm.

**Missing module signal**
If any rectifier is removed from a shelf in the system, the controller issues a Missing Module signal and a PMN alarm.

**Power Minor (PMN) and Power Major (PMJ) alarms**
Table 2-B summarizes the conditions that cause the controller to issue either PMN or PMJ alarms.

***Visual Displays***

The faceplate of the SC312 has four LEDs to indicate conditions. The names of the LEDs, their colors and their significance are:

| | | |
|---|---|---|
| NORMAL | Green | Normal |
| PMJ | Red | Power Major Alarm |
| PMN | Yellow | Power Minor Alarm |
| BD | Red | Battery on Discharge |

The faceplate of the ADM has one LED, the CB alarm.

The faceplate of the rectifier has four LEDs. The names of the LEDs, their colors and significance are:

| | | |
|---|---|---|
| PWR OK | Green | Normal |
| FAULT | Yellow | Rectifier malfunction |
| TEMP | Yellow | High temperature |
| I LIM | Yellow | Current limit |

***Alarm Distribution Module***

The alarm distribution module (ADM), which is mounted in a 1.75 inch high shelf located between the power shelf and the dc

distribution panel, is the interface between the controller and the host system.

Alarm outputs are brought to the ADM from the controller card via a cable to a 25 pin DIN connector. This also serves as an interface between the LVD contactor, the battery shunt, the emergency power off (EPO) pin, the circuit breaker alarm, and the controller. All Form-C relays mounted on the ADM are powered from the 48V bus.

***Host Interface***

The outputs of the alarm distribution module Form-C contacts may be connected to the Sparton™ or equivalent remote sensing device to monitor the battery plant.

***Thermal Sensor Connections***

The alarm distribution module receives signals from the battery thermal paddles or temperature probes for thermal compensation. The basic system can monitor up to two battery strings. Adding Lucent's Model 210E Thermal Multiplexer increases the system's monitoring capablity to eight strings.

***Auxiliary Alarm***

The auxiliary (AUX) alarm is a pass-through alarm, which the customer may configure to report any condition that can generate an alarm signal.

***Sense Jacks***

Three pairs of sense jacks are located on the face of the ADM. These provide points for measuring the plant bus voltage, load current, and battery current with a digital voltmeter.

***Lamp Test***

A lamp test pushbutton on the face of the controller lights the four controller LEDs, the circuit breaker alarm LED on the ADM panel, and all the LEDs on the 210E thermal multiplexer.

## *Battery Management*

Battery management functions of the SC312 Controller are float voltage adjustment for temperature compensation and low voltage disconnect (LVD) to prevent deep discharges of the batteries.

***Slope-step Thermal Compensation***

The temperature compensation function automatically adjusts the battery float voltage as a function of the highest monitored battery temperature. This function maintains the batteries at a proper state of charge while ensuring that elevated battery temperatures do not induce catastrophic failures.

***Low Voltage Disconnect (LVD)***

During a discharge, if the battery string voltage falls below a preset threshold (42V±3%), the controller sends a signal to de-energize the LVD contactor and disconnect the batteries. After being disconnected by the LVD contactor, the batteries remain disconnected until the bus voltage is greater than 51.0V±1%.

During normal operation, if the controller is removed from the shelf, the batteries remain connected to the bus.

## *Specifications*

Tables 2-E through 2-G list various electrical and physical specifications of the EPS 4802A plant and its components.

**Table 2-E: -48V EPS 4802A Plant Electrical Specifications**

| | |
|---|---|
| Plant | One, two, or three rectifier shelves per plant<br>One initial rectifier shelf per plant<br>One or two supplementary rectifier shelves per plant |
| Power Slots | Two power slots per shelf; maximum of six power slots per plant |
| Power Units | One rectifier per power slot |
| Plant Architecture | One primary output power bus per shelf |
| Rectifier Input Distribution | Separate ac feed provided to each power slot **or** two ac inputs per shelf; ac input for each shelf distributed to all slots) |
| Output Distribution - Primary Bus | -48 volt dc bulk power outputs to loads or distribution and protection panels (single-hole lugs). Battery connections: single-hole lugs to terminate four battery strings. |
| Primary Bus Protection and Distribution | Plug-in protection and distribution modules: module output limited to 63 amperes single pole or 3x63 ampere triple pole circuit breakers.<br>**(Note 1)** |
| Maximum Discharge Current | 73.4 amperes per shelf; 300 amperes per plant.<br>(**Note 2)** |

**Table 2-E: -48V EPS 4802A Plant Electrical Specifications**

| | |
|---|---|
| Maximum Recharge Current | Installed plant -48-volt rectifier capacity minus plant -48-volt load. |
| Low Voltage Disconnect | 42±0.5% volts |
| Operating Ambient Temperature | 32 to 122° Fahrenheit<br>(0° to 50° Celsius) (**Note 2)** |
| Altitude | -200 to 13,000 feet<br>(-61 to 3962 meters) (**Note 4)** |
| Humidity | 10-95% non-condensing |
| Audible Noise | 70 dBA measured 2 feet (0.6 meters) from the plant. |
| Harmonic | IEC/EN61000-3-2 |
| Radiated and Conducted Emissions | FCC Part 15, Class A, CISPR 22 Class A |
| Electromagnetic Immunity | IEC/EN61000-4-2 ESD Level 3 and 4<br>IEC/EN61000-4-3 Radiated Immunity, 10V/m<br>IEC/EN61000-4-4 EFT Level 3<br>IEC/EN61000-4-5 Lightning Surge, Level 3<br>IEC/EN61000-4-6 Conducted Immunity |
| Safety Agency Approvals | Rectifiers UL, CSA, VDE, CE; power shelves UL, CSA, VDE; System VDE, CE |

**Note 1:** The worst case maximum discharge current occurs at the end of discharge for plants powering constant loads which are equipped with one rectifier for recharging batteries. Bus bars in customer provided remote distribution and protection modules should be sized to carry 300 amperes at the maximum ambient operating temperature.

**Note 2:** LVD protection per plant is limited to 300A, the current carrying capacity of the contactor.

**Note 3:** For altitudes above 5000 feet, derate the temperature by 3.6 degrees Fahrenheit per 1000 feet. For altitudes above 1524 meters, derate the temperature by 0.656 degrees Celsius per 100 meters.

**Table 2-F: -48V EPS 4802A Plant Physical Specifications**

| | |
|---|---|
| Rectifier | Height: 5.25 inches (13.34 cm)<br>Width: 6.88 inches (17.48 cm)<br>Depth: 12.5 inches (31.75) cm)<br>Weight: 14.5 pounds (6.58 kg) |
| Shelf | Height: 5.25 inches (13.34 cm)<br>Width: 19 inches (48.26 cm)<br>Depth: 14.5 inches (36.83 cm)<br>Weight: 17 pounds (7.71 kg) |
| Single shelf equipped with two rectifiers | Weight: 46 pounds (20.87 kg) |
| Batteries:<br>Unigy I™ Gel Valve Regulated<br>12GVR-100 | Height: 9.4 inches (23.88 cm)<br>Width: 12.93 inches (32.84 cm)<br>Depth: 6.75 inches (17.15 cm)<br>Weight: 72.6 pounds (32.93 kg) |
| Frame Mounting Requirements | Standard 19 inch relay racks<br>Vertical mounting centers: 1.0 inch (2.54 cm) and 1.75 inches (4.45 cm).<br>Horizontal mounting centers: 18.25 inches (46.36) |

**Table 2-G: Rectifier Plant Specifications**

| | |
|---|---|
| Power Units | RM2000HA Rectifiers; Maximum of two units per shelf or six units per plant |
| Control Unit | SC312 Monitor and Control Unit |
| Nominal Output Voltages | 54.5 volts dc |
| Operating Voltage Range | 43-54.5 volts dc |
| Maximum Output Current | 75.2 amperes per shelf<br>225 amperes per system |
| Nominal Input Voltage | 200/208/240 volts ac |
| Input Voltage Ranges | 170-264 volts ac |
| Maximum Input Current | 13A per rectifier @ 180 volts ac |
| Efficiency | 87% typical |
| Output Voltage Regulation | ±1.5% |
| Wideband Output Noise | 300 mV peak to peak maximum, over the range 10 Hz to 20 MHz |
| Plant Output Noise | <32 dBrnC |
| Load Share Accuracy | ±10% of load current > 50% of rated load |
| Maximum Discharge Current | 12,000W at 42V<br>285A per plant |
| Maximum Recharge Current | Installed rectifier capacity minus plant load |
| Low Voltage Disconnect | 42 ±0.5 volts |
| Heat Dissipation | 111 watts (380 BTU/hour) maximum per rectifier |
| Power Factor | >0.98 for loads >60% of full load |
| Output Ripple | 150mV typical at 100% load |

# 3 Engineering and Ordering

## Engineering Information

This section discusses the factors to be considered in determining the number of rectifiers required in both non-redundant and redundant battery plants.

### Rectifier Sizing (Non-Redundant Systems)

In non-redundant systems, the installed rectifier capacity of the battery plant must be sufficient to provide the current required for the load during normal operations as well as the current required to recharge the battery following ac power outages.

For the telecommunications industry, the system load current is known as the average busy-hour current. (The average busy-hour current drain is defined as the average busy-hour current drain during busy season with the plant operating at the normal voltage.) Therefore, the minimum installed rectifier capacity (mirc) is the sum of the average busy-hour (abh) current and the required battery recharge current, or:

**mirc = abh + recharge current**

The battery recharge current is determined by two system considerations: the maximum time the system is required to operate in the absence of ac power (reserve time), and the time allocated to recharge the battery after ac power returns. These two times and Figure 3-1 may be used to determine the recharge factor. This factor, when multiplied by the average busy-hour current, determines the minimum installed rectifier capacity, or:

**mirc = abh x recharge factor**

The mirc divided by the individual rectifier capacity determines the number of rectifiers (of equal capacity) required for a non-redundant system.

***Rectifier Sizing (Redundant Systems)***

In redundant systems, a spare on-line rectifier is included so that the loss of any one rectifier will not cause the available plant capacity to fall below the required minimum installed rectifier capacity. Thus the loss of a rectifier will not affect the normal system operation nor will it cause the batteries to discharge.

In cases where the additional spare rectifier will provide the required battery recharge current, the mirc satisfies the requirements for both non-redundant and redundant systems. In other cases, rectifiers in addition to the redundant rectifier may be required to provide the battery recharge current.

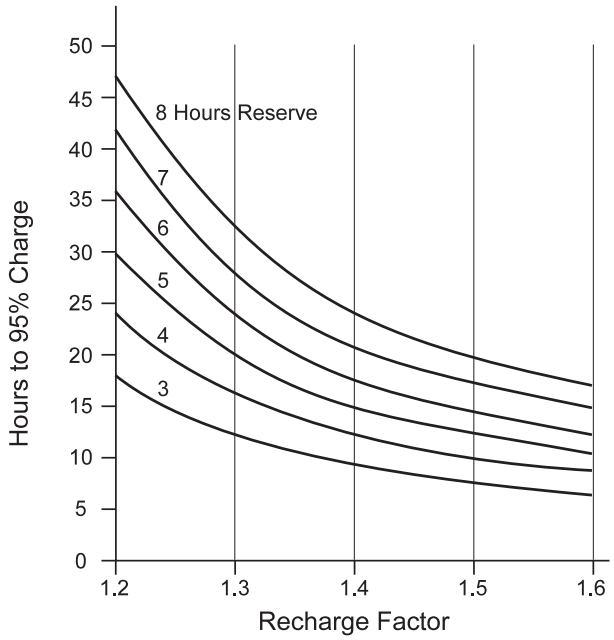



***Figure 3-1: Recharge Factor vs. Recharge Time***

***Plant Configuration Examples***

To illustrate the relationships between mirc, abh current drains, the recharge factor, and battery recharge current for non-redundant and redundant systems, consider the following examples.

1. A battery plant is required to provide a load current of 34 amperes, have an 8-hour discharge time (reserve time) and recharge to 95% of battery capacity in 24 hours. Determine the number of 12.5 ampere rectifiers required for non-redundant systems.

   From Figure 3-1, the recharge factor is 1.38.

**mirc = abh x recharge factor**
**mirc = 34 x 1.38 = 46.9 amperes**

Four 12.5 ampere rectifiers (46.9/12.5 = 3.8) are required to provide the minimum installed capacity of 46.9 amperes for a non-redundant system. However, if one rectifier fails, the one remaining rectifier will not provide the abh capacity. Therefore, one additional rectifier must be added to complete a redundant system.

2. A two-shelf battery plant is required to provide a load current of 85 amperes, have a 5-hour discharge time (reserve time) and recharge to 95% of battery capacity in 24 hours. Determine the number of 12.5 ampere rectifiers required for non-redundant and redundant systems. From Figure 3-1, the recharge factor is approximately 1.25.

**mirc = abh x recharge factor**
**mirc = 85 x 1.25 = 106.3**

Nine 12.5 ampere rectifiers (106/12.5 = 8.5) are required to provide the minimum installed rectifier capacity of 106.3 amperes. In this example, five rectifiers supply the abh capacity and one additional rectifier is required to supply the battery recharge current. This system also meets the requirements for non-redundant and redundant systems.

***Other Considerations***

Rectifiers having different output current capacities should not be mixed in the same battery plant.

- Figure 3-1 illustrates several general guidelines for choosing the recharge factor.
- A minimum recharge factor of approximately 1.2 is required to recharge the battery effectively.
- As the reserve time increases, the recharge factor required to maintain a given recharge time must also increase.
- Continuing to increase the recharge factor above approximately 1.4 does not significantly reduce the recharge time.

## *Ordering Information*

The -48V EPS plant is ordered by List (L) numbers. The plant has four main configurations:

- **List 10** provides the basic frame assembly, distribution assembly, alarm distribution module, PS3000A2910 rectifier shelf, a cable kit, and assorted hardware.
- **List 20** provides a kit to add a supplementary frame.
- **List 30** provides additional P3000A2910 rectifier shelves, cables, and associated hardware.
- **List 40** provides Unigy I™ batteries, battery boxes, cables, and associated hardware.

Table 3-A gives details of these Lists.

- Separately ordered or replacement parts include rectifiers, batteries, frame grounding kit and other items. See Table 3-B.

**Table 3-A: EPS 4802A Ordering Information**

| List | Quantity | Comcode | Description |
|---|---|---|---|
| 10 | 1 | 848153656 | frame assembly |
| | 1 | 848121430 | cable kit List 10 |
| | 1 | 848161980 | EPS 4802A distribution assembly |
| | 1 | 848162004 | EPS 4802A alarm distribution module |
| | 1 | 108274630 | PS3000A2910 rectifier shelf |
| | 6 | 848157400 | paint piercing ground washer |
| | 16 | 901078717 | 12-24x5/8 screw |
| | 6 | 841630155 | 1/4x2.0x2.0 washer |
| | 1 | 848156014 | dc cover assembly |
| | 1 | 848120515 | EPS 4802A L10 product ID label |
| | 1 | 400681607 | cable tie |
| 20 | 1 | 848153656 | supplemental frame assembly |
| | 1 | 848154266 | product identification label |
| | 6 | 841630155 | washer (package of 6 shipped with frame) |
| 30 | 1 | 108274630 | PS3000A2910 rectifier shelf |
| | 2 | 848157400 | paint piercing ground washer |
| | 4 | 901078717 | 12-24x5/8 screw |
| | 1 | 848121414 | EPS 4802A L30 cable kit |
| | 1 | 400681615 | cable tie |
| | 1 | 848156014 | dc cover assembly |
| 40 | 2 | 848144903 | battery box assembly |
| | 4 | 848155271 | auxiliary support bracket |
| | 1 | 848121422 | cable kit List 40 |
| | 2 | 848120499 | product identification label |
| | 4 | 848157400 | paint piercing ground washer |
| | 40 | 901078717 | 12-24x5/8 screw |

Notes:
Rectifiers (RM2000 36.7A output) are ordered separately. Each List 30 rectifier shelf will accept two rectifiers.

Each EPS 4802A requires one SC312 Alarm and Control Unit (the controller card) and an Alarm Distribution Module with panel. When multiple shelves are used, each auxiliary shelf requires a PSC5 Slave Aggregation Module (SAM) card in place of the SC312 controller card. The SAM communicates with the SC312 on the primary shelf.

## Table 3-B: EPS 4802A Ordering Information (Separately Ordered Parts)

| Comcode | Description |
|---|---|
| **Rectifier and Rectifier Shelf** | |
| 108276832 | RM2000 Rectifier |
| 108076860 | SC312 Controller |
| 108097643 | PSC5 Slave Aggregation Module |
| 848242533 | Rectifier Fan Kit |
| 405771601 | AC Input Receptacle |
| **Plant** | |
| 108107897 | ADM Board, BYS2 |
| 406066472 | Contactor |
| 402830871 | Shunt |
| 848153318 | Panel |
| **Monitoring** | |
| 847463841 | Sparton Remote Access Unit |
| 847494606 | Ring Type Thermal Probe |
| 847580529 | Thermistor Kit (Ring Probe/9 Ft Cable) |
| 847172152 | Thermal Cable Assembly 5 Ft |
| 847550175 | Thermal Cable Assembly 9 Ft |
| 847548476 | Thermal Cable Assembly 14.5 Ft |
| 847548468 | Thermal Cable Assembly 17.5 Ft |
| 601839426 | Thermal Probe Multiplexer (210) Kit |
| 847900180 | Thermal Probe Multiplexer Power Cable |
| **Distribution** | |
| 407958594 | 6 Amp Circuit Breaker |
| 407958552 | 20 Amp Circuit Breaker |
| 407958545 | 40 Amp Circuit Breaker |
| 408010155 | 63 Amp Circuit Breaker |
| 407958537 | 3X63 Amp Circuit Breaker |
| 848117586 | Distribution Output Tooth (Single Pole) |
| 848191078 | Distribution Output Tooth (Triple Pole) |
| **Anchor Bolt Kits** | |
| 847135738 | Anchor Bolt Kit 1 |

**Table 3-B: EPS 4802A Ordering Information (Separately Ordered Parts)**

| Comcode | Description |
|---|---|
| 847221074 | Anchor Bolt Kit 2 |

## *Documentation References*

**-48-Volt EPS 4802A Battery Plant**

| | |
|---|---|
| Assembly and Ordering Drawing | J85582S-1 |
| Product Manual Select Code | 167-793-100 |

# *4 Safety*

## *Safety Statements*

Please read and follow all safety instructions and warnings before installing, maintaining, or repairing the EPS 4802A power shelf:

- The EPS 4802A is CE marked to demonstrate compliance with the European Union's electromagnetic compatibility and low-voltage directives.
- The EPS 4802A is VDE Certified to DIN VDE 0805/ EN60950.
- Rectifiers are also individually UL Recognized and/or CSA Certified to UL1950 and CSA C22.2 No. 234/950. Rectifiers are also approved to IEC-950/EN60950 by an EC Notified Body and have outputs classified as SELV. The output voltages of -48-volt EPS rectifier plants meet SELV requirements per UL1950 and IEC950.
- Install only in restricted access locations (dedicated equipment rooms, equipment closets, or the like) as defined by IEC60950 and in accordance with articles 110-16, 110-17, and 110-18 of the U.S. National Electric Code (NEC), ANSI/NFPA No. 70, and pursuant to applicable local codes.
- This equipment is to be used in controlled environments (an area where the humidity is maintained at levels that cannot cause condensation on the equipment, the contaminating dust is controlled, and the steady-state ambient temperature is within the range specified).
- This equipment has been evaluated for use in a continuous ambient temperature of up to 50° Celsius.
- This equipment must not be installed over combustible surfaces.

- For all installations, the appropriate connector is to be applied only to the correct size conductor as specified by the connector manufacturer, using only the connector manufacturer's recommended tooling or tooling approved for that connector.
- If the proper connector for the country of installation is not provided, obtain appropriate connectors and follow manufacturer's and all local requirements for proper connections. All national and local rules and regulations should be followed when making field connections.
- Insulation on field-wired conductors should be rated no less than 90° Celsius. Wire conductor size should be no less than allowed by electrical codes for 60° Celsius wire (regardless of insulation temperature rating used) and based on the ampacity of the associated protection device.
- Torque electrical connections to the values specified on labels or in the product documentation.
- Battery input cables must be dressed to avoid damage to the conductors (caused by routing around sharp edges or routing in areas where wires could get pinched) and undue stress on the connectors.
- Alarm contacts on the distribution panel are not fused within the distribution panel. Therefore, current limiting protection for these contacts must be provided by external circuits. Maximum ratings for alarm connections are 60Vdc and 0.5 amperes. Exceeding these maximum ratings could result in fire or damage to the unit.
- Circuit breaker loads must **not** exceed 80% of the circuit breaker current rating. Distribute loads across the panel.
- The short circuit current capability of the battery input to the distribution panel must not exceed 9000A.
- AC branch circuits to this equipment must be protected with either fuses or circuit breakers sized as required by the National Electric Code (NEC) and/or local codes. The maximum size of the over-current protector is recommended to be no more than 20A for each rectifier slot. Refer to the equipment ratings to ensure ac source loading will not exceed 80% of the value of the protector chosen.
- Installing circuit breakers not specified for use in these distribution modules may result in injury to service personnel or equipment damage. Use only replacement parts listed in this manual and on the equipment drawings.

## *Warning Statements and Safety Symbols*

This symbol identifies the need to refer to the equipment instructions for important information.

These symbols (or equivalent) are used to identify the presence of hazardous ac mains voltage.

This symbol is used to identify the presence of hazardous ac or dc voltages. It may also be used to warn of hazardous energy levels.

The symbols may sometimes be accompanied by some type of statement; e.g., “Hazardous voltage/energy inside. Risk of injury. This unit must be accessed only by qualified personnel.”

This symbol is used to identify the need for safety glasses and may sometimes be accompanied by some type of statement, for example: “Fuses can cause arcing and sparks. Risk of eye injury. Always wear safety glasses.”

One of these two symbols (or equivalent) may be used to identify the presence of rectifier and battery voltages. The symbol may sometimes be accompanied by some type of statement, for example: “Battery voltage present. Risk of injury due to high current. Avoid contacting conductors with uninsulated metal objects. Follow safety precautions.”

This symbol is used to identify the presence of a hot surface. It may also be accompanied by a statement explaining the hazard. A symbol like this with a lightning bolt through the hand also means that the part is or could be at hazardous voltage levels.

This symbol is used to identify the presence of a hot surface. The marked item should not be touched without taking care.

This symbol is used to identify the protective safety earth ground for the equipment.

This symbol is used to identify other bonding points within the equipment.

## *Precautions*

When working on or using this type of equipment, the following precautions should be noted:

- This unit must be installed, serviced, and operated only by skilled and qualified personnel who have the necessary knowledge and practical experience with electrical equipment and who understand the hazards that can arise when working on this type of equipment.
- The equipment could be powered by multiple ac inputs. Ensure that the appropriate circuit protection device for each ac input being serviced is disconnected before servicing the equipment.
- For equipment connected to batteries, disconnecting the ac alone will not remove power to the equipment. Disconnect batteries from system before servicing. Make sure the equipment is not also powered by the batteries or the batteries are not connected to the output of the equipment.
- Hazardous energy and voltages are present in the unit and on the interface cables that can shock or cause serious injury. Follow all safety warnings and practices when servicing this equipment.
- Batteries may be connected in parallel with the output of the rectifiers. Turning off the rectifiers will not necessarily remove power from the bus. Make sure the battery power is also disconnected and/or follow safety procedures while working on any equipment that contains hazardous energy/ voltage.
- In addition to proper job training and safety procedures, the following are some basic precautions that should always be used:
  - Use **only** properly insulated tools.
  - Remove all metallic objects (key chains, glasses, rings, watches, or other jewelry).
  - Wear safety glasses.
  - Test circuits before touching.
  - Lock out and tag circuit breakers/fuses when possible to prevent accidental turn on.
  - Be aware of potential hazards before servicing equipment.
  - Identify exposed hazardous electrical potentials on connectors, wiring, etc. (note the condition of these circuits, especially wiring).

– Use care when removing or replacing covers; avoid contacting circuits.

# 5 Installation and Testing

## Introduction

This section outlines the sequence for installing the EPS shelf, battery boxes, and plug-in modules, as well as test procedures for verifying the integrity of the installation.

### Installation Tools and Hardware

You will need the following tools and hardware to install and test the EPS shelf and plug-in modules:

- Wire cutters and strippers
- Heat shrink gun
- Torque wrench (0-70 inch-pounds)
- 5/16 inch insulated hex driver
- 7/16 inch insulated hex driver
- Digital meter with an accuracy of ± 0.02%
- Small screw driver
- ESD wrist strap

## General Information

The plant must be installed so as to allow both front and rear access. The commercial ac power input wiring enters the plant at the rear. The alarm wiring to general office alarms exits the plant on the left rear.The inter-shelf signal connector is located on the right rear. Loads and batteries are connected to the power shelves through the output buses at the rear of the distribution cabinet. Clearance of 36 inches to the rear of the main frame upright is suffficient.

### *EMI Considerations*

When running the dc output cables, pair the positive and negative conductors over as much of their length as possible to minimize loop areas for EMI considerations.

## *Safety*

**Warning**
Only qualified personnel should install and service the EPS plant. Hazardous energy is present in the unit and on the interface cables and will shock or cause serious injury or death if safety precautions are ignored. Follow all safety warnings and practices when servicing this equipment.

## *Installation Sequence*

Please review all safety warnings in Section 4 before beginning the installation process. Observe all warnings and labels on the equipment.

The EPS 4802A plant consists of a frame in which a dc distribution assembly, an alarm distribution module, and a PS3000A2910 rectifier shelf are factory installed. Refer to Figure 1-1 for relationship of components.

### *PS3000A2910 Rectifier Shelf*

The EPS 4802A plant always ships with one rectifier shelf installed. Supplemental shelves, if used, are installed by the user. These shelves slide into the frame below the master shelf. Follow these steps to complete installation:

1. Insert four 12-24x5/8 screws through the front of the rectifier shelf assembly to hold the unit in place. Use paint piercing ground washers on the two top screws. Torque to 35 in-lbs.

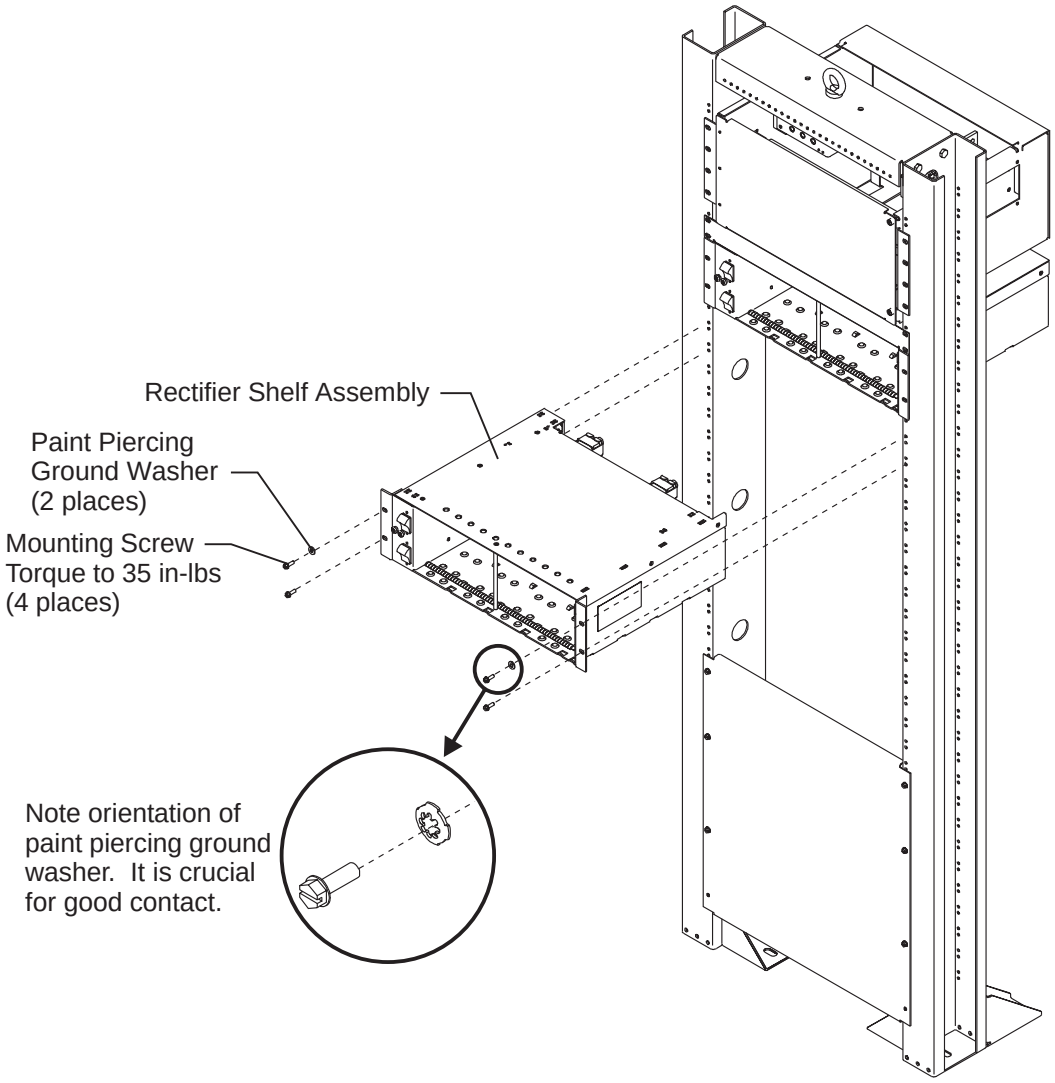



***Figure 5-1: Rectifier shelf installation***

***Power Units*** Individual RM2000 rectifiers are installed by sliding them into the PS3000A2910 shelf.

1. Verify that the circuit breaker is off for the rectifier slot before installation or removal.

2. Place the module in the shelf and slide it toward the backplane until it contacts the backplane.

3. Close the latch on the front of the rectifier and verify that the rectifier is firmly seated in the shelf.

**Caution**
When handling the plug-in modules, you must be properly grounded in order to prevent ESD damage to the unit(s).

***Control Unit***

The SC312 Controller card fits into the slot at the right-hand side of the master power shelf. If using supplementart (slave) units, insert the PSC5 SAM card into the same slot on these shelves.

***Battery Shelf Assembly***

Each battery shelf supports two batteries. Each battery string requires two battery shelves. Two battery strings may be installed in a frame. See Figure 5-2 for relationship of pieces.

1. The battery shelf assemblies are always installed from the lowest available frame position upwards. Slide a shelf into the bottom-most part of frame from the front and fasten it to the frame with ten 12-24x5/8 screws, using paint piercing ground washers on the two top screws.

2. Install the auxiliary support braces at the sides of each battery shelf using 12-24x5/8 screws.

3. Slide two Unigy I™ batteries into each battery shelf. See Figure 5-6 for proper battery orientation.

4. Fasten the batteries into place by screwing the horizontal brace onto the front of the battery shelf using four 12-24x5/8 screws.

5. Additional shelves may be added above this shelf.

6. Battery shelf assemblies allow sufficient clearance to install battery cables. The installer will need access from both front and rear of frame.

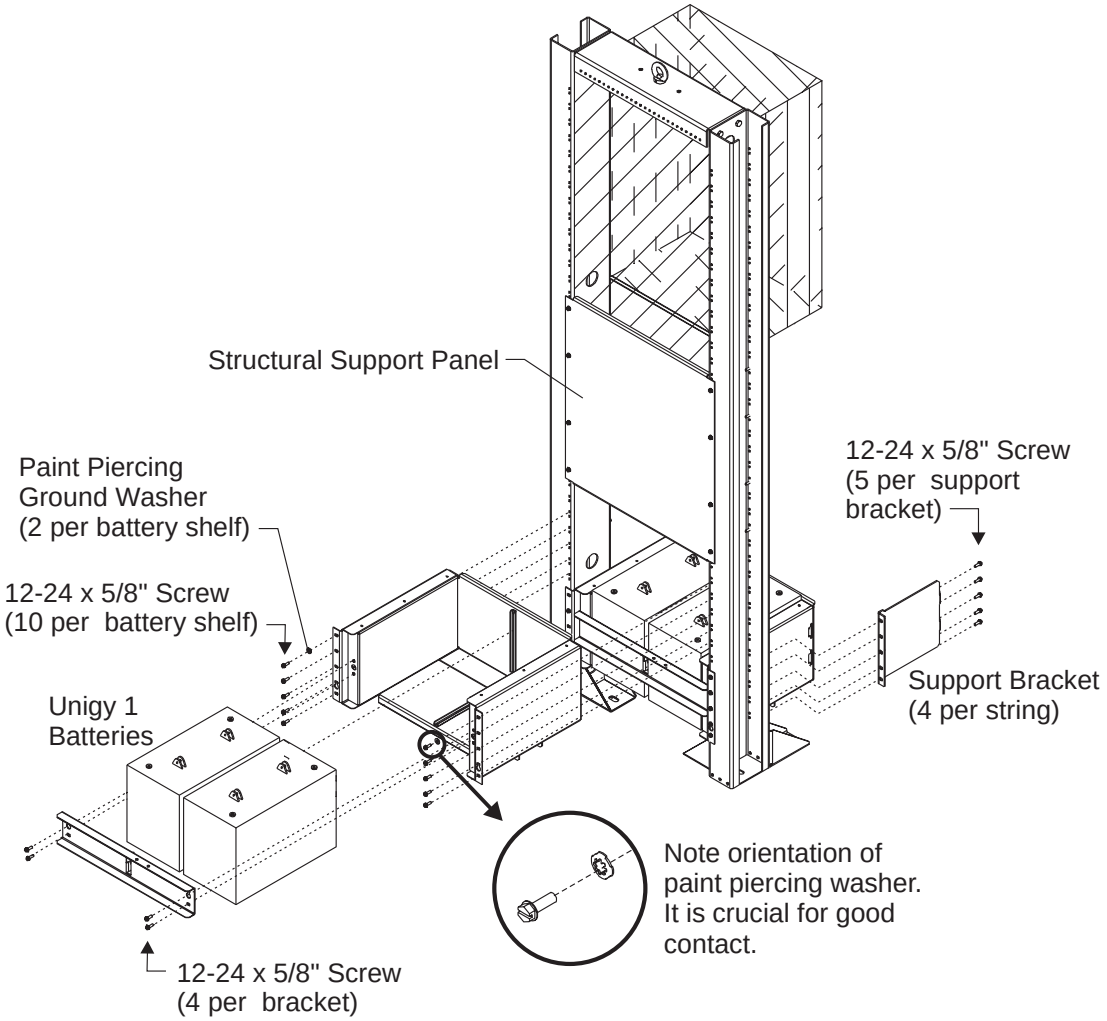



***Figure 5-2: EPS 4802A Battery box installation***

***AC Input Wiring***

The cable kit for the List 10 basic installation includes Hubble connectors, which are shipped loose. Terminate the ac input cable with these connectors and plug them into the PS3000 ac input module. See Figures 5-3 and 5-4 for more detail.

***Rectifier Output Wiring***

Kits providing the cables and hardware needed for this procedure are listed in Section 3, Engineering and Ordering. See Figures 5-3 through 5-5 for more detail.

**Note: In the intial frame, each rectifier shelf must have its own plus and minus dc output cables wired directly to the distribution. In the supplemental frame, for configurations with two rectifier shelves, the two shelf dc outputs can be**

**paralleled together, and a single pair of dc cables routed to the initial frame's distribution.**

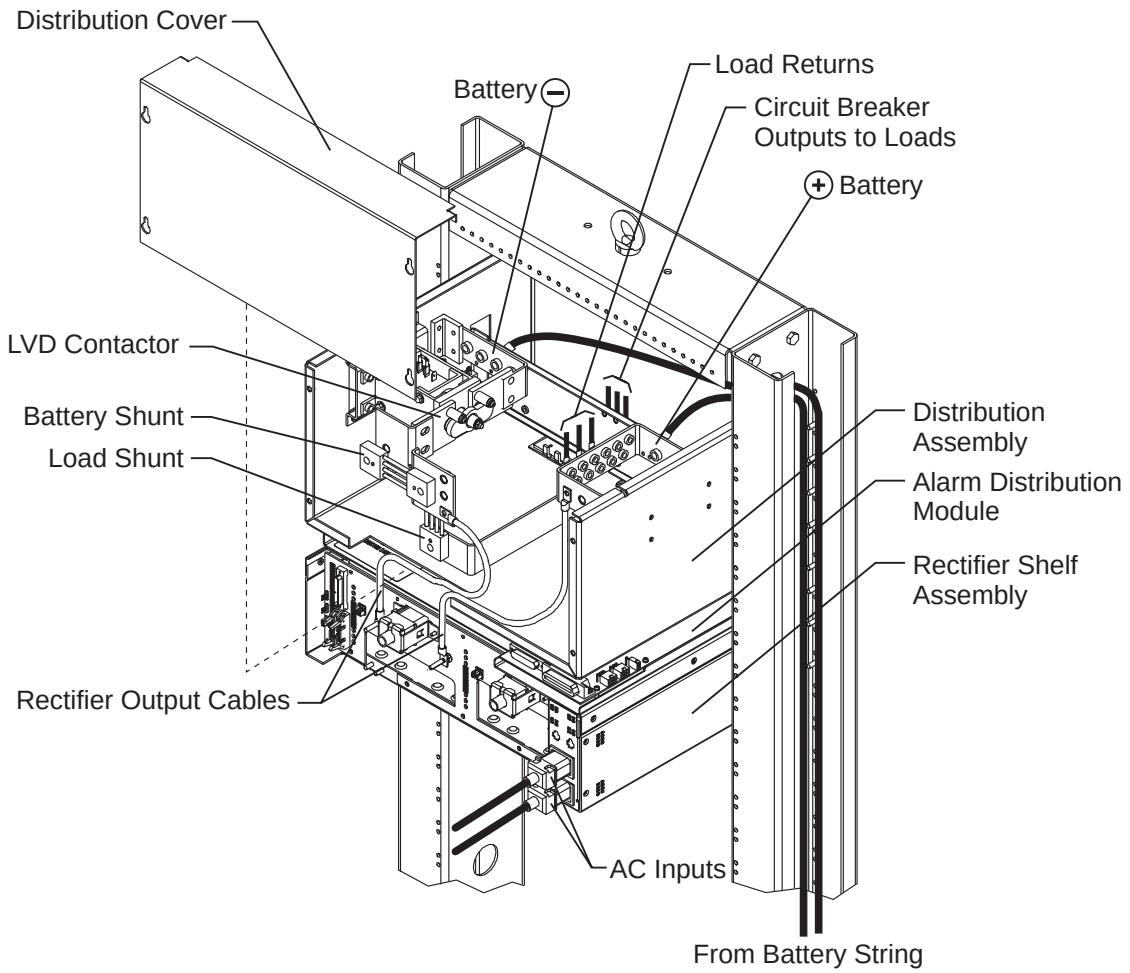



***Figure 5-3: Rear view of distribution assembly, alarm distribution module, and rectifier shelf***

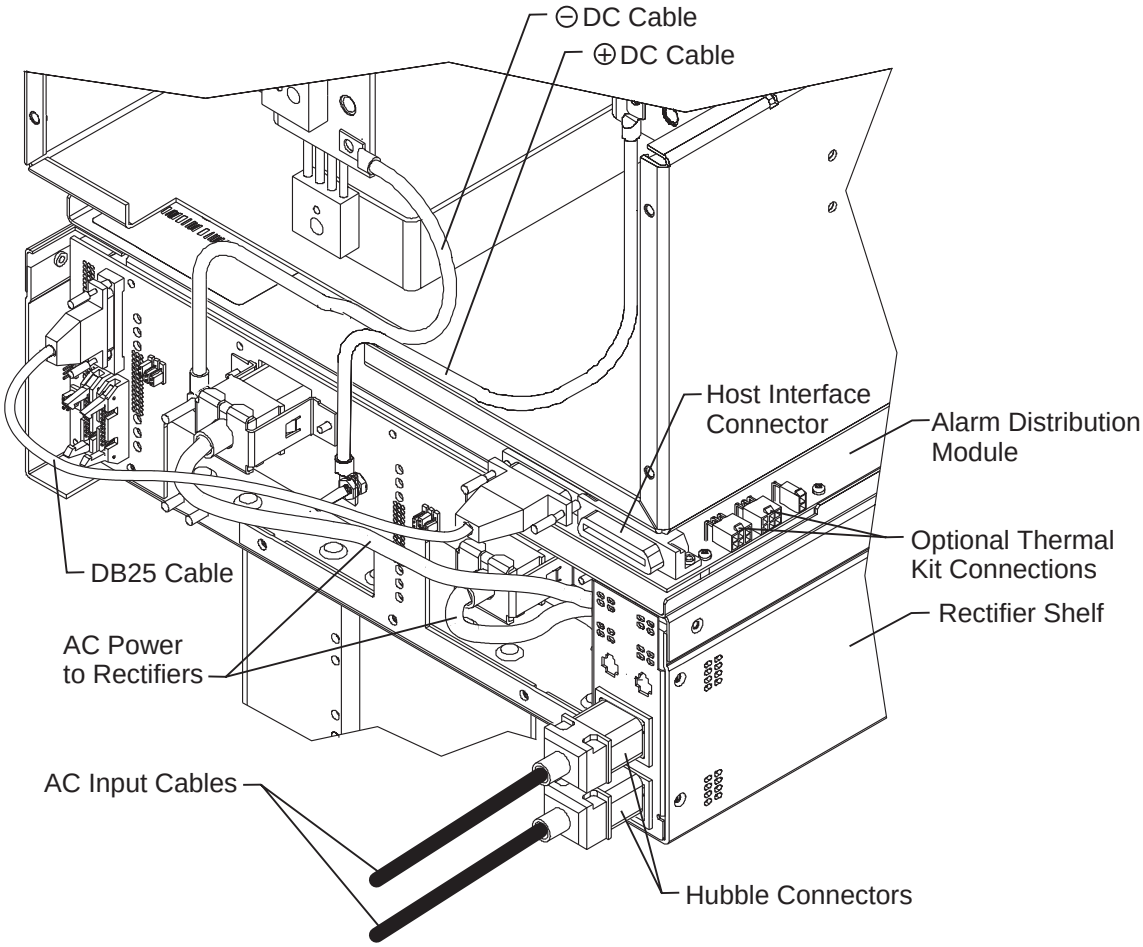



***Figure 5-4: Close-up view of alarm distribution module and rectifier shelf wiring***

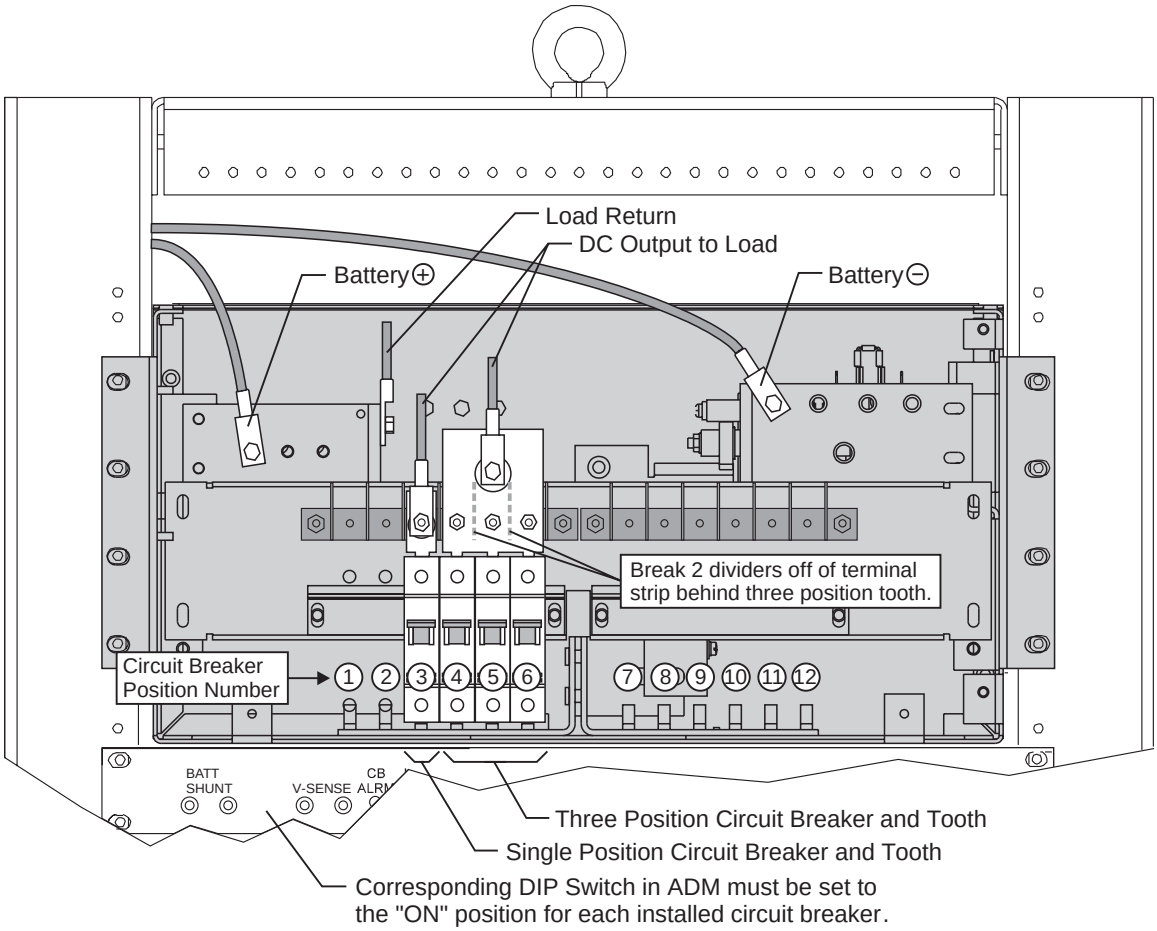



***Figure 5-5: Front view of distribution assembly***

1. Remove the cover on the output distribution module before installing the EPS 4802A List 10 cable kit.

2. Attach one end of the positive (DC+) cable to the stud marked DC+ on the rear of the PS3000A2910 rectifier shelf using the nut furnished. Torque to 25 in-lbs. Attach the other end of the cable to the DC+ busbar located inside the dc distribution assembly using the M6 screw furnished. Torque to 65 in-lbs. See figures 5-4 and 5-5 for more detail.

3. Attach one end of the negative (DC-) cable to the stud marked DC- on the rear of the PS3000A2910 rectifier shelf using the nut furnished. Torque to 25 in-lbs. Attach the other end of the cable to the DC+ busbar located inside the dc distribution assembly using the M6 screw furnished.

Torque to 65 in-lbs. See figures 5-4 and 5-5 for more detail.

4. Attach the dc cover assembly by turning the plastic nuts onto the dc output studs located on the rear of the PS3000A2910 rectifier shelf until a marked resistance is felt.

5. **For Master Shelf Only:**

   See Figure 5-4. Attach one end of the DB25 cable to the connector marked J109 located on the rear of the PS3000A2910 rectifier shelf. Attach the other end to the connector marked P5 located on the left rear corner of the alarm distribution module (ADM).

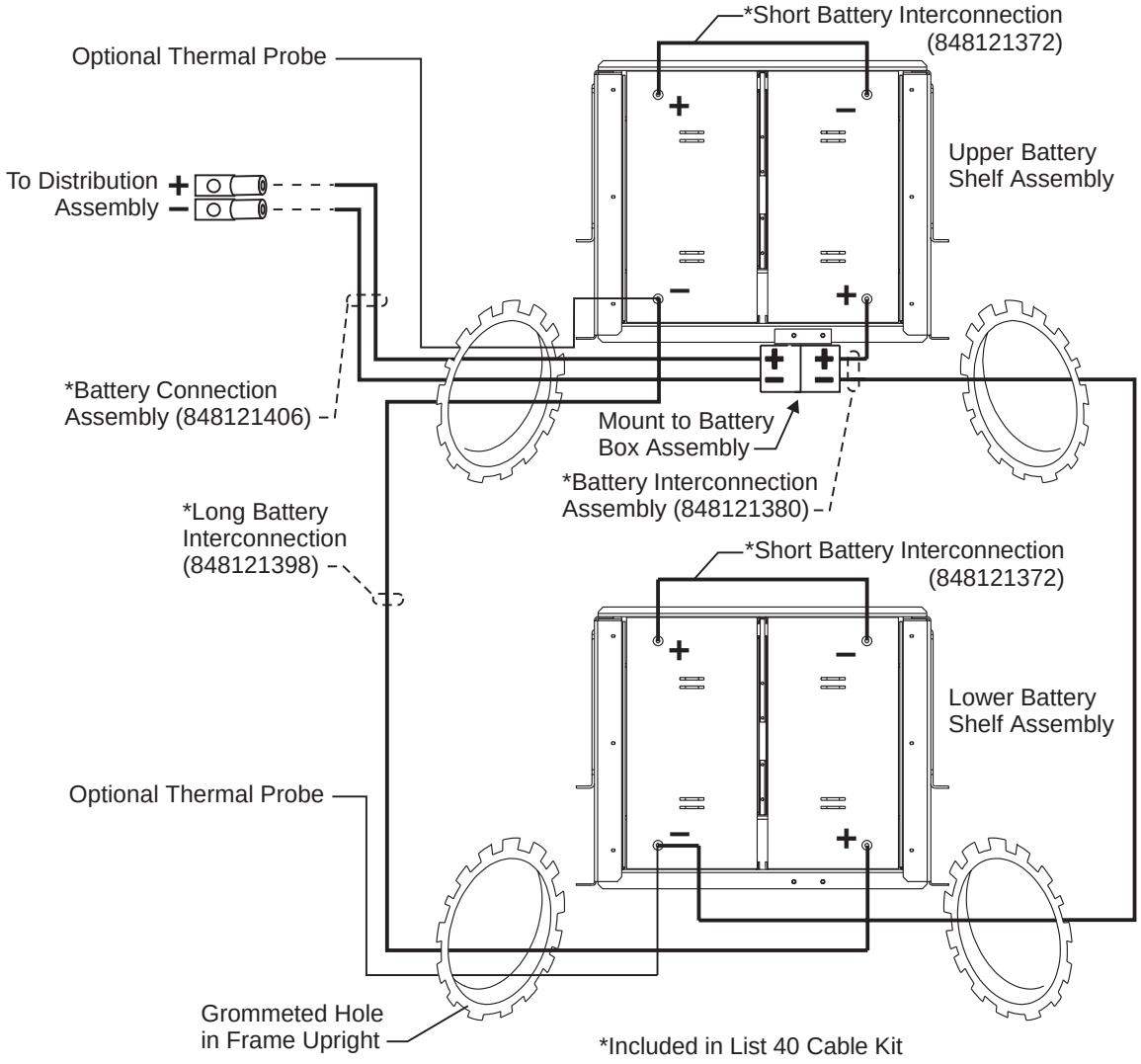



***Figure 5-6: Battery installation and wiring***

***Battery Installation and Wiring***

**WARNING:**
**Batteries contain hazardous electrical energy, sulfuric acid, and explosive hydrogen gas. Follow all precautions noted in the battery product manual.**

1. If required, remove the structural support panel. See Figure 5-2.

2. Install lower battery shelf and two batteries as instructed under “Battery Shelf Assembly,” above.

3. Install upper battery shelf and the remaining two batteries as instructed under “Battery Shelf Assembly,” above.

**Note:** each cable assembly has a 9-digit number printed on it, corresponding to these instructions and figures.

4. Using the long battery interconnection cable provided (848121398), connect the right-hand battery on the lower shelf to the left-hand battery on the top shelf as shown in Figure 5-6. Ensure that the cable is routed through the grommets on the frame as shown.

5. Mount the right-hand battery interconnection assembly (848121380) connector to the top shelf bracket.

6. Connect the battery interconnection assembly (848121380) cable to the negative terminal of the left-hand battery on the lower shelf. Ensure that the cable is routed through the grommets on the frame as shown.

7. Connect the positive lead of the mounted connector to the positive terminal of the right-hand battery on the top shelf.

8. Connect the short interconnection cables (848121372) on the top and bottom shelves as shown in Figure 5-6.

9. Connect the lugs of the battry connection cable assembly (848121406) to the positive and negative terminals of the distribution panel. See Figure 5-5.

10. Ensure that all polarities are correct.

11. Connect the two blue connectors together.

### *Intershelf Cabling and Jumper Settings*

Figure 5-7 shows position numbers for rectifier shelves and locations of control boards. Figure 5-8 shows jumper locations on the SC312 controller and the PSC5 Slave Aggregation Module.

The EPS 4802A supports six initial frame, supplemental frame and rectifier shelf configurations. For each configuration, jumpers on the SC312 controller board and PSC5 SAM boards (if used) must be set, and the power shelf cables and load/sense cables must be connected. Figure 5-9A and B through 5-14A and B show each of the six configurations. The “A” figures show the

jumper settings for each control board, and the “B” figures show cabling and backplane jumper settings for each configuration..

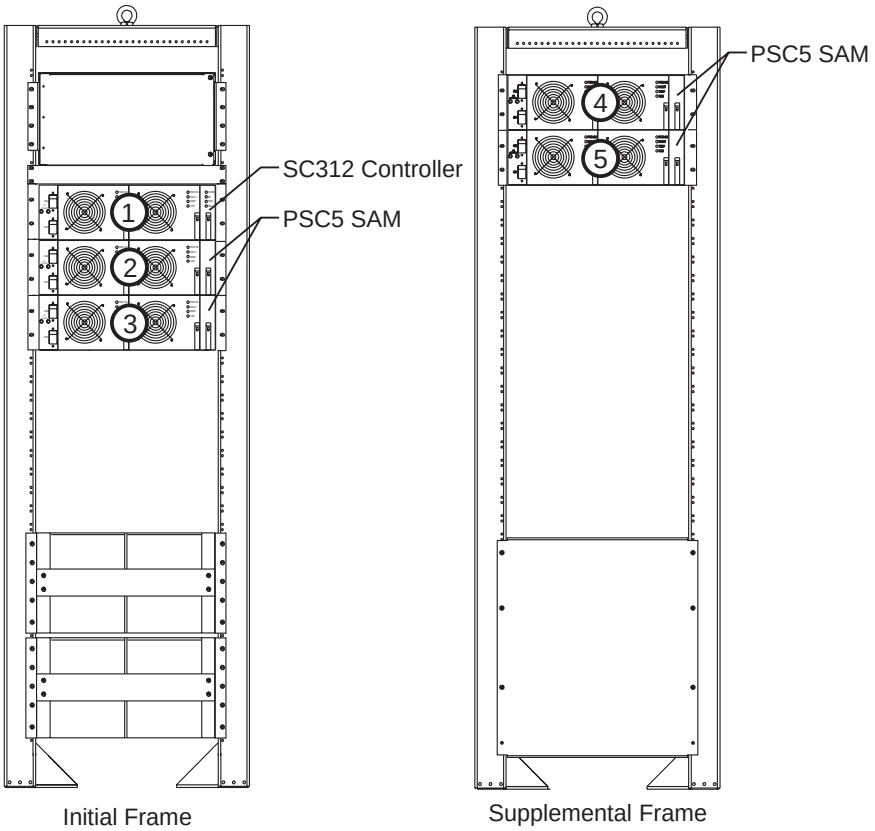



***Figure 5-7: Rectifier shelf position numbers and control board locations***

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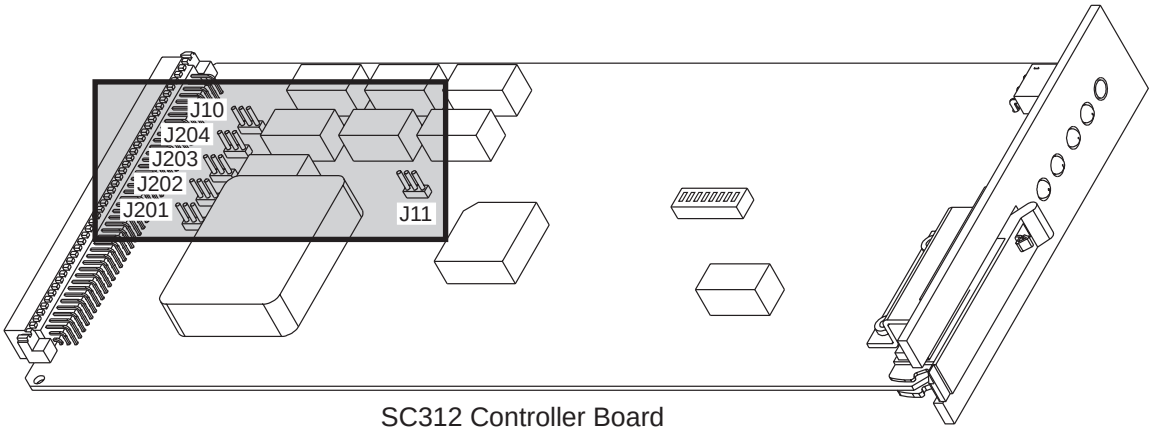


SC312 Controller Board


PSC5 Slave Aggregation Module

***Figure 5-8: Jumper locations on SC312 controller and PSC5 slave aggregation module***

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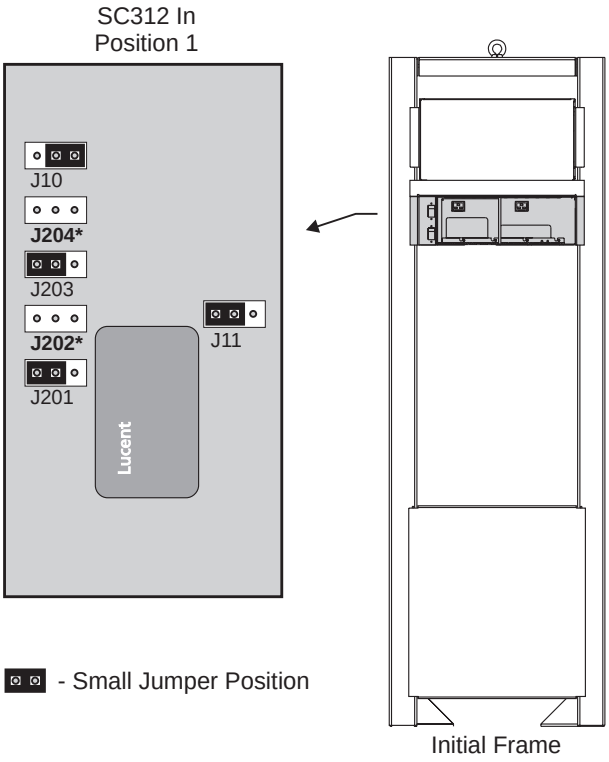
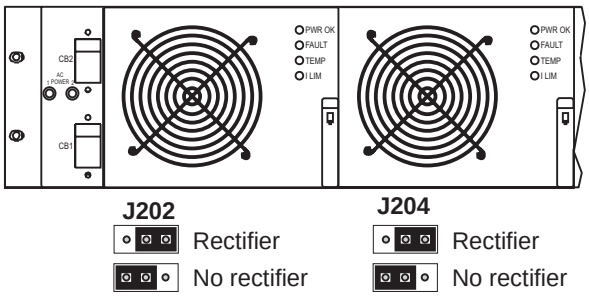



***J202 and J204**

J202 and J204 jumpers are set on the SC312 or PSC5 boards for each shelf, depending on whether or not rectifiers are present in the left or right shelf positions.




**J202**

Rectifier

No rectifier

**J204**

Rectifier

No rectifier

***Figure 5-9A: Control board jumper settings, one rectifier shelf in position 1***

.

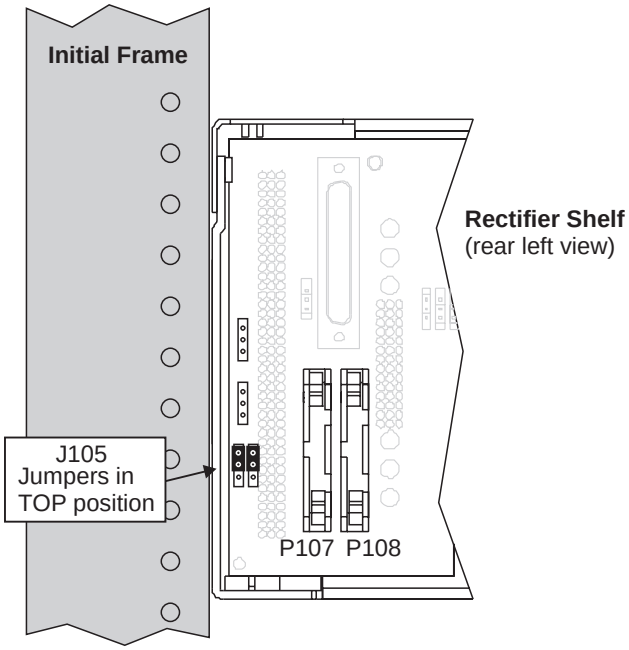



***Figure 5-9B: Backplane jumper settings, one rectifier shelf in position 1***

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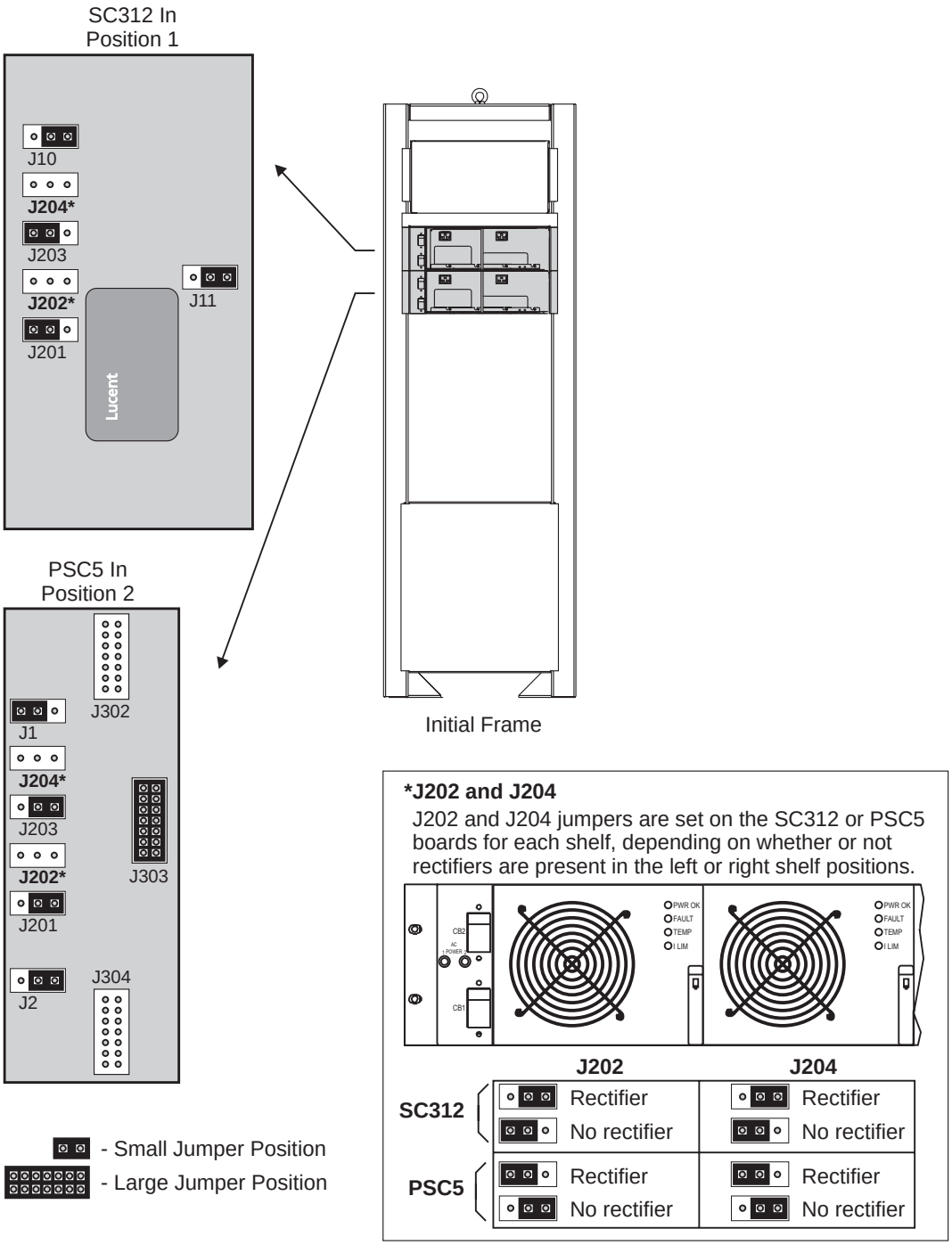


***Figure 5-10A: Control board jumper settings, two rectifier shelves in positions 1 and 2***

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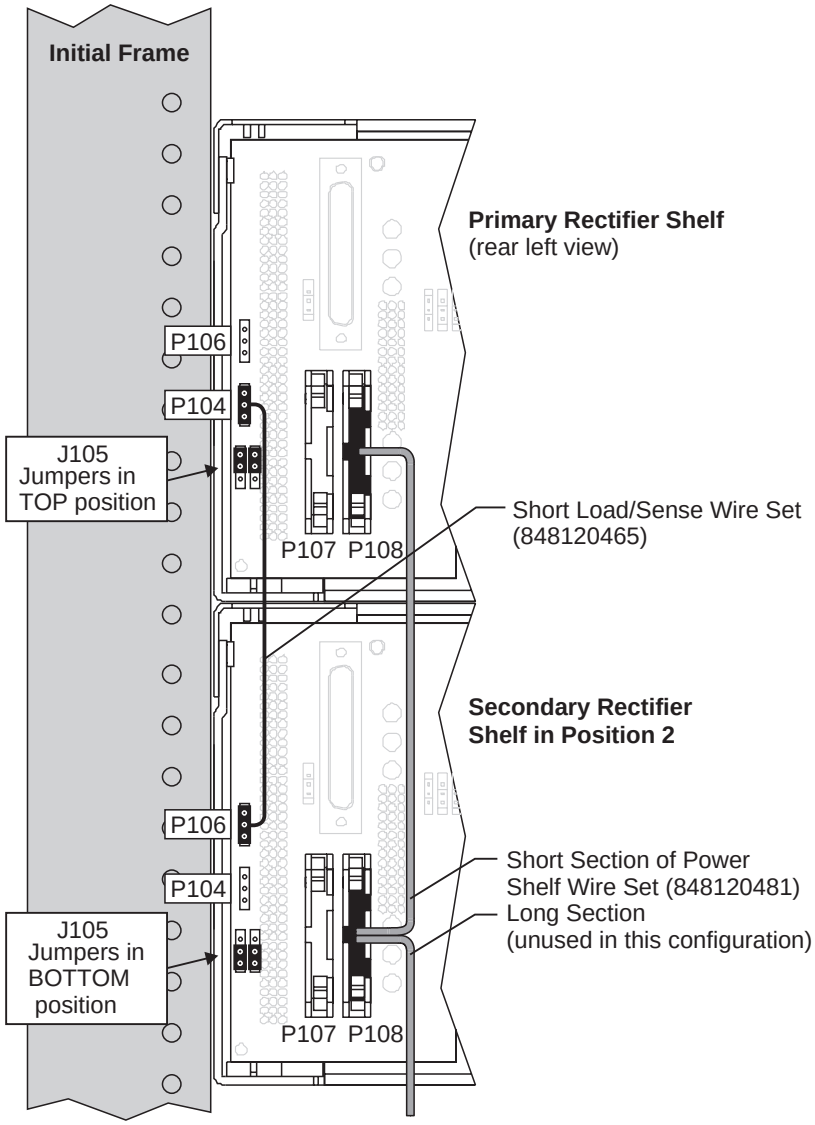


***Figure 5-10B: Backplane jumper settings, two rectifier shelves in positions 1 and 2***

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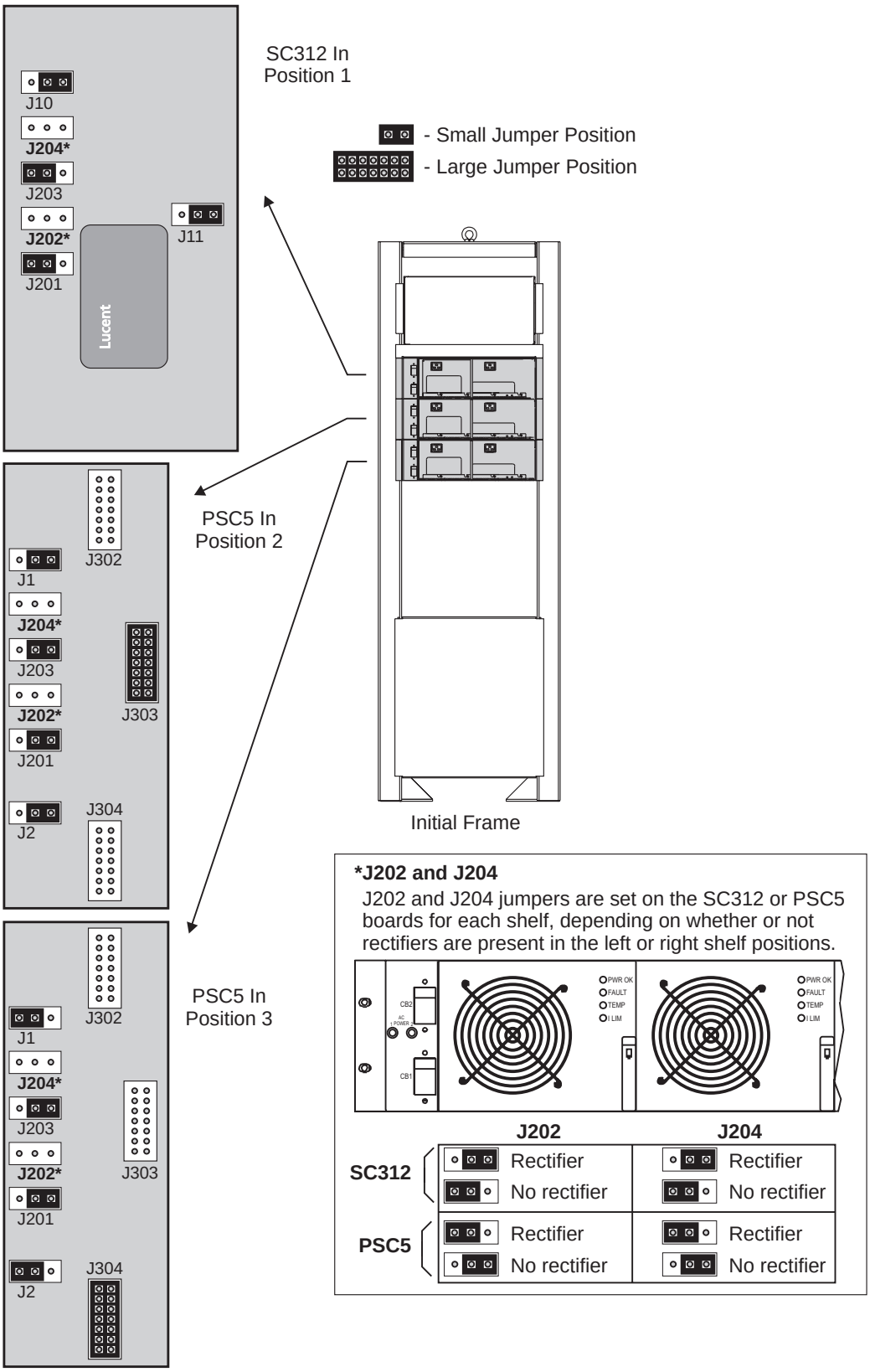



***Figure 5-11A: Control board jumper settings, three rectifier shelves in positions 1, 2 and 3***

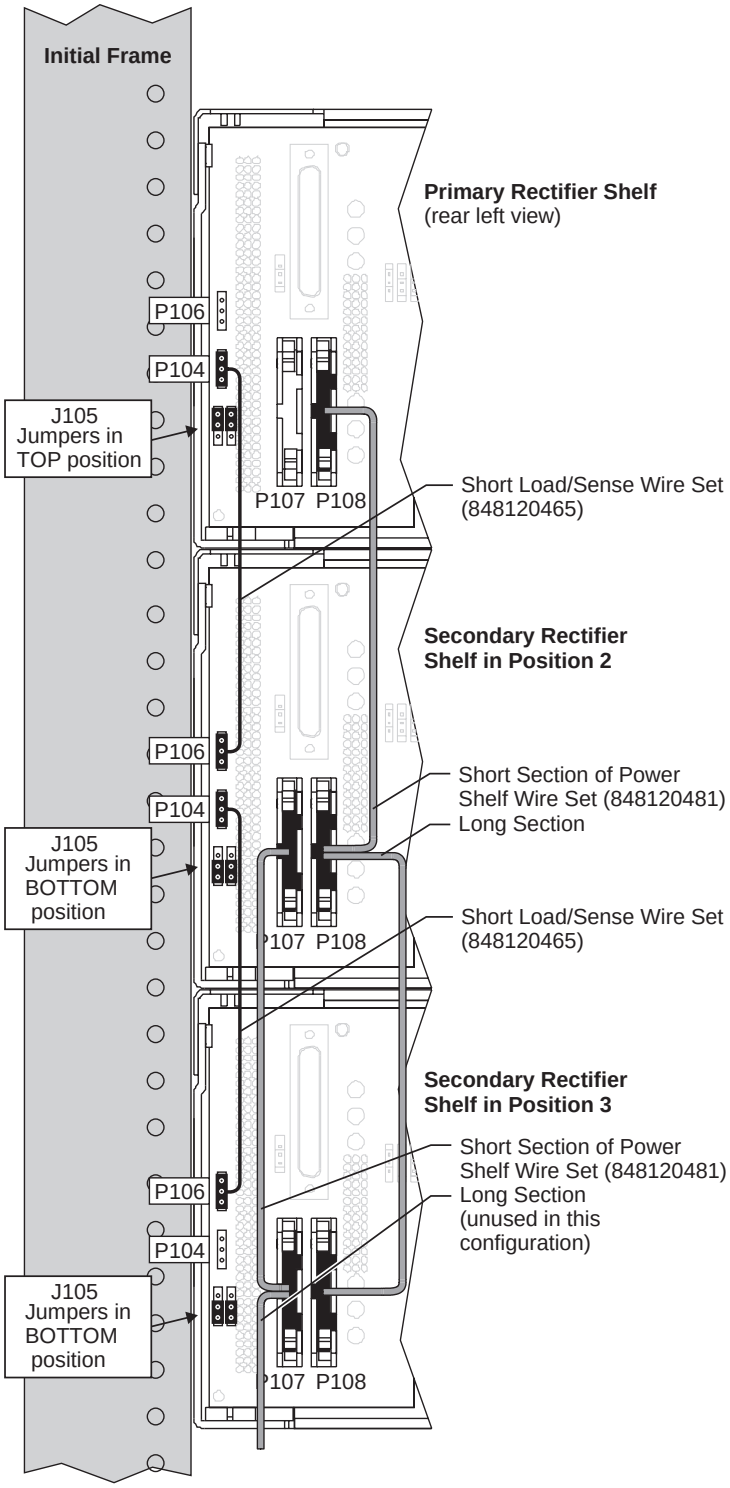
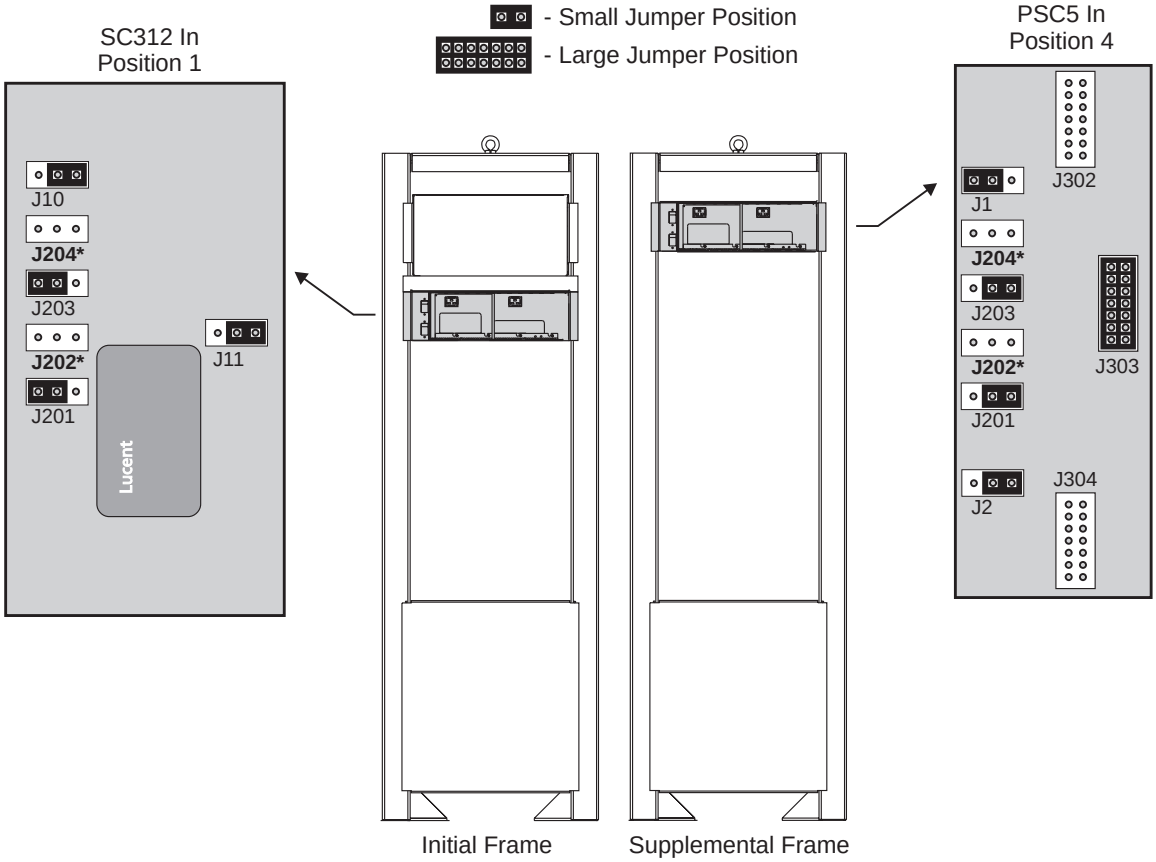
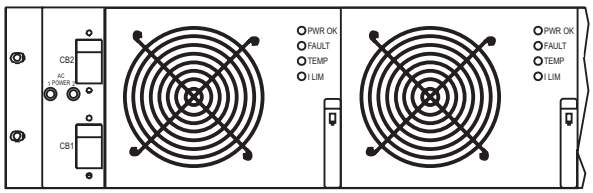



***Figure 5-11B: Backplane jumper settings, three rectifier shelves in positions 1, 2 and 3***




***J202 and J204**

J202 and J204 jumpers are set on the SC312 or PSC5 boards for each shelf, depending on whether or not rectifiers are present in the left or right shelf positions.




| | J202 | J204 |
|---|---|---|
| SC312 | Rectifier | Rectifier |
| | No rectifier | No rectifier |
| PSC5 | Rectifier | Rectifier |
| | No rectifier | No rectifier |

***Figure 5-12A: Control board jumper settings, two rectifier shelves in positions 1 and 4***

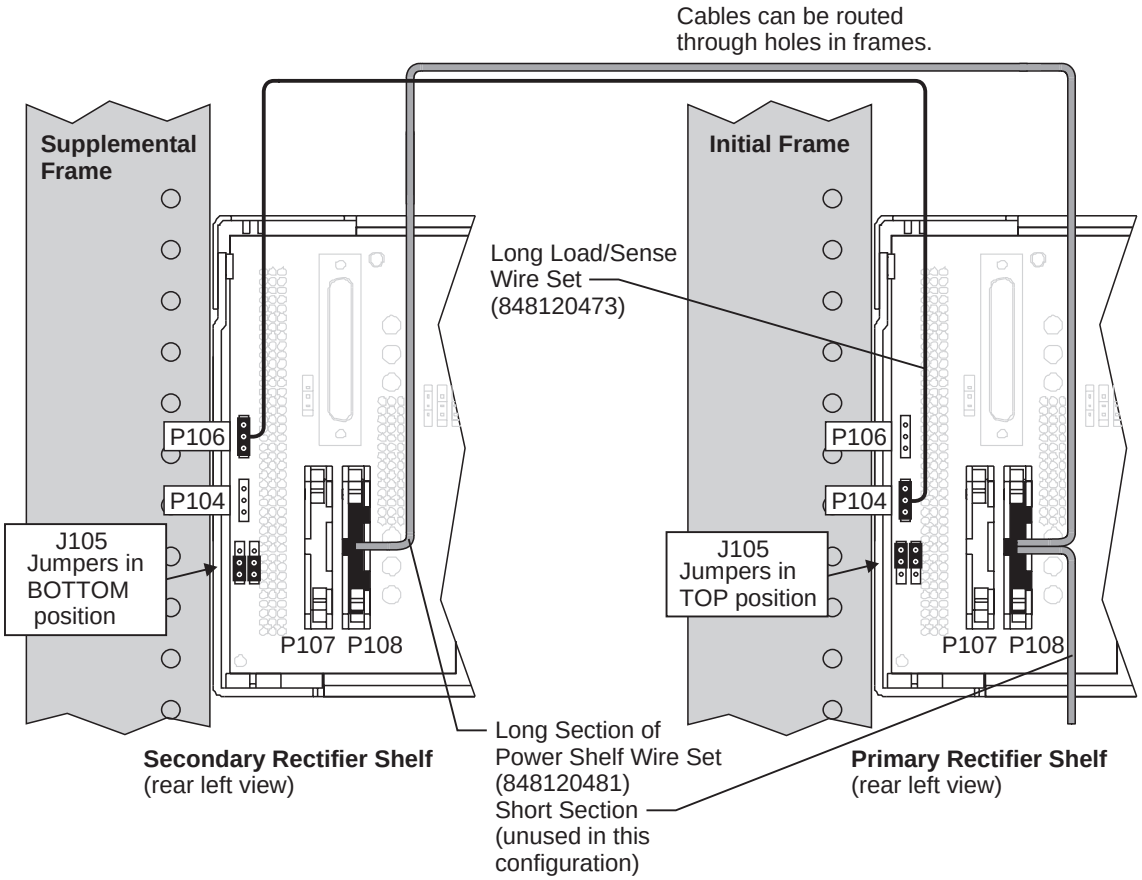
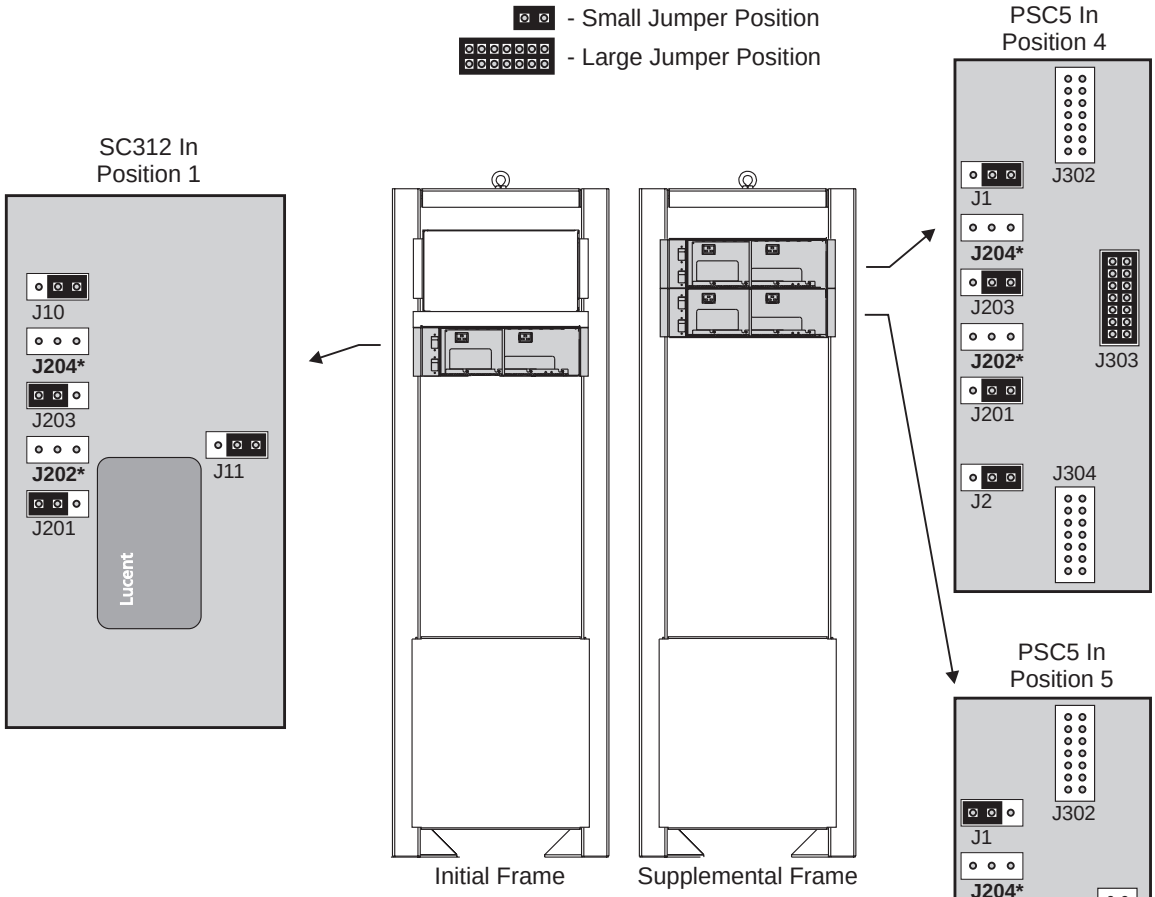
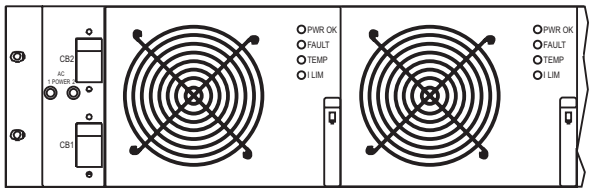



***Figure 5-12B: Backplane jumper settings, two rectifier shelves in positions 1 and 4***




***J202 and J204**

J202 and J204 jumpers are set on the SC312 or PSC5 boards for each shelf, depending on whether or not rectifiers are present in the left or right shelf positions.




| | J202 | J204 |
|---|---|---|
| **SC312** | Rectifier | Rectifier |
| | No rectifier | No rectifier |
| **PSC5** | Rectifier | Rectifier |
| | No rectifier | No rectifier |

***Figure 5-13A: Control board jumper settings, three rectifier shelves in positions 1, 4 and 5***

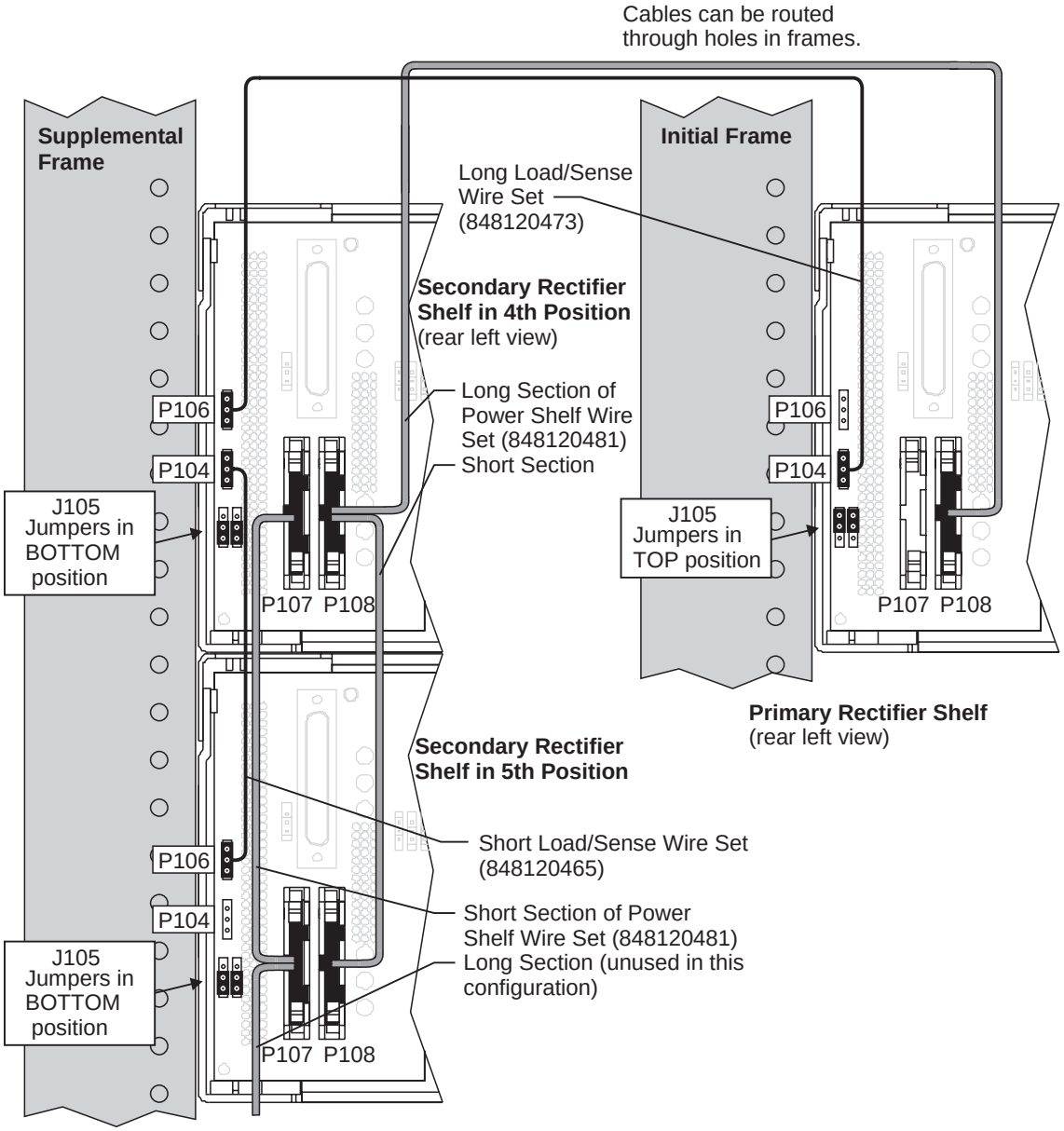



***Figure 5-13B: Backplane jumper settings, three rectifier shelves in positions 1, 4 and 5***

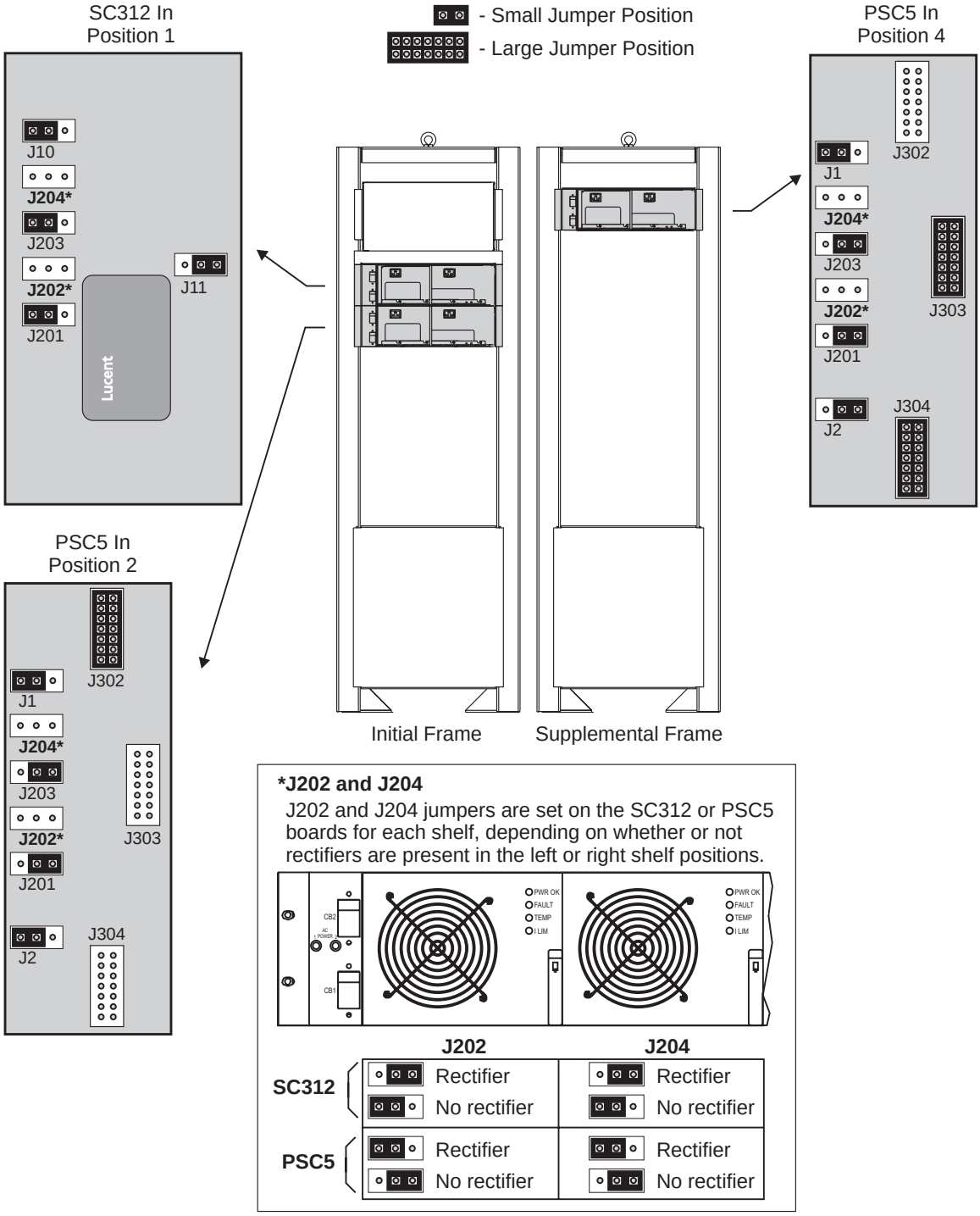



***Figure 5-14A: Control board jumper settings, three rectifier shelves in positions 1, 2 and 4***

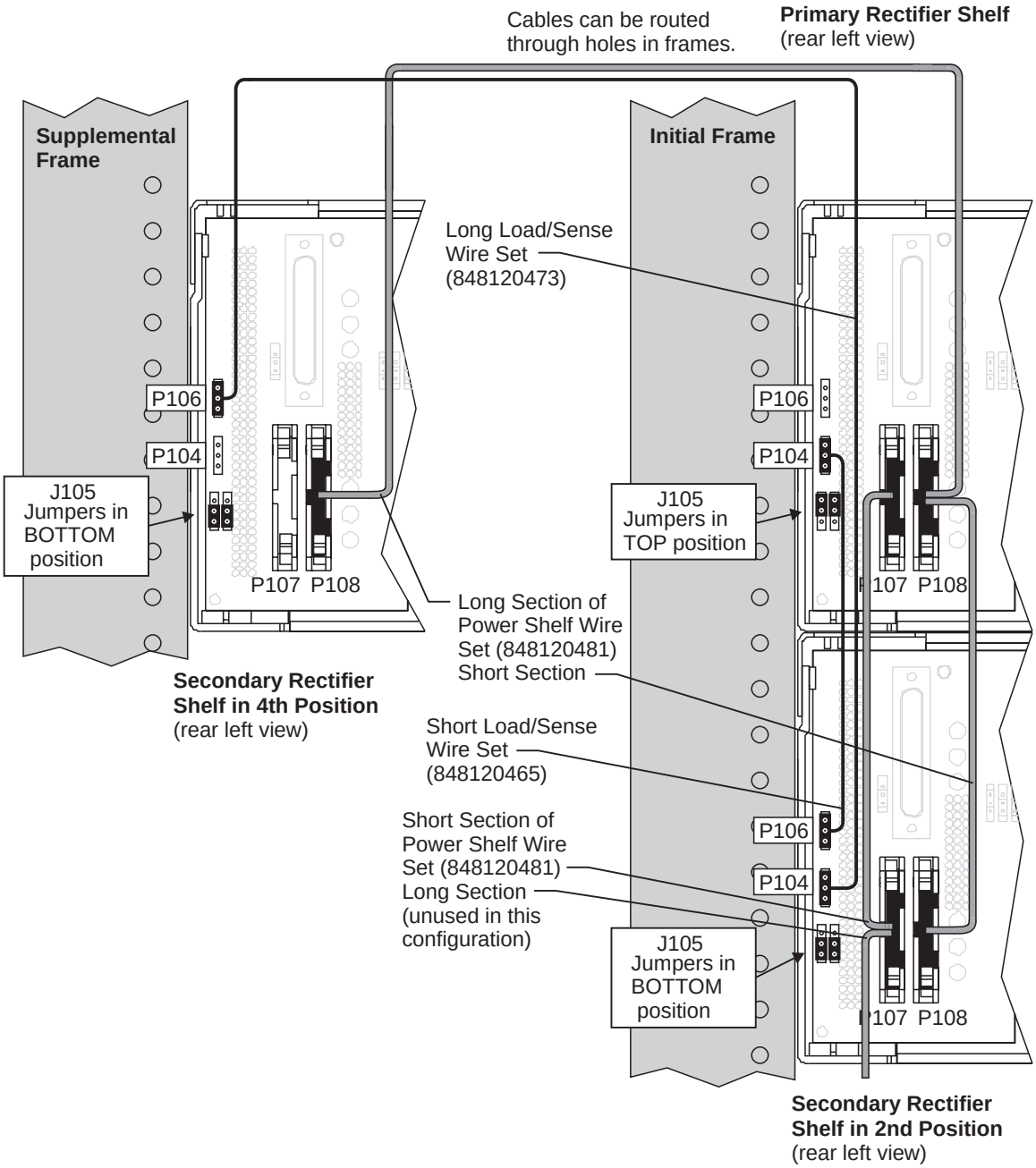



***Figure 5-14B: Backplane jumper settings, three rectifier shelves in positions 1, 2 and 4***

***Load Wiring*** Figure 5-5 shows both single and three-position circuit breaker and tooth assemblies and load connection points. Figure 5-15 shows circuit breaker configuration DIP switches on the Alarm Distribution Module. Switches 2 and 3, both six-position DIP switches, are associated with the plant circuit breakers installed

in the distribution assembly. Both the individual switches and the circuit breaker positions are numbered 1 through 12. For each position with an installed circuit breaker, turn the corresponding switch to the On position. For each vacant circuit breaker position, turn the switch to the Off position.

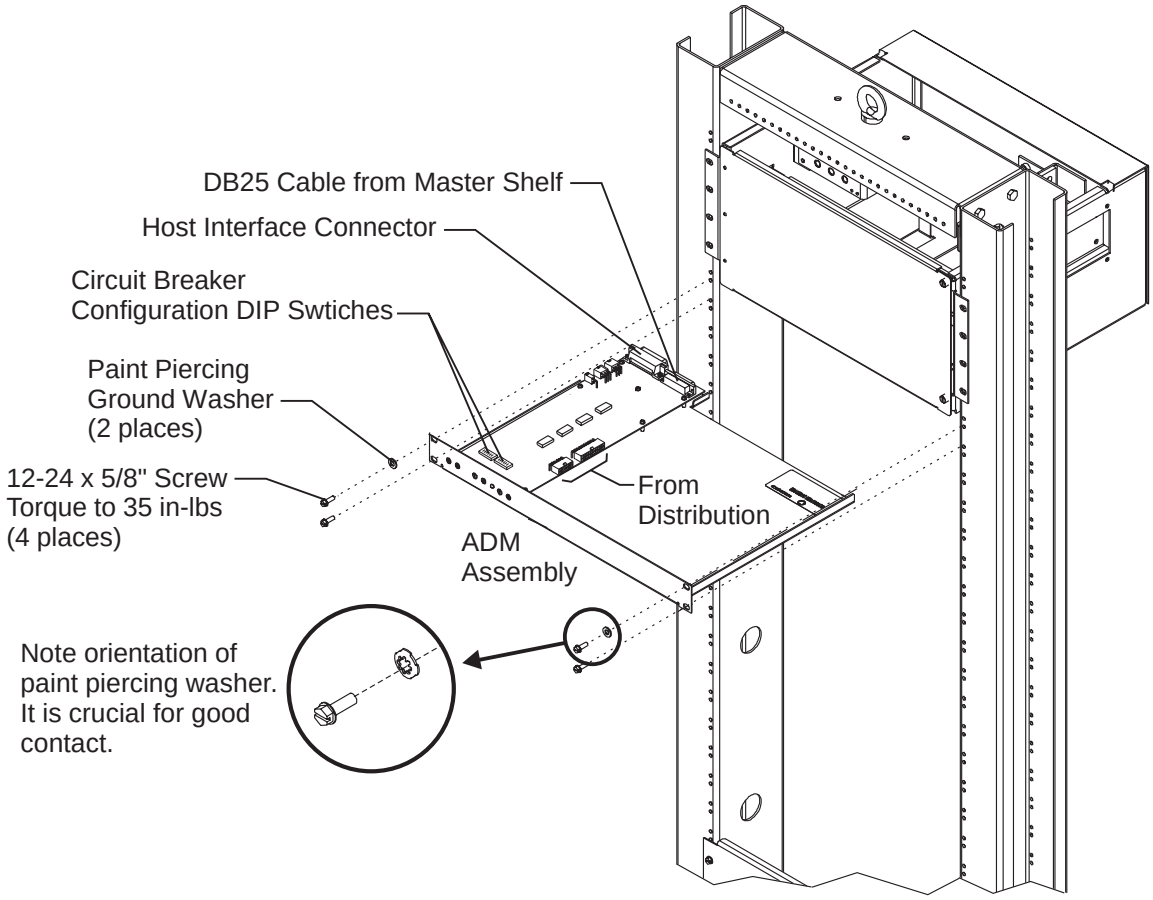



***Figure 5-15: Circuit board configuration DIP switches***

***Office Alarm Wiring***

Office alarms may be accessed on the host interface connector, located on the BYS2 circuit pack in the ADM. See Figure 5-15. These alarms are provided on Form-C, or transfer type contacts, allowing the alarms to be provided as normally open or normally closed sets of isolated contacts, rated at 60Vdc and 0.5A maximum. The three connections associated with each alarm are labeled NC, NO, and C. When an alarm occurs or power is removed from the Control Unit, a closure exists between the NC and C contacts and an open exists between the NO and C

contacts. See Table 5-A for numbers and descriptions of the signals on P4 of the ADM panel.

**Table 5-A: Host Interface Connector**

| P4 Pin No. | Signal Name | Return | Description |
|---|---|---|---|
| 1 | ALM1_NO | ALM_RTN | Alarm #1 ACF (AC Failure)<br>Normally open contact (open=alm) |
| 2 | ALM2_NO | ALM_RTN | Alarm #2 PMJ (Power Major)<br>Normally open contact (open=alm) |
| 3 | ALM3_NO | ALM_RTN | Alarm #3 PMN (Power Minor)<br>Normally open contact (open=alm) |
| 4 | ALM4_NO | ALM_RTN | Alarm #4 CB (Circuit Breaker Open)<br>Normally open contact (open=alm) |
| 5 | ALM5_NO | ALM_RTN | Alarm #5 OS (Open String -LVD-)<br>Normally open contact (open=alm) |
| 6 | ALM6_NO | ALM_RTN | Alarm #6 BD (Battery on Discharge)<br>Normally open contact (open=alm) |
| 7 | ALM7_NO | ALM_RTN | Alarm #7 RFA (Rectifier Failure)<br>Normally open contact (open=alm) |
| 8 | ALM8_NO | ALM_RTN | Alarm #8 AUX (host pass through alarm output)<br>Normally open contact (open=alm) |
| 9 | ALM_RTN | | Alarm return; isolated return for alarm signals |
| 10 | LOAD _S+ | LOAD_S- | Load shunt positive terminal (plant load current for remote monitoring)<br>Current limited to 100mA with a PTC resistor |
| 11 | LOAD _S- | LOAD_S+ | Load shunt negative terminal (plant load current for remote monitoring)<br>Current limited to 100mA with a PTC resistor |
| 12 | BATT_S- | BATT_S+ | Battery shunt negative (battery current for remote monitoring)<br>Current limited to 100mA with a PTC resistor |
| 13 | V-_OUT | V+_OUT | 48V 1.5A return output that can be used to power a remote monitoring unit |
| 14 | V+_OUT | V-_OUT | 48V 1.5A output that can be used to power a remote monitoring unit |
| 15 | ALM1_NC | ALM_RTN | Alarm #1 ACF (AC Failure)<br>Normally closed contact (closed=alm) |
| 16 | ALM2_NC | ALM_RTN | Alarm #2 PMJ (Power Major)<br>Normally closed contact (closed=alm) |
| 17 | ALM3_NC | ALM_RTN | Alarm #3 PMN (Power Minor)<br>Normally closed contact (closed=alm) |
| 18 | ALM4_NC | ALM_RTN | Alarm #4 CB (Circuit Breaker Open)<br>Normally closed contact (closed=alm) |

## Table 5-A: Host Interface Connector

| P4 Pin No. | Signal Name | Return | Description |
|---|---|---|---|
| 19 | ALM5_NC | ALM_RTN | Alarm #5 OS (Open String -LVD-)<br>Normally closed contact (closed=alm) |
| 20 | ALM6_NC | ALM_RTN | Alarm #6 BD (Battery on Discharge)<br>Normally closed contact (closed=alm) |
| 21 | ALM7_NC | ALM_RTN | Alarm #7 RFA (Rectifier Failure)<br>Normally closed contact (closed=alm) |
| 22 | ALM8_NC | ALM_RTN | Alarm #8 AUX (Host pass through alarm output)<br>Normally closed contact (closed=alm) |
| 23 | ALM_RTN | | AUX host pass through alarm return input |
| 24 | ALM8_NC | ALM_RTN | AUX host pass through ALM8_NC input |
| 25 | ALM8_NO | ALM_RTN | AUX host pass through ALM8_NO input |
| 26 | BATT_S+ | BATT_S- | Battery shunt positive terminal (battery current for remote monitoring; positive measurement=battery charge current)<br>Current limited to 100mA |
| 27 | V_SENSE- | V_SENSE+ | Negative bus voltage sense output for remote monitoring<br>Current limited to 100mA with a PTC resistor |
| 28 | V_SENSE+ | V_SENSE- | Positive bus voltage sense output for remote monitoring<br>Current limited to 100mA with a PTC resistor |
| 29-30 | Reserved | | Reserved |

A kit is available providing the connector and associated hardware to fabricate an office alarm cable.

**Caution**
Alarm contacts are not fused within the unit; current limiting protection for these contacts must be provided by external circuits. Exceeding these maximum ratings could result in fire or damage to the unit.

Wire to the office alarms as required.

## *Initial Start-up and Test*

Refer to Section 6, Alarms, Controls and Displays, and the glossary for a description of the parameters cited in this section.

1. Verify that all ac service circuit breakers are off or ac fuses are removed.

2. Verify that all output distribution circuit breakers are off .

3. Verify that the SC312 control unit and PSC5 slave aggregation module (if used) are seated firmly in the initial shelf (SC312) or secondary shelf (PSC5). Verify that these modules are configured properly.

4. Remove the distribution cover.

5. Verify that the batteries, if installed, are disconnected.

6. Verify that all ac power switches on the power shelves are in the Off position.

### *Power Units*

1. Turn the ac service circuit breakers on.

2. Seat each rectifier in the shelf and lock it into position with the front latch.

3. Turn the ac switches on the power shelves to the On position.

4. Verify that the green LED turns on and the fan operates on each rectifier.

5. Verify that the green Normal LED on the SC312 control unit lights and all alarm LEDs extinguish after all rectifiers are latched in place and all ac On switches are closed.

6. Using a digital voltmeter at the test points on the ADM, verify that the plant voltage is 54.0V.

7. Turn one ac input switch off. Verify that the PMN LED lights on the control unit. For systems with more than one rectifier installed, turn a second ac input switch Off. Verify that both PMN and PMJ LEDs light on the controller. Clear the alarms by turning the ac switches On.

***Circuit Breaker Test***

1. Install the plant circuit breakers in the distribution assembly.

2. Configure the DIP switches on the ADM for the installed load dc circuit breakers by selecting the On position for the numbered switch associated with each breaker position being used. Turn the switch to the Off position for each vacant breaker position.

3. Test by turning breakers off manually. Verify that the appropriate alarm LEDs light (CB and PMJ). Retire the alarms by turning the breakers back on.

***Thermal Management Test***

Test the thermal management probe (if ordered) using the following procedure:

1. Locate the exposed pins on the rear of a thermal probe and short them together. Verify that the **PMN** LED lights on the control unit if using a 210E module. Remove the short to clear the alarm.

2. Unplug the cable from the thermal probe. Verify that the **PMN** LED lights on the control unit if using a 210E module.

3. Repeat this procedure for each thermal probe installed.

***LED Test***

1. If installed, press the **LED Test** pushbutton on the SC312 control unit.

2. Verify that all LEDs on SC312, the ADM panel, and the 210E if installed are illuminated while the switch is depressed. LEDs on the rectifiers will not illuminate.

***LVD Test***

Simulate a failed low voltage disconnect contactor.

1. Remove one Quick-Connect® connector from the low voltage disconnect contactor coil.
2. Verify that the **PMJ** LED lights on the SC312.
3. Clear these alarms by replacing the Quick-Connect® connector.

## *Adding Rectifiers to a Working Plant*

Rectifiers and converters may be added with input power applied.

To install a rectifier in a working plant, do the following:

1. Verify that the ac switch on the power shelf is turned **Off**.
2. Place the module on the shelf and slide it toward the backplane until it contacts the backplane.
3. Close the latch on the front of the rectifier and verify that the rectifier is firmly seated in the shelf.
4. Turn the ac power switch on the power shelf **On**.

## *Installing an Additional Battery String in an Existing Battery Module*

To install an additional battery string in an existing -48-volt battery module or to add an additional battery string to a working -48-volt EPS plant, refer to the appropriate battery product manual.

For installation in new plants, follow the procedure in the section under “Battery Installation and Wiring.”

## *Installing Output Distribution Circuit Breakers in Working Plants*

To install circuit breakers needed for loads being added to the plant, **verify that each circuit breaker is off prior to installation**. Install the breakers and turn them on. Configure the CB Alarm DIP switches on the ADM board for each newly installed circuit breaker.

Figure 5-5 shows both single and three-position circuit breaker and tooth assemblies and load connection points. Figure 5-15 shows circuit breaker configuration DIP switches. Switches 2 and 3 on the Alarm Distribution Module, both six-position DIP switches, are associated with the plant circuit breakers installed in the distribution assembly. Both the individual switches and the circuit breaker positions are numbered 1 through 12. For each position with an installed circuit breaker, turn the corresponding switch to the On position. For each vacant circuit breaker position, turn the switch to the Off position.

# 6 Alarms, Controls, and Displays

## *Displays*

Figure 6-1 shows the displays of the PS3000A2910 Power Shelf, RM2000HA-200 Rectifiers, SC312 Controller, and Alarm Distribution Modules.

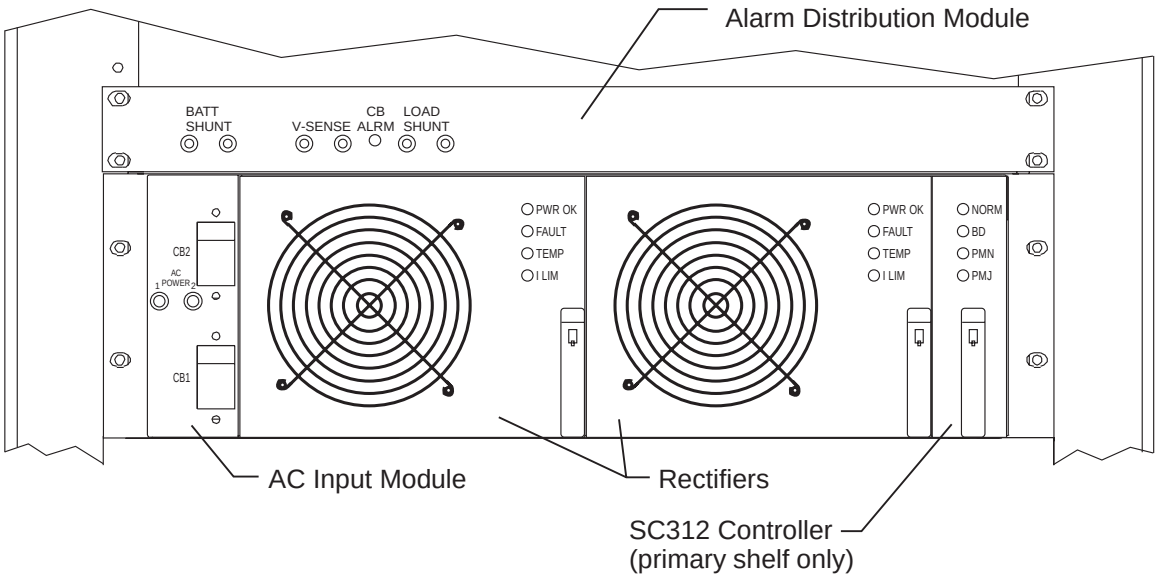



***Figure 6-1: Module Displays***

## *Alarm Processing*

The SC312 control unit administers alarm processing. One control unit supports a one-, two-, or three-shelf plant.

The control unit processes alarm conditions and presents them to the user as front panel LED indications and Form-C relay contact closures. The control unit sorts and groups alarm conditions occurring in the EPS plant into two categories based on their impact on plant functions: Power Major and Power Minor.

### *Power Major Alarms*

Conditions that impact service and require immediate attention are classified as major alarms and designated as Power Major (PMJ) alarms. Red LEDs signify major alarms.

### *Power Minor Alarms*

Conditions requiring service, but having no immediate impact on the plant output are classified as minor alarms and designated as Power Minor (PMN) alarms. Yellow LEDs signify minor alarms.

Where feasible, LEDs, indicators, and relay contact closures provide supplementary information to indicate which specific alarm condition resulted in the PMN or PMJ alarm.

## *Power Alarms*

The following table summarizes plant alarms and alarm indications (i.e., contact closures and/or LEDs).

**Table 6-A: Plant Alarms and Alarm Indications**

| Alarm Condition | Office Alarm (Contact Closure) | SC312 LED | Power Unit LED | AC Input LED | ADM LED |
|---|---|---|---|---|---|
| AC Fail (1) | PMN<br>ACF | PMN | -- | none | -- |
| AC Fail (more than 1) | PMJ<br>PMN<br>ACF | PMJ<br>PMN | -- | none | -- |
| Battery on Discharge | PMJ<br>BD | PMJ<br>BD | -- | -- | -- |
| Rectifier Failure Alarm (1) | PMN | PMN | Fault | green | -- |
| Rectifier Failure Alarm (more than 1) | PMJ<br>PMN | PMJ<br>PMN | Fault | green | |
| Circuit Breaker Open | PMJ<br>CB | PMJ | | -- | CB red |
| Open String | PMJ | PMJ | | -- | |

Table 6-B summarizes the SC312 features.

**Table 6-B: SC312 Controller and Alarm Distribution Module Features**

| Feature | SC312 | ADM |
|---|---|---|
| Plant voltage test point | | Yes |
| Battery voltage test point | | Yes |
| Load current test point | | Yes |
| Remote test (volts) | Yes | |
| Remote test (amperes) | Yes | |
| Temperature compensation | Yes | |
| PMJ LED | Yes | |
| PMN LED | Yes | |
| BD LED | Yes | |
| Plant normal LED | Yes | |

***Office Alarm Contacts***

A set of Form-C contacts is provided for each of the following plant alarms for the SC312:

- Power Major (PMJ)
- Power Minor (PMN)
- Battery-on-Discharge (BD)
- AC Fail (ACF)
- Rectifier Fail (RFA)
- Open Battery String (OS)
- Circuit Breaker Open (CB)

These are Form-C type contacts that allow an installer to connect the control unit to an office alarm system. Each set of isolated contacts consists of a combination of normally open (NO) and normally closed (NC) contacts with one side of each common (C). When the control unit has power and no alarm condition exists, all alarm relays are energized. When an alarm condition exists, the relay de-energizes and a closure exists between the NC and C poles and an open exists between the NO and C poles. If the control unit is powered down, the alarm relays are de-energized and all NC and NO closures are sent to the office alarm system. See Table 5-A for a summary of these contacts.

***SW1: BD Threshold and Battery Type***

Switch 1 on the SC312 control unit, a six-position DIP switch, allows selection of two variables: Battery On Discharge

threshold voltage and type of battery (Valve Regulated Lead Acid or Flooded). See Table 6-C.

**Table 6-C: SC312 SW1 Options**

| Switch | BD = 51V | BD = 50V | BD = 48V | VRLA Batteries | Flooded batteries* |
|---|---|---|---|---|---|
| 1 | off | off | on | | |
| 2 | off | on | on | | |
| 3 | on | on | on | | |
| 4 | Switches 4 and 5 reserved for future use | | | | |
| 5 | | | | | |
| 6 | | | | on | off |
| 7 | | | | on | off |
| 8 | | | | on | off |

*Reserved for future use. EPS 4802A Battery Plant has not been qualified with flooded batteries.

***Alarm Distribution Module Switches***

Switches 2 and 3 on the Alarm Distribution Module, both six-position DIP switches, are associated with the plant circuit breakers installed in the distribution assembly. Both the individual switches and the circuit breaker positions are numbered 1 through 12. For each position with an installed circuit breaker, turn the corresponding switch to the On position. For each vacant circuit breaker position, turn the switch to the Off position.

***Low Voltage Disconnect***

The low-voltage disconnect contactor threshold is preset at 42V±3%. Once a low voltage disconnect has occurred, the LVD contactor remains open until the bus voltage is greater than 51V±1%.

***Rectifier Alarms***

Whenever the control unit receives a single rectifier alarm, it issues a Power Minor (PMN) alarm. A yellow LED lights on the control unit face plate. If the controller receives two or more rectifier alarms, it will issue both a PMN and a Power Major (PMJ) alarm. Both the yellow PMN LED and the red PMJ LED on the SC312 faceplate will light.

Since a loss of a single rectifier may not necessarily affect the plant voltage, this condition is treated as a minor alarm. However, if two or more rectifiers have failed or are in standby (even if they are not required to power the load), the SC312 issues a PMJ.

***AC Fail Alarm***

The AC Fail Alarm indicates that ac input power to at least one rectifier is missing or has dropped below the minimum ac

voltage for the operating range being used. This alarm results in an isolated transfer contact for the office alarm system. The SC312 issues PMN and ACF alarms for a single ac failure. The yellow PMN LED lights.

***Two AC Fail Alarm***

If ac input power is missing from more than one rectifier, the SC312 issues ACF, PMJ, and PMN office alarms. The PMJ and PMN LEDs light on the SC312.

***Controller Fuse Alarm***

Issues a Power Minor Alarm (PMN).

***Circuit Breaker Alarm***

Issues a Power MajorAlarm (PMJ). The CB LED lights on the ADM, and the PMJ LED lights on the SC312.

***Front Panel Test Jacks***

Test points are provided on the front panel so that the plant and battery voltages and plant current may be checked with an external meter. The test points are current-limited to protect against accidental short-circuits.

***Lamp Test Button***

A push button on the controller faceplate tests the controller's status LEDs. Pressing the button lights all LEDs on the SC312, ADM and 210E if installed. Rectifier LEDs will not illuminate.

***Remote Monitoring Feature***

Remote monitoring functions are provided with the Sparton™ unit, ordered separately.

# *7 Maintenance*

## *General*

This section provides field maintenance information and procedures for the power units. Before performing the maintenance procedures, review the safety information in Section 4.

**WARNING:**
**All procedures described in this section are to be performed by qualified maintenance personnel only.**

## *Power Units*

The power units are repaired by replacement. Contact your Lucent representative for more details.

## *LED Test*

Use the following test to determine if all front panel LEDs are working properly.

1. Press the LED Test button on the SC312 control unit face plate. All front panel LEDs should illuminate. The LEDs on the rectifiers will not be illuminated.

## *Replacing a Contactor*

If it is not possible to disconnect battery input before changing the contactor, follow this procedure:

**WARNING:**
**Busbars are still connected to hazardous energy levels. Follow all safety procedures while working on energized equipment.**

**Caution:**
**If the contactor is open prior to replacement, measure the battery string voltage and the plant bus voltage. If the two voltages differ by more than 5V, disconnect the blue battery connector before starting this procedure. Reconnect after completing the procedure. The cable assembly is not needed if the contactor is open. Steps 1 and 4 below are needed only if the contactor is closed when replaced.**

1. A cable assembly as shown in Figure 7-1 is recommended for this procedure. Remove the two fastening bolts from the busbars and place cable assembly across contactor as shown. Note orientation of lugs and cable.

2. Remove the securing hardware for the contactor. Note that there are four bolts on one end and three on the other. Do not lose this hardware, which will be required to secure the replacement contactor.

3. Replace the old contactor with the new one and fasten with the original hardware.

4. Remove cable and refasten cable bolts.

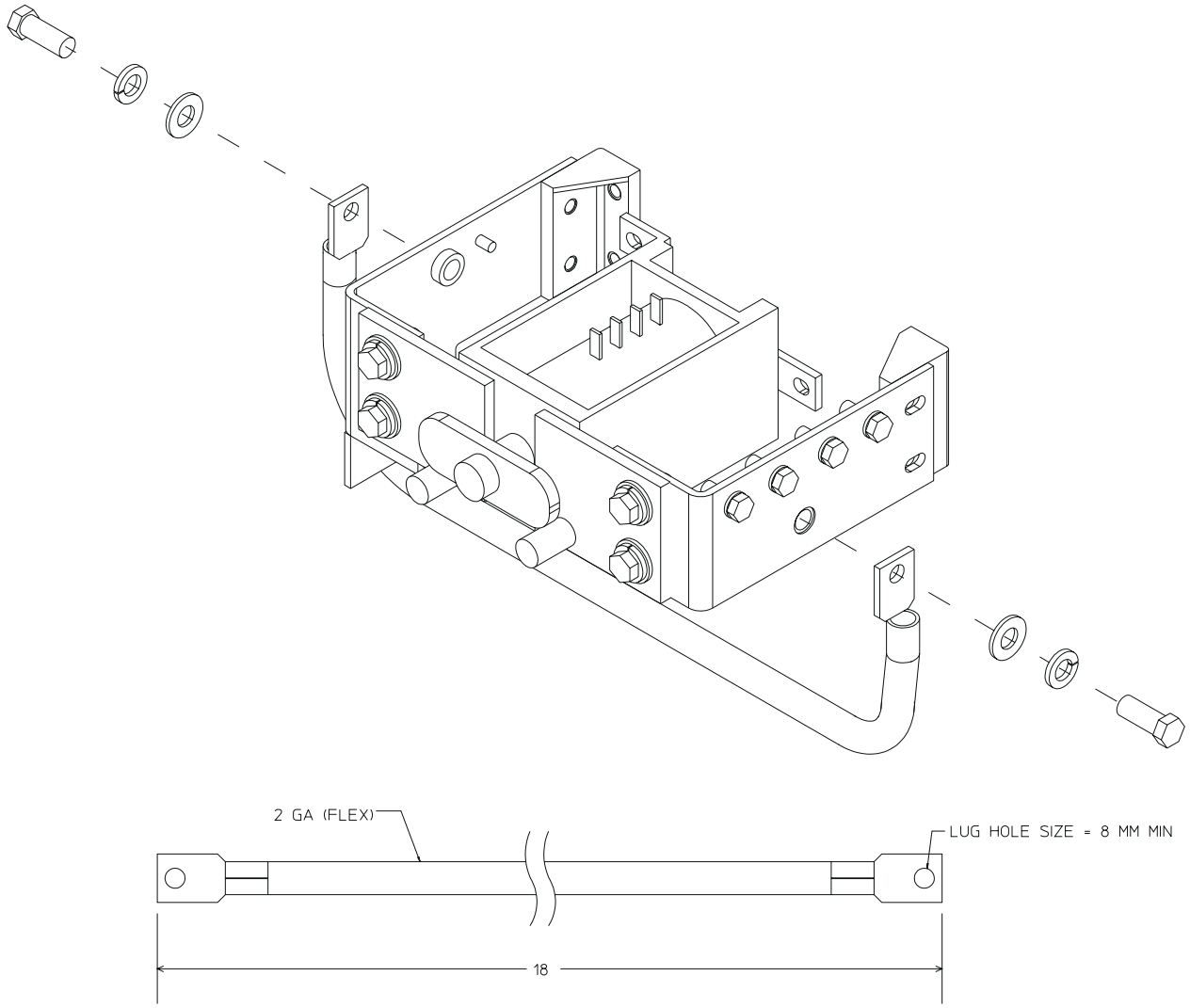



***Figure 7-1: Replacing a contactor***

# *8 Product Warranty*

A. Seller warrants to Customer only, that:

1. As of the date title to Products passes, Seller will have the right to sell, transfer, and assign such Products and the title conveyed by Seller shall be good;
2. Upon shipment, Seller's Manufactured Products will be free from defects in material and workmanship, and will conform to Seller's specifications or any other agreed-upon specification referenced in the order for such Product;
3. With respect to Vendor items, Seller, to the extent permitted, does hereby assign to Customer the warranties given to Seller by its vendor of such Vendor Items, such assignment to be effective upon Customer's acceptance of such Vendor Items. With respect to Vendor items recommended by Seller in its specifications for which the vendor's warranty cannot be assigned to Customer, or if assigned, less than Sixty (60) days remain of the vendor's warranty or warranty period when the Vendor's items are shipped to Customer or when Seller submits its notice of completion of installation if installed by Seller, Seller warrants that such Vendor's Items will be free from defects in material and workmanship on the date of shipment to Customer. In such an event, the applicable Warranty Period will be sixty (60) days.

B. The Warranty Period listed below is applicable to Seller's Manufactured Products furnished pursuant to this Agreement, unless otherwise stated:

## WARRANTY PERIOD

| Product Type | New Product | Repaired Product or Part |
|---|---|---|
| Central Office Power Equipment | 24 Months | 6 Months |

*The Warranty Period for a repaired Product or part thereof is as listed or, in the case of Products under Warranty, is the period listed or the unexpired term of the new Product Warranty Period, whichever is longer.

**The Warranty Period for Products ordered for Use in Systems or equipment Manufactured by and furnished by Seller is that of the initial Systems or equipment.

C. If, under normal and proper use during the applicable Warranty Period, a defect or nonconformity is identified in a Product and Customer notifies Seller in writing of such defect or nonconformity promptly after Customer discovers such defect or nonconformity, and follows Seller's instructions regarding return of defective or nonconforming Products, Seller shall, at its option attempt first to repair or replace such Product without charge at its facility or, if not feasible, provide a refund or credit based on the original purchase price and installation charges if installed by Seller. Where Seller has elected to repair a Seller's Manufactured Product (other than Cable and Wire Products) which has been installed by Seller and Seller ascertains that the Product is not readily returnable for repair, Seller will repair the Product at Customer's site.

   With respect to Cable and Wire Products manufactured by Seller which Seller elects to repair but which are not readily returnable for repair, whether or not installed by Seller, Seller at its option, may repair the cable and Wire Products at Customer's site.

D. If Seller has elected to repair or replace a defective Product, Customer shall have the option of removing and reinstalling or having Seller remove and reinstall the defective or nonconforming Product. The cost of the removal and the reinstallation shall be borne by Customer. With respect to Cable and Wire Products, Customer has the further responsibility, at its expense, to make the Cable and Wire Products accessible for repair or replacement and to restore

the site. Products returned for repair or replacement will be accepted by Seller only in accordance with its instructions and procedures for such returns. The transportation expense associated with returning such Product to Seller shall be borne by Customer. Seller shall pay the cost of transportation of the repair or replacing Product to the destination designated by Customer within the Territory.

E. The defective or nonconforming Products or parts which are replaced shall become Seller's property.

F. If Seller determines that a Product for which warranty service is claimed is not defective or nonconforming, Customer shall pay Seller all costs of handling, inspecting, testing, and transportation and, if applicable, traveling and related expenses.

G. Seller makes no warranty with respect to defective conditions or nonconformities resulting from actions of anyone other than Seller or its subcontractors, caused by any of the following: modifications, misuse, neglect, accident, or abuse; improper wiring, repairing, splicing, alteration, installation, storage, or maintenance; use in a manner not in accordance with Seller's or vendor's specifications or operating instructions, or failure of Customer to apply previously applicable Seller modifications and corrections. In addition, Seller makes no warranty with respect to Products which have had their serial numbers or month and year of manufacture removed, altered, or with respect to expendable items, including, without limitation, fuses, light bulbs, motor brushes, and the like.

THE FOREGOING WARRANTIES ARE EXCLUSIVE AND ARE IN LIEU OF ALL OTHER EXPRESS AND IMPLIED WARRANTIES, INCLUDING BUT NOT LIMITED TO WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE. CUSTOMER'S SOLE AND EXCLUSIVE REMEDY SHALL BE SELLER'S OBLIGATION TO REPAIR, REPLACE, CREDIT, OR REFUND AS SET FORTH ABOVE IN THIS WARRANTY.

# *Appendix A Glossary*

***ACU*** Alarm Control Unit, SC312, provides plant monitoring, controls, and office alarm outputs for the -48V EPS plant.

***Alarm Return (AR)*** A signal path between the Control Unit and the Battery Modules that provides a common return path for alarm signals.

***Ampere Hour (AH)*** Ampere hour is a rating for batteries that specifies duration of a discharge for a given load. It is a convention for expressing "drain (or load) current" multiplied by time (usually at 8 hours).

***Average Busy-Hour Current Drain*** The average busy-hour current drain during busy season with the plant operating at the normal voltage.

***Batt Major Alarm*** A signal to the Control Unit indicating that a battery temperature is above 65°C.

***Batt Minor Alarm*** A signal to the Control Unit indicating that a temperature probe cable is installed, but the probe is missing, a temperature probe has failed, or the LVD circuit has failed but the LVD contactor remains closed.

***BD*** Battery on Discharge occurs when the rectifier plant voltage is below a preset threshold. Typically, the ac service voltage to the

plant is low or missing and the load is being powered by the batteries. This condition results in a BD alarm.

***EPS*** Economical Power Solution

***ESD*** Electrostatic discharge

***Fault Alarm*** A signal to the SC312 indicating low rectifier output voltage resulting from a rectifier failure or excess load.

***LED*** Light emitting diode

***LVD*** Low voltage disconnect; preset voltage threshold at which the load is disconnected from the battery voltage in EPS Plants to protect both the batteries and the using equipment.

***NEC*** National Electric Code

***Norm*** This green LED lights while there are no alarms and the plant is operating normally and is able to furnish power to the load.

***Office Alarms*** The office alarm and control signals listed below are available.

- Power Major (PMJ): The controller generates a PMJ alarm in response to these alarm conditions:

  more than one Rectifier Failure (Fault) alarm
  more than one AC Failure (ACF) alarm
  Battery on Discharge (BD)
  Open String (OS), LVD contactor open
  Circuit Breaker (CB) tripped
  Battery temperature

- Power Minor (PMN): The controller generates a PMN alarm in response to these alarm conditions:

  one Rectifier Failure (Fault) alarm
  one AC FAIL (ACF) alarm

controller fuse failure
battery temperature alarm (53°C)
missing Slave Aggregation Module
battery thermal probe failure
missing rectifier in any shelf

- CB: Circuit Breaker Open alarm is generated whenever a load circuit breaker in the dc distribution trips. This is a Power Major (PMJ) alarm.

- BD: Battery on Discharge alarm is generated when batteries, rather than rectifiers, supply power to the load in the event of ac failure. This is a Power Major (PMJ) alarm.

- OS: Open String alarm is generated when the battery is disconnected from the output bus, as when the LVD contactor opens. This is a Power Major (PMJ) alarm.

- ACF: AC Failure alarm is generated when the ac input to at least one rectifier is missing or below the minimum ac input voltage. This is a Power Minor (PMN) alarm if only one rectifier is affected, a Power Major (PMJ) alarm if two or more rectifiers are affected.

- RFA (Rectifier Failure alarm is generated when a Fault signal is received from any rectifier in the system. This is a Power Minor (PMN) alarm if only one rectifier is affected, a Power Major (PMJ) alarm if two or more rectifiers are affected.

***Power Major Alarm (PMJ)***

Power Major Alarm: Conditions that impact service and require immediate attention are classified as major alarms and designated as Power Major (PMJ) alarms. (Red LEDs signify major alarms.)

This red LED lights to signify one or more of the following conditions:

- Two or more rectifiers fail

- The LVD fails (contactor open)

- Excessive battery temperature

- Output distribution circuit breaker or fuse has operated
- Battery module fuse has operated

***Power Minor Alarm (PMN)*** Power Minor Alarm: Conditions requiring service, but having no immediate impact on the plant output are classified as minor alarms and designated as Power Minor (PMN) alarms. (Yellow LEDs signify minor alarms.)

A yellow LED lights to signify one or more of the following conditions:

- one rectifier failure
- a temperature probe failure
- an LVD circuit failure (LVD open)
- one ac failure (ACF) alarm

***RTAC*** Regional Technical Assistance Center (1-800-CAL-RTAC)

***SC312*** Monitor and Control Unit

***Signal Interface*** A signal path interface between the Control Unit and the Office Alarm Interface which provides customer access to the office alarm and control.

***SAM*** Slave Aggregation Module, PSC5, used in supplemental shelves.

# *Appendix B German Language Notes*

**Installationsanleitung**

| | |
|---|---|
| Eingangsspannung ( Voltage ): | 200-240V |
| Eingangsstrom ( Current ): | 11.5A/rectifier |
| Eingangsleistung ( Watts ): | 10,000 (maximum) |
| Nennfrequenz ( Frequency ): | 50-60Hz |

Modellnummer (Modell No. ): EPS 4802A

Abmessungen sind nur zur Referenz: 483mm × 683mm
( Dimensions are for reference only)

Max. Umgebungstemperatur: 50°C
( Max. Operation temperatur)

**Achtung:** Für kontinuierlichen Feuerschutz sollte die Sicherung nur mit einer des gleichen Types ersetzt werden.
Sicherungswert:
(Warning: For continued protection against fire replace with same type and rating of fuse )

Das Schaltnetzteil ist ein Gerät der Schutzklasse **I**
(Power Supply is a Class I equipment)

Ausgangsspannungen und -stöme: 40-60V, 200A (maximum)
(Output Voltage and Current)

--Das Gerät darf nur in Räumen mit beschränktem Zutritt aufgestellt werden. (Nur ausgebildetes Personal)
(Restricted access)

--Das Gerät hat kein Brandschutzgehäuse. Es darf daher nur auf nicht brennbaren Untergrund aufgestellt werden. (Beton, Metall usw.)
(No fire enclosure, non-combustible floor)

-- Das Gerät wird fest am Boden installiert (siehe weitere Anleitung)
(Must be bolted to the floor)

--Beim Aufstellen des Gerätes ist darauf zu achten, daß alle Anforderungen gemäß EN60950 eingehalten werden.
(Evaluated to EN60950)