Product Manual

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Galaxy Power System 4824 (GPS 4824)

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.

Table of Contents

1 Introduction

2 Product Description

3 Ordering Information

4 Safety

5 Installation

6 Spare Parts

7 Specifications

8 Product Warranty

List of Figures

List of Tables

1 Introduction

General

The Galaxy Power System, model 4824, was developed by Lucent Technologies to support -48 volt telecommunication powering solutions in worldwide markets. GPS 4824 combines 100 ampere natural convection-cooled switch mode rectifiers, microprocessor control technologies, battery disconnect/ reconnect options and a comprehensive line of fuse and circuit breaker dc distribution options in a modular front-access design. This modularity ensures easy access, simple installation, and fast maintenance and allows the system to expand in capacity, hardware and software features incrementally as power needs grow.

The main emphasis of this manual is to provide a general product description that will familiarize the user with the main components of the system and provide an understanding of the installation, operation and maintenance of the Galaxy Power System.

Architecture

The system operates from commercial power in either 200-240 Vac, three phase (DELTA) applications or 350-415 Vac three-phase, four wire (WYE) applications over a frequency range of 47-63 hertz. It is designed for modular growth from a small 200 ampere capacity to a large 2400 ampere capacity using the same system components for all system sizes. The GPS 4824 is designed for a distributed architecture (see Figure 1-1), which means that each system cabinet contains rectifiers, dc distribution, and battery connections. Power is delivered from he rectifiers or batteries to load circuits terminated in the cabinet.

Thus, the load is distributed across the power systems' cabinets. In this distributed architecture design, the initial cabinet shown in Figure 1-2, is comprised of an AC circuit breaker box, two rectifiers, the controller, DC distribution panels and battery connection module. For larger systems, additional cabinets accommodate up to three rectifiers as shown in Figure 1-3. Each cabinet contains connecting bus bars, allowing current to be shared with an adjacent cabinet and insuring a common voltage reference for the rectifiers.One of the major advantages of the distributed architecture is that it enables gradual, cost-effective system growth. As the application requires increased capacity, the system can be grown by adding another system cabinet. Each cabinet has its own battery shunt. The system load current is the difference between the sum of all rectifier currents and the sum of all battery section currents. There is no system shunt, and therefore, there is no need to anticipate your maximum growth needs at the time of initial installation and invest in a system shunt and external bus that may or may not ever be fully utilized. It does, however, require a designated floor area be reserved for growth.

The GPS 4824 may also be configured in a centralized architecture as shown in Figure 1-4. Rectifiers, batteries, and distribution are cabled to external bus bar connected to a single system shunt. Each cabinet contains rectifiers and/or distribution. Distribution returns are terminated at the external discharge return bus. The J85500A-2 battery plant is an example of this architecture. This architecture requires a significant amount of engineering and capacity planning, but growth is not constrained to designated floor space.

Applications

With 2400 ampere capacity, distribution flexibility and universal ac input capability, the GPS 4824 supports switching, transmission, and wireless -48 volt power system applications ranging from central office to the environmentally controlled remote site (hut and vault).

Technical Support

Technical support for Lucent Technologies equipment is available to customers around the world.

USA, Canada, Puerto Rico, and the US Virgin Islands

On a post-sale basis, **during the Product Warranty period,** our Technical Support telephone number 1-800-CAL RTAC (1-800-225-7822) provides coverage during normal business hours. Product Specialists are available to answer your technical questions and assist in troubleshooting problems. For out-of-hours EMERGENCIES, the 800 number will put you in touch with a Regional Technical Assistance Center Engineer via our 24 hour a day, 7 day per week Help Desk.

When Technical Support is required in **the Post-Warranty Period**, the service may be billable unless you hold an extended warranty or contractual agreement.

Central and South America

If you need product technical support, contact your local Field Support/Regional Technical Assistance Center or contact your sales representative who will be happy to discuss your specific needs.

Europe, Middle East, and Africa

If you need product technical support, contact your local Field Support/Regional Technical Assistance Center or contact your sales representative who will be happy to discuss your specific needs.

Asia Pacific Region

If you need product technical support, contact your local Field Support/Regional Technical Assistance Center or contact your sales representative who will be happy to discuss your specific needs.

Product Repair and Return

Repair and return service for Lucent Technologies equipment is available to customers around the world.

USA, Canada, Puerto Rico, and the US Virgin Islands

For information on returning of products for repair, customers may call 1-800-255-1402 for assistance.

Central and South America

If you need to return a product for repair, your sales representative will be happy to discuss your individual situation.

Europe, Middle East, and Africa

If you need to return a product for repair, your sales representative will be happy to discuss your individual situation.

Asia Pacific Region

If you need to return a product for repair, your sales representative will be happy to discuss your individual situation.

Customer Service

For customer service, any other product or service information, or for additional copies of this manual or other Lucent Technologies documents, call 1-800-THE-1PWR (1-800-843-1797). Specify the select code number for manuals, or drawing number for drawings. Contact your regional customer service organization or sales representative for information regarding spare parts.

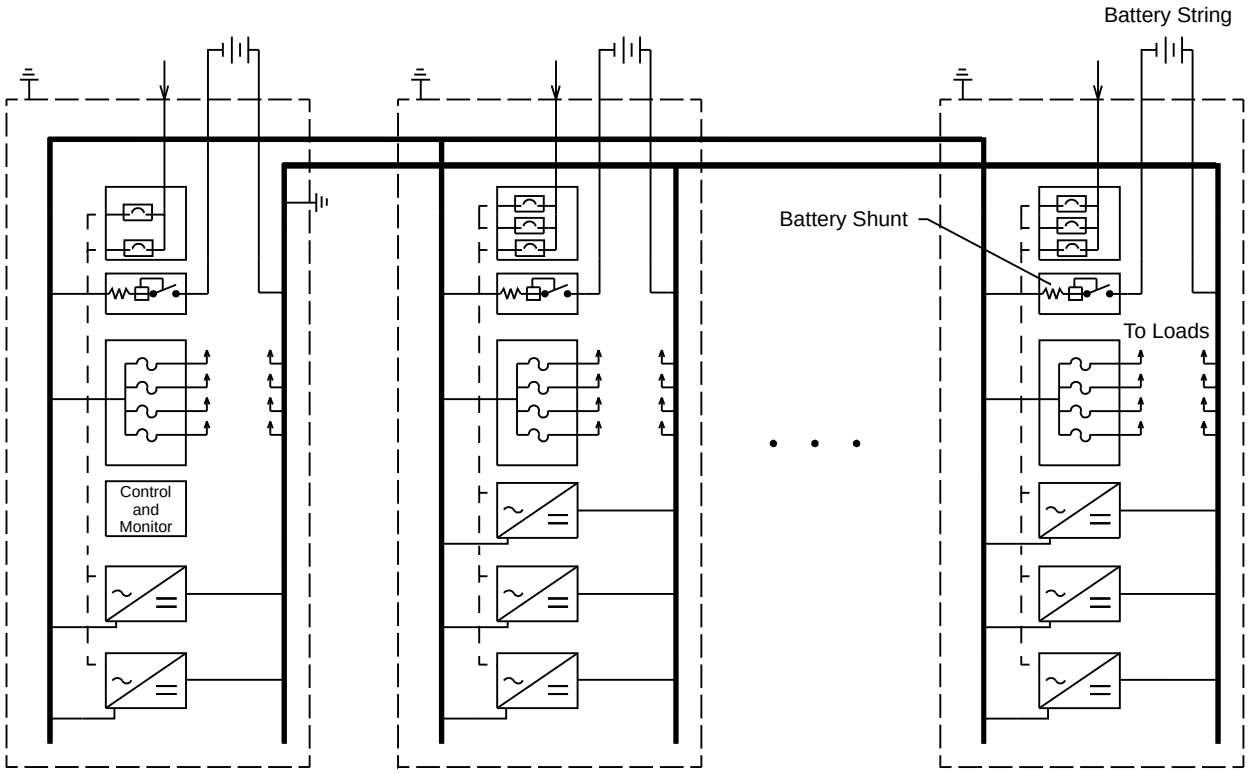


Figure 1-1: Distributed Architecture

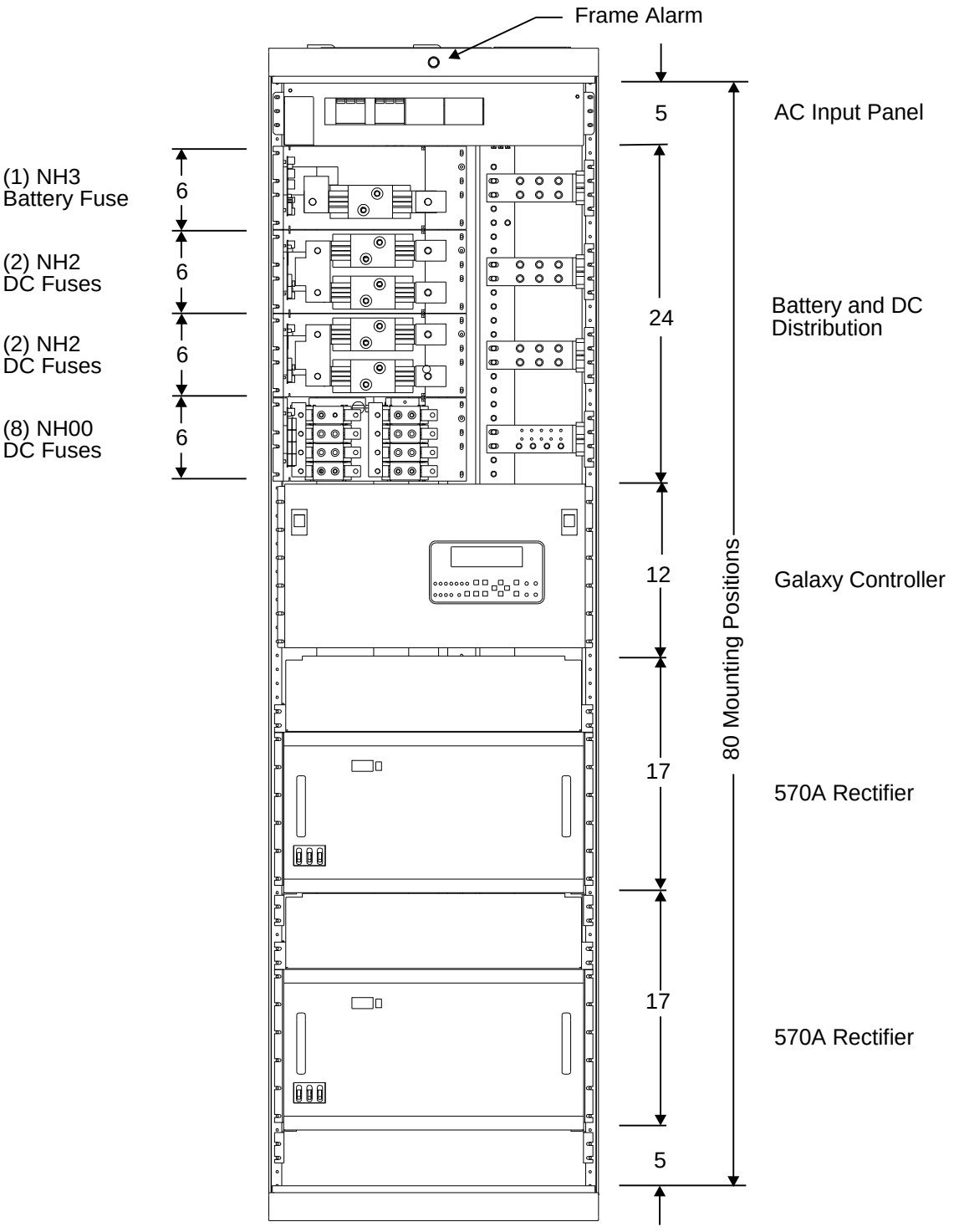


Figure 1-2: GPS 4824 Initial Cabinet

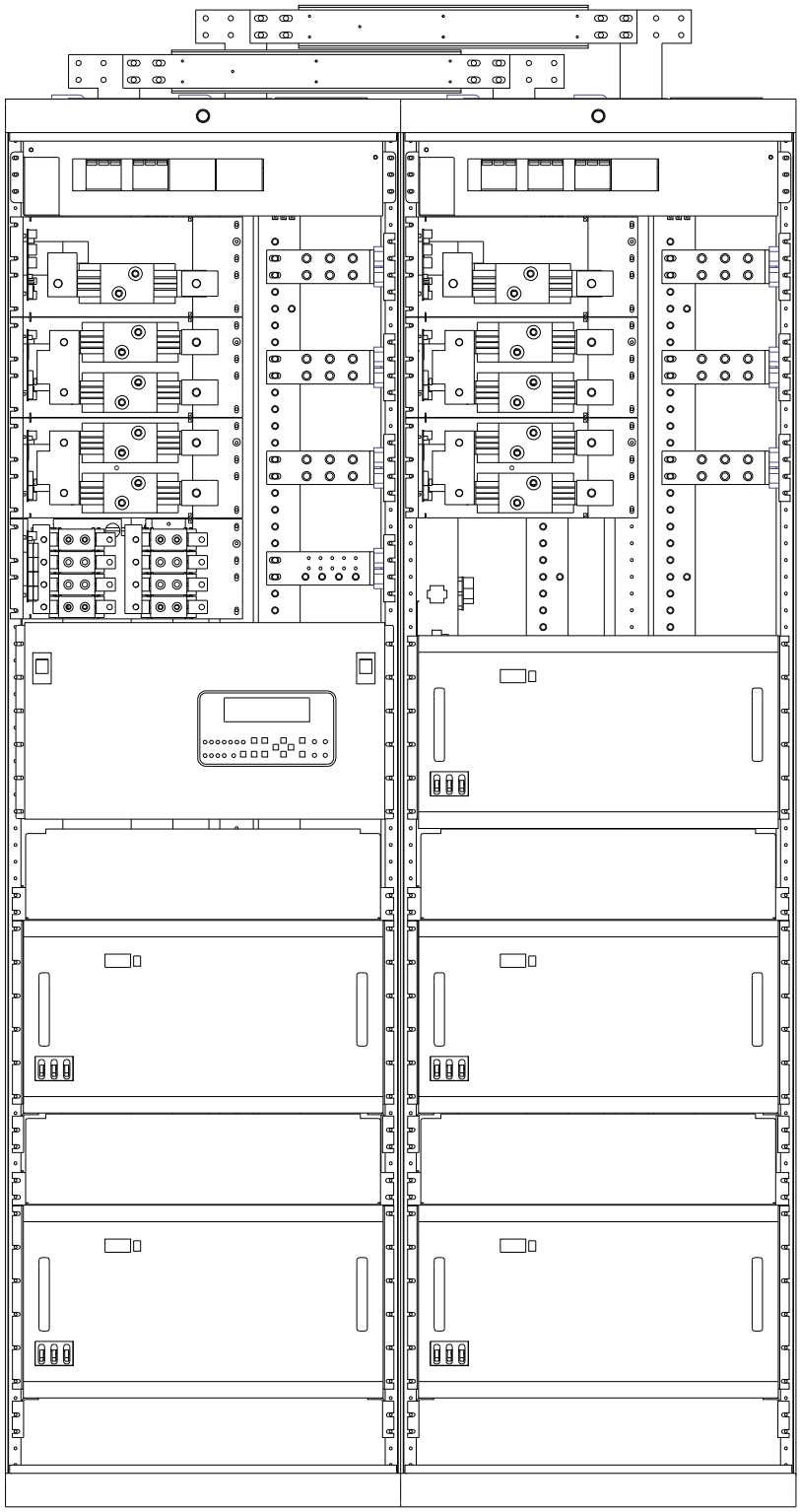


Figure 1-3: Growth of GPS 4824

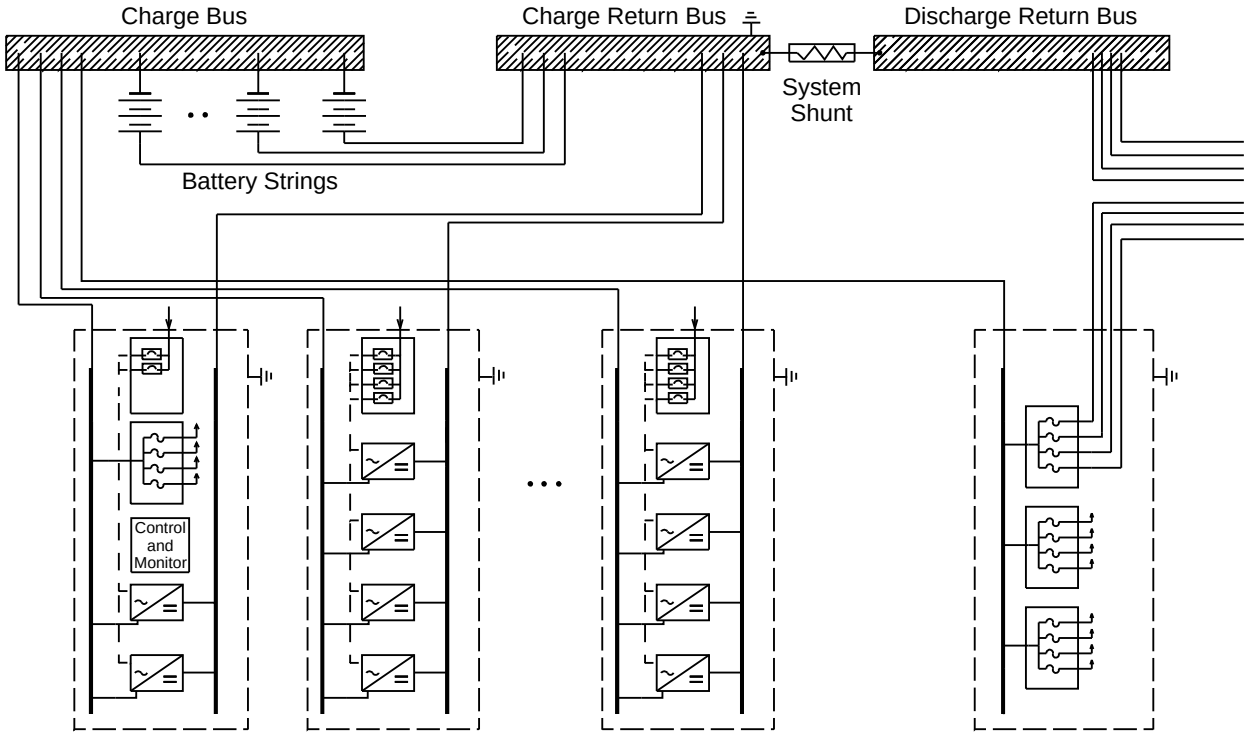


Figure 1-4: Centralized Architecture

2 Product Description

System Overview

A basic block diagram of the Galaxy Power System is shown in Figure 2-1. It illustrates the arrangement and interconnections of the system components from the ac input to the dc output. The power system accepts alternating current from the commercial utility or a standby ac power source and rectifies it to produce dc power for the using equipment. The system's control and alarm functions interact with the rectifiers and the office. In addition, the system provides overcurrent protection, charge, discharge, and distribution facilities. Battery reserve automatically provides a source of dc power if the commercial or standby ac fails. Battery reserve can be engineered to supply dc power for a specific period of time. In normal practice, battery capacity is sized to provide 3 to 8 hours of reserve time.

AC Input: connects the commercial and/or standby ac power sources to the rectifiers within the system and provides overcurrent protection.

Rectifiers: convert an ac source voltage into the dc voltage level required to charge and float the batteries and to power the using equipment.

Controller: provides the local and remote control, monitor and diagnostic functions required to administer the power system.

Batteries: provide energy storage for an uninterrupted power feed to the using equipment during loss of ac input or rectifier failure.

DC Distribution: provides overcurrent protection, connection points for the using equipment, and bus bars used to interconnect the rectifiers, batteries, and dc distribution.

Battery Connection Module: provides connection points for the battery strings through battery disconnect fuses or contactors and current monitoring shunts.

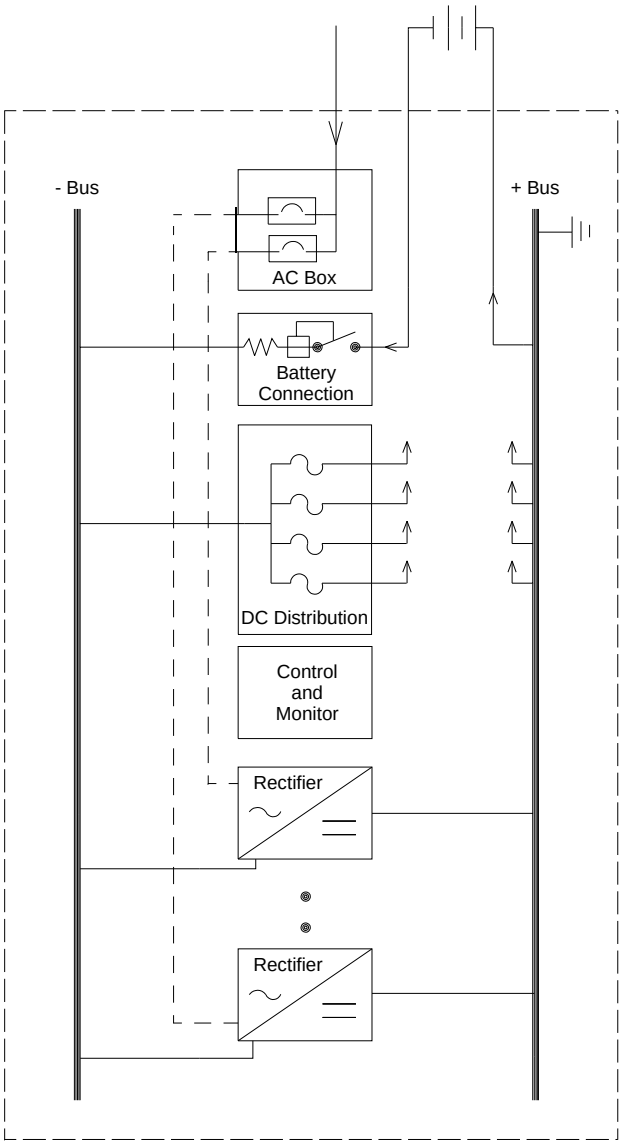


Figure 2-1: Block Diagram of the Power System

Cabinets and Component Options

Figure 2-2 shows an isometric view of the initial cabinet. System components of the GPS 4824 are mounted in a standard equipment cabinet. The cabinet requires front access only for installation and maintenance and allows installation against walls, back-to-back or in line-ups with other cabinets. The cabinet's specifications are summarized as follows:

Height:	2275 mm (Including cover panel for intercabinet bus bar)
Width:	600 mm
Depth:	600 mm
Mounting Positions:	80 (25.4 mm each)

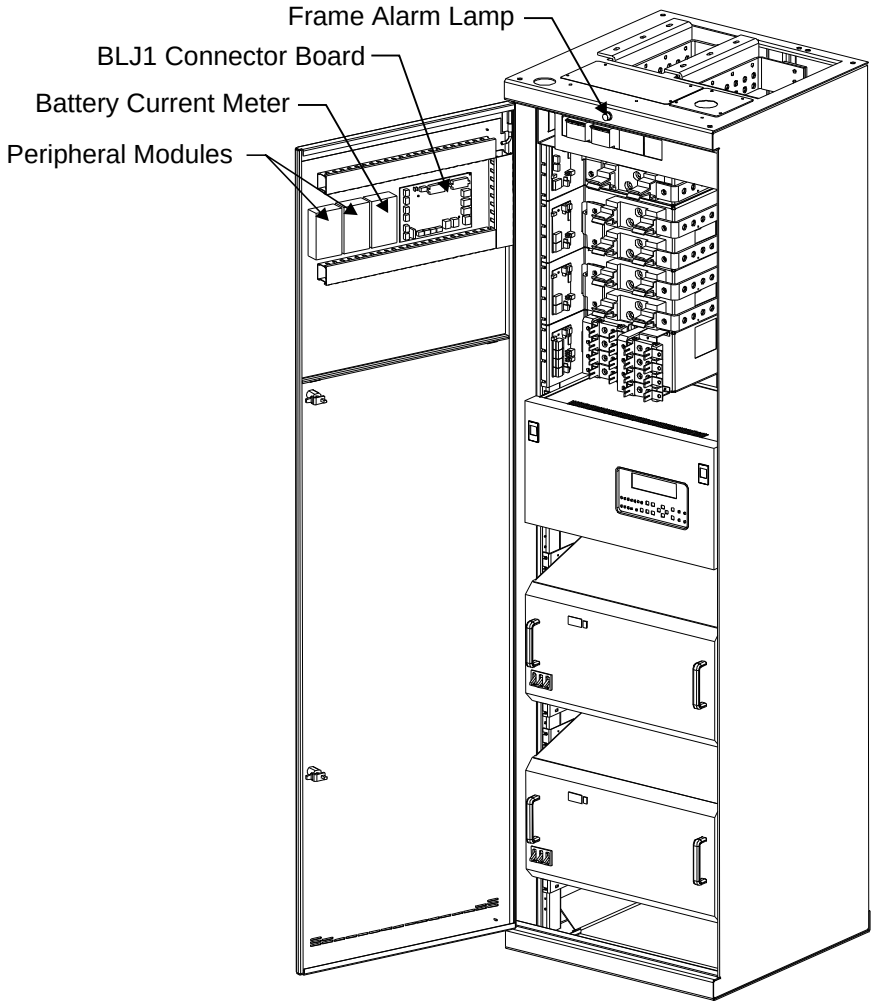


Figure 2-2: Isometric View of Initial Cabinet

The Galaxy Power System consists of an initial cabinet and up to eight supplementary cabinets. Each cabinet has 80 mounting positions as shown in Figures 1-1 and 1-2. Five positions must be left open at the bottom of the cabinet for anchoring the cabinet to the floor and five positions are reserved at the top of the bay for ac input panel (Figure 2-4) and system bus bars. There are 24 positions available for the battery connection module and the dc distribution panels in the initial cabinet and 21 positions are available in the supplemental cabinet. The three additional inches are required for access to the dc, ac and control cables of the third rectifier. The following are the component options for each cabinet:

Initial Cabinet

Qty	Component	No. of Positions Required
1-2	570A Rectifiers	17
1	Galaxy Controller	12
0-1	Battery Connection Module	6 or 9
1-4	DC Distribution Modules	6, 9, or 12
1	AC Input Panel	5

Supplemental Cabinet

Qty	Component	No. of Positions Required
1-3	Rectifiers	17 (12 for 3rd)
0-1	Battery Connection Module	6 or 9
1-3	DC Distribution Modules	6, 9, or 12
1	AC Input Panel	5

All bus bars in the system are copper with a solder plate finish and sized to support 800 ampere capacity per cabinet. Two bus bars are mounted vertically along the back of the cabinet. The negative charge bus is on the left side and the positive return bus is on the right side. Rectifiers are cabled directly to these two buses from the dc output connector on the top of each rectifier. The battery connection module and the dc distribution panels connect to these buses as well. The buses of adjoining cabinets are linked together with intercabinet bus bars to allow current to be shared with adjacent cabinets.

Each cabinet is equipped with a BLJ1 connector board mounted on the cabinet door (see Figure 2-2). The purpose of the connector board is to provide a single point of connection for alarms in the cabinet. The connector boards in each cabinet are interconnected back to the controller to communicate fuse and circuit breaker alarms, open battery string alarms, ac alarms, and to connect the rectifier serial communications cable.

There is a red alarm lamp (see Figure 2-2) at the top of each cabinet. This lamp is also connected to the BLJ1 and lights when a rectifier fails, a dc circuit breaker trips or fuse operates, an ac breaker trips, or an open battery string alarm exists in the cabinet.

Next to the BLJ1 connector board is space for an optional 211C voltage peripheral module to monitor the status of each battery fuse and the battery string voltage, a 211F current module to monitor load shunts or battery shunts, and a digital meter panel to indicate the current of one or two battery strings in a cabinet. See Figure 2-2 for module location.

Galaxy Front Access Controller

The Galaxy controller provides GPS 4824 with a wide range of control and monitoring features. The controller is equipped with a **Basic** control circuit that provides basic operations and an optional **Intelligent** control circuit to provide advanced local and remote monitoring and data acquisition features. These control circuits monitor each others status and issue appropriate alarms in the event a failure occurs.

The control panel has an 8 line by 40 character LCD display, 12 LED status indicators, test jacks for system output voltage and output current and keys for viewing various menus to configure and monitor the power system. A Microsoft Windows™ based configuration program, called EasyView, is included with the Intelligent controller to make configuration of advanced functions very user friendly by using a point and click interface. The controller menus and EasyView are available in both English and Spanish.

The Galaxy controller can monitor and control up to 24 rectifiers via an isolated digital RS-485 serial control interface. Using peripheral modules, the Galaxy controller can monitor up to 1530 points via a digital serial Local Area Network (LAN). These modules measure DC current shunts, temperatures, relay binary signals, voltage, and operate control relays.

The Galaxy front-access controller has two shelves (see Figure 2-3). The lower shelf contains plug-in circuit packs . Circuit packs on the right perform the basic functions, circuit packs on the left provide the Intelligent functions. The second shelf contains the user interface termination points. This pack has the alarm and status terminal blocks, phone lines, serial rectifiers interface, peripheral monitoring buses, modem RS-232 communication port, TL1 interface, and data switch connections. The top cover of the controller is removable to access these connections. The RS-485 serial rectifier interface and alarms from the BLJ1 connector board are connected to this board via a cable assembly.

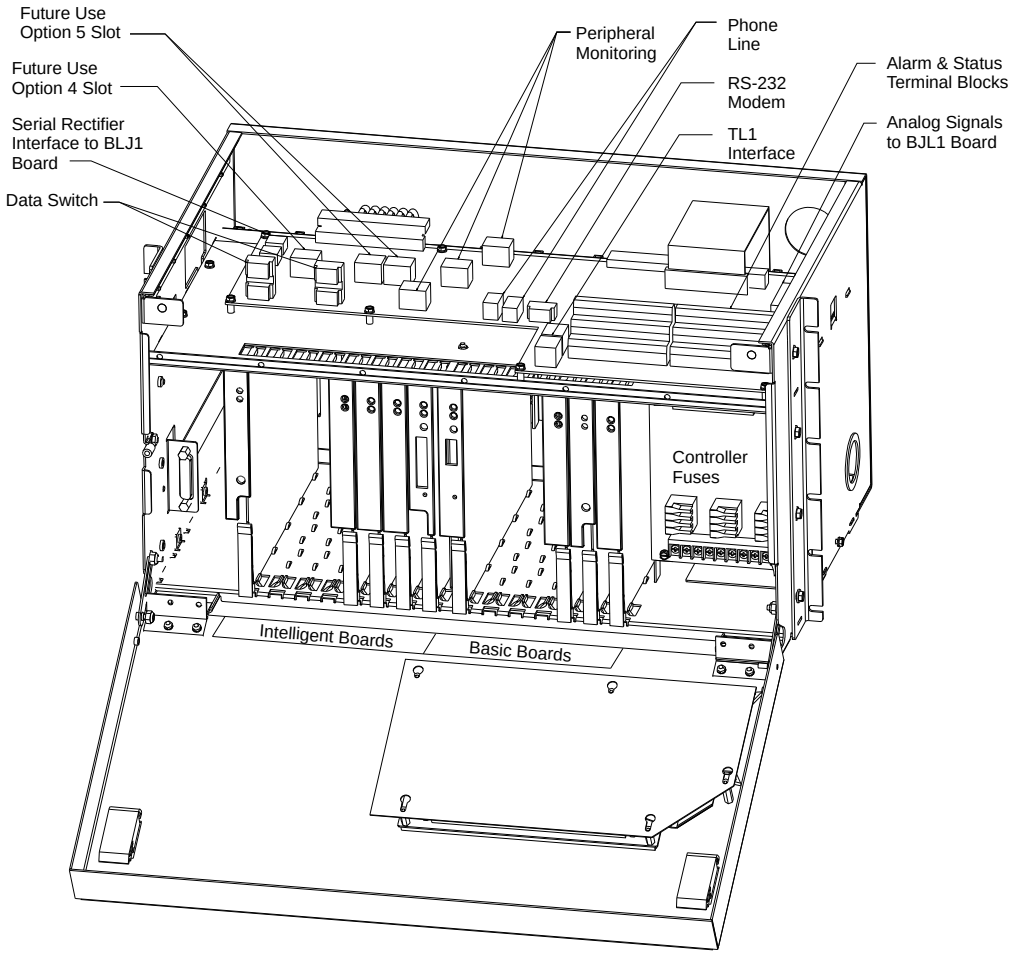


Figure 2-3: Galaxy Front Access Controller

The Galaxy Front Access Controller manual (167-792-110) is furnished with every GPS 4824. Refer to this manual for information regarding configuration and operation. Refer to the Galaxy Peripheral Monitor manual (167-790-063) for additional information regarding module operation.

570A Rectifier

The basic building block of the GPS 4824 is the natural convection-cooled, 100 ampere switch-mode rectifier, model 570A. This rectifies commercial 50 or 60 hertz, 3-phase ac power into highly regulated and filtered -48 volt dc output power for telecommunications equipment loads. Table 7-1 lists the specifications of the 570A rectifier.

The 570A rectifier is designed specifically for applications where natural cooling, high efficiency, light weight, and ease of installation are important. The rectifiers use a 70-kilohertz switching frequency to achieve a significant reduction in size and weight over ferroresonant rectifiers. The rectifiers are naturally cooled and maintain safe operating temperatures in a range form 0° C to 40° C. Air baffles mounted between the rectifiers create a cooling convection air flow.

A power factor correction circuit incorporated in the design ensures a power factor of 98 percent or greater for loads above 50 percent of the full load rating. The 570A rectifier is **CE** marked and **UL recognized** and complies with UL1950 (Information Technology Equipment) and EN60950 requirements.

The rectifiers are shipped separately from the cabinets for quick and straightforward installation on site. Interconnections to ac input, dc output, and control signals are via cable connections that plug into the rectifier where shown in Figure 2-4. The cables are shipped within the cabinet.

The rectifier identifies itself to the controller by transmitting it type and serial number , and the controller then sets the output voltage to a pre-established value. No settings or adjustment to potentiometers are necessary. The installer must set the rectifier's ID using the ON/STBY switch, to allow the controller to learn the rectifier's physical location.

Rectifier Features

Output current "walk-in": This circuit controls the time required for the rectifier to reach its configured float limit and set point voltage after it is turned on. Initially, the output current is about 30 percent of normal (about 30 amperes), and gradually increases to the required value or current limit set point in approximately 8 seconds or 90 amperes. This feature minimizes the starting surge on the customer's power source and is especially important with a more limited power source such as an engine driven alternator.

Electronic current limit: The rectifier provides a constant output voltage up to its rated output current, at which point it provides constant current. This current limit set point is adjustable (via the Galaxy controller) from 30 to 110 percent of the rectifier rating, 30 to 110 amperes. When the output current tends to increase above the current limit setting, the current limit circuit overrides the voltage regulating signal and safely limits the output current of the rectifier. A light on the rectifier illuminates when this occurs. NOTE: This light may also illuminate at the beginning of the walk-in cycle.

Selective high voltage shutdown (SHVSD): If the bus voltage goes too high, the Galaxy controller signals all of the connected rectifiers. This signal causes the rectifier(s) delivering more than 20 percent of average rectifier load to shut down. The remaining rectifiers continue to operate. The high voltage shutdown level is set at the controller.

Internal selective high voltage shutdown (ISHVSD): The 570A rectifier will sense a high voltage condition at its output terminals. If delivering more than 120 percent of its designated average load current share, the rectifier shuts down. If the Galaxy controller has not communicated the average load to the rectifier, the rectifier shuts down if it is delivering more than 20 percent of the rated average load (20 amperes).

This high voltage threshold is user-programmable from the Galaxy controller via the RICC circuit pack for Float, Boost, and Equalize voltages. The factory default setting for all three is 56.0 volts. The ISHVSD is a backup to the SHVSD.

Rectifier back-up high voltage shutdown: Each 570A has a hard-wired, fail-safe, high voltage shutdown. In float or boost mode, this value is ≅ 59.5 V. In equalize mode, this value is ≅ 68 V.

Dynamic response: For any step load change of 20 to 100 percent, or 100 to 20 percent, or a step change of 5 percent of the input voltage, the sense point voltage remains within 5 percent of its setting, and returns and remains in the 1/2 percent band within 50 milliseconds.

For operation without batteries, the sense point voltage remains within 5 percent of its setting and returns and remains in the 2 percent band within 500 milliseconds for any step load change of 50 to 100 percent, or 100 to 50 percent, or a step change of 5 percent of the input voltage.

Forced load sharing: The 570A rectifier is capable of load sharing with other 570A rectifiers to better than 10 percent of the full load rating of the rectifier.

Restart: Upon shutdown, the 570A will attempt restart except when the rectifier is in standby, when the rectifier is shut down during a remote restart attempt or when the rectifier detects an internal high voltage shutdown. The rectifier also accepts a restart command from the Galaxy controller for remote restarts

Output circuit breaker: A three pole, 30-ampere output circuit breaker protects the system from rectifier malfunction or excessive current, and may be used to disconnect the rectifier from the battery bus. The Galaxy controller can detect whether the circuit breaker has been operated manually or if it has been tripped due to a fault.

Output voltage adjustment range: The rectifier is capable of providing up to 65 volts dc output at 50 percent of its rated output power and nominal input voltage down to 43 volts at 100% of rated load.

Voltage/Current Display: A toggle switch controls the 570A rectifier's three-digit display. This display indicates the current and voltage status of the rectifier. The default position of the switches is to show current. It must be depressed to show voltage. Upon specific no power conditions, the 3 digit display will show informative messages (See Table 5-4).

Power Switch: This three position switch serves two purposes:

1. **Control of the on/standby state of the rectifier:** Two LEDs labeled ON and STBY reflect the rectifier's state. The ON LED is green and lights when the rectifier is

operating normally; the STBY LED is yellow and illuminates whenever the rectifier is in a standby condition.

2. **Display and programing of the rectifier ID:** Rectifiers will be automatically recognized and configured by a controller when they are connected in a shelf. For accurate alarm reporting and operator control, it is necessary for each rectifier to be configured with a unique rectifier ID (rectifier number). Configuration is accomplished via the momentary action rectifier ID switch. A short press of the switch will display the current rectifier ID. A display of 0 indicates unconfigured. The switch must be depressed upwards and held for approximately 5 seconds. After this, the displayed number will blink to indicate that it can be set. To set, press upwards and release the button until it reaches the desired ID number. Hold the switch in the upward position for approximately 5 seconds until the display ceases to blink. The new ID number is now set. Abandoning this process before the display stops blinking will default the ID to the last number set.

Lamp Test: To perform the lamp test, put the voltage/current toggle switch in the voltage mode and the power switch in the STBY position. All the LEDs on the 570A rectifier should light and the voltage/current display should read “888.”

Status Indicators: Three other LEDs on the 570A faceplate indicate the rectifiers condition. The FAIL LED is red and lights whenever the rectifier fails. The LIM LED is yellow and lights when the unit is in current limit. The EQL LED is also yellow and lights when the rectifier is in equalize mode.

Connectorized: The 570A rectifiers provide the Galaxy controller with a full complement of status and alarm signals. The rectifier status and alarm signals, ac input, and dc output are all connectorized for easy installation and maintenance.

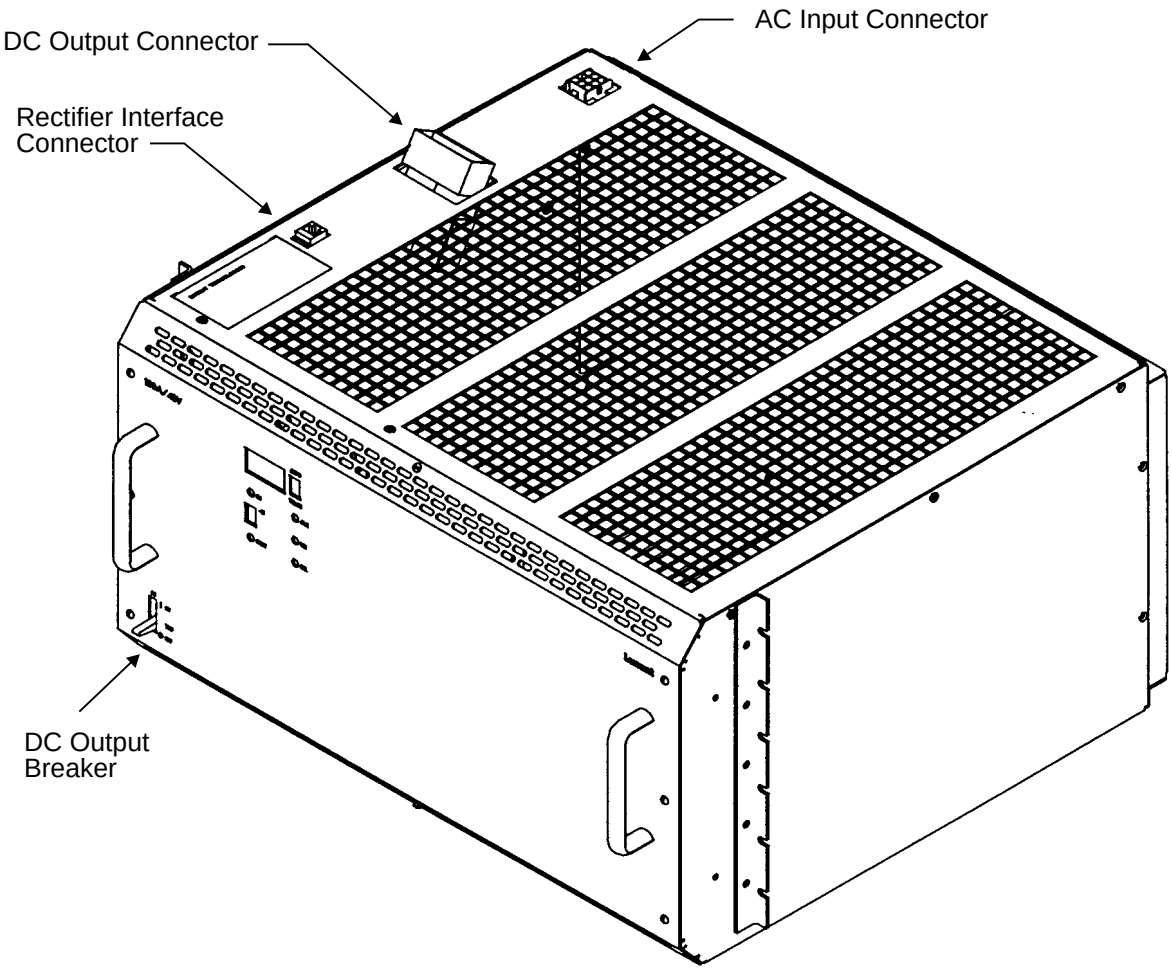


Figure 2-4: 570A Rectifier

AC Input Panel AC service for the Galaxy Power System is provided from either 200 Vac-240 Vac, three-phase DELTA plus protective earth ground (3W + PE) or 350 Vac-415 Vac three-phase, four wire WYE plus protective earth ground (3W + N + PE) service with a frequency range of 47-63 hertz. Removable panels at the top of the cabinet provide access to the AC panel with a 2 inch (50 mm) knockout for a 1-1/2 inch conduit fitting. AC wiring to each cabinet should be a minimum of 6 gauge or 25 mm^2 from a three-phase circuit breaker rated at 63 or 70 amperes per phase for WYE service or a minimum of 2 gauge or 35 mm^2 from a three-phase circuit breaker rated at 125 amperes per phase for DELTA service.

The AC input panel is shown in Figure 2-5. It consists of an ac box equipped with neutral, earth ground and phase 1 (R), 2 (S), 3 (T) connection points, and a three pole 30 ampere circuit breaker wired to each rectifier in the cabinet. AC input wiring to the rectifiers routes through a terminal board. This terminal board has two wiring connector positions. One for DELTA (Δ) AC service and the other for WYE (Y) AC service. From the terminal board, wiring is routed to the rectifiers in an enclosed channel in the back left corner of the cabinet. The wiring in the AC panel is factory configured to WYE AC service. If the system is to be used with DELTA service, the wiring must be moved from WYE to DELTA connector on the terminal board. Connection to the rectifier is shown in Figure 2-4. This connection is accessed by removing the air baffle above the rectifier.

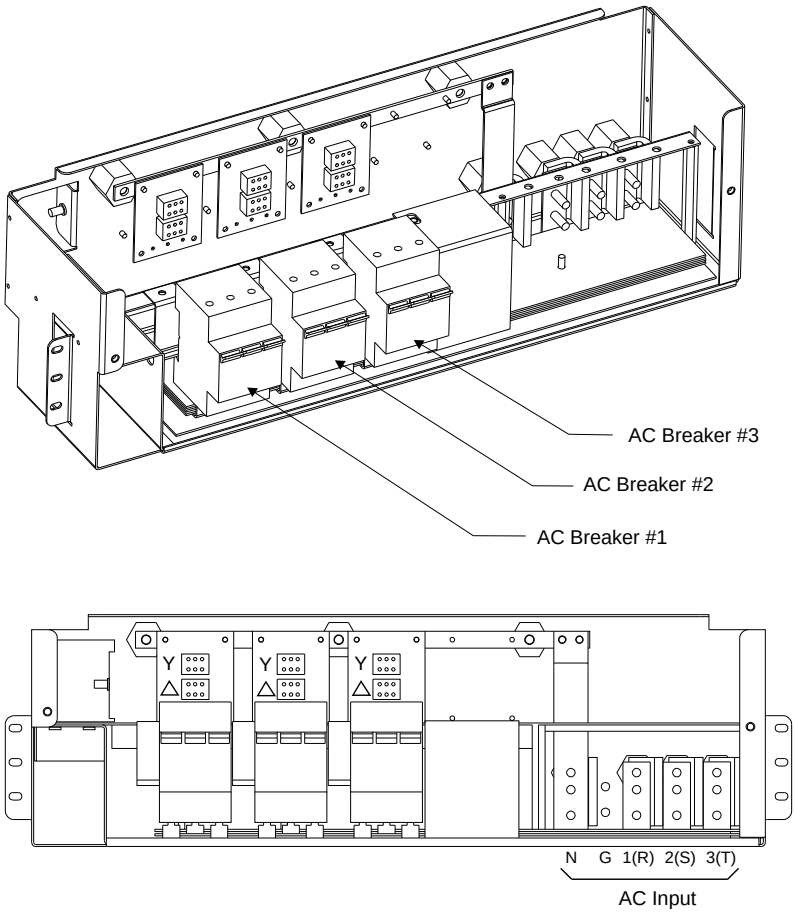


Figure 2-5: AC Input Panel

Battery Connection Modules

Batteries may be connected in a cabinet in one of two places. One option is to connect battery cables to bus bars located at the top of the cabinet behind the AC box. There is space for up to eight 150 mm^2 or 4/0 cables connected with a single or double hole terminal lug and M10 bolt. The negative bus with this option is equipped with a 2000 ampere current monitoring shunt. The second option is to connect battery cables to a battery connection module located immediately below the AC box. The types of battery connection modules are shown in Table 2-1.

Table 2-1: ED83143-30 Battery Connection Modules

Figure	Group	Disconnect Type	Shunt Type	Cabinet Mounting Positions	Battery Cable Connection
-	30	None	2000A	None	Single or Two Hole M10 Terminal Lugs
2 - 8	31	(1) 1200A Contactor	2000A	6	
2 - 9	32	(2) 600A Contactors	600A	9	
2 - 6	41	(2) NH3 Fuse Holder	600A	9	
2 - 7	42	(1) NH3 Fuse Holder	600A	6	

Each battery section has space for eight pairs of cables connected with single or two hole terminal lugs and M10 x 25 mm bolts. The negative battery leads connects through a DIN standard fuse holder, size NH3, or a low-voltage disconnect contactor through a current monitoring shunt to the negative charge bus. The positive battery leads connect directly to the positive charge return bus. Figures 2-6 through 2-9 show a front and rear view of the battery connection modules.

The current monitoring shunts in the battery sections measure the current supplied to or from the batteries. The shunt produces a millivolt signal proportional to the current flowing through it. The millivolt-to-ampere ratio of the shunt is the dc resistance of the shunt (in milliohms). The shunt has a full scale rating of 50 millivolts at its maximum current rating of either 600 amperes or 2000 amperes. The shunt millivolt signal is translated to amperes by either a digital meter panel mounted on the cabinet door or by the Galaxy controller through the 211F shunt peripheral module.

The panel with two fused battery sections is equipped with an alarm card. If the battery fuse operates, the corresponding indicating fuse operates and a red LED lights. The alarm card is

connected to the BLJ1 connector board on the door, lighting the frame alarm light at the top of the cabinet and sending the alarm to the controller. A terminal card on the panel is equipped with current limiting resistors wired to the pilot fuses, shunt(s) and panel buses for fuse status, current, and voltage monitoring. The panel with one fused battery section combines the alarm card and terminal card into one board. See Table 2-2.

Table 2-2: Terminal Card Monitoring Points

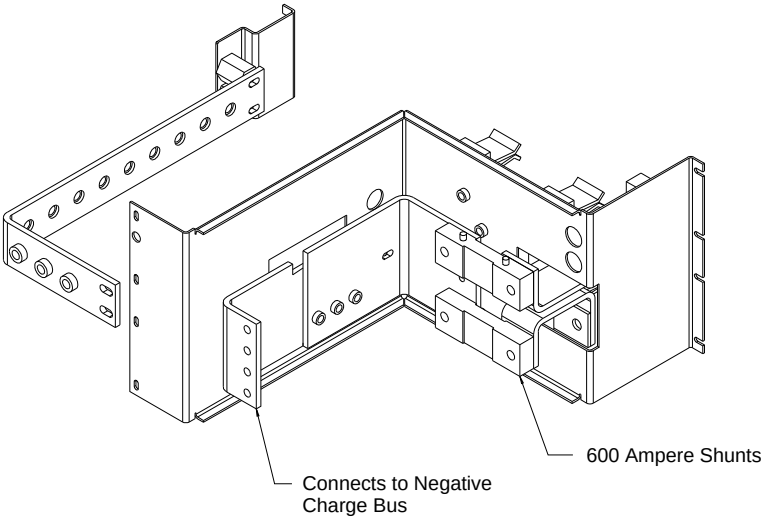
ED83143-30 Group 41	
Terminal	**Monitoring Point**
CH1+	Voltage - Battery String # 1
CH1-	Return
CH2+	Status - Battery Fuse # 2
CH2-	Return
CH3+	Current - Battery String # 1 (+)
CH3-	Current - Battery String # 1 (-)
CH4+	Status - Battery Fuse # 1
CH4-	Return
CH5+	Voltage - Battery String # 2
CH5-	Return
CH6+	Current - Battery String # 2
CH6-	Return
ED83143-30 Group 42	
Terminal	**Monitoring Point**
TB2-1	Voltage - Battery String
TB2-2	Return
TB1-1	Status - Battery Fuse

Table 2-2: Terminal Card Monitoring Points

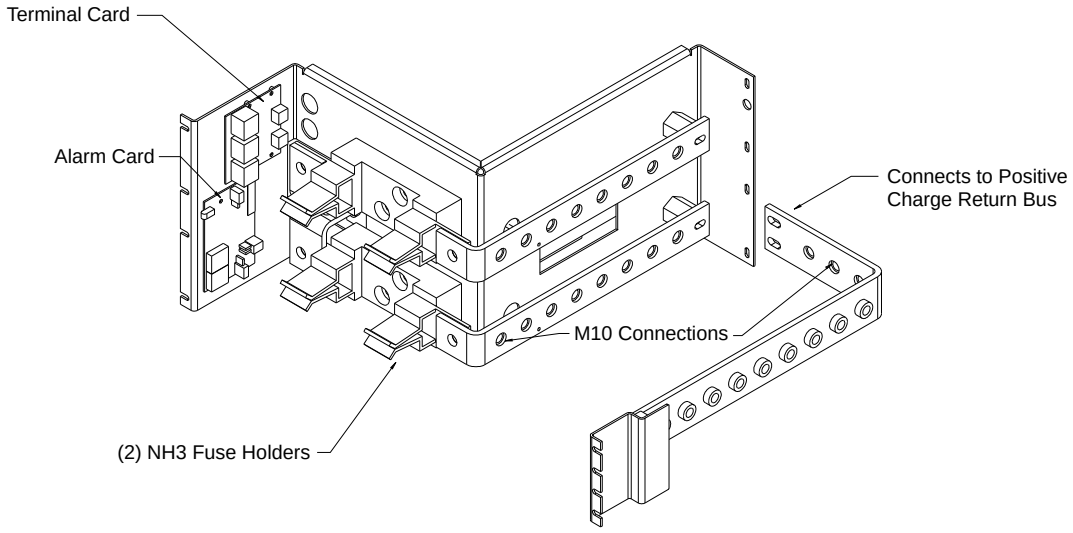
ED83143-30 Group 41	
Terminal	**Monitoring Point**
TB2-3	Return
TB1-3	Current - Battery String (+)
TB1-2	Current - Battery String (-)

In addition to the manual disconnect feature, battery modules with low voltage disconnect/reconnect (LVD/R) contactors disconnect batteries from the load when a controller preset disconnect level is reached. This prevents costly battery damage due to deep discharges. When the system once again reaches the reconnect voltage, the contactor closes, reconnecting the batteries to the rectifiers and load. Each contactor is wired to a control board. The control board is wired through the BLJ1 connector board back to the controller. The controller communicates the disconnect or reconnect signal to the contactors, the contactors communicate alarms or manual disconnect signals to the controller.

There are 3 switches on the control board. The top two switches are for a power system in normal operation. Activating these two switches locally opens the contactor for reasons such as battery string maintenance. The bottom switch is a emergency controller override. This switch is required for initial power up or after the system has shutdown due to an ac failure or if the controller must be powered down for repair. Activating this switch forces the contactor closed. Figure 2-15 shows a label describing the switch functions. When the contactor is open, a red LED on the control board lights along with the frame alarm light at the top of the cabinet. The yellow light indicates that the controller is attempting to disconnect the contactors. TB301-2. -3 terminals on the control board provide the “-” and “+” shunt signals for monitoring battery currents with a 211F peripheral module or digital meter panel.

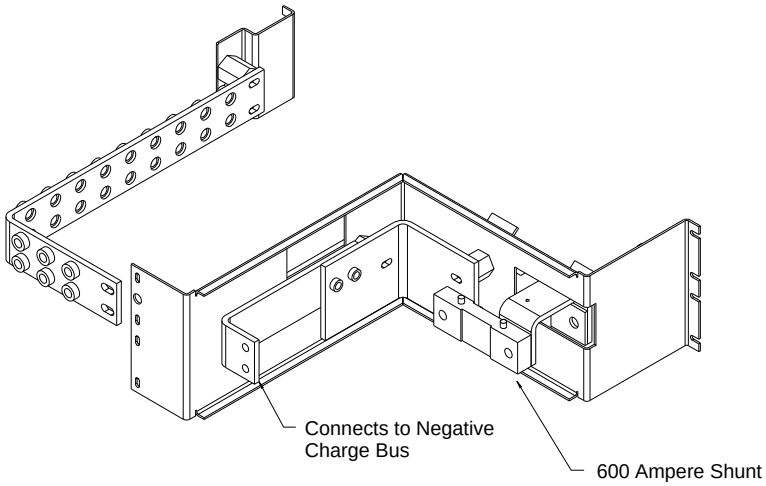


Back View

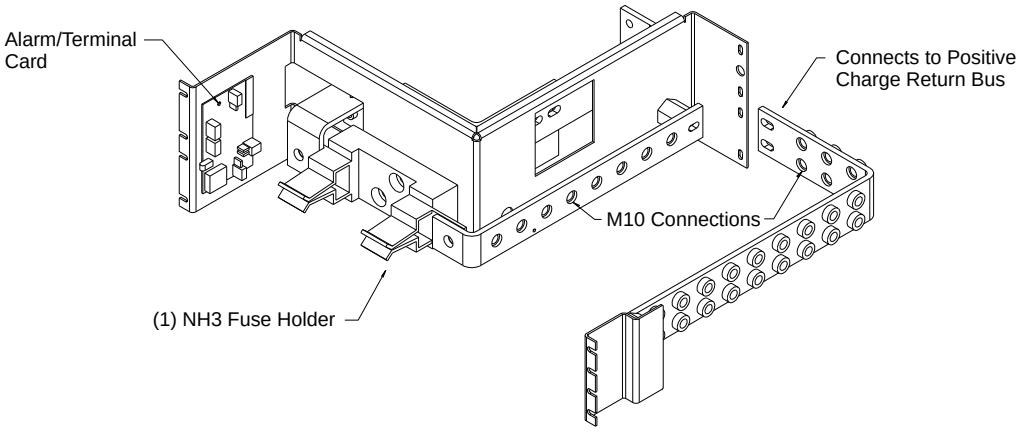


Front View

Figure 2-6: ED83143-30 Group 41 Battery Connection Module

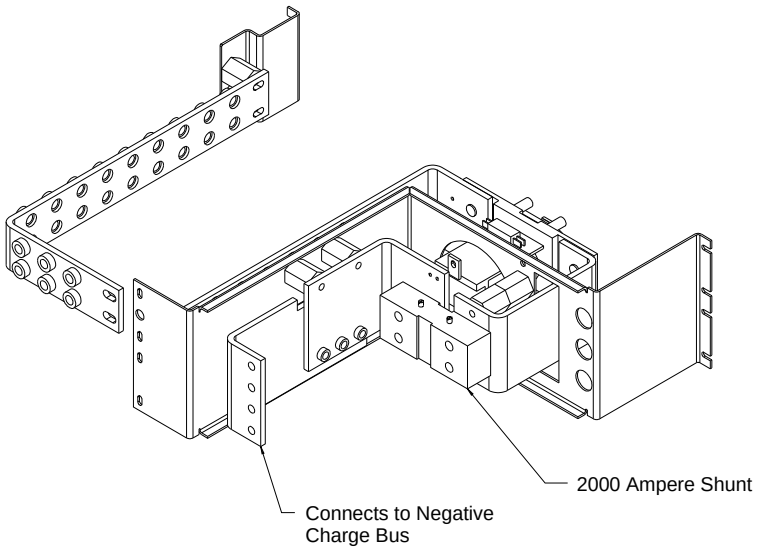


Back View

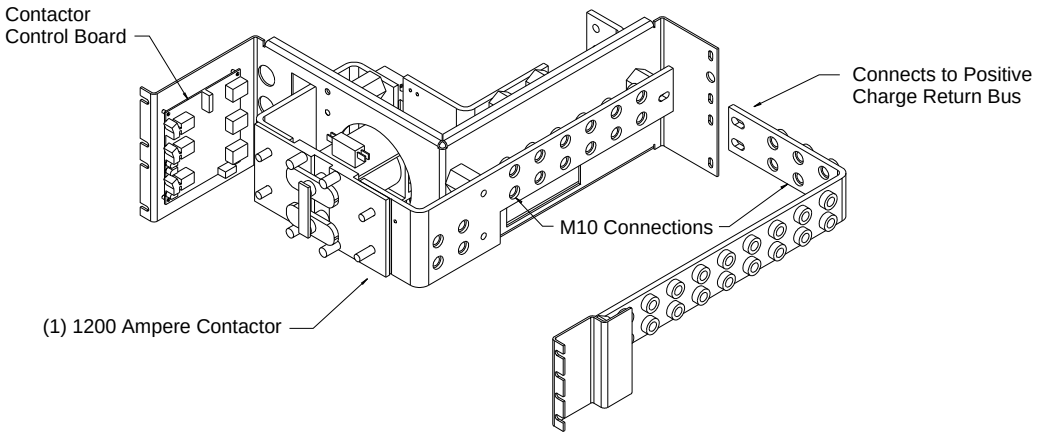


Front View

Figure 2-7: ED83143-30 Group 42 Battery Connection Module

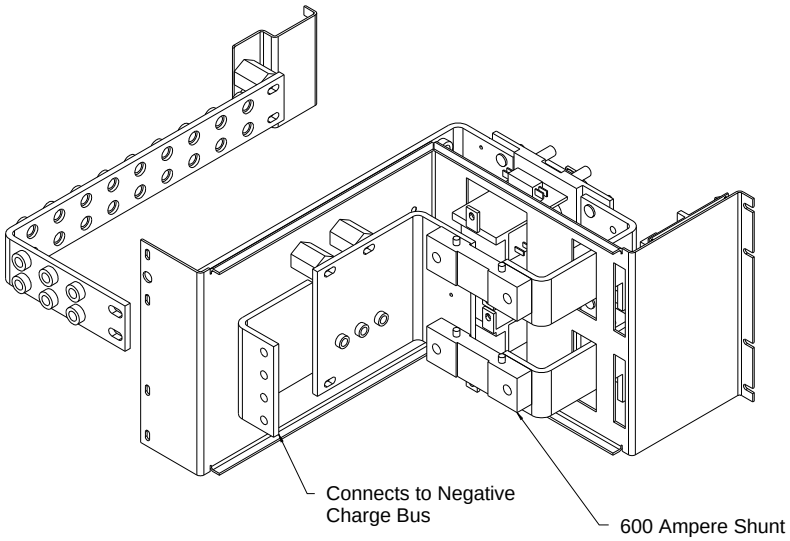


Back View

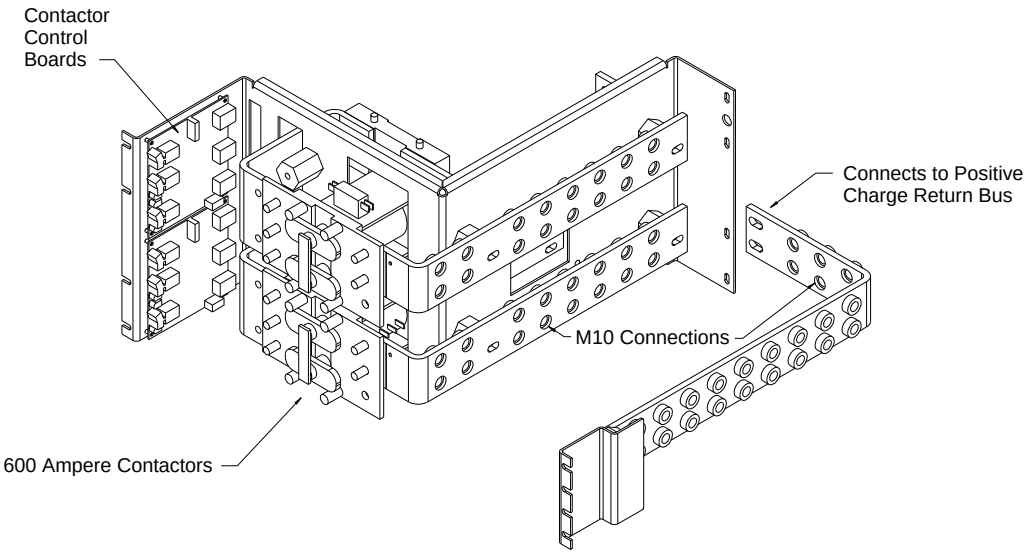


Front View

Figure 2-8: ED83143-30 Group 31 Battery Connection Module



Back View



Front View

Figure 2-9: ED83143-30 Group 32 Battery Connection Module

DC Distribution Panels

There are five types of DC distribution panels available. These panels are listed in Table 2-3.

Table 2-3: ED83143-30 DC Distribution Panels

Figure	Group	Panel Type	Current Range (Amps)	Cabinet Mounting Positions	Load Cable Connections
2-12	1	Circuit Breaker	125-600	12	M10
2-13	11	(13) Holders for Circuit Breakers of Fuses	3-50	6	M5
2-14	12	(21) Holders for Circuit Breakers of Fuses	3-50	9	M5
2-10	21	(2) Holders for NH2 DIN Fuses	0-400	6	M10
2-11	22	(8) Holders for NH00 DIN Fuses	0-160	6	M8

Two types of distribution panels with DIN standard fuse holders are available. Each panel is equipped with an alarm card. If a fuse operates on either panel the corresponding indicating fuse on that panel will operate and a red LED will light. Three types of panels with circuit breakers are available. Each panel has an alarm card equipped with an LED that lights when a circuit breaker trips due to overcurrent. The alarm cards are interconnected back to the BLJ1 connector board lighting the frame alarm at the top of the cabinet and sending the alarm to the controller.

Circuit Breakers for the large circuit breaker panel are factory installed and also include a shunt for measuring load currents. The shunts have a 25mV scale. A terminal card on this panel is

equipped with current limiting resistors wired to each shunt. The customer may wire to this terminal card to measure the load currents. See Table 2-4.

Table 2-4: Terminal Card Shunt Monitoring Points

Terminal	Circuit Breaker Position
CH1+	1 (+)
CH1-	1 (-)
CH2+	2 (+)
CH2-	2 (-)
CH3+	3 (+)
CH3-	3 (-)
CH4+	4 (+)
CH4-	4 (-)
CH5+	5 (+)
CH5-	5 (-)
CH6+	6 (+)
CH6-	6 (-)

Note: For multiple pole breakers, the monitoring channel is with the highest number channel (i.e. a three pole breaker in positions 1-2-3 would be monitored by channel 3).

The ED83143-30 Group 11 or 12 contain 13 and 21 positions respectively for mounting plug-in circuit breakers or fuses. A list of the available sizes is shown in Table 3-4. These are field installed items.

Charge Return Bus Bars

Charge Return Bus Bars shown in Figures 2-6 through 2-14 are optional. In a centralized architecture, they are not required. They are ordered per ED83143-30 Groups GA and GB. Group GA provides a bus bar with 12 two hole, size M10 termination points. Group GB provides a bus bar with 23 two hole, size M5 termination points and 16 single hole size M8 termination points.

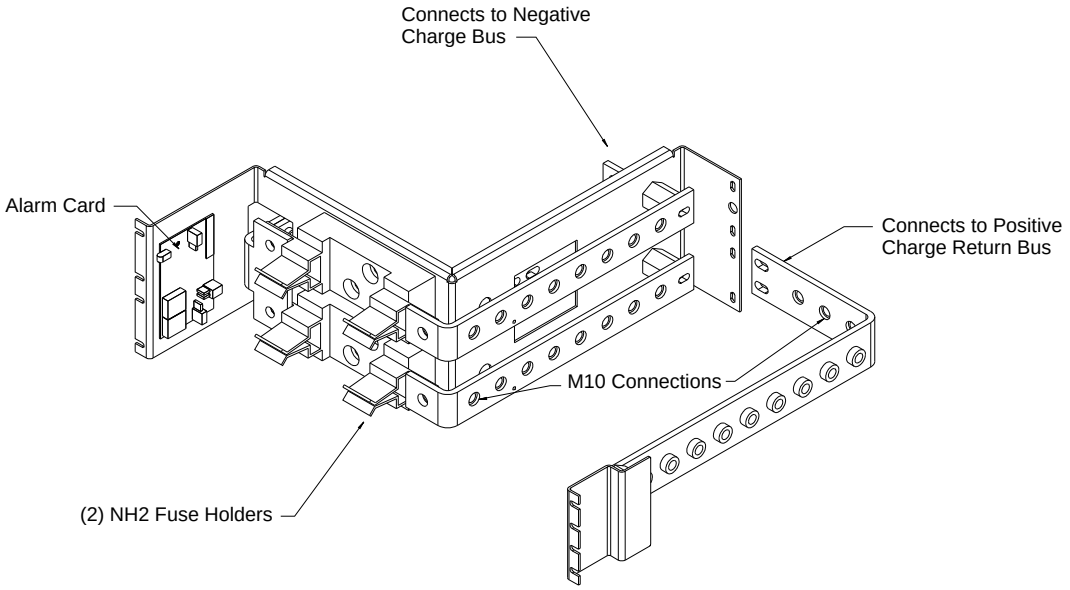


Figure 2-10: ED83143-30 Group 21 Battery Connection Module

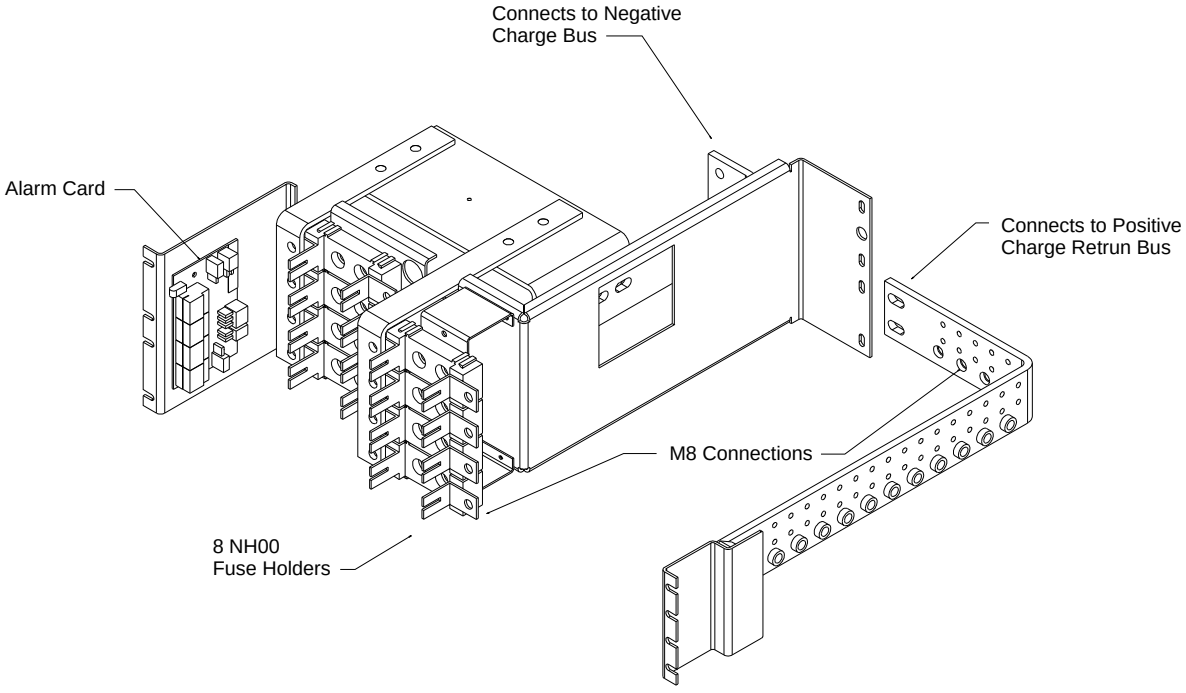


Figure 2-11: ED83143-30 Group 22 Battery Connection Module

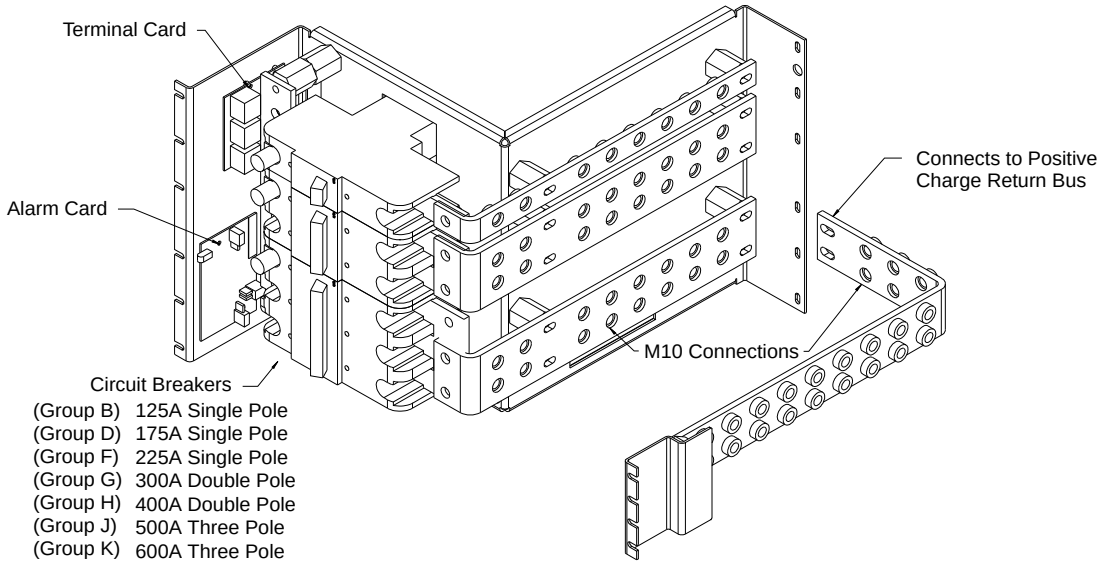


Figure 2-12: ED83143-30 Group 1 Battery Connection Module

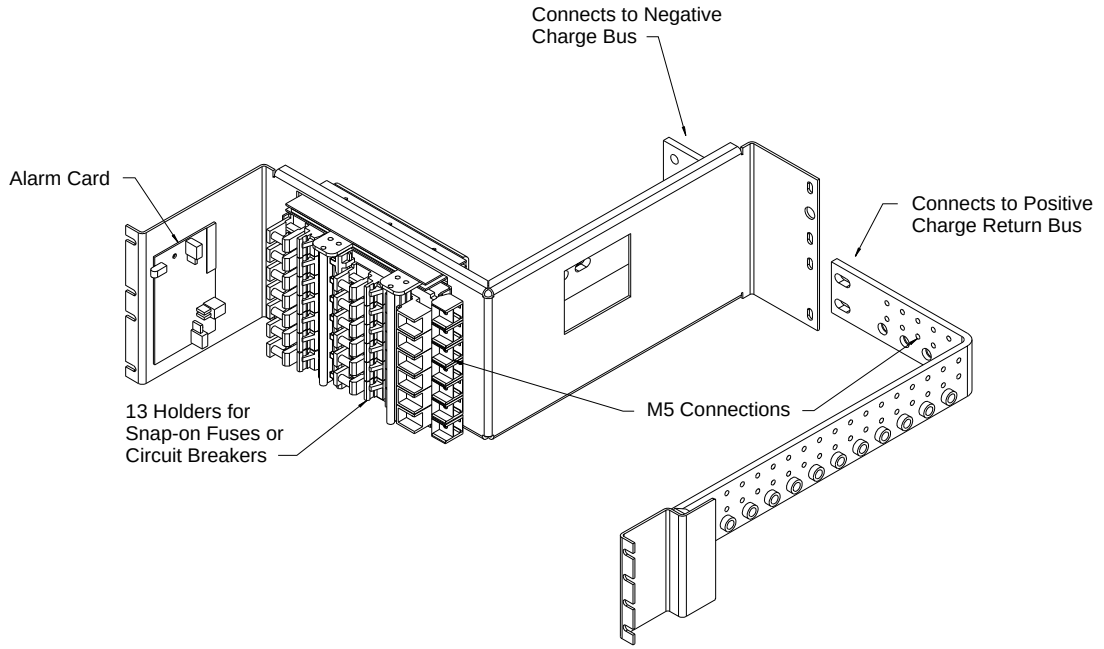


Figure 2-13: ED83143-30 Group 11 Battery Connection Module

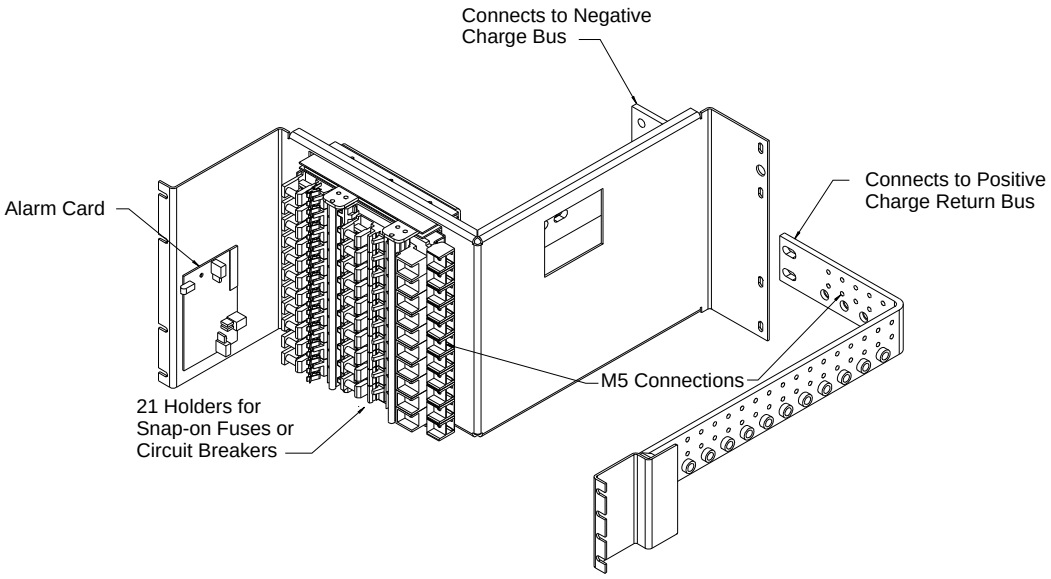


Figure 2-14: ED83143-30 Group 12 Battery Connection Module

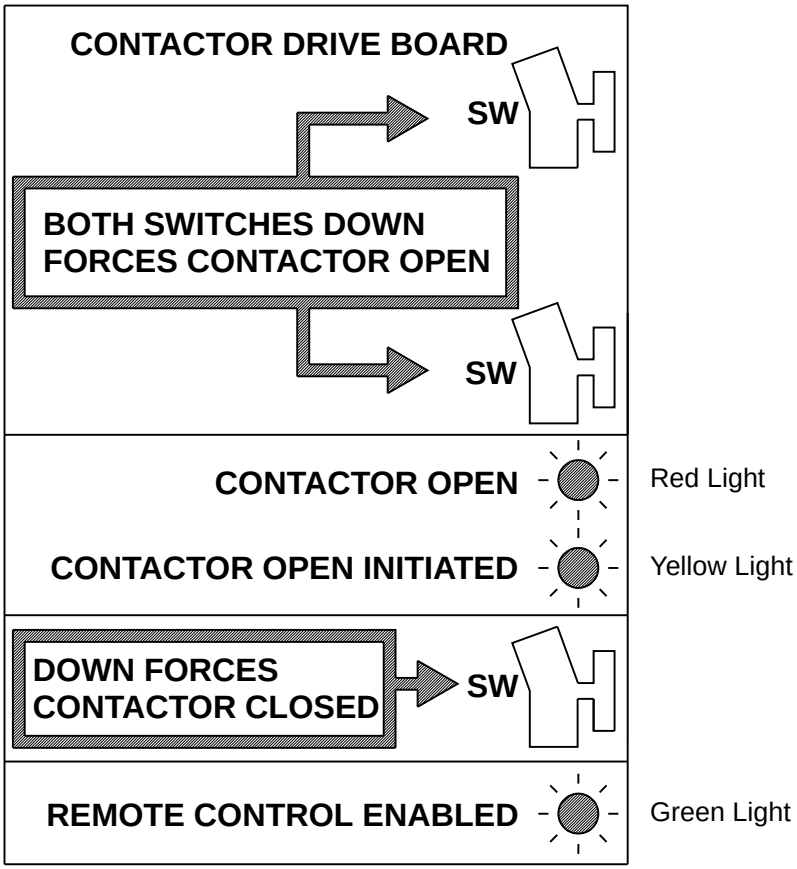


Figure 2-15: Contactor Control Board Label

3 Ordering Information

Documentation

The following table lists documentation associated with the GPS 4824.

Table 3-1: Product Documentation

Document Number	Description
107934226	GPS 4824 Ordering Brochure
J85582B-1	Plant Assembly Drawing
J85501F-1	Galaxy Controller Drawing
ED-83142-30	AC Input Panel
ED-83143-30	Battery and DC Distribution Panels
167-792-110	Galaxy Front Access Controller Product Manual
167-792-150	Galaxy Power System 4824 Product Manual
167-790-063	Remote Peripheral Monitoring System Product Manual
T-83314-30	Wiring Diagram
T-83217-30	Wiring Diagram for Galaxy Controller

GPS 4824 Ordering Guide

The ***GPS 4824 Ordering Guide*** provides ordering information for standard configurations refered to as Configured Marketable Items (CMIs) and Marketable Items (MIs).

Each CMI is a pre-configured system cabinet, fully assembled in the factory, that contains wiring for rectifiers, possibly a controller, and a selection of dc distribution modules and battery connection modules. Each MI is and easily field-installable option, such as a rectifier, controller option card, or supplementary distribution panel. Comcodes are available for miscellaneous hardware such as terminal lugs, anchor bolts, and mounting hardware are shown in Tables 3-3 through 3-6.

The CMI's are assembled in the factory and high volume CMIssourced at the Power Systems Distribution Center (PDSC).

The CMI's and MI's have been created to meet anticipated demand. Additional CMIs and MIs can be created for other high-volume configurations.

Replacement Parts

Table 3-2 provides a list of replacement parts for GPS 4824. Refer to the Galaxy Front Access Controller Product Manual 167-792-110 Appendix E for a complete listing of the circuit packs and accessory parts used in the controller.

Table 3-2: GPS 4824 Replacement Parts

Comcode	Description
Rectifier	
107542524	570A, 100 Ampere Rectifier
847704939	Air Baffle
847690799	Serial Rectifier Cable, 10 ft.
847837903	Serial Rectifier Cable, 1-1/2 ft.
847720695	AC/DC Rectifier Cables
107832685	BNB1 Circuit Pack
407249432	30 Ampere Circuit Breaker, AS 168X-CB-3G-300 (Weber)
Cabinet	
107637688	BLJ1 Connector Board

Table 3-2: GPS 4824 Replacement Parts

Comcode	Description
406204230	3 Ampere Fuse
407519305	Thermistor Wire Set
847837911	BLJ1 to BLJ1 Wireset
407227172	Lamp for Frame Alarm Light
847704913	Fascia Bracket
847837879	Fascia Cover
Monitoring	
406716803	600 Ampere Digital Current Meter 04-900135 (Modutec)
407655081	2000 Ampere Digital Current Meter 04-900199 (Modutec)
107668154	211C Voltage Peripheral Module (0 - 70 VDC)
107753543	211F Shunt Peripheral Module
847635851	Peripheral Connector Board
847526688	Peripheral Terminating Resistor, 560 Ohm, 10 Watt
407519305	Thermistor, AX-5050 (Keystone)
Distribution	
405673161	1/2 Ampere Alarm Fuse

Cabinet Anchor Kits

Table 3-3: Recommended Concrete Anchor Kits

Seismic Zone	Ordering Code	Description	Drill Size	Drill Depth
0, 1	847135712	(4) 3/8 inch, Self-Drill, Threaded Rod	-	1.5”
0, 1	847135720	(4) 3/8 inch, Drop-In, Threaded Rod	0.500”	1.5”
0, 1, 2	847135654	(4) 1/2 inch, Self-Drill, Threaded Rod	-	2”
0, 1, 2	847135662	(4) 1/2 inch, Drop-In, Threaded Rod	.625”	2”
3, 4	847532678	(4) 12mm dia. Anchors, Torque Cap Bolt	18mm	100mm
Floor Leveling Spacers				
-	842439861	0.063” Thick Spacer	-	-
-	842439879	0.125” Thick Spacer	-	-
-	842439887	0.250” Thick Spacer	-	-

Plug-In Circuit Breakers and Fuses

Table 3-4: Plug-In Circuit Breakers and Fuses for ED83143-30 Group 11 or 12

Circuit Breaker Options		
Size (Amperes)	**Comcode**	**Description**
3	407098417	Single Position Plug-In Circuit Breaker
5	4070984425	Single Position Plug-In Circuit Breaker
10	4070984433	Single Position Plug-In Circuit Breaker

Table 3-4: Plug-In Circuit Breakers and Fuses for ED83143-30 Group 11 or 12

Circuit Breaker Options		
Size (Amperes)	**Comcode**	**Description**
15	4070984458	Single Position Plug-In Circuit Breaker
20	4070984474	Single Position Plug-In Circuit Breaker
25	4070984482	Single Position Plug-In Circuit Breaker
30	4070984490	Single Position Plug-In Circuit Breaker
40	407245448	Single Position Plug-In Circuit Breaker
45	407098516	Single Position Plug-In Circuit Breaker
50	407098524	Single Position Plug-In Circuit Breaker
60	407098532	Two Position Plug-In Circuit Breaker
70	407098540	Two Position Plug-In Circuit Breaker
80	407098557	Two Position Plug-In Circuit Breaker
90	407098565	Two Position Plug-In Circuit Breaker
100	407098573	Two Position Plug-In Circuit Breaker
*** Terminal Lug Kits for use with circuit breakers (60 - 100A)**		
-	847301702	6 AWG Termination Kit. Includes bus bar, 3/8” mounting hardware and terminal lug.

Table 3-4: Plug-In Circuit Breakers and Fuses for ED83143-30 Group 11 or 12

Circuit Breaker Options		
Size (Amperes)	**Comcode**	**Description**
-	847301447	2 AWG Termination Kit. includes bus bar, 3/8" mounting hardware and terminal lug.
Fuse Options		
-	406980797	Fuse Holder
5	407006329	Fuse, TPA-5
10	407006337	Fuse, TPA-10
15	407006345	Fuse, TPA-15
20	407006352	Fuse, TPA-20
25	407006360	Fuse, TPA-25
30	407006524	Fuse, TPA-30

Terminal Lugs and Hardware

Table 3-5: Recommended Terminal Lugs

Double Hole Terminal Lugs for ED83142-30 AC Box (M6 Bolt, 0.75" Centers)					
Str Wire	Flex Wire	Metric Wire	WP-91412 List	Comcode	Die
6	6	16	110	406338442	Blue
4	4	25	117	406338578	Grey
2	-	-	122	406338673	Brown

Table 3-5: Recommended Terminal Lugs

Double Hole Terminal Lugs for Load Returns to ED83143-30 Group GB (M5 Bolt, 0..62" Centers)					
Str Wire	Flex Wire	Metric Wire	WP-91412 List	Comcode	Die
10	10	6	73	405356171	R5473
8	8	10	52	405348178	Red
6	6	16	108	406338400	Blue
Double Hole Terminal Lugs for Cabinet Ground and CO Ground Battery Leads to ED83143-30 Groups 31, 32 Load Leads to ED83143-30 Groups 1-G, H, J, K Load and Battery Returns to ED83143-30 Group GA (M10 Bolt, 1.00" Centers)					
Str Wire	Flex Wire	Metric Wire	WP-91412 List	Comcode	Die
6	6	16	111	406332841	Blue
4	4	25	116	406332940	Grey
2	-	35	121	406338665	Brown
1/0	-	-	56	405348228	Pink
2/0	1/0	70	57	405348236	Black
-	2/0	-	77	406021725	Orange
4/0	-	-	59	405348251	Purple
-	4/0	-	27	405347923	Yellow
Single Hole Terrminal Lufs for Load Leads to ED83143-30 Groups 11,12 Load Returns to ED83143-30 Group GB (M5 Bolt)					
Str Wire	Flex Wire	Metric Wire	WP-91412 List	Comcode	Die
10	10	6	93	406338145	R5473
8	8	10	1	405347402	Red
6	6	16	171	407334671	Blue

Table 3-5: Recommended Terminal Lugs

Single Hole Terminal Lugs for Load Leads to ED83143-30 Group 22 Load Returns to ED83143-30 Group GB					
Str Wire	Flex Wire	Metric Wire	WP-91412 List	Comcode	Die
8	8	10	99	406338210	Red
6	6	16	106	406338376	Blue
4	4	25	115	406338483	Grey
2	-	-	119	406338616	Brown
-	2	-	172	407334697	Green
1/0	-	-	140	406434514	Pink
2/0	1/0	70	129	406338822	Black
-	2/0	-	148	406434076	Orange
4/0	-	-	131	406338772	Purple
-	4/0	-	157	406434167	Yellow
Single Hole Terminal Lugs for Load Leads to ED83143-30 Groups 1-B, D, F, 21, 41, 42 Load Returns to ED83143-30 Group GA					
Str Wire	Flex Wire	Metric Wire	WP-91412 List	Comcode	Die
6	6	16	107	406338392	Blue
4	4	25	114	406338475	Green
2	-	-	120	406338640	Brown
1/0	-	-	55	405348210	Pink
2/0	1/0	70	10	405347717	Black
-	2/0	-	17	405347790	Orange
4/0	-	-	58	405348244	Purple
-	4/0	-	78	406021741	Yellow

Table 3-6: Mounting Hardware Required Per Equipped Position

Bolt Size	Comcode	Qty.	Description
M5	901276907	2	M5 x 10mm Screw (SEMS)
M8	847867124	1	M8 Hardware Kit
M10	847867132	1	M10 Hardware Kit

4 Safety

Safety Statements

Please read and follow all safety instructions and warnings before installing, maintaining, or repairing the power system. Reference the individual module product manuals for additional safety statements specific to the modules.

The Galaxy Power System is Underwriters Laboratories (UL) Listed per Subject Letter 1801, DC Power Distribution Centers for Telecommunications Equipment. Rectifiers are 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.

Install only in restricted access areas (dedicated equipment rooms, equipment closets, or the like) 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 can not 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 40°C. Short term excursions to 45°C is acceptable.

This equipment must not be installed over combustible surfaces.

For installations in the U.S. and Canada, Listed/Certified compression connectors are to be used to terminate Listed/ Certified field-wired conductors where required. 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 are to be followed when making field connections.

The ac input distribution has been evaluated for connection of minimum 90°C conductors sized per the US National Electrical Code using the 90°C ampacity tables.

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 routed in areas where wires could get pinched) and undue stress on the connectors.

The short circuit current capability of the battery input to the distribution panel shall not exceed 10,000A.

Fuses/circuit-breakers may not be provided with the equipment. Refer to the product documentation for the proper hardware. Use only the parts specified in the equipment documentation. Installing fuses or circuit breakers not specified for use in this equipment may result in injury to service personnel or equipment damage.

External loading must not exceed 80% of its fuse/circuit-breaker current rating.

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. Refer to the equipment ratings to assure rating of equipment will not exceed 80% of the value of the protector chosen. Reference drawing T-83314-30 for recommended circuit protection for the different options.

An accessible ac disconnect/protection device to remove ac power from the equipment in the event of an emergency must be provided. This device must open all poles and be connected together.

When connecting to 3-wire plus neutral supply systems, the neutral is to be reliably earthed at the supply, i.e., this equipment is not intended to be connected to IT supply systems.

Warning Statements And Safety Symbols:

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

This symbol (or equivalent) is used to identify the presence of hazardous AC mains voltages

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 - for example: "Hazardous voltage/energy inside. Risk of injury. This unit must be accessed only by qualified personnel."

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 Galaxy Power System can 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 necessarily remove power to the equipment. Make sure the equipment is not also powered by the batteries or the batteries are not connected to the output of the equipment.
- High leakage currents may be possible on this type of equipment. Make sure the equipment is properly safety

earth grounded before connecting power.

- 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. Exercise care when servicing this area.

The above 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."

The above symbol identifies 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."

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

- 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 any other jewelry).
- Wear safety glasses.
- Test circuits before touching.
- Lock out and tag any 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 any wiring).
- Use care when removing or replacing any covers - avoid contacting any circuits.

The above symbols are used to identify the safety earth ground or bonding point for the equipment.

5 Installation

General

This section outlines a sequence for installing a Lucent Technologies Galaxy Power System (GPS) 4824 as well as a test sequence for checking the integrity of the installation.

Installation Tools and Hardware

You will need the following tools and hardware to install the GPS:

- Material handling equipment to unload cabinet at site, remove from shipping container, and set in final position Minimum lifting capacity: **900 lb (410Kg)**
- Drill to bore holes for floor anchors
- Cable racks and associated hardware
- Battery and load cables and single or double hole terminal lugs for M8 and M10 bolts. (see Table 3-5)
- Crimping tools and dies for connectors
- Hand tools: 1/8 inch flat-blade screw driver, jeweler's screw driver (flat and Phillips), wire cutters and stripper, sockets and torque wrenches (8mm, 10mm, 13mm, and 17mm), and a crowbar (See Table 5-1 for torque requirements)
- M8 and M10 bolts, 25 mm long with washers and lockwashers for connecting terminal lugs of battery and load cables. (See Table 3-6)
- Digital multimeter (DMM) (0.05% accuracy on dc scale)
- 18 and 22 gauge stranded wire for connecting alarm wiring to the controller
- ESD wrist strap
- Load box (100 amperes @ 48V)

Table 5-1: Torque Settings for Metric Hardware

Screw Size	Torque (Nm)	Torque (in-lb)	Socket Size
M5	4	35	8 mm (5/16")
M8	18	160	13 mm (1/2")
M10	34	300	17mm (11/16")

Unpacking, Handling, and Frame Installation

Before opening the packaging, carefully inspect the outside, in the presence of shipping personnel, for signs of damage. If damaged, follow the shipping carrier's procedure for filing a damage claim.

Use the equipment weights and dimensions as a guideline for choosing material handling tools. Carefully open the packaging to verify that the contents are complete and undamaged. If the equipment must be returned, it should be repacked in the original shipping crate.

Figure 5-1 shows the cabinet footprint. The cabinet is 600 mm wide and 600 mm deep. It has four holes for anchoring it to the floors. A floor template, Comcode 847891280, is shipped with each cabinet. The paper template show a full size two cabinet footprint. This template may be taped to the floor to show the exact location for drilling holes for the floor anchors. Table 3-3 lists recommended floor anchor kits for seismic zone areas. Other types of floor construction may require other mounting methods. If the floor is not level, shims may be required to level the cabinets. Table 3-3 also lists 3 shim sizes; 0.063" thick, 0.0125" thick, and 0.250" thick. These should be ordered as needed.

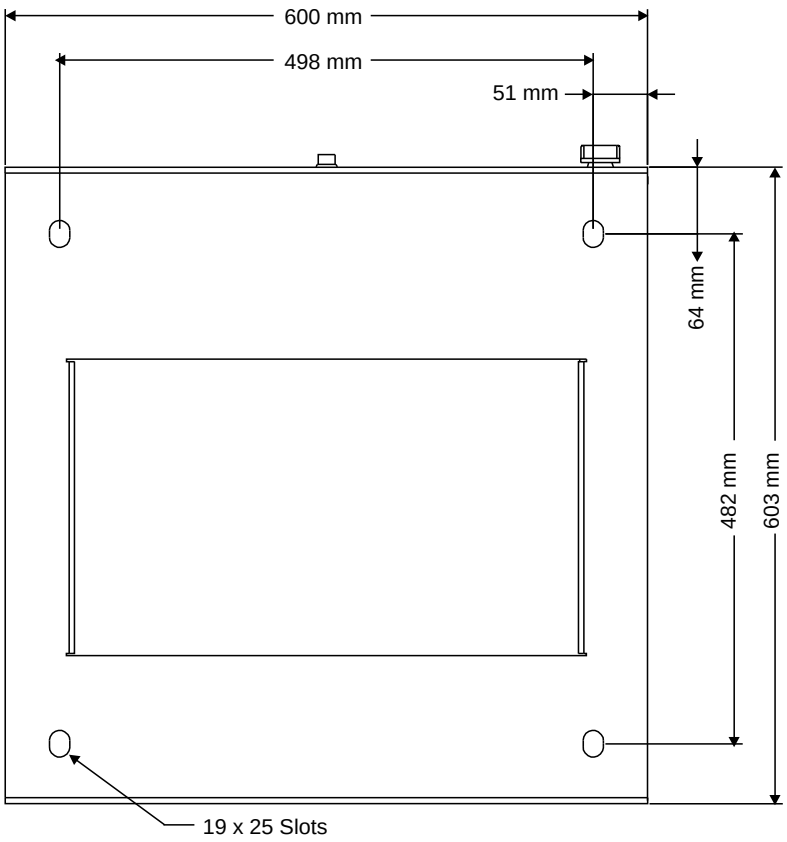


Figure 5-1: Cabinet Footprint

- Place the paper template on the floor.
- Using the appropriate drill bit, drill anchor holes to the specified drill depth.
- Locate cabinet in position using shims if required, four anchor bolts, and hold-down washers.
- Torque anchors to the specified value using a wrench or socket.

NOTE:

When locating cabinets, the initial cabinet with the controller must be located at the end of the equipment line-up. Additional cabinet must all be located either to the left or to the right of the controller cabinet.

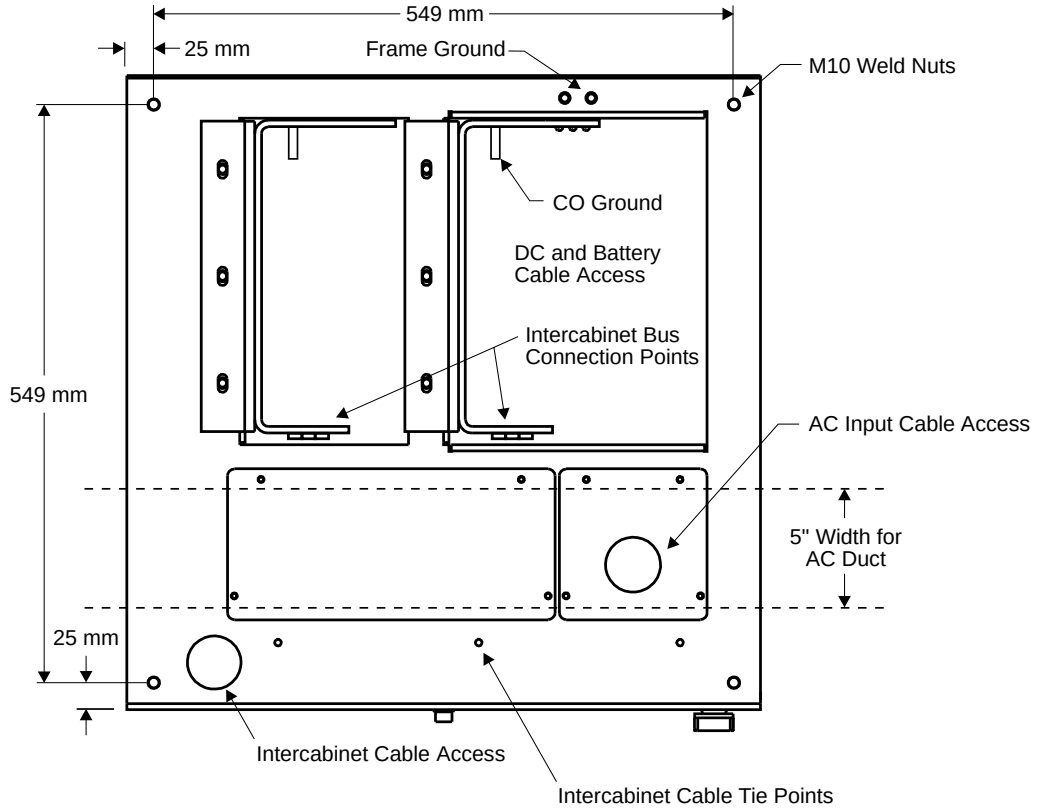


Figure 5-2: Top View of Cabinet

Cable Routing Strategy and Frame Ground

As with any battery plant, cabinet positioning with respect to cable racks, batteries and ac is very important in order to ensure not only easy installation but also proper maintenance and graceful growth of the system in the future.

Each cabinet is arranged in a manner that separates ac from dc leads. All dc leads should be separated from ac leads wherever possible to minimize electrical noise transmitted to the load.

It is recommended that ac cable be run either on a cable rack along the front of the cabinet or in an AC duct mounted on top of the cabinet. AC cable is dropped from the cable rack to each cabinet or routed into the AC duct to each cabinet. DC leads should be routed to a cable rack along the back of the cabinet.

Figure 5-2 shows a top view of the cabinet. Each corner of the cabinet has an M10 weld nut for attachment of eye bolts to lift the cabinet and support brackets for inter-cabinet connection, cable rack supports, and top cover attachment. If cable racks are

to be supported by the cabinets, this can be accomplished in one of two ways. Cable rack supports may be bolted to the facia brackets shown in Figure 5-3 or cable racks may be supported from 5/8" threaded rods. Order 847891264 M10 male/ 5/8" female adapters. Screw these into M10 weld nuts in the top of the cabinet to support 5/8" threaded rods.

The next step, after the cable racks are located, is to ground the cabinet framework. Local grounding practices will determine what type of grounding method is used and the size of the cable connected to the cabinet. A 2 gauge minimum conductor is recommended per Bell Laboratories Specification EIMP88NJ009 where the largest protector is 600A, minimum conductor voltage is 42V and the maximum length of the grounding conductor is 38 feet. Use an M8 x 25 mm long bolt, washer, lockwasher, and a single-hole terminal lug or double hole terminal lug with a 25 mm spacing for this connection.Refer to Table 3-5 and 3-6 for a lost of recommended terminal lugs and mounting hardware.

Central Office Ground

For systems with a distributed architecture, a CO (Central Office) ground should be connected. CO ground should be connected in the initial cabinet only as shown in Figure 5-2. This connection to building ground requires a M10 single or double hole terminal lug. Hardware is furnished with the cabinet, wire size is determined by local practices. Table 3-5 lists recommended terminal lugs.

Intercabinet Connections

Figure 5-3 shows the interconnection busing scheme between cabinets. Two T-shaped bus bars are connected where shown in figure 5-2. The large bus connects the right side (+charge return bus). The smaller bus connects to the left side (-charge bus). Insulated bus bars connect the T-buses of each cabinet together. The following hardware is provided for these connections:

(2)	847760196	Larger T-bus
(2)	847760204	Small T-bus
(2)	847720802	Insulated Bus
(16)	901263327	Bolt, M8 x 25 mm
(32)	901249821	Lockwasher, M8
(32)	901249813	Washer, M8
(16)	901249839	Nut, M8

Facia brackets are mounted to the front access corners of each cabinet using an M10 bolt, lockwasher, and washer. Brackets of adjoining cabinets are screwed together with two M8 bolts, lockwashers, washers, and nuts. A facia cover attaches to the brackets with four #8-32 nuts. Secure with a M9 or 11/32" nut-driver. The following hardware is provided for these conditions:

(1)	847837879	Facia Cover
(2)	847704913	Brackets
(4)	901015461	Nut, Hex 8-32
(2)	901284562	Bolt, M10 x 35mm
(2)	901845554	M10 Lockwasher
(2)	901284547	M10 Flat Washer
(2)	901263327	Bolt, M8 x 25mm
(2)	901249821	M8 Lockwasher
(4)	901249813	M8 Flat Washer
(2)	901249839	M8 Nut

If additional covers are desired to cover the sides or back, these must be ordered separately.

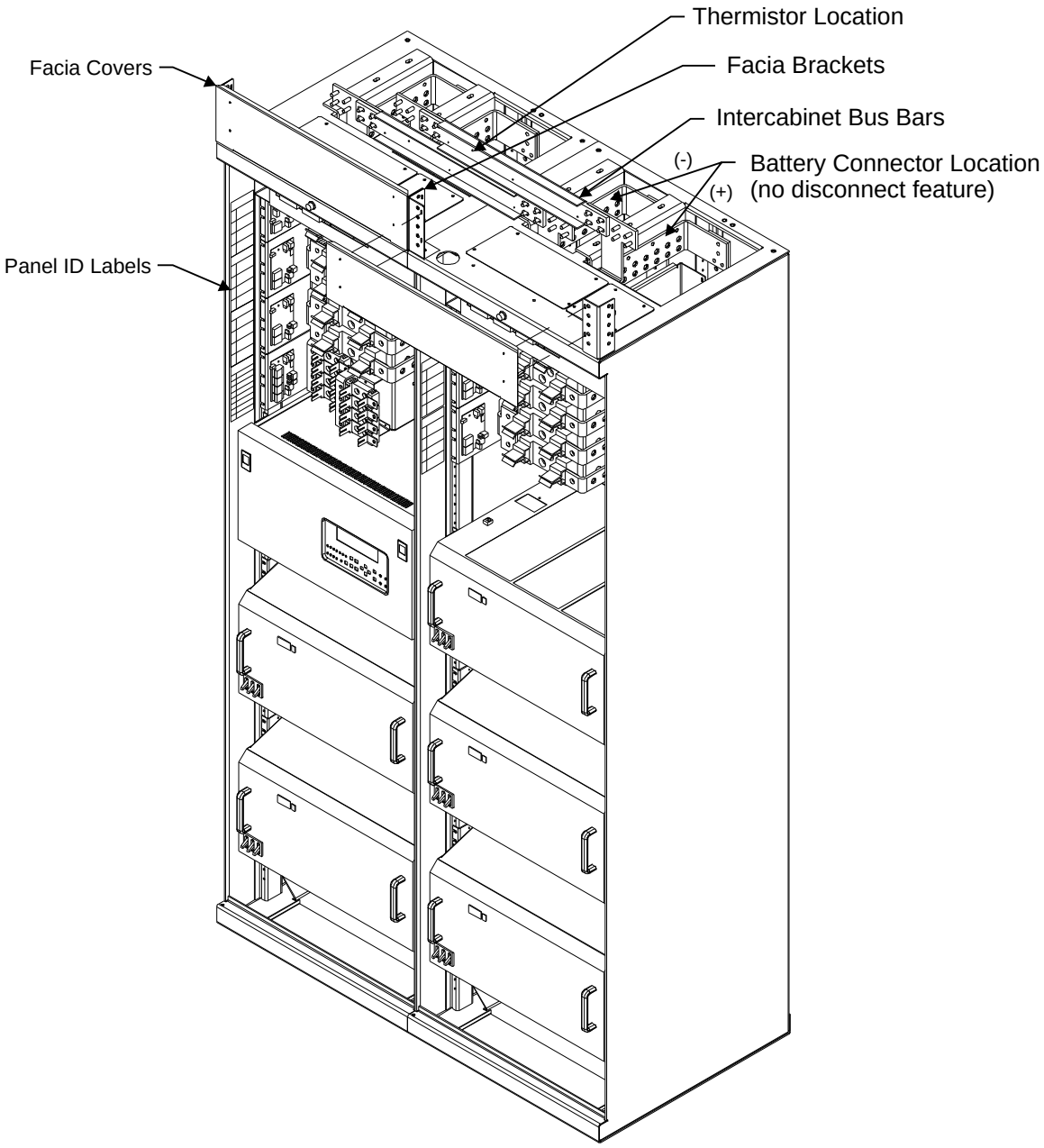


Figure 5-3: Intercabinet Bus Connections

BLJ1 Board Connections

The next step is to connect the alarm and signal cable, the thermistor cable, and the serial rectifier cable to the BLJ1 connector board. The alarm and signal cable and the serial rectifier cable connect between BLJ1 boards and adjoining cabinets. Connections are made from the previous cabinet and to the next cabinet to provide a communication path to and from the

controller. The thermistor cable is connected from a terminal block on BLJ1 to a thermistor mounted to the (+) charge return bus. The thermistor is attached to this bus bar where shown in Figure 5-3 using a 3.5mm screw. Trim the leads of the thermistor back to 1/2" in length. The thermistor cable simply plugs onto the thermistor leads. If the bus bar gets hot, a monitoring circuit on the BLJ1 lights a red LED and the frame alarm light at the top of the cabinet indicating too much current is flowing through the bus bar.

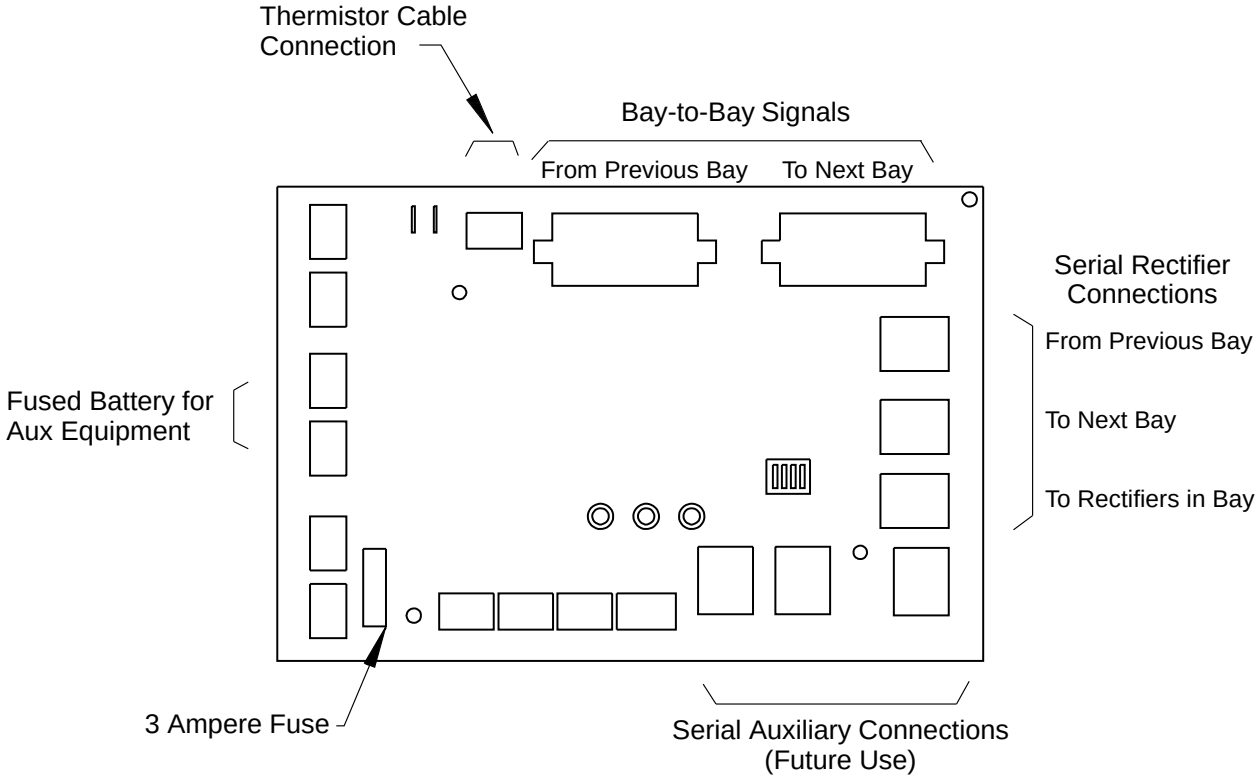


Figure 5-4: BLJ1 Board Connections

Route all cables through the intercabinet cable access hole shown in Figure 5-2. Secure the cables to the top of the cabinet at the cable tie points. The following components are furnished for these connections:

(3)	406954222	Cable Ties
(1)	847690799	Rectifier Serial Cable
(1)	847837911	Alarm and Signal Cable
(1)	847863164	Thermistor Cable
(1)	407519305	Thermistor
(1)	901230474	Screw, M3.5 x 8mm

Peripheral Modules

There are two types of peripheral modules: a 211C voltage peripheral module to monitor the status of each battery fuse and battery string voltage, and a 211F current module to monitor load shunts or battery shunts. The peripheral modules are mounted on the door as shown on Figure 2-2. Modules are comprised of two parts; an interconnection unit used to terminate all wiring, and a monitoring unit. Using two #6-32 nuts, secure the interconnection unit using an M5 or 5/16" nutdriver. Peripheral cable is provided with each module to interconnect modules. Connect all modules together as shown in Figure 5-5. Connect the first module to Bus 1 of the Galaxy controller and attach the 560 ohm, 10 watt terminating resistor to the last module.

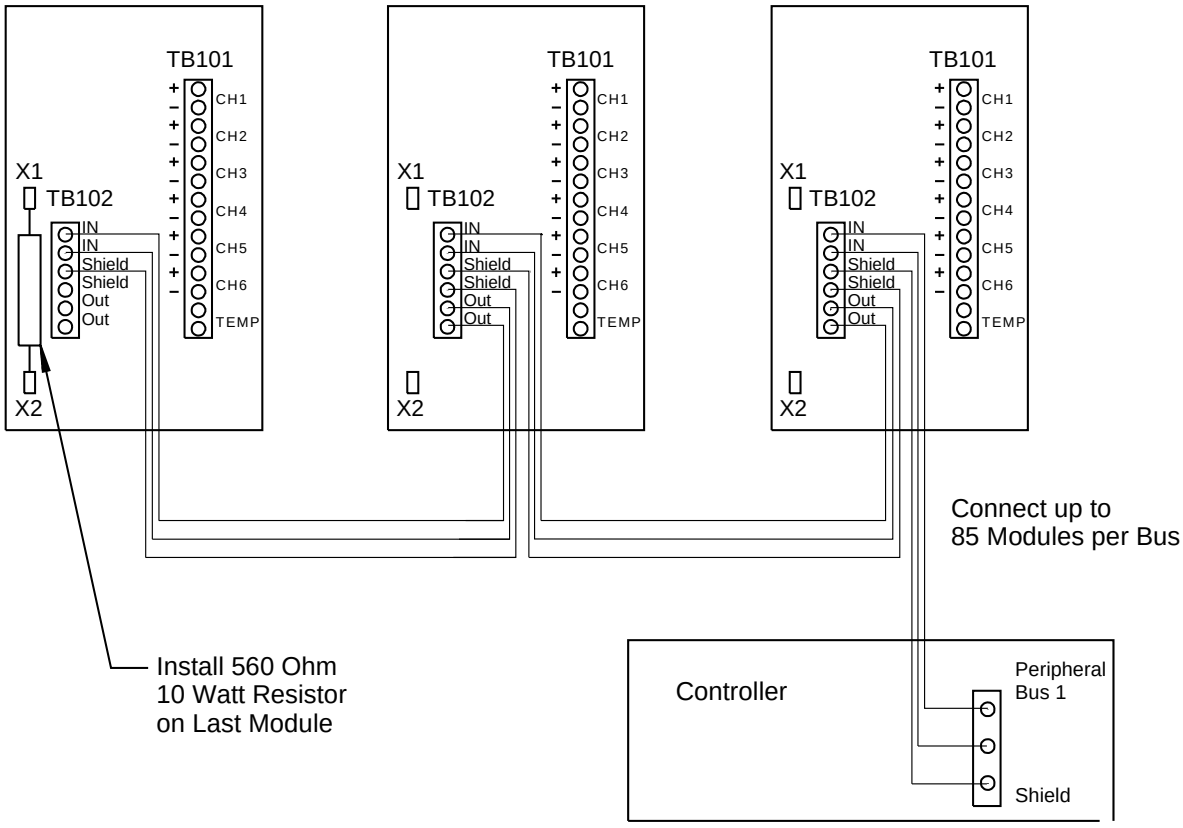


Figure 5-5: Peripheral Module Connections

NOTE: The location of the blue or white wire is interchangeable. Always connect the shield wire in the terminal marked shield.

On the last module, measure the resistance across the blue and white wires of TB102 input terminals. The measurement should be between 560 and 600 ohms.

Using a 20-22 gauge stranded wire and a jewelers screwdriver, wire channels of the peripheral module to the terminal cards of the battery fuse connection panels, the contactor boards of battery contactor panels, or the large circuit breaker panel as required. Refer to *Battery Connections* and *Load Connections* later in this section.

Each peripheral module requires a unique address for communications to the controller. The address is set by two switches (SW1-Hi and SW2-Low) located on the monitoring unit. The switches represent a hexadecimal address system. For example:

SW1-High=2
SW2-Low=D
(HEX address for this module is 2D)

A hexadecimal-to-decimal conversion table is provided in Table 5-2 for 100 module addresses.

NOTE: No two modules can have the same address. All addresses are valid except 00.

Table 5-2: Address Settings for Peripheral Modules

Module #	Switch Setting		Module #	Switch Setting		Module #	Switch Setting	
	SW1	SW2		SW1	SW2		SW1	SW2
1	0	1	35	2	3	69	4	5
2	0	2	36	2	4	70	4	6
3	0	3	37	2	5	71	4	7
4	0	4	38	2	6	72	4	8
5	0	5	39	2	7	73	4	9
6	0	6	40	2	8	74	4	A
7	0	7	41	2	9	75	4	B
8	0	8	42	2	A	76	4	C
9	0	9	43	2	B	77	4	D

Table 5-2: Address Settings for Peripheral Modules

10	0	A	44	2	C	78	4	E
11	0	B	45	2	D	79	4	F
12	0	C	46	2	E	80	5	0
13	0	D	47	2	F	81	5	1
14	0	E	48	3	0	82	5	2
15	0	F	49	3	1	83	5	3
16	1	0	50	3	2	84	5	4
17	1	1	51	3	3	85	5	5
18	1	2	52	3	4	86	5	6
19	1	3	53	3	5	87	5	7
20	1	4	54	3	6	88	5	8
21	1	5	55	3	7	89	5	9
22	1	6	56	3	8	90	5	A
23	1	7	57	3	9	91	5	B
24	1	8	58	3	A	92	5	C
25	1	9	59	3	B	93	5	D
26	1	A	60	3	C	94	5	E
27	1	B	61	3	D	95	5	F
28	1	C	62	3	E	96	6	0
29	1	D	63	3	F	97	6	1
30	1	E	64	4	0	98	6	2
31	1	F	65	4	1	99	6	3
32	2	0	66	4	2	100	6	4
33	2	1	67	4	3			
34	2	2	68	4	4			

Set the addresses of the modules using a jeweler’s screwdriver and attach them to their interconnection units. Secure the peripheral module to the interconnection unit with the two clips provided. On the space provided on the front of the monitoring unit, write the name of the monitored equipment and the module’s address.

After insertion of the peripheral monitoring circuit pack (BJM1) in the intelligent monitoring slot labelled RPM.BMJ of the controller, the modules will begin operating on controller power-up.

The modules will begin their initialization sequence. This is characterized by rapid flashing of the green LED (about four flashes per second) on the front of the module. This may take some time depending on the total number of modules. Once initialization is complete, the LED should stay lit with only a short (approximately one second) off time during the measurement cycle. A slow flashing of the green LED (about one per second) will occur if the address switches of the module is set to 00. In this case the module will never be recognized by the controller until the module is detached from the interconnection unit, a valid address is set on the switches, and then the module is re-attached to the interconnection unit.

NOTE: At any time, if the address of a module is to be set or changed, the module must be electrically detached from and then reattached to its interconnection unit before the address is recognized.

Configure any alarms or threshold information for the remote peripheral monitoring modules as described in the controller manual.

Adding or Replacing a Module

If adding a new module to the series of modules, simply wire the new module as described above. Move the terminating resistor from the present last module to the new last module. Set the module address as the next available in accordance with Table 5-2.

Replacing the monitoring unit of any module in the series will not affect data acquisition of the other units. If however, the termination unit must be replaced, data acquisition of the downstream modules will temporarily stop until the replacement unit is reconnected.

Troubleshooting

Table 5-3: Troubleshooting

Symptom	Possible Cause	Recommended Procedure
Module is not initialized (not monitoring)	Invalid Address	Verify unique module address (00 invalid)
Green LED flashes steady (approx. 1 second pulse)	Invalid Address - Module is not initialized	Verify unique module address (00 invalid)
Green LED stays on continuously (never flashes)	Module Failure	Run diagnostic on controller (replace module)
Measurement out of range	Excessive input voltage of reverse polarity	Verify input voltage for channel is less than the maximum. Verify that the channel is positive with respect to the negative (-) terminal
Module type conflict	Module type not as configured n software	Replace module with correct type or unlock and change software configuration

Connecting AC

The AC service cabinet providing power to each cabinet of the GPS 4824 shall provide connections to and distribution of either 200-240 Vac, three-phase , DELTA service (3W + PE) or 350-415 Vac, three-phase, WYE service (3W + N + PE) with a frequency range of 47-63 hertz plus protective earth ground.

AC wiring to each cabinet shall be a minimum of 6 gauge or 25mm^2 from a three-phase main AC circuit breaker rated at 63 or 70 amperes per phase for WYE service or a minimum of 2 gauge or 35mm^2 from a three-phase circuit breaker rated at 125 amperes per phase for DELTA service.

Follow these steps to connect AC to the GPS 4824. Review all safety statements before installing, maintaining, or troubleshooting the system:

Warning

Hazardous AC voltage. Use extreme caution when performing this procedure.

1. Check that all DC and AC circuit breakers are turned off (down).

2. Remove the cover to the AC input panel of each cabinet.

3. Each circuit breaker in the AC input panel is wired to a terminal board. The terminal has two connectors. Wiring from each rectifier connects to this terminal board in either the top connectors for WYE service or the bottom connectors for DELTA service. Verify that the connector is in the proper position for the AC service to be connected.

4. Figure 5-2 shows a removable cover with a 2 inch access hole at the top of the cabinet. Route the AC cables to each AC input panel. If the building code requires conduit, route the AC cables in a 1-1/2 inch conduit to each cabinet or in an AC duct mounted along the top of the cabinets.

5. Terminate earth ground and neutral (if WYE service is provided) to the appropriate termination point as shown in figure 2-5 using an 10mm socket wrench. Terminal lugs are listed in Table 3-5.

6. Using terminal lugs listed on Table 3-5, terminate lines 1, 2, and 3, and Neutral (if appropriate) to their connection points.

7. Turn the main AC circuit breaker on.

8. Use an AC voltmeter to check that proper AC voltage is present.

9. Replace the AC cover on the AC input panel. Repeat the above steps for each cabinet.

Battery Connection

If no battery fuse or contactor disconnect panel is provided, battery strings for each cabinet should be connected to the bus bars at the top of the cabinet as shown in Figure 5-3. Space is

provided for eight pairs of 4/0 or 150mm^2 cable connected with single or double hole terminal lugs and M10 x 25mm bolts, lockwashers and washers. Refer to Table 3-5 and 3-6 for terminal lugs and hardware kits. If the (-) bus is equipped with a shunt, this shunt will be factory wired if the cabinet is equipped with a digital meter panel. If not, there will be a cable assembly that the installer may connect to a 211F current peripheral module.

Low Voltage Battery Disconnect Contactor Modules

Danger

This procedure applies power to the system. Before contacting any un-insulated conductor surfaces, always use a voltmeter to insure that no voltage, or the expected voltage is present.

1. Set the bottom switch on the contactor control board to the up position. Set the top two switches to the down position. This should cause the contactor the stay open even after the battery string(s) are added. See Figure 2-15.

2. Connect the battery cables to the battery disconnect module. Refer to Figures 2-8 and 2-9. Depending on the panel type, there are one or two contactor battery sections. Each battery section has space for eight pairs of 4/0 or 150mm^2 cables connected with a single-hole or two-hole terminal lug and M10 x 25mm bolts, lockwashers, and washers. Refer to Table 3-5 and 3-6 for terminal lugs and hardware kits.

3. Terminate the cables at each battery string according to the manufacturer's documentation.

4. If connecting power to GPS 4824 for the first time, closing the bottom switch on the control board will close the contactor and apply battery power to the system. This will power the controller. The controller disconnect and reconnect voltage settings along with any other controller configurations may be completed.

5. Connect additional battery strings as described in steps 1, 2, and 3.

6. If the battery string voltages are below the desired float voltage, power up the rectifiers in the cabinet to charge the batteries to the float voltage desired. Closing the bottom switch on each control board will close the contactor.

7. Once the batteries are at the float voltage, move the top two switches to the up position, then move the bottom switch to the up position. This will enable the controller to monitor and control the low voltage disconnect setting.

8. With the system powered up, disconnecting a battery section may be accomplished by setting the two top switches on the control board to the down position.

9. If a 211F current peripheral module is equipped, wire 18-22 gauge wire to TB301-2, -3 terminals on the control board to access the "+" and "-" shunt signal of the battery shunt.

Fused Battery Disconnect Modules

1. Confirm that no fuses are inserted in the battery connection module fuse holders. Remove the 1/2 amp fuses from the alarm card.

2. Connect the battery cables to the battery disconnect module. Refer to Figure 2-6 and 2-7. Depending on the panel type, there are either one or two fused battery sections. Each battery section has space for eight pairs of 4/0 or 150mm^2 cables connected with a single-hole terminal lug and M10 x 25 mm bolts, lockwashers, and washers. Refer to Table 3-5 and 3-6 for terminal lugs and hardware kits.

3. Terminate the cables at each battery string according to the manufacturer's documentation.

4. Install NH3 size fuse(s) in the fuse holder(s). The fuse size should be determined by engineering based on the battery size and rating. Reinsert the 1/2 amp alarm fuses in the alarm card.

5. Identify the battery type and location of the batteries on the label provided. See Figure 5-3.

6. If 211C voltage peripheral modules or 211F current peripheral modules are equipped, they may be wired to the terminal cards on the battery panels using 18-22 gauge wire. Refer to Tables 2-2 for terminal designations.

Load Connections

Danger

Battery voltage is present. Remove all jewelry and use only insulated tools.

Warning

Alarms will be issued during the installation process. notify the alarm reporting center that alarms will be received.

1. For fused distribution, verify that no fuses are inserted in the DC distribution panel. Remove the 1/2 amp alarm fuses from the alarm card.

2. For small distribution panels with snap-on fuses or circuit breakers ordered per Table 3-2, install fuse holder or circuit breaker

3. Run paired leads (supply and return) to each load from the circuit breaker or fuse holder and charge return bus.Refer to Tables 3-5 and 3-6 for terminal lugs and hardware kits.

Warning

Before applying power to any individual load, follow the powering up instructions as provided by the associated load equipment documentation.

4. For fused distribution, install NH2 or NH00 size fuses in the fuse holders. Fuse size should be determined by engineering based on the load equipment specifications. Reinsert the 1/2 amp load fuses in the alarm card.

5. Identify the load and its location on the identification labels provided. See Figure 5-3.

6. For the large circuit breaker panel, there are load shunts on each circuit breaker. To monitor these shunts with a 211F current peripheral module, connect 18-22 gauge wire between the 211F and the terminal card of the circuit breaker panel per table 2-3.

Rectifier Turn Up

Figure 5-4 shows the switches and display lights on the 570A rectifier and the information communicated between the controller and rectifier on the serial interface cable. The rectifier is shipped separately from the cabinet and must be field installed. The following steps are necessary to install and turn on a rectifier.

CAUTION:

The rectifier weighs 110 lbs (50 kg). Two people are required to install rectifiers.It may also be necessary to temporarily detach the front door of the cabinet while inserting rectifiers. This is accomplished by pulling the release lever at the top hinge point of the door.

1. Verify the rectifier circuit breaker is off and the ON/STBY switch is in the STBY position. Verify that the AC circuit breaker for the rectifier position into which the rectifier will be placed is in the OFF position.

2. Insert the rectifier into the 1st (lowest) rectifier bracket in the cabinet. Fasten the rectifier to the cabinet with ten M5 x 12mm mounting screws provided with the rectifier. The AC cable , DC cable and serial communication cable that were shipped with the cabinet should be plugged into the top of the rectifier as shown in Figure 2-4

3. Turn the AC circuit breaker feeding rectifier 1 on. Note the leftmost AC circuit breakers in the AC panel is for the lowest mounted rectifier. All lights should illuminate and the display should read "8.8.8." for approximately 10 seconds. All lights should extinguish except for the "STBY" light and a blinking "ALM" light. The blinking "ALM" light indicates that communication has not as yet been established. If the controller is already powered from

batteries, communication with the rectifier should be established in approximately 20 seconds and the blinking "ALM" light should extinguish.

4. Repeat steps 1-3 for each rectifier in GPS 4824.

5. Moving the switch on the rectifier from "STBY" to "ON" and closing the rectifier DC output circuit breaker allows the rectifier to provide DC power.

6. Install the rectifier air baffle shipped with the rectifier between rectifiers. The topmost rectifier does not require a baffle. This baffle may be discarded. Us an 8mm (5/16") nutdriver and four 5 x 12mm mounting screws shippe with the rectifer to secure the air baffle.

The rectifiers communicate with the controller via a plug-and-play digital interface. The rectifier identifies itself to the controller by transmitting its type and serial number, and the controller then sets the output voltage to a pre-established value. No settings or adjustments to potentiometers are necessary. The installer must set the rectifier's ID using the ON/STBY switch, to allow the controller to learn the rectifiers physical location..

Table 5-4: 570A Rectifier Control and Monitoring

VISUAL INDICATORS	
ON	Green LED
STBY (Standby)	Yellow LED
ALM (Alarm)	Red LED
LIM (Limit)	Yellow LED
EQL (Equalize)	Yellow LED
CONTROL SWITCHES	
ON/STBY/ID	Rectifier operating or in standby or configuring physical location address
Meter	Voltage or current selection
SERIAL INTERFACE SIGNALLING (Controller to Rectifier)	
Remote sense	
Load share	
Voltage set points	

Table 5-4: 570A Rectifier Control and Monitoring

Current set points
Selective high voltage shutdown set points
Float/Boost/Equalize mode
High voltage shutdown
ON/STBY
SERIAL INTERFACE SIGNALLING (Rectifier to Controller)
Rectifier current
Rectifier Temperature
Serial number
Manufacturing information
Rectifier Fail Alarm (RFA)
DC Circuit Breaker trip (CB)
ON/STBY
AC Fail Alarm (ACF)‘
Phase Fail
Thermal Alarm (TA)
Internal selective high voltage shutdown

Configuring Rectifier ID

1. Enter the program mode by depressing the switch for 5 seconds (until the display status starts blinking).
2. To change the ID, depress and release the switch until the desired ID is displayed. No two rectifiers can have the same ID number.
3. To cancel the change, release the switch.
4. To store the new ID, depress the switch for 5 seconds (until the display stops blinking).

Troubleshooting

The toggle switch on the 570A rectifier controls the rectifier’s three-digit display. This display indicates the current and voltage status of the rectifiers. Upon specific no power conditions, the display will show informative messages (See Table 5-5).

Table 5-5: 570A Rectifier Display Messages

Display	Definition
A C F	ACF
O F F	Output Circuit Breaker Manually Opened
P F	Phase Fail
H O	High Output (Rectifier Shutdown with HV RFA)
T A	Thermal Alarm (Rectifier Shutdown RFA)
C B	Output Circuit Breaker Tripped (Rectifier Shutdown With RFA)
7 0 A	Internal Error (Rectifier Shutdown With RFA)
A L L	Internal Error (Rectifier Shutdown With RFA)
T R	Rectifier Remotely Turned Off.

Controller Circuit Packs

Refer again to figure 2-3 for this section. The controller contains two types of plug-in circuit packs. Some of the circuit packs are always required and provide BASIC controller functions. the other circuit packs add INTELLIGENT features such as a modem, data switch, TL1 communications protocol, remote peripheral monitoring (RPM), to name a few. these circuit packs are optional and field installed as needed by individual users. The following summarizes the circuit packs and their function:

Basic

1. BJA1 (Basic Controller Power Board): Provides the power required by the basic controller, and provides the hardwired high voltage (HV) detection and shutdown circuitry.

2. BJB1 (Basic Controller Digital Board): Contains the microprocessor, memory, serial interface, ship select logic, and other digital components use by the basic controller.

3. BJC3 (Serial Rectifier Interface Board): Provides serial interface switch mode rectifiers. The BJC3 can control up to twenty four serial interface rectifiers.

4. BJE2 (Relay/Alarm/Display Driver Board): Contains the remaining circuitry required by the Basic Controller. The circuit pack has isolation circuits to receive contact closures from other parts of the plant such as external fuse alarms, TR leads, and external timer float and boost leads. It also contains the alarm relays such as power major and power minor. The circuit pack also contains the interface circuits to the front panel display board (BJG1). It also contains form C contacts that may be used for external contactor control.

5. BJF3 (Termination Fuse Board): Contains the input power terminal blocks and fuses for the controller.

6. BLG1 (Front Access Board): This board mounts on top of the rest of the circuit packs internal to the chassis. It provides front access connections to all the customer's alarm wiring and signaling inputs.

7. BJG1 (Display Board): This board, which is mounted inside the front door, contains the switches, LEDs and eight-line display for the front panel, providing the primary user interface for the controller.

Intelligent

1. BJJ1 (Intelligent Controller Power Boards): Required for any intelligent features, this board provides power to the intelligent controller board and intelligent option boards.

2. BJH1/2 (Intelligent Controller Board): This board is required for all the Intelligent functions of the Galaxy Controller. It contains the microprocessor, memory, real time clock, serial interface, and interface circuitry to the other intelligent circuit packs. This board enables "intelligent" features, including alarm history, battery reserve time prediction, peripheral monitoring and control, etc.

3. BJL2 (Modem Board): Required for data access over telephone lines, this board provides the modem circuitry needed to interface the controller from a remote location over the switched telephone network at up to 14,400 baud.

4. BJM1 (Peripheral Monitoring Board): Required for any peripheral monitoring or control, this board provides interface circuitry for up to 255 remote monitoring

modules, allowing connections to as many as 1,530 monitoring points.

5. BJK1 (Data Switch): This board is required to operate the Data Switch, an optional interface with Lucent Technologies's XCS, ECS, RAS, and OMNIpulse units. Data Switch allows call-in and call-out access to as many as four RS-232 devices via the Galaxy access ports.

Circuit boards on the basic side of the controller may be "hot-inserted". Circuit boards on the Intelligent side of the controller require that the Intelligent Controller Power Board (BJJ1) be unseated before installation. Install all intelligent board options.

Controller Wiring and Power-Up

Once batterires are connected and/or the rectifiers are turned on, the controller should power-up.Refer to Section 3 of the Galaxy Controller Manual for wiring and power-up procedures

Display Language

You can view the information on the display in one of three languages. The default choice, called Symbol, uses short versions or acronyms of English words. The second choice is English, which uses longer English phrases. The third option is reserved for Spanish. To change the display language, first make sure that the default screen is on (one quick way to get the default screen is press <MENU> key to display the MAIN menu, then press the <ESCAPE> key). Then enter the following key sequence: <ESCAPE>, then <+> key, then <DOWN ARROW> key, then <ESCAPE> key, all within 10 seconds.

Refer to the Controller Manual, Section 4 to configure the alarm and control functions of the controller.

Controller Testing

Refer to Section 5 of the Controller Manual for this testing procedure.

Troubleshooting

Refer to Section 8 of the Galaxy Controller Manual for information on troubleshooting.

6 *Spare Parts*

Table 6-1: Spare Parts for GPS 4824

Spare Parts	
Ordering Comcode	Description
406204230	3 Amp GMT Fuse
405673161	1/2 Amp panel alarm fuse
407227172	Cabinet fuse alarm lamp

Spare parts for the Galaxy Controller are listed in Appendix E of the Galaxy Controller Manual (167-792-110)

Replacement parts for the GPS 4824 are listed in Section 3.

7 Specifications

Table 7-1: 570A Rectifier Specifications

INPUT	
Voltage Range	380 - 480 Vac, WYE, 4-wire, 184-277 Vac Delta, 3-wire
Frequency Range	47 - 63 Hz
Power Factor	> 0.98 for loads > 50%
Harmonic Distortion	< 10% for loads > 50%
OUTPUT	
Output Current	100 amperes
Float/Boost Voltage	44 -57 Vdc
Equalize Voltage	58 - 65 Vdc
Regulation	±0.5%
Ripple	100 mVrms
Noise	< 2mV Psophometric
Permanent Overload	110A
Current Limit Set Point	30A - 110A
Current Limit Set Point in Equalize	30A - 55A

Table 7-1: 570A Rectifier Specifications

MECHANICAL	
Width	546 mm (21.5 in)
Height	432 mm (17 in) (includes baffle)
Depth	508 mm (20 in) (includes handles)
Weight	50 kg (110 lbs)
ENVIRONMENTAL	
Efficiency	> 90% typical
Operating Temperature	0°C to 40°C
Short Term Operating Temperature (5 hour maximum)	-5°C to 45°C
Operating Relative Humidity	5% to 85%
Short Term Operating Relative Humidity	5% to 90%
Storage Temperature	-25°C to 55°C
Storage Relative Humidity	10% to 100%
Altitude (note about derating)	-50 to 4000 meters (Note 1)
Audible Noise	< 45dBA
Heat Dissipation	545 W 1860 BTU
EMC	EN 50022, level B, conducted and radiated (CISPR 22)
SAFETY	
Safety Standard	EN 60950 (IEC950)
Certification Marks	UL, TUV

Note 1: For altitudes above 1500 meters, de-rate the temperature by .656° Celsius per 100 meters.

Table 7-2: GPS 4824 Specifications

PHYSICAL	
System Output	
System Voltage	-48 Volt
Output Current	200 - 2400 Amperes
Cabinet	
Cabinet Dimensions (H X W X D)	2275 X 600 X 600 mm
Initial Cabinet Weight (2 Rectifiers)	300 kg (660 lbs)
Supplemental Cabinet Weight (3 Rectifiers)	340 kg (750 lbs)
Units Per Initial Cabinet	
Rectifiers	1 - 2
Controller	1
Battery Disconnect Modules	0 - 1
DC Distribution	1 - 4 (Maximum of 3 with Battery Disconnect)
Units Per Supplemental Cabinet	
Rectifiers	0 - 3
Battery Disconnect Modules	0 - 1
DC Distribution	1 - 3 (Maximum of 2 with Battery Disconnect)
AC Input	
WYE Input Distribution	63 or 70 ampere circuit breaker feed into each cabinet
DELTA Input Distribution	125 ampere circuit breaker feed into each cabinet
WYE Wire Size	Minimum 6 gauge or 25 mm^2 size cable to each cabinet

Table 7-2: GPS 4824 Specifications

DELTA Wire Size	Minimum 2 gauge or 35 mm^2 size cable to each cabinet
Rectifier Input	30 ampere circuit breaker feed to each rectifier
DC Distribution	
1 X DIN Fuse Holder (NH3) with Shunt	
2 X DIN Fuse Holder (NH8) with Shunt	
6 x 125-600A Circuit Breakers	
13 x 0-100A Snap-On Circuit Breakers or Fuses	
21 x 00-100A Snap on Circuit Breakers or Fuses	
Battery Disconnect Module	
2 X Din Fuse Holder (NH2)	
8 X DIN Fuse Holder (NH00)	
1 x 1200A Contactor with Shunt	
2 x 600A Contactor with Shunt	
ENVIRONMENTAL	
Operating Ambient Temperature	0°C to 40°C
Altitude	-50 to 4000 meters (Note 1)
Humidity	5% to 85% non-condensing
Radiated and Conducted Emissions	EN50082-1, EN50082-2
Electromagnetic Immunity	Level B
Earthquake Rating	Zone 4, upper floors
SAFETY	
Agency Approvals	**CE** Marked, UL

Note 1: For altitudes between 1500 and 4000 meters, de-rate the maximum temperature by 0.656°C per 100 meters.

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.

H. 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.