



OPS 24/800 Power Cabinet

Product Manual
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Notice:

The information, specifications, and procedures in this manual are subject to change without notice. Lineage Power assumes no responsibility for any errors that may appear in this document.

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1 *Introduction*

Overview

Lineage Power developed the Outdoor Power System (OPS) 24/800 Power Cabinet to support +24 volt outdoor telecommunications powering solutions in worldwide markets. The OPS 24/800 combines the use of 100-ampere, fan-cooled, switchmode rectifiers, microprocessor control and monitoring technologies, fused battery options with low voltage disconnect/reconnect, and circuit breaker dc and ac distribution options in a modular fan-cooled power cabinet design.

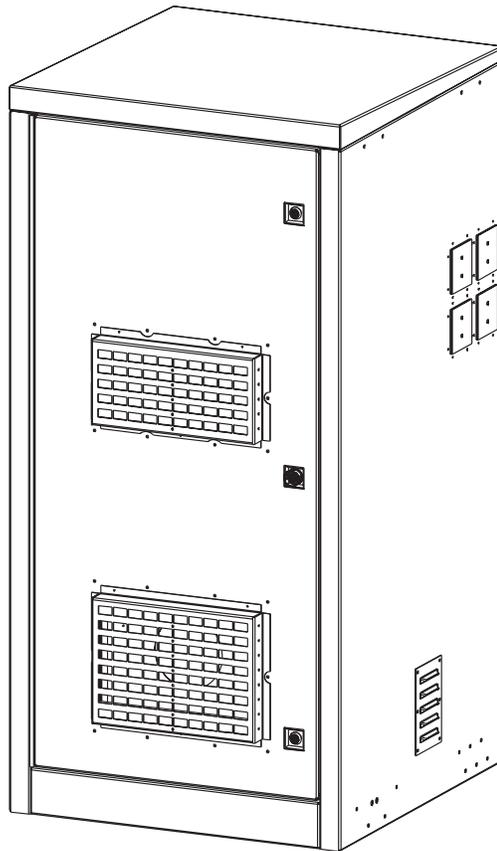


Figure 1-1: OPS 24/800 Power Cabinet

The power cabinet is a weatherproof enclosure equipped with a comprehensive heat exchanger allowing the electronics compartment to be sealed completely from both the external environment and the battery compartment. The separate vented battery compartment uses a combination of fans and battery heaters in its ventilation system, allowing the cabinet to function throughout the -40°C to $+46^{\circ}\text{C}$ standard outdoor temperature range. The modularity of the system design ensures easy access, simplified installation and maintenance, and allows the system to expand in capacity and features as power needs grow.

One or two optional supplemental battery cabinets may be added to a power cabinet to provide increased reserve time. The battery cabinet enclosure is similar in appearance and design to the power cabinet. Like the battery compartment of the power cabinet, the supplemental battery cabinet uses a combination of fans and battery heaters for its ventilation system, all controlled and monitored by the power cabinet circuitry. Additional battery strings and/or cabinets may be added to working systems as load and reserve time requirements dictate.

With 800-ampere maximum capacity, distribution flexibility, and universal ac input capability, the OPS 24/800 is the ideal solution for the outdoor wireless applications of both today and tomorrow, providing users with efficient, high-performance technology.

Customer Service Contacts

Customer Service, Technical Support, Product Repair and Return, and Warranty Service

For customers in the United States, Canada, Puerto Rico, and the US Virgin Islands, call 1-800-THE-1PWR (1-800-843-1797). This number is staffed from 7:00 am to 5:00 pm Central Time (zone 6), Monday through Friday, on normal business days. At other times this number is still available, but for emergencies only. Services provided through this contact include initiating the spare parts procurement process, ordering documents, product warranty administration, and providing other product and service information.

For other customers worldwide the 800 number may be accessed after first dialing the AT&T Direct country code for the country where the call is originating, or you may contact your local field support center or your sales representative to discuss your specific needs.

Customer Training

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

Downloads and Software

To download the latest product information, product software and software upgrades, visit our web site at <http://www.lineagepower.com>

2 *Product Description*

Overview

Figure 2-1 is a block diagram of the OPS 24/800 Power Cabinet, showing the interconnections and signal flow among the major components. Figures 2-2 and 2-3 provide front and rear views of the cabinet with the door open and access panels removed showing the components inside them.

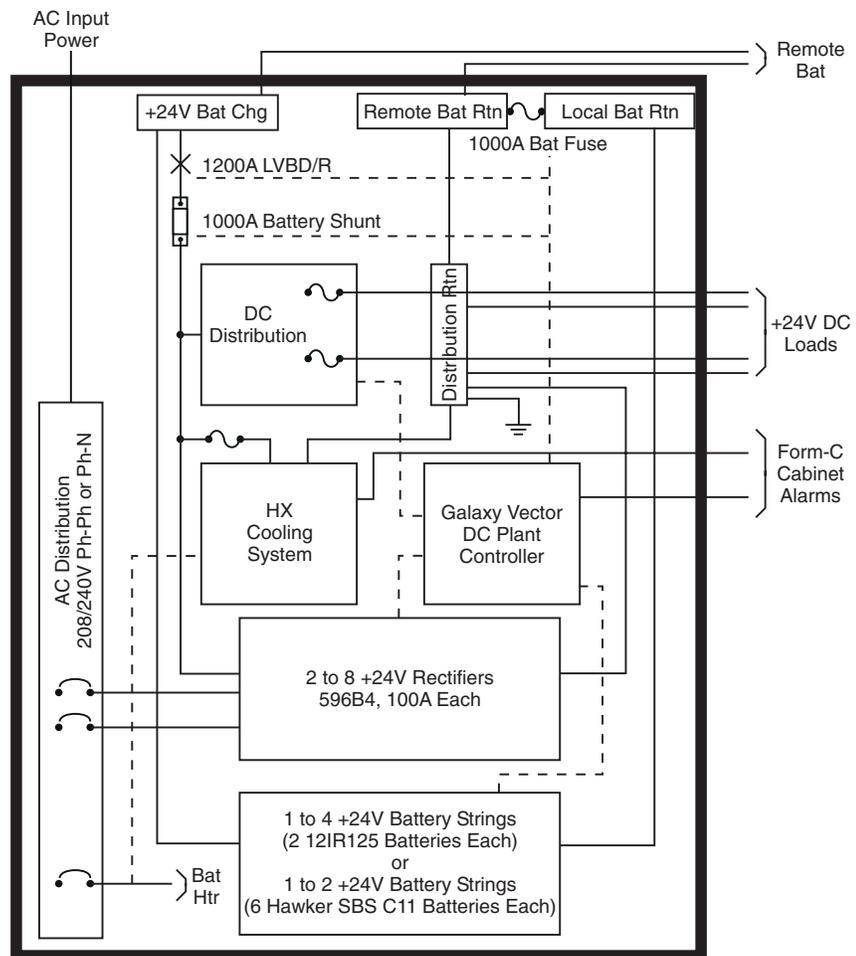


Figure 2-1: Block Diagram

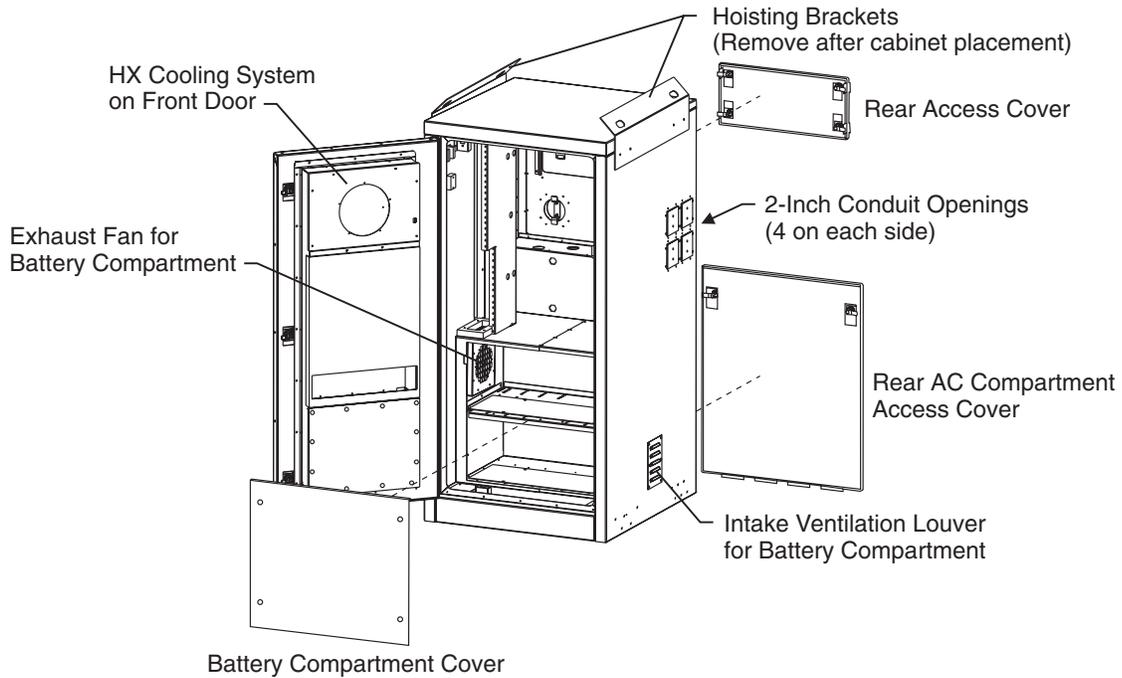


Figure 2-2: Front View, Door and Battery Compartment Access Open

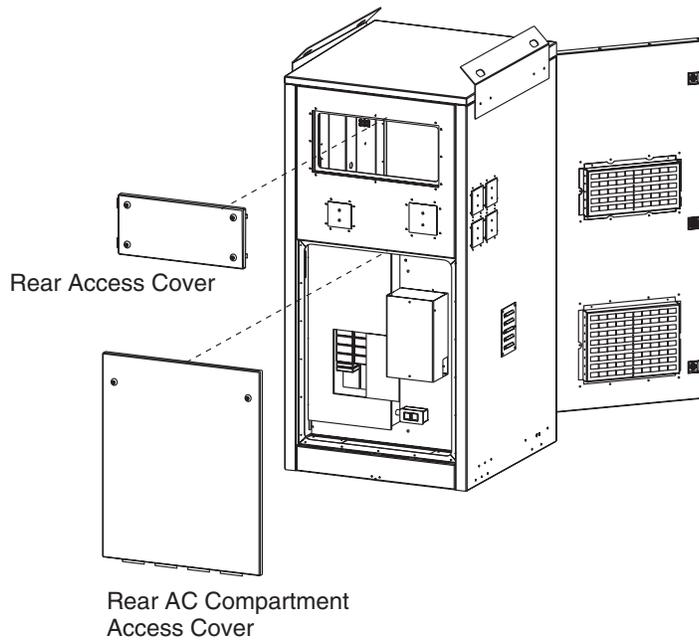


Figure 2-3: Rear View, Rear and AC Compartment Access Open

System Components

AC Input Panel The AC Input Panel, located in the rear AC Compartment, accepts 240/120Vac 1-phase (2W + N), or 200-240/155-138Vac 3-phase (3W + N) AC input service and is factory-equipped with breakers and wired for the 8 rectifier positions, battery heaters, and AC convenience outlet of the power cabinet. Open positions on this panel are available for service to battery heaters of supplemental battery cabinets and AC loads for customer equipment cabinets as necessary. Refer to T-drawing for location and rating.

Rectifiers 2 to 8 Rectifiers may be equipped on the 2 rectifier shelves of the OPS 24/800 Power Cabinet to convert the ac source voltage into the +24V DC voltage level used to charge and float the batteries of the power cabinet and to power the using equipment. The 596B4 100-ampere rectifier used in this system operates from 2-wire, single-phase ac service with a phase-to-phase or phase-to-neutral voltage within the range of 176-256Vac. The rectifiers are shipped separately from the cabinets for quick and straightforward installation into rectifier shelves at the site. Interconnections to AC input, DC output, and control signals occur automatically during insertion. No settings or adjustments to potentiometers are necessary during installation, only setting the rectifier's ID using the ON/STBY switch to allow the controller to learn the rectifier's physical location.

Batteries Batteries are located in parallel to the rectifiers and system distribution to provide energy storage so that service to the +24V powered load equipment is not interrupted with the loss of AC input service or rectifier failure. Two battery shelves, located in a separate compartment at the bottom of the OPS 24/800 Power Cabinet, can support up to 4 strings of Lineage Power model 12IR125 batteries (8, 12V modules), or 2 strings of Hawker SBS C11 batteries (12 modules). Quick-disconnect connectors for each string are located in the upper rear compartment allowing each string to be individually isolated for service or maintenance activities. Positions on the plant busbars are also reserved for use with supplemental battery cabinets (up to two cabinets with up to 10 strings per cabinet) to provide increased reserve time when the load or service requirements warrant it. The batteries in the

power cabinet are protected against a short-circuit fault with a 1000 amp battery fuse (separate 1000 amp fuse is provided in the battery cabinet) and all batteries in the system are protected against a deep discharge event with a low voltage battery disconnect/reconnect (LVBD/R) contactor. A battery shunt monitors total battery charge or discharge current in the system to allow the plant load to be properly reported at all times on the plant controller.

DC Distribution

2 types of DC distribution panels are available for the OPS 24/800 Power Cabinet and space is available for 2 of these panels in the cabinet. A 14-position panel using the plug-in breaker style (3-100A) and a 10-position panel using the bullet breaker style (3-100A) may be used. The larger sizes of the plug-in breakers require two positions on that panel, and the plug-in panel is limited to 400 amps total load capacity per panel, where the bullet panel load capacity is 510 amps per panel. The bullet panel therefore is more suited for service to a smaller number of larger loads and the plug-in panel for a larger number of smaller loads. There is also a common distribution return bus (that is grounded) with 2-position stud assignments for crimp lug connections for return conductors. DC distribution exits the power cabinet through any of the 4 available conduit openings on either side arranged for use with 2-inch Liquid Tight Flexible Metal (LFML) conduits.

***Galaxy Vector
Controller***

A Galaxy Vector controller provides monitoring, control, and alarm functions for the OPS 24/800 Power Cabinet system, using a digital serial interface for communication with the plant rectifiers. This control includes the setting of output voltage, current limit, high voltage shutdown, rectifier restart, sequencing, battery thermal compensation, low voltage battery disconnect, battery discharge test, and alarm threshold levels. The Galaxy Vector provides plant voltage and load values and visual alarm and plant status on the user display, along with Form C or transfer type contacts for processing the various alarm conditions of the power system to a user-provided alarm processing system. Maximum ratings for alarm relay connections are 60Vdc and 0.5 amperes. The setting of all controller configuration parameters to values appropriate for use in the OPS 24/800 system may be accomplished using a single dip switch at controller power-up or all parameters may be adjusted manually if desired.

Heat Exchanger

A Heat Exchanger (HX) cooling system is located on the inside of the cabinet door for the electronics compartment. It uses variable speed DC driven fans to circulate both internal cabinet air and external ambient air through separate front door ductwork compartments where the heat generated by the plant rectifiers is released. The electronics compartment is sealed completely from the outside air, providing a contaminant free environment for the electronic components.

The HX controller also monitors temperatures and voltage in the separate vented battery compartment to help prevent hydrogen build-up. It uses a combination of forced-air cooling to the outside air, and battery heaters in this ventilation system to maintain the battery temperature at a level to maximize both battery capacity and life. Both visual alarms and Form C or transfer type contacts are used on the HX controller for processing alarm conditions of the HX system to a user-provided alarm processing system. Maximum ratings for alarm relay connections are 60Vdc and 0.5 amperes.

Specifications

Table 2-1: OPS 24/800 Outdoor Power Cabinet Specifications

Electrical	
AC Input	
Input Distribution	125A circuit breaker (200-240/115-138Vac, 3-phase + N) or 150A circuit breaker (240/120Vac, 1-phase + N system) feed into each cabinet
Wire Size	Minimum 2/0 (phase conductor + N), Minimum 4 AWG equipment ground conductor each cabinet
System Output	
System Voltage	+24
Output Current	100 - 800 amperes
Mechanical	
Cabinet	
Nominal Cabinet Dimensions (H x W x D)	68" (1727mm) x 33" (838mm) x 35" (889mm)
Weight	674 lb (306 kg) Weight does not include batteries or rectifiers.
Units Per Power Cabinet	
Rectifiers	1 - 8
Battery Strings	1 - 4
Controller	1
Battery Short Circuit Fuse	1 (1000A)
Environmental	
Operating Ambient Temperature	-40°C to +46°C
Altitude	-50 to 4000 meters
Humidity	5% to 90% Indoor and inside cabinet electronics compartment, non condensing 5% to 100% Outdoor, outside the cabinet
Radiated and Conducted Emissions	FCC Rules & Regulations (Title 47, Code of Federal Regulations) Part 15, Class B Telcordia Technologies GR-001089-CORE 1-1994 EN5022 (CISPR22) Class B
Immunity	EN55024:1998 - Which includes IEC/EN61000-4-2 (ESD), IEC/EN61000-4-3 (Radiated), IEC/EN61000-4-4 (EFT) pending, IEC/EN61000-4-5 (Surge) pending, IEC/EN61000-4-6 (Conducted), and IEC/EN61000-4-11 (Voltage Dips, Interruptions, and Variations) pending; Some testing performed above EN55024 requirements.
Earthquake Rating	Zone 4, upper floors
Standards Compliance	
Agency Approvals	eULus Listed: UL60950/C22.2 No. 60950-00 Third Edition + UL Application Guideline: Certification of Information Technology Equipment Installed Outdoors; TUV-GS Licensed (pending): EN60950 Third Edition + IEC60529: 1989+A1: 1999 (IP44 Classification); CE Marking (pending): Council Directives 73/23/EEC and 89/336/EEC as amended by Directive 93/68/EEC

Table 2-2: OPS 24/800 Outdoor Battery Cabinet Specifications

Electrical	
System Output	
System Voltage	+24
Output Current	See Table 2-5
Mechanical	
Cabinet	
Nominal Cabinet Dimensions (H x W x D)	68" (1727mm) x 33" (838mm) x 31" (787mm)
Weight	400 lb (181 kg) Weight does not include batteries.
Units Per Cabinet	
Rectifiers	0
Battery Strings	1 - 10
Controller	0
Battery Short Circuit Fuse	1 (1000A)
Environmental	
Operating Ambient Temperature	-40°C to +46°C
Altitude	-50 to 4000 meters
Humidity	5% to 100% Outdoor, outside the cabinet
Radiated and Conducted Emissions	FCC Rules & Regulations (Title 47, Code of Federal Regulations) Part 15, Class B Telcordia Technologies GR-001089-CORE 1-1994 EN5022 (CISPR22) Class B
Immunity	EN55024:1998 - Which includes IEC/EN61000-4-2 (ESD), IEC/EN61000-4-3 (Radiated), IEC/EN61000-4-4 (EFT) pending, IEC/EN61000-4-5 (Surge) pending, IEC/EN61000-4-6 (Conducted), and IEC/EN61000-4-11 (Voltage Dips, Interruptions, and Variations) pending; Some testing performed above EN55024 requirements.
Earthquake Rating	Zone 4, upper floors
Standards Compliance	
Agency Approvals	cULus Listed: UL60950/C22.2 No. 60950-00 Third Edition + UL Application Guideline: Certification of Information Technology Equipment Installed Outdoors; TUV-GS Licensed (pending): EN60950 Third Edition + IEC60529: 1989+A1: 1999 (IP44 Classification); CE Marking (pending): Council Directives 73/23/EEC and 89/336/EEC as amended by Directive 93/68/EEC

Table 2-3: 596B4 Rectifier Specifications

Electrical				
Input				
Voltage Range	176-256Vac, 2-wire, single phase			
Frequency Range	47 - 63 Hz			
Power Factor	> 0.98 for loads > 50%			
High Voltage Shutdown				
Internal Selective High Voltage Shutdown (ISHVSD)	596B4	Float	28.75V	Nom. ¹
	596B4	Boost	28.75V	Nom. ¹
Backup High Voltage Shutdown ² (BUHVSD)	596B4	Boost/Float	29.76Vdc	Nom.
¹ Factory default setting – actual range is 22 - 30Vdc				
² Hardwired feature in rectifier – range is 29.275 - 30.265Vdc				
Rated Service Entrance Surge Protector: It is important that the service entrance surge protector (if provided) be coordinated with the internal surge protection and that it clamps at a lower voltage than the internal protection. The internal protection of the 596B4 has the following voltage and current characteristics:				
<u>Phase to Phase Voltage</u>	<u>MOV Conduction Current</u>			
320Vac (RMS)	0A			
565Vpeak maximum clamping	1mA (DC test current)			
850Vpeak	100A peak (8 x 20µs)			
Output				
Output Current (Max.)	110 amperes maximum (-40°C to +65°C)			
Float/Boost Voltage	22-29Vdc			
Total Harmonic Distortion	10% at Nom. Line V			
Regulation	±0.5%			
Ripple	100 mVrms			
Noise	< 1mV psophometric			
Permanent Overload	110A			
Current Limit Set Point	30A-110A			
Mechanical				
Width	5.25 in. (133.35 mm)			
Height	8 in. (203.2 mm)			
Depth	19.75 in. (501.65 mm)			
Weight	20 lbs. (9 kg)			
Environmental				
Efficiency	> 86% typical			
Heat Release	Per Rectifier:			
24Vdc, 100A Output	390 Watts (1331.3 BTU/hr.)			
24Vdc, 80A Output	312 Watts (1065 BTU/hr.)			
Storage Temperature	-40°C to 85°C			
Storage Relative Humidity	5% to 90%			

Table 2-3: 596B4 Rectifier Specifications (Continued)

Audible Noise	< 52dBA
EMC	EN 50022, level B, conducted and radiated (CISPR 22)
Standards Compliance	
Safety Standard	EN 60950 (IEC950)
Certification Marks	UL, TUV, CE 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.

Table 2-4: 55H2-63DC-001 Heat Exchanger Specifications

Electrical	
Voltage Range	19-30 Vdc (24 Vdc nominal)
Capacity	63W/°F or 113W/°C
Mechanical	
Dimensions (H x W x D)	55" (1397mm) x 19.1" (500mm) x 6.3" 160mm)
Shipping Weight	65 lbs (29.5 kg)
Air Movers	Speed Controlled; Closed Loop Control; Backward Curved Impeller
Circuit Board	
Input	Output
Inputs	Quick Test Button; 4 Temperature Sensors (internal, ambient, 2 battery shelf); 2 Tach signals for closed loop control of the HX impellers; Power
Outputs	5 Form C alarm relays corresponding to LEDs; Communication and power link to Battery Cabinet Controller (up to two controllers); 6 LED signals (BF Fail, TC Batt, Volts DC, High/Low, HX Fan Fail, TC Ambient H/C); 2 PWM signals for closed loop control of the HX impellers; 1 Battery Fan control (+, -, alarm). Fans are on/off only; Heater output (2-wire to power relay)
Environmental	
Operating Ambient Temperature	-45°C to +46°C
Storage Temperature	-15°C to +85°C

Ordering Information

All material required for a OPS 24/800 Power Cabinet installation is identified in the H569-453 Ordering Guide for this product. Power Cabinet wiring is documented on T83492-30. The basic complement of material furnished with all power cabinets includes the following:

- Cabinet Enclosure
- Heat Exchanger and Battery Compartment Heaters/
Ventilation
- Two Rectifier Shelves
- Two Battery Shelves
- Galaxy Vector Controller
- Low Voltage Battery Disconnect/Reconnect
- Battery Shunt
- 1000A Battery Short-Circuit Fuse
- Termination Bars for Supplemental Battery Cabinets and
Load Returns
- All factory wiring associated with this equipment

Selection of an AC input voltage option (240/120Vac 1-phase (2W + Neutral) or 200-240/115-138Vac 3-phase (3W + Neutral) adds a 30-pole AC distribution panel into the rear AC compartment equipped with breakers and wiring for the 8 rectifier positions, battery heaters, and a convenience outlet.

Material that must be provided separately includes the following:

- Anchor Material
- External Grounding Electrode and neutrals to connect the cabinet and the AC service neutral to the ground electrode.
- AC input service (2/0 conductors and 2-inch conduit, 150A rain-proof (outdoor rated panel) protection for 240/120Vac 1-phase, or 125A rain-proof (outdoor rated panel) protection for 200-240/115-138Vac 3-phase
- Rectifiers (2 to 8, 596B4, +24V/100A)
- Batteries (1 to 4, +24V strings of Lineage Power model 12IR125 batteries (2, 12V modules per string) or 1 to 2, +24V strings of Hawker SBS C11 batteries (6 modules per string))

- DC distribution panel(s) (1 or 2, bullet or plug-in circuit breaker style)
- DC distribution breakers, conductors, termination material, and conduit for external +24V load equipment
- AC breakers, conductors, and conduit for external AC load equipment (if required)
- Spare parts

One or two supplemental battery cabinets may be added to a OPS 24/800 power cabinet to provide increased reserve time or to support high load applications. The battery cabinet is provided via H569-453 G-10 and includes the following material:

- Cabinet Enclosure
- 5 Battery Shelves
- Battery Heaters, Ventilation Fan, and Control Unit
- 1000A Battery Short-Circuit Protection Fuse
- Hot and Return Termination Bars
- Internal Battery String Cable Sets for 10 strings of Lineage Power Model 12IR125 batteries (2, 12V modules per string) or 5 strings of Hawker SBS C11 batteries (6 modules per string)
- All factory wiring associated with this equipment

Material that must be provided separately for the battery cabinet(s) is shown on the H569-453 OPS 24/800 Ordering Guide and includes the following:

- Anchor Material
- Connection to a Framework Grounding Network
- Batteries
- Kits for conduit and wiring between the Power Cabinet and 1st Battery Cabinet or between the 1st Battery Cabinet and 2nd Battery Cabinet

An optional kit to monitor battery temperatures within each battery cabinet is also available. This 210E kit is recommended for use with the Slope Thermal Compensation feature provided with the Vector controller of the Power Cabinet.

Engineering

The major engineering decision regarding the OPS 24/800 cabinet involves the number of rectifiers and batteries that should be used for supporting a given +24V distribution load. Both of these components may easily be added to existing systems, enabling future growth to be made as conditions warrant. Table 2-5 “Load to Rectifier and Battery Matrix” may be used as a quick reference guide to aid in this selection process. It incorporates “N+1” rectifier redundancy, Lineage Power 12IR125 batteries, and a discharge to the 21.25V (1.77 volts per cell) low voltage battery disconnect threshold used in the Galaxy Vector for the OPS 24/800 default configuration. It does not add any aging factor for the batteries.

Table 2-5: Load to Rectifier and Battery Matrix

Max Load (Amps)	Number of Rectifiers	Number of Battery Strings (12IR125 to 1.77 Min VPC)			
		1 Hour Reserve	3 Hours Reserve	5 Hours Reserve	8 Hours Reserve
60	2	1	2	3	4
90	2	2	3	5	6
120	3	2	4	6	8
150	3	2	5	7	10
180	3	3	6	9	12
210	4	3	7	10	14
240	4	4	8	11	16
270	4	4	9	13	18
300	4	4	10	14	20
330	5	5	11	15	22
360	5	5	11	17	24
390	5	6	12	18	
420	6	6	13	19	
450	6	6	14	21	
480	6	7	15	22	
510	7	7	16	23	
540	7	8	17		
570	7	8	18		
600	7	8	19		
630	8	9	20		
660	8	9	21		
690	8	10	22		

3 *Safety*

Safety Statements

Please read and follow all safety instructions and warnings before installing, maintaining, or repairing the OPS 24/800 Power Cabinet. Reference the individual module product manuals for additional safety statements specific to the modules.

- The power cabinet 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 power cabinet has been evaluated for use in a continuous outdoor ambient temperature not to exceed 46°C.
- Fuses/circuit breakers may not be provided with the equipment. Refer to the documentation for the proper hardware. **Use only the parts specified in the documentation.** Installing fuses or circuit breakers not specified for use in this equipment may result in injury to service personnel or equipment damage.
- For installations in the U. S. or Canada, use Listed/Certified compression connectors to terminate Listed/Certified field-installed conductors where required. 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.
- Torque electrical connections to the values specified on labels or in the product documentation.
- Battery cables must be dressed to avoid damage to the conductors (caused by routing around sharp edges or routing in areas where wires could get pinched) and undue stress on the connectors.

Safety Statements, continued

- An external service disconnect suitable for outdoor use must be provided with either fuses or circuit breakers that protect/open all non-grounded poles, and must be 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. Refer to the system T-drawing (wiring diagram) for recommended circuit protection for the different options.
- The supply neutral conductor must be grounded at the external service supply disconnect panel.
- The subject Outdoor Cabinet has been tested to ANSI/IEEE C62.41 Category B and EN61000-4-5 (Lighting Surge, level 4). A transient voltage surge protector*, at the service entrance panel, is recommended for installations where surges are common or the AC Line is exposed after the point of protection.
- The ac input distribution has been evaluated for connection of minimum 90°C conductors sized according to the US National Electrical Code using the 75°C ampacity tables.
- The dc distribution is considered a Safety Extra Low Voltage (SELV) with the return side connected to the chassis (earth ground) inside the cabinet.

CAUTION

The dc distribution contains hazardous energy levels.

- DC Load cables must be sized in accordance with minimum cable lengths shown in the documentation to keep short circuit currents less than the interrupt ratings of dc protectors in each panel.
- Maximum ratings for alarm connections are 60Vdc and 0.5 amperes. Exceeding these maximum ratings could result in fire or damage to the unit.

*Note: For installations in the United States and Canada, this device shall be Listed/Certified. For installations in Europe and other countries following IEC60364 series installation standards, a devices compliant with IEC61643 should be used if required by local authorities having jurisdiction.

Warning and Safety Symbols

The symbols may sometimes be accompanied by some type of statement; e.g., “Hazardous voltage/energy inside. Risk of injury. This unit must be accessed only by qualified personnel.” Signal words as described below may also be used to indicate the level of hazard

DANGER

Indicates the presence of a hazard that will cause death or severe personal injury if the hazard is not avoided.

WARNING

Indicates the presence of a hazard that can cause death or severe personal injury if the hazard is not avoided.

CAUTION

Indicatas the presence of a hazard that will or can cause minor personal injury or property damage if the hazard is not avoided.



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



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



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



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



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



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



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



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

Precautions

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

- The internal equipment may be powered by multiple ac circuits. Make sure that the appropriate circuit protection device for each ac input being serviced is disconnected before servicing the equipment.
- Batteries are connected to the power system. Disconnecting the ac alone will not necessarily remove power to the equipment. Make sure the equipment is not also powered by the batteries.
- 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 power cabinet and on the interface cables that can shock or cause serious injury or death. Exercise care and follow all safety warnings and practices when servicing this equipment.
- Electricity produces magnetic fields that can affect implanted medical electronic devices, such as pacemakers. The strength of the magnetic field depends on the amount of current in the circuit, as well as other conditions (such as number of conductors, placement, and distance from the conductor). DC power and distribution systems, including the batteries, that are typically used in telecommunications utility rooms or equipment cabinets can operate at high current levels. Personnel with electronic medical devices need to be aware of their restrictions when working around electricity.

Precautions, continued

- In addition to proper job training and safety procedures, the following are some basic precautions that should always be used:
 - 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.
 - 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 power cabinet is extremely heavy and must be loaded, unloaded, and moved into place using suitable equipment, and by personnel properly trained in this activity and the use of the moving equipment. This manual does not provide instructions for performing these functions beyond identifying cabinet lifting points. Follow all safety and job precautions.

4 *Installation*

DANGER

The power cabinet contains electrical hazards that can cause serious injury or death.

The cabinet is extremely heavy and can cause severe injury or death if not handled properly.

Please review all safety warnings in Section 3 before beginning the installation process. Observe all warnings and labels on the equipment.

Power Cabinet

Cabinets are usually shipped to a staging area (for example, a garage or warehouse). Proper equipment should be available to unload and transport the cabinet to the job site. A forklift truck may be used to lift the packed cabinet as long as the forks are at least 4 feet long. If a dolly is used, a side of the cabinet without a removable panel should face the dolly and the cabinet should not be tilted more than 30 degrees from vertical. The Power Cabinet is equipped with hoisting brackets on its top sides that may be used for handling where the use of a forklift is not available or practical. The hoisting brackets shall be removed after cabinet placement and the bolts replaced to maintain the integrity of the cabinet.

The cabinet is shipped from the factory with protective packaging. This packaging includes a bottom pallet and protective cardboard sides and/or “bubble wrap.” Handling a cabinet that is not properly secured to the bottom pallet or has its protective packaging removed may result in damage. It is recommended that none of the protective packaging be removed until the cabinet has been placed at the job site.

Dimensions and Required Clearance

The weatherproof enclosure dimensions for the OPS 24/800 Power Cabinet are shown in Figure 4-1. Figure 4-2 depicts the minimum front, rear, and side access clearance required for installation and maintenance activities. Typically, a site layout should be arranged with supplemental battery cabinet growth to one side of the power cabinet and load equipment growth to the other, permitting maximum use of the 4 available external 2-inch conduit openings on each side of the cabinet.

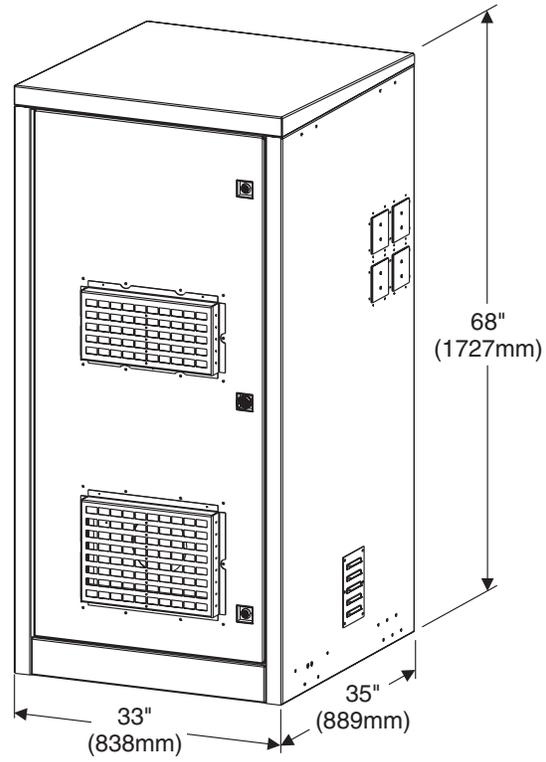


Figure 4-1: Power Cabinet Dimensions

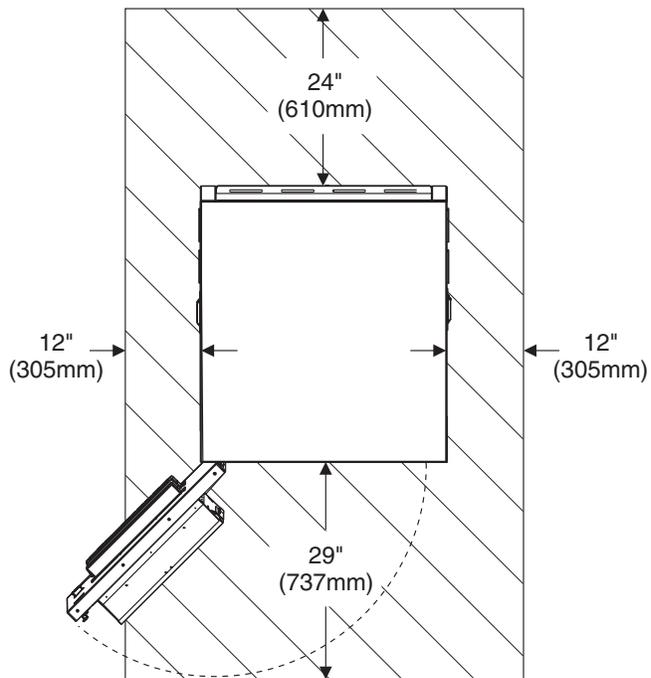


Figure 4-2: Cabinet Front, Rear, and Side Clearance

Mounting Footprint

The Power Cabinet may be mounted directly onto a concrete pad that has been equipped with anchor holes or it may be mounted onto a steel-mounting bracket or I-beam system. Figure 4-3 shows the cabinet mounting footprint, overall cabinet dimensions, and the location of the four cabinet mounting holes. The anchoring hardware is not provided as part of the cabinet and may be selected from choices provided in the H569-453 Ordering Guide to meet site requirements. Small covers in the floor of the cabinet must be removed in order to access the anchoring locations in the base of the cabinet.

NOTE:

If installation of the cabinet is not going to continue on the same day as cabinet placement outdoors, or it cannot be powered up for any reason, a 60-watt heat source must be activated inside the cabinet to prevent water condensation. An incandescent light bulb or other low power heat source may be used for this purpose.

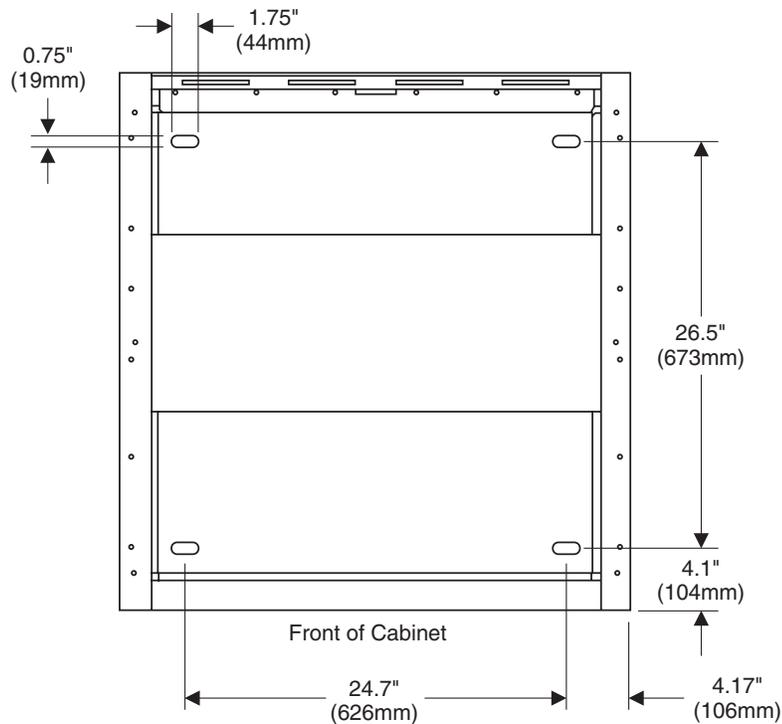


Figure 4-3: Cabinet Mounting Footprint

Grounding

Cabinet grounding consists of cabinet frame grounding to the grounding electrode, ring ground, halo ground, or central office ground as depicted by the using system grounding requirements. Both the AC System ground and DC Distribution Return are bonded to the cabinet

framework as part of the Power Cabinet circuitry. The DC return is connected to the cabinet as part of the power cabinet internal circuitry. Connection of the cabinet to the AC protective earth (safety earth) and to the ground electrode must be performed during installation.

External compression 2-hole grounding lugs for 2 AWG are provided with the cabinet and located near the cabinet base on both sides. Associated 2 AWG cable must be furnished and extended from these locations to suitable grounding terminations as required by the using system grounding requirements. Oxide-inhibiting joint compound (No Ox) must be applied and used at these ground connections.

AC Input Table 4-1 shows the AC input power requirements for the OPS 24/800 Power Cabinet. Two AC Input service choices are available and the service selected from Table 4-1 must match that ordered with the cabinet to permit the breakers and wiring furnished with the 30-position AC panel to be properly equipped and wired. Refer to the H569-453 Ordering Guide for details.

NOTE:

The feeds coming from the power pedestal to the power cabinet must have surge protection and dedicated breakers in the power pedestal. However, a surge arrestor upgrade kit is also available for the power cabinet on the H569-453 Ordering Guide. These arrestors and associated breakers are to be installed on the cabinet AC distribution panel per instructions furnished with the upgrade kit, when provided.

Table 4-1: AC Input Power Requirements

AC Source	240/120Vac 1-Phase, 2W +N	200-240/115-138Vac 3-Phase, 3W + N
Circuit Protection	150A	125A
Conductors*	Line: 2/0 AWG (2) Neutral: 2/0 AWG EG: 4 AWG	Line: 2/0 AWG (3) Neutral: 2/0 AWG EG: 4 AWG
Conduit	2-inch Liquid Tight Flexible Metal (LFML)	2-inch Liquid Tight Flexible Metal (LFML)

* Conductors listed in this table are selected based on the 2002 National Electric Code (NEC) for use in OPS 24/800 Power Cabinet applications at up to a 45°C outdoor environment. Local codes may supersede these requirements.

Fittings for 2-inch Liquid Tight Flexible Metal (LFML) conduit have been provided for convenience on the H569-453 Ordering Guide. The use of this conduit type is not mandatory, but the mechanical protection provided for these conductors must meet the weatherproof specifications of LFML conduit.

Inside the cabinet, on the rear wall above the AC panel compartment, there is an AC duct that must be removed for installation (Figures 4-4 and 4-5). The AC power feeds from the power pedestal will enter the cabinet at the rear 2-inch conduit opening dedicated for this purpose, located between the upper Rear Access Cover and the lower Rear AC Compartment Cover. Route the AC power feeds through the rear 2-inch opening in the cabinet. Once inside the cabinet, route all AC feed wires (not the green ground wire) through the two ferrite beads (407497734). Then route all AC feed wires and the ground wire down into the AC distribution panel conduit.

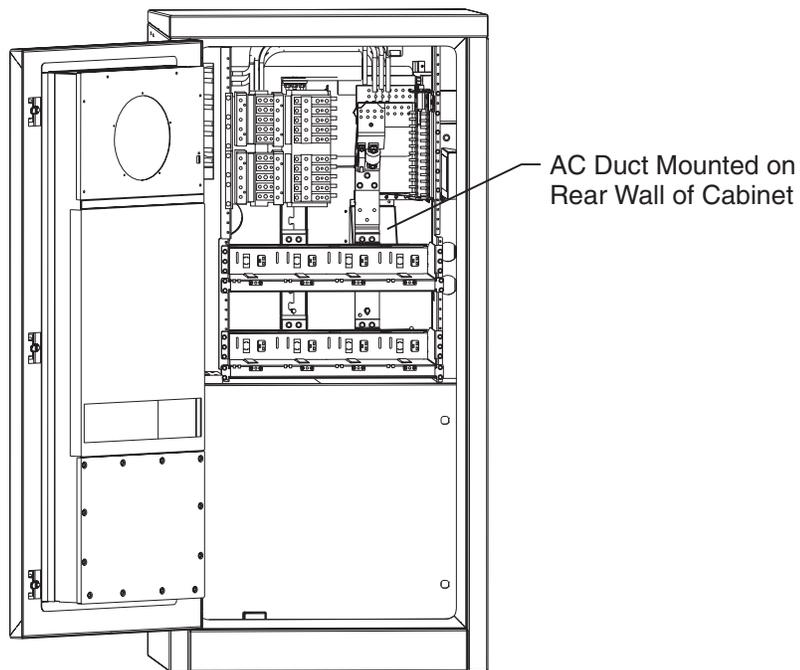


Figure 4-4: AC Duct Inside Cabinet

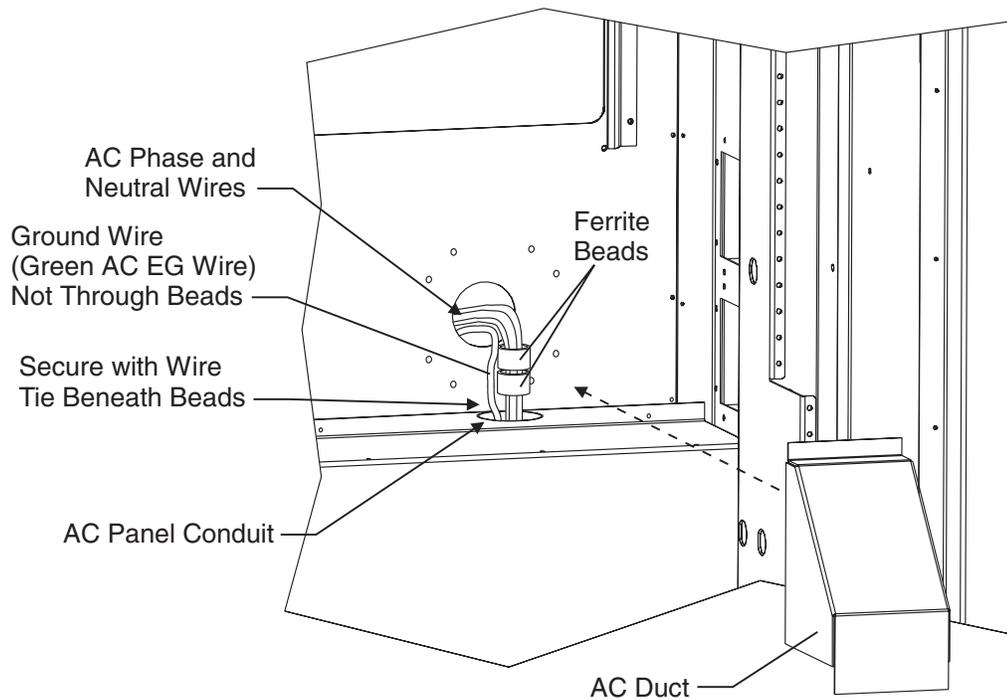


Figure 4-5: AC Cable Routing

Remove the cover of the AC distribution panel and terminate the AC source cabling directly onto the phase, neutral, and EG buses in the AC distribution panel as indicated on the appropriate Figure 1 and H-figure of wiring diagram T83492-30. Terminating material at the AC distribution panel for these conductors is provided with the cabinet. Verify that all breakers in the AC distribution panel are in the OFF position prior to wiring this circuit or energizing it at the power pedestal. Be sure to re-install the AC duct inside the cabinet.

Additional AC breakers for AC loads in equipment outside the power cabinet may be installed into the AC distribution panel at this time if they have been provided. The H569-453 Ordering Guide lists breakers that may be used for this purpose. Refer to T83492-30 for location and maximum load. It is expected that the total AC load for equipment external to the power cabinet will be limited to 10 amps or less. Wiring these loads is covered later in this instruction.

Batteries

The OPS 24/800 Power Cabinet may contain a maximum of 8 12IR125 battery modules or 12 Hawker SBS C11 battery modules that are used in a series/parallel configuration to provide +24 volt backup reserve. Up to four strings (two battery modules for each string) of 12IR125 batteries

can be mounted on the two shelves in the battery compartment (Figure 4-6). When the Hawker SBS C11 modules are used, they are arranged into 1, +24V battery string per shelf, with each string consisting of 6 battery modules in its own series/parallel configuration (Figure 4-9). Additional battery strings of either type may be installed to increase the reserve time by using one or two auxiliary battery cabinets, with a maximum of 10 strings per cabinet.

Installation instructions for the supplemental battery cabinet(s) are included at the end of Section 4 of this manual.

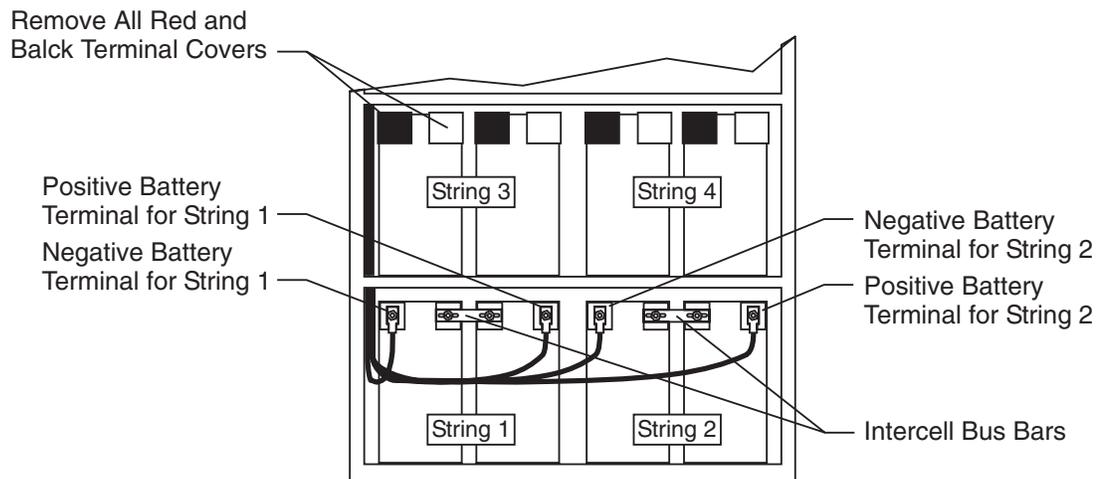


Figure 4-6: Battery Compartment with Front Cover Removed and Using 12IR125 Batteries

Battery Handling Precautions

CAUTION

Read the following safety precautions carefully before attempting to unpack and install any battery. Storage type batteries differ from other sources of power in that they are delivered to the points of installation as live units. Fully brief anyone who is permitted access to battery areas on the hazards of handling lead-acid batteries. Make it clear to anyone handling, unpacking, or installing lead-acid batteries that they contain electrolyte (sulfuric acid and water). Everyone must wear protective equipment such as rubber gloves, rubber aprons, full-facemask, and splash-proof goggles when performing any activity involving handling of batteries or cells containing electrolyte.

- In case of electrolyte contact with the skin, remove the electrolyte immediately by flushing the affected area with large amounts of plain tap water. In case of electrolyte in the eye, pour water into the inner corner of the eye and allow at least one quart of water to run

over the eye and under the eyelid. A physician should treat eye injuries immediately.

- A storage battery gives no indication by its appearance of the potential energy stored in it. All lead acid storage cells/batteries have enormous short circuit capability, which can result in serious burns. Use extreme care to avoid shorting out cell and/or battery terminals. Shorting a cell or battery with a non-insulated tool can vaporize or throw the tool.
- The use of insulated tools is mandatory. Never place metal objects on top of a battery module. Remove all metal jewelry such as rings and watches when working on or near batteries.
- All lead-acid batteries generate hydrogen gas, even under open circuit conditions. If not permitted to escape, this gas can build up to explosive concentrations. NEVER tamper with or block the vent caps of the battery modules. A damaged gas vent cap could become clogged, resulting in an explosion due to internal pressure. Such an explosion could short circuit other battery modules and result in a fire. ALWAYS place batteries in a well-ventilated area. NEVER place battery modules in a sealed environment.
- Avoid creating sparks, including those from static electricity, or the use of an open flame near batteries since the gas generated by batteries is highly explosive. Before performing each work operation, firmly touch a ground to discharge the static electricity from your body.
- Battery gases are flammable. NO sparks or open flame is allowed near battery modules. To direct attention to the possible source of danger from battery gases, post one or more warning signs, lettered in large characters, in a conspicuous location near the battery.

Battery Lifting Precautions

The 12IR125 battery module weighs 125 lbs. Refer to Figure 4-7 for lifting precautions.

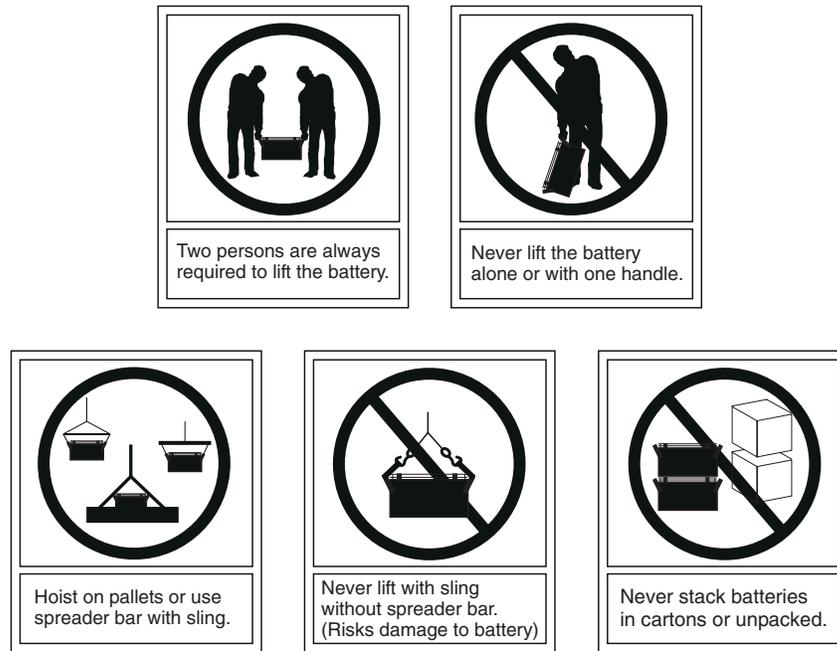


Figure 4-7: Battery Lifting Precautions

**12IR125 Battery
Storage and
Charging**

The 12IR125 battery module is shipped fully charged. The maximum time that a charged 12IR125 battery module may stay on open circuit is six months at 77°F. If the storage temperature exceeds 90°F (32°C), the time the battery stays on open circuit should NOT exceed four months.

The charge by date stamped on the shipping container is the date at which the battery will have been on open circuit for six months. If the batteries cannot be put into service by the date stamped on the shipping container, follow one of the maintenance procedures below and record the actions taken until the normal installation can be initiated.

DANGER

Provide adequate ventilation while charging.

For maximum safety, batteries should NOT be handled during charging and for 24 hours thereafter.

Procedure 1

Maintain the battery on continuous float charge operation (13.62 ± 0.06 volts per battery module) until the normal installation can be done.

Procedure 2

Charge at 13.62 ± 0.06 volts per battery module, 8 hours a day, 5 days a week until the normal installation can be done.

12IR125 +24V Battery Installation Procedure

1. Check the charge by date stamped on each battery-shipping container. Check the out-of-box voltage of each battery module. Any module with an open-circuit measurement of less than 12.60V should not be placed into service.

NOTE:

If the charge by date has been exceeded, the batteries must have been charged using one of the procedures listed above, or they cannot be put into service.

2. Remove the Upper Rear Access Cover and locate the battery cable connectors for the 4 battery strings of the power cabinet. Disconnect all 4 battery cable connectors.

CAUTION

Do not reconnect any of these connectors until ready to put the batteries into service during the start-up procedure of Section 5.

3. Open the Front Door of the cabinet and remove the Battery Compartment Access Cover. Pull all of the insulated battery cable sets and thermistor wire sets clear of the area where the battery modules will be located. Refer to Figure 4-6 for string locations. Strings are located left to right, and from the bottom battery shelf to the top shelf.

CAUTION

Due to the weight of each 12IR125 battery module (125 lbs.), two craftspersons are required to lift each module onto the cabinet shelf.

4. With the battery terminals facing the front of the cabinet, carefully slide a battery module onto the left side of the bottom battery shelf. Place another battery module onto the shelf and slide it to the immediate right of the first module.
5. Repeat for the 2nd battery string (2 battery modules) on the right side of the bottom shelf (if equipped). Repeat for strings 3 and 4 on the top shelf (if equipped).
6. Remove red and black terminal covers from each of the battery modules and spread a thin coat of antioxidant on all of the battery terminals.

NOTE:

In the following steps, be certain to check that the polarity marking on each cable matches that of the battery terminal. Positive polarity cables are Black w/Red tape, negative polarity cables are Black only. The lengths of the cables sets on each shelf determine the string for which they are intended. Refer to Figure 4-6.

7. For battery string 1, (left half of the bottom shelf) locate the negative (-) battery cable (Black). Spread a thin coat of antioxidant on the negative cable connector and place the coated connector onto the negative (left) terminal of the left-most battery module. If this is the only battery string to be equipped on this shelf, locate the thermal probe cable for this shelf, used with the HX controller. Spread a thin coat of antioxidant on its ring terminal and place it onto the negative (left) terminal of the battery module along with the negative (-) battery cable. Using a battery terminal nut and washer, secure the connector(s) to the terminal by hand tightening the nut. Neatly fold and secure any slack in the HX thermistor cable with a wire tie.
8. For battery string 1, (left half of the bottom shelf) locate the positive (+) battery cable (Black w/Red tape). Spread a thin coat of antioxidant on the positive cable connector and place the coated connector onto the positive (right) terminal of the 2nd battery module of string 1. Locate the thermal probe cable for this shelf, used with the Vector controller. Spread a thin coat of antioxidant on its ring terminal and place it onto the positive (right) terminal of the 2nd battery module of string 1 along with the positive (+) battery cable. Using a battery terminal nut and washer, secure the connectors to the terminal by hand tightening the nut.
9. Repeat these steps for battery string 2, made up of the 2 battery modules on the right half of the bottom shelf (if equipped). If string 2 is equipped, there will not be a 2nd Vector thermal probe cable set for it and the HX thermistor cable will be located onto the negative (-) terminal of sting 2 instead of on string 1.
10. Repeat also for strings 3 and 4 on the top shelf (if equipped). Place the Vector thermal probe for the upper shelf onto the positive (+) battery post of string 3 in the same manner as completed for string 1 on the bottom shelf. Place the HX controller thermal probe for the upper shelf onto the negative (-) post of string 4 if it is equipped or string 3 if it is not.

11. Locate the intercell bus bars provided with the battery modules. Spread a thin coat of antioxidant on one of the bus bars. For battery string 1, place the coated bus bar between the positive terminal of the left-most module and the negative terminal of the module to its right (Figure 4-6). Using a battery terminal nut and washer, secure the bus bar to each terminal by hand tightening the nut.
12. Repeat this step for battery strings 2 through 4 (if equipped).
13. Torque all battery connections using an insulated 7/16-inch socket and torque wrench set at 60 inch-pounds.
14. Recheck all battery connections to make sure that negative cables (Black) are connected only to negative battery terminals and that positive cables (Black w/Red tape) are connected only to positive battery terminals.
15. Remove the outer portions of the battery brackets from the battery compartment access cover (Figure 4-8). These are not required for use with 12IR125 batteries.

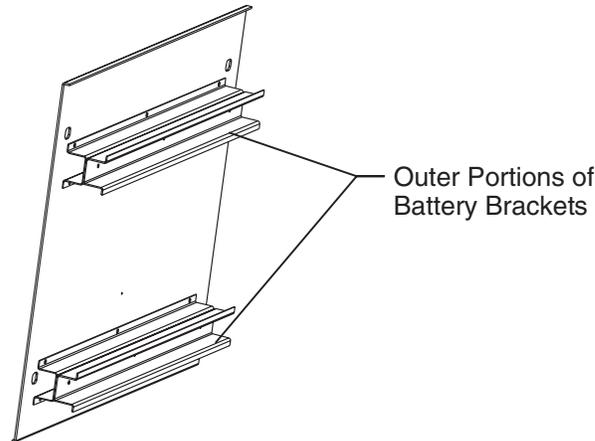


Figure 4-8: Battery Brackets on Battery Compartment Cover

CAUTION:

Do not connect any of the battery cable connectors inside the Upper Rear Access Cover until the start-up procedure. Leave the Battery Compartment Cover OFF until cabinet start-up.

**Hawker SBS C11
Battery Installation
Procedure**

1. Remove the Upper Rear Access Cover and locate the 4 battery cable connectors for the battery strings of the power cabinet. Disconnect all 4 battery cable connectors.

CAUTION

Do not reconnect any of these connectors until ready to put the batteries into service during the start-up procedure of Section 5.

2. Open the Front Door of the cabinet and remove the Battery Compartment Access Cover. Pull all of the insulated battery cable sets and thermistor wire sets clear of the area where the battery modules will be located. Refer to Figure 4-9 for mounting batteries on a shelf. Each shelf will hold a single string consisting of 6 battery modules in the C11 battery configuration. Strings should be added starting on the bottom battery shelf first.

CAUTION

Due to the weight of each battery module, two craft persons are required to lift each module onto the cabinet shelf.

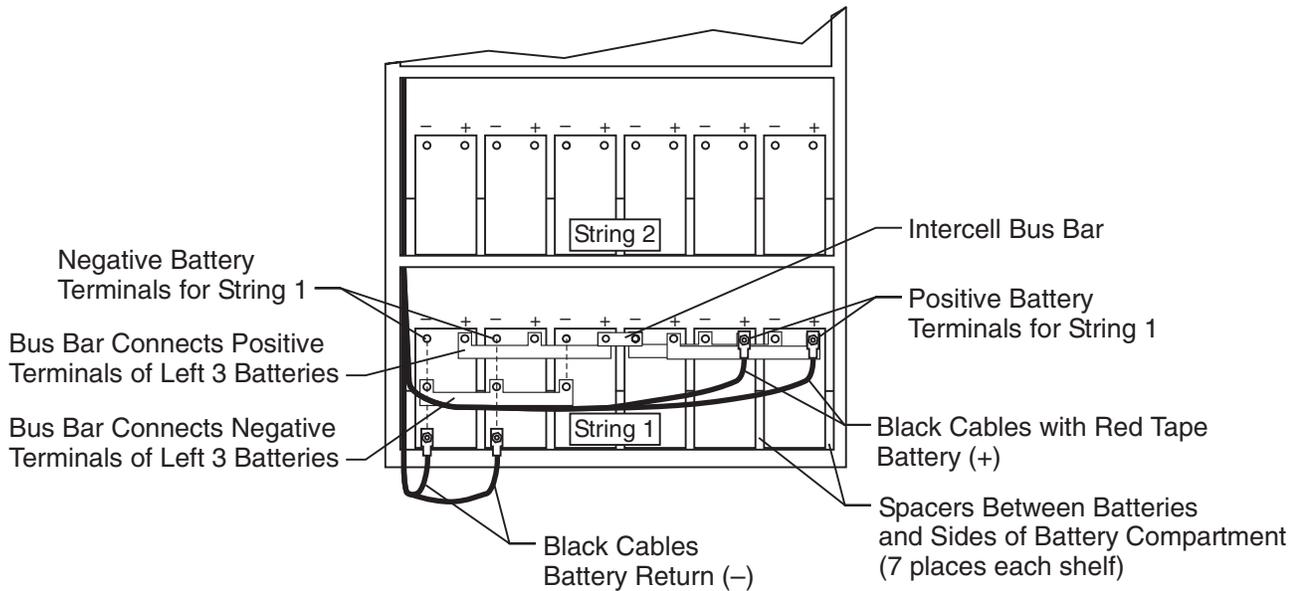


Figure 4-9: Battery Compartment with Front Cover Removed and Using Hawker SBS C11 Batteries

3. Place six C11 Hawker batteries on a shelf. The battery terminals should face the front of the cabinet as shown in Figure 4-9.

4. Place spacers in between each of the modules (5 places). In the battery compartment, place additional spacers at the end of each battery string for a total of (7 spacers).
5. Repeat for the 2nd battery string on the top shelf (if equipped).
6. Remove the black terminal covers from each of the battery modules and spread a thin coat of antioxidant on all of the battery terminals.

NOTE:

In the following steps, be certain to check that the polarity marking on each cable matches that of the battery terminal. Positive polarity cables are Black w/Red tape, negative polarity cables are Black only. Refer to Figure 4-9.

7. Locate the module straps that were provided with the C11 modules and spread a thin coat of antioxidant on each of them. Position the supplied 3-module straps over all the positive battery terminals and all the negative battery terminals as depicted in Figure 4-6. Position such that the positive strap is facing the cabinet front on the right half of the string and the negative strap faces out on the left half of the string. Hand tighten the 1/4-20 hardware, flat washer, lock washer and nut to hold the straps in place.
8. Position the single module strap on the fourth module positive terminal and the third module negative terminal to series the six modules into a single +24V string. Hand tighten the 1/4-20 hardware, flat washer, lock washer and nut to hold the strap in place.
9. For battery string 1 (bottom shelf), locate the two negative (-) battery cables (Black) for the shelf. Spread a thin coat of antioxidant on the negative cable connectors and place the coated connectors onto the negative (left) terminal of the two left-most battery modules. Locate the thermal probe cable for this shelf used with the HX controller. Spread a thin coat of antioxidant on its ring terminal and place it onto the negative (left) terminal of the third module from the left. Secure the connectors to their terminals by hand tightening the nuts. Neatly fold and secure any slack in the HX thermistor cable with a wire tie.
10. For battery string 1 (bottom shelf), locate the two positive (+) battery cables (Black w/Red tape) for the shelf. Spread a thin coat of antioxidant on the positive cable connectors and place the coated connectors onto the positive (right) terminal of the 2

right-most battery modules. Locate the thermal probe cable for this shelf, used with the Vector controller. Spread a thin coat of antioxidant on its ring terminal and place it onto the negative (left) terminal of the third module from the right. Secure the connectors to their terminals by hand tightening the nuts.

11. Repeat these steps for battery string 2 on the top shelf (if equipped).
12. Torque all battery connections using an insulated socket and torque wrench set at 62 in·lbs.
13. Recheck all battery connections to make sure that negative cables (Black) are connected only to negative battery terminals and that positive cables (Black w/Red tape) are connected only to positive battery terminals.
14. Replace all the black battery covers over the battery terminals.

CAUTION

Do not connect any of the battery cable connectors inside the Upper Rear Access Cover until the start-up procedure. Leave the Battery Compartment Cover OFF until cabinet startup.

Supplemental Battery Cabinets

One or two supplemental battery cabinets may be added to an OPS 24/800 power cabinet to support increased load requirements or supply increased reserve time. Table 2-5 has been provided as an aid in determining the number of IR125 battery strings necessary to support various loads for various reserve times to the 1.77 volts per cell cutoff level of the Low Voltage Battery Disconnect circuit of the power cabinet. When the number of IR125 battery strings required by the system exceeds 4 (see Figure 4-6) the supplemental battery cabinet may be used. If the Hawker SBS C11 (90 AH) battery modules are used in the 270 AH series/parallel configuration shown in Figure 4-9, the supplemental battery cabinet is needed if more than 2 of these strings are required.

Either one or two supplemental battery cabinets may be added, each holding up to 10 strings of IR125 batteries or 5 strings of the 270 AH Hawker SBS C11 configurations. Figure 4-10 is a view of the battery cabinet used with the OPS 24/800 system. Figure 4-11 shows its orientation in relation to the power cabinet. Battery cabinets may be placed to the left or right of the power cabinet, with load equipment cabinet growth in the opposite direction.

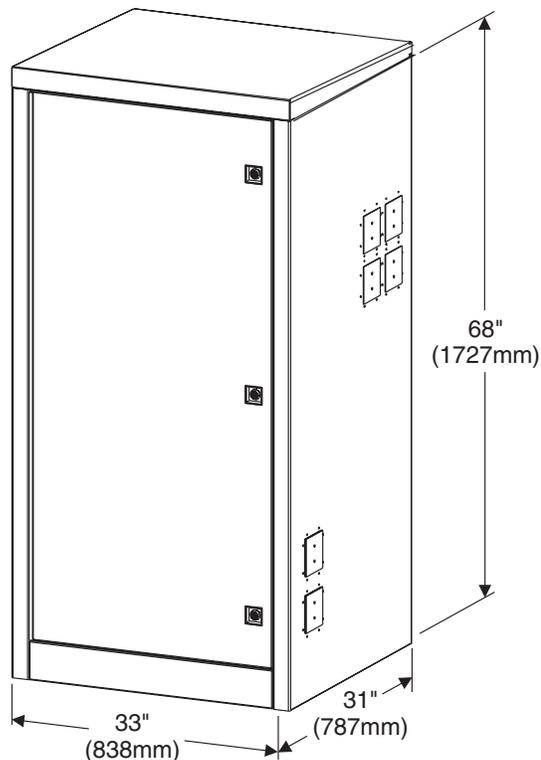


Figure 4-10: Battery Cabinet Dimensions

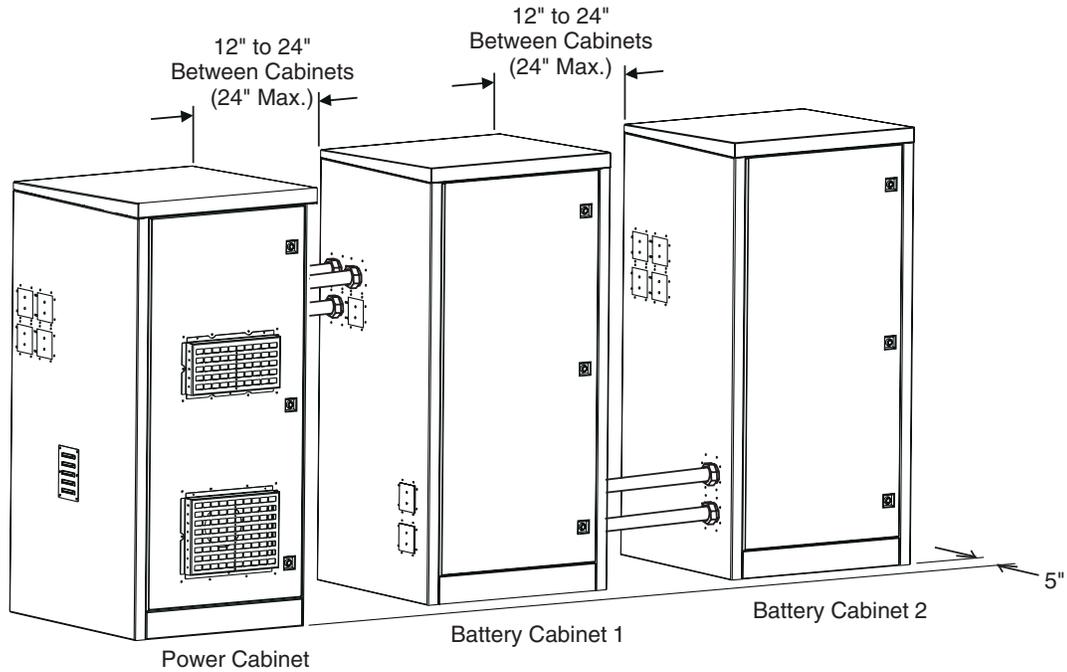


Figure 4-11: Three Cabinet System

Figure 4-12 shows the battery cabinet mounting footprint, overall cabinet dimensions, and the location of the four cabinet mounting holes. The anchoring hardware is not provided as part of the cabinet and may be selected from choices provided in the H569-453 Ordering Guide to meet site requirements.

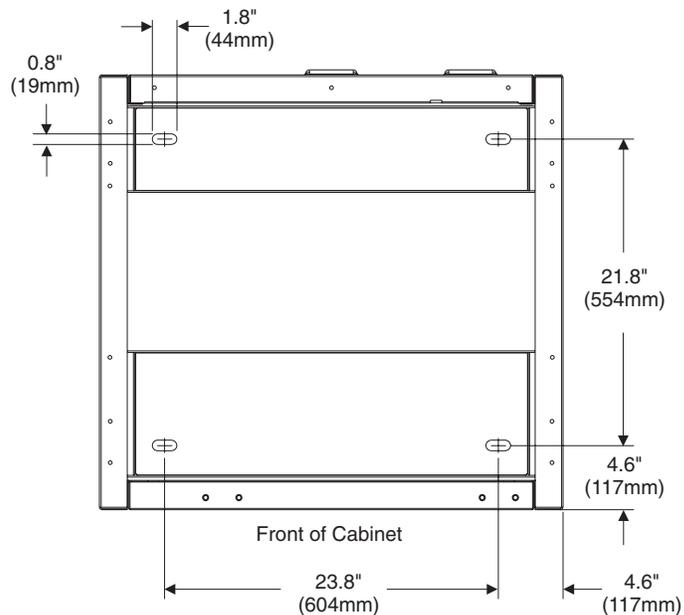


Figure 4-12: Battery Cabinet Dimensions

Grounding Cabinet grounding consists of cabinet frame grounding to the grounding electrode, ring ground, halo ground, or central office ground as depicted by the using system grounding requirements.

External compression 2-hole grounding lugs for 2 AWG are provided with the cabinet and located near the cabinet base on both sides. Associated 2 AWG cable must be furnished and extended from these locations to suitable grounding terminations as required by the using system grounding requirements. Oxide-inhibiting joint compound (No Ox) must be applied and used at these ground connections.

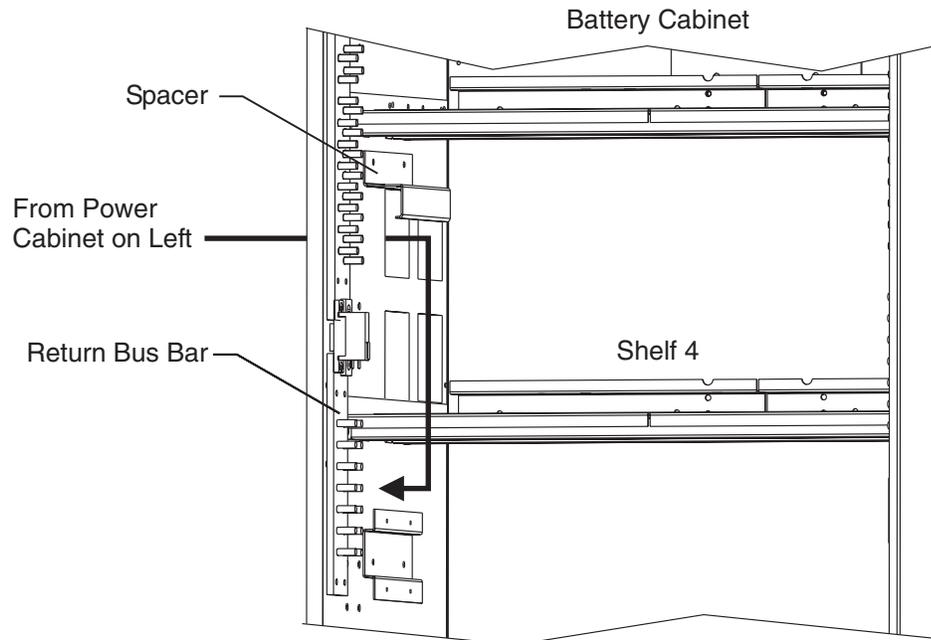
External Conduits and Wiring Two kits containing all external conduit and wiring required for the 1st battery cabinet (848654083) and 2nd battery cabinet (848668471) have been provided on the H569-453 OPS 24/800 Ordering Guide. These kits require that the battery cabinets be located as indicated in Figure 4-11, with the distance between cabinets within the 12 to 24 inches specified.

Instructions are furnished with each kit and should be followed to complete the required connections between cabinets as follows:

Power Cabinet to 1st Battery Cabinet

- 3, 2-inch type LFML (Liquid Tight Flexible Metal) conduits using 3 of the 4 available openings in the upper rear of both cabinets

NOTE: The conduit openings used in the 1st battery cabinet for cabling to the power cabinet enter at the rear portion of shelf-4. This shelf is equipped with a Z-shaped spacer on the left wall that shifts the battery modules of that shelf to the right in order to create a 2 inch clearance for cables using the conduit openings on the left side of the battery cabinet. If the power cabinet is located to the right of the 1st battery cabinet, this Z-shaped spacer must be removed from the left wall and relocated to the right wall to create the cabling clearance on that side instead. Refer to Figure 4-13.



The spacer on shelf 4 provides approximately 2" of clearance between the batteries and the left wall of the cabinet for routing cables from the power cabinet to the lower section of the return bus bar.

If the power cabinet is located on the right side of the battery cabinet, this spacer must be moved to the right side of shelf 4. Cables can then be routed through the access holes on the right side of the battery cabinet.

Figure 4-13: Cable Routing into the Battery Cabinet

- 6, 2 AWG +24V and return pairs (848657920) from the +24V Bat and Remote Bat Return bars of the power cabinet to the +24V Bat bar and the fused side of the Return bar of the battery cabinet

CAUTION

If the battery cabinet is being added to a working system, battery voltage will be present within the battery cabinet when this step is performed.

- 1, Fuse Alarm wire set (848657946) from the P309-1 jack of the wireset plugged into J27 of the Vector BTJ2 termination board of the power cabinet to the fuse alarm switch associated with the 1000A short circuit protection fuse on the Return bus of the battery cabinet
- 1, Battery Temperature Controller cable set (848657961) from P10 of the HX Controller of the power cabinet to J2 of the Bat Temp Controller of the battery cabinet.

- 1, Door Alarm wire set (p/o battery cabinet) from the battery cabinet to Krone Alarm Block positions 17-18 of the power cabinet
- 1, Battery Cabinet Heater AC circuit (848657953) from the designated breaker on the AC panel of the power cabinet to the Heater Circuit terminal block of the battery cabinet

1st Battery Cabinet to 2nd Battery Cabinet

- 2, 2-inch type LFML (Liquid Tight Flexible Metal) conduits using the 2 available openings in the lower front of both cabinets
- 3, 2 AWG +24V and return pairs (848657920) from the +24V Bat bar and the fused side of the Return bar of the 1st battery cabinet to the +24V Bat bar and the fused side of the Return bar of the 2nd battery cabinet

CAUTION

If the battery cabinet is being added to a working system, battery voltage will be present within the battery cabinet when this step is performed.

- 1, Fuse Alarm wire set (848657946) from the P309-2 jack of the wireset plugged into J27 of the Vector BTJ2 termination board of the power cabinet to the fuse alarm switch associated with the 1000A short circuit protection fuse on the Return bus of the 2nd battery cabinet
- 1, Battery Temperature Controller cable set (848657961) from J1 of the Bat Temp Controller of the 1st battery cabinet to J2 of the Bat Temp Controller of the 2nd battery cabinet
- 1, Door Alarm wire set (p/o battery cabinet) from the 2nd battery cabinet to Krone Alarm Block positions 17-18 of the power cabinet
- 1, Battery Cabinet Heater AC circuit (848657953) from the designated breaker on the AC panel of the power cabinet to the Heater Circuit terminal block of the 2nd battery cabinet

Batteries

Please refer to and heed the Battery Handling, Battery Lifting, Battery Storage and Charging precautions listed earlier in this Section 4 under the Installation Procedures for batteries into the power cabinet. Also note that if the battery cabinet is being added to a working system, battery voltage will be present at the +24V Bat bus and on its associated connector assemblies in the battery cabinet. Do NOT connect any of the battery connectors together until instructed to.

12IR125 +24V Battery Installation Procedure

Refer to Figure 4-14 front view of the battery cabinet and Figure 4-15 12IR125 battery wiring throughout this procedure.

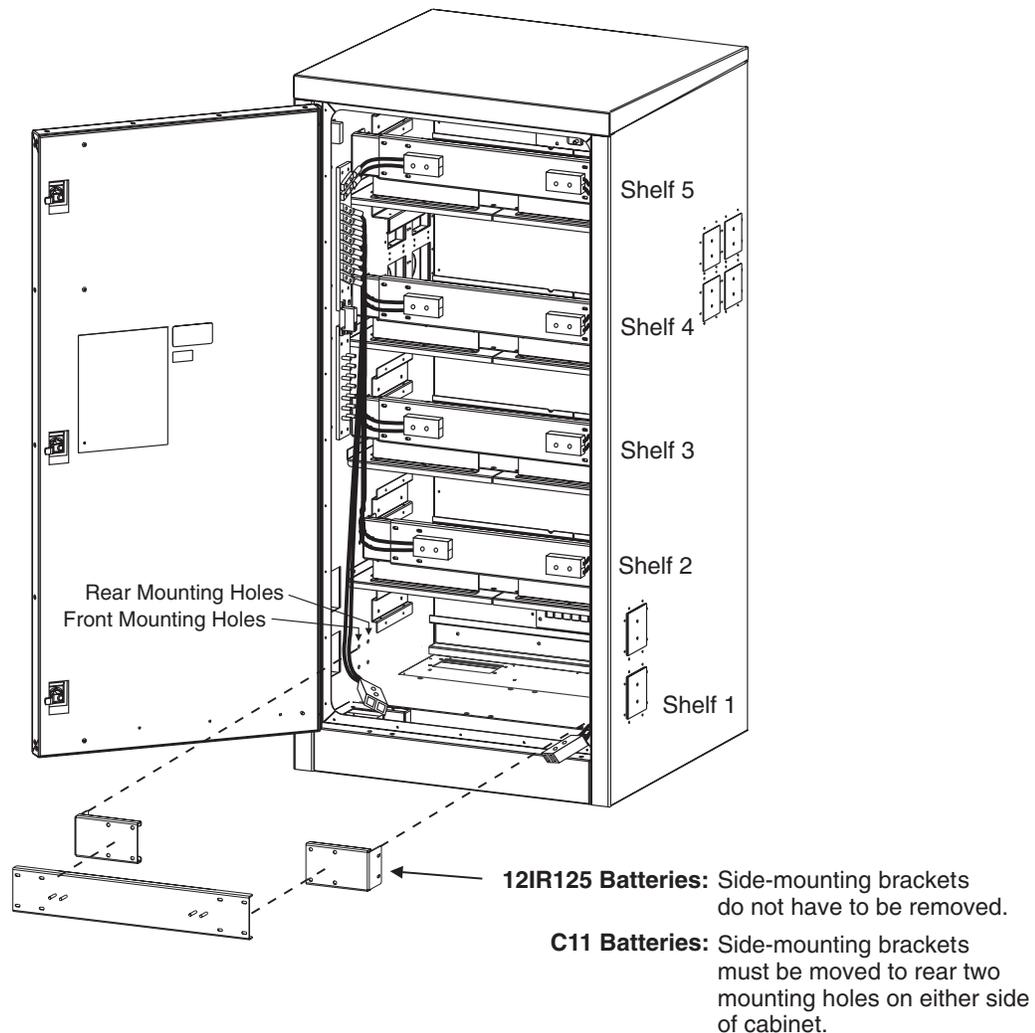


Figure 4-14: Shelf Brackets and Factory-Wired Connector Sets

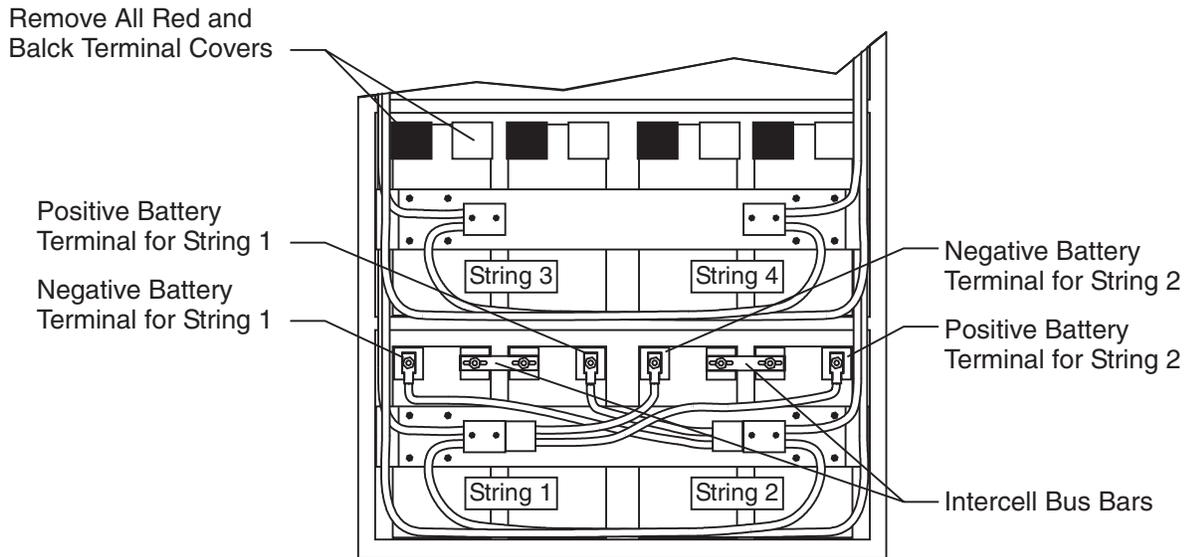


Figure 4-15: 12IR125 Battery Modules and Connectors

1. Check the charge by date stamped on each battery-shipping container. Check the out-of-box voltage of each battery module. Any module with an open-circuit measurement of less than 12.60V should not be placed into service.

NOTE:

If the charge by date has been exceeded, the batteries must have been charged using one of the procedures listed above, or they cannot be put into service.

2. Battery strings are to be equipped from left to right and starting from the bottom of the battery cabinet (shelf 1) to the top (shelf 5). Remove the shop-wired battery connectors from the front of each shelf that is to be equipped with batteries. Retain this hardware for reuse. Move the connector cable sets to the sides along with the thermistor wire sets (1 per shelf) for the Battery Temp Control unit. Remove the front mounting bracket for these shelves also, retaining all mounting hardware for reuse. Locate the battery side half of each of the connector assemblies (2 per shelf) and verify that they are disconnected from the shop-wired halves.

CAUTION

Do not reconnect any of these connectors until ready to put the batteries into service.

CAUTION

Due to the weight of each 12IR125 battery module (125 lbs.), two craft persons are required to lift each module onto the cabinet shelf.

3. With the battery terminals facing the front of the cabinet, carefully slide a battery module onto the left side of the bottom battery shelf. Place another battery module onto the shelf and slide it to the immediate right of the first module.
4. Repeat for the 2nd battery string (2 battery modules) on the right side of the bottom shelf (if equipped). Repeat for each remaining string to be equipped on upper shelves as necessary.
5. Remove red and black terminal covers from each of the battery modules and spread a thin coat of antioxidant on all of the battery terminals.

NOTE:

In the following steps, be certain to check that the polarity marking on each cable matches that of the battery terminal. Positive polarity cables have Red heat shrink over the connector barrels; negative polarity cables have Black. Be certain not to reverse the cables sets on each shelf. Refer to Figure 4-15.

6. For battery string 1, (left half of the bottom shelf) locate a battery side connector assembly half with a short positive (red) lead and a long negative (black) lead. Remove the wire tie and loose heat insulating covering to expose the 1-hole, 45° terminal of both leads of the assembly. Spread a thin coat of antioxidant on the negative cable terminal and place the coated connector onto the negative (left) terminal of the left-most battery module. If this is the only battery string to be equipped on this shelf, locate the thermal probe cable for this shelf, used with the Battery Cabinet Temperature controller. Spread a thin coat of antioxidant on its ring terminal and place it onto the negative (left) terminal of the battery module along with the negative (-) battery cable. Using a battery terminal nut and washer, secure the connector(s) to the terminal by hand tightening the nut. Neatly fold and secure any slack in the thermistor cable with a wire tie.
7. Spread a thin coat of antioxidant on the positive cable terminal of the same connector assembly and place the coated connector onto the positive (right) terminal of the 2nd battery module of string 1.

Using a battery terminal nut and washer, secure the connector to the terminal by hand tightening the nut.

8. Repeat steps 6 and 7 for battery string 2, made up of the two battery modules on the right half of the bottom shelf (if equipped), except that the battery side connector assembly half used for it must have a long positive (red) lead and a short negative (black) lead. If string 2 is equipped, the Battery Cabinet Temperature controller thermistor cable should be located onto the negative (-) terminal of sting 2 instead of on string 1. (Center of the cabinet.)
9. Repeat steps 6 to 8 for the remaining shelves to be equipped with battery strings in the cabinet.
10. Locate the intercell bus bars provided with the battery modules. Spread a thin coat of antioxidant on one of the bus bars. For battery string 1, place the coated bus bar between the positive terminal of the left-most module and the negative terminal of the module to its right (Figure 4-15). Using a battery terminal nut and washer, secure the bus bar to each terminal by hand tightening the nut.
11. Repeat this step for the remaining battery strings equipped in the cabinet.
12. Reassemble the front mounting brackets that were removed in step 2 onto each of the shelves where batteries have been placed, reusing the mounting hardware. Reassemble the shop-wired halves of the connector assemblies onto these front mounting brackets after they are in place.
13. Locate the connector half that was connected to string 1 on the left half of the bottom shelf in steps 6 and 7. Position the connector half near where it will plug into the shop-wired connector half for it **ON THE RIGHT SIDE** of the shelf 1 front bracket. **DO NOT PLUG THE CONNECTOR HALVES TOGETHER AT THISTIME**. Torque all battery connections for string 1 using an insulated 7/16-inch socket and torque wrench set at 60 inch-pounds.
14. Locate the connector half that was connected to string 2 (if equipped) on the right half of the bottom shelf in step 8. Position the connector half near where it will plug into the shop-wired connector half for it **ON THE LEFT SIDE** of the shelf 1 front bracket. **DO NOT PLUG THE CONNECTOR HALVES TOGETHER AT THISTIME**. Torque all battery connections for

string 2 using an insulated 7/16-inch socket and torque wrench set at 60 inch-pounds.

15. Repeat steps 13 and 14 for the remaining shelves equipped with battery strings in the cabinet.
16. Recheck all battery connections to make sure that negative cables (Black) are connected only to negative battery terminals and that positive cables (Red) are connected only to positive battery terminals. Also verify that when plugged into their associated connector halves, positive (red) battery cables end up connected to the +24V Bat bus running down the right wall of the cabinet and negative (black) battery cables end up connected to the top portion of the - Return bus running down the left wall of the cabinet.

If the battery cabinet is being added to a working system, the battery connector halves may be secured together at this time. First verify that +24V with respect to framework is measured on the +24V Bat bus located down the right wall of the battery cabinet and 0V or a very low voltage is measured on the ñ Return bus running down the left wall of the cabinet.

If the battery cabinet and power cabinet are being added together, do not plug in the connector halves until ready to put the batteries into service during the start-up procedure of Section 5.

Hawker SBS C11 Battery Installation Procedure

Refer to Figure 4-14 front view of the battery cabinet and Figure 4-16 Hawker SBS C11 battery wiring throughout this procedure.

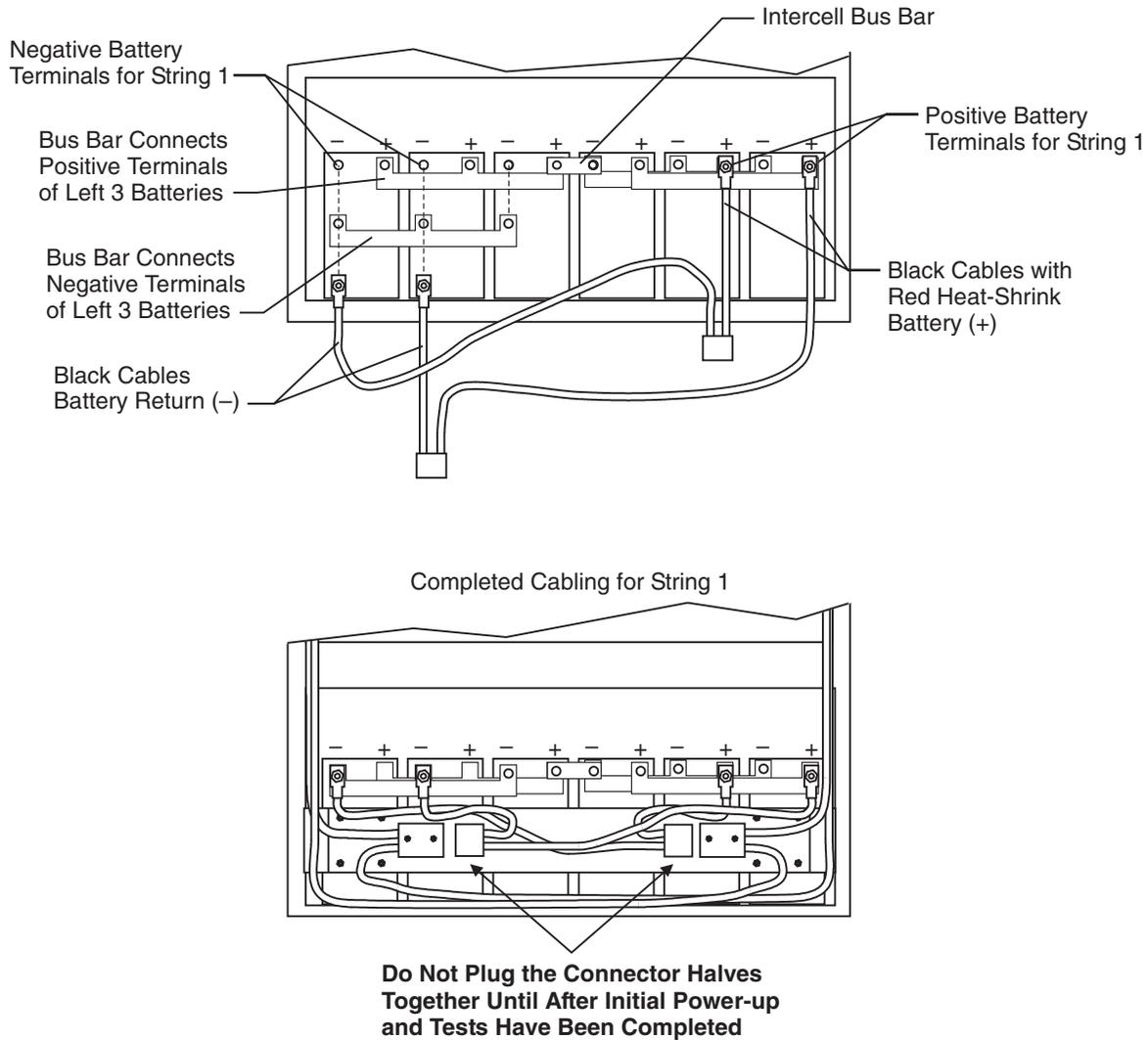


Figure 4-16: Hawker C11 Battery Modules and Connectors

1. Battery strings are to be equipped starting from the bottom of the battery cabinet (shelf 1) to the top (shelf 5). Refer to Figure 4-16 for mounting batteries on a shelf. Each shelf will hold a single string consisting of 6 battery modules in the C11 battery configuration. Remove the shop-wired battery connectors from the front of each shelf that is to be equipped with batteries. Retain this hardware for reuse. Move the connector cable sets to the sides along with the thermistor wire sets (1 per shelf) for the Battery Temp Control unit. Remove the front mounting bracket for these shelves also, retaining all mounting hardware for reuse. Move the

left and right side mounting brackets from the front hole pairs on the sides of the cabinet to the rear hole pair as shown in Figure 4-14. Locate the battery side half of each of the connector assemblies (2 per shelf) and verify that they are disconnected from the shop-wired halves.

CAUTION

Do not reconnect any of these connectors until ready to put the batteries into service.

CAUTION

Due to the weight of each battery module, two craft persons are required to lift each module onto the cabinet shelf.

2. Place six C11 Hawker batteries on a shelf. The battery terminals should face the front of the cabinet as shown in Figure 4-16. Repeat for the remaining battery strings to be equipped in the cabinet.
3. Remove the black terminal covers from each of the battery modules and spread a thin coat of antioxidant on all of the battery terminals. Repeat for all equipped shelves.

NOTE:

In the following steps, be certain to check that the polarity marking on each cable matches that of the battery terminal. Positive polarity cables have Red heat shrink over the connector barrels; negative polarity cables have Black. Be certain not to reverse the cables sets on each shelf. Refer to Figure 4-16.

4. Locate the module straps that were provided with the C11 modules and spread a thin coat of antioxidant on each of them. Position the supplied 3-module straps over all the positive battery terminals and all the negative battery terminals as depicted in Figure 4-16. Position such that the positive strap is facing the cabinet front on the right half of the string and the negative strap faces out on the left half of the string. Hand tighten the 1/4-20 hardware, flat washer, lock washer and nut to hold the straps in place. Repeat for all equipped shelves.
5. Position the single module strap on the positive terminal of the 3rd module from the left and the negative terminal of the 4th module from the left to series the six modules into a single +24V string.

Hand tighten the 1/4-20 hardware, flat washer, lock washer and nut to hold the strap in place. Repeat for all equipped shelves.

6. For battery string 1, (bottom shelf) locate a battery side connector assembly half with a short positive (red) lead and a long negative (black) lead and one with a long positive (red) lead and a short negative (black) lead. Remove the wire ties and loose heat insulating coverings to expose the 1-hole, 45° terminal of both leads of both assemblies. Spread a thin coat of antioxidant on the two negative cable terminals (one in each assembly) and place the coated connectors onto the negative (left) terminal of the 1st and 2nd battery module from the left, removing and reusing the hardware used in step 4, hand tightening the nuts. Locate the thermal probe cable for this shelf, used with the Battery Cabinet Temperature controller. Spread a thin coat of antioxidant on its ring terminal and place it onto the negative (left) terminal of the 3rd battery module from the left, again removing and reusing the hardware used in step 4 and hand tightening the nut. Neatly fold and secure any slack in the thermistor cable with a wire tie.
7. Spread a thin coat of antioxidant on the two positive cable terminals (one in each assembly) of the same pair of connector assemblies from step 6 and place the coated connectors onto the positive (right) terminals of the 5th and 6th battery modules from the left, removing and reusing the hardware used in step 4, hand tightening the nuts.
8. Repeat steps 6 and 7 for the remaining shelves to be equipped with battery strings in the cabinet.
9. Reassemble the front mounting brackets that were removed in step 1 onto each of the shelves where batteries have been placed, reusing the mounting hardware. Reassemble the shop-wired halves of the connector assemblies onto these front mounting brackets after they are in place.
10. For shelf 1, locate the connector half that has a long negative lead and short positive lead from steps 6 and 7. Position the connector half near where it will plug into the shop-wired connector half for it ON THE RIGHT SIDE of the shelf 1 front bracket. DO NOT PLUG THE CONNECTOR HALVES TOGETHER AT THIS TIME. Locate the connector half that has a long positive lead and short negative lead from steps 6 and 7. Position the connector half near where it will plug into the shop-wired connector half for it ON THE LEFT SIDE of the shelf 1 front bracket. DO NOT PLUG THE CONNECTOR HALVES TOGETHER AT THISTIME.

Torque all battery connections for string 1 using an insulated 7/16-inch socket and torque wrench set at 60 inch-pounds.

11. Repeat step 10 for each equipped shelf. Recheck all battery connections to make sure that negative cables (Black) are connected only to negative battery terminals and that positive cables (Red) are connected only to positive battery terminals. Also verify that when plugged into their associated connector halves, positive (red) battery cables end up connected to the +24V Bat bus running down the right wall of the cabinet and negative (black) battery cables end up connected to the top portion of the - Return bus running down the left wall of the cabinet.

If the battery cabinet is being added to a working system, the battery connector halves may be secured together at this time. First verify that +24V with respect to framework is measured on the +24V Bat bus located down the right wall of the battery cabinet and 0V or a very low voltage is measured on the ñ Return bus running down the left wall of the cabinet.

If the battery cabinet and power cabinet are being added together, do not plug in the connector halves until ready to put the batteries into service during the start-up procedure of Section 5.

210E Thermal Probe Multiplexer Installation

A 210E Temp Probe Multiplexer Kit is available as an option per 848669420 for each supplemental battery cabinet that is provided as indicated on the H569-453 OPS 24/800 Ordering Guide. Each 210E kit provides a temperature probe and cable set for each of the 5 shelves of the OPS Battery Cabinet. Three additional probes may also be added to each 210E if desired. The highest temperature of all probes attached to the 210E is passed back to the Vector controller for use with the Slope Thermal Compensation feature of the power plant. Refer to fig. 4-17 for a block diagram of the 210E.

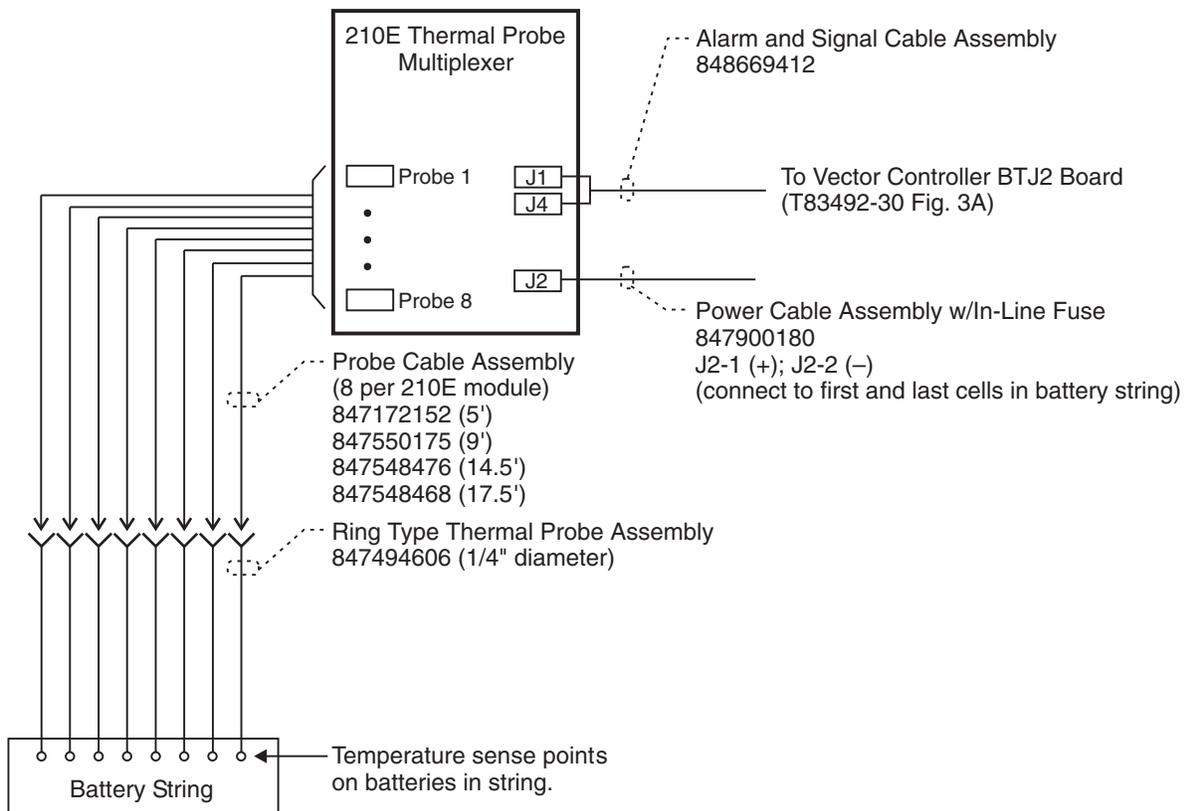


Figure 4-17: Typical Wiring Block Diagram for the 210E with the Vector Controller

The OPS Battery Cabinet 210E kit is provided with an instruction sheet containing detailed installation instructions that should be followed for this application. The 210E module is to be located on the upper left interior wall of the cabinet, using the supplied Velcro adhesion pads.

The kit includes a 10 ft power cable for the 210E with an in-line fuse that permits it to be powered off the first +24V battery string in the battery cabinet. Connect the red (unfused) side of this assembly to the positive battery post of string 1 and the black (fused) side to the negative battery post of string 1, using ring terminals furnished in the kit. Connect the plug for this cable set into jack J2 of the 210E.

Use at least one temperature probe and cable set for each equipped shelf in the OPS Battery Cabinet, connecting the ring terminal probes to any available battery post on the shelf, usually choosing one near the center of the battery shelf. Slack in any of these cables should be pulled back and neatly secured using cable ties furnished in the kit. Any spare probes and cable sets for shelves not yet equipped shall be stored on those shelves for future use.

The single connector side of the 210E signal cable to the Vector should be routed through the existing DC conduit(s) to the OPS Power Cabinet and terminated at J11 (1st battery cabinet) or J12 (2nd battery cabinet) of the BTJ2 Vector termination board. Connect the double connector end of this cable set to jacks J1 and J4 of the 210E.

5 *Initial Power-up and Tests*

This section provides the basic turn up procedures for the OPS 24/800 Power Cabinet. The following procedures are provided:

- Pre-turn-up Checks
- Turn-up AC Input Power
- Install and ID Rectifiers
- Review Vector Configuration and Function
- Activate and Test the HX Circuitry
- Connect Batteries
- Test Alarms

Pre-turn-up Checks

- Verify that the AC utility source circuit breaker is in the OFF position.
- Verify that all AC circuit breakers in the AC distribution panel are in the OFF position.
- Verify that all DC circuit breakers in the DC distribution bus are in the OFF position.
- Verify that the DC circuit breaker for the HX controller unit assembly (located on the cabinet interior, to the left of the rectifier shelves) is in the OFF position.
- Verify that 4 battery cable connectors located in the Upper Rear Access panel are disconnected.
- Verify the S1 DIP switch settings on the Galaxy Vector Controller (Table 5-1) and that the BIC2 circuit card is plugged in and secured to the BTJ2 Termination Board. Cable sets should be connected to J2 (Rect Serial Communication), J6 (Alarm), J9 (Bat Shelf 1 Temp Probe), J10 (Bat Shelf 2 Temp Probe), J14 (Vector Display), J27 (Bat Fuse), and J28 (Dist FAJ) of the Vector BTJ2 Termination Board. Verify that all five, 5A GMT fuses on the BTJ2 card are fully inserted.

Table 5-1: Vector Controller Switch 1

Position	Setting	Definition
1	0	Front Panel Configuration (0 = Enabled)
2	1	Software Defaults (1 = OPS 24/800)
3-6	0	Unused
7	0	Power Battery Test (0 = Disabled)
8	0	LVBD (0 = Vector; 1 = Forced Closed)

Turn-up AC Input Power

DANGER

The AC voltage that feeds the OPS 24/800 cabinet will cause death or severe personal injury. Be very careful when making the following measurements.

- Verify that all circuit breakers in the AC distribution panel are in the **OFF** position.
- Verify that the circuit breaker for the cabinet in the power pedestal or power panel that is feeding the OPS 24/800 cabinet is in the **OFF** position.
- If the AC distribution panel cover is still in place, remove the four screws and set the panel aside.
- Place the breaker for the cabinet in the pedestal or power panel to the **ON** position.

DANGER

The AC voltage that is now present on the distribution panel terminals will cause death or severe personal injury. Exercise extreme care when making the measurements in the following step.

- Using a multimeter on an appropriate AC Voltage scale, measure the voltage between L1 and L2, L2 and L3, and each L to Neutral in the AC distribution panel.

Requirement: 176 to 256 Vac L-L and 90 to 130 Vac L-N.
(Note that the single-phase input option has L1 and L3 connected together.)

NOTE: If the above voltage requirement is not met, correct the problem and repeat this measurement. Do not proceed with cabinet power-up until the AC source is within this voltage range.

- Replace the AC distribution panel cover.

Install and ID Rectifiers

Locate all 596B4 rectifier modules shipped for installation with the OPS 24/800 cabinet. 2 to 8 may be equipped, depending on the load requirements. The rectifiers must be located in the rectifier shelf positions assigned to their ID number so that the AC breaker for each unit is properly identified. Refer to Figures 5-1 and 5-2 for the shelf assignments and a front view of the 596B4 rectifier.

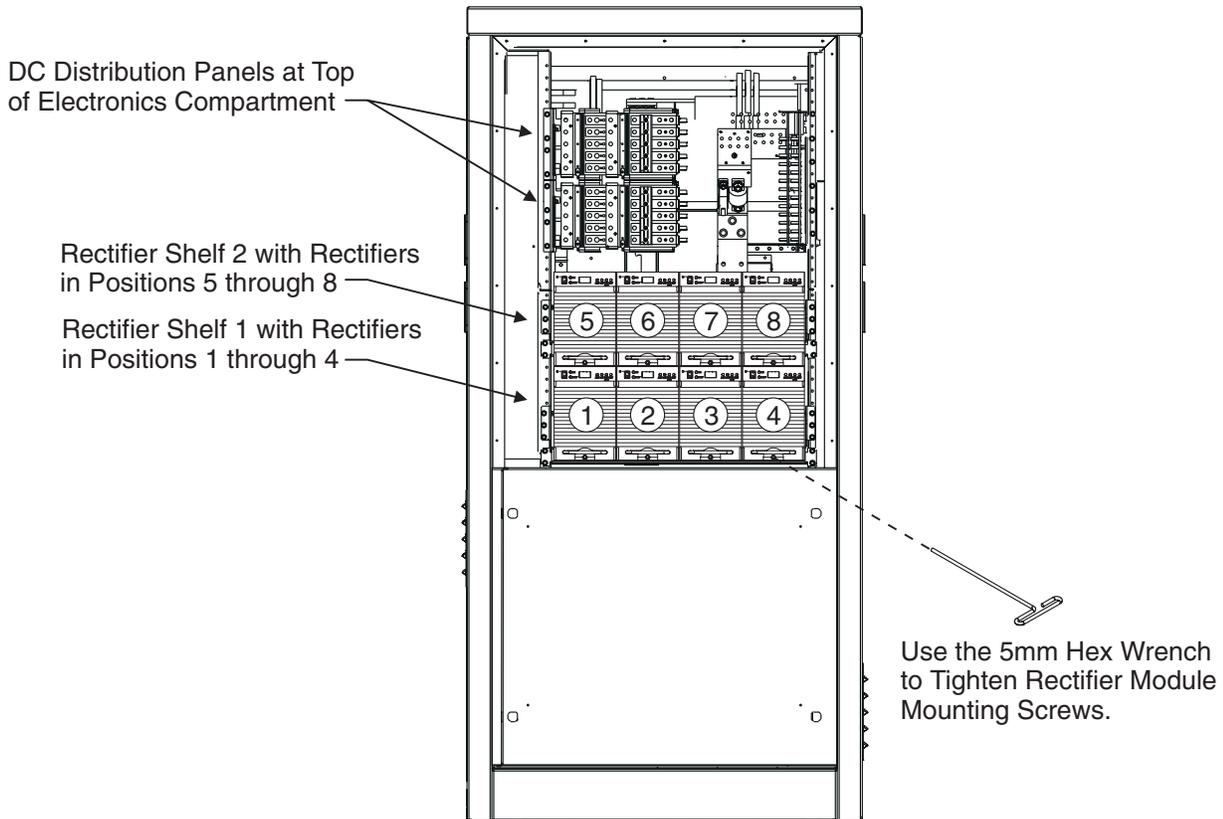


Figure 5-1: Rectifier Shelf Assignments

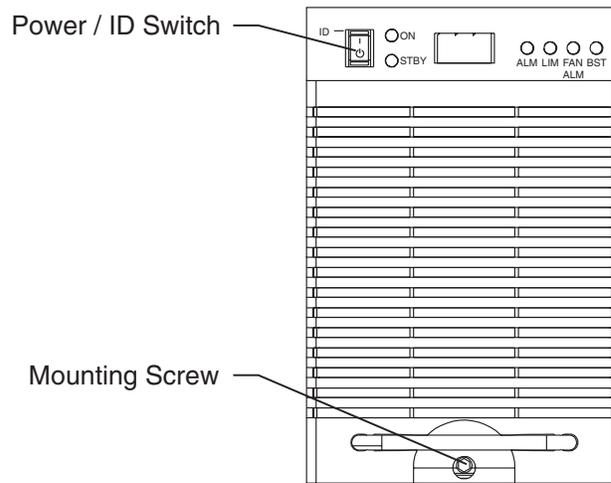


Figure 5-2: 596B4 (+24V / 100A) Rectifier

- On the AC distribution panel, turn ON circuit breakers assigned to each rectifier being installed and all remaining breakers assigned to working equipment in the power cabinet.
- Install the first rectifier module, first insuring that the power/ID switch on its front is set in the STBY (standby) position. Then place it into position on the appropriate rectifier shelf and carefully slide it toward the shelf backplane until the module's mounting screw prevents any further backward motion. Use the provided 5-mm hex wrench to seat the rectifier by turning the mounting screw clockwise until it is secure (Figure 5-2).
- Repeat for all remaining 596B4 rectifier modules.
- On rectifier 1, place the faceplate switch in the ON position.

NOTE:

When the switch is placed in the ON position, observe that the display on the Galaxy Vector Controller is illuminated and listen for the contacts to close on the low voltage disconnect switch. The MIN or MAJ status and RECT LEDs will also light on the Galaxy Vector Controller (depending on the number of rectifiers installed).

- Using a multimeter on an appropriate DC Voltage scale, measure the DC voltage at the PLANT VOLTAGE jacks on the Galaxy Vector Controller display.

Requirement: +27.24 V DC. Verify that it agrees also with that indicated on the Vector display when VOLTS is selected using the

switch to the right of the display. If the Thermal Compensation LED on the Vector display is active (temperature in the battery compartment is $> 25^{\circ}\text{C}$), the voltage may be slightly lower. If this is the case, temporarily disconnect the temp probe cable sets from J9 and J10 on the bottom edge of the BTJ2 Vector Termination board and verify that the voltage recovers to 27.24V. Replace these cable sets when the test is complete.

- The 596B4 rectifiers have identification (ID) numbers associated with each rectifier for communication with the Vector controller. Each rectifier must be assigned a unique number before the Galaxy Vector Controller alarm conditions can be cleared. The rectifier ID must be assigned according to its mounting position on the rectifier shelves. The rectifier mounted in position 1 in Figure 5-1 should be ID'd rectifier 1 for the controller and so on. Set the rectifier ID with the following procedure:
 1. Press the ON/STBY switch up and hold for five seconds until the display starts blinking "0" or whatever the present ID is.
 2. Release the switch; the display should continue to blink.
 3. Depress the switch again within 3 seconds and release. The display will increment up one number on each release of the switch, but will remain flashing. If the desired ID is past, continue incrementing and the ID selection will cycle back to 1 after 24.
 4. Once the desired ID number is displayed, release the switch. The display will stop blinking within 10 seconds, storing the present ID, and then revert to the rectifier current.
- Turn the remaining rectifier(s) ON and set their ID in the same manner. Verify the output voltage of each rectifier in turn by turning OFF all units except the rectifier being tested and verifying that the output voltage on the Vector display remains at 27.24V.

NOTE 1:

If the **RECT ALARMS** lamp remains active on the Vector display, attempt to clear the controller memory with the following steps:

1. Press the **CONFIGURE** key while in the default Voltage Display mode. The **CONFIGURE** LED will activate and the first parameter of the configuration menu (bdtr) will be displayed.
2. Use the + **or** ^ key 44 times until the USL (Update Serial Link) parameter is displayed.

3. Press the **ENTER** key to enter the edit mode for this parameter. The **CONFIGURE** LED will begin blinking and the USL value will display as 0.
4. Use the + key to increase the value from 0 to 1.
5. Press the **ENTER** key again to save the change.
6. Press the **ESCAPE** key to exit the configuration mode.

NOTE 2:

When all rectifier ID numbers have been set and all rectifiers are turned ON, the **NORM STATUS** lamp should be lit on the Galaxy Vector Controller and the green **ON** lamp should be lit on all rectifiers. Any deviation from this expected result must be resolved using the Troubleshooting section of this manual.

Review Vector Configuration and Function

Verify once again the settings for the S1 dip switch bank located on the Vector BTJ2 Termination board listed in Table 5-1. Position 2 establishes software configuration parameters recommended for use in the OPS 24/800 Power Cabinet application when it is enabled at controller power-up. Section 7 provides a complete description of all Vector configuration parameters. The following check should be performed after start-up to insure that the most critical of these parameters are in place:

1. Press the **CONFIGURE** key while in the default Voltage Display mode. The **CONFIGURE** LED will activate and the first parameter of the configuration menu (bdtr) will be displayed.
2. Use the + or ^ key to step through the 47 available configuration parameters. When a parameter listed in Table 5-2 is located, compare the value found for it with the expected setting in the table.
 - Press the **ENTER** key to enter the edit mode for this parameter. The **CONFIGURE** LED will begin blinking and the present value will display.
 - If a change is required, use the +/- keys to change the value and press the **ENTER** key to save the change.
 - If no change is necessary, press the **ESCAPE** key to return to the parameter listing.
3. When all parameters have been verified, press the **ESCAPE** key again to exit the configuration mode.

Table 5-2: Vector Controller Configuration Settings

Configuration Parameter ID	Description	Range	Setting
StyP	Shunt Type	0 = None; 1 = Load; 2 = Battery	2
SH1A	Shunt 1 Size	0 to 9999A	1000
FSP	Plant Float Set Point	22 to 28V	27.24
bd	Battery on Discharge Threshold	23 to 27.5V	25.00
btAt	Battery Thermal Alarm Threshold	30 to 85°C	75
btut	Battery Thermal Slope Upper Temperature	30 to 55°C	53
btEn	Battery Thermal Compensation Enable	0 = Disable; 1 = Enable	1
C1Ld	Contactor 1 LVD Threshold	20 to 26V	21.25
C1ty	Contactor 1 Type	0 = None; 1 = Load; 2 = Battery	2
bEn	Boost Enable	0 = Disable; 1 = Enable	0

Perform a Lamp Test using the switch labeled as such on the Vector display. Observe that all LEDs and display segments on both the display and on all rectifiers activate for approximately 10 seconds.

Vector functionality and rectifier control can easily be tested at this point by initiating the Plant Battery Test (PBT) feature. With all alarms clear, initiate PBT by setting dip switch S1-7 on the BTJ2 Termination board to the “1” position. Rectifier output voltage should immediately drop to 22V as observed on the Vector display or at the Plant Voltage test jacks on the display. The BD LED should activate during this test. Retire PBT and return to the 27.24 plant float voltage by resetting S1-7 back to the “0” position.

***Activate and
Test the HX
Circuitry***

The OPS 24/800 Power Cabinet Heat Exchanger (HX) thermal controller circuitry is shown on T83492-30 Figure 3C. Peripheral equipment associated with the HX circuit in addition to the HX controller card located on the power cabinet door includes:

Qty	Description
2	10K thermistors for battery temperature monitoring, one on each battery shelf
1	10K thermistor for battery compartment ambient temperature, located just inside the Intake Ventilation Louver within the lower battery shelf
1	DC-powered battery compartment fan, located inside the Exhaust Ventilation Louver within the upper battery shelf
2	AC-powered battery heaters, one on each battery shelf
1	Solid-state relay for control of the battery heaters
1	HX thermistor within the HX ductwork on the cabinet door
2	Variable speed DC fans and driver circuits within the HX ductwork on the cabinet door

Refer to Figure 5-3 for a view of the HX equipment on the cabinet door.

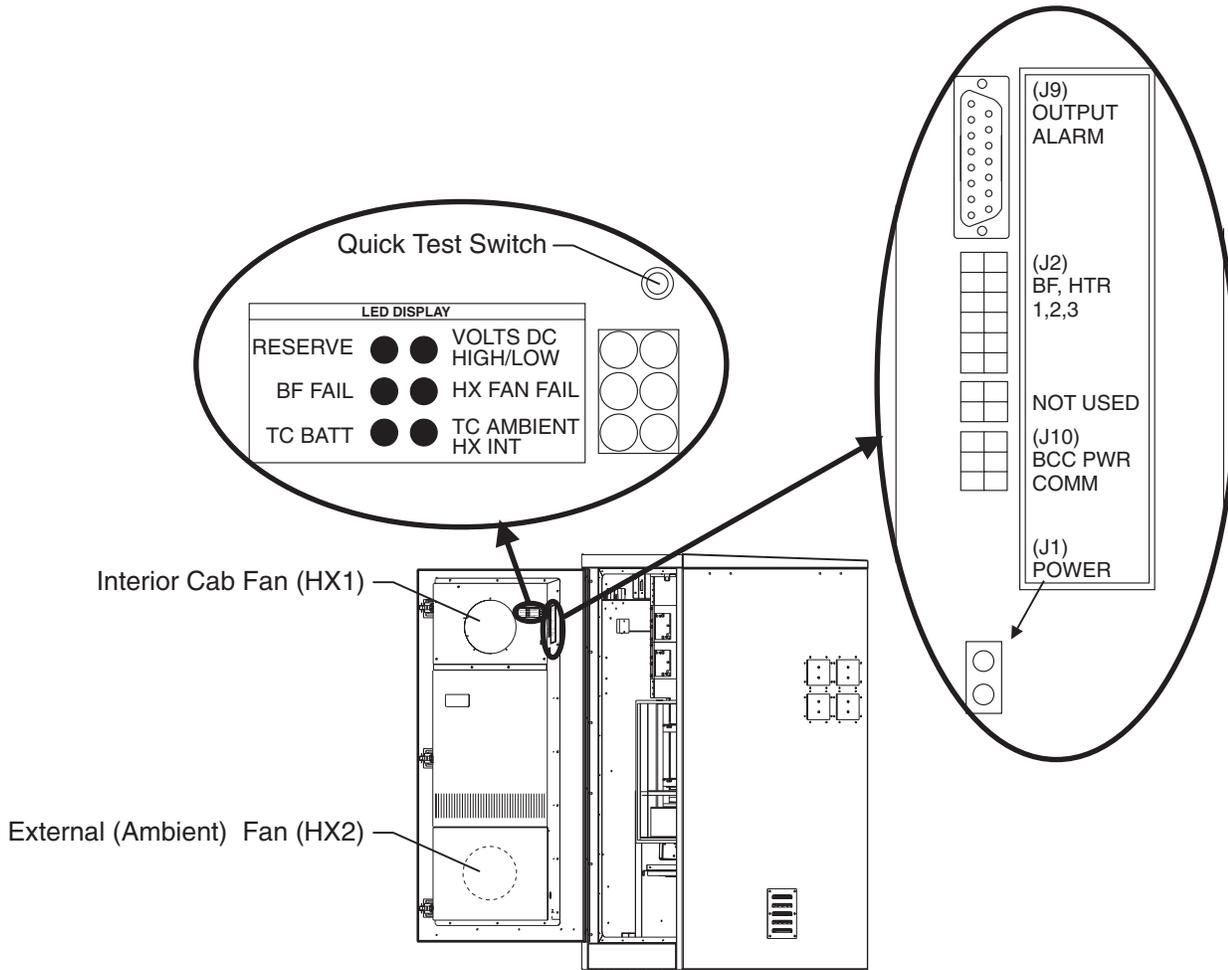


Figure 5-3: HX Equipment on Interior of Power Cabinet Door

6 bi-color (Green/Red) HX status LEDs are present as shown in Figure 5-3 and 5 sets of output alarms (Form-C) are cabled to a Krone cross-connect block on the left interior of the power cabinet as shown on T83492-30 Figure H6. Table 5-3 identifies the conditions causing the LEDs to activate Red, and Table 5-4 does the same for the HX alarm relays.

Table 5-3: HX Controller Status LED Conditions

LED	Conditions Resulting in a Red State
Battery T/C	5°C > Any Battery Temp Probe > 60°C; Any battery or battery compartment ambient temp probe open or shorted
Ambient/HX Int T/C	-10°C > HX Ambient Temp Probe (door) > 88°C; HX ambient or battery compartment ambient temp probe open or shorted
Battery Fan Fail	Battery Fan Speed < 1900 RPM while activated by the HX Controller
HX Fan Fail	HX Internal or External (ambient) Fan Speed < 800 RPM while activated by the HX Controller
Hi VDC	DC Voltage > 28V; Controller Fail
Unused	Unused

Table 5-4: HX Controller Alarm Relay Conditions

Alarm Relay (Contactor Set)	Conditions Resulting in an Alarm State
Controller (1-2-3)	Processor Fail; DC Voltage > 28V; No DC Power (All 5 alarm sets active)
Battery Fan (4-5-6)	Battery Fan Speed < 1900 RPM while activated by the HX Controller
Battery Temp Hi/Low (7-8-9)	5°C > Any Battery Temp Probe > 60°C; Any battery or battery compartment ambient temp probe open or shorted
HX Fan Fail (10-11-12)	HX Internal or External (ambient) Fan Speed < 800 RPM while activated by the HX Controller
Cabinet Temp Hi/Low (13-14-15)	-10°C > HX Ambient Temp Probe (door) > 88°C; HX ambient or battery compartment ambient temp probe open or shorted

Turn ON the DC circuit breaker for the HX controller unit assembly (located on the cabinet interior, to the left of the rectifier shelves). Fans should start up and the HX Controller will go through a boot-up process. Allow the unit to run for a minimum of 2-3 minutes or until stable.

Check the status of all HX system Status LEDs and Alarms as identified in Tables 5-3 and 5-4. If alarm indications are present, they should be cleared, using the Troubleshooting section of this manual before proceeding.

The HX controller has a Quick Test feature that allows each of the input/output devices in the HX system to be tested. It is initiated using the momentary switch designated as such above the status LEDs on the HX controller. Perform the HX system Quick Test as follows:

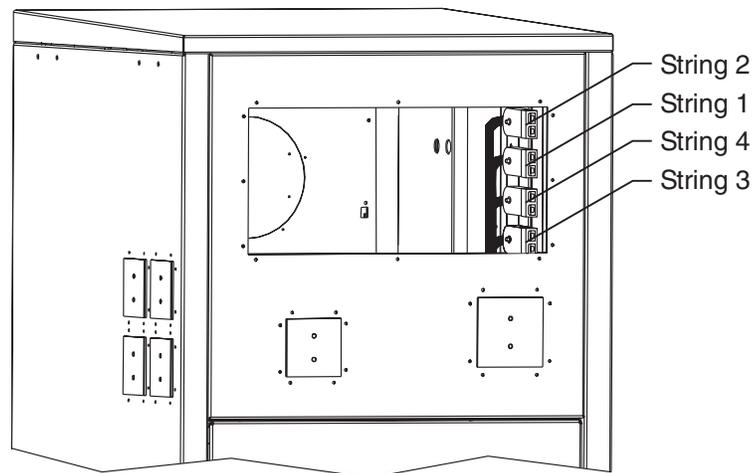
1. Press and hold the Quick Test switch on the HX controller until the status LEDs flash red/green then let go. The LEDs will flash red/green for about 20 seconds. During this time:
 - The HX external (ambient) fan will begin spooling down to less than 1000 RPM.
 - The remaining fans, heaters, etc., will also spool down to off.
 - Alarm outputs will cycle open/close.
2. For the next 20 seconds, the following should be noted:
 - The HX external (ambient) fan should be less than 1000 RPM.
 - All other fans are off.
 - Heaters are off.
 - LEDs should blink green/off. (Note - “off”, NOT red.) If the LEDs blink red/off, that indicates a failure has occurred. See the Troubleshooting section to resolve.
 - Alarm outputs should be closed (inactive). I.e. Krone alarm block positions (1,2), (4,5), (7,8), (10,11), and (13,14) should be closed. If not, a failure has been detected.
3. For the next 20 seconds, the following should be noted:
 - The HX external (ambient) fan goes to max speed.
 - All heaters turn on.
 - All other fans go to max speed.
 - LEDs should blink green/off. (Note - “off”, NOT red.) If the LEDs blink red/off, that indicates a failure has occurred. See the Troubleshooting section to resolve.
 - Alarm outputs should be closed (inactive). I.e. Krone alarm block positions (1,2), (4,5), (7,8), (10,11), and (13,14) should be closed. If not, a failure has been detected.
4. If there are no red LEDs flashing and all alarms are inactive, the test can be ended at this point by holding the Quick Test switch once again. To signify the test is complete, the LEDs will flash red/green for 4 seconds. The controller will then go to normal control mode. If the test is not ended in this fashion, it will terminate on its own in about 3 minutes.

5. During those next 3 minutes, if there was a fault detected, troubleshooting any problems may begin. The LEDs will continue flashing green/off during this time except for a fault detect. If the problem is fixed within the 3-minute period, the LEDs and alarms should clear. The test can be terminated at any time during this 3-minute dwell by pressing the quick test button only if there are no faults detected.
6. At the end of the test:
 - The LEDs will flash Red/Green for 4 seconds.
 - Any failures detected during the Quick Test will be latched “ON” until the problem is corrected. For example, if there is a battery fan fail detected, the Battery Fan Fail LED and alarm will be activated even if the HX controller does not call for the battery fan to be on.

Connect Batteries

With the HX system activated, it is safe to connect the batteries into the power system. First, the polarity and wiring of the battery disconnect cables that was completed in Section 4 must be verified:

1. Locate the 4 battery cable quick-disconnect connectors for the 4 available battery strings, located on the right half inside the Upper Rear Access panel of the OPS 24/800 power cabinet (Figure 5-4). All 4 should still be disconnected from their mating connectors for the plant at this point.



Rear View of Top of Cabinet
with Upper Access Panel Removed

Figure 5-4: Battery Quick-Disconnect Connectors

2. Using a multimeter on the appropriate DC voltage scale, carefully measure the open circuit voltage across each equipped battery string in turn at the connector body for the battery side of each cable set.

Requirement: Not less than 25.5 V DC or greater than 30V DC. If the voltage is less than 25 V DC, the batteries may contain shorted cells or if the voltage is greater than 30V DC, the connections to the battery terminals have been made incorrectly.

3. Observe the polarity of each reading and the meter probe orientation into the connector end. Determine the plant side connector direction required to mate to each battery side connector cable set. Make this measurement into the plant side connector and verify that the polarity matches that seen on the mating battery side connector.
4. Locate the J23 cable set plugged into the top left portion of the Vector controller BTJ2 Termination board and disconnect it. Listen to hear the opening of the 1200A LVBD contactor as this cable set is disconnected.

CAUTION

Do not connect or disconnect battery connectors while batteries are charging or discharging. This will create arcing that could damage the connectors or result in injury.

5. Plug in each of the battery cable quick-disconnect connectors for the battery strings that are equipped. **Do not plug in cables for strings that are not equipped.**
6. Reconnect the J23 cable set into the Vector BTJ2 Termination board. Listen to hear the closing of the 1200A LVBD contactor as this cable set is connected. The rectifier output currents observed on their displays may increase for a period as battery charging begins.
7. Measure the voltage across each installed battery string at the battery terminals with a multimeter on the appropriate DC voltage scale, again observing polarity. Verify that each measurement agrees with the reading at the Plant Voltage jacks of the Vector display.
8. Replace the Battery Compartment Cover when battery charging has been verified.
9. If one or two battery cabinets are also being installed, the battery connector halves for all equipped strings in them may be secured together at this time. First verify in each battery cabinet

that +24V with respect to framework is measured on the +24V Bat bus located down the right wall of the battery cabinet and 0V or a very low voltage is measured on the -Return bus running down the left wall of the cabinet.

Test Vector Alarms

Refer to Section 8 for information on alarm reporting available through the LEDs and display of the Vector controller. External alarm connections can be monitored on the Krone alarm blocks, mounted on the left interior wall of the power cabinet, and are assigned as shown on T83492-30 Figure H6.

Dist MJF and PMJ (Major Fuse Alarm)

Simulate a tripped DC load circuit breaker alarm, using a jumper across the hot bus and the alarm bus of an unused position of either a bullet or plug-in style breaker panel. Verify that the DIST and MAJ alarm LEDs illuminate on the Vector display and the controller screen reports FAJ when the View Active Alarms button is chosen. Both the MJF and PMJ alarm sets on the external alarm block must also change state.

Verify that all alarms retire when the jumper is removed.

ACF and PMN (AC Fail) and 2ACF and PMJ (Multiple AC Fail)

Turn OFF the ac circuit breaker assigned to rectifier #1 in the AC distribution panel. Verify that the AC and MIN alarm LEDs illuminate on the Vector display and the controller screen reports ACF when the View Active Alarms button is chosen. Rectifier #1 should now display ACF in place of the rectifier load and its green ON LED will go out. Both the ACF and PMN alarm sets on the external alarm block must also change state.

Turn OFF the ac circuit breaker assigned to rectifier #2 in the AC distribution panel. Verify that the AC and MAJ alarm LEDs are now illuminated on the Vector display and the controller screen now reports both ACF and nACF when the View Active Alarms button is chosen. Both Rectifier #1 and #2 should now display ACF in place of rectifier load and their green ON LEDs will be out. Both the 2ACF and PMJ alarm sets on the external alarm block also activate along with ACF, but the PMN alarm set retires.

Turn ON the ac circuit breakers assigned to rectifier #1 and rectifier #2 simultaneously in the AC distribution panel. Verify that both rectifiers sequence on at one-second intervals and that all alarms on both the Vector controller and on the external alarm block retire.

***BD and PMJ
(Battery on
Discharge) using
RO/S (Rectifiers
On Standby)***

Place a jumper across the RO/S pair at positions 19 and 20 on the Krone alarm block assigned to the Vector alarms. Verify that all rectifiers go to standby, with their STBY LED active and tr on their display. Observe the voltage on the Vector display. Verify that the BD and MAJ alarm LEDs illuminate on the Vector display when the plant voltage drops to the Battery on Discharge alarm threshold of 25.0 volts and that the controller screen then reports bod when the View Active Alarms button is chosen. (Note that this may take several minutes if the load on the system is only that provided by the HX cooling system.) Verify that both the BD and PMJ alarm sets on the external alarm block also activate when the alarm threshold is reached.

Verify that all rectifiers restart and that the alarms retire when the jumper is removed.

6 *Final Installation*

Remaining installation work involves taking alarm wiring and DC and AC distribution cabling out of the OPS 24/800 Power Cabinet to the load equipment locations where the power is required and the alarm signals can be monitored. Four 2-inch conduit openings are available on either side of the power cabinet to support the cabling to the load equipment cabinet(s).

Fittings for 2-inch Liquid Tight Flexible Metal (LFML) conduit have been provided for convenience on the H569-453 Ordering Guide. The use of this conduit type is not mandatory, but the mechanical protection provided for these conductors must meet the weatherproof specifications of LFML conduit when placed into an outdoor environment.

Note that AC and DC distribution conductors may not be routed together within the same conduits when exiting the power cabinet. Alarm cabling may be run with DC distribution cabling, subject to the 40% maximum fill requirement of that conduit. Tables have been provided on the H569-453 Ordering Guide to assist with the engineering of conduits and cables exiting the power cabinet.

Alarms

Alarm cross connects for the Vector power plant controller, HX cooling system controller, and power cabinet door alarms shall be made off two, 20-position Krone blocks mounted on the left interior wall of the power cabinet, as assigned on T83492-30 Figure H6. All Vector and HX controller alarms are Form-C transfer type contact sets that deactivate to signal an alarm condition. Maximum ratings for alarm relay connections are 60Vdc and 0.5 amperes. An Office Alarm Termination Tool for this application is separately orderable by comcode 408507713. The alarm condition is a closure from common to NC and an open from common to NO. Door alarms are a C and NO pair only and the Vector R O/S (Rectifier on Standby) pair is a control signal that places all rectifiers into standby mode when shorted.

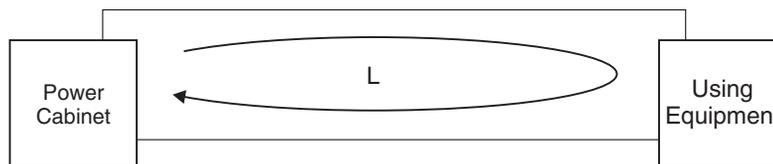
DC Distribution

Minimum DC Cable Length

A minimum cable length for a given cable size and protector type must be used to ensure proper short circuit protection in the case of a bolted fault.

Provide cable run lengths as least as long as the minimum length indicated here to assure that the short circuit currents are less than the interrupt current rating of 10,000A.

Cable Size	Minimum Cable Length "L"
10 GA (6mm ²)	5 feet
8 GA (10 mm ²)	8 feet
6 GA (16 mm ²)	12 feet
4 GA (25 mm ²)	19 feet
2 GA (35 mm ²)	30 feet



Load Connections

DC distribution loads may be assigned to circuit breakers on a panel located in the top left portion of the electronics compartment. Two styles of DC distribution panels are available and space is provided for 2 panels in the cabinet. A 14-position panel using the plug-in breaker style and a 10-position panel using the bullet breaker style may be used. Each distribution panel uses an alarm circuit board located on the left side of the panel. A breaker fail alarm LED is provided at the top of the alarm circuit board.

Breakers of the appropriate style must be installed into desired positions on the DC distribution panel(s). Both breakers and terminating material for the distribution conductors are listed in the H569-453 Ordering Guide.

When installing the circuit breakers, first insure that the breaker is in the OFF position and that the LINE and LOAD terminals of the breaker properly align with the associated positions on the panel. As the breaker

is installed, make sure the center contact (alarm contact) engages into the alarm position for that position on the distribution panel so that the alarm for a tripped breaker is properly reported.

Load assignments made to distribution breakers should be recorded on the breaker ID label for that panel, located on the side of the OPS power cabinet.

DC load conductors shall be terminated onto their assigned breakers and onto the common load return bus on the power cabinet, and routed out one of the four, 2-inch conduit openings on either side of the power cabinet to the load equipment cabinet(s). Make breaker assignments and route these conductors in a manner to avoid blocking access for future load assignments in the power cabinet.

DC conductor sizing to meet voltage drop requirements should be based on a minimum battery voltage of 1.77 volts per cell or 21.25V at the power cabinet. DC conductor and circuit breaker sizing may also be influenced by conductor ampacity de-rating caused by more than 3 conductors in a conduit and/or outdoor ambient temperatures of up to 45°C for the conduit(s). Reference Chapter 3 of the NEC or other local codes as necessary when selecting conductor and breaker sizes. The H569-453 Ordering Guide includes tables to assist in meeting the 40% conduit fill requirement when using the recommended LFML conduit type and KS24194 L-2 (Class I flexible) DC conductors.

AC Distribution

Spare positions are available on the AC input panel of the power cabinet as shown on the appropriate T83492-30 Figure 1 wiring diagram for service to battery heaters and AC convenience outlets of supplemental battery cabinets and/or AC loads in customer equipment cabinets as necessary. Breakers may be ordered for these applications off the H569-453 Ordering Guide and the AC load conductors may be routed out one of the four, 2-inch conduit openings on either side of the power cabinet. Do not mix AC and DC load conductors in the same conduit when exiting the power cabinet.

7 *Vector Controller Configuration Parameters and Features*

This section covers the installation and configuration procedures specific to the Galaxy Vector controller for its application in the OPS 24/800 Power Cabinet system. This controller is completely factory wired and assembled in the OPS power cabinet application.

Refer to Figures 7-1 and 7-2 for views of the Vector BMW3 Control panel and BTJ2 Termination board that are referenced throughout this manual.

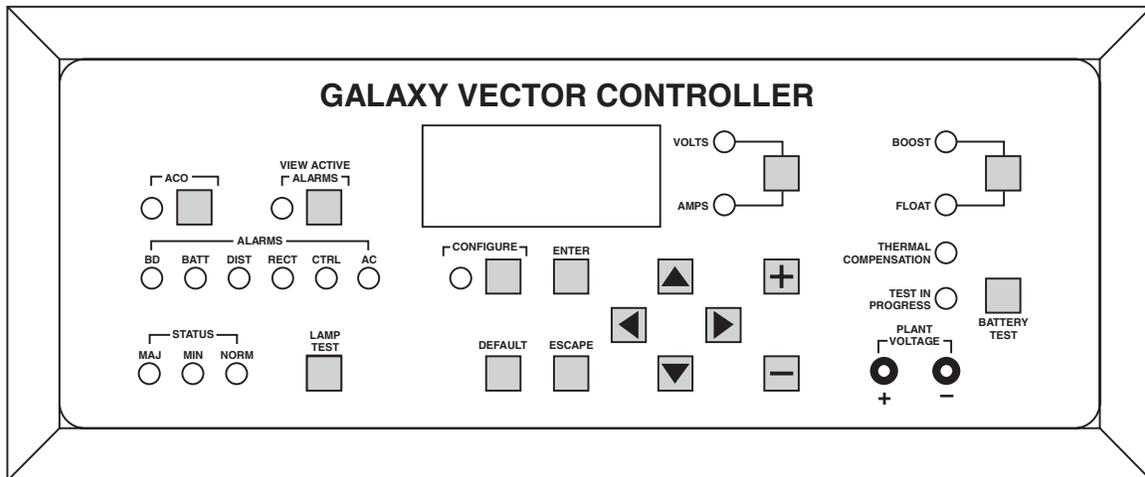


Figure 7-1: Galaxy Vector BMW3 Control Panel

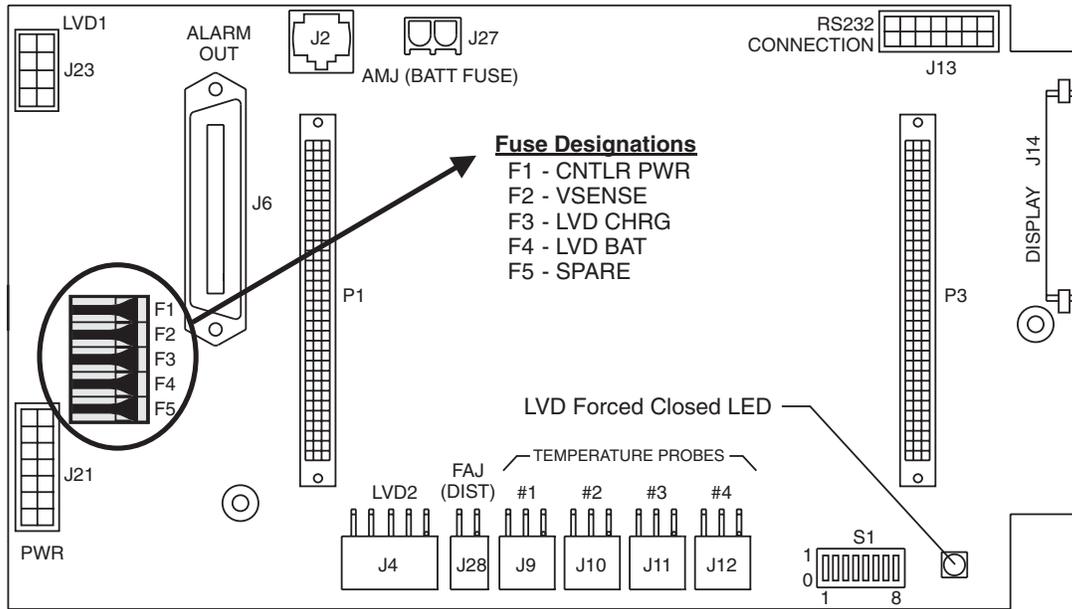


Figure 7-2: Galaxy Vector BTJ2 Termination Board
(See Table 5-1 for Switch S1)

Configuration

All rectifiers must be numbered uniquely for communication with the Vector. Valid ID numbers for rectifiers are 1 through 8 in the OPS application. Refer to Section 5 for instructions regarding setting ID numbers.

SW1 and Navigation of the BMW Display in Configuration Mode

SW1-1 of the BTJ2 Termination board is a hardware-enable switch for Configuration mode of the BMW3 Control Panel. If SW1-1 is not enabled (in position 1), the CONFIGURE switch of the display only permits the user to access and view the configuration parameters, but not to change any of them. To permit configuration changes, SW1-1 must be set to position 0. Once configuration has been completed, it is permitted to disable (position 1) SW1-1 to prohibit someone from mistakenly changing these parameters.

Configuration mode is entered by pressing the CONFIGURE key while in the default Voltage Display mode. After entering this mode, the CONFIGURE LED will light and the first parameter of the configuration menu will be displayed. Refer to Table 7-1 for a description of the parameters of the configuration menu. Note that two columns of default values are shown, for standard and OPS 24/800 Power Cabinet applications. The defaults are determined by the setting of SW1-2 at power-up of the controller and SW1-2 should be in position 1 for this OPS application.

Table 7-1: Configuration Parameters

NUM	ID	MNEM	Description	Range	Default Settings	
					Standard	OPS
1	bdtE	bdtR	Battery Discharge Test Results Error Code 0 : Test completed (new results) -1 : User aborted test (previous results) -2 : Alarm aborted test (previous results) -3 : Test failed (invalid results) Reserve Time ___ : Reserve time not available (test not run or test failed) hh.h : Reserve time in hours and tenths or hours Load ___ : Load not available (test not run or test failed) ddd : Load (amps) at beginning of test	Error Code Reserve Time Load	Error Code	Error Code
2	bdtE	bdtE	Battery Discharge Test Enable	0 to 1 (0=disable, 1=enable)	0	0
3	SEYP	StYP	Shunt Type	0 to 2 (0=none, 1=plant, 2=battery)	2	2
4	SH1A	SH1A	Shunt 1 Size	0 to 9999A (0=disable, other=shunt rating)	800	1000
5	SH2A	SH2A	Shunt 2 Size	0 to 9999A (0=disable, other=shunt rating)	0	0
6	FSP	FSP	Plant Float Set Point	22 to 28V, 44 to 56V	27.24, 54.48	27.24
7	FCL	FCL	Rectifier Float Current Limit	30 to 110%	100	110
8	FHO	FHO	High Voltage Float Threshold	25 to 30V, 50 to 60V	28.24, 57	28.5
9	FHFO	FHFO	High Float Voltage Float Threshold	25 to 30V, 50 to 60V	27.74, 56	27.74
10	bd	bd	Battery on Discharge Threshold	23 to 27.5V, 46 to 55V	25.54, 51.1	25.0
11	LLO	LLO	Very Low Voltage Threshold	20 to 25.5V, 40 to 51V	23, 46	23.00
12	rCL	rCL	Battery Recharge Current Limit	10 to 1,000A	1,000A	1,000A
13	rCLE	rCLE	Battery Recharge Current Limit Enable	0 to 1 (0=disable, 1= enable)	0	0
14	btAt	btAt	Battery Thermal Alarm Threshold	30 to 85 Deg C	55	75°C
15	btSt	btSt	Battery Thermal Step Temperature	45 to 85 Deg C	75	75°C
16	btut	btut	Battery Thermal Slope Upper Temp	30 to 55 Deg C	45	53°C
17	btnt	btnt	Battery Thermal Slope Nominal Temp	15 to 30 Deg C	25	25°C
18	btLt	btLt	Battery Thermal Slope Lower Temp	-5 to 20 Deg C	0	-5°C
19	btuS	btuS	Battery Thermal Upper Slope Per Cell	1 to 5 mV/Deg C	3	3
20	btLS	btLS	Battery Thermal Lower Slope Per Cell	1 to 5 mV/Deg C	3	3
21	btLE	btLE	Battery Thermal Slope Lower Enable	0 to 1 (0=disable, 1=enable)	0	0
22	btEn	btEn	Battery Thermal Compensation Enable	0 to 1 (0=disable, 1=enable)	0	1

Table 7-1: Configuration Parameters (continued)

NUM	ID	MNEM	Description	Range	Default Settings	
					Standard	OPS
23	C1Ld	C1Ld	Contactora 1 Low V Disconnect Threshold	20 to 26V, 40 to 52V	21, 43.2	21.25
24	C1Lr	C1Lr	Contactora 1 Low V Reconnect Threshold	20 to 26V, 40 to 52V	22.2, 44.4	25
25	C1ty	C1ty	Contactora 1 Type	0 to 2 (0=none, 1=load, 2=battery)	0	2
26	C2Ld	C2Ld	Contactora 2 Low V Disconnect Threshold	20 to 26V, 40 to 52V	21, 43.2	N/A
27	C2Lr	C2Lr	Contactora 2 Low V Reconnect Threshold	20 to 26V, 40 to 52V	22.2, 44.4	N/A
28	C2tY	C2tY	Contactora 2 Type	0 to 2 (0=none, 1=load, 2=battery)	0	0
29	bSP	bSP	Boost Plant Set Point	24 to 30V, 48 to 60V	27.24, 55.2	N/A
30	bCL	bCL	Boost Rectifier Current Limit	30 to 110%	100	N/A
31	bHO	bHO	Boost High Voltage Threshold	26 to 30V, 52 to 60V	28.24, 57	N/A
32	bHFO	bHFO	Boost High Float Voltage Threshold	25 to 30V, 50 to 60V	27.74, 56.2	N/A
33	bAF	bAF	Boost Auto Mode Factor	1 to 9 (1-9 times BD duration)	1	N/A
34	bAE	bAE	Boost Auto Mode Enable	0 to 1 (0=disable, 1=enable)	0	0
35	bEn	bEn	Boost Enable	0 to 1 (0=disable, 1=enable)	0	0
36	CSP	CSP	Converter Voltage Set-Point	46 to 57V	50	N/A
37	CLd	CLd	Converter Low V Disconnect Threshold	20 to 26V	21	N/A
38	CLr	CLr	Converter Low V Reconnect Threshold	20 to 26V	22.2	N/A
39	CLdE	CLdE	Converter Low V Disconnect Enable	0 to 1 (0=disable, 1=enable)	0	N/A
40	CFPC	CFPC	Converter Control Panel V Calibration	46 to 57V	Converter V	N/A
41	FPC	FPC	Control Panel Voltage Calibration	22-28V, 44 to 56V	Plant V	N/A
42	SH1C	SH1C	Control Panel Shunt 1 Calibration	-9999 to 9999A	Shunt 1 A	N/A
43	SH2C	SH2C	Control Panel Shunt 2 Calibration	-9999 to 9999A	Shunt 2 A	N/A
44	rOnE	rOnE	Rectifiers On Engine	1 to 24	24, 1	24
45	USL	USL	Update Serial Link and Clear Alarms	0 to 1 (0=do nothing, 1=update)	0	0
46	id	id	Identifiers Enable	0 to 1 (0=numeric, 1=alphanumeric)	1	1
47	rEL	rEL	Display Software Release			

Once in configuration mode, use either the + and - keys or the up and down arrow keys to select a parameter to edit and the ENTER key to choose a parameter to edit. While in configuration mode, the CONFIGURE LED will blink. Use the < or > keys to select a digit in the displayed parameter to change and the + and - or up and down arrow keys to increase or decrease the value of the selected digit. The DEFAULT key may also be used while editing a parameter to set it to its factory default, as defined in Table 7-1. If an attempt is made to set a

parameter higher than allowable, the maximum value will be displayed. Likewise, an attempt to set a parameter lower than allowed results in display of the minimum value.

To save changes made to a parameter value and return to the configure menu, press the ENTER key. To return to the configure menu without saving any changes to a parameter, press the ESCAPE key. To exit configuration mode and return to the default Voltage Display mode, press ESCAPE while viewing the configuration menu. If no key is pressed for 30 seconds, the display will return to the Voltage Display mode automatically.

Refer to Table 7-1 as each of the Configuration Parameters is explained in detail for its application in the OPS power cabinet the following sections.

***Battery Discharge
Test Results (bdtr)
and Battery
Discharge Test
Enable (bdtE)***

The Battery Discharge Test feature is explained in Section 8.

- bdtR is the record data (not manually changeable) for the battery test result. The default display is the error code in this field. “0” means the most recent test is successful and the new result (reserve time and load current during test) has been recorded. “-1” indicates that the most recent test has been aborted by user and the previous successful test result (reserve time and load current during test) is recorded. “-2” implies the most recent test has been aborted due to alarms and the previous successful result (reserve time and load current during test) is recorded. Finally, “-3” indicates that the most recent test failed and no test result (reserve time and load current during test) is recorded.

By pressing the up and down keys, the user can view the battery reserve time. The battery reserve time is displayed in the form of hours and tenths of hours (hh.h) if test results are available. By pressing the up and down keys again, the user can view the load current when the test started. The load current is displayed in the form of Amps without decimal point (dddd) if the test results are available.

- Two settings are available for bdtE, “1” or “0”. “1” enables the battery discharge test feature and “0” disables it. Press ENTER to save the selected setting. When the test is enabled, the Battery Test key may be used to initiate a test. Otherwise, the Battery Test key is disabled. Battery Discharge Test is default disabled in the OPS power cabinet system and must be enabled here in order to perform the test.

***Shunt Type/Size
(StYP, SH1A,
SH2A)***

OPS 24/800 uses a single battery type shunt at 1000A/50mV calibration to monitor the battery charge/discharge current in the system. As such, parameter StYP must be set to 2 (battery type), SH1A to 1000 amps, and SH2A to 0 (disabled). The load current reported on the Vector display will be the difference of the sum of the individual rectifier currents and the battery charge current.

***Plant Float Mode
(FSP, FCL, FHO,
FHFO, bd, LLO)***

- Plant Float Set-Point (FSP) is the voltage that all plant rectifiers will be set to while in Float mode. If Battery Thermal Compensation is enabled and active, actual plant voltage will be adjusted from FSP based on the highest battery temperature monitored. FSP is set to 27.24V in OPS 24/800 for use with 12IR125 batteries.
- Rectifier Float Current Limit (FCL) is adjustable from 30 to 110% of rectifier capacity while in Float mode. FCL default setting is 110% for OPS applications.
- Plant voltage monitored above the High Voltage Float threshold (FHO) results in a High Voltage alarm and shutdown while in Float mode. The default for OPS 24/800 is 28.5V.
- Plant voltage monitored above the High Float Voltage Float threshold (FHFO) results in a High Float Voltage alarm (minor, no shutdown) while in Float mode. The default for OPS 24/800 is 27.74V.
- Plant voltage monitored below the Battery on Discharge threshold (bd) results in a Battery Discharge alarm while in Float or Boost mode. The default for OPS 24/800 is 25.0V.
- In any plant mode, plant voltage monitored below the Very Low Voltage threshold (LLO) results in a Very Low Voltage alarm. The default for OPS 24/800 is 23.0V.

***Battery Recharge
Current Limit
(rCL, rCLE)***

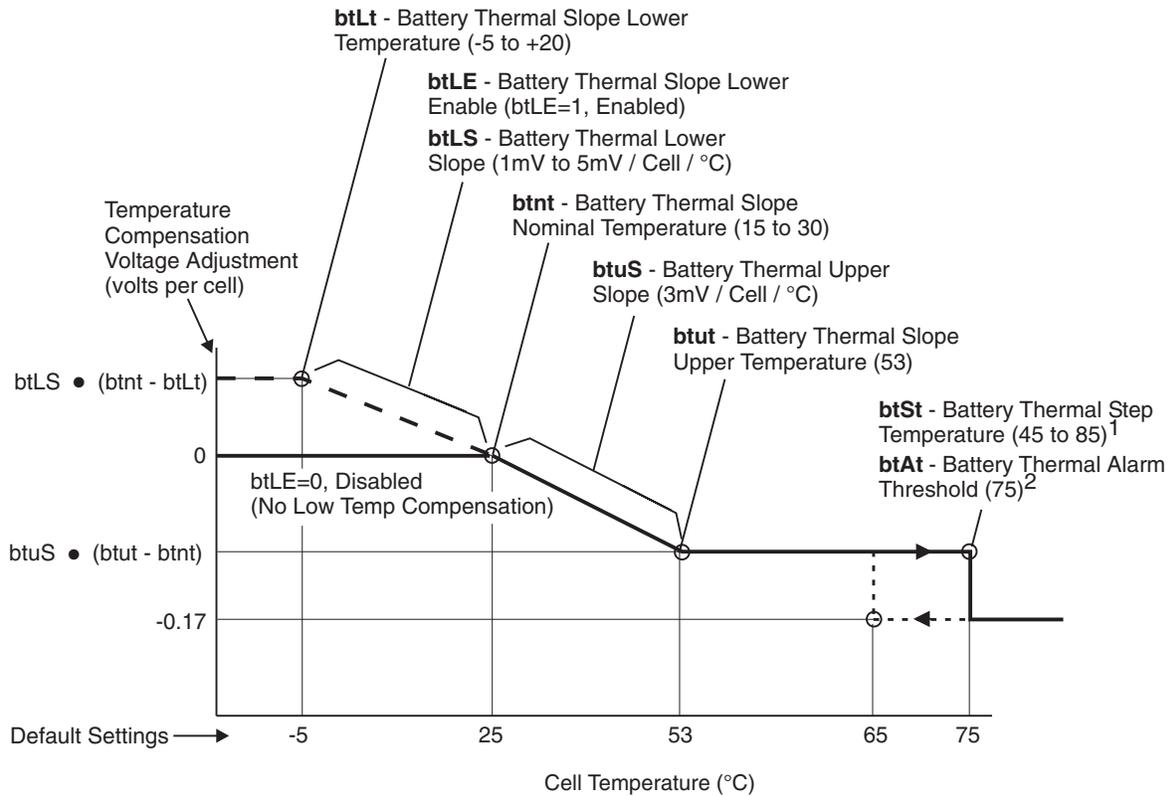
The battery recharge current limit feature enables the Vector Controller to limit the recharge current flowing into a battery section during the charge cycle to avoid recharged valve-regulated batteries too quickly. The recharge current flowing into the battery section can be limited to any value between 10 and 1000A. This feature will not have any impact on the discharge current allowed out the battery. The controller will maintain the recharge current within 10% of the level set through the Battery Recharge Current Limit (rCL) parameter. At least one battery must be present for this feature and Battery Recharge Current Limit Enable (rCLE) must be set to 1 to enable Battery Recharge Current Limit. The rCLE parameter is set to 0 (disabled) in the OPS default.

Battery Thermal Compensation
(*btAt, btSt, btut, btnt, btLt, btuS, btLS, btLE, btEn*)

The Galaxy Vector has a flexible Thermal Compensation feature that provides voltage compensation from that level established by the Plant Float Set-Point (FSP), dependent on the highest temperature monitored by thermistors located at the plant batteries. Thermal Compensation lowers plant voltage from the FSP for monitored battery temperatures that are above the ideal temperature established during configuration as the Battery Thermal Slope Nominal Temperature (btnt). Lowering the plant voltage at temperatures above their ideal operating temperature helps to keep the batteries at their optimum state of charge while protecting them from thermal runaway.

Thermal runaway is a complex sealed battery phenomenon where, for one or more of a number of reasons, one or more cells in a string are unable to dissipate the internal heat generated by their charging current and experience an increase in internal temperature. By lowering the float voltage as cell temperature increases, the float current is lowered to a point where this destructive behavior can be avoided. If a cell failure is imminent and the cell temperature continues to rise above the threshold configured for Battery Thermal Step Temperature (btSt), plant voltage drops in a single step to a level that keeps from overcharging the remaining cells in the string and damaging them also. Refer to Figure 7-3 for a graphical view of Battery Thermal Compensation and the relationship of its various set points.

Note: Any time that Battery Thermal Compensation is actively changing the plant voltage below that set by the FSP parameter during configuration, the green Thermal Compensation LED of the Display will be active. This is not an alarm condition, only an indication to the user that plant voltage is different than that set by the FSP parameter.



1. Plant voltage decreases 0.17 volts per cell when the temperature increases above the btSt set point. It is increased 0.17 volts per cell when the temperature decreases to 10 °C below the btSt set point, as indicated by the dashed line (65 °C default).
2. The Battery Thermal Alarm occurs when the temperature rises above the btAt set point. It retires when the temperature decreases to 10 °C below the btAt set point (65 °C default).

Figure 7-3: Battery Thermal Compensation Set Points

- A monitored battery temperature above the Battery Thermal Alarm Temperature threshold (btAt) results in a Battery Thermal alarm. The OPS setting is 75°C.
- A monitored battery temperature above the Battery Thermal Step Temperature threshold (btSt) results in a “step” decrease in plant voltage to a level corresponding to 0.17 volts per cell (VPC) below the Plant Float Set-Point (FSP). The OPS 24/800 setting is 75°C and the “step” voltage is 27.24 - 2.04 or 25.20V.
- Battery Thermal Slope Upper Temperature (btut) is the upper temperature where Battery Thermal Compensation will have reduced plant voltage to a level corresponding to $btuS \cdot (btut - btnt) \cdot \text{cells-per-string}$ below the FSP. Plant voltage will be reduced proportionally at any temperature between this point and the Battery Thermal Slope Nominal Temperature (btnt). The

OPS 24/800 setting is 53°C and the ending “slope” voltage at this temperature is 27.24 - 1.008 or 26.23V.

- Battery Thermal Slope Nominal Temperature (btnt) is the zero compensation temperature point. Temperatures monitored between this point and the Battery Thermal Slope Upper Temperature (btut) will result in a proportional decrease of plant voltage to a level corresponding to $btuS * (btut - btnt) * \text{cells-per-string}$ below the FSP at the btut. The OPS nominal temperature is 25°C (77°F).
- In the OPS system, Battery Thermal Slope Lower Compensation (BtLE) is disabled (set to 0), so no thermal compensation occurs at temperatures monitored between btnt and the Battery Thermal Slope Lower Temperature (btLt) threshold, making the setting of btLt and of Battery Thermal Lower Slope Per Cell (btLS) of no consequence.
- Battery Thermal Upper Slope Per Cell (btuS) is the slope rate for the voltage decrease per cell per degree C when the battery temperature is between btnt (Battery Thermal Slope Nominal Temperature) and btut (Battery Thermal Slope Upper Temperature). 3 mV per °C per cell is used in the OPS 24/800 configuration.
- Battery Thermal Compensation Enable (btEn) activates Battery Slope Thermal Compensation when set to 1 or disables it when set to 0. The OPS configuration enables btEn.

***Low Voltage
Disconnect
Contactor 1 or 2
(C1Ld, C2Ld,
C1Lr, C2Lr, C1tY,
C2tY)***

The OPS system uses only one low voltage disconnect, Contactor 1, which is a battery type. The controller opens this contactor when the plant voltage is less than the respective low voltage battery disconnect threshold. Likewise, the contactor is closed when the plant voltage is greater than the respective low voltage battery reconnect threshold. At controller power up, the contactor is closed and there is an 18-second delay before the controller determines the correct state for the contactor.

- Contactor 1 Low Voltage Disconnect Threshold (C1Ld) is the low voltage at which a signal will be sent to the contactor driver circuit, causing it to open, disconnecting the batteries from the load bus. C1Ld is set to open the contactor at 21.25V in the OPS 24/800 system.
- Contactor 1 Low Voltage Reconnect Threshold (C1Lr) is the plant voltage at which a signal will be sent to the contactor driver circuit, causing it to close, reconnecting the batteries to the load/rectifier bus, allowing battery recharging to begin. C1Lr reconnect is set to 25V in the OPS 24/800 system.
- Contactor 1 Type (C1tY) can be set to one of these three choices:

0 = no contactor available

1 = load contactor

2 = battery contactor

C1tY is a battery disconnect contactor in the OPS power cabinet.
C2tY is set to 0 in the OPS cabinet.

***Plant Boost Mode
Settings (bSP, bCL,
bHO, bHFO,
bAF, bEn)***

The Boost feature is not used with the valve-regulated type batteries used in the OPS power cabinet system. Therefore the only configuration boost parameter of any concern is Boost Enable (bEn). Setting bEn to 0 disables the Boost feature and is the required setting for the OPS cabinet system.

***Converter Settings
(CSP, CLd, CLr,
CLdE, CFPC)***

There are no converters used in the OPS power cabinet, so none of the converter configuration parameters have any effect.

***Voltage and
Current
Calibration (FPC,
SH1C, SH2C)***

Controller voltage and current sensing may be calibrated to a known, calibrated meter using these parameters.

CAUTION

This calibration affects all controller functions using plant voltage and/or current values. These functions include the float and boost set points.

- Front Panel Voltage Calibration (FPC) adjusts the displayed voltage until it matches the voltage obtained on a calibrated voltmeter measuring the plant output voltage.
- There is only the single battery type shunt in the OPS power cabinet and its calibration using the Shunt 1 Calibration (SH1C) parameter can only be completed during a battery discharge when there is significant load going through this shunt. There should be no need to use this parameter in the OPS system. Shunt 2 Calibration (SH2C) will also never be used since there is only a single shunt.

***Rectifiers On
Engine (rOnE)***

The Rectifiers On Engine rOnE feature requires an input signal from a stand-by generator that is not available with the BTJ2 Termination board of the OS power cabinet, making the setting of this parameter of no consequence.

Related to this somewhat is a feature that is used in the OPS power cabinet called Rectifier Sequencing, which allows the Vector to bring the plant rectifiers back on line one at a time following an ac power interruption. This serves to minimize their impact on the ac service, especially useful in avoiding loading down an emergency generator with an inrush surge. When a rectifier reports an ACF to the controller, it places that rectifier into standby. As rectifiers report good ac, they are turned on at 1 second intervals.

***Serial Bus
Updating and
Clearing***

Once a rectifier is connected to the digital serial communications bus and recognized by the Galaxy Vector, it is remembered and a Rectifier Fail Alarm (rFA) will be active if a rectifier is removed. If the controller indicates Rectifier Fail Alarm (rFA) and no alarm is indicated by the LEDs of any rectifier, it may be necessary to clear the Vector rectifier memory with the Update Serial Link and clear Alarms (USL) parameter. Setting the USL configuration parameter to 1 causes this to occur.

Note: A few seconds after executing Update Serial Link and Clear Alarms, the controller alarm rFA should clear and each rectifier should display no alarms. If alarms continue to be displayed, see Section 9 for Troubleshooting. USL will not restart a rectifier at any time.

***Choice of
Identifiers or
Numeric Codes***

Throughout this section, the Mnemonic Identifier codes for all configuration parameters have been used in the parameter descriptions. These are codes that can be displayed using the 4, 7-segment display of the Vector control panel. Table 7-1 also shows Numeric Identifier codes for each of the configuration parameters, which may be selected for use if desired using the Identifiers Enable (id) parameter. The id parameter provides a choice between the Mnemonic Identifier codes (id = 1 default) and the Numeric codes f(id = 0) for all configuration parameters and all active alarm codes shown in Table 8-A.

***Software Release
Information***

The final parameter in configuration mode is Display Software Release (rEL) and is actually just a report of the present software release active in the BIC2 control board microprocessor of the Vector controller.

8 ***Maintenance***

Vector Controller Alarm Indications

The Galaxy Vector controller of the OPS power cabinet issues PMJ (Power Major), PMN (Power Minor), MJF (Major Fuse), BD (Battery on Discharge), ACF (AC Fail) and HV/2ACF (High Voltage or Multiple AC Fail) external alarm indications to the Krone cabinet alarm cross-connect block as shown on T83492-30 Figure H6. Refer to Table 8-1 for a listing of the various available alarms and their mnemonics. Refer to Table 8-2 for a listing of alarm relays and their associated front panel LEDs.

To see active alarms, press the View Active Alarm key, then the up or down arrow to page through all active alarms. A mnemonic abbreviation (MNEM) for each alarm is displayed on the BMW3 Control Panel.

Table 8-1: Vector Controller Alarm Indications

NUM	ID	MNEM	Description	Alarm Status	BMW LED	BIC/BLJ Relay
0	nonE	nonE	No Active Alarms Present	Norm	None	None
1	LLO	LLO	Very Low Voltage	Major	BATT	None
2	bod	bod	Battery on Discharge	Major	BD	BD
3	HFO	HFO	High Float Voltage	Minor	RECT	None
4	HO	HO	High Voltage	Major	RECT	HV/2ACF
5	SEnS	SEnS	Voltage Sense Fuse Alarm	Major	CTRL	None
6	ACF	ACF	AC Fail	Minor	AC	ACF
7	nACF	nACF	Multiple AC Fail	Major	AC	HV/2ACF
8	rFA	rFA	Rectifier Fail	Minor	RECT	None
9	nrFA	nrFA	Multiple Rectifier Fail	Major	RECT	None
10	rid	rid	Invalid Rectifier ID	Major	RECT	None
11	rOFF	rOFF	Rectifier Manual Off Alarm	Minor	RECT	None
19	FAJ	FAJ	Major Fuse	Major	DIST	MJF
20	AUJ	AUJ	Auxiliary Major	Major	None	None
21	LSb	LSb	Load Share Imbalance	Minor	RECT	None
22	C1O	C1O	Contactor 1 Open	Major	BATT/DIST	None
23	C1F	C1F	Contactor 1 Failed	Major	BATT/DIST	None
26	btA	btA	Battery Thermal Alarm	Major	BATT	None
27	tPA	tPA	Temperature Probe Failure	Minor	CTRL	None

Table 8-2: Alarm Relays and Front Panel LEDs

Asserted Condition	Alarm Relays	Front Panel LEDs
High Voltage (HO)	PMJ, HV/2ACF	RECT (yellow), MAJ (red)
High Float Voltage (HFO)	PMN	RECT (yellow), MIN (yellow)
Battery on Discharge (bod)	PMJ, BD	BD (red), MAJ (red)
Very Low Voltage (LLO)	PMJ	RECT (yellow), MAJ (red)
AC Fail (ACF)	PMN, ACF	AC (yellow), MIN (yellow)
Multiple AC Fail (nACF)	PMJ, HV/2ACF	AC (yellow), MAJ (red)
Rectifier Fail (rFA)	PMN	RECT (yellow), MIN (yellow)
Multiple Rectifier Fail (nrFA)	PMJ	RECT (yellow), MAJ (red)
Invalid Rectifier ID (rid)	PMJ	RECT (yellow), MAJ (red)
Load Share Imbalance (LSb)	PMN	RECT (yellow), MIN (yellow)
Major Fuse (FAJ)	PMJ, MJF	DIST (yellow), MAJ (red)
LVBD Open (C1O)	PMJ	BATT (yellow), MAJ (red)
LVBD Fail (C1F)	PMJ	DIST (yellow), MAJ (red)
Controller Fail	PMJ	CTLR (yellow), MAJ (red)
Slope Thermal Comp Active		Thermal Compensation (green)
Thermal Probe Alarm (tPA)	PMN	CTLR (yellow), MIN (yellow)
Voltage Sense Fuse (SEnS)	PMJ	CTLR (yellow), MAJ (red)
Rectifier Manual Off (rOFF)	PMN	RECT (yellow), MIN (yellow)
Auxiliary Major (AUJ)	PMJ	MAJ (red)
Battery Thermal Alarm (btA)	PMJ	BATT (yellow), MAJ (red)
Controller Unpowered	PMJ, PMN, MJF, BD, ACF, HV/2ACF	

Alarm Descriptions

Very Low Voltage (LLO) and Battery on Discharge (bod)

When rectifier output is insufficient to maintain the load current at the set voltage (typically because of an ac power failure), the plant bus voltage will drop and the batteries will start providing current to the load. Any time that the plant voltage is below the threshold selected for BD, the Battery on Discharge alarm (bod) activates. If the plant voltage continues to drop, a second, lower threshold can be reached, activating a Very Low Voltage alarm (LLO). Values for these alarm thresholds can be changed by the operator in the configuration mode as described in Section 7.

Note that a BD alarm does not necessarily mean that the batteries are discharging, only that the present voltage is lower than the set point for this alarm. BD may be activated by an incorrectly set BD threshold or plant voltage set point. In addition, BD may remain active for some time

following the restoration of ac power after a battery discharge of significant depth, until the batteries have recharged to a level that allows the plant voltage to rise above the BD threshold.

The BD and VLV configuration thresholds selected for use with OPS 24/800 are below the voltage that the plant may drop to due to the Slope Thermal Compensation feature. These levels will generally avoid nuisance alarms from transient conditions yet provide alarm indications early in a true BD event, so that sufficient time is provided for maintenance personnel to respond before battery reserve is exhausted. VLV is intended to activate towards the end of the battery reserve period to indicate a critical service condition.

***High Float Voltage
Alarm (HFO) and
High Voltage
Alarm (HO) and
Shutdown***

Because of the importance of protecting the batteries and load from overvoltage conditions, three high voltage thresholds are provided in the OPS power cabinet system. Two are controlled by the controller and one backup threshold is hard-wired into Lineage Power rectifiers. The two lowest thresholds (HFO) and (HO) are adjusted through the control panel of the Vector. The third threshold (ISHVSD) is generated by the controller by adding 1.50V to the (HO) threshold. This value is then transmitted to the rectifiers in the system and stored. Each rectifier compares its own output voltage to this threshold value and initiates internal shutdown if the value is exceeded.

The Galaxy Vector is equipped to detect a high voltage condition on the plant bus. Such a high voltage condition might typically be caused by lightning-induced transients on the commercial ac or a rectifier failure may cause an individual rectifier to go high. When the plant voltage increases above the threshold for “High Float Voltage”, it issues the High Float Voltage alarm (HFO) as a minor severity. If the voltage continues to rise and reaches the threshold set for “High Voltage”, that alarm (HO) is issued as a major severity and a shutdown signal is issued simultaneously to the plant rectifiers in order to prevent the high voltage condition from damaging the connected load.

Any rectifier that is producing at least 10% of its rated capacity and is 10% over the average of all rectifier outputs in the plant, will respond to this shutdown signal by shutting down with a rFA condition active and reported back to the controller. A restart attempt initiated by the controller will occur 4 seconds after the controller receives the rFA signal from the rectifier. The rectifier will then attempt to restart three times. During the restart sequence, the rectifier, recognizing that its output current exceeds the average rectifier current, will shut down and try again up to three times.

- Voltage Sense Fuse Alarm (SEnS)*** A lack of voltage on the Vsense +/- pair to the Vector Controller as a result of a broken connection or a blown fuse while the Vector is still powered, results in a Voltage Sense Fuse Alarm (SEnS) and a displayed voltage of 16.xx volts.
- AC Fail (ACF) and Multiple AC Fail (nACF) Alarms*** If the proper ac input voltage is not available to any plant rectifier that is connected to the serial rectifier bus, an AC Fail alarm (ACF) activates as a PMN. More than one ACF results in a Multiple AC Fail alarm (nACF), changing this alarm status to a PMJ.
- Rectifier Failure (rFA) and Multiple Rectifier Failure (nrFA) Alarms*** Various rectifier failure modes cause a rectifier failure signal to be issued to the controller, such as high voltage, temperature over threshold, fan failure, and rectifier circuit breaker/fuse open. Additionally, when rectifiers are removed or fail to communicate with the controller, a rFA alarm is generated. This rFA alarm is cleared by setting the USL parameter to 1 (see Section 7). The rFA signal results in a rFA alarm (rFA) as a PMN to be issued by the controller. More than one rFA at any time results in a Multiple Rectifier Failure alarm (nrFA) and PMJ. The Vector does not attempt restarts for rFAs caused by TA (Thermal Alarm), CB/fuse trip, or Fan Failure.
- Rectifier ID (rid) Alarm*** This alarm occurs when rectifier ID numbers are duplicated or are zero. Refer to Section 5 for setting and viewing the rectifier ID numbers.
- Rectifier Manual Off (rOFF) Alarm*** Whenever the rectifier is manually turned to standby, this alarm will activate. A switch on the front panel for each rectifier allows the user to manually turn the rectifier on or to standby. When the switch is in the standby position, the rOFF alarm is activated.
- Major Fuse (FAJ) and Auxiliary Fuse (AUJ) Alarms*** To create either of these alarms, their input signal to the Vector must be connected to the cabinet battery potential. In the OPS cabinet system, the operation of an output distribution circuit breaker places battery voltage onto the FAJ lead of the J28 jack on the BTJ2 Termination board, activating the Major Fuse alarm (FAJ). An operated 1000A short-circuit protection battery fuse in the cabinet does the same at the J27 jack on the BTJ2 Termination board, activating the Auxiliary Major alarm (AUJ).

***Load Share
Balance (LSb)
Alarm***

This alarm is generated when the rectifiers do not share the current equally or within the current share boundaries. The controller monitors the current (I rect) delivered by each of the rectifiers and determines the total current delivered by the plant as the sum of all rectifier currents. The average rectifier current (I avg) is calculated by dividing the total current by the number of active rectifiers in the plant. If, for any rectifier, actual rectifier current (I rect) is different from the average rectifier current (I avg) by 10A or more for 5 minutes, then the controller will issue a Rectifier Current Imbalance Alarm (LSb). This alarm will retire when the difference between (I rect) and (I avg) drops below 10A.

***Contactor 1 Open
(C1O) and
Contactor 1
Failure (C1F)
Alarms***

A Contactor Open alarm (C1O) is reported whenever the controller senses that the Low Voltage Battery disconnect (LVBD) contactor is open. This alarm is processed by the Vector as a PMJ. A Contactor Fail alarm (C1F) is reported whenever the controller senses that the LVBD contactor is in the opposite state that it is calling for it to be in. This alarm is also processed as a PMJ.

***Battery Thermal
Alarm (btA) and
Temperature Probe
Failure (tPA)***

See Figure 6-3. Galaxy Vector reports a Battery Thermal Alarm (btA) when the temperature rises above the configured set point. See Section 7 for information on battery thermal compensation settings. Vector reports a Thermal Probe Alarm (tPA) when thermal compensation is enabled and a temperature probe is disconnected or returns a grossly inaccurate reading to the Thermal Compensation circuit. A 210E Thermal Probe Multiplexer Failure or temperature probe failure in a supplemental battery cabinet will also generate a tPA alarm to the Vector.

Rectifier Display Alarm Indications

Refer to Fig. 5-2 for a front view of the 596B4 +24V/100A rectifier used in the OPS 24/800 Power Cabinet. In addition to the ON and STBY LEDs, four other LEDs on the rectifier's faceplate indicate the rectifier's condition.

ALM LED

The ALM LED is red and lights whenever the rectifier fails. It blinks whenever serial bus communication with the Vector controller has not been established or has been interrupted.

LIM LED The LIM LED is yellow and lights when the unit is operating at its maximum current limit. This level is set by the Vector configuration parameter FCL, as described in Section 7.

FAN ALM LED The FAN ALM LED is red and lights when the cooling fan inside the rectifier is not functioning properly. Replacement of the fan assembly is the only servicing to the rectifier that may be completed without returning the unit for repair.

BST LED The BST LED is yellow and lights when the rectifier is in boost mode. Boost mode is disabled in the OPS power cabinet configuration.

Also prominent on the faceplate is a 3-digit current display. This display indicates the output current of the rectifier. Upon specific no-power conditions, the 3-digit display will show informative messages.

ACF Rectifier AC input voltage is out-of-range.

HO Rectifier has shut down on a High Output voltage.

tA Thermal Alarm. Rectifier has shut down due to a high temperature.

tr Rectifier is being held in standby mode by the controller.

SEn Thermal Sensor failure.

FSE Internal Fuse failure.

LO Low Output voltage.

ICS, IP5, IP6, IP7 Internal failures in the rectifier.

Section 9, Troubleshooting, should be referenced for more detail on investigating a suspected rectifier problem.

Remove / Replace a Rectifier

The following procedure shall be used when it is necessary to remove or replace a rectifier in a working OPS power cabinet.

1. Locate and turn off the breaker on the AC Distribution Panel on the rear of the power cabinet for the ac service feeding the rectifier. Do not turn off ac service to the entire system, only to the rectifier that has failed. Use Fig. 5-1 to determine the rectifier assignment number if necessary.
2. Turn the rectifier's ON/STBY switch to STBY.
3. Locate the Allen-head bolt in the center of the rectifier front panel. Using the 5mm Allen wrench provided, rotate the bolt counterclockwise to release the rectifier for removal.
4. Grasp the front handle and slide/pull the rectifier from the shelf assembly. Support the rear of the unit as it slides from the shelf.

If the rectifier is being replaced as this time, follow the procedure below for adding a rectifier. If it is not being replaced, use the following procedure to clear the rFA RECT alarm from the Vector controller.

1. Press the **CONFIGURE** key while in the default Voltage Display mode. The **CONFIGURE** LED will activate and the first parameter of the configuration menu (bdtr) will be displayed.
2. Use the + or ^ key 44 times until the USL (Update Serial Link) parameter is displayed.
3. Press the **ENTER** key to enter the edit mode for this parameter. The **CONFIGURE** LED will begin blinking and the USL value will display as 0.
4. Use the + key to increase the value from 0 to 1.
5. Press the **ENTER** key again to save the change.
6. Press the **ESCAPE** key to exit the configuration mode.

Replace Rectifier Fan

The replacement of a failed fan assembly may be completed as a field repair. All other repair of the 596B4 rectifier module must be completed by Lineage Power. Ordering information for replacement fan assemblies is provided in Section 9, Spare Parts. Use the following fan replacement procedure.

1. Remove the rectifier from the system using the “Remove / Replace” procedure in this section.
2. WAIT five minutes for capacitors inside the rectifier to fully discharge.
3. Loosen the white front cover by removing 14 screws (5 top, 5 bottom, 2 on each side). Before fully removing the cover, disconnect the ribbon cable from the display circuit pack.
4. Remove the screws attaching the old fan to the chassis and carefully unplug the fan connector. The fan connector is keyed and can be loosened by inserting a screwdriver into the slotted side of the connector and gently prying the fan-side connector loose.
5. Replace the old fan with a new fan.
6. Reconnect the ribbon cable removed in Step 3.
7. Attach the front cover.
8. Install the rectifier, following instructions in the “Add” procedure that follows.

Add a Rectifier

The following procedure shall be used when it is necessary to add a rectifier in a working OPS power cabinet.

1. Locate and turn on the breaker on the AC Distribution Panel on the rear of the power cabinet for the ac service feeding the rectifier. Use Fig. 5-1 to determine the rectifier assignment number if necessary.
2. Turn the rectifier's ON/STBY switch to STBY.
3. Slowly slide new rectifier onto the shelf until it contacts the rear connector.
4. Using the 5mm Allen wrench, turn the Allen-head bolt located in the center of the rectifier front panel clockwise to pull the rectifier into the shelf.
5. Once the rectifier has been installed, set the rectifier ID.

Note: The red ALM LED on the rectifier will blink until the rectifier establishes communication with the controller. After communication is established, the controller will issue a RECT MAJ (rid) alarm until the rectifier ID is set. The ID selected must match the AC breaker assignment for the rectifier shelf position as depicted in Fig. 5-1. To set the rectifier ID:

- Press the ON/STBY switch up and hold for five seconds until the display starts blinking "0" or whatever the present ID is.
- Release the switch; the display should continue to blink.
- Depress the switch again within 3 seconds and release. The display will increment up one number on each release of the switch, but will remain flashing. If the desired ID is past, continue incrementing and the ID selection will cycle back to 1 after 24.
- Once the desired ID number is displayed, release the switch. The display will stop blinking within 10 seconds, storing the present ID, and then revert to the rectifier current.

Battery Discharge Test

The Battery Discharge Test feature can be used to verify the battery capacity connected to the power cabinet. The controller predicts the reserve time following a successful test and stores the prediction in memory for future retrieval. By only discharging about 20% of the battery capacity, the controller can predict the total reserve time if 100% battery capacity was discharged at the same load condition.

The Battery Discharge Test feature must be enabled in the Vector configuration by setting parameter bdtE to "1." Refer to Section 7 for details regarding making changes to the Vector configuration. Once enabled, a test can be activated by manually pressing the Battery Test button on the BMW3 control panel. Pressing the Battery Test button again during the test will abort a test that is in progress.

After pressing the Battery Test button, use the up or down arrow keys if necessary to select "1" for the sealed battery type used in the OPS power cabinet. The configuration default is "1" for sealed or valve regulated batteries but subsequent tests will use the battery type selection from any previous test as the default. Press Battery Test again to start the test.

During the test, all plant rectifiers are set to a lower voltage so that the cabinet batteries go on discharge. The set voltage is the LVD1 threshold + 0.6V or 22V, whichever is higher. For the OPS 24/800 configuration defaults, the Battery Discharge Test rectifier voltage will be 22V. The plant mode is returned to float mode automatically if the batteries discharge to this set voltage during the test.

An active test will stop automatically whether it is successful or not. If it is successful, an error code "0" is stored under the bdtr configuration parameter. Otherwise, a negative number will be stored as an error code, such as -1, -2 and -3. Refer to the configuration portion of Section 7 for a description of these result codes. During the test, the Test in Progress LED of the control panel will light. Any alarm occurring during the test will abort the test, and cause the plant to return to float mode.

Add Distribution Panel

There is 12 inches of space in the OPS 24/800 Power Cabinet dedicated for distribution circuit breaker panels. Up to two of either the 14-position plug-in or 10-position bullet style breaker panels (6-inch each), may be used in this distribution space. Use the following procedure to add one of these panels to a working OPS power cabinet whenever necessary.

CAUTION

Use only insulated tools and protect from contact with all grounded surfaces when securing a distribution panel to the hot bus of the power cabinet.

1. Install the Distribution Panel frame using M5 screws. Torque to 30 in·lbs.

CAUTION

The next two steps will place equipment at the hot battery potential (+24V). Use only insulated tools and protect from contact with all grounded surfaces.

2. Connect the L-shaped input bus bar to the +24V load vertical bus bar in the rear of the cabinet using M8 hardware. Torque to 120 in·lbs.
3. Connect the link bus bar between the panel and the L-shaped bus using four M8 screws, lock-washers and washers. Torque to 120 in·lbs.
4. Mount the BNL alarm board for the panel on the left interior of the cabinet, adjacent to the distribution panel.
5. Strap J2 on the BNL alarm board should be set across pins 2 and 3 for the +24V OPS power cabinet system.
6. The alarm cable connected to P2 on the BNL board (yellow and orange wires) should be connected to P1 on the BNL of the panel mounted above this panel. If this is the first distribution panel installed in the cabinet, then this cable may be discarded and a cable connected to J28 the BTJ2 Termination board of the Vector controller should be connected in its place. This cable has an orange wire connected to DG and a yellow wire connected to FAJ on the BTJ2 board and should have sufficient length to reach the distribution panel.
7. Locate the breaker ID label on the left side of the cabinet near the new distribution panel so that loads assigned to breakers on it can be recorded.

Replace Battery Fuse

The 1000A short-circuit protection battery fuse assembly is located in the upper right hand side of the cabinet. This assembly is comprised of a 1000-Amp fuse, a trigger actuator, and a microswitch. The fuse and trigger actuator (RFI Indicator) are bolted into the return bus by 1/4-inch nuts and washers. An alarm lead connector from the microswitch is also provided for connection to J27 of the Vector BTJ2 Termination board.

When replacing the battery fuse, the trigger actuator (RFI Indicator) bolted to the bus beside it must also be replaced, but the microswitch can be reused if it has not been damaged. Just cut the wire ties and separate it from the RFI Indicator after removal. Reassemble onto the replacement RFI Indicator in the same manner, using new wire ties. Since the 1000A fuse is used for short-circuit protection (not overload protection), the cause of an open fuse should be investigated and determined before replacement.

The battery fuse connects the batteries of the power cabinet to the rectifier / load return bus and an open battery fuse results in the loss of charging to these batteries, allowing them to self-discharge down to a voltage lower than the plant bus. Therefore, it is recommended that the battery disconnects (located in the upper right portion of the rear compartment of the power cabinet) for all battery strings in the power cabinet be opened while this fuse is replaced in order to avoid surge currents in the fuse vicinity.

CAUTION

Use only insulated tools and protect from contact with all other surfaces when replacing the battery fuse in the power cabinet.

Each supplemental battery cabinet is also equipped with a 1000A short circuit protection fuse. The alarm leads for these fuse indicators can be removed to verify which cabinet is generating an active alarm signal. A battery cabinet fuse is replaced in the same manner described for the power cabinet. Disconnect all battery strings within a battery cabinet prior to replacing its fuse.

Replace Heat Exchanger Enclosure Fan

CAUTION

Do not perform maintenance procedures on the heat exchanger while heat exchanger power is applied.

1. Turn off power to the heat exchanger by turning off the HX Cooling System power switch. See Figure 8-1.

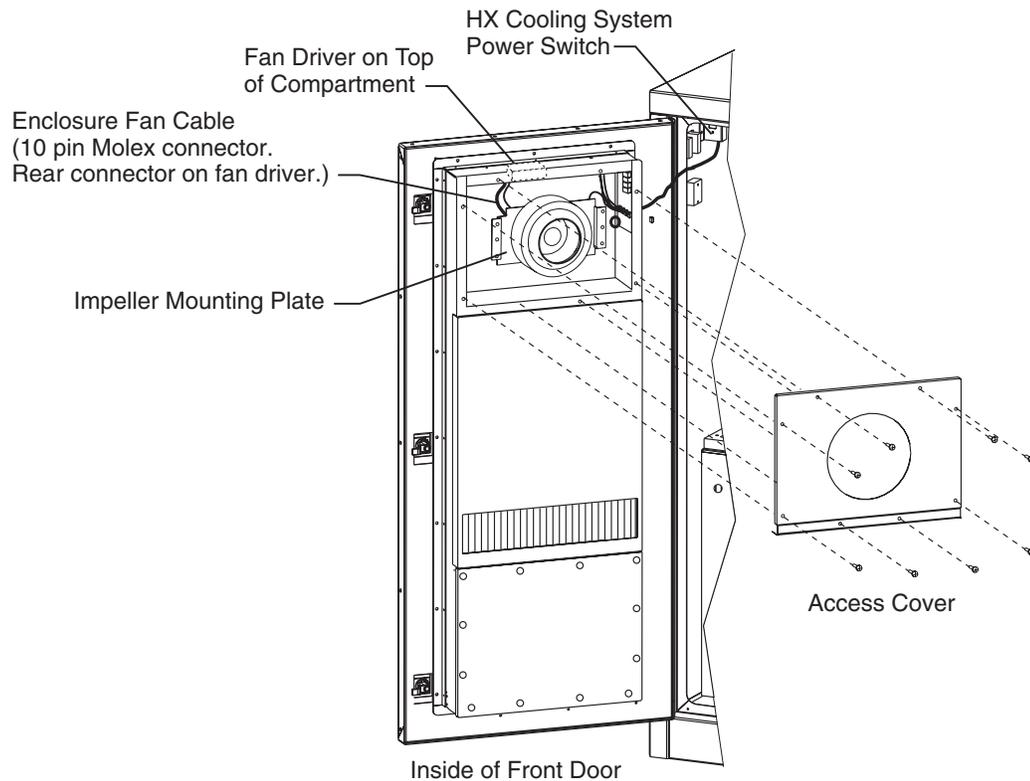


Figure 8-1: Removing Enclosure Fan Access Cover

2. Remove the enclosure fan access cover by removing the 8 access panel screws.
3. Disconnect the enclosure fan cable connector (10 pin Molex connector) from the fan driver.
4. Cut cable-ties that are securing the fan cable or the impeller mounting plate.

5. Remove the impeller assembly by removing the 4 mounting screws from the impeller mounting plate. See Figure 8-2.

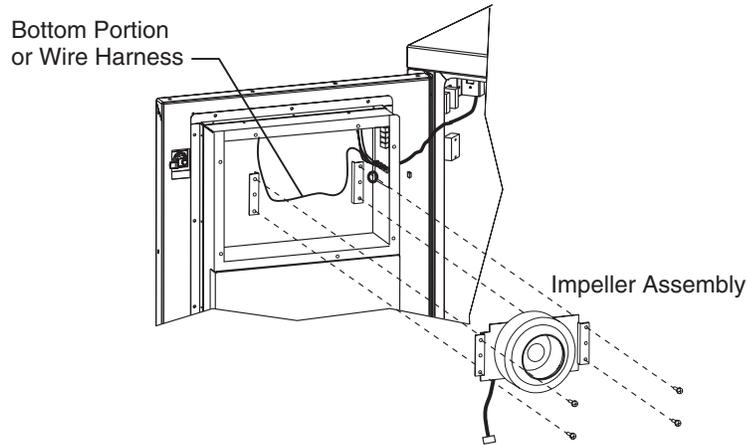


Figure 8-2: Removing the Enclosure Impeller Assembly

6. Remove the impeller by removing the four screws from the back of the impeller mounting plate. See Figure 8-3. Replace with new impeller.

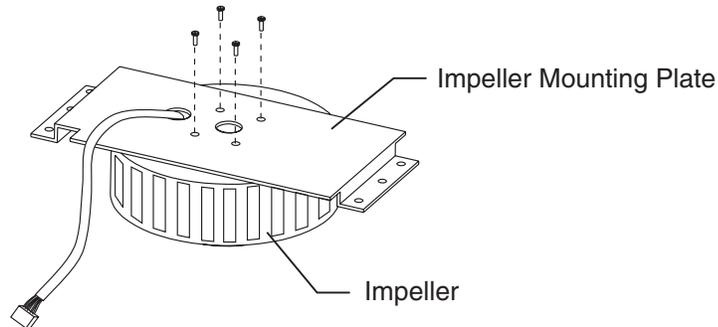


Figure 8-3: Replacing the Impeller

When re-installing the impeller assembly: One cable of the wire harness in the enclosure fan compartment runs behind the impeller assembly, as shown in Figure 8-2. The bottom portion of this cable must not extend beyond the bottom of the impeller mounting plate. Check to make sure that the cable is not pinched between the impeller mounting plate and the mounting brackets on the door.

CAUTION

Use cable-ties as necessary to prevent any cables from coming into contact with the rotating impeller.

Replace Heat Exchanger Ambient Fan

CAUTION

Do not perform maintenance procedures on the heat exchanger while heat exchanger power is applied.

1. Turn off power to the heat exchanger by turning off the HX Cooling System power switch. See Figure 8-4.

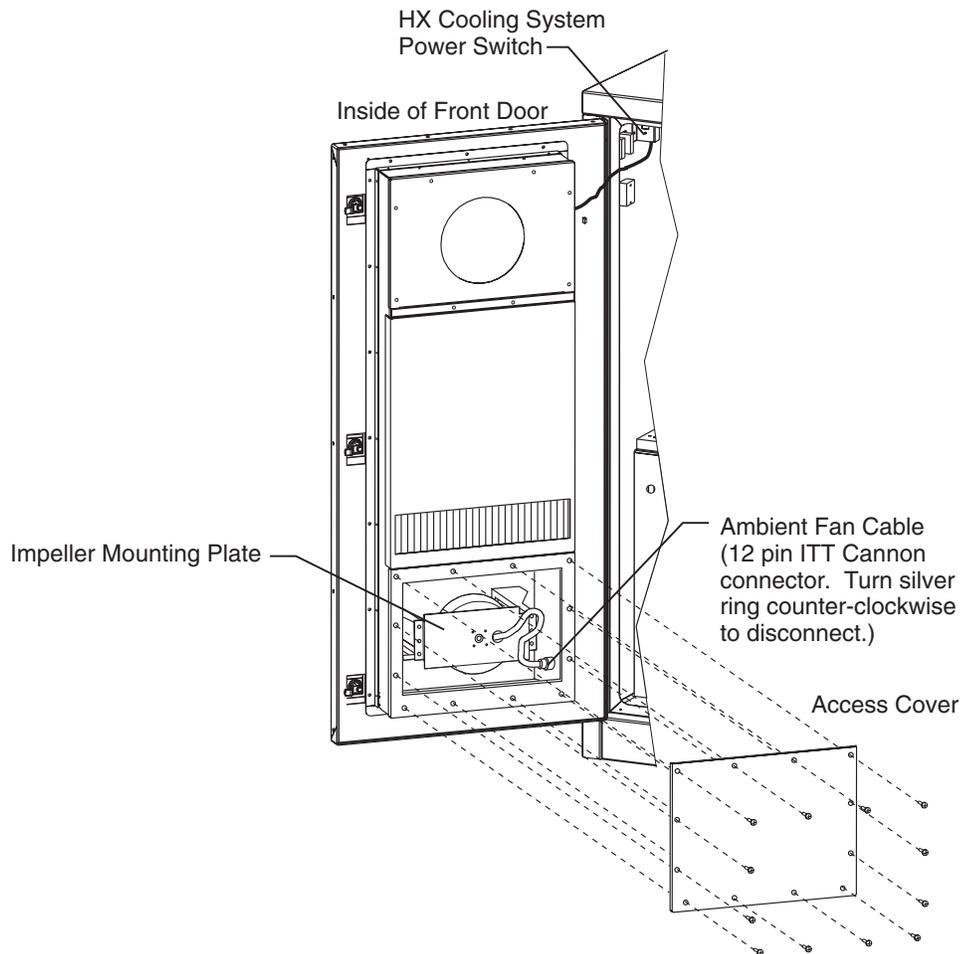


Figure 8-4: Removing Ambient Fan Access Cover

2. Remove the ambient fan access cover by removing the 12 access panel screws.
3. Disconnect the fan connector (12 pin ITT Cannon connector) by turning the silver ring counter-clockwise.

4. Cut cable-ties that are securing the fan cable or the impeller mounting plate.
5. Remove the impeller assembly by removing the 4 mounting screws from the impeller mounting plate. See Figure 8-5.

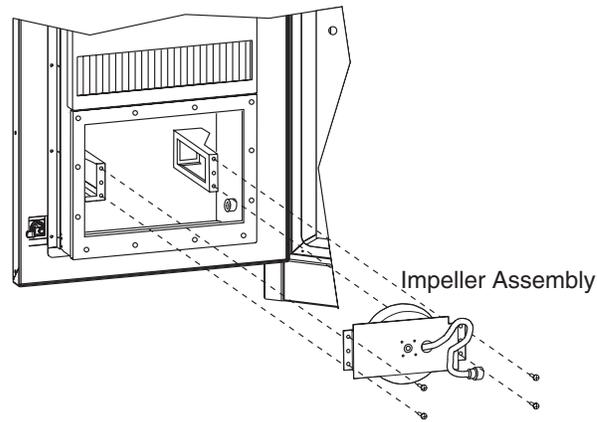


Figure 8-5: Removing the Ambient Impeller Assembly

6. Remove the impeller by removing the four screws from the back of the impeller mounting plate. See Figure 8-6. Replace with new impeller.

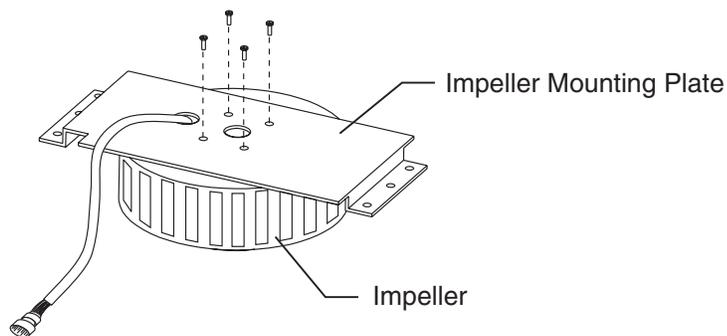


Figure 8-6: Replacing the Impeller

CAUTION

When re-installing the impeller assembly, use cable-ties as necessary to prevent any cables from coming into contact with the rotating impeller.

9 *Troubleshooting and Spare Parts*

Preliminary

This section provides information needed in preparation for locating and interpreting visual indicators to help identify problems. When replacing a part does not correct the problem or visual indicators do not identify a defective part, notify Lineage Power Technical Support.

Safety

Review all safety instructions and warnings in Section 3 of the manual before troubleshooting the OPS 48/400.

Tools

The following tools are necessary in order to troubleshoot the OPS 48/400:

- 3/16-inch (5 mm) Allen-head wrench
- Insulated hand tools
- Calibrated digital voltmeter (DVM) (0.05% accuracy on dc scale)
- ESD wrist strap

Warnings

- Hazardous ac and dc voltages and/or energy are present. Caution should be exercised. Tools must be insulated to help prevent accidental contact with live surfaces.
- Coordinate all troubleshooting activities with other personnel that may be working on the system.

The troubleshooting procedures that follow are used when a trouble condition has been identified and a technician has been dispatched to the system location as a first and fundamental step in diagnosing and correcting the problem.

DC Plant / Vector

Locate the Galaxy Vector controller display, inside the front door on the right side of the cabinet. The display is hinged on the right side and will swing out for easier access as necessary. Because a trouble condition exists, an alarm LED on the display may be active. Refer to Figure 7-1 for a view of the front display.

The initial troubleshooting step is to determine the system status. For most problems, one or more alarm and status LEDs will be illuminated. Also observe the system voltage on the Vector display. The desired system voltage is 27.24V, but may be up to 2V lower if the Thermal Compensation LED is active. If the screen is blank, but alarm and status LEDs are illuminated, call technical support.

If the entire panel is blank, check the controller power fuse (F1 on the Vector BTJ2 Termination board). Refer to Figure 7-2. Verify that the controller is getting power. If F1 is operated, replace the fuse. If the display is still blank, call technical support.

To view the Alarms Menu: Press the View Active Alarms button and up or down arrow keys as necessary to review all active alarm codes. Use the displayed message code(s) to help identify the problem. Refer to Table 8-2 and the alarm description portion of Section 8 in addition to the following Troubleshooting tables.

**Troubleshooting
Tables**

Table Reference - Use the reference below to locate the table corresponding to the message displayed after pressing the “View Alarms” key.

Display Message	Table
ACF - AC Failure	9-1, AC Alarms
nACF - Multiple AC Failure	
bod - Battery on Discharge	9-2, Battery Alarms
LLO - Very Low voltage	
C1O - Contactor 1 Open	
C1F - Contactor 1 Failed	
btA - Battery Thermal Alarm	
tPA - Thermal Probe Alarm	
AUJ - Auxiliary Major	
SEnS - Voltage Sense Fuse Alarm (no message)	9-3, Controller Alarms
FAJ - Major Fuse	9-4, Distribution Alarms
rFA - Rectifier Fail	9-5, Rectifier Related Alarms
nrFA - Multiple Rectifier Fail	
rid - Invalid Rectifier ID	
rOFF - Manual Off	
HFO - High Float Voltage	
HO - High Voltage	
LSb - Load Share Imbalance	

Table 9-1: AC Alarms

Controller LED	Vector Controller Display	Other Indication(s)	Possible Problem(s)	Possible Solution(s)
MIN AC	ACF	ACF on rectifier display	Rectifier(s) not receiving ac power:	<ol style="list-style-type: none"> 1. Verify that ac circuit breaker is closed; close circuit breaker if tripped. 2. Remove the rectifier and measure ph-ph voltage at the shelf ac jack for that position. Range is 176-256 Vac. 3. If ac is available at the shelf jack, replace the rectifier.
MAJ AC	nACF	ACF on more than one rectifier display	<ul style="list-style-type: none"> •AC input circuit breaker has operated. •AC input voltage is out of range. •Internal rectifier failure 	

Table 9-2: Battery Alarms

Controller LED	Vector Controller Display	Other Indication(s)	Possible Problem(s)	Possible Solution(s)
MAJ BD	bod	Rectifiers may say ACF, HO, or a number of other failure conditions	<ul style="list-style-type: none"> •Rectifier(s) not receiving ac power or failed. 	<ol style="list-style-type: none"> 1. Correct ACF condition. 2. Replace any failed rectifiers. 3. If the LIM LEDs are active on rectifiers, compare the sum of all rectifier outputs to plant load on Vector display. If equal, add rectifier(s). If rectifiers > plant load, just observe plant voltage as batteries recharge.
MAJ BATT	LLO		<ul style="list-style-type: none"> •Temporary condition due to recent battery discharge event. •Insufficient rectifier capacity for the dc load on the power cabinet. 	
MAJ BATT	C1O		<ul style="list-style-type: none"> •LVBD Contactor is open (batteries disconnected). •False alarm signal from LVBD. 	<ul style="list-style-type: none"> •Observe the plant voltage on the Vector display. <p>If < the configured C1Lr reconnect voltage (25.0), correct that problem.</p> <p>If > C1Lr, determine if the LVBD is actually open by comparing battery voltage (Bat bus to Local Bat Rtn bus) to plant voltage. If equal, the C1O is false and the trouble is the LVBD alarm switch.</p> <p>If LVBD is open, but the plant voltage > C1Lr, attempt to manually close by setting BTJ2 S1-8 to 1. Replace BIC2 if LVBD closes. Call Technical Support if LVBD does not close.</p> <ul style="list-style-type: none"> •If Vector display is dark, LVBD has opened on a deep discharge. Restore AC and/or rectifiers.
MAJ BATT	C1F		LVBD Contactor reporting the opposite condition (open or closed) that the controller is requesting.	<ul style="list-style-type: none"> •If C1O is active, follow procedures for it. •Check setting of BTJ2 S1-8. •Replace BIC2.

Table 9-2: Battery Alarms (Continued)

Controller LED	Vector Controller Display	Other Indication(s)	Possible Problem(s)	Possible Solution(s)
MAJ BATT	bTA	Thermal Comp LED active and plant voltage lower than 2V below FSP (27.24)	Batteries have exceeded temperature threshold.	Remove battery compartment cover and identify hot battery modules. Also check for hot battery modules in any supplemental battery cabinets. Disconnect defective module(s) with quick disconnect and replace.
MIN CTRL	tPA	--	Battery thermal probe open or shorted. Also check for a defective thermal probe in any supplemental cabinet(s). The Minor LED will be lit on a 210E module monitoring a defective probe.	Disconnect probe cables from BTJ2 J9-J12 until tPA retires. Measure resistance into probe cable set. Good = ~10K. Replace defective probe at its battery post termination within battery compartment.
MAJ	AUJ	Battery voltage (Bat bus to Local Bat Rtn bus) < plant voltage.	1000A short-circuit protection battery fuse is open.	Measure voltage drop across battery fuse to determine if the open fuse is in power cabinet or supplemental battery cabinet. Replace fuse using procedure in Section 8.

Table 9-3: Controller Alarms

Controller LED	Vector Controller Display	Other Indication(s)	Possible Problem(s)	Possible Solution(s)
MAJ CTRL	SEnS	16V on plant voltage display.	Broken connection or operated fuse.	Re-establish connection (O-R lead from BTJ2 J21 to +24V charge bus) or replace blown fuse (F2 on BTJ2).
MAJ or none	(no message)	Display may be dark.	Controller failure or display failure.	<p>If the green NORM LED is out and the red MAJ LED is lit, perform the following steps:</p> <ol style="list-style-type: none"> 1. Remove and reset the controller circuit board. If all diagnostics pass, it may have been a “one time” abnormality. 2. If the diagnostics do not pass, replace the BIC2 controller board and verify the failure is resolved. 3. Verify that the J21 and J2 cable sets are seated on BTJ2 board and connected at far end. 4. If only the display is dark, replace the display module. <p>If all LEDs and the display are dark, replace the F1 power fuse of the BTJ2 if operated.</p>

Table 9-4: Distribution Alarms

Controller LED	Vector Controller Display	Other Indication(s)	Possible Problem(s)	Possible Solution(s)
MAJ DIST	FAJ	Alarm LED on CB panel alarm card.	DC load circuit breaker has operated.	Locate and reset the tripped circuit breaker.

Table 9-5: Rectifier Related Alarms

Controller LED	Vector Controller Display	Rectifier LED	Rectifier Display	Possible Problem(s)	Possible Solution(s)
MIN RECT	rFA	Blinking ALM LED	None	Loss of communication with controller: <ul style="list-style-type: none"> •Defective interface from rectifier to controller •Internal controller or rectifier failure 	<ol style="list-style-type: none"> 1. Verify that the controller is powered and operating correctly. 2. If there are no controller alarms, replace the rectifier. 3. Trace the communications cable set from J2 of the BTJ2 to and between the rectifier shelves.
		ALM	tA	Thermal alarm: <ul style="list-style-type: none"> •Excessive ambient temperature •Internal rectifier failure 	<ol style="list-style-type: none"> 1. Verify that there is no obstruction of the fan inlet. 2. Toggle the ON/STBY switch into the STBY position and then back into the ON position. 3. If the problem is not corrected, replace the rectifier.
			FSE	Fuse alarm: <ul style="list-style-type: none"> •DC fuse open •Internal rectifier failure 	<ol style="list-style-type: none"> 1. Toggle the ON/STBY switch into the STBY position and then back into the ON position. 2. If the problem is not corrected, replace the rectifier.
			LO	Low output voltage: <ul style="list-style-type: none"> •Excessive output current •Internal rectifier failure 	
			Sen	Thermal sensor failure: <ul style="list-style-type: none"> •Internal rectifier failure 	<ol style="list-style-type: none"> 1. Place the ac circuit breaker for the rectifier in the OFF position. 2. Remove the rectifier from the shelf. 3. Wait for 30 seconds or until all front panel display LEDs have extinguished. 4. Replace the rectifier. 5. Return the ac breaker to the ON position. 6. Place the rectifier ON/STBY switch into the ON position. 7. If the problem is not corrected, replace the rectifier with a new one.
			ICS IP5 IP6 IP7	Internal rectifier failure	
FAN ALM	None	Fan Failure	Replace the fan in the rectifier.		

Table 9-5: Rectifier Related Alarms

Controller LED	Vector Controller Display	Rectifier LED	Rectifier Display	Possible Problem(s)	Possible Solution(s)
MIN RECT (continued)	rOFF	STBY	Blank	Rectifier has been manually turned off.	Turn rectifier on.
	HFO	None	None	High float voltage or FHFO threshold set too close to FSP.	Verify the FHFO and FSP thresholds in the controller. Set minimum 1/2 volt apart.
	LSb		Higher or lower load reading.	A rectifier is unable to load share properly.	Identify rectifier that is not functioning properly; reseal and retest. If rectifier still does not load share, replace rectifier.
MAJ RECT	nrFA	Blinking ALM LED on more than 1 rectifier	None	Loss of communication with controller: <ul style="list-style-type: none"> •Defective interface from rectifier to controller •Internal controller or rectifier failure 	<ol style="list-style-type: none"> 1. Verify that the controller is powered and operating correctly. 2. If there are no controller alarms, replace the rectifier. 3. Trace the communications cable set from J2 of the BTJ2 to and between the rectifier shelves.
		ALM LED on more than 1 rectifier	HO, tA, FSE, LO, SEn, ICS, IP5, IP6, IP7	More than one rectifier has an alarm condition.	See rectifier alarms listed above.
	rid	None	None	Rectifier ID number has not been set.	Set the rectifier ID using the procedure in Section 5.
	HO	ALM	HO	High output voltage: <ul style="list-style-type: none"> •Rectifier high voltage shutdown •Internal rectifier failure 	<ol style="list-style-type: none"> 1. Verify the HFO threshold in the controller. 2. Toggle the ON/STBY switch into the STBY position and then back into the ON position. 3. If the problem is not corrected, replace the rectifier.

HX Cooling System

Locate the HX controller status LEDs on the inside of the front door of the cabinet. If a trouble condition exists, an alarm LED (Red) on the display may be active. Refer to Figure 5-3 for a view of these alarm status LEDs.

The initial troubleshooting step is to determine the system status. For most problems, one or more alarm status LEDs will be Red and one or more alarm status relay sets will be active. See T83492-30 Figure H6 for the HX controller alarm relay assignments on the Krone terminal block located on the left interior side of the cabinet, near the HX controller. If all alarm relay sets are active but the alarm LEDs are dark, check the 30A breaker for the HX controller, also located near the alarm terminal block.

Refer to Tables 5-3 and 5-4 for an explanation of the alarm conditions that activate the HX system LEDs and alarm relays respectively. After any failure conditions have been corrected, the “Quick Test” switch may be used as described in Section 5 to verify the integrity of all components of the HX cooling system.

Battery Fan LED and Alarm

The Battery Fan in the battery compartment of the power cabinet or in a supplemental battery cabinet (if equipped) has failed. This alarm will only activate when the HX controller is asking the battery fan(s) to run. Battery fan(s) are either on or off, single speed.

- Avg Bat Temp < 20°C, fan off
- 20°C < Avg Bat Temp < 40°C, fan on if Bat Ambient 3°C cooler than Avg Bat Temp
- Any Bat Temp > 40°C, fan on
- DCV > 28V, fan on

Verify the cable set to the power cabinet battery compartment (HX controller P2) or battery cabinet(s) (HX controller P10). Replace the fan if necessary.

HX Fan LED and Alarm

The HX fans are located in the power cabinet door. The upper fan (HX Fan Int) circulates the internal cabinet air through the heat exchanger. The lower fan (HX Fan Amb) circulates ambient external air through the heat exchanger. For any temperature > 20°C, both fan impellers should be spinning. HX fans are variable speed, depending on temperature.

Verify the cable sets to the HX fans and drivers (HX controller P7, Int or P8 Amb). Replace the fan or driver if necessary.

**Battery T/C LED
and Battery Temp
Hi/Low Alarm**

Battery thermistors are located on battery module posts, one per battery shelf. A battery ambient thermistor is located inside the battery compartment at the air intake louver. Battery heaters turn on at 10°C and turn off at 20°C. This alarm activates if:

- 5°C > Any Battery Temp Probe > 60°C
- Any Battery or Battery Compartment Ambient Temp Probe Open or Shorted

Search for a hot battery module by touch. At > 60°C, Temp Comp in the Galaxy Vector controller (using different thermistors) will have lowered the plant voltage 1V or more from its 27.24V float set point. Measure resistance into each thermistor after disconnecting it from the HX controller P2 cable set to check for a shorted or open probe. Probe resistance should be between 2.5K and 25K ohms. To check the P2 cable set, each probe resistance measurement can be made at the P2 plug end, at 1-7, 2-8, and 3-9.

An open or shorted Battery Compartment Ambient Temp Probe should also result in the Ambient/HX Int T/C LED and Cabinet Temp Hi/Low Alarm.

Refer to the btA alarm in Table 9-2 for the resolution of a hot battery module.

Replace any open or short thermistor probe.

If the batteries are colder than 5°C, check the AC breaker for the heaters, the solid-state relay that activates them, or the heaters themselves.

**Ambient/HX Int T/
C LED and
Cabinet Temp Hi/
Low Alarm**

The HX Int T/C thermistor is mounted directly off J3 on the HX Control card and monitors the internal cabinet temperature. This alarm activates if:

- HX Int Temp Probe (door) > 88°C; both HX fans go to maximum speed
- HX Int Temp Probe (door) < -10°C; all fans off
- HX Int Temp Probe Open or Shorted; all fans go to maximum speed
- Battery Compartment Ambient Temp Probe open or shorted; battery fans on if Avg Bat Temp > 25°C.

If the Ambient/HX Int T/C LED and Cabinet Temp Hi/Low Alarm is active without the Battery T/C LED and Battery Temp Hi/Low Alarm and the temperature is between -10°C and 88°C, a shorted or open HX Int T/C thermistor is indicated. Probe resistance should be between 2.5K and 25K ohms when disconnected from J3 of the HX control card.

If the Ambient/HX Int T/C LED and Cabinet Temp Hi/Low Alarm is active along with the Battery T/C LED and Battery Temp Hi/Low Alarm, a shorted or open Battery Compartment Ambient Temp Probe is indicated.

***Hi VDC LED and
Controller Alarm***

A power cabinet voltage > 28V or a controller fail is present. Battery fan(s) go to maximum speed for the high voltage condition. All fans go to maximum speed for a controller fail condition.

Correct the high voltage condition on the power plant.

Try a reset of the controller processor by cycling the 30A breaker for it, located near the alarm terminal block. Replace the HX controller card if necessary.

All 5 HX System Alarm Relays activate simultaneously on loss of DC power. Check the status of the 30A breaker for it, located near the alarm terminal block.

Spare Parts**Table 9-6: Spare Parts**

Comcode	Description	Recommended Quantity
HX System Spares		
408506905	HX Controller Assy	1 per Area
408506871	Upper (Interior) Impeller	1 per Area
408506889	Lower (Exterior) Impeller	1 per Area
408506897	Impeller Driver Card	1 per Area
408506913	Thermistor Wire Harness	1 per Area
848658928	Thermistor	5 per Area
848658902	Battery Compartment Fan	1 per Area
848658910	Battery Shelf Heater Assy	1 per Area
408509917	Battery Cabinet Temperature Controller	1 per Area
Vector Controller Spares		
108173782	Vector Control Card, BIC2	1 per Area
108402017	Vector Display Card, BMW3	1 per Area
108629528	Vector Termination Board, BTJ2	1 per Area
401231535	GMT Fuse, 5A	5 per Area
Power Cabinet Spares		
408151140	1000 Amp Battery Fuse	1 per Area
407676972	RFI Indicator	1 per Area
407253053	Battery Fuse Alarm Microswitch	1 per Area
407961895	1200 Amp LVBD Contactor Assy	1 per Area
847494606	1/4 inch ring thermistor, 10K	5 per Area
107885618	Distribution Panel Alarm Bd, BNL1	1 per Area
Rectifier Spares		
108687765	+24V/100A Rectifier, 596B4	1 per Area
407840792	Rectifier Fan Assy	1 per Area
AC Distribution Spares		
408506855	QO115 1-pole, 15 Amp Circuit Breaker	As needed
408506863	QO220 2-pole, 20 Amp Circuit Breaker	As needed
408506848	QO230 2-pole, 30 Amp Circuit Breaker	As needed
848666939	Surge Arrestor Kit	1 per Area

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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. During the warranty period stated in Sub-Article B below, Seller's Manufactured Products (products manufactured by Seller), which have been paid for by Customer, will conform to industry standards and Seller's specifications and shall be free from material defects;
 3. With respect to Vendor items (items not manufactured by Seller), Seller warrants that such Vendor items, which have been paid for by Customer, will be free from material defects for a period of sixty (60) days commencing from the date of shipment from Seller's facility.
- B. The Warranty Period listed below is applicable to Seller's Manufactured Products furnished pursuant to this Agreement, commencing from date of shipment from Seller's facility, unless otherwise agreed to in writing:

Warranty Period

Product Type	New Product	Repaired Product*
Central Office Power Equipment	24 Months	6 Months

**The Warranty Period for a repaired Product or part thereof is six (6) months or, the remainder of the unexpired term of the new Product Warranty Period, whichever is longer.*

- 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 repaired or replacing Product to the destination designated by Customer.
- E. Except for batteries, the defective or nonconforming Products or parts which are replaced shall become Seller's property. Customer shall be solely responsible for the disposition of any batteries.
- 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 experimental products or prototypes or with respect to expendable items, including, without limitation, fuses, light bulbs, motor brushes, and the like. Seller's warranty does not extend to any system into which the Product is incorporated. This warranty applies to Customer only and may not be assigned or extended by Customer to any of its customers or other users of the Product.

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.