



Yukon™ Power System *-48V Indoor/Outdoor Battery Plant*

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-48V Indoor/Outdoor Battery Plant

Notice:

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1 Introduction

Yukon -48 Volt Indoor/Outdoor Cabinet Power System

Overview

The Yukon -48V Outdoor Cabinet Power System is an extremely flexible power system designed for 19-inch (483mm), 23-inch (584mm), and ETSI cabinet applications where space conservation and environmental considerations are critical. By limiting the system depth to 11 inches (280mm), the -48V architecture permits the cabinet designer to locate revenue-generating equipment behind the power system in 24-inch (600mm) deep cabinets.

The Yukon Power System supports -48V primary loads up to 4.2kW of N+1 redundant power in a single 19-inch shelf, and up to 5.6kW of N+1 redundant power in a 23-inch shelf. The Yukon Power System supports up to 15 rectifiers on three shelves.

The Yukon system employs constant power rectifiers, which feature automatic load-share circuits that force all rectifiers to apportion the plant load equally, reducing the stress on individual units. These power units are self-protected so that short circuits and system overloads are handled automatically; i.e., if a short circuit is removed or a system overload reduced, the power units will automatically resume normal operation.

The Yukon system allows integral output distribution options through the Auxiliary Box (Aux Box). It is used to offer flexible output distribution options when an external distribution is not practical. Output load distribution options include either DIN style circuit breakers or GMT style fuses. The Aux Box is where battery, load, and output ground connections are made. It is also where the controller, LVD board, and ringer modules reside.

The Yukon system controller card is powered off the system bus voltage and resides in the Aux Box. The controller allows the user to set system parameters, and various alarm thresholds. A personal computer with an

isolated local port or notebook computer can be used to interface with the controller. The computer can be used to custom configure controllers prior to shipping. This reduces overall installation time needed for the power system. It also provides test jacks to measure plant voltage and load current.

The Yukon platform has an optional ringer card, which is powered off the system bus voltage. It resides in the Aux Box and provides its output through connectors on the ringer card. The ringer module produces 50VA of redundant output power, and is configurable for multiple output voltages and frequencies.

The Yukon platform offers battery protection and maintenance options in the form of the LVD board. This board contains the LVD disconnect contactors allowing the system controller to disconnect batteries during discharge. It also allows users to manually disconnect a contactor, taking a string off-line for maintenance purposes. The LVD board also prevents users from connecting battery strings in reverse polarity.

Thermal probes and a remote voltage monitoring module are also available to enhance the functionality of the Yukon system.

Further enhancements, including a remote distribution module and Palm[®] PDA access for system configuration and monitor, are also available.

Applications

Yukon Power System fits digital loop carrier, remote switch, fiber in the loop, cable television cabinets, Intelligent Vehicle Highway System (IVHS), Personal Communications Service (PCS), cellular, and customer premises applications.

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

Block Diagram

Figure 2-1 is a basic block diagram of the Yukon Power System in a single shelf.

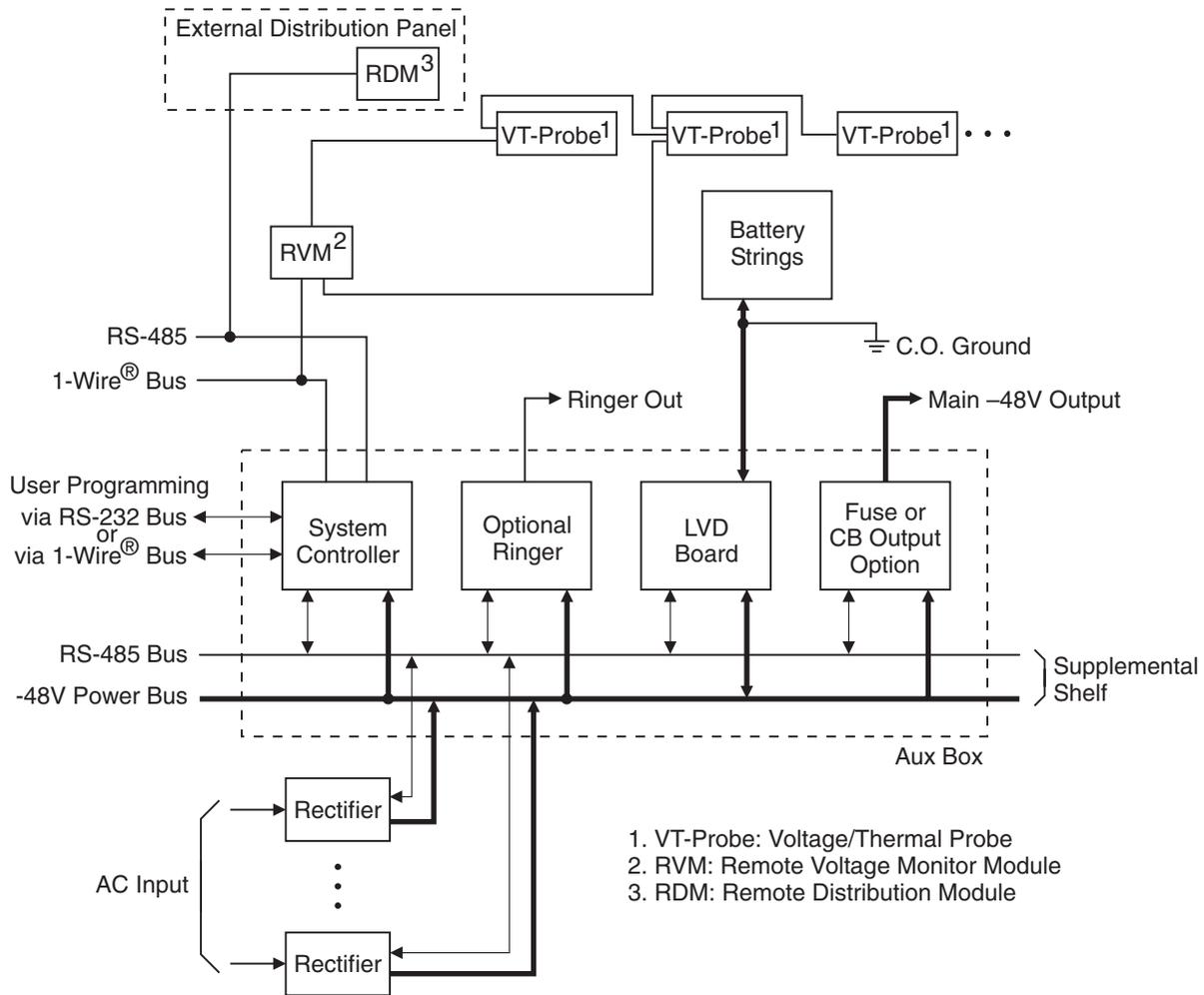


Figure 2-1: Block Diagram of Yukon Platform

Shelf Design

Features

The shelf is available in 19-inch and 23-inch standard widths and has the following features:

- Accepts plug-in rectifier modules and Aux Boxes.
- Shelf configurations can accept the following number of rectifiers:

Shelf	With Aux Box	Without Aux Box
19-inch	3	4
23-inch	4	5

- Permits growth of plant capacity and easy maintenance without service interruption.

Figures 2-2 through 2-4 show the show the locations of the Yukon components in the 19-inch shelf with the standard Aux Box, the 23-inch shelf with the optional display Aux Box, and the 23-inch shelf with the bulk output and controller-only Aux Box with the optional display.

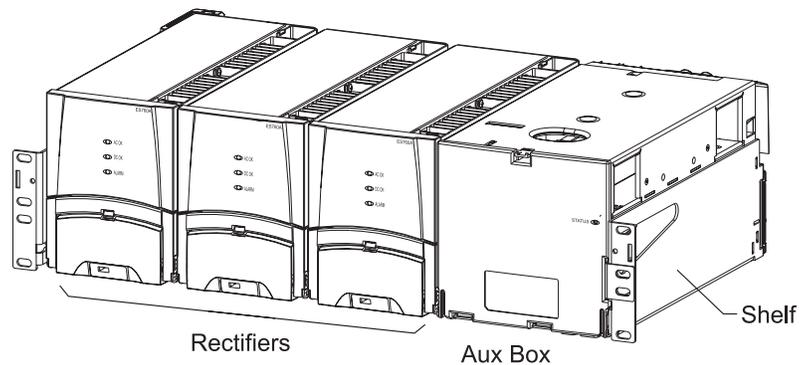


Figure 2-2: 19-Inch System with Standard Display Aux Box

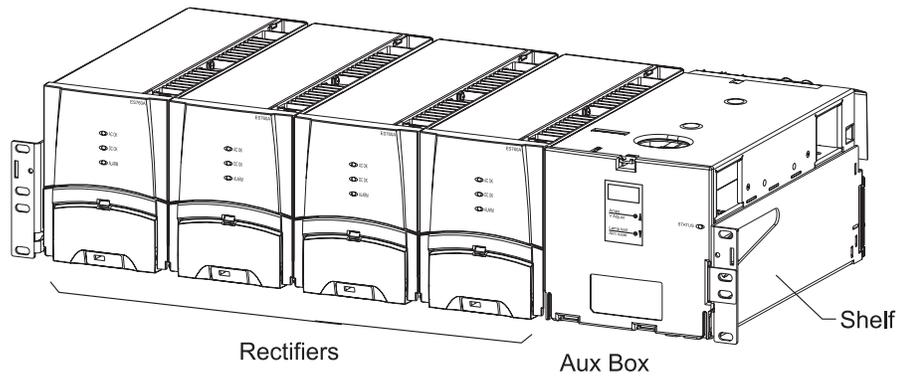


Figure 2-3: 23-Inch System with Optional Display Aux Box

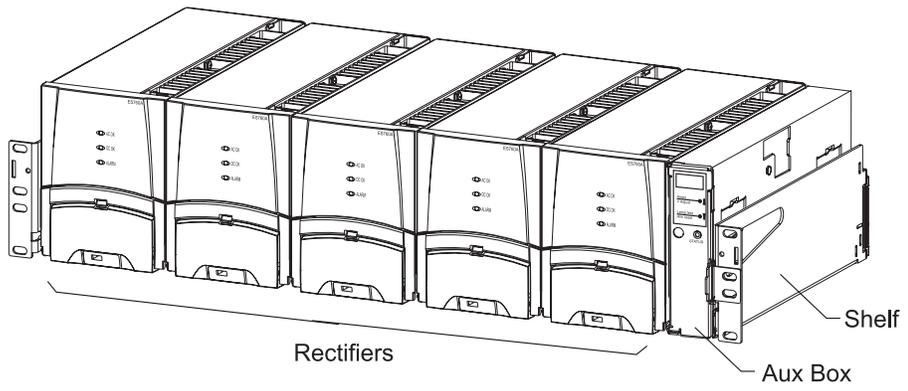


Figure 2-4: 23-Inch System

Configurations

The Yukon platform provides the facilities to combine rectifiers, a system controller, a low-voltage battery disconnect feature, and battery protection circuits in a single shelf. It is available in the following configurations:

19-Inch Rectifier Plant

The 19-inch rectifier plant can house an Aux Box, and up to three rectifiers, producing 1.3kW of redundant power. It can produce 1.95kW of redundant power when used as a supplemental shelf.

23-Inch Rectifier Plant

The 23-inch rectifier plant can house an Aux Box, and up to four rectifiers, producing 1.95kW of redundant power. It can produce 2.6kW of redundant power when used as a supplemental shelf.

Rectifier/Ringer Plant

Both the 19-inch and the 23-inch configurations may be equipped with a 50VA ringing waveform generator. In this configuration, the rectifiers provide input power to the ringers, as well as power for customer equipment. The ringer card contains two 50VA ringing modules to provide ringing feature redundancy.

Yukon Power System Overview

The Yukon Power System houses all components within the Yukon shelf, either in the 19-inch or 23-inch (see Figure 2-1) versions. This includes rectifiers and the Auxiliary Boxes (Aux Box). The Aux Box houses the system controller, optional ringer, low-voltage disconnect (LVD) boards and provides the distribution options.

The utility voltage is supplied to the rectifiers, which produces the nominal and regulated -48V dc output voltage. This voltage is used to power all other system components including the system controller, the optional ringer, and the LVD boards. Batteries are connected to the system at the Aux Box; under conditions when the ac utility service is available, the rectifiers both power the customer's load and float-charge the batteries.

The batteries are monitored by the system controller to ensure their peak performance and longevity against thermal issues. They are monitored via the Voltage/Thermal Probes (VT-Probes), which are connected from the Aux Box to the battery.

The Remote Voltage Monitor (RVM) module may be used with the VT-Probes in making voltage measurements for battery string-voltage imbalance detection. Additional VT-Probes may be used by connecting them in a daisy-chain fashion.

The system controller monitors all system parameters and performs battery management functions. It communicates with all devices using the RS-485 bus. The RVM and VT-Probe communicate with the controller using the 1-Wire®¹ from Maxim Integrated Products, Inc.

The optional ringer module produces the ring-waveform that is used to ring telephones in making voice calls. The ringer has two modules within it to make it redundant, i.e., if a module fails, the second module will support the load.

The LVD Board is used to connect the battery strings to the main power bus. Under ac fail conditions, the battery current will be flowing through the LVD Board to the output distribution in supporting the load. To prevent deep discharge of batteries, the LVD board will disconnect the batteries from the load by opening the battery disconnect contactors.

The output distribution is where customers may connect their load equipment to the Yukon Power System. Currently, a fuse or circuit breaker distribution options are available.

A supplementary shelf may be paralleled to the primary shelf to create a larger plant. Only the primary shelf would contain the system controller. The supplementary shelf only requires signal and power connections to the primary shelf.

External distribution panels may be used with the bulk output Yukon shelf. The Yukon controller can monitor for open protectors, monitor current from a battery shunt, and monitor and control a low-voltage disconnect contactor via the Remote Distribution Module (RDM).

Please delve deeper into the product manual for detailed information on the Yukon Power System.

¹ 1-Wire® is a registered trademark of Maxim Integrated Products.

Battery Reserve System

Introduction

A battery reserve system is a key ingredient for the Yukon Power System product line. A power plant provides a primary voltage of -48Vdc that drives your equipment. At the same time, the power plant provides float and recharge capability for the battery reserve system. If an ac power failure occurs, the batteries provide power to the customer equipment until the ac can be restored.

Types of Batteries

Yukon Power Systems may be used with valve-regulated lead-acid (VRLA) batteries. Up to four strings of VR-type batteries or equivalent general trade batteries may be connected directly to a 48V Yukon shelf.

Nickel-Cadmium (Ni-Cd) batteries may also be used with the Yukon Power System. Please contact your factory representative for details.

Specifications

Electrical

Table 2-A: Yukon Power System Electrical Specifications

Plant	Single 19-inch or 23-inch plant
Power Slots	4 power slots per 19" shelf; 5 power slots per 23" shelf
Power Units	1 rectifier per power slot; maximum of 15 per plant
Plant Architecture	Primary output: 1 primary output power bus per shelf; maximum output capability of 116A per 19" shelf; 145A per 23" shelf Secondary output: 1 secondary ringer output available on ringer card
Rectifier Input Distribution	1 ac input per rectifier slot
Ringer Input Distribution	Primary output bus provides input power for ringers
Output Distribution - Primary Bus	-48Vdc bulk power outputs to loads or distribution Battery connections: double-hole lugs to terminate two battery strings, see Note 1
Output Distribution - Secondary Bus	PWB mounted AMP MATE-N-LOK connector for ringer output
Primary Bus Protection and Distribution	Two distribution options available in the 5.5" aux box: <ul style="list-style-type: none"> • DIN style circuit breakers • GMT style fuses See Note 2
Maximum Discharge Current	100A per shelf, see Note 2
Maximum Recharge Current	Installed plant -48V rectifier capacity minus plant -48V load
Low-Voltage Disconnect	39V - 48Vdc
Operating Ambient Temperature	-40°F to 167°F, see Note 3 -40°C to 75°C, see Note 3
Altitude	-200 to 13,000 feet (-61 to 3962 meters) See Note 4
Humidity	10-95% non-condensing
Audible Noise	34.5 dBA measured 1 meter (3.3 feet) from the plant
Radiated and Conducted Emissions	FCC Part 15, Class B EN55022 (CISPR22), Class B
Harmonics	EN61000-3-2 (IEC61000-3-2)
Voltage Fluctuations	EN61000-3-3 (IEC61000-3-3)
Electromagnetic Immunity	Meets Telcordia GR-1089-CORE
Electrostatic Discharge	EN61000-4-2 Level 3
RF Immunity	IEC61000-4-3 Level 3, 10V/m
EFT	IEC61000-4-4 Level 3, No Error; Level 4, No Damage
Surge	IEC 61000-4-5 Level 3, No Error; Level 4, No Damage
Conducted Immunity	IEC 61000-4-6 Level 3, 10V

Table 2-A: Yukon Power System Electrical Specifications (continued)

Voltage Dips, Interruptions, and Variations	IEC 61000-4-11
Earthquake Rating	Zone 4, upper floors
Safety Agency Approvals	Underwriters Laboratories (UL) Listed per Subject Letter 1801: Power Distribution Center for Communications Equipment, and cUL Certified (CSA 22.2 950): Safety of Information Technology Equipment
	VDE licensed to VDE0805/EN60950
	Rectifiers are individually UL Recognized (UL1950), cUL Certified (CSA 22.2 234) or evaluated to EN60950 by an EC Notified Body, as appropriate.
European Economic Community (EEC) Directives	EMC Directive 89/336/EEC Low Voltage Directive 73/23/EEC as amended by Marking Directive 93/68/EEC
<p>Note 1: The Yukon Power System can be used with four strings of batteries, two strings may be paralleled and then terminated to the battery connection lugs.</p> <p>Note 2: When used with Aux Boxes with distribution options, maximum output is limited to 100A. See Section 8 for limitations on maximum currents through Aux Boxes when used with specific LVD Boards.</p> <p>Note 3: Operating temperatures and required airflow are different when used with specific rectifiers. See Tables 2D and 2E for rectifier information.</p> <p>Note 4: For altitudes above 5000 feet, derate the temperature by 3.6°F per 1000 feet. For altitudes above 1524 meters, derate the temperature by 0.656 degrees Celsius per 100 meters.</p>	

Installation Category

The Yukon Power System is suitable for connection to ac utility systems where the expected level of lightning surges complies with ANSI C62.41 Category B or IEC 60664-1 Overvoltage Category II.

A service entrance surge protector is required in applications where the installation categories can not be classified as being compliant to either ANSI C62.41 Category B or IEC 60664-1 Overvoltage Category II.

The Yukon rectifiers have been tested for repeated lightning surges typically found in an Overvoltage Category III installation; however, a service entrance surge protector is recommended in cabinet applications to bring the power feeds in compliance to the installation categories above. The service entrance protection should be coordinated with the protection provided in the power modules.

The power module provides common-mode protection via a 320V MOV in series with a 2500V gas-discharge device and differential-mode protection via a 320V MOV in series with a 6.2A fuse.

Physical

Table 2-B: Yukon Power System Physical Specifications

Rectifier	Height: 5.25 (133mm) Width: 4.0 (102mm) Depth: 9.5 (241mm) Weight: 7 lbs (2.3kg)
19-Inch Shelf	Height: 5.25 (133mm) Width: 17.5 (445mm) Depth: 11 (280mm) Weight: 7.5 lbs (3.4kg)
23-Inch Shelf	Height: 5.25 (133mm) Width: 21.5 (546mm) Depth: 11 (280mm) Weight: 8 (3.6kg)
Aux Box	Height: 5.25 (133mm) Width: 5.5 (140mm) Depth: 9.5 (241.3mm) Weight: 6.5 lbs (2.9kg)
Single 19-Inch Shelf with Three Rectifiers and Aux Box with LVD Board, Controller, and Fuse Option	Weight: 35 lbs (15.9kg) maximum
Frame Mounting Requirements	Standard 19-inch relay racks: Vertical mounting centers: 1.0 inch (25mm) and 1.75 inches (44mm) Horizontal mounting centers: 18.31 inches (465mm)
Single 23-Inch Shelf with Four Rectifiers and Aux Box with LVD Board, Controller, and Fuse Option	Weight: 42.5 lbs (19.3kg) maximum
Frame Mounting Requirements	Standard 23-inch and 26-inch relay racks: Vertical mounting centers: 1.0 inch (25mm) and 1.75 inches (44mm) Horizontal mounting centers: 22.32 inches (567mm)

Rectifier Plant

Table 2-C: Yukon Power System Rectifier Specifications

Power Units	Maximum number of: rectifiers: 3 per 19-inch shelf with Aux Box, 4 without 4 per 23-inch shelf with Aux Box, 4 without
Control Unit	ES740AD
Nominal Output Voltages	48/52/54.5Vdc
Operating Voltage Range	44V to 56.5Vdc
Maximum Output Current	116A per 19" shelf; 145A per 23" shelf See Note
Nominal Input Voltage	100/120/200/208/240Vac
Input Voltage Ranges	85V to 275Vac
Maximum Input Current per Rectifier (see Note 2)	11.3A @ 100Vac 9.4A @ 120Vac 7.8A @ 200Vac 6.7A @ 240Vac
Boost Voltage	48V to 56.5Vdc
Efficiency	>90% @ 230Vac, >88.5% @ 120Vac
Output Voltage Regulation	±0.5%
Output Noise: Ripple	100 mVrms peak to peak maximum, over the range 10 Hz to 20 MHz
C-Message Weighted Noise	32 dBnC
Wideband Noise	240 mV pk-pk over the range 10 Hz to 20 MHz
Psophometric Noise	2 mV peak
Load Share Accuracy	2.9A (maximum)
Maximum Discharge Current (see Note 2)	119A per 19" shelf; 145A per 23" shelf
Maximum Recharge Current	Installed rectifier capacity minus plant load
Low-Voltage Disconnect	39V to 48Vdc
Heat Dissipation (see Note 2)	136W (468 BTU) per rectifier at full load and 100 to 120Vac operation 155W 529 BTU) per rectifier at full load and 200 to 240Vac operation
Power Factor	>0.98 for loads >60% of full load
Note 1: Maximum current through Aux Box is limited to 100A and may be further limited by the LVD board chosen. See LVD Boards in Section 8 for more details.	
Note 2: Data is based on ES761A rectifier. See Table 2-E for more details.	

Rectifiers

Table 2-D: ES760A Rectifier Specifications

Nominal Output Voltage	48/52/54.5Vdc
Operating Output Voltage Ranges	44V to 56.5Vdc
Boost Voltage	48V to 56.5Vdc
Output Current	0A to 11.9A @ 54.5V
Nominal Input Voltage	100/120/200/208/240Vac
Input Voltage Ranges	85V to 275Vac
Input Current	7.4A @ 100Vac (See Note 2) 6.2A @ 120Vac (See Note 2) 3.6A @ 200Vac (See Note 3) 3.0A @ 240Vac (See Note 3)
Operating Frequency Range	47 to 63Hz
Efficiency	>90% typical @ 230Vac, >88.5% @ 120Vac
Output Voltage Regulation	±0.5%
Output Noise: Ripple	100 millivolts peak to peak maximum, over the range 10 Hz to 20 MHz
C-Message Weighted Noise	<26 dBmC
Wideband Noise	<10mVrms, over the range 10 Hz to 20 MHz
Psophometric Noise	0.55mV peak
Load Share Accuracy	1.2A maximum deviation between rectifiers
Heat Dissipation	89W (303.5 BTU) at full load and 100-120Vac operation 72W (245.5 BTU) at full load and 200-240Vac operation
Power Factor	>0.98 for loads > 60% full load
Total Harmonic Distortion	<5% for loads > 85% full load <15% for loads > 50% full load
Selective High-Voltage Shutdown	Above 58Vdc for 3 seconds
Backup High-Voltage Shutdown	Above 60Vdc for 100 milliseconds
Note 1: The ES760A produces 650W of constant power from 48V to 56.5V. See Rectifier in Section 7 for more details.	
Note 2: Input current specified at input voltage of 100/120V, an output of 54.5V @ 650W, and efficiency of 88.5%.	
Note 3: Maximum input current specified at input voltage of 200/240V, an output of 54.5V @ 650W, and efficiency of 90%.	

**Rectifiers
(continued)**

Table 2-E: ES761A Rectifier Specifications

Nominal Output Voltage	48/52/54.5Vdc
Operating Output Voltage Ranges	44V to 56.5Vdc
Boost Voltage	48V to 56.5Vdc
Output Current	0A to 18.3A @ 54.5Vdc and 120Vac 0A to 25.7A @ 54.5Vdc and 240Vac
Nominal Input Voltage	100/120/200/208/240Vac
Input Voltage Ranges	90V to 275Vac
Input Current	11.3A @ 100Vac (See Note 2) 9.4A @ 120Vac (See Note 2) 7.8A @ 200Vac (See Note 3) 6.7A @ 240Vac (See Note 3)
Operating Frequency Range	47 to 63Hz
Efficiency	>90% typical @ 230Vac, >88.5% @ 120Vac
Output Voltage Regulation	±0.5%
Output Noise: Ripple C-Message Weighted Noise Wideband Noise Psophometric Noise	250 mV pk-pk maximum, over the range 10 Hz to 20 MHz 37 dBnC 40 mVrms, over the range 10 Hz to 20 MHz 2 mV peak
Load Share Accuracy	2.9A maximum deviation between rectifiers
Heat Dissipation	136W (468 BTU) at full load and 100-120Vac operation 155W (529 BTU) at full load and 200-240Vac operation
Vertical Airflow	250 lfm (127 lms) minimum at full output power
Power Factor	>0.98 for loads > 60% full load
Total Harmonic Distortion	<5% for loads > 85% full load <15% for loads > 50% full load
Selective High-Voltage Shutdown	Above 58Vdc for 3 seconds
Backup High-Voltage Shutdown	Above 60Vdc for 100 milliseconds
<p>Note 1: The ES761A produces 1000W of constant power at nominal 120Vac, and 1400W at nominal 200-240Vac, from 48V to 56.5V. See “Rectifier” in Section 7 for more details.</p> <p>Note 2: Input current specified at input voltage of 100/120V, an output of 54.5V @ 1000W, and efficiency of 88.5%.</p> <p>Note 3: Maximum input current specified at input voltage of 200/240V, an output of 54.5V @ 1400W, and efficiency of 90%.</p>	

Ringer

Table 2-F: ES720B Ringer Card Specifications

Input Voltage	40V to 60Vdc
Input Current	Maximum 4A at 40Vdc
Input Noise Feedback	<56 dBrnC per ANSI T1.315
Output Voltage	User configurable from 70Vrms, 80Vrms, 90Vrms, and 100Vrms. Factory set to 100Vrms.
Output Frequency	User configurable from nominal 17Hz, 20Hz, 25Hz, and 50Hz. Factory set to 20 Hz.
Output Power	50VA for power factors between 0.6 leading and 0.9 lagging.
Output Voltage Regulation	+/- 5Vrms for all conditions of load, input voltage, and temperature.
Crest Factor	1.41 +/- 0.25
Harmonic Distortion	Maximum 10% for all load conditions and stated power factors
Maximum DC Loading	10W
Output DC Offset Voltage	DC input voltage
Output Noise Feedback	<90 dBrnC, referenced to 900 ohms per GR-1089-CORE
Efficiency	>70% for loads greater than 35VA
Output Surge	300V no damage, 250V no error per ITU K41

Control Units

Table 2-G: ES740AD Control Unit Specifications

Operating Input Voltage Range	38V to 60Vdc
Input Power	6.0 watts maximum
Plant Parameter Setting	Via IBM compatible PC with isolated RS-232 port connected to P6 on the system controller with Controller Programming Cable (848658100).
Alarm Contact Ratings	60Vdc, 0.5A, Form-C
Operating Temperature	-40°C to +75°C

3 *Engineering and Ordering*

Engineering Information

Introduction

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

Rectifier Sizing (Non-Redundant Systems)

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

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

$$\text{mirc} = \text{abh} + \text{recharge current}$$

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

$$\text{mirc} = \text{abh} \times \text{recharge factor}$$

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

Engineering Information, continued

Rectifier Sizing (Redundant Systems)

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

In cases where the additional spare rectifier will provide the required battery recharge current, the mirc satisfies the requirements for both non-redundant and redundant systems. In other cases, rectifiers in addition to the redundant rectifier may be required to provide the battery recharge current. Typically, the number of spare rectifiers required for a redundant system is the larger of one spare rectifier or 200% of the rated load.

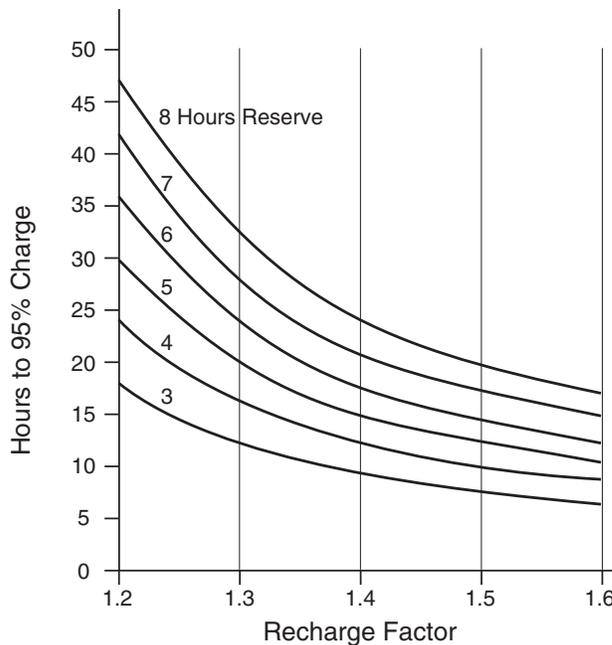


Figure 3-1: Recharge Factor vs. Recharge Time

Engineering Information, continued

Plant Configuration Examples

To illustrate the relationships between *mirc*, *abh* current drains, the recharge factor, and battery recharge current for non-redundant and redundant systems, consider the following examples. Note that the ES760A rectifier provides 11.9A at 54.5Vdc.

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

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

$$\begin{aligned} \mathbf{mirc} &= \mathbf{abh \times recharge\ factor} \\ \mathbf{mirc} &= \mathbf{34 \times 1.38 = 46.9\ amperes} \end{aligned}$$

Four rectifiers ($46.9/11.9 = 3.9$) are required to provide the minimum installed capacity of 46.9 amperes for a non-redundant system. If one rectifier fails, the remaining rectifiers will provide the *abh* capacity.

2. An alternate method to calculate the number of rectifiers necessary is to utilize power. In the above example, the requisite current is 34A. As most battery plant loads are looking into constant-power loads, the 34A would increase as the battery voltage decreases during battery discharge. Assuming the 34A is the current being drawn from the load at the plant float voltage of 54.5V, the total power being drawn by the load is 1853W ($54.5V \times 34A$).

We can utilize the recharge factors from Figure 3-1 and use a modified *mirc* formula, therefore:

$$\begin{aligned} \mathbf{mirc} &= \mathbf{power \times recharge\ factor} \\ \mathbf{mirc} &= \mathbf{1835W \times 1.38 = 2557W} \end{aligned}$$

The ES760A is a 650W constant-power rectifier; four rectifiers ($2557/650 = 3.9$) are needed to support the load and recharge the batteries within the requisite time.

Ordering Information

Ordering Guide

An ordering guide may be downloaded from the Lineage Power web site at <http://www.lineagepower.com>.

Comcodes

The Yukon System can be ordered by 9-digit numeric character sets called comcodes. The following guides you through the comcode selection process in creating a power system. Please refer to the product description section on the individual components for more details.

Power Shelves

Shelves are available in 19-inch (483mm) rail widths and in 23-inch (584mm) rail widths. Shelves are available for flush and mid-mounting. See table below and Section 5, “Other Mounting Methods” for more details.

Shelf	Size	Mounting	Comcode	Additional
ES700A	19 in. (483mm)	Flush	108936535	<p>Provided: Mounting hardware</p> <p>Ordered Separately:</p> <p>Mid-mount adapter bracket kit (848652426)</p> <p>ETSI-mount adapter bracket kit (848657425)</p> <p>19” to 23” mid-mount adapter brackets kit (848652848)</p> <p>19” to 23” flush-mount adapter brackets (848683009)</p> <p>Note: the only Auxiliary Boxes compatible with the ES700A Shelf are the ES712A and ES712B.</p>
ES701A	23 in. (584mm)	Flush	108959776	<p>Provided: Mounting hardware</p> <p>Ordered Separately:</p> <p>Mid-mount adapter brackets (848652426)</p> <p>Note: the only Auxiliary Boxes compatible with the ES701A Shelf are the ES712A and ES712B.</p>
ES700B	19 in. (483mm)	Mid	108969825	<p>Provided: Mounting hardware</p> <p>Ordered Separately:</p> <p>ETSI adapter bracket with battery disconnect breaker assembly (108975236)</p> <p>19” to 23” adapter bracket with battery disconnect breaker assembly (108975228)</p> <p>19” to 23” flush-mount adapter brackets (848830009)</p> <p>Note: Not normally used with the ES712A/ES712B AUX boxes.</p>
ES701B	23 in. (584mm)	Mid	108969833	<p>Provided: Mounting hardware</p> <p>Note: Not normally used with the ES712A/ES712B AUX boxes.</p>

Aux Boxes

The Yukon platform will have many Aux Box options. Aux Boxes shown in the following table are currently available. All Aux Boxes take up 5.5 inches (138mm) of space, including one rectifier slot position.

Aux Box	Description	Comcode	Additional
ES712A	Rear access Aux Box with 8 GMT fuses with connectorized load connections	108902057	Ordered separately*: 15 ft. (4.5m) load cables 12 Amp 848652442 15 Amp 848658233 Can only be used with flush-mount shelves ES700A and ES701A.
ES712B	Rear access Aux Box with 3 DIN circuit breakers	108960501	Provided with Aux Box: 3 alarm sensing wiresets (848649695), one for each circuit breaker position. Order only for replacement or spares. Can only be used with flush-mount shelves ES700A and ES701A.
ES713A	Front access Aux Box with 14 GMT fuses and FastOn tab load connections	108968066	User to supply load cables. Can only be used with mid-mount shelves ES700B, ES701B and ES701C.
ES713AD	ES713A with display option	108983065	
ES714AD	Front Access Aux Box with 4 bullet-style circuit breakers and 4 fuses.	108982802	User to supply load cables. Ordered separately: Load Contactor Shorting Plug: 848718078 Can only be used with mid-mount shelves ES700B, ES701B and ES701C.
*Load cables are terminated on one end with a connector that mates to the Aux Box, and un-terminated on the other end.			

The ES712A, ES713A, and ES713B Aux Boxes come with a GMT fuse puller. Order 408515823 to obtain a replacement.

The ES713A and ES713B are secured to the shelf mounting rails via a mounting bracket supplied with the Aux Boxes. Order 848683116 for spare or replacement parts.

The ES713AD and ES713BD are identical to the ES713A and ES713B, respectively, except that they provide for a display option when used with the ES740AD controller.

The ES714AD Aux Box is for use with “bullet” style circuit breakers and single-hole lugs for load connections. It uses compression lugs for fuse connections.

Load Contactor Shorting Plug is used to bypass the load contactor during LVD board replacement.

Aux Box Lugs

The 5.5-inch wide Aux Boxes require M5 double hole lugs on 5/8 in centers for battery and CO ground connections. Additionally, the ES712B Aux Box requires lugs for the load return connections.

Straight lugs may be used for most applications; however, certain applications using the ES712B Aux Box may require the use of 90° lugs for battery and load return connections. Refer to ES712B in the Battery and Load Return Connections section of Section 5 for more information.

Lug Type	Cable Size	Comcode
Straight	8 AWG	406021626
Straight	6 AWG	405347519
90°	8 AWG	408507739
90°	6 AWG	408507721

Aux Box Office Alarm Cable

A cable assembly is available that mates to the host-interface connector on the Aux Box allowing access to alarms. This cable is nominally 6-ft (1.8m) in length, terminated on one end with a connector that mates to the Aux Box host-interface connector, and un-terminated on the other end. Please choose the appropriate cable specification Aux Box.

Aux Boxes	Alarm Cable Comcode
ES712A, ES712B	848642559
ES713A, AD, B, BD, ES714AD	848667689

ES712B Circuit Breakers

The following DIN style circuit breakers, which have been accepted for use in dc load applications, are available for the ES712B Aux Box.

Size (Amps)	Comcode
6	408150175
10	408513893
16	408496016
20	408150217
32	408359180
40	408150258
50	408535538
63	408150274

Other sizes are available. Consult your Lineage Power representative for more details. See Appendix D for information on circuit breaker derating.

**ES712A,
ES713AD
ES713B/BD and
ES714AD Fuses**

The following GMT style fuses, which have been accepted for use in dc load applications, are available for the ES712A, ES713A, ES713B and ES714AD Aux Boxes.

Size (Amps)	Comcode
0.25	405006222
0.5	406976894
1.33	405673146
2	405181983
3	406976985
5	406159061
7.5	405725433
10	406159236
12	407845197
15	406473959

**ES714AD Circuit
Breakers**

The following circuit breakers are for use in the ES714AD Aux Box.

Size (Amps)	Comcode
3	407998137
5	407998145
10	407998152
15	407998160
16	407998178
20	407998186
25	407998194
30	407998202
45	407998210
50	407998228

Yukon Controller

The ES740AD is the plant controller and allows for control and monitor of plant functions and setting of all plant parameters. Refer to Section 5 for more controller details, and Appendix B for programming information.

It also allows for the display option for the ES710AD, ES713AD, ES713BD and ES714AD Aux Boxes.

A programming cable may be ordered with the controller which, when used with a notebook or desktop PC with an isolated RS232 connection, allows the user access to the controller's programming.

Controller	Comcode	Additional
ES740AD	108983099	Ordered Separately: Programming cable 848658100

LVD Boards

Refer to Section 8 for more details on the LVD Boards.

LVD Board	Comcode	Description
ES712_LVD_A	108904186	2 LVD contactors, 2 disconnect switches
ES712_LVD_B	108962952	1 LVD contactor, no disconnect switch
ES712_LVD_C	108976028	Board with no battery disconnect feature
ES712_LVD_D	108986662	Board with load and battery disconnect feature. This LVD board is only used in the ES714AD Aux Box.

Ringer Module

The ES720B is the Yukon ringing module, which allows for various ring voltages and frequencies. Refer to Section 10 for more details.

The ES720A_OPF Kit is a load filter that reduces the amount of output noise from the ringing output. This filter attenuates the switching noise from the ringer output.

The following load cable is available for the ringer. A maximum of two may be ordered per ringer module. This cable has the mating connector on one end and is unterminated on the other end.

Ringer	Comcode	Additional
ES720B	108965484	Ordered Separately:
ES720A_OPF Kit	108983016	Load cable 847922101
ES720_OPF Kit consists of the filter module and a wireset. If ordering replacement parts, order the following: Filter: 848696498 Wireset: 848690517		

Rectifiers

The Yukon constant-power rectifiers take up one slot in a rectifier shelf. If a full complement of rectifiers is not being ordered for a shelf, a rectifier-slot filler may be ordered. This slot-filler resembles a rectifier when viewed from the front; a shelf full of rectifiers may be more aesthetically pleasing. Note that this slot-filler is not necessary from an earthquake standpoint.

Item	Comcode
ES760A Rectifier	108895301
ES761A Rectifier	108985144
Rectifier Slot-Filler	108968462

Rectifier AC Power Cables

An ac power cable must be ordered. A standard ac cable set will not fit in the Yukon shelf. The following ac cables are available, 10 ft (3m) in length, terminated on the Yukon end with a right-angled header. The utility end either has the proper standard plug or is un-terminated. Order the ac cable that best suits your application. All cords have single or multiple right-angled IEC60320 C13 ac connectors for attachment to the Yukon shelf.

Verify that the sum of the input currents for all the rectifiers served by a particular ac circuit breaker does not exceed 80% of that breakers rating. Measure the ac line voltage and then use the following table to determine appropriate ac cable and breaker sizes.

AC Cord	Area of Usage	Temperature Rating	Wire Size	Input Plug	Rectifier Information			Min AC Circuit Breaker
					Type	Max Output Current per Rectifier	AC Voltage	
848545174	North America	105°C	14 AWG	None	1 ES760A	12A	120V or 200-240V	15A
					1 ES761A	18A		
848545166	North America	105°C	14 AWG	NEMA 5-15P	1 ES760A	12A	200-240V	
					1 ES761A	18A		
848671681	North America	105°C	10 AWG	None	2 ES760A	12A	120V	
					2 ES761A	18A	200-240V	
848671699	North America	105°C	10 AWG	None	3 ES760A	12A	20A	
					3 ES761A	26A	15A	
848713376 (ES701C Shelf Only)	North America	105°C	12AWG	None	2 ES760A	12A	30A	
					2 ES761A	26A	20A	
848545182	Japan	105°C	2.0 mm ²	J15 8003	2 ES760A	12A	200-240V	
					2 ES761A	26A	200-240V	
848545208	Europe	70°C	1.0 mm ²	IEC 884/CEE 7/7	1 ES760A	12A	120V	
					1 ES761A	26A	200-240V	
848545224	United Kingdom	70°C	1.0 mm ²	BS1363 w/ 13A Fuse	1 ES760A	12A	200-240V	
					1 ES761A	26A	200-240V	
848545323	Australia	70°C	1.0 mm ²	AS3112	1 ES760A	12A	200-240V	
					1 ES761A	26A	200-240V	
848545240	Argentina	70°C	1.0 mm ²	IRSM 2073:1982	1 ES760A	12A	200-240V	
					1 ES761A	26A	200-240V	
848545190	China	70°C	1.0 mm ²	GB2099-1:1996	1 ES760A	12A	200-240V	
					1 ES761A	26A	200-240V	
848545216	Italy	70°C	1.0 mm ²	CEI123-16/VII	1 ES760A	12A	200-240V	
					1 ES761A	26A	200-240V	

**Thermal
Compensation**

Thermal Compensation

For thermal compensation, the ES773A Voltage/Thermal probe (VT-Probe) and its associated cables must be ordered. Refer to Section 5 for details on their interconnection, and Section 9 for more information on VT-Probes.

Item	Comcode
ES773A VT-Probe	108964305
10 ft. (3m) Aux Box to Initial Probe Cable	848652939
5 ft. (1.5m) cable for additional probes	848657391

Weatherized Thermal Compensation

If battery compartment is to be used in an outdoor cabinet with the battery compartment ventilated to the external environment, the Weatherized VT-Probe should be used. Refer to Section 5 for details on their interconnection and Section 9 for more information on VT-Probes.

Item	Comcode
ES773B Weatherized VT-Probe Assembly	848680971

If multiple VT-Probes is required in a weatherized application, the Weatherized VT-Probe Kit should be ordered. The kit contains the Weatherized VT-Probe assembly and a 3-position RJ-45 terminal block for daisy chaining multiple Weatherized VT-Probe assemblies.

When determining the number of kits to order, note the number of battery strings to be monitored and order the same number of kits, less one. For the last string, order the 848680971 Weatherized VT-Probe assembly.

Item	Comcode
Weatherized VT-Probe Kit for multiple battery strings	848680989

Individual parts within the Kit may be ordered as replacement or spares.

Item	Comcode
3-Position RJ-45 Terminal Block	403756349

Thermal Compensation/Voltage Monitoring

When voltage monitoring for battery string voltage imbalance detection is to be implemented in addition to thermal compensation, the VT-probe and its associated cables must be ordered. Refer to Section 5 for details on their interconnection, and Section 9 for more information on VT-Probes and voltage monitoring.

Item	Comcode
ES771A Voltage Monitoring Module	108958422
ES773A VT-Probe	108964305
10 ft. (3m) Aux Box to ES771A Cable	848652947
5 ft. (1.5m) cable for additional probes	848657391
10 ft. (3m) cable for additional probes	848657383
10 ft. (3m) Voltage Monitoring Cable	848652954

Weatherized Thermal Compensation/Voltage Monitoring

Note the number of battery strings to be monitored and order the same number of Weatherized Thermal Probe kits, less one. For the last string, order the 848680971 ES773A Weatherized VT-Probe assembly.

The ES771A remote voltage-monitoring module can monitor up to three strings of batteries. Note the number of battery strings to monitor and order an appropriate number of ES771A modules. Also, order an Aux Box to ES771A Cable. If additional ES771A modules are required, order the 1.5 ft RJ-45 Interconnect Cable to interconnect ES771As. Refer to Section 5 for details on their interconnection and Section 9 for more information on VT-Probes.

***Remote
Distribution
Monitor Module***

The Remote Distribution Monitor Module allows the Yukon system controller to monitor for open circuit breakers and fuses, monitor current through a battery shunt, and monitor/control low-voltage disconnect contactors at an external distribution panel that is bulk-fed from the Yukon system. See Section 11 for more details.

Description	Comcode
ES772A	108963273

Multiple Shelves

A supplementary shelf may be added to the primary shelf to create a larger plant. Only one shelf need have the controller, the primary shelf. A shelf may be converted into a supplementary shelf with the 2 shelf kit. The kit consists of signaling and dc power cables, a shelf liner, a small Aux Box Filler, and conversion instructions. See Section 5, Multiple Shelves for more details.

Description	Comcode
2 Shelf Kit	108976002

The following parts may be ordered as replacement parts for the 108976002 two-shelf kit.

Part/Description	Comcode
Intershelf Communication Cable	848658548
Intershelf Power Cable Set	848682035
Shelf Liner	848643011
Small Aux Box Filler	108976044

4 *Safety*

Safety Statements

Please read and follow all safety instructions and warnings before installing, maintaining, or repairing the Yukon Power System:

- The CE Mark demonstrates compliance with the European Union Council Directives for Low Voltage and EMC.
- The Yukon platform is Underwriters Laboratories (UL) Listed per Subject Letter 1801, DC Power Distribution Centers for Telecommunications Equipment.
- Yukon shelves equipped with ES712A ringers have hazardous secondary voltages on the secondary bus output connectors.
- Install only in restricted access areas (dedicated equipment rooms, equipment closets, or the like) in accordance with articles 110-16, 110-17, and 110-18 of the U.S. National Electric Code (NEC), ANSI/NFPA No. 70, and pursuant to applicable local codes.
- This equipment is to be used in controlled environments (an area where the humidity is maintained at levels that cannot cause condensation on the equipment, the contaminating dust is controlled, and the steady-state ambient temperature is within the range specified).
- This equipment has been evaluated for continuous use in ambient temperature of up to 50°C, and up to 75°C with 100 lfm (minimum) forced air cooling when used with the ES760A rectifier.
- This equipment has been evaluated for continuous use in ambient temperature of up 75°C with 250 lfm (minimum) forced air cooling when used with the ES761A rectifier.
- This equipment must not be installed over combustible surfaces.

Safety Statements (continued)

- For installations in the United States, Listed compression connectors are to be used to terminate Listed field-wired conductors where required. For all installations, the appropriate connector is to be applied only to the correct size conductor as specified by the connector manufacturer, using only the connector manufacturer's recommended tooling or tooling approved for that connector.
- If the proper connector for the country of installation is not provided, obtain appropriate connectors and follow manufacturer's and all local requirements for proper connections. All national and local rules and regulations should be followed when making field connections.
- A bulk output option is provided; load connections should be made in close proximity to the power shelf.
- The main output voltage (48V) meets SELV requirements.
- Insulation on field-wired conductors should be rated no less than 90° Celsius. Wire conductor size should be sized per electrical codes for 90° Celsius wire, and based on the ampacity of the associated protection device. Wiring internal to enclosed equipment cabinets should be rated at 105° Celsius (minimum).
- Torque electrical connections to the values specified on labels or in the product documentation.
- Battery input cables must be dressed to avoid damage to the conductors (caused by routing around sharp edges or routing in areas where wires could get pinched) and undue stress on the connectors.
- Alarm contacts on the office alarm connector (J10) are not fused within the distribution panel; therefore, current limiting protection for these contacts must be provided by external circuits. Maximum ratings for alarm connections are 60Vdc and 0.5 amperes. Exceeding these maximum ratings could result in fire or damage to the unit.
- Fuse and/or circuit breaker loads must **not** exceed 80% of the fuse and/or circuit breaker current rating. Distribute loads across the panel.

Safety Statements (continued)

- Refer to Appendix D for circuit breaker derating information.
- The short circuit current capability of the battery input to the distribution panel must not exceed 10,000A.
- AC branch circuits to this equipment must be protected with either fuses or circuit breakers sized as required by the National Electric Code (NEC) and/or local codes. The maximum size of the over-current protector is recommended to be no more than 30A. Refer to the equipment ratings to assure rating of equipment will not exceed 80% of the value of the protector chosen.
- An accessible ac disconnect/protection device to remove ac power from the equipment in the event of an emergency must be provided.
- High leakage currents are possible. Earth ground connection is essential before connecting the ac source to the shelf.
- In enclosed equipment cabinets, the Yukon mounting framework must be connected directly to the cabinet ac service ground bus. For applications in huts, vaults, and central offices, the Yukon mounting framework must be connected to the system integrated ground grid.
- Installing fuses or circuit breakers not specified for use in these distribution modules may result in injury to service personnel or equipment damage. Use only replacement parts listed in this manual and on the equipment drawings.
- The telecom-type (e.g., GMT type) fuses can produce sparks during interruption or clearing of a fault on a high energy circuit. Use only fuses provided with safety caps for this type of circuit. Installing telecom-type fuses not equipped with safety caps may result in injury to service personnel.
- While installing batteries, follow all safety precautions outlined in the appropriate battery product manuals.

Warning Statements 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 Indicates 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.



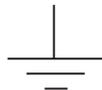
One of these two symbols (or equivalent) may be used to identify the presence of rectifier and battery voltages. The symbol may sometimes be accompanied by some type of statement, for example: “Battery voltage present. Risk of injury due to high current. Avoid contacting conductors with uninsulated metal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

- This unit must be installed, serviced, and operated only by skilled and qualified personnel who have the necessary knowledge and practical experience with electrical equipment and who understand the hazards that can arise when working on this type of equipment.
- The equipment could be powered by multiple ac inputs. Ensure that the appropriate circuit protection device for each ac input being serviced is disconnected before servicing the equipment.
- 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.
- Hazardous energy and voltages are present in the unit and on the interface cables that can shock or cause serious injury. Follow all safety warnings and practices when servicing this equipment. When equipped with ringer modules, hazardous voltages will be present on the ringer output connectors.
- In addition to proper job training and safety procedures, the following are some basic precautions that should always be used:
 - Use **only** properly insulated tools.
 - Remove all metallic objects (key chains, glasses, rings, watches, or other jewelry).
 - Wear safety glasses. Fuses can produce sparks. High energy levels on buses and distribution components can produce severe arcing.
 - Test circuits before touching.
 - Lock out and tag circuit breakers/fuses when possible to prevent accidental turn on.
 - Be aware of potential hazards before servicing equipment.
 - Identify exposed hazardous electrical potentials on connectors, wiring, etc. (note the condition of these circuits, especially wiring).
 - Use care when removing or replacing covers; avoid contacting circuits.

Special Installation Notes

German

Installationsanleitung (Installation Instructions)

- Eingangsspannung (Voltage):
3 x 120/200 – 240V (ES700A, ES700B)
4 x 120/200 – 240V (ES701A, ES701B)
2 x 120/200 – 240V (ES701C)
- Eingangsstrom (Current):
7/4A - ES760A
6.6/9.6A - ES761A
- Nennfrequenz (Frequency):
50/60Hz
- Abmessungen sind nur zur referenz:
(Dimensions are for reference only)
465mm x 278mm (ES700A und ES700B)
567mm x 278mm (ES701A, ES701B und ES701C)
- Max. Umgebungstemperatur:
(Max. operation temperature)
50°C, 75°C 100 lfm (ES760A)
75°C 250 lfm (ES761A)
- Achtung: Für kontinuierlichen Feuerschutz sollte die Sicherung nur mit einer des gleichen Types ersetzt werden.
(Warning: For continued protection against fire replace with same type and rating of fuse)
- Das Schaltnetzteil ist ein Gerät der Schutzklasse I
(Power Supply is a Class I Equipment)
- Ausgangsspannungen und -strome
(Output Voltage and Current)

	Ausgangsspannungen	und -strome
ES700A, ES700B	-48-56V	5600W
ES701A, ES701B	-48-56V	7000W

- Das Gerät darf nur in Räumen mit beschränktem Zutritt aufgestellt werden.
(Nur ausgebildetes Personal) (Restricted access)
- Das Gerät hat kein Brandschutzgehäuse es darf daher nur auf nicht brennbaren Untergrund aufgestellt werden. (Beton, Metall usw.)
(No fire enclosure, non-combustible floor)
- Modellnummer ES700A, ES701A, ES700B und ES701B: Beim Aufstellen des Gerätes ist darauf zu achten das alle Anforderungen gemäß EN60950 eingehalten werden.
(Evaluated to EN60950)

Special Installation Notes, continued

Spanish

Notas especiales para instalaciones en países de habla hispana

Instrucciones de instalación (Installation Instructions)

- Voltaje (Voltage):
Vea tabla 2-A
- Corriente (Current):
Vea tabla 2-A
- Frecuencia (Frequency):
50/60Hz
- Voltaje y corriente de salida (Output Voltage and Current):
Vea tabla 2-A
- Temperatura máxima de operación (Maximum Operation Temperature):
75°C (167°F)
- Sin cabina contra incendios, suelo no combustible
(No fire enclosure, non-combustible floor)
- Evaluado en EN60950
(Evaluated to EN60950)

5 ***Installation and Testing***

Preparation

This section outlines the sequence for installing the Yukon shelf and plug-in modules and provides a test procedure for verifying the integrity of the installation.

Safety

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

Installation Tools

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

- Wire cutters and strippers
- Heat shrink gun
- Torque wrench (0-70 in·lbs or 0-7.9N·m)
- 5/16 inch (8mm) hex driver
- 48V test load
- Digital meter with an accuracy of $\pm 0.02\%$
- Screw drivers (flat-blade and Phillips)
- ESD wrist strap
- IBM compatible PC with isolated RS-232 port or IBM compatible notebook PC to change factory set parameters if necessary
or
Palm PDA, Palm serial cable, and a null-modem connector

Preparation (continued)

Wiring Guidelines

- All electrical connections should be made using the proper crimping tools and dies and should be torqued to values specified.
- All building wiring should comply with the NEC and other applicable local codes. The temperature rating of the wire must be no less than 90° Celsius and may be sized using the 90° Celsius ampacity table in the NEC handbook. Wiring internal to enclosed equipment cabinets must be rated no less than 105° Celsius.

DANGER

Only qualified personnel should install and service the Yukon shelf and plug-in modules. Hazardous energy and voltages are present in the unit and on the interface cables and will shock or cause serious injury or death if safety precautions are ignored. Follow all safety warnings and practices when servicing this equipment.

Torque Specifications

Securing hardware is provided with many Yukon assemblies. When installing, tighten all connections per Table 5-A.

Table 5-A: Hardware Torque Specifications

Hardware	Torque	
	N·m	in·lbs
Metric M5	4	35
12-24	4	35

Installation Sequence

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

The Yukon plant consists of a 19-inch shelf or a 23-inch shelf in which rectifiers, a controller, an optional ring generator, and the low-voltage disconnect (LVD) boards are installed. Furthermore, output distribution options are provided in the Auxiliary Box (Aux Box). Refer to Figures 2-2 and 2-4 for relationship of components.

All components of the Yukon system are shipped in their own packaging, including shelf, rectifies, controller, ringer, LVD board, voltage monitor module, and Aux Box. All other items, such as ac cables, probe cables, probes, and lugs, will be shipped together in another package.

Preparation (continued)

CAUTION

When handling the modules, you must be properly grounded in order to prevent ESD damage to the unit(s). Put on ESD protection, such as a wrist strap, prior to handling the modules.

Note that rear access is required to install the Yukon system components.

When installing the Yukon in the end-use application, the following sequence is recommended:

- Shelf AC Cable Connection
- Shelf mounting
- Installing Aux Box
- Installing controller
- Installing LVD Board
- Installing Ringer
- Installing rectifiers
- Installing batteries
- CO Grounding
- Load Connections
- Connecting to ac utility
- Initializing system

Note: All packages should be opened with a box cutter with the blade minimally exposed so that only the sealing tape is cut. Save all packaging material until the system has been powered up and all parts are operating within specifications. The shipping package may be used to return defective parts.

Whenever possible, please recycle all packaging and packaging materials.

Installation

All shelves are provided with a spacer bar as shown in Figure 5-1. This bar is not to be removed until the shelf is mounted to its rail. Once the shelf has been mounted, the shelf spacer bar may be removed and discarded.

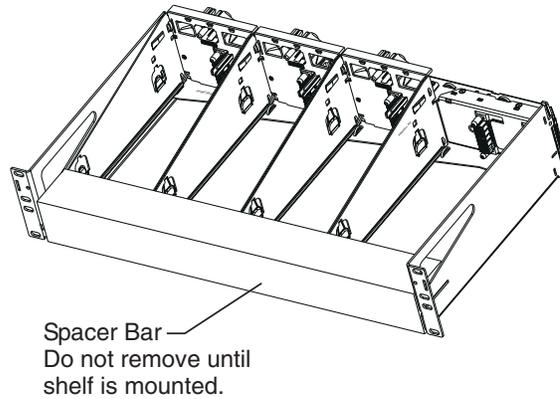


Figure 5-1: Shelf with Spacer Bar

**AC Cord
Connection to
Shelf**

Note: This section covers all shelves except for the ES701C. AC cord connection for the ES701C will be done after shelf mounting.

The ac cords should be connected to the Yukon shelf prior to the shelf being mounted onto the mounting rails. However, connecting to the ac utility service should not be done until the end of the installation.

Various ac cable assemblies are provided and are terminated in a right-angled IEC-320 plug on the Yukon end. Some of these assemblies have un-terminated leads on the utility end, while others have a plug that is suitable for a particular region. Cables with un-terminated leads are designed to allow users to affix a suitable plug for their particular region.

Yukon shelf rectifier slots are provided with liners that accept the IEC-320 right-angled plugs on the ac cable assemblies. See Figure 5-2. The liners are provided with a retainer that prevents the plug from coming out. Orient the plug and route the cables such that the ground pin is on top, and push the plug in all the way. The retainer should grab the plug and keep it in place. For added security, tie-wraps may be used to secure the plug to the receptacle.

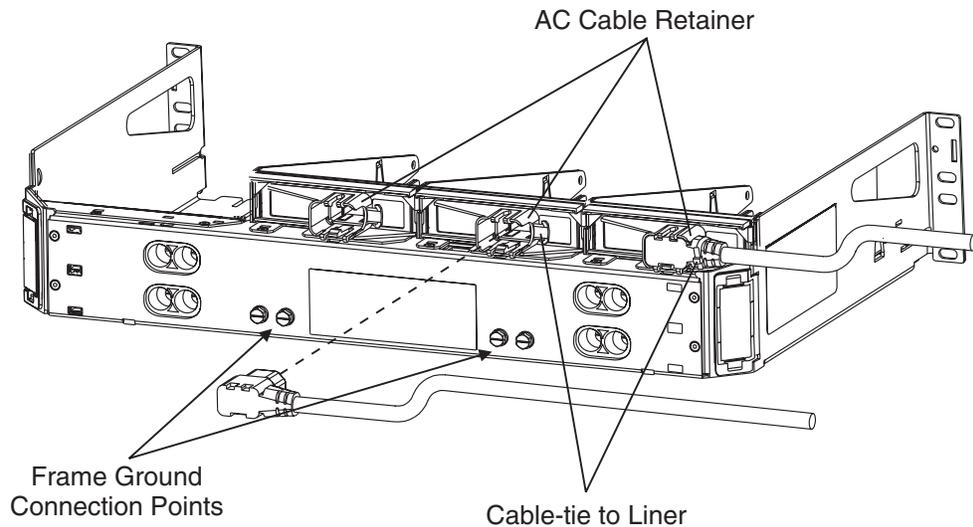


Figure 5-2: Installing AC Cables

Shelf Mounting

A package of 12-24 screws should have been supplied within the shelf container. These screws will be required during the shelf and Aux Box installation procedure.

ES700A and ES701A

Flush Mounting

The ES700A shelf mounts in 19-inch rail widths while the ES701A shelf mounts in 23-inch rail widths. Affix the chosen shelf to the mounting rail using the screws provided with the system. Screws are required in all mounting holes.

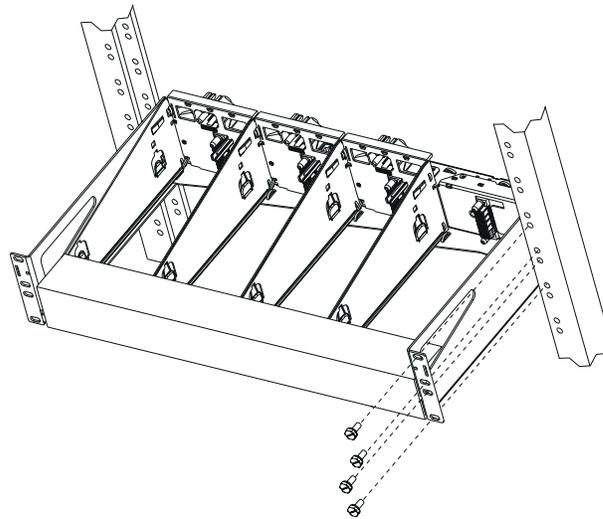


Figure 5-3: Flush Mounting the Shelf

Other Mounting Procedures

ETSI and mid-mount applications require the use of adapters between the shelf and the frame rails. The adapters must be affixed to the mounting rails prior to mounting the shelf to the adapters.

ETSI Mounting

If the ES700A shelf is being mounted on ETSI rails, the ETSI mounting adapters must be used. The 848657425, ETSI mounting kit contains brackets and screws that allows the shelf to be affixed to ETSI rail widths. The wider flange is to be mounted to the rails with the smaller flange bend facing outwards.

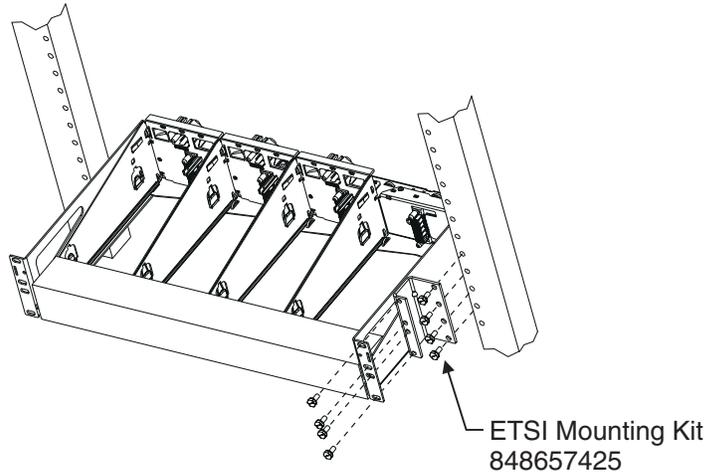


Figure 5-4: ETSI Mounting

Mid-Shelf Mounting

If the shelves are to be mid-mounted, the mid-mount adapters must be used. The 848652426, mid-mount kit contains brackets and screws that allow the shelves to be used in mid-mount applications. Note that the brackets are to be mounted with the wider screw openings to the rails and the shelf bracket-bend facing outwards.

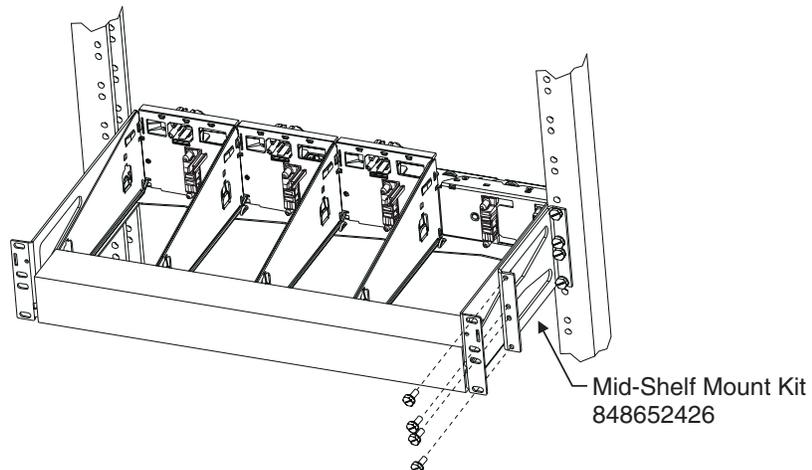


Figure 5-5: Mid-Shelf Mounting

19-inch to 23-inch Mid-Shelf Mounting

If the ES700A (19-inch) shelf is to be mounted into a 23-inch application, the 19-inch to 23-inch adapters must be used. The 848652848 Mid-mount kit contains brackets and screws that allow the shelf to be used in 23-inch mid-mount applications.

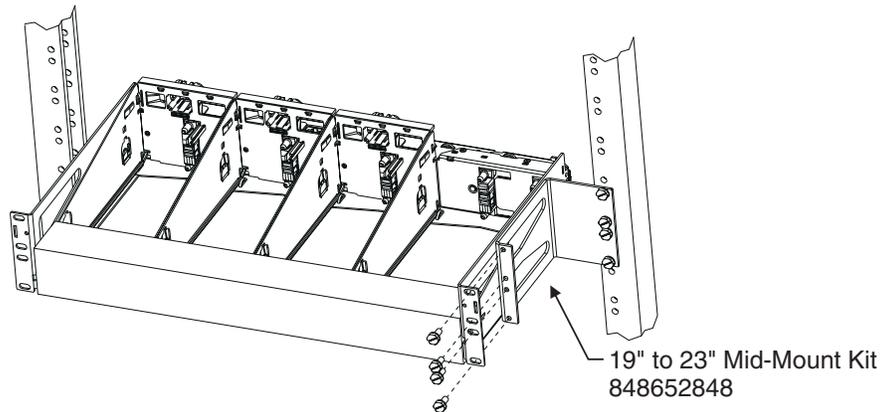


Figure 5-6: 19-inch to 23-inch Mid-Shelf Mounting

Secure the adapters to the mounting rails using the screws provided. Affix the shelf to the brackets using the screws provided with the system. Screws are required in all mounting holes.

19-inch to 23-inch Flush-Shelf Mounting

If the ES700A shelf is to be mounted into a 23-inch flush-mount application, the 19-inch to 23-inch flush-mount adapters are to be used. The 848683009 Flush-mount kit contains brackets and screws that allow the shelf to be used in 23-inch flush-mount applications.

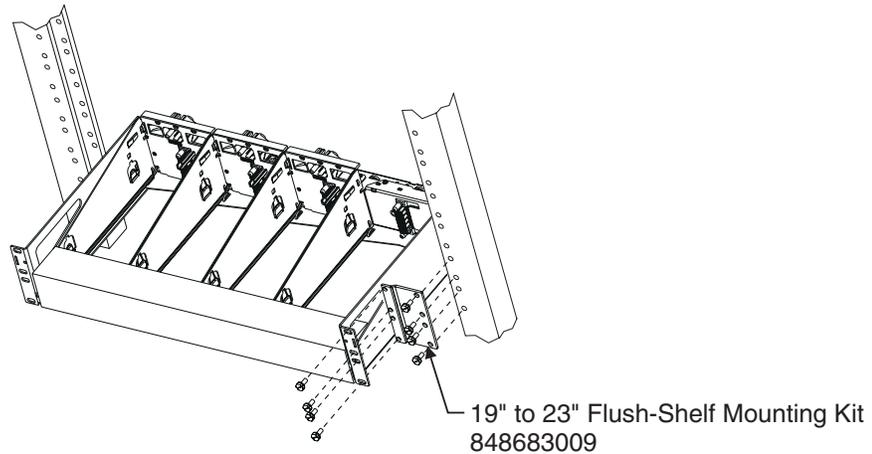


Figure 5-7: 19-inch to 23-inch Flush-Shelf Mounting

Secure the adapters to the mounting rails using the screws provided. Affix the shelf to the brackets using the screws provided with the system. Screws are required in all mounting holes.

ES700B and ES701B

Mid Mounting

The ES700B shelf mounts in 19-inch rail widths while the ES701B shelf mounts in 23-inch rail widths. Both shelves have the mounting flange located approximately 5.5 inches (140 mm) behind the front of the shelf. Affix the chosen shelf to the mounting rail using the screws provided with the system.

ES701C

The ES701C shelf is similar to the ES701B in that it is a 23-inch mid-mount shelf. It also has an added assembly, which allows for ac cord connections from the front. Only the 848713376 ac cord assembly is used with this shelf.

The shelf has two sockets for two ac cords, one cord powers slots 1 and 3 while the other cord powers slots 2 and 4. This shelf may be used in nominal 120/200-240Vac when used with the ES760A rectifier and for 200-240Vac when used with the ES761A rectifier.

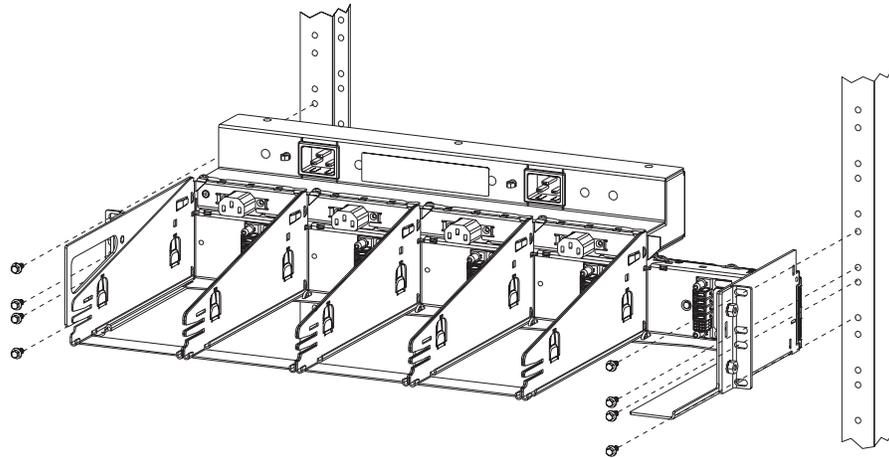


Figure 5-8: ES701C Mid-Shelf Mounting

Other Mounting Procedures

19-inch to 23-inch Flush-Shelf Mounting

If the ES700B shelf is to be mounted into a 23-inch mid-mount application, the 19-inch to 23-inch flush-mount adapters are to be used. The 848683009 Flush-mount kit contains brackets and screws that allow the shelf to be used in 23-inch flush-mount applications.

Secure the adapters to the mounting rails using the screws provided. Affix the shelf to the brackets using the screws provided with the system. Screws are required in all mounting holes.

ETSI Battery Breaker Bracket Kit

The ES700B shelf may be used in ETSI rail width applications where external battery circuit breakers are required. The 108975236 ETSI Battery Breaker Bracket kit is provided with a small bracket, which is mounted onto the left rail and a right bracket assembly consisting of two 60A breakers for external disconnection of battery strings and cables to connect to the Aux Box in the shelf.

1. Remove the mid-mount brackets that are attached to the shelf by unscrewing the two nuts on each bracket using a 5/16-in hex driver. See Figure 5-9. Save the hardware as it will be needed to attach the adapter brackets.

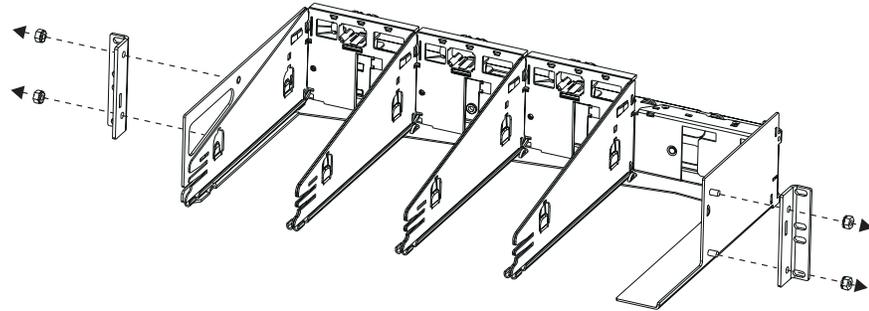


Figure 5-9: Mid-Mount Bracket Removal

2. Mount the smaller bracket to the left side of the shelf using the saved hardware. Then attach the battery breaker bracket assembly adapter bracket to the right side of the shelf using the saved hardware. See Figure 5-10. Ensure battery breakers are in the OFF position.

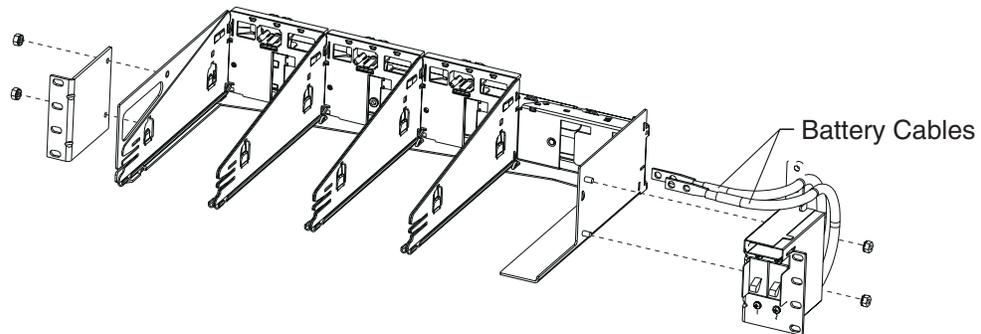


Figure 5-10: Battery Breaker Assembly Installation

3. Secure the shelf to the mounting rails using the screws provided. Screws are required in all mounting holes.
4. Mount the front-access Aux Box to the shelf, as described for the ES713A and ES713B Aux Boxes in the Aux Box mounting procedure that follows.
5. Note the two cables on the breaker bracket assembly marked Batt 1 (colored black) and Batt 2 (colored gray). Connect lugs of the

appropriate cables to the Batt 1 (-) and Batt 2 (-) terminals on the Aux Box and secure using M5 hardware provided.

6. Terminate V(-) cables from battery strings with M5 double-hole lugs on 5/8 in centers. Terminate leads on battery breaker assembly and secure using hardware provided.
7. Note the two lighter gauge wires on the breaker bracket assembly. These wires are to be terminated on the LVD Board. Follow instructions given in the LVD Board Installation procedure.
8. Inspect overall cable routing. Use tie-wraps to secure cables and prevent them from interfering.

19-inch to 23-inch Battery Breaker Bracket Kit

The ES700B shelf may be used in 23-inch rail width applications where external battery circuit breakers are required. The 108975228 19-inch to 23-inch Battery Breaker Bracket kit is provided with a small bracket, which is mounted onto the left rail and a right bracket assembly consisting of two 60A breakers for external disconnection of battery strings and cables to connect to the Aux Box in the shelf.

1. Mount the battery breaker bracket to the shelf's right mounting flange using the screws provided. See Figure 5-11. The bracket on the left side may be used as is. Ensure battery breakers are in the OFF position.

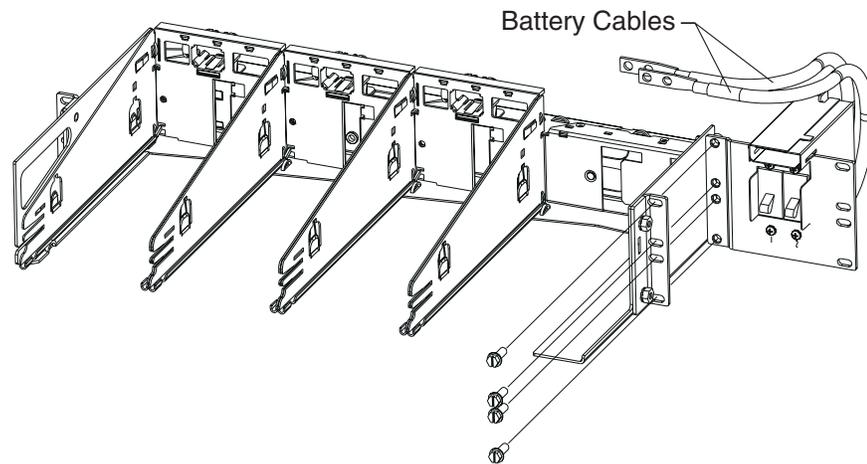


Figure 5-11: Battery Breaker Assembly Installation

2. Secure the shelf to the mounting rails using the screws provided. Screws are required in all mounting holes.
3. Mount the front-access Aux Box to the shelf, as described for the ES713A and ES713B Aux Boxes in the Aux Box mounting procedure that follows.
4. Note the two cables on the breaker bracket assembly marked Batt 1 (colored black) and Batt 2 (colored gray). Connect lugs of the appropriate cables to the Batt 1 (-) and Batt 2 (-) terminals on the Aux Box and secure using M5 hardware provided.
5. Terminate V(-) cables from battery strings with M5 double-hole lugs on 5/8 in centers. Terminate leads on battery breaker assembly and secure using hardware provided.

6. Note the two lighter gauge wires on the breaker bracket assembly. These wires are to be terminated on the LVD Board. Follow instructions given in the LVD Board Installation procedure.
7. Inspect overall cable routing. Use tie-wraps to secure cables and prevent them from interfering.

Supplementary Shelf

When requiring additional rectifiers for additional power, a supplementary shelf may be added to the system. However, see Section 8, LVD Boards for power limitations based on the LVD Board being used in the Aux Box.

When a supplementary shelf is required, the same shelf as used for the primary shelf and the 108976002 kit must be ordered. The kit is used to convert a shelf into a supplementary shelf and contains a signaling wireset, shelf to shelf dc power cables, a shelf liner and Small Aux Box filler.

The signaling wireset allows the system controller in the primary shelf to monitor and control the rectifiers in the supplementary shelves. The shelf-to-shelf power cables parallel the supplementary shelves to the primary shelf. The shelf liner is used to convert the slot allocated to the 5.5-inch Aux Box into a rectifier slot and a slot for the Aux Box filler. The Aux Box filler is required to be used as it takes up the 1.5 inches of space that is not used by a rectifier as well as providing the right-hand rectifier guide.

The following steps show how to convert a shelf into a supplementary, to mount it and connect it to the primary shelf.

1. One shelf in a two-shelf system must be converted into a supplementary shelf. Insert shelf liner to shelf as shown in Figure 5-12. If required, insert ac cord to new rectifier slot per instructions found in Installation: AC Cord Connection to Shelf.

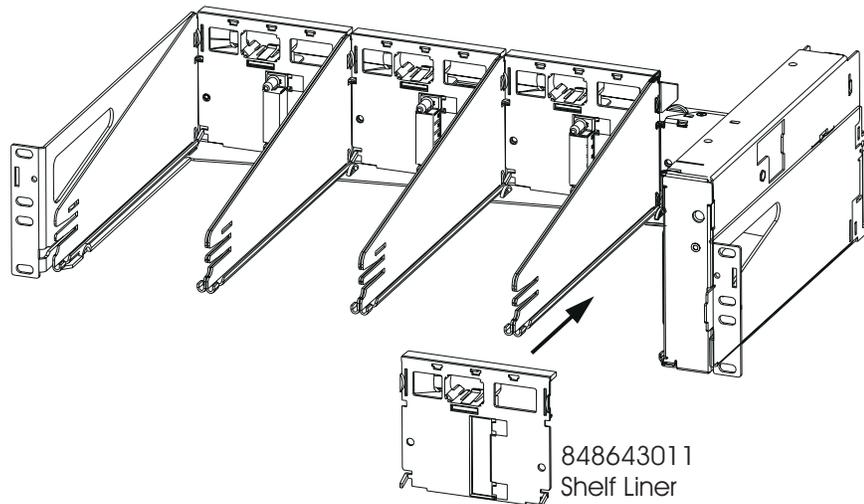


Figure 5-12: Installing the Shelf Liner

2. Inside the Aux Box filler should be a plastic bag containing a retention bracket and 12-24 securing hardware. Remove this package from the Aux Box filler and retain for later use. Gently place the Aux Box filler on the rightmost part of the supplementary shelf and slide it to the rear until the Aux Box rear connector mates with the receptacle on the shelf.

Note the two Retention Tabs on the Aux Box shown in Figure 5-13. The ES700A and the ES701A shelves will use the flush mount tabs while the ES700B and the ES701B shelves will use the mid-mount tabs. Secure the Aux Box to the shelf by placing the retention bracket through the required tab as shown in Figure 5-13 and placing the 12-24 screws provided through the tab.

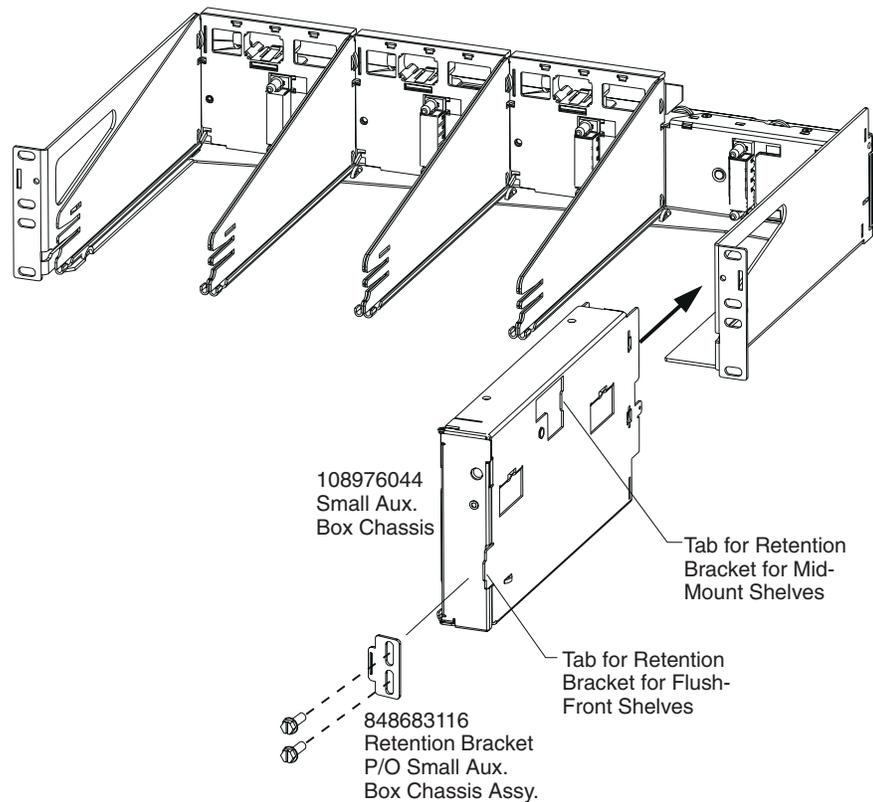


Figure 5-13: Securing the Aux Box with the Retention Bracket

3. Next, the signaling wireset and dc power cables are to be connected from the primary shelf to the supplementary shelf. Take the signal cable (848658548) and connect it to the Shelf Paralleling Signal Connector on the rear of both shelves.
4. Note the break-away tabs on rear sides of the shelves, determine which side is best to interconnect the primary shelf to the supplementary shelf and remove the tabs on both shelves on that side. This will provide access to the lugs for the power connections.
5. Take the positive and negative dc cables and connect them to the appropriate lugs of the primary and supplementary shelves and secure with the 12-24 screws provided.
6. Mount both shelves as instructed in section titled Shelf Installation. Note that the primary and secondary shelves may require physical spacing from each other, refer to Appendices D and E for instructions on spacing and airflow.

Aux Boxes

All Aux Boxes slide into the right-most slot of the shelf. The manner in which they are secured to the shelf differs.

ES710A and ES710AD

When using the shelves for bulk output, i.e., without any of the fuse or breaker distribution modules, the basic shelf must be converted into a bulk-output shelf and the ES710A/AD controller-only Aux Box must be installed. The 108969841 kit contains the ES710A Aux Box and a 848643011 shelf liner. The 108983081 kit contains the ES710AD Aux Box and an 848643011 shelf liner.

The following steps show how to convert a shelf into a bulk-output shelf and to mount it.

1. Insert the shelf liner to the shelf as shown in Fig 5-12. If required, insert ac cord to new rectifier slot per instructions found in Installation: AC Cord Connection.
2. Inside the Aux Box packaging should be a plastic bag containing a retention bracket, remove this bag and retain for later use. Gently place the Aux Box on the rightmost part of the shelf and slide it to the rear until the Aux Box rear connector mates with the receptacle on the shelf.
3. Mount the shelf as instructed in section titled Shelf Installation. If using the ES700A or ES701A shelves, do not make screw connections to the middle slots of the right flange.
4. Note the two Retention Tabs on the Aux Box shown in Fig 5-13. The ES700A and the ES701A shelves will use the flush mount tabs while the ES700B and the ES701B shelves will use the mid-mount tabs. Secure the Aux Box to the shelf by placing the retention bracket through the required tab as shown in Figure 5-14 and placing the 12-24 screws provided through the tab.
5. Loosen the fastening screw on the faceplate using a flathead screwdriver and open the door. Install the system controller as described further in the System Controller installation section. Then close the door and tighten the fastening screw.

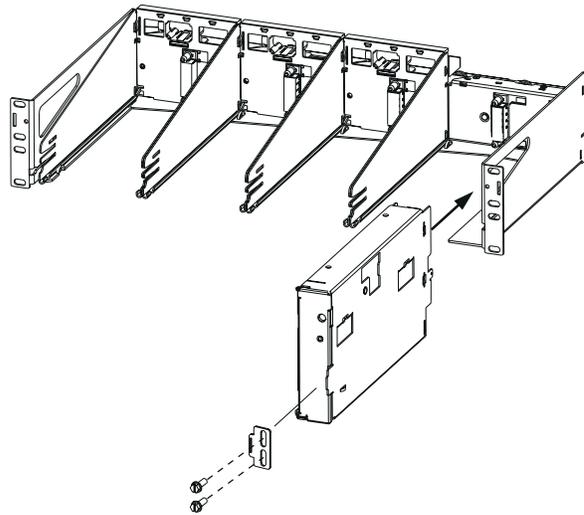


Figure 5-14: ES710A / ES710AD

**ES712A and
ES712B**

Gently place the Aux Box on the flange-rails and guide it to the rear until the Aux Box rear connector mates with the receptacle on the shelf. Secure the Aux Box to the shelf by placing screws through the tab on the right side.

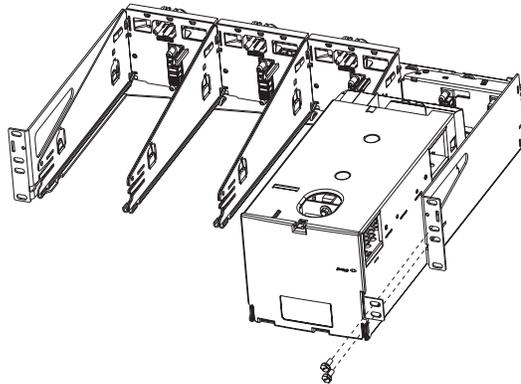


Figure 5-15: Aux Box Installation

**ES713A,
ES713AD,
ES713B,
ES713BD, and
ES714AD**

The ES713AD and ES713BD are identical to the ES713A and the ES713B, respectively, except that they are provided with a display option. The ES714AD is provided with the display option. The display board on the inside of the Aux Box door has a flex-cable that must be connected to the controller. This step is to be done at the end of the Aux Box installation process.

Inside the controller section of the Aux Box should be a plastic bag containing a retention bracket. Remove this package from the Aux Box and retain for later use. Gently place the Aux Box on the flange-rails and guide it to the rear until the Aux Box rear connector mates with the receptacle on the shelf. Note the slot on the Aux Box just in front of the shelf-mounting flange. Secure the Aux Box to the shelf by placing the retention bracket as shown in Figure 5-16 and placing screws through the tab.

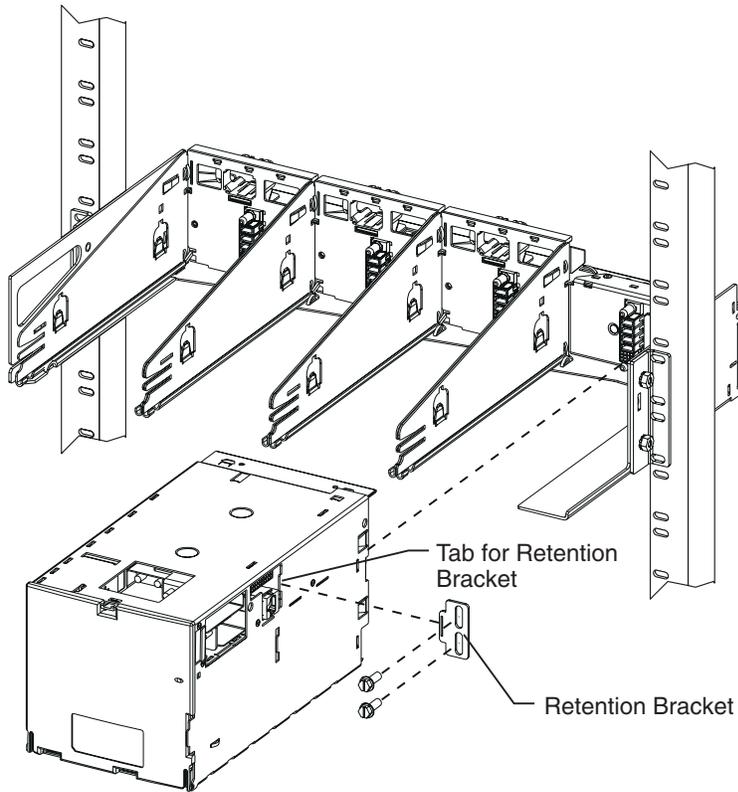


Figure 5-16: Mid-Mount Shelf Retention Bracket

If either the ETSI or 19-inch to 23-inch Battery Breaker Bracket assemblies are being used, terminate the two alarm leads from the bracket assembly to any two of the five pins marked "CB Alm Input", see Figure 5-27 for more details. Use tie-wraps to additionally secure these wires to the mounting rails, if necessary.

Faceplate Removal

The Aux Box faceplate must be removed to insert the system controller, LVD, and ringer boards. Open the faceplate by pressing the faceplate release tab at the top of the faceplate, and allowing the faceplate to swing down. To remove the faceplate, press on the thin side walls near the hinge of either side of the open faceplate until the hinge is free of the chassis receptacle and pull out.

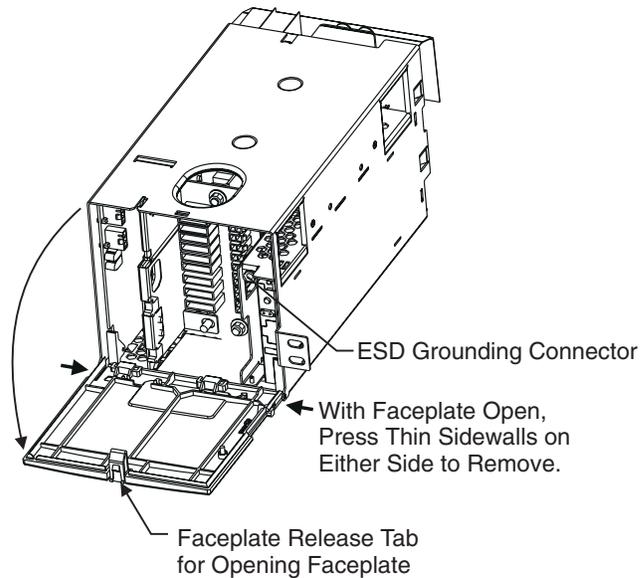


Figure 5-17: Aux Box Faceplate Removal

System Controller

The ES740AD controller is provided with a display option. It has a receptacle to which a flex-cable from the door of display Aux Boxes must be attached. This step should be performed at the very end.

ESD NOTE: You must properly protect yourself against ESD discharge prior to installing the following circuit cards. Connect wrist strap or similar device to the ESD Grounding Connector shown in Figure 5-17.

This section applies to all but the ES714AD Aux Box.

Controller Installation

The system controller slides into the right-most slot on the Aux Box. Gently insert the controller into the slot until it engages its mating receptacle in the shelf. Push against the ejector latch until the controller mates to the receptacle.

If installing into any of the display Aux Boxes (any Aux Box with a "D" suffix), the display board cable will have to be connected to the controller. Note the ZIF connector P5 on the controller (see Figure 6-1). Lift up the top of the ZIF connector and slide in the ribbon cable from the display board and push down on the connector to secure the cable.

Controller Removal

If removing the controller, use the ejector latch to disengage the controller card from its mating receptacle on the Aux Box. Handle the controller by holding it against the edges or by the insulator and guide it out.

If removing from any of the display Aux Boxes (any Aux Box with a "D" suffix), the display board cable will have to be removed prior to fully removing the controller. Slide the controller out about halfway. Note the ZIF connector P5 on the controller (see Figure 6-1). Lift up the top of the ZIF connector and pull out the ribbon cable from the connector. The controller may now be fully removed.

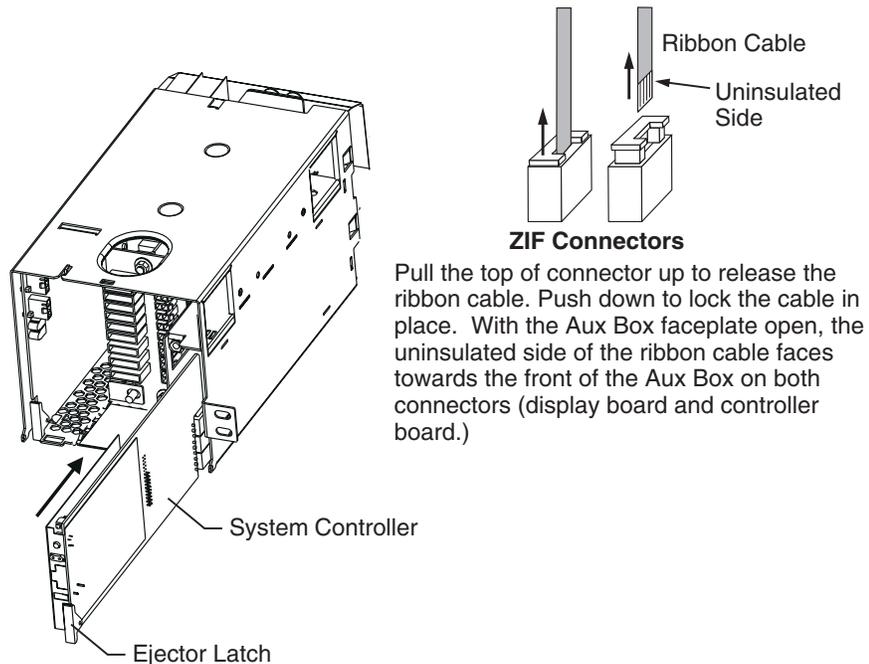


Figure 5-18: System Controller Installation/Removal

LVD Board Installation

ES714AD Aux Box Only

Installing the ES712_LVD_D LVD board into an ES714AD Aux Box requires the removal of the controller rider. Remove the screw shown in the diagram below and then remove the rider. Install the ES712_LVD_D board in the Aux Box as shown below.

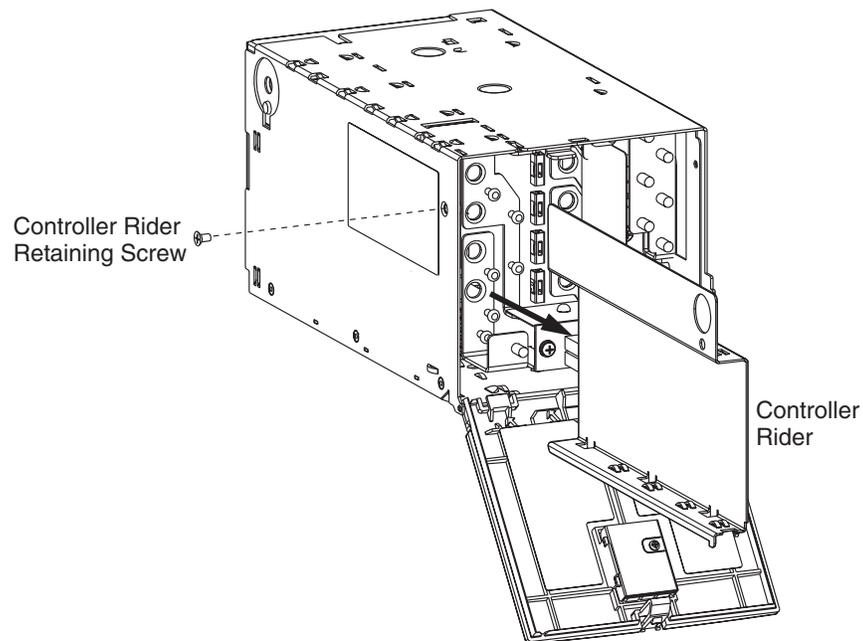


Figure 5-19: ES714AD Aux Box Controller Rider

1. Refer to Figure 5-20 to begin. Note the card guides on the leftmost slot of the Aux Box, insert LVD card until it is prevented from being inserted any further. A tab on the top-front of the LVD card will hit the chassis to prevent it from being inserted any further.

If Aux Boxes with fuse distribution are being used, connect the alarm sense lead from the fuse board on the Aux Box to one of the two pins marked FUSE ALM INPUT pins on the top-front of the LVD board. Make this connection prior to installing the shelf. This will allow the system controller to alarm for any fuse opening.

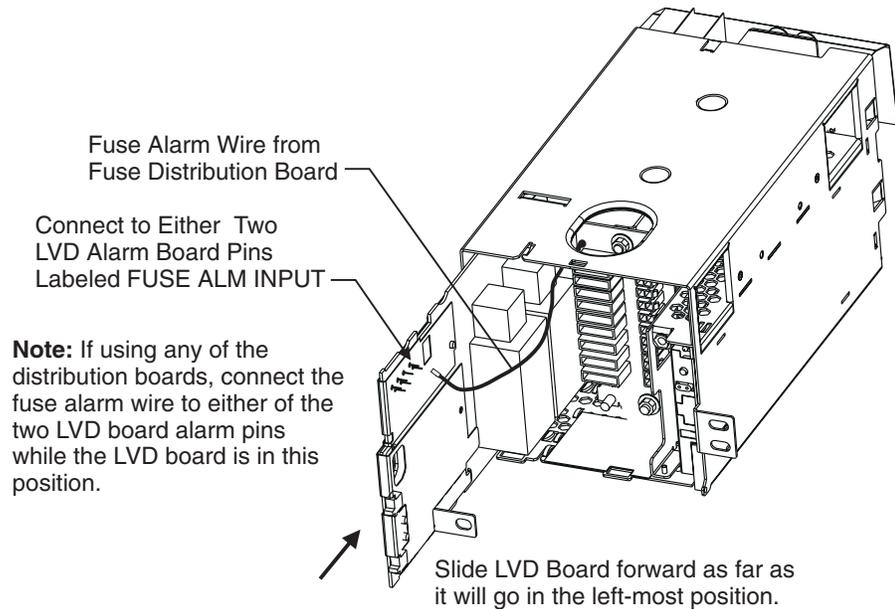


Figure 5-20: LVD Board Installation

2. Slide the card all the way to the right until the top-front tab lines up with the chassis slot and the mounting-tab on the card lines up with the mounting post on the Aux Box (Figure 5-21).

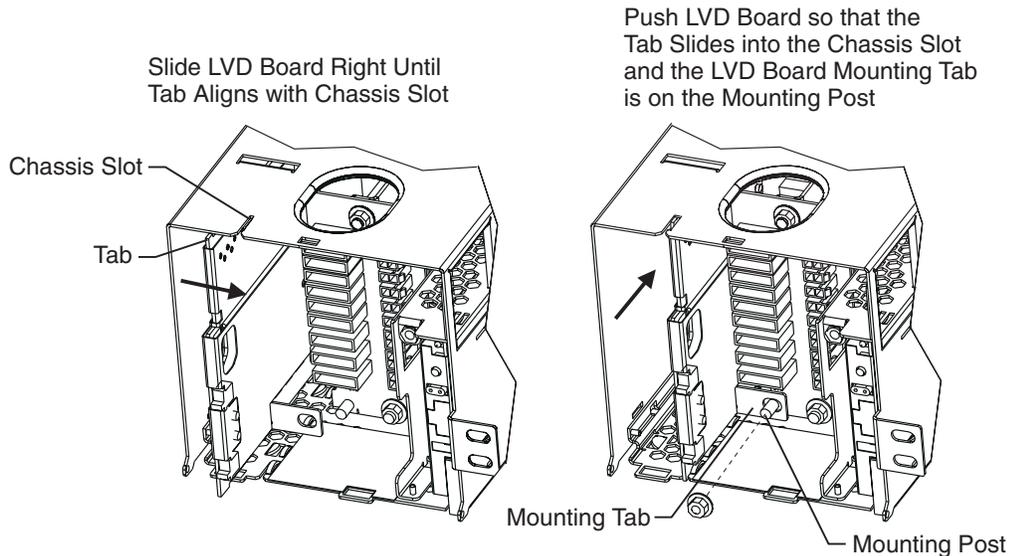


Figure 5-21: LVD Board Installation (continued)

3. Insert until it engages its mating receptacle in the shelf. Secure the Aux Box to the shelf using the nut provided.

4. If the ES712_LVD_A or ES712_LVD_D is being used, place the contactor disconnect switch(es) in the OFF position. They will be placed in the ON position when the installation procedure has been completed. Neither the ES712_LVD_B nor the ES712_LVD_C boards have disconnect switches.

LVD Board Removal

Replacing LVD Boards requires removing the ringing module, if one is being used.

CAUTION

Removing LVD board will require placing a nut-driver into contact with parts that are at the nominal -48V bus. Insulated tools are required to remove the LVD Boards.

If using the ES712B Aux Box, remove the circuit breaker alarm sense leads from the LVD board.

If using the ES714AD Aux Box, removal of the LVD board will require removing the adjacent rectifier to gain access to the space. Removing of the LVD board will result in dropping of loads connected through CB3, CB4, F3 or F4. To prevent this from happening, the Load Contactor Shorting Plug (ordered separately from Lineage Power, See Engineering and Ordering) is to be inserted into the slot as shown below. This will prevent the loads connected through the load contactor from being dropped when the LVD board is removed.

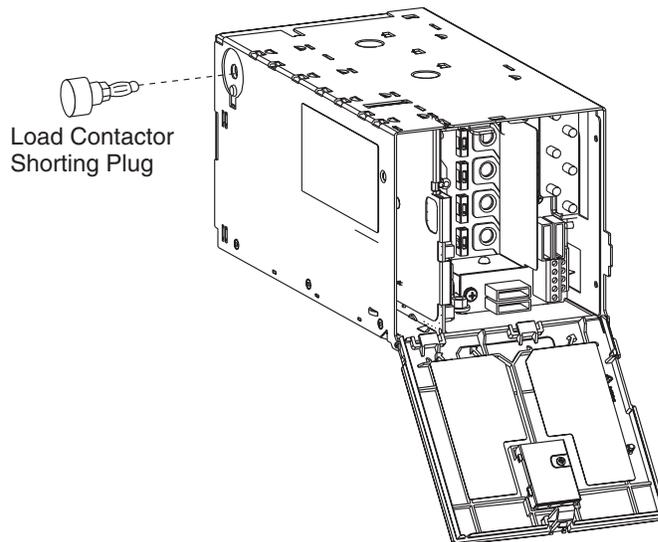


Figure 5-22: ES714AD Load Contactor Shorting Plug

Removing the LVD Board will require removing the controller and the controller rider. Remove the controller from the rider. Then remove the screw that secures the rider and pull it out. Then follow the instructions as noted below. Once the LVD board has been replaced, remove the plug, reattach the controller rider and insert the controller.

Using an insulated nut-driver, remove the nut that secures the LVD Board to the Aux Box. Pull out the board until the top tab clears the chassis slot and the mounting post clears the mounting-tab. Slide the Aux Box to the left. If using fuse distribution Aux Boxes or the ES714AD, pull the board out about halfway, remove the fuse alarm sense lead, and then pull out remaining way. For the ES712B Aux Box, the board may be removed once moved to the left.

ES714AD

Once the LVD board has been inserted, reinsert the controller rider and secure with the removed screw. Then install the controller as shown in System Controller.

Ringer

If a ringer card has been purchased, follow the installation instructions below. If no ringer is being used, skip this step and go to Faceplate Attachment.

Note: The ringer is not used with the ES714AD Aux Box.

Ringer Installation

Note that the ringer card must be installed after the LVD Board is installed. The ringer card slides into the left-most slot on the Aux Box. Gently insert the ringer card into the slot until it engages its mating receptacle in the shelf. Push against the ejector latch until the ringer card mates to the receptacle.

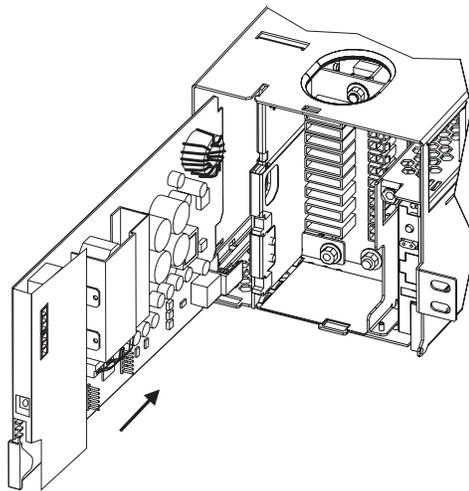


Figure 5-23: Ringer Installation

Ringer Removal

If removing the ringer card, use the ejector latch to disengage the ringer card from its mating receptacle on the Aux Box. Handle the ringer card by holding it against the edges or by the insulator and guide it out.

Faceplate Attachment

To replace the faceplate, press on the thin side walls near the hinge of either side of the open faceplate and insert inside of the chassis receptacle and release. The hinge should remain on the chassis.

If an Aux Box with the display option is being used with the ES740AD controller, connect the flex-cable from the Aux Box door to the ZIF connector P5 (see Figure 6-1) on the controller. Pull-up on the tab on the connector and place the flex-cable on the connector, then push down on the tab. The cable should be secured to the connector.

Rectifier

Rectifier Installation

Rectifiers are installed in the slots to the left of the Aux Box, and with the handle in the open position. Using a flat head screwdriver, insert screwdriver head in between the handle and the locking tab on the rectifier and press down on the screwdriver, this should disengage the handle from the locking tab.

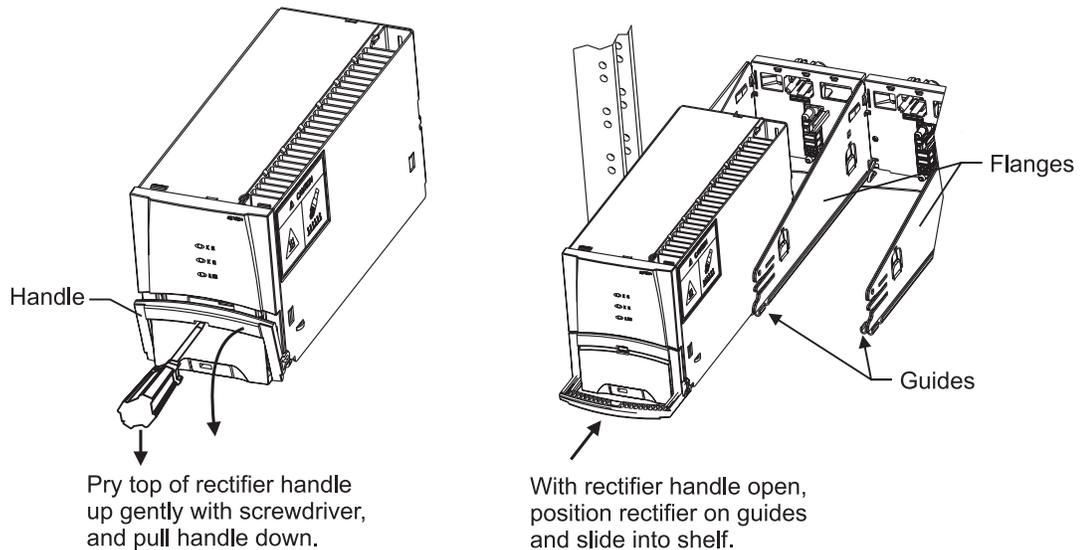


Figure 5-24: Rectifier Installation

Open the handle all the way down. Place the rectifier onto the guides on the lower portion of the flanges and slide to the rear until its connector engages its mating receptacle on the shelf, the handle should swing up somewhat. Push in the handle until it snaps shut. Repeat for all rectifiers being utilized.

If not using a full-complement of rectifiers, the rectifier slot-filler may be used. Insert and remove similar to the rectifiers.

Rectifier Removal

Removing a rectifier requires using the screwdriver to pry open the handle and swinging it down to the horizontal position. Gently pull on the handle until the rectifier slides out about half way. Handle the rectifier by holding it against the edges or by the handle and guide it out.

**Battery and Load
Return
Connections**

Preliminary Note

The following sections deal with battery and load cabling, and connection to the Yukon system. Individual cable routing needs vary. Figure 5-25 shows locations recommended for using cable-ties to tie-wrap and secure cables to the system.

M5 securing hardware is used for all lug connections on the Aux Box.

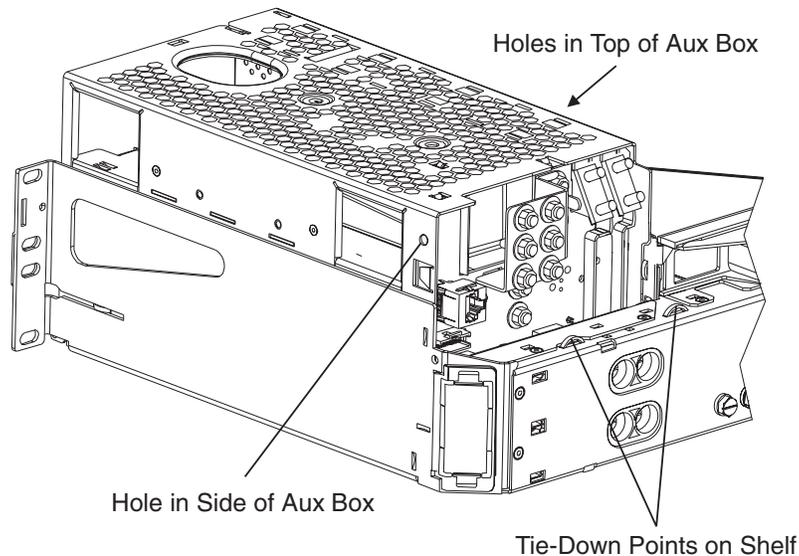


Figure 5-25: Recommended Cable-tie Locations

The Yukon Power System may be used with a maximum of four strings of batteries.

WARNING

Batteries contain hazardous electrical energy, sulfuric acid, and explosive hydrogen gas. Follow all precautions noted in the literature accompanying the batteries.

Place batteries on battery trays or other satisfactory supporting surface and interconnect per manufacturer's instructions so as to create a 48V string.

Installing Thermal Probes for Thermal Compensation

If thermal compensation is to be used, connect the ES773A VT-Probe or the ES773B Weatherized VT-Probe to the negative terminal of the batteries that are to be monitored. Remove the battery negative lug from the battery and attach the VT-Probe such that the receptacles (ES773A) or the cables (ES773B) on the probes are readily accessible. Secure bolt to battery and torque per manufacturer's specification. Do not connect

any cables to the probe(s), they will be connected during the start-up procedure.

Installing Thermal Probes and Remote Voltage Monitor Modules for Thermal Compensation with Voltage Monitoring

If thermal compensation is to be used along with voltage imbalance detection, connect the ES773A VT-Probes or ES773B Weatherized VT-Probes to the negative terminals of the middle battery of all strings to be monitored. It is important for the VT-Probe to be on the negative terminal of the middle battery, otherwise proper voltage imbalance detection will not occur. Secure probes to battery terminals as outlined above. See Figure 5-41 for illustration of wiring. When connected in this manner, the probe will be able to perform both slope thermal compensation and voltage imbalance detection. If more than 3 strings will be monitored, a second ES771A module will be required.

The ES771A module is provided with two RJ-45 jacks, a two-position connector, an LED, and three snap-fit pins. It is also provided with an adhesive-backed Velcro pad. Affix the module within the electronic equipment compartment such that the LED is facing the user. Note that the module should be placed such that the 848652947 cable (10-ft) may connect the ES771A to the first VT-Probe.

Do not connect any cables to the probe(s), they will be connected during the start-up procedure.

Battery (-)

ES712A and ES712B

Both the ES712A and the ES712B Aux Boxes are provided with two terminals, labeled Batt 1 and Batt 2, for battery (-) connections. See Figure 5-26. Note that all lug connections to the Aux Box are via M5 double-hole lugs on 5/8" centers.

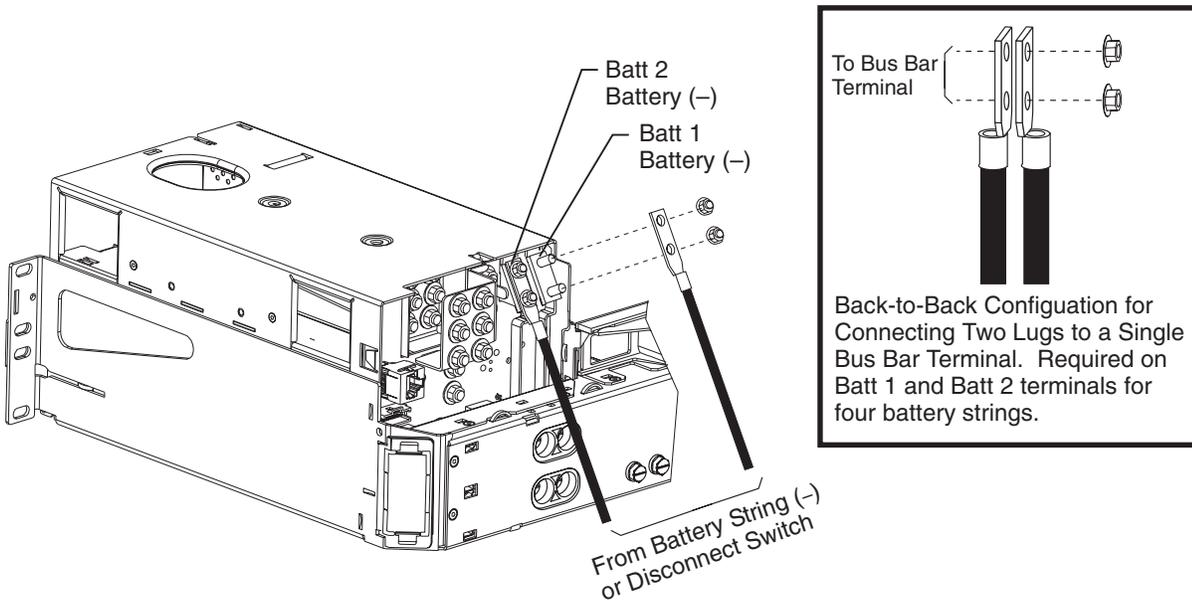


Figure 5-26: Battery (-) Connections to ES712A and ES712B Aux Box

If a disconnect switch is being used, physically mount switch to an appropriate place and ensure it is in the OFF position prior to making any connections. Connect the battery V- conductor(s) to the line side of the disconnect switch and torque connection per manufacturer's specification. Connect the load side conductor to the disconnect switch and torque connection per manufacturer's specification.

For one or two battery strings, connect the V- cables from the battery strings or the external disconnect switches to the Batt 1, or Batt 1 and Batt 2 terminals.

For four strings, back-to-back lug connections are required as shown.

**ES713A,
ES713AD, ES713B
and ES713BD**

Both ES713A/AD and ES713B/BD Aux Boxes are provided with two negative terminals to allow two battery string connections. Four battery negative connections may be made to these Aux Boxes using back-to-back lug connections.

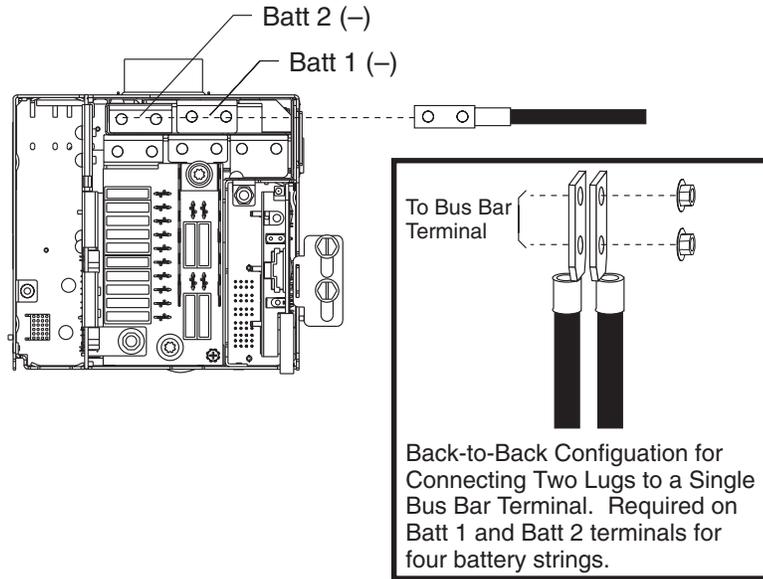


Figure 5-27: Battery (-) Connections to ES713A/AD and ES713B/BD Aux Boxes

If a disconnect switch is being used, physically mount switch to an appropriate place and ensure it is in the OFF position prior to making any connections. Connect the battery V- conductor(s) to the line side of the disconnect switch and torque connection per manufacturer's specification. Connect the load side conductor to the disconnect switch and torque connection per manufacturer's specification.

For one or two battery strings, connect the V- cables from the battery strings or the external disconnect switches to the Batt 1 or Batt 2 terminals.

For four strings, back-to-back lug connections are required as shown.

ES714AD

The ES714AD Aux Box is provided with two negative terminals to allow for two battery string connections. Four battery negative connections may be made to this Aux Box using back-to-back lug connections.

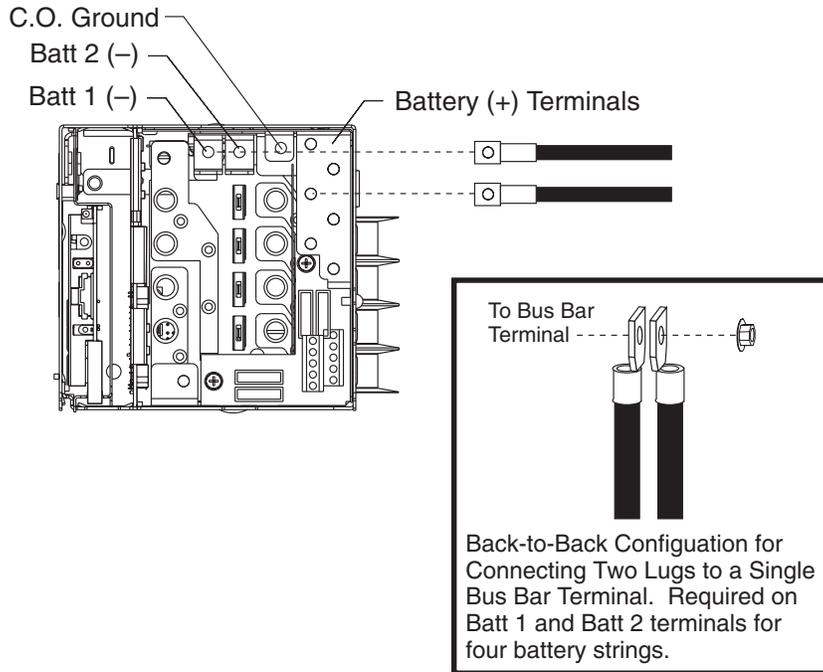


Figure 5-28: Battery (-) Connections to the ES714AD Aux Box

If a disconnect switch is being used, physically mount switch to an appropriate place and ensure it is in the OFF position prior to making any connections. Connect the battery V- conductor(s) to the line side of the disconnect switch and torque connection per manufacturer's specification. Connect the load side conductor to the disconnect switch and torque connection per manufacturer's specification.

For one or two battery strings, connect the V- cables from the battery strings or the external disconnect switches to the Batt 1 or Batt 2 terminals.

For four strings, back-to-back lug connections are required as shown.

CO Ground, Battery and Load Returns (+)

ES712A

The ES712A is provided with a three-terminal return (+) bus bar for CO ground and battery V+ connections (see Figure 5-29). One terminal is to be allocated exclusively to the CO ground cable, the remaining two may be used for the battery V+ terminations. The V+ cables from two strings may be directly connected to it. For four strings, back-to-back lug connections at the V+ terminals are required.

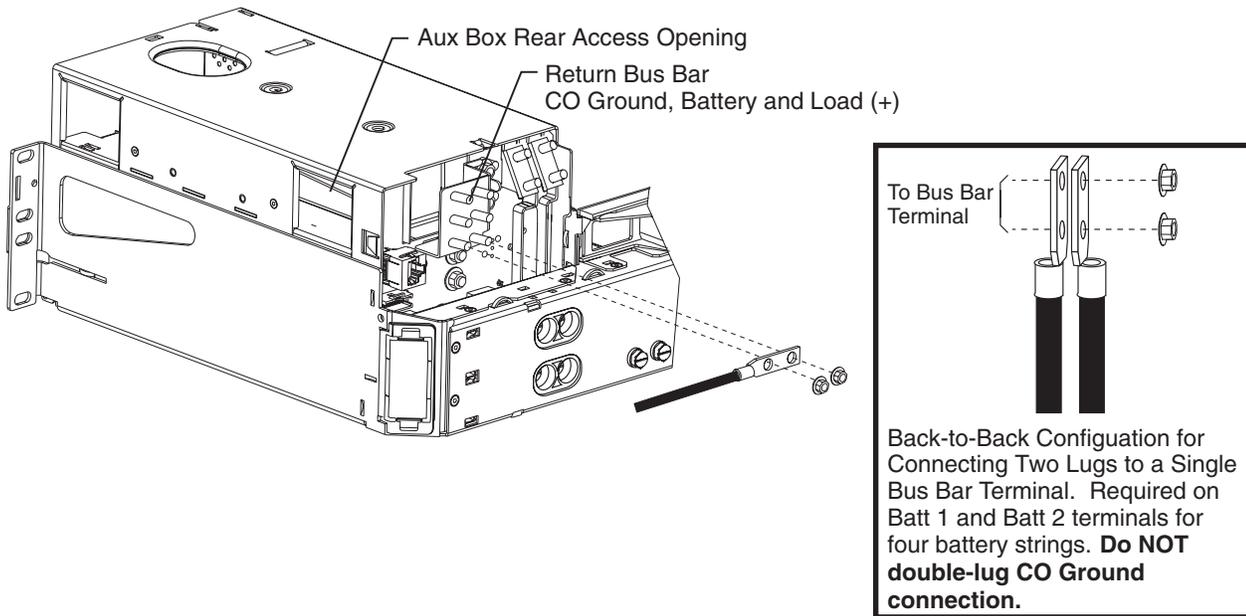


Figure 5-29: CO Ground, Battery (+) and Load (+) Connections to the ES712A Aux Box

ES712B

The ES712B is provided with one inner and one outer return (+) bus bar, each having three terminals for CO ground and battery V+ connections (see Figure 5-30). The outer bus bar must be removed to gain access to the terminals of the inner bus bar. Two nuts secure the outer bus bar to the inner bus bar. Removing the nuts will allow for removal of the outer bus bar. The CO Ground connection is to be made exclusively at one of the terminals on the inner bus bar. The remaining terminals on the inner bus bar and the outer bus bar are for load return and battery V+ connections.

It is highly recommended that the inner bus bar terminals be used up prior to connecting to the outer bus bar terminals. This will prevent having to remove the outer bus bar to gain access to the inner bus bar, which may result in dropping loads.

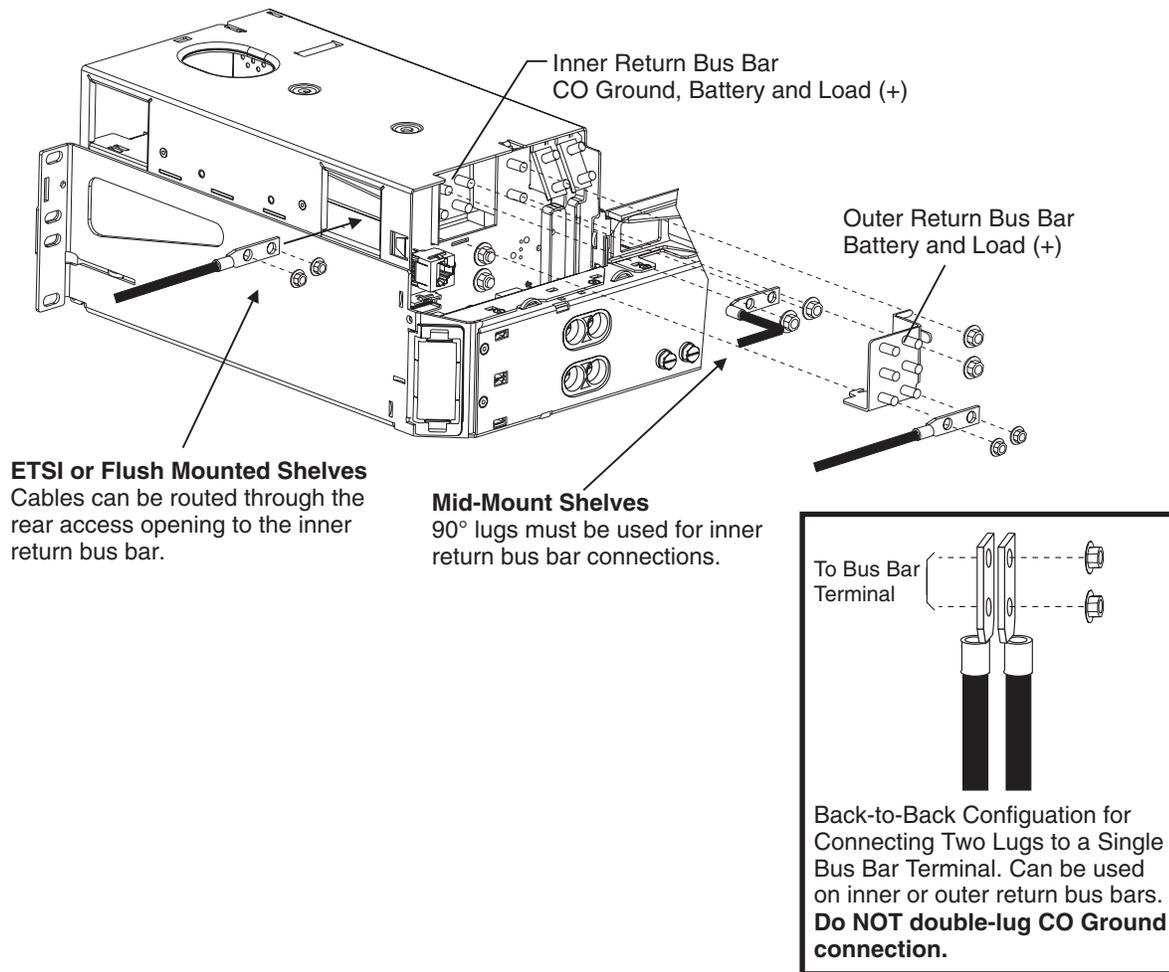


Figure 5-30: CO Ground, Battery (+) and Load (+) Connections to the ES712B Aux Box

For flush-mount and ETSI applications, cable access to the inner bus bar may be made using straight lugs through the Rear Access Opening. All lug-terminations except for the lug used to terminate the CO Ground cable may be terminated with back-to-back lugs. That is, the terminations may be used for load, battery V+, or a combination of load and battery V+ terminations.

For mid-mount applications, inner bus bar cable connections must be made with 90° lugs. Note that it is not possible to use back-to-back lugs on the inner bus bar; therefore, consideration as to how best to terminate load and battery V+ cables during initial installation with respect to future growth in battery and load must be given. That is, ensure initial connections will facilitate future growth without requiring removal of load terminations. The outer bus bar may use straight lugs, which may be double-backed.

**ES713A,
ES713AD, ES713B
and ES713BD**

Both the ES713A/AD and ES713B/BD Aux Boxes are provided with two positive terminals to allow two battery string positive connections and one terminal for the CO ground connection. Four battery positive connections may be made to these Aux Boxes using back-to-back lug connections.

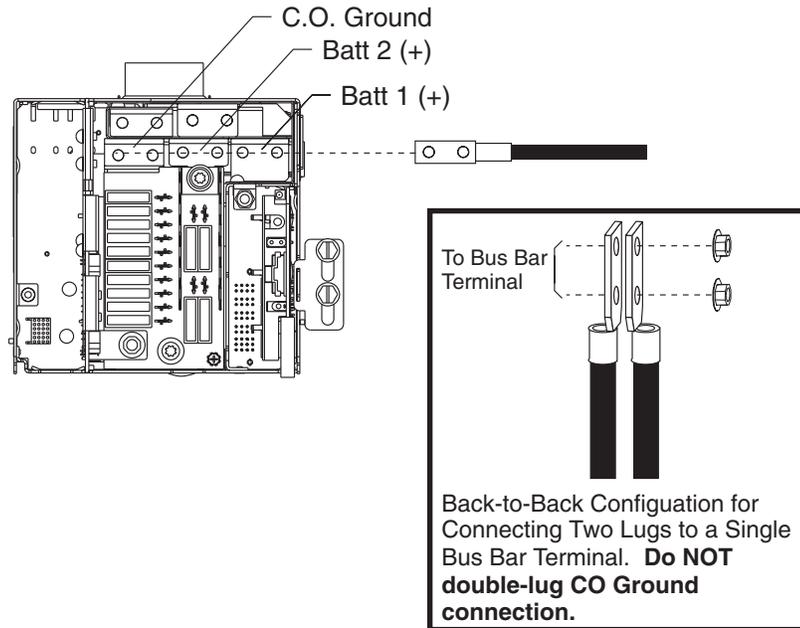


Figure 5-31: CO Ground and Battery (+) Connections to ES713A/AD and ES713B/BD Aux Boxes

Connect the battery V+ cables to either Batt 1 (+) or Batt 2 (+).

ES714AD

The ES714AD Aux Box is provided with two positive terminals to allow two battery string connections and one terminal for the CO ground connection. Four battery positive connections may be made to this Aux Box using back-to-back lug connections. Connections to this Aux Box are made via M5 single-hole lugs.

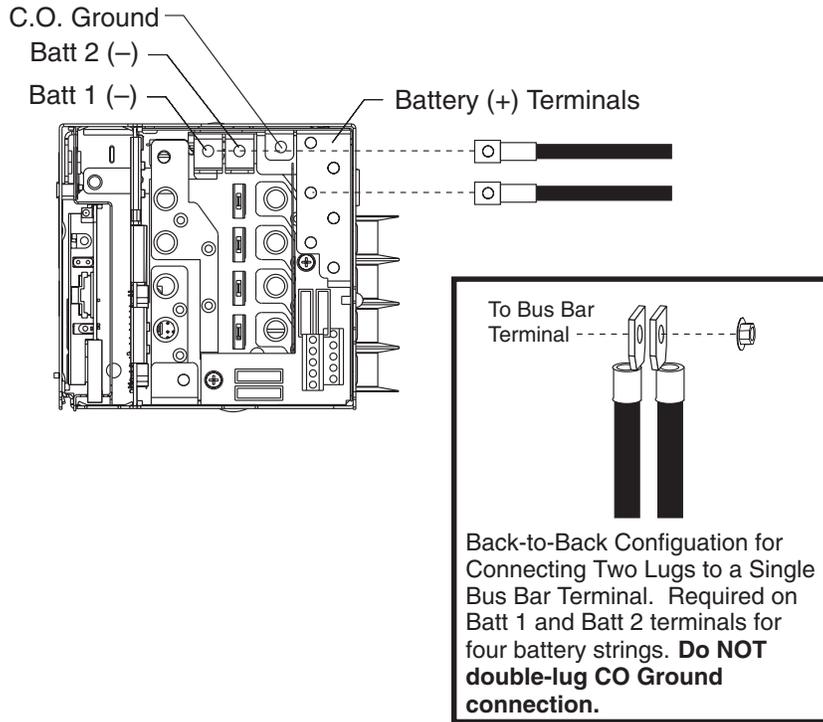


Figure 5-32: CO Ground and Battery (+) Connections to the ES714AD Aux Box

Connect the battery V+ cables from the battery strings to either of the terminals marked Batt1 (+) or Batt2 (+).

Grounding

C.O. Ground

Choose a conductor of suitable length, color, and gauge to serve as the conductor that will establish a ground reference for the power system. Terminate one end of the conductor with an M5 double-hole lug on 5/8 in centers. Use a straight lug if flush or ETSI mounting, and use the 90° lug for mid-mounting for the ES712xx Aux Boxes. Straight double-hole lugs may be used on all other aux boxes except for the ES714AD which uses single-hole lugs. Use the heat-shrink tubing to cover the cable-lug connection beyond the barrel of the lug. Terminate to the Return Bus

Bar (ES712A), to the Inner Return Bus Bar (ES712B), or to the CO ground terminal (ES713A/AD, ES713B/BD, ES714AD) with hardware provided. Terminate other end of conductor with lug appropriate for the installation site.

Frame Ground

Two frame ground connections are provided on the rear of the shelf. See Figure 5-2. If necessary, the shelf frame may be grounded at one of these terminations. Terminate the frame ground cable with the appropriate M5 double-hole lug on 5/8 in centers. Use the heat-shrink tubing to cover the cable-lug connection beyond the barrel of the lug. Secure to either termination point.

WARNING

Maximum current through the Aux Box is limited by the installed LVD board. See LVD Board in Section 8 for details.

CAUTION

All normal load currents are assumed to be at maximum 80% of the fuse or circuit breaker rating.

Load Power Connections

ES712B Circuit Breaker Distribution

The ES712B Aux Box with circuit breaker distribution option is provided with three positions for DIN Style Circuit Breakers.

When the Aux Box with the circuit breaker distribution option is ordered, three 848649695 wire sets should be provided with it. These are the alarm sense leads for the system controller to detect an open circuit breaker. Note the seven pins on the upper-front part of the LVD board. For each circuit breaker you wish to have - for a maximum of three - connect one end of the wire set to one of the five pins marked CB ALM INPUT. The other end will be connected to the load compression lug of the circuit breaker, along with the load cable.

Load return connections are made to any terminal on either the inner or outer rear busbar. Load power connections are made at the circuit breakers. See Figure 5-33 for more details. Note that the load terminals on the circuit breakers can secure copper cabling from No. 18 AWG (1mm²) to No. 4 AWG (25mm²).

Terminate load return cables with appropriate M5 double-hole lug on 5/8 in centers for connection to the Aux Box. Use the heat-shrink tubing to cover the cable-lug connection beyond the barrel of the lug. Secure to Load Positive Bus Bar with hardware provided.

Load power connections should be terminated to the circuit breakers prior to securing the circuit breakers to the Aux Box.

Strip ends of the power connections about 5/8 in (20mm) and tin with solder. Depending on the mounting method utilized, one or more cable routing means may be available to you. The load cables may be routed from the rear-side opening and brought out to the breakers via the wire channel. The load cables may also be routed from the front-side opening or the cables may be routed from the top opening and brought down to the breakers. Guide the load connection end of the cable using the appropriate route and terminate to the pressure terminals on top of the circuit breakers along with the alarming wire set. Secure via the compression lug and torque according to the following table.

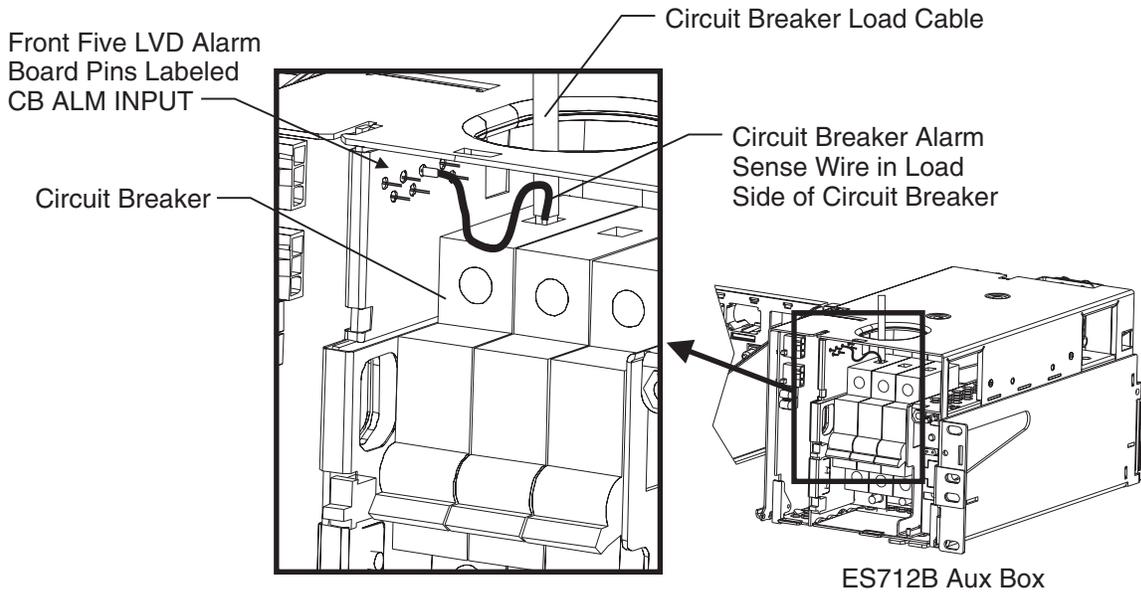


Figure 5-33: ES712B CO Ground, Battery (+) and Load (+) Connections to the Aux Box

Circuit Breaker Rating	Torque
<25A	17.7 in·lbs (2N·m)
>25A	31 in·lbs (3.5N·m)

The circuit breakers may be affixed to the Aux Box once the cables have been connected to it. With the circuit breaker right-angled such that the cable end is towards you, seat the circuit breaker onto one of the three teeth in the Aux Box and straighten it out. Lift the circuit breaker up slightly until the circuit breaker attaches itself to the rear rail. Secure the circuit breaker to the teeth via its compression lug and torque to 35 in·lbs (4N·m).

Route other end of cable to their mating connections on end-use application. When routing cables, please ensure they do not traverse any sharp, rough, or hot surfaces that may over time cause its insulation to abrade. Also, please be careful to route cables away from doors and the like to prevent any possible damage from pinching.

If desired, the load and return cables may be strain-relieved by tie-wrapping them to the chassis. See Figure 5-25.

If using these circuit breakers in ambient temperatures above 25°C, refer to Appendix D for manufacturer's circuit breaker derating information.

ES712A, ES713A/AD, ES713B/BD Fuse Distribution

The ES712A Aux Box with fuse distribution option is provided with five 12A load connections and three 15A load connections.

The ES713A/AD Aux Box distribution option is provided with ten 12A load connections and four 15A load connections. Load terminations are made using FastOn terminals.

The ES713B/BD Aux Box distribution option is provided with nine 12A load connections and three 15A load connections.

The ES713A/AD and ES713B/BD Aux Boxes are provided with an access gate which may be swiveled up to allow for ease of cable routing, see Figure 5-34

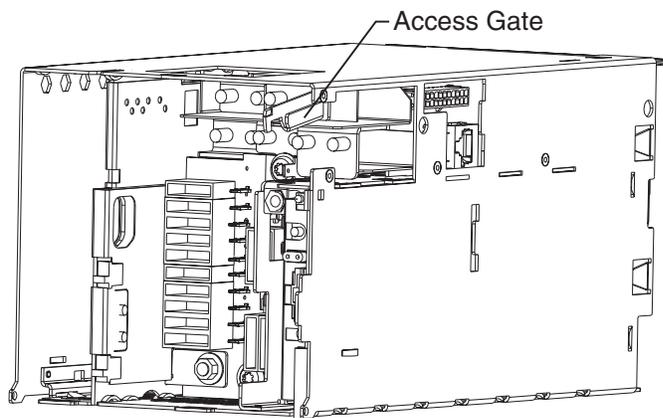
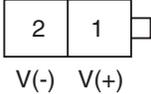
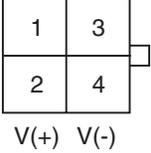


Figure 5-34: Access Gate on ES713A/AD and ES713B/BD Aux Boxes

These Aux Boxes have a fuse board with a wire that should have been connected to the FUSE ALM INPUT pins on the LVD board. If this has not been done, please refer to LVD Board installation section.

For ES712A and ES713B Aux Boxes, cable assembly 848652442 is a 15 foot long cable terminated on one end with a two-position connector that mates to any of the five 12A connectors in the Aux Box. Cable assembly 848658233 is a 15 foot long cable terminated on one end with a four-position connector that mates to any of the three 12A connectors in the Aux Box. Connector pin definitions are as follows:

Load Cable Connector Pin Definitions

Cable Assembly	Connector
848652442	
848658233	

Determine the type of cable needed. Size to the length necessary for the application and terminate with a suitable connector.

Depending on the mounting method utilized, one or more cable routing means may be available to you. The load cables may be routed from the rear-side opening and brought out to the fuse board via the wire channel. The load cables may also be routed from the front-side opening or the cables may be routed from the top opening and brought down to the fuse board. If desired, the cable may be strain-relieved by tie-wrapping them to the chassis. See Figure 5-25.

The ES713A Aux Box uses FastOn terminals, which require 0.032 by 0.187 in tabs. The use of insulated tabs is recommended and the following parts are available from Amp Inc.

Cable Gauge (AWG)	Strip Form	Loose Piece Part
22-18	2-520403-2	2-540411-2
16-14	3-520404-2	3-520412-2

Choose gauge of cable for the load in question and terminate with appropriate terminals using the Amp specified crimping tool. Size cable to appropriate length and provide appropriate termination for other end. Connect positive and negative cable assemblies to their tabs on the Aux Box. Note that the negative terminals are adjacent to its respective fuseholder, while the positive or return terminals are on two rails, see Figure 5-35.

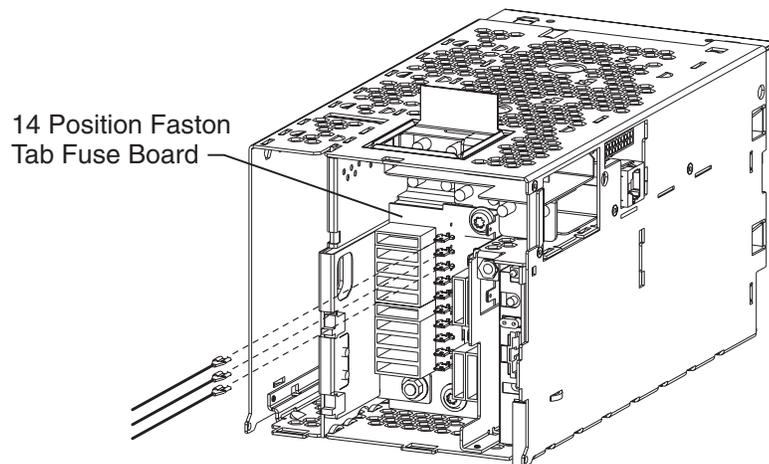


Figure 5-35: Load Connections to the ES713A Aux Box

The **ES714AD Aux Box** is provided with single-hole lugs for circuit breaker load connections. Choose lugs for cables of maximum 6AWG. It is also provided with a four-position terminal block with wire compression connections for fuse load connections. The fuse terminal block accepts 30 - 14 AWG cables. When securing fuse cables, strip roughly 0.24 in/6mm of insulation from wire and insert in terminal. Note that the raised terminal is the V(+) and the lower terminal is the V(-). Torque connections to 0.375 ft·lbs./0.5 N·m.

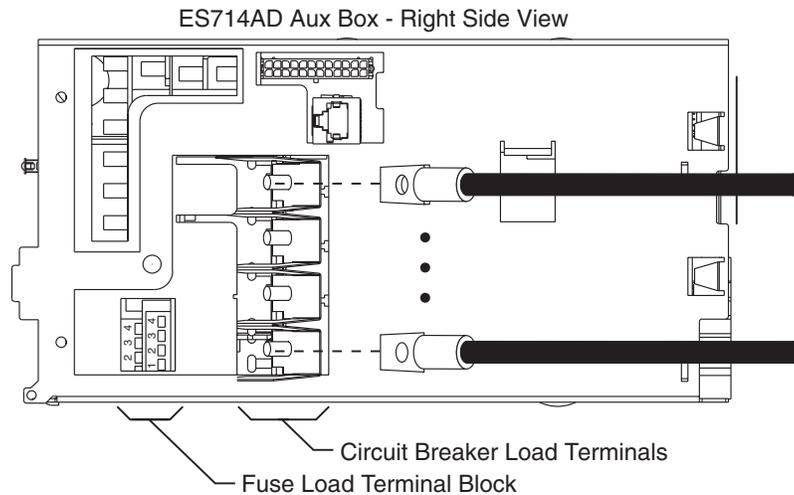


Figure 5-36: Load Connections to the ES714AD Aux Box

Once connections at the aux box have been made, route load cables to their mating receptacles on end-use applications. When routing cable, please ensure cable does not traverse any sharp, rough, or hot surfaces that may over time cause its insulation to abrade. Also, please be careful to route cables away from doors and the like to prevent any possible damage from pinching.

AC Utility Connection

Note: Each ac connection to the Yukon is to be provided with circuit breaker protection at maximum 20A.

CAUTION

Ensure ac power is OFF to the Yukon system before continuing with ac utility connection.

The Yukon Power System shelf should have the ac cords affixed to it. If not, please connect the ac cords to the power shelf per the instructions outlined in the section titled AC Cord Connection to Shelf, found earlier in this section.

The ES701C shelf requires the use of the 848713376 ac cord, which is unterminated at the utility end. This is to be inserted into the ac receptacles on the Yukon shelf. The other end is to be terminated with an appropriate plug; follow all safety rules provided with the plug when connecting the plug to the cable assembly. A commercially available right-angled 20A ac cord may also be used, consult your Lineage Power field representative for more details.

Guide the utility end of the ac cords to the utility source. When routing cable, please ensure cable does not traverse any sharp or rough surfaces that may over time cause its insulation to abrade. Also, please be careful to route cables away from doors and the like to prevent any possible damage from pinching.

When connecting to utility source, ensure all local and national wiring rules are being complied with.

Initial Start-up

The system is ready to be powered up. Please verify all connections are as described above prior to applying ac power.

If using external disconnect switches, place them in their ON positions prior to applying ac power.

Turn on the ac service circuit breakers to apply power to the Yukon power system. If the ES712_LVD_A or ES712_LVD_D board is being used, it should be blinking its LED in amber, and the controller should

illuminate its LED in red. Close the disconnect switch(es) on the LVD board, all LEDs should be illuminated in green.

All LEDs on all components including rectifiers, ringers, controllers, LVD boards, and remote voltage monitor modules should be green. If this is not the case, press and hold the Lamp Test button on the system controller for 6 seconds. If all LEDs still aren't green, review the installation procedure or refer to Section 12, Troubleshooting.

Using a digital voltmeter at the test jacks on the controller, measure the plant voltage. It should be 54.5Vdc. Note that if the connected batteries are not fully charged, the voltage may be lower. If possible, open the external disconnect switches or activate the disconnect switches on the LVD_A board prior to making measurements.

Remove a rectifier from its slot, the controller should illuminate its LED in amber signaling a missing rectifier condition. Depress the Lamp Test button for more than 6 seconds, the alarm condition should clear. Replace the rectifier.

If the above conditions yielded the proper results, the cables for the ES773A VT-Probes for thermal compensation, or the VT-Probes and the ES771A Remote Voltage Module for thermal compensation with voltage monitoring may now be connected.

If the above conditions did not yield the proper results, refer to Section 12, Troubleshooting.

Thermal Compensation Connections

Thermal Compensation (Without Voltage Monitoring)

The ES773A VT-Probe is provided with 2-position and 4-position receptacles and a 1/4-inch ring terminal. The 848652939 cable terminates on one end with a RJ-45 connector and on the other end with a 4-position connector. Both the 848657391 and the 848657383 cables terminate on one end with a 4-position connector and on the other end with a 2-position connector. These cables will be necessary to interconnect the VT-Probes in performing slope thermal compensation. Follow the installation instructions below to ensure proper interconnection of the VT-Probes to the system.

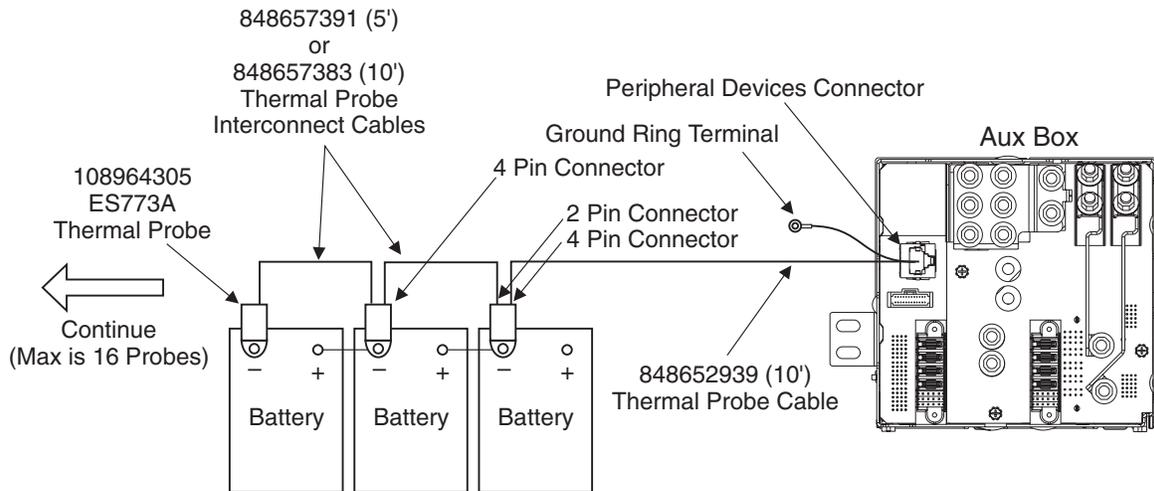


Figure 5-37: VT-Probe Connections to Aux Box

Connect the 848652939 cable to the Aux Box and to the 4-position receptacle of the closest VT-Probe and connect the 1/4-inch ring terminal to a grounded surface such as the mounting rail. Wait approximately 2 seconds and then disconnect the cable assembly from the probe. The system controller should illuminate its LED in amber color, signifying a missing probe. Reconnect the probe, the controller should illuminate its LED in green color. Alternatively, the number of registered probes may be known from the terminal interface (TI) by running the Number of Temperatures Present command, see Appendix B.

Connect either the 848657391 (5 ft) or the 848657383 (10 ft) cable to the 2-position receptacle of the first probe and to the 4-position receptacle of the second probe and wait approximately 2 seconds. Then disconnect the connection to the 4-position receptacle of the second probe, the system controller should illuminate its LED in amber color. Reconnect the probe, the controller should illuminate its LED in green color. The Number of Temperatures Present command may be used for confirmation.

Repeat until all probes have been similarly connected and tested. This procedure ensures all probes are connected and operational.

The Yukon controller is now set to make thermal measurements in performing slope thermal compensation. Additional parameters may be set on the controller to customize this feature, please refer to Appendix B for more details.

**Weatherized
Thermal
Compensation
(Without Voltage
Monitoring)**

The 848680971 Weatherized VT-Probe Assembly is provided with the 848652939 Thermal Probe Cable assembly and the 848652954 Battery Voltage Sense Cable connected to the ES771A VT-Probe in a sealed package.

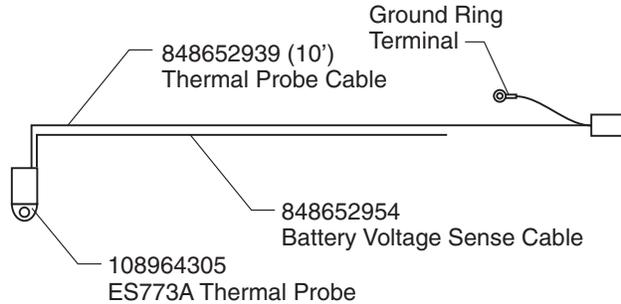


Figure 5-38: Sealed VT-Probe Cable Assembly (848680971)

If connecting to a single battery string, connect the probe to the battery terminal as described above and connect the other end of the assembly to the Peripheral Devices Connector on the rear of the Aux Box as shown in Figure 5-39. Connect the 1/4-inch ring terminal to a grounded surface such as the mounting rail.

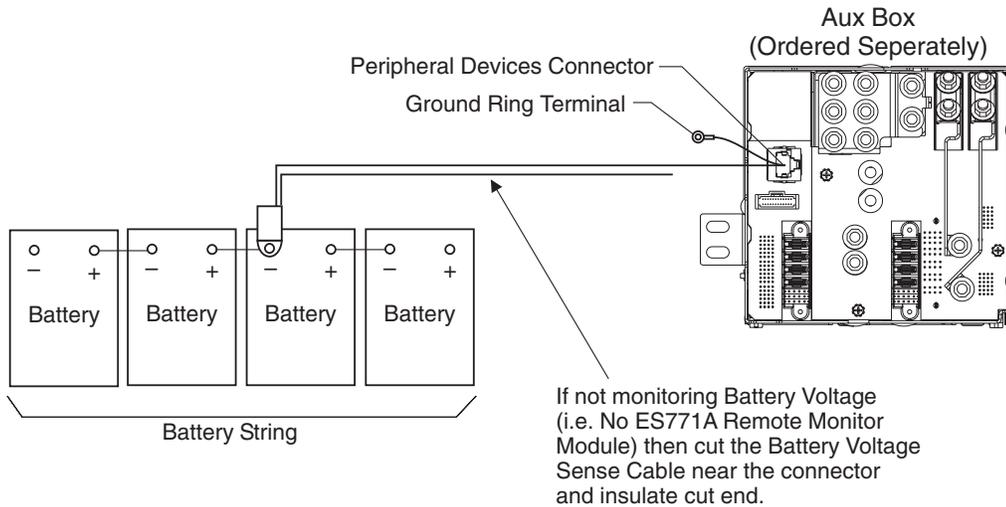


Figure 5-39: VT-Probe Connections

If connecting to multiple battery strings, the 848652947 RJ-45 to RJ-45 Cable as well as the 848680989 kit is required, see Section 3 Weatherized Thermal Compensation/Voltage Monitoring for ordering information. The 848680989 kit contains the Weatherized VT-Probe assembly, a 3-position RJ-45 terminal block, and a 1.5-ft Terminal Block Interconnect cable. The following instructions show how to interconnect for multiple battery strings.

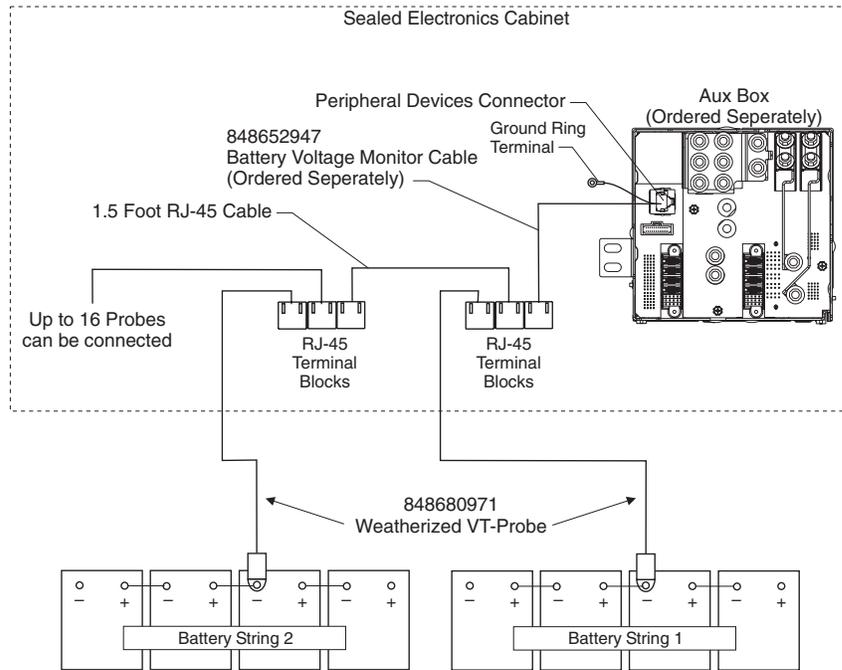


Figure 5-40: Weatherized VT-Probe Connections

1. The RJ-45 terminal block is provided with adhesive backing for attaching onto the cabinet interior wall. Attach the terminal block such that the 848652947 cable can connect to it. The terminal block is intended to be placed within the electronics equipment compartment and not within the compartment housing the batteries.
2. Connect the 848652947 cable from the Aux Box Peripheral Devices Connector to one of the terminals of the terminal block. Connect the 1/4-inch ring terminal to a grounded surface such as a convenient location on the cabinet interior wall. Note that all subsequent cable connections do not need to have the ring terminal grounded. The ring terminal on all subsequent connections may be cut off.
3. Connect the 848680971 Weatherized VT-Probe assembly to a second terminal. Terminate other end to the negative terminal of a battery in a string as previously described. The additional cable on the VT-Probe assembly is not needed in this application and may be cut and discarded. Ensure the cable is cut close to the heat shrink tubing to prevent contact with other parts.
4. For additional strings, mount the terminal block from the second 848680989 kit near the first terminal block. Connect the third

terminal of the first terminal block to the first terminal of the second terminal block using the 1.5-ft Terminal Block Interconnect cable. Connect the second Weatherized VT-Probe assembly to one of the free terminals of the second terminal block. Continue similarly with all strings.

***Voltage Imbalance/
Thermal
Compensation***

Figure 5-41 shows the interconnection of the maximum number of VT-Probes for both voltage monitoring and thermal compensation. All 16 batteries are being monitored for thermal compensation and all four strings are being monitored for voltage imbalance by the probes in the middle batteries of all strings. Your actual interconnection may only require monitoring one battery in each string, if so, the middle battery in each string should be used when both the voltage imbalance and thermal compensation features are desired.

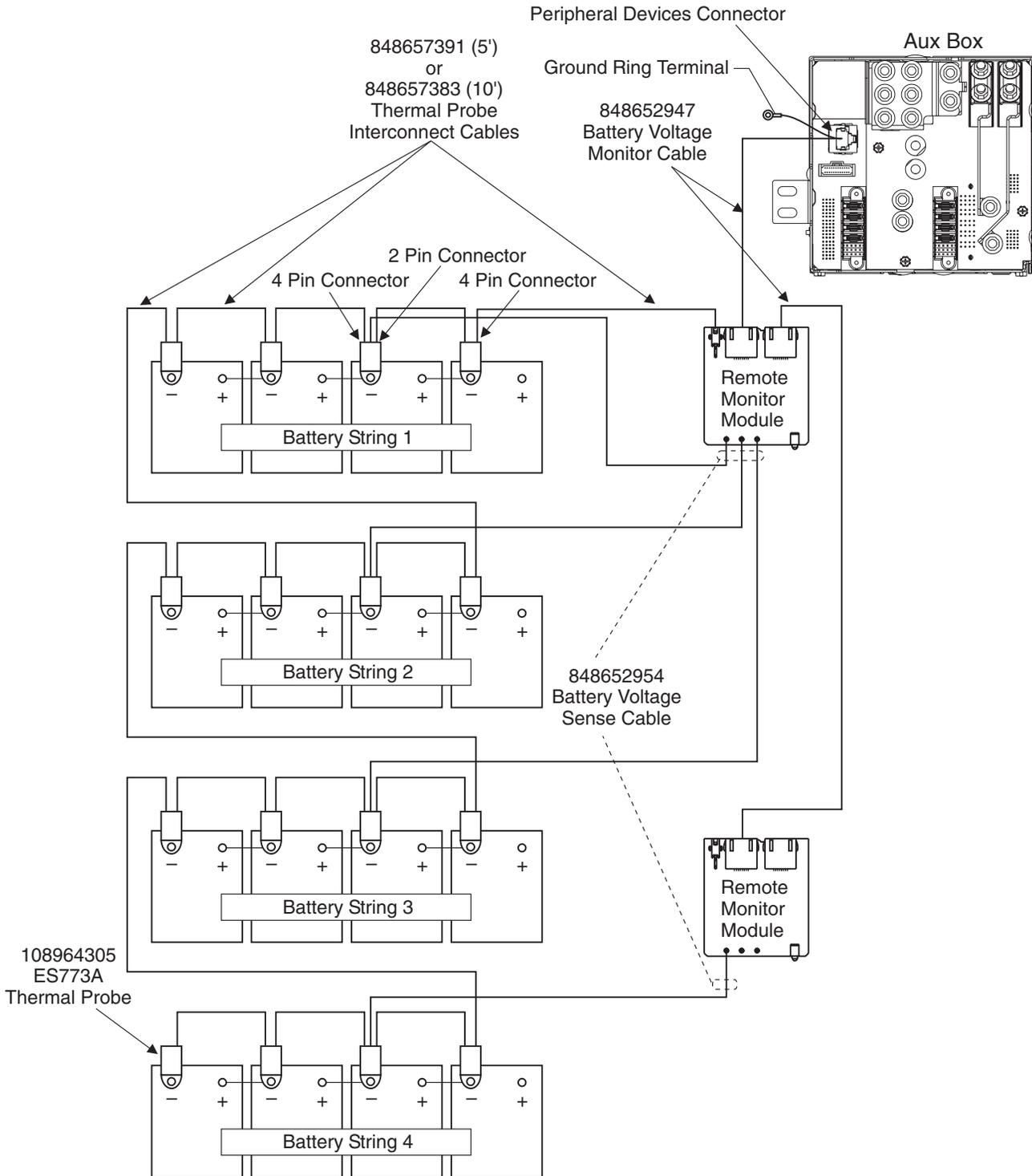


Figure 5-41: VT-Probe/Battery Voltage Monitor Connections to Aux Box

1. Connect one end of the 848652947 cable to the Aux Box Peripheral Devices Connector and the other end to the first ES771A Remote Voltage Monitor module. Connect the 1/4-inch ring terminal to a grounded surface such as the mounting rail. Note that all subsequent cable connections do not need to have the ring terminal grounded. The ring terminal on all subsequent connections may be cut off.

After approximately 2 seconds, the LED should be illuminated in green color. If using a second ES771A, connect a second 848652947 cable to the RJ-45 receptacles of both modules. The second module's LED should be illuminated in green color. The number of voltage monitoring modules registered by the system controller may be known from the TI by running the Number of Mid-cell Present command, refer to Appendix B. If the LEDs on the module is not on or is red or if the number of registered modules does not agree with the number used, check integrity of all cable connections and run the CLE command, see Appendix B. If the LED's are not illuminated in green color or the number of registered modules does not agree, call your RTAC representative.

2. Connect either the 848657391 (5 ft) or the 848657383 (10 ft) cable to the 2-position receptacle of the first ES771A and to the 4-position receptacle of the first probe and wait approximately 2 seconds. Then disconnect the connection to the 4-position receptacle of the second probe, the system controller should illuminate its LED in amber color. Reconnect the probe, the controller should illuminate its LED in green color. The number of registered probes may also be known from the TI by running the Number of Temperatures Present command, see Appendix B.
3. Connect either the 848657391 (5 ft) or the 848657383 (10 ft) cable to the 2-position receptacle of the first probe and to the 4-position receptacle of the second probe and wait approximately 2 seconds. Then disconnect the connection to the 4-position receptacle of the second probe, the system controller should illuminate its LED in amber color. Reconnect the probe, the controller should illuminate its LED in green color. The Number of Temperatures Present command may be used for confirmation.
4. Cable 848652954 cable (10-ft) terminates on one end with a right-angled snap-fit connector and on the other end with a connector pin-socket. Connect the snap-fit connector end of the cable to one of the three snap-fit pins on the ES771A module.

- Note that only two positions of the 4-position connector of the 848652939 cable connected to the ES773A module is being used. Connect the socket end of the 848652954 cable to either of the two unused positions of the 4-position connector on the probe. This connection will allow for voltage measurements for battery string voltage imbalance detection.

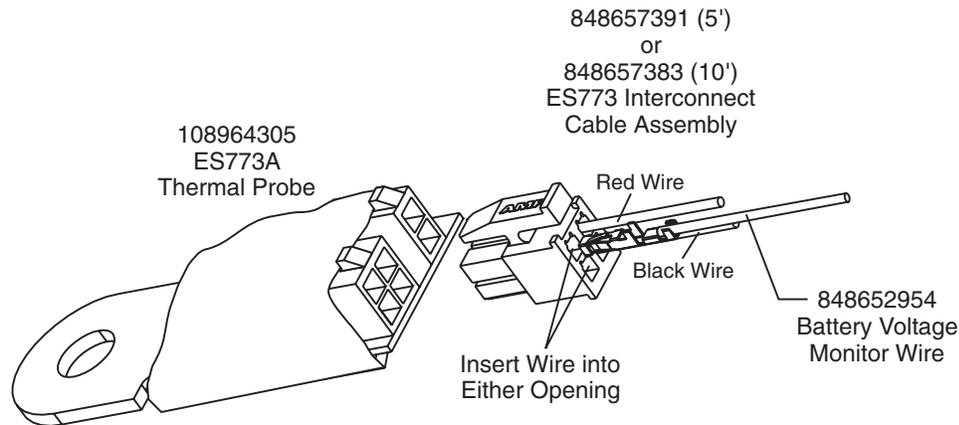


Figure 5-42: Connecting Battery Monitor Voltage Wire to Thermal Probe Cable

- Connect the remaining probes that are to monitor voltages similarly. If using four strings, the fourth probe must be connected to the second ES771A module.

***Weatherized
Voltage Imbalance/
Thermal
Compensation***

If connecting to multiple battery strings and voltage monitoring is required, the 848652947 Battery Voltage Monitor Cable, the ES771A module, and the 848680989 kit is required, see Section 3 Weatherized Thermal Compensation/Voltage Monitoring for ordering information. The following instructions show how to interconnect for multiple battery strings.

- Follow Step 1 in Voltage Imbalance/Thermal Compensation.
- Attach the RJ-45 terminal block near the ES771A module such that the 1.5-ft Terminal Block Interconnect cable from the 848680989 kit can connect to it. Connect the interconnect cable from the second RJ-11 jack on the ES772A module to a terminal on the terminal block. The terminal block is intended to be placed within the electronics equipment compartment and not within the compartment housing the batteries.
- Connect the 848680971 Weatherized VT-Probe to the negative terminal of the middle battery of the first battery string. Connect the

cable terminating in the RJ-45 jack to a terminal on the RJ-45 terminal block. Connect the other cable from the VT-Probe assembly to one of the snap-fit connectors on the ES771A module.

4. Disconnect the RJ-45 cable from the terminal block, the system controller should illuminate its LED in amber color. Reconnect the cable, the controller should illuminate its LED in green color. The number of registered probes may also be known from the TI by running the Number of Temperatures Present command, see Appendix B.
5. For a second string, attach the RJ-45 terminal block from the second 848680989 kit near the first terminal block and connect the 1.5-ft Terminal Block Interconnect cable from the between the free terminal of the first terminal block to the second terminal block.
6. Connect the 848680971 Weatherized VT-Probe to the negative terminal of the middle battery of the second battery string. Connect the cable terminating in the RJ-45 jack to a terminal on the RJ-45 terminal block. Connect the other cable from the VT-Probe assembly to one of the snap-fit connectors on the ES771A module.
7. Disconnect the RJ-45 cable from the terminal block, the system controller should illuminate its LED in amber color. Reconnect the cable, the controller should illuminate its LED in green color.
8. If only three strings are being monitored, connect the 848680971 Weatherized VT-Probe assembly to the negative terminal of the middle battery of the third string. Connect the cable terminating in the RJ-45 jack to the free terminal on the second terminal block. Connect the third cable to the snap-fit connector of the ES771A module. Disconnect the RJ-45 cable from the terminal block, the system controller should illuminate its LED in amber color. Reconnect the cable, the controller should illuminate its LED in green color.
9. For a fourth string, an additional ES771A module and an 848682035 1.5-ft RJ-45 to RJ-45 cable will be required in addition to the weatherized VT-Probe kits. Attach the second ES771A module near the last RJ-45 terminal block and interconnect them with the 1.5-ft RJ-45 to RJ-45 cable. Then follow Step 3 on.

The Yukon controller is now set to perform both voltage measurements in performing battery string voltage imbalance detection and thermal measurements in performing slope thermal compensation. Additional parameters have to be set on the controller, please refer to Appendix

The system is now ready for initializing, and modification to the factory default settings may now be made. Refer to Appendix B for a listing of all plant parameters, their factory default settings, and instructions on initializing the system controller.

6 System Controller

Overview

The ES740AD is the same as the ES740A but has the capability to drive the LED displays on the ES710AD, ES713AD and ES713BD Aux Boxes.

The ES740AD Alarm Control Unit provides plant monitoring and control features, as well as office alarm outputs from rectifiers, ringers, LVD boards, and remote modules. This section describes the controller features, functions and alarms.

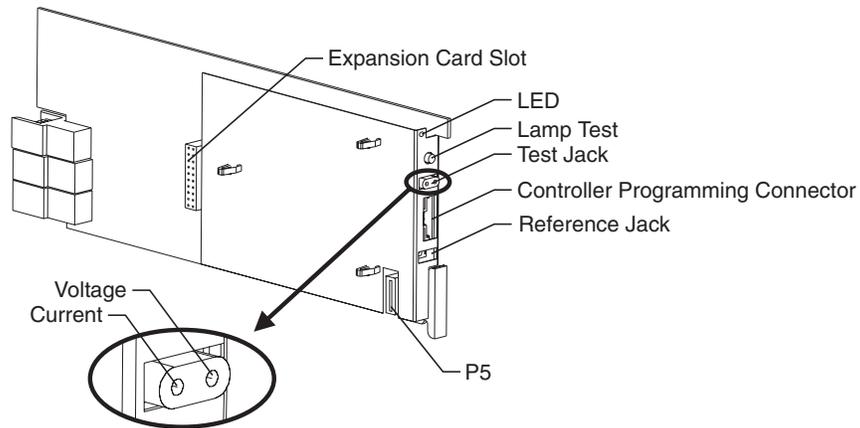


Figure 6-1: ES740AD Alarm Control Unit

Displays and Connectors

LED: This is a tri-color LED and will illuminate accordingly for the conditions shown below.

Status	LED		
	Green	Amber	Red
Normal	X		
Minor Alarm		X	
Major Alarm			X
Plant Battery Test		Blink	
Battery on Discharge			Blink
Battery Recharge Current Limit Active	Blink		

Lamp Test: This is a push-button switch that performs a Lamp Test when momentarily pushed. It also performs the Clear Latched Events (CLE) function when depressed for greater than 5 seconds. See Section 6 for more details on this feature.

Test Jack: This test jack, along with the reference test jack, allows the user to measure the plant voltage and load current using a digital volt-meter set to measure dc voltage. The right jack provides plant voltage and the left jack provides load current information.

When displaying voltage readings, the accuracy is +/- 0.01V. When displaying load current, the displayed voltage range will be from 0 to 6V, which corresponds to 0 to 600A. The accuracy of the current readings is +/- 1% +/- 1A.

Controller Programming Connector: This connector, when used with the 848658100 Controller Programming Cable and a Terminal Interface (TI), e.g., an IBM compatible PC or a Palm PDA, allows users to gain access to the programming features of the system controller. See Appendix B and Appendix F for more details.

This receptacle allows for RS-232 communication with the controller for programming. Note that connections to this receptacle are to be from an isolated RS-232 port from the connecting equipment. Connecting the controller to a grounded RS-232 port will result in improper RS-232 communication and may damage the using equipment and/or the system controller.

Reference Test Jack: This is the reference test jack for making voltage and current measurements.

Expansion Card Slot: Various cards will be developed that will enhance the functionality of the controller. This connector will allow the cards to be interfaced with the controller.

Display Receptacle (P5): Receptacle for connection of display cable from Aux Boxes with display option.

Features and Functions

Float Mode

Float mode is the default mode of operation of the battery plant. The plant voltage, while in float mode, is determined by the configuration parameter Rectifier Float Set point (fsp) and may be adjusted by the Battery Thermal Compensation circuit, if active. No individual adjustment of plant rectifiers is necessary and load sharing among plant rectifiers is automatic in all plant modes and will take effect within several seconds of a new rectifier being added to the system.

Refer to Appendix B for the fsp range settings and factory default. The fsp chosen should be set per the battery manufacturer's recommendations. Note that the actual fsp measured on the plant may differ from the value set by the user if thermal compensation is enabled. See Slope Thermal Compensation (next topic) for more details.

Changing Float Mode Voltage

When using any of the Aux Boxes with the display option (any Aux Box with a "D" suffix), plant float voltage can be changed two ways:

Front Panel

- Pressing the Amps/V Adjust button for 3 seconds will place the controller into the plant adjust mode. The decimal point on the display will blink. Press the "Lamp Test/Alm Reset" button to increase the voltage by 0.1V, or the "Amps/V Adjust" button to decrease the voltage by 0.1V.
- To accept the new float value, press the "Amps/V Adjust" for 3 seconds. The decimal point on the display will stop blinking.

Note: If no change has been made for 5 seconds, the controller will return to the normal display and no changes will be saved.

Serial Interface

- Refer to Appendix B for details on this method.

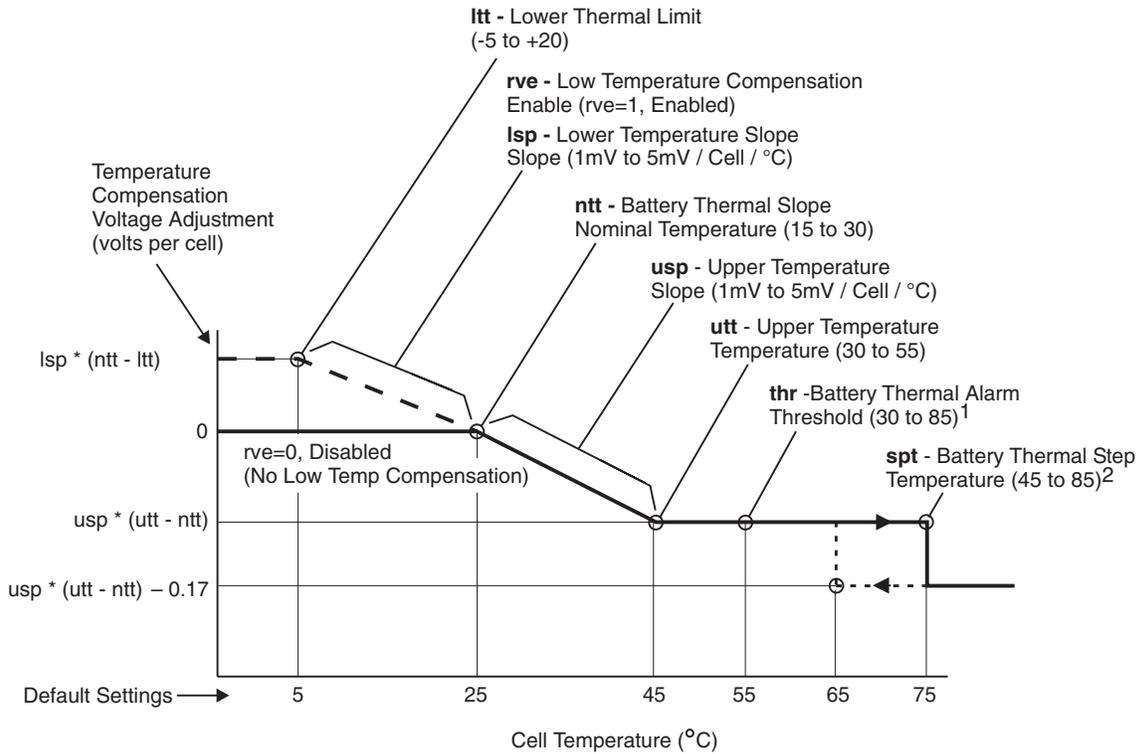
Slope Thermal Compensation

The ES740AD has a flexible Thermal Compensation feature which provides voltage compensation from that level established by the Plant Float Set-Point (fsp) or Boost Set-Point (bsp), dependent on the highest temperature monitored by the ES773A VT-Probes located at the plant batteries. Thermal Compensation should be used in a plant containing

“sealed” or valve regulated “maintenance free” batteries. Note that Thermal Compensation is automatically enabled if the system controller detects the presence of a VT-Probe. Refer to the Installation Instructions for more details on wiring and configuring this feature.

Thermal Compensation lowers plant voltage from the fsp for monitored battery temperatures which are above the ideal temperature established during configuration as the Battery Thermal Slope Nominal Temperature (ntt). (The items in parenthesis are the user configurable points referred to in the graph shown below.) Lowering the plant voltage 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 (stp), plant voltage drops in a single step to a level which keeps the remaining cells in the string from overcharging and being damaged. Refer to Figure 6-2 for a graphical view of Battery Thermal Compensation and the relationship of its various set points.

The ES740AD can also increase plant voltage above that set by the fsp or bsp for colder environments, again seeking to keep batteries at their optimum charge state. Batteries will lose capacity as the battery temperature drops below their optimal operating temperature. Increasing the plant voltage for decreases in temperature causes more current to flow into the batteries. This results in electrolysis of the water in the batteries. Since this reaction is exothermic, it also serves to keep batteries warm. This feature results in an increase in plant voltage, and is required to be enabled during controller configuration.



1. The Battery Thermal Alarm occurs when the temperature rises above the thr set point. It retires when the temperature decreases to 10°C below the thr set point (45°C default).
2. Plant voltage decreases an additional 0.17 volts per cell when the temperature increases above the spt set point. It is increased 0.17 volts per cell when the temperature decreases to 10°C below the spt set point, as indicated by the dashed line (65°C default).

Figure 6-2: Slope Thermal Compensation

The following describes the configuration parameters which may be activated or altered by the user. Refer to Appendix B for the ranges of values the parameters may take and their factory default settings.

Lower Thermal Limit (ltt): The lower temperature where, if Low Temperature Compensation is enabled, the Yukon controller will increase plant voltage to a level corresponding to $(lsp * (ntt - ltt) * 24)V$ above the fsp. Plant voltage will be increased proportionally at any temperature between this point and the Battery Thermal Slope Nominal Temperature (ntt).

Low Temperature Compensation Enable (rve): A 0 disables and 1 enables the Low Temperature Thermal Compensation feature. Since rve increases plant voltage rather than decreasing it based on temperature,

the option is provided to disable it separately from the entire feature so that equipment loads sensitive to high voltages can be protected.

Lower Temperature Slope (lsp): The slope rate for the voltage increase per cell when the battery temperature is below the ntt (Battery Thermal Slope Nominal Temperature).

Battery Thermal Slope Nominal Temperature (ntt): The zero compensation temperature point. Temperatures monitored between this point and the Upper Temperature Limit (utt) will result in a proportional decrease of plant voltage to a level corresponding to $(usp*(utt-ntt)*24)V$ below the fsp at the utt. If Low Temperature Compensation is enabled, temperatures monitored between this point and the Lower Thermal Limit (lft) will result in a proportional increase of plant voltage to a level corresponding to $(lsp*(ntt-lft)*24)V$ above the fsp at the lft.

Upper Temperature Slope (usp): The slope rate for the voltage decrease per cell when the battery temperature is above the ntt (Battery Thermal Slope Nominal Temperature).

Upper Temperature Limit (utt): The upper temperature where Battery Thermal Compensation will have reduced plant voltage to a level corresponding to $(usp*(utt-ntt)*24)V$ below the fsp. Plant voltage will be reduced proportionally at any temperature between this point and the Battery Thermal Slope Nominal Temperature (ntt).

Battery Thermal Alarm Threshold (thr): A monitored battery temperature above this threshold results in a Battery Thermal alarm with a PMN severity.

Battery Thermal Step Temperature (spt): A monitored battery temperature above this threshold results in an additional 4.08V “step” decrease in plant voltage.

Plant Battery Test

The purpose of this test is to allow the user to determine whether the connected battery strings can supply the requisite capacity. This test is activated by either a user-supplied contact closure across pins 19 and 20 of the host-interface connector, or by initiating the Plant Battery Test via the TI. See Appendix B for details.

During this test, the controller lowers the rectifier voltage to 44V. (This value was chosen to be higher than 1.2V plus the highest possible LVD contactor disconnect threshold so as not to accidentally open the LVD

contactor.) Lowering the rectifier output voltage to 44V creates a battery on discharge condition. If the batteries are present and healthy, the plant voltage will remain above 48V and the batteries will support the load. If the batteries are not present or are not able to support the load, the plant voltage will immediately drop to approximately 44V without any consequence to the load. The Battery on Discharge alarm is masked during this test.

The test is terminated by the occurrence of any of the following conditions:

- Releasing contact, if initiated by contact closure of pins 19 and 20 of the host-interface connector.
- Initiating another Plant Battery Test. That is, once the test has been initiated from the TI, the test may be stopped by initiating another test from either the TI or by contact closure of pins 19 and 20 of the host-interface connector.
- An alarm condition occurring. Any alarm condition that occurs during this test will result in the test being aborted regardless of whether the contact-closure exists between pins 19 and 20 of the host interface connector.
- The test has continued for over 100 minutes.
- The plant voltage has dropped below 44V. In this case, the system will abort the test and resume rectifier operation.

After the test has stopped, the plant will revert to the float mode. It may go to boost mode if the auto-boost feature has been enabled.

Note that during the Plant Battery Test, the LED on the controller will blink in amber color to signify the test running. It will retire upon completion of test, abortion of test, or termination of test.

Boost Charge

Boost charging is a feature of the ES740AD controller, which allows the user to temporarily raise the plant voltage to a higher, predetermined level in expediting the time needed to charge batteries. The Yukon plant may manually be placed in the boost-mode by setting the Plant State to Boost via the TI.

While in Boost mode, plant voltage is determined by the configuration parameter Rectifier Boost Set-Point (bsp). Refer to Appendix B for details.

Note that the measured boost voltage may not exactly match the value chosen by the user if the thermal compensation feature is enabled. This is because the ES740AD performs thermal compensated boost charging and will adjust the boost value based on the battery temperature per the slope chosen by the user.

The plant will exit the boost mode and enter the float mode if any of the following occurs:

- The current flowing into the battery string(s) is less than 5A
- The duration of boost mode charging has reached 8 hours
- The controller receives either a High-Voltage, Rectifier Fail alarm, or High-Battery Temperature alarms
- User sets the plant state to Float via the TI.

Once initiated, the boost mode may be exited by placing the Plant State to Float.

Auto-Boost Charge

This feature may be enabled from the TI. See Appendix B for details. When enabled, the plant enters the boost-charging mode of operation following a battery discharge once the BD alarm has been retired, provided the duration of the discharge was greater than 4 minutes. The controller will not enter the auto-boost-charging mode if the discharge duration was less than 4 minutes.

When in auto-boost mode, the controller raises the plant voltage to the value selected by the user. The controller keeps the plant in this mode of operation for a minimum of 5 minutes.

The exit conditions for the Auto-Boost Charge are the same as those for Boost Charge.

Redundancy Loss Function

This feature must be enabled from the TI. See Appendix B for details. The controller determines the number of rectifiers present and compares the actual currents being drawn by the load to that produced by the total number of rectifiers less one. If the measured load current exceeds the N rectifier's capacity for over 1 min, the alarm condition is activated. The alarm condition is latched on until the user activates the CLE command from the front panel switch or via the TI.

This feature may be used by customers to determine if the load being served is greater than N rectifiers worth, in an N+1 system. That is, the

load requirements have changed such that the power system is no longer operating as a redundant power system. An additional rectifier may be required to ensure continuous redundant operation.

If enabled, this feature will be disabled during battery discharge and recharge conditions. It will be enabled when the battery charging current falls below 5A.

***Battery Voltage
Imbalance
Detection***

This feature requires the use of the ES771A Remote Voltage Monitoring Module. Note that this feature is automatically enabled if the Yukon controller detects the presence of the ES771A module. This module is to be placed in the electronics cabinet and utilizes the ES773A VT-Probes to measure the voltage of the battery string being monitored. The VT-Probe is to be placed on a battery terminal in the middle of the battery string. The Yukon controller has data on the plant voltage; the half-string voltage measured from each monitored battery string is compared to the plant voltage minus the measured half-string voltage. If the comparison results in a difference of greater than 1.7V for longer than 24 hours, the alarm is asserted. The alarm may be retired by initiating the CLE command from the front panel switch or via the TI.

After this feature has been enabled, the system waits for 12 hours to ensure the battery strings are stable. A battery string is considered to be stable if the charging current is less than 3A. If a stable battery string yields a difference measurement greater than 1.7V for over 12 continuous hours, a Battery Voltage Imbalance alarm is generated.

When the alarm is issued, the Float Set-Point (fsp) and the Battery on Discharge (BoD) threshold values are reduced by 1/24th. Once the alarm has been cleared by the CLE command, the plant reverts to its normal fsp; however, the BoD threshold is maintained at the new threshold for up to four minutes before reverting back to the old threshold. This is done to ensure the batteries have had enough time to charge up to the nominal fsp and to prevent any spurious BoD alarm conditions.

This feature may be used by customers as part of their overall battery maintenance program in determining the health of battery strings. A voltage imbalance of 1.7V between half-string voltages may mean a shorted-cell somewhere in the string. A service person should be sent out to the site and determine if the string should be replaced.

***Imminent
Shutdown***

This feature must be enabled from the TI. See Appendix A for details. During a battery on discharge event, the load is being supplied by the batteries. As the voltage on the battery string goes lower and crosses the

disconnect threshold, the LVD contactor will disconnect the batteries from the load. This prevents batteries from being damaged from deep discharge. When enabled, the system controller will alarm the host that the LVD contactor will disconnect the battery string from the load in 15 seconds. This alarm may be used by the host system to perform an orderly shutdown, e.g., write critical system data onto a hard drive.

Lamp Test

Momentarily depressing the Lamp Test button on the controller will illuminate all LED's to ensure their proper operation. Multi-colored LED's will change color mid-stream.

CLE (Clear Latched Events)

When the system is first turned on, the controller makes note of all devices that are on its RS-485 bus, including rectifiers, ringers, LVD cards, and monitoring modules. If one of the devices fail or is removed, the controller sends the appropriate alarm to the host. Service personnel may then either replace the failed device, which causes the controller to reset, or the user may remove the defective device and activate the CLE feature. This allows the controller to update its list of active devices. The user then may replace the failed unit with a new unit at which time the controller will automatically update its list of active devices.

Latched events include communication failures, missing rectifiers, missing ES773A VT-Probes, missing ES771A Voltage Monitoring Module, open distribution fuses or circuit breakers, and the loss of redundancy alarm. This function is initiated by running the command from a terminal connected to the programming connector of the controller.

The CLE function may be initiated either by pressing the Lamp Test button for greater than 5 seconds or by running the command from a terminal connected to the programming connector of the controller.

Battery Recharge Current Limit

This feature must be enabled from the TI. See Appendix A for details. The battery recharge current limit feature enables the ES740AD controller to limit the recharge current flowing into a battery section during the charge cycle. The recharge current flowing into the battery section can be limited to any value between 5A and 100A.

Note that this feature will not have any impact on the current being delivered to the load. Further, there will be no effect on the discharge current flowing from the battery strings to the load during an ac fail condition. The controller will maintain the recharge current within 10% of the set level.

Alarms and Alarm Relays

Alarms

AC Fail: The ac fail alarm is asserted when the controller detects a single ac fail alarm from any rectifier. This alarm condition may be given if a rectifier's input voltage is missing or has gone below the minimum ac voltage necessary for normal operation of the rectifier. See Rectifier in Section 7 for more details.

Battery High Temperature: This feature is only possible when used with slope thermal compensation. The battery thermal alarm is asserted when the controller detects battery temperatures in excess of 55°C. The alarm is retired when the battery temperatures drop 10°C below the alarm threshold. See Slope Thermal Compensation in this section for details.

Battery on Discharge: The battery on discharge alarm is asserted when the controller detects the plant bus voltage going below the Battery on Discharge thresholds set by the user.

The Battery on Discharge alarm typically occurs during an ac failure condition. During this alarm condition, the system controller loses communication with the rectifiers. Running the CLE command during this time will not result in clearing the controller's count of acknowledged rectifiers.

Circuit Pack Failure: The circuit pack failure alarm is asserted when the controller detects a failure in the on-board 1-Wire[®] processor or one of the future option boards.

High Battery Current: This is an alarm from the LVD boards to indicate that the current flowing through it is exceeding 110% of its rated current. See LVD Boards in Section 8 for more details and thresholds.

High Battery Current Shutdown: This is an alarm from the LVD boards to indicate that the current flowing through it is exceeding 121% of its rated current and that it will disconnect the batteries from the load to protect itself. See LVD Boards in Section 8 for more details and thresholds.

High Voltage: The high voltage alarm is asserted when the controller detects the plant bus voltage going above the High Voltage threshold set by the user. Plant voltage monitored above this threshold results in a High Voltage alarm while either in Float or Boost mode.

When boost charging will be used, the High Voltage Alarm threshold must be set above the Boost Set-Point (bsp), or else a High-Voltage Alarm will be sent every time the system enters boost charge mode. See Appendix B for range of values for this alarm.

Imminent Shutdown: If enabled, the imminent shutdown alarm is asserted when the controller detects the LVD board about to disconnect the batteries from the load to prevent them from deep discharge. If asserted, this alarm may be used by the host to perform an orderly shutdown. See Imminent Shutdown above for more details.

Auxiliary Major: The auxiliary major alarm is asserted when the controller detects an external equipment fail alarm, if present and monitored. This alarm is activated when a contact closure exists on pins 23 and 24 of the host-interface connector. This alarm may be used with external equipment that creates a contact closure upon an event.

Major Communications Failure: The major communications failure alarm is asserted when the controller loses communication with multiple rectifiers, the LVD board, or the ringer board.

This alarm is masked for the rectifier if the ACF or RFA alarms are detected prior to loss of communications in the failed rectifier. This is because an ac fail or rectifier fail condition would also cause communications loss with the controller for valid reasons. The alarm is not asserted if loss of communications occurred as a result of the above reasons.

Major Fuse: The major fuse alarm is asserted when the controller detects an open load protector in the Aux Box.

Minor Communications Failure: The minor communications failure alarm is asserted when the controller can not detect a device that is required to be present. Alarm applies to rectifiers only.

This alarm is masked for rectifiers if the ACF or RFA alarms are detected prior to loss of communications in the failed rectifiers, see Major Communications Failure for more details.

Multiple AC Fail: The multiple AC fail alarm is asserted when the controller detects multiple ac fail alarms from the rectifiers. See Section 7 (Rectifier) for more details.

Multiple Rectifier Fail: The multiple rectifier alarm is asserted when the controller detects multiple rectifier fail alarms from the rectifiers. See Section 7 (Rectifier) for more details.

Open String: This alarm is only available when used with the ES772A Remote Distribution Module. This alarm is issued to indicate an open charge path to batteries when an external disconnect switch is used to disconnect the batteries from the charge bus; it is asserted with a PMJ severity. See Section 12 for more details including the required wiring connections to the ES772A from the Yukon power system.

Rectifier Fail: The rectifier fail alarm is asserted when the controller detects a single rectifier fail alarm from any rectifier. See Section 7 (Rectifier) for more details.

Rectifier Redundancy Loss: If enabled, the rectifier redundancy loss alarm is asserted when the total rectifier output current exceeds N rectifier capacity, assuming N+1 rectifiers are present in the system. See Redundancy Loss above for more details.

Ringer Fail: The ringer fail alarm is asserted when the controller detects a ringer fail alarm from the ringer, if present. See Section 10 (Ringer Module) for more details.

Ringer-Half Power: The ringer half-power alarm is asserted when the controller detects a single ringer module failure on the ringer card, if provided. See Section 10 (Ringer Module) for more details.

Sense Fuse: The voltage sense fuse alarm is asserted when the controller senses the bus voltage to be lower than 35.5V +/- 0.5V.

Voltage Imbalance Detection: If enabled and properly configured, the voltage imbalance detection alarm is asserted when the controller detects an imbalance between the two halves of each battery string being monitored. See Voltage Imbalance above for more details.

Alarm Relays

The control unit is provided with four alarm relays; two to provide the actual alarm condition, and two to provide the severity associated with the alarm. The severity relays transmit the either PMJ or PMN. Each alarm is factory assigned a severity based on industry practices; however, they may be reassigned to either MAJ, MIN, or RO (Record Only). An alarm condition with the RO severity results in the system controller transmitting the alarm without the severity. That is, neither MAJ (PMJ) or MIN (PMN) is transmitted with the alarm.

The two selectable alarm relays are called Alarm Relay 1 (R1) and Alarm Relay 2 (R2). Relays R1 and R2 are user definable in that the user may assign any combination of alarms from a given set of alarms. The following table shows which alarms may be assigned along with their factory default settings.

Alarm	Assignable	Default Severity	Default Alarm Relay
AC Fail	Yes	MIN	R2
Auxiliary Major	Yes	MAJ	--
Battery High Temp	Yes	MIN	--
Battery on Discharge	Yes	MAJ	R1
Battery Voltage Imbalance Detected	Yes	MAJ	--
Circuit Pack Failure	No	MIN	--
Contactor Fail	No	MAJ	--
Contactor Open	No	MAJ	--
Fuse Major	Yes	MAJ	--
High Battery Current	No	MIN	--
High Battery Current Shutdown	No	MAJ	--
High Voltage	Yes	MAJ	--
Imminent Low V Shutdown	Yes	MAJ	--
Major Communication Fail	No	MAJ	--
Minor Communication Fail	No	MIN	--
Multiple AC Fail	Yes	MAJ	R2
Multiple Rectifier Fail	Yes	MAJ	--
Open String	Yes	PMJ	--
Rectifier Fail	Yes	MIN	--
Rectifier Redundancy Loss	Yes	MIN	--
Ringer Failure	Yes	MAJ	--
Ringer Half Power	Yes	MIN	--
Sense Fuse	No	MAJ	--
Thermal Probe Fail	No	MIN	--

This feature allows the user to uniquely assign only those alarm conditions that they consider important and be alarmed for them.

All alarm relays are Form-C type and have the NO, NC, and C pins available on the host interface connector on the rear of the Aux Box. The relays are rated for a maximum contact voltage of 60Vdc and maximum contact current of 0.5A.

When an alarm occurs or power is removed from the control unit, a closure exists between the NC and C contacts and an open exists between the NO and C contacts. If one wanted a contact-closure on an alarm condition, one would place the detection circuitry between the NC and C contacts. If one wanted a contact-opening on alarm condition, one would place the detection circuitry between the NO and C contacts.

7 Rectifier

Overview

The ES760A and ES761A Rectifiers convert ac to dc power for user equipment. This section describes the rectifier features, functions and alarms.

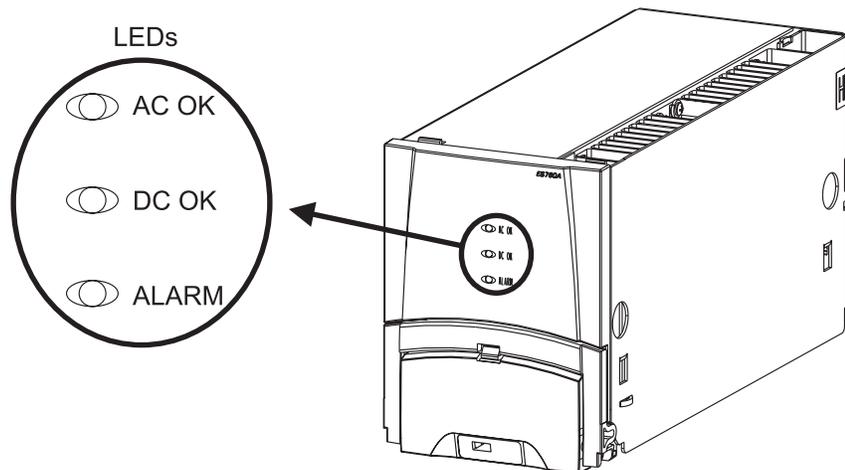


Figure 7-1: ES760A and ES761A Rectifier

The ES760A rectifier produces 650W from 85V-132Vac and from 150V to 275Vac. It operates from -40°C to 50°C with convection cooling and to 75°C with minimum 100 lfm (0.5 lms) of forced air-cooling.

The ES761A rectifier produces 1000W from 90Vac to 132Vac and 1400W from 150Vac to 275Vac. In both operating conditions, minimum 250 lfm (1.27 lms) forced-air cooling is required.

If the ES761A is initially powered up from 90V to 132V, it will operate as a 1kW rectifier and operate from 90Vac to 275Vac. If the ES761A is initially powered up from 170Vac to 265Vac, it will operate as a 1.4kW rectifier and will shut down for voltages below 150Vac.

Alarms and Displays

Status LEDs

Three LEDs are provided, two green LEDs named AC OK and DC OK, and a red LED named Alarm. Their indications are listed below, followed by complete status descriptions.

Status	LED		
	AC OK	DC OK	ALARM
Normal Operation	On	On	Off
High Voltage Shutdown	On	Off	On
Thermal Alarm	On	Off	On
Hiccup	On	Off	On
AC Fail	Off	Off	On
Current Limit Operation	On	Blink	Off
Remote Standby	On	Off	Off
Communication Loss	X	X	Blink

Status Descriptions

Normal Operation: Rectifier is operating within specified parameters.

High Voltage Shutdown: The Yukon rectifiers will shutdown if either of these conditions are true:

- If an individual rectifier's output voltage is above 58V for greater than 3 seconds.
- If an individual rectifier's output voltage is greater than 59.9V for 1ms.

In both cases, the rectifier will attempt to restart up to three times. If after the third attempt the fault conditions prevail, the unit will be latched off and will require user intervention.

If the rectifier does latch off, the power supply must be power cycled. This may be accomplished by disengaging the power supply from its mating connector on the shelf, waiting until the front panel LEDs have stopped illuminating and then reinserting it back in the shelf.

Thermal Alarm (Power Limiting): The rectifier power limits itself to protect itself from thermal damage, yet at the same time, trying to support the load. An internal critical temperature is monitored. If the temperature exceeds 108°C, the ES760A rectifier limits the output current to 10A. If the temperature exceeds 110°C, the rectifier will shutdown. It will restart when the temperature drops below 100°C.

If the temperature exceeds 108°C, the ES761A rectifier limits the output current to 14A when operating as a 1000W rectifier. If the temperature

increases to 108°C, the rectifier will shutdown. It will automatically restart when the temperature drops by 10°C.

If the temperature exceeds 108°C, the ES761A rectifier limits the output current to 20A when operating as a 1400W rectifier. If the temperature continues to increase to 110°C, the rectifier will shutdown. It will automatically restart when the temperature drops by 10°C

Prior to shutdown, the rectifier transmits a rectifier fail alarm to the system controller. While in the thermal shutdown mode, the rectifier front panel LEDs will light as indicated in the Status LED table.

Hiccup: If the rectifier output is short-circuited or if its output voltage drops below 36V, the rectifier will go into a hiccup mode. In this mode, the rectifier will shutdown for 10s and attempt to restart. If the short circuit conditions exist, the rectifier will shutdown and perform another restart in 10s. It will remain in this mode indefinitely until the short circuit condition is removed. While in the hiccup mode, the rectifier front panel LEDs will light as indicated in the Status LED table.

AC Fail: If the ac input voltage goes below 81V +/- 0.05% for greater than 4ms, the rectifier will transmit a Power Fail Warning (PFW) to the Yukon controller, which will in turn transmit an AC Fail alarm to the system controller. The signal is reset if the rectifier deasserts the PFW for more than 250ms.

For the ES761A, if the input voltage goes below 87V +/- 1% at nominal 120V (1kW) operation or below 148V +/- 1% at nominal 200-240V (1.4kW), the rectifier will transmit the PFW alarm to the system controller.

Current Limit: This is an indication that the rectifiers are delivering maximum current to the load. This is a situation that can occur after a battery on discharge event when the utility service comes back. The rectifiers will be powering the load as well as providing charging current to the batteries. Normal operation will resume and the blinking LED will stop blinking once the batteries are charged. See graph below for more details. While in the current limit mode, the rectifier front panel LEDs will light as indicated in the Status LED table.

Remote Standby: These rectifies may be placed in standby mode by the TI. When in standby, ac power is still provided to the rectifiers but the output is inhibited. When the controller is queried, it will report this rectifier's status as STANDBY. While in the standby mode, the rectifier front panel LEDs will light as indicated in the Status LED table.

Communication Failure: If the rectifier loses communication with the system controller, it will blink its Alarm LED. Once communication is lost with the system controller, the rectifier output voltage will remain at the last voltage set by the system controller.

Features and Functions

ES760A Output Power Curve

The following graph shows the ES760A rectifier's output power curve. Under approximately 650W, the rectifier operates in the constant voltage mode. Beyond 650W, the rectifier can deliver approximately 675W of output power before it enters the constant-power mode. The rectifier can deliver constant power to approximately 48Vdc. Further loading of the rectifier will result in the rectifier operating in the constant-current mode. If the rectifier is loaded below approximately 36V, the rectifier enters the hiccup mode.

The rectifier, during start-up, can deliver an increased amount of current for approximately 10 seconds. It provides roughly 16.5A of output current at 36V so as to ensure input capacitance of dc/dc converter loads do not overload the rectifier during their start-up.

Note that for prolonged operation at 50°C, full output power and ac voltage below 96Vac, the rectifier will power limit itself to 10A maximum.

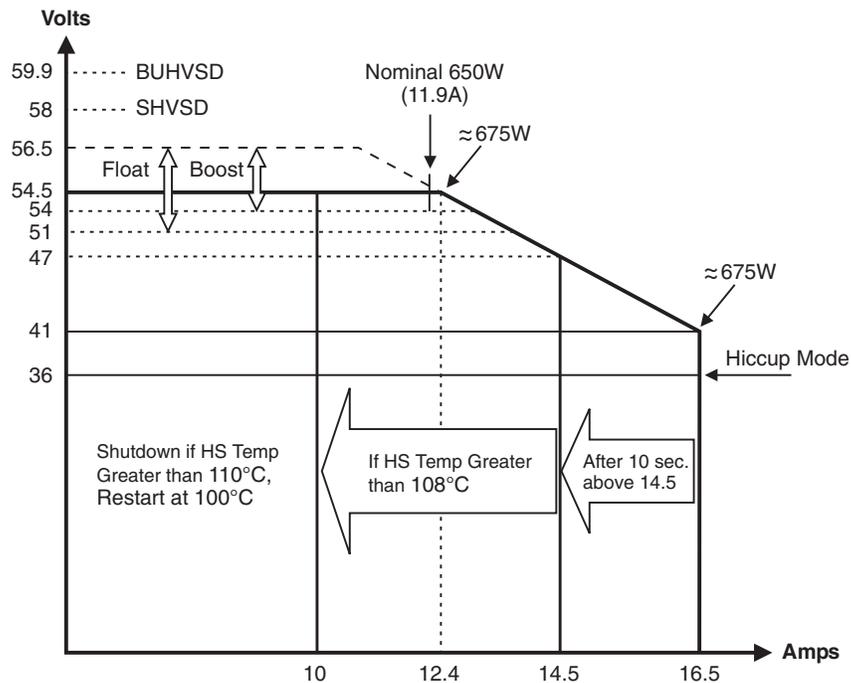


Figure 7-2: ES760A Power Curve

Output Voltage

The rectifier's output voltage is factory set to 52.0V. The voltage may be changed by the system controller. Note that the rectifier will remain at the last voltage it was set to should the system controller fail or be removed.

ES761A Output Power Curves

Low-Line

The Figure 7-3 shows the ES761A rectifier's output power curve operating at low-line (90-132Vac) and at 1000W. The rectifier operates in constant voltage mode until it hits 18A, whereby it operates in constant current mode. The rectifier can deliver constant current to approximately 36V, whereby it enters the hiccup mode.

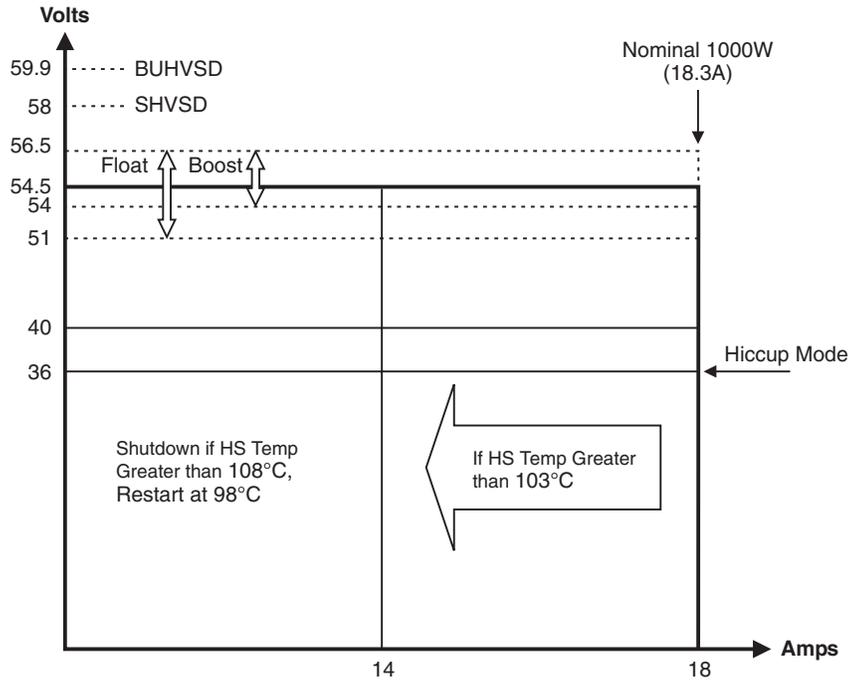


Figure 7-3: ES761A Low-Line Power Curve

High-Line

Figure 7-4 shows the ES761A rectifier's output power curve operating at high-line (150V-275Vac) and at 1400W. Under approximately 1475W, the rectifier operates in constant voltage mode. Loading beyond 1475W results in the rectifier entering the constant power mode. The rectifier can deliver constant power to approximately 48Vdc. Further loading of the rectifier will result in the rectifier operating in the constant-current mode. If the rectifier is loaded below approximately 36V, the rectifier reenters the hiccup mode.

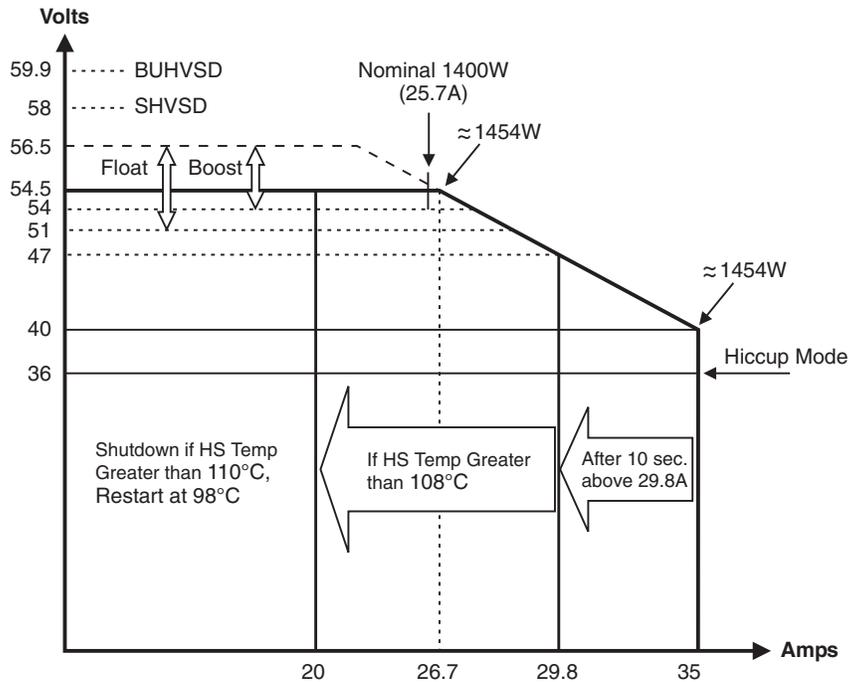


Figure 7-4: ES761A High-Line Power Curve

The ES761A rectifier during start-up and only in high-line operation can deliver an increased amount of current for approximately 10 seconds. It provides roughly 35A of output current at 36V so as to ensure input capacitance of dc/dc converter loads do not overload the rectifier during their start-up.

8 *LVD Boards*

Overview

This section describes the LVD board features, functions, and alarms. Figure 8-1 shows the ES712_LVD_A board. The following describes the components identified.

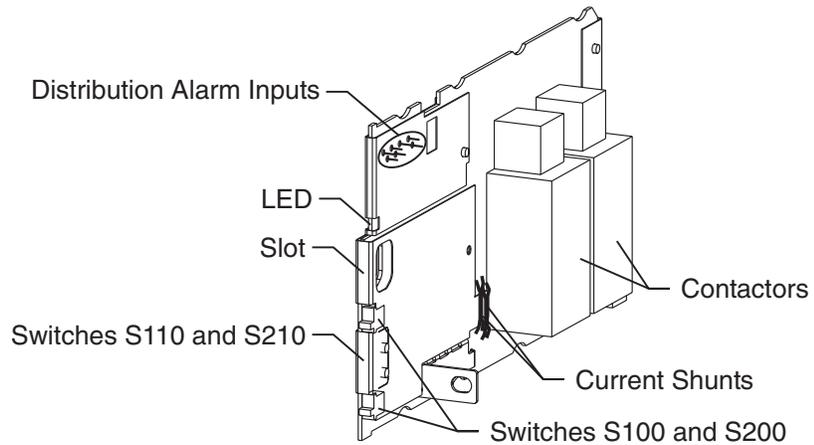


Figure 8-1: ES712_LVD_A Board

Distribution Alarm Inputs: These pins are used to detect open fuses or circuit breakers in the Aux Box modules. Pins J10 through J14 (marked CB ALM INPUT) detect open circuit breakers, while pins J15 and J16 (marked FUSE ALM INPUT) detect open fuses. See Aux Boxes for more details.

LED: This is a tri-color LED and will illuminate accordingly for the conditions shown below.

Status	LED		
	Green	Amber	Red
Normal	X		
Minor Alarm		X	
Major Alarm			X
Contactors Manually Opened with either S100 or S200		Blink	
Communication Loss with System Controller			Blink
Manual Reconnect Command Accepted	Blink (5 sec.)		

Slot: Use this to extract the LVD board from its mating receptacle and to extract it from the shelf.

Switches S110 and S210: These two switches perform the forced-reconnect function.

Switches S100 and S200: These two switches perform the battery disconnect function.

Current Shunts: These are 200A, 50mV devices. See the Installation section for more details.

Contactors: These contactors work in tandem to provide the low-voltage disconnect function, and separately to perform the battery maintenance disconnect function with Switches S100 and S200.

ES712_LVD_A: This LVD board is rated for maximum output loading of 4.0kW at 54.5Vdc, or 100A upon LVD disconnect.

ES712_LVD_B: This LVD board is rated for maximum output loading of 2.8kW at 54.5Vdc, or 70A upon LVD disconnect. It is similar to the LVD_A except that it has a single LVD contactor and no maintenance disconnect switches. See “Alarms” and “Features and Functions” for more differences.

To ensure that the maximum LVD currents are not exceeded, the current drawn by the load at a float voltage of 54.5V should not exceed 73.4A for the LVD_A board, or 51A for the LVD_B board.

ES712_LVD_C: This LVD board has no disconnect contactors, thus it does not support low-voltage battery disconnect, manual disconnect, forced reconnect, and reverse battery protection features. The power rating of this LVD board is based on 100A and the lowest input voltage the load equipment is capable of operating at.

For example, assuming the lowest operating input voltage specification for a load equipment is 35V, the power rating of this board then becomes 3.5kW (35V x 100A). Then, the maximum current loading at nominal battery float voltage is 64A (3.5kW / 54.5V). Perform a similar calculation on your load equipment to ensure you do not exceed the 100A rating.

ES712_LVD_D Note: This LVD board has battery disconnect with load disconnect ability and is for use only with the ES714AD Aux Box. This LVD board allows for opening of the load contactor prior to opening of the battery contactor and allows for load shedding when used in the ES714AD Aux Box. This board is rated for maximum output loading of 2.8kW.

Alarms

High Battery Current Warning

If the current flowing through the LVD boards exceed 110% of the maximum rated current, the LVD board's illuminates its LED in amber color and transmits the condition to the system controller. The system controller then transmits the High Battery Current alarm with a PMN severity.

High Battery Current Disconnect

If the current flowing through the LVD boards exceed 110% of the High Battery Current Warning threshold, the LVD board's illuminates its LED in red color and transmits the condition to the system controller. Also, the LVD board will open the contactors and disconnect the batteries from the output bus. The system controller transmits the High Battery Current Shutdown alarm with a PMJ severity. Note that the High Battery Current Shutdown alarm is not supported by the ES712_LVD_C. The thresholds for the High Battery Current and High Battery Current Shutdown are shown below.

	Warning	Disconnect
ES712_LVD_A	110A	121A
ES712_LVD_B	76A	84A
ES712_LVD_C	110A	--
ES712_LVD_D	76A	84A

Single Contactor Failure

If the status of the LVD contactor does not agree with the controller, the system controller transmits a Contactor Fail alarm with a PMJ severity. For example, the alarm condition will be given if the system controller commands the LVD board to close the contactors and the status of the contactors indicate that they are open. During this condition, the LVD board's LED is illuminated in red color.

If a single contactor fails on the LVD_A board, the Warning threshold is reset to 76A and Disconnect threshold changes to 84A. This board provides limited reserve time under a single contactor failure. The actual time will depend in large part to the load. That is, the time required to reach the disconnect threshold is dependent on the load being served. The LVD_B board will not have any reserve capability during a contactor failure condition. In either case, the respective LVD boards should be replaced as soon as possible after the condition is transmitted. This alarm is not provided on the ES712_LVD_C.

If the load contactor fails on the ES712_LVD_D board, the non-critical load will be dropped. If the priority contactor fails, the priority load will still be supported by the rectifiers; however, battery reserve will be lost. This board should be replaced as soon as possible after the condition is transmitted.

Contactor Open

If either (or both) switches S100 or S200 are in the OFF position, the LVD boards open their respective contactors. The system controller then transmits the Contactor Open alarm with a PMJ severity. As the contactor is manually opened, the LVD board will blink its LED in amber color. This alarm is not provided on the ES712_LVD_C.

Communication Failure

If the LVD board loses communication with the system controller, it will blink its LED in red color. Note that during a battery on discharge event, the system controller signals the LVD board to disconnect the batteries from the system once the battery strings have discharged to the threshold voltage set by the user. This command is not possible during a communication failure. If communication is lost during this event, the LVD boards will disconnect at the backup disconnect voltage of 35V +/- 1V.

Similarly, when the utility supply source returns, the rectifiers will power up and the output bus voltage will rise to the Float Set Point set by the user. Once the output voltage crosses the reconnect threshold also set by the user, the system controller commands the LVD board to close the LVD contactors and connect the batteries to the bus voltage. During communication loss with the controller, this command will not be possible. In this case, the LVD boards will reconnect at the backup reconnect voltage of 48V +/- 1V.

Features and Functions

Reverse Battery Protection

Note: This feature is not available on the ES712_LVD_C board.

This feature prevents closure of the LVD contactors if the LVD board detects the battery strings are connected in reverse polarity.

Note that the system will prevent contactor closure only if it detects improper polarity. If no batteries are connected to the system and the Yukon system is powered up, the LVD board will close the contactors and present the output bus voltage at the battery terminals.

If an external disconnect switch is being used to take battery strings off-line for replacement, care must be taken to ensure battery connections are correct at the switch. This is because the contactors remain closed when an external disconnect switch is used to disconnect the batteries from the bus. If the batteries are reconnected in reverse polarity, closing the switch will result in the batteries being connected to the bus in reverse polarity.

This added feature is only supported on the ES712_LVD_A and ES712_LVD_D boards. Both contactors on these boards will open if a battery string was replaced using the manual disconnect switch and connected in reverse polarity. During this time, no reserve capacity will be provided to the system. Determine the improperly connected battery string and manually open its switch, the properly connected string will then be reconnected to the system. This feature is not available on the ES7123_LVD_C board.

Battery Disconnect Function

This feature is found only on the ES712_LVD_A and ES712_LVD_D boards. Placing either S100 or S200 (ES712_LVD_A only) in the OFF position results in the opening of a contactor and removal of the battery string from the bus. This allows the battery string to be worked on during a maintenance procedure. When any or both switches are in the OFF position, the system controller will transmit a Contactor Open alarm with a PMJ severity. The LVD board will blink its LED in amber to signify manual contactor open.

Note that if either manual disconnect switch is used to disconnect and remove a battery string from the plant, then reconnected in reverse polarity and an attempt was made to reconnect the battery string to the system by closing the manual battery disconnect switch, the LVD board will detect the improper polarity and open both contactors. The LED on the LVD board will stop flashing in amber and show a steady red.

During this time, both the Contactor Fail and Contactor Open alarms with a PMJ severity will be transmitted.

If an external disconnect switch is being used in conjunction with the ES712_LVD_A board, the external switch must be closed prior to closing the manual disconnect switch in order for the reverse battery protection feature to work.

Note that switch S100 will open the contactor to the Batt 1 terminal on the Aux Box, and switch S200 will open the contactor to Batt 2.

Forced Reconnect of Batteries

This function allows the Yukon system to resume powering the load after low voltage disconnect of batteries following a battery on discharge event. The fully depleted battery strings are to be replaced with fully charged strings. Once the strings have been replaced, depressing switches S110 and S210 on the front of the LVD board will result in the LVD contactors closing and the LED blinking in green color. Continue to depress the switches until the LED stops flashing and displays a continuous green color. This indicates acceptance of command and continued closure of contactors.

Note that releasing the switches prior to the LED displaying a continuous green color will result in the contactor opening and removing power to the load.

The ES712_LVD_B has only the S110 switch and a single contactor.

This feature is not available on the ES712_LVD_C.

The ES712_LVD_D has only the S110 switch and both a load and battery contactors. Depressing the S110 switch will result in the battery contactor closing and the system coming to life. Once the system comes to life, the load contactor will close.

Load Shedding

This feature is only provided on the ES712_LVD_D board and the ES714AD Aux Box. Two contactors are provided on this board, one for load shedding and one for battery disconnecting. The contactors can be programmed to have different disconnect thresholds. The load contactor is to power non-critical loads, which may be dropped earlier during a battery on discharge event to preserve uptime for the critical loads. The load contactor is connected to circuit breakers CB3 and CB4 and to fuses F3 and F4 in the ES714AD Aux Box. Circuit breakers CB1 and CB4 and fuses F1 and F3 are for the critical loads and bypass the load disconnect contactor.

9 *Auxiliary Boxes and Peripheral Devices*

Overview

The Auxiliary Box (Aux Box) is where battery, load, and output ground connections are made. It provides output load protection options of either DIN style circuit breakers or GMT fuses. It is also houses the controller, the LVD board, and the ringer module.

There are two types of Aux Boxes, the controller only Aux Box and the distribution Aux Boxes. The controller only Aux Box provides housing for a controller and connections for the office-alarm and VT-Probe cables. This Aux Box is designed for bulk-output from the Yukon shelf to an external distribution panel and allows for the maximum number of rectifiers on a shelf. The remaining Aux Boxes provide for circuit-breaker or fuse distribution options, battery connections, low-voltage battery disconnect and an optional ringer. Being wider than the controller only Aux Box, it takes up the space of one rectifier slot.

The ES712A/B Aux Boxes require rear access to make battery, CO Ground, office alarm, and VT-Probe connections; the ES712B Aux Box also requires rear access to make load return connections. The ES710A, ES713A, and ES713B Aux Boxes allow all connections from the front and side.

The ES712AD/BD, ES713AD/BD, and the ES710AD are identical to the ES712A/B, ES713A/B, and ES710A, respectively, except that they provide for a display option.

The ES714AD Aux Box provides four circuit breaker and four fused load protectors and provides for load shedding. Two of the circuit breakers and two of the fuses are placed in series with the load disconnect contactor, while the other two circuit breakers and fuses bypass the load disconnect contactor. Note that the ES714AD Aux Box is only for use with the ES712_LVD_D LVD board.

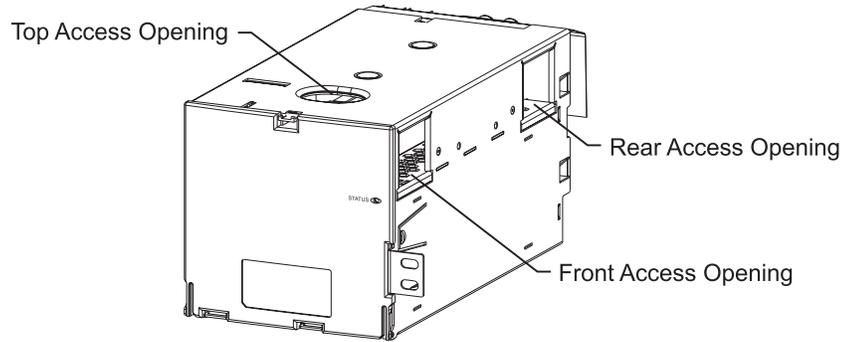


Figure 9-1: ES712A/B Auxiliary Box

Top Access Opening

This access point may be used to route load cables for fused or circuit breaker outputs.

Front Access Opening

This access point may be used to guide load cables for fused outputs.

Rear Access Opening

This access point may be used to guide cables in making battery positive and CO ground cable terminations. **Note:** that this access may be blocked if using the mid-mount adapters, see Installation Instruction for more details.

ES712A Fuse Distribution

This aux box is for use with the ES700A and ES701A flush-front shelves. It will not work with the mid-mount ES700B, ES701B and ES701C Shelves.

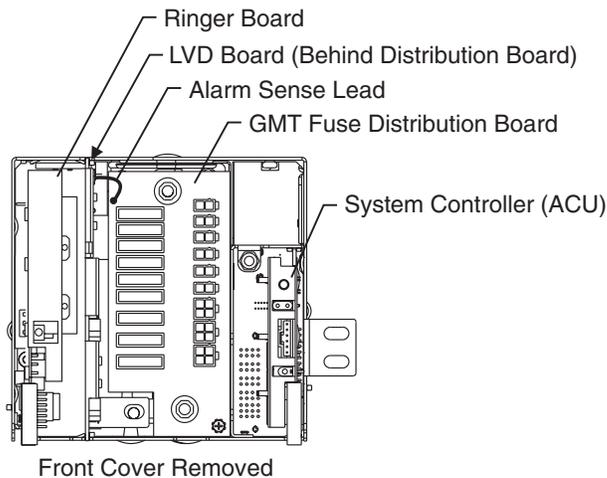


Figure 9-2: ES712A Fuse Distribution Aux Box

Figure 9-2 shows the arrangement of circuit cards in the ES712A Aux Box. The ES712A is provided with the fused distribution output board. The board uses the GMT fuses from Bussman. The top five positions are for maximum 12A fuses while the lower three positions are for maximum 15A fuses. Note that all nominal loads are to be at maximum 80% of the fuse value. Also note that the total power from the distribution module is limited by the LVD Board chosen. Refer to Section 8 (LVD Boards) for more details.

The fuse distribution board is provided with an alarm sense wire that must be connected to a Fuse Alarm Input pin on the LVD board. This allows the system controller to detect open fuses, and send appropriate alarms and contact closures. See Installation Instructions for more details.

Load cables may be purchased from Lineage Power, see page 3-5. Alternatively, users may create their own load cables and terminate the mating connector to the load receptacles on the Aux Boxes to the Yukon end of the cable.

The manufacturer of the mating part is Molex. Note that 16AWG cables are recommended for all load cables; the 12A positions use a pair of cables and the 15A load connections utilize two pairs of cables.

Load Rating	Part. Number	Positions	Socket
12A	39-01-2025	2	44476-3111
15A	39-01-2045	4	39-00-0079

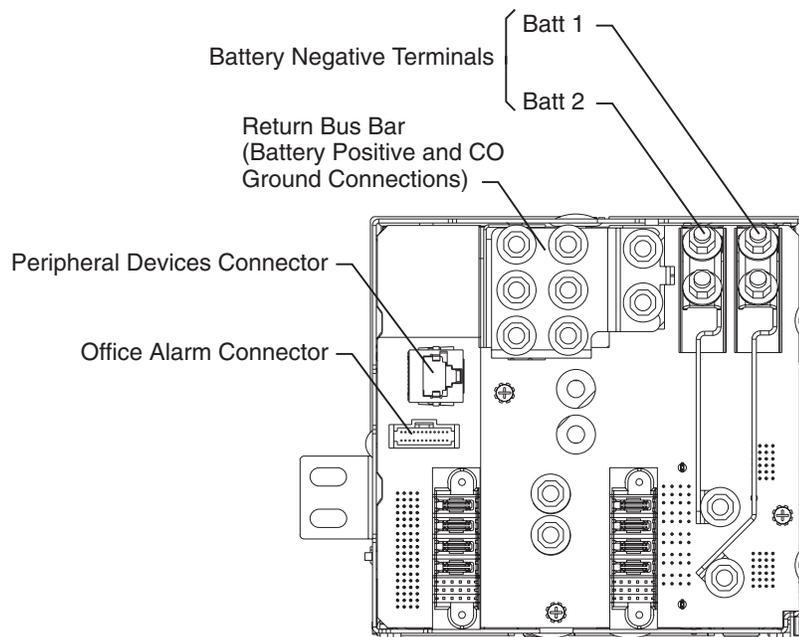


Figure 9-3: ES712A Aux Box, Rear View

Battery Negative Terminals: Batt 1 and Batt 2 are lug terminations for the battery negative connections. The terminals accept M5 lugs on 5/8-inch centers.

Note that the forced reconnect switches (S110 and S210) and the manual disconnect switches (S100 and S200) correspond to Batt 1 and Batt 2, respectively.

Return Bus Bar: These terminals are for battery return and CO ground connections. Three lug terminations are provided: two for the battery positive connections and the third for the CO Ground termination. The terminals accept M5 lugs on 5/8-inch centers.

Peripheral Devices Connector: This is an RJ-45 connector and connects devices such as the ES771A Remote Voltage Monitor Module, ES772A Remote Distribution Module (to be developed) and the ES773A Voltage/Thermal Probes. Future developments will allow for a cable assembly to connect the Yukon system to an un-grounded PC for custom programming of the system controllers.

Office Alarm Connector: Also known as the Host Interface Connector, this connector provides access to the alarm relay pins, has inputs to perform the Plant Battery Test and has inputs to alarm for external equipment failure. The connector has the following pin designations.

Pin	Designation	Pin	Designation
1	PMJ NO	2	PMJ C
3	PMJ NC	4	PMN NO
5	PMN C	6	PMN NC
7	R2 NO	8	R2 C
9	R2 NC	10	R1 NO
11	R1 C	12	R1 NC
13	RESERVED	14	RESERVED
15	RESERVED	16	RESERVED
17	RESERVED	18	RESERVED
19	PBT_IN	20	SIG_RTN
21	RESERVED	22	RESERVED
23	AUX_PMJ	24	AUX_PMJ_RTN

The connector is an AMP AMPMODU type 1-104068-1 connector. It mates to an AMP-LATCH type 111196-5, 24 position receptacle.

Cable assembly 848642559 provides 6-ft (1.8m) of cable terminating on one end in the mating connector and is un-terminated on the other end. Users may order this part, size and terminate accordingly for the application. The black wire on the ribbon cable is connected to pin 1.

Note that PBT is the Plant Battery Test and is referenced to SIG_RTN. See Controller section for more details.

The AUX_PMJ and AUX_PMJ_RTN are the contacts for the Auxiliary Major Fuse Alarm. See Auxiliary Major Fuse in Section 6 for more details.

ES712B Circuit Breaker Distribution

This aux box is for use with the ES700A and ES701A flush-front shelves. It will not work with the mid-mount ES700B, ES701B and ES701C Shelves.

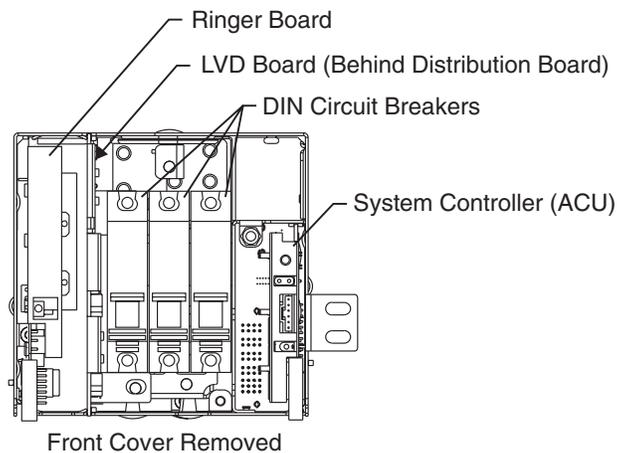


Figure 9-4: ES712B Circuit Breaker Distribution Aux Box

The ES712B Aux Box is provided with three positions for DIN style circuit breakers. The breakers chosen are type C60N from Merlin Gerin. Note that all loads are to be at maximum 80% of the circuit breaker value. Also note that the total power from the distribution module limited by the LVD Board chosen, refer to section 8 (LVD Boards) for more details.

Refer to Appendix D for circuit breaker derating information.

The circuit breaker distribution module is provided with three alarm sense wires that must be connected to the circuit breaker compression lug along with the load cable. This will allow the system controller to

alarm for open circuit breakers. See Installation Instructions in Section 5 for more details.

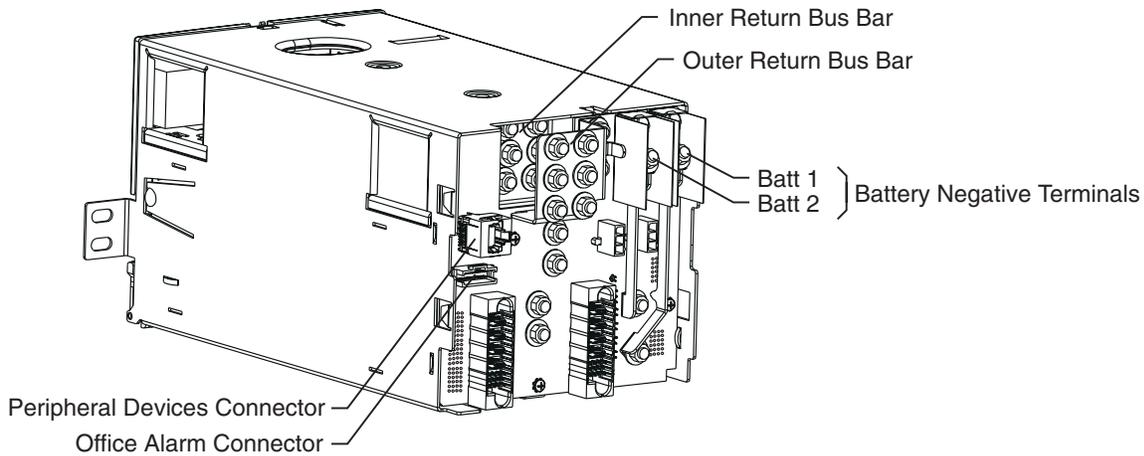


Figure 9-5: ES712B Aux Box, Rear View

Inner Return Bus Bar: Three double-hole lug terminations are provided for CO ground, load and battery returns. The terminal accepts M5 lugs on 5/8-inch centers. Refer to ES712B in the Battery and Load Return Connections section of the Installation Instructions in Section 5 for more details.

Outer Return Bus Bar: This bus bar is located behind the inner return bus bar, and must be removed for access to the inner bus bar. Three double-hole lug terminations are provided for battery and load returns. The terminals accept M5 lugs on 5/8-inch centers. Refer to ES712B in the Battery and Load Return Connections section of the Installation Instructions in Section 5 for more details.

Battery Negative Terminals: Same as ES712A.

Office Alarm Connector: Same as ES712A.

Peripheral Devices Connector: Same as ES712A.

ES713A and ES713AD Fuse Distribution

This aux box is for use with the mid-mount ES700B, ES701B and ES701C Shelves. It will not work with the ES700A and ES701A flush-front shelves.

The ES713A/AD Aux Boxes are provided with a fused distribution board for 14 load connections. Load connections are made using Amp FastOn Tabs, the mating tab should be 0.032 in by 0.187 in and should be the insulated types. Lineage Power recommends Amp Part Number 2-520411-2 for 22-18AWG conductors and Part Number 3-520412-2 for 16-14 AWG conductors. Note that all nominal loads are to be at 80% of the fuse value. Also note that the total power from the distribution module is limited by the LVD board chosen. Refer to Section 8 (LVD Boards) for more details.

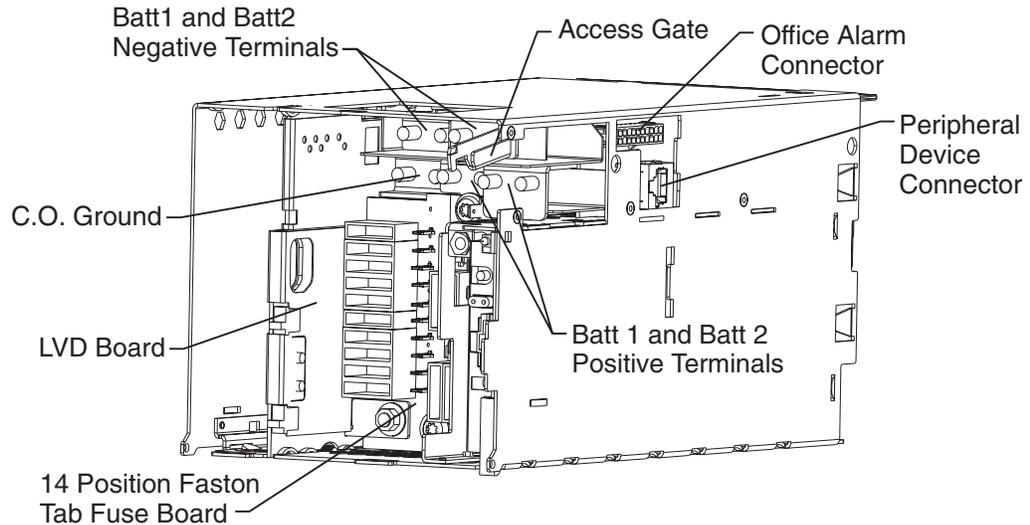


Figure 9-6: ES713A/AD Aux Box

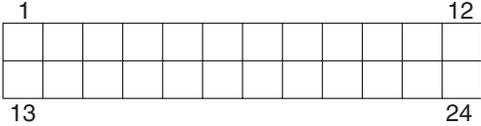
The fuse distribution board is provided with an alarm sense wire that must be connected to a Fuse Alarm Input pin on the LVD board. This allows the system controller to detect open fuses, and send appropriate alarms and contact closures. See Installation Instructions for more details.

Battery Negative Terminals: Same as ES712A.

Battery Positive Terminals: Terminals for the positive battery conductors. Terminals accept M5 lugs on 5/8-inch centers.

Office Alarm Connector: Same as ES712A, except a different cable is used. This cable has the following pinout arrangement and cable colors:

Pin	Designation	Color	Pin	Designation	Color
1	PMJ NO	BK	2	PMJ C	BR
3	PMJ NC	R	4	PMN NO	O
5	PMN C	Y	6	PMN NC	G
7	R2 NO	BL	8	R2 C	V
9	R2 NC	S	10	R1 NO	W
11	R1 C	W-BK	12	R1 NC	W-BR
13	RESERVED	W-R	14	RESERVED	W-O
15	RESERVED	W-Y	16	RESERVED	W-G
17	RESERVED	W-BL	18	RESERVED	W-V
19	PBT_IN	W-S	20	SIG_RTN	W-BK-R
21	RESERVED	--	22	RESERVED	--
23	AUX_PMJ	W-BK-R	24	AUX_PMJ_RTN	W-BK-O



Receptacle Pin Numbering
(looking at receptacle)

The connector is a 24-pin AMP MIRCO MATE-N-LOK connector. It mates to a MICRO MATE-N-LOK receptacle with housing 2-794617-4 and contact sockets 794606-3 for 20-24 AWG conductors.

Cable assembly 848667689 provides 6-ft (1.8 m) of cable terminating on one end in the mating connector and is un-terminated on the other end. Users may order this part, size and terminate accordingly for the application.

Peripheral Devices Connector: Same as ES712A.

Access Gate: Gate swivels down to allow greater access to Front Access Opening.

CO Gnd: Terminal for the CO ground connection. Terminals accept M5 lugs on 5/8 in centers.

ES714AD Aux Box

This aux box is for use with the mid-mount ES700B, ES701B and ES701C Shelves. It will not work with the ES700A and ES701A flush-front shelves.

Figure 9-7 shows the arrangement of parts in the ES714AD Aux Box. This Aux Box is provided with circuit breaker and fused output load connections. This Aux Box is for use only with the ES712_LVD_D LVD Board; when the LVD board is inserted into the Aux Box, the load contactor is connected to circuit breakers CB3 and CB4 and to fuses F3 and F4 in the ES714AD Aux Box. Circuit breakers CB1 and CB4 and fuses F1 and F3 are for the critical loads and bypass the load disconnect contactor.

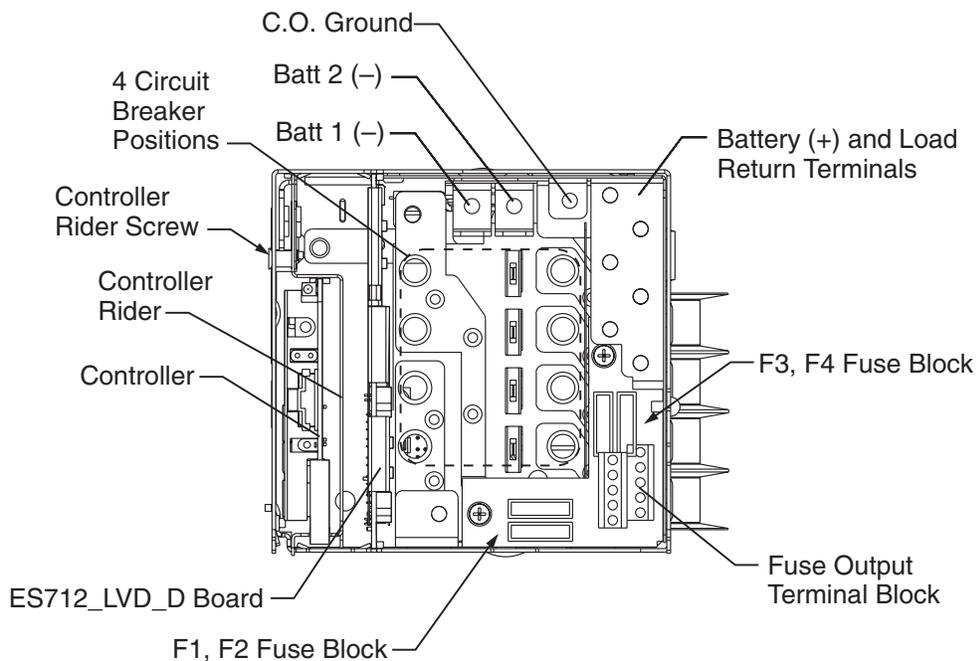


Figure 9-7: ES714AD Aux Box - Front View with Door Removed

All terminal connections except for the fuse output connections are through single-hole M5 lugs.

Fuse terminals connections are to a terminal block with compression wire terminations.

Controller Rider: Holds controller when used in this Aux Box.

ES712_LVD_D: Load shedding LVD board and only for use in ES714AD Aux Box.

Controller Rider Screw: Controller rider mounting screw.

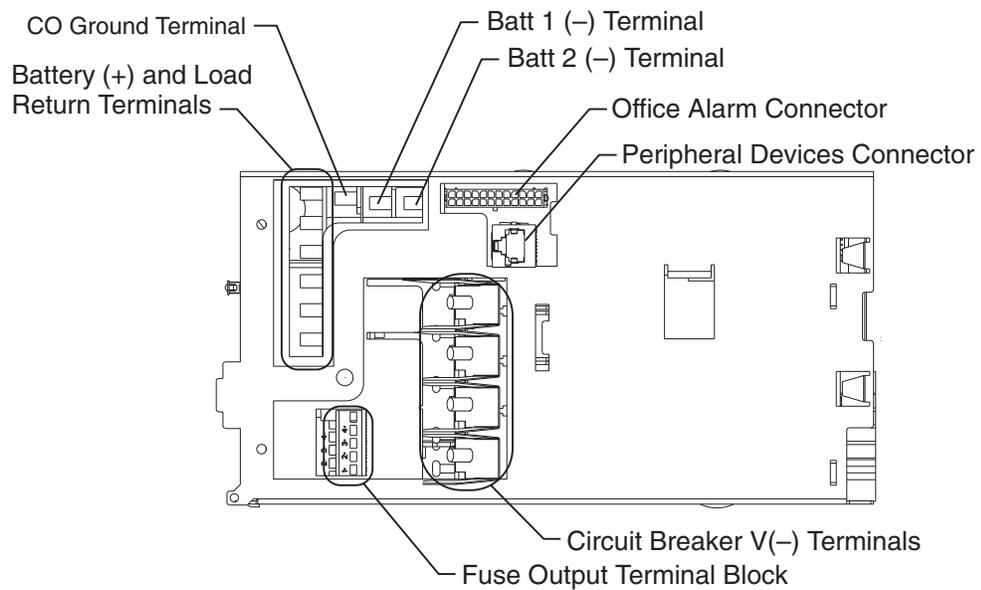


Figure 9-8: ES714AD Aux Box - Right Side View

Office Alarm Connector: Same as ES713A.

Peripheral Devices Connector: Same as ES713A.

ES713B and ES713BD Fuse Distribution

This aux box is for use with the mid-mount ES700B, ES701B and ES701C Shelves. It will not work with the ES700A and ES701A flush-front shelves.

The ES713B/BD Aux Boxes are provided with a fused distribution board for 12 load connections. It is provided with eight 2-position connectors rated for maximum 12A loads and four 4-position connectors rated for maximum 15A loads. Note that all nominal loads are to be at 80% of the fuse value. Also note that the total power from the distribution module is limited by the LVD board chosen. Refer to Section 8 (LVD Boards) for more details.

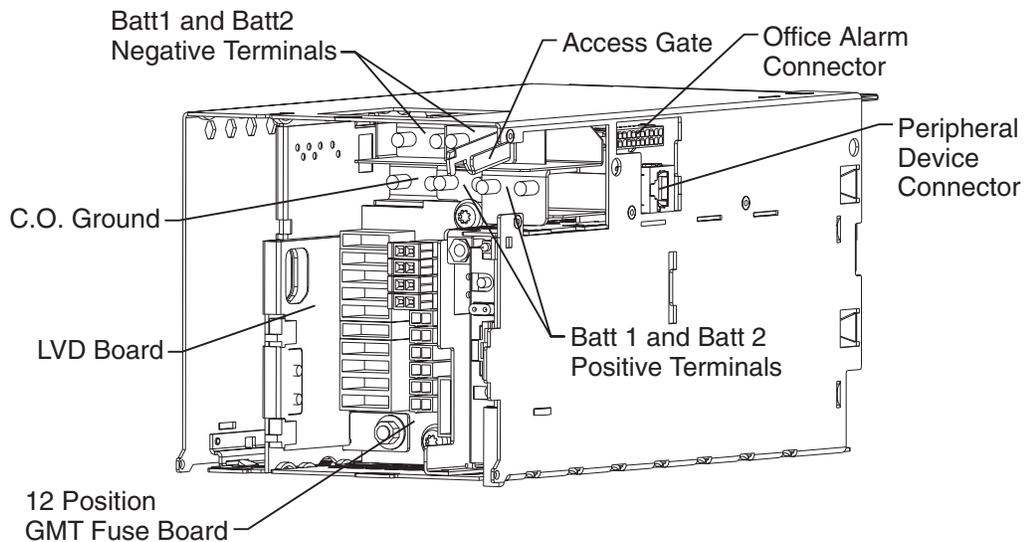


Figure 9-9: ES713B/BD Aux Box

Load cables may be purchased from Lineage Power, see page 3-5. Alternatively, users may create their own load cables and terminate the mating connector to the load receptacles on the Aux Boxes to the Yukon end of the cable.

The manufacturer of the mating part is Molex. Note that 16AWG cables are recommended for all load cables; the 12A positions use a pair of cables and the 15A load connections utilize two pairs of cables.

Load Rating	Part. Number	Positions	Socket
12A	39-01-2025	2	44476-3111
15A	39-01-2045	4	39-00-0079

The fuse distribution board is provided with an alarm sense wire that must be connected to a Fuse Alarm Input pin on the LVD board. This allows the system controller to detect open fuses, and send appropriate alarms and contact closures. See Installation Instructions for more details.

Battery Negative Terminals: Same as ES713A.

Battery Positive Terminals: Same as ES713A

Office Alarm Connector: Same as ES713A.

Peripheral Devices Connector: Same as ES713A.

Access Gate: Same as ES713A.

CO Gnd: Same as ES713A.

ES710A and ES710AD Aux Boxes

This aux box is for use with the mid-mount ES700B, ES701B and ES701C Shelves. It will not work with the ES700A and ES701A flush-front shelves.

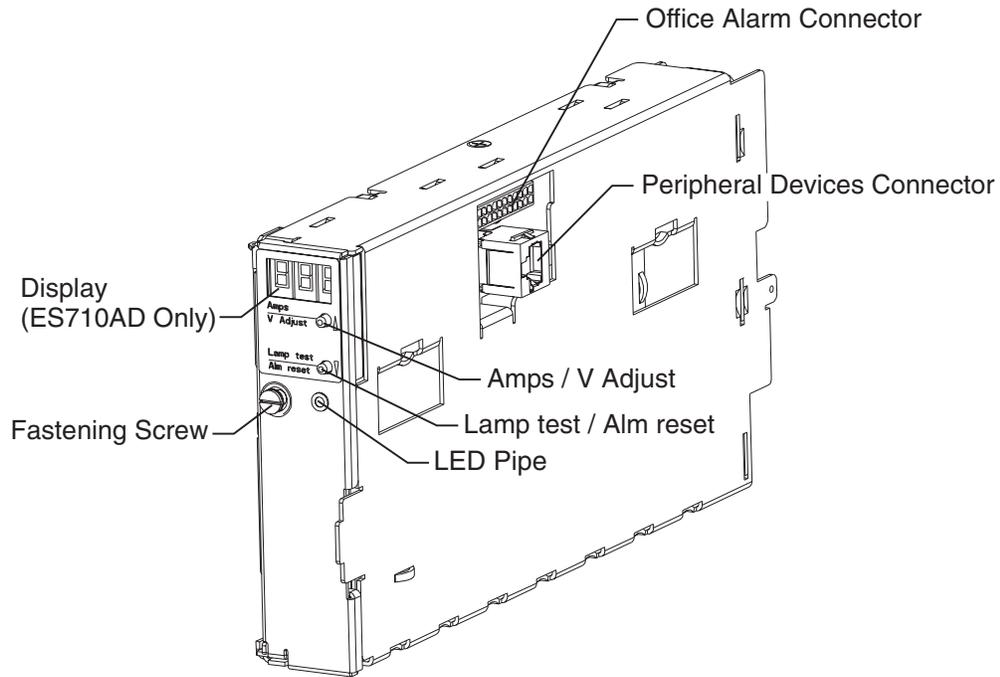


Figure 9-10: ES710AD Aux Box

Office Alarm Connector: Same as ES713A.

Peripheral Devices Connector: Same as ES713A.

Amps/V Adjust (ES710AD only): Momentary contact switch to change the display from voltage to plant load current. Press and hold for 3 seconds to display the “Float Voltage Change” mode (see Float Mode in Section 6 for more details).

Lamp test/Alm reset (ES710AD Only): Momentary contact switch to perform Lamp Test and to reset any alarms (CLE function - refer to Section 6 for more details).

LED Pipe: Allows controller LED to be seen externally.

Fastening Screw: Captive screw used to latch and unlatch door.

Display (ES710AD Only): Displays plant voltage and load current to one significant digit.

Peripheral Devices

ES773A Voltage/Thermal Probes (VT-Probes)

VT-Probes are used to measure battery temperatures for slope thermal compensation, and to measure battery voltage for battery voltage imbalance detection. They convert temperature measurements into serial data and transmits them to the system controller using the 1-Wire[®] bus from Maxim. They can also send battery voltage measurements to the system controller when used with the ES771A Remote Voltage Monitor. All probes are provided with a ptc device to protect against accidental short circuit during voltage measurements. **Note:** The Yukon system cannot use the thermal probes that are used with other Lineage Power systems, e.g., CPS4000. The ES773A VT-Probe must be used.

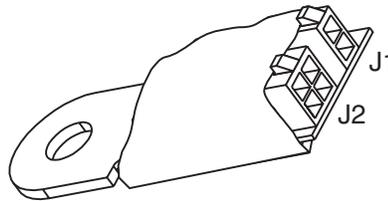


Figure 9-11: ES773A Voltage/Thermal Probes (VT-Probes)

Connector J2: This 4-position connector serves to connect the VT-Probe to the Aux Box using the 848652939 cable. It may also be connected to the ES771A Remote Voltage Monitor Module or be connected to other VT-Probes in daisy chaining using either the 848657391 (5-ft) or the 848657383 (10-ft) cable.

This connector also serves to connect the VT-Probes to the ES771A in making voltage measurements. This is accomplished by using the 848652954 cable. This cable terminates on one end in a right-angled snap-fit connector and on the other end with a connector pin-socket. The pin-socketted end of the cable is to be inserted into either of the two unused pin housings of the connector. See Installation Instructions for more details.

Connector J1: This 2-position connector serves to connect the VT-Probe to J2 on other VT-Probes in daisy-chaining them together.

**ES773B
Weatherized
VT-Probes**

These are ES773A probes that have been additionally protected so that they survive in the environments typically seen by batteries in outdoor cabinets. All cables have been connected to the probe and sealed prior to shipping from the factory. See Sections 3 and 5 for more details.

**ES771A Remote
Voltage Monitor
Module**

The Remote Voltage Monitor Module connects to the Peripheral Devices Connector on Aux Box rear. It takes the voltage measurements from the VT-Probe and transmits them to the system controller in performing voltage imbalance detection. It also transmits the thermal data from the VT-Probes for slope-thermal compensation.

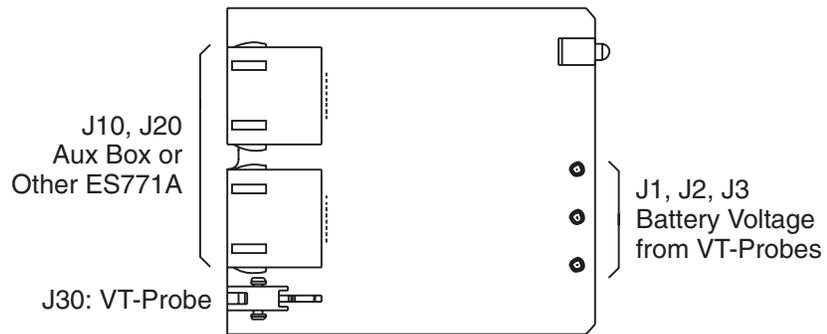


Figure 9-12: ES771A Remote Voltage Monitor Module

Connectors J10 and J20: These are RJ-45 connectors that connect the ES771A to the Aux Box or to another ES771A using 848652947 cable assemblies.

Connector J30: This connector connects the ES771A to the VT-Probes using either the 848657391 (5-ft) or the 848657383 (10-ft) cables.

Connectors J1, J2, and J3: Input connectors for the battery voltage from the VT-Probes. They accept the right-angled snap-fit connectors on the 848652954 cable assemblies.

10 *ES720B Ring Generator*

Overview

The ringer card is powered off the Yukon Power System's -48V bus voltage and provides ring voltages of various voltages and frequencies. The ringer card utilizes two on-board ringer modules to provide redundancy, should a module fail.

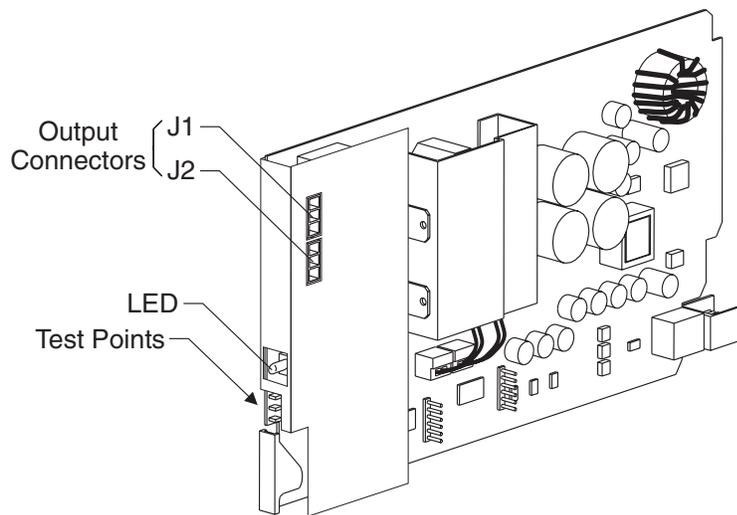


Figure 10-1: ES720B Ring Waveform Generator

Displays and Connectors

Output Connector J1 and J2

Output connectors for Module 1 (J1) and Module 2 (J2).

Status LEDs

This is a tri-color LED and will illuminate accordingly for the conditions shown below.

Status	LED		
	Green	Amber	Red
Normal	X		
Thermal Alarm			X
Overload/Short Circuit			X
External Fault		X	
Input Under/Over Voltage			X
Module Failure			X
Communication Failure			Blink
Circuit Pack Failure			X

Test Points

Used for measuring ringer modules' output voltage and frequency. Test points marked R1, R2, and T1, corresponding to Ring output from Module 1, Ring output from Module 2, and the common Tip connection.

Status Descriptions

Normal Operation

Ringer card is operating within specified parameters.

Thermal Alarm

The ringer module protects itself from thermal damage. Individual sensors monitor internal module temperatures and will shut down the module if the measured temperature climbs above 116°C +/-10%. The module will automatically turn-on when the temperature goes below 94°C +/-10%. While in the thermal shutdown mode, the ringer front panel LED will light as indicated in the Status LED table.

Overload/Short Circuit

In cases of extreme overload or short circuit load conditions, the modules will shutdown and attempt to recover, see Shutdown/Recover for more details. While in the shutdown mode, the ringer front panel LED will light as indicated in the Status LED table

External Fault

The ringer module has determined that an external fault is causing an overload condition or short circuit condition for the module, if this condition exists, the ringer module will disconnect itself from the load and attempt to reconnect, see Shutdown/Recover for more details. While in this mode, the ringer front panel LED will light as indicated in the Status LED table

Input Under/Over Voltage

If the input voltage is below 38Vdc +/-2Vdc or above 62Vdc +/-2Vdc, the ringer card will shut down. While in this shutdown mode, the ringer front panel LED will light as indicated in the Status LED table. When the input voltage goes back to its normal levels, the ringer card automatically turns-on.

Module Fail

An internal fault in the ringer module that results in the module failing will result in the front panel LED to light as shown in the table above.

Communication Failure

If the ringer card loses communication with the system controller, it will blink its Alarm LED. Once communication is lost with the system controller, the ringer output voltage and frequency will remain at the last voltage and frequency set by the user.

Circuit Pack Failure

A fault condition that results in the failure of the ringer card will result in the front panel LED to light as shown in the table above.

Theory of Operation

Figure 10-2 shows a block diagram of the ringer card. When ac power is applied to the Yukon System and the rectifiers produce the nominal -48V, the ringer is then powered up. During normal operation, both modules are operating, Relays A and B are closed and Relay C open. At this point, both modules on the ringer card are producing output voltage; Module 1's output voltage is available on J1 and Module 2's output voltage is available on J2.

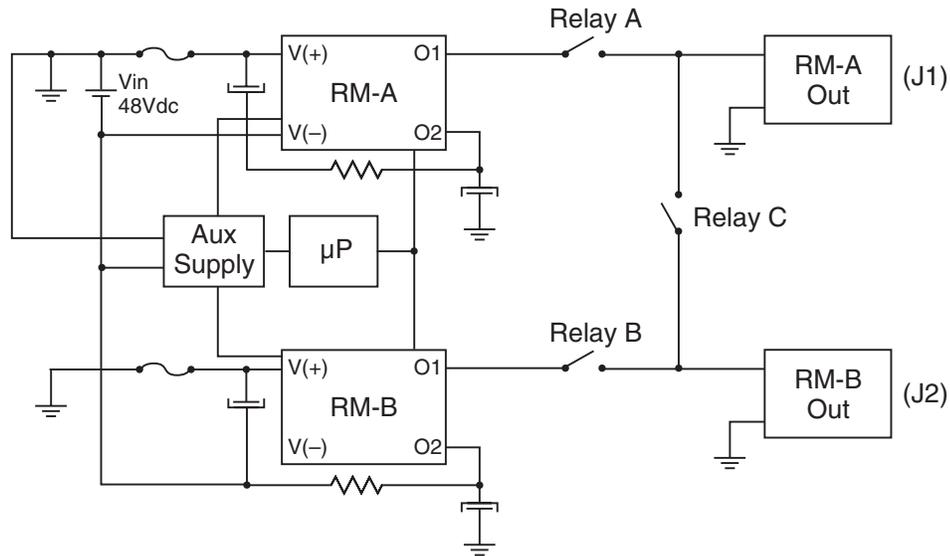


Figure 10-2: ES720B Ringer Block Diagram

If a single module fails or shuts down, e.g., module RM-1 (RM-2), the ringer card will first open Relay A (Relay B) and then close Relay C. This will allow module RM-2 (RM-1) to power both loads. During any failure mode, appropriate signals will be sent to the system controller for processing.

If RM-1 (RM-2) goes into a shutdown mode, the ringer card will open Relay A (Relay B) and wait 5 +/-2 seconds to determine if the fault condition to RM-1 (RM-2) still exists. If the fault indication exists, relay C is then closed. The ringer card considers this as an internal fault and illuminates the status LED in red color. Internal faults result in latched shutdowns of the module.

If after the ringer card has opened Relay A (Relay B) and RM-1 (RM-2) recovers and retires its fault signal, the ringer card waits 5 +/-2 seconds to ensure fault has been cleared. If RM-1 (RM-2) continues to operate normally, the ringer card attempts to reconnect RM-1 (RM-2) by closing

Relay A (Relay B). If fault condition persists, the entire procedure is repeated. This procedure is repeated a third time. If RM-1 (RM-2) resumes normal operation for 5 +/-2 seconds at anytime after the first or second reconnect attempts, the ringer card resumes normal operation. If after the third attempt, the fault condition still persists, the ringer card will consider this as an external fault and illuminate the status LED in amber color. The ringer card then attempts to reconnect every 2 minutes.

If RM-1 (RM-2) indicates an over-temperature condition, the ringer card first opens Relay A (Relay B) to disconnect RM-1 (RM-2) and then close Relay C. The status LED is illuminated in red.

If afterwards RM-1 (RM-2) retires its over-temperature fault signal, the ringer card first opens Relay C and then closes Relay A (Relay B). It then retires the fault signal and illuminates the status LED in green color.

If both modules fail, Relays A and B are to open and status LED illuminated in red. Upon cooling, the units automatically resume normal operation.

Features and Functions:

Output Voltages User selectable, via system controller, from 70, 80, 90, and 100Vrms, all with +/-5Vrms tolerance. The factory default setting is 100Vrms.

Output Frequency User selectable, via system controller, from 17, 20, 25 and 50Hz, all with +/-1 Hz tolerance. The factory default setting is 20 Hz.

Output Overload/Short Circuit In case of overload condition, the Ring Generator will reduce its output voltage and maintain a constant current, based on the voltage set point at 50VA. The Ring Generator will continue to reduce its output voltage until it reaches 50% of its nominal set point. The ringing generator is capable of continuous operation in current limit at output voltage greater than 50% of its set point. Further overloads is considered to be a short-circuit condition.

An output short circuit condition will be considered to exist if the output current is greater than 2A. During this condition, the ringer card will exhibit the behavior described in Theory of Operation.

If a single ringer module fails, the operating module will then provide power to all loads. This is accomplished via the relay switching, see Theory of Operation for more details. Under this condition, the system controller will transmit the Ringer Half Power alarm, indicating that the ringer has a single module failure. This alarm will be transmitted under any condition of module failure, including thermal shut down.

If the ringer card itself fails, the system controller will transmit the Ringer Fail alarm, indicating that the ringer card itself has failed.

Note that a single module failure on the ringer card will result in the LED on the ringer card being illuminating in RED color; however, the system controller will report this as a Minor alarm and illuminate its LED in AMBER color. This is because a failure or shut down of a ringer module may require the replacement of the entire card itself. However, from a system standpoint, ring power is still provided and therefore, considered to be a minor alarm condition.

OPF Filter

The ES720A_OPF filter is provided to attenuate the output noise from the ringing generator for equipment that is sensitive to switching noise. One filter must be purchased for each output connection to the ringer. The filter is to be placed in between the ringer output and the using equipment.

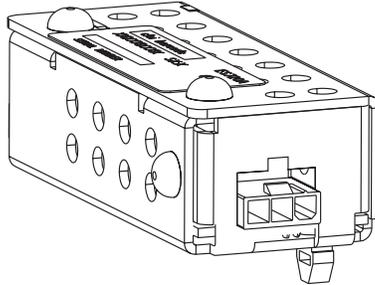


Figure 10-3: ES720A_OPF Filter

The connector on the cable end is connected to the ringer output and the load connections are made to the ES720A_OPF. The filters may be further tie-wrapped to the mounting rails in the using equipment.

11 *ES772A Remote Distribution Module*

Overview

The ES772A will allow the ES740AD Yukon Controller to communicate with devices in TEPS or OEM distribution panels. It will allow the ES740AD to alarm for open load and battery protectors, read battery current from an external shunt, and control up to two contactors. One of the contactors could be a load-disconnect and one could be a battery disconnect type.

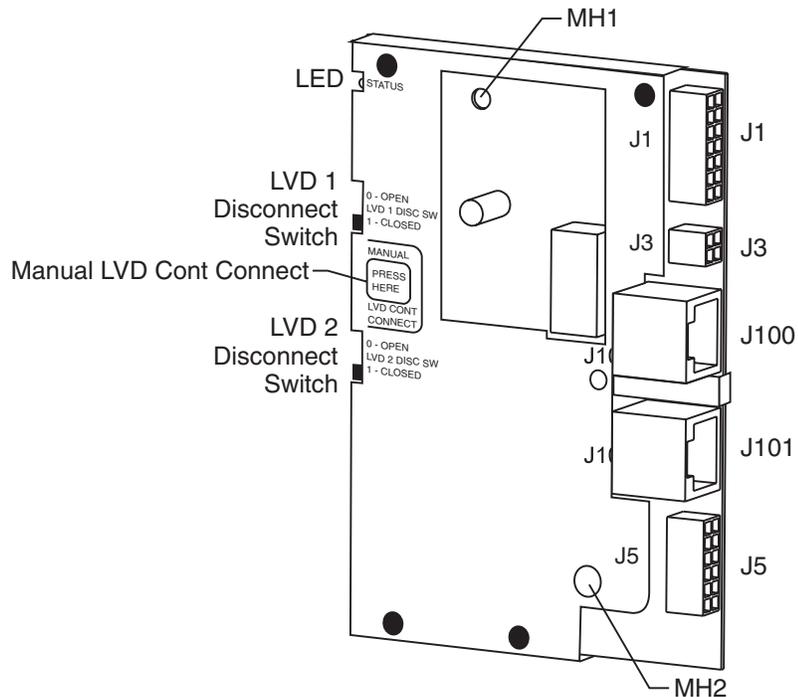


Figure 11-1: ES772A Remote Distribution Module

Controls, LED and Connectors

Receptacle J1: User connections to external distribution module.

Receptacle J3: User connections to external distribution module.

J100/J101: User connections to Aux Box Peripheral Devices Connector and to other Yukon devices such as the ES773A VT-Probe and the ES771A Remote Voltage Monitor Module.

Receptacle J5: User connections to external distribution module.

Mounting Hole MH1: Mounting hole to mount module in user application.

LVD2 Disc SW: Disconnect switch for external contactor 2, when wired as described in installation section.

Manual LVD Cont Connect: Switches for forced reconnect function.

LVD1 Disc SW: Disconnect switch for external contactor 1, when wired as described in installation section.

LED: This is a tri-colored LED and will illuminate accordingly for the conditions shown below.

Status	LED		
	Green	Amber	Red
Normal	X		
Minor Alarm		X	
Major Alarm			X
External Contactor(s) Manually Opened with either LVD1 or LVD2 DISC SW		Blink	
Communication Loss with System Controller			Blink
Manual Reconnect Command Accepting	Blink (5 sec)		X

Mounting Hole MH2: Mounting hole to mount module in user application.

Introduction

The ES772A is referenced to VBus(-), therefore, all alarm inputs are either alarmed on an open or a closure to VBus(-) as described below.

Module Features

The ES772A module has the following features:

- 16 Alarm inputs. These inputs may be used to monitor for distribution circuit breakers with micro-switch closures for protector opening, GMT style fuses with or DIN style circuit breakers. Furthermore, the two Auxiliary Major alarms may be used to monitor micro-switch closures from other devices such as a fan or a door, etc.

The alarming states for the different inputs are as stated below:

- o 10 inputs to alarm on an open to VBus(-) for DIN style circuit breakers, (J5, pins 1-10)
- o 2 inputs to alarm on closure to VBus(-) for Auxiliary Major alarming from external source, (J5, pins 11, 12)
- o 2 inputs to alarm upon closure to VBus(-), for distribution protector open alarms, (J1, pins J1, pins 6, and 13)
- o 2 inputs to alarm upon closure to VBus(-), for battery circuit breaker open alarms, (J1, pins 7, and 14)
- (2) LVBD or LVLD Contactor Manual Disconnect Switches are provided. These switches allows users to manually open up to two external contactors to disconnect a battery string from the V(-) bus and allow the user to perform maintenance on the battery. The switches can also disconnect a load from the V(-) bus if the contactor is configured for load disconnect.
- Reverse Battery Protection. If wired as instructed in Fig. 2 or 3 (see below), the ES772A will prevent the closure of contactors with batteries that are wired in reverse polarity. It will be active during initial start-up and also during servicing if the integral battery disconnect switches are used to connect and disconnect the battery strings from the V(-) bus. If the battery strings are wired in reverse polarity and an attempt was made to close the contactor, the ES772A will disconnect all contactors and appropriate alarms will be transmitted.

If an external disconnect switch is used to take battery strings off-line for servicing, care must be taken to ensure battery connections are correct at the disconnect switch. This is because the contactors remain closed when an external disconnect switch is used to disconnect the batteries from the bus. If the batteries are reconnected in reverse polarity, closing the switch will result in the batteries being connected to the bus in reverse polarity.

If the external disconnect switch is connected as shown in Fig 3, then the reverse battery protection feature will be provided.

Please read all warning statements prior to making any connections.

- **Manual LVD Cont Connect - Manual LVD Contactor Connect.**
This feature allows the Yukon system to resume powering the load after low voltage disconnect of batteries following a battery on discharge event. The fully depleted battery strings are to be replaced with fully charged strings. Once the strings have been replaced, depressing the Manual LVD Cont switches on the front of the ES772A module will result in the LVD contactors closing and the LED blinking in green color. Continue to depress the switches until the LED stops flashing and displays a continuous green color. This indicates acceptance of command and continued closure of contactors. Note that releasing the switches prior to the LED displaying a continuous green color will result in the contactor opening and removing power to the load.
- **External battery shunt input, (J1, pins 4 and 11)** The battery shunt must be in the VBatt(-) leg to maintain proper reference with the ES772A module. These inputs are for the system controller to read battery current. The polarity of the connections should be positive during battery discharge.
- **Control and monitor two contactors.** These connections are to control and monitor two contactors, either of which could be a load or battery disconnect device.
- **Monitor plant voltage for backup LVD function** (in case of failure of controller during battery discharge)

Module Connector Definitions

The ES772A module has five connectors that the user interfaces to, two are RJ-45 connectors that are used for serial communication to ES773A VT-Probes, the ES771A Remote Voltage Monitoring Module, and to the ES740AD Yukon controller. The remaining connectors are used for monitoring circuit breakers, contactors and shunts.

Mating part for J1 (14 pin) is Amp, part number 1-794617-4.

Mating part for J3 (4 pin) is Amp, part number 794617-4.

Mating part for J5 (12 pin) is Amp, part number 1-794617-2.

All use Amp 30 Au contacts for 20-24 AWG wires, 794606-3 (strip form), and 796410-3 (loose pieces).

The Tables 11-A and 11-B provide the pinout definitions for J1 and J3. See Table 11-3 for J5 pinout definitions.

Table 11-A: Connector J1 Pinout Definitions

Pin	Name	Definition	Comments/Connections
1	VPWR +	V(+) Power	Power for ES772A, connect to VBus(+)
2	N/A	Reserved	
3	N/A	Reserved	
4	SHUNT-	Neg Batt Shunt Input	Polarity is during battery discharge
5	BATT1_SENSE	Polarity Sense for String 1	Connect to battery negative, V(-) of String 1
6	DIST_ALM_1	Trip-Indicator Input-1 for US Style CB or GMT Fuse. Alarm on closure to VBus(-).	Connect to NC terminal of breaker micro switch or to indicator lead of GMT fuse, other end (C) referenced to VBus(-).
7	EXT BAT SW1	Alarm input for external battery disconnect switch; alarm on closure to VBus(-).	Connect to NC micro switch of US Style CB, other end (C) referenced to VBus(-), micro switch must close upon manual opening of CB.
8	VPWR -	V(-) Power	Power for ES772A, connect to VBus(-)
9	STATUS1_RTN	Reference for STATUS1	Connect to C pin of micro switch of Contactor 1.
10	STATUS1	Contactor 1 Status Monitor	Connect to NO pin of micro switch of Contactor 1.
11	SHUNT+	Positive Battery Shunt Input	Polarity is during battery discharge
12	LVD1_COIL	Contactor 1 coil input	Connect to one side of Contactor 1 coil, other side of coil connected to VBus(+).
13	DIST_ALM_2	Trip-Indicator Input-2 for US Style CB or GMT Fuse. Alarm on closure to VBus(-).	Connect to NC terminal of breaker micro switch or to indicator lead of GMT fuse, other end (C) referenced to VBus(-).
14	EXT BAT SW2	Alarm input for external battery disconnect switch; alarms on closure to VBus(-).	Connect to NC micro switch of US Style CB, other end (C) referenced to VBus(-), micro switch must close upon manual opening of CB.

Table 11-B: Connector J3 Pinout Definitions

Pin	Name	Definition	Comments
1	BATT2_SENSE	Polarity Sense for String 2.	Connect to battery negative VBus(-) of string 2.
2	STATUS2_RTN	Reference for STATUS2.	Connect to C pin of micro switch of Contactor 2.
3	STATUS2	Contactor 2 Status Monitor.	Connect to NO pin of micro switch of Contactor 2.
4	LVD2_COIL	Contactor 2 coil input.	Connect to one side of Contactor 2 coil, other side of coil connected to VBus(+).

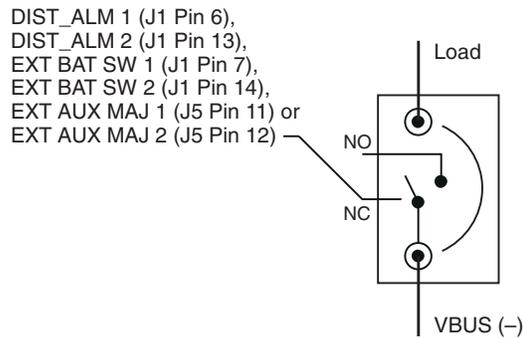


Figure 11-2: Typical Alarm Connections

The DIST_ALM(1, 2) EXT BAT SW(1, 2), and the EXT AUX MAJ(1, 2) alarm inputs are to be connected as shown in Figure 11-2. All of these inputs alarm on a closure to VBus(-).

The DIST_ALM(1, 2) alarm inputs are to be used for monitoring US Style CBs and GMT style fuses.

The EXT BAT SW(1, 2), alarm inputs are to be used for monitoring battery disconnect switches or circuit breakers with a micro switch that closes on manual opening of switch.

The EXT AUX MAJ(1, 2) alarms may be connected to external devices with a micro switch that closes on an alarmed state. Examples of this might be a Door Open alarm, or a Fan Fail alarm.

Since these devices all alarm on a contact closure, the protectors of the same type may have the indicating NC terminal connected together and the C terminals connected together and connected as shown above. This is not the case for DIN style circuit breakers, which must be individually monitored via different alarm inputs as shown in Figure 11-5.

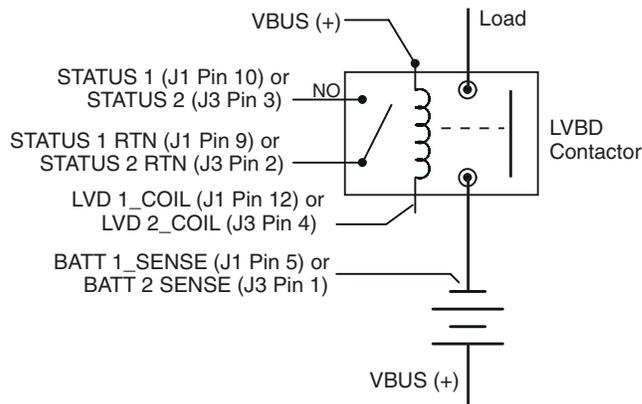


Figure 11-3: Alarm Connections with Reverse Polarity Protection

Figure 11-3 shows the connection required if Reverse Polarity Protection is to be used with the integral battery disconnect switches LVD1_DISC or LVD2_DISC. Note that the sense lead BATT1 or BATT2 must be connected as shown in order for the reverse polarity protection feature to work. If two strings are being used, connect one string to STATUS1, LVD1, LVD1_COILRTN, STATUS1_RTN, BATCB1, and BATT1_SENSE connections and the other to the "-2" connections. When more than two strings are being used, divide the strings among the two inputs.

WARNING

When two battery strings are connected to the same battery terminal, care must be taken to ensure the polarity of the two strings is correct to each other. Improper connection will result in one string being shorted to the other string and the system can not protect against this.

With the above connections, the following alarms will be issued for the conditions noted.

	Contactor Fail Alarm	Contactor Open Alarm	Open String Alarm	ES740AD LED	ES772 LED
Open Integral ES772A Disconnect Switch		X		RED	Blinking AMBER
Battery reconnected in reverse polarity	X	X		RED	RED
System started w/ reverse battery polarity	X	X		RED	RED

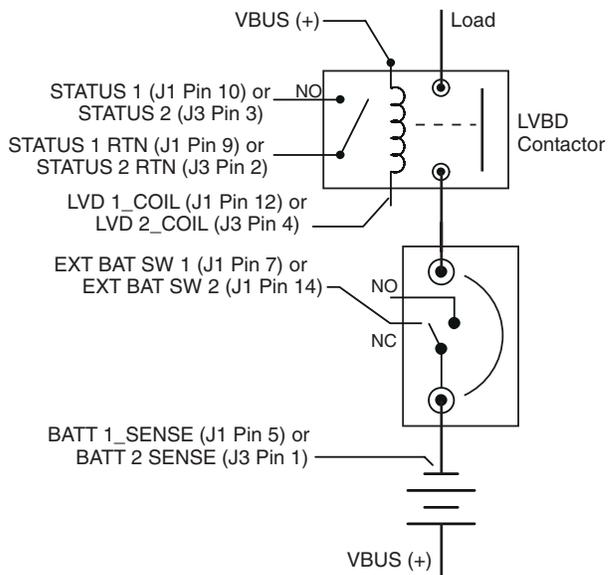


Figure 11-4: Reverse Polarity Protected Alarm Connections with an External Battery Disconnect Switch

Figure 11-4 shows the connections required if Reverse Polarity Protection is to be used with an external disconnect switch. Note that the sense lead BATT1_SENSE or BATT2_SENSE must be connected as shown in order for the reverse polarity protection feature to work. If two strings are being used, connect one string to STATUS1, LVD1_COIL, STATUS1_RTN, BATCB1, and BATT1_SENSE connections and the other to the "-2" connections. When more than two strings are being used, divide the strings among the two inputs.

WARNING

When two battery strings are connected to the same battery terminal, care must be taken to ensure the polarity of the two strings is correct to each other. Improper connection will result in one string being shorted to the other string and the system can not protect against this.

With the above connections, the following alarms will be issued for the conditions noted. This assumes the external disconnect switch is used to open and close the battery charging path to the batteries.

	Contactor Fail Alarm	Contactor Open Alarm	Open String Alarm	ES740AD LED	ES772 LED
Open Integral ES772A Disconnect Switch			X	RED	Blinking AMBER
Battery reconnected in reverse polarity	X	X		RED	RED
System started w/ reverse battery polarity	X	X		RED	RED

Pin	Function	Pin	Function
1	DIN CB-1	2	DIN CB-2
3	DIN CB-3	4	DIN CB-4
5	DIN CB-5	6	DIN CB-6
7	DIN CB-7	8	DIN CB-8
9	DIN CB-9	10	DIN CB-10
11	EXT AUX MAJ-1	12	EXT AUX MAJ-2

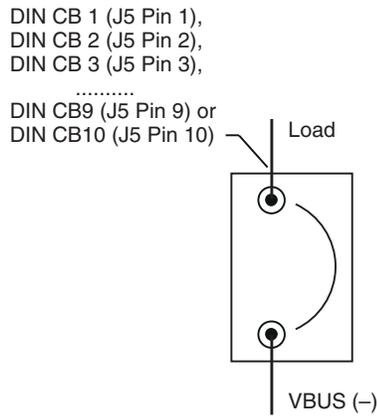


Figure 11-5: Alarm Connections for DIN Style Load Protectors

Figure 11-5 shows the connections required if load protectors are the DIN style circuit breakers. Note that 10 alarm inputs are provided for monitoring up to 10 DIN breakers because these breakers must be monitored individually. The DIN CB(1-10) inputs are alarmed on an open to VBus(-). Attach a sense lead from the load terminal to the

***J100 and J101
Serial Ports***

J100 and J101 are used to connect the ES772A to the ES740AD Yukon controller. Note that if ES773A VT-Probes are to be used in conjunction with the ES772A, connect J100 or J101 on the ES772A to the Yukon controller via the Peripheral Devices connector on the Aux Box and then connect the ES773A to the unused RJ-45 jack on the ES772A.

If the ES772A is being used with both the ES773A and the ES771A Remote Voltage Monitoring Module, connect either the ES771A or the ES773A to the Aux Box as both have two RJ-45 jacks for serial communication purposes. Then connect the two-jack device not connected to the Aux Box to the unused serial port of the two-jack device connected to the Aux Box and connect the ES773A to its second serial port.

**ES772A Module
Mounting**

Use the template in Figure 11-6 as a guide to mount the ES772A in your application. The location of the mounting holes MH1 and MH2 are outlined.

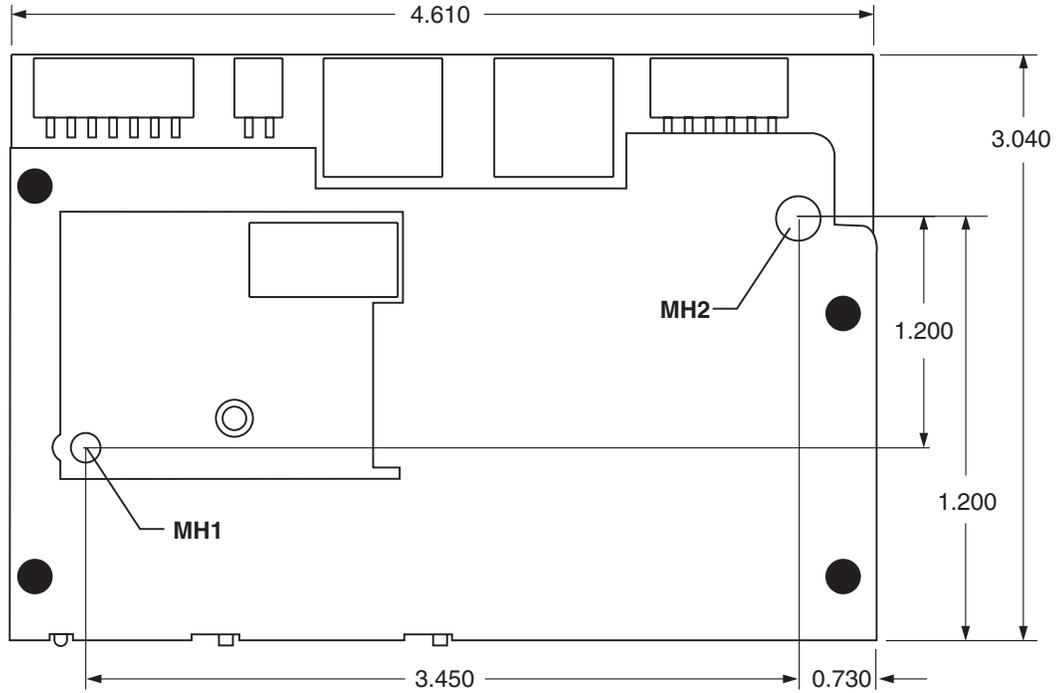


Figure 11-6: Mounting Hole Locations

12 Troubleshooting

Table 12-A: Yukon System Without ES720B Ring Waveform Generator

Controller LED	User Interface Display	Rectifier LED	LVD Board LED	Possible Problem(s)	Possible Solution(s)
AMBER	MIN, AC Fail	ALARM	GREEN	<p>Single Rectifier not receiving ac power.</p> <ul style="list-style-type: none"> AC input circuit breaker has opened. AC input voltage is out of range. 	<ol style="list-style-type: none"> Verify ac power to rectifier is available. Verify rectifier input circuit breaker is closed. If problem not corrected, replace rectifier.
RED	MIN, AC Fail MAJ, Multiple AC Fail MAJ, Battery on Discharge	None	GREEN	<p>Multiple rectifiers not receiving ac power, batteries are powering load.</p> <ul style="list-style-type: none"> AC input circuit breakers have opened. AC input voltage is out of range. Internal rectifier fault. 	<ol style="list-style-type: none"> Verify ac power to rectifiers is available. Verify rectifier input circuit breakers are closed. If problem is not corrected, replace rectifiers.
RED	MAJ, Battery on Discharge	AC OK DC OK	GREEN	Rectifier output voltage has fallen below the battery on discharge threshold set by the user.	If commercial ac power is present but the system voltage remains low, call your local field representative. Investigate other alarms that may be present such as rectifier related problems.
AMBER	MIN, Rectifier Fail (Note 1)	AC OK ALARM (Note 1)	GREEN	Rectifier output has dropped below 36V, rectifier has entered hiccup mode.	Replace rectifier.
RED	MIN, Rectifier Fail MAJ, Rectifier Fail (Note 1)	AC OK ALARM (Note 1)	GREEN	All rectifier outputs have dropped below 36V, all rectifiers have entered hiccup mode. Defective controller.	Remove controller; if output voltage does not go to set-point previously set by user, call your local field representative.
RED	MAJ, Contactor 1 Open	AC OK DC OK	AMBER (Blinking)	One or both of the LVD contactors is open; someone may have manually opened LVD contactor.	Place disconnect switch in ON position.

Table 12-A: Yukon System Without ES720B Ring Waveform Generator (continued)

Controller LED	User Interface Display	Rectifier LED	LVD Board LED	Possible Problem(s)	Possible Solution(s)
AMBER	MIN, Battery High Temperature	AC OK DC OK	GREEN	Batteries have exceeded temperature threshold set by user.	Call your local field representative.
None	No response.	RED (Blinking)	RED (Blinking)	Controller failure, all devices on the communication bus reporting loss of communication with controller.	<p>Check controller to ensure it is properly inserted into its slot. If so, perform the following steps:</p> <ol style="list-style-type: none"> 1. Remove the controller board for 1 minute and then reset. 2. If problem persists, replace controller with new controller board. 3. If problem still persists, call your local field representative.
AMBER	MIN, Thermal Probe Fail	AC OK DC OK	GREEN	Battery thermal probe failed.	<ol style="list-style-type: none"> 1. Ensure thermal probe is properly connected to thermal probe cable. 2. Ensure cable is properly connected to the rear of the Aux Box. 3. If problem persists, replace thermal probe per ensuing instructions. 4. If problem still persists, call your local field representative.
RED	MAJ, Fuse Major	AC OK DC OK	RED	One or more of the output circuit breakers or fuses have opened.	Reset circuit breakers or replace fuse.
AMBER	MIN, Rectifier Fail	AC OK ALARM	Normal	<p>Single rectifier thermal alarm: Excessive ambient temperature Multiple rectifier failure</p>	<ol style="list-style-type: none"> 1. Verify that there is no obstruction of the vertical airflow path. 2. Reset the rectifier by removing the rectifier, waiting approximately 30 seconds, and replacing the rectifier. 3. If problem persists, replace the rectifier. 4. If problem still persists, call your local field representative.

Table 12-A: Yukon System Without ES720B Ring Waveform Generator (continued)

Controller LED	User Interface Display	Rectifier LED	LVD Board LED	Possible Problem(s)	Possible Solution(s)
RED	MIN, Rectifier Fail MAJ, Multiple Rectifier Fail MAJ, Battery on Discharge	AC OK ALARM	Normal	Multiple rectifier thermal alarm: Excessive ambient temperature Multiple rectifier failure	<ol style="list-style-type: none"> 1. Verify that there is no obstruction of the vertical airflow path. 2. Reset rectifies by removing them, waiting approximately 30s and replacing them. 3. If problem persists, replace the rectifiers. 4. If problem still persists, call your local field representative.
RED	MAJ, High Voltage	AC OK ALARM	Normal	High output voltage from rectifier(s) Rectifier(s) high voltage shutdown Internal rectifier(s) failure	<ol style="list-style-type: none"> 1. Reset the rectifier(s) by removing the rectifier(s), waiting approximately 30s and replacing the rectifier(s). 2. If problem persists, replace the rectifier. 3. If problem still persists, call your local field representative.
AMBER	MIN, Minor Communication Fail	RED Blinking Single rectifier	GREEN	Rectifier lost communication with controller.	<ol style="list-style-type: none"> 1. Reset the rectifier by removing the rectifier, waiting approximately 30 seconds, and replacing. 2. If problem persists, replace the rectifier. 3. If problem still persists, call your local field representative.
RED	MAJ, Major Communication Fail	GREEN	RED (Blinking)	LVD Board lost communication with the controller.	<ol style="list-style-type: none"> 1. Replace LVD Board. (Note 2) 2. If problem persists, call your local field representative.
<p>Note 1: While in hiccup mode, the rectifier will attempt to restart every 10 seconds.</p> <p>Note 2: Refer to Section 5, LVD board Removal for removal details. Note that the power system will continue to power the load while the LVD board is out of the system; however, there will be no possibility of battery backup until the LVD board is replaced.</p>					

Table 12-B: Yukon System With ES720B Ring Waveform Generator

Controller LED	User Interface Display	Ringer LED	Possible Problem(s)	Possible Solution(s)
AMBER	MIN, Ringer Half-Power	RED	<ul style="list-style-type: none"> • Ringer thermal alarm • Excessive ambient temperature • Failure of a module on the ringer card 	<ol style="list-style-type: none"> 1. Verify there is no obstruction of the vertical airflow path in the Aux Box 2. Reset ringer cards by removing, waiting approximately 30 seconds, and replacing them. 3. Measure the voltage on the ringer card test points and ensure that both modules' outputs are operating. 4. Replace the ringer card. 5. If problem persists, call your local field representative.
RED	MAJ, Ringer Fail	RED	<ul style="list-style-type: none"> • Ringer thermal alarm • Excessive ambient temperature • DC input over or under voltage • Ringer card failure 	<ol style="list-style-type: none"> 1. Verify there is no obstruction of the vertical airflow path in the Aux Box 2. Reset ringer cards by removing, waiting approximately 30 seconds, and replacing them. 3. Measure the voltage on the ringer card test points and ensure that both modules' outputs are operating. 4. Ensure bus voltage is within that set for via the system controller. 5. Replace the ringer card. 6. If problem persists, call your local field representative.
AMBER	MIN, Ringer Half-Power	AMBER	External ringer fault	Verify load is operational.
RED	MAJ, Ringer Fail	RED (Blinking)	Ringer has lost communication with the controller.	<ol style="list-style-type: none"> 1. Replace the ringer card. 2. If problem persists, call your local field representative.

Checking for Defective VT-Probes (Non-Weatherized Version)

If multiple VT-Probes are being used and the Thermal Probe Fail alarm is being generated, use the following steps to determine which probe in a chain of probes has failed.

Note that this procedure requires running the CLE command. The CLE function may be initiated by either depressing the front panel switch on

the system controller for greater than 5 seconds or by initiating it from the TI.

The controller should have its LED illuminated in amber color and should be transmitting a Thermal Probe Fail alarm along with the PMN severity, unless changed by the user. To determine the faulty probe, follow the instructions noted below. Note that the first probe is the probe closest to the Aux Box or ES771A Remote Voltage Monitoring Module. Note also that the steps outlined refer to the Aux Box; however, the steps are equally applicable to probes connected to the ES771A.

1. Disconnect the cable to the 4-position connector of the second probe in the daisy chain of probes. That is, only the first probe should be connected to the system. Run the CLE function. If afterwards the system controller illuminates its LED in green color, the probe is operational. Alternatively, the number of registered probes may be known from the terminal interface (TI) by running the Number of Temperatures Present command, see Appendix B. If the registered number of probes is 1, then the probe is functional.

Had the system controller illuminated its LED in amber color or registered 0 as the number of probes connected to the system, it would indicate that the first probe was defective.

To verify this, disconnect the cable to the 4-position connector of the first probe from the Aux Box and connect it to the 4-position receptacle of the second probe, including the chain of probes connected to the second probe, and run the CLE command. If the first probe is defective, the system controller's LED should be illuminated in green color. Verify this by running the Number of Temperatures Present command and see if system responds with the correct number of probes connected to the system.

2. If the first probe was good, remove the cable to the 4-position connector of the third probe from the chain and run the CLE command. If afterwards the system controller illuminates its LED in green color, both the first and second probes are operational. Had the system controller illuminated its LED in amber color, or the TI respond to the Number of Temperatures Present command was not 2, it would indicate that the second probe was defective. This is because we have verified the first probe was operational.

To verify this, disconnect the cable from the Aux Box to the 4-position connector of the first probe and connect it to the 4-position receptacle of the third probe, including the chain of probes connected to the third probe, and run the CLE command. If

the second probe is defective, the system controller's LED should be illuminated in green color. Verify this by running the Number of Temperatures Present command and see if system responds with the correct number of probes connected to the system.

3. Continue this procedure until the defective probe has been found. Once the defective probe has been found, replace it with a new probe and run the CLE command. The system controller should be illuminating its LED in green color. Verify this by running the Number of Temperatures Present command and see if system responds with the correct number of probes connected to the system.

***Checking for
Defective
VT-Probes
(Weatherized
Version)***

1. Disconnect the first probe from its RJ-45 terminal block.
2. Run the CLE function. If the system controller illuminates its LED in green color, the probe is defective. Alternatively, the number of registered probes may be known from the terminal interface (TI) by running the Number of Temperatures present command, see Appendix B. If the registered number of probes is equal to the total number of probes connected, remember you've removed a probe, so the total number should be one less than that during installation, then the first probe is defective. Replace the probe with a different probe and follow the above procedure to ensure it is operational.
3. If the system controller LED remains green or the number of registered probes is still incorrect, replace the first probe and remove the second probe and repeat Step 2. Continue this procedure until the defective probe has been found.

Appendix Glossary

A

<i>AC Fail</i>	An indicator found in YUKON plants, this alarm is issued when the ac utility voltage to a rectifier is missing or falls below the normal input operating voltage range.
<i>ACU</i>	Alarm Control Unit or the system controller (ES740AD). It provides plant monitoring, control features, and sets up system parameters and alarm thresholds.
<i>Alarm</i>	1. Any condition that is not considered normal to plant operations. The system controller transmits the particular fault condition. 2. An indication on the rectifier indicating it has shut down due to an output under voltage condition, a thermal alarm, an internal fault, or an operated internal fuse.
<i>Ampere Hour (AH)</i>	Ampere-hour is a rating for batteries that specifies duration of a discharge for a given load. It is a convention for expressing drain (or load) current multiplied by time, usually 8-hours.
<i>ANSI</i>	American National Standards Institute. The U.S. standards organization that establishes procedures for the development and coordination of voluntary American National Standards.
<i>Attribute</i>	A property of a managed object that has a value.
<i>Average Busy-Hour Current Drain</i>	The average load demand during busy season with the plant operating at the normal voltage.
<i>Battery High Temp</i>	A signal from the system controller indicating that a battery temperature is above the threshold set by the user.

<i>BD</i>	Battery on Discharge, occurs when the rectifier plant voltage is below a preset threshold. Typically, the ac service voltage to the plant is low or missing and the batteries are powering the load. This condition results in a BD alarm from the system controller.
<i>Bellcore</i>	See Telcordia.
<i>C- Message Weighting</i>	A type of weighting filter that provides equal attenuation of all frequencies within the voice band. Used to measure electrical noise in the voice band.
<i>CB Report</i>	A review from a certification body such as UL or VDE of the product to requirements of other countries. This report may be used to obtain certifications from a particular country, if required.
<i>CE Mark</i>	The official marking required by the European Community for all Electric- and Electronic equipment that will be sold, or put into service for the first time, anywhere in the European community. It proves to the buyer -or user- that this product fulfills all essential safety and environmental requirements as they are defined in the so-called European Directives. In return for fulfilling the CE marking requirements, the manufacturer or its agent gets the opportunity to cover the entire European market using only one approval procedure for the topics covered in the miscellaneous directives.
<i>Central Office (C.O.)</i>	A common carrier switching center in which trunks and loops are terminated and switched.
<i>CISPR</i>	The International Special Committee on Radio Interference (CISPR) was established in 1934 by a group of international organizations to address radio interference. CISPR is a non-governmental group composed of National Committees of the International Electrotechnical Commission (IEC), as well as numerous international organizations.
<i>Common Carrier</i>	In a telecommunications context, a telecommunications company that holds itself out to the public for hire to provide communications transmission services.
<i>dBrnC</i>	Weighted noise power in dBrnC, measured by a noise measuring set with C-message weighting.

<i>EMI</i>	Electromagnetic Interference, the radiated or conducted interference equipment causes to equipment in its surrounding environment. Organizations such as CISPR, Telcordia, ETSI, and FCC set up maximum amount of interference equipment may cause.
<i>EMC</i>	Electromagnetic Compatibility, the interference equipment may face when placed in its intended application. The interference may come from lightning surges, static discharge, radiated and conducted interference and the like. Organizations such as Telcordia and ETSI set up minimum levels that equipment must tolerate.
<i>ESD</i>	Electrostatic discharge, the rapid discharge of accumulated charge from a body to equipment. This discharge may be as high as 4kV. Equipment should be able to tolerate this amount of charge without any stoppage of operation. See also EMC.
<i>ETSI</i>	European Telecommunications Standards Institute. The European counterpart to ANSI. Founded in 1988, ETSI's task is to pave the way for telecommunications integration in the European community as part of the single European market.
<i>FCC</i>	Federal Communications Commission, standards writing body involved in promulgating standards for EMI in the US. Note that the FCC accepts tests performed per the CISPR standards.
<i>Float Set Point</i>	A plant voltage control originating in the control unit that sets the rectifier output voltage to the desired value within the rectifier operating voltage range.
<i>Host Interface Connector</i>	Same as office alarm connector.
<i>IEC</i>	The International Electrotechnical Commission is the international standards and conformity assessment body for all fields of electrotechnology.
<i>LED</i>	Light emitting diode, a semiconductor device that emits optical radiation when biased in the forward direction
<i>Loop</i>	In telephone systems, a pair of wires from a central office to a subscriber's telephone.

<i>LVD</i>	Low-voltage disconnect; preset voltage threshold at which the battery is disconnected from the system bus to protect them from deep discharge.
<i>Major Alarm (PMJ)</i>	Conditions that are considered to impact service and require immediate attention.
<i>Major Fuse Alarm</i>	An alarm from the system controller to signify that an output distribution circuit breaker or fuse has operated due to excessive current. A circuit breaker in either the off or trip position will also result in an alarm condition.
<i>Mean Time Between Failures (MTBF)</i>	An indicator of expected system reliability calculated on a statistical basis from the known failure rates of various components of the system.
<i>Minor Alarm (PMN)</i>	Conditions requiring service, but having no immediate impact on the plant output.
<i>Minor Fuse Alarm</i>	This alarm condition will be given from the system controller for any open fuse or circuit breaker in the Aux Box if the user changed the severity associated with the event to minor.
<i>National Electric Code (NEC)</i>	A standard that governs the use of electrical wire, cable, and fixtures, and electrical and optical communications cable installed in buildings. Note: The NEC was developed by the NEC Committee of the American National Standards Institute (ANSI), was sponsored by the National Fire Protection Association (NFPA), and is identified by the description ANSI/NFPA 70-XXXX, the last four digits representing the year of the NEC revision.
<i>NEBS</i>	Network Equipment Business Systems, GR-63-CORE. Telcordia standard outlining generic environmental and physical criteria necessary for equipment to perform reliably and safely in the central office and other telephone facilities. Telecom equipment is subject to natural environments such as vibration, earthquakes, temperature, humidity, and fire spread.
<i>Normal</i>	An indication from Yukon components that they are operating within their normal parameters. Their green LEDs indicate this.
<i>Object</i>	An abstract representation of resources that are managed.

<i>Office Alarm Connector</i>	Connector on the Aux Box allowing access to alarm relays as well as pins to initiate the Plant Battery Test and for an auxiliary alarm input.
<i>Parameter</i>	Range of values that an Object-Attribute pair may take.
<i>Psophometric Noise</i>	Pronounced "so-fo-metric", term used for electrical noise over the voice-channel in telephone circuits, as measured using a set of weighting filters.
<i>Record Only (RO)</i>	Conditions the user has designated to be neither Major nor Minor. When this condition occurs, the system controller will transmit only the condition without a severity.
<i>Ring</i>	The conductor that uses the Tip conductor as its reference. It may be used to complete a circuit in making a telephone call or to ring a telephone.
<i>Reliability</i>	The probability that a system, including all hardware, firmware, and software, will satisfactorily perform the task for which it was designed or intended, for a specified time and in a specified environment.
<i>Ringer Equivalency Number (REN)</i>	A number determined in accordance with the Code of Federal Regulations, Title 47, part 68, which number represents the ringer loading effect on a line. Note: A ringer equivalency number of 1 represents the loading effect of a single traditional telephone set ringing circuit. Modern telephone instruments may have a REN lower than 1. The total REN expresses the total loading effect of the subscriber's equipment on the central office ringing current generator. The service provider usually sets a limit, e.g., 3, 4, or 5 (representing "extension," i.e., parallel-connected telephones), to the total REN on a subscriber's loop. The actual number of instruments across the loop may be greater than the service provider's REN limit, if their respective individual RENs are less than 1.
<i>Severity</i>	Describes the urgency of the alarm condition when transmitted from the system controller. May take on either Major, Minor or Record Only.
<i>Standby</i>	A command from the control unit that prevents any user-selected rectifier from producing output power. Note that the standby command is commuted if the output voltage drops below the BD threshold.

<i>Step Voltage</i>	A user selected battery temperature threshold; if battery temperatures exceed this limit, the plant voltage is immediately dropped to approximately 48V in order to prevent any more current from going to the battery. If the battery cools by approximately 10°C, thermal compensation is resumed.
<i>T1.317 Command Language</i>	This standard defines a uniform method of communicating with power systems in a telecommunications environment. This standard specifically addresses command language elements necessary for human-to-machine communication with systems that monitor and control power equipment.
<i>Telcordia</i>	The company now known as Telcordia Technologies, formerly Bellcore, was created during the divestiture of the Bell System in 1984 to serve the Bell operating companies by providing a center for technological expertise and innovation. In 1997, Telcordia was acquired by Science Applications International Corporation (SAIC), one of the world's largest providers of systems integration and program management. Telcordia now serves a much wider range of customers.
<i>Thermal Compensation</i>	The changing of the plant output voltage with changing battery temperature in order to minimize battery damage
<i>Thermal Probe Fail</i>	A signal from the system controller indicating that a temperature probe cable is installed, but the probe is missing, or a temperature probe has failed.
<i>TI</i>	Terminal Interface. Notebook or IBM compatible PC with an isolated local port connected to the system controller for programming purposes.
<i>Tip</i>	The grounded conductor in a telephone cable pair. It is the cable that is connected to the positive battery terminal in a telephone power system.
<i>Total Harmonic Distortion (THD)</i>	The ratio of (a) the sum of the powers of all harmonic frequencies above the fundamental frequency to (b) the power of the fundamental frequency.
<i>Trunk</i>	A circuit between switchboards or other switching equipment, as distinguished from circuits which extend between central office switching equipment and information origination/termination equipment.

<i>UL</i>	Underwriters Laboratories; a standards writing and certification body for safety of electrical equipment in the US. The UL mark is used to identify a UL certified product. Also, a c-UL mark may be present to identify those products that UL has certified to meet the applicable Canadian safety standards.
<i>VDE</i>	Verband Deutscher Elektrotechniker, a standards writing and certification body for safety of electrical equipment in Germany. The VDE mark is used to identify a VDE licensed product.
<i>Voice Band</i>	A set of frequencies, typically between 300Hz and 3400Hz, that are used in the transmission of speech.
<i>Weighting filters</i>	Special type of filters designed to compliment the way we hear; used in measuring loudness levels.
<i>Yukon</i>	Name of the cabinetized power system.

Appendix T1.317 Command Language B

Initializing the ES740AD Controller

The ES740AD is a highly flexible controller with many features. The following table outlines the features, range of values, and default values. The 848658100 Controller Programming Cable assembly is to be used with a notebook computer or a PC with an isolated RS-232 port.

Note that connections to this receptacle are to be from an isolated RS-232 port from the connecting equipment. Connecting the controller to a grounded RS-232 port will result in improper RS-232 communication and may damage the using equipment and/or the system controller.

Connect the 9-pin DIN connector to the computer and the 6-pin header to the mating receptacle on the controller. The controller receptacle is behind a flap on the controller insulator.

This section outlines programming the controller using the Hyper Terminal program that is shipped with most IBM compatible PC's. After Hyper Terminal has started and the programming cable connected to the controller and the PC, you should see the login screen that allows access to the ES740AD's programming features.

Two levels of security protect incoming access: user and super-user. A user is one who only has read ability and can only get status information from the Yukon. A super-user is one who not only can get status information, but also change configurations and perform control operations. All access to Yukon is via the T1.317 command set, to be discussed later.

This section describes how to log into the system via an RS-232 local port. The first step to logging in is to get to an "ENTER PASSWORD:"

prompt. From a terminal connected to the RS-232 port, simply press ENTER until you see the log-in prompt. The number of ENTER keys required will depend on the baud rate you are trying to connect at. The controller will adjust its baud rate automatically until it recognizes the carriage return character (ASCII 13) sent by pressing ENTER.

At the “ENTER PASSWORD:” prompt, type the user or super-user password. The default password for each level of security is listed below.

Default user password - lineage

Default super-user password - super-user

After receiving the correct password, the controller will respond with one of the following command line prompts:

User command-line prompt: *

Super-user command-line prompt: **

When these prompts appear the controller is ready to accept commands. Note that the session will be terminated if the port is idle for 15 minutes.

T1.317 Command Language

The ES740AD command language is based on the T1.317 standard. This section describes the commands, objects and attributes used to access measurements, configuration, and control parameters in the ES740AD controller.

Objects and Attributes

The T1.317 standard organizes system parameters called attributes into groups called objects. Note that all commands, objects, attributes and ranges for their respective parameters for the ES740AD controller are given in the following tables.

An object-attribute pair uniquely identifies a measurement, configuration, or control parameter. For example, the object-attribute pair “dc1,vdc” identifies the plant voltage while the object-attribute pair “dc1,adc” identifies the plant load current. In each of these examples “dc1” identifies the plant object and “vdc” and “adc” identify DC voltage and DC current, respectively.

There are three main commands involved with plant operations in the system controller command set, . The command “sta” is used to get the status of the plant, the command “cha” is used to change a plant parameter, and the command “ope” is used to initiate a plant function. A person at the “user” level can only perform the sta operations. A person at the “super-user” level can also perform the cha and ope operations.

Instructions in the T1.317 command set take the following form:

command object,attribute[=parameter].

Certain commands do not require a value for parameter, while others do. Note that text parameters are to be enclosed in quotation marks while numeric parameters are not to be enclosed in quotation marks.

For example, to obtain the plant voltage, type in the following command:

sta dc1,vdc

To enable low-temperature slope thermal compensation, type in the following command:

cha sc1,rve=1

To change the voltage at which the LVD contactor disconnects the batteries from the load to 40V, type the following:

cha cn1,dth=40

To initiate a manual boost charging, i.e., place the plant into boost charging mode, type in the following command:

ope dc1,slt=“boost”

The tables below summarize the object-attribute pairs in the system along with the commands that can be used with the pair and the valid range that the attribute may have. The values in bold text are the default settings for the attributes. Explanatory notes are provided after each object.

Power System		Related Commands				
obj,attr	description	sta	cha	ope	type	range of values
ps1,des	Power system description	✓			text	“Yukon ACU”
ps1,sid	Site ID	✓	✓		text	Up to 15 characters:””
ps1,swv	Software Version	✓			text	ACU software version
ps1,ltt	Lamp test			✓	number	1: do lamp test
ps1,usl	Update Serial Link			✓	number	1:perform update serial link

Site ID: If desired, you may type in a maximum 15 alpha-numeric character set to uniquely define a site location.

Update Serial Link: Running this command allows the system controller to retake inventory of using equipment. Use this command to update acknowledged equipment when, for example, a system is to run with one less rectifier.

DC Plant		Related Commands				
obj,attr	description	sta	cha	ope	type	range of values
dc1,stt	Plant state	✓		✓	text	“FLOAT”, “BOOST”
dc1,vdc	Plant voltage	✓			number	dd.dd V
dc1,adc	External Battery Shunt Size	✓			number	ddd.d A
dc1,shal	Plant shunt size	✓	✓		number	0-9999: 200 , 0: none
dc1,trd	Plant total rectifier drain	✓			number	ddd.d A
dc1,isd	Imminent shutdown enable	✓	✓		number	0: disable , 1: enable

Plant State: The plant is normally in the float-charge mode; however, the super-user may instruct the plant to enter the boost-charge mode. See Boost Charge in Section 6 for more details on boost charging.

Plant Voltage: The voltage of the plant at the time of querying.

Plant Current: The current being drawn by the load at the time of querying.

External Battery Shunt Size: In determining the load current, a current shunt is needed. If using the Aux Box with an ES712 LVDboard, the controller automatically changes the setting to the correct value. Future enhancements will allow users to utilize OEM distribution panels with different shunt values. Users may calibrate the Yukon controller by changing the shunt setting. At this time, no action need be taken on this.

Plant Total Rectifier Drain: The current being drawn by the battery and load from the plant at the time of querying.

Imminent Shutdown Enable: Factory shipped disabled. When enabled, prior to disconnecting of LVD contactor during battery

discharge, the controller will transmit the Imminent Shutdown alarm to the host indicating batteries will disconnect from the load in 15 seconds. See Imminent Shutdown in Section 6 for more details on this feature.

Alarm Thresholds/Relays		Related Commands			type	range of values
obj,attr	description	sta	cha	ope		
bda1,thr	Battery on discharge threshold	✓	✓		number	46-55, 51 V
bda1,sev	Battery on discharge severity	✓	✓		text	“ MAJ ”, “ MIN ”, or “ RO ”
bda1,acc	Battery on discharge relay	✓	✓		text	“ R1 ”, “ R2 ”, or “”
hva1,thr	High voltage threshold	✓	✓		number	50-60, 56 V
hva1,sev	High voltage severity	✓	✓		text	“ MAJ ”, “ MIN ”, or “ RO ”
hva1,acc	High voltage alarm relay	✓	✓		text	“ R1 ”, “ R2 ”, or “”
bta1,thr	Battery high temperature	✓	✓		number	30-85, 55°C
bta1,sev	Battery high temperature severity	✓	✓		text	“ MAJ ”, “ MIN ”, or “ RO ”
bta1,acc	Battery high temperature relay	✓	✓		text	“ R1 ”, “ R2 ”, or “”
Separator						
macfl,sev	Multiple AC fail severity	✓	✓		text	“ MAJ ”, “ MIN ”, or “ RO ”
macfl,acc	Multiple AC fail relay	✓	✓		text	“ R1 ”, “ R2 ”, or “”
mrfa1,sev	Multiple rectifier fail severity	✓	✓		text	“ MAJ ”, “ MIN ”, or “ RO ”
mrfa1,acc	Multiple rectifier fail relay	✓	✓		text	“ R1 ”, “ R2 ”, or “”
rfl,sev	Ringer fail severity	✓	✓		text	“ MAJ ”, “ MIN ”, or “ RO ”
rfl,acc	Ringer fail relay	✓	✓		text	“ R1 ”, “ R2 ”, or “”
faj1,sev	Major fuse alarm severity	✓	✓		text	“ MAJ ”, “ MIN ”, or “ RO ”
faj1,acc	Major fuse alarm relay	✓	✓		text	“ R1 ”, “ R2 ”, or “”
amj1,sev	Auxiliary major alarm severity	✓	✓		text	“ MAJ ”, “ MIN ”, or “ RO ”
amj1,acc	Auxiliary major alarm relay	✓	✓		text	“ R1 ”, “ R2 ”, or “”
isd1,sev	Imminent shutdown severity	✓	✓		text	“ MAJ ”, “ MIN ”, or “ RO ”
isd1,acc	Imminent shutdown relay	✓	✓		text	“ R1 ”, “ R2 ”, or “”
scd1,sev	Voltage imbalance detected severity	✓	✓		text	“ MAJ ”, “ MIN ”, or “ RO ”
scd1,acc	Voltage imbalance detected relay	✓	✓		text	“ R1 ”, “ R2 ”, or “”
Separator						
acfl,sev	AC fail severity	✓	✓		text	“ MAJ ”, “ MIN ”, or “ RO ”
acfl,acc	AC fail relay	✓	✓		text	“ R1 ”, “ R2 ”, or “”
rfa1,sev	Rectifier fail severity	✓	✓		text	“ MAJ ”, “ MIN ”, or “ RO ”
rfa1,acc	Rectifier fail relay	✓	✓		text	“ R1 ”, “ R2 ”, or “”
rhp1,sev	Ringer half-power severity	✓	✓		text	“ MAJ ”, “ MIN ”, or “ RO ”
rhp1,acc	Ringer half-power relay	✓	✓		text	“ R1 ”, “ R2 ”, or “”
rls1,sev	Rectifier redundancy loss severity	✓	✓		text	“ MAJ ”, “ MIN ”, or “ RO ”
rls1,acc	Rectifier redundancy loss relay	✓	✓		text	“ R1 ”, “ R2 ”, or “”
osa1,sev	Open string alarm severity	✓	✓		text	“ MAJ ”, “ MIN ”, or “ RO ”
osa1,acc	Open string alarm relay	✓	✓		text	“ R1 ”, “ R2 ”, or “”

The previous table outlines the various alarms that are available through the ES740AD controller, please refer to Alarm Relays in Section 6 for more details. The ES740AD controller is provided with two severity relays and two relays that may be assigned to any combination or all of the alarms noted above.

The controller is shipped with ACF assigned to Alarm Relay 2 and BOD to Alarm Relay 1. Also, for each alarm condition noted above, the factory severity is noted in bold. The user may change the severity of configurable alarms from the factory set severity. Note that the alarms noted above may also be assigned a severity of RO (Record Only). If so assigned, the alarm condition will be transmitted without any PMJ or PMN severity.

The following section provides a brief explanation of the alarm conditions. Where a brief explanation is not thorough enough, a reference is made to the Section 6 where additional details are provided.

Battery on Discharge: The battery on discharge alarm is asserted when the controller detects the plant bus voltage going below the Battery on Discharge thresholds set by the user. See Battery on Discharge in Section 6 for more details.

High Voltage: The high voltage alarm is asserted when the controller detects the plant bus voltage going above the High Voltage thresholds set by the user. See High Voltage Alarm in Section 6 for more details.

High Battery Temperature: This feature is only possible when used with slope thermal compensation. The battery thermal alarm is asserted when the controller detects battery temperatures in excess of 55°C. The alarm is retired when the battery temperatures drop 10°C below the alarm threshold.

Multiple AC Fail: The multiple AC fail alarm is asserted when the controller detects multiple ac fail alarms from the rectifiers.

Multiple Rectifier Fail: The multiple rectifier alarm is asserted when the controller detects multiple rectifier fail alarms from the rectifiers.

Ringer Fail: The ringer fail alarm is asserted when the controller detects a ringer fail alarm from the ringer, if present.

Major Fuse: The major fuse alarm is asserted when the controller detects an open load protector in the Aux Box.

Auxiliary Major: The auxiliary major alarm is asserted when the controller detects an external equipment fail alarm, if present and monitored. See Auxiliary Major in Section 6 for more details.

Imminent Shutdown: If enabled, the imminent shutdown alarm is asserted when the controller detects the LVD board about to disconnect the batteries from the load to prevent them from deep discharge. If asserted, this alarm may be used by the host to perform an orderly shutdown. See Imminent Shutdown in Section 6 for more details.

Voltage Imbalance Detection: If enabled and properly configured, the voltage imbalance detection alarm is asserted when the controller detects an imbalance between the two halves of each battery string being monitored. See Voltage Imbalance in Section 6 for more details.

AC Fail: The ac fail alarm is asserted when the controller detects a single ac fail alarm from any rectifier.

Rectifier Fail: The rectifier fail alarm is asserted when the controller detects a single rectifier fail alarm from any rectifier.

Ringer-Half Power: The ringer half-power alarm is asserted when the controller detects a single ringer module has failed on the redundant ringer module, if provided.

Rectifier Redundancy Loss: If enabled, the rectifier redundancy loss alarm is asserted when the total rectifier output current exceeds N rectifier capacity, assuming N+1 rectifiers are present in the system. See Redundancy Loss in Section 6 for more details.

Open String: This alarm is only available when used with the ES772A Remote Distribution Module. This alarm is issued to indicate an open charge path to batteries when an external disconnect switch is used to disconnect the batteries from the charge bus; it is asserted with a PMJ severity. See Section 11 for more details including the required wiring connections to the ES772A from the Yukon power system.

Rectifier Management		Related Commands				
obj,attr	description	sta	cha	ope	type	range of values
gm1,fsp	Rectifier float set-point	✓	✓		number	51-56.5, 54.5 V
gm1,bsp	Rectifier boost set-point	✓	✓		number	54-56.5, 55.2 V
gm1,rme	Redundancy monitor enable	✓	✓		number	0: disable , 1: enable

Rectifier Float Set-point: The voltage at which the plant will float charge the battery strings. See Rectifier Float Set-Point in Section 6 for more details.

Rectifier Boost Set-point: The voltage at which the plant will boost charge the battery strings. See Boost Charge and Auto-Boost Charge in Section 6 for more details.

Redundancy Monitor Enable: Activates the Redundancy Loss alarm feature.

Rectifiers		Related Commands			type	range of values
obj,attr	description	sta	cha	ope		
gsr,slt	Individual rectifier state	✓		✓	text	“ON”, “OFF”, “STANDBY”, “MISSING” Only “ON” and “STANDBY” can be used with ope.
gsr,adc	Individual rectifier current	✓			number	ddd

s stands for shelf number (1, 2, or 3)
r stands for rectifier number (1 to 5)

Individual Rectifier State: When requested, shows the state of the individual rectifiers. Note that the rectifier numbering starts from the left-most position of the master shelf (shelf number 1.)

When obtaining individual rectifier status information, the following information may be transmitted:

- **ON:** Rectifier operating normally. User may use ope to turn ON a rectifier in standby.
- **OFF:** Rectifier has been shutdown due to hardware failure.
- **STANDBY:** User has inhibited the rectifier's output voltage. User may use ope to place a rectifier into a standby condition.
- **MISSING:** An acknowledged rectifier has been removed.

Rectifiers may also be put in standby; however, the ability to place rectifiers in standby requires some backup plan to take the rectifier out of standby automatically under a low voltage condition. The battery on discharge (BOD) threshold is used as a rectifier-on voltage threshold. In other words, when the plant voltage dips below the BOD threshold, the controller turns on all rectifiers that are in standby.

Individual Rectifier Current: When requested, shows the current output from an individual rectifier.

Battery Reserve Management		Related Commands				
obj,attr	description	sta	cha	ope	type	range of values
br1,hbt	Highest battery temperature	✓			number	<i>dd</i> °C
br1,adc	Total battery current	✓			number	<i>d</i> A (+ for discharge, - for charge)
br1,bts	Plant battery test	✓		✓	number	0: stop, 1: start
br1,scd	Voltage imbalance detection enable	✓			number	0: disable , 1: enable (Automatically enabled when ES771A Voltage Monitor detected)
br1,ntm	Number of temperatures present	✓				<i>d</i>
br1,nvm	Number of mid-cell V present	✓				<i>d</i>
br1,cle	Battery recharge current limit enable	✓	✓		number	0: disable , 1: enable
br1,clt	Battery recharge current limit	✓	✓		number	5-100, 10

Highest Battery Temperature: When requested, will show the hottest temperature monitored by the VT-Probes.

Total Battery Current: When requested, will display the current being drawn by the battery string. This is determined by subtracting the load current from the total rectifier output current.

Plant Battery Test: When initiated, this function lowers the plant voltage to 44V and allows the batteries to discharge into the load. This may be used to determine the health of the batteries. See Plant Battery Test in Section 6 for more details on this function.

Voltage Imbalance Detection Enable: Activates the Shorted Cell Detection alarm. See Shorted Cell Detection in Section 6 for more details on this feature.

Number of Temperatures Present: When requested, will display the number of ES773A (VT-Probes) that are currently connected to the system.

Number of mid-Cell V Present: When requested, will display the number of ES771A (Remote Voltage Monitoring Modules) that are currently connected to the system.

Battery Recharge Current Limit: The maximum current flowing into battery during the recharge period is adjustable to any value between 5A and 100A, in 1A increments. At least one battery string must be present to have this function operate.

Serial Ports		Related Commands				
obj,attr	description	sta	cha	ope	type	range of values
lp1,bdr	Local RS-232 baud rate	✓	✓		number	“ AUTO ”, 2400, 4800, 9600, 19200
lp1,hsh	Local RS-232 handshaking	✓	✓		text	“ NO ”: none, “ SW ”: xon/xoff, “ HW ”: rts/cts

Boost Management		Related Commands				
obj,attr	description	sta	cha	ope	type	range of values
bs1,abe	Auto boost enable	✓	✓		number	0: disable , 1: enable

Auto Boost Enable: Activates the Auto-Boost function. See Auto Boost in Section 6 for more details on this feature.

Battery Contactor		Related Commands				
obj,attr	description	sta	cha	ope	type	range of values
cn1,dth	Low voltage battery disconnect threshold	✓	✓		number	39-48, 42 V
cn1,rth	Low voltage battery reconnect threshold	✓	✓		number	39-48, 44 V
cn2,dth	Low voltage load disconnect threshold	✓	✓		number	39-48, 42 V
cn2,rth	Low voltage load reconnect threshold	✓	✓		number	39-48, 44 V

Low Voltage Battery Disconnect Threshold: Sets the voltage at which the battery contactor disconnects the battery strings from the load.

Low Voltage Battery Reconnect Threshold: Sets the voltage at which the battery contactor reconnects the battery strings to the system bus voltage.

Low Voltage Load Disconnect Threshold: Sets the voltage at which the battery contactor disconnects the battery strings from the load.

Low Voltage Load Reconnect Threshold: Sets the voltage at which the battery contactor reconnects the battery strings to the system bus voltage.

The load disconnect feature is only supported in the ES714AD Aux Box and in the ES712_LVD_D LVD board.

Slope Thermal Compensation		Related Commands			type	range of values
obj,attr	description	sta	cha	ope		
sc1,stt	Slope compensation enable	✓			number	0: disable , 1: enable (Automatically enabled when temperature monitor detected)
sc1,rve	LT Compensation Enable	✓	✓		number	0: disable , 1: enable
sc1,ltt	Low temperature limit	✓	✓		number	-5-20, 0°C
sc1,ntt	Nominal temperature	✓	✓		number	15-30, 25°C
sc1,utt	Upper temperature limit	✓	✓		number	30-55, 45°C
sc1,spt	Step temperature	✓	✓		number	48-85, 75°C
sc1,lsp	Low temperature slope	✓	✓		number	1-5, 3 mV/°C per cell
sc1,usp	Upper temperature slope	✓	✓		number	1-5, 3 mV/°C per cell

Slope Compensation Enable: The activation of the slope thermal compensation function is automatically enabled if the controller detects the presence of an ES773A (VT-Probe) configured for a thermal probe.

Low Temperature Compensation Enable: When enabled, this activates the low-temperature slope thermal compensation and the low temperature attributes of slope thermal compensation.

Low Temperature Limit: This sets the minimum temperature for which low temperature thermal compensation is continued.

Nominal Temperature: This sets the reference temperature at which increases in temperature above this reference temperature will result in the output voltage being decreased at the slope selected by the user. Temperatures below the reference temperature will result in the output voltage being increased at the slope selected by the user.

Upper Temperature Limit: This sets the maximum temperature for which thermal compensation is continued.

Step Temperature: This is the temperature at which float charging is terminated. This signifies that the batteries are too hot and charging current is stopped in order to cool the batteries. Once the battery strings have cooled by 10°C, thermally compensated float charging is resumed.

Low Temperature Slope: This sets the slope for low temperature slope thermal compensation.

Upper Temperature Slope: This sets the slope for the high temperature slope thermal compensation.

See Slope Thermal Compensation in Section 6 for more details on this feature.

Ringer Plant		Related Commands				
obj,attr	description	sta	cha	ope	type	range of values
rp1,vsp	Ring output voltage set-point	✓	✓		number	70, 80, 90, 100 V
rp1,frq	Frequency set-point	✓	✓		number	17, 20 , 25, 50 Hz

Ring Output Voltage Set-Point: If the optional ringer module is present, this command sets the output voltage of the ringer.

Frequency Set-Point: If the optional ringer module is present, this command sets the output voltage frequency of the ringer.

**Additional T1.317
Commands**

ala Report Active Alarms

Syntax: ala

Description

This command reports all the active alarm conditions in the plant. One alarm message is listed per line in the report. The table below lists the default alarm messages. Note that if user changes the severity of the alarm, the corresponding change will show up in the alarm message. However, alarm conditions with the RO severity will not be displayed, the rec command, discussed later, should be used.

Alarm Message

- MAJ, Multiple Rectifier Fail
- MAJ, Multiple AC Fail
- MAJ, Battery On Discharge
- MAJ, High Voltage
- MAJ, Sense Fuse
- MAJ, Fuse Major
- MAJ, Auxiliary Major
- MAJ, Contactor 1 Open
- MAJ, Contactor 1 Fail
- MAJ, Ringer Failure
- MAJ, Major Communication Fail
- MAJ, High Battery Current Shutdown
- MAJ, Shorted Cell Detected
- MAJ, Imminent Low V Shutdown
- MAJ, Open String

- MIN, Rectifier Fail
- MIN, AC Fail
- MIN, Thermal Probe Fail
- MIN, Ringer Half Power
- MIN, Battery High Temp
- MIN, Rect Redundancy Loss
- MIN, High Battery Current
- MIN, Minor Communication Fail
- MIN, Circuit Pack Failure
- MIN, Mid-cell V Monitor Fail

If no alarms are active “NO ACTIVE ALARMS” is reported.

bye Log-off

Syntax: bye

Description

This command is used to terminate the session.

cha Change Value

Syntax: `cha obj,attr=value`
 where: *obj,attr* is an object-attribute pair. For example, `ps1,sid`.

Description

This command is used to change system configuration parameters. Examples are listed below to illustrate how this command works.

```
cha ps1,sid="My Plant"    Change the site id to My Plant
cha p1,phn="123456789"    Change the primary phone number to 123456789
```

You must be logged in as a super-user to use this command.

cle Clear All Latched Events

Syntax: `cle`

Description

This command is used to clear latched events. These events include communication failures, missing rectifiers, missing thermal probes, missing voltage monitoring module, distribution fuses, and loss of redundancy alarm.

You must be logged in as a super-user to use this command.

lis List Rectifiers

Syntax: `lis rec`

Description

This command is used to list all the rectifiers in the system. The command will list all present and missing rectifiers. Missing rectifiers are rectifiers that have been removed from a shelf. The `cle` will clear missing rectifiers from the controller's memory and they will no longer be listed by this command. Return value for a system with 3 rectifiers on shelf 1 would look like the following:

```
* lis rec
G11
G12
G13
.
*
_
```

login **Log-in**

Syntax: login "*password*"
 where *password* is either the user or super-user password

Description

This command is used to log-in as a user or super-user. For example, if you are currently logged into the controller as a user but would like to change the site id you must first use this command to log-in as a super-user.

ope **Operate a Control**

Syntax: ope *obj,attr=value*
 where: *obj,attr* is an object-attribute pair. For example, dc1,pbt.

Description

This command is used to operate a system control parameter. Examples are listed below to illustrate how this command works.

ope ps1,usl=1	Update serial link
ope dc1,stt="boost"	Place plant into boost mode

You must be logged in as a super-user to use this command.

pas **Change Passwords**

Syntax: pas *t*, "*password*", "*password*"
 where *t* is *u* to change the user password, or *s* to change the super-user password
 password is the new password

Description

This command changes either the user or super-user password. You must be logged in as a super-user to use this command. The password is sent twice in order to avoid mistakes. The password must have at least 6 characters but no more than 15 characters.

You must be logged in as a super-user to use this command.

rec **Active Record Only Events**

Syntax: rec

Description

This command reports all the active alarm conditions in the plant with RO severity. One alarm message is listed per line in the report.

If no alarms are active "NO ACTIVE RECORD ONLY EVENTS" is reported.

sta Report Status

Syntax: ope *obj,attr*
 where: *obj,attr* is an object-attribute pair. For example, ps1,sid.

Description

This command reports the value of the measurement, configuration, or control parameters in the system. A couple examples are listed below to illustrate how this command works.

```
sta dc1,vdc        Report plant voltage
sta dc1,adc        Report plant load current
```

The command line would respond as follows for first command listed above.

```
* sta dc1,vdc
:DC1
VDC=-52.48
.
* _
```

The "*" in the example above is the user command line prompt. The line ":DC1" indicates that the information that follows is for the plant object. The line starting with "VDC" identifies the DC voltage. The "." line is the end-of-command identifier.

Error Messages

While logging into the ES740AD controller or while entering commands, you may encounter one or more of the following error messages:

Error Message	Description
!-112, SYNTAX ERROR	Unrecognizable command was entered.
!-220, SECURITY	Super-user command was entered by someone with user status.
!-221, EXCESSIVE LOGIN ATTEMPTS	Too many attempts were made to login with an unrecognized password.
!-223, INVALID PASSWORD	New password contains an illegal character.
!-224, NEW PASSWORD MISMATCH	First and second copy of new passwords don't match
!-304, INVALID PARAMETER	An attempt was made to change a parameter to an illegal value.
!-319, INVALID ATTRIBUTE	An invalid object id was specified in the command or, a command referred to an attribute that doesn't support it.
!-320, INVALID OBJECT	An invalid object id was specified in the command
!328, FEATURE DISABLED	An attempt was made to initiate a feature that is disabled.
!335, COULD NOT EXECUTE	Command could not execute because of active alarms or a conflicting operation.

Appendix Air Flow Management

C

Overview

The Yukon Power System has been designed for mounting in relay racks or in equipment cabinets where -48Vdc power is required. When used with ES760A rectifiers, the system is capable of natural convection operation with ambient inlet temperatures between -40°C and 50°C. In other words, for temperatures below 50°C, the rectifiers are capable of self-cooling by natural convection. When used with ES761A rectifiers, the system is capable of full power operation up to 75°C with minimum 250 lfm (1.27 lms) forced air cooling. This section provides the forced external airflow requirements when used with either rectifier.

Air-Flow Requirements

The direction of the forced airflow through the Yukon Power System may be either top-to-bottom or bottom-to-top. Figure C-1 shows the front and bottom of the 19-in Yukon Power System; similar measurements may be made for the 23-inch shelf.

Air flow requirements for operating the Yukon Power System in ambient temperatures from 50°C to 75°C (ES760A) and for operation up to 75°C (ES761A) can be obtained by making airflow measurements at the identified location on the shelf using an anemometer.

In order to guarantee the requisite airflow is being provided in the end-use application, measurements should be taken at the locations identified, summed and divided by the number of measurements made to arrive at an average airflow.

Place the measuring device approximately 2 inches below the shelf in the end-use application and make the measurements. The average reading should be minimum 100 lfm or 0.51 mps for the system when used with ES760A rectifiers.

The average reading should be minimum 250 lfm (1.27 mps) when used with ES761A rectifiers. Figures C-2 and C-3 show output power vs. ambient temperature curves for different airflows. For proper operation,

ensure that airflow is adequate for power loading and ambient temperature.

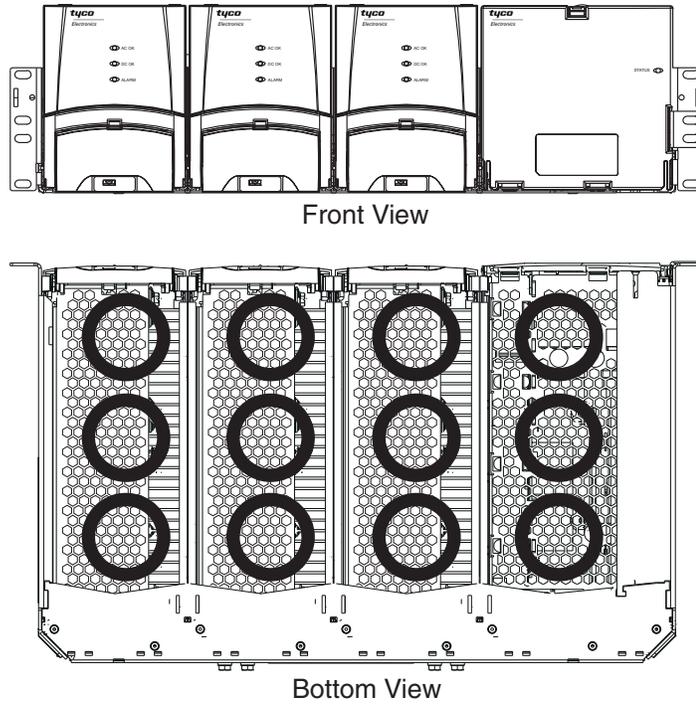


Figure C-1: Yukon Shelf Airflow

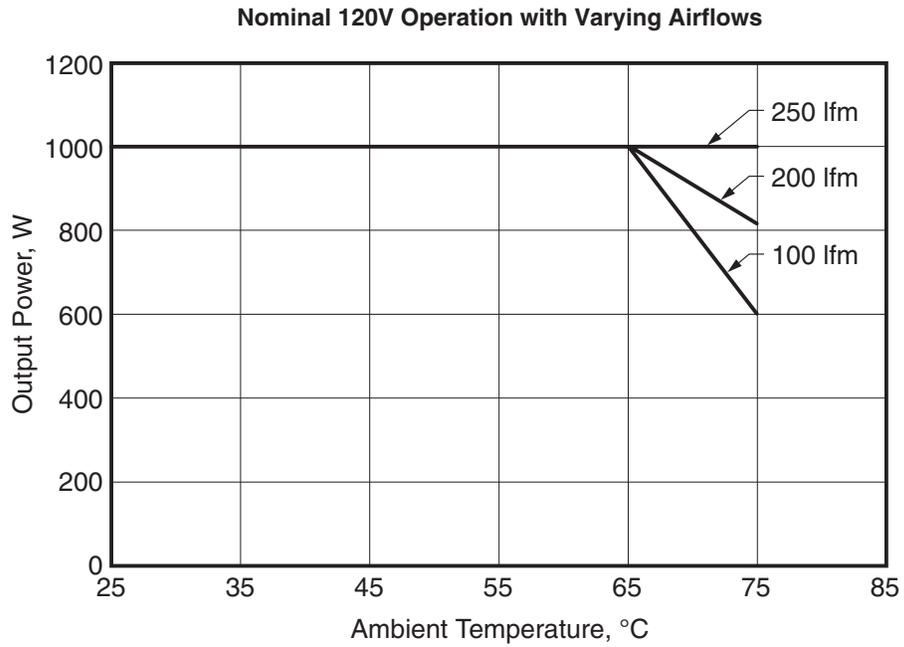


Figure C-2: ES761A Airflow vs. Ambient Temperature to 1000W

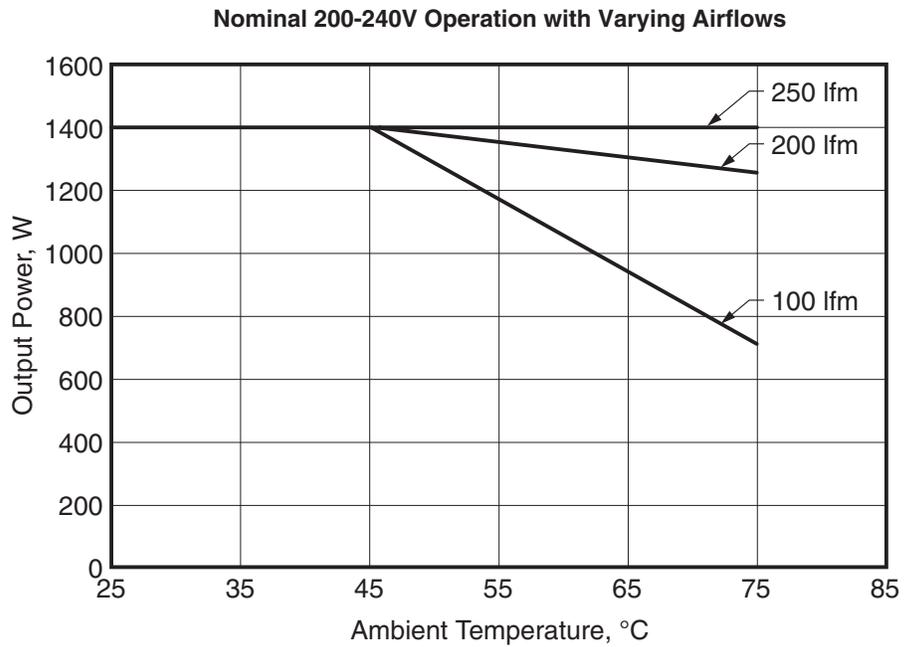


Figure C-3: ES761A Airflow vs. Ambient Temperature to 1400W

Appendix Varying Ceiling Heights

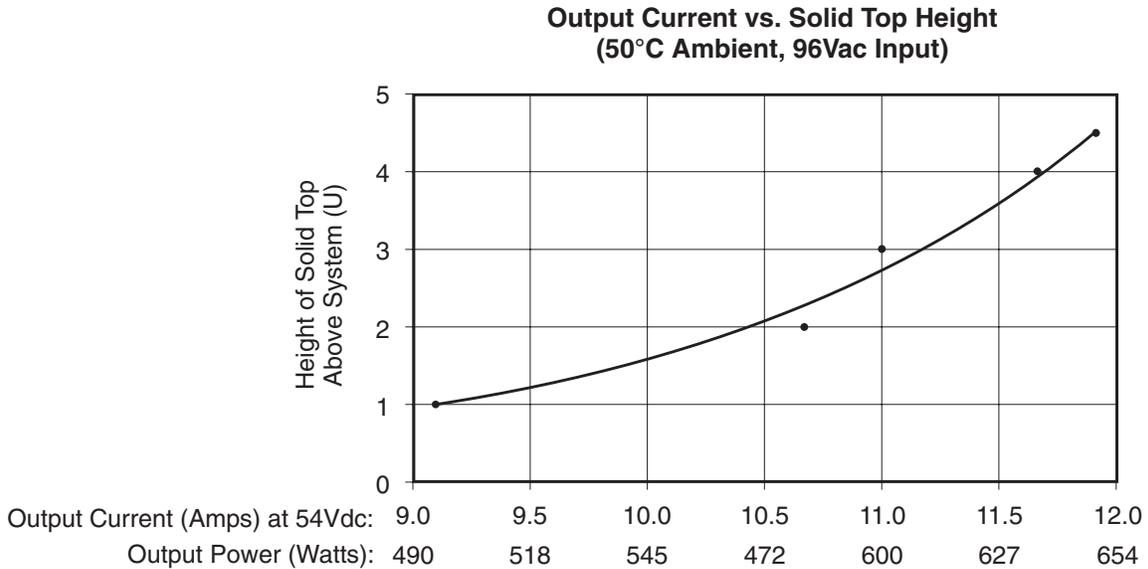
D

Overview

The Yukon Power System has been designed for mounting in relay racks or in equipment cabinets, where -48Vdc with optional ringing power is required. It is designed for use with other equipment that require vertical airflow cooling. Equipment may be placed on top of the Yukon power system provided airflow is not impeded or sufficient spacing is provided. The purpose of this note is to provide vertical spacing requirements for equipment.

Vertical Spacing Requirement

The graph below was obtained by measuring temperatures on critical components internal to the Yukon rectifier with a solid metal plate placed at various distances above the power system. Use this chart as a guide in determining the distance your equipment should be spaced from the power system.



Appendix E ***Circuit Breaker Derating***

Merlin Gerin, a Square D company, provides the following circuit breaker derating information. This statement is taken verbatim from the Square D catalog:

"When a number of miniature circuit breakers that operate simultaneously are mounted side-by-side in a small enclosure, the temperature rise inside the enclosure causes a reduction in the permissible utilization current.

For example, C60N rated at 20A installed on a back plate on a site where the ambient temperature is 60°C: Maximum utilization current:
 $20 \times 0.82 = 16.4\text{A}."$

The manufacturer's recommended derating factors are given in the following table.

Rating	30°C	40°C	50°C	60°C	70°C
6A	0.98	0.93	0.87	0.82	0.76
16A	0.98	0.93	0.87	0.81	0.75
20A	0.98	0.93	0.87	0.82	0.76
32A	0.98	0.93	0.88	0.82	0.77
40A	0.98	0.93	0.88	0.82	0.76
63A	0.97	0.91	0.85	0.78	0.71

Appendix F EasyView for PalmOS[®] for the Yukon Controller

Overview

EasyView for PalmOS (EasyView) is a program that runs on a Palm™ handheld device and provides access to a Yukon Controller. The program provides access to controller alarms, system status, control and configuration. To use EasyView you will have to load the EasyView application onto your PDA, connect your PDA to the Yukon controller, and run the EasyView application.

For detailed information on the actual controller alarms, system status, control and configuration parameters, refer to Section 6 of the Yukon Product Manual.

Compatibility

EasyView will run on PDAs running the PalmOS operating system. However, PDA serial ports vary from one manufacturer to the other or may not be supported at all. Some PDA serial ports, support RS-232 signal levels that are compatible with the Yukon controller configuration port. Other PDA serial ports, such as Handspring[®] for example, support TTL levels that require special cables with circuitry built into them to generate the RS-232 signal levels. Signals required to enable this circuitry may not be present on the Yukon controller configuration port. EasyView was developed and tested using several Palm PDAs. See section for 4.4 for cautions and limitations on using a Handspring PDA to connect to a Yukon controller.

Loading the EasyView Application

Before loading the EasyView application onto your Palm handheld device, install the Palm Desktop software onto your PC. The Palm Desktop software comes packaged with your PDA. If EasyView is already loaded on your PDA, follow the instructions that came with your PDA to perform a HotSync[®] operation. If the EasyView application is not installed on your handheld device follow the steps outlined below to install EasyView.

PalmOS and HotSync are registered trademarks of Palm, Inc. Palm is a trademark of Palm, Inc. Handspring is a registered trademark of Handspring, Inc.

On your PDA:

1. Select the "Prefs" icon from the home screen.
2. Select "owner" from the drop-down menu to the right of the "Preferences" title bar.
3. Make a note of the owner. If no owner is listed, enter your name as the owner.
4. Press the home icon next to the Graffiti writing area to go back to the home screen
5. Place the handheld device in the HotSync cradle
6. Connect the HotSync cradle to your PC

On your PC:

1. Start the Palm Desktop software on your PC
2. Under Tools->Users select the New... button and enter your handheld owner name.
3. Press OK to exit the Tools->Users screen.
4. Select the Install icon located on the left side of the window.
5. Select the User name that matches your handheld owner's name.
6. Select the "Add..." button.
7. Select the EasyViewVm.n.prc file (may have come on a disk or from web)
8. Press the Done button to exit the install tool.

On your HotSync cradle:

Press the HotSync button.

Once the HotSync operation has completed look for the icon  on the home screen. To test the installation, click the EasyView icon and enter demo at the password prompt. Enter the demo password either using Graffiti[®] alphabet or click the abc dot in the lower-left corner of the Graffiti writing area to call up a keyboard. After entering demo, press the Login button. If everything went well you should see the EasyView default screen. Press the menu button next to the Graffiti writing area and select Yukon->Exit to exit EasyView

Making the Connection

To use EasyView to access a Yukon controller you will need a Palm handheld device, Palm HotSync Cable, null modem adapter, and a Yukon controller programming cable (comcode 848658100).

Palm Handheld Device

While EasyView will work with most Palm handheld devices, we recommend one with Palm OS v3.1 or later and one with the Palm Universal Connector.

Palm HotSync Cable

The following table is a cross-reference of standard Palm HotSync cables to Palm Handheld devices. The devices listed on the first row have the Palm Universal connector.

Palm Part No.	Description	Supported Palm Handheld Devices
P10804U	Palm m500 HotSync Cable-Serial	m125, m130, m500, m505, m515, i705
P10701U	Palm m100 HotSync Cable-Serial	m105, m100
10104U	HotSync Cable	VIIx, VII, IIIc, IIIxe, IIIx, IIIe, III, PalmPilot

DB9M to DB9M Null Modem Adapter

The null modem adapter routes the RS-232 signals from a Yukon Controller Programming Cable to a Palm HotSync Cable. The null modem adapter must have 9-pin DB type male connectors on both sides. Many manufactures sell a DB9M to DB9M null modem adapter. We used the following adapter:

Part No.	Description
30D1-18100	DB9/DB9 M/M, Null Modem Adapter/Mold
Cablewholesale.com ph: 1-888-212-8295 http://www.cablewholesale.com/catalog/computeradaptors.htm	

Connecting to a Handspring PDA

The Handspring PDA serial port supports TTL signals instead of RS-232 signals. A device built into a Handspring compatible serial HotSync cable or cradle translates the TTL signals to RS-232 signals. An RS-232 DSR signal from the Yukon programming connector provides power to this device. This RS-232 DSR signal is available with the following ES740A controller and programming cable:

ES740A Controller series 1:2 (AM5)
Yukon controller programming cable (848658100) Issue 2

Use a Handspring compatible serial HotSync cable, a null modem adapter, and a Yukon programming cable as described earlier to make

the connection between your Handspring PDA and Yukon controller. Handspring compatible serial HotSync cables are available from 3rd party vendors. At this time, Handspring doesn't sell them. An appropriate cable may be obtained from <http://www.gethightech.com>.

EasyView version 1.1 and later support Handspring PDA serial connections. Earlier versions of EasyView will run on a Handspring PDA in demo mode but will not connect to a Yukon controller.

Using EasyView

The EasyView application is designed to be user-friendly. Most changes in configuration values and operation can be made with a few taps of the stylus. Some information, such as passwords, must be entered letter for letter. If you are familiar with the Graffiti handwriting recognition software, use the Graffiti writing area at the bottom of the screen. If you are not familiar the Graffiti handwriting software, tap on the abc dot in the lower-left corner of the Graffiti writing area to call up a keyboard or select Tools->Keyboard Help from the menu. This section explains how to start EasyView, Log into the Yukon controller, navigate menus, and how to change values.

Starting EasyView and Logging In



Find and tap the EasyView icon . The first thing EasyView does is check to see if you are already logged into a controller. If you are not logged in, then you will be prompted to do so. The login form and a description of the login options are as follows:

Password	Description
demo	Allows full access to simulated status and configuration data.
lineage	Allows full access to alarm and status information and view-only access to configuration.
super-user	Allows full access to alarm, status and configuration.

Login

Use this form to:

- 1) Login for the first time
- 2) Login at a different Security level

Password:|.....

Main

Yukon Controller V1.0
Site ID: Demo

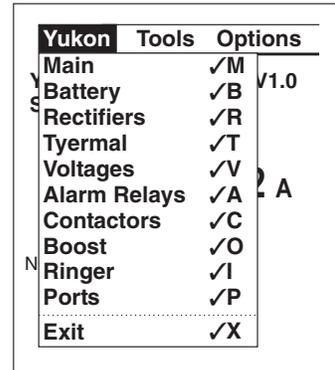
54.5 v 30.2 A

FLOAT
NO ACTIVE EVENTS

Menus

Display the menu bar by tapping the menu icon to the left of the Graffiti writing area or by tapping the title bar at the top of the screen (this may not be supported on older devices). The menu bar contains three menus: Yukon, Tools, and Options. The following describes these three menus:

Menu	Description
Yukon	Allows you to view and configure the Yukon controller features and exit EasyView
Tools	Allows you to login at a different security level, change passwords, and get help to edit text.
Options	Allows you to set preferences and see the EasyView version.



Buttons

Push buttons are used to perform operations. Some of the more common push buttons are as follows:

- Load standard factory defaults
- Send configuration fields to the controller
- Increment the selected numeric value
- Decrement the selected numeric value
- Start specified operation
- Stop specified operation

Square Edit Fields

Many screens have values displayed in square boxes. These values can be changed once they are selected by tapping on them. Numeric values are changed using the + and - keys. Following are the different types of square edit fields and an example of each:

Type	How To
Numeric	Use the + and - keys to increment or decrement the value (example: voltages)
Drop-List	Tap a new value in the drop-down box (example: alarm relays)
Push Button	Tap the associated push button to change the field (example: rectifier status)
Text Field	Use Graffiti alphabet or keyboard to edit the text (example: ID)

Drop-List

When an attribute has a fixed number of possible values a drop-list is used to select a new value. Just tap on the upside-down triangle next to the present value and tap on a new value. An example of a drop-list can be found on the ringer screen.

Checkbox

The checkbox is used enable or disable a controller feature. Tap on the box to either enable or disable the controller feature. The feature is enabled when a check mark appears in the box.

Appendix G *EasyView for Windows[®] for the Yukon Controller*

Overview

EasyView[®] for Windows OS (EasyView) is a program that runs on an IBM[®]-compatible PC with an isolated RS-232 port or laptop computer and provides access to a Yukon Controller. (Hereafter the term PC is used to refer to a PC with an isolated RS-232 port or laptop computer.) The program provides access to controller alarms, system status, control and configuration. To use EasyView you will have to load the EasyView application onto your PC, connect your PC to the Yukon controller, and run the EasyView application.

For detailed information on the actual controller alarms, system status, control and configuration parameters, refer to Section 6 of the Yukon Product Manual

Loading the EasyView Application

The EasyView software may be freely downloaded from the Lineage Power web site at <http://www.lineagepower.com>.

Making the Connection

To use EasyView to access a Yukon controller you will need a PC, and a Yukon controller programming cable (comcode 848658100). Connect the cable to the serial port of your PC and to the controller programming connector of the Yukon controller, see Fig 6-1.

Configuring a Site

Start the EasyView program by selecting its icon. Once started, you will enter the Default screen. This is where the system alarms, warnings, and site descriptions are displayed. To configure a site, press the F11 key from this screen, or select Setup Sites from the Options menu. The Site List popup screen is displayed.

On this screen, hit the Add button and then the Modify button.

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IBM is a registered trademark of IBM Corporation*

On the Description field, type in an identifier, e.g., Yukon Controller Connection. Then select Set Default Passwords button. To view controller status information without being able to change any settings, select User in the Connect Password field. If you will be changing parameters, select Super User. Super-users have configuration privileges.

Serial Port Setup

This selection defines the entire connection method except for password. If a suitable Serial Port Setup choice is not listed, you must define one by:

1. Clicking on Show Serial Port Setups.
2. Clicking on Add.
3. Clicking on Modify.

You will be making a direct connection to the Yukon controller. Look for the Set Default Values for: field and hit either Com 1 direct, Com 2 direct, Com 3 direct, or Com 4 direct depending on which communications port you will be using to connect to the controller. Hitting the button will automatically set all other parameters for you. Hit the OK button to exit this field. Hit OK again to exit the Site field. Then hit the Close button.

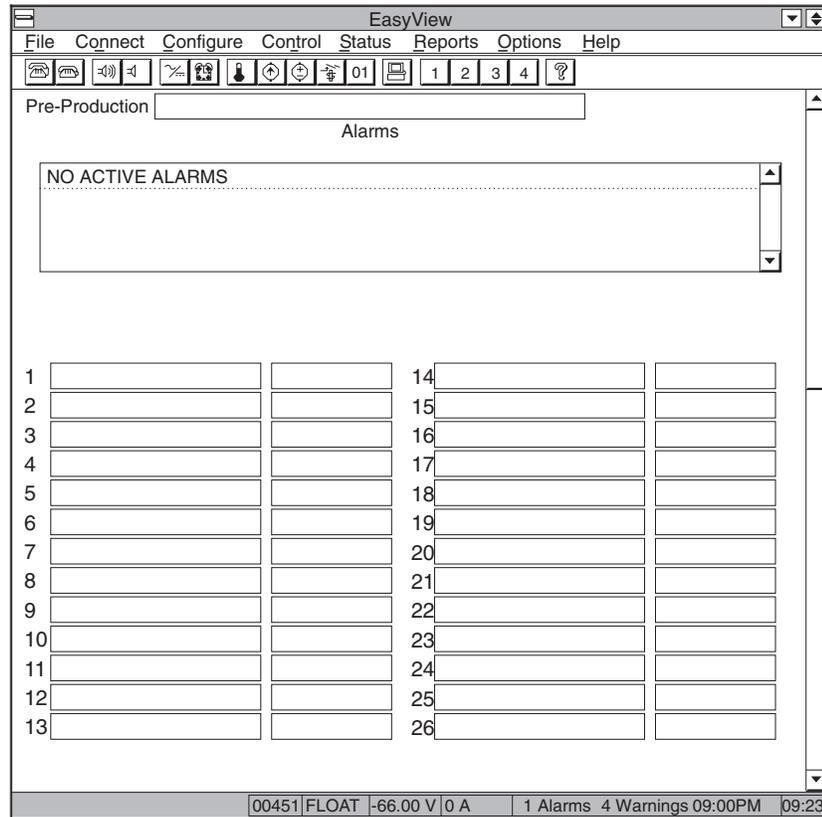
Connect to Site

To connect to the Yukon controller, hit F12 or from the Connect menu, select the Connect to Site option. You may now select one of the listed sites. EasyView will start the connect process and display the commands it is sending to the Yukon controller and responses it is getting back. When the connection process is completed, EasyView will obtain the alarms and warnings of the Yukon controller and display them on the default screen.

You should be connected to the controller at this time.

Navigating Once Connected

Once you've connected to the controller, you should see the following screen. Note that any alarms currently on the plant will be visible.



There are three pull-down menus you may choose to gain access to plant features and functions. They are Configure, Control, and Status.

Configure

This pull-down menu allows one to access all Yukon controller parameters that may be uniquely configured. It allows access to set alarm thresholds and alarm relays, set battery connect and disconnect thresholds, enable auto-boost mode and set boost charge thresholds, change passwords, enable imminent shutdown feature, set rectifier parameters, set ringer parameters, configure serial ports, and configure slope thermal compensation.

Control

This pull-down menu allows one to access all Yukon controller parameters that may be activated to perform a function. It allows one to perform a plant battery test, clear all clearable alarms, perform a lamp test, change the plant state from float to boost mode, and inhibit or restart rectifiers.

Status

This pull-down menu allows one to obtain the status of the battery management system, i.e., battery current, battery temperature, number of VT-Probes and ES771A Voltage Imbalance Detection modules are present. It also allows rectifier management, i.e., provides information as to the number of rectifiers present and their output current.

Exiting

To exit the program, either hit the Disconnect icon or hit File and Exit.

Revision History

Issue 11 Rebranding

Issue 10 Updated ordering information.

Issue 9 Page 3-4, 3-5: Indicated shelf / aux box compatibility. Section 9: Indicated shelf compatibility for each aux box. Page 3-12: corrected comcode for ES772A. Figure 11-1: Corrected caption.

