



-48V CPS4000+
19" Cabinet Power System
J85500R-3

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Notice:

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

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1 Introduction

-48 Volt Cabinet Power System

Overview

The J85500R-3, CPS 4048, -48V Cabinet Power System (CPS) is an extremely flexible power system designed for 19" cabinet applications where space conservation and environmental considerations are critical. By limiting the system depth to 12 inches, the -48V CPS architecture permits the cabinet designer to locate revenue-generating equipment behind the power system in 24-inch deep cabinets.

The plant supports -48V primary loads up to 60 amperes in a single shelf with an optional embedded battery disconnect contactor. A supplementary shelf may also be added to support loads up to 120A.

-48V CPS power units feature automatic load-share circuits that force the power units 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 power modules are designed to operate in ambient temperatures of -40° to +65°C (-40° to 149°F), with excursions to +75°C (167°F), and are provided with self-contained cooling fans, making the -48V CPS a reliable power solution for various outside plant applications. Its dual power bus architecture supports applications where more than one voltage is required, which eliminates the need to invest in two separate power plants.

Signal interfaces between the -48V CPS rectifiers and the plant control unit provide alarm monitoring, rectifier output voltage adjustment, plant current monitoring, LED test, and rectifier On/Standby control.

-48 Volt Cabinet Power System, continued

Applications

CPS 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.

Shelf Design

The shelf design provides a platform that accepts plug-in modules, which simplifies plant assembly and repair. This plug-in design also permits growth of plant capacity and easy maintenance without interruption of service. Keying prevents insertion of incompatible modules.

Configurations

The -48V CPS plant provides the facilities to combine rectifiers, ringing generators, a control unit, a low-voltage battery disconnect feature, battery protection circuits, and input and output distribution in a single shelf.

A control unit is included in a single-shelf plant or in the initial shelf of a two-shelf plant. The control unit provides monitoring and control features, and office alarm outputs.

The J85500R-3 -48V CPS is available in two configurations:

- A rectifier plant capable of providing -48V power within the load range of zero to 60 amperes in a one-shelf plant or zero to 120 amperes in a two-shelf plant
- A rectifier/ringer plant in which -48V rectifiers can provide load power and power to operate 50/100 VA ringers

CPS4000

Introduction

This product manual describes the features and functionality of the 19" CPS4000 product line.

Customer Service Contacts

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

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

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

Customer Training

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

Downloads and Software

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

2 *Product Description*

Overview

Block Diagrams

Figure 2-1 is a basic block diagram of the -48V 19" Cabinet Power System (CPS) configured as an initial shelf or with Low-voltage Disconnect (LVD).

Shelf assemblies house and interconnect power modules and a control unit.

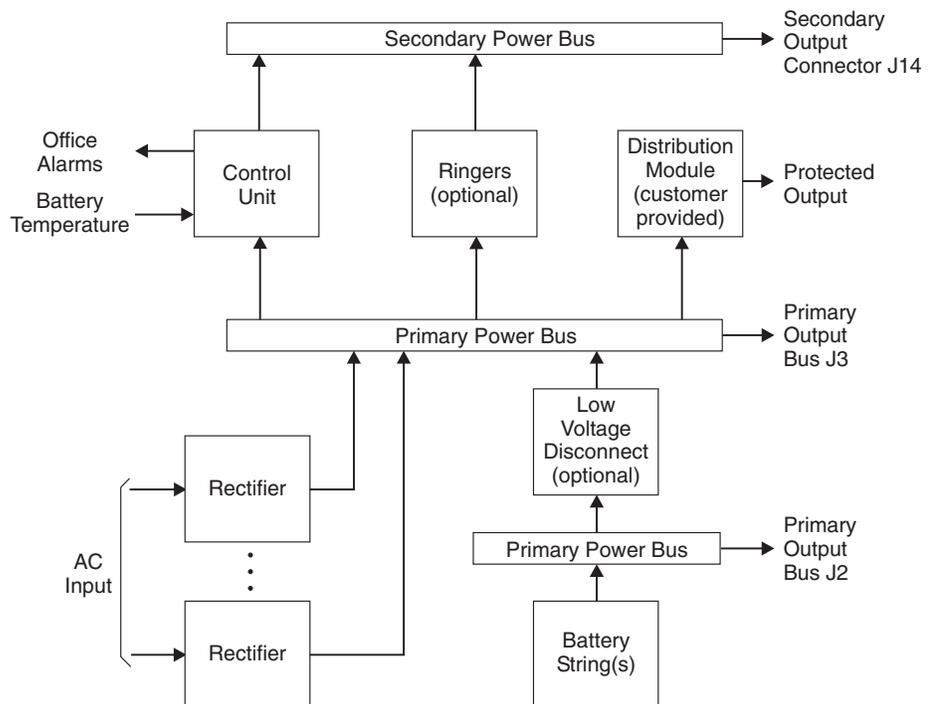


Figure 2-1: Block Diagram of -48V CPS With LVD Contactor

Shelf Design

Features

The shelf is available in the 19" standard width and has the following features:

- Accepts plug-in modules, such as rectifiers, ringers, and control units, which simplifies plant assembly and repair.
- Accepts up to four rectifiers per shelf.
- Permits growth of plant capacity and easy maintenance without service interruption.
- Provides keying to prevent improper insertion of incompatible modules.

Figure 2-2 illustrates the shelf design and location of the modules. This figure shows the CPS configured for dual ac feeds, where one ac feed powers two rectifier slots. Not shown is a four ac feed option, where one ac feed powers one rectifier slot.

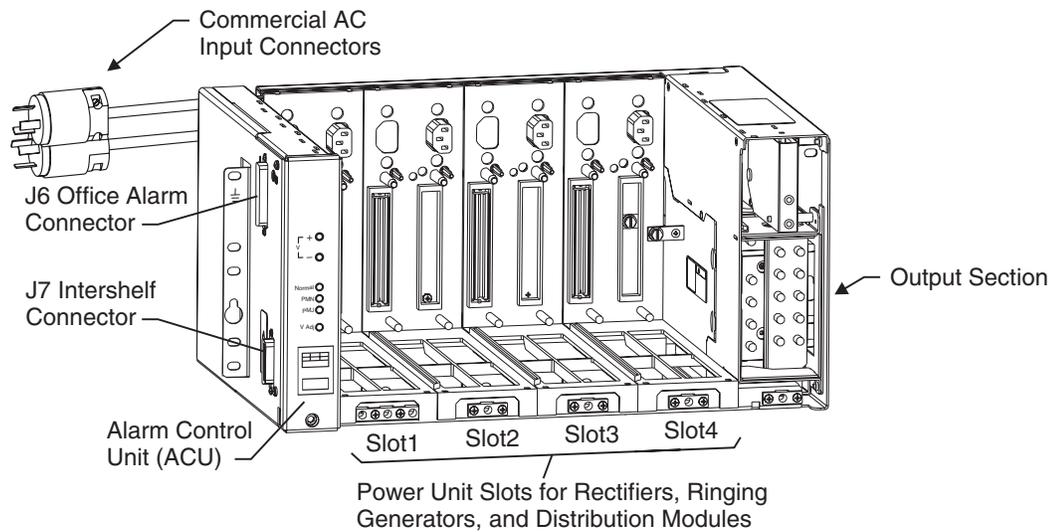


Figure 2-2: CPS Shelf

Shelf Design, continued

Two-Shelf Plants

In two-shelf plants the system is made up of an initial shelf and a supplemental shelf. This initial/supplemental architecture eliminates redundant equipment in two-shelf plants while offering the full feature set available in single-shelf plants.

Initial Shelf

The initial shelf houses the control unit (including the office alarm interface), power modules, and a distribution module with or without an optional low-voltage disconnect (LVD).

Supplemental Shelf

The supplemental shelf uses blank panels in place of the control unit and distribution module.

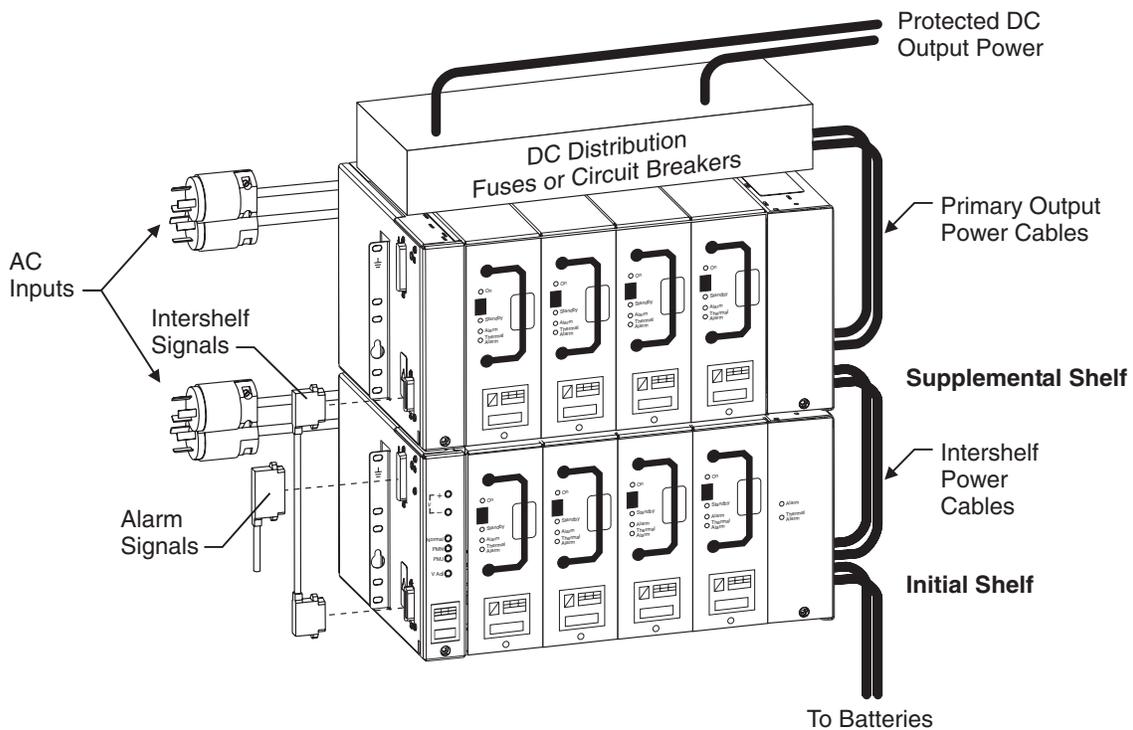


Figure 2-3: Two-shelf Rectifier Plant Configuration

Configurations

Introduction

The -48V CPS 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 two configurations:

Rectifier Plant

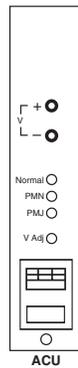
The rectifier plant is capable of providing -48V power within the load range of zero to 60 amperes in a one-shelf plant or zero to 120 amperes in a two-shelf plant.

Rectifier/Ringer Plant

The rectifier/ringer plant has -48V rectifiers that can provide load power and power to operate 50/100VA ringers. Up to two ringers may be installed in a single-shelf plant to provide redundant ringing power. Additional ringing power may be obtained in two-shelf plants that can support two ringers per shelf. The rectifiers provide input power for ringers whose output is available on the secondary output bus through connector J14 on the CPS shelf. The ringing plant design permits on-line redundant ringing capacity of 50VA in a single-shelf plant or 100VA in a two-shelf plant with ES620 or ES620B ringers. ES621, ES621A, ES621B, and ES622C ringers support an on-line redundant ringing capacity of 100VA in a single-shelf plant or 200VA in a two-shelf plant. Two ringers are required for each shelf, one active unit and one standby unit. In the two-shelf configuration, two active and two standby units are required. Note: If a two-shelf plant is used, the ringer loads on two shelves *must* be isolated.

Control Units

ES647B Alarm Control Unit



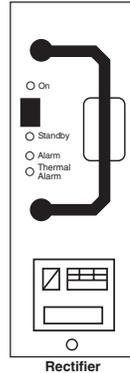
Included in single-shelf plants or in the initial shelf of two-shelf plants is the ES647B Alarm Control Unit. This unit provides plant monitoring and control features as well as office alarm outputs from rectifiers.

The ES647B provides the following features:

- Capability for a customer-provided Plant Battery Test (PBT), which sets the rectifier output voltage to approximately -48V for battery testing, allowing the batteries to be discharged without affecting plant load
- Green, yellow, and red LEDs that display plant status
- Form-C office alarms corresponding to the alarm indicators
- Customer-accessible encoder or potentiometer to adjust the plant voltage
- Alarm monitor circuit that determines the status of the installed rectifiers, converters, or ringers and incorporates this information into the plant power minor or power major alarms
- Capability of remote On/Standby control that is “passed-on” to installed power modules

Power Modules

Overview



-48V CPS rectifiers are designed specifically for applications where size, weight, wide temperature range, and ease of installation and maintenance are of overriding importance. Switchmode circuit design provides excellent output regulation over a wide range of load currents and input voltages. Power processing at higher frequencies allows for substantial reduction in the size and weight of energy storage elements. Higher frequencies and the use of forced-air cooling help achieve high power density and light weight.

Each power unit is equipped with two field-replaceable, self-contained cooling fans. Thermal alarm circuitry offers additional protection by shutting the power unit down and providing an alarm when the internal temperature exceeds 75° Celsius. Forced air cooling improves the reliability of power units by maintaining their internal temperatures very close to the outside ambient temperature.

-48V CPS power units feature automatic load-share circuits which force the power units 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.

Signal interfaces between -48V CPS rectifiers and the plant control unit provide alarm monitoring, rectifier output voltage adjustment, and rectifier On/Standby control.

ES660C Rectifiers

The ES660C rectifier provides an output of 15.0 amperes at 54.5 volts.

Power Modules, continued

Ringling Generators



Two CPS ringling generators installed in a single-shelf plant provide redundant ringling power. Two-shelf plants offer additional ringling capacity with up to two ringling generators in each shelf.

Two ringers are installed in the shelf first beginning in Slot 1, then rectifiers are installed beginning in Slot 2, installing from left to right. Note: If ringers are not installed, rectifiers are installed beginning in Slot 1.

The ringers feature ROM-based wave form generation typical of Lineage Power Type-3 Ringling Generators. CPS ringers feature a unique self-contained ring switch unit that automatically detects a failed ringling generator and switches the on-line spare into active service.

Ringling output is provided on the shelf from the secondary bus output connector J14. The ring signal cadencing and tripping device must be provided by the end-use product.

Table 2-A provides information about the ringling power of the ringling generators.

Table 2-A: CPS4000 Ringling Generators

Apparatus Code	Output Capacity	Vout (ac-rms)			Vout (dc)			Frequency Hz
		Min.	Nom.	Max.	Min.	Nom.	Max.	
ES620	50VA	95	100	105	-43	-48	-60	20
ES620B	50VA	71	75	79	-43	-48	-60	25
ES621	100VA	95	100	105	-43	-48	-60	20
ES621A	100VA	95	100	105	-43	-48	-60	20
ES621B	100VA	85	90	95	-43	-48	-60	20
ES622B	100VA	75	80	85	-43	-48	-60	25
ES622C	100VA	95	100	105	-43	-48	-60	20

Power Modules, continued

Features

The J85500R-3 power modules provide the following features:

- **Lightweight, easy to install:** These connectorized, pluggable units may be installed in -48V CPS power plants in less than one minute.
- **Simplified plant administration:** Power modules may be installed in a working plant without adjustment and without interruption of service. System failures are easily corrected by replacing defective power modules. Defective fans are easily replaced in the field.
- **Front access only:** Power modules and the -48V CPS power plants may be installed and serviced without the need for rear access.
- **User friendly:** Front panel LED indicators on power modules and the Alarm Control Unit (ACU) indicate system status.
- **Parallel operation:** Power modules operate in parallel with other power modules.
- **Load share:** A load share circuit automatically forces the power modules to apportion the plant load. The load share circuit is made fail-safe by using an isolated load share bus between power modules. Upon failure, an inoperative power module is disconnected from the load share bus.
- **Active inrush current limiting:** Upon application of the source voltage, an active circuit limits the peak inrush current, eliminating nuisance tripping of customer-provided input breakers.

Power Modules, continued

Features, continued

- **Output current limit:** Power modules provide a constant output voltage up to their rated output current, at which point they begin to provide constant current outputs. The maximum output current is inherently limited to less than 110% of the rated output without user adjustment.
- **Internal selective high-voltage shutdown:** If the plant voltage goes too high, only the defective power module will shut down.
- **Backup high-voltage shutdown:** If the internal high-voltage shutdown fails, a backup is provided that is faster and is set to 60 volts.
- **Restart circuit:** If a rectifier or converter has shut down due to high plant output voltage, it will attempt to restart a maximum of two times automatically. After two unsuccessful attempts, the power module shuts down and locks down. This assumes that a battery is present to maintain the circuitry on the MCU or ACU.
- **Ringer redundancy:** If a ringer fails, that ringer will be automatically removed from service and a hot on-line redundant ringer will be switched into service.
- **Power module alarm:** The power module alarm provides both a local visual indication of low output voltage and a signal to the plant ACU. In addition, alarms are generated by a high module temperature and/or an operated internal fuse.
- **Thermal alarm:** The -48V CPS rectifiers are fan cooled to increase their reliability. Excess internal temperature caused by fan failure or other conditions initiates a thermal alarm.
- **Power factor:** State-of-the-art circuits in the rectifiers increase the power factor to near unity.
- **Total harmonic distortion:** By controlling the power factor, the total harmonic distortion is reduced to less than 5% at full load, less than 15% at half load.
- **Voltage range selection:** CPS power modules automatically accept a wide range of ac input voltages.

Power Modules, continued

Features, continued

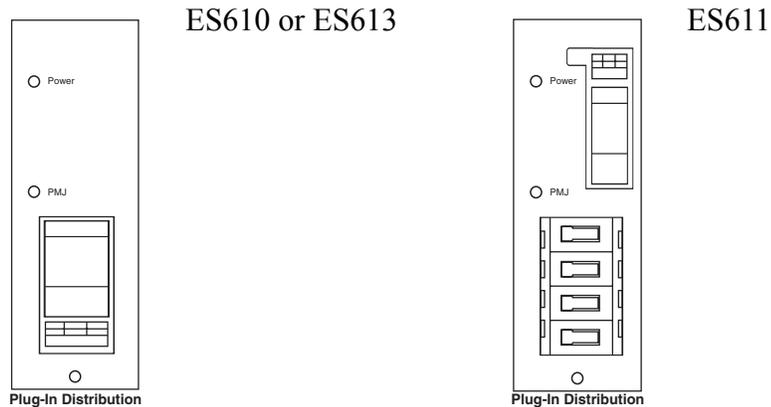
- **Plant alarms:** Alarm reporting for the -48V CPS plants is typical of telecommunication battery plants. Isolated Form-C contact closures provide office alarms on a user-accessible connector. Visual indications of alarms are provided by LEDs located on front panels of the -48V CPS modules. Alarms are categorized as Power Major (PMJ), indicating service affecting problems, or Power Minor (PMN), suggesting that the problem may become service affecting if additional problems occur.
- **EMI Class A Installations:** CPS4000 components, including the ES647B Control Unit, the ES660C rectifier, and the J85500R-3 shelf, provide EMI protection for use in a Class A environment, as defined in EN55022 or FCC Part 15.
- **Dynamic response:** Step changes in load over the range of 10 to 90 percent will not cause the voltage measured at the point of regulation to overshoot or undershoot more than 5 percent. After the step change the voltage will typically return to and stay within the regulation band within 300 milliseconds.
- **Lightning protection:** -48V CPS power modules are capable of withstanding repeated surges of the following waveforms without damage (See ANSI C62.41-1991 Category B):
 - 1.2/50 microseconds - 8/20 microseconds combination wave with a peak current of 1000 amperes
 - 0.5 microsecond - 100 kHz ring wave with a peak voltage of 2000 volts

A service entrance surge protector is recommended in cabinet applications. (See IEEE C62.41-1991 for location Category C and high system exposures.) The service entrance protection should be coordinated with the protection provided in the rectifier.

Plug-in Distribution Modules

Introduction

CPS offers three plug-in distribution modules, ES610, ES611, and ES613, which can eliminate the need for separate distribution protection panels and save cabinet space. The distribution modules require 1-inch of space above for wiring. All three modules plug into one power module slot.



ES610

The ES610 module provides twelve primary bus outputs protected by GMT-type fuses. The number of fuse modules used in a system is not restricted; however, the total output per module is restricted to 25 amperes. A DIP switch is provided that allows the user to assign groups of four fuses as either minor or major power alarms.

ES611

The ES611 module provides six primary bus outputs; four are protected by 3-30A circuit breakers and two are protected by GMT-type fuses. The total output of the ES611 should be restricted to 30 amperes; but, as with the ES610, the number of modules used in a system is not restricted. Both tripped circuit breakers and blown fuses result in a power major alarm.

ES613

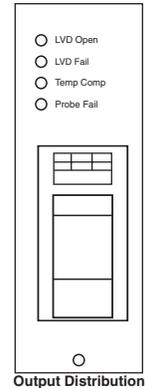
The ES613 module provides twelve ringer outputs protected by GMT-type fuses. Blown fuses result in a power major alarm.

Output Distribution

Overview

The Output Distribution contains the following:

- BSR1, which provides connectorized terminations for:
 - distribution fuse alarms (J9)
 - battery temperature thermal probes (J10-J13)
 - plant secondary output loads (J14)
 - secondary current monitoring (J15)
- Current sensing shunt to measure battery discharge current
- Double-hole lug termination points to connect:
 - plant primary output loads
 - four battery strings
- Optional LVD/Thermal Management Circuit Pack (BSP2 or BSP2C) with:
 - Low-voltage disconnect contactor and its control circuit
 - Battery thermal management (slope compensation)



Thermal Probes

Thermal probes are included with the -48V CPS system for the purpose of monitoring battery temperature. Battery temperature should be monitored in at least two places (two thermal probes) to protect batteries against potential thermal overload.

The temperature information provided by the probes is input for a battery thermal protection feature that implements slope compensation; i.e., if the battery temperature exceeds 25°C (77°F), the plant voltage is automatically reduced to help protect the batteries against thermal instability and to extend battery life at high temperatures.

See “LVD/Thermal Management” in Section 6 for more information.

Output Distribution, continued

LVD/Thermal Management Circuit Pack

In single-shelf plants or in the initial shelf of multiple-shelf plants, the -48V CPS Output Distribution unit equipped with a Low-voltage Disconnect (LVD)/thermal management optional circuit pack (BSP2 or BSP2C) provides the following features:

- Alarm conditioning for control unit presentation
- A low-voltage disconnect contactor suitable for 120A of output current and its control circuit
- The -48V CPS system features optional thermal probes for monitoring battery temperature. This temperature information is utilized as input for a battery thermal protection feature that is implemented as slope compensation.

CPS4000 incorporates a thermal management system for battery protection against thermal instability. If the battery temperature exceeds 25°C, the plant voltage is automatically reduced to help protect the batteries against thermal instability and to extend battery life at high temperatures (see Figure 6-2). This feature is provided with the ES647B control unit and all ES660C rectifiers. This feature compensates the battery float voltage over the temperature range of +25°C to +75°C.

Battery Reserve System

Introduction

A battery reserve system is a key ingredient for the CPS product line. A power plant provides a primary voltage of -48Vdc that drives the switches of transmitting customer 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

Typically, a CPS plant will use Lineage Power 12IR125 batteries. As alternatives, CPS plants may be equipped with other valve-regulated (VR) batteries. Up to four strings of VR-type batteries or equivalent general trade batteries may be connected directly to a 48V CPS shelf.

Specifications

Electrical

Table 2-B: -48V CPS4000 Electrical Plant Specifications

Plant	1 initial shelf per plant 1 supplementary shelf per plant
Power Slots	4 power slots per shelf; maximum of 8 power slots per plant
Power Units	1 rectifier per power slot; maximum of 4 per shelf or 8 per plant 2 ringers per power slot (1 slot per shelf only); maximum 2 per shelf or 4 per plant
Plant Architecture	Primary output: 1 primary output power bus per shelf; maximum output capability of 60 amperes per shelf or 120 amperes per plant Secondary output: 1 secondary ringer output per shelf
Rectifier Input Distribution	2 ac inputs per shelf; one to power slots 1 and 3, one to power slots 2 and 4, or 4 individual ac feeds, one 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 and protection panels (double-hole lugs) Battery connections: double-hole lugs to terminate four battery strings
Output Distribution - Secondary Bus	PWB mounted AMP MATE-N-LOK connector for ringer output
Primary Bus Protection and Distribution	Plug-in protection and distribution modules: 12 GMT-type fuses; module output limited to 25 amperes or four 3-30A circuit breakers and four GMT-type fuses output limited to 30 amperes Remote protection and distribution modules: fuses or circuit breakers; output limited to 170 amperes (Note 1)
Maximum Discharge Current	68 amperes per shelf; 136 amperes per plant (Note 2)
Maximum Recharge Current	Installed plant -48V rectifier capacity minus plant -48V load
Low-Voltage Disconnect	40.5 ±0.5 volts or 42 ±0.5 volts (switch selectable)
Operating Ambient Temperature	-40° to 149° Fahrenheit (-40° to 65° Celsius) (Note 3)
Altitude	-200 to 13,000 feet (-61 to 3962 meters) (Note 4)
Humidity	10-95% non-condensing
Audible Noise	65 dBA measured 2 feet (0.6 meters) from the plant

Table 2-B: -48V CPS4000 Electrical Plant Specifications (Continued)

Radiated and Conducted Emissions (Note 5)	CPS4000: FCC Part 15, Class A EN55022 (CISPR22), Class A
Harmonics (Note 5)	EN61000-3-2 (IEC61000-3-2)
Voltage Fluctuations (Note 5)	EN61000-3-3 (IEC61000-3-3)
Electromagnetic Immunity	Meets Telcordia GR-1089-CORE
Electrostatic Discharge (Note 5)	EN61000-4-2 Level 3
RF Immunity (Note 5)	IEC61000-4-3
EFT (Note 5)	IEC61000-4-4
Surge (Note 5)	IEC 61000-4-5
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 – see Note 5
	Rectifiers are individually UL Recognized (UL1950), CSA 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 – see Note 6 Low Voltage Directive 73/23/EEC as amended by Marking Directive 93/68/EEC – see Note 5
<p>Note 1: Bus bars in customer-provided remote distribution and protection modules should be sized to carry a minimum of 170 amperes at the maximum ambient system temperature.</p> <p>Note 2: LVD protection per plant is limited to 150 amperes.</p> <p>Note 3: CPS can withstand temporary fluctuations in temperature up to 75°C (167°F).</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> <p>Note 5: Only the J85500R-3 L4 with (L21R, L21RB, L25R, 25RB) and (any output assembly list option from Table 3-A) has been evaluated to the IEC/EN Standards and are CE Marked.</p> <p>Note 6: CPS4000 is a Class A EMC product. In a domestic environment this product may cause radio interference, in which case user may be required to take adequate measures.</p>	

Physical

Table 2-C: -48V CPS4000 Physical Specifications

Rectifier	Height: 8.75 inches Width: 3.2 inches Depth: 10.75 inches Weight: 10 pounds (maximum)
Shelf	Height: 8.75 inches Width: 17.4 inches Depth: 12 inches Weight: 35 pounds
Single shelf equipped with four rectifiers	Weight: 75 pounds (maximum)
Frame Mounting Requirements	Standard 19 inch relay racks: Vertical mounting centers: 1.0 inch and 1.75 inches. Horizontal mounting centers: 18.31 inches

Rectifier Plant

Table 2-D: Rectifier Plant Specifications

	CPS4000
Power Units	ES660C rectifiers; maximum of 4 units per shelf or 8 units per plant
Control Unit	ACU: ES647B
Nominal Output Voltages	48/52/54.5Vdc
Operating Voltage Range	48-58.1Vdc
Maximum Output Current	60 amperes per shelf (Note 2) 120 amperes per plant (see Note 1)
Nominal Input Voltage (L25R, L25RB)	200/208/240Vac
Input Voltage Ranges (L25R, L25RB)	180-264Vac
Maximum Input Current per Rectifier (L25R, L25RB)	Float Mode: 4.0 amperes @ 240Vac 5.3 amperes @ 180Vac Boost Mode: 4.2 amperes @ 240Vac 5.7 amperes @ 180Vac
Nominal Input Voltage (L21R, L21RB)	100/120Vac
Input Voltage Ranges (L21R, L21RB)	90-132Vac
Maximum Input Current per Rectifier (L21R, L21RB)	Float Mode: 8.1 amperes @ 120Vac 10.9 amperes @ 90Vac Boost Mode: 8.7 amperes @ 120Vac 10.9 amperes @ 90Vac
Boost Voltage	58.1Vdc
Efficiency	88.5%
Output Voltage Regulation	±0.5%
Output Noise: Wideband Noise (Ripple)	100 millivolts peak to peak maximum, over the range 10 Hz to 20 MHz
Electrical Noise	<32 dBmC
Load Share Accuracy	1.50 amperes (maximum)
Maximum Discharge Current	68 amperes per shelf 136 amperes per plant
Maximum Recharge Current	Installed rectifier capacity minus plant load
Low-Voltage Disconnect	40.5 ±0.5 volts or 42 ±0.5 volts
Heat Dissipation	106 watts (363 BTU/hour) maximum
Power Factor	>0.98 for loads >60% of full load
Note 1: Low-voltage disconnect protection per plant is limited to 150 amperes.	
Note 2: Maximum output current capability.	

**Rectifier-Ringer
Plant**

Table 2-E: Rectifier-Ringer Plant Specifications

Power Units	ES660C rectifiers; maximum of 3 per shelf or 7 per plant (limited by LVD rating) ES620, ES620B, ES621, ES621A, ES621B, or ES622C ringers; maximum of two per shelf or four per plant
Control Unit	ACU: ES647B
Primary Bus Output	The primary bus -48V output current capacity is reduced by two amperes for each active ringer installed in the plant.
Secondary Bus	50VA ringer (ES620, ES620B) 100VA ringer (ES621, ES621A, ES621B, ES622B, ES622C)
Nominal Output Voltage	80Vrms (ES622B) 90Vrms (ES621B) 100Vrms (ES620, ES620B, ES621, ES621A, ES622C)
Operating Voltage Range	75-105Vrms
Composite Power	70W per shelf (ES620, ES620B) 140W per shelf (ES621, ES621A, ES621B, ES622B, ES622C)
Output Volt-amperes	50VA per shelf (ES620, ES620B) 100VA per shelf (ES621, ES621A, ES621B, ES622B, ES622C)
DC Offset Voltage	-50 volts
Output DC Offset Power	10W per shelf (ES620, ES620B) 20W per shelf (ES621, ES621A, ES621B, ES622B, ES622C)
Typical Ringer Input Voltage	52-54.5Vdc
Ringer Input Voltage Range	38-60Vdc
Input Current	1.4 amperes per ringer (ES620, ES620B) 2.8 amperes per ringer (ES621, ES621A, ES621B, ES622C)

ES660C Rectifier

Table 2-F: ES660C Rectifier Specifications

Nominal Output Voltage	48/52/54.5Vdc
Operating Output Voltage Ranges	48-56Vdc
Boost Voltage	58.1Vdc
Output Current	0-15 amperes
Nominal Input Voltage	100/120/200/208/240Vac
Input Voltage Ranges	90-132Vac 180-264Vac
Input Current (Float Mode)	4.0 amperes @ 240Vac (Note 1) 5.3 amperes @ 180Vac (Note 2)
Input Current (Boost Mode) (58.1Vdc output)	4.2 amperes @ 240Vac 5.7 amperes @ 180Vac
Operating Frequency Range	47-63Hz
Efficiency	88% typical @ 208/240Vac (Notes 1 and 3)
Output Voltage Regulation	±0.5%
Output Noise: Wideband Noise (Ripple)	100 millivolts peak to peak maximum, over the range 10 Hz to 20 Mhz
Electrical Noise	<26 dBnC
Load Share Accuracy	1.50 amperes maximum
Heat Dissipation	106 watts (363 BTU/hour) maximum (Note 1)
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 55.5 volts for 3 seconds (except when in boost or low temperature compensation mode, then 1 volt above set boost level)
Backup High-Voltage Shutdown	Above 61.6Vdc for 100 milliseconds
Note 1: Input current specified at input voltage of 240 volts, an output of 54.5 volts and 15.0 amperes and efficiency of 88%.	
Note 2: Maximum input current specified at input voltage of 180 volts, an output of 54.5 volts and 15.0 amperes and efficiency of 86%.	
Note 3: Boost Mode Operation input current specified at input voltage of 240 volts, an output of 57.6 volts and 15.0 amperes, and efficiency of 90%. $(57.6V \times 15A)/(240V \times 4A) = 0.90\%$	

**Ring
Generators**

Table 2-G: ES620, ES620B, ES621, ES621A, ES621B, ES622B, and ES622C Ringing Generator Specifications

Nominal Output Voltage	75Vrms (ES620B) 80Vrms (ES622B) 90Vrms (ES621B) 100Vrms (ES620, ES621, ES621A, ES622C)
Composite Power	70W (ES620, ES620B) 140W (ES621, ES621A, ES621B, ES622B, ES622C)
Output Volt-Amperes	50VA (ES620, ES620B) 100VA (ES621, ES621A, ES621B, ES622B, ES622C)
Output DC Offset Voltage	-50 volts
Output DC Offset Power	10W (ES620, ES620B) 20W (ES621, ES621A, ES621B, ES622C)
Nominal Input Voltage	48/52/54.5Vac
Input Voltage Ranges	38 - 60Vdc
Input Current	1.4 amperes @ 54.5Vdc (ES620, ES620B) 2.8 amperes @ 54.5Vdc (ES621, ES621A, ES621B, ES622C)
Regulation	±0.5%
Ringer Interchange	Inherent in unit
Output Noise	< 1 volt P-P
Output Frequency	25Hz (ES620B, ES622B) 20Hz (ES620, ES621A, ES621B, ES622C)

Control Units

Table 2-H: ES647B Control Unit Specifications

Operating Input Voltage Range	38 - 60Vdc
Input Power	6.0 watts maximum
Plant Voltage Setting	Adjustable via encoder on face plate
Alarm Contact Ratings	60Vdc, 0.5 ampere, Form-C
BD Settings	Adjustable from 46 to 56.0 volts in increments of 0.5V ±0.5V
Operating Temperature	-40°C to +65°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.

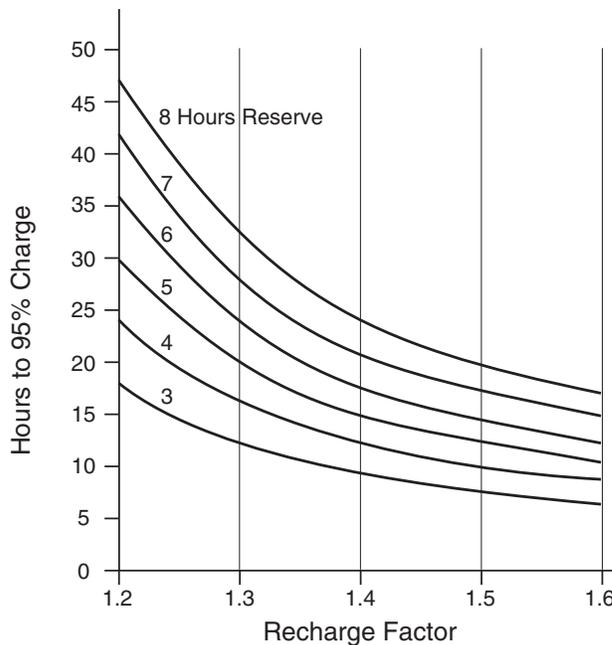


Figure 3-1: Recharge Factor vs. Recharge Time

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.

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 required for non-redundant systems.

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

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

Four 15A rectifiers ($46.9/15 = 3.1$) are required to provide the minimum installed capacity of 46.9 amperes for a non-redundant system. If one 15A rectifier fails, the remaining rectifiers will provide the abh capacity.

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

$$\begin{aligned}\text{mirc} &= \text{abh} \times \text{recharge factor} \\ \text{mirc} &= 85 \times 1.25 = 106.3\end{aligned}$$

Eight rectifiers ($106/15 = 7.1$) are required to provide the minimum installed rectifier capacity of 106.3A. In this example, six rectifiers supply the abh capacity, and the additional rectifier is required to supply the battery recharge current. This system also meets the requirements for non-redundant and redundant systems.

Ordering Information

List Numbers

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

- **List 3** provides a CPS shelf with a -48V dc primary output and a secondary output for ringing.
- **List 4** provides a CPS shelf with only a -48V dc output.

Other lists on the J85500R-3 drawing are ordered as “Equipped With” items. This means that they are ordered in addition to a main list and will be assembled in the factory.

Note

Order plug-in modules separately.

Table 3-A provides a summary of the J85500R-3 List structure. Read carefully all of the notes in Table 3-A before ordering.

Shelf Assemblies

Each -48V CPS shelf assembly consists of a chassis assembly with voltage keying, an input assembly, and an output assembly. In addition to choosing a main list, you must also specify an ac input assembly and an output assembly. These assemblies must be factory-assembled and are not available separately.

- Order rectifiers, other plug-in modules, and miscellaneous equipment from Table 3-B.
- Order fuses, circuit breakers, and lug kits from Table 3-C.
- Order cable assemblies for output and office alarm connections from Tables 3-D and 3-F. The tables include both the Lineage Power kit and the commercial equivalent.
- Tables 3-E and 3-G provide torquing information for input and output connections.

Ordering Information, continued

-48V Cabinet Power System

Table 3-A: -48V CPS Ordering Information

List No.	Description
	<p>-48V chassis assemblies; one is always required per shelf. Each chassis assembly provides five equipment unit slots arranged for ES series power units and distribution modules. Lists 3 and 4 provide keying functions to prevent insertion of incompatible power units. Select a list appropriate to the power units required.</p>
3	<p>Output 1: -48Vdc, 60 amperes maximum Output 2: Ringing, 100VA maximum Arranged for the following apparatus codes: ES660C 48V rectifier ES620 50VA ringing generator (two/power unit slot), or ES621 100VA ringing generator (two/power unit slot), or ES621A 100VA ringing generator (two/power unit slot), or ES621B 100VA ringing generator (two/power unit slot), or ES622C 100VA ringing generator (two/power unit slot) ES610 48V fuse distribution module ES611 48V circuit breaker/fuse distribution module ES613 ringer fuse distribution module See Note 2.</p>
4	<p>Output 1: -48Vdc, 60 amperes maximum Output 2: none Arranged for the following apparatus codes: ES660C 48V rectifier ES610 48V fuse distribution module ES611 48V circuit breaker/fuse distribution module See Note 2.</p>
5 -20	Reserved.
<p>AC input assemblies; one is always required per shelf unless otherwise noted. Each input assembly is arranged for ac input to the shelf, ES647B ACU, office alarm output connection, and intershelf signal connection. See Note 3 for conditions of UL acceptability.</p>	
21R	<p>AC input assembly (initial shelf) wired for and equipped with four pluggable 100-120Vac feeds that power each equipment unit slot separately (true n+1 redundancy). IEC 320 Type Connector. See Note 3.</p>
21RB	<p>Same as List 21 except used for second shelf in a multiple shelf plant. Not arranged for control unit or office alarm connections. IEC 320 Type Connector. See Note 3.</p>

Table 3-A: -48V CPS Ordering Information (Continued)

List No.	Description
25R	AC input assembly (initial shelf) wired for and equipped with two pluggable 200-240Vac feeds where one powers equipment unit slots 1, 3, and 5 and the other, slots 2 and 4. Product is factory shipped with two ac line cords, each with "twist-lock" type plugs, rated at 20A.
25RB	Same as List 25 except used for the second shelf in a multiple shelf plant. Not arranged for control unit or office alarm connections. Product is factory shipped with two ac line cords, each with "twist-lock" type plugs, rated at 20A.
DC output assemblies ; one is always required per shelf unless otherwise noted. Each output assembly is arranged for the connection of a maximum of four battery strings or IR series battery trays, an intershelf power connection, one LVD/thermal BSP2 board, a maximum of four thermal probe assemblies, and bulk power outputs for outputs 1 and 2.	
31A	Output assembly applicable for initial shelves with rectifiers without LVD or slope thermal management. See Notes 4 and 5.
34	Output assembly applicable to supplementary shelves in multiple shelf plants, and to initial shelves in systems operating without batteries. Does not provide connection points for batteries or thermal probes. See Note 4.
36	Output assembly with 150 ampere low-voltage disconnect (LVD) contactor. Applicable to single-shelf rectifier and rectifier/converter plants and the initial shelf in plants with rectifiers in the initial shelf only, with slope thermal management. Always includes a BSP2 or BSP2C board for LVD/slope thermal compensation. See Notes 4, 5, and 6.
37A	Same as list 31 but with slope thermal management. Applicable to single-shelf rectifier and rectifier-ringer plants and the initial shelf in plants with rectifiers in the initial shelf only. See Notes 4 and 6.
38	Output assembly equipped with BSP2C LVD/Thermal Management PWB and wireset A/F connection to external contactor. Applicable for initial shelves with rectifiers when LVD is required, and LVD contactor is supplied externally.
K2	Wire set and cable assembly for connecting two shelves in a two-shelf plant.
K4	Adapter cable required for two-shelf plant where ringers are used in both shelves.

Table 3-A Notes 1. These tables describe the arrangement of the chassis assemblies.

List 3: 48V Primary Output, Ringing Secondary Output (see Note 2)

Slot 1A	Slot 1B	Slot 2	Slot 3	Slot 4
ES620, ES620B, ES621, ES621A, ES621B, ES622B, or ES622C	ES620, ES620B, ES621, ES621A, ES621B, ES622B, or ES622C	ES660C	ES660C	ES660C
Ringer	Ringer	Rectifier	Rectifier	Rectifier

Ordering Information, continued

**Table 3-A Notes,
continued**

List 4: 48V Output Only (see Note 2)

Slot 1	Slot 2	Slot 3	Slot 4
ES660C	ES660C	ES660C	ES660C
Rectifier	Rectifier	Rectifier	Rectifier

- Shelf assemblies (Lists 3 and 4) provide keying functions to prevent insertion of incompatible power units. Select the appropriate list for your application.
- Input assemblies (Lists 21R, 21RB, 25R and 25RB) provide ac cords for ac input to rectifiers, office alarm outputs, intershelf jumper, and control unit plug-in slot. List with a “B” suffix are identical to the numbered list except that they have no office alarm outputs and are intended for use as supplemental shelves.
- Output assemblies provide connection points for batteries, primary and secondary outputs, and thermal probes. Some are equipped with low-voltage disconnect contactors.
- The low-voltage disconnect feature requires an output list equipped with contactor and an LVD/thermal management board. List 36 includes a BSP2 or BSP2C board for LVD/slope thermal compensation. The factory default setting for LVD is 42.5 volts.
- The battery thermal management feature can accommodate, via direct connections to shelf J10-J13, a maximum of four (4) thermistor probe assemblies. In multiple shelf plants, the probe assemblies must be connected to the initial shelf.
- If more than four thermal probe monitoring points are required, a 210E Thermal Probe Multiplexer (TPM) is capable of monitoring up to 8 thermal probes. The TPM uses the same thermal probe that is currently being supplied with the CPS for thermal compensation. The TPM polls the 8 thermal probes on the input and provides the highest temperature probe to the output electrically. The output of the TPM mimics a thermal probe to the CPS. To the CPS, the TPM looks like a standard thermal probe electrically.

Ordering Information, continued

Table 3-A Notes, continued

8. Distribution modules provide load protection as follows: for 48V loads, 25 amperes/ES610 and 30 amperes/ES611; the ES613 provides load protection for ringer loads. The ES610 is arranged for twelve (12) 0.25 to 10 ampere telecom type fuses. The ES611 is arranged for four (4) 3-30 ampere plug-in circuit breakers and two (2) 0.25 to 10 ampere telecom type fuses. The ES613 is arranged for twelve (12) 0.25 to 10 ampere telecom type fuses. These units plug into any power unit slot and require a minimum of 1 inch above the shelf for cabling space. Each shelf accepts a maximum of two plug-in distribution units. Order lug kits from Table 3-C. The ES610 and ES613 require two kits per module. The ES611 requires only one kit per module.
9. Kit K2 provides cables and wire sets for power and signal interconnection of two CPS shelves into a two-shelf plant. Kit K4 provides an adapter cable required for two-shelf plants where ringers are used in both shelves. Shelves in a multiple shelf plant must be mounted in the same rack with no more than a 2" gap between adjacent shelves. The initial shelf must be at the top or bottom of the system.
10. Ringers are half the width of other CPS power modules and are mounted in power slot #1 (1A and 1B). Each shelf accepts a maximum of two ringers.
11. CPS shelves and related equipment mount in standard 19" equipment frames with 1" or 1 3/4" rack spaces.
12. Each CPS shelf/plant requires one ES647B Alarm Control Unit (ACU). One control unit mounted in the initial shelf monitors in a single-shelf as well as in a two-shelf plant. The ES647B and the BSP2 or BSP2C LVD/thermal board provide slope battery thermal management. The factory setting for Battery on Discharge alarm (BD) is preset at 51.0 volts.
13. The -48V CPS plant can support the following configurations:
 - No redundancy for either output
 - N+1 redundancy for the primary output; no redundancy for the secondary output
 - N+1 redundancy for both the primary and secondary outputs

Ordering Information, continued

CPS Plug-in Modules and Miscellaneous Equipment

Order rectifiers, other plug-in modules, and miscellaneous equipment from Table 3-B, which lists the modules and their associated apparatus codes and comcodes.

Table 3-B: CPS Plug-In Modules and Miscellaneous Equipment

Unit	Apparatus Code	Comcode
48V, 15A Rectifier	ES660C	108286055
Alarm Control Unit (ACU)	ES647B	108960295
50VA, 100V, 20Hz Ringing Generator	ES620	107138679
50VA, 75V, 25Hz Ringing Generator	ES620B	107864845
100VA, 90V, 20Hz Ringing Generator	ES621B	108276601
100VA, 80V, 25Hz Ringing Generator	ES622B	108407909
100VA, 100V, 20Hz Ringing Generator	ES622C	108541517
LVD Circuit Pack	BSP2*	107332984
LVD Circuit Pack	BSP2C*	108274044
Distribution Module - (12) GMT fuses	ES610	107266397
Distribution Module - (4) C/B and (2) GMT fuses	ES611	107502825
Distribution Module - (12) GMT fuses for ringing output	ES613	107966616
Thermistor Kit (Paddle Type Thermal Probe, 5' Cable)	N/A	847198751
Thermistor Kit (1/4" Ring Type Thermal Probe, 9' Cable)	N/A	847580529
5/16" Ring Type Thermal Probe/Cable Assembly, 10'	N/A	848221552
5/16" Ring Type Thermal Probe/Cable Assembly, 25'	N/A	848221560
DC Fan Cradle Assembly	N/A	847244100
Office Alarm Wiring Kit	N/A	847541653
Insulated "T" Handle Wrench	N/A	901181834
*The BSP2 and BSP2C circuit packs are factory-installed in the shelf, but may also be ordered as spares.		

Ordering Information, continued

Fuses, Circuit Breakers, Lugs

Order fuses, circuit breakers, and lugs from Table 3-C.

Table 3-C: Fuses, Circuit Breakers, and Lugs

Description	Comcode
AX1 1/4-ampere GMT type fuse with cover	405006222
AX1 1/2-ampere GMT type fuse with cover	406976894
AX1 1 1/3-ampere GMT type fuse with cover	405673146
AX1 2-ampere GMT type fuse with cover	405181983
AX1 3-ampere GMT type fuse with cover	406976985
AX1 5-ampere GMT type fuse with cover	406159061
AX1 7.5-ampere GMT type fuse with cover	405725433
AX1 10-ampere GMT type fuse with cover	406159236
AX1 12-ampere GMT type fuse with cover	407845197
AX1 15-ampere GMT type fuse with cover	406473959
KS23616 List 31 circuit breaker (3-ampere)	407098417
KS23616 List 32 circuit breaker (5-ampere)	407098425
KS23616 List 33 circuit breaker (10-ampere)	407098433
KS23616 List 34 circuit breaker (15-ampere)	407098458
KS23616 List 36 circuit breaker (20-ampere)	407098474
KS23616 List 37 circuit breaker (25-ampere)	407098482
KS23616 List 38 circuit breaker (30-ampere)	407098490
Fuse alarm wire set for ES610, ES611, and ES613	847380698
Kit with (12) 10-12 GA lugs	847572716
Kit with (12) 14-16 GA lugs	847572724

Ordering Information, continued

Input Assembly Hardware

Order cable assemblies for input, output and office alarm connections from Table 3-D. The table includes both the Lineage Power kit and the commercial equivalent.

Table 3-D: Input Assembly Hardware

List	Connector	Function	Mating Connection	
			Lineage Power	Commercial
21R, 21RB	J1 - J4	Rectifier Input	Shelf is supplied with four 6 ft ac line cords with integral 5-15P plugs, rated at 125Vac.	
25R, 25RB	J1 - J2	Rectifier Input	Shelf is supplied with two 6 ft ac line cords with integral 20A "twist-lock" type plugs, rated at 250Vac.	
25R	J6	Office Alarm Output	847415874 Kit provides office alarm plug, strain relief housing, and retaining clip for 24 AWG stranded or 24-26 AWG solid wire. Order Tyco Electronics tool R4623B or R5250 separately. (1) kit optional per shelf or 848418216 Kit provides P6 plug and 150 feet of multicolored cable or 848418851 Kit provides P6 plug and 25 feet of multicolored cable.	Discrete wire set equipped with (1) Amp 552274-1 plug, (1) Amp 552414-1 strain relief, (1) Amp 552723-2 retaining clip or Ribbon cable equipped with (1) Amp 553600-1 plug, (1) Amp 552723-2 retaining clip. Order Amp tool 229378-1 or 229764-2.

Torque and Tool Information for Input Hardware

Table 3-E: Torque and Tool Information for Input Hardware

Connector	Comcode	Directions
J6	847415874	Apply using Tyco Electronics tools R4623B, R5250, AMP tools 229378-1, 229764-2, or Tyco Electronics hand tool kit 900533027.

Ordering Information, continued

Output Assembly Hardware

Table 3-F: Output Assembly Hardware

List	Connector	Function	Mating Connection	
			Lineage Power	Commercial
31A, 34, 36, 37A, 38	TB1	Battery positive load return	847415858 Kit for 6 ga wire provides (5) T&B 54205UF 45° lug, (5) T&B 54205 straight lug, (20) 1/4-20 nut with integral belville, (8) frame mounting screws or 847439841 Kit for 2 ga wire provides (5) T&B 54208UF 45° lug, (5) T&B 54208 straight lug, (20) 1/4-20 nut with integral belville, (8) frame mounting screws Order (1) kit per shelf.	For 6 ga: T&B 54205UF 45° lugs For 2 ga: T&B 54208UF 45° lugs TBM5S tool (2) 1/4-20 nuts with integral belville per lug
	TB2	Battery negative		For 6 ga: T&B 54205 straight lugs For 2 ga: T&B 54208 straight lugs (2) 1/4-20 nuts with integral belville per lug
31A, 36, 37A, 38	TB3	Primary output bulk feed negative	Order (1) kit per shelf.	(2) 1/4-20 nuts with integral belville per lug
31A, 34, 36, 37A, 38	J9	Fuse alarm from external distribution panel	847415841 kit provides 27" fuse alarm wire set; distribution end must be terminated and should provide an isolated contact closure. (1) kit optional per shelf.	Wire set equipped with (1) Amp 350777-7 plug and (2) Amp 350537-3 sockets. Order Amp tool 90298-2.
31A, 36, 37A, 38	J10-13	Thermal probe	847198751 Thermistor kit provides (1) thermal probe with 5-foot connecting wire included. Optional kit. 4 kits per plant maximum.	Not available
31A, 34, 36, 37A, 38	J14	Ringer Output	847450772 Kit provides (1) secondary output wire set equipped with (12) 14 AWG power conductors and (2) 20 AWG alarm conductors 48" long	Amp 770023-1 15-position MATE-N-LOK II plug equipped with Amp 770008-3 sockets Amp crimping tool 90546-1
31, 34, 36, 37	J15	Output 2 Current Monitor	847922177 kit provides (1) 15-foot cable with connector for shelf on one end and unterminated leads on the other end. 16AWG wire Order (1) per shelf.	Molex Plug 39-01-2025 Socket Terminal Type 5556 16 AWG 39-00-0079 18 AWG 39-00-0059 Order (2) sockets per plug.

Ordering Information, continued

Torque and Tool Information for Output Hardware

**Table 3-G: Torque and Tool Information for
Output Hardware**

Connector	Comcode	Directions
TB1	847415858	Apply lugs using T&B tool TBM5S; torque TB1 fasteners to 65 inch-pounds $\pm 10\%$.
TB2, TB3	847398841	Apply lugs using T&B tool TBM5S; torque TB1 fasteners to 65 inch-pounds $\pm 10\%$.
J9	847415841	Apply using Tyco Electronics tools R4623B, R5250, AMP tools 229378-1, 229764-2, or Tyco Electronics hand tool kit 900533027.

Thermal Probes and Cable Extension Kits

If the thermistor kits in Table 3-B are not long enough, order an extension cable from Table 3-I in addition to any of the thermal probes from Table 3-H.

Table 3-H: Thermal Probes

Type	Comcode
Paddle	846818706
1/4" ring	847494606
5/16" ring type	848194221

Table 3-I: Thermal Probe Cable Kits

Length	Comcode
5 feet	847172152
9 feet	847550175
14.5 feet	847548476
17.5 feet	847548468

Ordering Information, continued

Sample Order

The order below is a sample order for a CPS4000 one-shelf -48V CPS plant for nominal 240Vac operation with dual ac inputs, three rectifiers, one alarm unit, and one distribution module. This plant does not have low-voltage disconnect or slope thermal compensation (STC). This order does not include spares.

CPS4000 Sample Order

Quantity	Description
1	J85500R-3 L-4, 48V only chassis assembly equipped with:
1	L25R (2) ac input assembly for nominal 240Vac
1	L31A output assembly without LVD or STC
3	108286055 ES660C 48V rectifiers
1	108960295 ES647B alarm control unit
1	107266397 ES610 distribution module

The order below is a sample order for a CPS4000 one-shelf -48V CPS plant for nominal 120Vac operation with four ac inputs, three rectifiers, two ringing generators, and one alarm and control unit. This plant has thermal management and low-voltage disconnect (LVD) capability. This order does not include spares.

CPS4000 PLUS Sample Order

Quantity	Description
1	J85500R-3 L3 48V chassis assembly equipped for rectifiers-ringers
1	L21R (4) ac input assembly for nominal 120Vac
1	L36 output assembly with LVD and STC
3	108286055 ES660C 48V rectifiers
1	108960295 ES647B alarm and control unit
2	108541517 ES622C 100VA Ringers
4	Thermal probe kits - 1/4" ring type, 9-ft. cable (comcode 847580529)

Ordering Information, continued

Spare Parts

With the exception of a fan failure, the power units are repaired by replacement; therefore, each service area needs one set of spares. Table 3-J contains recommended spare parts for the -48V CPS plant. One each is recommended for each service area.

Table 3-J: Recommended Spares

Unit	Apparatus Code	Comcode
-48V, 15A Rectifier	ES660C	108286055
Alarm Control Unit (ACU)	ES647B	108960295
50VA, 100V, 20Hz Ringing Generator	ES620	107138679
50VA, 75V, 25Hz Ringing Generator	ES620B	107864845
100VA, 90V, 20Hz Ringing Generator	ES621B	108276601
100VA, 80V, 25Hz Ringing Generator	ES622B	108407909
100VA, 100V, 20Hz Ringing Generator	ES622C	108541517
LVD Circuit Pack	BSP2C	108274044
Distribution Module	ES610	107266397
Distribution Module	ES611	107502825
Distribution Module	ES613	107966616
Thermistor Kit (1/4" Ring Type Thermal Probe, 9' Cable)	N/A	847580529
Thermistor Kit (Paddle Type Thermal Probe, 5' Cable)	N/A	847198751
5/16" Ring Type Thermal Probe/Cable Assembly, 10'	N/A	848221552
5/16" Ring Type Thermal Probe/Cable Assembly, 25'	N/A	848221560
Thermistor kit for 13Ahr battery	N/A	847494606
Intershelf control harness for two shelves	N/A	847334786
Thermistor Kit (1/4" Ring Type Thermal Probe, 9' Cable)	N/A	847580529
Thermistor Kit (Paddle Type Thermal Probe, 5' Cable)	N/A	847198751
5/16" Ring Type Thermal Probe/Cable Assembly, 10'	N/A	848221552
5/16" Ring Type Thermal Probe/Cable Assembly, 25'	N/A	848221560
DC Fan Cradle Assembly.	N/A	847244100
Contactors 150A	N/A	847401262

Documentation

-48V CPS Lineage[®] 2000 Battery Plant

Assembly and Ordering Drawing	J85500R-3
Wiring Diagram	T83490-30
Schematic Drawing	SD83490-01
Product Manual Select Code	167-102-102

Batteries

Battery	Product Manual Select Code
EVR Series Battery	157-622-011
IR Series Battery	157-622-020
IR125 Battery	157-622-025

4 *Safety*

Safety Statements

Please read and follow all safety instructions and warnings before installing, maintaining, or repairing the J85500R-3 power shelf:

- The CE Mark demonstrates compliance with the European Union Council Directives for Low Voltage and EMC.

Standard configurations are:

- J85500R-3 Shelf
 - ES660C 15A/+48Vdc Rectifier
 - ES647B Alarm and Control Unit (ACU)
 - ES622B 25Hz 100VA 80Vac rms Ringer
- The J85500R-3 is Underwriters Laboratories (UL) Listed per Subject Letter 1801, DC Power Distribution Centers for Telecommunications Equipment. Shelves equipped with AMP MATE-N-LOK II type ac input connectors are UL Recognized only and are used in enclosed equipment cabinets where their installation and mounting are evaluated in the end equipment.
 - CPS shelves equipped with ES620/ES621/ES621A/ES621B/ES622C ringers have hazardous secondary voltages on the secondary bus output connector (J14) and on ES613 outputs (if equipped). In all applications, exposed primary output bus bars have hazardous energy levels.
 - 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.

Safety Statements, continued

- This equipment is to be used in controlled environments (an area where the humidity is maintained at levels that cannot cause condensation on the equipment, the contaminating dust is controlled, and the steady-state ambient temperature is within the range specified).
- This equipment has been evaluated for use in a continuous ambient temperature of up to 65° Celsius. Short term excursions to 75° Celsius are allowed.
- This equipment must not be installed over combustible surfaces.
- 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.

Safety Statements, continued

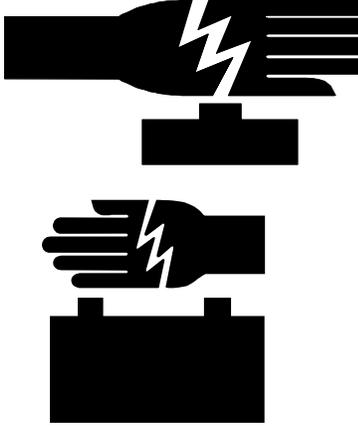
- Battery input cables must be dressed to avoid damage to the conductors (caused by routing around sharp edges or routing in areas where wires could get pinched) and undue stress on the connectors.
- Alarm contacts on the distribution panel (J6 on left side of shelf and J2 on ES610, ES611, and ES613) 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.
- The short circuit current capability of the battery input to the distribution panel must not exceed 9000A.
- AC branch circuits to this equipment must be protected with either fuses or circuit breakers sized as required by the National Electric Code (NEC) and/or local codes. The maximum size of the over-current protector is recommended to be no more than 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 CPS mounting framework must be connected directly to the cabinet ac service ground bus. For applications in huts, vaults, and central offices, the CPS mounting framework must be connected to the system integrated ground grid.
- ES610/ES611/ES613 GMT fuse outputs may not be acceptable for protection of building wiring as defined by the NEC. Protection for internal wiring or short interconnecting cables that are not part of the building wiring is acceptable.

Safety Statements, continued

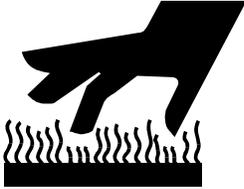
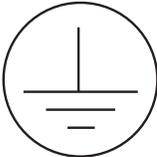
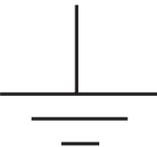
- Installing fuses or circuit breakers not specified for use in these distribution modules may result in injury to service personnel or equipment damage. Use only replacement parts listed in this manual and on the equipment drawings.
- The telecom-type (e.g., GMT type) fuses can produce sparks during 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.
- There are no user-serviceable parts inside the CPS shelf. All service should be performed by Lineage Power authorized service personnel.

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.”

	<p>This symbol identifies the need to refer to the equipment instructions for important information.</p>
	<p>These symbols (or equivalent) are used to identify the presence of hazardous ac mains voltage.</p>
	<p>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.</p>
	<p>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.”</p>

Warning Statements and Safety Symbols, continued

 A black silhouette of a hand reaching down towards a series of wavy lines representing flames.	<p>This symbol is used to identify the presence of a hot surface. It may also be accompanied by a statement explaining the hazard. A symbol like this with a lightning bolt through the hand also means that the part is or could be at hazardous voltage levels.</p>
 A black outline of a triangle containing three wavy lines representing heat or a hot surface.	<p>This symbol may also be used to identify the presence of a hot surface. The marked item should not be touched without taking care.</p>
 A black outline of a circle containing a vertical line that meets a horizontal line, which is above another horizontal line, representing a protective safety earth ground.	<p>This symbol is used to identify the protective safety earth ground for the equipment.</p>
 A vertical line meeting a horizontal line, which is above another horizontal line, representing other bonding points within the equipment.	<p>This symbol is used to identify other bonding points within the equipment.</p>
 A black silhouette of a person's head and shoulders wearing safety glasses, enclosed in a black circle.	<p>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."</p>

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 secondary distribution board and connector J14. The ES613 plug-in distribution also contains hazardous ringer voltages.
- 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 Instructions

German

- Installationsanleitung
(Installation Instructions)
 - Eingangsspannung (Voltage): See Table 3-D.
 - Eingangsstrom (Current): See Table 3-D.
 - Nennfrequenz (Frequency): 50-60
 - Schutzklasse (Protection Class): I
 - Modellnummer (Model No.): See Table 3-D.
 - Max. Umgebungstemperatur (Maximum Operating Temperature): 65°C
 - Ausgangsspannungen und -ströme
(Output Voltage and Current): See Table 3-D.
 - Terminal Block Version:
Das Gerät hat keinen eigenen Ausschalter, es muß daher mit einem Ein- und Ausschalter im Versorgungskreis versehen sein
(Mains disconnect switch required in the installation)
 - Beim Aufstellen des Gerätes ist darauf zu achten das alle Anforderungen gemäß EN60950 eingehalten werden
(Evaluated to EN60950)
 - Das Gerät hat kein Brandschutzgehäuse es darf daher nur auf nicht brennbaren Untergrund aufgestellt werden (Beton, Metall usw)
(No fire enclosure, non-combustible floor)

Special Installation Instructions, continued

Spanish

Notas especiales para instalaciones en países de habla hispana

- Instrucciones de instalación
(Installation Instructions)
 - Voltaje (Voltage):
Vea el vector
 - Corriente (Current):
Vea el vector
 - Frecuencia (Frequency):
50/60Hz
 - Voltaje y corriente de salida (Output Voltage and Current):
Vea el vector
 - Temperatura máxima de operación (Maximum Operation Temperature):
65°C (113°F)
 - Terminal block version: Se requiere un interruptor de desconexión de la línea principal en la instalación (Mains disconnect switch required in the installation)
 - Sin cabina contra incendios, suelo no combustible (No fire enclosure, non-combustible floor)
 - Evaluado en EN60950
(Evaluated to EN60950)

5 ***Installation and Testing***

Preparation

Introduction

This section outlines the sequence for installing the CPS 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 CPS shelf and plug-in modules:

- 3/16 inch Allen wrench (one provided with each shelf)
- Wire cutters and strippers
- Heat shrink gun
- Torque wrench (0-70 in·lbs)
- 5/16 inch hex driver
- 7/16 inch hex driver
- 48V test load
- Digital meter with an accuracy of $\pm 0.02\%$
- Small screw driver
- Test cable
- ESD wrist strap

Hardware

Mount the CPS shelves and battery modules in the frame using the 12-24 x 5/8 hex-head self-tapping screws provided in the output lug kits. Screws are required in all mounting holes and should be torqued to a minimum of 30 in·lbs.

Preparation, continued

Wiring Guidelines

- The commercial ac power input wiring enters through the rear of the plant. The plant output wiring exits the plant on the right. The alarm wiring to general office alarms exits the plant on the left. The inter-shelf signal connector is located on the left. Loads and batteries are connected to the power shelves at the output buses of the CPS shelf on the right side. With the remote access option, the communication connections exit from the left-side access slot in the control unit faceplate.
- All electrical connections should be made using the proper crimping tools and dies and should be torqued to values specified on the product labels and in Tables 3-E and 3-G.
- 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

<p>Only qualified personnel should install and service the CPS 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.</p>
--

Installing Shelves

One-Shelf Plants

To install a one-shelf CPS plant, ensure that adequate space is available for mounting the shelf. Dimensions are shown in Figure 5-1.

- The shelf is mounted in a 19-inch framework.
- The shelf requires a minimum of 10.75 inches of vertical height, including a minimum of 1 inch above and 1 inch below the unit for cooling.

Twelve inches of space in front of the shelf is required for insertion and removal of the power units.

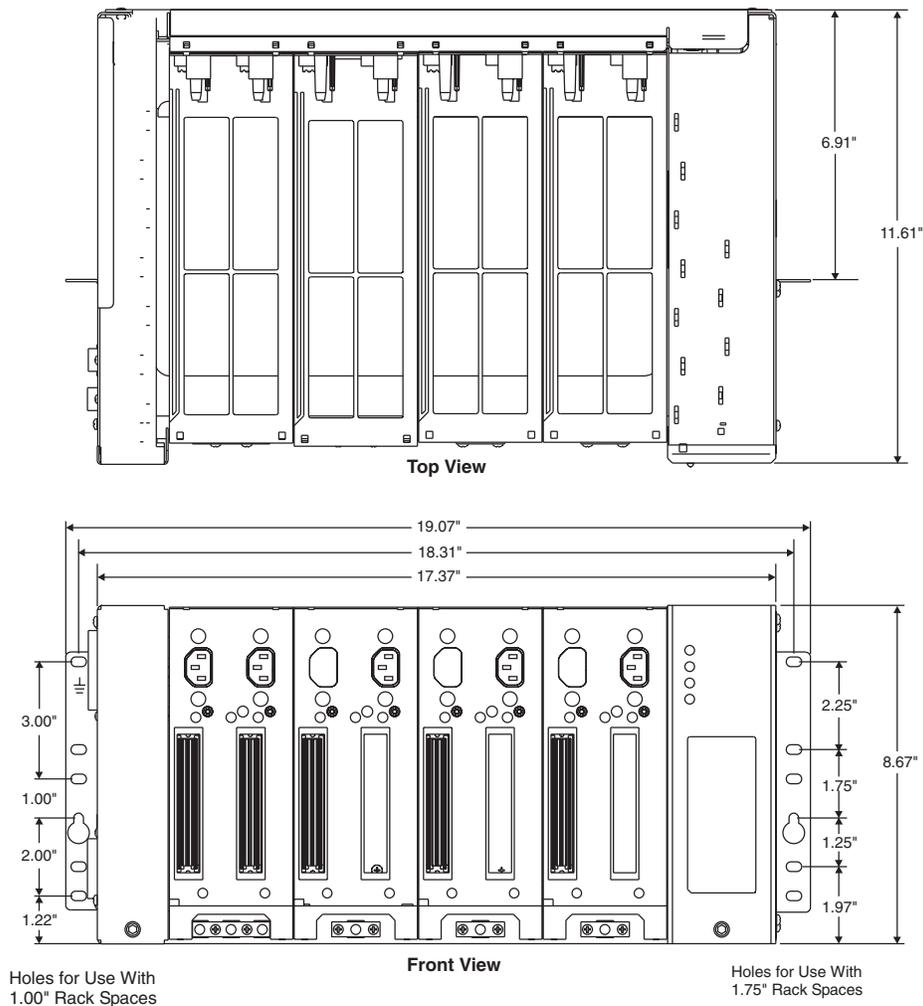


Figure 5-1: CPS Shelf Dimensions

Installing Shelves, continued

Multiple-Shelf Plants

A multiple-shelf CPS plant is composed of:

- an initial shelf, which provides for:
 - rectifiers
 - ringing generators
 - a control unit
 - an LVD contactor (see Note below)
 - associated control and temperature compensation circuits
 - output bus bars, which are used to interconnect the shelves and connect the batteries

- one supplemental shelf which provides for:
 - rectifiers
 - ringing generators
 - output bus bars, which provide terminations for the plant's primary output

Installing Shelves, continued

Interconnecting the Initial and Supplemental Shelves

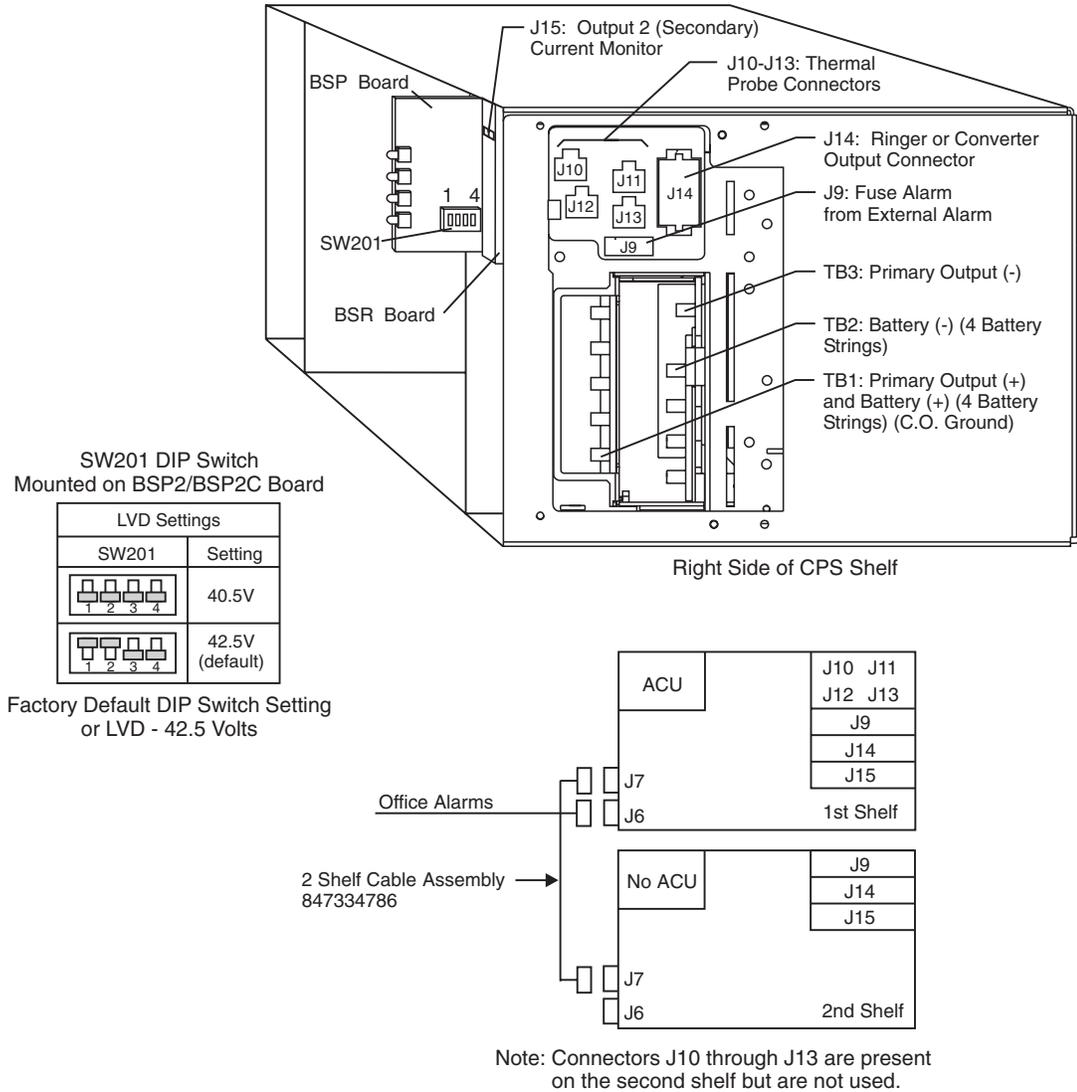


Figure 5-2: Alarm, Intershelf, LVD/Thermal Management

Installing Shelves, continued

Interconnecting Initial and Supplemental Shelves, continued

Interconnecting initial and supplemental shelves to form one plant requires power connections between TB1, TB2, and TB3 on the initial shelf and between TB1 and TB2 on the supplemental shelves.

Note

You may order cables and associated hardware for interconnecting two shelves with list K2.
--

Refer to Figure 5-2.

Interconnecting Initial and Supplemental Shelves	
Step	Action
1	Connect TB-3 on the initial shelf to TB-2 on the supplemental shelf.
2	Connect TB-1 on the initial shelf to TB-1 on the supplemental shelf.
3	Connect batteries, if provided, between TB-1 and TB-2 on the initial shelf. Ensure proper polarity when connecting batteries.
4	Connect the loads between TB-1 and TB-2 on the supplemental shelf.
5	Connect an intershelf cable from J7 on the left of the initial shelf to J7 on the left of the supplemental shelf.

AC Input Wiring

Options

Two ac input options are available:

L21R and L21RB: Four ac feeds to power individual rectifier slots for nominal 100/120V operation.

L25R and L25RB: Two ac feeds for nominal 200/208/240V operation. One feed powers slots 1 and 3, and one feed powers slots 2 and 4.

Refer to Figure 5-3 for an illustration of the CPS input assembly.

Warning

- High leakage currents are possible. Earth ground connection is essential before connecting the ac source to the shelf.
- In enclosed equipment cabinets, the CPS mounting framework must be connected directly to the cabinet ac service ground bus. For applications in huts, vaults and central offices, the CPS mounting framework must be connected to the system integrated ground grid.
- An accessible circuit disconnect must be provided that removes power from **all** branch circuit inputs to the CPS.
- AC input voltages are provided to CPS via multiple input cables. Verify that the circuit protector for each ac input is disconnected while servicing this equipment.
- Interconnecting control/logic circuits are at hazardous voltage levels with respect to ground.

AC Input Wiring, continued

Notes

- The -48V CPS shelf may be powered from a single branch circuit or from separate branch circuits for each input.
- Branch circuits must be protected using fuses or circuit breakers sized as required by the National Electric Code. Overcurrent protection should not exceed 30 amperes.

The recommended AC input circuit protection is listed below.

Input Assemblies	AC Input Connections	Input AC Voltage	Recommended Circuit Protection
List 21R, 21RB	4	120V	15A each
List 25R, 25RB	2	240V	20A each

- To maintain the reliability inherent in a -48V CPS plant, separate branch circuits must be run to each ac line cord to provide an N+1 configuration.
- If rectifiers are powered from separate branch circuits, all rectifier slots should be prewired during initial installation. If this is done, increasing rectifier capacity is as simple as plugging in an additional rectifier.

Caution

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

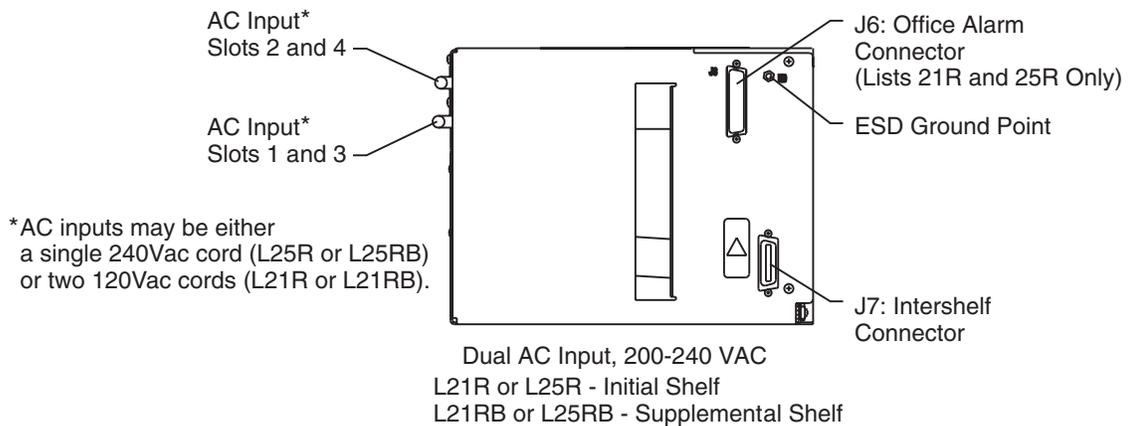


Figure 5-3: Input Assemblies (Left Side of CPS Shelf)

Installing Control Units

Introduction

A single control unit can control a one-, two-, or three-shelf plant.

Procedure

Installing Control Units	
Step	Action
1	Identify and unpack the control unit.
2	Verify that the Battery on Discharge (BD) threshold on the control unit is set appropriately. On switch SW440, the following switch settings support a 51.0V BD threshold: DIP switches 1, 3, and 5 are closed; switches 2, 4, and 6 are open. Refer to Table 6-C for SW440 DIP switch settings.
3	Refer to Table 6-B to set switch SW1.
4	Insert the control unit into the left-most slot in the initial CPS shelf.
5	Using the 3/16 inch Allen wrench, torque the module's mounting fastener to a maximum of 12 in·lbs.

Office Alarm Wiring

Access to Alarms

Office alarms may be accessed on J6, located on the left side of the shelf adjacent to the control unit. These alarms are provided on Form-C, or transfer type contacts, allowing the alarms to be provided as normally open or normally closed sets of isolated contacts, rated at 60 volts dc and 0.5 amperes maximum. The three connections associated with each alarm are labeled NC, NO, and C. When an alarm occurs or power is removed from the control unit, a closure exists between the NC and C contacts and an open exists between the NO and C contacts.

Interconnections for remote Rectifier On/Standby and Plant Battery Test of the power modules are also provided on J6. For proper operation of the rectifier remote On/Standby function, a battery must be provided with the -48V CPS system.

Hardware Kit

A kit is available providing the connector and associated hardware to fabricate an office alarm cable. (See Section 3, *Engineering and Ordering*.)

Wire to the office alarms provided on J6 as required.

Caution

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

Plug-in Modules

Introduction

Refer to Figure 5-4 and the illustration in the following procedure for the locations of the plug-in modules (power units).

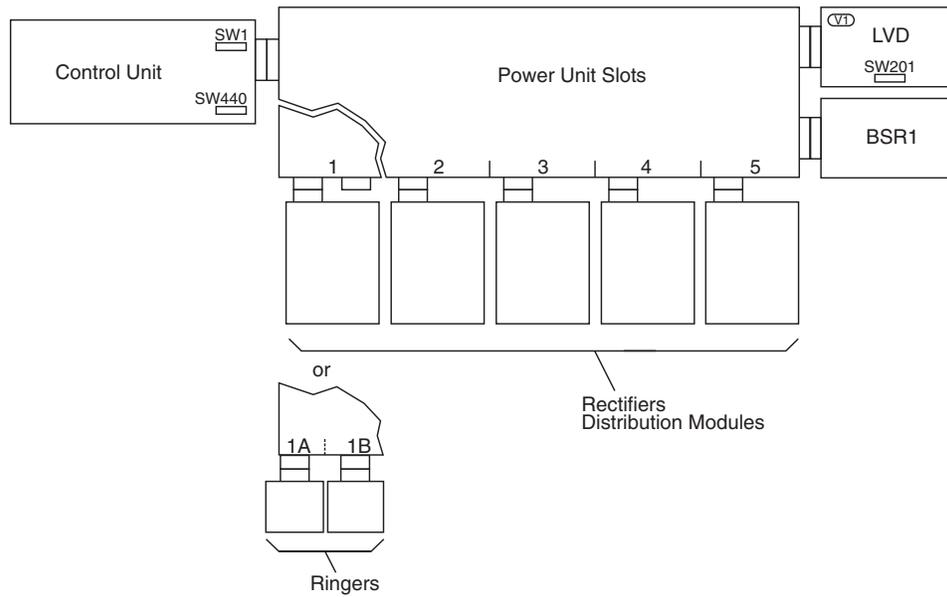


Figure 5-4: CPS Plug-In Modules

Plug-In Modules, continued

Procedure

Plug-in Modules	
Step	Action
1	Verify that the proper modules have been ordered and received.
2	Disconnect the power to the shelf by turning the ac service circuit breakers Off.
3	Place On/Standby switch on each rectifier or converter to the Standby position. Caution To avoid arcing on the contacts of the interface connector, the On/Standby switch on each rectifier or converter must be in the Standby position before installing the module.
4	Install each rectifier and/or converter and/or ringer by placing it on the CPS shelf, beginning with the left-most position slot #1, and carefully sliding it toward the backplane until its mounting screw prevents any further backward motion. Do not seat the rectifiers.
5	If provided, remove the BSP2 or BSP2C module and verify the low-voltage disconnect/reconnect threshold setting.

The diagram illustrates the internal structure of the 48V CPS4000+ 19-inch cabinet power system. On the left side, there are several connectors: Commercial AC Input Connectors, J6 Office Alarm Connector, J7 Intershelf Connector, and Alarm Control Unit (ACU). The main body of the cabinet contains four vertical slots labeled Slot1, Slot2, Slot3, and Slot4, which are designated as Power Unit Slots for Rectifiers, Ringing Generators, and Distribution Modules. On the right side, there is an Output Section with multiple terminals. The diagram shows the internal components and their relative positions within the cabinet.

Low-Voltage Disconnect (LVD) Function

Overview

The Low-Voltage Disconnect (LVD) function is pre-set in the factory at 42.5 volts (SW201 switches 1 and 2 in the ON position). For 40.5V Low-Voltage Disconnect, set SW201 switches 1 and 2 to the OFF position. See “Low-Voltage Disconnect” in Section 6 for more information.

DC Distribution Wiring

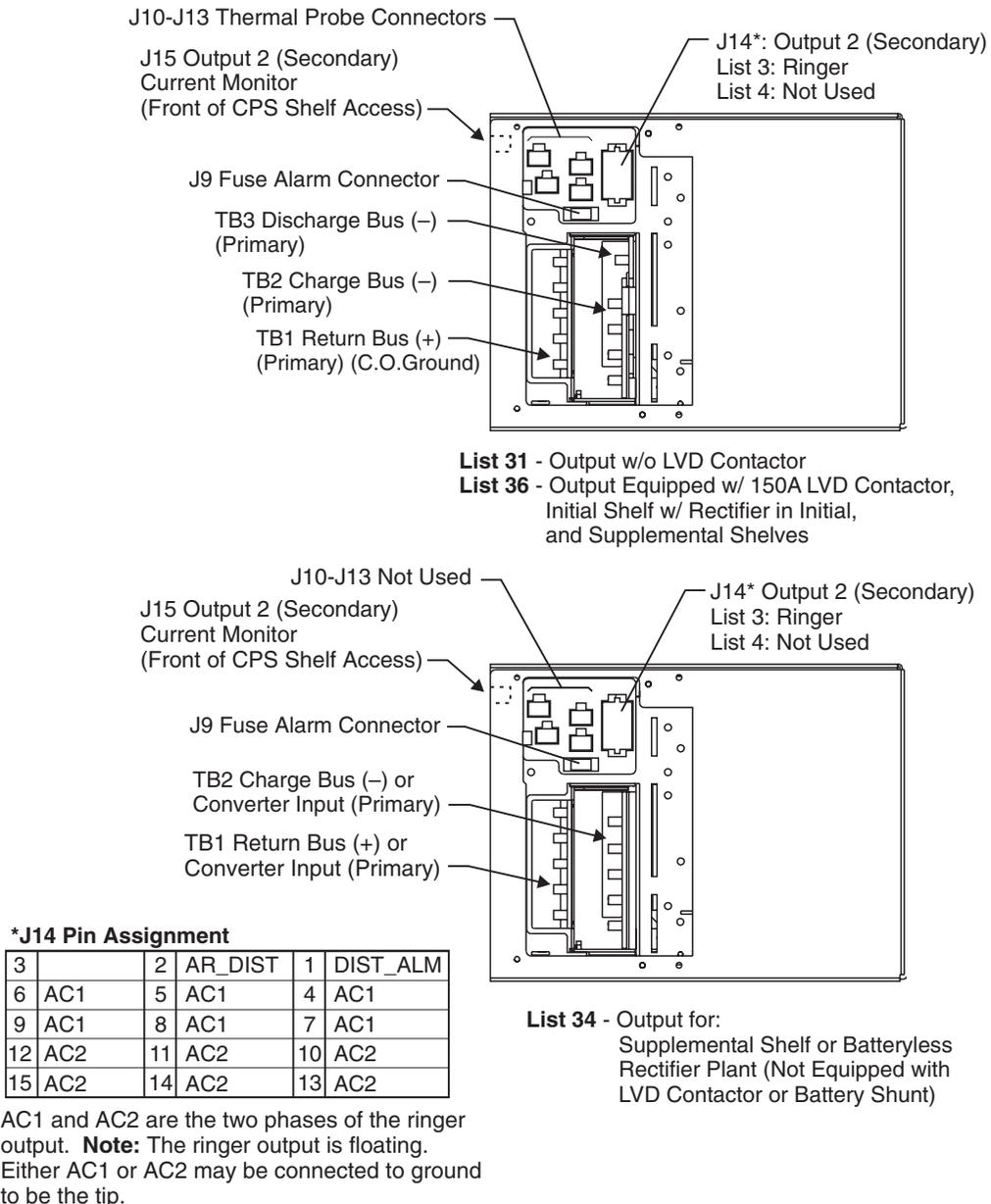


Figure 5-5: Output Assemblies (Right Side of CPS Shelf)

DC Distribution Wiring, continued

Kits

Kits providing the cables and hardware needed for this procedure are listed in Section 3, *Engineering and Ordering*.

Procedure

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

DC Distribution Wiring	
Step	Action
1	Remove the cover on the output distribution module (on the far right of the shelf) using the 3/16" Allen wrench provided.
2	Determine the appropriate wire size for the load and return leads.
3	Dress the wire from the load to the output port on the right of the shelf.
4	Terminate the wire with the proper connector using the proper crimping tool.
5	Apply heat-shrink tubing over the exposed barrel of the lug.
6	Secure the terminated wire to the correct output position on the CPS shelf, and torque the lug fasteners to 65 in-lbs.
7	Strain relieve these wires as appropriate to remove undue stress on the connectors.

Warning

CPS shelves equipped with ES620, ES621, ES621A, ES621B, or ES622C ringers have hazardous voltages on the secondary bus output connector (J14). Ring signal cadencing and tripping device must be provided by end-use product. In all applications, exposed primary output bus bars have hazardous energy levels.

Distribution Modules

Introduction

If you are using a plug-in distribution module, refer to the appropriate paragraph (ES610, ES611, ES613) in this section.

Warning

Installing fuses or circuit breakers not specified for use in these distribution modules may result in injury to service personnel or equipment damage.

Installing telecom-type fuses not equipped with safety caps may result in injury to service personnel.

Fuses can produce sparks. Always wear safety glasses to avoid eye injury.

Caution

Alarm contacts are not fused within the distribution unit. Therefore, current limiting protection for these contacts must be provided by external circuits. Maximum ratings for alarm connections on J2 of the ES610, ES611, and ES613 are 60Vdc and 0.5A. Exceeding these maximum ratings could result in fire or damage to the unit.

Note

These modules may not be acceptable for protection of building wiring as defined by the NEC. Protection for internal wiring or short interconnecting cables that are not part of the building wiring is acceptable.

Distribution Modules, continued

ES610

The ES610 plug-in distribution module provides up to twelve GMT type telecom fuses ranging in rating from 1/4 to 10 amperes. Twelve load and return wire termination slots are provided with each module. **The total output current of each module is limited to 25 amperes.** Distribute system loads across fuse blocks. Refer to Figure 5-6.

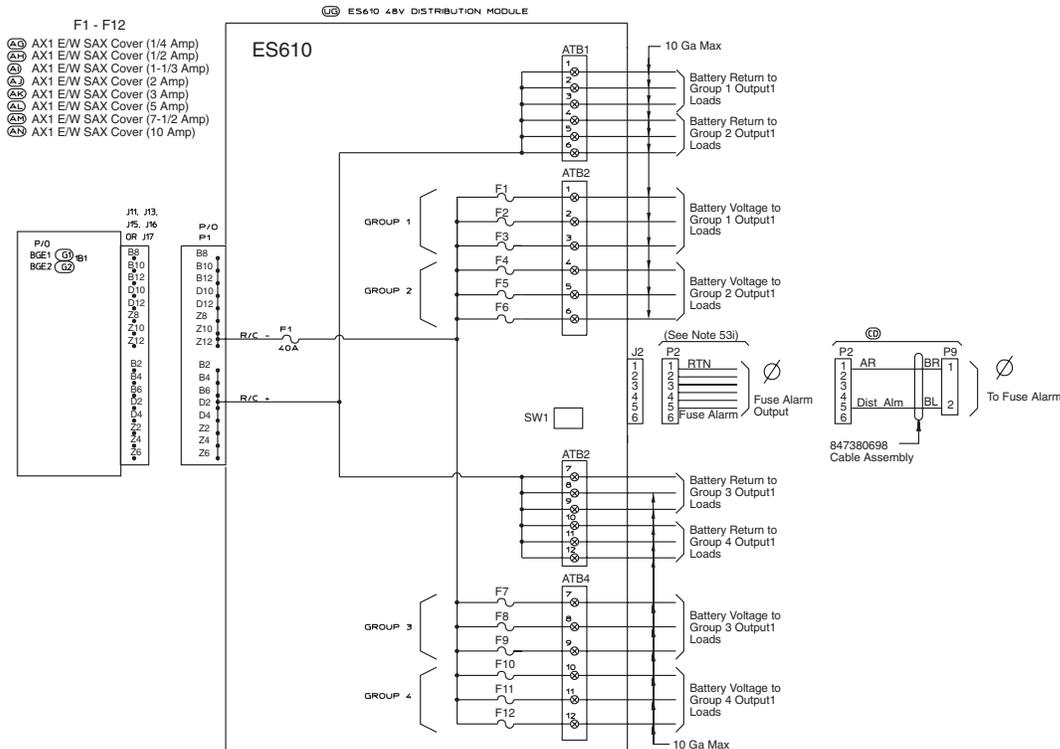


Figure 5-6: ES610 Distribution Module Wiring

Distribution Modules, continued

ES611

The ES611 plug-in distribution module provides up to four circuit breakers ranging in rating from 3 to 30 amperes and two GMT type telecom fuses ranging in rating from 1/4 to 10 amperes. Six load and return wire termination slots are provided with each module. **The total output current of each module is limited to 30 amperes.** Distribute system loads across circuit breakers. Refer to Figure 5-7.

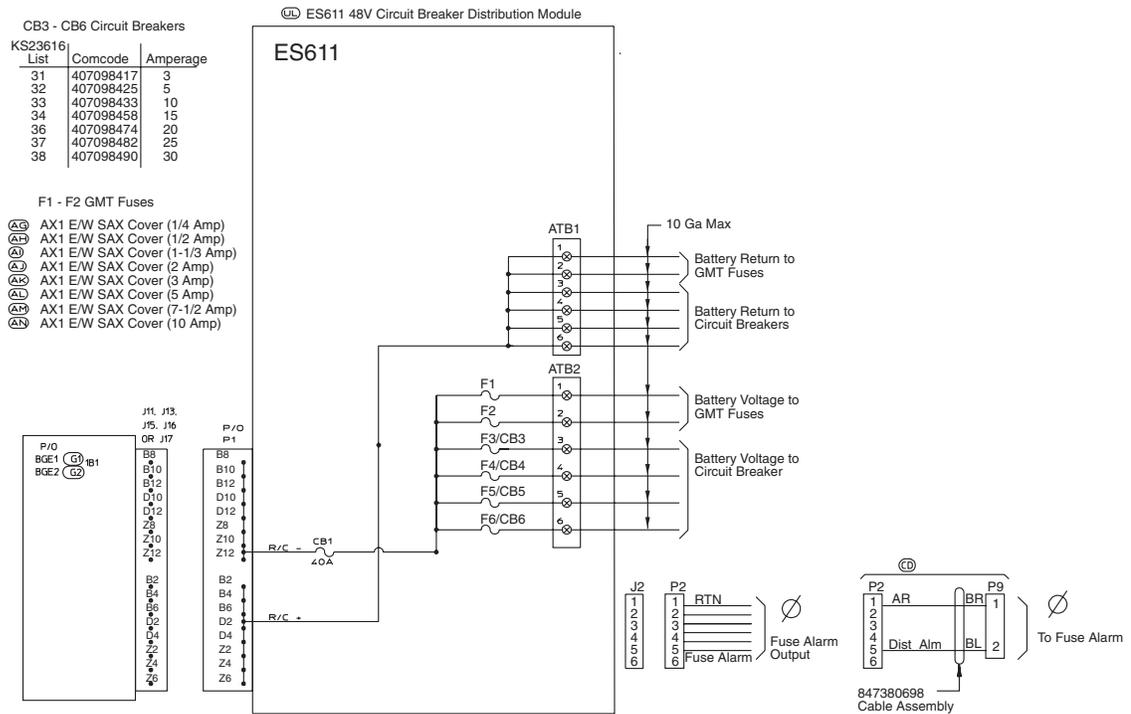


Figure 5-7: ES611 Distribution Module Wiring

Distribution Modules, continued

ES613

The ES613 plug-in distribution module provides up to twelve GMT type telecom fuses ranging in rating from 1/4 to 10 amperes. All outputs are secondary 100V protected outputs from the ringing generators and are fully front accessible via terminal block connections. Twelve load and return wire termination slots are provided with each module. Refer to Figure 5-8.

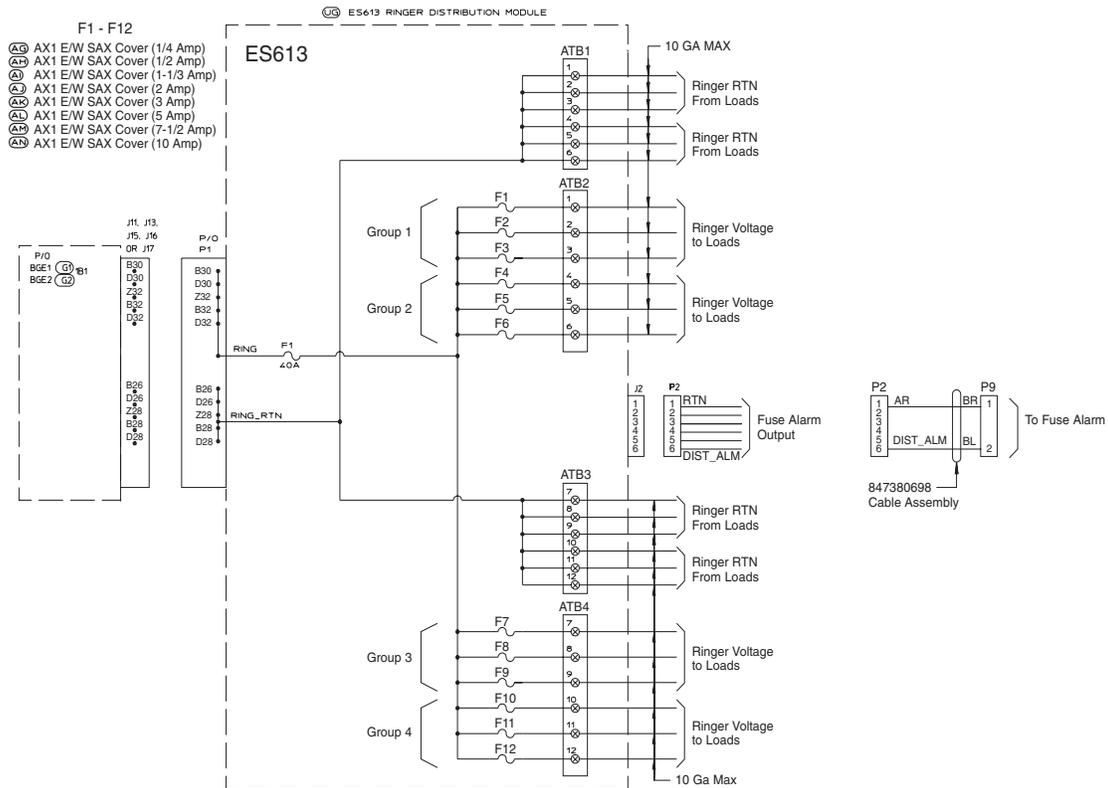


Figure 5-8: ES613 Distribution Module Wiring

Initial Start-up and Test

Checklist

Refer to Section 6 and the Glossary for a description of the parameters cited in this section.

- Verify that all ac service circuit breakers are **Off** or ac fuses are removed.
- Verify that all output distribution circuit breakers are **Off** or output distribution fuses are removed.
- If provided, verify that the LVD unit (BSP2 or BSP2C) and the control unit are seated firmly in the initial shelf.
- Remove the distribution unit (BSP2 or BSP2C) cover.
- Verify that batteries, if installed, are disconnected.

Initial Start-up and Test, continued

Power Units

Power Units	
Step	Action
1	Turn the ac service circuit breakers on.
2	Seat each rectifier using the 3/16-inch Allen wrench, turning the mounting screw clockwise. Verify that the fans operate on the rectifiers. Note: In order to verify fan operation, it may be necessary to have only one rectifier seated and operating at a time.
3	After all the rectifiers are seated, verify that the yellow Standby LED lights on all of them.
4	Turn one rectifier on and verify: <ul style="list-style-type: none">• LVD Fail LED lights momentarily on the BSP2 or BSP2C distribution unit (occurs with the first rectifier only)• LVD contactor (if equipped) closes, and the Alarm LED on the BSP2 or BSP2C goes off. (You will hear the contactor close)• Plant voltage exceeds the BD threshold.
5	Place a test load across TB1 (+) and TB3 (-) located in the bulk distribution module for the primary bus output on the initial shelf or TB1 (+) and TB2 (-) for the primary bus output on the supplemental shelf. Set the test load to approximately 2 amperes. This test verifies that the rectifier(s) will support a load.
6	If ringers are being used, place a test load across J14 pins 4 through 9 (+) and J14 pins 10 through 15 (-) for the secondary output.
7	Turn all remaining rectifiers and/or ringers on using the On/Standby switches. Verify that the yellow Standby LEDs extinguish and the green On LED lights on all power units.
8	Verify that the green Normal LED on the control unit lights and all Alarm LEDs extinguish after all rectifier switches are in the On position.

Initial Start-up and Test, continued

Adjust Plant Voltage

Adjust Plant Voltage	
Step	Action
1	If provided, remove the thermal probe cables from J10-J13 on the connector board while adjusting the plant voltage.
2	<p>Set the plant voltage using the V Adj encoder located on the control unit. If batteries are connected to the system, the plant voltage must be adjusted to the voltage recommended by the battery vendor. For Lineage Power IR or VR batteries, the plant voltage should be 54.5 volts for battery ambient temperatures below 25° Celsius (77° Fahrenheit).</p> <p>Note: It may take a few moments for the plant voltage to change if batteries are discharged. See specific battery product manuals for additional information.</p>
3	<p>Reinstall the thermal probes, if provided, to J10-J13 on the connector board. If the temperature sensed by any probe is above the nominal temperature setting (25°C), the TEMP COMP LED will activate and the plant voltage will decrease to the appropriate level for the temperature sensed. <i>This is not an alarm condition</i>, but is only an indication that TEMP COMP is actively adjusting the plant float voltage from that which was originally set. Refer to Figure 6-2 for additional information regarding the TEMP COMP feature.</p> <p>Note: Do not readjust plant voltage on the ES647B with the TEMP COMP LED active or the plant voltage will increase above the initial voltage setting when the temperature decreases.</p>

Initial Start-up and Test, continued

High Voltage Shutdown Test

Note: Batteries may need to be removed from the circuit for this test.

High Voltage Shutdown Test	
Step	Action
1	Using the V Adj encoder, slowly increase the plant voltage until the rectifier shuts down and the Alarm LED lights; quickly reduce the plant voltage to approximately 54.5 volts and verify that the rectifier restarts.
2	Turn all remaining rectifiers on using the On/Standby switches. Verify that the yellow Standby LED extinguishes and the green ON LED lights on all power units.
3	Verify that the green Normal LED on the control unit lights and all Alarm LEDs extinguish after all rectifier switches are in the ON position.

Rectifier on Standby (1)

Rectifier on Standby (1)	
Step	Action
1	Simulate a rectifier alarm by placing one rectifier in standby.
2	Verify that the PMN LED lights on the control unit.
3	Clear this alarm by turning the rectifier On. Note: The standby mode and power unit alarms both use the same communication paths to the control unit; therefore, they test the same system and power unit interfaces.

Rectifier on Standby (2)

Rectifier on Standby (2)	
Step	Action
1	Place two rectifiers in standby.
2	Verify that the PMN and PMJ LEDs light on the control unit
3	Clear these alarms by turning the rectifiers On.

Initial Start-up and Test, continued

AC Fail (1)

AC Fail (1) - L21R, L21RB	
Step	Action
1	For systems with one ac feed per rectifier, turn one input circuit breaker Off.
2	Verify that the PMN LED lights on the ES647B control unit

AC Fail (2)

AC Fail (2) - L21R, L21RB	
Step	Action
1	For systems with one ac feed per rectifier, and more than two rectifiers installed, turn a second circuit breaker Off.
2	Verify that the PMJ and PMN LEDs light on the ES647B control unit
3	Clear the alarms by turning the circuit breakers On.

AC Fail

AC Fail - L25R, L25RB	
Step	Action
1	For systems with one ac feed per two rectifiers, and with two rectifiers installed on the ac feed being tested, turn one input circuit breaker Off.
2	Verify that the PMJ and PMN LEDs light on the ES647B control unit
3	Clear the alarms by turning the circuit breakers On.

Initial Start-up and Test, continued

Battery on Discharge

Note: Disconnect batteries or remove the LVD board for this test.

Battery on Discharge	
Step	Action
1	Disconnect batteries or remove the LVD board.
2	Verify that the BD threshold is set properly by reducing the plant voltage below the BD threshold using the V Adj encoder on the control unit.
3	As the plant primary bus voltage is reduced below the BD threshold, verify that the PMJ LED lights on the control unit
4	Clear these alarms by returning the voltage to 54.5 volts.

Distribution Fuse Alarm

Distribution Fuse Alarm	
Step	Action
1	Simulate a distribution fuse alarm by placing a clip lead between J9 pins 1 and 2 to simulate a primary output fuse alarm or between J14 pins 1 and 2 to simulate a secondary output fuse alarm.
2	Verify that the simulated distribution alarm lights the PMJ LED on the control unit
3	Clear these alarms by removing the clip leads or removing the blown fuses.

Initial Start-up and Test, continued

Test Thermal Management Probe

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

Test Thermal Management Probe	
Step	Action
1	Locate the exposed pins on the rear of a thermal probe and short them together. Verify: <ul style="list-style-type: none">• Probe Fail LED lights on the distribution unit• PMN LED lights on the control unit Remove the short to clear the alarm.
2	Unplug the cable from the thermal probe. Verify: <ul style="list-style-type: none">• Probe Fail LED lights on the distribution unit• PMN LED lights on the control unit
3	Repeat this procedure for each thermal probe installed.

Load Test

Load Test	
Step	Action
1	Adjust the test load to the installed plant capacity.
2	Verify that the power modules can deliver output power.
3	Reduce the test load so that about 10 amperes is available to charge the batteries. Install the battery cables removed earlier. Follow the instructions in the battery product manual for charging the battery.
4	Remove the test load. Note: The system load may be used instead of a test load to test the plant's capacity to deliver power.

Initial Start-up and Test, continued

LVD Test

LVD Test	
Step	Action
1	<p>To simulate a failed low-voltage disconnect contactor (if provided):</p> <ul style="list-style-type: none">a. Remove modules in slots 4 and 5 (right-most slots) in the CPS initial shelf.b. Remove shelf liner in slot 5.c. Remove black plastic cover on the LVD compartment.d. Remove one Quick-Connect[®] connector from the LVD contactor coil.e. Verify:<ul style="list-style-type: none">– LVD Open LED lights on the output module– PMJ LED lights on the control unitf. Clear these alarms by reconnecting the Quick-Connect[®] connector.g. Replace the shelf liner in slot 5 and the modules in slots 4 and 5.
2	<p>Reconnect the thermal probe cables (P10/P13) on the output distribution board (J10-J13).</p>

Adding Rectifiers to a Working Plant

Introduction

Rectifiers and converters may be added with input power applied. However, the **On/Standby** switch on the unit added must be in the **Standby** position.

Procedure

To install a rectifier in a working plant:

Adding Rectifiers to a Working Plant	
Step	Action
1	Verify that the On/Standby switch on the module is in the Standby position.
2	Begin installation of the rectifier in slot #1, installing rectifiers left to right. Place the module on the shelf and slide it toward the backplane until the mounting screw prevents any further backward motion.
3	Using a 3/16" (5mm) Allen-head wrench, seat the module by turning the mounting screw clockwise.
4	If required, turn the module on.

Installing Output Distribution Circuit Breakers

In Working Plants

To install circuit breakers for loads being added to a working plant, follow this procedure:

Installing Output Distribution Circuit Breakers in Working Plants	
Step	Action
1	Verify that each circuit breaker is Off prior to installation.
2	Install the breakers.
3	Operate all circuit breaker switches to On position.

6 *Alarms, Controls, and Displays*

Displays

Illustration

Figure 6-1 shows the displays of the alarm control unit, monitor and control unit, ringing generator (ringer), rectifier and converter (same display), distribution unit, and output wiring (low-voltage disconnect/thermal management) modules:

Displays, continued

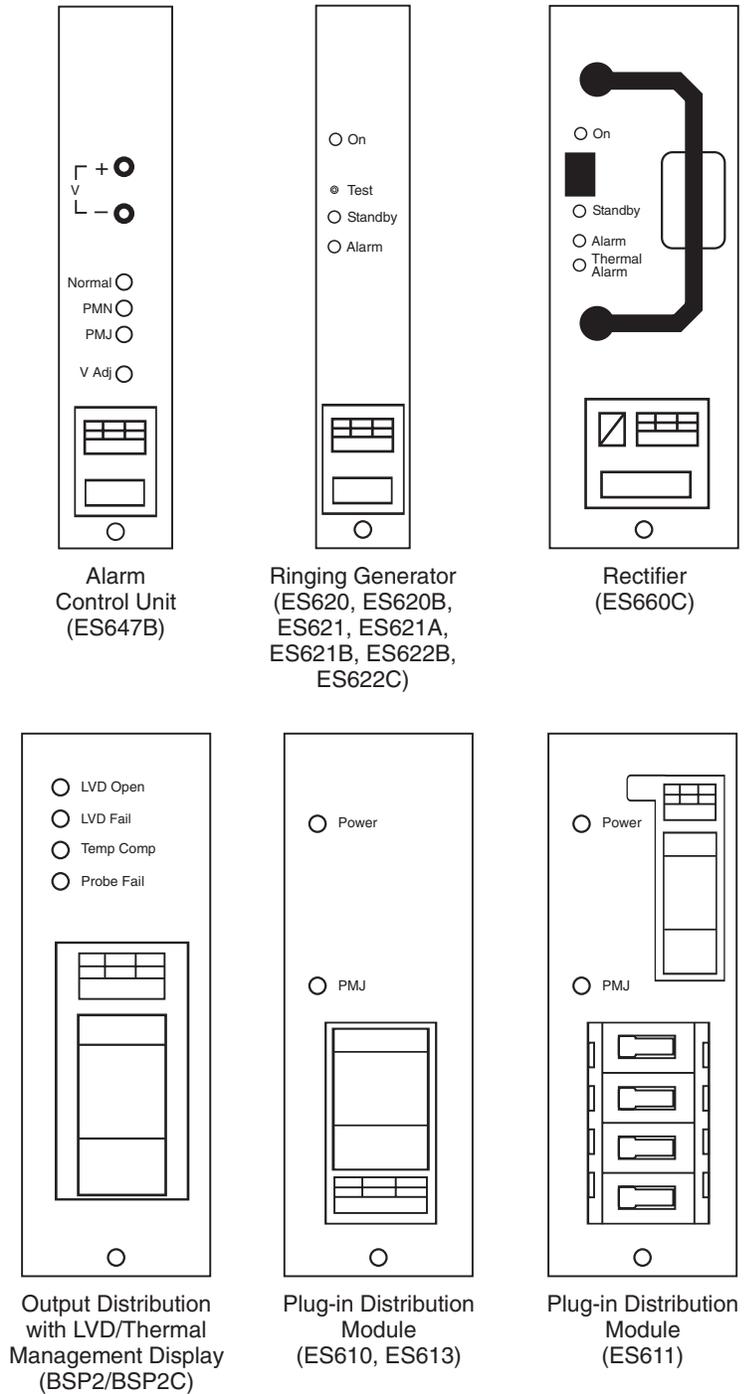


Figure 6-1: Module Displays

Displays, continued

Float Voltage Adjust

The **V Adj** feature on the faceplate of the control units allow users to adjust the rectifier output voltage.

- The ES647B has an adjustment range from 48-57V.
- If the control unit fails, the plant output voltage reverts to its preset voltage at 52 volts.
- An encoder is provided on the control unit faceplate to allow the customer to adjust the rectifier output voltage. If the control unit fails, the plant output voltage reverts to its preset voltage (approximately 52 volts dc). Be sure to follow the procedure outlined in Section 5, "Initial Start-up and Test."

Front Panel Test Jacks

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

Control Units

Overview

The control unit administers alarm processing, rectifier On/Standby control, Plant Battery Test, and plant voltage adjustments in the CPS -48V plant. One control unit supports a one- or two-shelf plant.

Features

Table 6-A summarizes the ES647B features for primary and secondary outputs.

Table 6-A: Control Unit Features for Primary and Secondary Outputs

Feature	ES647B	
	Primary	Secondary
Plant meter (volts)	No	No
Plant meter (amperes)	No	No
Test point (volts)	Yes	No
Remote test (volts)	No	No
Remote test (amperes)	No	No
Temperature compensation	Yes	No
Plant voltage adjust	Yes	No
PMJ LED	Yes	Yes
PMN LED	Yes	Yes
ACF LED	No	No
MJF LED	No	No
BD LED	No	No
Plant normal LED	Yes	Yes
Rectifier On/Standby	Yes	N/A
PMJ office alarm	Yes	Yes
PMN office alarm	Yes	Yes
Auxiliary PMJ Alarm	Yes	Yes
Auxiliary PMN Alarm	Yes	Yes
ACF office alarm	Yes	N/A
2ACF/LV office alarm	Yes	No
BD office alarm	Yes	No
MJF office alarm	Yes	Yes
Plant battery test	Yes	Yes
LED test	No	No

Control Units, continued

SW1 Options

Switch 1 on the control units provide feature selection as outlined in Table 6-B. Switch position 1 is not used on any of the control units.

Table 6-B: ES647B SW1 Options

Switch	Position	Feature
1	N/A	Not used
2		
3	Closed	BD alarm also generates a PMJ alarm
3	Open	BD alarm does not generate a PMJ alarm
4	Closed	Enable rectifier On/Standby capability
4	Open	Disable rectifier On/Standby capability
5	Closed	Enable plant battery test
5	Open	Disable plant battery test

Alarms

Adjustable Battery on Discharge (BD)

In the event that AC power is lost, the batteries provide power for the load. While the batteries are providing the plant's power, the plant voltage will decrease below the float voltage. The ES647B ACU monitors the plant voltage and issues a Battery on Discharge (BD) alarm. DIP switch SW440 on the control unit controls the set point for the BD threshold. Whenever the plant voltage drops below this preset threshold, the ES647B issues a BD alarm and a PMJ alarm if SW1 position 3 is closed.

Voltage Threshold for the BD Alarm

The voltage threshold for the BD alarm is selected using SW440 on the main circuit board of the control unit. See Table 6-C. The setpoint is typically **at least one volt below the low-temperature plant float voltage** for nominal -48V plants **without battery thermal management**. If battery thermal management is used, the BD setting should be at least three volts below the plant float voltage when the plant is at room (ambient) temperature. This lower threshold is required to prevent a BD alarm from occurring as the plant float voltage is lowered as a result of high temperature. The factory default BD setting is 51.0V*.

Table 6-C: ES647B SW440 BD Settings

1	2	3	4	5	6	Voltage
C	C	C	C	C	O	46.0
O	C	C	C	C	O	46.5
C	O	C	C	C	O	47.0
O	O	C	C	C	O	47.5
C	C	O	C	C	O	48.0
O	C	O	C	C	O	48.5
C	O	O	C	C	O	49.0
O	O	O	C	C	O	49.5
C	C	C	O	C	O	50.0
O	C	C	O	C	O	50.5
C	O	C	O	C	O	51.0*
O	O	C	O	C	O	51.5
C	C	O	O	C	O	52.0
O	C	O	O	C	O	52.5
C	O	O	O	C	O	53.0
O	O	O	O	C	O	53.5
C	C	C	C	O	O	54.0
O	C	C	C	O	O	54.5
C	O	C	C	O	O	55.0
O	O	C	C	O	O	55.5
C	C	O	C	O	O	56.0

Alarms, continued

Low-Voltage Disconnect (LVD)

DIP switches in the BSP2/BSP2C circuit pack permit the user to set the plant voltage at which the plant load is disconnected from the battery. The disconnect threshold may be set for either 42.5 volts or 40.5 volts. The 40.5-volt threshold may be used when the drop between the plant and the load is minimal. The BSP2/BSP2C is installed in the factory and has a default setting of 42.5 volts.

Table 6-D: SW201 LVD Settings

1	2	3	4	Voltage
On	On	Off	Off	42.5
Off	Off	Off	Off	40.5

Rectifier Alarms

Whenever the ES647B control unit receives a single rectifier alarm, it issues a Power Minor (PMN) alarm. A yellow LED lights on the control unit face plate. If it receives two or more rectifier alarms, it will issue both a Power Minor (PMN) and a Power Major (PMJ) alarm. Both the yellow PMN LED and the red PMJ LED will light.

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

Ringer Alarms

Whenever the ES647B receives a single ringer fail alarm, it issues a PMN alarm and the yellow LED lights on the control unit faceplate. Two or more ringer failures result in a PMJ alarm.

AC Fail Alarm

The AC Fail Alarm indicates that ac input power to at least one rectifier is missing or has dropped below the minimum ac voltage for the operating range being used. This alarm results in an isolated transfer contact for the office alarm system.

The ES647B control unit issues a PMN alarm for a single ac failure, and the PMN LED will light on the ACU

Two AC Fail Alarm

If ac input power is missing from more than one rectifier, the PMJ LED will light on the ACU.

Alarm Processing

<i>Overview</i>	The control unit processes alarm conditions and presents them to the user as front panel LED indicators and Form-C relay contact closures. The control unit sorts and groups alarm conditions occurring in the CPS plant into two categories, Power Major or Power Minor, based on their impact on plant functions.
<i>Power Major Alarms</i>	Conditions that impact service and require immediate attention are classified as major alarms and designated as Power Major (PMJ) alarms. Red LEDs signify major alarms.
<i>Power Minor Alarms</i>	Conditions requiring service, but having no immediate impact on the plant output are classified as minor alarms and designated as Power Minor (PMN) alarms. Yellow LEDs signify minor alarms.
<i>Supplementary Information</i>	Where feasible, LEDs, indicators, and relay contact closures provide supplementary information to indicate which specific alarm condition resulted in the PMN or PMJ alarm.

Alarm Processing, continued

Plant Alarm Conditions and Alarm Indications

Table 6-E summarizes plant alarms and alarm indications (i.e., contact closures and/or LEDs) of the control unit.

Table 6-E: Plant Alarm Conditions and Indications

Alarm Condition	Office Alarm (Contact Closure)	LED	Power Unit LED	BSP2/BSP2C LED	ES610 ES611 ES613
AC Fail (1)	PMN ACF	PMN	--	--	--
AC Fail (2)	PMJ PMN ACF 2ACF	PMJ PMN	--	--	--
Battery on Discharge	PMJ* BD	PMJ*	--	--	--
Battery Disconnect	PMJ	PMJ	--	--	--
Ringer Alarm (1)	PMN	PMN	Alarm	--	--
Ringer Alarm (2)	PMJ PMN	PMJ PMN	Alarm	--	--
Distribution Fuse Alarm	PMJ MJF	PMJ	--	--	PMJ or PMN**
Excess Battery Temp [†]	PMJ	PMJ	--	--	--
Low Voltage	N/A	N/A	--	--	--
LVD Fail	PMN	PMN	--	LVD Fail	--
LVD Open	PMJ	PMJ	--	LVD Open	--
Major Fuse Alarm	PMJ MJF	PMJ	--	--	--
Probe Fail	PMN	PMN	--	Probe Fail	--
Rectifier Alarm** (1)	PMN	PMN	Alarm	--	--
Rectifier Alarm** (2)	PMJ PMN	PMN PMJ	Alarm	--	--
Rectifier Standby (1)	PMN	PMN	Stby	--	--
Rectifier Standby (2)	PMN PMJ	PMN PMJ	Stby	--	--
Temp Comp	--	--	--	Temp Comp	--
<p>*May be inhibited by opening SW1 position 3. **A thermal alarm will also generate a rectifier failure alarm. [†]Excess battery temperature alarm occurs at 65°C, and extinguishes at 55°C as temperature decreases.</p>					

Office Alarm Contacts

Introduction

These are 60-volt, 0.5-ampere, Form-C or transfer type contacts that allow an installer to connect the control unit to an office alarm system. Each set of isolated contacts consists of a combination of normally open (NO) and normally closed (NC) contacts with one side of each common (C). When the control unit has power and no alarm condition exists, all alarm relays are energized. When an alarm condition exists, the relay de-energizes and a closure exists between the NC and C poles and an open exists between the NO and C poles. If the control unit is powered down, the alarm relays are de-energized and all NC and NO closures are sent to the office alarm system.

ES647B Alarm and Control Unit

A set of Form-C contacts is brought out on J6 for each of the following plant alarms for the ES647B:

- Power Major (PMJ)
- Power Minor (PMN)
- Battery on Discharge (BD)
- AC Fail (ACF)
- Two-AC Fail (2ACF)
- Major Fuse Alarm (MJF)

Office Alarm Contacts, continued

J6 Pin Assignments

Table 6-F gives the office alarm pin assignments on J6.

Table 6-F: Office Alarm Assignments (J6)

Pin Number	Office Alarm
1	PMJ_NO
2	PMJ_C
3	PMJ_NC
4	PMN_NO
5	PMN_C
6	PMN_NC
7	BD_NO
8	BD_C
9	BD_NC
10	MJF_NO
11	MJF_C
12	MJF_NC
13	
14	2ACF_NO/LV_NO
15	2ACF_C/LV_C
16	2ACF_NC/LV_NC
17	
18	EARTH_GND
19	AUX_PMJ
20	AUX_PMN
21	BATT
22	ACF_NO
23	ACF_C
24	ACF_NC
25	
26	Reserved
27	
28	R_O/S_IN
29	PBT
30	O/S_RTN
31	
32	
33	Reserved
34	
35	
36	EARTH_GND

Plant Battery Test (PBT)

Introduction

A plant battery test feature is available that allows the user to test battery health and capacity safely without jeopardizing the load; i.e., a user supplied contact closure across J6-29 and J6-30 will reduce the rectifier output voltage set point to approximately 48 volts, which creates a battery on discharge condition.

SW1 is used to enable the Plant Battery Test and Rectifier On/Standby feature.

Plant Voltage Indication

If the batteries are present and healthy, the plant voltage will remain above 48 volts. If the batteries are not present or are not able to support the load, the plant voltage will immediately drop to approximately 48 volts without any consequence to the load.

Determining Reserve Capacity

If the batteries are present and working, the user may then safely place the rectifiers in standby by placing a short across J6-28 and J6-30 in order to continue the discharge and further determine the reserve capacity of the batteries.

LVD/Thermal Management

Introduction

The display on the Output Wiring module has four LEDs: LVD Open, LVD Fail, Temp Comp, and Probe Fail. An explanation of the circumstances that cause the LEDs to light are given in the following paragraphs:

LVD Open

The Low-Voltage Battery Disconnect contactor is open.

LVD Fail

This pack has redundant circuitry for monitoring plant voltage. This LED lights when the monitoring circuits disagree with each other, indicating the LVD pack is defective and should be replaced.

Probe Fail Alarm

If a thermal probe becomes defective, either open or short, the thermal management control issues the Probe Fail Alarm and a yellow LED on the LVD/Thermal Management circuit pack lights. This alarm is not service affecting.

Note: Monitor batteries at a minimum of two points (two thermal probes) to ensure battery protection to prevent potential thermal overload.

Temperature Compensation

If the temperature of the batteries exceeds 25°C (77°F), the thermal management control transmits a signal to the control unit, which then lowers the float voltage on the batteries proportionally to the rise in temperature above 25°C (77°F) and lights a [yellow/BSP2 or green/BSP2C] LED on the LVD/Thermal Management circuit pack.

LVD/Thermal Management, continued

Slope Thermal Compensation Algorithm

- As temperature rises between 25°C (77°F) and 53°C (127°F), plant voltage is lowered 72mV per degree. At 53°C (127°F) the plant voltage is two volts less than the uncompensated battery float voltage.
- For temperatures between 53°C (127°F) and 75°C (167°F), the plant voltage remains at two volts less than the uncompensated battery float voltage.
- For temperatures higher than 75°C (167°F), the plant voltage is reduced to approximately 48 volts to protect against thermal runaway. The 48-volt plant setting will stay in effect until the battery temperature drops to 65°C (149°F), where thermal compensation resumes normal operation.

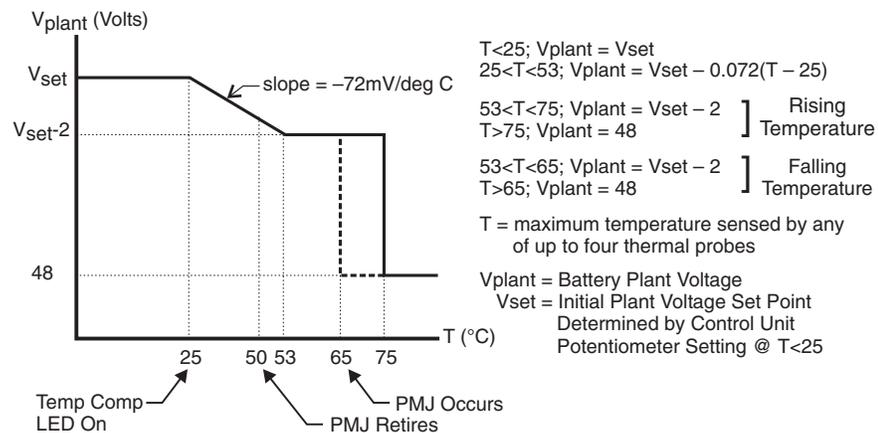


Figure 6-2: -48V Slope Temperature Compensation Algorithm

7 *Maintenance*

Overview

In This Section This section provides field maintenance information and procedures for the power units.

Safety Before performing the maintenance procedures, review the safety information in Section 4.

Warning

AC input voltages are provided to the CPS via multiple input cables. Ensure that the circuit breaker for each ac input is disconnected while installing or servicing this equipment.

The units intended for use in the CPS shelf are not suitable as disconnect means, and the spacings of the shelf backplane do not provide adequate spacing to act as a disconnect means.

Hazardous energy levels can exist on dc output (from power supply outputs **and** batteries). Before working on any output circuit, turn off ac service circuit breakers to the rectifier shelf and turn off circuit breakers on the cabinet output. Disconnect batteries and generator output circuit breaker.

Power Units

Introduction

With the exception of a fan failure, the power units are repaired by replacement.

Fan Maintenance

The expected life of the power unit fans at 25°C (77°F) is seven years. The fans in CPS power units may be replaced in the field without opening the power unit. When one or both fans fail, the power unit eventually shuts down as it overheats and issues a power unit alarm and a thermal alarm.

Two approaches can be taken to fan maintenance. The first approach is to replace the chassis fan cradle assembly on a routine basis every five years; this ensures that the fans do not fail in the field under normal operating conditions. This approach is appropriate when there are no remote alarm facilities at the site. The second approach, assuming one has remote alarm capability, is to wait until the fans fail. The power unit will safely shut down and issue both a fail alarm and a thermal alarm. The fan cradle assembly can then be replaced. Since it is likely that all the power units in that installation are of roughly the same age, all power unit fans at that site should be replaced at that time. The approach used depends on the convenience of the site as well as the monitoring of alarms used at the site.

Fan Replacement

Fan Replacement	
Step	Action
1	Using the Allen wrench provided with each shelf, remove the power unit from the system.
2	Remove the screw holding the fan cradle assembly onto the bottom of chassis.
3	Separate the fan cradle assembly from the chassis.
4	Unplug the connectors on the old fans from the power unit.
5	Plug in fan connectors on the new fan cradle.
6	Reattach fan cradle assembly to chassis bottom panel using one screw.
7	Replace and restore ac service according to the procedures outlined in Section 5.

8 *Troubleshooting*

Overview

Safety

Review all safety instructions and warnings before troubleshooting the CPS.

Warning

The modules intended for use in the CPS shelf are not suitable as disconnect means and the spacings of the shelf backplane do not provide adequate spacing to act as a disconnect means.

Before working on any output circuit, turn off ac service circuit breakers to the rectifier shelf and turn off circuit breakers on the cabinet output. Disconnect batteries.

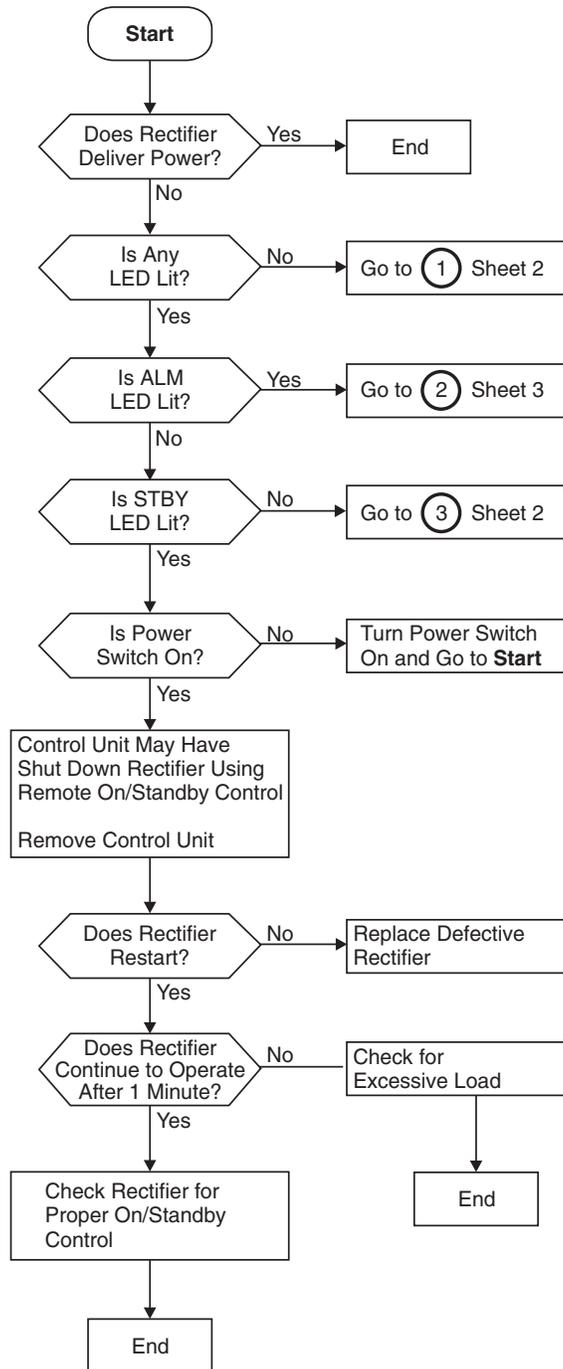
AC input voltages are provided to the CPS via multiple input cables. Ensure that the circuit protector for each ac input is disconnected while installing or servicing this equipment.

Hazardous energy levels can exist on dc output (from power supply outputs **and** batteries). Make sure batteries are **also** disconnected.

Flowcharts

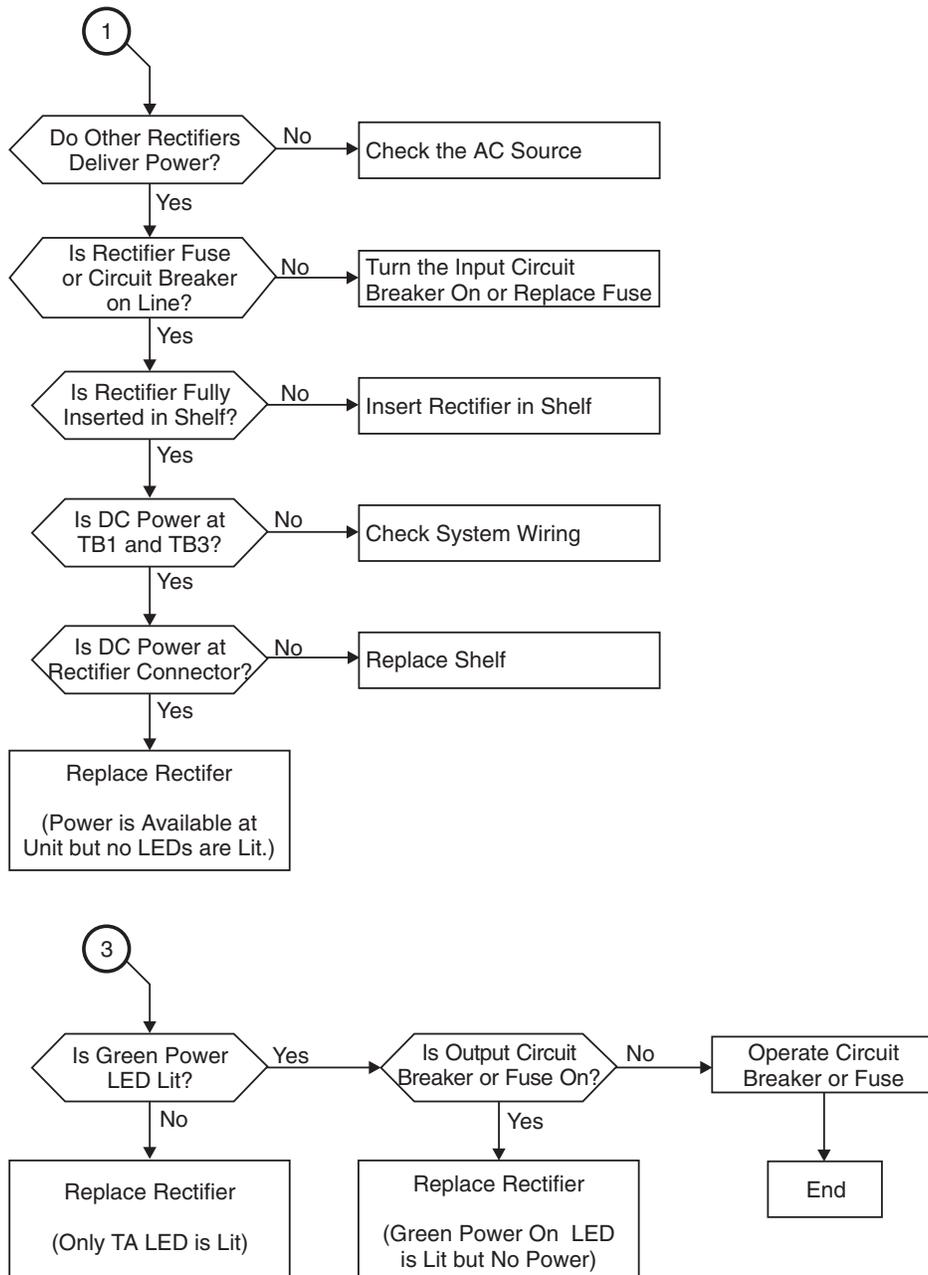
The following flowcharts list indications and the corrective action(s) to take when a rectifier or converter does not deliver power. Match specific site conditions to those listed in the chart. If none of these corrective actions remedies the problem, call Lineage Power Technical Support.

Rectifier Flowchart

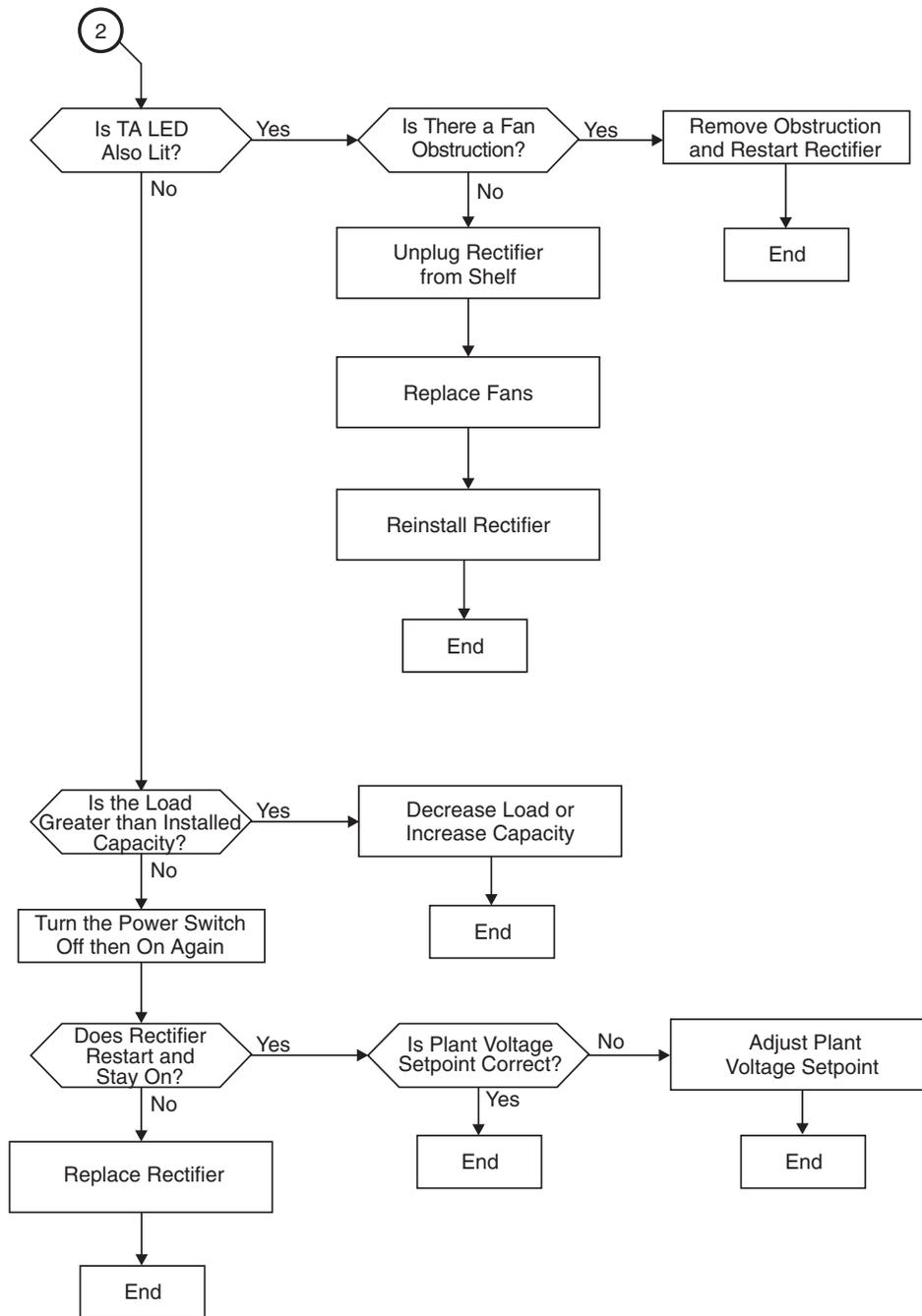


Sheet 1

Rectifier Flowchart, continued



Rectifier Flowchart, continued



Sheet 3

9 *Product Warranty*

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

Warranty Period

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

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

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

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

- D. If Seller has elected to repair or replace a defective Product, Customer shall have the option of removing and reinstalling or having Seller remove and reinstall the defective or nonconforming Product. The cost of the removal and the reinstallation shall be borne by Customer. With respect to Cable and Wire Products, Customer has the further responsibility, at its expense, to make the Cable and Wire Products accessible for repair or replacement and to restore the site. Products returned for repair or replacement will be accepted by Seller only in accordance with its instructions and procedures for such returns. The transportation expense associated with returning such Product to Seller shall be borne by Customer. Seller shall pay the cost of transportation of the repaired or replacing Product to the destination designated by Customer.
- E. Except for batteries, the defective or nonconforming Products or parts which are replaced shall become Seller's property. Customer shall be solely responsible for the disposition of any batteries.
- F. If Seller determines that a Product for which warranty service is claimed is not defective or nonconforming, Customer shall pay Seller all costs of handling, inspecting, testing, and transportation and, if applicable, traveling and related expenses.
- G. Seller makes no warranty with respect to defective conditions or nonconformities resulting from actions of anyone other than Seller or its subcontractors, caused by any of the following: modifications, misuse, neglect, accident, or abuse; improper wiring, repairing, splicing, alteration, installation, storage, or maintenance; use in a manner not in accordance with Seller's or Vendor's specifications or operating instructions, or failure of Customer to apply previously applicable Seller modifications and corrections. In addition, Seller makes no warranty with respect to Products which have had their serial numbers or month and year of manufacture removed, altered, or experimental products or prototypes or with respect to expendable items, including, without limitation, fuses, light bulbs, motor brushes, and the like. Seller's warranty does not extend to any system into which the Product is incorporated. This warranty applies to Customer only and may not be assigned or extended by Customer to any of its customers or other users of the Product.

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

Appendix Glossary

A

- AC Fail*** An indicator found in CPS plants, this alarm is issued (yellow LED) when the ac service voltage to a rectifier falls below the normal input operating voltage range.
- ACU*** The Alarm Control Unit (ES647B) provides plant monitoring, display and control features, and office alarm outputs.
- Alarm*** This red LED lights to indicate that a rectifier has shut down due to an output under voltage condition, a thermal alarm, or an operated internal fuse.
- Alarm Return (AR)*** A signal path between the control unit and the battery modules that provides a common return path for alarm signals.
- Ampere Hour (AH)*** Ampere hour is a rating for batteries that specifies duration of a discharge for a given load. It is a convention for expressing “drain (or load) current” multiplied by time.
- Average Busy-Hour Current Drain*** The average busy-hour current drain during busy season with the plant operating at the normal voltage.
- Batt Major Alarm*** A signal to the Control Unit indicating that a battery temperature is above 65 degrees Celsius.

<i>Batt Minor Alarm</i>	A signal to the Control Unit indicating that a temperature probe cable is installed, but the probe is missing, a temperature probe has failed, or the LVD circuit has failed but the LVD contactor remains closed.
<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 load is being powered by the batteries. This condition results in a BD alarm.
<i>BSP2/BSP2C</i>	Low-voltage disconnect/thermal management control circuit pack used with the -48V Monitor and Control Units and Alarm Control Unit
<i>CPS</i>	Cabinet Power System
<i>EMI</i>	Electromagnetic interference
<i>ES610</i>	Plug-in Distribution Module
<i>ES611</i>	Plug-in Distribution Module
<i>ES613</i>	Plug-in Distribution Module
<i>ES620</i>	Ringling Generator; 50VA, 100Vac, 20Hz
<i>ES620B</i>	Ringling Generator; 50VA, 75Vac, 25Hz
<i>ES621</i>	Ringling Generator; 100VA, 100Vac, 20Hz
<i>ES621A</i>	Ringling Generator; 100VA, 100Vac, 20Hz
<i>ES621B</i>	Ringling Generator; 100VA, 90Vac, 20Hz
<i>ES622B</i>	Ringling Generator; 100VA, 80Vac, 25Hz

<i>ES622C</i>	Ringing Generator; 100VA, 100Vac, 20Hz
<i>ES647B</i>	Alarm Control Unit; for use in -48Vdc CPS battery plants
<i>ES660C</i>	Rectifier; power module that converts ac into -48Vdc with load current rating of 15.0 amperes
<i>ESD</i>	Electrostatic discharge
<i>LED</i>	Light emitting diode
<i>LV</i>	Low-voltage alarm issued when the CPS plant voltage drops below a threshold
<i>LVD</i>	Low-voltage disconnect; preset voltage threshold at which the load is disconnected from the battery voltage in CPS Plants to protect both the batteries and the using equipment.
<i>Major Fuse Alarm (MJF)</i>	This red PMJ LED lights 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 results in an alarm condition.
<i>NEC</i>	National Electric Code
<i>Normal</i>	This green LED lights while there are no alarms and the plant is operating normally and is able to furnish power to the load.
<i>Output Voltage Adjust</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>Power Major Alarm (PMJ)</i>	Conditions that impact service and require immediate attention are classified as major alarms and designated as Power Major (PMJ) alarms. (Red LEDs signify major alarms.)

<i>Power Minor Alarm (PMN)</i>	Conditions requiring service, but having no immediate impact on the plant output are classified as minor alarms and designated as Power Minor (PMN) alarms. (Yellow LEDs signify minor alarms.)
<i>Power On/Standby Switch</i>	This two-position switch determines the operational status of the rectifier.
<i>Rectifier Alarm</i>	A signal to the control unit indicating low rectifier output voltage resulting from a rectifier failure or excess load
<i>Signal Interface</i>	A signal path interface between the control unit and the office alarm Interface that provides customer access to the office alarm and control tie-points on J6
<i>Standby</i>	In this mode, the power unit control and alarm circuits are powered; however, the power circuits are inhibited to prevent these units from producing output power.
<i>Thermal Alarm (TA)</i>	This red LED lights when the rectifier shuts down due to inadequate air flow indicating possible intake air blockage, fan failure, or inlet air temperature above 65°C.
<i>Voltage Test Jacks</i>	Test jacks are provided to measure the plant primary output voltage.
<i>Volts Adjustment (Vadj)</i>	This is a recessed encoder used to adjust the plant output primary voltage.