GE
Critical Power

-48V CPS4000+
23" Cabinet Power System
J85500R-1

Product Manual

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-48V CPS4000+
23" Cabinet Power System
J85500R-1

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1 Introduction

-48 Volt Cabinet Power System

Overview

The J85500R-1, CPS 4048, -48V Cabinet Power System (CPS) is an extremely flexible power system designed for 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 75 amperes in a single shelf with an embedded battery disconnect. In a two-shelf plant it can also deliver regulated +24 volts for secondary loads up to 50 amperes. Above 150 amperes, an external battery disconnect is required.

-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. For converters, the signal interface with the control unit provides alarm monitoring and lamp test, but does not allow voltage adjustment or current monitoring.

-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, 48/24V converters, 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, display and control features, and office alarm outputs.

The -48V CPS is available in four configurations:

- A rectifier plant capable of providing -48V power within the load range of zero to 75 amperes in a one-shelf plant or zero to 150 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
- A rectifier/converter plant in which -48V rectifiers can provide load power and power to operate converters capable of providing 24 volts at 25 amperes per converter or 130 volts at 4 amperes per converter
- A converter plant that is powered from an external -48V source

CPS4000+

Introduction

This product manual describes the features and functionality of the existing CPS4000 product line, as well as the enhanced CPS4000+ products. The enhancements to the CPS4000 product are explained in Table 1-A. All other features and functionality of the enhanced CPS4000+ products are identical to the existing product.

CPS4000+, continued

Enhancements

Table 1-A: CPS4000+ Enhancements

CPS4000+ Enhancements	Product Description
Complete form/fit/function compatibility with deployed base of CPS4000	Provides extended life of current CPS4000 product
Operating temperature range of -40°C to +75°C (-40°F to 167°F)	Provides continuous full power operation of the system over the outside plant temperature range of -40°C to +65°C (-40°F to 149°F), with excursions to +75°C (167°F)
Low temperature compensation below 25°C (77°F)	Increases battery float voltage as an inverse function of battery temperature over the temperature range of -40°C to +75°C (-40°F to 167°F)
EN55022, Class "B" compliance	Allows for greater flexibility in the selection of installation sites, including customer premise locations
CE Marking for LVD and EMC	Demonstrates safety and EMC compliance to European market standards
Rectifier power increase to 15 amperes at 48 volts	Provides full power utilization of CPS shelf
Control unit operational from low 24-volt input to high level 48-volt input	A single Monitor and Control Unit (MCU) operating at either 24 volts or 48 volts
Boost charge capability (option)	For rapid battery charging
Remote access and control capability (option)	Option to allow for dial-up access to CPS plant to report and access alarm conditions, monitor and/or adjust plant voltage and current, determine condition of system battery and control generator exercising
Rectifier efficiency improvement	Improvement of rectifier efficiency from 87% (typical) to 88.5% will help the using systems to manage thermal management
Retrofitability of new control functions (option)	Allows for the following new control functions into existing deployed base of CPS system: • remote access and control • boost charging only with new rectifiers
External equipment initiation	Option to allow the capability to initiate equipment start-up or activation via remote access

Reference Documents

Product manuals, product line brochures, and software are available on-line at www.gecriticalpower.com
Software includes Easy View and SNMP MIB

Contact Information

Phone: +1 888 546-3243
Email: PE.TechSupport@ge.com
Web site: www.gecriticalpower.com

2 Product Description

Overview

Block Diagrams

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

Shelf assemblies house and interconnect power modules, a control unit, and a distribution module.

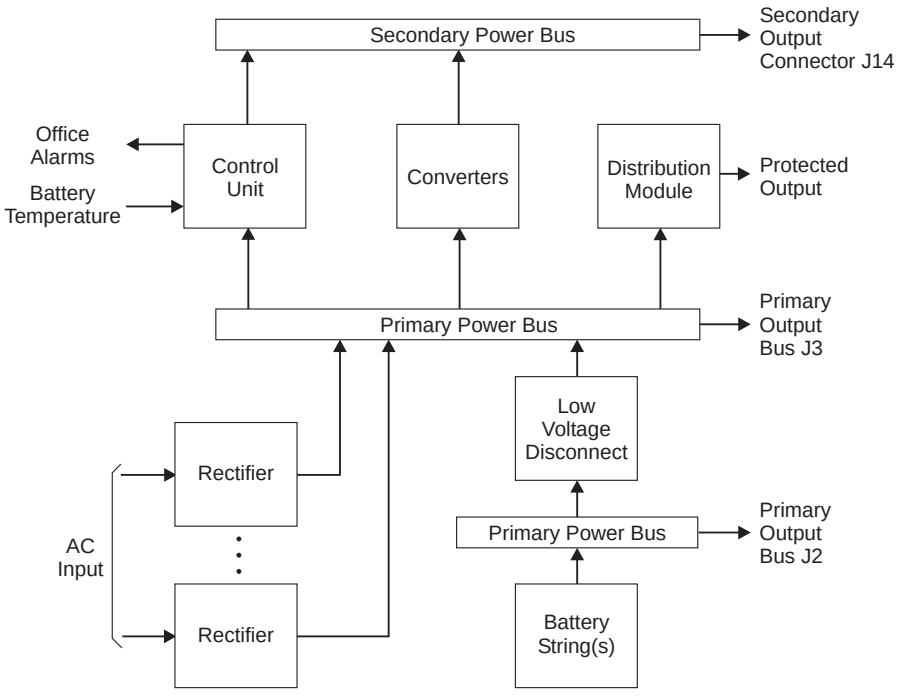


Figure 2-1: Block Diagram of -48V CPS With LVD Contactor

Overview, continued

Block Diagrams, continued

Figure 2-2 is a block diagram of the CPS configured as a secondary shelf or without Low-voltage Disconnect (LVD).

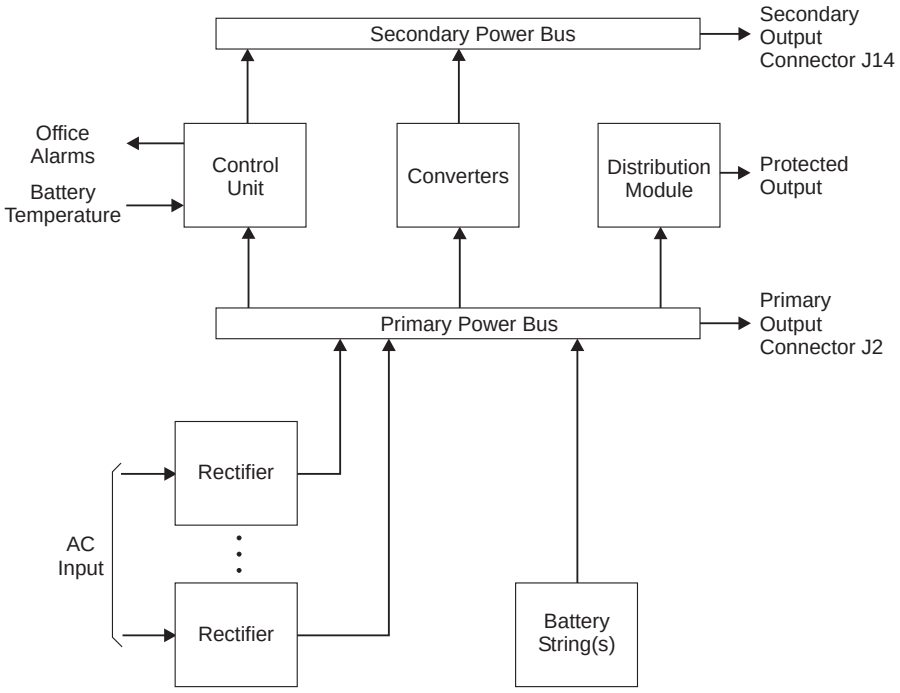


Figure 2-2: Block Diagram of -48V CPS Without LVD Contactor

Shelf Design

Features

The shelf is available in the 23" standard width and has the following features:

- Accepts plug-in modules, such as rectifiers, converters, ringers, and control units, which simplifies plant assembly and repair.
- Accepts up to five power slots per shelf.
- Accepts converters or ringers from the primary output bus as needed.
- Provides both primary and secondary outputs.
- Provides a built-in distribution that will accept distribution modules in any of the power slots.
- Permits growth of plant capacity and easy maintenance without service interruption.
- Provides keying to prevent improper insertion of incompatible modules.

Figure 2-3 illustrates the shelf design and location of the modules.

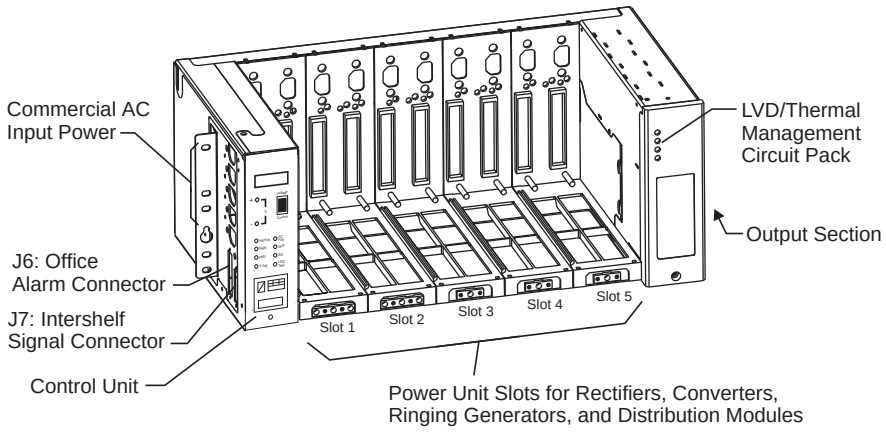


Figure 2-3: CPS Shelf

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.

Example

Figure 2-4 is an example of a two-shelf rectifier-converter plant. This system is appropriate for applications where battery-backed -48V power is required for one load and regulated 130-volt power is needed for a second load; e.g., T1 circuits in a customer premises application. In this example, ES660 or ES660C rectifiers operating from commercial ac source voltages provide the -48V output and furnish the input for the converters.

To accommodate dual output applications, as in this example, -48V CPS shelves are equipped with two power buses. A primary bus serves the rectifier outputs and a secondary bus serves either ringer or converter outputs.

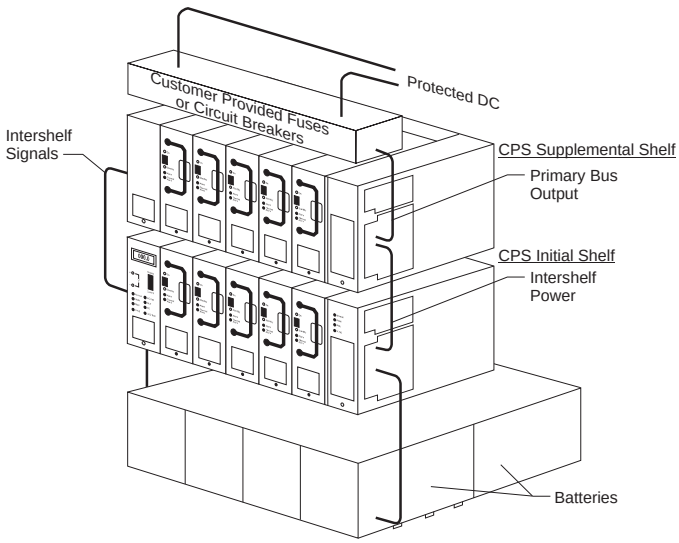


Figure 2-4: Two-shelf Rectifier/Converter Plant

Configurations

Introduction

The -48V CPS provides the facilities to combine rectifiers, converters, ringing generators, monitor and control units, a low-voltage battery disconnect feature, battery protection circuits, and input and output distribution in a single shelf. The -48V CPS is available in four configurations, which are described below.

Rectifier Plant

The **rectifier plant** is capable of providing -48V power within the load range of zero to 75 amperes in a one-shelf plant or zero to 150 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.

Rectifier/Converter Plant

The **rectifier/converter plant** has -48V rectifiers that can provide load power and power to operate converters capable of providing 24 volts at 25 amperes per converter or 130 volts at 4 amperes per converter. The rectifiers provide input power for converters whose outputs are provided on the secondary output bus. Methods of determining the number of rectifiers and converters required to meet load, redundancy, and reserve time requirements are discussed in Section 3.

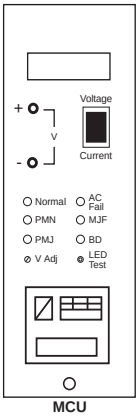
Converter Plant

The **converter plant** is powered from an external -48V source. In this configuration, the converters operate from the primary power bus and provide outputs on the secondary power bus. The plant input is provided on the primary bus bulk output terminals. Restrictions on current capacity of the secondary bus limits the secondary output.

Control Units

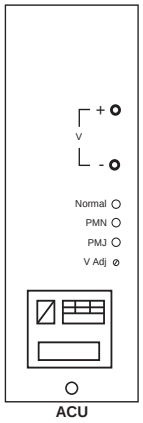
Overview

Included in single-shelf plants or in the initial shelf of two-shelf plants is **either**:



a Monitor and Control Unit (ES646, ES646B, ES648A, ES648B, ES648C, or ES648BZ)

or



an Alarm Control Unit (ES647)

These units provide plant monitoring and control features as well as office alarm outputs from rectifiers.

ES647 Alarm Control Unit

Alarms only are provided for converters or ringers in combination plants or for converters in converter plants. The ES647 Alarm Control Unit (ACU) offers a reduced feature set, providing an economical alternative to the Monitor and Control Units.

Alarm Control Unit features are listed below:

- 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

Control Units, continued

ES646, ES646B, ES648A/B/C/BZ MCUs

All Monitor and Control Units (MCU) provide plant monitoring, display and control features, and office alarm outputs. **The difference between MCUs is the alarm scheme and how the alarms are presented to the user.** This difference in alarm schemes is summarized in Table 7-H.

All MCUs offer the following features:

- Digital meter that displays plant rectifier voltage or current (switch-selectable)
- 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 installed rectifiers and converters and incorporates this information into plant power minor or power major alarms
- LED test switch that activates all plant LEDs
- Capability of remote On/Standby control that is "passed-on" to installed power modules
- 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

ES648A/B/C MCUs Only

- Option to boost charge the batteries after the plant has experienced a battery on discharge event
- Option to set boost voltage value
- Local control available via RS-232 or RS-485 connections
- Remote access via an external modem

ES648BZ MCU

- Features and functionality are identical to the ES648B MCU.
- Remote access is available via an internal modem supporting an RJ-11 telephone line connector.

Control Units, continued

Alarm Reporting

Alarm reporting for the -48V CPS plant is typical of telecommunication battery plants. Alarms are categorized as Power Major (PMJ), indicating service-affecting problems, or Power Minor (PMN), suggesting the problem may become service-affecting if additional problems occur.

Section 7, *Alarms, Controls, and Displays*, provides additional information about the system alarms.

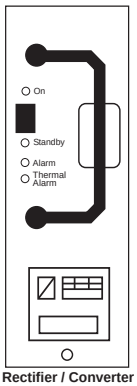
Remote Access and Control

The ES648 MCU provides remote access and control. The modem option will support remote access to plant status indication, remote plant voltage adjustment, and remote execution of Plant Battery Test (PBT) or rectifier On/Standby.

Refer to Section 6, *Remote Access and Control*, for the installation and configuration of the remote access feature of the ES648 MCU.

Power Modules

Overview



Rectifier / Converter

-48V CPS rectifiers and converters 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. For converters, the signal interface with the control unit provides alarm monitoring but does not allow voltage adjustment.

ES660 and ES660C Rectifiers

- The ES660 rectifier provides an output of 12.5 amperes at 54.5 volts.
- The ES660C rectifier provides an output of 15.0 amperes at 54.5 volts.

ES680 and ES681 Converters

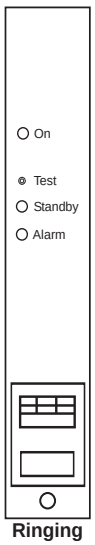
- The ES680 converter converts 48Vdc to 130Vdc at 4 amperes.
- The ES681 converter converts 48Vdc to 24Vdc output at 25 amperes.

Note: Alternative voltages are available under certain conditions.

Power Modules, continued

Ringing Generators

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



Ringing Generator

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 GE Critical Power Type-3 Ringing Generators. CPS ringers feature a unique self-contained ring switch unit that automatically detects a failed ringing generator and switches the on-line spare into active service.

Ringing 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 ringing power of the ringing generators.

Table 2-A: CPS4000 Ringing 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
*Provides EMI protection for Class B installations.								

Power Modules, continued

Ringing Generators, continued

Two CPS ringing generators installed in a single-shelf plant provide redundant ringing power. Two- and three-shelf plants offer additional ringing capacity with up to two ringing generators in each shelf. Intershelf signal cable adaptor, comcode 847922135, is to be installed at J7 on each supplementary shelf that has ringers present. This cable is to be used in conjunction with the two- or three-shelf cable assemblies. The output ringing power on each shelf is provided on connector J14, and is electrically isolated from the output ringing power of the other shelves and from frame ground. Either one of the outputs at J14 may be connected to frame ground to reference the ringing voltage to frame ground.

Caution

Do not parallel the output ringing power of a multi-shelf plant together. Ringer damage may result.

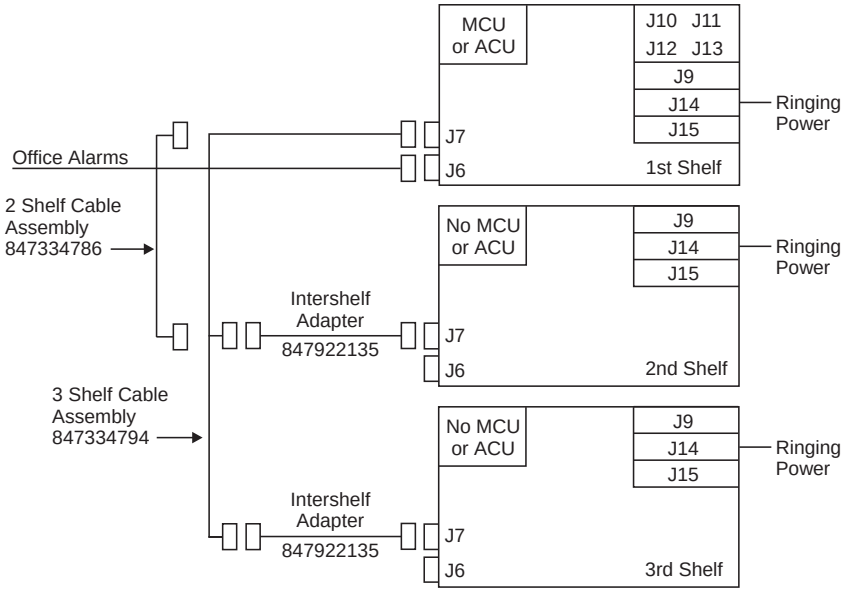


Figure 2-5: Intershelf Adapter Cables

Power Modules, continued

Features

The following paragraphs describe standard features of the -48V CPS power modules.

- **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.
- **Backward compatible:** The CPS4000+ modules are unconditionally compatible with the existing embedded CPS4000 products. The CPS4000+ modules can be added to existing systems to provide partial benefits of the CPS4000+ enhancements.
- **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, the Monitoring and Control Units (MCU), and the Alarm Control Unit (ACU) indicate system status.
- **LED test:** A push-to-test switch on the plant Monitor and Control Unit activates all plant alarm and status LED indicators.
- **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 MCU or ACU. In addition, alarms are generated by a high module temperature and/or an operated internal fuse.

- **Thermal alarm**: The -48V CPS rectifiers and converters 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 B Installations:** CPS4000+ components, including the ES648C Monitor and Control Unit, the ES660C rectifier, ES622C ringing generator, and the J85500R-1 shelf, provide EMI protection for use in a Class B 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

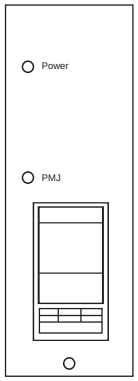
  A service entrance surge protector is recommended in cabinet applications. (See IEEE C62.41-1991 for location Category C and high system exposures.) The service entrance protection should be coordinated with the protection provided in the rectifier.

Plug-in Distribution Modules

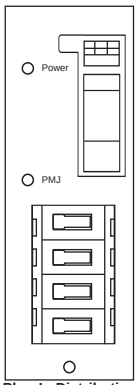
Introduction

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 or ES613



ES611



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.

Module Compatibility

Overview

The flexibility of the -48V CPS system is based on the ability to mix physically similar modules in the same shelf assembly. These modules are keyed to prevent incompatible modules from being installed in the same shelf. As an additional aid, labels on the modules are coded using symbols, colors, and alpha-numeric designations to allow a visual check of module compatibility.

Keying System

The keying system depends on coded keying brackets installed in the power modules and corresponding keying strips installed in the shelf assemblies. Control units are keyed using tabs on the control unit circuit pack and pins on the keying strip.

Symbols

Symbols on module labels indicate each module's input and/or output and its functional classification. Colors indicate compatible voltages, and alpha-numeric codes are used to show voltage and current levels as well as functional classifications.

Step vs. Slope Module Compatibility

Matching Control Units With LVD/ Thermal Units

In a -48V plant, keying does not prevent mixing control units and LVD/ thermal boards with different temperature compensation conventions in the same plant; that is, using slope compensation units with those equipped with step compensation. This allows units in the field to be upgraded from step to slope compensation without modification to the CPS shelf.

Table 2-B matches control units with the proper LVD/thermal unit.

Table 2-B: Slope Module Matrix

	Control Units	LVD/Thermal Unit
Slope Compensation	ES646 ES646B ES647	BSP2[1]
	ES648A ES648B ES648C ES648BZ	BSP2C[1]
Step Compensation[2]	ES640[2] ES640A[2] ES641[2]	BSB1[2]

[1]BSP2 and BSP2C are compatible with ES646, ES646B, ES647, and ES648 controllers.

[2]The step function thermal compensation has been discontinued and should not be used in equipment currently being manufactured. The step function units have been discontinued and are no longer available. Step function equipment is not compatible with currently manufactured equipment.

Step vs. Slope Module Compatibility, continued

Mixing Step and Slope Units

Table 2-C outlines the results of mixing slope-compensated units and step-compensated units in a -48V CPS plant.

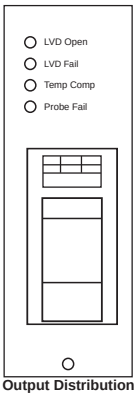
Table 2-C: Step/Slope Compatibility

LVD/ Thermal Unit	Control Unit	Result
Step	Step	Step compensation provided.
Slope	Step	Constantly in step temperature. Plant voltage cannot be adjusted above 54.0 volts. Plant will register a PMJ (Power Major) alarm at 65°C.
Step	Slope	No temperature compensation is provided. Control unit will register a PMJ (Power Major) alarm at 42°C, indicating a mismatch of units.
Slope	Slope	Slope compensation provided.

Output Distribution

Overview

The Output Distribution contains the following:



Output Distribution

- 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)
  - Low temperature 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 7 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
- LED test power for up to four J85504D-1 Battery Modules
- A low-voltage disconnect contactor (100A for single-shelf plants or 150A for multiple-shelf plants) 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 7-2). This is the factory-set NAFTA Thermal Management Mode System for North America only. This feature is provided with ES646, ES646B, ES647, ES648A/B/C/BZ control units and all ES660 and ES660C rectifiers. This feature compensates the battery float voltage over the temperature range of +25°C to +75°C.

CPS4000+ offers an optional extended range slope thermal compensation (EURO Mode). The EURO Mode slope thermal compensation is a switch-selectable option, with the NAFTA Mode as the factory set standard. Available in plants with an ES648 MCU and **only** ES660C rectifiers, this thermal management feature compensates the battery float voltage over the temperature range of -20°C to +75°C. This option will provide a higher float voltage for temperatures below 20°C. By boosting the float voltage as battery temperatures decrease, the battery capacity reduction at low temperatures can be minimized.

Caution

Using a mixture of ES660 and ES660C rectifiers in a shelf with a new control unit that is set to the EURO mode will cause the ES660 rectifiers to go into a high voltage shutdown.

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 or +24Vdc 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 GE Critical 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.

IR30/IR40 Batteries

Up to four J85504D-1 IR battery modules may be connected directly to a -48V CPS shelf. These modules interface with the CPS Bulk Distribution Unit to provide the low-voltage disconnect and battery thermal monitoring features inherent in the CPS plant. J85504D-1 battery modules include the following:

- Space for two -48V battery strings of IR30or IR40 batteries
- Output fusing (with fuse alarm signalling) at 40 amperes per J85504D-1 module
- Battery interconnection
- Thermistor assembly (847050010)
- Alarm wire set (847157674)
- Temperature wire set (847157716)

Specifications

Introduction Tables 2-D through 2-P list the specifications for the 48V CPS4000 and CPS4000+ systems.

Electrical

Table 2-D: -48V CPS4000/CPS4000+ Electrical Plant Specifications

Plant	One, two, or three shelves per plant One initial shelf per plant One or two supplementary shelves per plant
Power Slots	Five power slots per shelf; maximum of 15 power slots per plant
Power Units	One rectifier or one converter per power slot; maximum of five per shelf or 15 per plant. Two ringers per power slot in only one slot per shelf; maximum of two ringers per shelf or six per plant
Plant Architecture	**Primary output**: One primary output power bus per shelf; maximum output capability of 75 amperes per shelf or 150 amperes per plant **Secondary output**: One secondary output power bus per shelf; maximum output of 50 amperes per shelf or 150 amperes per plant
Rectifier Input Distribution	Separate ac feed provided to each power slot or two ac inputs per shelf; one to power slots 1, 3, and 5 and one to power slots 2 and 4 or one ac input for each shelf distributed to all slots (Note 1)
Converter/Ringer Input Distribution	Primary output bus provides input power for converter or 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 converter or ringer output

continued on next page

Table 2-D: -48V CPS4000/CPS4000+
Electrical Plant Specifications (continued)

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 2)
Maximum Discharge Current	85 amperes per shelf; 170 amperes per plant (Note 3)
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). 100A internal contactor for single-shelf plants or 150A external contactor for two- and three-shelf plants
Operating Ambient Temperature	-40° to 149° Fahrenheit (-40° to 65° Celsius) (Note 4)
Altitude	-200 to 13,000 feet (-61 to 3962 meters) (Note 5)
Humidity	10-95% non-condensing
Audible Noise	65 dBA measured 2 feet (0.6 meters) from the plant
Radiated and Conducted Emissions (Note 6)	CPS4000: FCC Part 15, Class A EN55022 (CISPR22), Class A
	CPS4000+: FCC Part 15, Class B EN55022 (CISPR22), Class B
Harmonics (Note 6)	EN61000-3-2 (IEC61000-3-2)
Voltage Fluctuations (Note 6)	EN61000-3-3 (IEC61000-3-3)
Electromagnetic Immunity	Meets Telcordia GR-1089 CORE
Electrostatic Discharge (Note 6)	EN61000-4-2 Level 3
RF Immunity (Note 6)	IEC61000-4-3
EFT (Note 6)	IEC61000-4-4
Surge (Note 6)	IEC 61000-4-5
Earthquake Rating	Zone 4, upper floors

continued on next page

Table 2-D: -48V CPS4000/CPS4000+
Electrical Plant Specifications (continued)

Safety Agency Approvals	Underwriters Laboratories (UL) Listed per Subject Letter 1801: Power Distribution Center for Communications Equipment Shelves equipped with AMP MATE-N-LOCK type ac input connectors are UL Recognized components under Subject 1801 for use in enclosed equipment cabinets.
	CPS4000+: VDE Certification to EN60950 (except converter configurations) VDE licensed to VDE0805/EN60950 – see Note 6
	Rectifiers, Converters, and Ringers 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 7 Low Voltage Directive 73/23/EEC as amended by Marking Directive 93/68/EEC – see Note 6
Remote Access Product Certification	FCC Part 68 Regulatory Statement CS-03 Canadian Certification See Note 8.

Note 1: Shelves equipped with one or two ac input feeds are limited to operation at 180 to 264Vac.

Note 2: 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.

Note 3: LVD protection per plant is limited to 150 amperes.

Note 4: CPS can withstand temporary fluctuations in temperature up to 75°C (167°F).

Note 5: 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.

Note 6: Only the J85500R-1 L4 with (L21, L21B, 22, 22B, 25, 25B, 25R, 25RB, 26, 26B) and (any output assembly list option from Table 3-A) has been evaluated to the IEC/EN Standards and are CE Marked.

Note 7: 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. CPS4000+ is a Class B EMC product.

Note 8: Refer to Appendix A for the FCC Part 68 Regulatory Statement, Industry Canada Certification, and European Union Statement.

Physical

Table 2-E: -48V CPS4000/CPS4000+
Physical Specifications

Rectifier/Converter	Height: 8.75 inches Width: 3.2 inches Depth: 10.75 inches Weight: 10 pounds (maximum)
Shelf	Height: 8.75 inches Width: 21.5 inches Depth: 12 inches Weight: 35 pounds
Single shelf equipped with five rectifiers	Weight: 85 pounds (maximum)
J85504D-1 Module with IR-30 Batteries	Height: 9 inches without batteries Width: 21.5 inches Depth: 13 inches Weight: 17 pounds
J85504D-1 Module with IR-40 Batteries	Height: 9 inches without batteries Width: 21.5 inches Depth: 20 inches Weight: 18 pounds
Batteries: IR-30EC IR-40C	 Weight: 21 pounds each Weight: 32 pounds each
Frame Mounting Requirements	Standard 23 and 26 inch relay racks: Vertical mounting centers: 1.0 inch and 1.75 inches. Horizontal mounting centers: 22.32 inches

Rectifier Plant

Table 2-F: Rectifier Plant Specifications

	CPS4000	CPS4000+
Power Units	ES660 and ES660C rectifiers; maximum of five units per shelf or 15 units per plant	ES660 and ES660C rectifiers; maximum of five units per shelf or 15 units per plant
Control Unit	MCU: ES646, ES646B, ES648A, ES648B, ES648C, ES648BZ ACU: ES647	MCU: ES646, ES646B, ES648A, ES648B, ES648C, ES648BZ ACU: ES647
Nominal Output Voltages	48/52/54.5Vdc	48/52/54.5Vdc
Operating Voltage Range	48-56Vdc (54.5Vdc - ES660)	48-56Vdc (58.1Vdc - ES660C)
Maximum Output Current	75 amperes per shelf (Note 2) 150 amperes per plant (see Note 1)	75 amperes per shelf (Note 2) 150 amperes per plant (see Note 1)
Nominal Input Voltage	100/120/200/208/240Vac	100/120/200/208/240Vac
Input Voltage Ranges	90-132Vac 180-264Vac	90-132Vac 180-264Vac
Maximum Input Current per Rectifier	ES660 Float Mode: 3.3 amperes @ 240Vac 4.6 amperes @ 180Vac 6.9 amperes @ 120Vac 9.7 amperes @ 90Vac ES660C Float Mode: 4.0 amperes @ 240Vac 5.3 amperes @ 180Vac 8.1 amperes @ 120Vac 10.9 amperes @ 90Vac	ES660C Float Mode: 4.0 amperes @ 240Vac 5.3 amperes @ 180Vac 8.1 amperes @ 120Vac 10.9 amperes @ 90Vac ES660C Boost Mode: 4.2 amperes @ 240Vac 5.7 amperes @ 180Vac 8.7 amperes @ 120Vac 11.6 amperes @ 90Vac

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Table 2-F: Rectifier Plant Specifications (continued)

	CPS4000	CPS4000+
Boost Voltage	N/A	58.1Vdc (using ES660C rectifier)
Efficiency	86% typical	88.5% (using ES660C rectifier)
Output Voltage Regulation	±0.5%	±0.5%
Output Noise: Wideband Noise (Ripple) Electrical Noise	 100 millivolts peak to peak maximum, over the range 10 Hz to 20 MHz <32 dBrnc	 100 millivolts peak to peak maximum, over the range 10 Hz to 20 MHz <32 dBrnc
Load Share Accuracy	1.25 amperes	1.50 amperes (maximum)
Maximum Discharge Current	85 amperes per shelf 170 amperes per plant	85 amperes per shelf 170 amperes per plant
Maximum Recharge Current	Installed rectifier capacity minus plant load	Installed rectifier capacity minus plant load
Low-Voltage Disconnect	40.5 ±0.5 volts or 42 ±0.5 volts	40.5 ±0.5 volts or 42 ±0.5 volts
Heat Dissipation	111 watts (380 BTU/hour) maximum per ES660 rectifier (Note 3)	106 watts (363 BTU/hour) maximum per ES660C rectifier
Power Factor	>0.98 for loads >60% of full load	>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 with ES660C rectifiers only. Note 3: Input current specified at input voltage of 240 volts, an output of 54.5V and 12.5A, and efficiency of 86%.		

Rectifier-Ringer Plant

Table 2-G: Rectifier-Ringer Plant Specifications

Power Units	ES660, ES660C rectifiers; maximum of four per shelf or nine 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	MCU: ES646, ES646B, ES648A, ES648B, ES648C, ES648BZ ACU: ES647
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)

Rectifier-Converter Plant

Table 2-H: Rectifier-Converter Plant Specifications

Power Units	ES660, ES660C rectifiers; maximum of four per shelf or nine per plant ES680 converters; maximum of five per shelf or ten per plant; maximum of 20 amperes per shelf ES681 converters; maximum of 50 amperes per shelf Note: Primary bus feeds converters; subtract from primary bus capacity.
Control Unit	MCU: ES646, ES646B, ES648A, ES648B, ES648C, ES648BZ ACU: ES647
Primary Bus Output	The CPS4000 primary bus output current capacity is reduced by 12.5 amperes for each active converter installed. The CPS4000+ primary bus output current capacity is reduced by 15 amperes for each active converter installed.
Secondary Bus	24Vdc or 130Vdc
Output Voltage	ES680: 130Vdc ES681: 24Vdc
Max. Output Current	ES680: 20 amperes per shelf ES681: 50 amperes per shelf
Nominal Input Voltage	48/52/54Vdc
Input Voltage Range	38-60Vdc
Max. Input Current	ES680: 16 amperes per converter ES681: 18 amperes per converter
Efficiency	ES680: 86% typical ES681: 84% typical* *The maximum current capacity of the secondary output bus is 50 amperes. Two ES681 converters operating at full-load may be installed in a -48V CPS shelf or three may be installed in a N+1 redundant configuration.
Voice-band Noise	ES680: <32 dBrnc ES681: <32 dBrnc
Load Share Accuracy	ES680: 0.4 amperes ES681: 2.4 amperes

Converter Plant

Table 2-I: Converter Plant Specifications

Power Units	ES680; maximum of five per shelf or 10 per plant ES681; maximum of two per shelf or 4 per plant
Control Unit	MCU: ES646, ES646B, ES648A, ES648B, ES648C, ES648BZ ACU: ES647
Primary Bus	Required for input power via the primary bus bulk connections
Secondary Bus	24Vdc or 130Vdc
Output Voltage	ES680: 130Vdc ES681: 24Vdc
Max. Output Current	ES680: 20 amperes per shelf ES681: 48 amperes per shelf
Nominal Input Voltage	48/52/54Vdc
Input Voltage Range	38-60Vdc
Input Current	Typical: ES680: 12.5 amperes per converter ES681: 12.5 amperes per converter Maximum: ES680: 16 amperes per converter (Note 1) ES681: 18 amperes per converter (Note 2)
Efficiency	ES680: 86% typical ES681: 84% typical
Voice-band Noise	ES680: <32 dBrnc ES681: <32 dBrnc
Load Share Accuracy	ES680: 0.4 amperes ES681: 2.4 amperes
Operating Ambient Temperature	-40°F to 149°F (-40°C to 65°C) CPS plant can withstand temporary fluctuations in temperature up to 167°F (75°C)
Note 1: Input current specified at input voltage of 54.5 volts, an output of 130 volts and 4 amperes and efficiency of 86%. Note 2: Input current specified at input voltage of 54.5 volts, an output of 24 volts and 24 amperes and efficiency of 84.5%.	

ES660 Rectifier

Table 2-J: ES660 Rectifier Specifications

Nominal Output Voltage	48/52/54.5Vdc
Operating Output Voltage Ranges	48-56Vdc (Note 5)
Output Current	0-12.5 amperes
Nominal Input Voltage	100/120/200/208/240Vac
Input Voltage Ranges	90-132Vac 180-264Vac
Operating Frequency Range	47-63Hz
Input Current	3.3 amperes @ 240Vac (Note 1) 6.9 amperes @ 120Vac (Note 2) 4.6 amperes @ 180Vac (Note 3) 9.7 amperes @ 90Vac (Note 4)
Efficiency	86% typical @ 208/240Vac
Output Voltage Regulation	±0.5%
Output Noise: Wideband Noise (Ripple) Electrical Noise	 100 millivolts peak to peak maximum, over the range 10 Hz to 20 MHz <26 dBrnc
Load Share Accuracy	1.25 amperes
Heat Dissipation	111 watts (380 BTU/hr) maximum (Note 1)
Power Factor	>0.98 for loads > 60% full load
Total Harmonic Distortion	<15% for loads > 60% full load
Selective High-Voltage Shutdown	Above 55.5 volts for 3 seconds
Backup High-Voltage Shutdown	Above 60Vdc for 100 milliseconds
Note 1: Input current specified at input voltage of 240 volts, an output of 54.5 volts and 12.5 amperes and efficiency of 86%. Note 2: Input current specified at input voltage of 120 volts, an output of 54.5 volts and 12.5 amperes and efficiency of 82%. Note 3: Maximum input current specified at input voltage of 180 volts, an output of 54.5 volts and 12.5 amperes and efficiency of 84%. Note 4: Maximum input current specified at an input voltage of 90 volts, and output voltage of 54.4 volts and 12.5 amperes and efficiency of 78%. Note 5: Adjustment above 54.5Vdc only for testing over-voltage shutdown.	

ES660C Rectifier

Table 2-K: 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) 8.1 amperes @ 120Vac (Note 3) 10.9 amperes @ 90Vac (Note 4)
Input Current (Boost Mode) (58.1Vdc output)	4.2 amperes @ 240Vac 5.7 amperes @ 180Vac 8.7 amperes @ 120Vac 11.6 amperes @ 90Vac
Operating Frequency Range	47-63Hz
Efficiency	88% typical @ 208/240Vac (Notes 1 and 5)
Output Voltage Regulation	±0.5%
Output Noise: Wideband Noise (Ripple) Electrical Noise	 100 millivolts peak to peak maximum, over the range 10 Hz to20 Mhz <26 dBrnc
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: Input current specified at input voltage of 120 volts, an output of 54.5 volts and 15.0 amperes and efficiency of 84%.
Note 4: Maximum input current specified at an input voltage of 90 volts, and output voltage of 54.5 volts and 15.0 amperes and efficiency of 83%
Note 5: 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 x 15A)/(240V x 4A) = 0.90%

ES680 Converter

Table 2-L: ES680 48/130V Converter Specifications

Nominal Output Voltage	132Vdc
Output Current	0 - 4 amperes
Nominal Input Voltage	48/52/54.5Vac
Input Voltage Ranges	38 - 60Vdc
Input Current	11.3 amperes (Note 1) 26.0 amperes (Note 2)
Efficiency	86% typical @ 54.5Vdc
Output Voltage Regulation	±3.5%
Output Ripple	150 millivolts peak to peak maximum, over the range 10 Hz to 20 MHz
Output Noise	<32 dBrnc
Load Share Accuracy	0.3 amperes maximum
Heat Dissipation	86 watts (294 BTU/hr) maximum (Note 1)
High-Voltage Shutdown	146Vdc
Operating Ambient Temperature	-40°F to 149°F (-40°C to 65°C) CPS plant can withstand temporary fluctuations in temperature up to 167°F (75°C)
Note 1: Input current specified at input voltage of 54.5 volts, an output of 132 volts and 4 amperes and efficiency of 86%. Note 2: Input current specified at input voltage of 38 volts, an output of 132 volts and 4 amperes and efficiency of 85%.	

ES681 Converter

Table 2-M: ES681 48/24V Converter Specifications

Nominal Output Voltage	24Vdc
Output Current	0 - 25 amperes
Nominal Input Voltage	48/52/54.5Vac
Input Voltage Ranges	38 - 60Vdc
Input Current	13.1 amperes (Note 1) 19.0 amperes (Note 2)
Efficiency	84% typical @ 54.5Vdc
Output Voltage Regulation	±3.5%
Output Ripple	150 millivolts peak to peak maximum, over the range 10 Hz to 20 MHz
Output Noise	<32 dBrnc
Load Share Accuracy	2.5 amperes maximum
Heat Dissipation	114 watts (390 BTU/hr) maximum (Note 1)
High-Voltage Shutdown	26.5Vdc
Operating Ambient Temperature	-40°F to 149°F (-40°C to 65°C) CPS plant can withstand temporary fluctuations in temperature up to 167°F (75°C)
Note 1: Input current specified at input voltage of 54.5 volts, an output of 24 volts and 24 amperes, and efficiency of 84%. Note 2: Input current specified at input voltage of 38 volts, an output of 24 volts and 25 amperes, and efficiency of 83%.	

Ringing Generators

Table 2-N: 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-O: ES646, ES646B, ES647, ES648A, ES648B, ES648C, and ES648BZ Control Unit Specifications

Operating Input Voltage Range	38 - 60Vdc (ES646, ES646B, ES647) 19 - 60Vdc (ES648A/B/C/BZ)
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

Display Meters

Table 2-P: ES646, ES646B, ES648A, ES648B, ES648C, and ES648BZ Display Meter Specifications

LCD	3.5 inch backlit
Range	0 to 72 volts (voltmeter)
Range	0 to 450 amperes (ammeter)
Voltage Accuracy	± 1% of reading
Current Accuracy	± 2% of reading ± 1.0 ampere
Voltage Resolution	0.1 volt
Current Resolution	ES646: 0.1 ampere ES648: 1.0 ampere
Output 2 Current Monitor	1mV per ampere ±1.5%
Datalogger Output Voltage	0 to 6 volts (1 volt per 25 volts)
Datalogger Output Voltage Accuracy	± 1% of reading
Datalogger Output Current	0 to 9 volts (1 volt per 25 amperes)
Datalogger Output Current Accuracy for 48V Application	± 2% of reading ± 1.0 ampere
Note: The ES646 and ES646B control units are being superseded by ES648A and ES648B control units, respectively.	

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

mirc = abh + recharge current

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

mirc = abh x recharge factor

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

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 20% of the rated load.

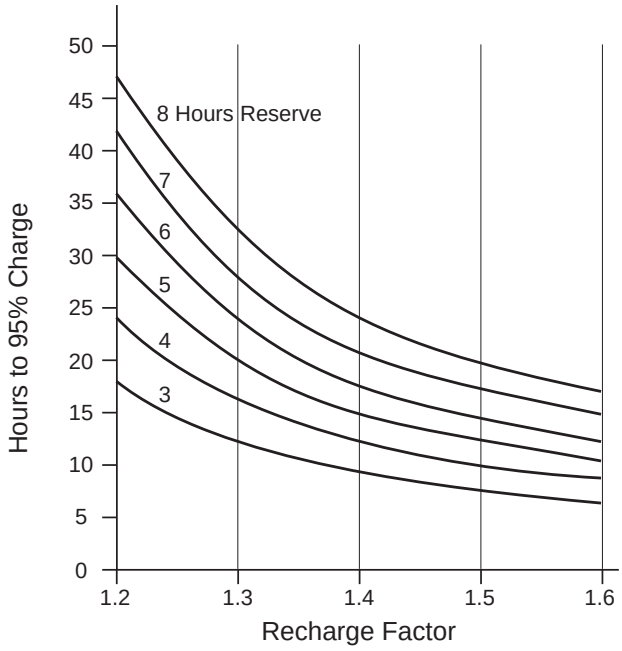


Figure 3-1: Recharge Factor vs. Recharge Time

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 12.5A or 15A rectifiers required for non-redundant systems.

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

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

   Four 12.5A rectifiers (46.9/12.5 = 3.8) or 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 12.5 rectifier fails, the remaining rectifiers will not provide the abh capacity, and one additional 12.5A rectifier must be added to complete a 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 12.5A rectifiers required for non-redundant and redundant systems. From Figure 3-1, the recharge factor is approximately 1.25.

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

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

Engineering Information, continued

Battery Sizing Considerations

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

Figure 3-1 illustrates several general guidelines for choosing the recharge factor.

- A minimum recharge factor of approximately 1.2 is required to recharge the battery effectively.
- As the reserve time increases, the recharge factor required to maintain a given recharge time must also increase.
- Continuing to increase the recharge factor above approximately 1.4 does not significantly reduce the recharge time.

Rectifier/Converter Sizing

ES660 and ES660C rectifiers having different output current capacities can be mixed in the same battery plant.

Note

These notes describe plants using fully loaded converters. Using partially loaded converters may divide the primary bus load between the converter inputs and primary bus output.

In most configurations two rectifiers are required to start one converter, which is providing constant-power loads typical of telecommunications applications. Two rectifiers are required for continued operation of one converter. A third rectifier becomes the redundant rectifier in an N+1 rectifier plant. For plant configurations with redundant rectifiers and redundant converters, the number of installed converters is twice the number of installed rectifiers.

For applications requiring four fully loaded converters in batteryless plants, two additional rectifiers may be required to start the system. For applications requiring an external load on the primary bus, an additional rectifier must be added to supply this load and continue to maintain an N+1 system configuration.

Ordering Information

List Numbers

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

- **List 1** provides a dual dc output CPS shelf with a primary output of 48 volts and a secondary output of 24 volts.
- **List 2** provides a dual dc output CPS shelf with a primary output of 48 volts and a secondary output of 130 volts.
- **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-1 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-1 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 the configured systems in Table 3-B using comcodes.
- Order rectifiers, converters, other plug-in modules, and miscellaneous equipment from Table 3-C.
- Order fuses, circuit breakers, and lug kits from Table 3-D.
- Order cable assemblies for input, output, and office alarm connections from Tables 3-E and 3-G. The tables include both the GE Critical Power kit and the commercial equivalent.
- Tables 3-F and 3-H 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
-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 1-4 provide keying functions to prevent insertion of incompatible power units. Select a list appropriate to the power units required.	
1	Output 1: -48Vdc, 75 amperes maximum (using ES660C rectifiers only) Output 2: 24Vdc, 50 amperes maximum Arranged for the following apparatus codes: ES660 and ES660C 48V rectifier ES681 48/24V converter ES610 48V fuse distribution module ES611 48V circuit breaker/fuse distribution module See Note 2.
2	Output 1: -48Vdc, 75 amperes maximum (using ES660C rectifiers only) Output 2: 130Vdc, 22 amperes maximum Arranged for the following apparatus codes: ES660 and ES660C 48V rectifier ES680 48/130V converter ES610 48V fuse distribution module ES611 48V circuit breaker/fuse distribution module See Note 2.
3	Output 1: -48Vdc, 75 amperes maximum (using ES660C rectifiers only) Output 2: Ringing, 100VA maximum Arranged for the following apparatus codes: ES660 and 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.

continued on next page

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

List No.	Description
4	Output 1: -48Vdc, 75 amperes maximum (using ES660C rectifiers only) Output 2: none Arranged for the following apparatus codes: ES660 and ES660C 48V rectifier ES610 48V fuse distribution module ES611 48V circuit breaker/fuse distribution module See Note 2.
5 -20	Reserved.
AC input assemblies; one is always required per shelf unless otherwise noted. Each input assembly is arranged for ac input to the shelf, ES646, ES646B, ES648A/B/C/BZ MCUs, or ES647 ACU, office alarm output connection, and intershelf signal connection. See Note 3 for conditions of UL acceptability.	
21	AC input assembly **(initial shelf)** wired for and equipped with five pluggable 100-240Vac feeds that power each equipment unit slot separately (true n+1 redundancy). IEC 320 Type Connector. See Note 3.
21B	Same as List 21 except used for the second shelf in a multiple shelf plant. Not arranged for control unit or office alarm connections. IEC 320 Type Connector. See Note 3.
22	AC input assembly **(initial shelf)** wired for and equipped with one pluggable 200-240Vac feed common to all five equipment unit slots. Use only where ac wiring to the shelf is factory installed. AMP MATE-N-LOCK II Connector. See Notes 3, 4.
22B	Same as List 22 except used for the second shelf in a multiple shelf plant. Not arranged for control unit or office alarm connections. Use only where ac wiring to the shelf is factory installed. AMP MATE-N-LOCK II Connector. See Note 3.
23	Input assembly **(initial shelf)** without ac input feed for use with converter only shelf applications. See Note 3.
23B	Same as List 23 except used for the second shelf in a multiple shelf plant. Not arranged for control unit or office alarm connections. See Note 3.
25	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. Use only where ac wiring to the shelf is factory installed. AMP MATE-N-LOCK II Connector. See Notes 3, 4.
25B	Same as List 25 except used for the second shelf in a multiple shelf plant. Not arranged for control unit or office alarm connections. Use only where ac wiring to the shelf is factory installed. AMP MATE-N-LOCK II Connector. See Note 3.
25R	AC input assembly **(initial shelf)** wired for and equipped with two 10-ft, 3-10 gauge, 200-240Vac feeds extending from the rear of the shelf. One cable powers equipment unit slots 1, 3, and 5, the other, unit slots 2 and 4. Cable-end termination is by the customer. See Note 2 and 3.
25RB	Same as List 25R except used for the second shelf in a multiple shelf plant. Not arranged for control unit or office alarm connections. Cable-end termination is by the customer. See Note 2 and 3.

continued on next page

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

List No.	Description
26	AC input assembly **(initial shelf)** wired for and equipped with one 200-240Vac feed common to all five equipment unit slots for installation with ac wiring run in conduit. May be used where ac wiring to the shelf is field installed or factory installed. See Note 3.
26B	Same as List 26 except used for the second shelf in a multiple shelf plant. Not arranged for control unit or office alarm connections. May be used where ac wiring to the shelf is field installed or factory installed. See Note 3.
27-30	Reserved
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.	
31	Output assembly applicable for initial shelves with rectifiers without LVD or slope thermal management. See Notes 5 and 6.
32	Discontinued Availability
33	Discontinued Availability
34	Output assembly applicable to supplementary shelves in multiple shelf plants, initial shelves in systems operating without batteries, and to converter only shelves. Does not provide connection points for batteries or thermal probes. See Note 5.
35	Output assembly with 100 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. Applicable to single-shelf rectifier and rectifier/converter plants and the initial shelf in plants with rectifiers in the initial shelf only. Always includes a BSP2 or BSP2C board for LVD/slope thermal compensation. See Notes 5, 6, and 7.
36	Same as list 35 with a 150 ampere low-voltage contactor. Applicable to first shelf of multiple shelf plants with rectifiers in the first and second shelves. Always includes a BSP2 or BSP2C board for LVD/slope thermal compensation. See Notes 5, 6, and 7.
37	Same as list 31 but with slope thermal management. Applicable to single-shelf rectifier and rectifier/converter plants and the initial shelf in plants with rectifiers in the initial shelf only. See Notes 5 and 7.
38	Output assembly with BSP2C LVD/thermal management plus wireset 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. See Notes 2 and 10.
K3	Wire set and cable assembly for connecting three shelves in a three-shelf plant.
K4	Adaptor cable required for two-shelf plant where ringers are used in both shelves.

Ordering Information, continued

Table 3-A Notes

1. These tables describe the arrangement of the chassis assemblies.

List 1: 48V Primary Output, 24V Secondary Output (See Note 2)

Slot 1	Slot 2	Slot 3	Slot 4	Slot 5
ES660 and/or ES660C	ES660 and/or ES660C	ES660 and/or ES660C	ES681	ES681
Rectifier	Rectifier	Rectifier	Converter	Converter

List 2: 48V Primary Output, 130V Secondary Output (See Note 2)

Slot 1	Slot 2	Slot 3	Slot 4	Slot 5
ES660 and/or ES660C	ES660 and/or ES660C	ES660 and/or ES660C	ES680	ES680
Rectifier	Rectifier	Rectifier	Converter	Converter

List 2: 130V Secondary Output (Converter Only Shelf) (See Note 2)

Slot 1	Slot 2	Slot 3	Slot 4	Slot 5
ES680	ES680	ES680	ES680	ES680
Converter	Converter	Converter	Converter	Converter

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

Slot 1A	Slot 1B	Slot 2	Slot 3	Slot 4	Slot 5
ES620, ES620B, ES621, ES621A, ES621B, ES622B, or ES622C	ES620, ES620B, ES621, ES621A, ES621B, ES622B, or ES622C	ES660 and/or ES660C	ES660 and/or ES660C	ES660 and/or ES660C	ES660 and/or ES660C
Ringer	Ringer	Rectifier	Rectifier	Rectifier	Rectifier

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

Slot 1	Slot 2	Slot 3	Slot 4	Slot 5
ES660 and/or ES660C	ES660 and/or ES660C	ES660 and/or ES660C	ES660 and/or ES660C	ES660 and/or ES660C
Rectifier	Rectifier	Rectifier	Rectifier	Rectifier

Ordering Information, continued

Table 3-A Notes, continued

2. Shelf assemblies (Lists 1 - 4) provide keying functions to prevent insertion of incompatible power units. Select the appropriate list for your application.

3. Input assemblies (Lists 21 - 26) provide connection points 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.

4. Shelves equipped with the following lists are UL Listed: Lists 21, 21B, 23, 23B, 26, and 26B. Shelves equipped with Lists 22, 22B, 25, 25B, 25R, and 25RB are UL Recognized only when factory wired and mounted in enclosed equipment cabinets where installation and mounting are evaluated as part of the end product.

5. Output assemblies (Lists 31 - 36) provide connection points for batteries, primary and secondary outputs, and thermal probes. Some are equipped with low-voltage disconnect contactors.

6. The low-voltage disconnect feature requires an output list equipped with contactor and an LVD/thermal management board. Lists 35 and 36 include a BSP2 or BSP2C board for LVD/slope thermal compensation. The factory default setting for LVD is 42.5 volts.

7. 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.

8. 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

9. 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-D. The ES610 and ES613 require two kits per module. The ES611 requires only one kit per module.

10. Kit K2 provides cables and wire sets for output power (right side of shelf) and signal (left side of shelf) interconnection of two CPS shelves into a two-shelf plant. Kit K3 provides cables and wire sets for a three-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.

11. 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.

12. CPS shelves and related equipment mount in standard 23" equipment frames with 1" or 1 3/4" rack spaces.

13. Each CPS shelf/plant requires one Monitor and Control Unit (ES646, ES646B, ES648A, ES648B, ES648C, ES648BZ) or one ES647 Alarm Control Unit (ACU), or an alarm unit slot cover (847345576). An ACU slot cover is provided with List 23 only. One control unit mounted in the initial shelf monitors single-shelf as well as multiple-shelf plants. The ES640A, ES641, and the BSB1 LVD/thermal board support step battery thermal management. The ES646, ES646B, ES647, ES648A, ES648B, ES648C, ES648BZ, and the BSP2 or BSP2C LVD/thermal board provide slope battery thermal management. The factory setting for Battery on Discharge (BD) is preset at 51.0 volts.

Ordering Information, continued

Table 3-A Notes, continued

14. 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
15. Standard configured systems can be ordered using comcodes in Table 3-B.
16. Order rectifiers, converters, other plug-in modules, and miscellaneous equipment from Table 3-C.
17. Order fuses, circuit breakers, and lug kits from Table 3-D.
18. Order cable assemblies for input, output, and office alarm connections from Tables 3-E and 3-G. The tables include both the GE Critical Power kit and the commercial equivalent.
19. Tables 3-F and 3-H provide torquing information for input and output connections.

Ordering Information, continued

Configured Systems by Comcode

The following table shows complete systems orderable by comcode. Refer to Table 3-A for shelf, ac, and dc list descriptions..

Table 3-B: Configured Systems by Comcode

Shelf List	AC List	DC List	Comcode
L1	L21	L31	601451875
L1	L21	L35	601787757
L3	L21	L31	601451891
L3	L21	L35	601787773
L3	L21	L36	601787781
L3	L21B	L34	601803166
L3	L22	L35	108675000
L3	L25	L31	601783723
L3	L25	L34	601784465
L3	L25	L35	601797798
L3	L25	L36	601787799
L3	L25R	L36	108950999
L3	L25R	L37	107973174
L3	L25RB	L31	107973166
L3	L25RB	L34	109023002
L3	L26	L34	601787617
L3	L26	L35	601787807
L3	L26	L36	601787815
L3	L26B	L34	601803174

Ordering Information, continued

CPS Plug-in Modules and Miscellaneous Equipment

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

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

Unit	Apparatus Code	Comcode
48V, 15A Rectifier	ES660C	108286055
48/24V, 25A, Converter	ES681	107128571
Monitor and Control Unit (MCU)	ES648A	108344490
Monitor and Control Unit (MCU)	ES648B	108344508
Monitor and Control Unit (MCU) with Remote Access and Control Function	ES648BZ	108344524
Alarm Control Unit (ACU)	ES647	107335069
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
MCU/ACU Slot Cover	N/A	847345576
DC Fan Cradle Assembly	N/A	847244100
Internal Modem	EMC1	108284456
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-D.

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

Description	Comcode
AX1 1/4-ampere GMT type fuse	405006222
AX1 1/2-ampere GMT type fuse	406976894
AX1 1 1/3-ampere GMT type fuse	405673146
AX1 2-ampere GMT type fuse	405181983
AX1 3-ampere GMT type fuse	406976985
AX1 5-ampere GMT type fuse	406159061
AX1 7.5-ampere GMT type fuse	405725433
AX1 10-ampere GMT type fuse	406159236
AX1 12-ampere GMT type fuse	407845197
AX1 15-ampere GMT type fuse	406473959
Fuse Shield	405584335
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-E. The table includes both the GE Critical Power kit and the commercial equivalent.

Table 3-E: Input Assembly Hardware

List	Connector	Function	Mating Connection	
			GE Critical Power	**Commercial**
21, 21B	J1 - J5	Rectifier Input 100-120Vac (9A) 200-240Vac (4.5A)	847415825 Kit provides (5) 14 ft. ac cords with right angle plugs and wire ties. Order 1 kit per shelf. **-and-**	IEC 320 cord set with right angle on female end. Example: Power Dynamics 42R02-3212-150 right angle plug set.
		100-120Vac (9A)	847541638 Kit for use with 847415825 provides (5) NEMA 5-15 plugs for 120V service end termination **-or-**	(5) 5-15 NEMA plugs for 120V service
		200-240Vac (4.5A)	847541646 Kit for use with 847415825 provides (5) NEMA L6-15- plugs for 200-240V service end termination	(5) NEMA L6-15 plugs for 200-240V service end termination
22, 22B	J1	Rectifier Input	847415833 Kit provides (1) 30A input cord, 6 ft., consisting of (3) 10 ga wires in a Heyco 8478 flex conduit. 848651501 Kit provides (1) 30A input cord, 8 ft., consisting of (3) 10 ga wires in a Heyco 8478 flex conduit. Order 1 kit per shelf. (200-240Vac)	10 ga wire set equipped with (1) Amp 770018-10 housing, (3) Amp 193797-1 socket, (2) Amp 641945-1 strain relief, #6-32 x 3/8” type 8 SH screw, M310 Daniels crimping tool

Table 3-E: Input Assembly Hardware (continued)

List	Connector	Function	Mating Connection	
			GE Critical Power	**Commercial**
25, 25B	J1 - J2	Rectifier Input	847415833 Kit provides (1) 30A input cord, 6 ft., consisting of (3) 10 ga wires in a Heyco 8478 flex conduit. 848651501 Kit provides (1) 30A input cord, 8 ft., consisting of (3) 10 ga wires in a Heyco 8478 flex conduit. Order 2 kits per shelf. (Dual ac, 200-240Vac)	(2) 10 ga wire sets equipped with (1) Amp 770018-10 housing, (3) Amp 193797-1 socket, (2) Amp 641945-1 strain relief, #6-32 x 3/8" type 8 SH screw, M310 Daniels crimping tool
25R, 25RB	AC Input Wires	Rectifier Input	847439833 Kit provides (4) 10-12 ga insulated lugs. Order 1 WT1455 or ERG2001 tool separately. Order 2 kits per shelf.	Insulated, double crimped #8 ring-lug for 12 AWG wire, T&B RC10-10 or T&B RC363. Order 1 WT1455 or ERG2001 tool separately.
26	TB4	Rectifier Input	847439833 Kit provides (4) 10-12 ga insulated lugs. Order 1 WT1455 or ERG2001 tool separately. Order 1 kit per shelf.	Insulated, double-crimped #8 ring-lug for 12 AWG wire, T&B RC10-10 or T&B RC363. Order 1 WT1455 or ERG2001 tool separately.
21 - 26B	J7	Intershelf Signal Conn.	847409695 List K2 includes an intershelf jumper for a two-shelf plant. 847922135 List K4 includes an intershelf jumper for a two-shelf plant when ringers are used in both shelves.	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 553598-1 plug, (1) Amp 552723-2 retaining clip. Order Amp tool 229378-1.
31, 35, 36, 37	J10-13	Thermal probe	847198751 Thermistor kit provides (1) paddle type thermal probe with 5-foot connecting wire included. Optional kit. 4 kits per plant maximum.	Not available

Ordering Information, continued

Torque and Tool Information for Input Hardware

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

Connector	Comcode	Directions
TB4	847439833	Apply lugs using WT1455 or ERG2001 tool; torque TB4 lug to 20 inch•pounds ± 10%.
J6	847415874	Apply using Tyco Electronics tools R4623B, R5250, AMP tools 229378-1, 229764-2, or Tyco Electronics hand tool kit 900533027.

Output Assembly Hardware

Table 3-G: Output Assembly Hardware

List	Connector	Function	Mating Connection	
			GE Critical Power	Commercial
31 - 37	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
	TB3	Primary output bulk feed negative		
31, 36, 37	J14	Converter/ 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

Table 3-G: Output Assembly Hardware (continued)

List	Connector	Function	Mating Connection	
			GE Critical Power	Commercial
31 - 37	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.
21, 21B	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. or 848666921 Kit provides P6 plug and 150 feet of multicolored cable, cable routes down from connector or 848666905 Kit provides P6 plug and 25 feet of multicolored cable, cable routes down from connector. (1) kit optional per shelf.	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.
22, 23, 25, 26	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. or 848418216 Kit provides P6 plug and 150 feet of multicolored cable, cable routes up from connector or 848418851 Kit provides P6 plug and 25 feet of multicolored cable, cable routes up from connector. (1) kit optional per shelf.	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.

Table 3-G: Output Assembly Hardware (continued)

<table>
<tr><th rowspan="2">List</th><th rowspan="2">Connector</th><th rowspan="2">Function</th><th colspan="2">Mating Connection</th></tr>
<tr><th>GE Critical Power</th><th>Commercial</th></tr>
<tr><td rowspan="2">31-37</td><td rowspan="2">J15</td><td rowspan="2">Output 2 Current Monitor</td><td>847922077 kit provides (1) 15′ cable with connector for CPS4000+ shelf on one end and unterminated leads on the other end.
Connector:
<table><tr><th>Pos. No.</th><th>Color</th><th></th></tr><tr><td>1</td><td>BR</td><td>-48</td></tr><tr><td>2</td><td>BK</td><td>RTN</td></tr></table>Order (1) per rectifier output.
16 AWG wire</td><td>Molex plug
39-01-2025
Socket Terminal Type 5556
16 AWG 39-00-0079
18 AWG 39-00-0059
Order (2) sockets per plug.</td></tr>
<tr><td>848652442 kit provides (1) 15′ cable with connector for CPS4000+ shelf on one end and unterminated leads on the other end.
Connector:
<table><tr><th>Pos. No.</th><th>Color</th><th></th></tr><tr><td>1</td><td>BK</td><td>RTN</td></tr><tr><td>2</td><td>R</td><td>-48</td></tr></table>Order (1) per rectifier output.
16 AWG wire</td><td>Molex plug
39-01-2025
Socket Terminal Type 5556
16 AWG 44476-3111
Order (2) sockets per plug.</td></tr>
<tr><td>38</td><td>J26</td><td>External LVD Contactor Connector</td><td>This connector allows the CPS system controller to work with an external contactor. Ensure that contactor ratings are suitable for the application. Contact your GE Critical Power Field Representative if you have any questions.</td><td>Two-position AMP connector, 350777-1 with 350536-3 sockets. Two sockets required per plug. Use 20 AWG stranded wire, length to fit application.</td></tr>
</table>

Ordering Information, continued

Torque and Tool Information for Output Hardware

Table 3-H: 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 ±10%.
TB2, TB3	847398841	Apply lugs using T&B tool TBM5S; torque TB1 fasteners to 65 inch-pounds ±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-C are not long enough, order an extension cable from Table 3-J in addition to any of the thermal probes from Table 3-I.

Table 3-I: Thermal Probes

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

Table 3-J: Thermal Probe Cable Kits

Length	Comcode
5 feet	847172152
9 feet	847550175
17.5 feet	847548468

Ordering Information, continued

Sample Order

The order below is a sample order for a CPS4000 one-shelf -48V CPS plant with five ac inputs, three rectifiers, and one alarm unit. This plant does not have low-voltage disconnect or thermal management. This order does not include spares.

CPS4000 Sample Order

Quantity	Description
1	J85500R-1 L-4, 48V only chassis assembly equipped with:
1	L21 (5) ac input assembly
1	L31 output assembly without LVD
3	107076259 ES660 48V rectifiers
1	107138901 ES641 alarm control unit
1	107266397 ES610 distribution module

The order below is a sample order for a CPS4000+ one-shelf -48V CPS plant with two ac inputs, four rectifiers, two ringing generators, and one monitor and control unit. This plant has a low-voltage disconnect and thermal management. This order does not include spares.

CPS4000+ Sample Order

Quantity	Description
1	J85500R-1 L3 48V chassis assembly equipped for rectifiers-ringers
1	L25 (2) ac input assembly
1	L37 output assembly with LVD
4	ES660C 48V rectifiers
1	ES648A monitor and control unit
2	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-K contains recommended spare parts for the -48V CPS plant. One each is recommended for each service area.

Table 3-K: Recommended Spares

Unit	Apparatus Code	Comcode
-48V, 15A Rectifier	ES660C	108286055
48/130V, 4A Converter	ES680	107128563
48/24V, 25A Converter	ES681	107128571
Monitor and Control Unit (MCU)	ES648A	108344490
Monitor and Control Unit (MCU)	ES648B	108344508
Monitor and Control Unit (MCU)	ES648C	108344516
Monitor and Control Unit (MCU) w/Remote Access/Control Function	ES648BZ	108344524
Alarm Control Unit (ACU)	ES647	107335069
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 three shelves	N/A	847334794
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
MCU/ACU Slot Cover	N/A	847345576
DC Fan Cradle Assembly.	N/A	847244100
Internal Modem	EMC1	108284456
Contactor 100A	N/A	847439866
Contactor 150A	N/A	847401262

Documentation

-48V CPS Battery Plant

Document		Comcode
-48V Documentation Package includes:		
– Assembly and Ordering Drawing	J85500R-1	
– Wiring Diagram	T83196-30	847290384
– Schematic Drawing	SD83196-01	
– Product Manual Select Code	167-102-100	

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-1 power shelf:

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

  Standard configurations are:

  – J85500R-1 Shelf
  – ES660C 15A/+48Vdc Rectifier
  – ES648A/B/C/BZ Monitor and Control Units (MCU)
  – ES622B 25Hz 100VA 80Vac rms Ringer

- The J85500R-1 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 ES680 converters or 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.

- AC input cords equipped with AMP MATE-N-LOK II connectors must be dressed and strain-relieved to avoid undue stress on the ac connectors.

Safety Statements, continued

- Install only in restricted access areas (dedicated equipment rooms, equipment closets, or the like) in accordance with articles 110-16, 110-17, and 110-18 of the U.S. National Electric Code (NEC), ANSI/NFPA No. 70, and pursuant to applicable local codes.

- This equipment is to be used in controlled environments (an area where the humidity is maintained at levels that cannot cause condensation on the equipment, the contaminating dust is controlled, and the steady-state ambient temperature is within the range specified).

- This equipment has been evaluated for 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 no less than allowed by electrical codes for 60° Celsius wire (regardless of insulation temperature rating used) and based on the ampacity of the associated protection device. Wiring internal to enclosed equipment cabinets should be rated at 105° Celsius (minimum).

Safety Statements, continued

- Torque electrical connections to the values specified on labels or in the product documentation.

- Battery input cables must be dressed to avoid damage to the conductors (caused by routing around sharp edges or routing in areas where wires could get pinched) and undue stress on the connectors.

- Alarm contacts on the distribution panel (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.

Safety Statements, continued

- 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.

- 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.

Special Installation Instructions

German

- Installationsanleitung
  (Installation Instructions)

  – Eingangsspannung (Voltage): See Table 3-E.
  – Eingangsstrom (Current): See Table 3-E.
  – Nennfrequenz (Frequency): 50-60
  – Schutzklasse (Protection Class): I
  – Modellnummer (Model No.): See Table 3-E.
  – Max. Umgebungstemperatur (Maximum Operating Temperature): 65°C
  – Ausgangsspannungen und -stöme
  (Output Voltage and Current): See Table 3-E.
  – 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 daraf 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 ± 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 the plant on the left (or rear on List 25R or 25RB only). 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-F and 3-H.

- 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 should be sized using the 60° Celsius ampacity table in the NEC handbook. Wiring internal to enclosed equipment cabinets must be rated no less than 105° Celsius.

DANGER

Only qualified personnel should install and service the 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.

Installing Shelves and Batteries

Frame Mounted Shelves, Batteries, and Modules

If -48V CPS shelves, batteries, or battery modules are already mounted in a cabinet or frame, proceed to "AC Input Wiring."

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 23-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.

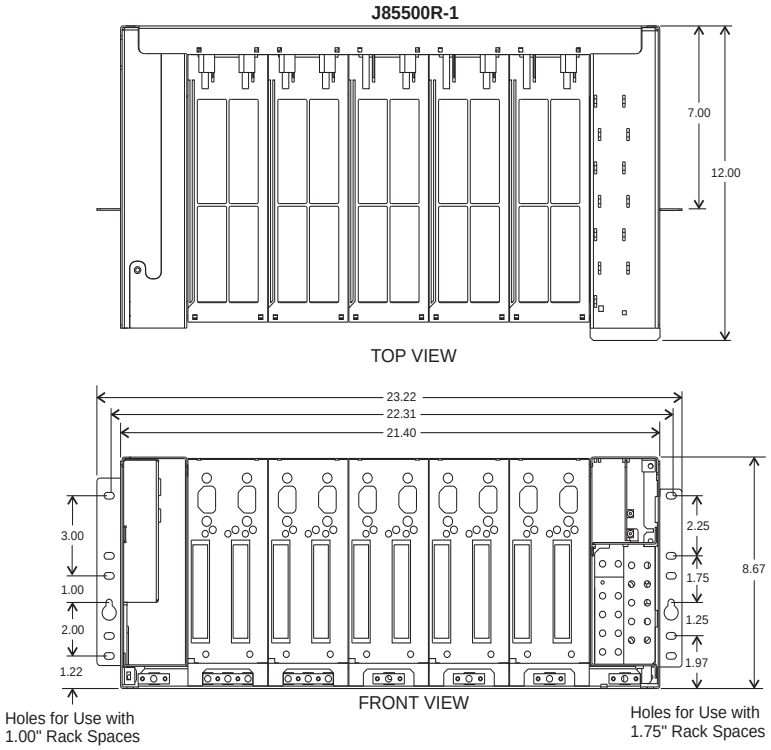


Figure 5-1: CPS Shelf Dimensions

Installing Shelves and Batteries, continued

Multiple-Shelf Plants

A multiple-shelf CPS plant is composed of:

- an initial shelf, which provides for:
  - rectifiers
  - converters or 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

Note

The LVD disconnect/reconnect feature is not available for multiple shelf plants with N + 1 loads greater than 150 amperes.

- one or two supplemental shelves, each of which provides for:
  - rectifiers
  - converters or ringing generators
  - output bus bars, which provide terminations for the plant's primary output

Note: The initial shelf must be installed as the top or bottom shelf in a three-shelf system.

Installing Shelves and Batteries, continued

Interconnecting the Initial and Supplemental Shelves

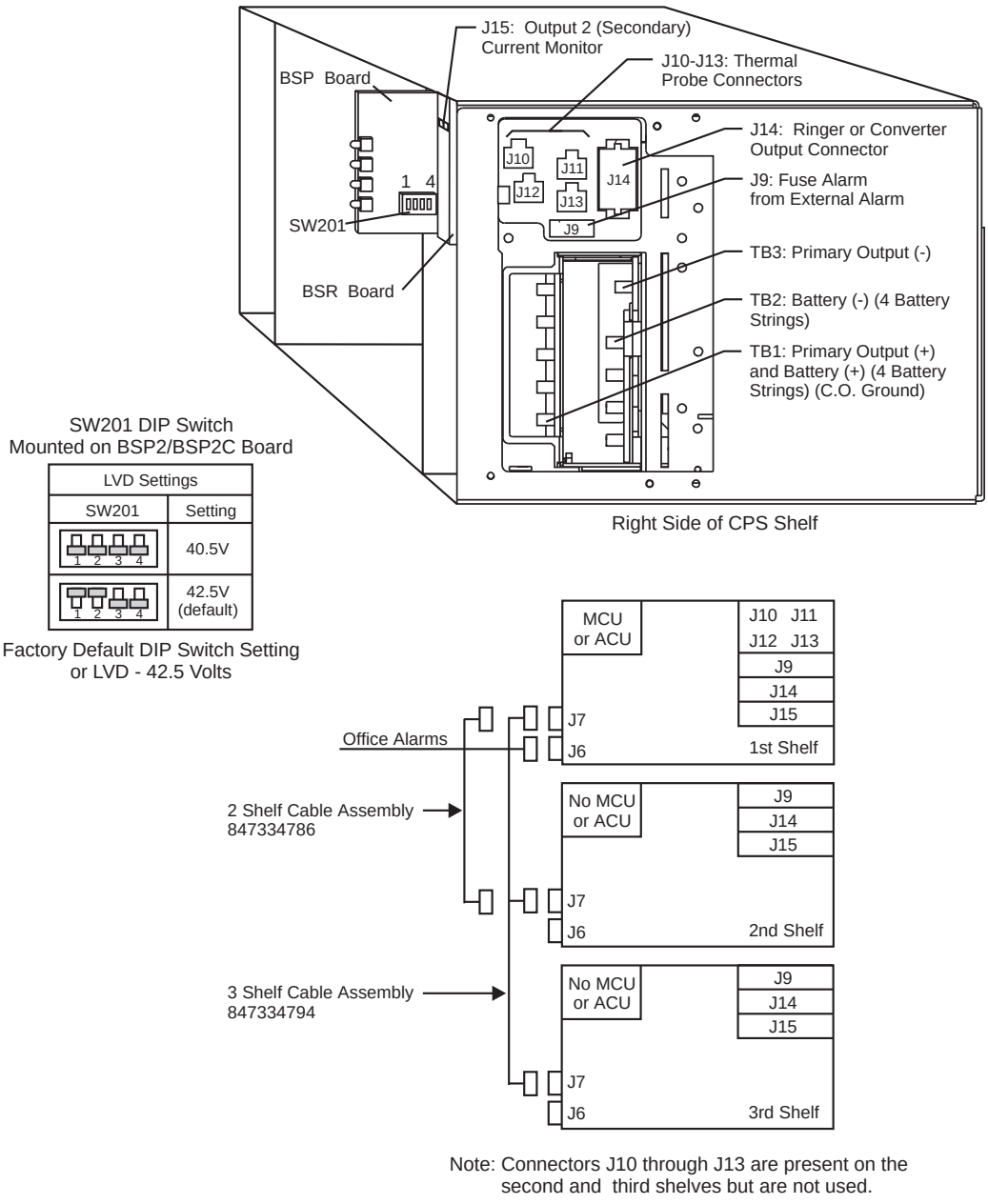


Figure 5-2: Alarm, Intershelf, LVD/Thermal Management

Installing Shelves and Batteries, 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 or three shelves with lists K2 and K3, respectively.

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. (See “Installing Batteries” procedure.)
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.

Installing Shelves and Batteries, continued

Installing Batteries

Installing Batteries	
Step	**Action**
1	Verify that the proper batteries have been ordered and received.
2	• To install GE Critical Power 12IR125 or VR-type batteries, refer to the appropriate product manuals. Follow all safety precautions when installing batteries. • To install a J85504D-1 IR 30/40 Battery Module, ensure that adequate space is available for mounting the module. Each module requires a minimum of nine inches of vertical height. Modules to house IR30 batteries require 13 inches of depth; modules to house IR40 batteries require 20 inches of depth. The battery module(s) should be mounted as close to the -48V CPS shelf as practical, preferably immediately below the shelf. The 1-inch vertical space required to cool -48V CPS power shelves is inherent in battery modules. See Figure 5-3. **Warning** **For safety reasons, the batteries must be disconnected while installing and testing the equipment.** **While installing batteries, follow all safety precautions outlined in the appropriate battery product manuals.**

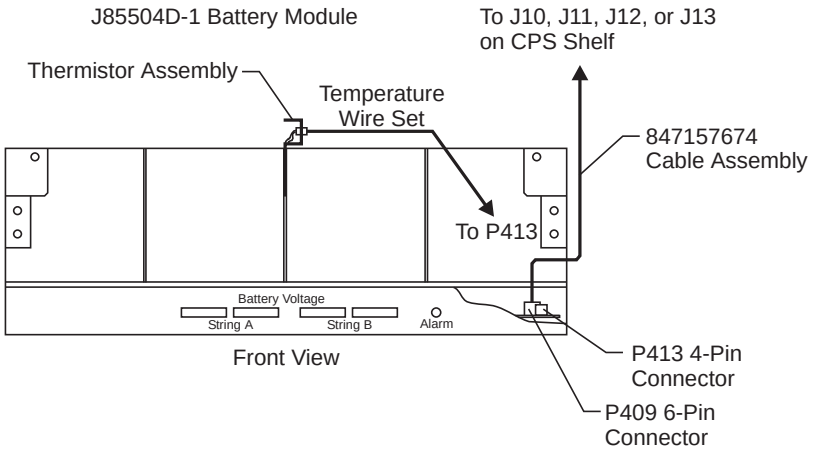


Figure 5-3: J85504D-1 Battery Module

Installing Shelves and Batteries, continued

If J85504D-1 Battery Modules Are Installed

If battery modules are installed, proceed as follows:

If J85504D-1 Battery Modules Are Installed	
Step	**Action**
1	Locate the alarm cable (847157674) provided for each battery module. Install it between either J10, J11, J12, or J13 on the -48V CPS shelf and P409 on the battery module. One module alarm cable assembly is required for each battery module.
2	Connect the thermistor assembly to P413 using the temperature wire set. Locate the thermistor(s) between two adjacent batteries, as shown on Figure 5-3.
3	Install battery cables to P401 through P408.
4	Using the #6 AWG wire and double-hole lugs provided, fabricate the cables needed to interconnect the -48V CPS shelf and battery modules. One set of cables is required for each battery module. See Table 3-A Note 4 for additional information.

If J85504D-1 Battery Modules Are Not Installed

If battery modules are not installed, proceed as follows:

If J85504D-1 Battery Modules Are Not Installed	
Step	**Action**
1	Locate the thermistor(s) between two adjacent batteries, as shown on Figure 5-3. Note: Up to four thermistor kit assemblies may be used.
2	Connect the thermistor(s) directly to the CPS shelf J10, J11, J12, or J13.

Installing Shelves and Batteries, continued

Installing Batteries Below 0°C Temperature

- Installing cold batteries with temperature probes in ambient temperatures below -10°C may generate a PMN alarm and a Probe Fail alarm due to a failed temperature probe condition.
- The length of time it will take the batteries to heat up and obtain an operating state to retire the PMN and Probe Fail alarms depends on the condition of the batteries, the length of time the batteries were stored and at what temperature, the batteries' operating ambient temperature, and the charging capacity of the plant.
- It is recommended that batteries not be installed in a temperature below -20°C.

Follow the steps in the tables below to install batteries in the Cabinet Power System.

Installing Batteries Below 0°C Temperature	
Step	**Action**
1	Verify that the proper batteries have been ordered and received.
2	To install GE Critical Power IR30/40,12IR125 or VR-Type batteries, refer to the appropriate product manuals. **Warning** **For safety reasons, the batteries must be disconnected while installing and testing the equipment.** **While installing batteries, follow all safety precautions outlined in the appropriate battery product manuals.**

AC Input Wiring

Options

There are various options available for input wiring for the -48V CPS shelves:

- Separate ac inputs for each power slot with connectors designated as J1 through J5
- Two ac inputs; one to power slots 1, 3, and 5 (connector J1) and one to power slots 2 and 4 (connector J2)
- One ac input distributed to all five power slots (connector J1)
- Two ac input wire sets (10 feet long, extending from the rear of the CPS shelf); one to power slots 1, 3, and 5, and one to power slots 2 and 4
- One ac input distributed to all five power slots (terminal block TB4)

Refer to Figure 5-4 for an illustration of the CPS input assemblies.

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 for each of the five ac input options is listed in Figure 5-4.

Input Assemblies	AC Input Connections	Input AC Voltage	Recommended Circuit Protection
Lists 21 and 21B	5	120V and 240V	15A each
Lists 22, 22B, 26 and 26B	1	240V	30A
List 25, 25B, 25R and 25RB	2	240V	20A each
List 23 and 23B	None	Converter Shelf Only	

- AC input cords equipped with AMP MATE-N-LOK II connectors are for use only inside enclosed equipment cabinets.
- AC input cords equipped with AMP MATE-N-LOK II connectors must be dressed and strain-relieved to avoid undue stress on the ac connectors.
- To maintain the reliability inherent in a -48V CPS plant, separate branch circuits must be run to each rectifier 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.

AC Input Wiring, continued

Input Assemblies

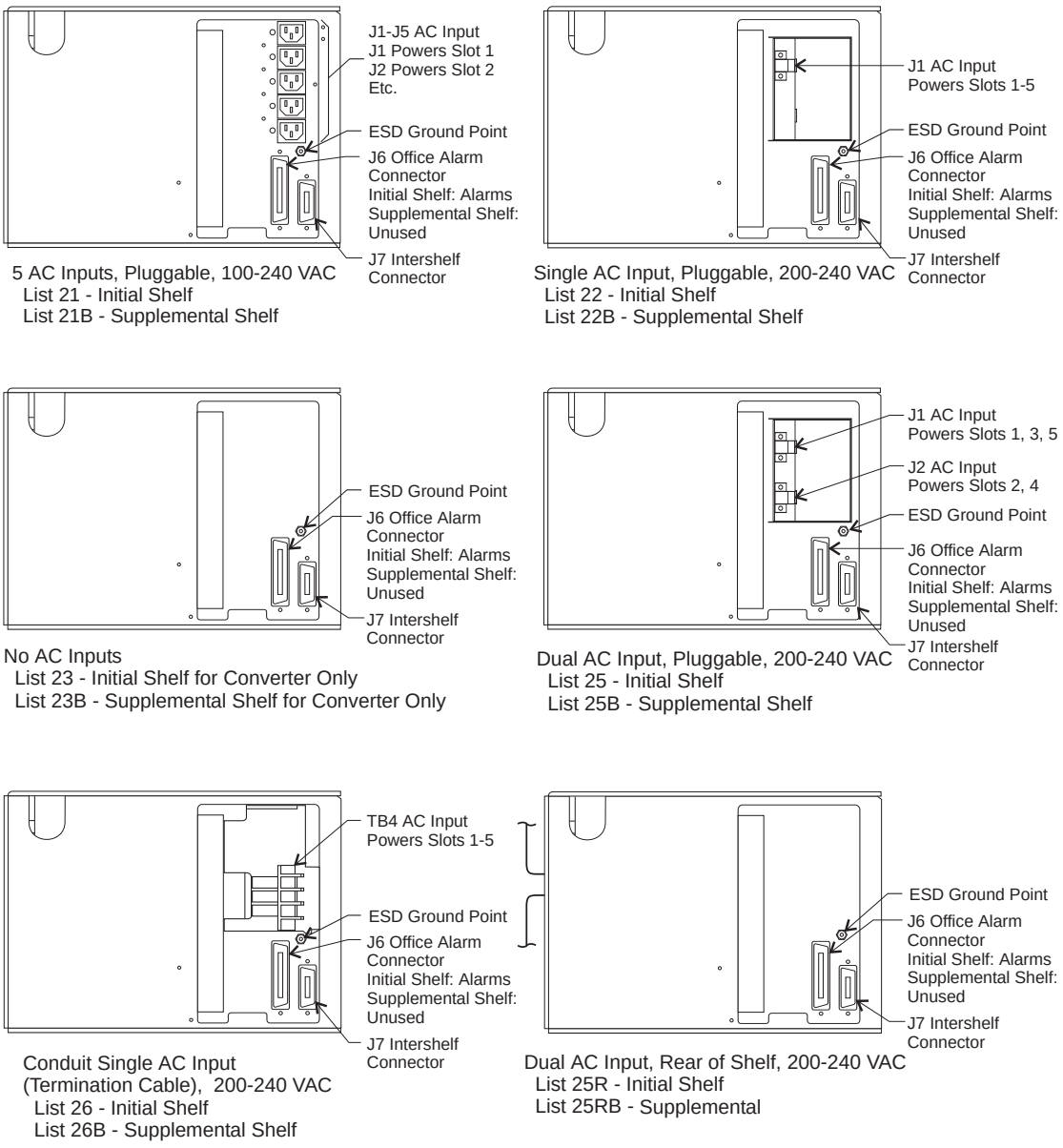


Figure 5-4: Input Assemblies (Left Side of CPS Shelf)

Installing Control Units

Introduction

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

Procedure

Installing Control Units	
Step	**Action**
1	Determine whether a Monitor and Control Unit or an Alarm Control Unit is to be installed.
2	Identify and unpack the control unit.
3	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 7-F for all control units.
4	Refer to Table 7-B, 7-C, or 7-D to set switch SW1.
5	Insert the control unit into the left-most slot in the initial CPS shelf.
6	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

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.

Plug-in Modules

Introduction

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

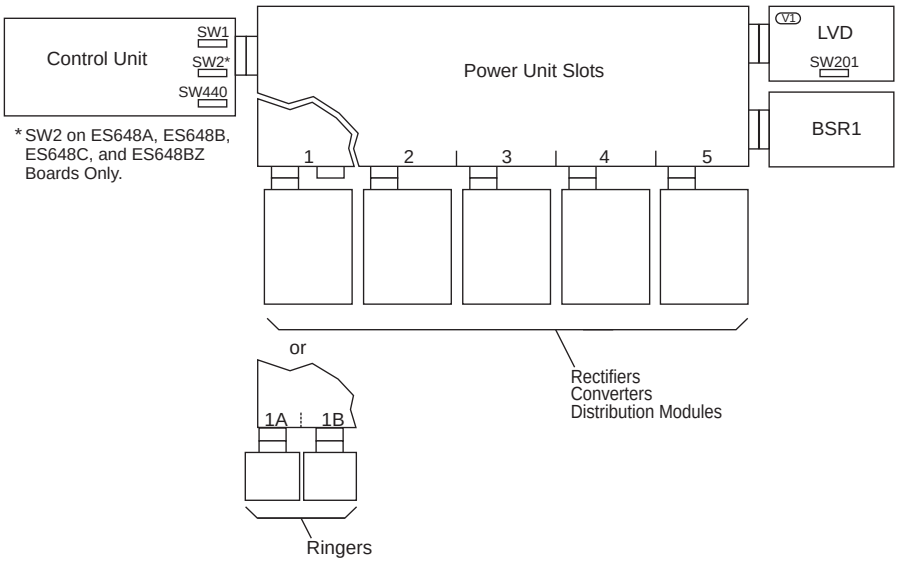
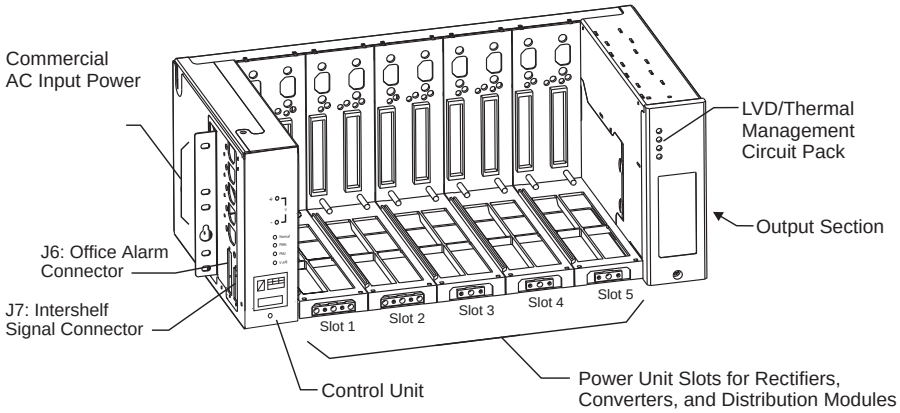


Figure 5-5: CPS Plug-In Modules

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.



Low-Voltage Disconnect (LVD) Function

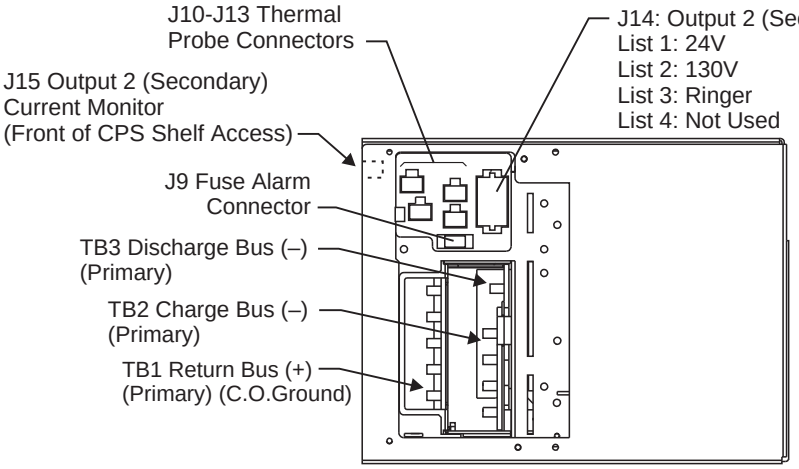
Overview

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.

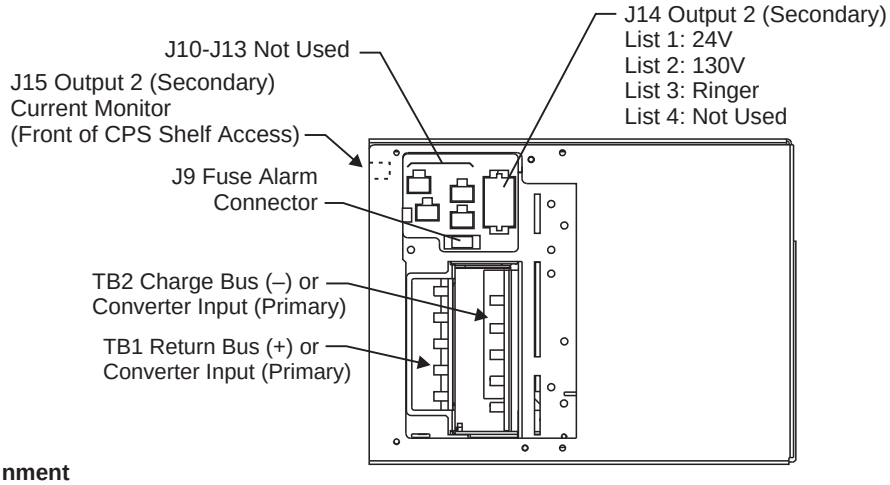
See “Low-Voltage Disconnect” in Section 7 for more information.

DC Distribution Wiring

Output Assemblies



List 31 - Output w/o LVD Contactor
List 35 - Output Equipped w/ 100A LVD Contactor, Initial Shelf w/ Rectifier in Initial Shelf Only
List 36 - Output Equipped w/ 150A LVD Contactor, Initial Shelf w/ Rectifier in Initial, and Supplemental Shelves



List 34 - Output for:
Supplemental Shelf or
Converter Only Shelf or
Batteryless Rectifier Plant
(Not Equipped with LVD
Contactor or Battery Shunt)

***J14 Pin Assignment**

3		2	AR_DIST	1	DIST_ALM
6	C+/AC1	5	C+/AC1	4	C+/AC1
9	C+/AC1	8	C+/AC1	7	C+/AC1
12	C–/AC2	11	C–/AC2	10	C–/AC2
15	C–/AC2	14	C–/AC2	13	C–/AC2

J14 provides the secondary (converter or ringer) output. When configured for ringers, the output is floating. AC1 and AC2 are the two phases of the ringer output, and either may be grounded to make the Tip in a typical Tip and Ring arrangement.
C+ and C– indicate the dc/dc converter output polarity.

Figure 5-6: 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.

DC Distribution Wiring, continued

Warning

CPS shelves equipped with ES680 converters or ES620/ES621/ ES621A/ES621B/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.

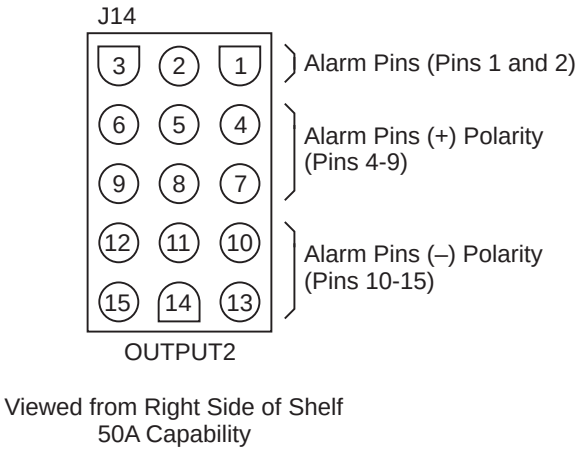


Figure 5-7: CPS Secondary Bus Output Connector J14

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.

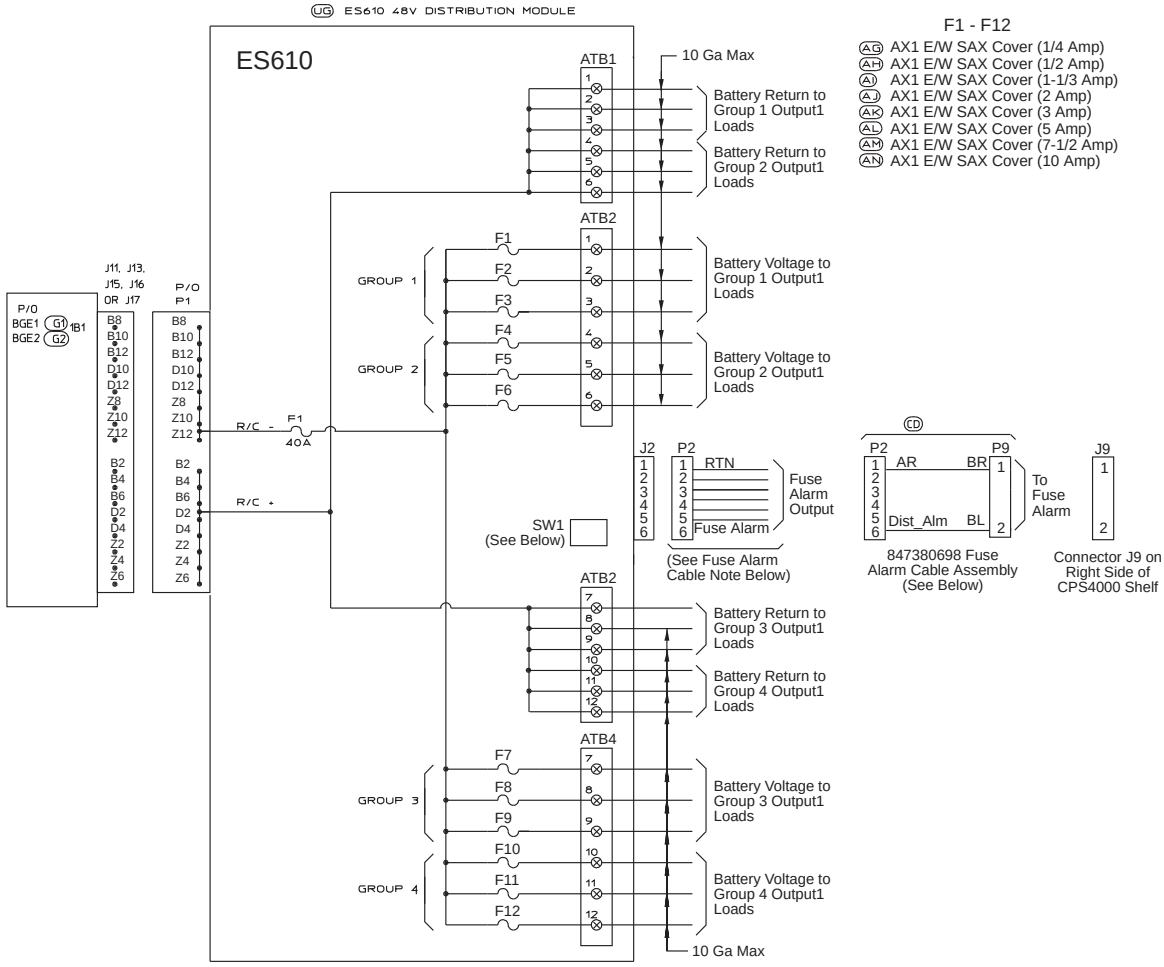
Note

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.

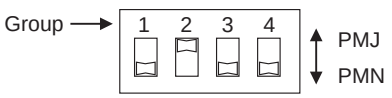
Distribution Modules, continued

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 5-8.



SW1



Switches in the down position result in PMN alarm when a fuse is blown in that group. Switches in the up position will result in a PMJ alarm. For example, for the setting shown here, blown fuses in Group 2 will result in a PMJ alarm, while blown fuses in Groups 1, 3, and 4 will result in a PMN alarm.

847380698 Fuse Alarm Cable Assembly

This cable assembly is used to send an MJF alarm signal to the controller in the event of a blown fuse. It is shipped from the factory using pins 1 and 6 of connector P2 on the ES610 end. This will result in the controller's MJF LED lighting if a blown fuse is detected in any group. Other P2 pins can be used instead of pin 6, so that blown fuses in only one group light the controller's MJF LED. These pins are assigned as shown here.

Use Pins 1 and	MJF Alarm Group
2	Group 1
3	Group 2
4	Group 3
5	Group 4
6	Any Group

Figure 5-8: 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 5-9.

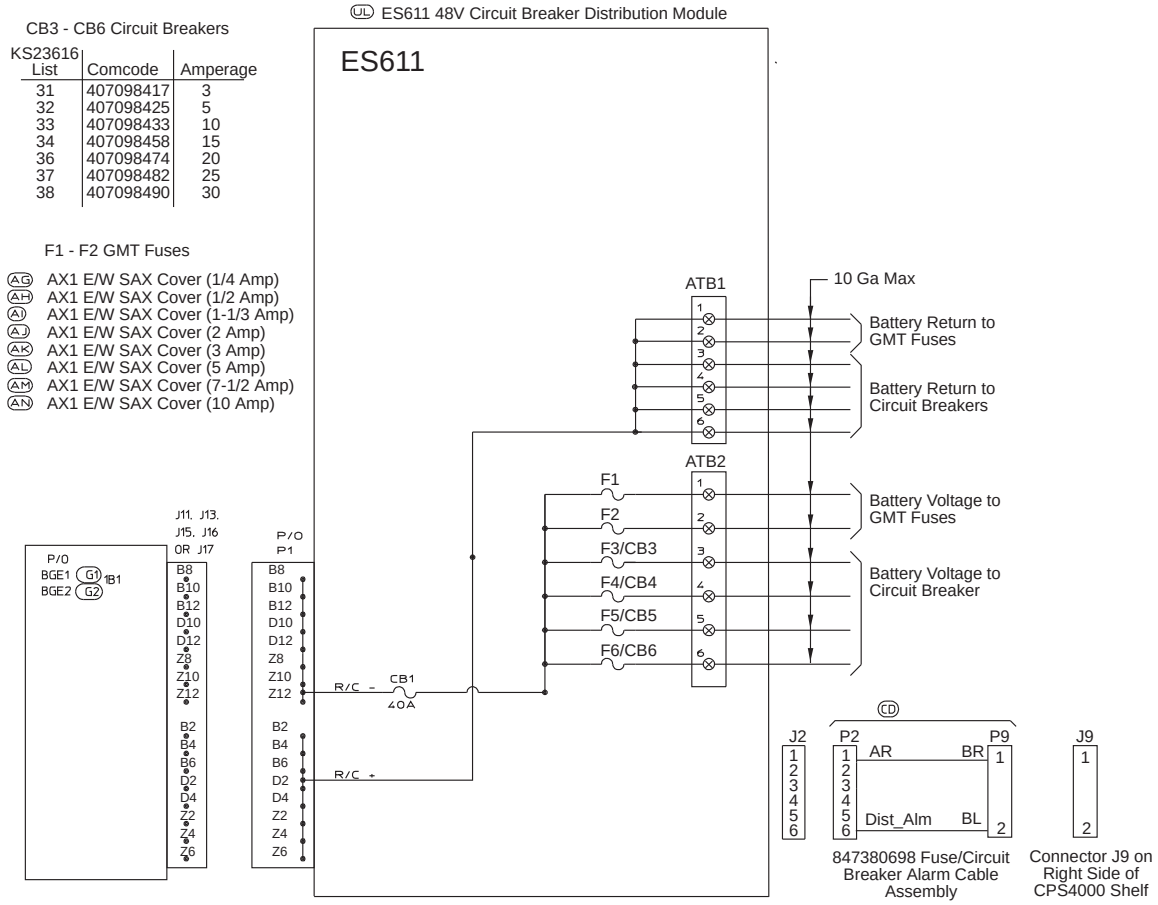


Figure 5-9: ES611 Distribution Module Wiring

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 5-10.

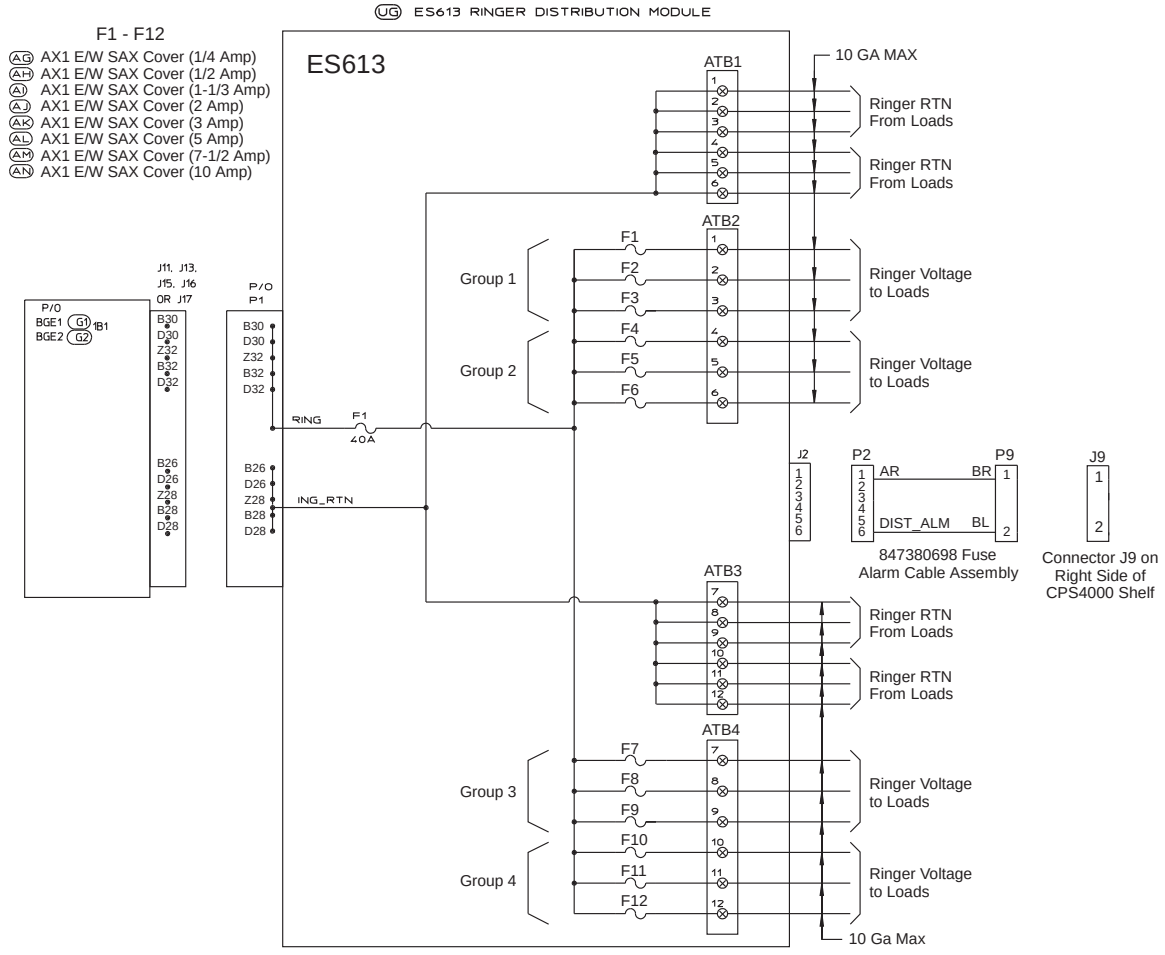


Figure 5-10: ES613 Distribution Module Wiring

Initial Start-up and Test

Checklist

Refer to Section 7 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 the battery, if installed, is 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 and/or converter using the 3/16-inch Allen wrench, turning the mounting screw clockwise. Verify that the fan operates on the rectifier or converter. Note: In order to verify fan operation, it may be necessary to have only one rectifier or converter seated and operating at a time.
3	After all the rectifiers and/or converters are seated, verify that the yellow **Standby** LED lights on all of them.
4	Turn one rectifier or converter On. As the rectifier is turned On, verify: • **LVD Fail** LED lights momentarily on the BSP2 or BSP2C distribution unit (occurs with the first rectifier only)
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	Place a test load across J14 pins 4 through 9 (+) and J14 pins 10 through 15 (-) for the secondary output. Set the test load to approximately 2 amperes if ES680 or ES681 converters are installed.
7	Turn all remaining rectifiers and/or converters 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

LED Test

LED Test	
Step	**Action**
1	If installed, press the **LED Test** pushbutton on the MCU (**ES646, ES646B, ES648A/B/C/BZ**).
2	Verify that all LEDs and meter segments are illuminated while the switch is depressed.

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	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 GE Critical Power IR or VR batteries, the plant voltage should be 54.5 volts for battery ambient temperatures below 25° Celsius (77° Fahrenheit). **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.
3	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 for CPS4000 or CPS4000+ using NAFTA temperature compensation or 20°C for CPS4000+ using EURO temperature compensation), the TEMP COMP LED will activate and the plant voltage will decrease to the appropriate level as defined by the Standard/ NAFTA or EURO algorithm for the temperature sense. ***This is not an alarm condition***, but is only an indication that TEMP COMP is actively adjusting the plant float voltage from that which was originally set. Refer to Figures 7-2 and 7-3 for additional information regarding the TEMP COMP feature. **Note: Do not readjust plant voltage on the MCU/ACU with the TEMP COMP LED active or the plant voltage will increase above the initial voltage setting when the temperature decreases.**

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 and/or converters 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.

Initial Start-up and Test, continued

Boost Mode

This feature is only available when the ES648 control unit is installed with ES660C Rectifiers.

Boost Mode	
Step	**Action**
1	Verify that all rectifiers are ES660C.
2	Verify that the plant load is less than the total current capacity of the ES660C rectifiers installed.
3	On the ES648 control unit, operate SW2 position 1 to the closed position to enable the Boost Mode.
4	On the ES648 control unit, operate SW1 position 5 to the closed position to enable Plant Battery Test.
5	Verify that the Battery on Discharge threshold is at 51.0 volts.
6	Disconnect the battery from the system.
7	Turn On the ac power to the system.
8	Perform a Plant Battery Test by shorting contacts J6-29 and J6-30 together.
9	Verify that the plant voltage is now approximately 48 volts.
10	Verify that the ES648 control unit is issuing a BD alarm.
11	Remove the short between J6-29 and J6-30 to exit the Plant Battery Test mode.
12	Verify that the plant voltage is now approximately 58.1* volts. Note: The system will remain in this condition for about 5 minutes or until the LED Test is executed.

* ES648 controllers series 1:2 and greater have a variable boost voltage adjustment. See Section 7 for details.

Initial Start-up and Test, continued

Self-Diagnostics

Before running the self-diagnostics on the ES646 and ES648 control units, determine whether you want to exercise only the **Alarm** LEDs or if you want to test both the LEDs and the office alarm relays. With SW1-position 6 closed (default), the office alarms are not affected by the self-diagnostics. Opening SW 1-position 6 results in a momentary transmission of each office alarm contact. See "Self-Diagnostics Routine" in Section 7 for the order in which the tests are run.

Self-Diagnostics	
Step	**Action**
1	To perform self-diagnostics, depress the LED Test pushbutton for 6 seconds until the diagnostics start. (Release the pushbutton after the diagnostics start.) While each alarm is tested, the LCD display is blank. If a test fails, a code appears momentarily on the LCD. (See "Self-Diagnostics Routine" in Section 7 for a list of the error codes.) If the self-diagnostics pass, the Normal (green) LED will light. Any test that fails results in a PMN alarm that is retired only when the unit passes self-diagnostics or when the unit is powered down and then powered up again.
2	Disconnect the thermal probe cables (P10-P13) on the distribution module before adjusting the plant voltage.
3	Plug a digital multimeter (DMM) into the test jacks on the control unit.
4	Set the plant voltage to 54.5 volts using the V Adj encoder located on the control unit.
5	Reconnect the thermal probe cables (P10/P13) on the output distribution module.

Initial Start-up and Test, continued

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: • **PMN** and **PMJ** LEDs light on the [**ES646, ES647, or ES648A/C]** control unit • **PMN** LED lights on the [**ES646B or ES648B/BZ]** control unit.
3	Clear these alarms by turning the rectifiers On.

Initial Start-up and Test, continued

AC Fail (1)

AC Fail (1)	
Step	**Action**
1	For systems with one ac feed per rectifier, turn one input circuit breaker Off.
2	Verify: • **PMN** and **AC Fail** LEDs light on the [**ES646**, **ES646B, or ES648**] control unit • **PMN** LED lights on the **ES647** control unit

AC Fail (2)

AC Fail (2)	
Step	**Action**
1	For systems with more than two rectifiers installed, turn a second circuit breaker Off.
2	Verify: • **PMJ, PMN,** and **AC Fail** LEDs light on the [**ES646 or ES648A/C**] control unit • **PMN** and **AC Fail** LEDs light on the [**ES646B or ES648B/BZ**] control unit • **PMJ** and **PMN** LEDs light on the **ES647** control unit
3	Clear the alarms by turning the circuit breakers On.

Initial Start-up and Test, continued

Converter on Standby (1)

For rectifier-converter or converter-only plants, repeat these tests for the installed converters.

Converter on Standby (1)	
Step	**Action**
1	Place one converter in standby.
2	Verify that one converter in standby activates: • **PMN** LED on the [**ES646, ES646B, ES647, ES648A/B/BZ**] control unit • **PMN** and **PMJ** LEDs on the **ES648C** control unit
3	Clear these alarms by turning the converters On.

Converter on Standby (2)

Converter on Standby (2)	
Step	**Action**
1	Place two converters in standby.
2	Verify that two converters in standby activate: • **PMN** and **PMJ** LEDs on the **[ES646, ES647, ES648A/C]** control unit • **PMJ LED** on **[ES646B, ES648B, ES648BZ]** control unit
3	Clear these alarms by turning the converters 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	If the system contains an ES648 control unit, disable the Boost Mode feature.
3	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.
4	As the plant primary bus voltage is reduced below the BD threshold, verify: • **PMJ** and **BD** LEDs light on the [**ES646 and ES648A/C]** control unit • **BD** LED lights on [**ES646B, ES648B/BZ]** control unit • **PMJ** LED lights on the **ES647** control unit
5	Clear these alarms by returning the voltage to 54.5 volts. Note: If the boost is enabled and ES660C rectifiers are installed, the voltage may go to the boost voltage setting.

Initial Start-up and Test, continued

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: • **PMJ** and **MJF** LEDs on the **ES646**, **ES646B, or ES648** control unit • **PMJ** LED on the **ES647** 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: • **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: • **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	To simulate a failed low-voltage disconnect contactor: 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: – **LVD Open** LED lights on the output module – **PMJ** LED lights on the control unit f. 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	Reconnect the thermal probe cables (P10/P13) on the output distribution board (J10-J13).

J85504D-1 Battery Module Alarm

Connect batteries to the plant before administering this test.

J85504D-1 Battery Module Alarm	
Step	**Action**
1	Simulate a battery module alarm (if equipped) by inserting a blown GMT-type fuse in H101 or H102 on the J85504D-1 Battery Module circuit board.
2	Verify that the **PMJ** LED lights on the control unit. Clear this alarm by replacing the fuse.

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 an Additional Battery String

Adding To An Existing Battery Module or Working -48V CPS Plant

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

Installing in New Plants

Note: GE Critical Power recommends using an authorized service representative to install and connect batteries to a new or existing power plant due to the exposure to hazardous voltages.

For installation in new plants, follow the procedure below:

Installing in New Plants	
Step	**Action**
1	Disconnect one battery from each battery string.
2	Verify that all power units are in **Standby**.
3	Install circuit breakers or fuses.
4	Reconnect the batteries.
5	Turn the power unit(s) 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 Remote Access and Control

Overview

Ports

The ES648 control unit provides remote access ports that can be used in different ways:

- With a GE Critical Power proprietary modem that plugs into the control unit card, i.e., the Internal Modem – Circuit Pack EMC1 (ES648BZ)
- With an External Modem – RS-232 Connector
- To communicate with a terminal device, such as a computer, using either an RS-232 or RS-485 connection.

  The following list is the order of precedence for the port types:

  – RS-232 Local
  – RS-232 External Modem
  – Internal Modem (GE Critical Power Proprietary Modem – EMC1, available in North America only)
  – RS-485

If a terminal is connected to the Local RS-232 connection, then the control unit communicates with the device connected to the RS-232 connection even if an internal modem card is plugged into the control unit.

For the RS-485 connection to operate, the cables to the RS-232 local connection and external modem ports must be disconnected, and the Internal Modem (EMC1) must be removed from the control unit.

Overview, continued

ES648 LCD Display

While the ES648 control unit is in communication with the remote access port, a series of ones (1) and zeros (0) will be periodically flashed across the ES648 LCD display instead of the plant voltage or current being displayed. This is to inform a user at the CPS plant that the control unit is in the remote access mode. A user at the CPS plant may interrupt and disconnect the user on the remote access port by pressing the LED Test button.

If either an internal modem or an external modem is connected to the ES648 control unit, then the control unit can be configured to dial-out on alarm and dial-out when all alarms are cleared.

EasyView Software

An option is available to use the EasyView Software program for viewing remote access and control functions of the ES648 control unit. Contact a local GE Critical Power sales representative to download a free copy of the EasyView Software program.

User Interface

The ES648 control unit may be accessed remotely from a modem or terminal device. Two levels of security protect incoming access. Users who log into the control unit successfully use T1.317 commands to access measurements, configuration, and control parameters in the system. The control unit can be configured to dial-out on alarm.

Making the Connections

Introduction

The Internal Modem connection on the EMC1 circuit pack uses an RJ11 connector for connection to a phone line. The ES648BZ control unit has a Internal Modem circuit pack, EMC1, factory installed and tested.

The ES648A/B/C control units may be upgraded for remote access by ordering circuit pack EMC1 comcode 108284456.

Procedure

Making the Remote Access Connections	
Step	**Action**
1	Remove the ES648 control unit from the shelf.
2	Refer to Figure 6-1 and locate the connectors used for the remote access ports. Note: Direct connect cables are used for both RS-232 connections. A null modem cable is not needed.

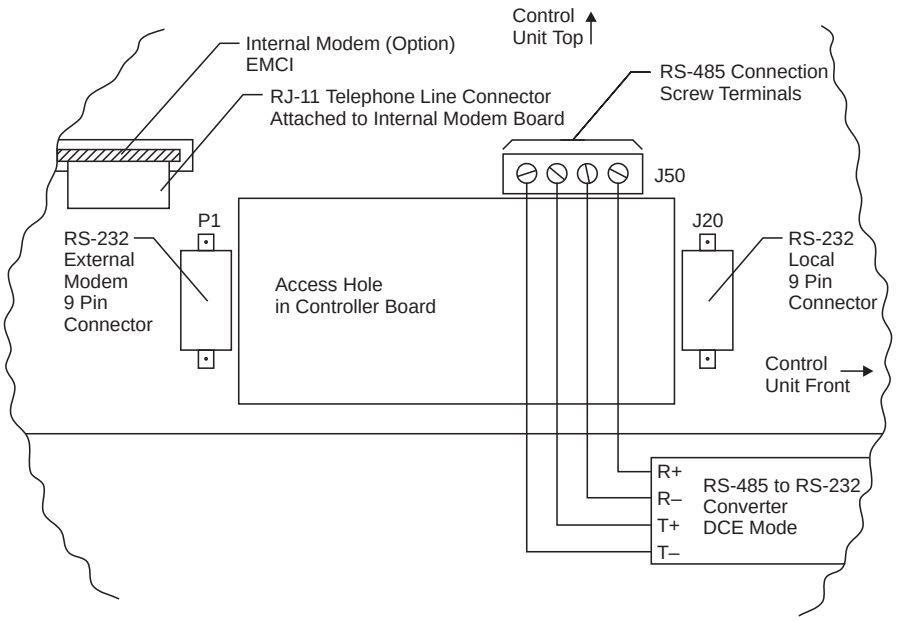


Figure 6-1: ES648 Remote Access Connections

Port Settings

Introduction

This section describes the communication port settings for the internal modem, external modem, RS-232 terminal, and RS-485 terminal ports.

Internal and External Modem

The control unit communicates with the internal modem and an external modem at the same communication settings. These settings are as follows:

Baud rate: 2400

Data bits: 8

Stop bits: 1

Parity: None

RS-232 and RS-485 Terminal Interfaces

The control unit communicates over the RS-232 and RS-485 terminal interfaces using the following settings:

Baud rate: 9600 default, auto baud from 1200 to 19200

Data bits: 8

Stop bits: 1

Parity: None

Logging In to the System

Procedure This section describes how to log into the system.

Obtaining an "Enter Password" Prompt	
Step	**Action**
1	• From a modem: Dial into the control unit and wait for the modem to connect. After the modem connects, you will be presented with the log-in prompt. If you do not see the log-in prompt after the modem connects, you may have to press the ENTER key at least twice in order to obtain the prompt. • From a terminal connected to the RS-232 or RS-485 port: Press ENTER at least twice until you are presented with the log-in prompt. The number of ENTER key strokes required will depend on the baud rate at which you are trying to connect. The control unit will adjust its baud rate automatically until it recognizes the carriage return character (ASCII 13) sent by pressing ENTER.
2	At the ENTER PASSWORD prompt, type the user or super-user password. The default password for each level of security is listed below. lineage default user password (The "user" may view any measurement, configuration, or control parameter.) super-user default super-user password (The "super-user" may view any measurement, configuration, or control parameter, and, in addition, can set configuration and control parameters, as well as change system passwords.)
Note: After receiving the correct password, the control unit will respond with one of the command line prompts listed below. * user command line prompt ** super-user command line prompt When these prompts appear the control unit is ready to accept commands. If the port is idle, no characters received or sent, for 15 minutes then the session will terminated.	

T1.317 Command Language

Introduction

The command language is based on the T1.317 standard. The T1.317 standard has been adapted to the needs of a small plant control unit. This section describes the command line log-in sequence as well as commands, objects and attributes used to access measurements, configuration, and control parameters in the control unit.

Objects

The T1.317 standard organizes attributes into groups called objects. Table 6-A lists the objects supported for remote access.

Table 6-A: Objects Supported for Remote Access

Identifier	Description
ps1	Power system description / site name
dc1	DC plant
sc1	Slope thermal compensation type
bs1	Boost manager
bda1	BD alarm
br1	Battery reserve
p1	Primary phone number
a1	Alternate phone number
gm1	Rectifier manager
eeq1	External equipment
mp1	Modem

T1.317 Command Language, continued

Object-Attribute Pairs

The T1.317 standard provides access to system measurements, configuration, and control through attributes. Each measurement, configuration, or control parameter is uniquely identified by an object-attribute pair. For example, the object-attribute pair “dc1,vdc” identifies the plant voltage while the object-attribute pair “dc1,adc” identifies the plant load current. In each of these examples “dc1” identifies the plant object and “vdc” and “adc” identify DC voltage and DC current respectively.

Table 6-B summarizes the object-attribute pairs in the system along with the commands that can be used with the pair and the valid range for the attribute.

T1.317 Command Language, continued

Table 6-B: Object-Attribute Pairs – Related Commands

Obj,attr	Description	Sta	Cha	Ope	Type	Range of Values
ps1,des	Power system description	x			text	GE Critical Power ES648 control unit
ps1,sid	Site ID	x	x		text	up to 15 characters
ps1,swv	Software version	x			text	ES648 software version
dc1,stt	Plant state	x			text	FLOAT, BOOST, PBT
dc1,vdc	Plant voltage	x			number	dd.dd V
dc1,adc	Plant load current	x			number	ddd.d A
dc1,ubt*	Plant battery temperature	x			number	dd C
br1,pbt	Plant battery test state	x		x	number	0:pbt not active 1:pbt active
br1,pbte	Plant battery test enable	x			number	0:disabled 1:enabled
p1,phn	Primary phone number	x	x		text	up to 25 characters
a1,phn	Alternate phone number	x	x		text	up to 25 characters
gm1,fsp	Rectifier float voltage set-point	x	x		number	dd.dd
gm1,bsp†	Rectifier boost voltage set-point	x	x		number	dd.dd
gm1,ros	Rectifier on standby control	x		x	number	0:ros not active 1:ros active
gm1,rose	Rectifier on standby enable	x			number	0:disabled 1:enabled
bda1,thr	BD threshold	x			number	dd.dd (52.0 - 55.0)
bda1,sev	BD is major or none	x			text	MAJ or NO
bs1,bse	Boost enable	x			number	0:disabled 1:enabled
sc1,typ	Compensation type	x			text	NAFTA or EURO
eeq1,stt	External equipment control state	x		x	number	0:open 1:closure
eeq1,alrn	External equipment alarm state	x			number	0:no alarm 1:alarm closure
eeq1,inp	External equipment input	x			number	0:open 1:closure
mp1,ins**	Modem initialization string	x	x		text	up to 25 characters

*Although several thermal probes may be connected to a CPS system, only the highest battery temperature is displayed. The battery temperature is displayed in degrees Celsius.

**This string of characters is sent by the ES648 control unit to the modem to initialize it into active service. Up to 25 characters may be entered.

- cha mpl,ins = “at&fev” – change the modem initialization string to “at&fev”
- cha mpl,ins = “” – change the modem initialization string to the default value “at&fev&c1”

†Rectifier boost voltage set-point adjustment test is available on ES648 controllers series 1:2 and greater

Commands

Introduction

This section describes each of the remote access commands supported by this control unit.

Command Descriptions

Table 6-C lists the syntax and description of the commands. Note that all commands are case sensitive.

Table 6-C: Command Descriptions

Command		Syntax	Description
ala	Report active alarms	ala	Reports all the active alarm conditions in the plant. One alarm message is listed per line in the report. Table 6-D lists the available alarm messages and a brief description of each. Refer to Section 7, *Alarms, Controls, and Displays*, for specific details concerning the criteria for issuing alarms.
bye	Log-off	bye	Terminates the remote access session. If the user is connected via a modem, the control unit will disconnect the user.
cha* *You must be logged in as a super-user to use this command.	Change value	cha,*obj,attr*=value where: *obj,attr* is an object-attribute pair. For example: ps1,sid	Changes system configuration parameters. Examples: • cha ps1,sid=“My Plant” – change the site id to My Plant • cha p1,phn=“123456789” – change the primary phone number to 123456789
login	Log-in	login “password” where: password is either the user or super-user password	Log-in as a user or super-user. For example, if you are currently logged in to the control unit as a user but would like to change the site id, you must first use this command to log-in as a super-user.
ope* *You must be logged in as a super-user to use this command.	Operate a control	ope *obj,attr*=value where: *obj.attr* is an object-attribute pair. For example, dc1,pbt	Operates a system control parameter. Examples are listed below to illustrate how this command operates: • ope dc1,pbt=1 – start a plant battery test • ope eeq1,stt=1 – close the external equipment control relay

continued on next page

Table 6-C: Command Descriptions (continued)

Command		Syntax	Description
pas* *You must be logged in as a super-user to use this command.	Change passwords	pas *t*,"password", "password" where: "*t*" is "*u*" to change the user password or "*s*" to change the super-user password; "*password*" is the new password	Changes either the user or super-user password. The password is sent twice in order to avoid mistakes. The password must have at least 6 characters but no more than 15 characters.
sta	Report status	sta *obj,attr* where: *obj,attr* is an object-attribute pair. Example, ps1,sid	Reports the value of the measurement, configuration, or control parameters in the system. Examples: • sta dc1,adc – report plant load current • sta dc1,vdc – report plant voltage Response for this example: * sta dc1,vdc :DC1 VDC=-52.48 V . * (The * is the user command line prompt. The line ":DC1" indicates that the information that follows is for the plant object. The line starting with "VDC" identifies the DC voltage. the "." line is the end-of-command identifier.)

Alarm Messages

Descriptions

Table 6-D lists the available alarm messages and a brief description of each.

Table 6-D: Alarm Messages

Alarm Message	Description
No alarms	No alarms are active in the system
Power Major	A major alarm is being reported
Power Minor	A minor alarm is being reported
AC Failure	At least one rectifier is reporting AC failure
Multiple AC Failure	Two or more rectifiers are reporting AC failure
Rectifier Failure	One rectifier is reporting a failure
Multiple Rectifier Failure	Two or more rectifiers are reporting a failure
Converter/ringer Failure	One converter or ringer is reporting a failure
Multiple Converter/ringer Failure	Two or more converters/ringers are reporting a failure
Battery Major	Plant is reporting a battery major alarm, the low-voltage disconnect contactor is open, or a battery fuse has operated, or a battery disconnect is open.
Battery Minor	Plant is reporting a battery minor alarm, a thermal probe has failed, or the low-voltage disconnect circuit pack BSP2 has failed
Major Fuse	Plant is reporting a major fuse alarm
Battery on Discharge	Plant voltage is below battery discharge threshold
Low Voltage	Plant voltage is below low-voltage threshold
Control Unit Failure	Control unit has diagnosed a failure in its circuits

Dial-out On Alarm

Overview

This section describes the configuration parameters and the algorithm used for dial-out.

By default, the control unit is configured not to dial-out at all. It can be configured to dial-out to a primary phone number or an alternate phone number. The alternate phone number is used in the event that the control unit fails to connect to the primary phone number. The control unit will attempt to dial-out when an alarm occurs that it has not reported yet and when all alarms retire.

Phone numbers may be up to 25 characters long and may contain any of the following characters: 0123456789,()#* or space. Configuring the phone numbers enables the control unit to dial-out. The phone number must be the number of a modem. After the control unit connects to the remote modem it will send an alarm report. The alarm report is the same report generated by the T1.317 ala command with the addition of the site id at the beginning of the report.

When attempting to dial-out, the control unit will first attempt to dial the primary phone number. It will make up to three attempts, at 1-minute intervals, to connect to the primary phone number. If unsuccessful, the control unit will make up to three attempts, at 1-minute intervals, to connect to the alternate phone number. If still unsuccessful, the control unit will wait for 15 minutes and then repeat this cycle again. The cycle will be attempted 6 times before giving up completely. If the control unit successfully contacts either the primary or alternate phone number it will send the alarm report and then disconnect.

Whether or not the control unit successfully connects with the primary or alternate phone number, it will make a new attempt to dial-out when a new alarm occurs or all active alarms clear.

External Equipment Control and Alarm

Input and Alarm Features

- Applies to the ES648A/B/C/BZ control unit only. Refer to Table 7-I for external equipment input and alarm connections to the ES648.
- An isolated contact closure between J6-31 EXT_E_GOOD(NO) and J6-32 EXT_E_COM(C) will generate an input signal to the ES648 control unit.
- An isolated contact closure between J6-33 EXT_E_ALARM(NO) and J6-32 EXT_E_COM(C) will generate an input alarm signal to the ES648 control unit
- The status of the input and alarm signals must be determined using the remote access feature with T1.317 commands or with EasyView. There are no visual or audible alarms on the CPS shelf that are associated with the External Equipment Alarm.
- The contact closures must be isolated from frame ground. These connections are not fused, and improper use may result in damage to the CPS shelf and/or the ES648 control unit.

Examples

A fan that generates an isolated contact closure because it has failed or a door interlock that generates an isolated contact closure if the door is open may be connected to J6-33 and J6-32. Using the remote access feature, the status of this alarm can be determined.

External Equipment Control Features

- Available with the ES648 control unit only. Refer to Table 7-I for external equipment control connections to the ES648.
- Using the remote access feature with T1.317 commands or EasyView software, an isolated contact closure can be generated between J6-34 EE_ACT_NO and J6-35 EE_ACT_COM. The relay contacts are rated for 60-volts at 0.5 amperes.
- These connections are not fused and improper use may result in damage to the CPS shelf and/ or the control unit.

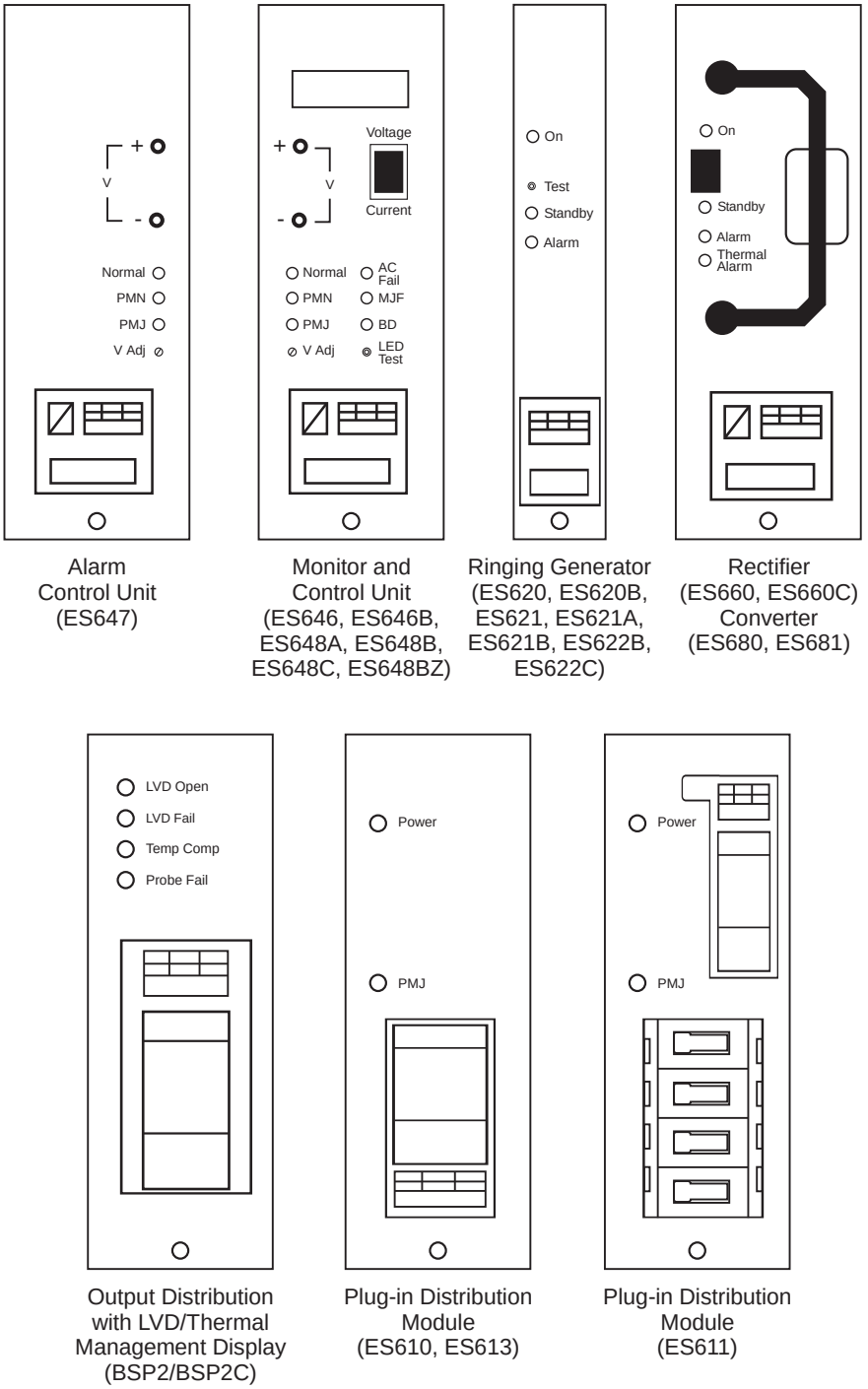
7 Alarms, Controls, and Displays

Displays

Illustration

Figure 7-1 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



Alarm Control Unit (ES647)

Monitor and Control Unit (ES646, ES646B, ES648A, ES648B, ES648C, ES648BZ)

Ringing Generator (ES620, ES620B, ES621, ES621A, ES621B, ES622B, ES622C)

Rectifier (ES660, ES660C) Converter (ES680, ES681)

Output Distribution with LVD/Thermal Management Display (BSP2/BSP2C)

Plug-in Distribution Module (ES610, ES613)

Plug-in Distribution Module (ES611)

Figure 7-1: 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 ES646, ES646B, and ES647 have an adjustment range from 48-57V.
- The ES648A/B/C/BZ control unit can permanently set the plant voltage between 52V and 55V. If the plant voltage is set outside this range, for example, higher than 55 volts to test the high voltage shutdown features, the plant voltage reverts back to its last valid setpoint. The ES648A/B/C/BZ can temporarily adjust the plant voltage between 47.6 and 56.5 volts.
- When turning the voltage adjust screw on the ES648A/B/C/BZ control unit, temperature compensation is temporarily disabled. Temperature compensation returns approximately 10 seconds after the operator stops turning the voltage adjust screw.
- 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.”
- ES648 controllers series 1:2 and greater need to have switch SW1 position 2 in the closed position to enable float voltage adjustment. This is the factory setting. The lower left-most segment of the front panel display will blink when the float voltage is being adjusted.

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.

Front Panel Meter

A 3-1/2 digit, backlit liquid-crystal display is located on the faceplate of the ES646, ES646B, and ES648 MCUs. A toggle switch next to the display selects either the plant voltage or the plant current to be displayed. When the meter select switch is set in the current position, the display indicates primary bus output current. When the meter select

Displays, continued

switch is set to voltage, the display indicates the primary bus (rectifier) output voltage.

LED Test Button Depressing the LED Test button on the MCU will cause all of the LCD segments to display 188.8 and all LEDs in the -48V CPS to light. If the button is depressed for 6 seconds, the MCU will initiate self-diagnostics. The button may be released as soon as the self-diagnostics start.

Control Units

Overview

The control unit (ES646, ES646B, ES648A/B/C/BZ MCUs or ES643 ACU) 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-, two-, or three-shelf plant.

Features

Table 7-A summarizes the ES646, ES647, and ES648 features for primary and secondary outputs.

Table 7-A: Control Unit Features for Primary and Secondary Outputs

Feature	ES646, ES646B, ES648A/B/C/BZ		ES647	
	Primary	Secondary	Primary	Secondary
Plant meter (volts)	Yes	No	No	No
Plant meter (amperes)	Yes	No	No	No
Test point (volts)	Yes	No	Yes	No
Remote test (volts)	Yes	No	No	No
Remote test (amperes)	Yes	No	No	No
Temperature compensation	Yes	No	Yes	No
Plant voltage adjust	Yes	No	Yes	No
PMJ LED	Yes	Yes	Yes	Yes
PMN LED	Yes	Yes	Yes	Yes
ACF LED	Yes	N/A	No	No
MJF LED	Yes	Yes	No	No
BD LED	Yes	N/A	No	No
Plant normal LED	Yes	Yes	Yes	Yes
Rectifier On/Standby	Yes	N/A	Yes	N/A
PMJ office alarm	Yes	Yes	Yes	Yes
PMN office alarm	Yes	Yes	Yes	Yes
Auxiliary PMJ Alarm	Yes	Yes	Yes	Yes
Auxiliary PMN Alarm	Yes	Yes	Yes	Yes
ACF office alarm	Yes	N/A	Yes	N/A
2ACF/LV office alarm	Yes*	No	Yes	No
BD office alarm	Yes	N/A	Yes	No
MJF office alarm	Yes	Yes	Yes	Yes
Plant battery test	Yes	N/A	Yes	Yes
LED test	Yes	Yes	No	No

* The ES646, ES648A, ES648C, and ES647 have a 2ACF alarm; ES646B, ES648B, and ES648BZ have an LV alarm.

Control Units, continued

SW1 Options

Switch 1 on the control units provide feature selection as outlined in Tables 7-B through 7-D. Switch position 1 is not used on any of the control units. The factory default switch settings are: all closed.

Table 7-B: ES646, ES648A, ES648C SW1 Options

Switch	Position	Feature
1	N/A	Not used
2*	Closed	Series 1:2 and greater: Enable float voltage adjustment
	Open	Series 1:2 and greater: Enable boost voltage adjustment
3	Closed	BD alarm also generates a PMJ alarm
	Open	BD alarm does not generate a PMJ alarm
4	Closed	Enable rectifier On/Standby capability
	Open	Disable rectifier On/Standby capability
5	Closed	Enable plant battery test
	Open	Disable plant battery test
6	Closed	Self diagnostics does not send alarms to office alarm connector
	Open	Self diagnostics sends alarms to office alarm connector

*Not used on ES646.

Table 7-C: ES646B, ES648B, ES648BZ SW1 Options

Switch	Position	Feature
1	N/A	Not used
2*	Closed	Series 1:2 and greater: Enable float voltage adjustment
	Open	Series 1:2 and greater: Enable boost voltage adjustment
3	N/A	Not used
4	Closed	Enable rectifier On/Standby capability
	Open	Disable rectifier On/Standby capability
5	Closed	Enable plant battery test
	Open	Disable plant battery test
6	Closed	Self diagnostics does not send alarms to office alarm connector
	Open	Self diagnostics sends alarms to office alarm connector

*Not used on ES646.

Control Units, continued

SW1 Options, continued

Table 7-D: ES647 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

SW2 Options

Switch 2 on the control units provides feature selection as outlined in Table 7-E. Switch positions 3 through 6 are not used on any of the control units. The factory default switch settings are: 1,3,4,5,6 - open; 2 - closed.

Table 7-E: ES648A/B/C SW2 Options

Switch	Position	Feature
1	Closed	Boost mode enabled after a BD event
	Open	Boost mode disabled
2	Closed	NAFTA Temperature Compensation Algorithm
	Open	EURO Temperature Compensation Algorithm
3	Not used	
4		
5		
6		

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 ES646, ES646B, and ES648 MCUs, and the ES647 ACU monitor the plant voltage and issue 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 ES646, ES647, ES648A, and ES648C issue a BD alarm and a PMJ alarm if SW1 position 3 is closed. The ES646B, ES648B, and ES648BZ issue only a BD alarm.

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 7-F. 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 7-F: ES646, ES646B, ES647, and ES648 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 7-G: SW201 LVD Settings

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

Rectifier Alarms

Whenever the control unit receives a single rectifier alarm, it issues a Power Minor (PMN) alarm. A yellow LED lights on the control unit face plate. If the ES646, ES647, ES648A, or the ES648C receives two or more rectifier and/or converter 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 ES646, ES648A, ES648C, or ES647 issues a PMJ.

With the ES646B, ES648B, and ES648BZ, both single and multiple rectifier failures result in a PMN alarm and yellow LED lights.

Ringer/Converter Alarm

Whenever the ES646, ES648A, ES648BZ, or ES647 receive a single ringer/converter fail alarm, it issues a PMN alarm and the yellow LED lights on the control unit faceplate. Two or more ringer/converter failures result in a PMJ alarm.

With the ES648C, both single and multiple ringer/converter failures result in PMN and PMJ alarms, and the yellow and red LEDs light.

Alarms, continued

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.

All control units issue a PMN alarm for a single ac failure:

- the yellow PMN and ACF LEDs on the MCUs will light
- only the PMN will light on the ACU

Two AC Fail Alarm

If ac input power is missing from more than one rectifier:

- ES646, ES648A, and ES648C
  - issue 2ACF, PMJ, and PMN office alarms
  - the PMJ, PMN, and ACF LEDs light
- ES646B, ES648B, and ES648BZ
  - issue the PMN and ACF office alarms
  - the PMN and ACF LEDs light
- ES647
  - PMJ only lights on the ES647

Major Fuse Alarm

The MCUs monitor the distribution for blown fuses and/or tripped circuit breakers. A blown fuse indicates that some part of the customer's equipment has lost power; a Power Major (PMJ) alarm will be issued in addition to the Major Fuse (MJF) alarm (ES648C issues a Power Major (PMJ) alarm only). The red PMJ and MJF (ES646, ES646B, ES648A/B/C/BZ) LEDs on the face plate will light.

Low-Voltage Alarm

The ES646B, ES648B, and ES648BZ issue a low-voltage alarm whenever the plant voltage drops below 46 volts. This alarm retires at 46.5 volts.

Alarm Processing

Overview

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.

Power Major Alarms

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

Power Minor Alarms

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

Supplementary Information

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

The ES646, ES646B, ES648 MCUs, and the ES647 ACU provide the same basic alarm functions; the ES646, ES646B, and ES648 MCUs, however, offer additional alarm LEDs and a front panel display with a toggle switch to display primary voltage or current; they also send two voltages that are proportional to the plant's voltage and load current to the office alarm connector.

The ES646, ES646B, and ES648A/B/C/BZ differ in alarm schemes and alarm presentation.

- The ES646B, ES648B, and ES648BZ replaces the "Two AC Fail" alarm with a "Low-Voltage Alarm" and defines a Battery on Discharge alarm as simply a battery on discharge alarm without a corresponding power major alarm. In addition, the ES646B, ES648B, and ES648BZ issue certain alarm conditions as either minor or major; the ES646 and ES648A issue both a major and minor.

- The ES648C issues power major and power minor alarm when at least one installed ringer or converter has failed or is in the Standby mode. The ES648C replaces the "Major Fuse" alarm with a "Ringer or Converter Fail" alarm on the office alarm connector.

Table 7-H summarizes plant alarms and alarm indications (i.e., contact closures and/or LEDs) of the control units.

Alarm Processing, continued

Table 7-H: Plant Alarm Conditions and Indications

Alarm Condition	ES646 and ES648A		ES646B, ES648B, and ES648BZ		ES648C		ES647		Power Unit LED	BSP2/ BSP2C LED	ES610 ES611 ES613
	Office Alarm (Contact Closure)	LED	Office Alarm (Contact Closure)	LED	Office Alarm (Contact Closure)	LED	Office Alarm (Contact Closure)	LED			
AC Fail (1)	PMN ACF	PMN ACF	PMN ACF	PMN ACF	PMN ACF	PMN ACF	PMN ACF	PMN	--	--	--
AC Fail (2)	PMJ PMN ACF 2ACF	PMJ PMN ACF	PMN ACF	PMN ACF	PMJ PMN ACF 2ACF	PMJ PMN ACF	PMJ PMN ACF 2ACF	PMJ PMN	--	--	--
Battery on Discharge	PMJ* BD	PMJ* BD	BD	BD	PMJ* BD	PMJ* BD	PMJ* BD	PMJ*	--	--	--
Battery Disconnect	PMJ	PMJ	PMJ	PMJ	PMJ	PMJ	PMJ	PMJ	--	--	--
Converter or Ringer Alarm (1)	PMN	PMN	PMN	PMN	PMJ PMN Ringer/ Converter MJF	PMJ PMN	PMN	PMN	Alarm	--	--
Converter or Ringer Alarm (2)	PMN PMJ	PMN PMJ	PMJ	PMJ	PMJ PMN Ringer/ Converter MJF	PMJ PMN	PMJ PMN	PMJ PMN	Alarm	--	--
Converter Standby (1)	PMN	PMN	PMN	PMN	PMJ PMN Ringer/ Converter MJF	PMJ PMN	PMN	PMN	Stby	--	--
Converter Standby (2)	PMN PMJ	PMN PMJ	PMJ	PMJ	PMJ PMN Ringer/ Converter MJF	PMJ PMN	PMJ PMN	PMJ PMN	Stby	--	--
Distribution Fuse Alarm	PMJ MJF	PMJ MJF	PMJ MJF	PMJ MJF	PMJ	PMJ MJF	PMJ MJF	PMJ	--	--	PMJ or PMN**
Excess Battery Temp***	PMJ	PMJ	PMJ	PMJ	PMJ	PMJ	PMJ	PMJ	--	--	--
Low Voltage	N/A	N/A	LV (2ACF)	BD	N/A	N/A	N/A	N/A	--	--	--
LVD Fail	PMN	PMN	PMN	PMN	PMN	PMN	PMN	PMN	--	LVD Fail	--

continued on next page

Table 7-H: Plant Alarm Conditions and Indications (continued)

Alarm Condition	ES646 and ES648A		ES646B, ES648B, and ES648BZ		ES648C		ES647		Power Unit LED	BSP2/ BSP2C LED	ES610 ES611 ES613
	Office Alarm (Contact Closure)	LED	Office Alarm (Contact Closure)	LED	Office Alarm (Contact Closure)	LED	Office Alarm (Contact Closure)	LED			
LVD Open	PMJ	PMJ	PMJ	PMJ	PMJ	PMJ	PMJ	PMJ	--	LVD Open	--
Major Fuse Alarm	PMJ MJF	PMJ MJF	PMJ MJF	PMJ MJF	PMJ	PMJ MJF	PMJ MJF	PMJ	--	--	--
Probe Fail	PMN	PMN	PMN	PMN	PMN	PMN	PMN	PMN	--	Probe Fail	--
Rectifier Alarm** (1)	PMN	PMN	PMN	PMN	PMN	PMN	PMN	PMN	Alarm	--	--
Rectifier Alarm** (2)	PMN PMJ	PMN PMJ	PMN	PMN	PMJ PMN	PMJ PMN	PMJ PMN	PMN PMJ	Alarm	--	--
Rectifier Standby (1)	PMN	PMN	PMN	PMN	PMN	PMN	PMN	PMN	Stby	--	--
Rectifier Standby (2)	PMN PMJ	PMN PMJ	PMN	PMN	PMN PMJ	PMN PMJ	PMN PMJ	PMN PMJ	Stby	--	--
Temp Comp	--	--	--	--	--	--	--	--	--	Temp Comp	--

*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.

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.

ES646, ES647, ES648A Control Units

A set of Form-C contacts is brought out on J6 for each of the following plant alarms for the ES646, ES647, and ES648A:

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

ES646B, ES648B, and ES648BZ Control Units

The set of Form-C office alarm contacts for the ES646B, ES648B, and ES648BZ is as follows:

- Power Major (PMJ)
- Power Minor (PMN)
- Battery on Discharge (BD)
- AC Fail (ACF)
- Low Voltage (LV)
- Major Fuse Alarm (MJF)

ES648C Control Unit

The set of Form-C office alarm contacts for the ES648C is as follows:

- Power Major (PMJ)
- Power Minor (PMN)
- Battery on Discharge (BD)
- AC Fail (ACF)
- 2AC Fail (2ACF)
- Ringer/Converter Fail

Office Alarm Contacts, continued

J6 Pin Assignments

Table 7-I gives the office alarm pin assignments on J6.

Table 7-I: Office Alarm Assignments (J6)

Pin Number	Office Alarm	Color
1	PMJ_NO	W-BL
2	PMJ_C	BL-W
3	PMJ_NC	W-O
4	PMN_NO	O-W
5	PMN_C	W-G
6	PMN_NC	G-W
7	BD_NO	W-BR
8	BD_C	BR-W
9	BD_NC	W-S
10	MJF_NO Ringer/Converter_NO	S-W
11	MJF_C Ringer/Converter_C	R-BL
12	MJF_NC Ringer/Converter_NC	BL-R
13		
14	2ACF_NO/LV_NO	R-O
15	2ACF_C/LV_C	O-R
16	2ACF_NC/LV_NC	R-G
17		
18	EARTH_GND	G-R
19	AUX_PMJ	R-BR
20	AUX_PMN	BR-R
21	BATT	R-S
22	ACF_NO	S-R
23	ACF_C	BK-BL
24	ACF_NC	BL-BK
25	R_VV	BK-O
26	R_VI	O-BK
27	R_RTN	BK-G
28	R_O/S_IN	G-BK
29	PBT	BK-BR
30	O/S_RTN	Y-BL
31	EXT_E_GOOD(NO)*	BR-BK
32	EXT_E_COM(C)*	BK-S
33	EXT_E_ALARM(NO)*	S-BK
34	EE_ACT_NO*	Y-G
35	EE_ACT_COM*	G-Y
36	EARTH_GND	BL-Y
*Applies to ES648A/B/C/BZ control units only.		

Self-Diagnostics Routine

ES646, ES646B, ES648 MCUs

For plants equipped with the ES646, ES646B, or ES648 MCU, a series of self diagnostics can be performed. Depressing the LED Test button on the MCU faceplate for more than 6 seconds will initiate the self-diagnostic routine in which the PMJ, PMN, ACF, 2ACF/LV, Aux PMN, Aux PMJ, MJF, and BD alarms are tested as well as the analog signals that are proportional to the plant current. If SW1-6 on the MCU circuit pack is closed, then the test alarms are not sent to the office alarm connector. If SW1-6 is open, the test alarms are sent to the office connector.

Test Failure Codes

Test failures are momentarily set to the MCU's LCD display as follows:

Code	Failure
188.0	2 RFA
188.1	2 CFA/Ringer
188.2	2 ACF
188.3	BD
188.4	Batt PMJ
188.5	Batt PMN
188.6	MJF
188.7	Remote voltage proportional to the plant current

In addition to these self-diagnostics, the rectifier voltage adjust signal is monitored continuously. If the actual voltage is not within 10% (I/V) of the proportional value, the voltage adjust signal is disconnected from the rectifiers and a PMN is issued.

Note

This test reports on the integrity of the alarm unit only. It does not verify system faults reported by the alarm unit.

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.

Boost Mode

Overview

This function recharges the batteries after a BD (Battery on Discharge) event has occurred.

The ES648A, ES648B, ES648BZ, and ES648C control units along with the ES660C rectifiers provide the Boost Mode function.

The Boost Mode is independent of the PMJ alarm being generated with a BD event. After the plant has experienced a BD event, the control unit will drive the rectifiers to approximately 58.1 volts. The temperature compensation feature will be disabled; however, the control unit will continue to monitor the battery temperature and issue a battery temperature alarm and/or decrease the plant voltage to approximately 48 volts if the highest battery temperature attained is greater than 75°C.

Note: The Boost Mode function should not be enabled if there are any ES660 rectifiers installed in the system.

To enable the Boost Mode function, operate the SW2 position on the control unit to the closed position. The boost mode will last a minimum of 5 minutes to a maximum of 8 hours, or until the total battery current is less than 5 amperes. To manually exit the boost mode, perform an LED Test.

Boost Voltage Adjust

ES648 controllers series 1:2 and greater have the capability to adjust the boost voltage from 54.5 to 58.1 volts. The factory setting is 58.1. To adjust the boost voltage, set switch SW1 position 2 to the open position and insert the controller into a powered shelf. Place the front panel Voltage/Current switch to the Voltage position. The boost voltage can now be adjusted using **V Adj** on the front panel. While adjusting, the front panel display will display the boost voltage, and the upper left-most segment will blink indicating that the boost voltage is being adjusted. The plant voltage will remain at the float level during this procedure. When the left-most segment stops blinking, the new boost voltage setting is registered by the controller.

After adjusting the boost voltage, set switch SW1 position 2 back to the closed position to enable float voltage adjustments. The boost voltage setting can be verified with the procedure described in Section 5.

External Equipment

External Equipment Alarm

The external equipment alarm applies to the ES648 control units only. Refer to Table 7-I for external equipment alarm connections to the ES648 control unit.

There are no visual or audible alarms on the CPS shelf that are associated with the External Equipment Alarm. A fan that generates an isolated contact closure if it has failed or a door interlock that generates an isolated contact closure if the door is open may be connected to J6-33 and J6-32. The status of this alarm can be determined by using the remote access feature with T1.317 commands or with EasyView software.

Datalogger Outputs

Overview

The ES646, ES646B, and ES648 control units send two analog voltages to the office alarm connector for monitoring the plant voltage and current remotely. The primary voltage equals the measured voltage multiplied by 25. There is a 31.6K ohm in series with each lead to form a Class 2 circuit. The voltage measured between R_VI (J3-26) and R_RTN (J3-27) is proportional to the plant load current. This voltage multiplied by 25 equals the load current.

Each CPS4000+ shelf also has the means to monitor the output current of the secondary output through the use of connector J15, located on the right-hand side of the shelf. The voltage at J15 is proportional to 1mV per ampere of secondary output current. The contacts on connector J15 are protected against accidental short-circuit to frame ground and will automatically recover.

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°), 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°) and lights a [yellow/BSP2 or green/ BSP2C] LED on the LVD/Thermal Management circuit pack.

Use DIP Switch SW 2.2 on the ES648 MCUs to choose the appropriate algorithm for this feature:

- Open is EURO Mode
- Closed is NAFTA Mode

These algorithms are illustrated in Figures 7-2 and 7-3.

LVD/Thermal Management, continued

NAFTA 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.

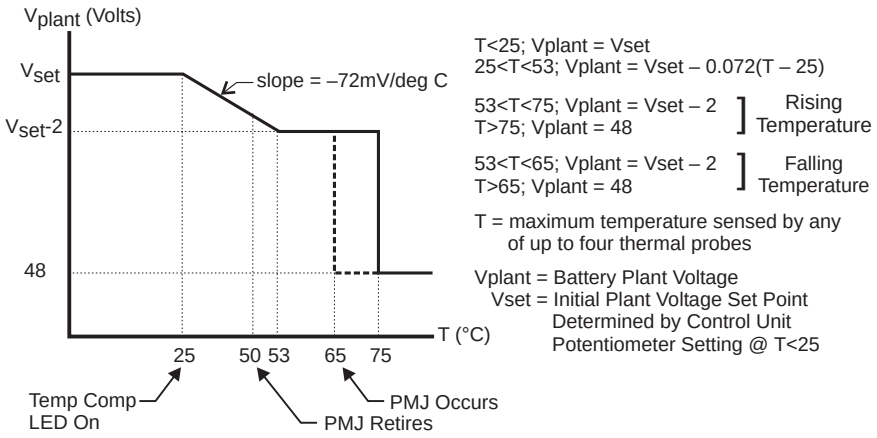


Figure 7-2: -48V Slope Temperature Compensation NAFTA Mode Algorithm

The ES647 ACU and ES646 MCUs provide the NAFTA Mode thermal management control feature, which is illustrated in Figure 7-2.

ES648 MCUs provide the factory-set NAFTA Mode thermal management control that is switch-selectable to EURO Mode (Option), which is shown in Figure 7-3.

LVD/Thermal Management, continued

EURO Mode Algorithm

- As temperature rises between 20°C (68°F) and 53°C (127°F), plant voltage is lowered 72mV per degree.
- As the temperature decreases below 20°C (68°F), the plant voltage increases at the same rate of 72mV per degree until it reaches a maximum of 56.7 volts.
- For temperatures between 53°C (127°F) and 75°C (167°F), the plant voltage depends upon the plant set voltage. If the plant set voltage is between 52 and 54.5, the voltage will be at two volts less than the uncompensated battery float voltage. If the plant set voltage is between 54.5 and 55, the plant voltage will be determined by the formula: $V_{min} = 121.125 - 1.25 * V_{set}$
- For temperatures higher than 75°C (167°F), the plant voltage is reduced to approximately 47.5 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.

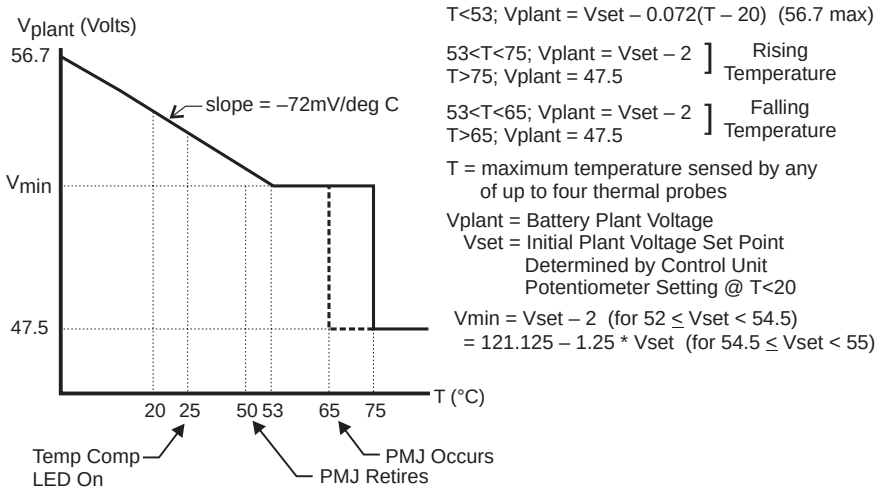


Figure 7-3: -48V Slope Temperature Compensation EURO Mode Algorithm

ES648 MCUs provide the switch-selectable EURO Mode thermal management option (illustrated in Figure 7-3), with the NAFTA Mode the factory-set standard.

8 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.

Power Units, continued

LED Test

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

LED Test	
Step	**Action**
1	Press the LED Test button on the MCU face plate.
2	While the LED Test button is depressed all front panel LEDs should be illuminated.
3	To initiate self-diagnostics for the MCUs, depress the LED Test button for 6 seconds. See “Self-Diagnostics Routine” in Section 7.

9 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.

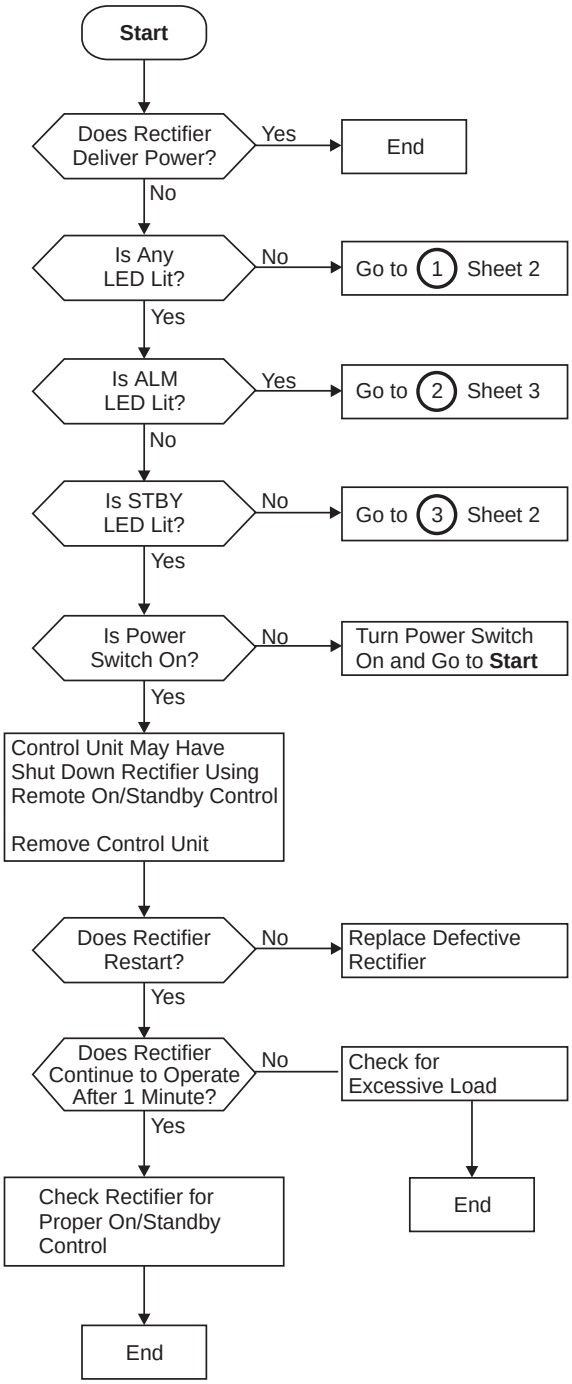
AC input voltages are provided to the CPS via multiple input cables. Ensure that the circuit protector for each ac input is disconnected while installing or servicing this equipment.

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

Flowcharts

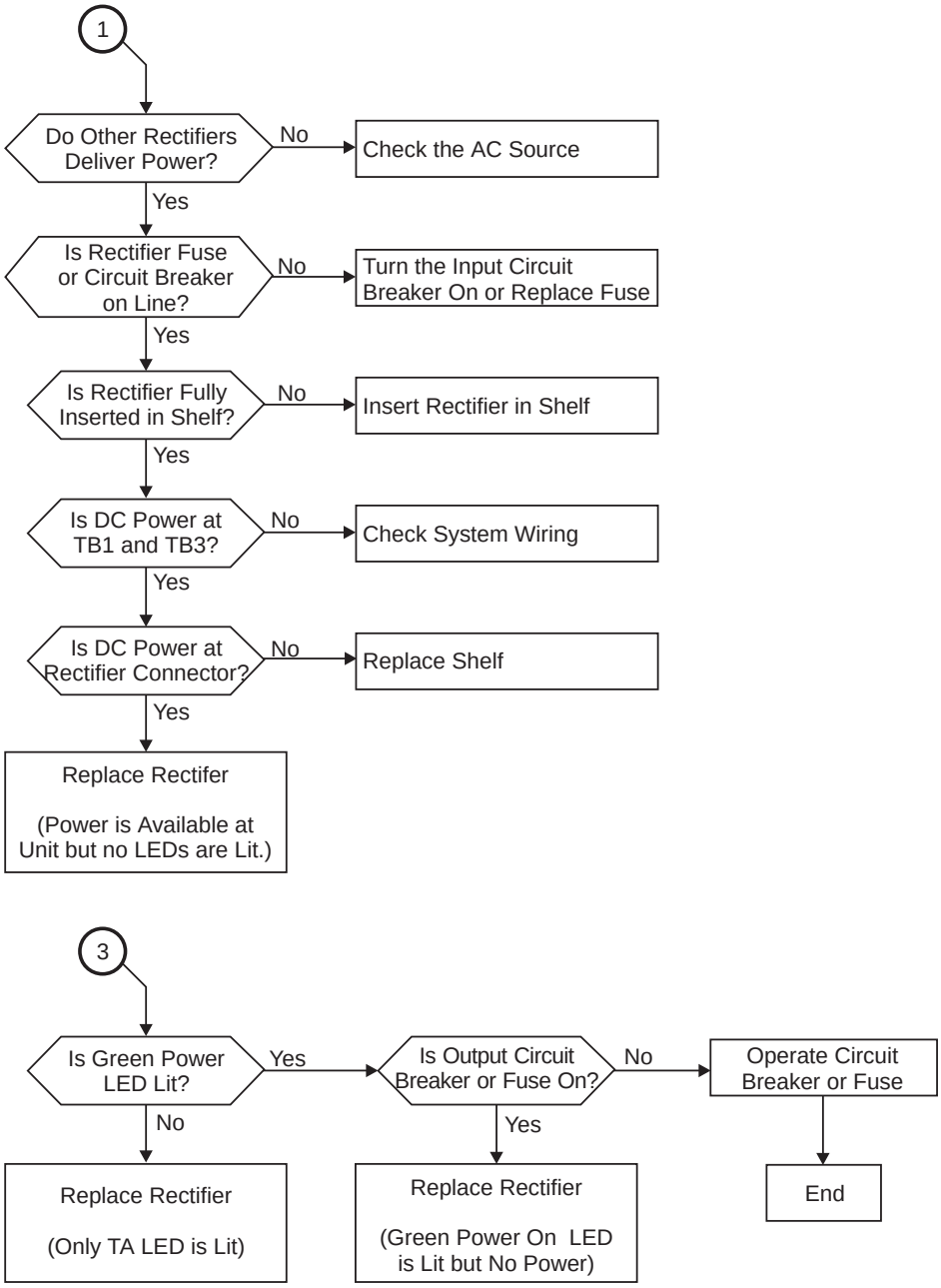
The following flowcharts list indications and the corrective action(s) to take when a rectifier or converter does not deliver power. Match specific site conditions to those listed in the chart. If none of these corrective actions remedies the problem, call GE Critical Power Technical Support.

Rectifier Flowchart



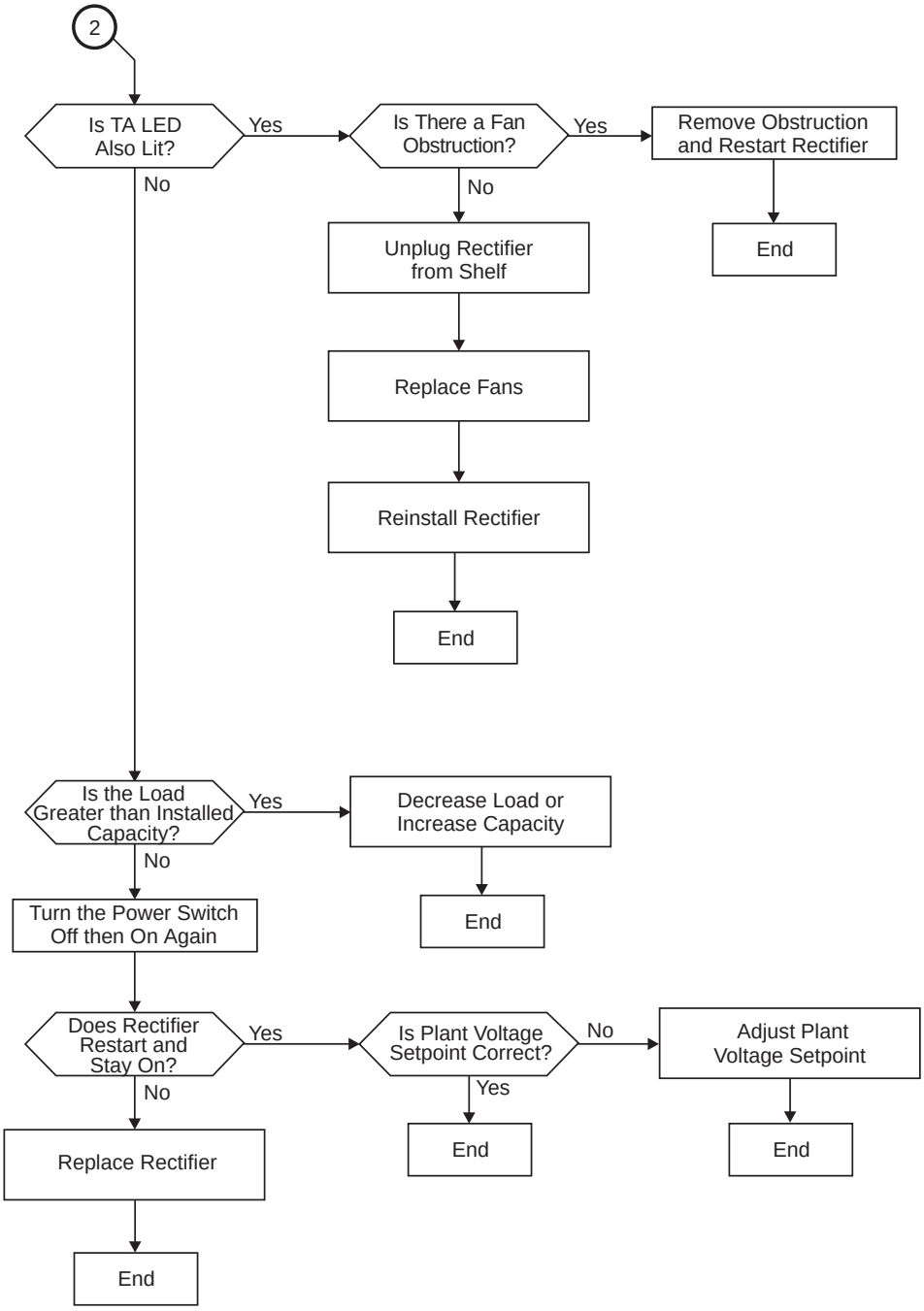
Sheet 1

Rectifier Flowchart, continued



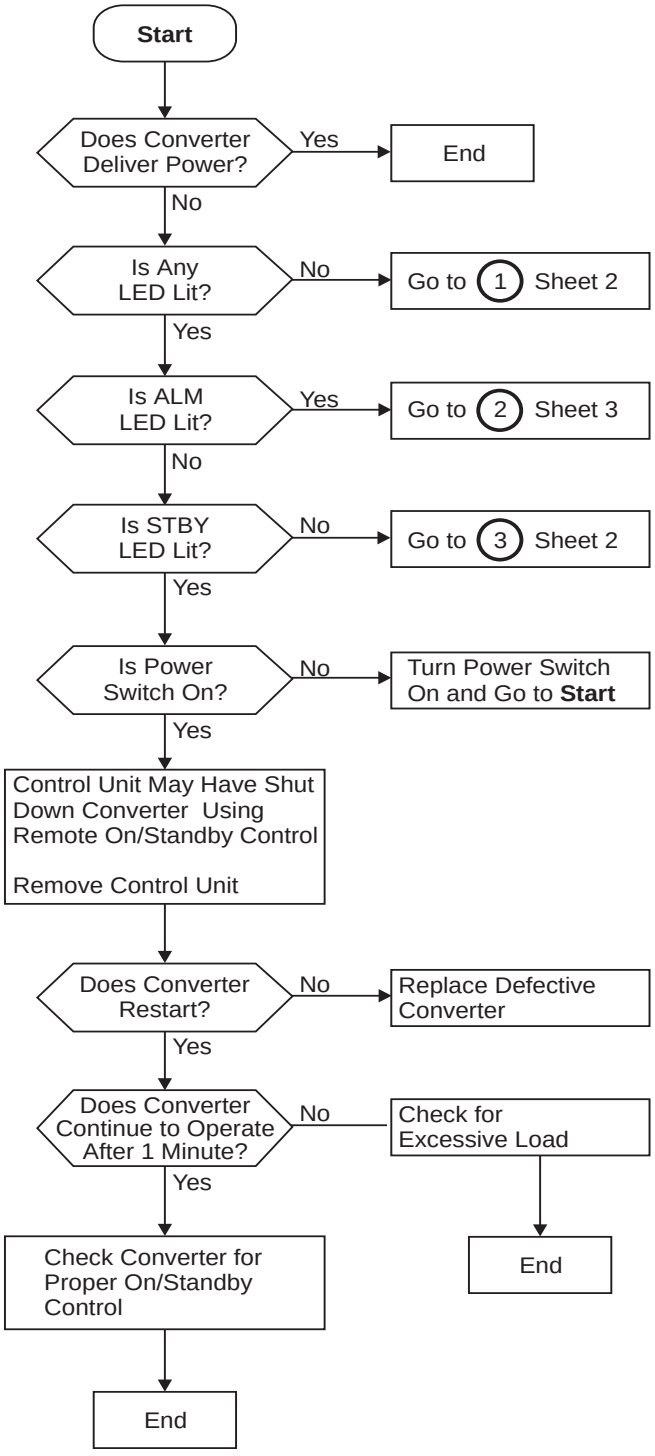
Sheet 2

Rectifier Flowchart, continued



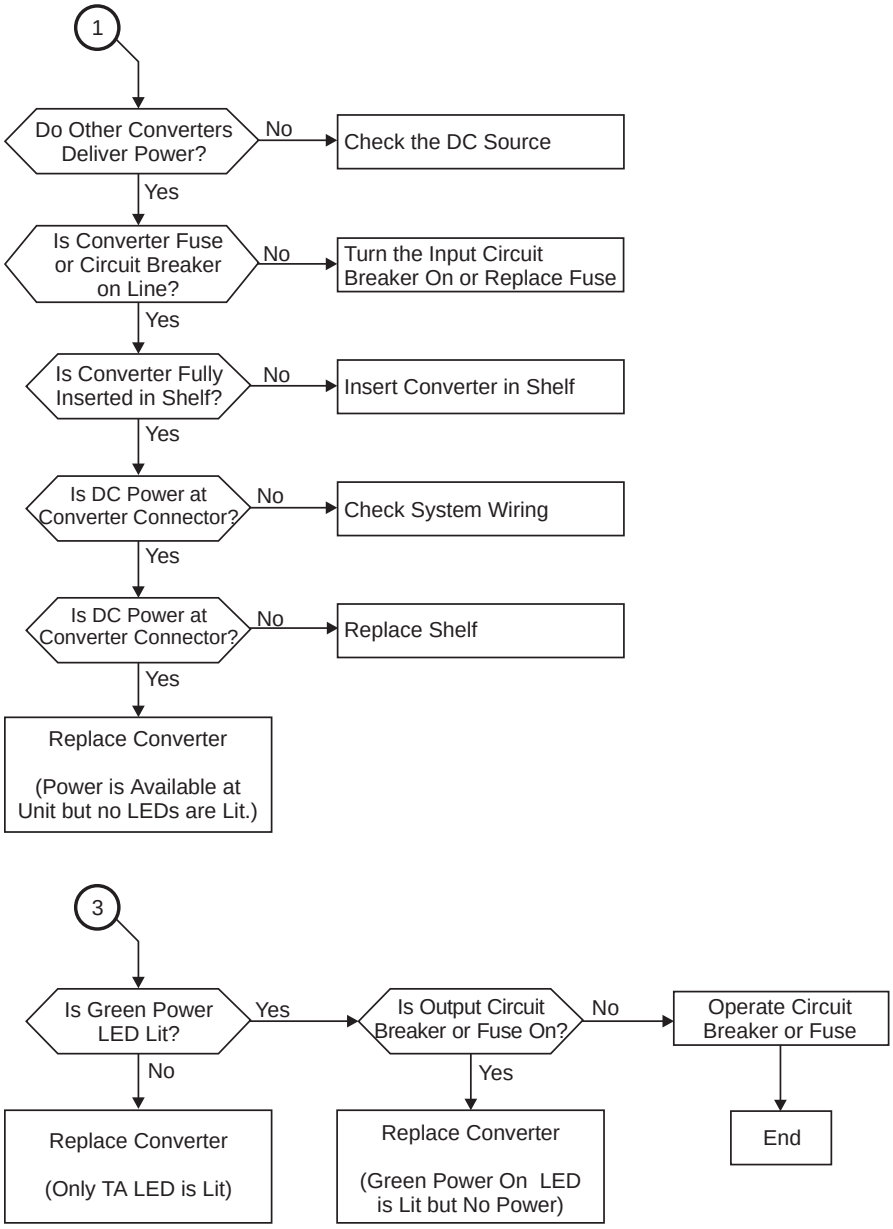
Sheet 3

Converter Flowchart



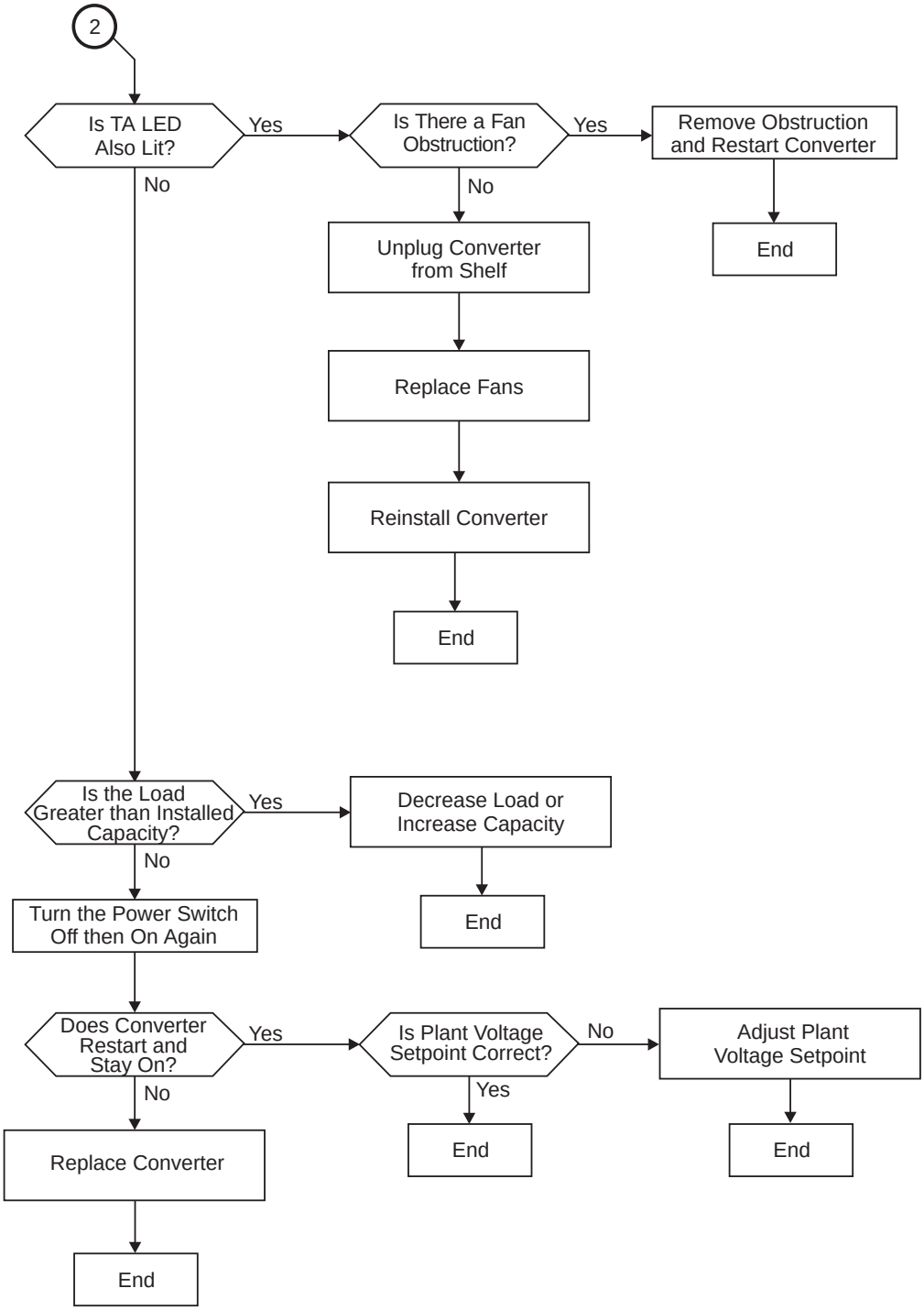
Sheet 1

Converter Flowchart, continued



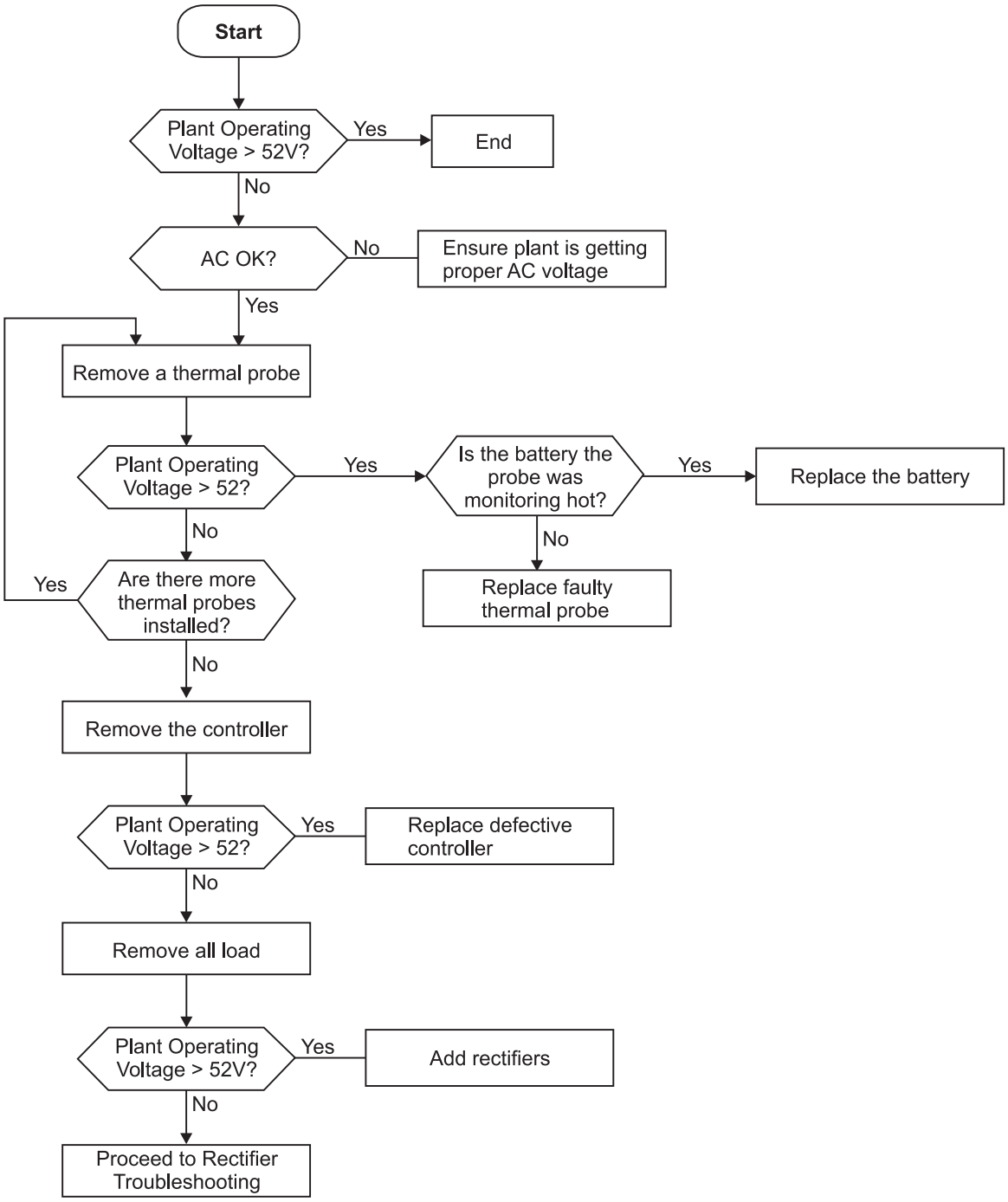
Sheet 2

Converter Flowchart, continued



Sheet 3

Unexplained BD Troubleshooting Process



After the Problem Has Been Resolved

If the controller has been replaced, check the plant voltage and verify that it is set to the appropriate level for your batteries.

Appendix A Regulatory Statements

FCC Part 68 Regulatory Statement

The EMC1 modem board complies with Part 68 of the Federal Communications Commission Rules. On the outside surface of this equipment is a label that contains the FCC registration number.

FCC Registration Number: TYCMUL-43100-MD-E

An FCC Compliant modular jack is provided with this equipment. This equipment is designed to be connected to the telephone network or premises wiring using a compatible modular plug which is Part 68 compliant. See installation instructions for details.

If this equipment causes harm to the telephone network, the telephone company will notify GE Critical Power in advance that temporary discontinuance of service may be required. But if advance notice is not practical, the telephone company will notify GE Critical Power as soon as possible. The customer also has the right to file a complaint with the FCC if necessary.

The end use customer may make changes in its facilities, equipment, operations or procedures that could affect the operation of this equipment. If this happens, the customer will provide advance notice in order for GE Critical Power to make any necessary modifications to maintain uninterrupted service.

Customers who experience trouble with the EMC1 should contact GE Critical Power Technical Support. If the equipment is causing harm to the network, the customer can remove the equipment from the network until the problem is solved.

The purchaser of this product should not make any repairs to the EMC1. Repairs are to be made only by GE Critical Power or its licensees. Unauthorized repairs void registration and warranty.

This equipment cannot be used on public coin service provided by the telephone company. Connection to Party Line Service is subject to state tariffs. (Contact the state public utility commission, public service commission or corporation commission for information.)

Industry Canada Certification

NOTICE: The Industry Canada label identifies certified equipment. This certification means that the equipment meets telecommunications network protective, operational and safety requirements as prescribed in the appropriate Terminal Equipment Technical Requirements document(s). The Department does not guarantee the equipment will operate to the user's satisfaction.

Before installing this equipment, users should ensure that it is permissible to be connected to the facilities of the local telecommunications company. The equipment must also be installed using an acceptable method of connection. The customer should be aware that compliance with the above conditions may not prevent degradation of service in some situations.

Repairs to certified equipment should be coordinated by a representative designated by the supplier. Any repairs or alterations made by the user to this equipment, or equipment malfunctions, may give the telecommunications company cause to request the user to disconnect the equipment.

Users should ensure for their own protection that the electrical ground connections of the power utility, telephone lines and internal metallic water pipe system, if present, are connected together. This precaution my be particularly important in rural areas.

Caution: Users should not attempt to make such connections themselves, but should contact the appropriate electric inspection authority, or electrician, as appropriate.

NOTICE: The Ringer Equivalence Number(REN) assigned to each terminal device provides an indication of the maximum number of terminals allowed to be connected to a telephone

interface. The termination on an interface may consist of any combination of devices subject only to the requirement that the sum of the Ringer Equivalence Numbers of all the devices does not exceed 5.

European Union Statement

The subject controller, when incorporated with EMC1, is not intended to be connected to a public telecommunications network in the European Union Member States.

The connection of such equipment to a public telecommunications network in the Community Member State will be in violation of the national law implementing Directive 1999/5/EC of the European Parliament and the Council of 9 March 1999 on radio equipment and telecommunications terminal equipment and the mutual recognition of their conformity.

Appendix B Glossary

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 (ES647) 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.

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

ES622C	Ringing Generator; 100VA, 100Vac, 20Hz
ES646/ES646B	Monitor and Control Unit; for use in -48Vdc CPS battery plants
ES647	Alarm Control Unit; for use in -48Vdc CPS battery plants
ES648A/B/C	Monitor and Control Unit; for use in both -48Vdc and +24Vdc battery plants
ES648BZ	Monitor and Control Unit with remote access and control functions; for use in both -48Vdc and +24Vdc battery plants
ES660	Rectifier; power module that converts ac into -48Vdc with load current rating of 12.5 amperes
ES660C	Rectifier; power module that converts ac into -48Vdc with load current rating of 15.0 amperes
ES680	Converter; power module that converts -48Vdc to 130Vdc
ES681	Converter; power module that converts -48Vdc to 24Vdc
ESD	Electrostatic discharge
EURO Algorithm	European slope thermal compensation
LED	Light emitting diode
LV	Low-voltage alarm issued when the CPS plant voltage drops below a threshold

LVD	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.
Major Fuse Alarm (MJF)	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.
MCU	Monitor and Control Units (ES646, ES646B, ES648A, ES648B, ES648C, and ES648BZ); provide plant monitoring, display and control features, and office alarm outputs
NAFTA	North American Free Trade Association
NEC	National Electric Code
Normal	This green LED lights while there are no alarms and the plant is operating normally and is able to furnish power to the load.
Output Voltage Adjust	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.
Power Major Alarm (PMJ)	Conditions that impact service and require immediate attention are classified as major alarms and designated as Power Major (PMJ) alarms. (Red LEDs signify major alarms.)
Power Minor Alarm (PMN)	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.)
Power On/Standby Switch	This two-position switch determines the operational status of the rectifier.
Rectifier Alarm	A signal to the control unit indicating low rectifier output voltage resulting from a rectifier failure or excess load

Signal Interface	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
Standby	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.
TB	Terminal block
Thermal Alarm (TA)	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.
Voltage Test Jacks	Test jacks are provided to measure the plant primary output voltage.
Volts Adjustment (Vadj)	This is a recessed encoder used to adjust the plant output primary voltage.

Revision History

Issue 19	Rebranding.
Issue 18	Rebranding.
Issue 17	Updated ordering information and troubleshooting section.