Lucent Technologies
Bell Labs Innovations

CPS2000
Cabinet Power System
J85582R-2

Product Manual
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July 2000

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Notice:
Every effort was made to ensure that the information in this document was complete and accurate at the time of printing. However, information is subject to change.

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1 Introduction

CPS2000

Overview

The Cabinet Power System 2000 (CPS2000) is an extremely flexible power system designed for cabinet applications where space conservation and environmental considerations are critical. The entire system fits into either a 23" or 19" shelf. By limiting the system depth to 12 inches, CPS2000 architecture permits the cabinet designer to locate revenue-generating equipment behind the power system in 24-inch deep cabinets. By designing the rectifiers to operate in ambient temperatures of -40° to 50°C (-40° to 122°F) without forced air circulation, and up to 75°C (167°F) with forced air circulation, the CPS2000 furnishes a reliable power solution for various outside plant applications.

The rectifier-ringer plant provides 48-volt power and ringing on a single shelf.

The ringer plant is compliant with ETSI 300mm (11.8″) rack mount dimensions with a depth of 295mm (11.6″).

Applications

Lucent Technologies developed the CPS2000 plant to satisfy the growing needs of outside plant and customer premises markets. Its multiple power bus architecture of the rectifier-ringer plant supports applications where more than one voltage is required, which saves investment in two separate power plants. Typical applications of the CPS2000 include cellular telephone systems, digital loop carrier systems, cable television systems, intelligent vehicle highway systems, personal communications systems, and remote switching cabinets.

The ringer plant provides up to six 50VA outputs plus a redundant spare. It is powered by -48Vdc. A typical application of the ringer plant is access switches.

CPS2000, continued

Configurations

Rectifier-ringer plants are available in both 23" and 19" shelves. Both shelves provide facilities to combine rectifiers, ringing generators (ringers), a monitor and control unit or alarm control unit, a low-voltage battery disconnect feature, and input and output distribution in a single shelf. The 23" plant is available with battery disconnect circuit breakers.

Ringer plants are available in 19" shelves. Mounting adapters are available for ETSI and 23" rack applications.

Rectifier-ringer plants provide the facilities for up to two output voltages in a single shelf design. The rectifier output voltage is considered the primary voltage and the plant can be configured to accommodate a secondary ringer output voltage.

CPS2000 shelves are available in three configurations:

- A rectifier plant with two ac feeders per shelf, one for rectifier slots 1 and 2 and one for rectifier slots 3 and 4.
- A rectifier-ringer plant with up to three rectifiers and two ringers with one or two ac inputs. This system is appropriate for applications where battery-backed power is required for one load and regulated ringing voltage is needed for a second load.
- A ringer plant with up to seven ringers and redundant inputs. This system provides up to six 50VA ringing outputs with n+1 redundancy.

Figure 1-1 is an example of a 23" rectifier-ringer plant. Figure 1-2 shows an example of a 19" rectifier-ringer plant. Figure 1-3 shows an example of a 19" ringer plant.

CPS2000, continued

Illustrations

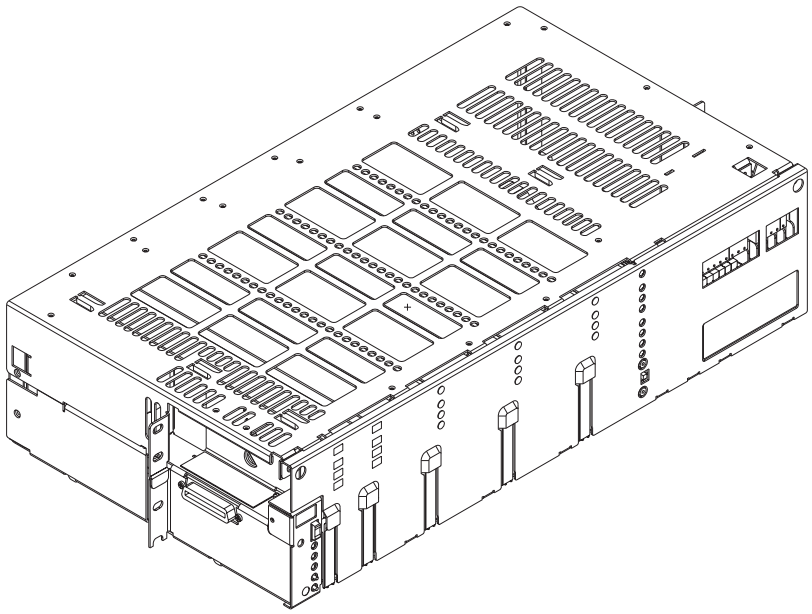


Figure 1-1: Rectifier-Ringer Plant—23"

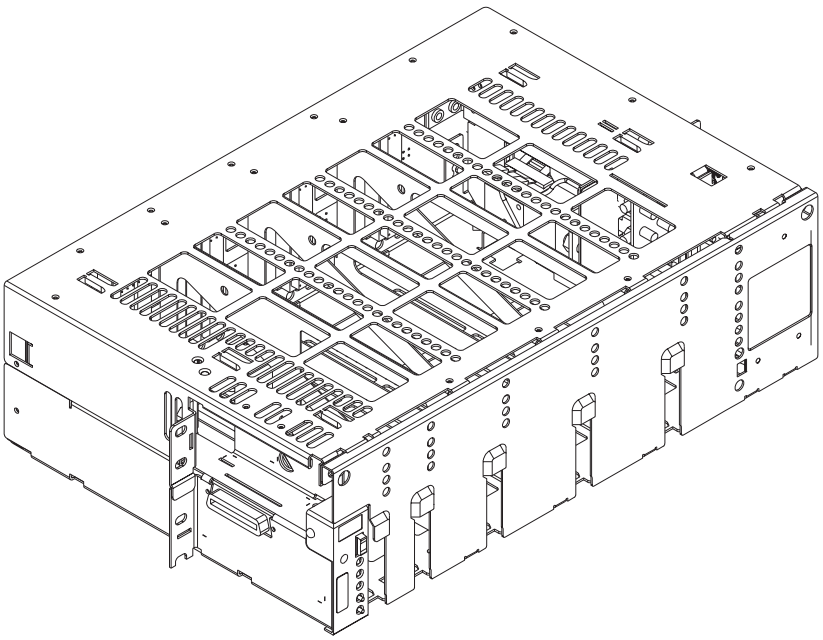


Figure 1-2: Rectifier-Ringer Plant—19"

CPS2000, continued

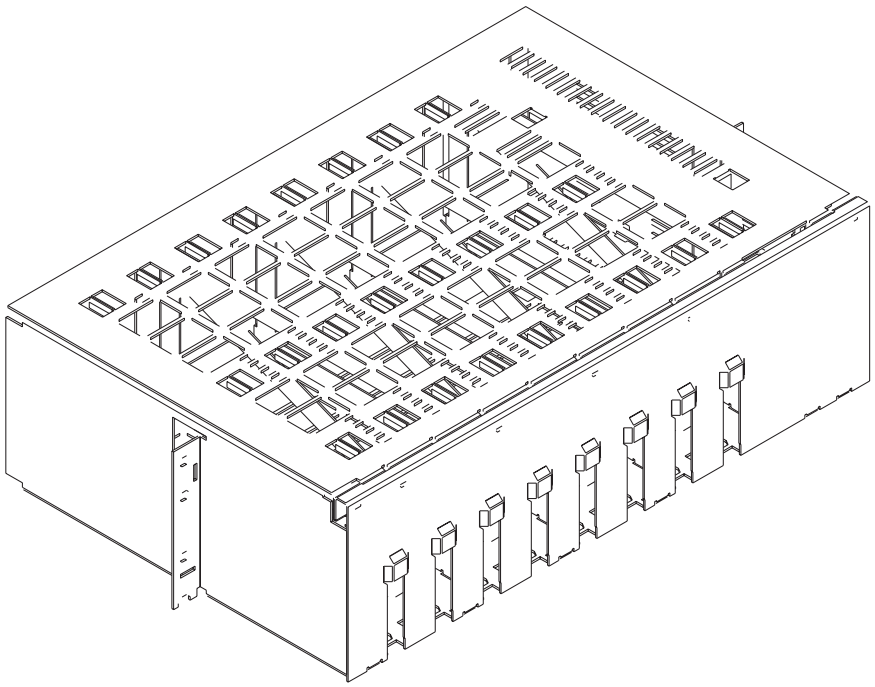


Figure 1-3: Ringer Plant—19"

CPS2000, continued

Enhancements

Table 1-A: CPS2000 Enhancements	
Enhancement	**Description**
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
NEBS Level 3 compliance	Demonstrates safety and EMC compliance to US market standards

Customer Assistance Contacts

Customer Training

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

Customer Service

For customers in the United States, Canada, Puerto Rico, and the US Virgin Islands, call 1-800-THE-1PWR (1-800-843-1797). Services provided through this contact include initiating the spare parts procurement process for out of service emergencies, ordering Lucent Technologies documents, and providing other product and service information.

For other customers worldwide, call 001-972-840-0382. This number is answered from 8:00 a.m. until 4:30 p.m., Central Time Zone (Zone 6), Monday through Friday.

Technical Support

Technical support for Lucent Technologies customers is available around the world during the normal product warranty period and also while specific contractual agreements extend this service.

For customers in the United States, Canada, Puerto Rico, and the US Virgin Islands, call 1-800-CAL-RTAC (1-800-225-7822) to contact a product specialist to answer your technical questions and assist in troubleshooting problems.

For other customers worldwide, contact your local field support center or your sales representative to discuss your specific needs.

Product Repair and Return

Repair and return service is provided for Lucent Technologies customers around the world.

For customers in the United States, Canada, Puerto Rico, and the US Virgin Islands, call 1-800-255-1402 for information on returning of products for repair.

For other customers worldwide, contact your sales representative to discuss your particular circumstances.

Customer Assistance Contacts, continued

Warranty Service

For domestic warranty service, contact your Warranty Service Manager (WSM). For international warranty service, contact your sales representative.

On-Line Power Systems Product Manuals

For Lucent Technologies users logging in from inside the corporate firewall, the address of the "Power Systems On-Line Product Manuals" page is *http://www.cic.lucent.com/lineage.html*.

For customers logging in from outside the firewall, the address is *http://www.lucent8.com/lineage.html*. The annual subscription fee for access to this site is $25. To obtain a password, follow the instructions on-line or call 1-888-Lucent8 (1-888-582-3688). When prompted for an order number, enter or say "167-790-010."

2 Product Description

Block Diagrams

Rectifier-Ringer Plants

Figure 2-1 is a block diagram of the CPS2000 rectifier-ringer plants. The battery plant accepts alternating current from the commercial utility or a standby ac power source and rectifies it to produce dc power for the using equipment. The plant's control and alarm functions interact with the rectifiers and the monitoring office. In addition, the plant provides overcurrent protection, charge, discharge, and distribution facilities. Battery reserve automatically provides a source of dc power if the commercial standby ac fails. This battery reserve is engineered to supply dc power for a specific period of time. In normal practice, battery capacity is sized to provide 3 to 8 hours of reserve time.

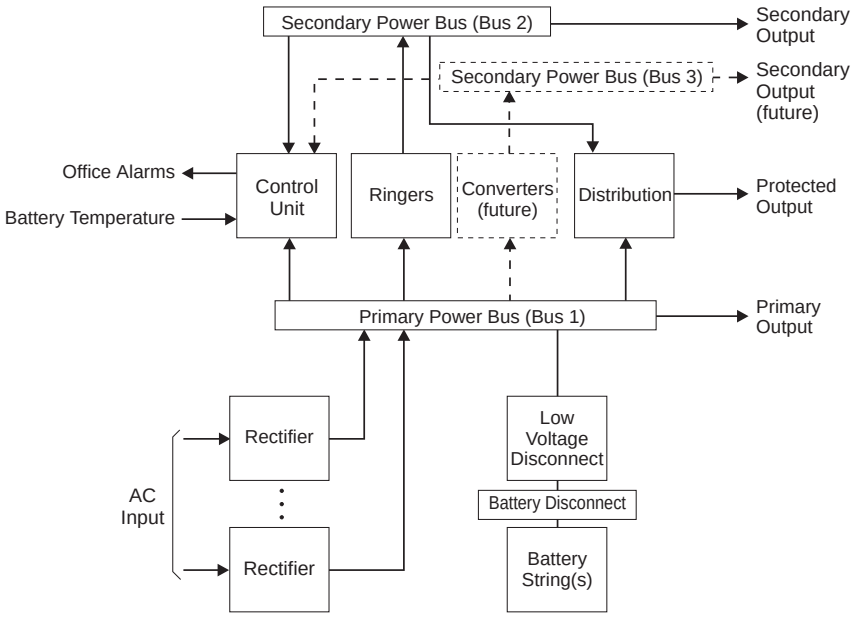


Figure 2-1: Block Diagram of Rectifier-Ringer Plant

Block Diagrams, continued

Ringer Plant

Figure 2-2 is a block diagram of the CPS2000 ringer plant. The plant accepts -48Vdc from a battery plant. The ringers and controllers are powered by -48Vdc. The controller interacts with the ringers to switch the redundant spare ringer to the output of a failed or removed ringer. The controller also provides office alarms. Dual dc feeds are internally isolated and alarmed. Each dc feed is provided with voltage surge protection that may be disconnected via a jumper plug. Ringer outputs may be tip-earthed via a jumper plug.

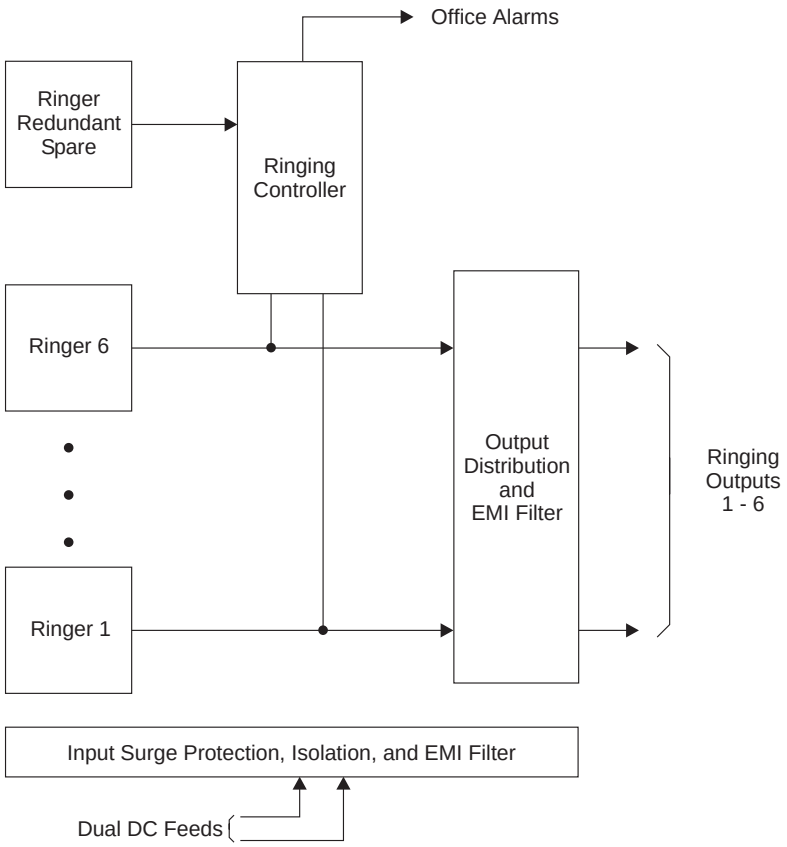


Figure 2-2: Block Diagram of Ringer Plant

Plant Design

Configurations

CPS2000 plants are orderable in 23" or 19" shelf configurations. Each shelf assembly houses and interconnects rectifiers, the control unit, and distribution. The shelf design provides modular, plug-in architecture that simplifies plant assembly and repair, permits growth of plant capacity, and provides easy maintenance without interruption of service. Keying prevents improper insertion of incompatible modules.

Both 19" and 23" shelves are orderable with two basic configurations:

- A rectifier plant with two ac feeders per shelf, one for rectifier slots 1 and 2 and one for rectifier slots 3 and 4
- A rectifier-ringer plant with up to three rectifiers and two ringers with one or two ac inputs

An ETSI compatible 19" shelf is orderable as a ringer plant with up to six ringer outputs.

Components

Rectifier-ringer plants:

The components of the CPS2000 system can be combined in a single shelf.

The rectifier-ringer plant provides four equipment slots. Slots one through four accept rectifiers. Slot one also accepts two ringing generators. Both the 23" and 19" shelves are orderable with single or dual ac input. The shelves are equipped with facilities for two output voltages. The rectifier 48-volt output voltage is considered the primary voltage. In the 19" shelf this voltage can be configured for either bulk or fused output. Ringers provide the secondary output voltage.

The left side of the rectifier-ringer plant provides ac input distribution, a connector for the office alarms, and the Monitor and Control Unit, including battery thermal protection circuits.

The right side of the rectifier-ringer plant provides output distribution including a low-voltage battery disconnect/reconnect contactor and the associated control and alarm circuits, battery terminations, battery disconnect circuit breakers (23" shelf only), and load terminations.

Plant Design, continued

Ringer plants:

The ringer plant provides eight equipment slots. Slots one through six and slot eight accept ringing generators. Slot seven accepts the controller. The 19" ETSI rack compatible shelf comes equipped with dual, redundant dc inputs. In applications not requiring dc input redundancy, both inputs may be powered by the same feed. Six independent ringer outputs are provided.

The right side of the ringer plant provides input, office alarm, and output distribution.

Illustration Figure 2-3 shows front, open views of the 23" and 19" rectifier-ringer and 19" ringer plants.

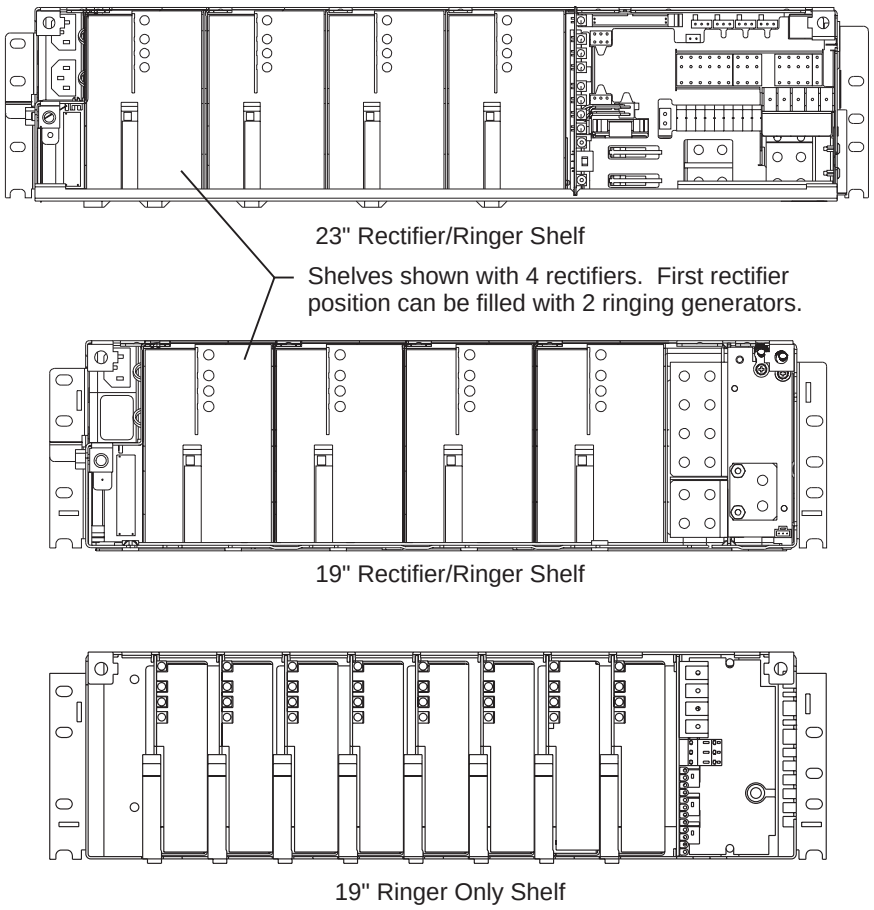


Figure 2-3: Shelf Assemblies with Front Doors Open

Plant Design, continued

Options

Rectifier-ringer plants are available with one or both of the following options:

- An optional low-voltage battery disconnect/reconnect circuit is provided in the distribution. If the battery voltage falls below a preset threshold, a contactor opens to disconnect the battery from the load.
- Battery disconnect circuit breakers (23" shelf only)
- Each rectifier-ringer plant is orderable with single or dual ac feed(s). See Figure 5-1. The ac input connects the commercial and/or standby ac power source to the rectifiers within the plant and provides overcurrent protection. This subsystem is usually supplied by the customer.

Control Units

Rectifier-Ringer Plant

Included in the rectifier-ringer plant is either a Monitor and Control Unit (MCU) or an Alarm Control Unit (ACU). The MCU (ES446 or ES446A) monitors and displays the plant primary voltage and current, adjusts the primary plant voltage, provides battery thermal protection circuits, and processes plant alarms. The ACU (ES447) monitors plant primary voltage and current, adjusts the primary plant voltage, provides battery thermal protection circuits, and processes plant alarms. The ES446 MCU is for the 23" shelf; the ES446A MCU and the ES447 ACU are for both the 19" and 23" shelves.

Alarm reporting for the CPS2000 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 CPS2000 modules. Alarms are categorized as major alarms (PMJ) that indicate service affecting problems, or minor alarms (PMN) that suggest that the problem may become service affecting if additional problems occur.

The rectifier-ringer control units offer the following features:

- Green, yellow, and red LEDs that display the plant status
- Form-C office alarms corresponding to the alarm indicators
- Customer-accessible controls to adjust the plant voltage
- Alarm monitor circuit that determines the status of the installed rectifiers or ringers and incorporates this information into the plant power minor or power major alarms
- Battery thermal management
- LED test procedure that activates all plant LEDs
- Capability for a customer-provided remote On/Standby control that is “passed-on” to the installed rectifiers
- Capability for a customer-provided Plant Battery Test (PBT) that sets the rectifier voltage to approximately 48V for battery testing
- A plant reset feature that allows the user to restart system rectifiers without the need to physically remove and re-seat the units

In addition to features listed above, the Monitor and Control Unit offers a digital meter that displays primary plant voltage and current (switch-selectable) and provides visual feedback when setting user-selectable thresholds such as the BD alarm voltage.

Control Units, continued

Ringer Plant

Included in the ringer plant is a ringing control unit (controller). This controller monitors each ringer and each -48 Vdc input. The controller switches the redundant ringer to replace a failed or removed primary ringer and processes plant alarms.

Alarm reporting for the CPS2000 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 CPS2000 modules. Alarms are categorized as major alarms (PMJ) that indicate service affecting problems, or minor alarms (PMN) that suggest that the problem may become service affecting if additional problems occur.

The ringer plant control unit offers the following features:

- Green, yellow, and red LEDs that display the plant status.
- Form-C office alarms corresponding to the alarm indicators
- Alarm monitor circuit that determines the status of the installed ringers
- Switching circuitry that switches the redundant ringer to replace a failed or removed primary ringer
- LED test procedure that activates all plant LEDs
- Configuration reset procedure to reset and store the ringer configuration

Rectifiers and Ringers

Rectifiers

The 48-volt, 7.2-ampere rectifiers provide primary output bus power and input power for ringers. Ringer output is available on the secondary output bus.

The ES460 is used in 19" and 23" shelves for EMI Class A applications; the ES460B and ES460C meet EMI Class B applications for the 19" shelf and Class A applications for the 23" shelf.

Refer to Section 3, *Engineering and Ordering Information,* for a discussion of rectifier sizing for non-redundant and redundant systems. N+1 redundancy provides for service protection in the event of a failure of a single unit.

Ringers

Each ringer (ringing generator) can provide 50VA of ringing power. These ringers feature ROM-based wave form generation typical of Lucent Technologies Type-3 Ringing Generators. Ringers feature a unique self-contained ring switch unit that automatically detects a failed unit and switches the on-line spare into active service in rectifier-ringer shelves.

Two ringers installed in a single-shelf rectifier-ringer plant provide redundant ringing power.

Up to seven ringers installed in a ringer plant provide up to six ringer outputs with optional n+1 redundancy.

The ES421 is for the 23" shelf; the ES421A and ES422 are for both the 19" and 23" shelves.

Rectifiers and Ringers, continued

Features

- CPS2000 series rectifiers are designed specifically for applications where size, weight, ease of installation and maintenance are important. The 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.

- Thermal alarm circuitry offers equipment protection by shutting the rectifier down and providing an alarm when the internal temperature exceeds thermal limits. User-provided forced air cooling, where required by operating conditions, extends the operating range of the rectifiers by maintaining their internal temperatures very close to the ambient temperature.

- CPS2000 series rectifiers feature automatic load-share circuits that force the rectifiers to apportion the plant load equally, thus reducing the stress on individual units.

- Rectifiers and ringers 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 rectifiers will automatically resume normal operation.

- Signal interfaces between the CPS2000 rectifiers and the plant control unit provide alarm monitoring, rectifier output voltage adjustment, plant current monitoring, LED testing, and rectifier On/Standby control. For ringing generators, the signal interface with the control unit provides alarm monitoring and LED testing, but does not allow voltage adjustment or current monitoring.

- These connectorized, pluggable units may be installed in CPS2000 power plants in less than one minute.

- Rectifiers may be installed in a working plant without adjustment and without interruption of service. System failures can be easily corrected by replacing defective rectifiers.

- Rectifiers and the CPS2000 power plants may be installed and serviced without the need for rear access.

- Front panel LED indicators on rectifiers as well as the control unit front panel indicate system status.

Rectifiers and Ringers, continued

- A push-to-test button on the plant control unit activates all plant alarm and status LED indicators.
- Rectifiers are capable of operating in parallel with other rectifiers.
- Ringing generators must not be operated in parallel.
- A load share circuit automatically forces the rectifiers to apportion the plant load. The load share circuit is made fail-safe by using an isolated load share bus between rectifiers. Upon failure, an inoperative rectifier is disconnected from the load share bus.
- Upon application of the source voltage, an active circuit limits the peak inrush current, thus eliminating nuisance tripping of customer provided input breakers.
- Rectifiers 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.
- If the plant voltage goes too high, only the defective rectifier will shut down.
- If a rectifier has shut down due to high voltage, it will try to restart a maximum of two times automatically. After two unsuccessful tries, the rectifier shuts down and locks down.
- If a ringer fails, that ringer will be automatically removed from service and a hot on-line redundant ringer will be switched into service. A controller is required for redundant switching in ringer plants. A controller is required for alarming and monitoring of failed ringers. A controller is not required for proper operation of the ringers.
- The rectifier alarm provides both a local visual indication of low output voltage and a signal to the plant control unit. In addition, alarms are generated by either a high module temperature and/or an operated internal fuse.
- The CPS2000 series rectifiers and ringers are designed to operate with or without the use of cooling fans. Excess internal temperature initiates a thermal alarm.

Rectifiers and Ringers, continued

- State-of-the-art circuits in the rectifiers increase the power factor to near unity.

- By controlling the power factor, the total harmonic distortion is reduced to less than five percent at full load.

- CPS2000 rectifiers automatically accept a wide range of ac input voltages.

- Step changes in dc 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 return to and stay within the regulation band within 300 milliseconds.

- CPS2000 rectifiers are capable of withstanding repeated surges of the following waveforms without damage (see ANSI C62.41-1991 requirements for category B and high system exposures):

  – 1.2/50 microseconds - 8/20 microseconds combination wave with a peak current of 300 amperes

  – 0.5 microsecond - 100 kHz ring wave with a peak voltage of 6000 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.

LVD/Thermal Management

LVD Circuit Pack

The -48V CPS2000 output distribution is equipped with a Low-Voltage Disconnect (LVD)/thermal management optional circuit pack (EDC1) that provides the following features:

- Alarm conditioning for control unit presentation
- A low-voltage 100A disconnect contactor 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.

CPS2000 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. This is the factory-set NAFTA Thermal Management Mode System for North America only. This feature is provided with ES446, ES446A, ES446C, and ES447 control units and all ES460 and ES460C rectifiers. This feature compensates the battery float voltage over the temperature range of +25°C to +75°C.

CPS2000 also 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 ES446C MCU and **only** ES460C 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 ES460, ES460B, and ES460C rectifiers in a shelf with a new control unit that is set to the EURO mode will cause the ES460 or ES460B rectifiers to go into a high voltage shutdown.

For proper operation of the control unit in the EURO mode, it is essential to perform a HVSD test to 57.6 volts upon initial installation of the rectifiers. This level can only be reached with ES460C rectifiers installed in the shelf.

Output Distribution

Illustrations

Figures 2-4 and 2-5 show the distribution modules of the 23" and 19" shelves. Figure 2-6 shows the ringer plant output distribution.

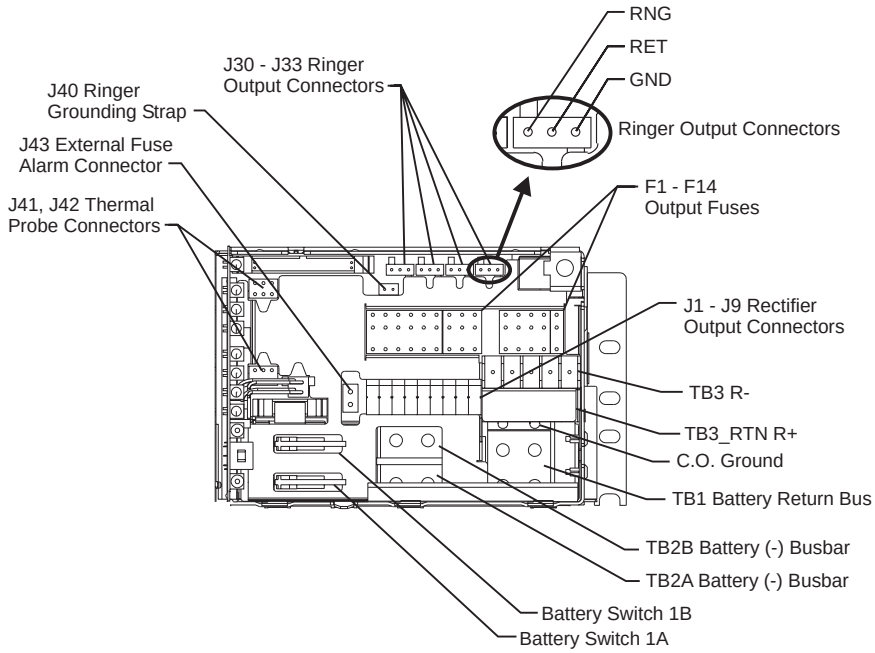


Figure 2-4: 23" Shelf Distribution Module

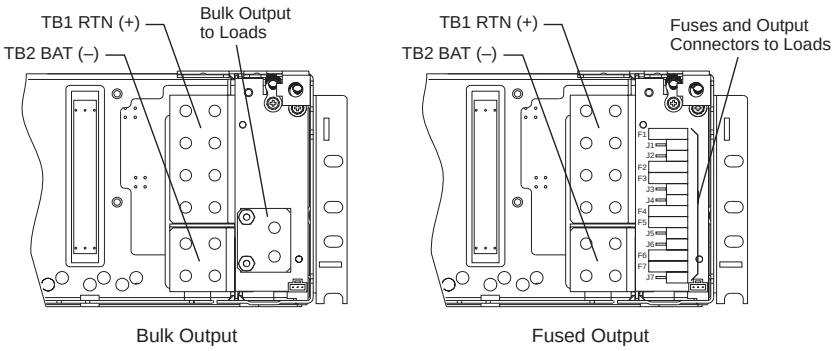
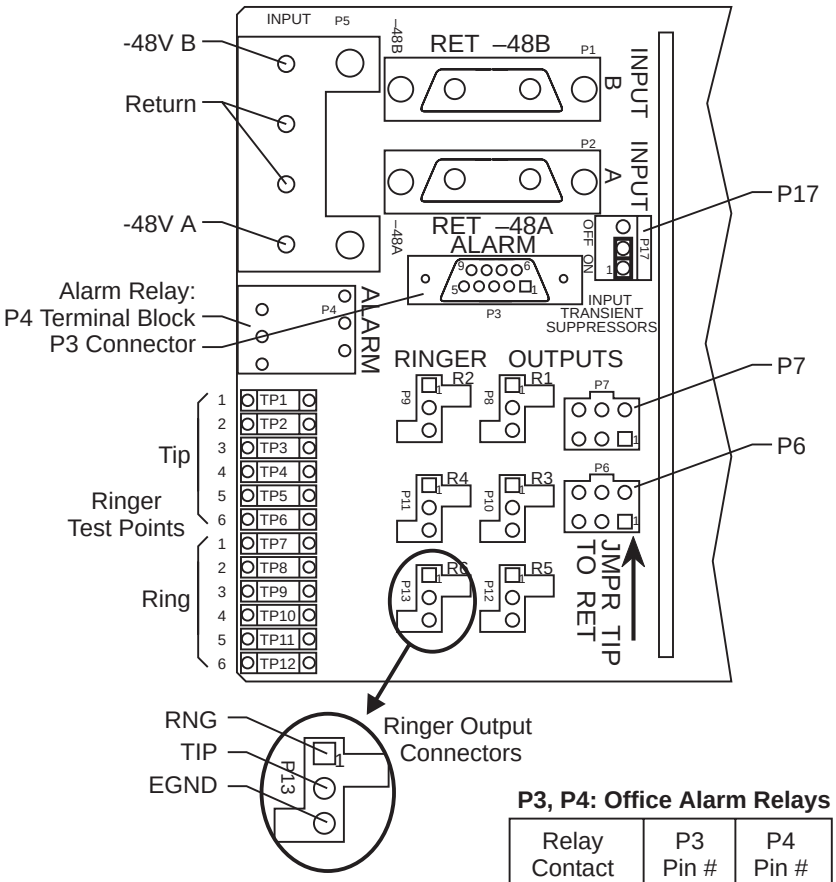


Figure 2-5: 19" Shelf Bulk and Fused Outputs

Output Distribution, continued



P17: Input Transient Suppressors

Jumper Across Pins:	
1 and 2 (shown)	Connected
2 and 3	Not Connected

P6, P7: Tip to Ground (–48V Return)

Jumper Connector Plugged Into:	
P6	Tips Connected to Ground
P7	Tips Not Connected to Ground

P3, P4: Office Alarm Relays

Relay Contact	P3 Pin #	P4 Pin #
PMJ_C	4	1
PMJ_NO	5	2
PMJ_NC	6	3
PMN_C	7	4
PMN_NO	8	5
PMN_NC	9	6

"NO" contacts are connected to "C" when alarm condition exists.

"NC" contacts are connected to "C" when no alarm condition exists.

Figure 2-6: Ringer Plant Output Distribution

Battery Reserve System

Overview The CPS2000 is designed to operate with all types of valve regulated batteries and has been tested with Lucent Technologies EVR, IR, and HR Series batteries.

Specifications

Electrical

Table 2-A: CPS2000 Plant Electrical Specifications

Electrostatic Discharge	IEC 61000-4-2: – Level 3, contact discharge 6KV, air discharge 8 KV, no errors – Level 4, contact discharge 9KV, air discharge 15 KV, no damage
Radiated and Conducted Emissions	Radiated and Conductive Emissions: – EN55022, Class A (23" shelves only) – EN55022, Class B (19" shelves only) Harmonics: – IEC/EN 61000-3-2 Voltage Fluctuations: – IEC/EN 61000-3-3
Electromagnetic Immunity	Radiated Immunity: – IEC/EN 61000-4-3 Conducted Immunity: – Electromagnetic energy injected longitudinally with the following limits: Frequency (MHz) Line Current (dBµA) 0.01-8 62-21.05 log f 0.8 - 100 65 Electrical Fast Transients/Burst (EFT/B): – IEC/EN 61000-4-4, Level 3 Surge: – IEC/EN 61000-4-5, Level 3

Specifications, continued

Physical

Table 2-B: CPS2000 Plant Physical Specifications

Shelf	Height: 5.25 inches Width: 21.5 inches (23" shelf) 17.5 inches (19" shelf) Depth: 12 inches (ringer-rectifier shelves) 295 mm (11.6 inches, ringer shelves) Weight: Less than 35 pounds empty
Frame Mounting Requirements	**Standard 19" and 23" relay racks:** Vertical mounting centers: 1.0 inch and 1.75 inches Horizontal mounting centers: 22.32 inches (23" shelf only) 18.31 inches (19" shelf) **19" shelf with ETSI brackets:** Vertical mounting centers: 0.98 inches (25mm) Horizontal mounting centers: 20.28 inches (515.0mm)
Operating Ambient Temperature (see Note 1)	-40° to 122° Fahrenheit (-40° to 50° Celsius) without supplemental cooling -40° to 167° Fahrenheit (-40° to 75° Celsius) with supplemental cooling (See Appendix A, *Application Note*, for supplemental cooling requirements.)
Altitude	-200 to 13,000 feet (-61 to 3962 meters) See Note 1.
Humidity	10-90% non-condensing
Audible Noise	65 dBA measured 2 feet (0.6 meters) from the plant
Earthquake Rating	Zone 4, upper floors
Note 1: For altitudes above 5000 feet, derate the temperature by 3.6 degrees Fahrenheit per 1000 feet. For altitudes above 1524 meters, derate the temperature by 0.656 degrees Celsius per 100 meters.	

Specifications, continued

Rectifier Plant

Table 2-C: Rectifier Plant Specifications

Plant	A one-shelf plant capable of supporting two output voltages
Power Slots	Four power slots per plant
Rectifiers	One rectifier or two ringers per power slot; maximum of four rectifiers per plant or 2 ringers and 3 rectifiers
Plant Architecture	**Primary output**: One primary output power bus per shelf; maximum output of 28.8 amperes per plant **Secondary output**: Two secondary output power buses per shelf; maximum of 15 amperes per bus
Rectifier Input Distribution	Two ac inputs per shelf (four rectifiers or three rectifiers and two ringers) One ac input per shelf (three rectifiers and two ringers)
Ringer Input Distribution	Primary output bus provides input power for ringers
Output Distribution - Primary Bus	48-volt dc power outputs to loads via connectors, terminal blocks, or bulk output Battery connections: double-hole lugs to terminate battery strings
Output Distribution - Secondary Bus	Circuit card mounted connector for ringer outputs
Primary Bus Protection and Distribution	14 GMT fuses (23") 7 GMT fuses or bulk output (19")
Maximum Discharge Current	30 amperes per plant
Maximum Recharge Current	Installed plant 48-volt rectifier capacity minus plant 48-volt load
Low -Voltage Battery Disconnect	40.5 ±0.5 volts or 42.5 ±0.5 volts (switch selectable) 100A contactor
Battery Switch 1A and 1B (circuit breaker)	100A Rating
Rectifiers	ES460, ES460B, or ES460C Rectifiers; Maximum of four units per plant.
Control Units	ES446 or ES446A Monitor and Control Unit ES447 Alarm Control Unit

Table 2-C: Rectifier Plant Specifications

Nominal Output Voltages	48/52/54.5 volts dc
Operating Voltage Range	48-56 volts dc
Maximum Output Current	28.8 amperes
Nominal Input Voltage	100/120/200/208/240 volts ac
Input Voltage Ranges	90-132 volts ac 170-264 volts ac
Maximum Input Current	Single ac input (3 rectifiers) 15A @ 90V Single ac input (3 rectifiers) 7.5A @ 180V Dual ac input (2 rectifiers each) 10A @ 90V Dual ac input (2 rectifiers each) 5A @ 180V Single ac input (4 rectifiers) 10A @ 180V
Efficiency	86% typical
Output Voltage Regulation	±1.2%
Output Ripple	85 millivolts peak to peak maximum, over the range 10 Hz to 20 MHz
Plant Output Noise	<32 dBrnC
Load Share Accuracy	0.72 amperes
Maximum Discharge Current	30 amperes
Maximum Recharge Current	Installed rectifier capacity minus plant load
Low-Voltage Battery Disconnect	40.5 ±0.5 volts or 42.5 ±0.5 volts

Specifications, continued

Rectifier-Ringer Plant

Table 2-D: Rectifier-Ringer Plant Specifications

Plant	A one-shelf plant capable of supporting two output voltages
Power Slots	Four power slots per plant
Rectifiers	One rectifier or two ringers per power slot; maximum of four rectifiers per plant or 2 ringers and 3 rectifiers
Plant Architecture	**Primary output**: One primary output power bus per shelf; maximum output of 28.8 amperes per plant **Secondary output**: Two secondary output power buses per shelf; maximum of 15 amperes per bus
Rectifier Input Distribution	Two ac inputs per shelf (four rectifiers or three rectifiers and two ringers) One ac input per shelf (three rectifiers and two ringers)
Ringer Input Distribution	Primary output bus provides input power for ringers
Output Distribution - Primary Bus	48-volt dc power outputs to loads via connectors, terminal blocks, or bulk output Battery connections: double-hole lugs to terminate battery strings
Output Distribution - Secondary Bus	Circuit card mounted connector for ringer outputs
Primary Bus Protection and Distribution	14 GMT fuses (23") 7 GMT fuses or bulk output (19")
Maximum Discharge Current	30 amperes per plant
Maximum Recharge Current	Installed plant 48-volt rectifier capacity minus plant 48-volt load
Low -Voltage Battery Disconnect	40.5 ±0.5 volts or 42.5 ±0.5 volts (switch selectable) 100A contactor
Battery Switch 1A and 1B (circuit breaker)	100A Rating
Rectifiers	ES460, ES460B, or ES40C Rectifiers; maximum of three ES421 or ES421A Ringers; maximum of two or ES422 Ringers; maximum of two

Table 2-D: Rectifier-Ringer Plant Specifications

Control Unit	ES446 or ES446A Monitor and Control Unit ES447 Alarm Control Unit
Primary Bus Output	The primary bus 48-volt output current capacity is reduced by two amperes when ringers are installed in the plant.
Secondary Bus:	Ringer
Nominal Output Voltage	100 volts rms (ES421 or ES421A) 80 volts rms (ES422)
Operating Voltage Range	95-105 volts rms (ES421 or ES421A) 75-85 volts rms (ES422)
Output Volt-amperes	50VA per shelf (ES421 or ES421A or ES422)
DC Offset Voltage	-52 volts (ES421 or ES421A) -48 volts (ES422)
Typical Ringer Input Voltage	52-54.5 volts dc
Input Voltage Range	38-60 volts dc
Input Current	1.4 amperes per ringer (ES421 or ES421A or ES422)
Output Frequency	20 Hz (ES421 or ES421A) 25 Hz (ES422)

Specifications, continued

Ringer Plant

Table 2-E: Ringer Plant Specifications

Plant	A one-shelf plant capable of supporting from one to six ringer outputs.
Power Slots	Seven power slots per plant; six primary, one redundant spare.
Ringer Modules	ES41A or ES422 Ringers; minimum 1 to maximum 7
Plant Architecture	Six independent ringer outputs with a single redundant spare ringer that is switched to a single output on demand.
Ringer Input Distribution	Two dc inputs per shelf. Redundant, diode isolated within shelf. Alarmed on low voltage. Maximum 9 amperes total input current @ 40 Vdc, full load outputs. Surge protectors provided on each input. These may be isolated from the inputs via a jumper plug.
Ringer Output Distribution	Circuit card mounted connector for each ringer output (6).
Control Units	ES490 Ringing Control Unit
Nominal Input Voltage	-48 Vdc
Typical Ringer Input Voltage	-52 to -54.5 Vdc
Input Voltage Range	-38 to -60 Vdc
Input Current	maximum @ 40 Vdc: 1.4 A per active ringer at full load + 0.4 A per spare ringer + 0.1 A controller
Input Fuse or Circuit Breaker	15 A maximum
Nominal Output Voltage	ES421A: 100 Vrms ES422: 80 Vrms
Operating Output Voltage Range	ES421A: 95 - 105 Vrms ES422: 75 - 85 Vrms

Table 2-E: Ringer Plant Specifications

dc Offset Voltage	ES421A: -52 Vdc ES422: -48 Vdc
Output Volt-amperes	50 VA
Output Frequency	ES421A: 20 Hz ES422: 25 Hz

ES460 or ES460B Rectifier

Table 2-F: ES460, ES460B, or ES460C Rectifier Specifications

Nominal Output Voltage	48/52/54.5 volts dc
Operating Output Voltage Ranges	48-56 volts dc
Operating Frequency Range	47-63Hz
Output Current	0-7.2 amperes
Nominal Input Voltage	100/120/200/208/240 volts ac
Input Voltage Ranges	90-132 volts ac 170-264 volts ac
Input Current	3.8 amperes @ 120 volts ac 1.9 amperes @ 240 volts ac 2.5 amperes @ 180 volts ac 5.0 amperes @ 90 volts ac
Efficiency	86% typical @ 120 volts ac
Output Voltage Regulation	±1.2%
Ripple	85 millivolts peak to peak maximum, over the range 10 Hz to 20 MHz
Output Noise	<32 dBrnC
Load Share Accuracy	0.72 amperes maximum
Power Factor	>0.98 for loads > 60% full load
Total Harmonic Distortion	<5% for loads > 60% full load
Selective High-Voltage Shutdown	Above 55.5 volts for 3 seconds
Backup High-Voltage Shutdown	Above 60 volts dc for 100 milliseconds

Specifications, continued

ES421 or ES421A Ringing Generator

Table 2-G: ES421 or ES421A Ringing Generator Specifications

Nominal Output Voltage	100 volts rms
Operating Voltage Range	95-105 volts rms
Output Volt-Amperes	50VA
Output DC Offset Voltage	-52 volts
Nominal Input Voltage	48/52/54.5 volts dc
Input Voltage Range	38 - 60 volts dc
Input Current	1.4 amperes @54.5 volts dc full load
Output Frequency	20 Hz
Ringer Interchange	Inherent in unit when 1+1 redundant in rectifier-ringer plant

ES422 Ringing Generator

Table 2-H: ES422 Ringing Generator Specifications

Nominal Output Voltage	80 volts rms
Operating Voltage Range	75-85 volts rms
Output Volt-Amperes	50VA
Output DC Offset Voltage	-48 volts
Nominal Input Voltage	48/52/54.5 volts dc
Input Voltage Range	38 - 60 volts dc
Input Current	1.4 amperes @54.5 volts dc full load
Output Frequency	25 Hz
Ringer Interchange	Inherent in unit when 1+1 redundant in rectifier-ringer plant

Specifications, continued

ES446 or ES446A Monitor and Control Unit

Table 2-I: ES446 or ES446A Monitor and Control Unit Specifications (see Notes)

Operating Voltage Range	38 - 72 volts dc
Input Power	4.0 watts maximum
Plant Voltage Setting	Adjustable via control switches on face plate
Alarm Contact Rating	60 volts dc, 0.5 ampere, Form-C
BD Setting	Adjustable from 46 to 58 volts in increments of 0.1 volts
Notes: The ES446 MCU can be used only in the 23" shelf. The ES446A MCU can be used in both the 19" and 23" shelves.	

ES447 Alarm Control Unit

Table 2-J: ES447 Alarm Control Unit Specifications

Operating Voltage Range	38 - 72 volts dc
Input Power	4.0 watts maximum
Plant Voltage Setting	Adjustable via control switches on face plate
Alarm Contact Rating	60 volts dc, 0.5 ampere, Form-C
BD Setting	Adjustable from 46 to 58 volts in increments of 0.5 volts

ES490 Ringing Control Unit

Table 2-K: ES490 Ringing Control Unit Specifications

Operating Voltage Range	-40.5 - 60Vdcvolts dc
Input Power	4.0 watts maximum
Alarm Contact Rating	60 volts dc, 0.5 ampere, Form-C

Specifications, continued

Display Meter

Table 2-L: ES446 or ES446A Display Meter Specifications

Range	0 to 72 volts (voltmeter) 0 to 30 amperes (ammeter)
Voltage Accuracy	± 1% of reading
Current Accuracy	± 2% of reading ± 1.0 ampere
Resolution	0.1 volt 0.1 ampere
Datalogger Output Voltage	0 to 6 volts
Datalogger Output Voltage Accuracy	± 1% of reading

Class B EMI Configurations

Table 2-M: Class B EMI Configurations

19" Rectifier-Ringer Plant	
19" Rectifier-Ringer Plant	Shelf
ES460B	Rectifier
ES460C	Rectifier
ES446A	Monitor and Control Unit
ES447	Alarm Control Unit
19" Ringer Plant	
19" Ringer Plant	Shelf
ES490	Ringing Control Unit
ES421A	Ringing Generator
ES422	Ringing Generator

Compliance

The CPS2000 shelf assembly with all plug-in modules complies with all of the following:

- UL Subject Letter 1801 - rectifier-ringer plants only
- 19" shelves are also UL or CSA Certified to CAN/CSA-C22.2 No. 950, and VDE Marked to IEC 950/EN60950/VDE0805.
- UL 1950 Listed - ringer plant only
- The CE Mark on the 19" version of the shelves is applied to show conformance to the requirements outlined in the European Union's Low Voltage Directive (73/23/EEC) and EMC Directive (89/336/EEC), both as amended by the CE Marking Directive (93/68/EEC).
- Rectifiers and Ringer Modules are also individually marked as follows:
  - UL recognized and/or CSA certified UL1950^{3rd} and CSA950^{3rd}/234
  - Rectifiers EC notified body approval to IEC-950/EN60950. Outputs are SELV.
  - Ringers comply with IEC-950/EN 60950. Outputs are classified as hazardous voltage.
- 19" Ringer Plant is compliant with Telecordia NEBS Level 3.

Mechanically, the CPS2000 is compliant with Telecordia "NETWORK EQUIPMENT SYSTEMS" (NEBS) generic equipment requirements for Transportation, Vibration, Installation Handling, Office Vibration and Zone 4 Earthquakes to increase reliability and network robustness.

CPS2000 is compliant with applicable sections of Telecordia document TR-TS4-000406, "DC Bulk Power System for Confined Locations."

3 Engineering and Ordering

Engineering Information

Introduction

This section discusses the factors to be considered in determining the number of rectifiers and ringers 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.

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.

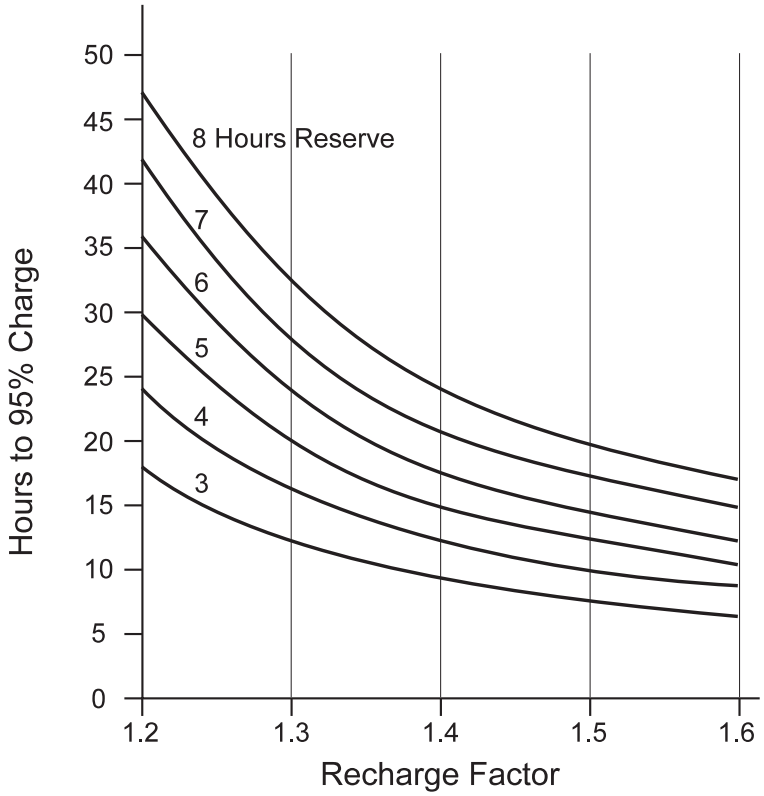


Figure 3-1: Recharge Factor vs. Recharge Time

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 example:

A battery plant is required to provide a load current of 15 amperes, have an 8-hour discharge time (reserve time) and recharge to 95% of battery capacity in 24 hours. Determine the number of 7.2 ampere rectifiers required for non-redundant systems.

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

mirc = abh x recharge factor

mirc = 15 x 1.38 = 20.7 amperes

Three 7.2 ampere rectifiers (20.7/7.2 = 2.9) are required to provide the minimum installed capacity of 20.7 amperes for a non-redundant system. However, if one rectifier fails, the two remaining rectifiers will not provide the abh capacity. Therefore, one additional rectifier must be added to complete a redundant system.

Other Considerations

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

Ringers in Rectifier-Ringer Plants

One or two ringers may be installed in rectifier-ringer shelves to power the single ringer output. When a second ringer is installed it acts as a redundant spare to the first. The ringer in either slot may power the output.

Engineering Information, continued

Ringers in Ringer Plants

Up to six primary ringers may be installed. Each primary ringer slot powers a specific ringer output. Each of the six ringer outputs are independent of the others.

A redundant ringer may be installed in slot 8. The shelf will operate properly with or without the redundant ringer installed.

When the redundant ringer is installed in slot 8 it will switch to power the ringer output of a failed or removed primary ringer.

Ordering Information

CPS2000 The CPS2000 plant can be ordered using the shelf, rectifier, controller, and ringer comcodes shown in Table 3-A.

Table 3-A: CPS2000 Ordering Information

Comcode	Apparatus Code	Description
107733057	ES460	48V, 7.2A Rectifier
108152125	ES460B	48V, 7.2A Rectifier + Class B EMC Emissions
108384777	ES460C	48V, 7.2A Rectifier + Class B EMC Emissions
107775215	ES446	Monitor and Control Unit
108218462	ES446A	Monitor and Control Unit + Class B EMI Emissions
107775223	ES447	Alarm and Control Unit + Class B EMI Emissions
108679986	ES490	Ringing Control Unit + Class B EMI Emissions
107999690	ES421	50VA Ringing Generator
108173279	ES421A	50VA Ringing Generator + Class B EMI Emissions
107992190	ES422	50VA Ringing Generator
107775306	EDF1	LED Board
107775272	EDC1	LVBD Module
23" Shelf Configurations		
107999237	J85582R-2 L21*, 31	CPS Shelf, Rectifier-Ringer Configuration
107994717	J85582R-2 L21*, 32	CPS Shelf, Rectifier-Ringer Configuration
107999229	J85582R-2 L21*, 33	CPS Shelf, Rectifier-Ringer Configuration
601828817	J85582R-2 L21*, 34	CPS Shelf, Rectifier-Ringer Configuration
107999211	J85582R-2 L22, 31	CPS Shelf, Rectifier-Ringer Configuration
107999294	J85582R-2 L22, 32	CPS Shelf, Rectifier-Ringer Configuration
107999286	J85582R-2 L22, 33	CPS Shelf, Rectifier-Ringer Configuration
107999278	J85582R-2 L22, 34	CPS Shelf, Rectifier-Ringer Configuration
107999245	J85582R-2 L22, 41	CPS Shelf, Rectifier Only Configuration
107999260	J85582R-2 L22, 42	CPS Shelf, Rectifier Only Configuration
107999252	J85582R-2 L22, 43	CPS Shelf, Rectifier Only Configuration
601832462	J85582R-2 L22, 44	CPS Shelf, Rectifier Only Configuration
*List 21 rectifier cannot be used in slot #1.		

Continued on next page.

Table 3-A: CPS2000 Ordering Information

19" Shelf Configurations		
601861891	J85582R-2 L24, 51	CPS Shelf, Rectifier-Ringer Configuration
601861909	J85582R-2 L24, 52	CPS Shelf, Rectifier-Ringer Configuration
601861917	J85582R-2 L24, 53	CPS Shelf, Rectifier-Ringer Configuration
601861925	J85582R-2 L24, 54	CPS Shelf, Rectifier-Ringer Configuration
601861933	J85582R-2 L25, 51	CPS Shelf, Rectifier-Ringer Configuration
601861941	J85582R-2 L25, 52	CPS Shelf, Rectifier-Ringer Configuration
601861958	J85582R-2 L25, 53	CPS Shelf, Rectifier-Ringer Configuration
601861966	J85582R-2 L25, 54	CPS Shelf, Rectifier-Ringer Configuration
601861974	J85582R-2 L25, 61	CPS Shelf, Rectifier Only Configuration
601861982	J85582R-2 L25, 62	CPS Shelf, Rectifier Only Configuration
601861990	J85582R-2 L25, 63	CPS Shelf, Rectifier Only Configuration
601862006	J85582R-2 L25, 64	CPS Shelf, Rectifier Only Configuration
108684457	J85582R-2 L91	CPS Shelf, Ringer Only Configuration
601869142	J85582R-2 L100, 60	ETSI Brackets (75mm depth in 600x600 ETSI rack)
108875312	J85582R-2 L191	ETSI Brackets (40mm depth in 300x300 ETSI rack) Can be ordered only with CPS Ringer Plant, J85582R-2 L-91
848535217	J85582R-2 L192	23" Bracket Kit

Ordering Information, continued

List Options Table 3-B provides descriptions for the list options as well as other lists that might be included in future shelf configurations.

Table 3-B: CPS2000 List Options

List Number	Description
21	Provides single ac input with 1 IEC 320 type appliance inlet for 23" shelf (rectifier-ringer plant configuration only) (Sheet C-14).
22	Provides dual ac input with 2 IEC 320 type appliance inlets for 23" shelf (Sheet C-14).
23	Provides single ac terminal input for 19" and 23" shelves.
24	Provides single ac input with 1 IEC 320 type appliance inlet for 19" shelf (Sheet C-14).
25	Provides dual ac input with 2 IEC 320 type appliance inlets for 19" shelf (Sheet C-14).
31	Provides for 23" shelf equipped for ringers and 48-volt rectifiers; **without battery disconnect circuit breakers or low voltage battery disconnect.**
32	Provides for 23" shelf equipped for ringers, 48-volt rectifiers, and low voltage battery disconnect; **without battery disconnect circuit breakers.**
33	Provides for 23" shelf equipped for ringers, 48-volt rectifiers, and battery disconnect circuit breakers; **without low voltage battery disconnect.**
34	Provides for 23" shelf equipped for ringers, 48-volt rectifiers, low voltage battery disconnect, and battery disconnect circuit breakers.
41	Provides for 23" shelf equipped for 48-volt rectifiers; **without ringers, battery disconnect circuit breakers, or low voltage battery disconnect.**
42	Provides for 23" shelf equipped for 48-volt rectifiers and low voltage battery disconnect; **without ringers and battery disconnect circuit breakers.**
43	Provides for 23" shelf equipped for 48-volt rectifiers and battery disconnect circuit breakers; **without ringers or low voltage battery disconnect.**
44	Provides for 23" shelf equipped for 48-volt rectifiers, low voltage battery disconnect, and battery disconnect circuit breakers; **without ringers.**

Continued on next page.

Table 3-B: CPS2000 List Options

51	Provides for 19" shelf equipped for ringers and 48-volt rectifiers, and bulk output; **without low voltage battery disconnect or battery disconnect circuit breakers.**
52	Provides for 19" shelf equipped for ringers, 48-volt rectifiers, bulk output, and low voltage battery disconnect; **without battery disconnect circuit breakers.**
53	Provides for 19" shelf equipped for ringers, 48-volt rectifiers, fused output; **without low voltage battery disconnect or battery disconnect circuit breakers.**
54	Provides for 19" shelf equipped for ringers, 48-volt rectifiers, fused output, and low voltage battery disconnect; **without battery disconnect circuit breakers.**
61	Provides for 19" shelf equipped for 48-volt rectifiers and bulk output; **without ringers, low voltage battery disconnect, or battery disconnect circuit breakers.**
62	Provides for 19" shelf equipped for 48-volt rectifiers, bulk output, and low voltage battery disconnect; **without ringers or battery disconnect circuit breakers.**
63	Provides for 19" shelf equipped for 48-volt rectifiers and fused output; **without ringers, low voltage battery disconnect, or battery disconnect circuit breakers.**
64	Provides for 19" shelf equipped for 48-volt rectifiers, fused output, and low voltage battery disconnect; **without ringers or battery disconnect circuit breakers.**
91	Provides for 19" ringer shelf with ringing controller equipped for - 48 Vdc input and six ringer outputs.
100	Provides ETSI mounting brackets and hardware for one 19" rectifier-ringer plant
191	Provides ETSI brackets and hardware for 19" ringer shelf.
192	Provides 23" bracket and hardware for 19" shelf.

Ordering Information, continued

Fuse Information

Table 3-C: CPS2000 Fuse Information

Comcode	Description
405006222	.25 Amp GMT-type fuse
406976894	.5 Amp GMT-type fuse
405673146	1.33 Amp GMT-type fuse
405181983	2 Amp GMT-type fuse
406976985	3 Amp GMT-type fuse
406159061	5 Amp GMT-type fuse
405725433	7.5 Amp GMT-type fuse
406159236	10 Amp GMT-type fuse
407845197	12 Amp GMT-type fuse
406473959	15 Amp GMT-type fuse

Ordering Information, continued

Miscellaneous Wiresets and Hardware

Table 3-D: Miscellaneous Wiresets and Hardware

Connector Designation	Function	Mating Connection	
		Lucent Kit	**Commercial**
Input Side			
J101, J102	AC input for rectifiers	847861192 kit provides (1) 14′ ac cord with straight plug; requires service end termination. Order (1) kit per ac receptacle in shelf. AC input cord conductors: L or L1 = BR N or L2 = BL EG = G	IEC 320 Cord Set with straight plug on female end Example: Newark P/N 37F3344 Type 17505
J46 (Rectifier-Ringer)	Office alarm output	Parts to make a cable: 847415874 kit provides office alarm plug, strain relief housing and retaining clip for 24 AWG solid wire. Wire is not provided. Assembly requires Lucent tool R46238 or R5250 (900533027); **or** **preassembled cable assemblies for quick installation on customer premises:** 847616828 kit provides preassembled 25′ office alarm cable. 847541653 kit provides preassembled 150′ office alarm cable.	Discrete wire set equipped with: (1) AMP 552274-1 plug (1) AMP 552414-1 strain relief (1) AMP 552723-1 retaining clip **or** ribbon cable equipped with: (1) AMP 553600-1 plug (1) AMP 552723-1 retaining clip AMP tool 229378-1 or 229764-2 may be ordered as 900533027.

Continued on next page.

Table 3-D: Miscellaneous Wiresets and Hardware

Connector Designation	Function	Mating Connection	
		Lucent Kit	**Commercial**
Output Side			
J43 (23" shelf)	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. 20 AWG wire	Wire set equipped with: (1) AMP 350777-7 plug (2) AMP 350537-3 sockets (1) AMP tool 90298-2
J43 (19" rectifier-ringer plant)	Fuse alarm from external distribution panel	848068524 kit provides 27″ fuse alarm wire set; distribution end must be terminated and should provide an isolated contact closure. 1 kit optional per shelf. 20 AWG wire	Wire set equipped with: (1) AMP 172165-1 plug (2) AMP 770986-1sockets (1) AMP 90758-1 tool
Continued on next page.			

Table 3-D: Miscellaneous Wiresets and Hardware

Connector Designation	Function	Mating Connection	
		Lucent Kit	**Commercial**
J41, J42	Thermal probe from batteries	**Complete kits (probe and cable):** 847198751 kit provides (1) paddle type thermal probe with (1) 5′ cable **or** 847580529 kit provides (1) ring type thermal probe with (1) 9′ cable **Thermal probe only:** 846818706 paddle type thermal probe and (1) cable listed at right **or** 847494606, 1/4″ ring type thermal probe and (1) cable listed at right **or** 848194221, 5/16″ ring type thermal probe and (1) cable listed at right	No commercial equivalent available. **Cable only:** Order (1) cable assembly for use with (1) thermal probe listed at left. 847172152, 5′ 847550175, 9′ 847548476, 14.5′ 847548468, 17.5′ Thermal probe/cable assembly (cable and probe are spliced together): 848221552, 5/16″ ring type thermal probe, 10′ **or** 848221560, 5/16″ ring type thermal probe, 25′
TB3, TB3_RTN (23" shelf only)	Rectifier output terminal blocks	**Lug kits for rectifier output:** 847572716 kit provides (12) 10-12 AWG lugs and heat shrink tubing or 847572724 kit provides (12) 14-18 AWG lugs and heat shrink tubing	10-12 gauge: T&B C220 14-18 gauge: T&B B220

Continued on next page.

Table 3-D: Miscellaneous Wiresets and Hardware

Connector Designation	Function	Mating Connection	
		Lucent Kit	**Commercial**
TB1, TB2 (23") TB1 - TB3 (19")	Lugs for battery and load connection and mounting hardware	847990918 kit provides (7) 6 AWG 2-hole lugs, (7) PCS 3/8″ heat shrink tubing 2″ long, (14) 1/4-20 nuts, (2) 10-32 nuts, and (6) shelf mounting screws. Maximum (1) kit per plant.	6 AWG: T&B 54205 2 AWG: T&B 54208 Crimping tool T&B TBM55
J1 - J9 (23") J1 - J7 (19")	Rectifier output connectors	847922077 kit provides (1) 15′ cable with connector for CPS2000 shelf on one end and unterminated leads on the other end. Order (1) per rectifier output. 16 AWG wire	Molex plug 39-01-2025 Socket Terminal Type 5556 16 AWG 39-00-0079 18 AWG 39-00-0059 Order (2) sockets per plug.
J30 - J33 (23") J30 (19" rectifier-ringer plant) J8 - J13 (19" ringer plant)	Ringer output connectors	847922101 kit provides (1) 15′ cable with connector for CPS2000 shelf on one end and unterminated leads on the other end. Order (1) per ringer output. 22 AWG wire	Molex plug 39-01-4031 Socket Terminal Type 5556 16 AWG 39-00-0079 18 AWG 39-00-0059 Molex tool 11-01-0197 Order (3) sockets per plug.
Bus bar connection and mounting hardware	(7) 6 AWG lugs and (6) mounting screws	847990918 kit for 6 AWG	T&B 54205 T&B 54208

Ordering Information, continued

Distribution Module Connectors

Table 3-E: Distribution Module Connectors (Refer to SD-83342-01)

Connector	Description	Connection
Distribution Rectifier Output Busbar Connections	CO Ground. Angled terminal for earth grounding TB1 (23" shelf only)	Terminal lug sizes: for 6AWG T&B 54205 or equivalent for 2 AWG T&B 54208 or equivalent 6 AWG lug kit available as Lucent Technologies kit 847990918
	For Battery (+) TB1 For Load (+) 19" Lists 51, 52, 61, 62 For Load (-) 19" Lists 51, 52, 61, 62	
J1 - J9 (23" shelf) J1 - J7 (19" rectifer-ringer plant)	Used for full slot output primary power. Part number of terminal depends on wire gauge used. J1-9 pin 2 are individually fused to F1-F9.	P1 - P9 Mating connector Molex 39-01-2025 Socket Terminal Type 5556 16 AWG 39-00-0079 18 AWG 39-00-0059 Available as Lucent Technologies kit 847922077
J30 - J33 (23" shelf) J30 (19" rectifier- ringer plant) J8 - J13 (19" ringer plant)	Ringer output connectors, used for half slots output power; chassis used as shield.	P30-P33 Mating connector Molex 39-01-4301 Socket Terminal Type 5556 16 AWG 39-00-0079 18 AWG 39-00-0059 Header AMP 39-29-9069 Available as Lucent Technologies kit 847922101.
J40 (23" shelf only)	Ringer Return Used to strap ringer return to plant return. This connector is included. Remove if not required.	P40

Continued on next page.

Table 3-E: Distribution Module Connectors
(Refer to SD-83342-01)

Connector	Description	Connection
R4 (19" rectifer-ringer plant only)	Ringer Return Used to strap ringer return to plant return. This jumper is factory installed. R4 can be clipped (removed).	
J43 (23" shelf)	Auxiliary Distribution Alarm Used for secondary distribution alarm. An isolated contact closure is needed to activate alarm.	P43 Mating connector AMP 350777-7 Socket AMP 350537-3 Available as Lucent Technologies kit 847451841
J43 (19" rectifer-ringer plant)	Auxiliary Distribution Alarm Used for secondary distribution alarm. An isolated contact closure is needed to activate alarm.	P43 Mating connector AMP 172165 Socket AMP Available as Lucent Technologies kit 848068524
TB2A	Battery String 1 (-)	Battery lug connections to TB2 use the following lugs: for 2 AWG wire use T&B 54206 or equivalent for 6 AWG wire use T&B 54208 or equivalent
TB2B	Battery String 2 (-)	
TB3 (23" shelf only)	TB3 all pins are individually fused to F10 - F14	Terminal lug size: for 10-12 AWG use T&B C220 or equivalent for 14-18 AWG use T&B B220 or equivalent
TB3_RTN (23" shelf only)	TB3_RTN pins are all common	
J41, J42	Temperature Probes Used for thermal sensing of batteries for Thermal Compensation. Can have single or multiple sensing points. Highest reading is used for thermal compensation.	P41-42 Lucent Technologies Thermistor kit Assembly 847198751 (1 kit/probe)

Ordering Information, continued

Spare Parts

The rectifiers are repaired by replacement; each service area needs one set of spares. Table 3-F contains recommended spare parts for the CPS plant. One each is recommended for each service area.

Table 3-F: CPS2000 Recommended Spares

Unit	Apparatus Code	Comcode
48V, 7.2A Rectifier + Class B EMC Emissions	ES460B	108152125
48V, 7.2A Rectifier + Class B EMC Emissions	ES460C	108384777
Monitor and Control Unit (MCU)	ES446	107775215
Monitor and Control Unit (MCU)	ES446A	108218462
Alarm Control Unit (ACU)	ES447	107775223
Ringer Control Unit	ES490	108679986
50VA Ringing Generator	ES421	107999690
50VA Ringing Generator	ES421A	108173279
50VA Ringing Generator	ES422	107992190
LED Board	EDF1	107775306
LVBD Module	EDC1	107775272
Battery Circuit Breaker, 100A	N/A	407654797

Documentation

CPS2000 Battery Plant

Assembly and Ordering Drawing	J85582R-2
Wiring Diagram	T-83342-30
Schematic Drawing	SD-83342-01
Product Manual Select Code	167-102-101

Batteries

Battery	Product Manual Select Code
EVR Series	157-622-011
IR Series	157-622-020
IR125	157-622-025
HR Series	157-622-035

4 Safety

Safety Statements

Please read and follow all safety instructions and warnings before installing, maintaining, or repairing the CPS2000 power system.

- Install only in restricted access areas (dedicated equipment rooms, equipment closets, or the like) in accordance with articles 110-16, 110-17, 110-18, and 800 of the U.S. National Electric Code (NEC), ANSI/NFPA No. 70, and pursuant to applicable local codes.

- Use this equipment only in controlled environments (an area where the humidity is maintained at levels that can not cause condensation on the equipment, the contaminating dust is controlled, and the steady-state ambient temperature is within the range specified).

- Do not install this equipment over combustible surfaces - rectifier ringer plants only.

- This equipment has been evaluated for use in a continuous ambient temperature of up to 50°C; up to 75°C with minimum 150 lfm forced air cooling at a nominal 240Vac and minimum 165 lfm forced air cooling at a nominal 120Vac (covered in Application Note AP97-014LIN dated April, 1997).

- For installations in the United States, use Listed compression connectors to terminate Listed field-wired conductors where required. For all installations, apply the appropriate connector 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.

Safety Statements, continued

- 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. Follow all national and local rules and regulations when making field connections.

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

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

- The short circuit current capability of the battery input to the distribution panel must not exceed 9000A.

- Bulk output option (from power supply and batteries) with no overcurrent protection may not be suitable for building wiring. This option should be used with an external distribution located within the same frame or cabinet as the power shelf. The distribution overcurrent protectors should be capable of interrupting the short circuit current available from the batteries.

- Alarm contacts are not fused or otherwise current limited within the unit. Therefore, current limiting protection for these contacts must be provided by external circuits. Maximum ratings for alarm connections are 60VDC and 0.5A. Exceeding these maximum ratings could result in fire or damage to the unit.

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

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

Safety Statements, continued

- 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.

- Rectifier-ringer shelves are provided with either one or two IEC-320 (Sheet C14) appliance inlets. When using an ac power cord-set with the single ac feed option in North America, the cable should be Listed/Certified and sized per codes, and have a minimum 20A attachment-plug. Follow all national and local wiring rules for providing ac mains power to this equipment.

- An accessible ac disconnect/protection device to remove ac power from the equipment in the event of an emergency must be provided.

- In enclosed equipment cabinets, the CPS2000 mounting framework must be connected directly to the cabinet AC service ground bus. For applications in huts, vaults, and central offices, the mounting framework must be connected to the system integrated ground grid.

- The output fuses are not acceptable for protection of building wiring as defined by the National Electrical Code (NEC). The modules are only suitable for protecting internal wiring or short interconnecting cables that are not part of the building wiring.

- Output connectors are not to be disconnected under load.

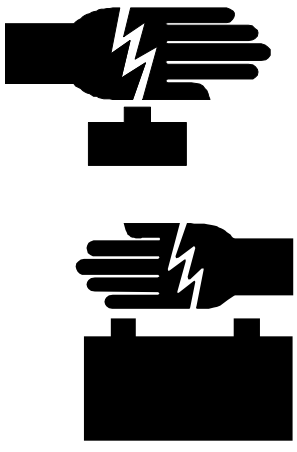
- Shelf outputs are not connected to earth.
  Earthing of ringer tip outputs is optional via jumper.
  Earthing of rectifier outputs may be performed externally to the shelf at a “ground window” or “mesh ground.”

- Plant chassis is earthed to the rack via the chassis mounting ears.

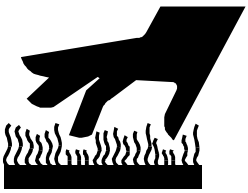
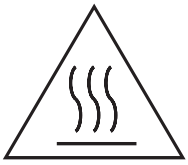
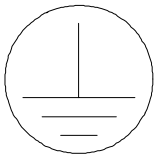
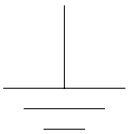
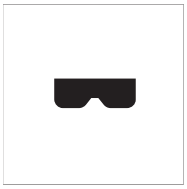
- Ringer plants may be powered by two dc imputs. Use caution to assure that both dc inputs are disconnected to remove power in that case.

Warning Statements and Safety Symbols

The symbols may sometimes be accompanied by some type of statement; e.g., “Hazardous voltage/energy inside. Risk of injury. This unit must be accessed only by qualified personnel.”

		This symbol identifies the need to refer to the equipment instructions for important information.
		These symbols (or equivalent) are used to identify the presence of hazardous ac mains voltage.
		This symbol is used to identify the presence of hazardous ac or dc voltages. It may also be used to warn of hazardous energy levels.
		One of these two symbols (or equivalent) may be used to identify the presence of rectifier and battery voltages. The symbol may sometimes be accompanied by some type of statement, for example: “Battery voltage present. Risk of injury due to high current. Avoid contacting conductors with uninsulated metal objects. Follow safety precautions.”

Warning Statements and Safety Symbols, continued

	This symbol is used to identify the presence of a hot surface. It may also be accompanied by a statement explaining the hazard. A symbol like this with a lightning bolt through the hand also means that the part is or could be at hazardous voltage levels.
	This symbol is used to identify the presence of a hot surface. The marked item should not be touched without taking care.
	This symbol is used to identify the protective safety earth ground for the equipment.
	This symbol is used to identify other bonding points within the equipment.
	This symbol is used to identify the need for safety glasses and may sometimes be accompanied by some type of statement, for example: “Fuses can cause arcing and sparks. Risk of eye injury. Always wear safety glasses.”

Precautions

When working on or using this type of equipment, note the following precautions:

- This unit must be installed, serviced, and operated only by skilled and qualified personnel who have the necessary knowledge and practical experience with electrical equipment and who understand the hazards that can arise when working on this type of equipment.

- The CPS2000 can be powered by multiple ac inputs. Ensure that the appropriate circuit protection device for each ac input being serviced is disconnected before servicing the equipment.

- For equipment connected to batteries, disconnecting the AC alone will not necessarily remove power to the equipment. Make sure the equipment is not also powered by the batteries or the batteries are not connected to the output of the equipment.

- High leakage currents may be possible on this type of equipment. Make sure the equipment is properly safety earth grounded before connecting power.

- Hazardous energy and voltages are present in the unit and on the interface cables that can shock or cause serious injury. Follow all safety warnings and practices when servicing this equipment. Connectors J30-33 and J40 contain hazardous voltages when equipped with plug-in ringer module. Exercise care when servicing this area.

- The telecom-type (ex. 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.

- Batteries may be connected in parallel with the output of the rectifiers. Turning off the rectifiers will not necessarily remove power from the bus. Make sure the battery power is also disconnected and/or follow safety procedures while working on any equipment that contains hazardous energy/voltage.

Precautions, continued

- Electricity produces magnetic fields that can affect implanted electronic medical devices. The strength of the magnetic field depends on the amount of current in the circuit, as well as other conditions (such as: number of conductors, placement, and distance from the conductor). DC power and distribution systems, including the batteries, that are typically used in telecommunication utility rooms can operate at high current levels. Personnel with electronic medical devices need to be aware of their restrictions when working around electricity.

- In addition to proper job training and safety procedures, always use the following are some basic precautions:

  – Use **only** properly insulated tools.

  – Remove all metallic objects (key chains, glasses, rings, watches, or any other jewelry).

  – Wear safety glasses.

  – Test circuits before touching.

  – Lock out and tag any circuit breakers/fuses when possible to prevent accidental turn on.

  – Be aware of potential hazards before servicing equipment.

  – Identify exposed hazardous electrical potentials on connectors, wiring, etc. (Note the condition of these circuits, especially any wiring.)

  – Use care when removing or replacing any covers; avoid contacting any circuits.

5 Installation

Introduction

In This Section

This section outlines the sequence for installing the CPS2000 plant and plug-in modules. It also includes 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. Also review "Safety Statements" in Section 4 to insure that the product is being installed and used properly.

Tools

You will need the following tools and hardware to install and test the CPS2000 plant and plug-in modules:

- Wire cutters and strippers
- Heat shrink gun
- Torque wrench (0-70 in-lb)
- Insulated 5/16 inch hex driver
- Insulated 3/8 inch hex driver
- Insulated 7/16 inch hex driver
- Test load of 48V, 30A
- Digital meter with an accuracy of ± 0.05% (Fluke 8060A or equivalent)
- No. 1 Phillips screwdriver
- Test cable
- ESD wrist strap
- Insulated deepwell socket or nut driver set

Warning

Due to the possibility of working on energized circuits during these procedures, all tools and test equipment must be insulated in an approved manner.

Introduction, continued

Wiring Guidelines

- When running the output cables, pair the positive and negative conductors over as much of their length as possible to minimize loop areas for EMI considerations.
- All electrical connections should be made using the proper crimping tools and dies and torqued to values specified on the product labels and later in this section.
- 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 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.

Rectifier-Ringer Plant Wiring

- The commercial ac power input wiring enters the plant on the left. The plant output wiring exits the plant on the right. The alarm wiring to general office alarms exits the plant on the left. Loads and batteries are connected to the power shelf at the output buses of the CPS2000 plant on the right side.

Ringer Plant Wiring

- All wiring enters and exits the plant on the right. This includes dc input, ringing output, and general office alarms.

Introduction, continued

Torque Requirements

Table 5-A identifies the torque requirements to be followed when making power connections throughout these procedures:

Table 5-A: Minimum Torque for All Electrical Connections

Screw Size	Torque - lb-in or (lb-ft)					
	Wire Connections		Head Tightened		Nut Tightened	
	Slotted Machine	Hex or Socket Cap	Slotted Machine	Hex or Socket Cap	Slotted Machine	Hex or Socket Cap
6-32	9	9	9	9	9	9
8-32	15	15	19	19	19	23
10-32	21	21	27	27	27	33
1/4-20	50	50	65	65	65	80
5/16-18	-	100	-	135	135	165
3/8-16	-	180	-	240	240	290
7/16-14	-	280	-	385	385	465
1/2-13	-	500	-	585	585	710
5/8-11	-	(71)	-	(97)	(97)	(118)
3/4-10	-	(125)	-	(172)	(172)	(209)

Installation Sequence

DANGER

Only qualified personnel should install and service the CPS2000 plant 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.

Caution

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

Frame Mounted Plants

If the CPS2000 plant is already mounted in a cabinet or frame, proceed to "Power Input Wiring."

CPS2000 Plant

To install a CPS2000 plant, ensure that adequate space is available for mounting. The plant requires a minimum of 5-1/4 inches of vertical height. In addition, the equipment above and below the plant must allow for a flow of cooling air or additional space must be left above and below the plant for air circulation. **Refer to Appendix A, *Application Note,* for further information on air flow management.**

Twelve inches of space in front of the plant is required for insertion and removal of the rectifiers.

Mount the CPS2000 plants in the frame using 12-24 x 5/8 hex-head self-tapping screws. Screws are required in all mounting holes that line up with the rack spacing and should be torqued to a minimum of 30 in-lb.

For Telcordia NEBS compliance install a baffle above the plant. The baffle will require vertical space.

Assure that the addition of the plant does not exceed the mechanical loading or stability limits of the frame.

Installation Sequence, continued

Installing Batteries Below 0°C Temperature

- Installing cold batteries with temperature probes in ambient temperatures below 0°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 Lucent Technologies 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 Circuits

The CPS2000 rectifier-ringer plants are powered from one or two branch circuits.

AC input circuits must be protected using fuses or circuit breakers sized as required by the National Electric Code. Overcurrent protection should not exceed 30 amperes. (Refer to Figure 5-1 for location of ac input locations.)

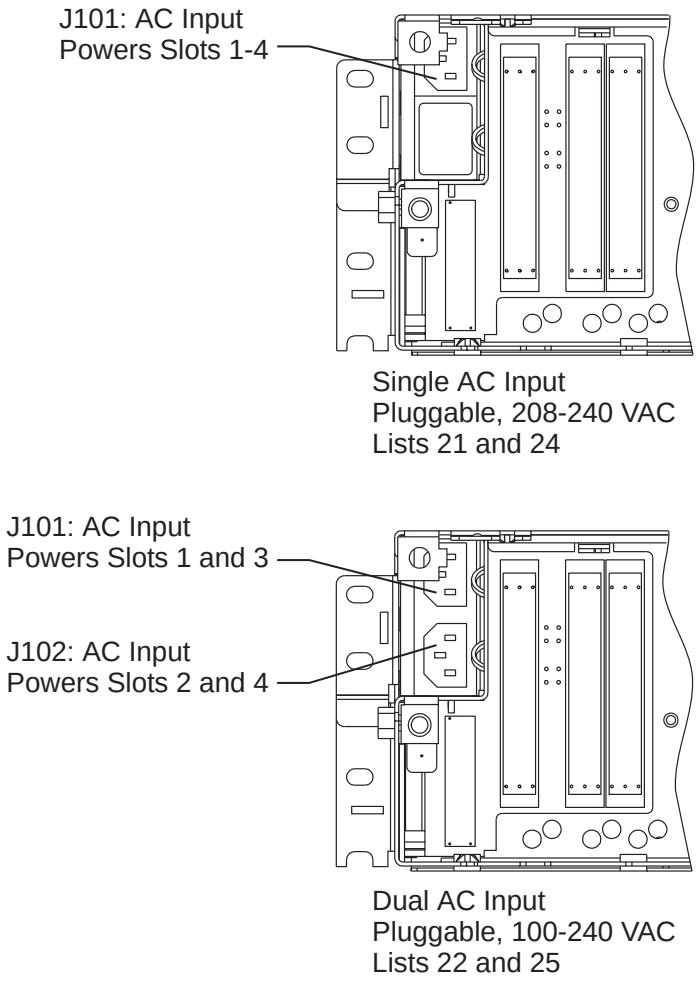


Figure 5-1: AC Feed Locations

AC Input Circuits, continued

Warnings

High leakage currents are possible. Earth ground connection is essential before connecting the ac source to the shelf.

In enclosed equipment cabinets, the CPS2000 mounting framework must be connected directly to the cabinet ac service ground bus. For applications in huts, vaults, and central offices, the CPS2000 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 the CPS2000 via multiple input cables. Ensure that the circuit protector for each ac input is disconnected while servicing this equipment.

Caution

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

DC Input Circuits

CPS2000 ringer plants are powered from one or two dc power circuits. These circuits must be protected using fuses or circuit breakers sized as required by the National Electric Code. Overcurrent protection should not exceed 15 amperes. (Refer to Figure 2-6 for input locations.)

Input protectors (fuses or circuit breakers) must be installed in a readily accessible location.

Dual dc inputs are provided. They are labeled "-48A" and "-48B". The inputs are diode "ORed" within the shelf. Either input may fully power the shelf. The shelf monitors both inputs for voltage and alarms upon loss of voltage on either input.

For plants with dual dc inputs a prominent marking is to be provided by the installer at each disconnect device describing the location of the other disconnect device and the need for both devices to be deactivated for the shelf to be powered down.

Dual means of connection to dc inputs is provided. Terminal block P5 is in parallel with subminiature D power connectors P1 and P2. This allows dc input to use either connection type.

When the shelf is powered by a single dc power circuit, place a jumper between -48A and -48B on terminal block P5.

Input surge protection is provided on each dc power input. P17 connects or disconnects this protection. See Figure 2-6.

Installing a Control Unit

Installing a Control Unit	
Step	**Action**
1	Identify and unpack the control unit.
2	For the ES446, ES446A, and ES447 control units, determine which type of alarm scheme will be used. (See Section 6).
3	Insert the control unit into the left-most slot on the CPS2000 rectifer-ringer plant or into slot 7 of the CPS2000 ringer plant.
4	Using a Phillips screwdriver, torque the ACU's or MCU's mounting fastener to a maximum of 12 in-lb.

Office Alarm Wiring

Access to Alarms

Warning

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.

Rectifier-Ringer Plants

Office 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. Office alarms may be accessed on an alarm connector located on the left side of the shelf adjacent to the control unit.

Interconnections for remote On/Standby control of the rectifiers are also provided on J46. For proper operation of these functions and for battery testing, a battery must be provided with the CPS2000 power system.

Wire to the office alarms provided on the alarm connector on the left side of the CPS2000 as required. Kits for this function are listed in Table 3-D.

See Table 6-F for office alarm pin assignments.

Ringing Plants

Office alarms may be accessed on an alarm connector located on the front right side of the shelf.

See Table 6-G for office alarm pin assignments.

Output Distribution Wiring

See Figures 2-3 and 2-4 for the location of the various output connection points.

Output Distribution Wiring	
Step	**Action**
1	Determine the appropriate wire size for the load and return leads. Dress the wire from the load to the output port on the right of the shelf. Terminate the wire with the proper connector using the proper crimping tool.
2	**For battery connections only,** apply heat-shrink tubing over the exposed barrel of the lug.
3	Secure the terminated wire to the correct output position and torque the lug fasteners to 65 in-lb. Strain relieve these wires as appropriate to remove undue stress on the connectors.
4	For connectorized output, use the appropriate tool for connecting the pins to the output wiring. **Warning** **CPS2000 plants equipped with ringers have hazardous voltages on the secondary bus output connector. In all applications, exposed primary output busbars have hazardous energy levels.**

Installing Plug-In Modules

Installing Plug-In Modules	
Step	**Action**
1	Ensure that the proper modules (rectifiers, ringers) have been ordered and received.
2	Unlock mounting latch on module.
3	Install each module by placing it on the CPS2000 plant and carefully sliding it toward the backplane until its mounting latch prevents any further backward motion. Do not seat the rectifiers.
4	The LVD function is pre-set at the factory at 42.5 volts. SW1 on the contactor assembly in the up position supports the 42.5 volt setting. See “Low-Voltage Battery Disconnect” in Section 6 for more information.

Installing Batteries

Installing Batteries	
Step	**Action**
1	Ensure that the proper batteries have been ordered and received. For safety reasons, the batteries must be disconnected while installing and testing the CPS2000 equipment. **Warning** **While installing batteries, follow all safety precautions outlined in the appropriate battery product manuals.**
2	To install batteries, follow the instructions in the appropriate product manual.

Initial Start-up and Test

Guidelines

Refer to Section 6 for a description of the parameters cited in this section. Verify that:

- all ac service circuit breakers are off or ac fuses are removed and that all dc input circuit breakers are off or dc fuses are removed
- output distribution fuses are removed
- the battery, if installed, is disconnected and any leads from the battery or CPS2000 are properly insulated

Initial Start-up and Test, continued

Shelves with ES446 or ES446A MCU

Shelves with ES446 or ES446A MCU	
Step	**Action**
1	Seat each rectifier and ringer using the latch on the unit.
2	Turn the ac service circuit breakers on.
3	Place a test load across one dc output located in the output distribution for the primary bus output on the shelf. Install a test fuse (5-10 amperes). Set the test load to approximately 2 amperes. This test verifies that the rectifier(s) will support a load.
4	Perform an LED test by depressing and holding both pushbuttons (Amps and Vadj/Mode) on the lower part of the control until the LED displays 8.8.8. Release the pushbuttons and verify that all LEDs and meter segments are illuminated.
5	Set the battery on discharge (BD) alarm threshold by pressing the Vadj/Mode pushbutton on the control unit until “bd” is displayed. Press the pushbutton a second time to display the current “bd” setting. The battery on discharge is adjusted by using the toggle switch on the top of the control unit to raise or lower the setting. To make the change in the setting permanent, press the Vadj/Mode pushbutton a third time. If you do not wish to make the changes effective, you may wait approximately 6 seconds and the display will revert to displaying plant voltage, and the previous setting will be retained.
Continued on next page.	

Initial Start-up and Test, continued

Shelves with ES446 or ES446A MCU, continued

Shelves with ES446 or ES446A MCU, continued	
Step	**Action**
6	Set the high battery temperature (Hbt) alarm threshold by pressing the Vadj/Mode pushbutton on the control unit until “bd” is displayed. Use the rocker switch at the top of the control unit to toggle to “hbt” on the LED display. Press the Vadj/Mode pushbutton a second time to display the current “hbt” setting. Use the toggle switch at the top of the control unit to change the setting. To make the change in the setting permanent, press the Vadj/Mode pushbutton a third time. If you do not wish to make the changes effective, you may wait approximately 6 seconds and the LED display will revert to displaying plant voltage, and the previous setting will be retained.
7	Place a digital voltmeter on the test points and place the two position switch in the “VBatt” position. Set the plant voltage in accordance with the engineering specifications for the specific plant by pressing the Vadj/Mode pushbutton on the control unit until “bd” is displayed. Use the rocker switch at the top of the control unit to toggle to “Adj” on the LED display. Press the Vadj/Mode pushbutton a second time to display the current “Adj” setting. Use the toggle switch at the top of the control unit to change the setting. To make the change in the setting permanent, press the Vadj/Mode pushbutton a third time. If you do not wish to make the changes effective, wait approximately 6 seconds and the LED will revert to displaying plant voltage, and the previous setting will be retained. **Note** The battery thermal management function is disabled while in plant voltage setting mode.
	Continued on next page.

Initial Start-up and Test, continued

Shelves with ES446 or ES446A MCU, continued

Shelves with ES446 or ES446A MCU, continued	
Step	**Action**
8	Verify that the BD threshold is set properly by reducing the plant voltage below the BD threshold using the Vadj/Mode controls on the control unit. As the plant primary bus voltage is reduced below the BD threshold. The BD and the PMJ alarm LEDs will light on the shelf and control unit. Clear these alarms by returning the voltage to 54.5 volts.
9	Simulate a distribution fuse alarm by inserting a blown fuse in the distribution module. Verify that the simulated distribution alarms light the control unit PMJ alarm LED on the control unit and MJF alarm LED on the shelf. Clear these alarms by replacing the blown fuses.To simulate a distribution fuse alarm for bulk output, short both pins to each other at J43.
10	Adjust the test load to 80% of the test fuse rating.
11	Verify that the rectifiers can deliver output power.
12	Reduce the test load so that about 10 amperes is available to charge the batteries. Connect the battery strings that were removed earlier. Follow the instructions in the battery product manual for charging the battery.
13	Remove the test load.

Initial Start-up and Test, continued

Shelves with ES447 ACU

Shelves with ES447 ACU	
Step	**Action**
1	Seat each rectifier and ringer using the latch on the unit.
2	Turn the ac service circuit breakers on.
3	Place a test load across one dc output located in the output distribution for the primary bus output on the shelf. Install a test fuse (5-10 amperes). Set the test load to approximately 2 amperes. This test verifies that the rectifier(s) will support a load.
4	Perform an LED test by depressing the LED Test pushbutton for approximately 1 second. Release the pushbutton and verify that all LEDs are illuminated.
5	Set the battery on discharge (BD) alarm threshold by removing the ES447 from the shelf and set the switches on SW440 as indicated in Table 6-B.
6	The high battery temperature alarm threshold for the ES447 is fixed at 65 °C. Place a digital voltmeter on the test points and place the two-position switch in the “Vbatt” position. Set the plant voltage in accordance with the engineering specifications for the specific plant by pressing and holding the Vadj/ Mode pushbutton until the Normal LED begins to blink. Use the toggle switch at the top of the control unit to change the setting. To make the change permanent, momentarily press the Vadj/Mode pushbutton and the normal LED will stop blinking and the new plant voltage setting will be saved. If you do not wish to make the changes effective, wait approximately 6 seconds and the LED will revert to displaying plant voltage and the previous setting will be retained. **Note** The battery thermal management function is disabled while in plant voltage setting mode.
	Continued on next page.

Initial Start-up and Test, continued

Shelves with ES447 ACU, continued

Shelves with ES447 ACU, continued	
Step	**Action**
7	Verify that the BD threshold is set properly by reducing the plant voltage below the BD threshold using the Vadj/Mode controls on the control unit. As the plant primary bus voltage is reduced below the BD threshold, the BD and the PMJ alarm LEDs will light on the shelf and control unit. Clear these alarms by returning the voltage to 54.5 volts.
8	Simulate a distribution fuse alarm by inserting a blown fuse in the distribution module. Verify that the simulated distribution alarms light the control unit PMJ alarm LED on the control unit and the MJF alarm LED on the shelf. Clear these alarms by replacing the blown fuses. For those shelves equipped with a bulk distribution output, the MJF function may be exercised by shorting the two contacts on connector J43 together.
9	Adjust the test load to 80% of the test fuse rating.
10	Verify that the rectifiers can deliver output power.
11	Reduce the test load so that about 10 amperes is available to charge the batteries. Connect the battery strings that were removed earlier. Follow the instructions in the battery product manual for charging the battery.
12	Remove the test load.

Initial Start-up and Test, continued

Shelves with ES490 Ringing Controller

Shelves with ES490 Ringing Controller	
Step	**Action**
1	Seat the control unit and each ringer using the latch on the unit.
2	Apply dc input power to both dc inputs of the shelf.
3	Verify ringing voltage at the test jacks in the distribution area.
4	Verify that only green LEDs are illuminated.

Adding Rectifiers and Ringers to a Working Plant

Procedure

Rectifiers and ringers may be added with input power applied.

Adding Rectifiers and Ringers to a Working Plant	
Step	**Action**
1	Unlock mounting latch on rectifier.
2	Place the module on the shelf and slide it toward the backplane until the latch prevents any further backward motion.
3	Using latch, seat the module.

Removing Ringers from Plants with ES490 Control Unit

Removing ringers will cause the controller to switch the redundant ringer (if present) to power the associated ringing output and to assert an alarm. This action will continue until a functional ringer has replaced the removed ringer or the plant configuration has been reset to accept the empty slot as permanent.

Ringers are automatically added to the plant configuration when present in the shelf and powered.

Ringers may be removed with or without input power applied.

Removing Ringers from Shelves with ES490 Control Unit	
Step	**Action**
1	Unlock mounting latch on ringer.
2	Remove module by pulling it out.
3	Press Lamp Test / Reset switch on controller. **Note: This will cause alarms to be NOT asserted for slots not occupied at this time.**
4	Verify that only green LEDs are illuminated.

6 Alarms, Controls, and Displays

Displays

Types of Displays Figure 6-1 shows the displays of the ACU, MCU, Ringer, and Rectifier.

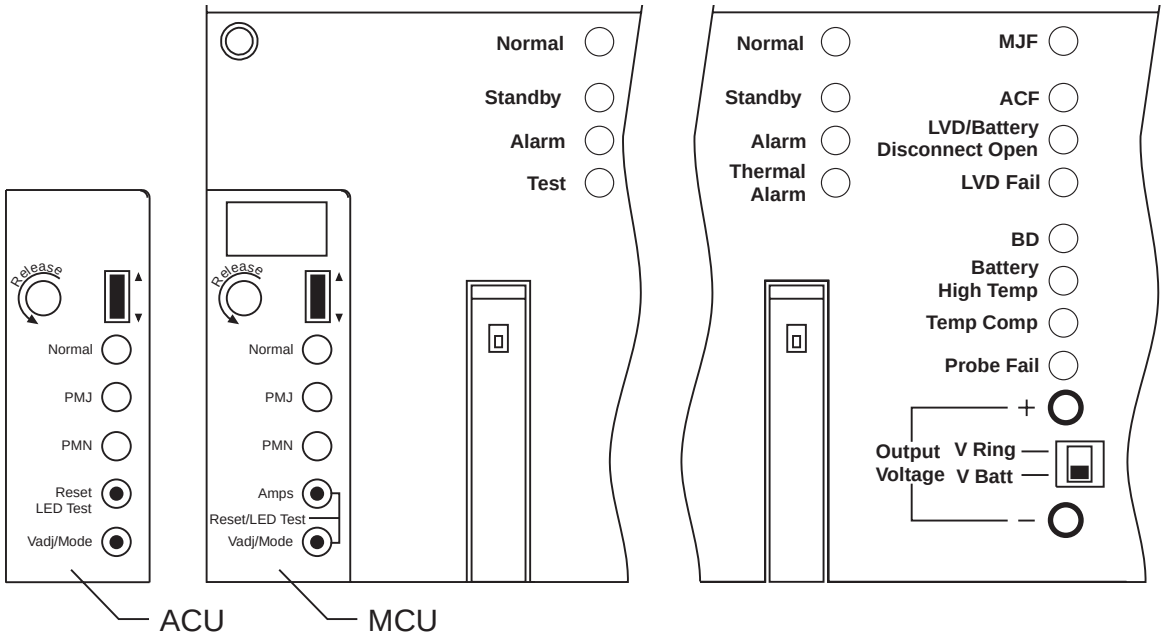


Figure 6-1: Front Panel Displays

Displays, continued

Voltage Adjust

Controls on the control unit allow the customer to adjust the rectifier output voltage from approximately 48 volts to 56 volts. If the control unit fails, loses power, or is removed, the plant output voltage reverts to its preset voltage (52.5Vdc).

Front Panel Test Jacks

Test points are provided on the rectifier-ringer shelves so that the plant's primary and secondary voltages may be checked with an external meter. The test points are current-limited to protect against accidental short-circuits. A two-position switch allows the test points to measure primary and secondary voltages.

Front Panel Meter

A 3-1/2 digit LED is located on the faceplate of the ES446 or ES446A Monitor and Control Unit. Momentarily pressing the "Amps" pushbutton displays plant current. When the pushbutton is selected, the display indicates primary bus output current. The plant default display indicates the primary bus (rectifier) output voltage. The current is displayed for approximately 5 seconds and then the plant voltage is displayed. When in the current display mode, the plant current and individual rectifier currents can be displayed with the sequential activation of the + and - pushbutton keys.

Ringer Standby

The Ringer Standby LED indicates that the ringer is ready to provide ringing power in the event of failure or removal of the other ringer in a rectifier-ringer plant.

This LED will not illuminate except in LED test in a ringer plant.

LED Tests

ES446 or ES446A

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

LED Test for ES446 or ES446A	
Step	**Action**
1	Simultaneously press the Amps and Vadj/Mode pushbuttons on the Monitor and Control Unit face plate.
2	Verify that all front panel LEDs illuminate while both pushbuttons are depressed. **Note** Depressing both the Amps and Vadj/Mode pushbuttons simultaneously will also restart any rectifiers that have shut down due to high voltage or excessive thermal conditions.

ES447

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

LED Test for ES447	
Step	**Action**
1	Press the LED Test pushbutton on the Alarm Control Unit face plate.
2	While the LED Test pushbutton is depressed, all front panel LEDs should illuminate. **Note** Activating the LED Test will also restart any rectifiers that have shut down due to high voltage or excessive thermal conditions.

LED Tests, continued

ES490

Use the following test to determine if all LED displays are working properly.

LED Test for ES490	
Step	**Action**
1	Press the LED Test pushbutton on the ringer controller face plate.
2	While the LED Test pushbutton is depressed, all module LEDs should illuminate. **Note** Activating the LED Test will also reset the Ringer plant configuration. This accepts any non-occupied ringer as OK for alarm purposes.

Control Units

Overview

The control unit administers alarm processing, plant on/standby control, and plant voltage adjustments in the CPS2000 plant. In addition, the control unit provides alarm LEDs and a front panel display (on ES446 or ES446A only) with a pushbutton for viewing voltage or current. The control unit provides two voltages that are proportional to the plant's voltage and load current to the office alarm connector.

Operational Modes

The MCU (Monitor and Control Unit) has two operational modes. These modes can be selected by settings on Switch 440, position 6. Refer to Table 6-B for specific Switch 440 settings.

On the ES447 ACU (Alarm Control Unit), Switch 440 has other features. The operation mode for alarms is hardwired the same as ES446 or ES446A. Table 6-C shows how the switch adjustments given in Table 6-B are used to obtain the desired BD level on the ES447.

TheES490 Ringer Controller also manages the switching of a redundant ringer to power a failed or removed ringer.

Features

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

Control Units, continued

Table 6-A: Control Unit Features

Feature	ES446/ES446A	ES447	ES490
Plant Meter (volts)	Yes	No	No
Plant Meter (amperes)	Yes	No	No
Remote Test (volts)	Yes	Yes	No
Remote Test (amperes)	Yes	Yes	No
Temperature Voltage Adjust	Yes	Yes	No
Plant Voltage Adjust	Yes	Yes	No
PMJ Alarm LED	Yes	Yes	Yes
PMN Alarm LED	Yes	Yes	Yes
ACF Alarm LED (see Note 1)	Yes	Yes	No
MJF Alarm LED (see Note 1)	Yes	Yes	No
BD Alarm LED (see Note 1)	Yes	Yes	No
Plant Normal LED	Yes	Yes	Yes
Temperature Comp LED (see Note 1)	Yes	Yes	No
High Bat Temp LED (see Note 1)	Yes	Yes	No
Probe Fail LED (see Note 1)	Yes	Yes	No
Remote On/Standby	Yes	Yes	No
Plant Battery Test	Yes	Yes	No
PMJ Office Alarm	Yes	Yes	Yes
PMN Office Alarm	Yes	Yes	Yes
AUX PMJ Alarm	Yes	Yes	No
BATT (AUX alarms) (see Note 2)	Yes	Yes	No
ACF Office Alarm	Yes	Yes	No
BD Office Alarm	Yes	Yes	No
On-Standby Disable	Yes	No	No
PBT Disable	Yes	No	No
BD as a PMJ	Yes	Yes	No
Front Panel Menu	Yes	No	No
Switch Select BD Level (see Note 3)	No	Yes	No
Ind. Current Monitor	Yes	No	No
LED Test	Yes	Yes	Yes
Rectifier Fail Detect	Yes	Yes	No
Converter Fail Detect	Yes	Yes	No
Ringer Fail Detect	Yes	Yes	Yes

Notes:
1. Needs EDF1 board to display.
2. Needs special probe connector to attach to distribution. A contact closure is needed to activate alarm.
3. Not needed in MCU since front panel menu can program BD level.

Control Units, continued

Switch 440 Settings

Table 6-B: Switch 440 Settings

Switch	Position	Control Unit Features		
		ES446 MCU	**ES446A MCU**	**ES447 ACU**
1	Open	N/A	Temperature Compensation (EURO Mode)*	Adjust BD up 0.5V**
	Closed	N/A	Temperature Compensation (NAFTA Mode)*	N/A
2	Open	N/A	N/A	Adjust BD up 1V**
	Closed	N/A	N/A	N/A
3	Open	BD alarm does not generate a PMJ alarm	BD alarm does not generate a PMJ alarm	Adjust BD up 2V**
	Closed	BD alarm also generates a PMJ alarm	BD alarm also generates a PMJ alarm	N/A
4	Open	Disable rectifier On/ Standby capability	Disable rectifier On/ Standby capability	Adjust BD up 4V**
	Closed	Enable rectifier On/ Standby capability	Enable rectifier On/ Standby capability	N/A
5	Open	Disable Plant Battery Test	Disable Plant Battery Test	Temperature Compensation (EURO Mode)*
	Closed	Enable Plant Battery Test	Enable Plant Battery Test	Temperature Compensation (NAFTA Mode)*
6	Open	Enable “B” Type Operation (see Table 6-E)	Enable “B” Type Operation (see Table 6-E)	BD alarm does not generate a PMJ alarm.
	Closed	Enable regular Type Operation (see Table 6-E)	Enable regular Type Operation (see Table 6-E)	BD alarm also generates a PMJ alarm.

*EURO and NAFTA Mode Settings available only on ES446A and ES447 control units, with Series 1:2 or later.
**BD starting voltage is 46 Volts. The BD setpoint on the ES446 or ES446A is set on the front panel.

Control Units, continued

Table 6-C: ES447 SW440 BD Settings

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

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 control unit monitors the plant voltage and provides a BD alarm. The threshold for the battery on discharge alarm is set using the controls on the control unit.

Voltage Threshold for the BD Alarm

The setpoint is typically at least one volt below the low-temperature plant float voltage for nominal -48V plants without battery thermal management. The BD setting should be at least three (3) volts below the low-temperature plant float voltage if battery management is used. 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.

Low-Voltage Battery Disconnect

DIP switches on the EDC1 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 factory default setting is 42.5 volts.

Table 6-D: SW1 LVD Settings

Switch 1	Voltage
Up	42.5
Down	40.5

Rectifier/Converter Alarms

Whenever the control unit receives a single rectifier and/or ringer alarm, it issues a Power Minor (PMN) alarm. A yellow LED lights on the CPS2000 unit faceplate. If the control unit receives two or more rectifier and/or converter alarms, they will issue both a PMN and a Power Major (PMJ) alarm (for ES446 or ES446A and ES447). Both the yellow PMN LED and the red PMJ LED on the control unit for the CPS2000 will also light. See Table 6-E.

Since a loss of a single rectifier and/or converter may not necessarily affect the plant voltage, this condition is treated as a minor alarm. However, if two or more rectifiers have failed or are in standby (even if they are not required to power the load), the control unit issues a PMJ (for ES446 or ES446A and ES447).

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. The control unit issues a PMN alarm for a single ac failure. The yellow PMN and ACF LEDs will light.

Two AC Fail Alarm

If ac input power is missing from more than one rectifier, the control unit issues 2ACF, PMJ, and PMN office alarms. The PMJ, PMN, and ACF LEDs light on the ES446 or ES446A and ES447.

Major Fuse Alarm

The control unit monitors 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. The red PMJ and MJF LEDs on the CPS2000 will light.

Low-Voltage Alarm

The ES446A issues the low-voltage alarm whenever the plant voltage drops below 46 volts. The alarm retires at 46.5 volts.

High Battery Temperature Alarm

The control unit monitors the battery temperatures via the installed thermal probes. When the control unit detects that the battery temperature has exceeded the alarm threshold, the control unit issues a high battery temperature alarm and a power major (PMJ) alarm.

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 CPS2000 plant into two categories based on their impact on plant functions: Power Major (PMJ) and Power Minor (PMN). Where feasible, LEDs, indicators, and relay contact closures provide supplementary information to indicate that a specific alarm condition resulted in the PMN or PMJ alarm.

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.

Alarm Processing, continued

Plant Alarms and Indications

Tables 6-E and 6-F summarize plant alarms and alarm indications (i.e., contact closures and/or LEDs).

Table 6-E: Rectifier-Ringer Plant Alarms and Alarm Indications

Alarm Condition	ES446 or ES446A SW440 Position 6 Closed		ES446 or ES446A SW440 Position 6 Opened		Rectifier LED	Shelf LED
	ES447					
	Office Alarm	LED	Office Alarm	LED		
Rectifier Standby (1)	PMN	PMN	PMN	PMN	Stby	
Rectifier Standby (2)	PMN PMJ	PMN PMJ	PMN	PMN	Stby	
Rectifier Alarm (1)	PMN	PMN	PMN	PMN	Alarm	
Rectifier Alarm (2)	PMN PMJ	PMN PMJ	PMN	PMN	Alarm	
Ringer Standby (1)	PMN	PMN	PMN	PMN	Stby	
Ringer Standby (2)	PMN PMJ	PMN PMJ	PMJ	PMJ	Stby	
Ringer Alarm (1)	PMN	PMN	PMN	PMN	Alarm	
Ringer Alarm (2)	PMN PMJ	PMN PMJ	PMJ	PMJ	Alarm	
AC Fail (1)	PMN ACF	PMN	PMN ACF	PMN		ACF
AC Fail (2)	PMJ PMN ACF 2ACF	PMJ PMN	PMN ACF	PMN		ACF
Excess Battery Temp	PMJ	PMJ	PMJ	PMJ		Battery High Temp
Battery on Discharge	PMJ* BD	PMJ*	BD			BD
Distribution or Major Fuse Alarm	PMJ MJF	PMJ	PMJ MJF	PMJ		MJF
Low Voltage	N/A	N/A	LV			BD
LVD Open	PMJ	PMJ	PMJ	PMJ		LVD/Battery Disconnect Open
Probe Fail	PMN	PMN	PMN	PMN		Probe Fail

Continued on next page.

Table 6-E: Rectifier-Ringer Plant Alarms and Alarm Indications

Alarm Condition	ES446 or ES446A SW440 Position 6 Closed		ES446 or ES446A SW440 Position 6 Opened		Rectifier LED	Shelf LED
	ES447					
	Office Alarm	LED	Office Alarm	LED		
Temp Comp						Temp Comp
LVD Fail	PMN	PMN	PMN	PMN		LVD Fail
Battery Disconnect Open	PMJ	PMJ	PMJ	PMJ		LVD/Battery Disconnect Open
LED Test		All		All		All
* May be inhibited by opening SW440 Position 3 on the ES446 or ES446A or by opening SW440 Position 6 on the ES447.						

Table 6-F: Ringer Plant Alarms And Alarm Indication

Alarm Condition	Office Alarm	Controller LED	Ringer LED
Normal	none	Normal (green)	Norm (green)
One Ringer Fail or Removed, Redundant Ringer Present	PMN	PMN (yellow)	Fail (red) if not removed
One Ringer Fail or Removed, Redundant Ringer not Present	PMJ	PMJ (red)	Fail (red) if not removed
More Than One Ringer Fail or Removed	PMJ	PMJ (red)	Fail (red) if not removed
One dc input under voltage	PMN	PMN (yellow)	N/A
Shelf Under Voltage or Unpowered	PMN & PMJ[1]	N/A	N/A
Controller Loss of Sanity	PMJ	PMJ (red)	N/A
Controller Removed	none	removed	N/A
Ringer Output Shorted[2]	PMJ	PMJ (red)	Fail (red)
Note 1: PMJ and PMN are only simultaneously asserted while the controller is present and un-powered or under powered. Note 2: The redundant spare ringer is NOT switched to power a shorted output.			

Office Alarm Contacts

Overview

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 closures are sent to the office alarm system.

Ringer-Rectifier Plants

A set of form-C contacts is brought out on the alarm connector on the left side of the CPS2000 for each of the following plant alarms for the control unit:

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

Ringer Plants

A set of form-C contacts is brought out on the alarm terminal block and connector on the right side of the shelf for each of these plant alarms:

- Power Major (PMJ)
- Power Minor (PMN)

Office Alarm Contacts, continued

Rectifier-Ringer Plant J46 Pin Assignments

Table 6-G: Rectifier-Ringer Plant Office Alarm Assignments

J46 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	S-W
11	MFJ_C	R-BL
12	MJF_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-BK
20	AUX_PMN	BK-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		BR-BK
32		BK-S
33		S-BK
34		
35		
36	EARTH_GND	BL-Y

Office Alarm Contacts, continued

Ringer Plant Pin Assignments

Table 6-H: Ringer Plant Office Alarms Assignments

Pin / Position	P3 Connector	P4 Wago Block
1		PMJ_C
2		PMJ_NC
3		PMJ_NO
4	PMJ_C	PMN_C
5	PMJ_NO	PMN_NC
6	PMJ_NC	PMN_NO
7	PMN_C	
8	PMN_NO	
9	PMN_NC	

Plant Battery Test

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 J46-29 and J46-30 will reduce the rectifier output voltage setpoint to approximately 48 volts, which creates a battery on discharge condition.

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 the 48 volt rectifier setpoint 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 J46-28 and J46-30 in order to continue the discharge and further determine the reserve capacity of the batteries.

Datalogger Outputs

All control units send two analog voltages to the office alarm connector for monitoring the plant voltage and current remotely. There is a 31.6K ohm resistor in series with each lead to form a Class 2 circuit. The voltage measured between R_VV (J46-25) and R_RTN (J46-27) is proportional to the plant primary voltage. This voltage multiplied by 25.56 equals the primary plant voltage. The voltage measured between R_VI (J46-26) and R_RTN (J46-27) is proportional to the plant load current. This voltage multiplied by 25 equals the load current.

LVD/Thermal Management

Introduction

The display on the Output Wiring module has eight LEDs: LVD Open, MJF (Major Fuse), LVD Fail, ACF (AC Fail), BD (Battery on Discharge), Battery High Temperature, Temp Comp (Temperature Compensation), 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.

Temp Comp (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 [green LED on the EDF1 LVD/Thermal Management circuit pack.

Use DIP Switch SW440 Position 5 on the ES446 MCU to choose the appropriate algorithm for this feature:

- Open is EURO Mode
- Closed is NAFTA Mode

These algorithms are illustrated in Figures 6-2 and 6-3.

Probe Fail

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.

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.

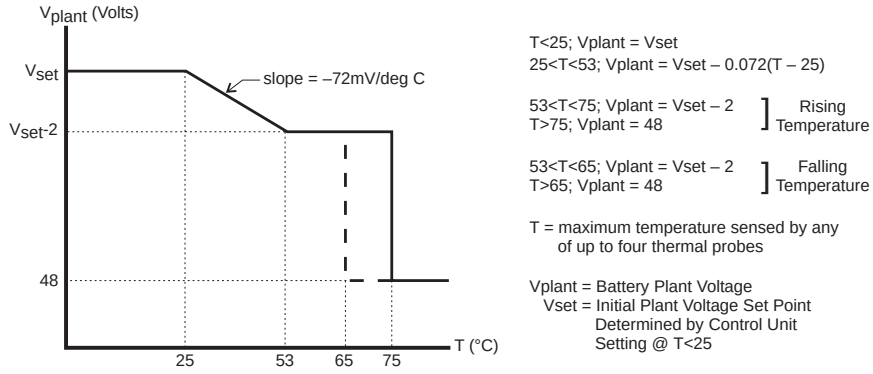


Figure 6-2: -48V Slope Temperature Compensation NAFTA Algorithm

The ES447 ACU and ES446 and ES446A MCUs provide the NAFTA Mode thermal management control feature, which is illustrated in Figure 6-2.

The ES446C MCU provides the factory-set NAFTA Mode thermal management control that is switch-selectable to EURO Mode (Option), which is shown in Figure 6-3.

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.

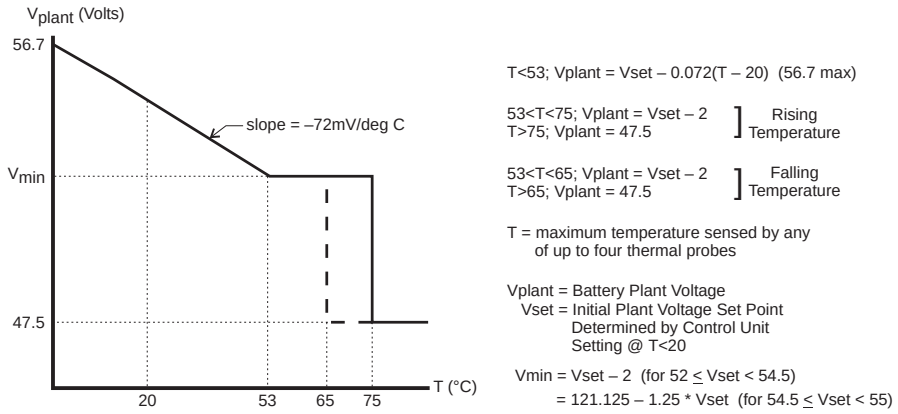


Figure 6-3: -48V Slope Temperature Compensation EURO Mode Algorithm

The ES446C MCU provides the switch-selectable EURO Mode thermal management option (illustrated in Figure 6-3), with the NAFTA Mode the factory-set standard.

7 Troubleshooting

Overview

Safety

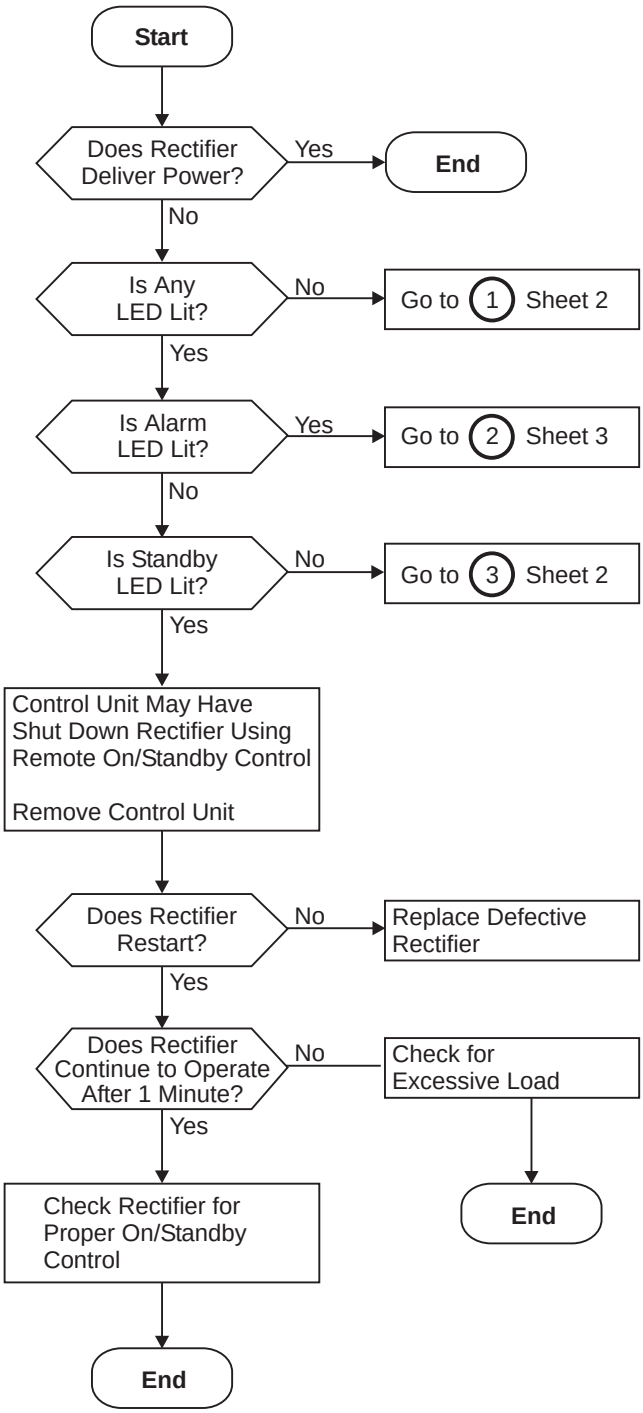
Review all safety instructions and warnings in Section 4 and the warning below before performing any troubleshooting procedures.

Warning

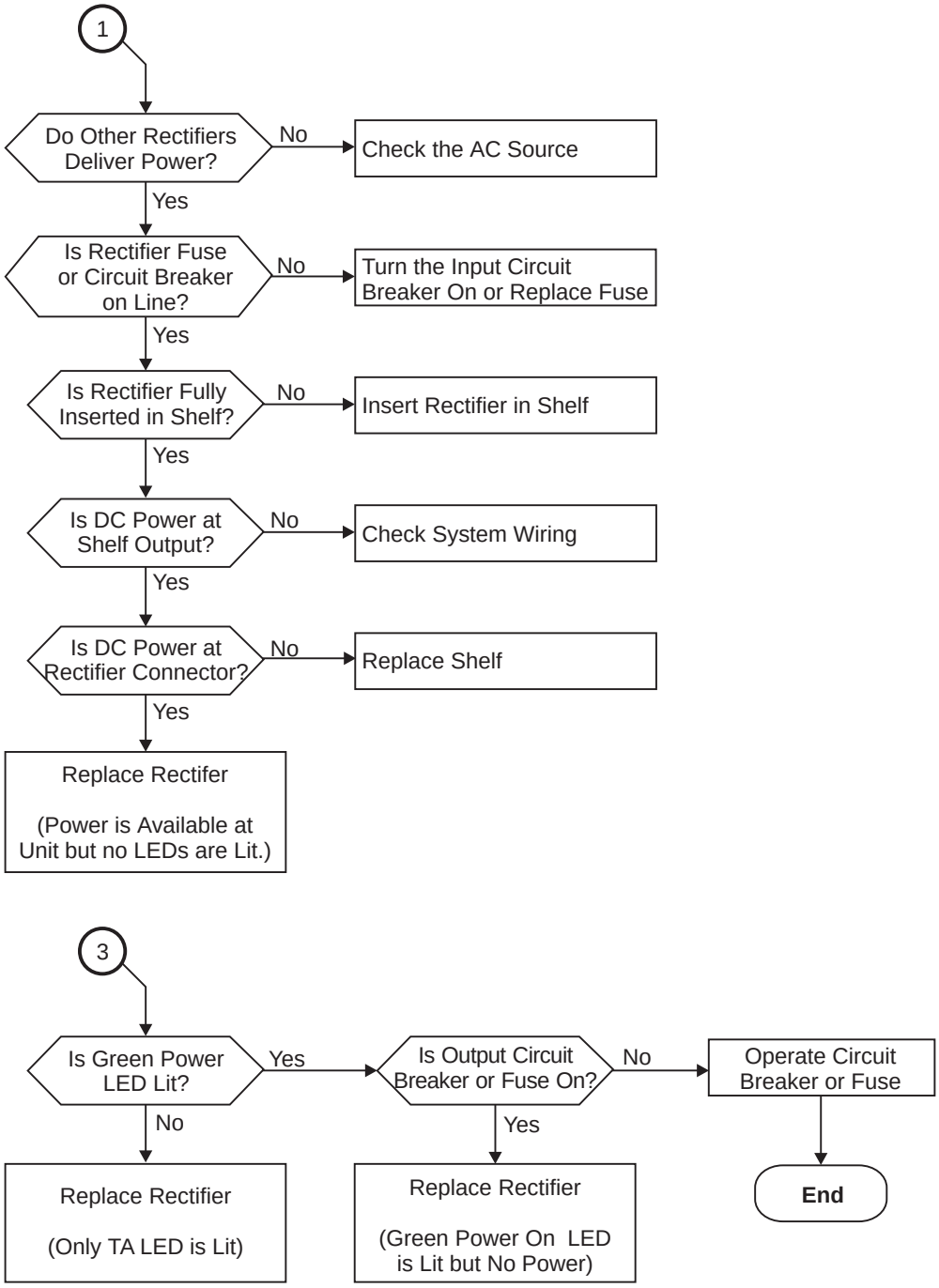
Input power voltages may be provided to the CPS2000 via multiple input cables. Ensure that the circuit protector for each power input is disconnected while installing or servicing this equipment.

Rectifier Troubleshooting Flowcharts

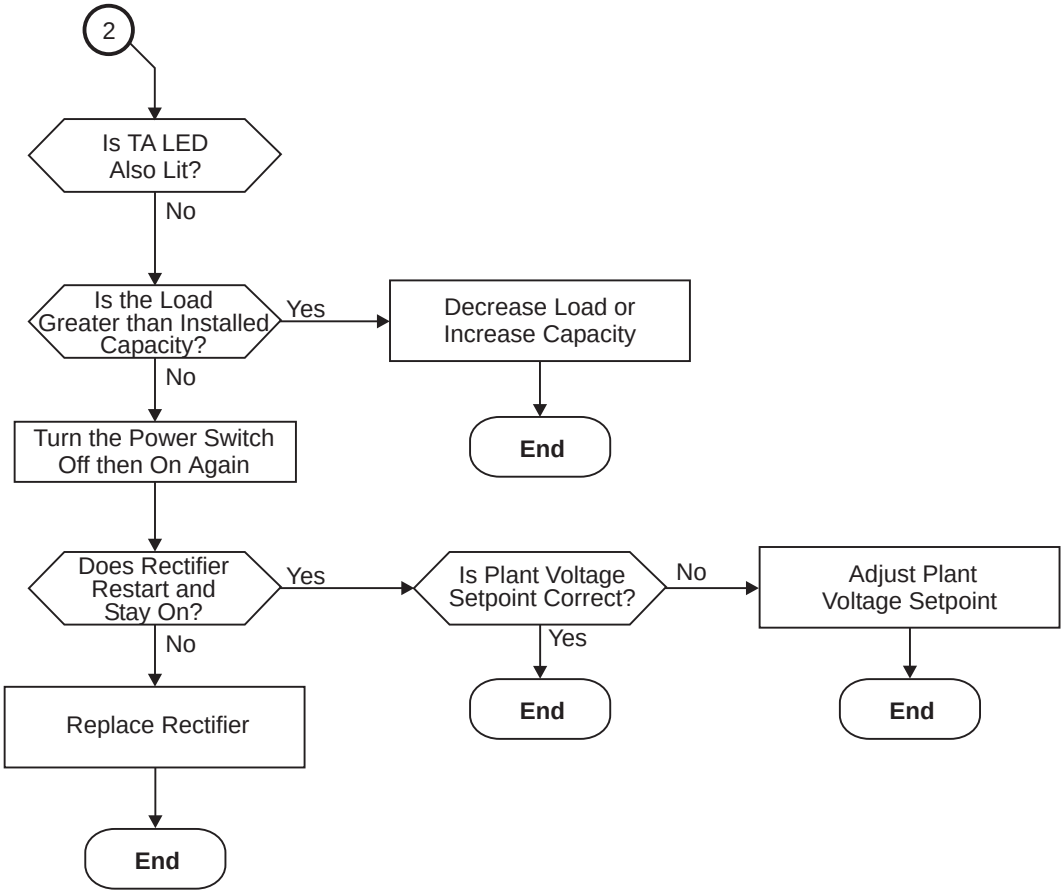
The following flowcharts list indications and the corrective action(s) to take when a rectifier does not deliver power. Match specific site conditions to those listed in the chart. If none of these corrective actions remedies the problem, call your local RTAC representative at 1-800-CAL-RTAC (1-800-225-7822).



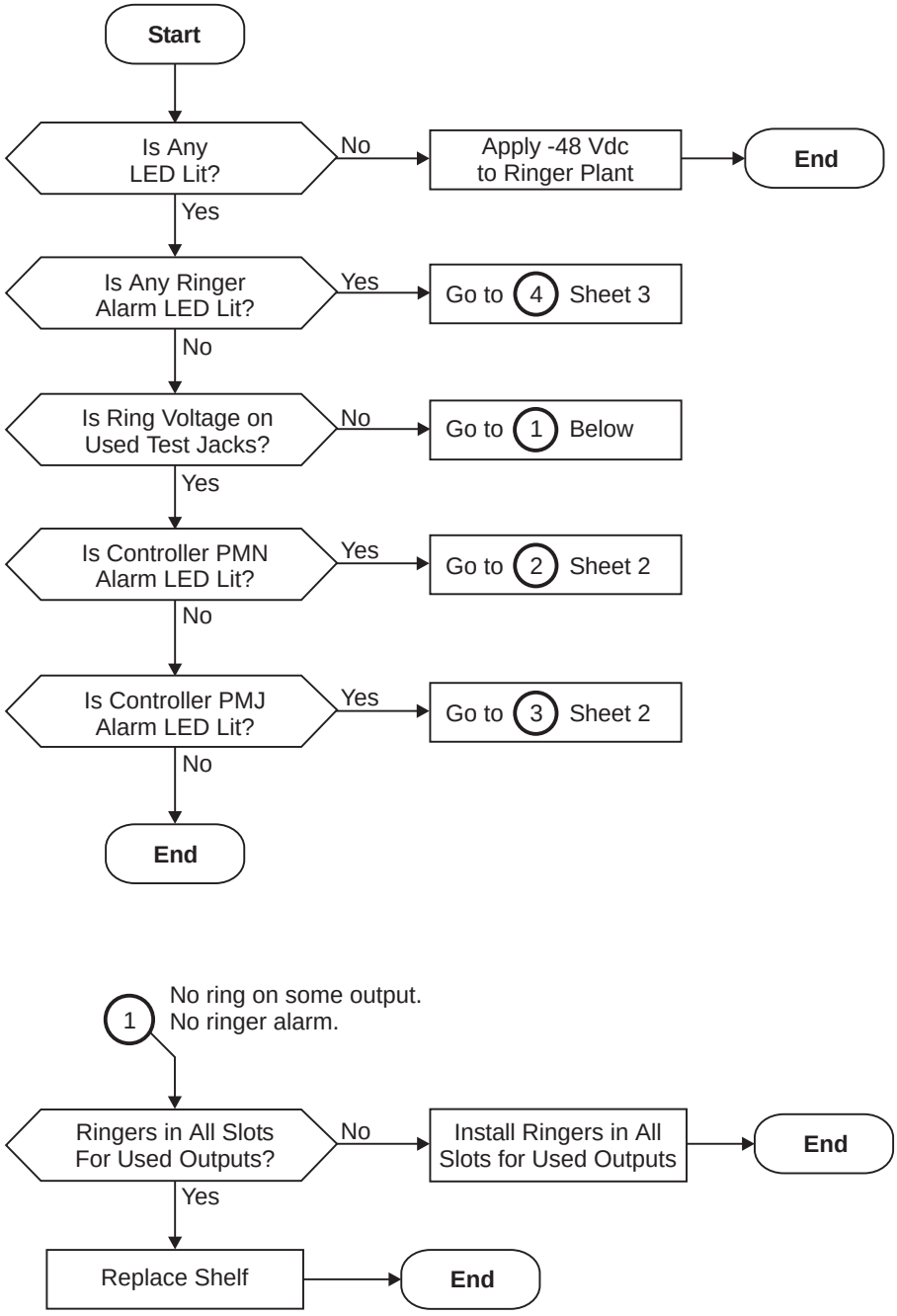
Rectifier Plant Troubleshooting Flowcharts - Sheet 1



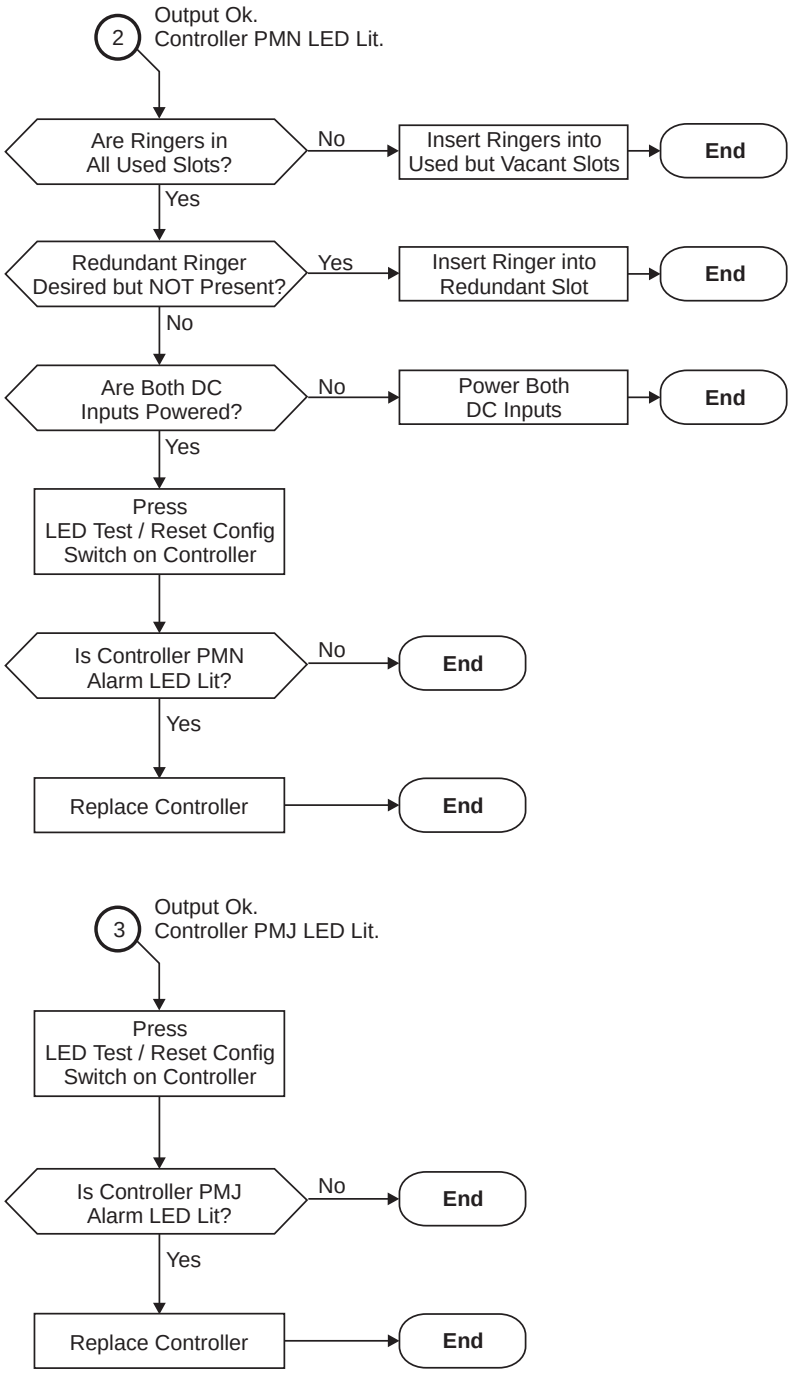
Rectifier Plant Troubleshooting Flowcharts - Sheet 2



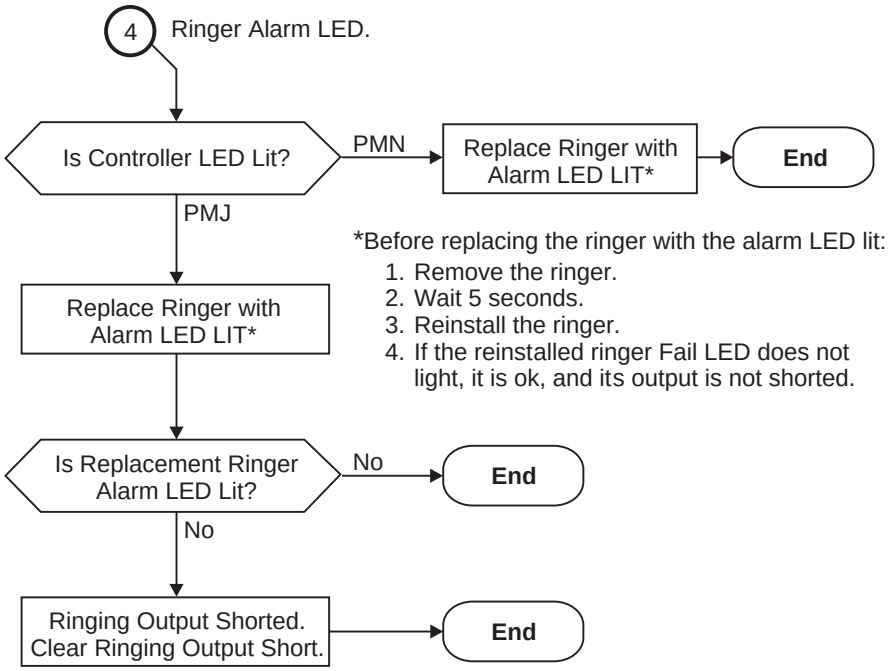
Rectifier Plant Troubleshooting Flowcharts - Sheet 3



Ringer Plant Troubleshooting Flowcharts - Sheet 1



Ringer Plant Troubleshooting Flowcharts - Sheet 2



Ringer Plant Troubleshooting Flowcharts - Sheet 3

8 Product Warranty

A. Seller warrants to Customer only, that:

1. As of the date title to Products passes, Seller will have the right to sell, transfer, and assign such Products and the title conveyed by Seller shall be good;
2. Upon shipment, Seller's Manufactured Products will be free from defects in material and workmanship, and will conform to Seller's specifications or any other agreed-upon specification referenced in the order for such Product;
3. With respect to Vendor items, Seller, to the extent permitted, does hereby assign to Customer the warranties given to Seller by its vendor of such Vendor Items, such assignment to be effective upon Customer's acceptance of such Vendor Items. With respect to Vendor items recommended by Seller in its specifications for which the vendor's warranty cannot be assigned to Customer, or if assigned, less than Sixty (60) days remain of the vendor's warranty or warranty period when the Vendor's items are shipped to Customer or when Seller submits its notice of completion of installation if installed by Seller, Seller warrants that such Vendor's Items will be free from defects in material and workmanship on the date of shipment to Customer. In such an event, the applicable Warranty Period will be sixty (60) days.

B. The Warranty Period listed below is applicable to Seller's Manufactured Products furnished pursuant to this Agreement, unless otherwise stated:

Warranty Period

Product Type	New Product	Repaired Product or Part*
Central Office Power Equipment**	24 Months	6 Months
*The Warranty Period for a repaired Product or part thereof is as listed or, in the case of Products under Warranty, is the period listed or the unexpired term of the new Product Warranty Period, whichever is longer. **The Warranty Period for Products ordered for Use in Systems or equipment Manufactured by and furnished by Seller is that of the initial Systems or equipment.		

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

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

D. If Seller has elected to repair or replace a defective Product, Customer shall have the option of removing and reinstalling or having Seller remove and reinstall the defective or nonconforming Product. The cost of the removal and the reinstallation shall be borne by Customer. With respect to Cable and Wire Products, Customer has the further responsibility, at its expense, to make the Cable and Wire Products accessible for repair or replacement and to restore the site. Products returned for repair or replacement will be accepted by Seller only in accordance with its instructions and procedures for such returns. The transportation expense associated with returning such Product to Seller shall be borne by Customer. Seller shall pay the cost of transportation of the repair or replacing

Product to the destination designated by Customer within the Territory.

E. The defective or nonconforming Products or parts which are replaced shall become Seller's property.

F. If Seller determines that a Product for which warranty service is claimed is not defective or nonconforming, Customer shall pay Seller all costs of handling, inspecting, testing, and transportation and, if applicable, traveling and related expenses.

G. Seller makes no warranty with respect to defective conditions or nonconformities resulting from actions of anyone other than Seller or its subcontractors, caused by any of the following: modifications, misuse, neglect, accident, or abuse; improper wiring, repairing, splicing, alteration, installation, storage, or maintenance; use in a manner not in accordance with Seller's or vendor's specifications or operating instructions, or failure of Customer to apply previously applicable Seller modifications and corrections. In addition, Seller makes no warranty with respect to Products which have had their serial numbers or month and year of manufacture removed, altered, or with respect to expendable items, including, without limitation, fuses, light bulbs, motor brushes, and the like.

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

Appendix A Application Note

Air Flow Management

The Cabinet Power System 2000 (CPS2000) has been designed for telephone equipment cabinet applications where -48 VDC and ringing are required in 3U (5.25 inches) of frame height. The CPS2000 system is capable of natural convection operation with ambient inlet temperatures between -40°C and 50 °C. In other words, for temperatures below 50 °C the rectifiers are capable of self cooling by natural convection. The purpose of this document is to provide forced external airflow requirements for operating temperatures above 50 °C.

Air Flow Requirements

Air flow requirements for operating the CPS2000 system in ambient temperatures exceeding 50 °C can be obtained by using the information presented in Figure A-1.

Example:

If the ambient temperature where CPS2000 is located is 70 °C, the minimum air flow required exiting the CPS2000 system is 70.0 Linear Feet per Minute (.356 Meters per Second).

The following paragraphs provide a description of how the data for Figure A-1 was collected. It is important when using Figure A-1 that data for your application be collected in like fashion.

Air Flow Configurations

The direction of the forced air flow through the CPS2000 can be either from top-to-bottom or from bottom-to-top. The air flow measurements, for Figure A-1, were taken for the worst case situation which was air flow from bottom-to-top, with the fans placed below the CPS2000. Figure A-2 below shows the front and top of the CPS2000 system.

Air Flow Measurement

The air flow exiting from the top of the CPS2000 was measured by using an Omega hand held digital anemometer, model HH-32A. The measuring probe was positioned above the heat sink of each rectifier at the locations marked with circles in Figure A-2. The dashed rectangle shows the area where the average airflow must meet the requirements of Figure A-1.

An air flow measurement was taken at each location and the sum was divided by four to obtain the average air flow in LFM. The CPS2000 was not connected to power while these air flow measurements were taken. This was to ensure that the data was for forced convection only and that natural convection from the rectifiers did not interfere with the forced airflow measurements. Please note that exiting air is the minimum requirement in order for CPS2000 to perform within the guide lines specified in the product manual.

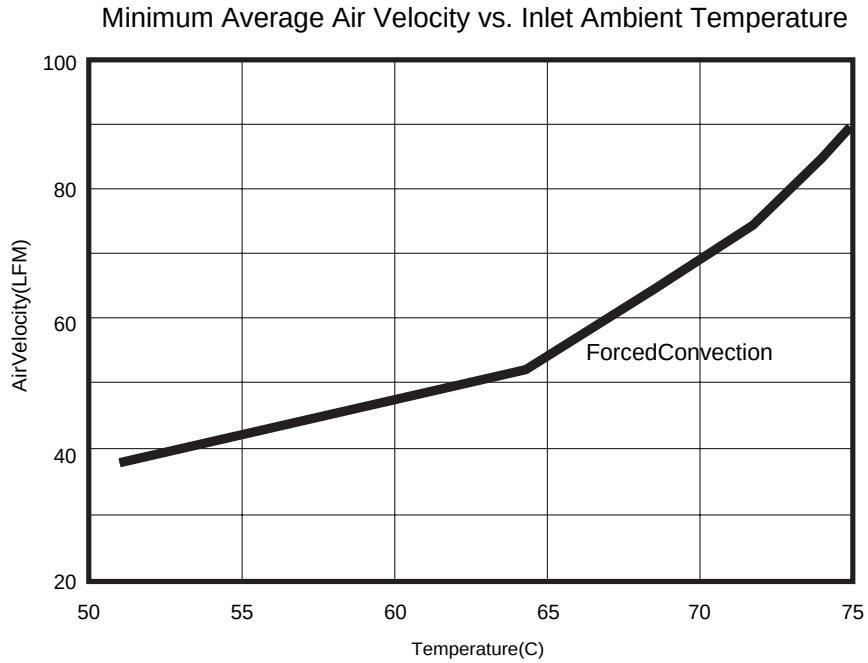


Figure A-1: Required Exiting Air Flow vs. Inlet Ambient Temperature

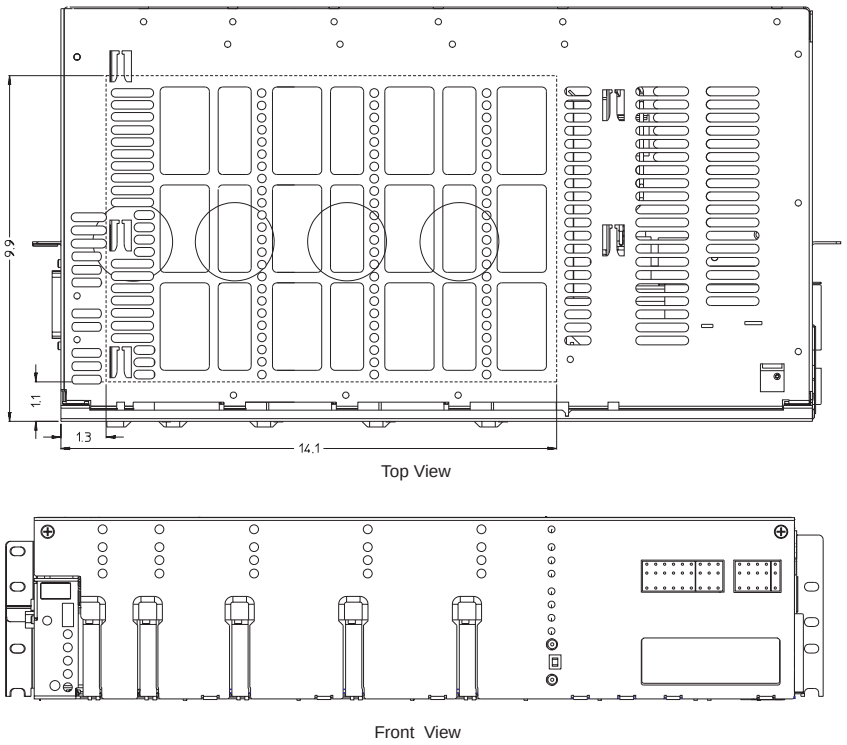


Figure A-2: Top and Front Views of the CPS2000

Pressure Drop Measurement

The pressure drop through the CPS2000 system may be used to construct an experimental setup in the cabinet, or using system, without the CPS2000 hardware. Using a hand held TSI Model 8360 Velocicalc Plus meter, the pressure drop through a fully loaded CPS2000 system at 85 LFM was measured to be approximately .01 mm Hg.

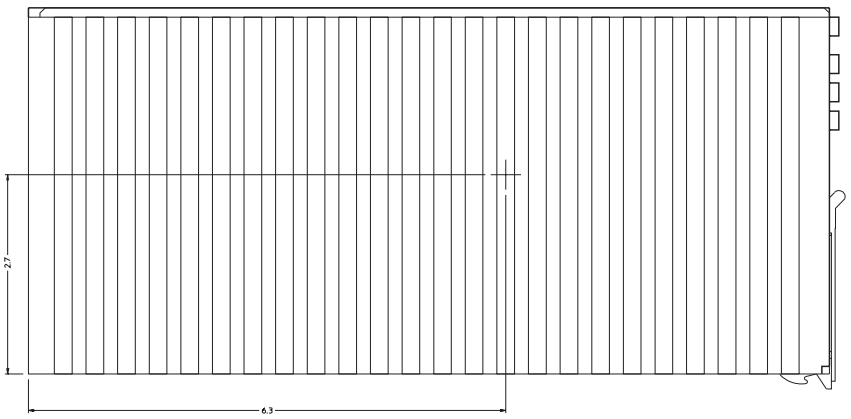


Figure A-3: Approximate Thermocouple Location on Rectifier Heatsink

Requirements for No Forced External Air Flow

The CPS2000 is rated for use up to 50°C with no external forced airflow. This is because the natural convection generated by the rectifiers is sufficient to provide enough airflow to cool itself. In order to determine if a shelf is thermally capable of operating up to 50 °C, in a specific cabinet with no external airflow, it is necessary to place a fully loaded shelf (4 rectifiers) inside the cabinet. Thermocouples should be placed on the heat sink of each rectifier in the approximate position shown in Figure A-3. Temperature measurements should be recorded with the system operating at full load for a period of three hours to allow it to thermally stabilize. The system should not be used in a cabinet location if any temperature exceeds 95 °C on the heatsinks. If any heatsink temperature exceed 95 °C, more space for airflow is required either above and/or below the shelf.

NOTE **This application note is for planning purposes only and is not intended to modify or supplement any Lucent Technologies specifications or warranties relating to this product.**

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