

Lucent Technologies
Bell Labs Innovations



Lineage[®] 2000
1800-Ampere, -48-Volt
ECS Battery Plant
J85500S-1

Product Manual
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Issue 6
January 1999
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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

Thank you for making the Right Choice, a Lucent Technologies Lineage[®] 2000 Energy Systems product. The Lineage[®] 2000 family name of premier energy system products is globally recognized as the right choice for the ultimate in systems performance and reliability. Selecting this product brings the Lucent commitment to product and service excellence to your own telecommunications system. This long-standing Lucent Technologies commitment has been gained from over 80 years of worldwide telecommunications experience in the development, manufacturing, engineering, installation and servicing of leading-edge energy systems products and services.

This product manual describes the Lineage[®] 2000 Evolutionary Control System (ECS) Battery Plant, model J85500S-1. This member of the ECS family of battery plants operates from a nominal 208/240-volt ac, 3-phase commercial source at 50 or 60 hertz. It produces a nominal -48-volt dc output with a maximum system capacity of 1800 amperes.

The J85500S-1 is a totally integrated energy system package that uses switchmode rectifier (SR) and microprocessor control technologies with the comprehensive line of fuse and circuit breaker distribution options offered with our large capacity battery plant, model J85500A-2. The controller, rectifiers, and dc distribution systems are modularly packaged to ensure easy installation and maintenance while accommodating a wide range of current capacities and configurations. This modular design architecture allows the system to begin small and expand capacity, hardware and software features incrementally as demands require.

The basic system consists of charge/discharge bus bars with optional low-voltage battery or load disconnect/reconnect, an

ECS, up to twelve 150-ampere switchmode rectifiers, model SR 150/-48V, ac distribution, system shunt and ED83018-31 dc distribution panels with fuse and circuit breaker options from 1 to 600 amperes.

The J85500S-1 is compatible with flooded and valve-regulated batteries that float within the range of 47 through 58.5 volts. In addition, the plant is capable of operating in the batteryless mode, making it suitable for those applications where battery backup is not necessary or is achieved through the use of an uninterrupted power supply (UPS).

The topics covered in this manual include a general product description, basic features and options, ordering guides and engineering and installation information. The main emphasis will be to familiarize the user with each major component in the system and step by step installation and start-up procedures.

Documentation

This document (Lucent Technologies 167-790-061) is part of a set of documentation developed to assist engineering and installation personnel. Additional product information includes the following:

<i>Battery Plant</i>	J85500S-1	Assembly and Ordering Drawing
	ED-83130-30	AC Distribution Drawing
	ED-83018-31	DC Distribution Drawing
	T-83214-30	Wiring Drawing
	SD-83214-01	Schematic Drawing

Supplementary information on the ECS controller, optional Omnipulse data acquisition unit, and the 150-ampere SR series rectifier may be found in the following documents.

<i>ECS Controller</i>	J85501E-2	Assembly Drawing
	SD-83181-01	Schematic Drawing
	167-790-056	Product Manual
	167-790-109	Optional Circuit Pack Product Manual
<i>SR 150/-48V Rectifier</i>	J85702E-1	Assembly Drawing
	T-83185-30	Wiring Drawing
	SD-83185-01	Schematic Drawing
	169-790-126	Product Manual

***Omnipulse Data
Acquisition and
Control System***

J85576A-1 Assembly Drawing
167-790-116 Product Manual

***System
Specifications***

**Table 1-A: Electrical Specifications for
J85500S-1 Battery Plant**

Nominal Output Voltage	-48 volts dc
Operating Voltage Range (Float or Boost)	-48 to -58 volts dc
Output Current Rating	0 to 1800 amperes
Nominal Input Voltage	208/240 (3 wire & ground)
Input Voltage Range (per phase)	180 to 264 volts ac
Input Frequency Range	47 to 63 hertz
Input Current (per single rectifier)	15.5 amperes @ 220 volts ac
Efficiency (full load)	85% typical
Power Factor (full load, nominal input)	0.97 typical
Regulation (full output range, full input range)	± 0.5%
AC Ripple	250 millivolts peak-peak
Output Noise	2 millivolts psophometric
Active Load Share Accuracy (per rectifier)	±15 amperes
Electrostatic Discharge	IEC 801-2 Level 5
Electromagnetic Immunity	10 volts/meter over 20 to 2000 megahertz

Table 1-B: Physical and Thermal Specifications for J85500S-1 Battery Plant

Depth	23.6 in. (600 mm)
Width (rectifier cabinet) (distribution cabinet)	23.6 in. (600 mm) 25.3 in. (643 mm)
Height	86.6 in. (2200 mm)
Weight (per cabinet)	500 lbs. (227 kg)
Heat Release (54 volts, 600 amperes per cabinet)	5750 watts (19,602 BTU/hr)
Operating Temperature (0 to 1500 m)	0-50°C
Altitude (Derate maximum temperature by 0.656° C /100 meters above 1500 meters)	-60 to 4000 meters
Humidity Rating	5 - 90% Noncondensing
Audible Noise (12 rectifiers)	65 dBA (1 meter away)

***Customer
Training***

Lucent Technologies offers customer training on many power 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.

2 *Ordering*

Figure 2-1 and Table 2-A show the system configuration and ordering structure for the J85500S-1 Battery Plant. Section 3, “Product Description,” presents a detailed description of each option in the ordering table.

The J85500S-1 is ordered with List (L) numbers. Lists 1, 2 and 3 are main lists that provide the cabinets and busing arrangement for the system. The system is configured with an initial rectifier cabinet (List 1) and a distribution cabinet (List 3). One or two supplemental rectifier cabinets (List 2) provide system growth. Supplemental lists are ordered as “equipped with” (E/W) items, which means they are ordered in addition to the main list and will be installed at the factory.

The initial rectifier cabinet (List 1) has a J85501E-2 ECS-12U controller, up to four 150-ampere SR series rectifier housings (List 4), an optional 1200 or 1800-ampere low voltage battery or load disconnect/reconnect (LVD/R) contactor (List 7, 8, 17 or 18), a 1200 or 2000-ampere plant shunt (List 9 or 10), and an ac distribution assembly that provides either 40-ampere, 3-pole circuit breaker protection (List 6) or quick-connect terminal blocks (List 5) factory-wired to each rectifier housing.

The supplemental rectifier cabinet (List 2) is equipped with up to four 150-ampere SR series rectifier housings per List 4, ac distribution assembly per List 5 or 6, and optional mounting brackets to field install a J85576A-1 Omnipulse unit.

The distribution cabinet (List 3) has ED83018-31 fuse and circuit breaker panels. There are 66 mounting positions. Each of these positions must be occupied by either a distribution panel or a blank panel (List B through F). The job specification should give a mounting position for each panel. Refer to the ED83018-

31 drawing for ordering options. Table 3-B lists the available distribution panels. If distribution requirements include a precharge feature for capacitive loads, the List 3 cabinet can also be equipped with a capacitor charge panel, model ED83012-30, for use with ED83018-31 Group 15 or 16 circuit breakers.

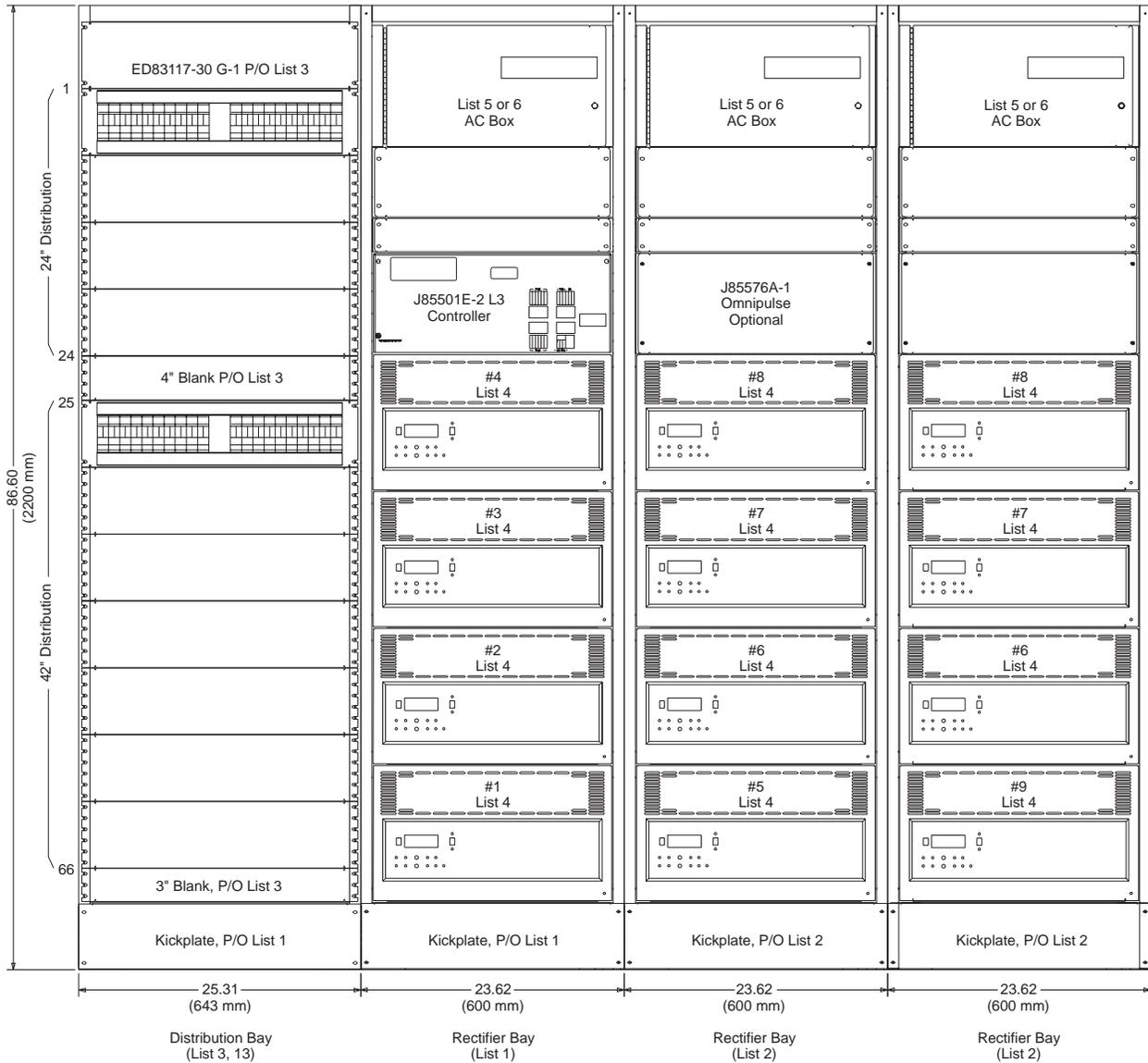


Figure 2-1: J85500S-1 ECS Battery Plant

Table 2-A: Ordering Table for J85500S-1 Battery Plant

Description	List No. or Comcode
One initial rectifier bay. Provides a 2200 x 600 x 600 mm cabinet equipped with 1800-ampere capacity plant bus bars.	1
One supplemental rectifier bay. Provides a 2200 x 600 x 600 mm cabinet equipped with 1800-ampere capacity bus bars.	2
One distribution bay. Provides a 2200 x 643 x 600 mm cabinet equipped with 1800-ampere capacity distribution feeder bus running from the top to the bottom of the bay.	3
Provides one -48-volt, 150-ampere switch mode rectifier housing (RHA) for List 1 or 2 (maximum 4 per bay).	4
AC termination panel for List 1 or 2. Provides quick-connect terminal blocks pre-wired to rectifiers.	5
AC circuit breaker box for List 1 or 2. Provides four 40-ampere, three-pole circuit breakers prewired to rectifiers.	6
Provides 1200-ampere low voltage disconnect/reconnect contactor for List 1.	7
Provides 1800-ampere low voltage disconnect/reconnect contactor for List 1.	8
Provides one 1200-ampere plant shunt for List 1.	9
Provides one 1800-ampere plant shunt for List 1.	10
Framework, assembly, wiring and equipment for one distribution bay arranged for List 17 or 18 low voltage load disconnect. Provides a 2200 x 643 x 600 mm cabinet equipped with 1800-ampere capacity distribution feeder bus running from the top to the bottom of the bay.	13
Optional equipment required in addition to List 13 for a 1200 ampere low voltage load disconnect/reconnect feature.	17
Optional equipment required in addition to List 13 for an 1800 ampere low voltage load disconnect/reconnect feature	18
Mounting hardware to field install a J85576A-1 Omnipulse in List 2 bay.	A
2-inch high blank panel for List 3	B
3-inch high blank panel for List 3	C
4-inch high blank panel for List 3	D
6-inch high blank panel for List 3	E

Table 2-A: Ordering Table for J85500S-1 Battery Plant

Description	List No. or Comcode
9-inch high blank panel for list 3	F
Three PMAs for the 150-ampere rectifier	847360161
Equipment for plant controller to provide microprocessor circuit (CP2)	847366788
Same as 847366734 (CP2) with voice response feature	847366796
Equipment for plant controller to provide datalogger circuit pack (CP3)	847575223

3 *Product Description*

Typical Battery Plant Description

The block diagram in Figure 3-1 shows the design for a typical battery plant. The 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 provides control and alarm functions to interact with the rectifiers and the office. The plant also provides overcurrent protection, charge, discharge, and distribution facilities. Battery reserve automatically provides a source of dc power if the commercial or standby ac fails. This reserve is engineered and batteries are sized to supply dc power for a specific period of time. In normal practice, reserve time is three to eight hours.

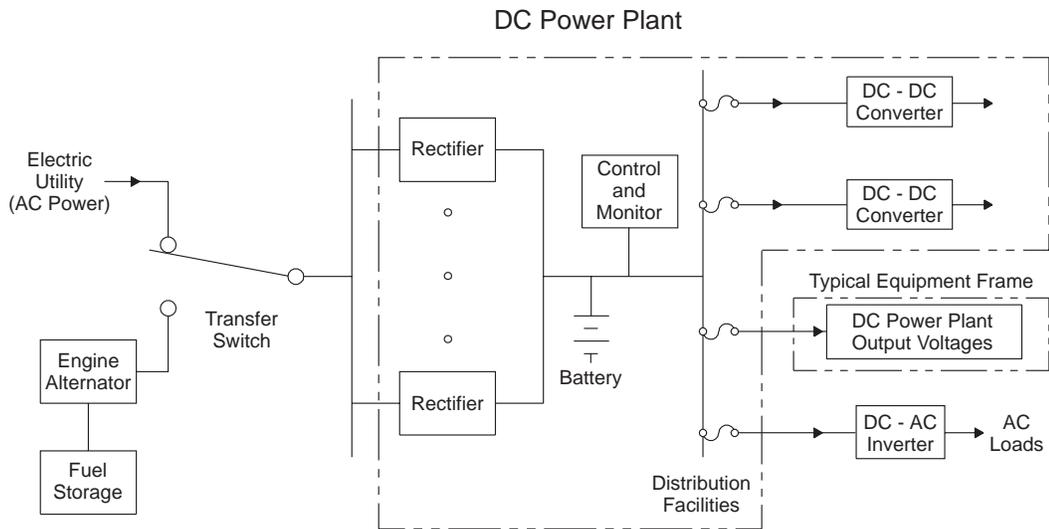


Figure 3-1: Block diagram of a typical battery plant

Figure 3-2 illustrates the arrangement and interconnections of the J85500S-1 battery plant subsystems from the ac input to the dc output. These subsystems are defined as follows:

AC Distribution: connects the commercial and/or standby ac power sources to the rectifiers within the plant and provides overcurrent protection.

Rectifiers: convert an ac source voltage into the dc voltage level required to charge and float the batteries and to power the using equipment.

Controller: provides the local and remote control, monitor and diagnostic functions required to administer the battery plant.

Batteries: provide energy storage for an uninterrupted power feed to the using equipment during loss of ac input or rectifier failure.

DC Distribution: provides overcurrent protection, connection points for the using equipment, and bus bars used to interconnect the rectifiers, batteries, plant shunt, and dc distribution.

Battery Plant Description

The ECS battery plant, model J85500S-1, provides power for the using equipment as well as float and recharge capability for the battery reserve. The plant operates from nominal 208/240-volt ac, three phase commercial power at 50 or 60 Hz. The nominal output is -48-volt dc with a maximum system capacity of 1800 amperes.

The system consists of multiple rectifier cabinets and a distribution cabinet connected electrically by plant bus bars. This system includes ac distribution, up to twelve Lineage[®] 2000 -48-volt, 150-ampere switchmode rectifiers, an ECS controller, charge/discharge bus bars with optional low voltage battery or load disconnect/reconnect contactor, system shunt, and ED-83018-31 dc distribution panels with fuse and circuit breaker options. If additional data acquisition and control capability is required, space is provided to field install a J85576A-1 Omnipulse unit. The following sections describe each of these components.

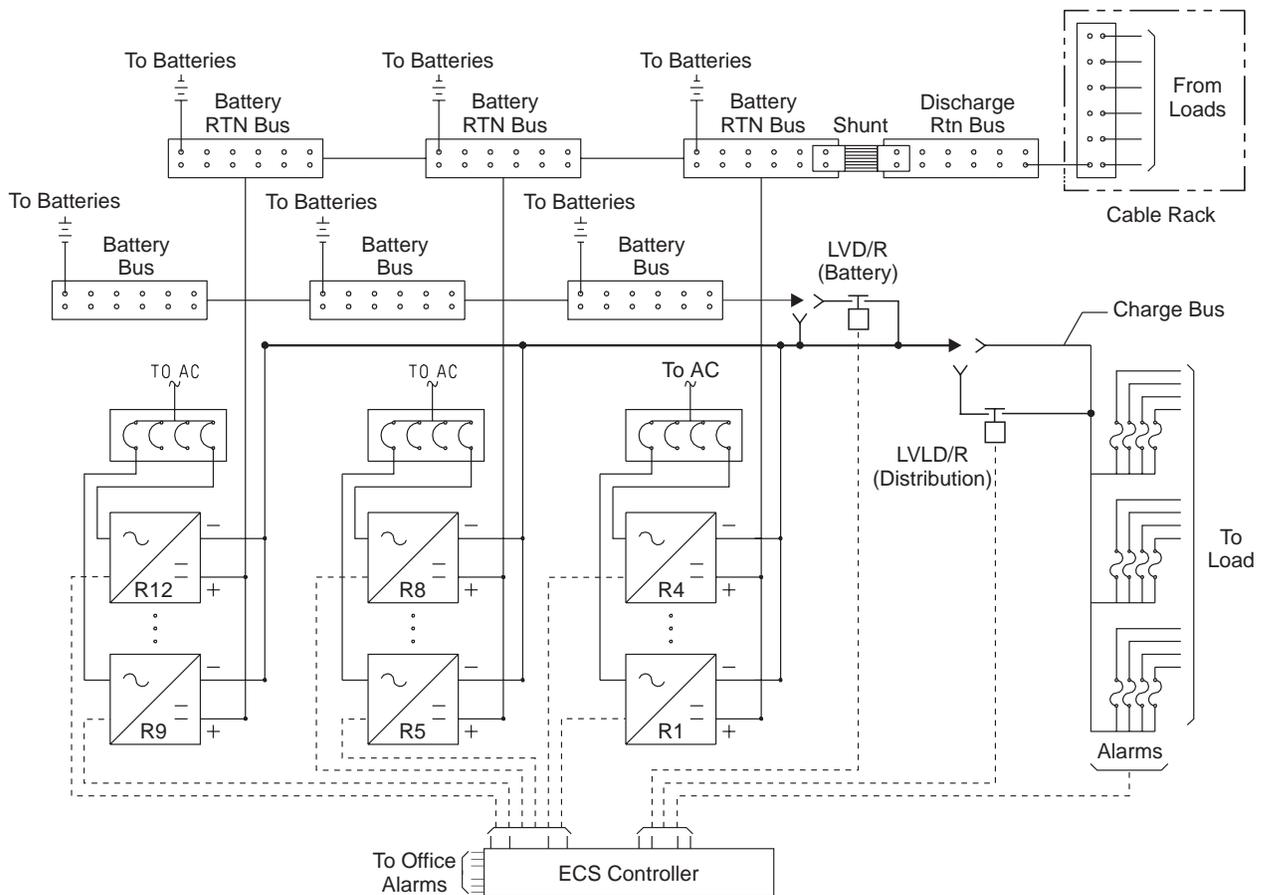


Figure 3-2: Block diagram of J85500S-1 Battery Plant

Rectifier

The Lineage[®] 2000 SR series 150-ampere, -48-volt rectifier converts commercial 50 or 60-hertz ac input power into highly regulated and filtered, low-noise, -48-volt dc output power for telecommunications equipment loads. This rectifier incorporates a 70-kilohertz switching frequency, advanced technology and forced-air cooling to achieve high power density and a light weight of less than 100 pounds (45 kilograms).

The rectifier consists of three Power Module Assemblies (PMAs) in a Rectifier Housing Assembly (RHA) shown in Figure 3-3. The drawing in Figure 3-4 shows how the power modules plug into the housing assembly. All interconnections between the rectifier, controller, and ac distribution are completed through the RHA. This plug-in design reduces installation time to minutes, permitting easy growth and maintenance without service interruption. Signals from the three rectifiers are routed to the controller via a control cable.

Monitoring and alarm signals generated by the rectifiers are sent to the controller for processing. The controller generates local or remote alarms and/or sends control signals back to the rectifier. Control cables are furnished with the List 1 and 2 rectifier cabinets for each of the four potential rectifier housings in a cabinet. Control cables not connected in the factory are shipped with the cabinet for future use.

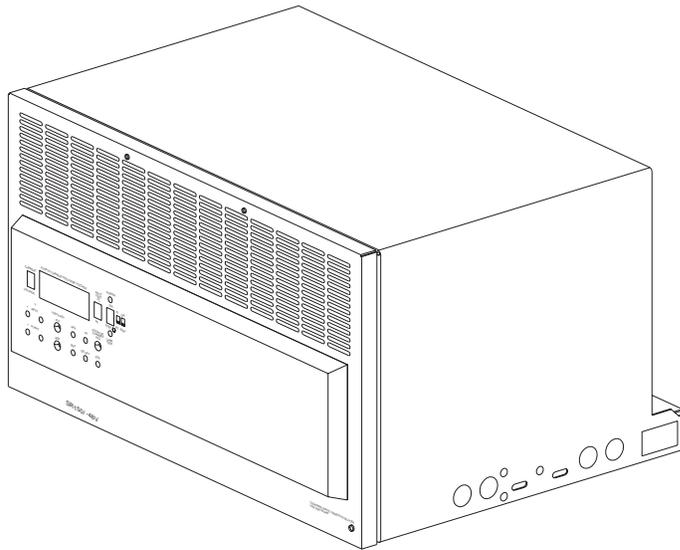


Figure 3-3: 150A, -48V switchmode Rectifier Housing Assembly (RHA)

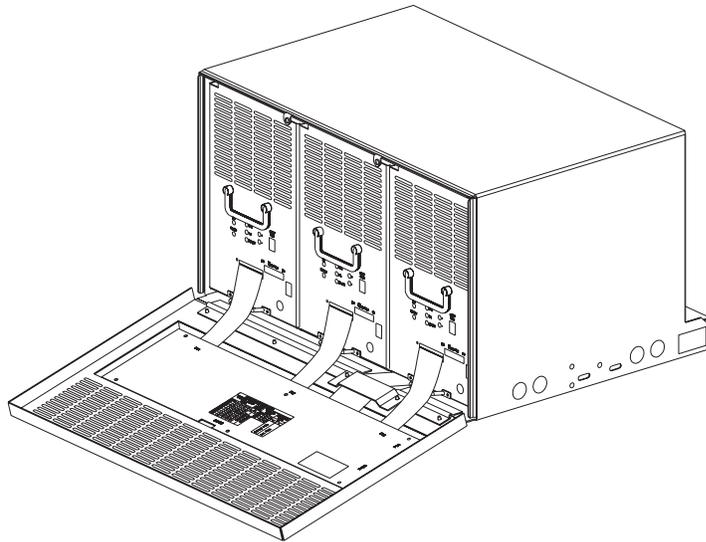


Figure 3-4: Power modules installed in Rectifier Housing Assembly (RHA)

Rectifier Housing Assemblies (RHA) are usually factory-installed in the J85500S-1 cabinet. They may be field-installed by ordering J85702E-1 List 1 and hardware kit 847301835. In this case, the RHA is shipped in a separate container with all the mounting hardware needed to install it in the cabinet. Rectifier product manual 169-790-126 provides set-up and installation procedures for the RHA.

Power Module Assemblies (PMA's) are packaged individually and shipped in foam filled cartons whose dimensions are approximately 18 x 21 x 13 inches. Order comcode 847360161 for a set of three PMA's for the SR 150-ampere rectifier.

For detailed information concerning features and operation of the rectifier, refer to product manual 169-790-126.

ECS Controller

The ECS controller, also referred to as the ECS-12U, performs the centralized monitoring, control, and reporting functions for the battery plant. The basic controller can monitor and control up to twelve SR 150-ampere rectifiers. It also provides a single interface point for power alarm and status reporting.

The controller is shown in Figure 3-5. The top portion of the controller has a slide-out tray with a standard analog control unit

(113B), plugged into a backplane and two expansion slots for a microprocessor controller board (CP2) and a datalogger board (CP3). Two standard Rectifier Interface Boards (RIB) plug into a second backplane located below the tray. This backplane is equipped with twelve rectifier control cable ports and two expansion slots for optional Rectifier Adapter Boards (RAB). A Fuse Alarm Board (FAB) is mounted on the door to provide a low voltage battery disconnect/reconnect circuit and fusing for the controller and rectifier sense leads.

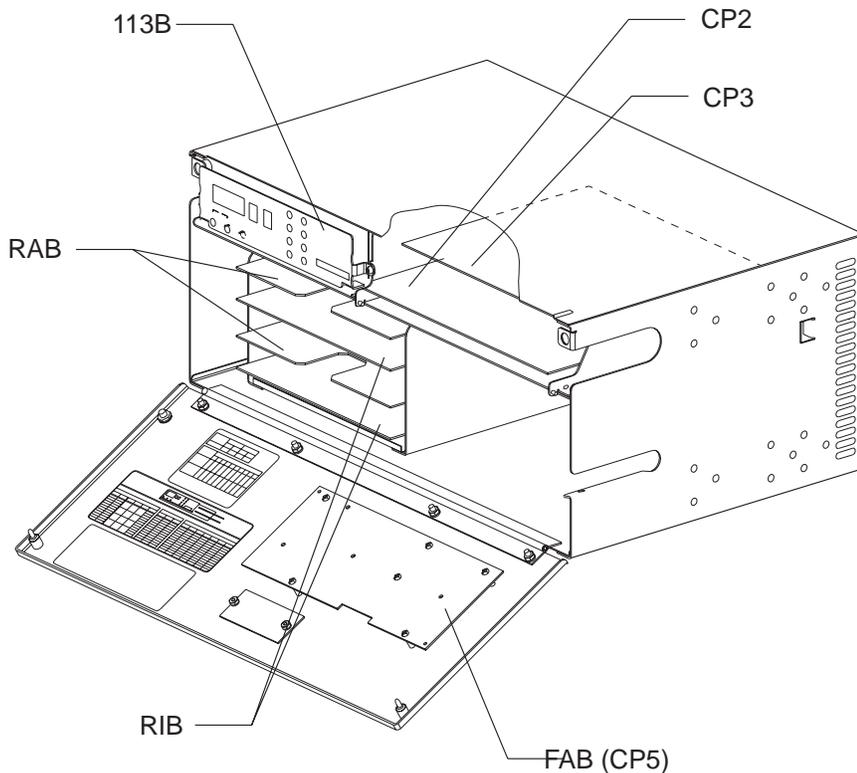


Figure 3-5: ECS-12U Controller

The expansion boards for the ECS Controller include

- **Microprocessor Controller Board (CP2):** The microprocessor controller board adds sophisticated firmware features such as remote communications, alarm history, optional voice response, diagnostics, and statistics to the controller. This board is available as comcode 847366788 or as comcode 847366796 with the voice response feature.

- **Datalogger Board (CP3):** The datalogger board is used in conjunction with the microprocessor option to provide general purpose ac and dc voltage, current, and transducer monitoring, and relay control using sixteen data monitoring channels and eight Form-C relay contacts. This board is available as comcode 846575223.
- **Rectifier Adapter Board (RAB):** The rectifier adapter board allows non-Lineage rectifiers to be connected to the system. This may be desirable for customers who want to re-use existing rectifiers.

For more information about the controller, refer to the ECS-12U Controller Product Manual 167-790-056. For more information on the microprocessor board (CP2), datalogger board (CP3), and voice response option, refer to ECS Controller Options Product Manual, 167-790-109.

Omnipulse Monitor and Control System

In some configurations, the sixteen data-monitoring channels provided with the datalogger board (CP3) in the controller may be insufficient to satisfy data acquisition needs. The J85576A-1 Omnipulse can be used in addition to, or in place of, CP2 and CP3 in the controller to manage the collection and processing of data. The Omnipulse contains a microprocessor board and up to four datalogger boards for a total of 64 data monitoring channels. The microprocessor board provides the local and remote interface. The controller and Omnipulse can both be monitored remotely with a single phone line using a “pass-thru” feature to access either unit. The Omnipulse unit is field-installed in a List 2 rectifier cabinet using mounting hardware furnished per List A. “Omnipulse Installation” in Section 4 details this procedure. For more information about Omnipulse, refer to its Product Manual (167-790-116).

Batteries

The ECS battery plant is compatible with all flooded and valve-regulated batteries which accept float voltages within the range of 48 to 58 volts dc. Battery plant operating voltage is directly related to the recommendations of the battery manufacturer. The nominal cell voltage of lead-acid type batteries is usually defined as 2 volts. The actual recommended float voltage of lead-acid batteries differs slightly among vendors and varies with chemistry. The most common float voltages are 2.17, 2.27 and 2.35 volts per cell. Nominal 48-volt systems typically use 24 cell battery strings for float voltages that range from 52.08 to

56.40 volts per string. The float voltage per string, the minimum string voltage at the end of discharge, and the maximum charging voltage per string must be provided by the battery vendor in order to properly configure the battery plant.

AC Distribution

AC service for the battery plant is provided from a 3-phase 220/127-volt ac, delta or wye source at 50 or 60 hertz. The ac distribution scheme for the plant consists of an ac box equipped with either quick-connect terminal blocks or a 3-pole, 40-ampere circuit breaker factory-wired to each rectifier in the system. AC wiring to the rectifiers is enclosed in channels that run along both sides of the cabinet. Snap-on covers allow access to the channels for wiring field-installed rectifier housings. All wiring is 8-gauge and color coded for easy reference as follows

Earth Ground	Green/Yellow
Line 1	Blue
Line 2	Black
Line 3	Red

Connections to the rectifier housing for a 3-wire system are shown in the Wiring Diagram in Figure 3-6. These connections are accessed by removing the three black plastic covers inside each rectifier housing.

Each rectifier in the system must be protected with a fuse or circuit breaker overcurrent protection device as described in the AC Input Table (Table 3-A). The quick-connect terminal block is a simple and inexpensive option. AC protection is located external to the plant (i.e. a wall-mounted circuit breaker box). This option is the most common since an ac service box is usually located close to the battery plant.

Table 3-A: AC Input Data for J85500S-1 Rectifier

Input Voltage (volts ac)	Input Current* (amps), per phase	RHA Line Fuse Type	Input Circuit Breaker Size	Input Wire Gauge†	AC Box Knockout/ Conduit Size (inches)‡
208 / 127, 3-wire, delta or wye	28	FRN-R, 40A Three required per RHA	40A, 3-pole	8 AWG	1.109 / $\frac{3}{4}$ 1.375 / 1 1.984 / $1\frac{1}{2}$

* Specified at 55.5 volts dc, 150 amperes output, and nominal input voltages

† Each rectifier requires 4 input wires including “green wire ground.” Use KS5482, KS20785 or 24 ° Celsius (75° F) commercial wire.

‡ Where trade size of conduit is smaller than knockout, use appropriate knockout reducing washers.

AC circuit breakers are sometimes located in a battery plant as a means to quickly identify and disconnect ac service to a rectifier. Four 40-ampere, 3-pole circuit breakers are mounted in each rectifier cabinet with this option. This option is more expensive since it still requires ac protection at the external ac box. This protection may be a 50-ampere, 3-pole circuit breaker directly feeding each 40-ampere, 3-pole circuit breaker in the plant, or a 150-ampere, 3-pole circuit breaker bulk feeding terminal blocks that are factory-wired to the four 40-ampere circuit breakers in each rectifier cabinet.

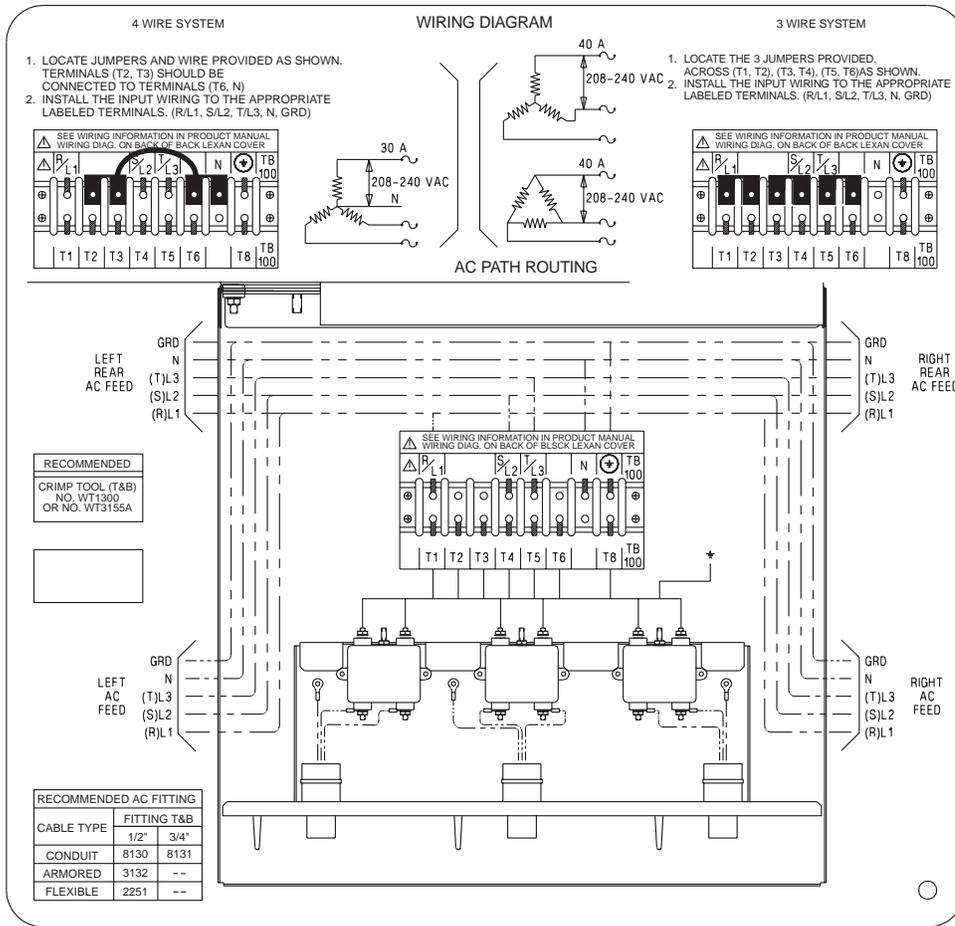


Figure 3-6: AC wiring diagram in rectifier

The ac box at the top of each rectifier cabinet is equipped with four nominal 1.109-inch knockouts for 3/4-inch conduit, two nominal 1.375-inch knockouts for 1-inch conduit, and one 1.984-inch knockout for 1-1/2 inch conduit. This range of knockout sizes allows the customer the option to supply ac power to the four rectifiers in a cabinet with four 3/4-inch conduits or two 1-inch conduits, or to supply ac power with a bulk feed in the 1-1/2 inch conduit.

DC Distribution

DC distribution consists of the plant charge and discharge bus bars, battery bus bars, plant shunt, low voltage battery disconnect/reconnect contactor with associated circuitry, and fuse and/or circuit breaker load distribution panels.

***Distribution Bus
Bars***

Figure 3-7 shows the busing scheme for the plant. All bus bars used are copper with a solder finish and sized to provide a 1800-ampere current capacity.

Two sets of bus bars extend vertically along the back of the cabinet. Looking at the inside back of the cabinet, the charge bus (-48-volt) is on the right side and the charge return bus is on the left. Rectifier Housing Assemblies (RHA) connect directly to these buses. Battery cables terminate on the battery bus (shown in Figure 3-7) and the battery return bus. The bus bars are located at the top of the cabinet behind the ac box. A field installed bus bar strap connects common buses of adjoining rectifier cabinets together.

Each charge and charge return bus in a cabinet has eight sets of 3/8-inch studs on 1.00-inch centers to accommodate eight double-hole, copper, crimp terminal lugs for 4/0 conductors. This allows two strings of Lucent Technologies Round Cell batteries to terminate in each rectifier cabinet. If larger conductors are required, such as 350, 500 or 750 MCM conductors, only four sets of connections are possible.

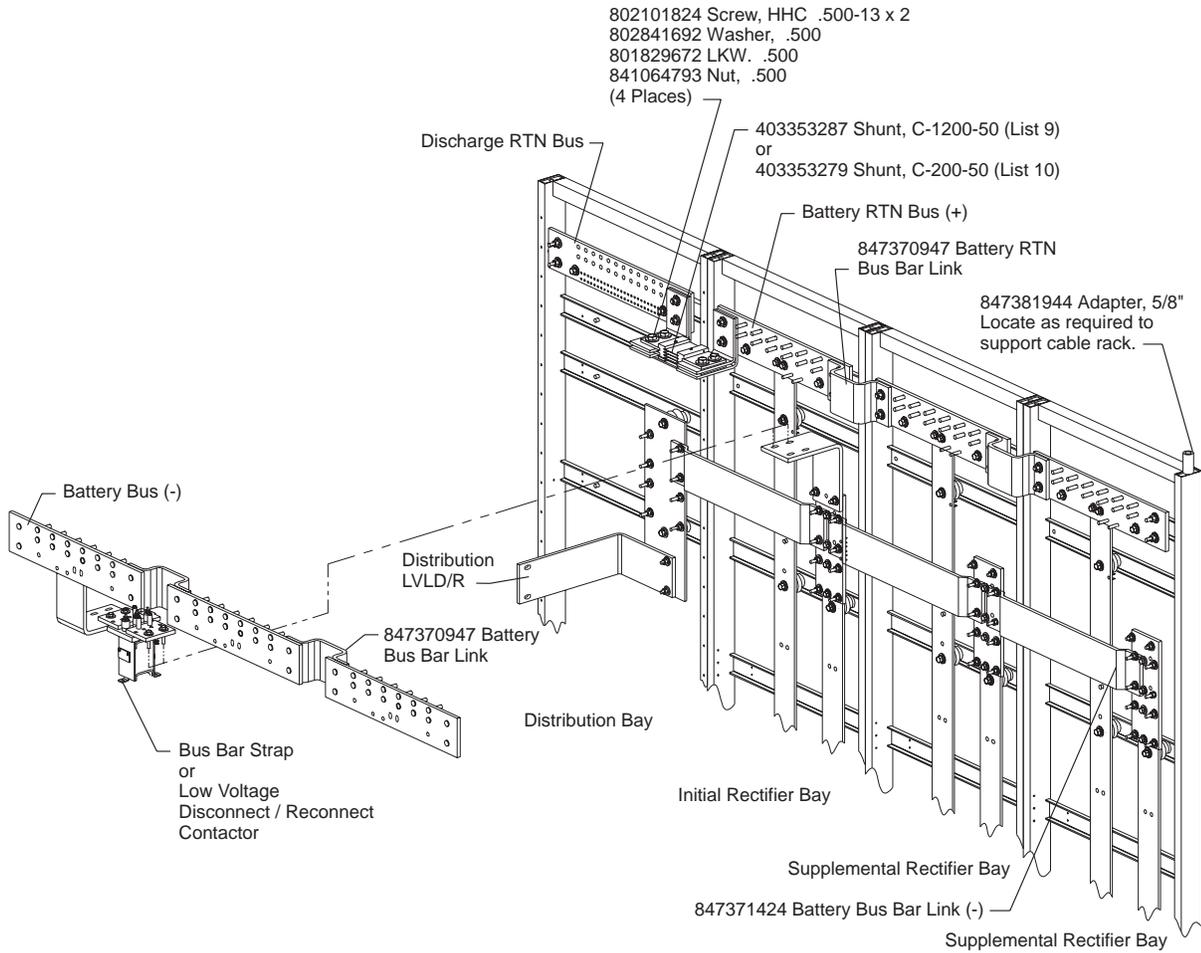


Figure 3-7: J85500S-1 plant bus bars

The discharge return bus is located in the distribution cabinet. This bus has space to cable six 750 MCM conductors to a load return bus bar arrangement, such as ED83019-50, located in the cable rack. It is recommended that load return cables be terminated in the cable rack due to the limited space on the discharge return bus. For small distribution requirements, there are twelve sets of holes for double-hole terminal lugs connected with 3/8-inch hardware on 1.00-inch centers and twenty-four sets of holes for double-hole terminal lugs connected with #10 hardware on 5/8-inch centers.

The battery bus connects to the charge bus in the initial rectifier cabinet via a bus bar strap or low voltage disconnect/reconnect contactor. A bus bar link connects the charge bus of each rectifier cabinet and the distribution cabinet together. This bus bar link is coated with a blue epoxy that insulates and identifies the bus.

Plant Shunt

A current shunt is a sensing device which provides a millivolt signal proportional to the current flowing through it. The millivolt-to-ampere ratio of the shunt is the dc resistance of the shunt (in milliohms), which is thermally stable and accurately known.

The current shunt in the J85500S-1 is connected between the charge return bus in the initial rectifier cabinet and the discharge return bus in the distribution cabinet. It is used to measure the total current supplied to the load from the rectifiers and/or batteries. The shunt has a full scale rating of 50 millivolts at the maximum plant shunt rating of either 1200 amperes (List 9) or 2000 amperes (List 10). The shunt millivolt signal is sent to the controller where it is translated back to amperes and displayed on the digital meter

***Low Voltage
Battery
Disconnect/
Reconnect
(LVD/R) Feature***

To prevent costly damage due to deep discharges, the J85500S-1 List 1 may be equipped with an optional automatic battery disconnect/reconnect feature. This disconnect isolates batteries from the load when the plant voltage reaches the lowest usable battery voltage. The disconnect level is below the operating range of most load equipment, in which case service to the load would already have been lost. The disconnect does not separate the load circuits from the rectifiers, thus enabling the rectifiers to begin powering the load as soon as ac power is restored.

List 7 provides a 1200-ampere contactor and List 8 provides an 1800-ampere contactor. The contactor is located between the battery bus and the charge bus in the initial rectifier cabinet. The LVD/R contactor is controlled by circuitry in the controller and is used to either connect or disconnect the charge bus and battery bus. The LVD circuit monitors the battery bus voltage. When the voltage drops below a preset level, the controller senses the low voltage condition and removes power from the contactor. This opens the connection between the charge bus and battery bus, disconnecting the batteries from the rectifiers and the load. The user has the choice of setting the disconnect threshold voltage at either 40.5 volts or 42.5 volts. When the contactor is open and the rectifiers are not delivering power, the controller is also without power. In this state, the controller displays LEDs go off and various alarms are issued to the alarm reporting center.

The red “LVD OPEN” and yellow “LVD FAIL” LEDs are located on the controller door. The red “LVD OPEN” LED lights whenever the contactor is open, during a normal disconnect or in the unlikely event of a contactor failure. The LVD sensing circuitry is redundant. A failure of either voltage detector circuit lights the yellow “LVD FAIL” LED but the contactor stays closed. A Fuse Alarm Minor (MNF) is issued when a LVD circuit fails, lighting a yellow LED on the controller front panel and sending Power Minor (PMN) alarms to the reporting center.

Once the contactor opens, it remains open until the voltage again exceeds the set voltage threshold. Voltage does not return until ac power is restored and the rectifiers restart and deliver power. The LVD circuit then restores power to the LVD/R contactor, which reconnects the batteries to the rectifiers and load. The batteries then accept charging current from the rectifiers.

DC Distribution Panels

The distribution cabinet contains a vertical distribution bus bar that extends from the top to the bottom of the cabinet. This bus connects to the bus bar scheme shown in Figure 3-7. ED83018-31 fuse and circuit breaker panels are mounted to this bus and distribute power to the load equipment. The panels are wired to an alarm indicator panel at the top of the cabinet. If a fuse in the cabinet operates or a circuit breaker trips, a red light activates indicating a major fuse alarm, and an alarm signal is sent to the controller.

ED83018-31 distribution panels provide circuit breaker and fuse options ranging from 1 to 600 amperes. Table 3-B shows the

panel type and space requirements. Refer to the ED83018-31 equipment drawing for ordering options.

Table 3-B: ED83018-31 Distribution Panels

Group	Panel Type	Current Range (amps)	Panel Height (inches)
15	Circuit breaker	1-100	9
16	Circuit breaker	100-600	9
17	Circuit breaker e/w LVD circuit	125-250	9
18	Fuse mountings	3-30	4
19	Fuse mountings	1-60	6
20	Fuse mountings	70-100	6
21	Fuse mountings	110-200	6
22	Fuse mountings	70-200	6
23	Switch & fuse unit	225-600	15
25	Fuse mountings	0-5	4
26	Fuse mountings	225-600	15
31	Fuse mountings	70-600	6
32	Fuse mountings	0-70	6
33	Switch & fuse unit	70-600	9

Cabinet Access

The J85500S-1 is an open framework design that allows easy access for installation personnel to connect cabling and equipment to the cabinet. Removable side and rear covers enclose the cabinet after installation is complete. Plastic clips are attached to the sides of the cabinet. The covers are then hooked onto the clips. See “Side and Rear Cover Installation” in Section 4. Three covers are provided with the List 1 cabinet, two for the sides and one for the back. A rear cover is provided with the List 2 and List 3 cabinets.

BLY2 Low Voltage Load Disconnect

The BLY2 Low Voltage Load Disconnect (LVLD) Circuit Board, 107717399, provides the circuitry needed for the load disconnect feature within a 48V J85500S-1 application. It contains two redundant circuits that monitor the plant voltage and control a single contactor that feeds a customer's load. Separate disconnect and reconnect thresholds are programmable via DIP switches. Form-C contact closures located at office alarm connector TB1001 are provided for customer access to the alarms. The DIP switches and TB1001 are located behind the front panel cover.

Specifications

- Input voltage range: 27Vdc - 60Vdc
- Operating temperature range: 0°C - 50°C
- Default reconnect threshold: 48.0V
- Default disconnect threshold: 42V
- Disconnect/reconnect threshold accuracy: ± 0.5 Vdc

Operation

Normal load disconnect operation:

- Set SW100 and SW200 to desired reconnect and disconnect thresholds. See Table 3-C.
- Set front panel toggle switch to the center, NORMAL, position.
- Place jumpers across pins 1 and 2 of P1 and P2 (default).
- Unit will now operate as described below in "Operation Modes" under NORMAL mode.

Opening the contactor manually:

- To open the contactor when the plant voltage is above the reconnect threshold, place the jumpers across pins 2 and 3 of P1 and P2 (SERVICE mode).
- To only be able to open the contactor when the plant voltage is below the reconnect threshold, place the jumpers across pins 1 and 2 of P1 and P2 (default position).
- Set front panel toggle switch to MANUAL DISCONNECT ENABLE.
- Simultaneously hold down the two MANUAL DISCONNECT pushbuttons until the contactor opens.
- The contactor will stay open until the plant voltage rises above the reconnect threshold or the toggle switch is placed in the MANUAL CONNECT position.

Closing the contactor manually:

- Moving the toggle switch to MANUAL CONNECT position causes the contactor to close regardless of the positions of the other switches or jumpers provided that the plant voltage is above the pull-in voltage of the contactor being used.

Alarms Load Disconnected Alarm

- A Load Disconnected Alarm is asserted if the contactor opens.
- A red LED lights
- A Form-C contact closure is available at TB1001 pins 4 (NO), 5 (C) and 6 (NC). The relay releases when a Load Disconnected Alarm is present placing a short across pins 5 and 6.

LVLD Fail Alarm

- An LVLD Fail Alarm is asserted if any of the following are true:
 - (1) the actual contactor status and its command status disagree
 - (2) the two redundant control circuits disagree
 - (3) the reconnect threshold is lower than the disconnect threshold
- A yellow LED will light.
- A Form-C contact closure is available at TB1001 pins 7 (NO), 8 (C) and 9 (NC). The relay releases when a Load Disconnected Alarm is present placing a short across pins 8 and 9.

LVLD Inhibit Alarm

- An LVLD Inhibit Alarm is asserted if either of the following is true:
 - (1) The mode switch is in the MANUAL CONNECT position
 - (2) an external contact closure has been presented across the remote LVLD inhibit connections, TB1001 pins 1 and 2
- A yellow LED will light.
- A Form-C contact closure is available at TB1001 pins 10 (NO), 11 (C) and 12 (NC). The relay releases when a Load Disconnected Alarm is present placing a short across pins 11 and 12.

Table 3-C: Disconnect/Reconnect Thresholds (Volts)

Disconnect Threshold SW200 (0=Off, 1=On)						Reconnect Threshold SW100 (0=Off, 1=On)					
Disconnect Threshold	1 & 2	3 & 4	5 & 6	7 & 8	9 & 10	Reconnect Threshold	1 & 2	3 & 4	5 & 6	7 & 8	9 & 10
38.0V	0	1	0	1	1	44.0V	0	0	1	0	1
38.5	1	0	0	1	1	44.5	1	1	0	0	1
39.0	0	0	0	1	1	45.0	0	1	0	0	1
39.5	1	1	1	0	1	45.5	1	0	0	0	1
40.0	0	1	1	0	1	46.0	0	0	0	0	1
40.5	1	0	1	0	1	46.5	1	1	1	1	0
41.0	0	0	1	0	1	47.0	0	1	1	1	0
41.5	1	1	0	0	1	47.5	1	0	1	1	0
*42.0	0	1	0	0	1	*48.0	0	0	1	1	0
42.5	1	0	0	0	1	48.5	1	1	0	1	0
43.0	0	0	0	0	1	49.0	0	1	0	1	0
43.5	1	1	1	1	0	49.5	1	0	0	1	0
44.0	0	1	1	1	0	50.0	0	0	0	1	0
44.5	1	0	1	1	0	50.5	1	1	1	0	0
45.0	0	0	1	1	0	51.0	0	1	1	0	0
45.5	1	1	0	1	0	51.5	1	0	1	0	0
46.0	0	1	0	1	0	52.0	0	0	1	0	0
46.5	1	0	0	1	0	52.5	1	1	0	0	0
47.0	0	0	0	1	0	53.0	0	1	0	0	0
47.5	1	1	1	0	0	53.5	1	0	0	0	0
48.0	0	1	1	0	0	54.0	0	0	0	0	0

* = default values

Operation Modes

The modes of operation for the LVLD board are controlled by a toggle switch in the center of the panel, two input pins on TB1001, and two jumpers (P1 and P2) located behind a cover on the front panel. The toggle switch places the LVLD unit in the NORMAL, MANUAL DISCONNECT ENABLE, or MANUAL CONNECT mode. The jumpers allow the LVLD unit to be placed in a SERVICE mode which allows the

contactor to be manually opened even when the plant voltage is above the reconnect threshold. A contact closure across TB1001 places the LVLVD in the INHIBIT mode which inhibits it from opening the contactor when the plant voltage drops below the disconnect threshold.

NORMAL mode

In the NORMAL mode, the plant voltage is compared to user-settable disconnect and reconnect thresholds. As long as there is no remote LVLVD inhibit closure across TB1001 pins 1 and 2, the following is implemented:

- If $V_{\text{plant}} < V_{\text{disconnect}}$ then the contactor is opened.
- If $V_{\text{plant}} > V_{\text{reconnect}}$ then the contactor is closed.
- If $V_{\text{disconnect}} < V_{\text{plant}} < V_{\text{reconnect}}$ then the status of the contactor remains unchanged from the previous state.

INHIBIT mode

If there is a remote LVLVD inhibit closure across TB1001 pins 1 and 2, the following is implemented:

- If $V_{\text{plant}} < V_{\text{disconnect}}$ then the status of the contactor remains unchanged from the previous state.
- If $V_{\text{plant}} > V_{\text{reconnect}}$ then the contactor is closed.
- If $V_{\text{disconnect}} < V_{\text{plant}} < V_{\text{reconnect}}$ then the status of the contactor remains unchanged from the previous state.

MANUAL DISCONNECT ENABLE mode

In the manual disconnect enable mode, two system behavior characteristics are possible depending on the placement of the jumpers on P1 and P2.

The default condition is that both jumpers are on pins 1 and 2 of P1 and P2 which causes the system to behave exactly like it is in the NORMAL mode until the two manual disconnect switches are depressed simultaneously. If both manual disconnect switches are depressed momentarily and the plant voltage is less than the reconnect threshold, the contactor will open. After the disconnect switches are released, the disconnect command will remain asserted until the plant voltage rises above the reconnect threshold or the mode switch is moved to the manual connect position. With the jumpers across pins 1 and 2 of P1 and P2, it is

not possible to manually disconnect the load as long as the voltage is above the reconnect threshold.

With the P1 and P2 jumpers placed across pins 2 and 3, the SERVICE mode, the Manual Disconnect Enable mode allows the contactor to be opened regardless of plant voltage. Once a manual disconnect has occurred, the load will remain disconnected until the mode switch is moved out of the manual disconnect enable position.

4 ***Installation***

This chapter gives a procedure for installing the J85500S-1 Battery Plant and a suggested test sequence to check the integrity of the installation. Upgrades, retrofits, and replacement of equipment in the controller, rectifier, and battery subsystems are covered in their respective manuals.

The rectifier, controller, ac distribution, and dc distribution subsystems, described in Section 3, are factory-tested as a system. The rectifier housings, controller, and distribution subsystems are shipped assembled in the cabinet, ready for use. To improve shipping and handling, Power Module Assemblies (PMAs) are packaged separately and must be plugged into the Rectifier Housing Assemblies (RHA) during installation. The installer must also assemble the battery subsystem.

The battery plant installation procedure that follows refers to the rectifier, controller, Omnipulse, and battery manuals for details on those subsystems. Read this section and referenced sections in other subsystem manuals completely before starting work.

Installation Tools and Test Equipment

Battery plant installation and testing requires the following tools and test equipment.

- Material handling equipment to unload cabinet at site, remove from shipping container and set in final position. Minimum lifting capacity of 500 lbs
- Floor anchors and drill to bore holes for anchors
- Cable racks and associated hardware
- Input and output cables and terminal lugs

- Common electrician's hand tools, including jeweler's screwdriver, electrical tape, wire cutters and strippers
- Proper crimping tools and dies for connectors
- Common mechanic's hand tools, including flat blade screwdriver, socket and torque wrench sizes 1/2, 9/16 and 5/8-inch, and crowbar for uncrating
- Cable, connectors, and 3/8-inch bolts, washers, lockwashers, and nuts for connecting discharge ground bus to ED83019-50 load return bus assembly in the cable rack
- Digital Multimeter (DMM) with at least 0.05% accuracy on the dc scale
- Insulated 3/16-inch allen wrench key (provided with List 1)
- For LVD/R option only: Six clip leads each capable of carrying 3 amperes
- DC dummy load bank rated for 75 amperes minimum at 60 volts dc. For LVD/R option only: power supply, variable from 0 to 60 volts dc at 2 amperes. Supply should have both coarse and fine output controls.

Unpacking, Handling and Frame Installation

Before opening the packaging, carefully inspect the outside, in the presence of shipping personnel, for signs of damage. If damaged, follow the shipping carrier's procedure for filing a damage claim.

Use the equipment weights and dimensions, given in the Physical and Thermal Specifications (Table 1-B), as a guideline for choosing material handling tools. Carefully open the packaging to verify that the contents are complete and undamaged. If the equipment must be returned, it should be repacked in the original shipping crate.

Figure 4-1 shows the cabinet footprint. As in other figures in this manual, the distribution cabinet is shown on the left and rectifier cabinet growth is to the right. The distribution cabinet may be on the right, however, and rectifier growth to the left. Refer to the job specifications for required orientation.

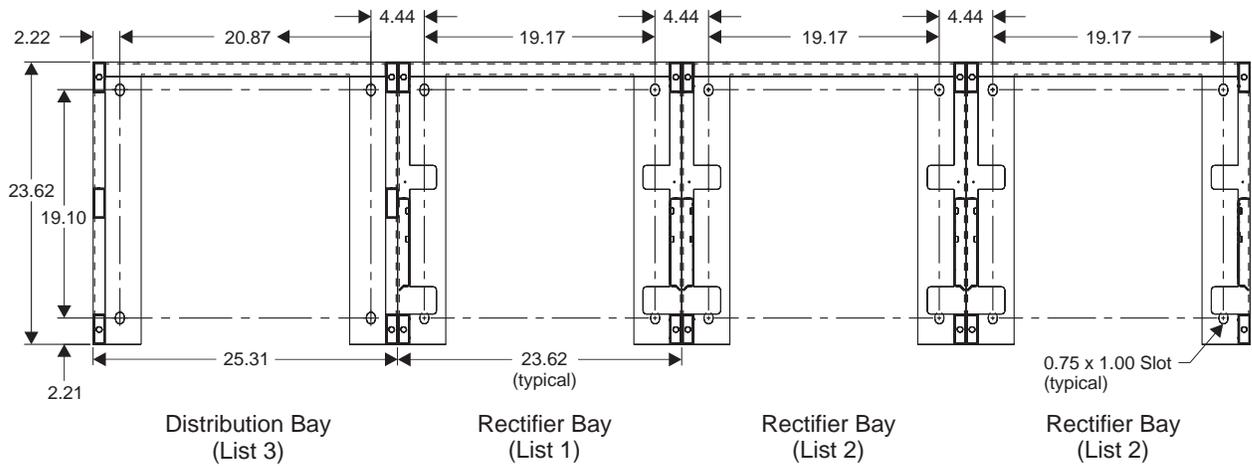


Figure 4-1: Footprint of J85500S-1 battery plant cabinet

Rectifier cabinets are 600 x 600 millimeters wide and deep. Distribution cabinets are 643 x 600 millimeters wide and deep. Each cabinet has four .750 by 1.00-inch slots for anchoring the cabinet to concrete floors. Anchors are not provided with each cabinet, but must be furnished separately. If the installation is in a Zone 4 seismic area, 12-millimeter, heavy-duty anchors are required. Figure 4-2 shows typical floor-mounting detail for concrete floors. Other types of floor construction may require other mounting methods.

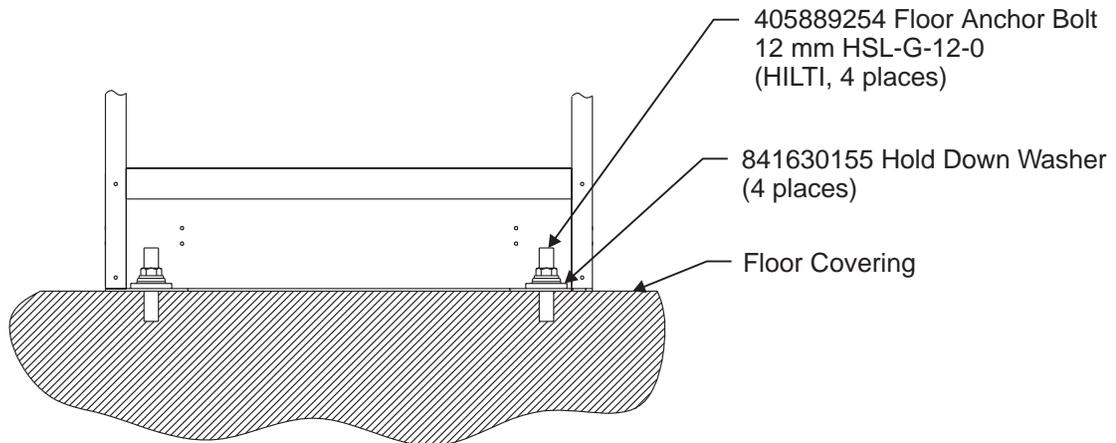


Figure 4-2: Typical floor mounting for concrete floors

Cable Routing Strategy and Frame Ground

As with any battery plant, cabinet positioning with respect to cable racks, batteries and ac distribution is very important in order to assure not only a trouble free installation but also easy maintenance and growth of the system in the future.

The cabinet is arranged to separate ac leads from dc leads. Leads should be separated wherever possible to minimize electrical noise transmitted to the load. AC cables should run on a cable rack along the front of the cabinet while dc leads are routed to a cable rack along the back of the cabinet. It is also important to separate dc cables to the battery strings from the dc distribution cables because these cables are not protected by any overcurrent protection device.

Figure 4-3 shows the top view of a rectifier cabinet. In each corner of the cabinet is a M8 threaded hole. Two M8/male - 5/8"/female threaded adapters are furnished with each cabinet. These should be used as required to support cable rack from the cabinets. Threaded 5/8" rods are screwed directly into these adapters. Hang all cable support systems, as well as any auxiliary ground bus bars, as required by the job specifications.

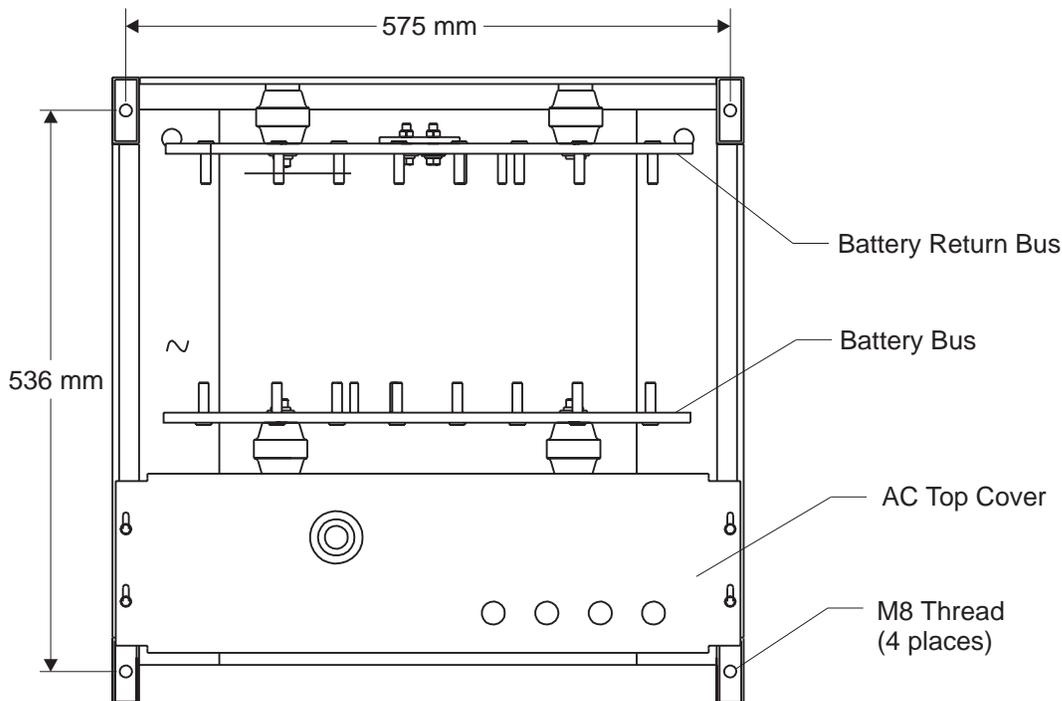


Figure 4-3: Top view of a rectifier cabinet

The next step after cable racks are located is to connect frame ground to each cabinet. Frame ground is located at the top of each cabinet. The connection is sized for a double hole terminal lug secured with two 3/8-inch bolts on 1.00-inch centers.

Intercabinet Bus Bar and Shunt Installation

Figure 3-7 shows the plant bus bar scheme for the battery plant. As supplemental rectifier cabinets are added to the system, the battery buses, battery return buses, and charge buses of each cabinet must be interconnected. Each List 2 supplemental rectifier cabinet is shipped with three bus bar links, two for connecting the battery and return buses and one blue, epoxy-coated bus bar for connecting the charge bus. This bus is also furnished with the List 3 distribution cabinet and connects the distribution bus to the charge bus of the rectifier cabinets. All hardware for connecting these bus bars is furnished with the cabinets.

As you can see in the bus bar drawing in Figure 3-7, the plant shunt is located between the charge return bus in the initial rectifier cabinet and the discharge return bus in the distribution cabinet. List 9 provides a 1200-ampere shunt and List 10 provides a 2000-ampere shunt. 1/2" mounting hardware is also furnished with these lists for the installer. The shunt should first be connected to the L-shaped bus bars as shown (2 per side) and then connected to the bus bars in the bay.

Three wires in the initial rectifier cabinet must now be connected, two to the shunt and one to the discharge return bus. Connect the orange wire to the shunt on the charge return bus side and the orange-black wire to the shunt on the discharge return bus. Next connect the blue wire to the discharge return bus using #10 hardware.

If the installation will use a discharge return bus mounted on the cable rack such as ED83019-50 for load return connections, locate this bus bar on the rack and route cables from the plant discharge return bus to the cable rack mounted bus. Size and number of connections should be listed on the job specification. System ground should also be run at this time, preferably from the cable rack bus arrangement.

Connecting AC

AC service for the battery plant is provided from a three-phase 220/127 Vac, delta or wye source at 50 or 60 Hz. AC service should be provided to the ac box located at the top of each

rectifier cabinet. The ac box is equipped with either quick-connect terminal blocks or 40-ampere, three-pole circuit breakers factory wired to each rectifier in the cabinet.

Each rectifier in the system must be protected with a fuse or circuit breaker overcurrent protection device as described in AC Input Table (Table 3-A). The ac box with the quick-connect terminal blocks should be connected to 40-ampere fuses or three-pole circuit breakers at the external ac service box. The ac box with the 40-ampere, three-pole circuit breakers must also be protected at the external ac box. This protection may be 50-ampere fuses or a three-pole circuit breaker directly feeding each 40-ampere, three-pole circuit breaker in the ac box or a 150-ampere, three-pole circuit breaker bulk feeding terminal blocks in the ac box that are factory wired to the four 40-ampere circuit breakers.

Each ac box is equipped with a removable top cover. This cover has four nominal 1.109-inch knockouts for 3/4-inch conduit, two nominal 1.375-inch knockouts for 1-inch conduit, and one 1.984-inch knockout for 1-1/2 inch conduit. This range of knockout sizes allows the option to supply ac power to the four rectifiers in a cabinet with four 3/4-inch conduits, two 1-inch conduits, or to bulk feed in the 1-1/2 inch conduit.

Connect ac to each rectifier cabinet using one of the described options. Turn off all ac breakers before establishing connections.

Battery Connections

Battery strings are terminated to the charge and charge return bus bars located at the top of the cabinet behind the ac box. Each bus is equipped with eight sets of 3/8-inch studs on 1.00-inch centers to accommodate eight double-hole terminal lugs for 4/0 conductors. Two strings of Lucent Technologies round cell batteries can be terminated in each rectifier cabinet. If larger conductors are required, such as 350, 500 or 750 MCM conductors, only four sets of connections are possible. Hardware for terminating battery leads is not provided with the cabinet.

ECS Controller and LVD/R Set-up

Follow the controller setup procedure given in the controller manual to complete the steps below. Table 4-A lists the factory default settings for controller jumpers and switches.

1. Enable/Disable equalize charge setup.

2. Enable/Disable rectifier restart setup.
3. Set HV shutdown level(s).
4. Set BD alarm level.
5. Run other controller wiring.
6. Set up other optional circuit packs.
7. Set low voltage disconnect/reconnect setting, if provided.
8. Run office alarm wiring.

Several connections should be made between the distribution cabinet and the controller to monitor major and minor distribution alarms. Refer to wiring drawing T-83214-30, Figure H3 for the location of these connections.

Low Voltage Battery Disconnect/ Reconnect Test

Note:

The low voltage battery disconnect option is available only with the J85501E-2 ECS-12U Controller in the J85500S-1 battery plant.

1. Identify the Orange-White "LV-" lead on TB501-6 of the ECS-12U LVD/Fuse board. Follow this lead to its termination on a quick-disconnect tab terminal on the vertical battery bus of the initial rectifier bay. Disconnect LV- from the vertical battery bus. Observe the following:

The LVD contactor OPENS.

The LVD Open LED on the front of the LVD/fuse board activates.

The MNF LED of the ECS-12U activates.

Alarm contacts TB102 10-11 on CP1 of the ECS-12U
CLOSE.

2. Connect a 0-60Vdc variable power supply from the plant ground bus to the disconnected "LV-" lead, along with a voltmeter. Turn on the power supply and adjust its output to 48V. Observe the following:

The LVD contactor CLOSES.

The LVD Open LED on the front of the LVD/fuse board of the ECS-12U retires.

The MNF LED of the ECS-12U retires.
Alarm contacts TB102 10-11 on CP1 of the ECS-12U
OPEN.

3. Check the locations of the jumpers P505.1 and P505.2 on the rear of the ECS-12U LVD/fuse board. Both jumpers across pins 1 and 2 set an LVD threshold of $42.5 \pm 0.5V$; both across pins 2 and 3 set an LVD threshold of $40.5 \pm 0.5V$. Slowly lower the power supply voltage toward the selected threshold.

Note:

As the power supply voltage decreases and approaches the disconnect threshold, the yellow "LVD Fail" LED may light. This is normal and indicates that one part of the LVD circuit has reached its threshold before the other redundant circuit. If the yellow LED lights within the disconnect tolerance and then the contactor opens, also within the tolerance, the low-voltage battery disconnect circuit is functioning normally.

4. Note the disconnect voltage at which the contactor opens and observe the external conditions listed in Step 1.
5. Raise the power supply voltage above the LVD threshold identified in Step 3. When the contactor operates again, observe the external conditions listed in Step 2.
6. Turn off and disconnect the power supply and volt meter. The LVD will open once again. Reconnect "LV-" to its quick-disconnect tab on the vertical battery bus. Verify that the contactor closes once again and that all alarm indications retire.

Table 4-A: Default Settings for Controller Jumpers and Switches

Board									
Backplane 846575280	P602.1 P602.2 P602.3 P602.4	2 & 3	-48 volts						
CP1	P105 P106 P107	1 & 2	Restart Enabled Equalize Disabled For SR Series Rectifiers						
CP4 (113B Display)	SW409	No Decimal Position	Shunt Size > 1000A						
CP3	P302	2 & 3	-48 volts						
CP5	P505.1 P505.2	1 & 2	-42.5V Low Voltage Disconnect						
Switch Settings (0=open, 1=closed)									
Board	Switch	Function	Switch Settings						
			-1	-2	-3	-4	-5	-6	-7,-8
CP1	SW101	HV/EQ Level -55 V	1	1	1	0	1	0	N/A
	SW102	HV/FL Level -53 V	1	1	1	0	1	0	N/A
	SW103	BD Level -51 V	1	0	1	0	1	0	N/A
	SW109	2000A Shunt (List 10)	0	0	1	0	1	1	N/A
	SW109	1200A Shunt (List 9)	0	1	0	0	0	0	N/A

Rectifier Setup and Test

Refer to the rectifier manual for setup, Power Module plug-in, and test.

Number rectifiers from 1 to 12 as shown in Section 2 and at the ac box. List 1 and List 2 rectifier cabinets provide labels for this purpose. Refer to Figure 4-4 for the location of rectifier identification labels.

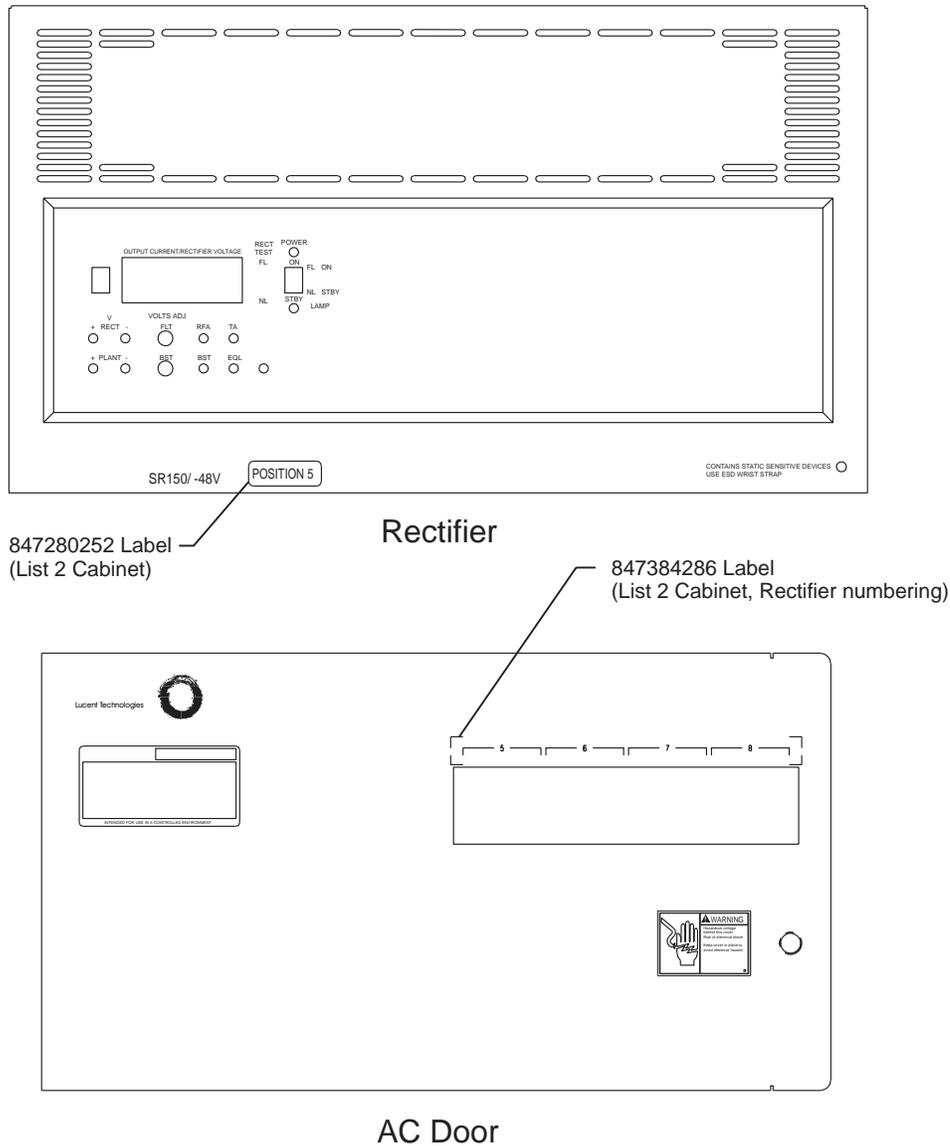


Figure 4-4: Location of rectifier identification labels

Controller Test

Follow the controller test procedure given in the controller product manual to complete the steps below.

1. Test Enable/Disable equalize charge feature.
2. Test Enable/Disable rectifier restart feature.
3. Test HV shutdown levels.
4. Test BD alarm levels.

5. Test fuse alarms.
6. Test remote ON/OFF (TR signal) for rectifiers.
7. Test Low Voltage Battery Disconnect (if equipped).
8. Test other optional circuit packs.

Omnipulse Installation

If a J85576A-1 Omnipulse unit is to be installed in the battery plant, it should be located in the List 2 supplemental rectifier cabinet adjacent to the initial rectifier cabinet. Mounting brackets should be ordered per List A for this installation. The Omnipulse unit is shipped from the factory in a separate container. Included with the Omnipulse are mounting brackets and hardware for installation on a wall or framework. These brackets will not be used.

Figure 4-5 shows the Omnipulse installation. The first step is to remove the 3 and 9 inch covers and brackets on the List 2 cabinet. Attach the List A mounting brackets to the Omnipulse as shown using hardware provided with the Omnipulse. Set the Omnipulse above the fourth rectifier position (rectifier #8) and attach to the cabinet using the four screws used to mount the removed 3 inch cover.

Refer to the Omnipulse product manual for startup and test procedures. Power for Omnipulse may be provided from the fuse alarm board in the controller. TB501-6,7 or 8 on this fuse board correspond to fuse positions 19,20 or 21 and provide fused power for equipment. Connect a 18 gauge wire from one of these positions and another from the discharge return bus in the distribution cabinet. Connect these wires to TB1 in the Omnipulse.

Side and Rear Cover Installation

After installation is complete, the final procedure involves securing the side and rear covers to the cabinets. Figure 4-6 shows how the covers are connected to the cabinets. The List 1 rectifier cabinet is shipped with three covers to cover the sides of the plant and the rear of the initial rectifier cabinet. List 2 and 3 cabinets are shipped with rear covers. Six plastic clips and mounting hardware attach to the side of each cabinet as shown. The blue side covers are then hooked onto the clips to enclose the system.

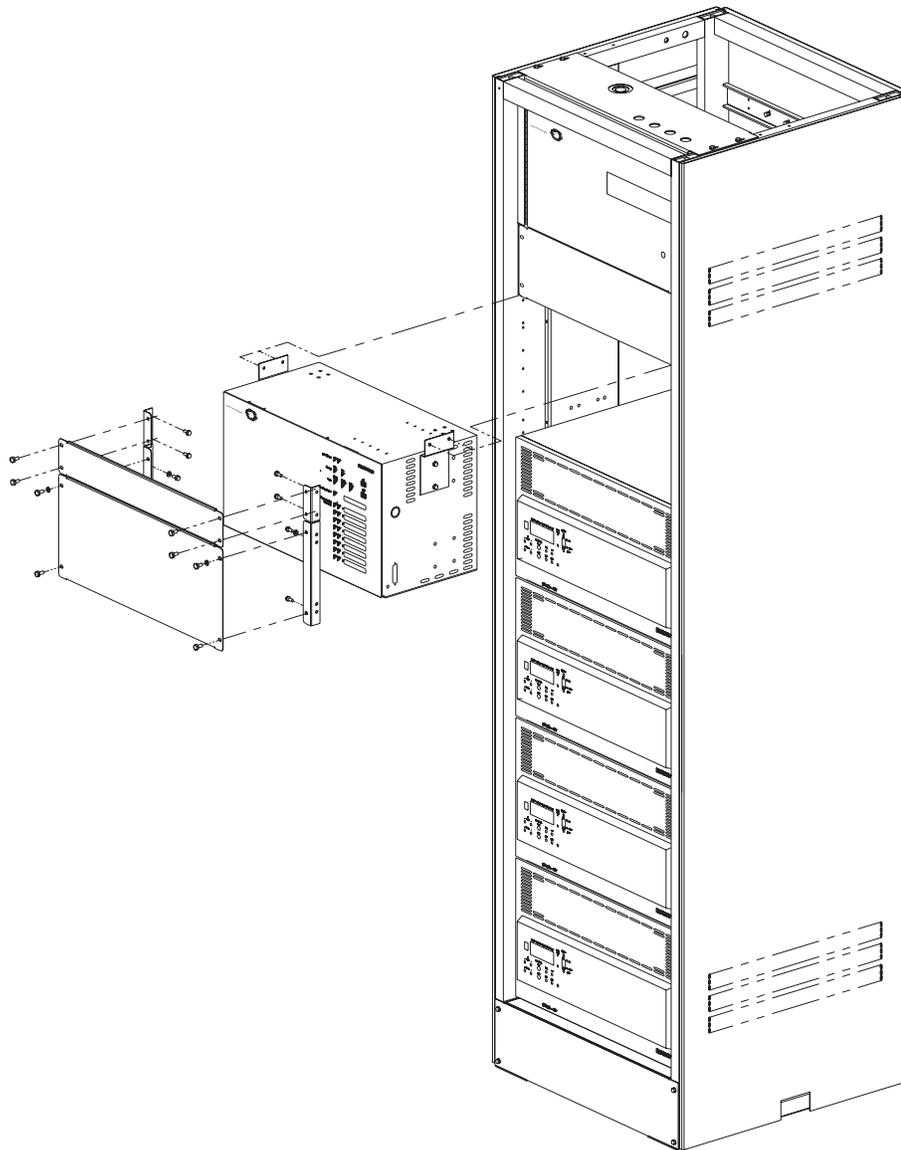


Figure 4-5: Omnipulse installation

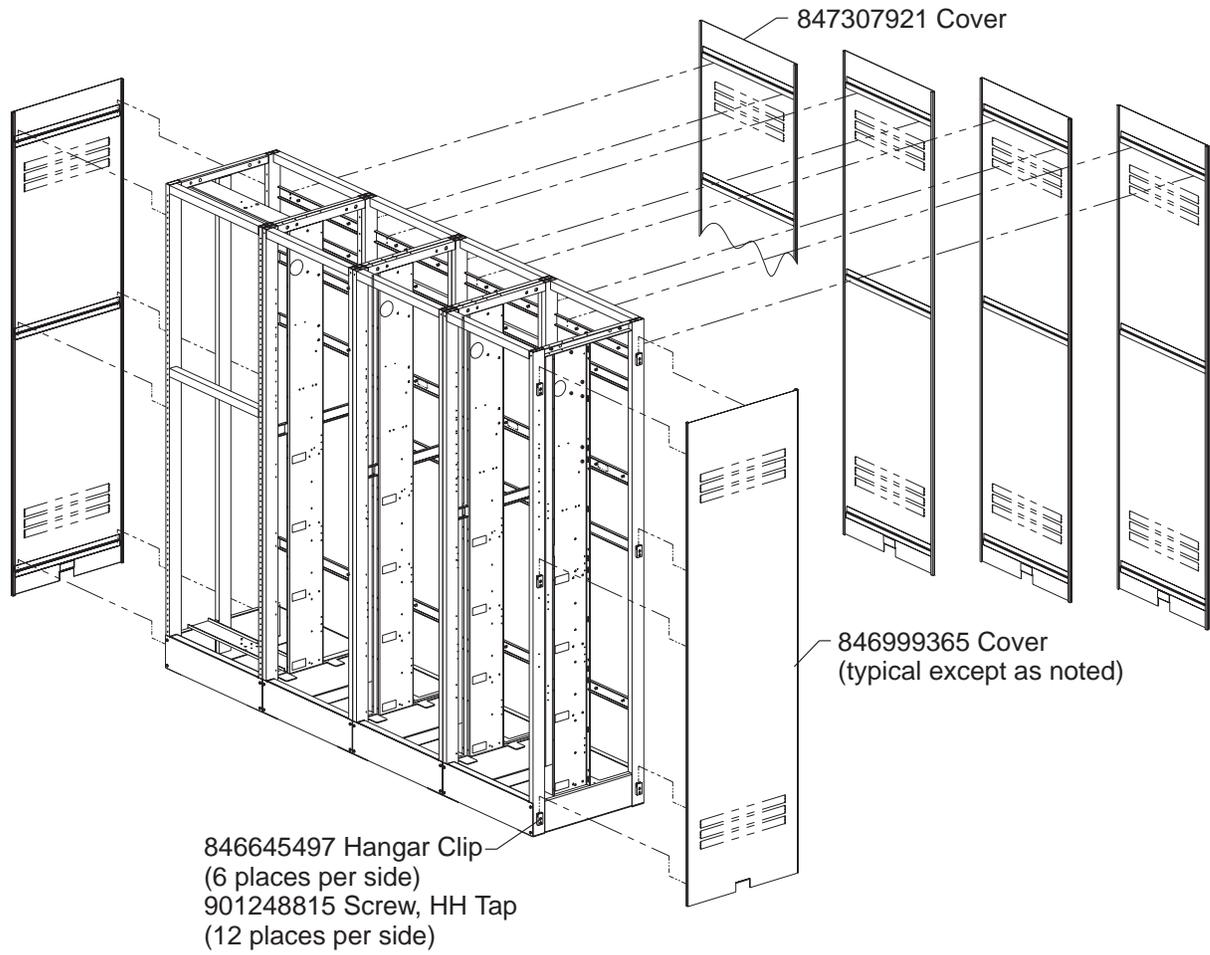


Figure 4-6: Side and rear cover installation

5 Spare Parts

Table 5-A lists the recommended spare parts for the J85500S-1 battery plant.

Table 5-A: Recommended Spare Parts

Ordering Code	Description
846835882	DC Fan Kit (KS22501 L15)
107093676	BGB1 Circuit Pack for Rectifier
106395064	113B Control Unit
405673146	1 $\frac{1}{3}$ A fuse (WP90247 L7)
405181983	2A fuse (WP90247 L9)
406159061	5A fuse (WP90247 L13)

Table 5-B lists some of the comcoded accessories for the J85500S-1 battery plant.

Table 5-B: Battery Plant Accessories

Ordering Code	Description
90118134	Allen wrench, $\frac{3}{16}$ -inch
107093684	1 Power module (1PS302A)
847360161	3 Power modules (1PS302A)
847366788	CP2 Microprocessor circuit pack
847366796	CP2 equipped with voice
846575223	CP3 Datalogger circuit pack
406526079	Replacement battery for CP2

6 ***Product Warranty***

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.

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

If, under normal and proper use during the applicable Warranty Period, a defect or nonconformity is identified in a Product and

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.

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.

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.

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

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 related expenses.

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 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.

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