Product Manual
364B2

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Lucent Technologies LINEAGE® 2000 100-Ampere, +24-Volt SR Series Rectifier

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

Introduction

This product manual describes Lucent Technologies' LINEAGE® 2000 364B2 100-ampere, +24-volt SR series rectifier (Figure 1-1) and the associated rectifier shelf assembly, J85702C-2 (Figure 1-2). The 364B2 replaces all 364B type rectifiers described in previous issues of this product manual. These rectifiers are backward and forward compatible and may be interchanged at will in any system. Although the apparatus codes and comcodes are different, the ordering procedures are identical for all +24-volt SR series rectifiers.

A complete technical description of the product is given in this manual as well as detailed information on engineering, installation, operation, and maintenance.

Lucent Technologies has designed the 364B2 rectifier specifically for remote sites or any installation where small size, low weight, and ease of installation and maintenance are critical. UL recognized, the 364B2 rectifier can be operated with or without batteries, providing maximum applications flexibility. The rectifier is plugged into the Rectifier Shelf Assembly (RSA), shown in Figure 5-3, and all interconnections between the controller, rectifier, and distribution are completed.

Technical Support

Technical support for Lucent Technologies equipment is available to customers around the world.

USA, Canada, Puerto Rico, and the US Virgin Islands

On a post-sale basis, **during the Product Warranty period,** our Technical Support telephone number 1-800-CAL RTAC (1-800-225-7822) provides coverage during normal business hours. Product Specialists are available to answer your technical

questions and assist in troubleshooting problems. For out-of-hours EMERGENCIES, the 800 number will put you in touch with a Regional Technical Assistance Center Engineer via our 24 hour a day, 7 day per week Help Desk.

When Technical Support is required in **the Post-Warranty Period**, the service may be billable unless you hold an extended warranty or contractual agreement.

Central and South America

If you need product technical support, contact your local Field Support/Regional Technical Assistance Center or contact your sales representative who will be happy to discuss your specific needs.

Europe, Middle East, and Africa

If you need product technical support, contact your local Field Support/Regional Technical Assistance Center or contact your sales representative who will be happy to discuss your specific needs

Asia Pacific Region

If you need product technical support, contact your local Field Support/Regional Technical Assistance Center or contact your sales representative who will be happy to discuss your specific needs.

Product Repair and Return

Repair and return service for Lucent Technologies equipment is available to customers around the world.

USA, Canada, Puerto Rico, and the US Virgin Islands

For information on returning of products for repair, customers may call 1-800-255-1402 for assistance.

Central and South America

If you need to return a product for repair, your sales representative will be happy to discuss your individual situation.

Europe, Middle East, and Africa

If you need to return a product for repair, your sales representative will be happy to discuss your individual situation.

Asia Pacific Region

If you need to return a product for repair, your sales representative will be happy to discuss your individual situation.

Customer Service

For customer service, any other product or service information, or for additional copies of this manual or other Lucent Technologies documents, call 1-800-THE-1PWR (1-800-843-1797). Specify the select code number for manuals, or drawing number for drawings. These numbers are listed in the following reference table.

Contact your regional customer service organization or sales representative for information regarding spare parts.

Documentation References

SR Series Rectifier Shelf Assembly

Assembly and Ordering Drawing	J85702C-2
Wiring Diagram	T-82668-31
Schematic Drawing	SD-82668-02
Product Manual Select Code	169-790-115

ECS Battery Plant

Assembly and Ordering Drawing	J85500E-2
Wiring Diagram	T-82578-31
Schematic Drawing	SD-82678-02
Product Manual Select Code	167-790-038

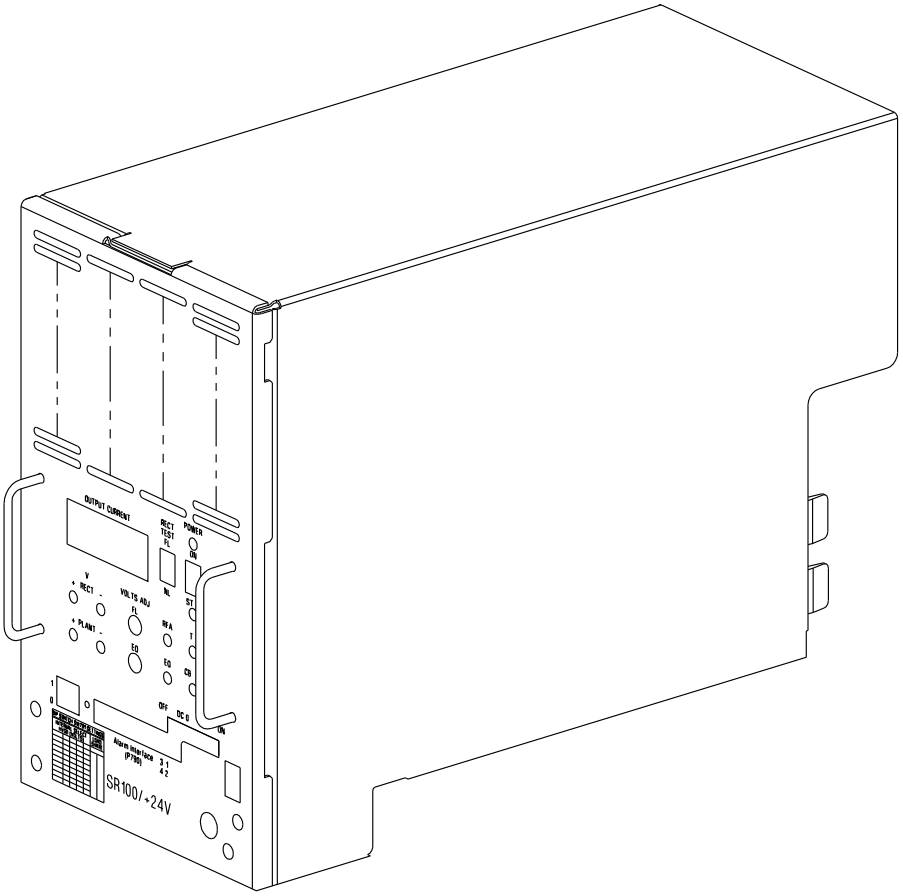


Figure 1-1: 364B2 LINEAGE® 2000 SR 100A +24V Rectifier

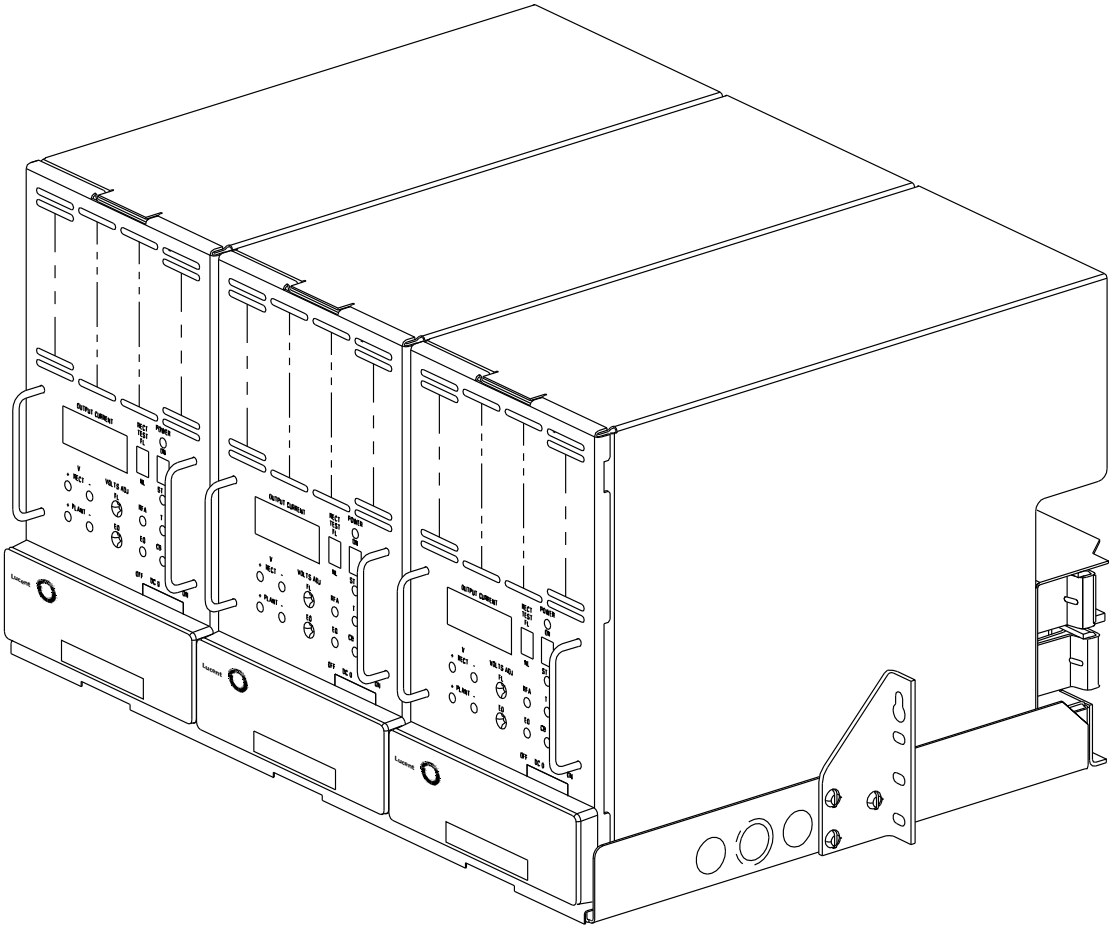


Figure 1-2: 364B2 Rectifiers in Rectifier Shelf Assembly

2 Product Description

Electrical Specifications

Table 2-A: 364B2 Electrical Specifications

Nominal Output Voltage	+24 volts dc
Operating Voltage Range	24-29 volts dc
Output Current	0-100 amperes over entire operating voltage range
Input Voltage	208/220/240 volts ac, single phase
Input Voltage Range	180-264 volts ac
Input Frequency Range	47-63 Hz
Input Current	16.5 amperes @ 208 volts ac 14 amperes @ 240 volts ac (Note 1)
Efficiency	84% typical (Note 1)
Power Factor	0.99 typical (Note 1)
Regulation	±0.5% (Note 2)
AC Ripple	250 millivolts peak to peak
Output Noise	22 dBrnc with battery 26 dBrnc without battery (Note 2)
Load Share Accuracy	10 amperes

Table 2-A: 364B2 Electrical Specifications

Heat Dissipation	1836 BTU/hr. (Note 1)
Temperature	32° F to 122° F (0° C to 50° C)
Altitude	-200 to 13,000 feet (-61 to 3962 meters) (Note 3)
Humidity	10 - 95% non-condensing
Audible Noise	57 dBA measured from 2 feet (0.6 meters) from the rectifier
Electrostatic Discharge	IEC 801-2 Level 5 (15 KV)
Radiated and Conducted Emissions	FCC Level A
Electromagnetic Immunity	10V/m over the range of 20 to 2000 mHz
Earthquake Rating	Zone 4, upper floors
Safety Agency Approvals	UL 1950

Notes:

1. Specified at a rectifier terminal voltage of 28.25 volts, 100 amperes load, nominal input voltages and frequencies.

2. Specified at the terminals of a 400 ampere-hour battery (8-hour rate) with the rectifier operating as specified in Note 1 and with a 1-volt lead drop between the rectifier and the battery.

3. For altitudes of 5000 to 13000 feet, derate maximum temperature by 3.6° F per 1000 feet above 5000 feet. For altitudes of 1524 to 3962 meters, derate maximum temperature by 0.656° C per 100 meters above 1524 meters.

Physical Specifications

The 364B2 rectifier is a plug-in, connectorized unit. It must be installed into a Rectifier Shelf Assembly (RSA), J85702C-2. This assembly can house up to three rectifiers as illustrated in

Figure 1-2. The frame mounting dimensions and weight of the 364B2 rectifier and the RSA unit are given below.

Table 2-B: 364B2 Physical Specifications

Rectifier	
Height	11.6 inches (295 millimeters)
Width	7.0 inches (178 millimeters)
Depth	15.25 inches (387 millimeters)
Weight	25 pounds (11.3 kilograms)
Rectifier Shelf Assembly (J85702C-2)	
Height	4.91 inches (125 millimeters)
Width	21.5 inches (546 millimeters)
Depth	17.41 inches (455 millimeters)
Weight	23.25 pounds (10.57 kilograms)
Rectifier Shelf Assembly Equipped With Three Rectifiers	
Height	12 inches (305 millimeters)
Weight	100 pounds (45.2 kilograms)
Frame Mounting Requirements	
Relay Rack	Standard 23 or 26 inch
Vertical Mounting Centers	1 inch (25 millimeter)
Horizontal Mounting Centers	22.32 inches (567 millimeters)

SR Series Rectifier Technology

The LINEAGE® 2000 364B2 100-ampere, +24-volt SR series rectifier uses switchmode technology to convert commercial 50/60 Hz ac input power into highly regulated and filtered, low-noise, +24-volt dc output power for telecommunications equipment loads. Since telecommunication systems typically obtain their primary power from potentially noisy commercial ac lines (and emergency alternators during commercial power failures) and since high-quality dc power is required in order for

the equipment to function correctly, the 364B2 rectifier is an excellent choice for any telecommunications power plant. The rectifier provides excellent output regulation over a wide range of load currents, input voltages, and input frequencies. Processing the power at higher frequencies allows for substantial reduction in the size and weight of the energy storage elements.

Benefits

Improved Space Efficiency: The 364B2 rectifier allows optimum use of space. This compact, 100-ampere rectifier plugs into a rectifier shelf assembly that can house three rectifiers. In addition, 364B2 rectifiers can be configured in parallel arrangements which provide capacities up to 1200 amperes in 48 inches of vertical space.

Reduced Installation and Maintenance: Its unique plug-in design, front access capability, and light weight make the 364B2 rectifier easy to install and simple to maintain.

Continuous Operation: 364B2 rectifiers can easily be added to LINEAGE® 2000 battery plants without interrupting power to the load.

Increased Cost Effectiveness: Space efficiency, ease of installation and maintenance, high reliability, and near-unit power factor result in lower operating costs. The 364B2 rectifier's modular design allows your plant to begin small and to grow as required.

High Reliability: The 364B2 rectifier's forced convection design improves the mean time between failure of its components by a factor of two, thus ensuring high reliability.

Power Factor Correction Circuit: The SR series rectifiers contain a power factor correction circuit that ensures power factor above 0.98 for all loads above 50 amperes. This circuit allows for an input current waveshape with low harmonic distortion, insuring compatibility with engine alternators and UPS. This is a substantial improvement over commercially available switchmode rectifiers. The power factor correction circuit also allows operation over a much wider input voltage range than ferroresonant or SCR technologies, eliminating the need for tap changes in the rectifier.

Forced Air Cooling: The SR series rectifiers use forced-air cooling to help achieve high power density and light weight.

Each unit is equipped with an easily replaceable, self-contained cooling fan (see Section 7, *Maintenance*). Thermal alarm circuitry offers additional protection by shutting the rectifier down and providing an alarm when the internal temperature exceeds approximately 60° C. Forced air cooling improves the reliability of the rectifier by reducing the internal ambient temperatures of the rectifier to essentially the outside ambient temperature. This allows Lucent Technologies to offer a switchmode product that meets the same high reliability standards as our ferroresonant rectifiers.

Self-Protection: Short circuits and overloads are handled safely and automatically. Various monitoring and alarm signals are generated by the rectifiers and sent to the ECS controller (if present) for processing and further action. The resulting action may be local or remote alarm indications or control signals fed back to the rectifier. (Refer to the LINEAGE® 2000 ECS Controller Product Manual for a description of rectifier signal processing and resultant action.) See Figure 3-1 for typical signal flow between a rectifier and the ECS controller.

Batteries and Load: In most telecommunications applications, the output of the rectifiers is electrically connected in parallel with the batteries and the load. Under normal conditions the rectifiers power the load and provide the float and charging current required by the batteries. During a commercial ac power outage, the batteries supply the dc power to the load. No switching is needed in this transition because of the parallel connection of the rectifiers and batteries. Although the rectifiers are typically used in a battery plant, these rectifiers can operate without batteries, making them suitable for those applications where battery back-up is not necessary or is achieved using a UPS (Uninterruptible Power Supply).

Features

The following is a list and description of the standard features designed into the LINEAGE® 2000 SR series rectifier covered in this manual.

Load Share: The rectifiers can be enabled to load share with other SR series rectifiers. The load share circuit is fail safe using an isolated load share bus between the rectifiers. Unit failure results in total disconnection from the load share bus.

Note

CB OFF must be lit and the DC OUTPUT breaker in the OFF position to adjust the output of the rectifiers correctly in load share mode.

Equalize: The rectifier, in conjunction with the ECS controller, can charge batteries at higher voltages than the float voltage. A separate potentiometer allows the equalize voltage to be set independently of the float voltage. A front-panel LED indicates when the rectifier is in equalize mode.

Parallel Operation: The rectifiers are capable of parallel operation.

Safety Interlock: A mechanical interlock in the rectifier prevents installation or removal of the rectifier with the circuit breaker closed. On installation, the interlock and associated circuits limit surges of current into the rectifier output capacitors when the rectifiers are initially connected to the battery bus.

Output Current "Walk-in": This circuit controls the time required for the rectifier to reach full output current after it is turned on. Initially, the output current is zero and is gradually increased to the required output current in about 10 seconds at full load. This feature minimizes the starting surge on the customer's power source, which is especially useful when the source is finite, such as with an engine alternator set.

External Selective High-voltage Shutdown: If the plant voltage is too high, the LINEAGE® 2000 ECS controller will signal all of the operating rectifiers that a high voltage is present. The rectifier(s) causing the overvoltage will shut down. The remaining rectifiers will continue operation.

Internal Selective High-voltage Shutdown: If the rectifier voltage is too high (based on a user-selectable level) and the rectifier is delivering at least 10% of its rated output current, the rectifier will shut down. When rectifiers are operating in load share mode and a high-voltage situation occurs, only the defective rectifier will shut down. If the rectifier is connected to a LINEAGE® 2000 ECS controller, the internal high-voltage shutdown will automatically be disabled and the controller will furnish the selective high voltage shutdown signal. The high-voltage shutdown level can be set in increments of 0.5V

(±0.25V) between 25V and 29V by a DIP switch on the front of the rectifier.

Backup High-voltage Shutdown: This feature prevents damage to the rectifier and its loads if a high-voltage condition occurs. The rectifier monitors its own output voltage and shuts down when this voltage exceeds a preset value. This voltage is factory set to 29.5V ±0.25V.

Output Current Limit: The rectifier provides a constant output voltage up to its rated output current, at which point it provides constant current. The output current is limited to less than 110% of the rated output and no user adjustment is necessary.

Rectifier Test: A front panel switch is provided for automatically raising or lowering the output voltage of the rectifiers a small amount in order to test operation.

Restart Circuit: The rectifiers are compatible with the automatic restart features of the LINEAGE® 2000 ECS controller. If a rectifier has been shut down due to high voltage, the plant will try once to restart it automatically.

Metering: A 3-1/2 digit, back lit, LCD meter indicates the output current of the rectifier with an accuracy of ± 0.9% of full scale ± 1 count.

Active Inrush Current Limiting: Upon initial application of ac source voltage, an active circuit limits the current drawn by a rectifier to a low value. This prevents possible tripping of input breakers or overloading of engines during start-up.

Initial Charge Mode: The rectifiers are capable of providing 30 volts and less than rated current when used out of their RSA for initial charging of flooded cells.

Rectifier Failure Alarm (RFA): An RFA alarm provides both a local visual indication of failure and a signal to the plant controller. An RFA is generated by the following:

1. high voltage shutdown
2. thermal alarm
3. rectifier fuse alarm or circuit breaker overcurrent operation

AC Fail Alarm: An ac input voltage of less than approximately 170 vrms causes an alarm to be issued to the controller. An ACF is also transmitted to the controller if the ac input fuses located inside the rectifier have operated.

Transfer (TR): The rectifier may be placed in the standby externally by a controller-generated signal. The rectifier will remain in the standby mode until removal of that signal.

Thermal Alarm (TA): The SR series rectifiers are fan cooled to increase their reliability. High temperatures caused by fan failure or other conditions cause a thermal alarm to be issued. See Section 7, *Maintenance,* for details on fan replacement.

DC Output Breaker: A circuit breaker is provided to protect the rectifier from malfunction and overcurrent. It may also be used to disconnect the rectifier from the battery.

Remote Sense: The rectifier can regulate remotely and can compensate for a voltage drop of up to 2 volts between the rectifier's output terminals and the regulation point.

Test Jacks: Two sets of test jacks are provided. One set measures the plant voltage at the remote regulation sense point. The other set measures the voltage internal to the rectifier before the dc output circuit breaker. This second voltage represents the output voltage of the rectifier plus the voltage drop of the output circuit breaker. When the breaker is open and the rectifier is on but disconnected from the local bus, this voltage can be used to adjust the rectifier’s output voltage.

Wide ac Input Frequency Range: The rectifier's power factor correction circuit and switchmode technology allow it to operate over 47 to 63 Hz with no degradation in performance.

Operation Without Batteries: The LINEAGE® 2000 SR series rectifier is capable of working without batteries without affecting performance.

Note

Although all other specified characteristics remain within limits, the presence of a battery does alter both the output noise and transient response of the rectifier.

Dynamic Response: Using a battery having an ampere-hour capacity (8-hour rate) four times greater than the output rating of the rectifier, step changes in load over the range of 10 to 90 percent, or 90 to 10 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.

Shipping: The rectifier in its shipping container will withstand the vibrations and shocks normally encountered in shipping without damage or degradation of performance.

Lightning and Switching Surge Protection: The rectifiers are capable of withstanding, without damage, repeated surges of the following waveforms (as defined in the referenced tables in IEEE C62.41-1991):

Table 2-C: Lightning and Switching Surge Protection

Wave Form	C62.41 Reference
100 KHz Ring Wave	Table 3 (Category B3)
8/20uS Pulse	Table 4 (Category 3B)
10/1000uS Pulse (364B series 1:2 and higher)	Table 8 (High Exposure)

In addition, a metal oxide varistor (MOV) type service entrance protector is recommended. (See IEEE C62.41-1991 Figure B10.) Service entrance protection should be coordinated with the MOV rating in the rectifier. All rectifiers 364B series 1:1 and before have 275 vrms MOV. Additional information on Total Surge Management is available in Applications Note 94ESDEV044 (available from Power Systems Document Control Center).

Typical Battery Plant

Figure 2-1 shows a basic block diagram of a typical dc battery plant. 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 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

or 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.

Battery Plant Subsystems

AC Input: connects the commercial and/or standby ac power sources to the rectifiers within the plant and provides overcurrent protection. This subsystem is usually supplied by the customer.

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.

Converters: transform -48-volt source voltages into regulated, low noise 24-volt dc power sources for use with telecommunications loads.

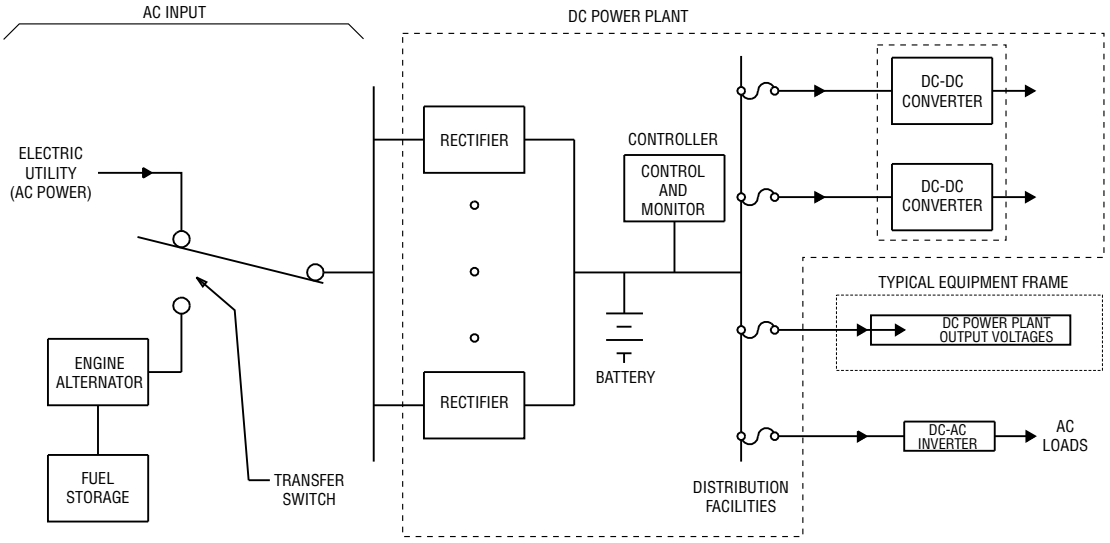


Figure 2-1: Block Diagram of Typical Battery Plant

3 Engineering and Ordering

Engineering Installation Preparations

This section contains the information that should be considered before installing the rectifiers in a LINEAGE® 2000 battery plant. This section also gives a description of the input and output wiring required, and the recommended procedure for installing a rectifier in the rectifier shelf assembly.

AC Power Service

To assure reliability of the system, it is recommended that separate branch circuits be run to each rectifier. An MOV type service entrance protector is recommended (see IEEE C62.41-1991, Fig. B10). Service entrance protection should be coordinated with the MOV rating in the rectifier. (All rectifiers 364B series 1:1 and before have 275 Vrms MOVs.) The wiring method used should meet national and applicable local codes. Data needed in consideration of ac input installation is given in Table 3-A.

If the codes governing your installation permit, using Armored Cable, also known as BX, will make routing of the ac wiring within the bay easier.

The RSAs have access holes for conduit in both the left and right side to ease wiring of the frame. Each RSA has slots for three rectifiers. All slots should be wired for ac during initial system installation upon regardless of whether they are going to be used initially. This will substantially reduce the time and expense required to add rectifiers later.

Table 3-A: AC Input

Rectifier Shelf	Input Voltage Current	Line Fuse Type	Input Circuit Breaker	Input Wire Gauge	RSA Conduit Knockout (Trade Size/Inches)
J85702C-2	208	16.5	FRN-R 30A	10 AWG	.875/.50 1.125/.75
	240	14.0			

Notes:

1. The input wire gauge is specified at 28.25 volts dc, 100 amperes output, and nominal input voltages.

2. Each rectifier requires 3 input wires including "green wire ground." Use KS24194 L2, KS20785, KS20747 or 75° C commercial wire.

3. Where the trade size of the conduit actually used is smaller than the trade size for which the conduit knockout was sized, use appropriate knockout reducing washers.

DC Power Output Connection

When the RSA is factory installed on the plant frame, the RSA dc power output bus bars are pre-wired to the plant dc bus bars at the factory. When the RSA is field installed, the dc power bus bars and installation hardware are supplied in a separate package with the RSA.

Rectifier and Controller Interface Cables

When the RSA is factory installed on the plant frame, the controller is also installed on the frame, and the RSA interface ribbon cable is routed, dressed, and connected to the controller. If the RSA is for field installation into a J85500E-2 plant frame, the interface cable from the controller will be included as part of the original plant and dressed to the normal locations for field additions of RSAs.

Site Preparation

Note

The installation of the RSA and rectifiers at the customer designated frame work location is to be performed by personnel experienced in telecommunications power equipment. The user is responsible for providing ac power to the designated frame location.

The RSA is designed to be mounted to a standard 23 inch rack frame with 22-5/16 inch mounting centers. It must be mounted so that a minimum of 12 inches exists between the bottom of the RSA and the bottom of the equipment directly above the RSA.

When the frame is located against a wall, be sure that at least three inches exists between the rear of the mounted rectifier and the wall. For RSAs mounted in J85500E-2 plants, the three-inch clearance is assured by the plant framework. More details on framework installation can be found in the plant product manuals.

Shipping and Receiving of Rectifiers

The 364B2 rectifiers are packaged individually and shipped in a foam filled carton approximately 18 x 21 x 13 inches and weighing about 30 pounds.

The RSA is typically shipped assembled in a plant frame. Refer to the plant manual for details. When not shipped assembled in a plant frame, the RSA is shipped with all mounting hardware needed for assembly to standard network bay frameworks.

Additions to Existing Plants

When adding additional rectifiers to existing plants, consideration must be given to rectifier loads, battery reserve time, the number of rectifiers required for battery recharge, the capacity of the charge and discharge conductors, and the availability of both ac service power and load feeder circuits in the battery plant.

Heat Dissipated to Environment

The maximum heat load exhausted to the environment by each rectifier is provided in Table 2-A. The 364B2 rectifiers are designed for forced air cooling. The building or area must have a maximum ambient temperature of less than 50° C.

Warning

Do not block rectifier ventilation openings or unit may shut down due to overheating.

Unpacking and Handling

Immediately upon removal from shipping cartons, check contents against the respective shipping lists and check for possible shipping damage. Contact carrier if the equipment was

damaged in transit, and request instructions for filing a damage claim

Rectifier Control Signals

Table 3-B outlines the input and output signals the 362B2 rectifier provides on the front panel connector P790. Brief descriptions of these signals follow the table. When the SR100/+24V rectifier is installed in an ECS plant, this connector is prewired to the controller. These details are provided for engineering custom jobs as well as for anyone who needs further information about the interface. When rectifiers are used in the RSA, some of these signals are "ORed" together in the ribbon cable to the controller or the controller backplane. Consult drawing SD-82668-01 for details. A typical signal flow between the rectifier and controller is shown in Figure 3-1.

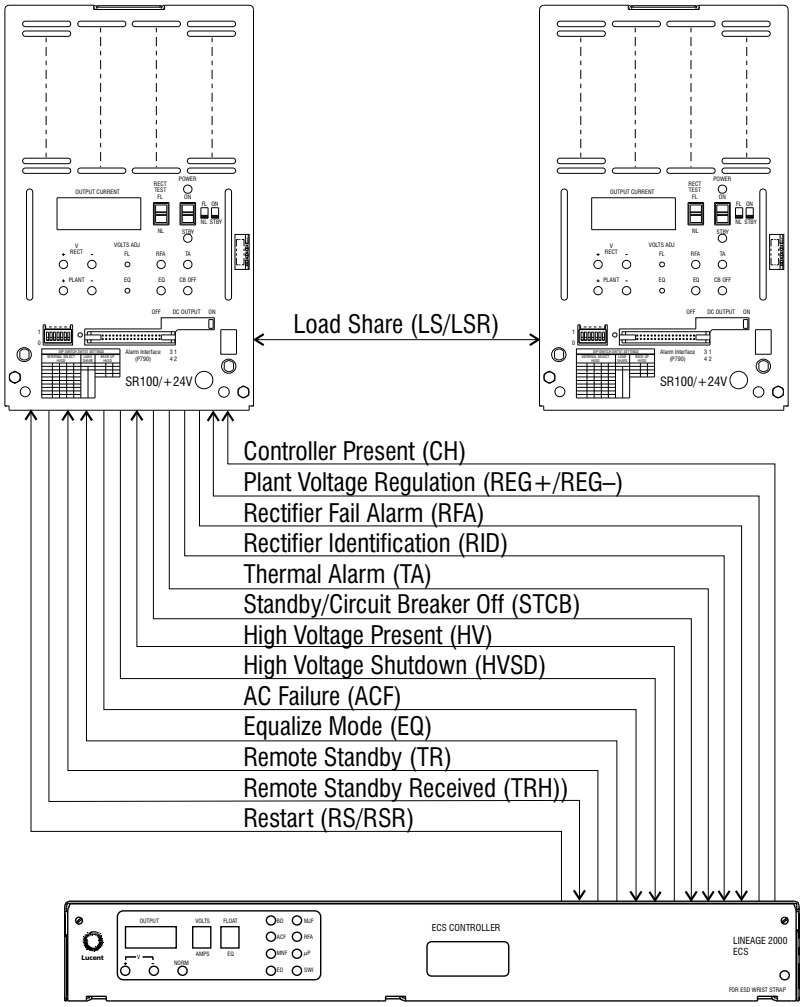


Figure 3-1: Signal Flow Between Rectifier and Controller

Table 3-B: Rectifier Control Signals

Control Signal	Abbreviation	Pin Number
Return 2	RTN2	1
Low Current Alarm	LCA	2
Rectifier in Cage	RIC	3
Auxiliary Restart	AR	4
Rectifier Identification	RID1	5
Load Share	LS	6
Rectifier Identification	RID2	7
Load Share Return	LSR	8
Rectifier Identification	RID3	9
Thermal Alarm	TA	10
Transfer Handshake	TRH1	11
Standby/Circuit Breaker Off	STCB	12
Transfer Handshake	TRH2	13
Battery	BAT	14
Transfer Handshake	TRH3	15
Return	RTN	16
Output Transfer	OTR	17
High Voltage Shutdown	HVSD	18
Output Transfer	OTR1	19
AC Fail	ACF	20
Output Transfer	OTR2	21
Rectifier Fail Alarm	RFA	22
Regulation	REG-3	23

Table 3-B: Rectifier Control Signals

Control Signal	Abbreviation	Pin Number
Equalize	EQ	24
Regulation	REG-2	25
High Voltage	HV	26
Regulation	REG-1	27
Controller Handshake	CH	28
Regulation	REG+1	29
Restore Return	RSR	30
Regulation	REG+2	31
Restore	RS	32
Regulation	REG+3	33

AR If a rectifier restarts for any reason it will issue a signal to all other rectifiers to restart.

ACF AC Fail is a contact closure between ACF and RTN (pin 16) indicating to the controller that the rectifier ac source voltage has fallen below approximately 170 Vrms or the rectifier input fuses have operated.

BAT The -48 volt dc plant voltage is required on pin 14 to power the CH, EQ, HV and OTR alarm circuits in the rectifier. In ECS battery plants, the -48 source is protected by a 1-1/3 ampere fuse located on the LVD/R circuit board.

CH Controller Handshake is a contact closure between CH and RTN (pin 16) originating in the controller. This connection disables the rectifier's internal high voltage shutdown circuits and allows the system to rely on the controller's high voltage shutdown circuits instead.

EQ Equalize is a contact closure between EQ and RTN (pin 16) originating in the controller, which forces the rectifier into equalize mode.

HV High Voltage is a contact closure between HV and RTN (pin 16) indicating the plant voltage is too high. Upon receipt of the HV signal, the rectifier responsible for the high voltage condition will shut down.

HVSD High Voltage Shutdown is a contact closure between HVSD and RTN (pin 16) indicating to the controller that the rectifier has shut down due to high voltage.

LCA Low Current Alarm is a contact closure between LCA and RTN (pin 16) indicating that the rectifier is producing less than 1.5 amperes and is in the load share mode. This signal is not used by the ECS controller.

LS/LSR Load Share and Load Share Return are connected to other SR series rectifiers to facilitate automatic (forced) load sharing.

OTR A contact closure between OTR and RTN (pin 16) originating in the controller which forces the rectifier into the standby mode.

REG +/REG - Used to sense the plant voltage at the point of regulation.

Note

In plants without a controller, the REG- sense leads should be fused with 1-1/3 ampere fuses.

RFA A contact closure between RFA and RTN (pin 16) indicating to the controller that the rectifier has shut down due to high output voltage, excessive internal temperature, a blown fuse or an operated circuit breaker.

RIC Rectifier in cage is a connection between RIC and the positive rectifier output which disables the rectifier's high voltage shutdown circuits. No provisions for this connection are made in the RSA.

RID Rectifier Identification is an opto-isolated closure between RID and RTN2 (pin 1) indicating to the controller that the rectifier is in a normal mode and is able to supply power to the load.

RS/RSR RS/RSR is an isolated contact closure between RS and RSR originating in the controller which forces shutdown rectifiers to attempt a restart following high voltage shutdowns.

Note

Use of a non-isolated contact or improper mixing of rectifiers could result in improper operation of the rectifier high voltage shutdown and restart circuits.

RTN Return is used as the signal return for all non-isolated contact closures between the basic controller board and the rectifier. This lead is connected to the plant discharge return bus.

RTN2 Return 2 is used as the signal return for all opto-isolated contact closures between the rectifier and the microprocessor board of the ECS controller (CP2). The emitters of the opto-isolators are connected to this lead in the rectifier. This lead is connected to discharge return in the controller.

STCB Standby/Circuit Breaker off is an opto-isolated closure between STCB and RTN2 (pin 1) indicating to the controller that the rectifier is in the standby mode or that the output circuit breaker in the off position.

TA Thermal Alarm is an opto-isolated closure between TA and RTN2 (pin 1) indicating to the controller that the rectifier has shut down due to overtemperature.

TRH Transfer Handshake is a contact closure between TRH and RTN2 (pin 1) confirming to the controller that the rectifier has shut down in response to an OTR signal.

Rectifier Sizing

This section discusses the factors to be considered in determining the minimum number of rectifiers required in a battery plant. Since rectifiers of different output current capacities can be paralleled in a plant, size mixing is also discussed in relationship to determining the number of necessary rectifiers.

Any time the plant load exceeds the combined capacity of the rectifiers, the batteries (which are in parallel) must discharge to supply the additional current demand. Momentary discharges are handled easily by the batteries; this capability precludes the need for the rectifiers to handle infrequent, momentary peak current conditions. However, the total rectifier capacity of the plant must be designed to meet prolonged periods of current drain during "busy" demand times. In a telecommunications environment, this is known as the "average busy hour" (abh) current drain. It is defined as the average busy hour of busy season current drain drawn at normal plant operating voltage.

Other parameters that can be decided on by the customer are the maximum length of time the batteries are allowed to discharge (reserve time) and the maximum amount of time allowed for the batteries to be recharged to 95% of their capacity. These two times are used in determining the "recharge factor" from battery data similar to that shown in Figure 3-2. The recharge factor determines the amount of current required (over and above the load demand) to recharge the batteries concurrent with supplying the abh load demand.

Figure 3-2 illustrates some general bounds on sizing rectifiers for recharging batteries. With other conditions fixed, it illustrates three generalities.

- As the reserve time of batteries increases, so does the recharge factor required for a given recharge time.
- Some minimum recharge factor is required to effectively recharge the batteries.
- Continuing to increase the recharge factor will not materially reduce the recharge time.

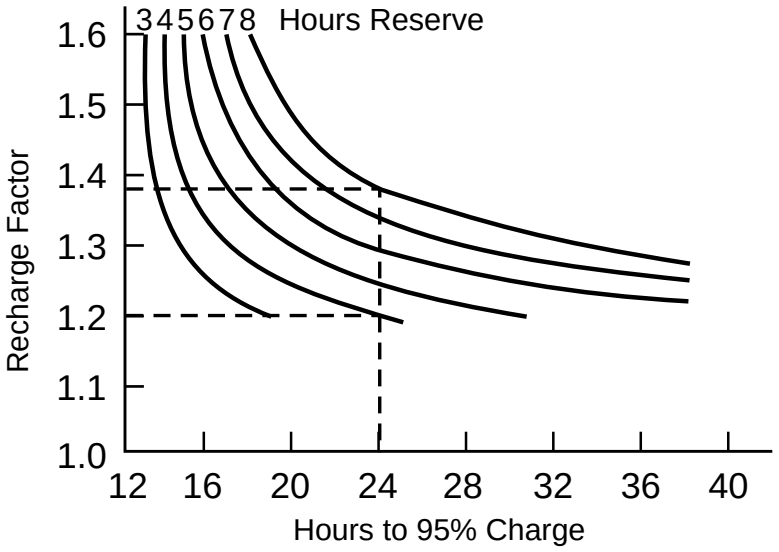


Figure 3-2: Recharge Factor vs. Recharge Time

Redundant vs. Non-Redundant Systems

The recharge factor (1.2 to 1.6) multiplied by the abh current drain will give the minimum installed rectifier capacity (mirc) for any plant.

mirc = abh x recharge factor

The mirc is also the sum of the abh and the recharge current. For example, a 1.2 recharge factor in a plant with an abh current drain of 100 amperes will simultaneously allow 100 amperes for plant load, and 20 amperes for battery recharge in 24 hours, following a 3-hour discharge period.

The mirc value of current is a requirement of either a redundant or a non-redundant rectifier system. It is the only requirement defining a non-redundant system. A redundant system additionally requires that the loss of any one rectifier will not cause the remaining rectifier capacity to fall below the abh value. This is another way of saying that the loss of any one rectifier in the system will not cause the batteries to discharge. In some cases, meeting the mirc value current requirement will also meet the additional requirement for a redundant system; in other cases it will not.

Sizing Examples

The following two examples will illustrate the sizing principles given above.

The average busy hour current (abh) of a plant is 2850A. It is required to have a 4-hour reserve (discharge) time and a 24-hour recharge time. Calculate the minimum installed rectifier capacity (mirc) and the number of 400A rectifiers required in redundant and non-redundant systems.

From Figure 3-2, a 24-hour recharge time intersects the 4-hour reserve curve at a recharge factor of approximately 1.2.

mirc = abh x recharge factor

mirc = 2850A x 1.2 = 3420A

The number of 400A rectifiers required to supply at least 3420A is nine (9 x 400A = 3600A). Nine rectifiers are required in a non-redundant system. If one rectifier fails, the remaining rectifier capacity is 3200A (8 x 400A), which is greater than the 2840A abh. Therefore, nine 400A rectifiers are also enough for a redundant system.

The average busy hour current drain (abh) of a plant is 210A. It is required to have an 8-hour reserve time and a 24-hour recharge time. Calculate the mirc and the number of 100A rectifiers required in redundant and non-redundant systems.

From Figure 3-2, a 24-hour recharge time intersects the 8-hour reserve curve at a recharge factor of approximately 1.38.

mirc = abh x recharge factor

mirc = 210 x 1.38 = 290A

The number of 100A rectifiers required to supply at least 290A is three (3 x 100 = 300A). Three rectifiers are required in a non-redundant system If one rectifier fails, the remaining rectifier capacity is 200A (2 x 100A), which is less than the 210A abh. Therefore, at least one more 100A rectifier is required for a redundancy, making the total needed for a redundant system four rectifiers. If one fails, a 300A capacity remains that is greater than the 210A abh.

Note that in the previous example the redundant system could also be realized by the following combinations of rectifiers.

- One 200A and three 100A rectifiers
- Two 200A and one 100A rectifiers.

As long as the loss of any one rectifier does not leave a remaining capacity of less than 210A, the system is redundant.

Order the 364B2 100-ampere, +24-volt rectifier using Table 3-C.

Rectifier Ordering Information

Table 3-C: Rectifier Ordering Information

Apparatus Code	Comcode
364B2	107306599

Table 3-D provides ordering information for the rectifier shelf assembly (RSA).

RSA Ordering Information

Table 3-D: J85702C-2 RSA Ordering Information

List	Description
1	Unassigned
2	Unassigned
3	Unassigned
4	Equipment required to mount a maximum of three +24-volt, 100-ampere SR series rectifiers. DC output is for rear bus bar plants of the J85500E type.
5	Unassigned
6	Equipment required to provide one +24-volt, 100-ampere SR series rectifier.
7	Same as List 4 except is for installation in a J85500E-2 bay.
8	Same as List 4 except is for installation in an 80F cabinet.
PM	SR100/+24V product manual, SD-82668-02 schematic, T-82668-31 wiring diagram, and J85702C-2 assembly drawing.

Spare Parts

The recommended spare part for the 364B2 rectifier and associated RSAs is given in Table 3-E. Although procedures may have been outlined for replacement of other passive parts in the RSAs or rectifiers, it is not recommended that they be spared since it is unlikely that these parts will fail. If it becomes necessary to replace these parts, ordering information can be found on the J85702C-2 drawing.

With the exception of a fan failure, the rectifier is usually repaired by replacement. Your company's maintenance plan will outline rectifier sparing levels.

Table 3-E: Recommended Spare Part

Part Description	Comcode
DC Fan	406418491

4 Safety

Safety Statements

Please read and follow all safety instructions and warnings before installing, maintaining, or repairing the 364B2 rectifier and the J85702C-2 RSA (rectifier shelf assembly).

The 364B2 and J85702C-2 were Recognized by Underwriters Laboratories Inc. to the requirements of UL 1950 Information Technology Equipment. Recognition is based on the items noted below:

4. The output voltage is a hazardous energy level Extra Low Voltage (ELV) as defined by UL 1950.

5. The 364B2 is evaluated as a component rectifier for use only in a shelf that provides mating connectors for the input and output terminals of the rectifier, e.g., J85702C-2 RSA. The input and output terminals of the rectifier are not intended for direct connection of field wiring conductors. Field wiring connections are made inside the RSA.

6. Install the 364B2 rectifier only in restricted access areas (dedicated equipment rooms, equipment closets, etc.) in accordance with articles 110-16, 110-17, and 110-18 of the U.S. National Electric Code (NEC), ANSI/NFPA No. 70, and pursuant to applicable local codes. In addition, this rectifier may be installed as a component to other equipment where the acceptability of the combination has been evaluated by Underwriters Laboratories Inc.

7. This equipment is to be used 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).

8. This equipment has been evaluated for use in a continuous ambient temperature of up to 50° C.

9. 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 size of the overcurrent protector used must not exceed 30 amperes. Refer to the equipment ratings to assure rating of equipment will not exceed 80% of the value of the protector chosen.

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

11. For installations in the United States, UL Listed compression connectors should be used to terminate UL Listed field-wired conductors where required. For all installations, the appropriate connector should be applied only to the correct size conductor as specified by the connector manufacturer, using only the connector manufacturer's recommended tooling or tooling approved for that connector.

12. For electrical connections requiring crimp-on lugs, make sure the proper crimping tools and dies are used (information for these connections are provided in the product documentation). Torque electrical connections to the values specified on labels or in the product documentation.

13. This equipment is intended to be mounted in a rack with the dimensions as noted in Section 5, *Installation.* For proper ventilation, the front and back of the rectifier must not be obstructed (refer to Section 5, *Installation,* for space requirements).

Warning Statements and Safety Symbols

This symbol identifies the need to refer to the equipment instructions for important information

This symbol (or equivalent) is 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.

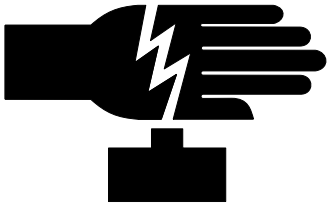
The symbols may sometimes be accompanied by some type of statement. For example, "Hazardous voltage/energy inside. Risk of injury. This unit must be accessed only by qualified personnel."

Precautions

When working on or using this type of equipment, the following precautions should be noted:

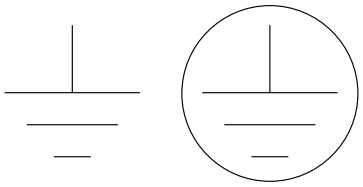
- This unit must be installed, serviced, and operated only by skilled and qualified personnel who have the necessary knowledge and practical experience with electrical equipment and who understand the hazards that can arise when working on this type of equipment.
- The J85702C-2 RSA is normally powered by multiple ac inputs (possibly one per rectifier). 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.

This symbol identifies 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."



When working on this type of equipment, the following safety precautions should be noted:

- 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.
- In addition to proper job training and safety procedures, the following are some basic precautions that should always be used:
  - — Use **only** properly insulated tools
  - — Remove all metallic objects (key chains, glasses, rings, watches, or 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 in the area you are working before entering the 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.



The above symbols are used to identify the safety earth ground or bonding point for the equipment.

5 Installation

Introduction

This section covers the installation requirements, unpacking and handling, rectifier shelf assembly (RSA) installation and removal, rectifier installation and removal, and initial start-up and check procedures for the 364B2 rectifier. If the RSA is purchased as part of an ECS system, the RSA will be factory installed in the ECS frame.

Only persons trained and experienced in the installation of telecommunications power equipment should install the rectifier and associated RSA. Furthermore, it is recommended that the commercial ac power be wired by a qualified electrician.

Please review Section 4, *Safety*, before installing or maintaining this equipment.

Installation Tools and Test Equipment

The following tools and test equipment are required for installation and test of the rectifiers.

- Common electrician's hand tools
- Common mechanic's hand tools, including a 20 foot-pound torque wrench and a set of deep english sockets
- Insulated 3/16" Allen wrench key (provided with each ECS frame)
- Crimp tools
- Fluke 8060A Digital Multimeter (DMM) or equivalent. The accuracy of an equivalent meter should be ±0.05% on the dc scale.

Field Installation of an RSA

Please review Section 4, *Safety*, before installing or maintaining the rectifier shelf assembly.

ECS Battery Plants

The 364B2 rectifier is a component in the J85500E-2 battery plant. The following installation procedure should be followed when performing field installation of the J85702C-2 rectifier shelf assembly (RSA) into a new or operating J85500E-2 plant.

Initial Bay Installation

Refer to Figure 5-4 and proceed as follows:

1. Mount the bus bars (Items 1 and 2) onto the RSA as shown in the rear view of the RSA (see Figure 5-4). Secure using the 1/4-20 hardware (Items 3, 4, 5). Do not tighten.

2. If the plant is accessible from the rear, go to Step 3. If the plant is accessible only from the front, slide the bus bars (Items 1 and 2) toward each other as far as possible and torque the 1/4-20 nuts (Item 5) to 50 in-lbs.

3. Install the RSA onto the frame, leaving eight (8) empty holes above the top of the RSA mounting bracket. Bolt the RSA to the frame using #12-24 screws (Item 6).

4. Secure the RSA bus bars (Items 1 and 2) to the vertical plant bus bars using 5/16-18 hardware (Items 8, 9 and 10). Torque to 135 in-lbs.

5. If the plant is accessible from the front only, skip to Step 6. From behind the frame, torque the 1/4-20 nuts (Item 5) to 50 in-lbs.

6. The J85500E-2 plant is factory wired with ribbon cables from the controller to each RSA slot. Locate and connect the appropriate cable to the RSA interface connector.

7. The rectifier positions in the plant are numbered from right to left and from top to bottom to correspond to the locations assigned to rectifiers by the controller software. (See Figure 5-5). Apply the appropriate rectifier labels (Item 7) to the face of the rectifier front cover (See Figure 5-4).

Wiring AC Into a -48V RSA

Installation procedures must be followed when wiring ac into an RSA. Please review Section 4, *Safety*, before proceeding.

RSA Setup

Refer to Figure 5-1 and proceed as follows:

1. Determine whether the individual ac line feeds will enter the RSA from the right or left.
2. Remove all RSA rectifier slot covers.
3. Remove the hole plugs from the desired ac feed side of the RSA.

Note

If the RSA is not fully wired, wire the slot furthest from the side where the ac lines enter.This will allow operating rectifiers to remain on line while an unused rectifier RSA slot is later filled.

Installation of AC Power to the RSA

1. Disconnect ac power from distribution box/panel to be used to supply power to the RSA rectifiers.
2. Install fuse holders or circuit breaker for each feed line in distribution box/panel. Remove fuses or set circuit breaker in OFF position.
3. Route the ac input line feeds in BX (armored) cable, flexible cable, or 1/2 inch conduit, as required by local wiring code, to the selected RSA side.
4. Secure each line feed to the RSA using the applicable type fitting, in accordance with local code. Recommended fittings are provided in Figure 5-2.
5. Strip the outer jacket of the cable to expose a sufficient length of the individual conductors (3) to allow for non-jacketed runs inside the RSA.
6. At each RSA slot location terminal block, proceed according to Figure 5-2 as follows:

Warning

Use the correct crimping tool and die for the conductors. See Figure 5-2.

a. Crimp and connect each ac input feed ground lead to RSA ground terminals on bottom of the RSA.

b. Crimp and connect each ac input feed line lead to RSA line terminals on terminal blocks.

7. Replace RSA rectifier slot covers.

Post-Installation Instructions

Refer to Figure 5-1 and proceed as follows:

1. At plant ac distribution box/panel, close circuit breakers or install fuses which supply ac power to each RSA rectifier slot location.

2. Use a DMM to check for presence of 208/220/240 volts ac at each RSA ac connector.

Adding a Rectifier

The procedures for installation of a rectifier in an operating plant or a new plant are identical.

1. Remove the fuse clip cover from the selected RSA rectifier mounting slot.

2. Set POWER switch on rectifier to be installed to STBY position (See Figure 5-1).

3. Set DC OUT circuit breaker on rectifier to be installed to OFF.

4. Slide rectifier front cover (part of RSA) out from under RSA guide pin (Figure 5-4). Cover and attached ribbon cable connectors must be out of the way of the rectifier. (See Figure 5-3.)

5. Place rectifier at the selected RSA rectifier slot. The rectifier must be horizontal and at the correct height so that it rests on the top of the RSA.

6. Grasp the two front handles and carefully slide the rectifier toward the back panel of the RSA. Push until seated. The front edge of the rectifier (not including cover) should overhang the RSA by approximately 1/4 inch.

7. Use a 3/16" (5mm) Allen head wrench to turn the recessed rectifier locking screw (located in the lower right corner of the rectifier) clockwise until the screw is firmly seated.

8. Mate the ribbon cable from the RSA with the receptacle on the rectifier.

9. Snap front cover into place on the rectifier.

10. Proceed to Initial Start-up and Check.

Disconnecting a Rectifier

Refer to Figure 5-3 when disconnecting a rectifier from an operating plant.

1. On the rectifier to be removed, set DC OUTPUT circuit breaker to OFF and the POWER switch to STBY.

2. Remove the rectifier cover by grasping firmly and pulling outward.

3. Disconnect ribbon cable plug connector from receptacle.

4. Insert a 3/16" (5mm) Allen wrench in rectifier locking screw opening. Turn locking screw counterclockwise until the screw turns freely.

5. Grasp front panel handles and slide/pull rectifier from the RSA. Support the underside of the rectifier with one hand as it comes out of the RSA.

Note

Due to energy storage in the rectifier, the front panel LEDs will remain lit for approximately one minute after removal of ac voltage. No hazardous voltages exist on the rectifier terminals during this time.

Disconnecting an RSA

Refer to Figure 5-1 when disconnecting an RSA from an operating plant. Please read Section 4, *Safety*, before proceeding.

Danger

Turn power off at branch protector. (Lock and tag out per procedures.)

1. Remove all rectifiers from the RSA as described above.
2. To disconnect ac wiring from the RSA, proceed as follows.
   a. At the plant ac distribution panel, open the circuit breakers or remove the fuses which supply the RSA with power. Tag the circuit breakers or fuse holders to instruct others to leave the circuits de-energized.
   b. Disconnect ac power conductors at each RSA line filter.
   c. Remove the ac fittings from the side of the RSA and remove the wiring.

Danger

Plant bus bars are electrically “hot.” Use insulated tools. Remove rings, watches, and other jewelry.

3. Remove and tape the (+) conductor.
4. Disconnect the dc output conductors from the RSA bus bars and tape the terminal lugs.
5. Disconnect ribbon cable plug connector from back of shelf.
6. Remove hardware securing RSA brackets to frame and remove the RSA from frame.

Initial Start-up and Check

This section describes the testing procedure for both newly installed or replacement rectifiers. If the plant to which the rectifier is being connected has never been operational, consult the plant and controller product manuals for their installation test

procedures. The rectifier installation test must be performed after plant and controller tests have been completed.

Electrical Testing for Rectifiers

The following procedures can be used to verify that the rectifiers are working either after initial installation, subsequent addition, or replacement of a rectifier. For troubleshooting and diagnostics, refer to Section 7, *Maintenance*. Refer to the appropriate figures in Section 6, *Operating Controls And Displays* during the performance of these procedures. Those unfamiliar with the function of rectifier controls and indicators should read Section 6, *Operating Controls And Displays*.

Danger

Before turning on any rectifier, be sure that the associated framework and cable rack are properly grounded per local job instructions and code requirements.

Voltage required to operate the indicators on the rectifier, as well as some of the relays, is derived from the ac input voltage. The ac voltage is available to these circuits whenever ac service is available to the rectifier.

Selection of Internal Selective High Voltage Shutdown Level

The rectifier Internal Selective High Voltage Shutdown feature is disabled when a controller is present since the controller provides this feature. However, this voltage level should still be set correctly to avoid false shutdowns in the event the controller is removed for maintenance, repair or replacement. This level should be set at least 1.5 volts above the normal float voltage to avoid false shutdowns. See Figure 5-1 for location of DIP switches. Set the DIP switches according to the table provided just below the DIP switch on the face of the rectifier. This table is reproduced here as Table 5-B.

Enabling/ Disabling of Load Sharing

The load share feature of the rectifier can be enabled or disabled through DIP switch 701 located on the front of the rectifier. Set it according to Table 5-B.

Table 5-B: 364B2 Rectifier Dip Switch (701) Settings

Internal Selected HVSD (Volts)					Load Share		Back-Up HVSD		
Volts	1	2	3	4	5		Volts	6	7
25.0	1	1	1	1	enabled	disabled			
25.5	1	1	1	0					
26.0	1	1	0	1	1	0			
26.5	1	1	0	0					
27.0	1	0	1	1					
27.5	1	0	1	0					
28.0	1	0	0	1					
28.5	1	0	0	0					
29.0	0	1	1	1					

Initial Power up and Adjustment

Set the ac supply and rectifier controls as follows:

Associated ac circuit breaker ON or replace fuse at the ac service panel.

Rectifier POWER switch to STBY and DC OUTPUT circuit breaker lever to OFF.

1. Ensure the controller is set such that the rectifier will be enabled and in float mode (refer to controller manual if necessary). If no controller exists, the rectifier will default to float mode.

2. Verify that only the following LEDs are lit on the rectifier: POWER STBY, CB OFF.

3. At the rectifier, set the POWER switch to ON. Verify that only the following LEDs are lit: POWER ON, CB OFF. Check that OUTPUT CURRENT display reads 00.0.

Note

If LED's status is not as specified, refer to Section 7, *Maintenance,* for troubleshooting help.

4. Connect DMM to the PLANT (+) and (-) test jacks on the rectifier. If batteries are present or if other rectifiers in the plant are ON and adjusted properly, the meter should read the proper plant voltage. If there are no batteries or other rectifiers ON, the meter should read zero.

5. Connect DMM to the RECT (+) and (-) test jack. The meter reading represents the rectifier output voltage produced with the DC OUTPUT circuit breaker in the OFF position. (See notes below.) Adjust the VOLTS ADJ - FL potentiometer using a jeweler's screwdriver until the desired plant voltage level is obtained. The meter reading should match the value read at the PLANT (+) and (-) test jacks.

Note

If plant voltage is present, the voltage appearing at the RECT test jacks is never less than 1.5V below the plant voltage, even with the rectifier turned off. When adjusting the rectifier, it may take many turns before the voltage at the rectifier test jacks begins to change

Note

At this time do not close the DC OUTPUT circuit breaker.

6. Repeat Steps 2-5 for all rectifiers to be put on line at this time.

7. If the plant is not to be configured for equalize operation proceed to Step 16.

8. At the controller, put the rectifier in equalize mode. (See controller product manual for details, if necessary.)

9. At the rectifier, verify that only the following LEDs are lit: POWER ON, CB OFF, EQ. Check that OUTPUT CURRENT display reads 00.0.

Note

If LED's status is not as specified, refer to Section 7, *Maintenance,* for troubleshooting help.

10. Connect DMM to the PLANT (+) and (-) test jacks on the rectifier. If batteries are present or if other rectifiers in the plant are ON and adjusted properly, the meter should read the proper plant voltage. If there are no batteries or other rectifiers ON, the meter should read zero.

11. Connect DMM to the RECT (+) and (-) test jack. The meter reading represents the rectifier output voltage produced with the DC OUT circuit breaker in the OFF position. (See Notes below.) Adjust the VOLTS ADJ - EQ potentiometer using a jeweler's screwdriver until the desired plant equalize voltage level is obtained. The meter reading should match the value read at the PLANT (+) and (-) test jacks.

Note

If plant voltage is present, the voltage appearing at the RECT test jacks is never less than 1.5V below the plant voltage, even with the rectifier turned off. When adjusting the rectifier, it may take many turns before the voltage at the rectifier test jacks begins to change.

Note

At this time do not close the DC OUTPUT circuit breaker.

12. Repeat Steps 9 through 11 for all rectifiers to be put on line at this time.

13. Set DC OUTPUT circuit breaker on all rectifiers to be put on-line to ON position. Verify that the CB-OFF LED is extinguished. If plant is delivering load current, verify that all on-line rectifiers are delivering current. (If not see note below.) In addition, for plants configured for load sharing, verify that plant load is divided among the rectifiers within specifications (10% of rating) as indicated on the rectifier OUTPUT CURRENT display.

Note

Because of the sharing of the dc bus between rectifiers on an RSA, a rectifier's RECT test points may read higher than the PLANT test points although the rectifier is not producing any current.

Note

In some operational instances, the OUTPUT CURRENT display on a rectifier may read 00.0 amperes. This is not a malfunction condition. It signifies that another rectifier is taking all the load. Refer to Full Load Testing in Section 7.

14. Verify that only the EQ and ON LEDs are lit on each rectifier put on line.

Note

If LED's status is not as specified, refer to Section 7, *Maintenance* for troubleshooting help.

15. Return the rectifiers to float mode by setting the appropriate controller switch.

16. Set DC OUTPUT circuit breaker on all rectifiers to be put on-line to ON position. If plant is delivering load current, verify that all on-line rectifiers are delivering current. In addition, for plants configured for load sharing, verify that plant load is divided among the rectifiers within 10 amperes as indicated on the rectifier OUTPUT CURRENT display.

Note

Because of the sharing of the dc bus between rectifiers on an RSA, a rectifier's RECT test points may read higher than the PLANT test points although the rectifier is not producing any current.

Note

In some operational instances, the OUTPUT CURRENT display on a rectifier may read 00.0 amperes. This is not a malfunction condition. It signifies that one rectifier is taking all the load. Refer to Full Load Testing in Section 7.

17. Verify that only the ON LED is lit on each rectifier put on line.

Note

If LED's status is not as specified, refer to Section 7, *Maintenance,* for troubleshooting help.

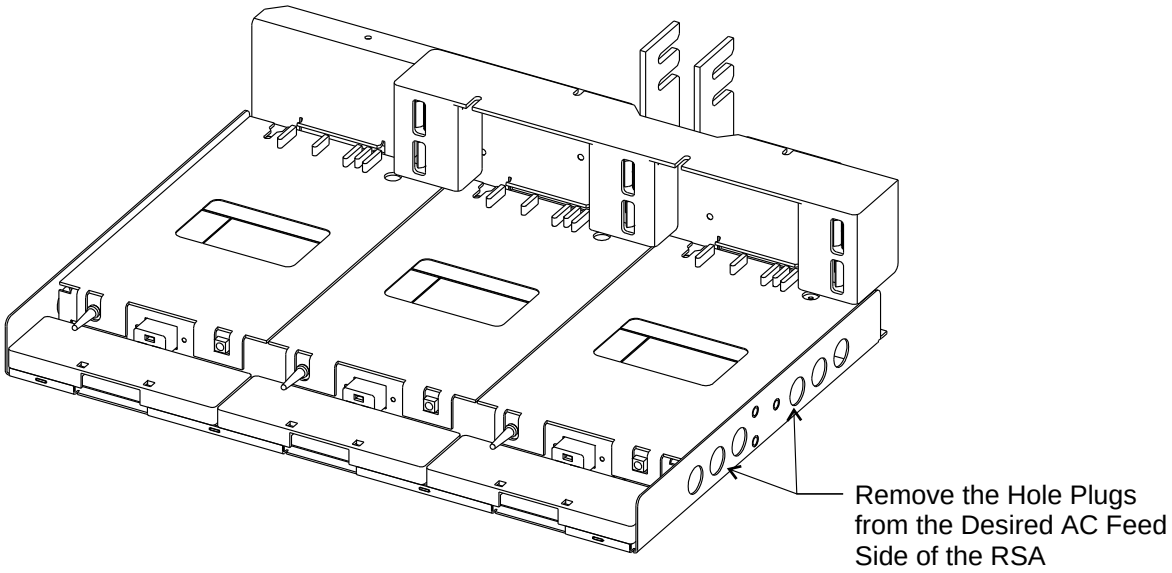
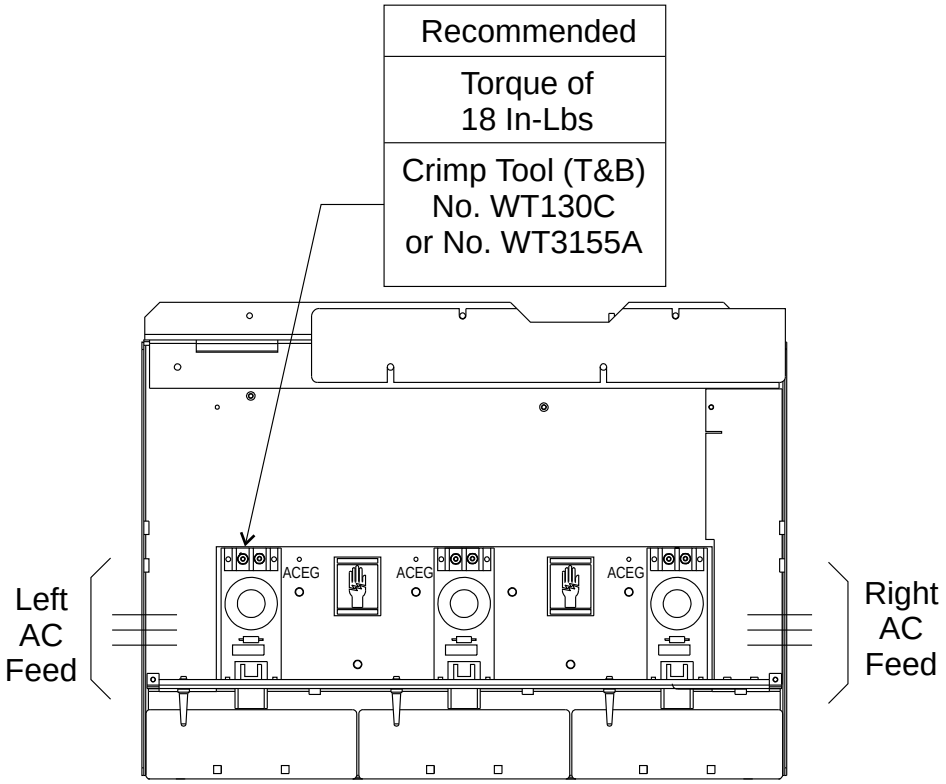


Figure 5-1: Rectifier Shelf Assembly



Recommended AC Fitting		
Cable Type	Fitting (T&B)	
	1/2"	3/4"
Conduit	8130	8131
Armored	3132	–
Flexible	2251	–

Figure 5-2: RSA Wiring Instructions

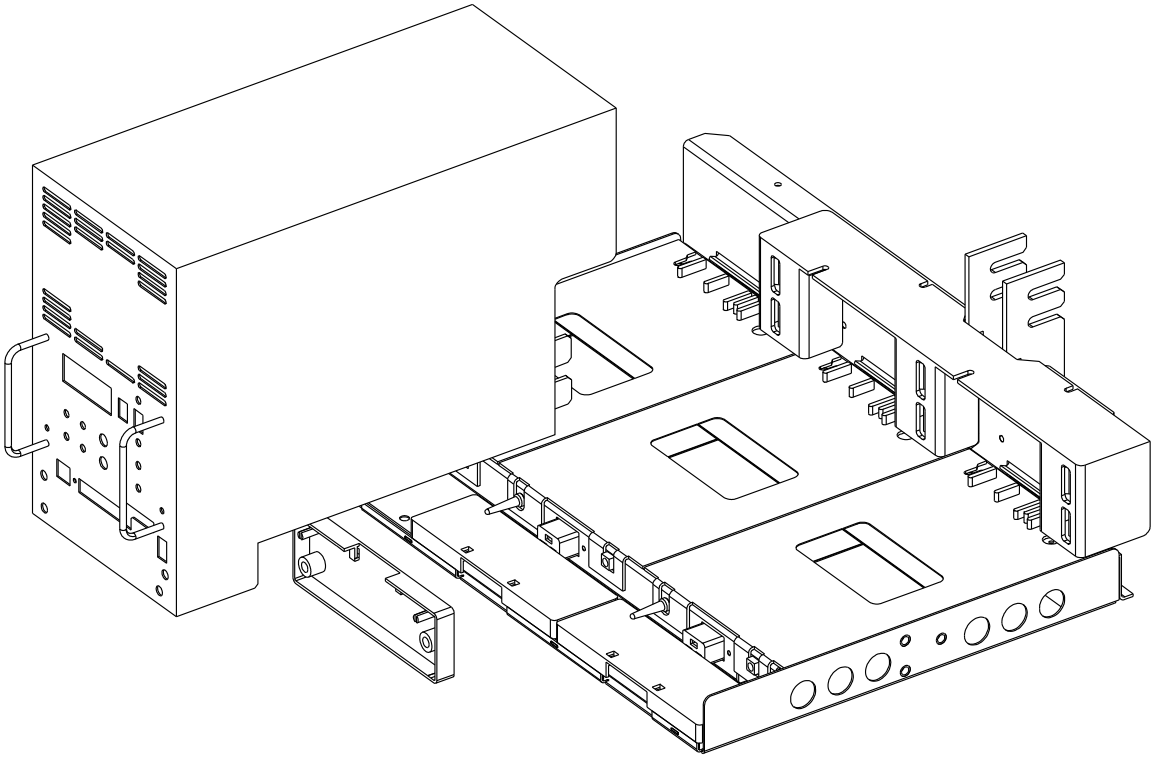


Figure 5-3: Rectifier Installation into RSA

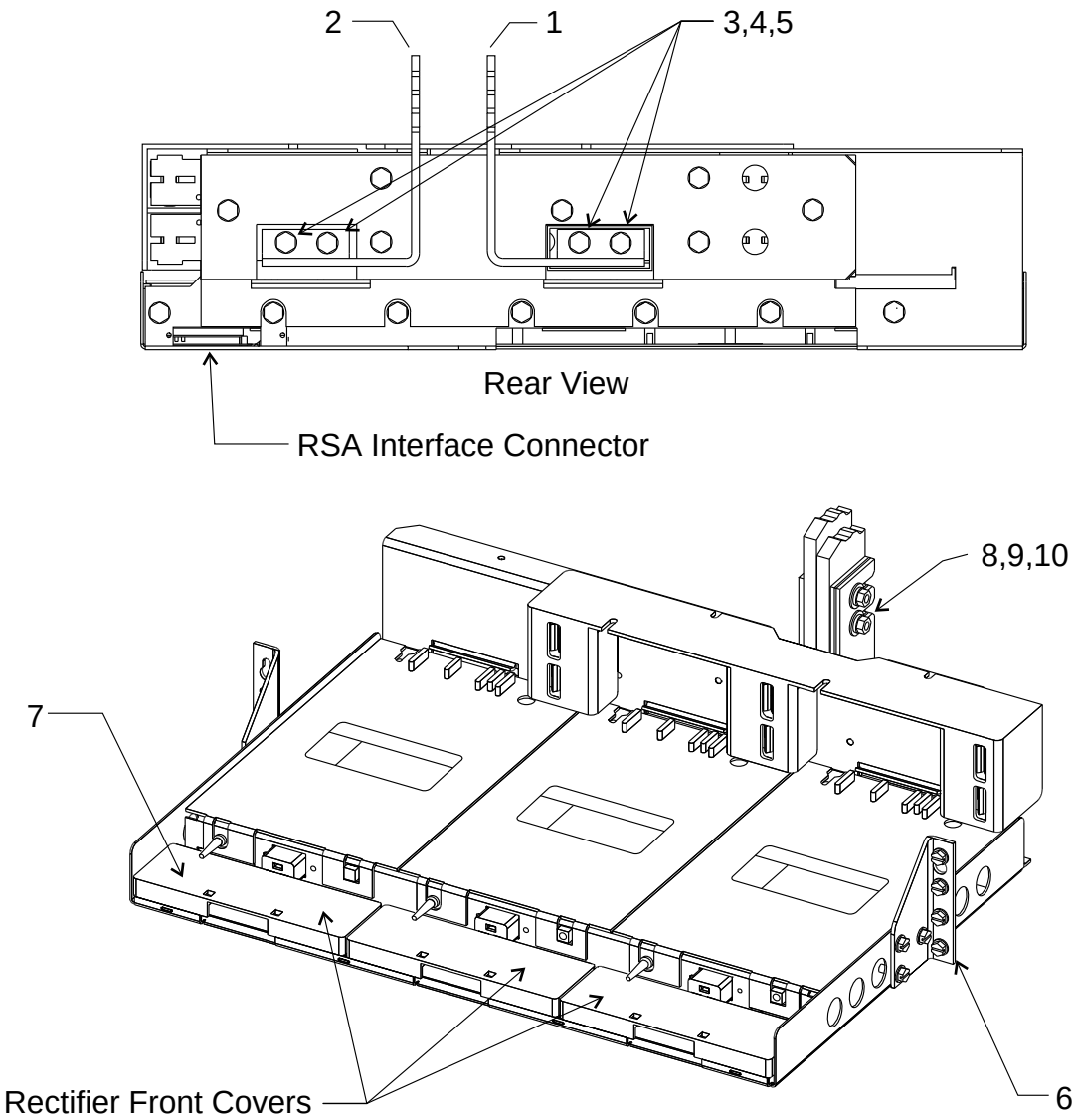


Figure 5-4: Field Installation Kit (J85702C-2 into J85500E-2)

6 Operating Controls and Displays

General

This section describes the components of the 364A3 rectifier used and operated manually.

Specifics

The 364A3 rectifier front panel controls, switches, indicators, displays, and connectors are shown in Figure 6-1. Each item is identified in the figure by an index number. The function of each item, called out by index number assigned, is listed and described below.

Volts Adj - Eq (1) A screwdriver-adjustable recessed potentiometer, used during equalize mode to set rectifier output voltage. The range of control is between 48 and 58V.

V-Plant Test Jacks (2, 3) Jacks are used to measure the plant voltage at the remote sense point.

V-Rect Test Jacks (4, 5) Jacks are used to measure the rectifier internal sense point voltage. This voltage is measured before the dc output circuit breaker.

Volts Adj - Fl (6) A screwdriver-adjustable recessed potentiometer adjustment, used during float mode to set rectifier output voltage. The range of control is between 48 and 58V.

Output Current Ammeter (7) A three-digit, backlit, LCD display used to display the value of current during operation. Its accuracy is ±0.5%.

Rect Test Switch (8) This switch provides a manual test of the rectifier regulation by simulating a full load or no load condition on the output (momentary up or down operation of switch selects either FL or NL position). When switch is in the center position, the rectifier is in the normal operating state. This switch also provides for a lamp test of all front panel LEDs and display (when the POWER ON/STBY switch is in the STBY position, momentary up or down operation of the switch initiates lamp test).

Power On (9) This green LED is lit when the rectifier is operating normally and in the float, equalize, or adjust modes.

Power On/Stby Switch (10) This switch manually turns the rectifier on or into standby. When the switch is in the STBY position, the rectifier can not be turned on by the plant controller. When in the ON position, the rectifier may be turned on or off remotely via the OTR leads. Power On LED will be extinguished when rectifier is turned off manually or remotely.

STBY (11) This yellow LED is lit when the rectifier is in standby mode. In this mode ac voltage is present in the rectifier providing power to the rectifier's logic; however, it is electronically prevented from producing output power. The rectifier can be put into standby either locally, using the POWER ON/STBY switch, or remotely through use of a controller.

RFA (12) This red LED provides indication of a rectifier shutdown due to a high output voltage condition, internal fuse and/or output circuit breaker overcurrent event, or inadequate airflow.

TA (13) This red LED lights when the rectifier has shut down due to inadequate air flow, indicating possible blockage, fan failure, or inlet air temperature above 122° F (approximately 50° C).

EQ (14) This yellow LED provides a visible indication that the rectifier is in equalize mode.

CB OFF (15) This yellow LED provides a visible indication that the output breaker is open.

DC OUTPUT Circuit Breaker (16) Used to disconnect the rectifier from the output bus for test purposes. It also protects the plant from rectifier malfunction and overcurrent conditions. When the circuit breaker is in the OFF position, the yellow LED CB OFF indicator is lit and an alarm is sent to the controller.

DIP Switch (17) Used to set rectifier internal selective high voltage shutdown level (Switches 1-4), enable/disable the load share function (Switch 5), and to set back-up high-voltage shutdown level (Switches 6 and 7).

Interface Connector (18) Thirty-four (34) pin keyed connector provides interface between rectifier and controller via RSA ribbon cable. See Table 3-B and list of descriptions (Section 3, "Rectifier Control Signals") for details of the signals available at this connector.

Mounting Screw (19) Hex screw used to secure rectifier to the RSA.

Note

The screw is accessible only with DC OUTPUT circuit breaker in the OFF position.

Test Connector (20) A ten pin keyed factory test connector.

Note

This is a factory test connector and is not used during field maintenance. Improper use of this connector can result in rectifier damage.

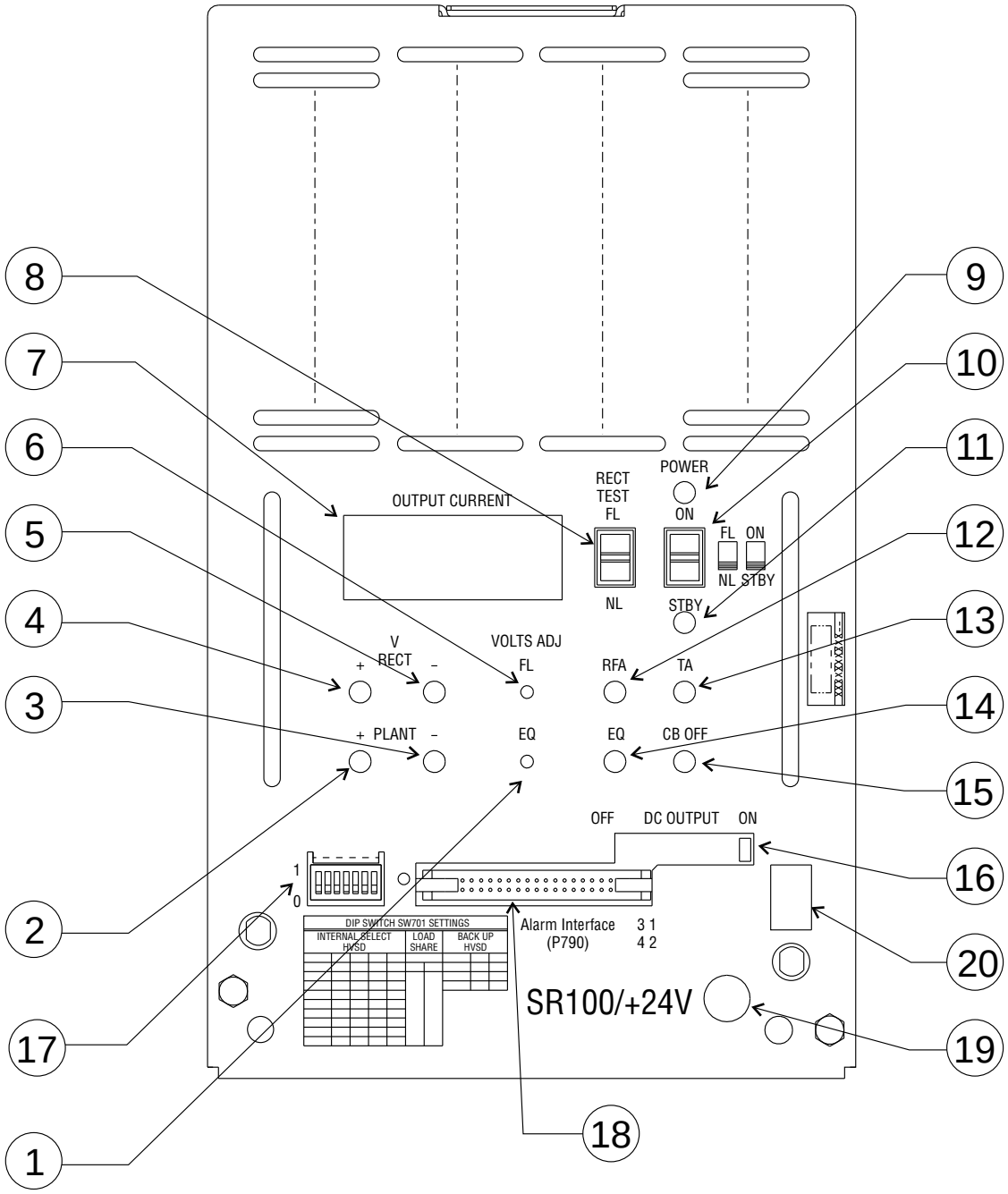


Figure 6-1: Controls, Switches, Indicators, Displays, and Connectors

7 Maintenance

Introduction

This section provides field maintenance information and procedures for the 364B2 rectifier and the J85702C-2 rectifier shelf assembly (RSA). Those unfamiliar with the function of rectifier controls and indicators should read Section 6, *Operating Controls and Displays.*

Fan Maintenance

The expected life of the rectifier fan at 25° C (77° F) is seven years. The fan is mounted external to the rectifier, allowing the fan to be replaced without opening the rectifier. The fan is easily replaced in the field, requiring only a screwdriver. When a fan fails, the rectifier shuts down and issues an RFA alarm and a TA alarm both locally and to a controller.

Two approaches can be taken to fan maintenance. The first approach is to routinely replace all fans every five years, insuring that the fans do not fail in the field under normal operating conditions. This approach is appropriate when there are no remote alarm facilities at the site. The second approach, assuming one has remote alarm capability, is to wait until the fan fails. The rectifier will safely shut down and issue both an RFA and a TA alarm. The fan can then be replaced. Since it is likely that all the rectifiers in that installation are of roughly the same age, all rectifier fans at that site should be replaced at that time. The approach used depends on the convenience of the site as well as the monitoring of alarms used at the site.

Performance Testing

When load sharing is disabled, it is perfectly normal for one rectifier to be fully loaded and another producing no current. However, the following tests can be done to insure that all rectifiers are capable of producing current. These tests may be

performed when the plant is in float or equalize mode and with the rectifiers in or out of loadshare mode.

No Load Testing (NL)

This test is typically done on rectifiers which have load share disabled. This test can be performed on a rectifier which is producing any output current.This test should not be performed on a plant consisting of only one rectifier.

1. Press and hold the RECT TEST switch in the NL position.

2. Observe that the reading on the OUTPUT CURRENT display of the rectifier decreases in value and the readings on the other rectifiers increase.

Note

It is normal for rectifiers not in load share to share load very unevenly; it is also possible that the rectifiers are not adjusted properly. Rectifiers not running in load share mode can be adjusted with the circuit breaker closed. Rectifiers may also be adjusted such that some carry the majority of the load with remaining units functioning as “hot” spares.

3. If the rectifier's current does not decrease when the RECT TEST switch is in the NL position, turn the applicable potentiometer (FL or EQ) fully CCW. If the rectifier is still producing a disproportionate amount of current, press and hold the RECT TEST switch in the NL position. If the rectifier's current does not decrease, replace the rectifier according to procedures outlined in Section 5, *Installation*. If the rectifier's current does decrease, readjust its output according to the procedures outlined in Section 5.

Full Load Testing (FL)

This test can be performed on a rectifier which is producing no output current although the other rectifiers on-line are producing full output current. This test should not be performed on plants consisting of only one rectifier.

1. Press and hold the RECT TEST switch in the FL position.

2. Observe that the reading on the OUTPUT CURRENT display of the rectifier increases in value and the readings on the other rectifiers decreases.

Note

It is normal for rectifiers not in load share to share load very unevenly; it is also possible that the rectifiers are not adjusted properly. Rectifiers not running in load share mode can be adjusted with the circuit breaker closed. Rectifiers may also be adjusted such that some carry the majority of the load with remaining units functioning as “hot” spares.

3. If the rectifier's current does not increase when the RECT TEST switch is in the FL position, turn the applicable potentiometer (FL or EQ) fully CW. If the rectifier is still producing no current, press and hold the RECT TEST switch in the FL position. If the rectifier's current does not increase, replace the rectifier according to procedures outlined in Section 5, *Installation*. If the rectifier's current does increase, readjust its output according to the procedures outlined in Section 5, "Initial Start-up and Check."

Diagnostics

This section diagnoses possible problems that may occur with the rectifier subsystem. Use the flow chart in Figure 7-1 to isolate the malfunction to the defective replaceable components or assembly.

With the exception of fan replacement, the 364B2 rectifier is designed to be repaired only at a Lucent Technologies factory. The RSA for the 364B2 rectifier can be repaired in the field. Diagnostics consist of determining whether or not the rectifier needs to be replaced in the event it is not delivering power. Diagnostics also help determine if the problem is in a component other than the rectifier.

Required Test Equipment

Depending on the tests to be performed, one or more of the following may be required.

- DMM (Digital Multimeter) Fluke 8060A or equivalent meter having .05% accuracy on dc scale
- Jeweler's screwdriver for adjusting potentiometer.
- 3/16" Allen wrench for replacing rectifiers.

Repair

Replacement of Fan

Refer to Figure 7-2 and proceed as follows:

1. Refer to Section 5, "Disconnecting a Rectifier," to perform the rectifier removal procedure.
2. Remove two (2) screws holding fan and fan guard onto back panel of chassis.
3. Separate fan assembly from chassis back panel.
4. Disconnect black plug from terminals of old fan.
5. Connect black plug to terminals of new fan.
6. Attach fan assembly to chassis back panel using two (2) screws.
7. Replace rectifier and restore ac service according to the procedures outlined in Section 5, *Installation.*

Replacement of Rectifier

In the event the rectifier has to be replaced, follow the steps outlined in Section 5, *Installation*.

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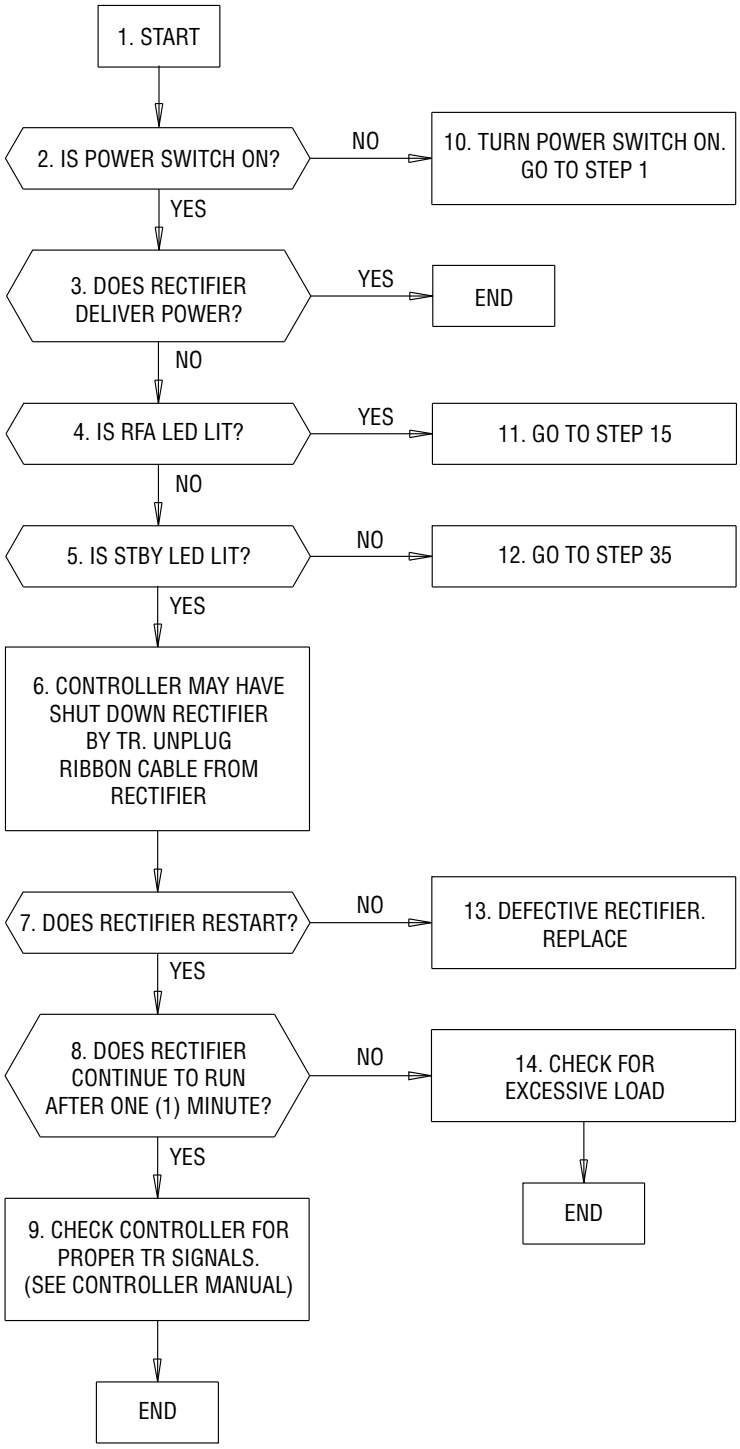

Figure 7-1: Troubleshooting Flowchart

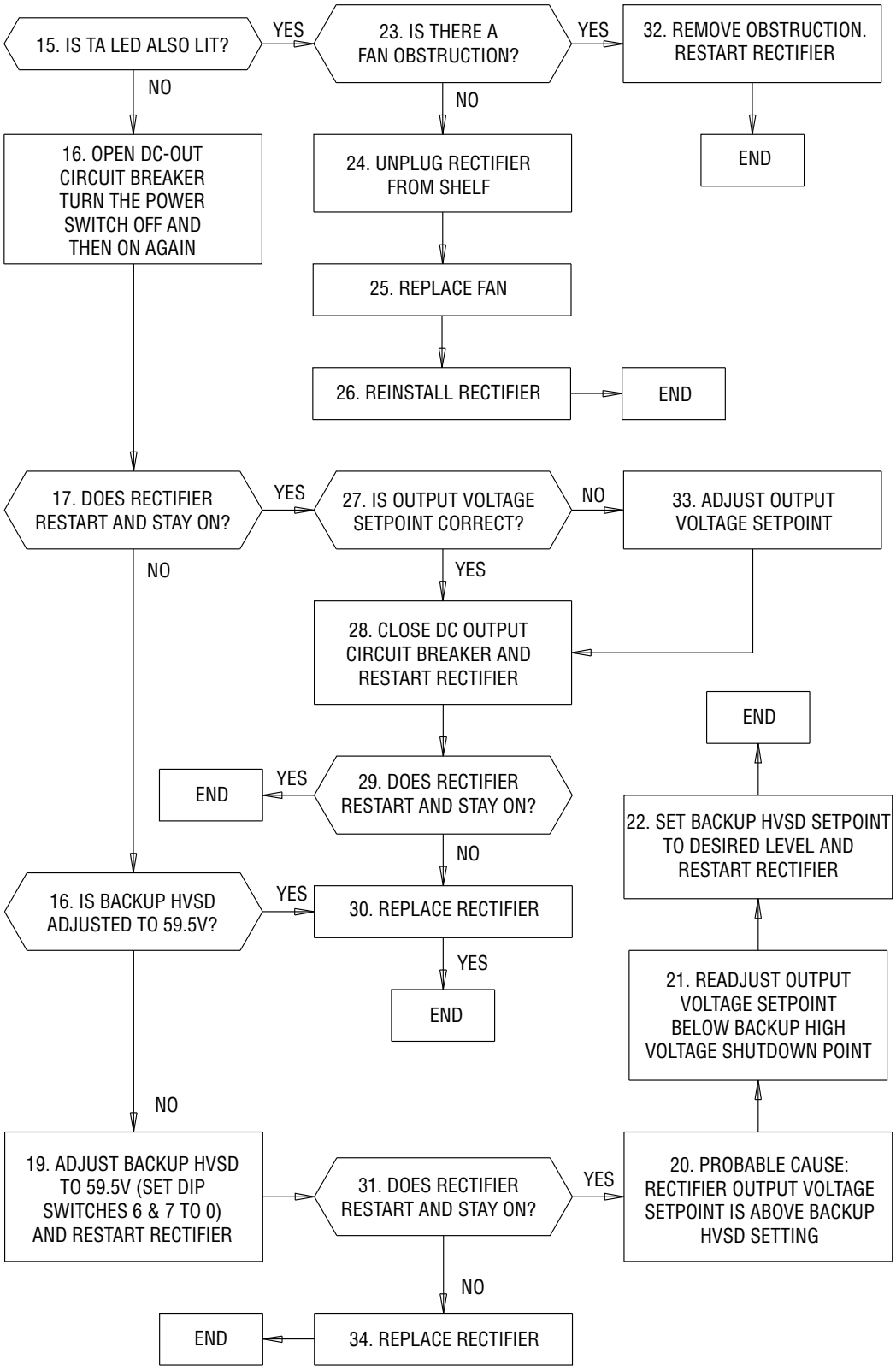

Figure 7-1: Troubleshooting Flowchart (continued)

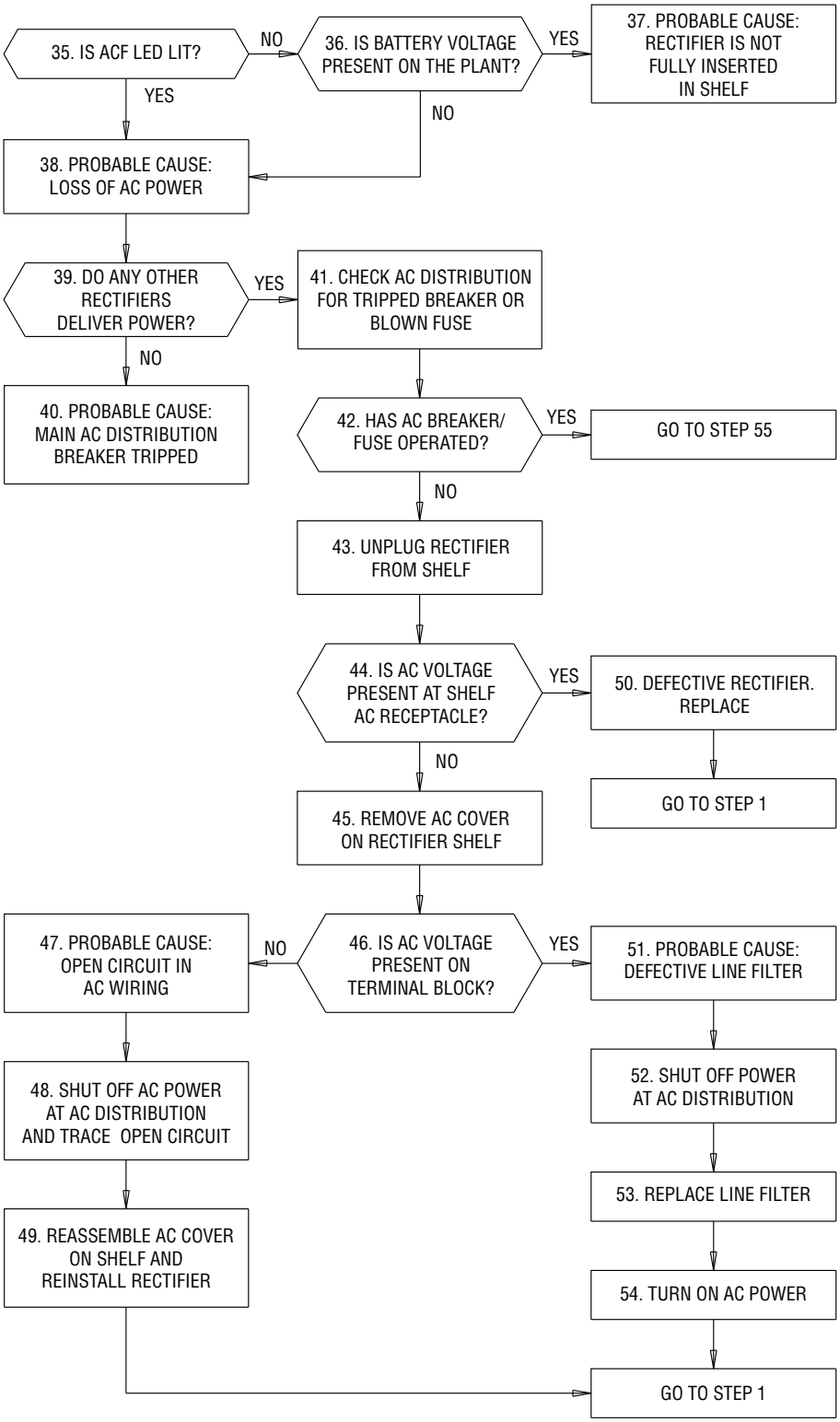

Figure 7-1: Troubleshooting Flowchart (continued)

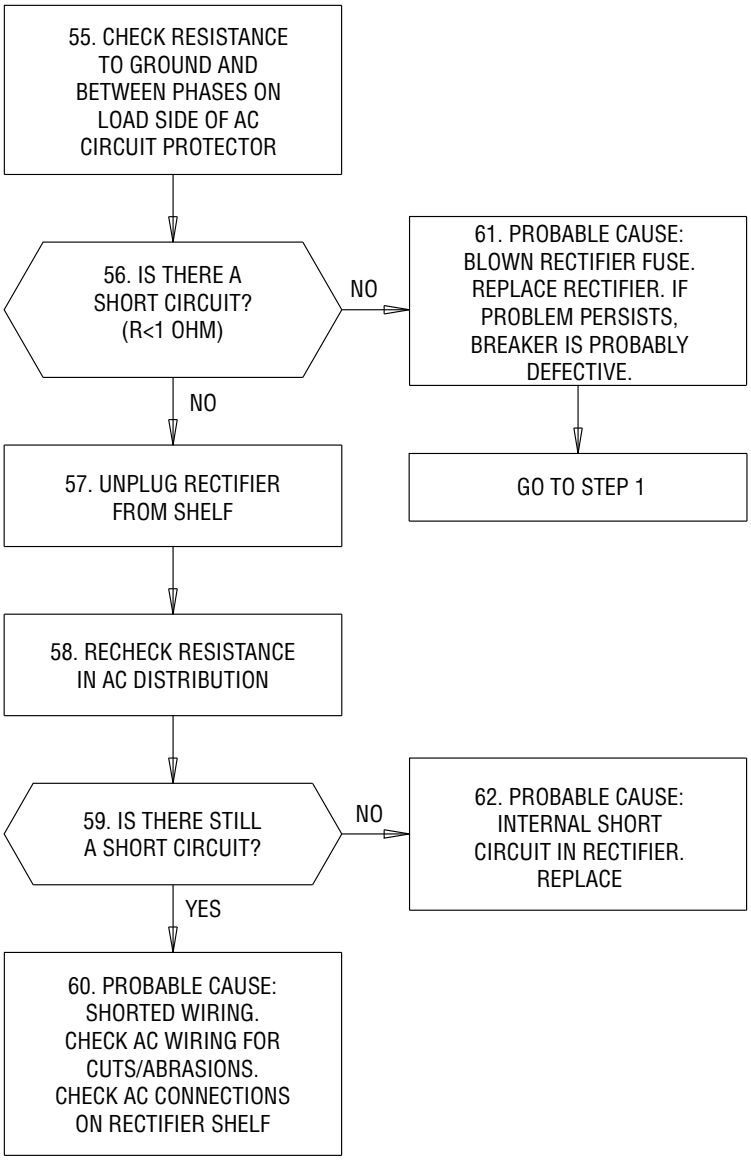

Figure 7-1: Troubleshooting Flowchart (continued)

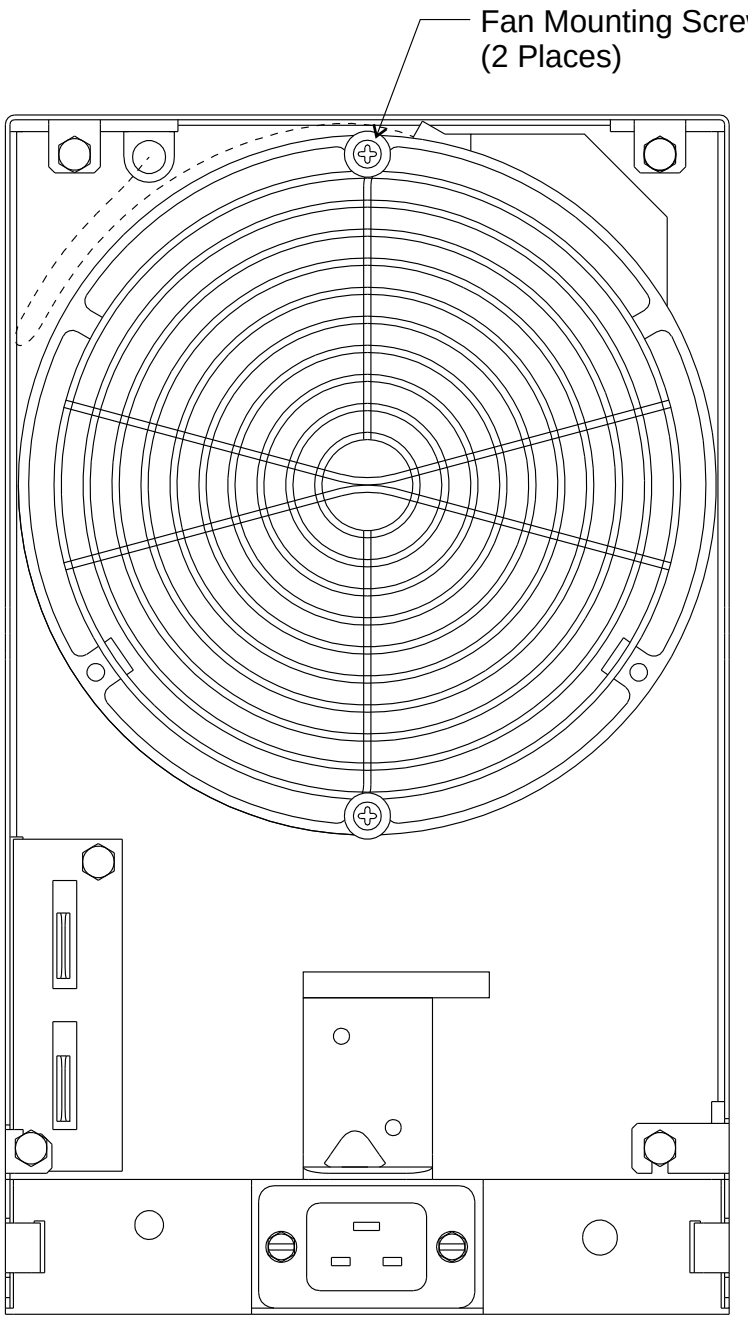

Figure 7-2: Fan Replacement

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.