Lorain® Model RHM800E50 Rectifier

Spec. No. 548502500

Technical Documentation

Power Products

LP 942 C1 1/98

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LORAIN® MODEL RHM800E50

FLOTROL® RECTIFIER

SPEC. NO. 5485-025-00 SERIAL NO. ________

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Section 2992
October 7.1996

ADDENDUM

INSTALLER'S CONNECTIONS
INSTALLER'S **INFORMATION** NOTES
FOR
LORAIN® RECTIFIERS

Remote voltage sensing lead connections should be made to the rectifier side of any battery protective or disconnect devices present.

If a temperature compensation module is used to regulate rectifier output voltage, the temperature compensation module battery connections should also be made to the rectifier side of any battery protective or disconnect devices present.

CAUTION

Turn off all rectifiers before removing any leads from a previously installed battery charge tern-perature compensation module.

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ADDENDUM

PREPARATION FOR SHUTDOWN

LORAIN® MODEL RL AND RHM SERIES RECTIFIERS

This instruction manual contains various testing, adjustment, and maintenance procedures in which the rectifier will be shutdown either before or during the procedure. Before performing any of these procedures the load sharing lead if installed must be removed using the following procedure then reinstalled after the test or adjustment is made. If the *load sharing* lead is not removed during these procedures there is a potential for service interruption.

CAUTION

Before removing the rectifier from service, provisions should be made to insure that power to critical loads is not interrupted, and that any external office alarms associated with the rectifier an? disabled. if possible. If the extended alarms cannot be disabled Qt the remote location, the appropriate personnel should be notified to disregard any office alarms extended from the rectifier while this procedure is in progress. If the load must be maintained while the rectifier is removed from service, the following considerations should be made:

a) If the rectifier is operating in parallel with one or more additional rectifiers, can the remaining rectifier(s) power the load? If not. the load must be shutdown or an alternate DC source must be used.

b) If a battery is to be used to provide load power during rectifier shutdown, is the battery fully charged and capable of powering the load for the time required to make the adjustment.

1) Place the AC INPUT circuit breaker to the OFF position.

2) Refer to the Power Data sheet for location of the load sharing lead.

3) Disconnectthe load sharing lead from the terminal block and insulate exposed end.

4) Restart the rectifier by referring to the rectifier instruction manual starting and stopping section.

5) Perform the desired test, adjustment, or maintenance procedure in the rectifier instruction manual.

6) When the test, adjustment, or maintenance procedure is complete place the AC INPUT circuit breaker to the OFF position.

7) Reconnect the load sharing lead removed in an earlier step.

8) Restart the rectifier by referring to the rectifier instruction manual starting and stopping section.

9) This completes the procedure.

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LORAIN®
MODEL RHM800E50 RECTIFIER
SPEC. NO. 548602500

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1. DESCRIPTION

General

1.1 These Lorain® Rectifiers operate from 60 Hz three phase input. to maintain a battery in a fully charged condition while powering a toad. The Model RHM800E50 Rectifier can be operated from 480 VAC input power.

1.2 Float Charging: This rectifier provides constant output voltage; therefore. output current remains equal to load current as tong as load current does not exceed a predetermined. adjustable value. This mode of operation is known as float charging. Since, in normal operation, the battery is not required to furnish load current, it remains in a fully charged condition.

1.3 Equalize Charging: If a higher DC voltage is required to equalize the charge on all battery cells, the FLOAT/EQUALIZE switch can be operated focally to obtain higher equalize charge voltage. The equalize function may also be controlled from a remote location if desired.

1.4 Current Limiting: When an AC power failure causes battery discharge. or if a DC overload occurs, an output current limiting circuit prevents the increase of output current above a predetermined value.

1.5 Paralleling: This rectifier is equipped with an automatic current liiitiig circuit which enables paralleling with any other battery charger which can be adjusted to the same output voltage. In addition. a forced bad sharing circuit is furnished which ensures proportional sharing of load between paralleled rectifiers with compatible negative bus load sharing circuits when interconnected with external bad sharing wiring.

Description	Model
Power Supply	Variable Power Supply (0-60 VDC at 10 amps) or equivalent
Adjustable Resistive Test Load	Adjustable from 15 ohms to 0.052 ohms: 50 KW power rating
Digital Multimeter	Fluke Model 8022A or equivalent
DC Ammeter	O-20 amps DC
AC Ammeter	0-60 amps AC
Oscilloscope	Tektronix Model T921 or equivalent
Insulated Screwdriver	GC Electronics Type 8728A or equivalent

Table 2-1
Test Apparatus

1.6 Overvoltage Shutdown: If rectifier output voltage increases beyond a preset value while delivering greater than 3% of rated output current, a circuit trips open the AC input contactor to disable rectifier output.

2. TEST APPARATUS

2.1 Refer to Table 2-1 for a list of tools and test equipment that is sufficient to perform any test or adjustment procedure detailed in this instruction manual.

3. INSTALLATION

3.1 Equipment placement at the central office location should be given consideration, as discussed in the following paragraphs.

3.2 Wiring Considerations: Location of the rectifier should be chosen to minimize required lead lengths for both AC input and DC output. Optimum equipment performance and cost effectiveness of the installation can be realized by proper location of the rectifier.

3.3 Mounting Requirements This rectifier is designed for floor mounting only. The cabinet base contains four mounting holes which accept 1/2 inch diameter bolts for securing the rectifier in Its mounted position. Refer to the Power Data sheet for further information.

3.4 Ventilation Requirements: All ventilation openings in the rectifier cabinet must remain unobstructed for proper component cooling during operation. Temperature of the air entering the cabinet must not exceed +50°C (+122°F).

Electrical Connections

3.5 Wiring: All wiring and branch circuit protection should follow provisions of the current edition of the National Electric Coda. Referenced to the 1996 edition for specific requirements are:

Article 240-6 Branch Circuit Rating

Table 310-16 (75°C) Ampacity of Power Conductors

DANGER

*The **rectifier operates from** AC voltage capable of **producing** severe, perhaps fatal. electrical shock. **Before commencing** installation. **ensure** that AC and DC **sources** an? **completely** disconnected or disabled.*

3.6 General: To gain access to input, output. and control terminals, loosen the captive fasteners securing the meter and control panels. These panels pivot open on separate hinges. If less restricted access to input and output terminals is required, remove the Phillips type screws securing two removable panels immediately above the meter and control panels.

3.7 Input Connections: Connect the three phase AC 60 Hz. power leads at terminals L1, L2 and L3 on contactor K1 at the left side of the rear panel.

3.6 Output Connections: Connect DC output leads to output terminals +BAT. and -BAT at the right side of the rear panel.

3.9 Eanh Ground (Green Wire) Connections: A frame ground lug (GND), located near contactor K1, must be connected to an earth ground (green wire). Do not connect to power system neutral.

Alarm and Control Connections

WARNING

Polarity of the voltage sensing leads is critical. When connecting these leads, verify connections carefully to assure correct polarity, terminal 1(+) and 2(-) on terminal board TB3

OPERATION

3.10 Local or Remote Voltage Sensing: Terminals 1 (positive) and 2 (negative) on terminal board TB3 are provided as voltage sensing terminals. These terminals may be connected at the output of the rectifier or extended to sense the voltage at a remote location. To achieve the most effective regulation of output voltage, the sense leads should be extended to the battery or power board at which regulation is required.

NOTE

The high voltage shutdown circuit is connected across the output voltage leads.

3.11 Load Sharing: This rectifier is equipped with a negative bus load sharing circuit which enables it to divide the load in proportion to the output current ratings wlth arty other LORAIN RL or RHM Series rectifier of the same output voltage rating. When both rectifiers have compatible load sharing circuits, a load sharing connection should be made between the toad sharing terminals of each rectifier. The load sharing terminal of this rectifier is located at terminal board TB3 terminal 3. Refer to the Power Data Sheet for recommended size of the toad sharing lead and terminal block capacity. For proper operation, it is essential that each rectifier be adjusted for proper output voltage and load sharing loop voltage. Refer to the ADJUSTMENT section for detailed information.

3.12 Remote Equalize: Equalize mode of operation can be remotely controlled by providing a closed circuit between terminals 4 and 5 of TB3, or by providing positive battery voltage at terminal 4 only. An open circuit between these terminals or removal of positive battery voltage from terminal 4 restores operational mode control to the FLOAT/EQUALIZE switch on the rectifier front panel.

3.13 Phase Loss/Reduced Load Alarm: If for any reason, rectifier experiences a high ripple condition caused by an AC input phase loss an alarm is activated and the rectifiers output voltage and current will be at a reduced level. Extended alarm contacts are activated to provide closed loop circuits between terminals 26 to 27 and 29 to 30 of terminal block TB3, while open loop circuits are provided between terminals 25 to 26 and 26 to 29 of terminal block TB3. During normal operation closed loop circuits are provided between terminals 25 to 26 and 26 to 29 of terminal block TB3, while open loop circuits are provided between terminals 26 to 27 and 29 to 30 of terminal block TB3.

3.14 Rectifier Fail Alarm: During normal rectifier operation, positive battery is provided at TB3 terminal 12 to provide an external normal operation indication. If a rectifier failure condition occurs, positive battery is removed from TB3 terminal 12 and applied to TB3 terminal 10 to actuate external rectifier fail alarms. A rectifier failure condtiin includes the following operational modes or alarm conditions:

a) High voltage alarm
b) Low voltage alarm
c) Low current alarm
d) Partial load current limit operation
e) Fan fail alarm
f) Heatsink over-temperature alarm
g) Fuse alarm
h) Manual or automatic removal of AC power. including commercial power failure condition

NOTE

If closed loop actuated alarms are desired disconnect and insulate the jumper lead from 7733 terminal 11. Closed loop rectifier fail alarm is then provided at TB3 terminals 10 to I I during a rectifier/ail condition.

3.15 End Cell Switch Inhibit: A positive battery control signal is available at TB3 terminal 13 to inhii activation of an automatically controlled end cell switch during normal rectifier operation. If a low current alarm occurs in the rectifier, this control signal is automatically removed from terminal 13.

3.16 HVA: A positive battery alarm signal is present at TB3 terminal 14 if rectifier shutdown results from a high output voltage condition.

3.17 LCA: A positive battery alarm signal is present at TB3 terminal 15 during a low current alarm condition.

3.18 RCC: Positive battery to TB3 terminal 16 is normally supplied through a factory installed jumper wire between terminals 16 and 20. Positive battery at terminal 16 of TB3 is required for AC input power control. If rectifier starting and stopping is required from a remote location or automatic control device, disconnect and insulate the jumper wire at TB3 terminal 16. Connect positive battery to terminal 16 through the remote switch or control device.

3.19 Voltmeter Indicating Optiin: Connect terminals 17 and 16 of TB3 with a jumper wire if front panel voltmeter indication of battery voltage is desired when rectifier is turned off. If voltmeter indication of zero volts is desired with rectifier turned off, do not connect jumper to terminals 17 and 18.

320 Float and Eaualire Mode Indications: When rectifier is operating in float mode, positive battery is available at TB3 terminal 19. When the equalize mode is selected, positive battery is removed from TB3 terminal 19 and supplied at terminal 21.

321 Optional Auxiliary Power Supply: If, due to a prolonged AC input power failure, the associated battery discharges to below 38 VDC. the rectifier will be Unable to restart. To permit restarting the rectifier in this event, a customer-furnished auxiliary 48 volt power supply may be connected to terminals 1 (+) and 2 (-) of auxiliary power supply terminal block TB1. TB1 is located on inside the rectifier cabinet on the rear wall. The auxiliary power supply must be capable of supplying 10 amperes.

Initial Startup and Checkout

322 This rectifier was completely tested and adjusted by the manufacturer before shipment: however, the installer should perform the following initial checks to insure proper equipment operation after installation is completed.

a) Initial Preparation

1) Place the HVSD and POWER switches on the front panel to the OFF position. Place the FLOAT/EQUALIZE switch to the FLOAT position.

2) Open the front access panels by loosening the captive fasteners, then locate battery disconnect link S2. Remove this link fmm its receptacle.

3) Check to insure that all fuses are securely installed in their fuseholders. Any tape and packing materials used in the interior of the rectifier for shipping purposes should be removed at this time.

4) Connect all input, output, and control wiring in accordance with the Power Data sheet. Refer to Paragraph 3.06 for further wiring information.

b) Initial Startup Procedure

DANGER

Steps 1) through 4) must be performed exactly as presented in these instructions. The rectifier must be started off battery to charge the filter capacitors before installing BATTERY DISCONNECT link S2. Installing the disconnect link before charging the capacitors can result in personal injury, equipment damage, and blown fuses in the rectifier.

1) If reference leads are extended to the battery, perform the following steps:

A) Remove the local sensing leads from their storage terminals on circuit card A9.

B) Working with one lead at a time, disconnect the extended reference leads from terminals 1 and 2 of TB3 on circuit card A9. Temporarily insulate these leads.

C) Connect the local sensing leads to TB3, terminal 1 (+)

and terminal 2 (-). Insure that polarity is correct.

D) Install the M option capacitor assembly, Part No 4251-014-00, on the appropriate edge connector of regulator and alarm circuit card A7. Refer to Figure 3-1.

2) Insure that the external AC protective device is property sized for rectifier input requirements. Close this device to apply AC input power to the rectifier.

3) Place the HVSD circuit breaker toggle and the POWER rocker switch to the ON position. The rectifier should start, although the LOW CURRENT ALARM and an extended rectifier fail alarm may be activated.

4) Wait for the voltmeter on the rectifier front panel to indicate 52 volts. At this time, insert BATTERY DISCONNECT link S2.

5) Place the POWER switch to the OFF position. If reference leads extended to the battery or load are required, perform the following steps. If internal reference only is required, disregard

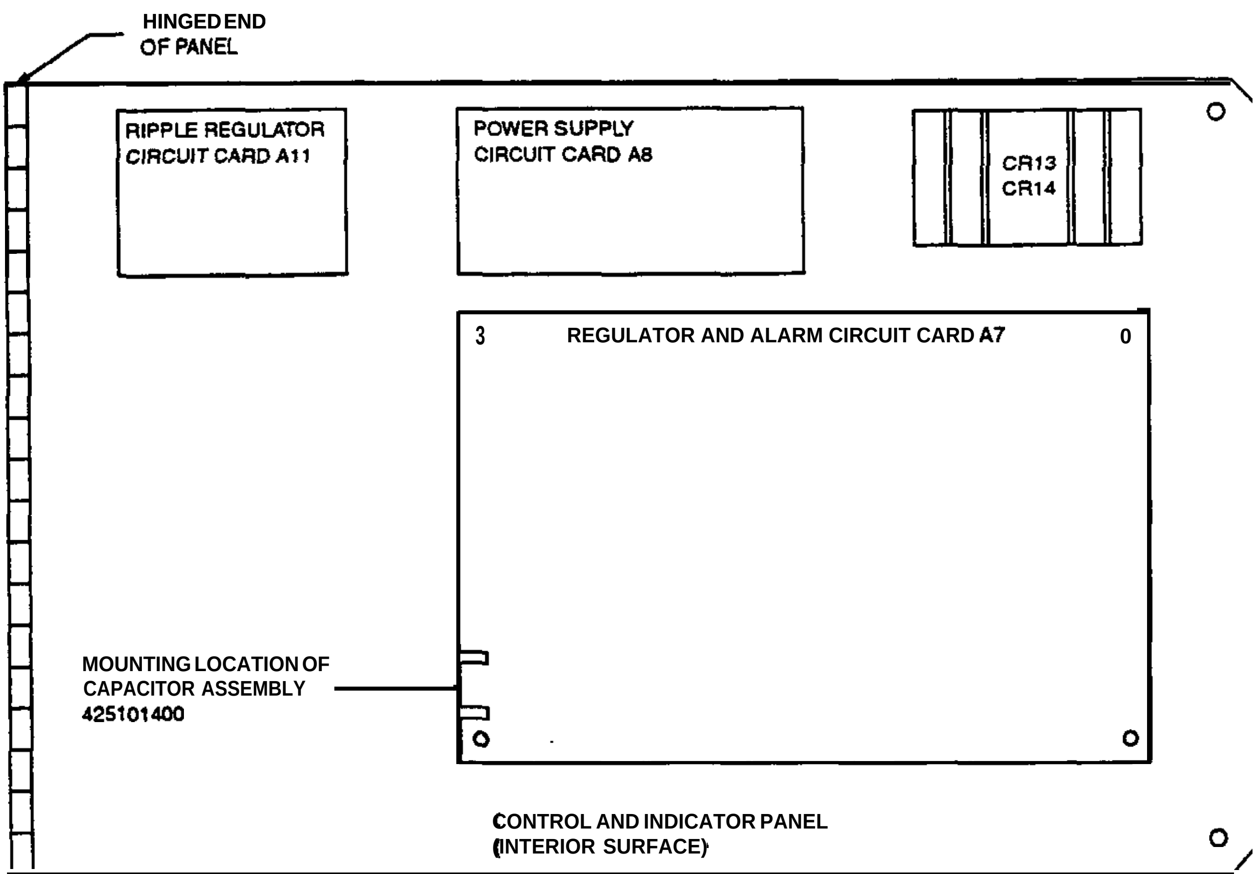


Figure 3-1. Capacitor Assembly Connector Location

Steps a) through c) which follow. then proceed with Step 6).

DANGER

If the rectifier is connected to a battery, voltaye is present at the local and extended reference leads. Exercise care in the following steps that the leads are not accidentally shorted together or allowed to touch cabinet ports or any other electrical terminations.

AC voltage capable Of producing severe, perhaps fatal electrical shock is present at input contactor K2. Exercise caution that w&dental bodily contact with any electrical termination does not occur.

A) Disconnect and temporarily insulate the local reference leads from TB3, terminals 1 and 2.

B) Working with one lead at a time, connect the remote sens- fng leads to TB3, terminal 1 (+) and 2 (-). Insure mat polarity is correct.

C) Remove the temporary insulation from the focal reference leads, and connect these leads to the storage terminals on circuit card A9.

6) If the rectifier is used in charging a battery, remove the M option capacitor assembly from its edge connector on regulator and alarm circuit card A7.

7) Place the POWER switch to the ON position. The rectifier should start and deliver output voltage within the range of 48 to 54 VDC.

8) The float output Voltage of the rectifier should be checked and adjusted to meet load conditions. Unless otherwise specified. the rectifier has been factory adjusted to provide 52.08 VDC during float operation. This is based on a float charge of 2.17 volts per cell for a 24-cell battery. When charging a 23-cell battery, or when a higher or lower voltage per cell is desired, the float output voltage can be changed by adjusting the FLOAT ADJUST potentiometer, accessible through a hole in the front panel of the rectifier. Turn the potentiometer adjustment screw slowly clockwise or counterclockwise as necessary. Voltage should be monitored at the battery while adjusting float output. The rectifier thereby compensates for distribution losses, and the battery remains fully charged.

9) Operate the rectifier FLOAT/EQUALIZE switch to the EQUALIZE position and note the equalize output voltage. Unless otherwise specified, the rectifier has been factory adjusted to provide 54 VDC during equalize charge operation. This is based on an equalize charge of 2.25 volts per cell for a 24-cell battery. When charging a 23-cell battery, or when a higher or lower voltage per cell is desired, the equalize output voltage can be changed by adjusting the EQUALIZE ADJUST potentiometer, accessible through a hole in the front panel of the rectifier. Turn the potentiometer adjustment screw slowly clockwise or counterclockwise as necessary. Voltage should be monitored at the battery while adjusting equalize output, thereby allowing the rectifier to compensate for distribution losses. Return the FLOAT/EQUALIZE switch to the FLOAT position.

10) Check the rectifier current limit circuitry by loading the rectifier to at least 120% of the rated output of the unit. If the existing load is less than rated bad, a resistive test bad may be connected to the DC output terminals of the rectifier. The rectifier should limit is output current at 110% of rated output. If adjustment is required, refer to Paragraph 5.98 of this manual. Remove the test load after check or adjustment.

11) Before placing the rectifier into service, refer to Table 3-1 and note the factory settings of the overvoltage shutdown circuit and the high and low voltage alarm circuit. If these factory settings are acceptable, the rectifier may be placed into service. If readjustment of these circuits is required to meet customer requirements. follow the appropriate adjustment procedure referenced in Table 3-l before placing the rectifier into service.

Adjustment	Factory Setting	Adjustment Procedure Para. No.
Overvoltage Shutdown	55VDC	5.10
High Voltage Alarm	57.6VDC	5.8
Low Voltage Alarm	47.15VDC	5.7

Table 3-1. Shutdown and Alarm Levels

4. OPERATION

Starting and Stopping

4.1 Normal Start and Stop: The rectifier may be started or stopped locally by placing the HVSD and POWER controls to the ON or OFF position. respectively.

4.2 Remote Start and Stop: If remote starting and stopping control is desired, allow the HVSD and POWER controls on the front panel to remain in the ON position. Applying or removing positive battery at terminal 16 of TB3 starts or stops the rectifier, respectively.

4.3 Starting After AC Power Failure: The rectifier restarts automatically following commercial AC power failure if the HVSD and POWER controls are in the ON position and positive battery is applied to TB3 terminal 16 at the time of power restoration.

NOTE

If batte y voltage discharges below 38 volts DC during an extended commercial AC power failure. the rectifier will be unable to restart automatically unless an auxiliary power supply is connected to terminal block TB1 (see Pam 3.211. If an auxiliary power supply is not connected to TB1. refer to Test Procedure 9 in Chapter 7. TROUBLESHOOTING. for a startup procedure in this event.

Controls and Indicators

4.4 The following controls and light emitting diode indicators control the operation and indicate the status of the rectifier. All controls and indicators are located on the rectifier front panel unless otherwise noted.

a) HVSD Circuit Breaker. This circuit breaker operates in conjunction with the POWER switch for starling and stopping the rectifier and normally remains in the ON position. The circuit breaker contains a trip coil which is energized in case of a high output voltage condition, thereby releasing the AC input contactor which removes AC input power.

b) POWER Switch: This rocker switch. located adjacent to the HVSD circuit breaker, is used to start or stop the rectifier by placing it lo the ON or OFF position, respectively.

c) BATTERY DISCONNECT Link S2: The disconnect link inserts into a mating receptacle located at the upper right portion of the rear panel inside the rectifier. Access is gained by opening the meter and control panels. The link serves as a convenient method for connecting or disconnecting the battery lo or from the output circuits of the rectifier.

d) FLOAT/EQUALIZE Switch: When this switch is in the FLOAT position. sufficient voltage is provided to maintain the battery in a fully charged condition while supplying load demands. When this switch is placed in the EQUALIZE position, the rectifier output voltage is increased to equalize the charge of all battery cells. Refer to Para. 4.6.

e) POWER ON Indicator: Illuminates when the AC input voltage is present and the HVSD and POWER controls are placed in the ON position.

f) HIGH VOLTAGE ALARM Indicator: Illuminates when the output voltage increases to a predetermined adjustable high voitage alarm value. The high voltage alarm circuit monitors output voltage continuously: therefore. this alarm is operational even when the rectifier is turned off.

g) LOW VOLTAGE ALARM Indicator: Illuminates when the output voltage decreases to a predetermined adjustable low voltage alarm value. The low voltage alarm circuit monitors output voitage continuously; therefore, this alarm is operational even when the rectifier is turned off.

NOTE

The LOW VOLTAGE ALARM indicator may illuminate during a battery recharge condition if the rectifier operates in the *current limiting mode. and reduces output voltage accordingly. This is normal operation and the alarm will extinguish as the battery voltage increases.*

h) LOW CURRENT ALARM Indicator: Illuminates when the rectifier is operating and supplying less than 0.5% of rated output current or when the rectifier is turned off.

i) FUSE ALARM Indicator: es if one or more fuses F1 through F4 should open.

j) FAN FAILURE ALARM Indicator: Illuminates if cooling fans B1 or B2 should fail.

Metering

4.5 A DC ammeter and a DC voltmeter indicate rectifier output current and voltage, respectively. Since the voltmeter is connected across the reference leads, this meter indicates battery voltage if remote sensing is used.

Float Charging

4.6 This rectifier provides constant output voltage: therefore, output current remains equal to bad current as long as load current does not exceed the current limit setting. This mode of operation is known as float charging. In normal operation. the battery is not required to furnish bad current and remains in a fully charged condition.

NOTE

If *the* current demand by the load exceeds *the current limit* setting. *the battery is required to furnish* the difference and *subsequently begins discharging*

Equalize Charging

4.7 Higher charging voltage is sometimes required to equalize *the charge* of all battery cells, or to recharge the battery as quickly as possible following commercial AC power failure. To obtain thii voltage, operate the FLOAT/EQUALIZE switch to EQUALIZE position. To restore usual float operation, operate the switch to the FLOAT position.

4.9 The equalize function of the rectifier can also be initiated from. a remote location. if desired. (Refer to Power Data Sheet.) When the equalize function is controlled remotely, the FLOAT/EQUALIZE switch on the rectifier is diiled.

WARNING

Do not supply equalize voltage for a longer period than necessary. Prolonged higher charge voltage will overcharge *the battery cells and reduce **battery** life.*

Automatic Rectifier Shutdown

4.9 Occurrence of any of the following conditions results in automatic rectifier shutdown:

a) Operation of any fuse in the rectifier. other than fan fuses F5 and F6

b) Overvoltage condition at rectifier output

If condition a) occurs, indicator FUSE ALARM illuminates but all other operating controls remain in their normal positions. Correction of the failure condition and replacement of the opened fuses allows the rectifier to restart.

If condition b) occurs, the rectifier will restart automatically after twenty seconds. If a second HVSD occurs within a 5 minute period, the rectifier will shut down and trip the HVSD circuit breaker located on the front door. Once the failure has been corrected, placing the circuit breaker toggle to the ON position should restart the rectifier. If the rectifier can operate for a period of 5 minutes without a HVSD the circuit will reset and be ready for the next HVSD event.

4.10 This rectifier contains a circuit which permits selective overvoltage shutdown when two or more rectifiers are operated in parallel. The circuit allows operation of the overvoltage shutdown circuit only in the rectifier which causes the overvoltage condition.

RippleRegulator Circuit

4.11 This rectifier is equipped with a ripple regulator circuit, located on circuit card Al 1, which continuously monitors the ripple current through the rectifier DC output filter capacitors. In the event of a high ripple current *condition* caused by the loss of an AC input phase, the ripple regulator circuit senses the high tipple through the capacitors and provides a signal to the rectifier regulation circuitry which reduces rectifier output voltage and current. This permits the rectifier to continue operating at a reduced capacity until such time as the phase loss is corrected. External alarms are also activated refer to Paragraph 3.14 for details.

Batteryless Operation (M Option)

4.12 If rectifier operation off battery is required. a capacitor assembly, Part No. 425101400. must be installed on circuit card A7 to stabilize rectifier output voltage. See Figure 4-l.

Cooling Fans and Temperature Sensors

4.13 The rectifier is equipped with cooling tans and temperature sensors mounted on heatsink assemblies at me bottom of the cabinet. The cooling fans circulate air across the heatsinks to cool power semiconductors while me temperature sensors monitor heatsink temperature. If air flow ceases or if heatsink temperature reaches +85°C (+185°F), output currant of the rectifier is reduced to approximately 66% of the full load rating, and an external rectifier fail alarm is activated, if connected. In addition. if a cooling fart has failed. a red FAN FAILURE indicator will illuminate. When the temperalure decreases or fans have been repaired, the rectifier returns to full load capability and the external rectifier fail alarm is canceled.

Fuses

4.14 Table 4-1 lists the rating and types for all the fuses used in the rectifier. Fuses should be replaced with the type and size listed, or equivalent. To gain access to all fuses except F5 and F6, open the meter and control panels. Fuses F5 and F6 are accessible after removal of the lower panel at the front of the rectifier.

Desig.	Size (Amps)	Type
F1	1000	Gould-ShawmutA13Z1000-4
F1A	1/4	Bussmann GMT
F2	3	Bussmann GMT
F3. F4	60	Bussmann GMT
F3A, F4A	1/4	Bussmann GMT
F5, F6	5	Bussmann GMT

Table 4-1. Fuse Types and Sizes

Circuit Cards

4.15 Any of the circuit cards listed in Table 4-2 can easily be replaced as individual assemblies if the need arises.

Circuit Card	Description
Al -A6 (433401600)	SCR Firing Circuit Card
A7 (486508700)	Regulator 8 Alarm Card
A8 (486562200)	Power Supply Card
A9 (433852700)	Alarm Interface Assy
Al 1 (486569800)	Ripple Regulator Card
A12, Al3 (433837100)	Fan Failure Alarm
A14.15 (425702200)	LED Alarm Card
Al6 (433800209)	HVSD Resart Circuit

Table 4-2. Replaceable Circuit Cards

5. ADJUSTMENTS

General

5.1 Various adjustment potentiometers are accessible on the control and indicator panel at Regulator and Alarm Circuit A7 and Ripple Regulator Circuit All. These potentiometers are factory adjusted and readjustment is not normally required.

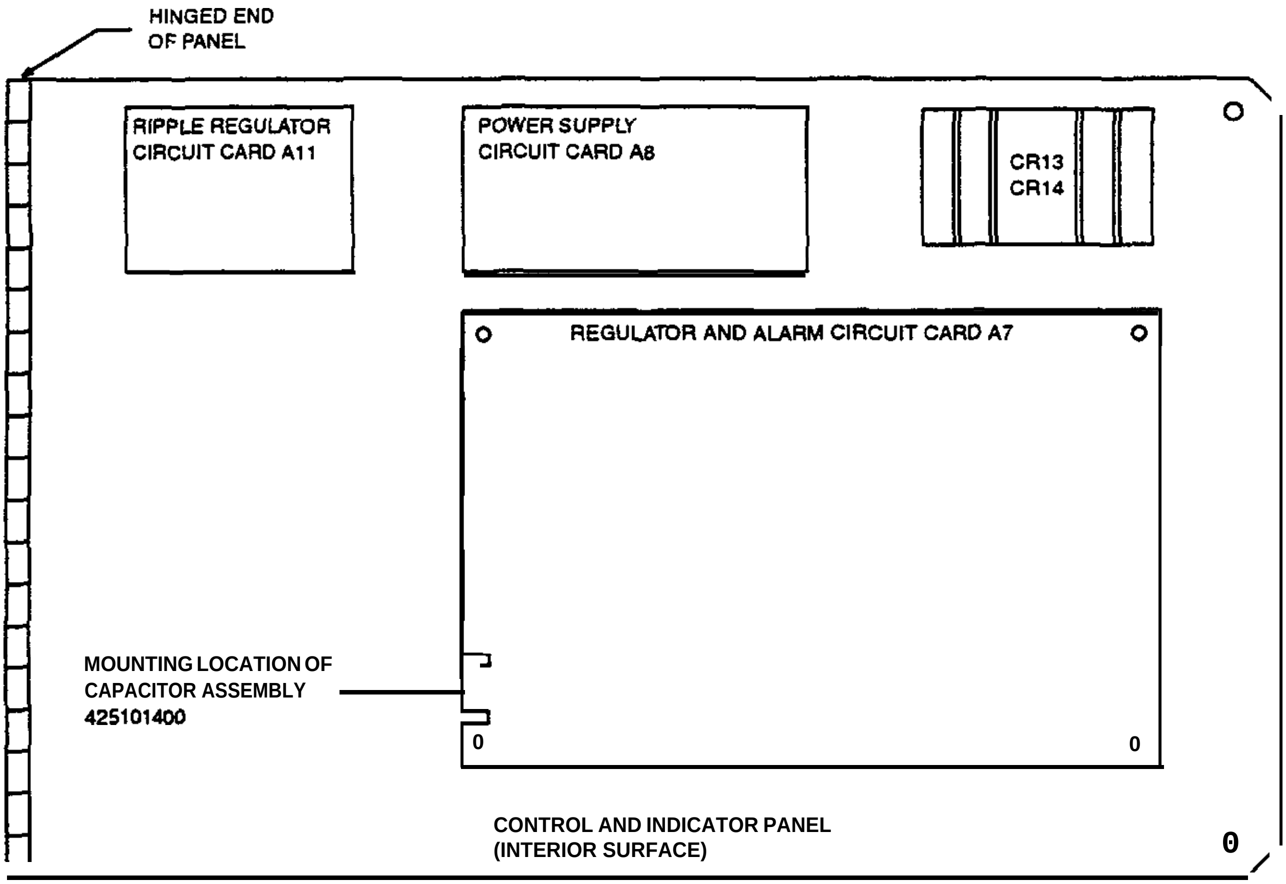


Figure 4-1. Capacitor Assembly Connector Location

WARNING

Adjustment of this rectifier should only be attempted by trained service personnel. Adjusment outside of ranges or beyond limits stated in the Power Data Sheet is not recommended.

Float Voltage Adjustment

5.2 Potentiometer FLOAT ADJUST is accessible through a hole on the front panel of the rectifier. This potentiometer sets the value of the float output voltage. Unless otherwise specified, the float voltage is factory adjusted to 52.08 VDC (24 cells at 2.17V/cell). The potentiometer setting, if changed, should be done in small increments. Before adjustments are made. verify that the battery is fully charged.

a) To obtain float output voltage, place the FLOAT/EQUALIZE switch in the FLOAT position.

b) To increase float voltage, adjust potentiometer FLOAT ADJUST slowly clockwise. To decrease float voltage, adjust potentiometer slowly counterclockwise.

c) When the setting of potentiometer FLOAT ADJUST has been changed, allow battery voltage to stabilize at its new value, then note whether this value is as desired.

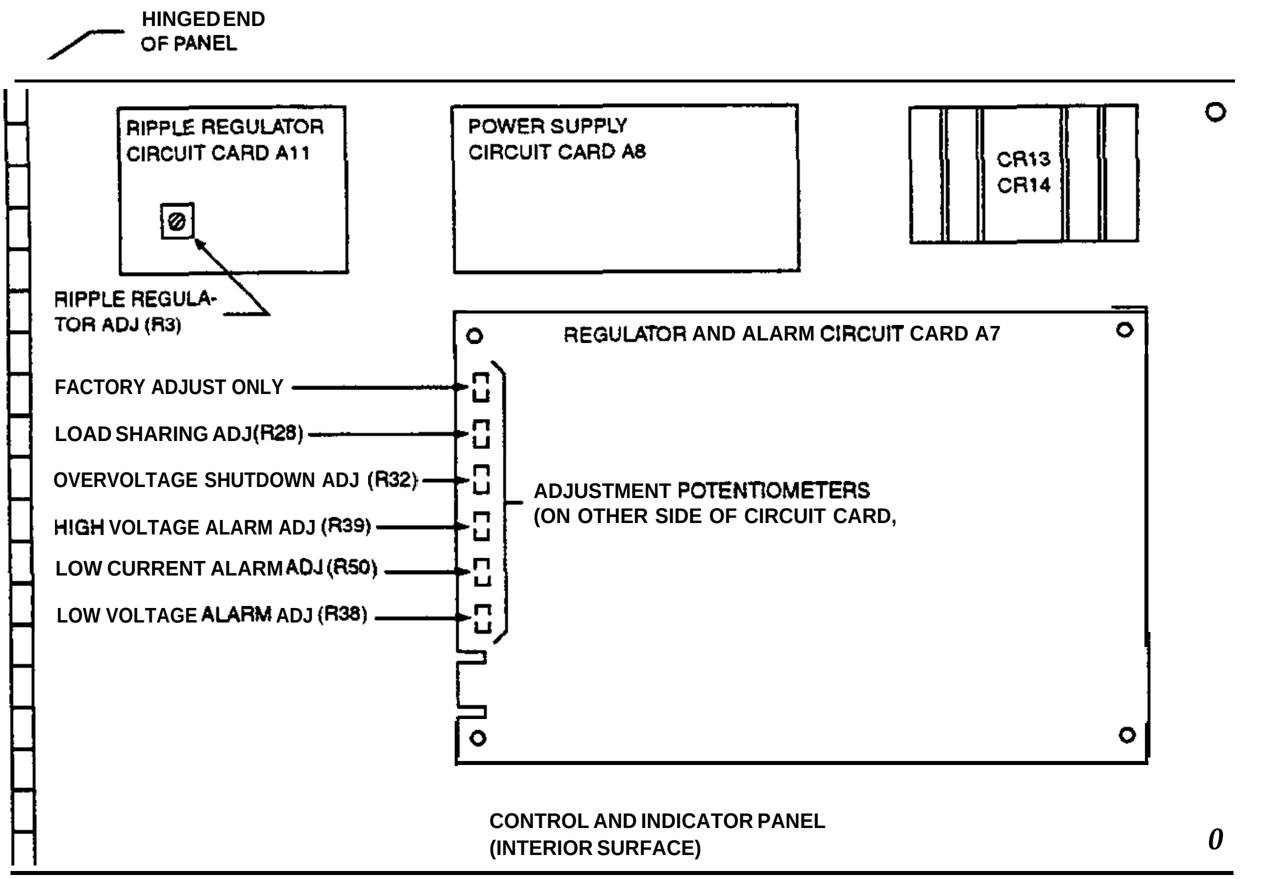


Figure 5-1. Regulator and Alarm Circuit Card Adjustment Potentiometer Locations

d) Repeat Steps b) end c) as necessary to obtain the required float voltage.

NOTE

When the float voltage is adjusted. the equalize voltage will be affected. It is recommended that the equalize voltage be checked. Md if necessary. readjusted.

Equalize Voltage Adjustment

5.3 Potentiometer EQUALIZE ADJUST is accessible through a hole on the front panel of the rectifier. This potentiometer sets the value of the equalize output voltage. Unless otherwise specified, the equalize voltage has bee" factory adjusted to 54 VDC (24 cells at 2.25V/cell). The potentiometer setting, if changed, should be done in small increments.

a) To obtain equalize output voltage. place the FLOAT/EQUALIZE switch in the EQUALIZE position.

b) Allow DC output voltage to stabilize at its new value.

c) To increase equalize voltage, adjust potentiometer EQUALIZE ADJUST clockwise. To decrease, adjust potentiometer counter-clockwise.

d) Repeat steps b) and c) as necessary to obtain desired equalize voltage.

Current Limit Adjustment

5.4 The value at which the current limit circuit prevents further increase of output current is set by potentiometer CURRENT LIMIT ADJUST accessible through a hole on the front panel of the rectifier. Unless otherwise specified. the rectifier is factory adjusted to limit current at 110% of rated load. To change the current limit setting, observe the following procedure:

WARNING

This rectifier is not rated for continuous duty above 110% of rated current. Loads of up to 125% may be tolerated for short periods of time (e.g., when recharging a discharged battery). Prolonged operation over 110% load may overheat the rectifier and cause permanent damage to some components.

a) If the load on the rectifier is not greater than the desired current limit setting. a resistive test load should be used to insure the amount of toad exceeds the desired output current limit setting.

b) To decrease the current limit setting, adjust potentiometer CURRENT LIMIT ADJUST counterclockwise until the output current decreases to the desired limit.

c) To increase the current limit setting, adjust potentiometer CURRENT LIMIT ADJUST clockwise until the output current increases to the desired limit.

Low Voltage Alarm Adjustment

5.5 The low voltage alarm adjustment potentiometer R38, located on Regulator and Alarm circuit card A7. sets the value at which light emitting diode LOW VOLTAGE ALARM illuminates and a" external ala"" is activated, If connected. Unless otherwise specified, the low voltage alarm is factory adjusted for 47.15 VDC. To readjust this limit, observe the following procedure:

a) Turn off the rectifier by operating the POWER switch to the OFF position.

b) Open the meter and control panels by loosening the captive fasteners. Disconnect the rectifier from battery by removing the BATTERY DISCONNECT link.

DANGER

Exercise extreme caution when performing Step c). Hazardous DC voltage is present at the DC output terminals.

c) Connect a" adjustable DC supply capable of supplying 60 volts DC to the positive output terminal (+) and either terminal of fuse F1(-), observing proper polarity.

d) Adjust potentiometer R38 fully counterclockwise. Refer to Figure 5-l for location.

e) Turn on the external DC supply and adjust output voltage to the desired low voltage ala"" value.

NOTE

The *filter* capacitors charge *slowly when* the *external DC supply is turned on. Allow approximately 40* seconds to elapse *before final* supply *adjustment to the desired low voltage alarm value.*

f) Slowly adjust potentiometer R38 clockwise until *light emitting diode* LOW VOLTAGE ALARM on the front panel illuminates.

g) As a check, Increase the output voltage of the external DC supply; light emitting diode LOW VOLTAGE ALARM should extinguish. Slowly decrease the voltage until light emitting diie LOW VOLTAGE ALARM illuminates. Repeat Steps 9 and g), if necessary. until the alarm is activated at the desired voltage.

h) Adjust power supply output voltage to exactly the same value of battery voltage at the rectifier output terminals. These voltages should be measured with a digital multimeter.

i) With power supply output voltage property adjusted. insert the BATTERY DISCONNECT link.

j) Turn off the external DC power supply, then disconnect the test leads.

k) Close the meter and control panels, then start the rectiiisr by placing the POWER switch to the ON position.

High Voltage Alarm Adjustment

6.6 The high voltage alarm adjustment potentiometer R39, located on Regulator and Alarm Circuit card A7, sets the value at which light emitting diode HIGH VOLTAGE ALARM illuminates and an external alarm is activated, if connected. Unless otherwise specified, the high voltage alarm is factory adjusted for 57.6 VDC. To readjust this limit. observe the following procedure:

a) Turn off the rectifier by operating the POWER switch to the OFF position.

b) Open the meter and control panels by loosening the captive fasteners. Disconnect the rectifier from battery by removing the BATTERY DISCONNECT link.

DANGER

***Exercise* extreme caution when performing step *c). Hazardous* DC *voltage* is p-t at the DC output terminals.**

c) Connect an adjustable DC supply capable of supplying 60 volts DC to the positive output terminal (+) and either terminal of fuse F1 (-), observing proper polarity.

d) Adjust potentiometer R39 fully clockwise. Refer to Figure 5-l for location.

e) Turn on the external DC supply and adjust output voltage to the desired high voltage alarm value.

NOTE

The filter capacitors charge slowly when the *external DC* supply is *turned on. Allow approximately* 40 seconds to elapse *before final supply adjust*ment to the desired high voltage *alarm value.*

f) Slowly adjust potentiometer R39 counter-&&wise until light emitting diode HIGH VOLTAGE ALARM on the front panel illuminates.

g) As a check, decrease the output voltage of the external DC supply; light emittmg diode HIGH VOLTAGE ALARM should extinguish. Slowly increase the voltage until light emitting diode HIGH VOLTAGE ALARM illuminates. Repeat Steps f) and g), if necessary, until the alarm is activated at the proper voltage.

h) Adjust power supply output voltage to exactly the same value of battery voltage al the rectifier output terminals. These voltages should be measured with a digital multimeter.

i) With power supply output voltage properly adjusted, insert the BATTERY DISCONNECT link.

j) Turn off the external DC power supply, then disconnect the test leads.

k) Close tie meter and control panels, then start the rectifier by placing the POWER switch to the ON position.

Low Current Alarm Adjustment

5.7 The low current alarm adjustment potentiometer R50, located on Regulator and Alarm Circuit card A7, sets the value at which light emitting diode LOW CURRENT ALARM illuminates and an external low current alarm is activated, if connected. Unless otherwise specified, the low current alarm adjustment is factory set to provide an alarm when rectifier output decreases below 0.5% of rated current. To readjust the low current alarm. observe the following procedure:

DANGER

This *adjustment procedure is performed* with the *rectifier* operating in *a test* mode. *AC voltages capable* of *producing severe, perhaps fatal electrical* shock *are* p-t *at contactor* K2 and in other *portions of the circuit* when the rectifier *is operating. Exercise caution* that accidental contact with *any* electrical *terminationsdoes* not occur.

a) Turn off the rectifier by operating the POWER switch to the OFF position. Open the meter and control panels.

b) If remote sensing is used in the rectifier, disconnect and temporarily insulate the remote sensing leads. These leads are connected at TB3 terminals 1 and 2.

c) Connect the local sensing leads to TB3 terminals 1 (+) and '2 (-). Insure that polarity is correct.

d) Remove the BATTERY DISCONNECT liik to isolate the rectifier from the battery or load.

e) Install the M option capacitor assembly, PartNo. 425101400, on the appropriate edge connector of regulator and alarm circuit card A7. Refer to Figure 4-l for mounting location.

DANGER

Exercise extreme caution when performing Step f). Hazardous DC voltage is present at the DC output terminals.

f) Connect a DC ammeter and a resistive test load in series. Connect the leads of this test circuit to the positive output terminal (+) and either terminal of fuse F1 (-), observing proper polarity.

g) Adjust potentiometer R50 fully counterclockwise. Refer to Figure 5-l for location.

h) Adjust the resistive test load for maximum resistance.

i) Start the rectifier by placing the POWER switch to the ON position. Adjust the test load for an ammeter indication of 4 amperes (0.5% full load). The LOW CURRENT ALARM indicator should be extinguished.

j) Slowly adjust potentiometer R50 clockwise until the LOW CURRENT ALARM indicator illuminates.

k) Adjust the resistive test bad to place slightly more load on the rectifier output. The LOW CURRENT ALARM indicator' should extinguish.

l) Reduce the amount of load to 4 amperes. The indicator should illuminate. If necessary. adjust R50 to obtain the alarm indication at a load of 4 amperes.

m) Place the BATTERY DISCONNECT link into its receptacle, then immediately place the POWER switch to the OFF position.

n) Disconnect the test leads of the external ammeter and resistive load.

o) If the rectifier is normally connected to a battery, remove the M option capacitor assembly from the regulator and alarm circuit card A7.

p) If remote sensing is normally used at the battery or load, disconnect the local sensing leads from TB3 terminals 1 and 2. Connect these leads to the storage terminals on circuit card A9.

q) Connect the remote sensing leads to TB3, terminals 1 (+) and 2 (-). Insure that polarity is correct.

r) Start the rectifier by placing the POWER switch to the ON position. Close the meter and control panels, then note the status of indicators and front panel meters for proper operation.

Overvoltage Shutdown Adjustment

5.8 This adjustment sets the limit at which the rectitier is shutdown if a high voltage condition occurs. This adjustment is made by overvoltage adjustment potentiometer R32 on Regulator and Alarm Circuit card A7. Unless otherwise specified, the overvoltage shutdown adjustment is factory set at 55.0 VDC. To readjust the overvoltage shutdown limit, observe the following procedure:

NOTE

To avoid nuisance shutdowns. choose an overvoltage shutdown value which is a minimum of 2 volts above the float voltage value.

a) Turn the rectifier off by operating the POWER switch to the OFF position.

b) Open the meter and control panels by loosening the captive fasteners. Disconnect the rectifier from battery by removing the BATTERY DISCONNECT link.

DANGER

Exercise extreme caution when performing step c). Hazardous DC voltage is present at the DC output terminals.

c) If remote voltage sensing leads are extended (T Option), disconnect and insulate. Connect internal voltage sensing leads (R Option) to terminals 1 (+) and 2 (-) of TB3.

d) Install M option capacitor assembly AI0 on circuit card A7.

e) Connect the test load to the positive output terminal (+) and either terminal of fuse F1. Adjust potentiometer R32 fully clockwise. Refer to Figure 5-1 for location.

f) Start the rectifier and apply approximately 5% load.

g) Connect a digital multimeter capable of measuring 60 VDC to monitor jacks TP1 and TP2 and note the float and equalize output voltage settings.

h) Adjust the output voltage by means of potentiometer FLOAT ADJUST to the value at which overvoltage shutdown is desired. If the desired output voltage cannot be obtained with the float potentiometer alone, place the FLOAT/EQUALIZE switch in the EQUALIZE position. Continue to increase the output voltage using the EQUALIZE ADJUST potentiometer.

i) Slowly adjust potentiometer R32 counterclockwise until circuit breaker HVSD trips open.

j) As a check, turn the FLOAT and/or the EQUALIZE ADJUST potentiometer down. Reset HVSD circuit breaker to the ON position. Slowly increase the output voltage until the circuit breaker trips at the proper voltage. Repeat, if necesssary, until the proper shutdown voltage value is attained.

k) Adjust the FLOAT and EQUALIZE ADJUST potentiometers for rectifier output voltage lower Man the shutdown level. Start the rectifier and adjust float and equalize output voltages to the values noted in Step g).

l) While the rectifier is operating, place the BATTERY DISCONNECT link into its receptacle. Immediately place the power switch to the OFF position.

m) Disconnect the test load and multimeter leads. If the rectifier is normally connected to a battery remove the M option capacitor assembly from circuit card A7.

n) If remote sensing is normally used at the battery or load. disconnect the local sensing leads from TB3 terminals 1 and 2. Connect these leads to the storage terminals on circuit card A9.

o) Connect the remote sensing leads to TB3, terminals 1 (+) and 2 (-). Insure that polarity is correct.

P) Start the rectifier by placing the POWER switch to tie ON position. Close the meter and control panels. then note the status of indicators and front panel meters for proper operation.

Load Sharing Adjustment

5.9 This rectifier is equipped with a load sharing circuit which allows the rectifier to share the load proportionately with other rectifiers that can be adjusted to the same output voltage, and are equipped with negative-bus load sharing circuits. For proper load sharing, it is essential that each rectifier be adjusted to the same output voltage, using the following procedure:

a) Temporarily open the rectifier load sharing leads of all paralleled rectifiers and turn off all but one rectifier.

CAUTION

If the load demand exceeds the rating of a single rectifier, the remaining load power is supplied by the batteries, causing battery discharge.

b) With the other paralleled rectifier(s) turned off. insure that the one rectifier still operating is adjusted to the required output voltage at 100% rated load.

c) Check the load sharing voltage across TB3 terminals 2 (-) and 3 (+) to determine if it is 6 VDC. If not. adjust Potentiometer R28 on circuit card A7 to obtain 8 VDC. Refer to Figure 5-l for location.

d) Start the second rectifier to be adjusted, turn off Me first rectifier, and repeat Steps b) and

c) for the second rectifier. Repeat this procedure for each paralleled rectifier, one at a time, until all the rectifiers are adjusted for the same output voltage at 100% load and the toad sharing voltage is 8 VDC.

e) Close the load sharing lead between ail paralleled rectifiers, then restart the rectifiers. The toad should now be shared proportionally by the rectifiers.

Ripple Regulator Adjustment

5.10 This adjustment potentiometer is located on circuit card *Al 1 which* monitors the amount of ripple current through the DC output filter capacitors. This adjustment determines the amount of ripple current required to reduce rectifier output voltage. The ripple regulator is factory adjusted to start limiting rectifier output voltage when ripple current through the DC fitter capacitors reaches 55 amperes. Customer adjustment of this circuit under normal operating condiiins is not recommended. The only time this adjustment should be made by the customer is when a replacement Af 1 circuit card has bean installed in the rectifier. Circuit card All is located on the inner surface of the control and indicator panel, as shown in Figure 5-l. lb adjust the ripple regulator circuit card. observe the following procedure:

DANGER

Voltage capable of producing severe, perhaps fatal, electrical shock are present within the rectifier. Insure that the external AC disconnect device is opened before performing this procedure; otherwise, hazardous voltages will be encountered in Steps i) and n).

a) Turn off the rectifier by operating the AC INPUT switch to the OFF position. and disconnect battery or load from the output tarminals. *If remote voltage sensing leads are* extended, (T Option) disconnect and insulate. Connect internal voltage sensing leads (R Option) to terminals 1(+) and 2(-) of TB3.

b) Install M Option capacitor assembly A10 on circuit card RAC-A7.

c) Connect a test load to the DC output terminals.

d) Remove DC filter capacitor alarm fuse F3A and DC filter capacitor fuse F3 from their respective fuseholders.

e) Connect a clamp on type AC ammeter capable of measuring around the lead to the fuse socket of DC filter capacitor fuse F3.

f) Disconnect the AC input at the external distribution point and disconnect any one AC input phase to the rectifier at terminal block TB1 Temporarily insulate the disconnected wire.

g) Close the external AC input disconnect device and restart the rectifier by operating the AC INPUT switch to the ON position.

h) Apply 55 amperes of load at the rectifier output terminals. Adjust potentiometer R3 on circuit card RR-Al 1 until the output voltage starts to decrease. Increase the load current at the rectifier output terminals and verify that the output voltage decreases as the output currant increases.

i) The adjustment procedure is now complete. Turn the rectifier off and open the external AC input distribution device. Reconnect the AC input phase removed in Step e), remove the ammeter, and replace fuses F3 and F3A in that order. Reconnect the load at output terminal block TB2, extend the remote voltage sensing leads, if desired, and return the rectifier to service.

6. CIRCUIT DESCRIPTION

General

6.1 This rectifier provides isolated. filtered and regulated DC power from a three-phase AC source for powering a load while charging batteries.

62 The description of the circuit is presented by functional blocks. Refer to Figure 6-l for a rectifier block diagram.

AC Input Circuit

6.3 Commecial 208/240, 60 Hz, three phase AC power is applied through contactor K2 connected to the primary of power transformer Tl.

Power Supply Assembly PSA-AS

6.4 This power supply assembly provides the +12 and -12 VDC required to power the Regulator and Alarm Circuit Card A7. An additional DC output of this assembly provides an input to the current walk-in circuit.

6.6 The +12 VDC output of this assembly is derived from AC voltage at the secondary winding of power transformer Tl The AC voltage is applied to the power supply circuit through resistors R7, R9, and RIO. The AC input is rectified by diodes A8-CR1 and A8-CR2 and a portion of the resultant DC is applied to the current walk-in circuit of the Regulator and Alarm Circuit A7. The remainder of the DC is passed through diode A8-CR3 to the zener regulator. Zener diode CR13, in conjunction with fifter capacitor A8-C2, provides a regulated +12 VDC output which is applied to the Regulator and Alarm Circuit A7.

6.6 The -12 VDC output of this assembly is derived fmm negative battery voltage, applied to the power supply through resistor R12. Zener diode CR14. in conjunction with filter capacitor A8-C1, produces the regulated -12 VDC output which is applied to the Regulator and Ahrm Circuit A7.

Power Circuit

6.7 The six phase star-connected secondary of power transformer T1 feeds a six phase rectifier. Basically, the rectifier circuits consist of six power diodes and six thyristors. Each of the six rectifier circuits are identical: therefore. one is described as typical. The conduction of the thyristor is controlled by a pulse circuit on A7 which will be explained later. When the thyrfstor is not conducting, the output of the power transformer is supplied through the power diode only. When higher output voltage is required, a pulse tires the thyristor causing it to conduct. When the thyrfstor conducts. an additional winding of the power transformer is inserted into the circuit thus increasing output voltage. The amount of output voltage added is dependent upon the time the thyrfstor was fired. in relation to the phase of the AC input voltage. The outputs of the rectifier circuits are applied to an interphase transformer. which balances the outputs of the rectifier circuits before applying the resultant output to the filter circuit. A resistor and capacitor network across the thyristors and the power diodes reduces conducted RF interference. The DC output of the rectifier which contains appreciable amount of ripple is passed through an LC type filter which reduces the ripple to a minimum. The resulting filtered DC output power is connected through the output fuse and battery disconnect device to the output terminals.

Voltage and Current Regulation Circuitry

6.6 During normal rectifier operation, the voftage and current regulation functions of the rectifier are controlled by circuitry on Regulator and Alarm Circuit A7. During a high output ripple condition caused by the loss of an AC input phase, the regulation of rectifier output voltage and current is partially controlled by the Ripple Regulator Circuit Card Al 1.

Circuit card A7 utilizes integrated circuitry to perform the phase control regulation function. The regulation and phase control circuit monitors the output of the rectifier and ultimateiy produces a pulse which gates the thyristors in the power circuit. Depending upon the output voltage, the gate pulse is either advanced or delayed in relation to the phase of the AC input voltage to control the rectifier output. If the thyristor is gated early in the AC cycle, me output voltage increases. If the thyristor is gated later in the AC cycle, the output voltage decreases.

6.9 A current limiting circuit senses rectifier output current and provides a signal to the regulator circuit which limits output current to a preset, safe value. The regulation function is performed by three separate but interacting circuits. These circuits are me voftage reference and error detection circuit. the current sensing and current regulation circuit, and the pulse generation and phase control circuit.

Voltage Reference and Error Detection

6.10 This circuit compares the output of the rectifier with a fixed voftage and provides an error signal which represents the magnitude and direction of any difference. The negative sense voltage is applied to a resistance network consisting of resistors R8 and R10, EQUALIZE and FLOAT ADJUST potentiometers R11 and R12 respectively, resistors R13 and R74, and range potentiometer R18. Potentiometer R18 is connected to the cathode of zener reference diode CR3. The anode of CR3 is connected to common (0). Therefore, the voltage at the junction of diode CR3 and potentiometer R16 is more positive than me positive sensing lead. The resistors in ma resistor network mentioned above are proportioned such that the slider of potentiometer R12 is at ground potential when me voltage on the sensing leads is at the correct regulated value. If the rectifier output voltage is too high, the voltage at the slider of potentiometer R12 becomes negative with respect to common, causing the output of amplifier Al7 to go positive. If the rectifier output voltage is too low, the voltage at the slider of potentiometer RI 2 becomes positive with respect to common. causing the output of amplifier A17 to go negative. Diode CR1 at the output of amplifier At7 is used in conjunction with diode CR4 of the current sense *circuit* to *provide* isolation of control between the voltage and current regulating circuits. The current sensing and current regulation circuit is connected into the regulation circuit at the cathode of CR1. At this point, the voltage and current regulator circuits are connected in an OR type configuration. Whichever regulator output is more positive controls the pulse and phase control circuits. The output of this OR circuit is connected to an inverting voltage follower A18, which generates a second error signal equal in magnitude but of opposite polarity to the signal generated by A17. The positive and negative error signals thus generated by Al7 and Al8 are *applied* to the pulse generation circuits where the error signal inputs are used to generate the thyristor gate pulses.

Current Sensing and Current Regulation

6.11 This circuit senses the output current of the rectifier and changes the operation of the rectifier fmm voltage regulation to current regulation when the output current reaches a predetermined value. The positive output of the rectifier is passed through 50 millivolt meter shunt R25. The voltage drop across me shunt deflects the output ammeter and also provides a control signal proportional to the output current. This control signal is applied to the input of shunt amplifier A6 through resistors R21 and R26. Shunt amplifier A6 provides an output voftage to both the bw current alarm and toad sharing circuit as well as the current regulator circuit which limits and *regulates rectifier* output. The current limit setting of the rectifier is determined by a series string of resistors *connected* at the output of shunt amplifier A6. These *resistors include* CURRENT LIMIT potentiometer R23 and resistors R17, R19, and R64.

6.12 Resistor R17 is associated with the temperature sensing and fan fail circuitry. Resistor R17 is normally shorted out by closed contacts of relay K3 which are connected at J4 pins 11 and 12. When the temperature of the rectifier heat sinks exceeds +85°C (+185°F) or if air flow through the cabinet ceases, resistor R17 is inserted into the circuit to decrease the rectifier output current, Refer to the description of the temperature sensing circuit for details.

6.13 Resistor R64 is connected to the cathode of *zener* diode CR3. When the rectifier is supplying less current than the current limit setting of potentiometer *R23, the current limit circuit* performs no regulation function. When output current exceeds the level set by potentiometer R23, the voltage at the junction of potentiometer R23 and resistor Al5 (34) causes amplifier A5 to generate an error signal. The current limit error signal output of currant control amplifier A5 is coupled to the voltage control circuit through CR4. This signal causes the rectifier to operate in the current regulation mode.

Pulse Generation and Phase Control Circuits

6.14 This circuit card contains three identical pulse circuits, one for each AC phase. Each pulse circuit generates the firing pulse used to gate two thyristors in each phase. The pulse circuits control *the phaseback angle* of the thyristors in response to a signal from the voftage regulator described previously. The firing circuit for each thyristor consists of a driver transistor which is controlled by two comparators. a reference comparator and a synchronizing comparator. The reference comparator receives an error signal from the regulator circuit which is compared to an integrated sine wave derived from the power transformer Tl secondary winding. The reference comparator *utilizes* this information to determine when to turn on the driver transistor. The synchronizing comparator provides damping action to prevent firing of the thyristor when the thyristor is reverse bled.

6.16 The control of phaseback *angle* is based on a comparison of a cosine reference voltage, which leads the line by 90". against a signal from the voltage regulator circuit. Since the circuit card contains three identical phase control circuits. the operation of the one may be taken as typiil. The *cosine voltage* is generated by an active integrator consisting of an operational amplifier A4. resistors A9 (6-9). At0 (6-9), and capacitor C11. Resistors A9 (5-10) and Al0 (5-10) and capacitor Cl4 balance the input to amplifier A4. The cosine voftage at the output of A4 is applied to the inputs of two comparators of A3. Since the voltages on the power thyristors are 180" out of phase. it follows that their corresponding firing pulses must be 180° out of phase. To develop two signals with the same phaseback angle but 160' out of phase with each other, the cosine voltage is applied to the *non-inverting input* of one comparator of A3, and to the inverting input of the second comparator of A3. At this point, *the* positive and *negative* error signals generated by the regulator circuit are applied to the pulse generation cinuit. These error signals are equal in

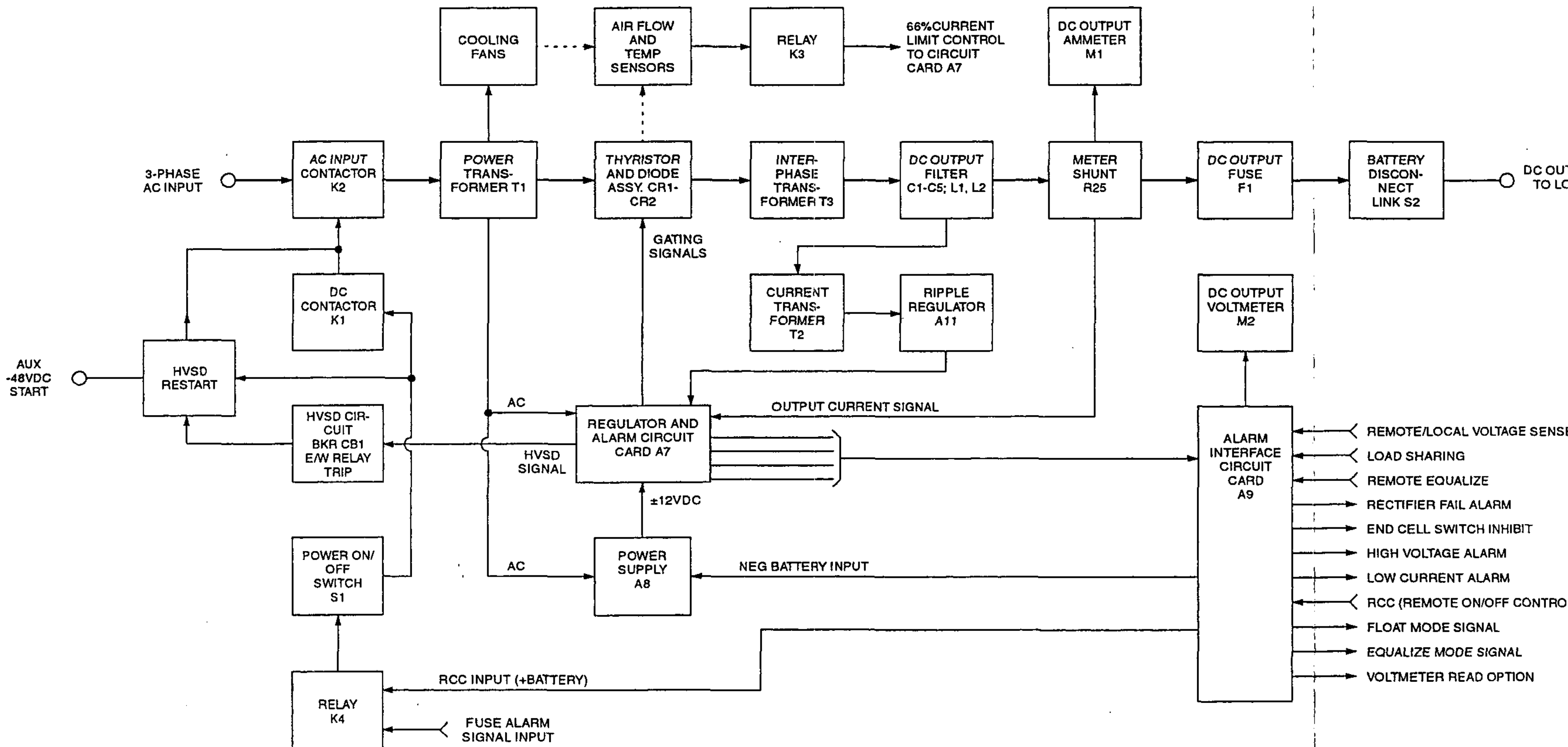


Figure 6-1. Rectifier Block Diagram

magnitude but opposite in polarity. The cosine voltage applied to the non-inverting input of comparator A3 at pin 5 is compared to the positive error signal applied to the comparator at pin 4. When the cosine voftage at pin 5 becomes more positive than the reference signal at pin 4. the output signal of the comparator at pin 2 unclamps the base of driver transistor A8, causing transistor conduction and generation of a firing pulse which is applied to the respective thyristor. At the same time. the positive going cosine voltage applied to comparator A3 at inverting input 6 is compared to the negative error signal applied to the comparator non-inverting input 7. With the non-inverting input more positive during the entire half cycle. the output of the comparator at pin 1 remains clamped to its negative power supply voltage which is sufficient to bias its respective driver transistor A6 off. During the negative half cycle. the first driver transistor is cut off and the second driver transistor conducts, generating a firing pulse which is applied to its respective thyristor.

6.16 The synchronizing comparators of A3 receive a signal from a secondary winding of power transformer T1 This signal is voftage divided by resistors A12 (4-13) and Al6 (3-4) and applied to the synchronizing comparators where the signal is referenced to common. The sampled voftage is applied to the inputs of the synchronizing comparators which function as open collector type comparators. The comparator inputs are paralleled but opposite in polarity. The opposite polarity is achieved by applying the sampled voftage to the non-inverting input of the first comparator at pin 9 and applying the sampled voltage to the inverting input of the second comparator at pin 10. During a positive haff cycle. the output of one comparator is damped to the negative supply and the output of the second comparator is allowed to float. The two comparator outputs are applied to the base of their respective driver transistor A8. In this way, the comparators are used to clamp the base of the respective driver transistor to assure no firing pulses are applied to the thyristors when the thyristors are reverse biased. Transistor Q2, zener diode CR19, diodes CR6 and CR7 and associated components are used in single phase rectifiers only, and have no function in this application.

Current Walk-in Circuit

6.17 A current walk-in circuit on Regulator and Alarm circuit card A7 prevents the rapid application of initial load. A timer circuit provides an approximate 8 second delay from the time the rectifier is started until full rated output current is available to the load. The current walk-in feature of the rectifier is achieved by suppressing the current regulator reference voltage and allowing it to increase at a fixed rate. When the rectifier is turned off, the walk-in circuit is reset to time 0. The walk-in circuit consists of amplifiers A4 and A5 and associated components. Amplifier A5 transistor Q9, zener diode CR21 and associated components form a walk-in reset circuit which assures that the walk-in circuit resets to zero in the event of momentary AC power failures.

6.16 When the rectifier is started. a positive DC output from Power Supply A0 is applied to the cathode of zener diode CR21. This voltage causes transistor Q9 to conduct. Conduction of transistor Q9 provides 0 volts to the inverting input of amplifier A5 (1, 2, 3) which produces a positive output. This positive voltage is applied to voltage follower A5 (12, 13. 14). The voltage follower charges capacitor C6 which is connected to the input of a second voltage follower A4, the output of which follows the capacitor voltage directly. This voltage is diode coupled through CR14 to the current limiting voltage divider circuit to limit the output current. The output current gradually increases as capacitor C6 charges. Once capacitor C6 charges to a level higher than the reference voltage, it is decoupled by diode CR14. The time required to charge capacitor C6 to the reference voltage will be the same as the time required for the walk-in.

6.19 When the rectifier is turned off or the commercial AC input fails momentarily, the positive DC input from Power Supply A8 is removed from CR21. This biases transistor Q9 into cutoff: subsequently, amplifier A5 (1. 2.3) produces a 0 volt output which is applied to voltage follower A5 (12, 13, 14). When the 0 volt signal is applied, the output of the voltage follower seeks common to balance its input. In so doing, capacitor C6 is discharged through diode CR2 into the amplifier, resetting the walk-m circuit.

Negative Load Sharing Circuit

6.20 As mentioned in the current sensing and current regulation description previously given, shunt amplifier A6 provides a voltage which is dependent on rectifier output current. This voltage is applied to amplifier A7 at non-inverting input pin 10. Amplifier A7, transistor Cl, resistors R9, R20, R77, R29 and load sharing adjust potentiometer R28 comprise the load sharing circuit. A negative load sharing lead at J2 pin 16 of the circuit card is connected at the junction of resistors R9 and R20. This load sharing lead is connected to the similar load sharing lead on the other paralleled rectifiers. The output of amplifier A7 at pin 8 causes transistor Cl to conduct. Conduction of Q1 inserts resistor R29 and load sharing adjustment potentiometer R28 into a voltage divider circuit which also includes resistors R20 and R9. This voltage divider is connected across negative rectifier output and common. As mentioned previously, the load sharing lead is connected at the junction of resistors R9 and R20. If a paralleled rectifier is supplying more or less than its proportional share of the load, the voltage at the load sharing terminal, and thus the voltage across resistor R9, is decreased or increased. This change in voltage across R9 is applied to the voltage regulator circuit at the junction of resistors R8 and R10. By altering the voltage in the voltage regulator circuit. the rectifier output voltage is increased or decreased which increases or decreases rectifier output current.

Alarm Circuits

6.21 The Regulator and Alarm Circuit card A7 contains the following alarm circuits: low current alarm. high and low voftage alarm, and an overvoltage shutdown alarm. The operation of each is described as follows.

622 Low Current Alarm: As mentioned previously in the current sensing and current regulation description. shunt amplifier A6 provides a voltage dependent on rectifier output current. This voltage is applied to amplifier A5 at non-inverting input pin 10. The inverting input at pin 9 is connected to the slider of the low current alarm adjustment potentiometer R50 through resistor R51. Potentiometer R50 and resistor R51 provide an offset adjustment for amplifier A5 which compensates for circuit variations. The output of the amplifier at pin 8 is proportional to rectifier output current and is applied to the inverting input of amplifier A7 at pin 6. The non-inverting input to amplifier A7 at pin 5 is connected to a reference voltage circuit consisting of resistors A13 (8-9), AI3 (6-11) and R81. When the rectifier output current decreases below the low current alarm value, the voltage at pin 6 of amplifier A7 crosses the reference. voltage at pin 5 of the amplifier. When this happens, a negative oufpuf signal from amplifier A7 at pin 7 is applied to the base of transistor Q6 Mmugh resistor R48. This signal drives transistor Q6 into conduction. supplying common to the anode of LOW CURRENT ALARM LED3 which then illuminates. Positive voltage is also applied to the base of transistor Q7 through resistor AI4 (5-6). This voltage drives Q7 to conduction, thereby applying negative voltage to the base of transistor Q8 which is biased into cutoff. When Q8 is cut off, the coil of alarm relay K1 is deenergized, causing K1 to release. Contacts of relay K1 are used to actuate external alarms, if connected. During normal operation with rectifier output current within limits, the base of Q8 is connected to common thmugh resistor R43. This causes Q8 to conduct, providing negative voltage to relay K1 which energizes the coil.

6.23 High and Low Voltage Alarm: Since the operation of the high and low voltage alarms is similar, the operation of the high voltage alarm circuit described below may be taken as typical. This circuit compares the rectifier output voltage with a constant reference voltage developed on the circuit card. A sense voltage from the negative rectifier output is applied to a voltage divider consisting of resistors R36, R40 and potentiometer R39. Adjustment of potentiometer R39 determines the value at which a high voltage alarm is given. The voltage at the junction of resistors R36 and R40 is applied to amplifier A7 at non-inverting input pin 12. This signal is compared to a constant reference voltage applied to the amplifier at inverting input pin 13. When rectifier output voltage exceeds the setting of potentiometer R39, a negative signal from the amplifier at pin 14 is applied to the base of transistor Q4 through resistor R42. This signal drives transistor Q4 into conduction. supplying common to the anode of HIGH VOLTAGE ALARM LED1 which then illuminates. Positive voltage is also applied to the base of transistor 010 through resistor AI4 (I-2) and jumpered pins 2A to 6A of J5. This voitage drives Q10 into conduction. supplying negatiii voltage to the base of transistor Q11 which *is* biased into cutoff. When Q11 is cut off, the coil of alarm relay K1 on Alarm Interface Assembly A9 is deenergized causing relay A9-K1 to release. Contacts of relay A9-K1 provide open and closed circuits at TB3 for actuation of external rectifier failure alarms, if connected.

624 Overvoltage Shutdown: This circuit monitors the rectifier output voltage and initiates shutdown if the output voltage exceeds a preset adjustable value. A voltage divider consisting of resistors R85, R33, R31 and potentiometer R32 is connected between the rectifier negative output and common. The setting of potentiometer R32 determines the voltage value at which the rectifier is shutdown. The base of transistor Q3 is connected at the function of resistors R31 and R33 through zener diode CR5. When the rectifier output voltage exceeds the preset high voltage limit, transistor Q3 conducts, which provides a gate signal to thyristor CR13 through diode CR17. Thyristor CR13 conducts which energizes the trip coil in HVSD circuit breaker CB1. When the circuit breaker opens, contactor K2 deenergizes which opens the AC input contacts.

Ripple Regulator Circuit Card All

625 This circuit card continuously monitors the ripple currant through the **rectifier** DC output **filter capacitors.** During **normal** rectifier operation, the **ripple current** is **within** the adjustable **limits** set by the tipple regulator circuit card and no output signal is provided. However. if one AC input phase is lost or another failure occurs **which** results in a high output ripple condition exceeding the **ripple** currant setting of circuit card Al **1**, the ripple regulator provides a positive output signal. This signal is applied to the regulation **circuitry** of Regulator and **Alarm** circuit card A7 causing a subsequent reduction in **rectifier** output voltage. The ripple regulator reduces **rectifier** output voltage until the ripple current through the fitter capacitor is reduced to normal limits.

6.26 Current transformer **T2** senses the ripple current through the DC filter **capacitor** and applies a voltage to Ripple Regulator circuit card Al 1 at **pins** 1 and 2. This input is **rectified** by diodes CR1 through CR4 and filtered by resistor **R2** and capacitor Cl. The **resulting** voltage is applied **through** resistor R5 to the **non-inverting** input of comparator Al The variable input at the non-inverting input of Al is compared to a reference voltage applied at the inverting **input** of Al. The **reference voltage** is derived from potentiometer R3 and resistor **R4**, and is adjustable depending upon the setting of potentiometer **R3.** This reference input determines the value of ripple current at **which** the tipple **regulator circuit** provides a signal to the regulation **circuitry** on circuit card A7. When the ripple currant through the **capacitor** exceeds the ripple current **setting** of potentiometer **R3**, comparator **A1** provides a positive output signal through diode CR5 to the regulator and alarm **circuit.**

627 This **positive** signal is applied to **the** inverting input of voltage follower A18 on circuit card A7 which generates a negative error **signal of equal amplitude** but opposite **polarity.** The resulting positive and negative error signals are then applied to the **pulse** generation circuitry **previously** described.

Fuse Alarm **Circuit**

6.26 The **fuse alarm** circuit initiates rectifier shutdown and provides visual indication of an open fuse **if** any fuse **in** the rectifier, **with the** exception **of** fan fuses F5 and **F6**, opens. The DC output and **filter** fuses are connected to associated **alarm** fuses **F1A**, **F3A**, and **F4A.** An **alarm** type fuse, **F2**, protects the negative battery input **circuits** used for control purposes. If any of these fuses open. the alarm contact of the fuse connects **negative** battery to the coil of K4 and the cathode of the FUSE ALARM light emitting diode. The LED illuminates and contacts of **K4** open which **deenergizes K1** and **K2.** When **K2** releases, its contacts open which interrupt AC input power to the rectifier. This automatic shutdown activates external rectifier **failure** alarms, if connected.

Temperature Sensina Circuit

6.29 This rectifier is equipped with cooling fans and tan failure and temperature sensors. The tan tail sensors **are** located on **circuit** cards Al2 and Al3 which **are** mounted beneath each **heatsink** fan while the temperature sensors S3 and S4 are mounted at the approximate canter of the heat sinks. The fan fail circuits **continuously monitor** the presence of air flow across the heat sinks while temperature sensors S3 and **S4** continuously monitor the temperature **of** the heat sinks. **If** the air **flow** ceases, relay **K5** releases and. in addition, illuminates indicator FAN FAILURE. If the air flow ceases or **the** temperature of the heat sink reaches **+85°C (+185°F)**, relay K3 opens a sat of contacts which reduce rectifier output current to 88% of full rated load and activate an external rectifier fail alarm. **if** connected.

6.30 Fan fail **circuit** cards A12 and Al3 and temperature sensors S3 and S4 are connected in series **with** the coil of relay K3. In addition. fan fail circuit cards A12 and Al3 are connected in series with the coil of relay **K5.** During normal operation. the temperature sensors and fan fall monitors are closed which energizes the coil of K3. Contacts of relay K3. energized. provide closed circuits between **J4** pins 11 to 12 and J2 pin 14 to **J5** pin 11 of circuit **card** A7. The closed circuit across J4 pins 11 to 12 bypasses resistor **A7-R17** in the current limiting voltage divider **circuit**, while the **closed** circuit across **J2**-14 to **J5-11** supplies **voltage** to hold **rectifier** fail relay **K1** on **alarm** interface assembly A9 energized. This inhibits the external **rectifier** tail alarms. With resistor **A7-R17** bypassed in the **voltage** divider. the current limiting circuit is adjusted by potentiometer **A7-R23** to provide full rated output currant. During a fan failure **condition**, relay K5 releases and, through normally closed contacts, causes indicator FAN FAILURE to illuminate. **During** a fan failure or **overtemperature** condition. **relay** K3 is **deenergized**, removing the bypass across resistor **A7**-R17 in the current **limit circuit** and opening the coil circuit of relay **K1** on **A9.** Addition of resistor **A7-R17** into **the** current **limit voltage divider** alters the voltage in the divider which results in reducing the current **limit** setting of potentiometer **A7-R23.** Insertion of resistor **A7-R17** results in limiting **output** current at approximately 66% of full load. This prevents damage from **overheating** the rectifier during a fan failure. Opening the coil path **of** relay K1 on A9 causes the relay to release, activating an external rectifier fail alarm circuit, if connected.

7. TROUBLESHOOTING

General

7.1 Before attempting to troubleshoot this rectifier, it must be determined that a failure has occurred in the rectifier. Since various rectifier alarms sense battery voltage. an incorrect battery voltage could reflect back to the rectifier as an alarm condition. Erroneous alarm conditions due to incorrect battery voltage may be caused by interconnection with other equipment. Some examples of interconnecting equipment which could cause incorrect battery voltage are given below. Eliminate any interconnected equipment as a trouble cause before proceeding.

a) When used in a power system, certain failures in DC-DC Converters and/or DC-AC Inverters may affect battery voltage and subsequently cause alarm indicators on the rectifier to illuminate.

b) When used with other parallel connected rectifiers, a failure in one rectifier may cause alarm indicators on other rectifiers to illuminate.

7 2 Once trouble has been isolated to the rectifier, various visual and operational checks should be made to eliminate obvious failure causes.

DANGER

Voltages capable of producing severe, perhaps fatal, electrical shack are present throughout all portions of the rectifier cabinet. Disconnect AC and DC sources before performing any troubleshooting procedures.

Fault Isolation Chart Use

7.3 The fault isolation chart included in these instructiis is designed to aid service personnel in locating possible failures in the rectifiers. The chart is in the form of a flow diagram containing interrogatory and directive statements in diamond-shaped and rectangular geometric figures. respectively. A yes or no response sufficiently answers each inquiry. and the servicing technician should follow the respective YES or NO line of flow to the next inquiry or directive statement. The directive statements require that the technician perform an adjustment or test to verify certain operational condiitions. If the line of flow terminates in a block entitled POSSIBLE CAUSES, the servicing technician should check each cause listed and take appropriate corrective action if a faulty component or assembly is located.

Testing Precautions

DANGER

Do not connect grounded test equipment to any energized component: otherwise. damage to the rectifier can result. At the same time, a personnel shock hazard exists since the chassis and case of ungrounded test equipment is energized to the same voltage level as the circuit or component under test. Servicing personnel must exercise caution that simultaneous contact is not made with the test equipment chassis or case and some grounded object when the test equipment is connected to the rectifier while it is operating.

Repair and Replacement Information

WARNING

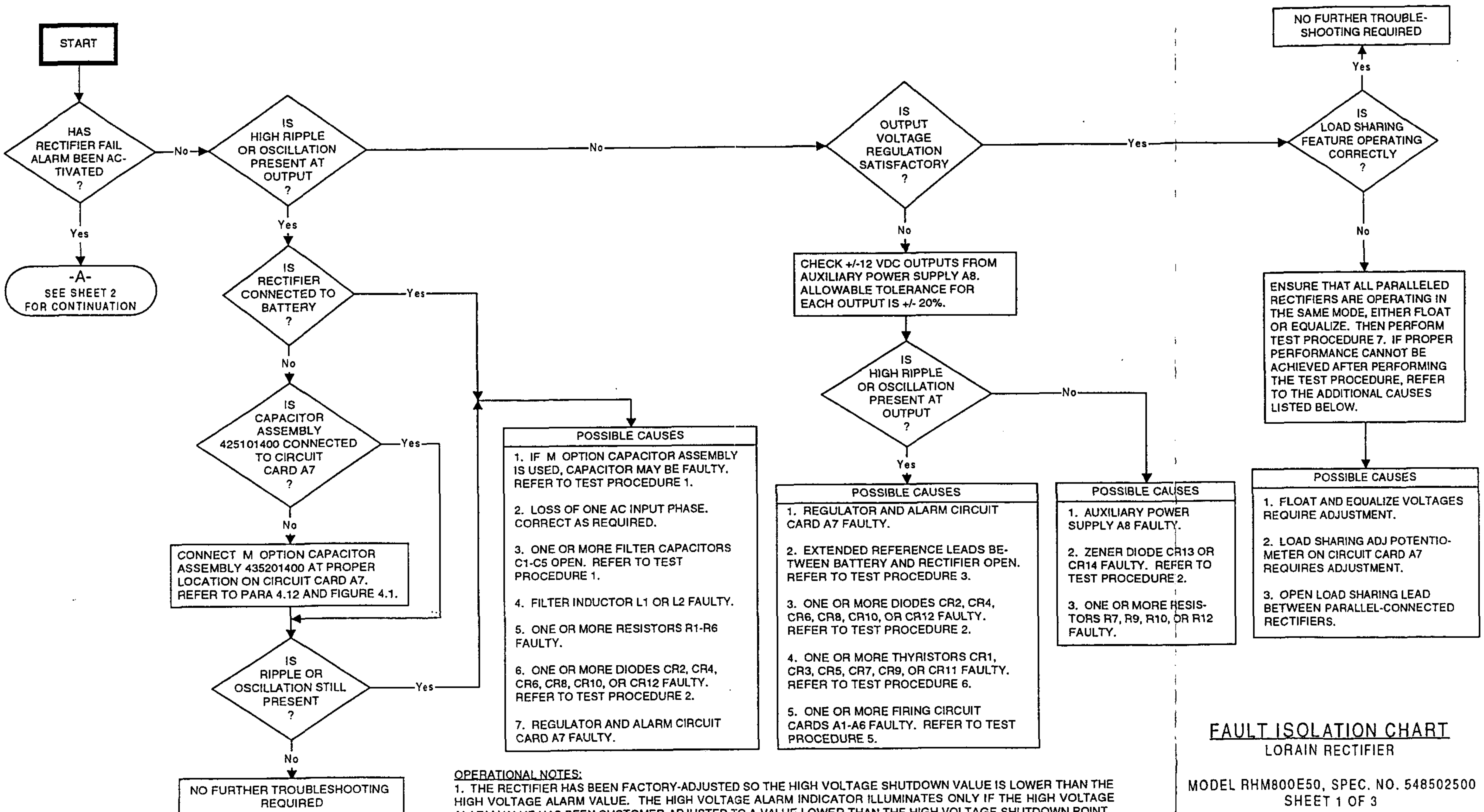
Insure that all power sources are fully disconnected from the rectifier before performing any repair or replacement procedures.

7.4 When a trouble symptom is localized to a faulty circuit card. that particular circuit card should be replaced in its entirety. No attempt should be made to troubleshoot or repair individual circuit cards.

7.5 If the suspected cause of a trouble symptom is an out of adjustment condition, the particular adjustment setting should be checked or reset using the appropriate adjustment procedure.

7.6 Component failures are sometimes evident during a visual inspection of the circuitry. Obvious trouble symptoms such as loose connections, overheated, discolored or burned components, open fuses, or burned and melted wire insulation should be corrected and the cause determined before proceeding with more detailed maintenance procedures.

7.7 Various test procedures referenced on the fault isolation chart provide the servicing technician With suggested methods for testing certain circuit components and checking for the presence or absence of certain control signals. Whenever a numbered test procedure is encountered in the chart, service personnel should



OPERATIONAL NOTES:

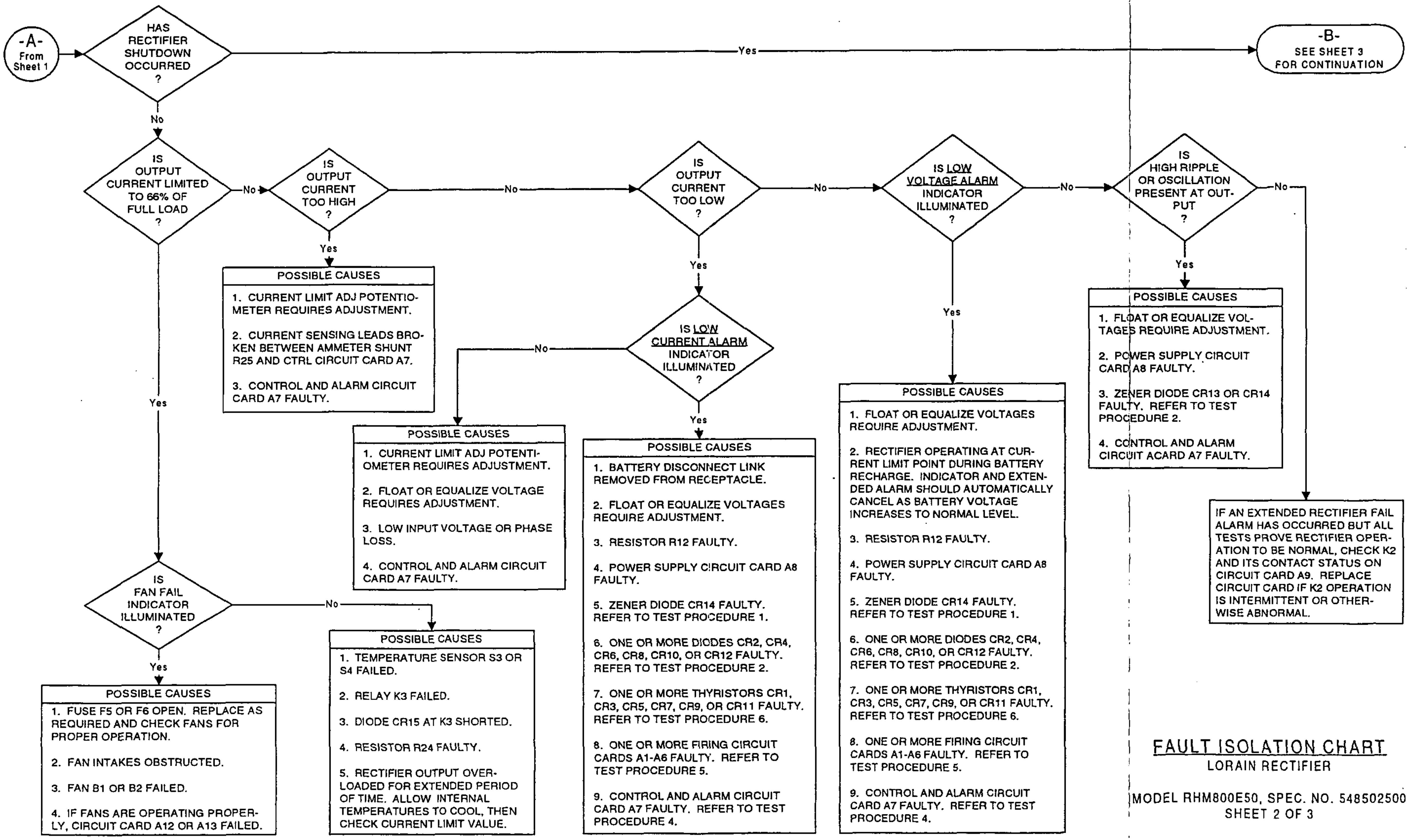
1. THE RECTIFIER HAS BEEN FACTORY-ADJUSTED SO THE HIGH VOLTAGE SHUTDOWN VALUE IS LOWER THAN THE HIGH VOLTAGE ALARM VALUE. THE HIGH VOLTAGE ALARM INDICATOR ILLUMINATES ONLY IF THE HIGH VOLTAGE ALARM VALUE HAS BEEN CUSTOMER-ADJUSTED TO A VALUE LOWER THAN THE HIGH VOLTAGE SHUTDOWN POINT.

FAULT ISOLATION CHART

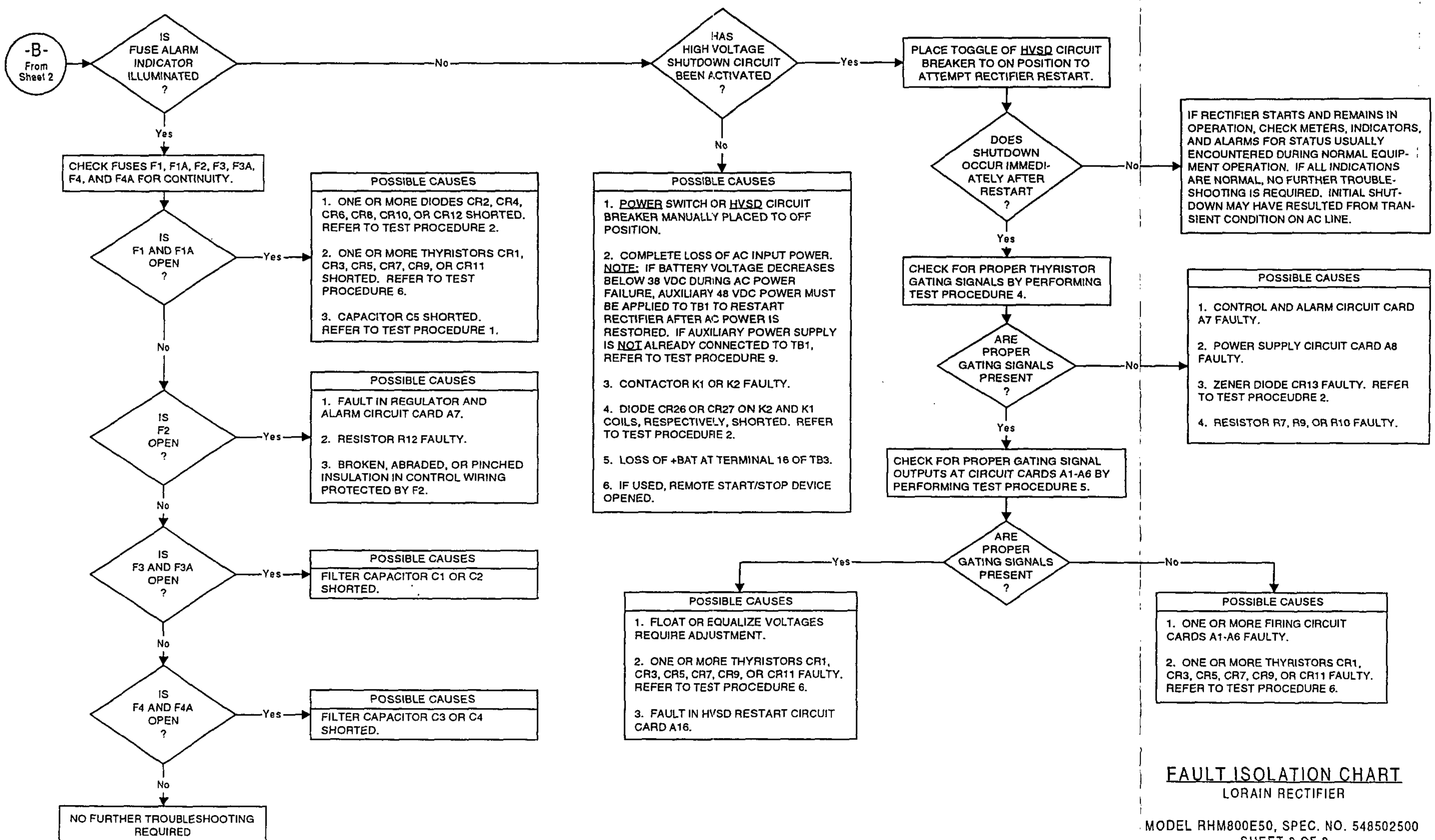
LORAIN RECTIFIER

MODEL RHM800E50, SPEC. NO. 548502500

SHEET 1 OF 3



FAULT ISOLATION CHART
LORAIN RECTIFIER
MODEL RHM800E50, SPEC. NO. 548502500
SHEET 2 OF 3



FAULT ISOLATION CHART
LORAIN RECTIFIER

MODEL RHM800E50, SPEC. NO. 548502500
SHEET 3 OF 3

refer to that particular test procedure in this section for further troubleshooting information.

7.8 Semiconductor device outlines for diodes and thyristors (SCR's) used in this rectiiier are shown in Figure 7-1. The outlines are intended to aid servicing personnel in identiiiing semiconductor terminations during troubleshooting or replacement procedures.

Test Procedures

7.9 The following test procedures are those referenced by number on the fault isolation chart. By following one of the appropriate procedures, the servicing technician cart perform a test on components suspected of failure. or on the rectifier to verify an operating condition. In the operational test procedures, appropriate cautionary statements are inserted where necessary. The servicing technician must observe the contents of each statement and follow normal precautionary procedures necessary when servicing electronic equipment to minimize the possibifii of accidental electrical shock.

7.10 Test Procedure 1. Perform thii test when checking a capacitor for opens or shorts.

a) Place the POWER switch to the OFF position. Insure that the external AC disconnect is opened and the BATTERY DISCONNECT link is removed.

b) Allow at least 60 seconds to elapse from time of rectifier shutdown, then disconnect both leads or terminals of the capacitor to be tested.

c) Set the digital muftimeter (DMM) for ohmmeter function, using a high resistance range.

d) Momentarily short the capacitor leads or terminals to insure complete diiarge. Connect meter test leads to capacitor leads or terminals, and observe indicated resistance. For a good capacitor without any faults, initial resistance is low and gradually increases as capacitor takes a charge. Final resistance is usually several hundred thousand ohms, approaching 1 megohm. Initial high resistance approaching infinity indicates an open capacitor. Initial and continued low resistance near zero ohms indicates a shorted capacitor. Replace arty capacitor which indicates an open or shorted condition.

e) Perform Steps b) through d) on all capacitors suspected of being faulty.

f) When all tests are completed, insure that wiring to subject capacitors is property connected.

g) If no further tests are required, return rectifier to normal operation. Refer to Test Procedure 8 for the startup procedure.

7.11 Test Procedure 2. Perform this test when checking a diode for opens or shorts.

a) Place the POWER switch to the OFF position. Insure that the external AC disconnect is opened and the BATTERY DISCONNECT link is removed.

b) Disconnect all wiring from one terminal of the diode to be tested.

c) Set the DMM for ohmmeter function, using 2K resistance range.

d) Connect meter test leads to diode terminals, and note indicated resistance. Reverse test lead connections, and again note indicated resistance. A good diode without any faults indicates a low resistance, typically 0.7K ohms when forward biased, and nearly infinite resistance when reverse biased. A shorted diode typically indicates zero ohms regardless of test lead connections; conversely, an open diode indicates very high resistance regardless of test lead connections. Replace any diode which indicates an open or shorted condition.

e) Perform Steps b) through d) on all diodes suspected of being faulty.

f) When all tests are completed, insure that wiring to subject diodes is properly connected.

g) g) If no further tests are required, return rectiiier to normal operation. Refer to Test Procedure 8 for the startup procedure.

7.12 Test Procedure 3. Perform this test when checking continuity of extended voltage reference leads.

a) Place the POWER switch to the OFF position. Open the meter and control panels and locate TB3 on circuit card A9.

DANGER

AC *power, capable* *of producing* *severe,* *perhaps* *fatal electrical* *shock is p-t at* *contactor* *Kl.*

b) Set the DMM to monitor DC voltage. Select the appropriate range for approximately 60 volts maximum.

c) Connect the DMM test leads to TB3 terminal 1 (+) and terminal 2 (-).

d) The meter should indicate battery voltage, nominally 43 VDC. If Voltage is not present, reference leads are open at some point between rectifier and battery. Check reference lead connections, and correct any faults as required.

e) If no further tests are required, return rectifier to normal operation.

7.13 Test Procedure 4. Perform this test when checking for proper gating outputs from Regulator and Alarm Circuit card A7. The gating signal should be checked at each of the six thyristors used in the rectifier. If any gat-

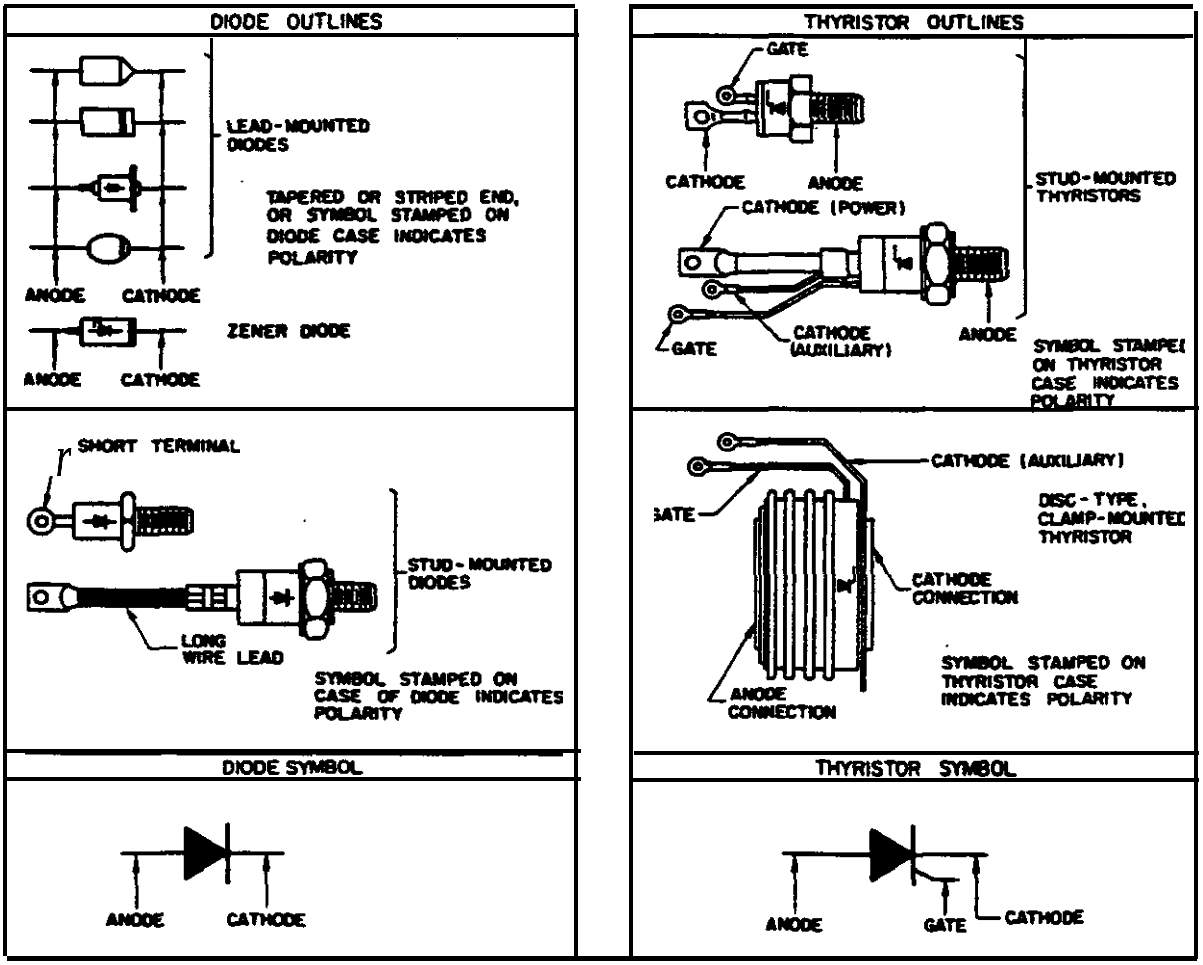


Figure 7-1. Semiconductor outline Drawings

ing signal is missing or abnormal, the control and alarm circuit card A7 should be replaced.

DANGER

This procedure is performed *with power* applied to the rectifier. Hazardous AC voltages capable of producing. severe. perhaps fatal electrical shock are present at various locations throughout *the cabinet. and especially at transformer T1. Exercise caution that accidental contact is not made with any exposed electrical termination or with test* equipment cabinets while *the rectifier is operating.*

a) Place the POWER switch to the OFF position. Do not disconnect AC or DC power sources.

b) Remove the lower front panel from the rectifier to gain access to both heatsink assemblies and power transformer T1 Locate the firing circuit cards, Part No. 4334-016-00, on each heatsink assembly.

c) Adjust the vertical sensitivity of an oscilloscope for 5 volts par centimeter (5V/cm). Adjust horizontal time base for 2 milliseconds per centimeter (2 ms/cm).

DANGER

Do not use a grounded oscilloscope when performing ***this procedure; otherwise,*** damage to ***the rectifier may result. At the same time, a*** *personnel shock hazard exists since the* ***chassis*** and case of ungrounded, ***AC-operated*** test ***equipment becomes energized to the same voltage level as the circuit under test. Servicing personnel*** must ***exercise caution*** that ***simultaneous contact is not made with the test instrument chassis or case and some grounded*** object *when the test equipment is connected to the* ***rectifier while*** it ***is operating.***

d) Open the meter and control panels by loosening the captive fasteners.

e) Remove the edge connector fmm one of the firing circuit cards. Connect the oscilloscope probe to contact pin 5 in the edge connector. Connect the oscilloscope common lead to terminal 3 of any phase on transformer T1

f) Start the rectifier by operating the POWER switch to the ON position.

g) Observe the waveform displayed on the oscilloscope. The waveform should be similar to that shown in Figure 7-2. Amplitude should be approximately 12 volts peak-to-peak with a variable time duration dependent upon AC input voltage and output voltage setting. The waveform illustrated was taken with the rectifier operating at 208 VAC input and 52 VDC output with 50% load.

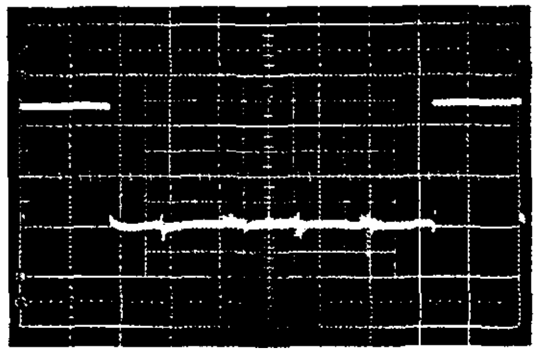


Figure 7-2. Thyristor Gate Pulses

h) After noting the firing waveform characteristics, place the POWER switch to the OFF position. Disconnect the oscilloscope probe and replace the edge connector on its respective thyrfstor firing circuit card.

i) Repeat Steps e) through h) for each remaining firing circuit card input. If the waveshape at any input edge connector is missing or abnormal. replace Regulator and Alarm circuit card A7.

j) When all tests are completed and any necessary repairs accomplished. perform the following steps:

1) Completely disconnect all test equipment leads from the rectifier.

2) Replace the lower front panel on the rectifier and secure it in place with the hardware originally used.

3) If the DC output leads were disconnected or if the BATTERY DISCONNECT link was removed during repairs. refer to Test Procedure 8 for recommended startup procedure. If the battery was not disconnected from rectifier output, perform the following step.

k) Place the POWER switch to the ON position. Check the meters and indicators on the rectifier to insure normal operation.

7.14 Test Procedure 5. Perform this test when checking for proper gating outputs from firing circuit cards Al through A6. The gating signal should be checked at the gate and cathode leads of each thyristor used in the rectifier. If any gatfng signal is missing or abnormal, the faulty firing circuit card, Part No. 433401600, should be replaced.

DANGER

This procedure is performed with power applied to the rectifier. Hazardous AC voltages capable of producing severe, perhaps fatal electrical shock are p-t at various locations throughout the cabinet, and especially at transformer T1. Exercise caution that accidental contact is not made with any exposed electrical termination or with test equipment cabinets while the rectifier is operating.

a) Place the POWER switch to the OFF position. Do not disconnect AC or DC power sources.

b) Remove the lower front panel from the rectifier to gain access to both heatsink assemblies and power transformer T1. Locate the firing circuit cards, Part No. 4334-016-00, on each heatsink assembly.

c) Adiust the vertical sensitivity of an oscilloscope for 0.5 volts per centimeter (0.5V/cm). Adjust horizontal time base for 2 milliseconds per centimeter (2 ms/cm).

DANGER

Do not use a grounded oscilloscope when performing this procedure; otherwise, damage to the rectifier may result. At the same time. a personnel shock hazard exists since the chassis Md case of ungrounded, AC-operated test equipment becomes energized to the same voltage level as the circuit under test. Servicing personnel must exercise caution that simultaneous contact is not made with the test instrummt chassis or case and some grounded object when the test equipment is connected to the rectifier while it is operating.

d) Open the meter and control panels by loosening the captive fasteners.

e) Connect the oscilloscope probe to terminal 6 of one firing circuit card. Connect the oscilloscope common lead to terminal 7 of the same circuit card.

f) Start the rectifier by operating the POWER switch to the ON position.

g) Observe the waveform displayed on the oscilloscope. The waveform should be similar to that shown in Figure 7-3. Amplitude should be approximately 1.5 volts peak-to-peak with a variable time duration dependent upon AC input voltage and output voltage setting. The waveform illustrated was taken with the rectifier operating at 206 VAC input and 52 VDC output with 50% load.

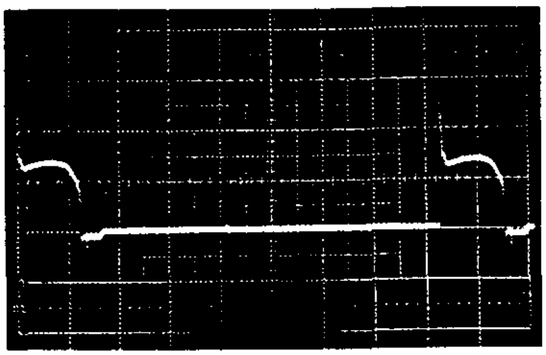


Figure 7-3. SCR Gate Pulses

h) After noting the firing waveform characteristics, place the POWER switch to the OFF position. Disconnect the oscilloscope probe leads from the circuit card under test.

i) Repeat Steps e) through h) for each remaining firing circuit card. If the waveshape at any output is missing or abnormal, replace that respective firing circuit card.

j) When all tests are completed and any necessary repairs accomplished, perform the following steps:

1) Completely disconnect all test equipment leads from the rectifier.

2) Replace the lower front panel on the rectifier and secure it in place with the hardware originally used.

3) If the DC output leads were disconnected or if the BATTERY DISCONNECT link was removed during repairs, refer to Test Procedure 8 for recommended startup procedure. If the battery was not disconnected from rectifier output, perform the following step.

k) Place the POWER switch to the ON position. Check the meters and indicators on the rectifier to insure normal operation.

7.15 Test Procedure 6. Use the following general procedure when checking thyristors for an open or shorted condition. The POWER switch must be placed to the OFF position, and AC and DC power soources disconnected before proceeding with the test. Disconnect the cathode and gate leads of arty thyristor to be checked. The cathode and gate leads may be disconnected at a terminal board, or the leads themselves may be disconnected from the circuit. If the thyrfstor has short, lug-type terminals, circuit wiring may be disconnected at these terminals. If the rectifier utilizes the clamp mounted disc- type thyristors, do not attempt to loosen the clamping device in order to remove the thyristor from its heat sink. Disconnect power circuit wiring at the heat sink, and remove the firing circuit (gate and cathode) leads at their terminal board. A thyrfstor tester should be used to check for an anode-tocathode open or short. It such a tester is not available, the thyristor can be checked by the use of an ohmmeter. To check for an anode-to-cathode short. measure the resistance from anode-to-cathode; a low resistance indicates an anode-to-cathode short. To check for an open or shorted thy. ristor gate, measure the resistance of the gate-to-cathode in both directions. A reading of zero ohms in both directions. indicates a shorted thyristor. A reading of infinity in both directions indicates an open thyristor. Replace the thyristor as required. Refer to Test Procedure 8 for rectifier startup tollowing completion of repairs.

7.16 Test Procedure 7. Use this procedure to check operation of the load sharing circuit.

DANGER

This procedure is performed with power applied to the rectifier. Hazardous AC voltages capable of producing severe, perhaps fatal electrical shock are present at various locations throughout the cabinet. Exercise caution that accidental contact is not made with any exposed electrical termination while the rectifier is operating.

a) Place the POWER switch to the OFF position. Open the meter and control panels and locate TB3 on circuit card A9.

b) Connect the test leads of a DMM to TB3, terminal 2 (-) and terminal 3 (+). Adjust the DMM so it will indicate a maximum of 8 VDC when the rectifier is operating.

c) Place the POWER switch to the ON poskion. Since the load sharing circuit output voltage varies linearly with output current, circuit operation can be checked at various toad levels as shown in Table 7-1.

d) Insure that output voltage and load sharing adjustment controls are properly set in parallel-connected rectifiers equipped with negative-bus load sharing circuits. Refer to ADJUSTMENT section of these instructions for details.

e) If the load sharing voltage remains absent or irregular after adjustment settings have been verified, replace circuit card A7.

f) After all tests are completed and before commencing any necessary repairs, place the POWER switch to the OFF position.

Percentage of Rated Rectifier Output Current	Load Sharing Output Voltage (VDC)
12.5	1
25	2
37.5	3
50	I4
62.5	5
75	6
67.5	7
100	8

Table 7-1. Output Voltage Current/Load Sharing Voltage Relationships

7.17 Test Procedure 6. Observe the following procedure when startiig the rectifier after performing tests or repairs which required disconnection from the battery.

DANGER

steps ***a)*** through ***e)*** must ***be performed*** *exactly* ***as presented*** in these ***instructions.*** The ***rectifier must be started off battery to charge the filter capacitors before installing BATTERY DISCONNECT link S2. Installing the disconnect link before charging*** the ***capacitors*** CM ***result in personal injury, equipment damage, and blown fuses in the rectifier.***

a) Ensure that BATTERY DISCONNECT link in removed from Its receptade. If DC output leads were removed, connect them to appropriate terminals in the rectifier.

b) If reference leads are extended to the battery, perform the following steps:

1) Remove the local sensing leads from their storage terminals on circuit card A9.

2) Working with one lead at a time, disconnect the remote sensing leads from terminals 1 and 2 of TB3 on circuit card A9. Temporarily insulate these leads.

3) Connect the local sensing leads to TB3. terminal 1 (+) and terminal 2 (-). Insure that pohrity is correct.

4) Install the M option capacitor assembly, Part No. 425101400, on the appropriate edge connector of Regulator and Alarm Circuit card A7.

c) Close the external AC disconnect device to apply input power to the rectifier.

d) Place the HVSD circuit breaker toggle and the POWER rocker switch to the ON position. The rectifier should start, although the LOW CURRENT ALARM and an extended rectifier fail alarm may be activated.

e) Wait for the voltmeter on the rectifier front panel to indicate 52 volts. At this time, insert BATTERY DISCONNECT link S2.

f) Place the POWER switch to the OFF position. If reference leads extended to the battery or load are required, perform the following steps. If internal reference only is required, disregard Steps 1) through 3) which follow, then proceed with Step g).

DANGER

If the ***rectifier is*** connected to ***a battery, voltage is present*** at the local and *extended reference* ***leads. Exercise care in the following*** Steps ***that the leads are*** Mt ***accidentally shorted together or allowed to touch cabinet parts or*** *any other* ***electrical terminations.***

DANGER

AC ***voltage capable of producing severe,*** *perhaps* fatal ***electrical*** *shock is* ***present*** *at* ***input contactor K2. Exercise*** caution that ***accidental bodily*** contact with any electrical ***termination does not occur.***

1) Disconnect and temporarily insulate the local reference leads from TB3, terminals 1 and 2.

2) Working with one lead at a time, connect the remote sensing leads to TB3, terminal 1 (+) and 2 (-). Insure that polarity is correct.

3) Remove the temporary insulation from the local reference leads. and connect these leads to the storage terminals on circuit card A9.

g) If the rectifier is used in charging a battery, remove the M option capacitor assembly from its edge connector on Regulator and Alarm Circuit card A7.

h) Place the POWER switch to the ON position. The rectifier should start and deliver output voltage within the range of 48 to 94 VDC.

i) Observe the front panel meters and indicators. Verify that rectifier operation is normal after restart.

7.18 Test Procedure 9. If. due to a prolonged AC input power failure. the associated battery discharges to below 38 VDC, the rectifier will be unable to restart. An optional customer-furnished power supply permanently connected to terminal block TB1 enables automatic restart in this event. If an optional auxiliary power supply has not been permanently connected to TB1, a special startup procedure is required. Perform the following procedure to restart the rectifier in this event. This procedure will require an external 48 VDC power supply capable of furnishing 10 amperes of current.

DANGER

If the rectifier is connected to battery, DC voltage is present at various points throughout the rectifier, including the local and extended reference leads.

DANGER

AC voltage capable of producing fatal electrical shack is present at various points throughout the rectifier, including input contactor K2. Exercise caution that accidental bodily contact with any electrical termination does not occur.

a) Ensure that HVSD circuit breaker and POWER switch on the rectifier are both in the OFF position.

b) Open the two rectifier front doors by loosening the captive fasteners and pivoting the doors outward.

c) Provide an external power supply adjusted for 48 VDC and capable of 10 amperes. Ensure that the external power supply is turned off.

W - G

In the next step. observe correct polarity; otherwise equipment damage may occur.

d) Connect the external power supply to terminals 1 (+) and 2 (-) of auxiliary power supply terminal block TB1. TB1 is located inside the rectifier cabinet on the rear wall. Refer to Figure 7.4 for details. Observe correct polarity.

e) Turn on the auxiliary power supply.

f) Place the HVSD circuit breaker and the POWER switch to the ON position. The rectifier should start and deliver output voltage within the range of 48 to 54 VDC.

g) Observe the front panel meters and indicators. Verify that rectifier operation is normal after restart.

h) Turn off the auxiliary power supply and disconnect from the rectifier.

i) Close the rectifier front doors and secure by tightening the captive fasteners.

j) This completes the low battery rectifier restart procedure.

8. MODEL DATA

8.1 Refer to the Power Data Sheet for information concerning the input and output ratings, operating limits. dimensions. recommended input and output lead sizes, fusing and terminal lug capacity of the rectifier.

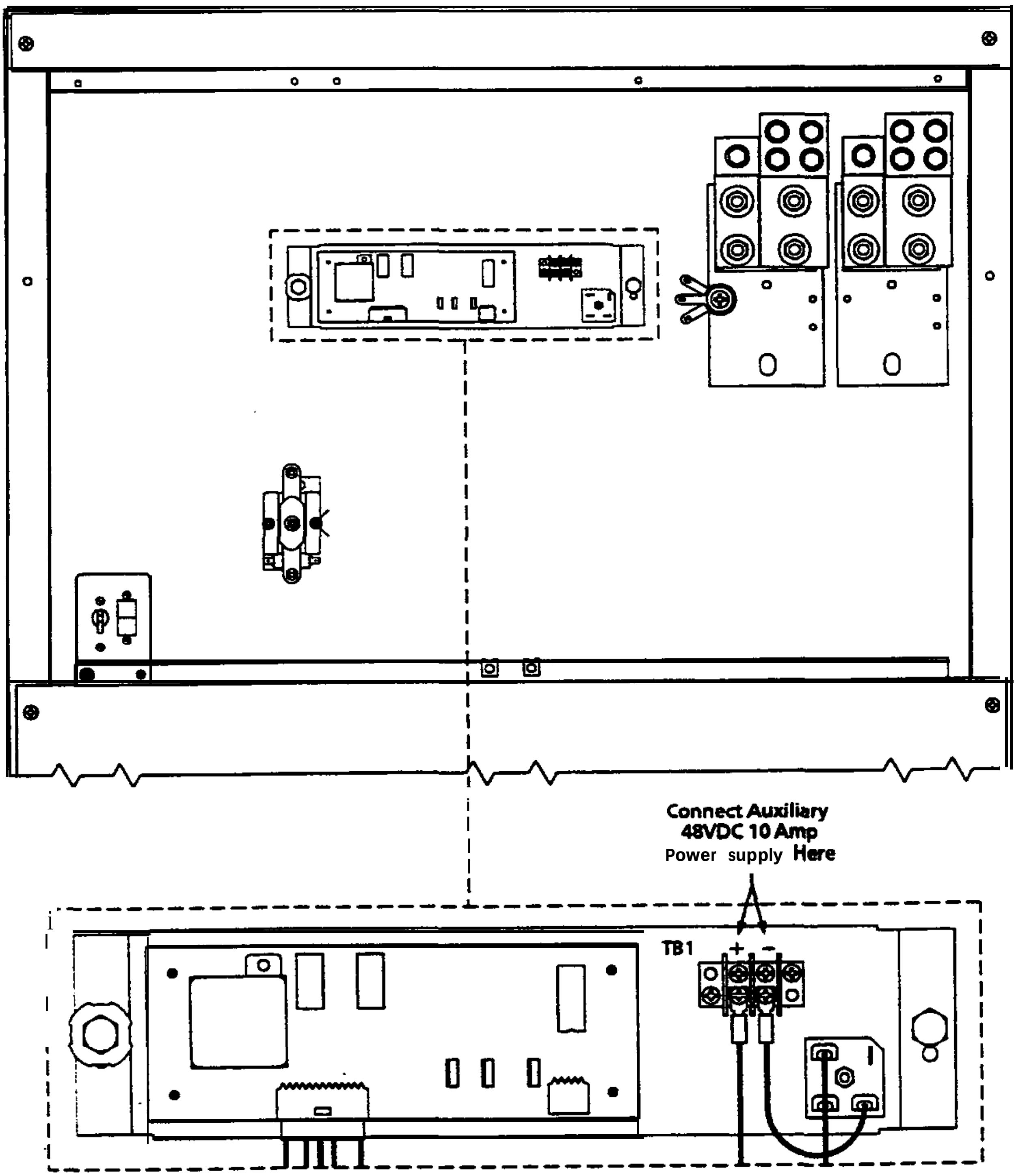


Figure 74. Front Partial View of Rectifier Interior Rear Panel Showing Location of Auxiliary Power Supply Connections (Detail Removed for Clarity)

APPENDIX

RECORD OF INSTRUCTION MANUAL CHANGES

ISSUE OR DATE	PRN	DESCRIPTION OF CHANGES
1	_	NEW
2	183-8181	FAN FAILURE ALARM indicator added.
		CONVERSION TO LAMPS
CI	--	Load Sharing Clarified.
D1	183-9754	Phase Loss Alarm added.
EI	--	Fuse F1 Part No. corrected in Table 4-l
F1	183-7087	Revised to reflect addition of HVSD restart circuit and auxiliary low battery startup terminals: added Test Procedure 9.

Power Products I 1122 F Street I Lorain, Ohio 44052-2293 I (440) 288-l 122

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RELTEC Canada
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In Mexico :
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ADDENDUM

In addition to the customer adjustable selective high voltage shutdown circuit described in the instruction manual, this FLOTROL Rectifier also contains a second non- adjustable high voltage shutdown circuit. This second high voltage shutdown circuit is designed to shutdown the rectifier in the event of a failure which inhibits the customer adjustable selective high voltage shutdown circuit. This circuit assures that rectifier output voltage will not increase to a level that could cause damage to the rectifier or the load. The circuit is proportioned so that the non-adjustable high voltage shutdown point always remains 2 volts above the adjustable setting for 50 volt rectifiers and 1 volt above the adjustable setting for 25 volt rectifiers.

The non-adjustable high voltage shutdown point is determined by resistor R88 (©option) on the regulator and alarm printed circuit card. If resistor R88 is removed, the non-adjustable high voltage shutdown circuit is removed and the selective high voltage shutdown feature of the rectifier is inhibited.

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RELTEC”

REPLACEMENT OF DISC-TYPE THYRISTORS AND DIODES USING CLAMP ASSEMBLY 2868-234-00 OR 2868-235-00

CONTENTS PAGE

1. GENERAL

1.01 These instructions provide a step-by-step procedure for replacement of disc-type thyristors or diodes. These semiconductors are used in various type LORAIN® equipment, and the procedures outlined in these instructions should be followed to correctly replace disc-type thyristors or diodes.

1.02 Refer to Figure 1 for identification outlines of the disc-type thyristor and diode. The replacement device should be compared to the outline drawing prior to replacement. Identify the polarity and type of the replacement semiconductor to insure that the new diode or thyristor is correctly installed in its heatsink.

1.03 Figure 2 provides an illustration showing force gauge use during the replacement procedure. Refer to Figures 2A through 2C during installation to insure that correct mounting force is exerted on the replacement diode orthyristor.

2. REQUIRED TOOLS AND MATERIALS

2.01 The following tools and materials are required to replace a 'disc-type' semiconductor:

Qu[illegible]	[illegible]ption
1 Set	[illegible]wre[illegible]ith ratc[illegible]dle and extension; 3/8 or 1/2[illegible]e
1	Screwdriver; medium sized flat blade
1	Force gauge; LP. Part No. 6774-007-00
1 Container	Thermal joint compound; Wakefield Engineering, Inc., Type 120 (L.P Part No. 1762-510-00), or equivalent.

3. INSTALLATION PROCEDURE

3.01 Remove all sources of power to the equipment requiring repair. Open all AC and/or DC input and output circuit breakers or switches according to the Stopping Procedure in the appropriate instruction manual. Open the external disconnect on protective device prior to the replacement procedure.

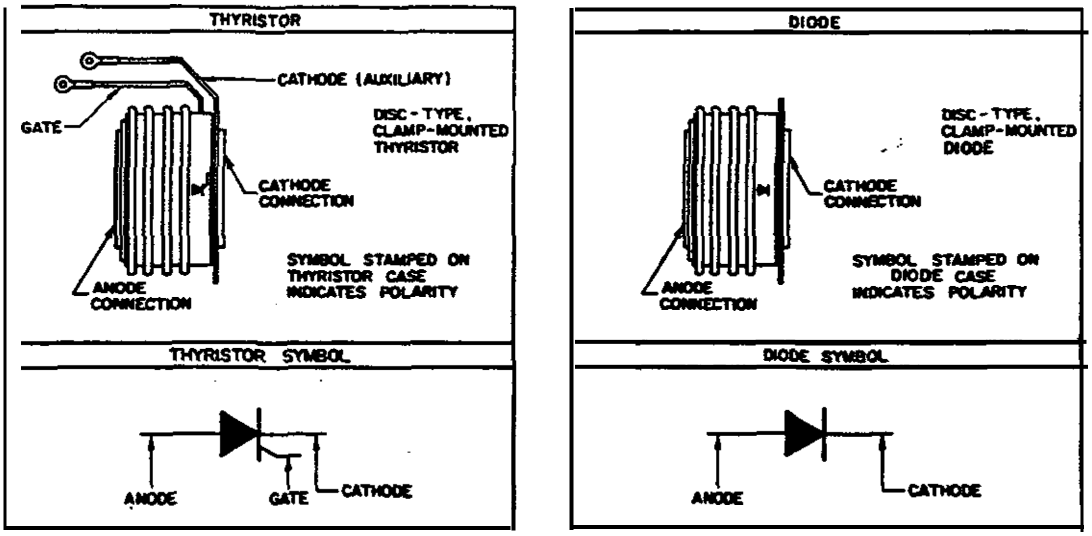
NOTE

Refer to the Schematic Diagram of the equipment being repaired. Insure that the equipment is completely isolated from all power sources. In some instances, it may be necessary to remove input, output, and control fuses to completely isolate the equipment from any power source.

DANGER

Hazardous voltage may be present within the cabinets of some LORAIN equipment after input and output power sources have been disconnected. Servicing personnel must exercise extreme caution that contact is not made with interconnection terminal blocks or any portion of the circuitry other than the diode or thyristor assembly requiring repair.

FIGURE I
SEMICONDUCTOR IDENTIFICATION OUTLINES



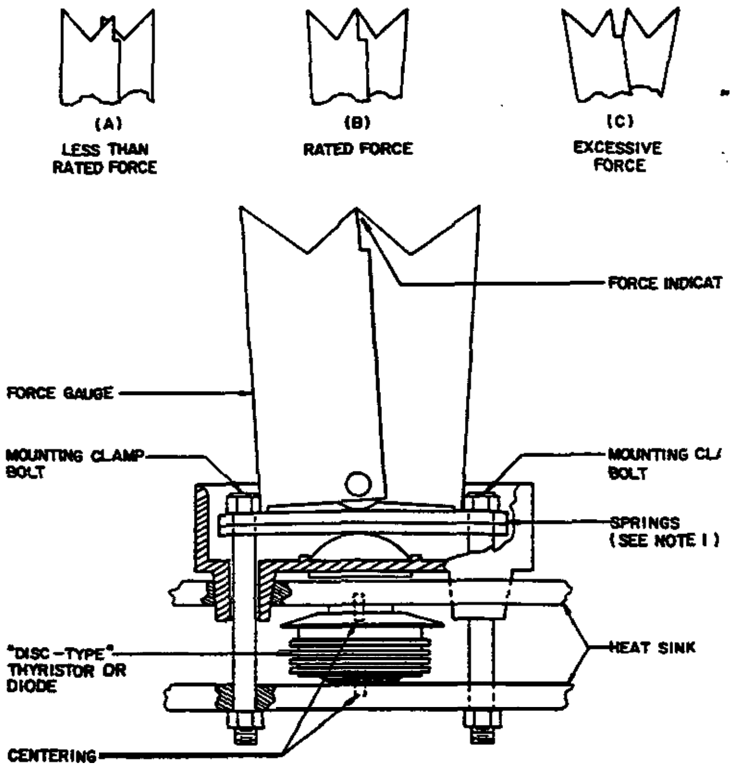


FIGURE 2

CUT-AWAY VIEW OF "DISC-TYPE" SEMICONDUCTOR INSTALLATION DETAILS

NOTE I: CLAMP ASSEMBLY (L.P.C. PART NO. 2868-234) HAS TWO SPRINGS.
CLAMP ASSEMBLY (L.P.C. PART NO. 2868-235) HAS FOUR SPRINGS.

3.02 Open the equipment access doors or covers and remove any inner protective grilles or covers to gain access to the diode or thyristor assembly. Proceed as follows:

a) If a thyristor is being replaced, disconnect the cathode (K) and gate (G) leads from their terminal board. These leads are usually red and white wires, and are connected to a terminal board mounted on the heatsink near the thyrirtor.

b) Loosen and remove the two mounting clamp bolts. The clamp, heatsink. and semiconductor may now be removed from the equipment

NOTE

NOTE THE POLARITY OF THE FAULTY *SEMICONDUCTOR BEFORE REMOVING IT FROM ITS HEATSINK.*

c) One mounting surface is the anode connection, whereas the other mounting surface is the cathode connection. The polarity of the device is usually indicated by a symbol stamped on the ceramic portion of the device. Refer to the Identification Outlines (Figure 1) if any doubt exists concerning the polarity of the device. It may be necessary to remove circuit wiring or loosen a busbar connection from the heatsink before it can be removed from the equipment.

d) Remove the faulty semiconductor from its heatsink. Using a clean rag or paper towel clean both portions of the heatsink assembly to remove any thermal compound residue.

e) If a thyristor is being replaced, carefully inspect the gate lead connection at the pin entering the ceramic body of the thyristor. It is of utmost importance that this connection is tight. tf this connection point is suspected of being loose, carefully solder the push-on-connector to the pin to insure good electrical contact

f) Apply a thin coating of thermal joint compound to the mounting surfaces of the replacement semicnductor.

WARNING

Da not apply an excessive amount of thermal joint compound on the mounting surfaces of the replacement device. The compound possesses electrical insulating qualities, and may prevent the semiconductor device from functioning properly if an excessive amount is applied. A thin, almost transparent coating is adequate.

g) Install the replacement device on the heatsink, observing correct polarity and insuring it is correctly centered on the pins imbadded in the heatsinks. Replace the mounting clamp bolts, and secure them finger-tight only.

h) Using a force gauge (LP. Part No. 6774-007-00) placed against the clamp springs as shown in Figure 2, tighten the mounting clamp bolts alternately, 1/4 turn at a time. The bolts should be tightened equally until the force gauge indicates rated force is applied as shown in Figure 2 (B).

NOTE

***If excessive force is applied by overtightening the mounting clamp bolts, as shown by the force gauge* indication in Figure 2 (C), completely loosen the two bolts and repeat the tightening process. *Never attempt to adjust spring tension by backing off the bolts since the force gauge* may provide a *false* indication in this case.**

i) When the mounting clamp bolts are correctly tightened, remove the force gauge. Reconnect any wiring removed from the heatsinks, insure that all hardware used to make electrical connections is tightened securely.

j) If replacing a thyristor, reconnect gate and cathode leads to their respective terminals. Refer to the equipment Wiring Diagram (T-drawing) for details.

WARNING

***Insure that these leads are connected to the* proper terminal board connection *points, or* damage *to* the equipment end *semiconductor* device *may result* when *power* is applied.**

NOTE

On the gate and cathode lead terminal board, the cathode connection is usually marked "K" and the gate connection is usually marked "G". If any doubt exists regarding the correct connection points, refer to the equipment wiring diagram.

3.03 After all electrical connections have been made, replace any protective grilles or covers which were previously removed. Close the equipment access doors or coven.

3.04 Restore input power to the equipment, and insure that any output disconnect or protective devices are connected or reset for normal operation. If necessary, refer to the Starting Procedure in the appropriate instruction manual to restore the equipment to normal operation.

APPENDIX

RECORD OF INSTRUCTION CHANGES		
ISSUE OR DATE	PRN	DESCRIPTION OF CHANGE
D1	183-7444	Revised to reflect current instruction format.

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Apartado Postal 77001 I Mexico 10 D.F., MX 11200 / (905) 5764277

RELTEC”

1. SPECIFICATION

1.1 GENERAL: This LORAIN® Rectifier is designed to **power a** load while charging **a** battery **in a positive** grounded system. Thii rectifier is listed by Underwriters Laboratories under standard 1012 for power conversion equipment in a controlled environment.

1.2 OUTPUT **RATINGS**

1.2.1 **Voltage:** Float voltage **is** adjustable fmm **48** to 54 vofts for floating 23 or 24 cells of battery, Equalize **voltage** is adjustable from float **voltage** to 57 **volts** for equalizing 23 or 24 cells of battery. A front panel mounted **switch** selects float or **equalize** charge operation.

1.22 Regulation

(A) Static: Steady state output **voltage** remains **within ±1/2 %** of any **voltage within** the range of 48.3 to 55 **volts** for any load current from no load to full load for the input **voltage** and frequency **range** specified.

(B) Temperature **Coefficient:** Output **voltage** change does not exceed an average of 0.01% per degree C **within** the ambient temperature range of 0' C to **+50°** C. Refer to paragraph 1 **.8.1.**

(C) Dynamic: For a **step load** change of **250** amps within the range of 5% to 100% of full load, the maximum **voltage** transient does not exceed **±** 5% of the **initial** steady state **voltage.** Recovery to withm steady state voltage **regulation** range does not exceed **200** milliseconds and **all** transient behavior disappears within 500 milliseconds. Refer to paragraph **1.8.1.**

1 2 . 3 **Filtering**

When connected to a battery **rated** in ampere-hours four times the full **load** current rating of the rectifier.

(A) voice band noise **is** less then 32 dbm with C-message weighting

(B) wide band **noise** does not exceed 500 MV peak to peak or 30 MV **RMS** over the frequency range of 10 Hz to 14 **MHz.** Refer to paragraph 1 **.8.1.**

1.2.4 Current: **800 amperes**

ISSUE	PRN NO.	REVISION DESCRIPTION
G1	183-7838	**Revised** to current software **format.** Updated Dimensions and **Installers** pages to include **TB1** Added Notes **4.24 and 4.25.** J. Bartlome 3-10-98 (PRN) MAR 1 0 1998 B P

LP728-2/92

RELTEC™ Power Products

POWER DATA

LORAIN® Model RHM800E50

Rectifier

SPEC. NO. 548502500

DR BY R. Lash	DATE 5-25-83	GRP LDR B. Barnes	DATE 5-26-83	**PD548502500**
CH BY D. Dembinski	DATE 5-26-83	APP BY D. Dembinski	DATE 5-26-83	
ENGR BY J. Rader	DATE 5-26-83			PAGE **1 of 10**

1.3 INPUT RATINGS.

1.3.1 voltage: Nominal 480 volts, three phase. 60 Hz ±3 Hz, with a range of 424 to 508 volts.

1.32 Typical Input Data:

(I) 52.08 Volts DC at the rectifier output

Input Volts	Amount Of Load	Amperes	VA	Watts	VAR	Efficiency (%)	Displacement Factor (%)
467	No Load	1.25	1011	·532	860	-	
	Half Load	30.47	24646	22230	10642	94.0	93.1
	Full Load	62.00	50150	45080	21973	92.9	92.8

(2) Input current with rectifier supplying full bad current and with 68 volts at the rectifier output.

Input Voltage	424
Max. Input Current	66.5

1.33 **Efficiency:** Greater than 86% from 60% bad at the design center input voltage. at 80 Hz input and 50 volts output.

1.3.4 Displacement Factor: Displacement factor is greater than 80% from 40% bad to full bad at the design center input voltage with 60 Hz input and 50 volts output.

1.35 Telephone **Influence Factor:** The IT product does not exceed 26000 for any normal input and output condition. Refer to paragraph 1.8.1.

1.3.6 Distortion: The peak to peak amplitude of any distortion in the line to line AC voltage wave does not exceed 20% of the fundamental RMS voltage If the AC source impsdance produces no more than 2% voltage drop when the rectifier is delivering full bad. Refer to paragraph 1.8.1.

1.4 STANDARD FEATURES

1.4.1 Power Circuit: Delta-double wye connected six phase rectifier.

1.42 **Input Protection:** A three pole contactor opens fhe AC input lines.

1. SPECIFICATION

1.4.3 Output **Protection:**

(A) Current Limiting: DC output current is limited at an adjustable value from 90% to 110% of full bad. factory set at 110% of full load.

(B) Short Circuit: A 1000 ampere fuse is located in the negative output lead.

(C) Overvoltage Shutdown: If rectifier output voltage exceeds a preset adjustable value while the rectifier is delivering more than 3% of full bad current (24 amperes), the rectifier will shutdown, Refer to Table 1.

1 A.4 **Remote Voltage** Sensing: Point of regulation can be extended to battery or power board.

1.4.5 **Alarms:** Alarm relay contacts are rated for 29 volts at one ampere.

(A) RECTIFIER FAIL ALARM: A rectifier fall alarm is activated for any of the following condiilns: loss of AC input power, turning off the rectifier either manually or automatically, excessive input current, high output voltage, bw output voltage, bw output current, bss of rectifier control circuitry supply voltage, fuse alarm. fan fail, heatsink over temperature alarm, or partial bad current limit operation. A rectifier fail alarm indication supplies positive battery to two alarm circuits and removes positive battery from two alarm circuits, with closed bop alarms available as wiring options.

(B) LOW CURRENT ALARM: A bw current alarm is activated if output current decreases below 4 amperes. A bw current alarm condition illuminates a yellow LOW CURRENT ALARM indicator, supplies positive battery to an alarm terminal, removes positive battery fmm an alarm terminal. and activates me rectifier tail alarm.

(C) HIGH VOLTAGE ALARM: A high voltage alarm is activated if output voltage increases above a preset value. A high voltage alarm condition illuminates a red HIGH VOLTAGE ALARM indicator, sup plies positive battery to an alarm terminal. and activates the rectifier fait alarm. Refer to Table 1.

(D) LOW VOLTAGE ALARM: A bw voltage alarm is activated if output voltage decreases below a preset value. A bw voltage alarm condition illuminates a red LOW VOLTAGE ALARM indicator and activates the rectifier fail alarm. Refer to Table 1.

Low Voltage Alarm		High Voltage Alarm		Overvoltage Shutdown	
Range	Factory Setting	Range	Factory Setting	Range	Factory Setting
39.1V To 52.8V	47.15V	52.8V To 60.0V	57.6V	52.8V To 60.0V	55.0V

Table 1:

(E) FUSE ALARM: A fuse alarm is activated if output fuse F1, reference fuse F2, or filter capacitor fuses F3 or F4 open. A fuse alarm condition illuminates a red FUSE ALARM indicator and activates the rectifier fail alarm.

(F) FAN FAILURE ALARM: A fan failure alarm is activated if cooling fans B1 or B2 should fail. A fan failure condition illuminates a red FAN FAILURE indicator and activates the rectifier fail alarm.

1.4.6 Indicators: A green POWER ON (LED) indicator illuminates when the AC input contactor (K2) is energized and AC input voltage is present.

1.4.7 Load Sharing: A circuit is furnished for proportional division of total toad current when the output of this rectifier is connected in parallel with other LORAIN RL or RHM Series rectifiers of the same output voltage rating.

1.4.6 Remote Equalize: Float or equalize charging can be selected from a remote location if desired. Refer to INSTALLER'S CONNECTIONS and Note 4.9.

1 A.9 Remote Start: The rectifier may be started or stopped from a remote location by application or removal of positive battery. Refer to Section 3, INSTALLER'S CONNECTIONS and Note 4.14.

1.4.10 Partial Load Current Limit: Application of positive battery causes the rectifier to limit output current to 66% of full rated load. Refer to Section 3 INSTALLATION CONNECTIONS and Note 4.10.

1 A.11 End Call Charging: The output voltage can be increased for charging three end cells by connecting the DC output to the end cells and leaving the external reference leads connected across the main 23 cell string.

1.4.12 Phase Shift: Main power transformer shifts the phase of input current 15° to lower line distortion when two rectifiers are operated in parallel. Refer to paragraph 1.8.1.

1.4.13 Thermal Protection: If rectifier cooling fans fail, or if the temperature of the heatsink reaches +85° C (+185° F), load carrying capability is reduced to 66% of full rated load and the rectifier fail alarm is activated.

1.4.14 Conducted Radio Frequency Interference: Conducted radio frequency interference in the frequency range of 150 KHz to 25 MHz on the AC input and DC output power line does not exceed the broad band conducted tadiitfon of NEMA Standard. Refer to paragraph 1.8.1.

1.4.15 Audible Noise: Audible noise at any point five feet from any vertical surface of the rectifier does not exceed 65 dB 'A' weighting conforming to ANSI S1.4. Refer to Paragtaphl.8.1.

1.4.16 Current Walk-in: When the rectifier is turned on, output current gradually increases to no greater than 50% of full load in 2.5 seconds. 75% of full load in 5.0 seconds, and 90% of full load in 8.0 seconds.

1.4.17 Meters: Thii rectifier is equipped with a 3-1/2 inch rectangular type DC voltmeter and ammeter. ±2% accuracy at full scale wfth ranges as follows: Volts; 0 - 75V, Amperes: 0 - 1200A.

1.4.16 Mounting: This rectifier is designed for floor mounting only.

1.4.19 Output Disconnect: An output disconnect switch opens the negative output lead.

1.4.20 Phase Loss/Reduced Load Alarm: If for any reason the rectifier experiences a high ripple condition caused by a AC input loss an alarm is activated and the rectifiers output voltage and current will be at a reduced level. External alarm contacts are provided.

1.421 Rectifier Restart Circuit: This circuit provides automatic restart of the rectifier after the first high voltage shutdown (HVSD). If a second HVSD occurs within five minutes of the first HVSD this circuit will shutdown and lo&out the rectifier.

1.4.22 Auxiliary 46 VDC Terminals (TB1): Screw-type terminals are provided on the rectifier restart assembly for connection of an external DC supply. An external 10 ampere DC supply connected to these terminals will provide power to the AC contactor if battery voltage should drop below pull-up voltage of contactor.

1.5 ENVIRONMENTAL RATINGS

1.5.1 Ambient Operating Temperature Range: 0°C to +50°C (+32°F to +122°F)

1.5.2 Storage Temperature Range: 40°C to +85°C (-40°F to +185°F)

1.53 Humidity: This rectifier is capable of operating in an ambient relative humidity range of 10% to 95%. noncondensing.

1.5.4 Altitude: This rectifier is capable of operating at altitudes from sea level to 10,009 feet at maximum ambient temperatures of +45°C (+113°F) at 4600 fast and +40°C (+104°F) at 7000 feet.

1 .5.5 Ventilation Requirements: The rectifier should be mounted so that ventilating openings are not blocked and temperature of the air entering the cabinet does not exceed +50°C (+122°F).

1.5.6 Heat Dissipation: 11,666 Btu/Hr

1.6 ACCESSORIES: There are no accessories available for use with this rectifier.

1 . 7 MICELLANEOUS

1.7.1 Schematic Diagram: SD546502500

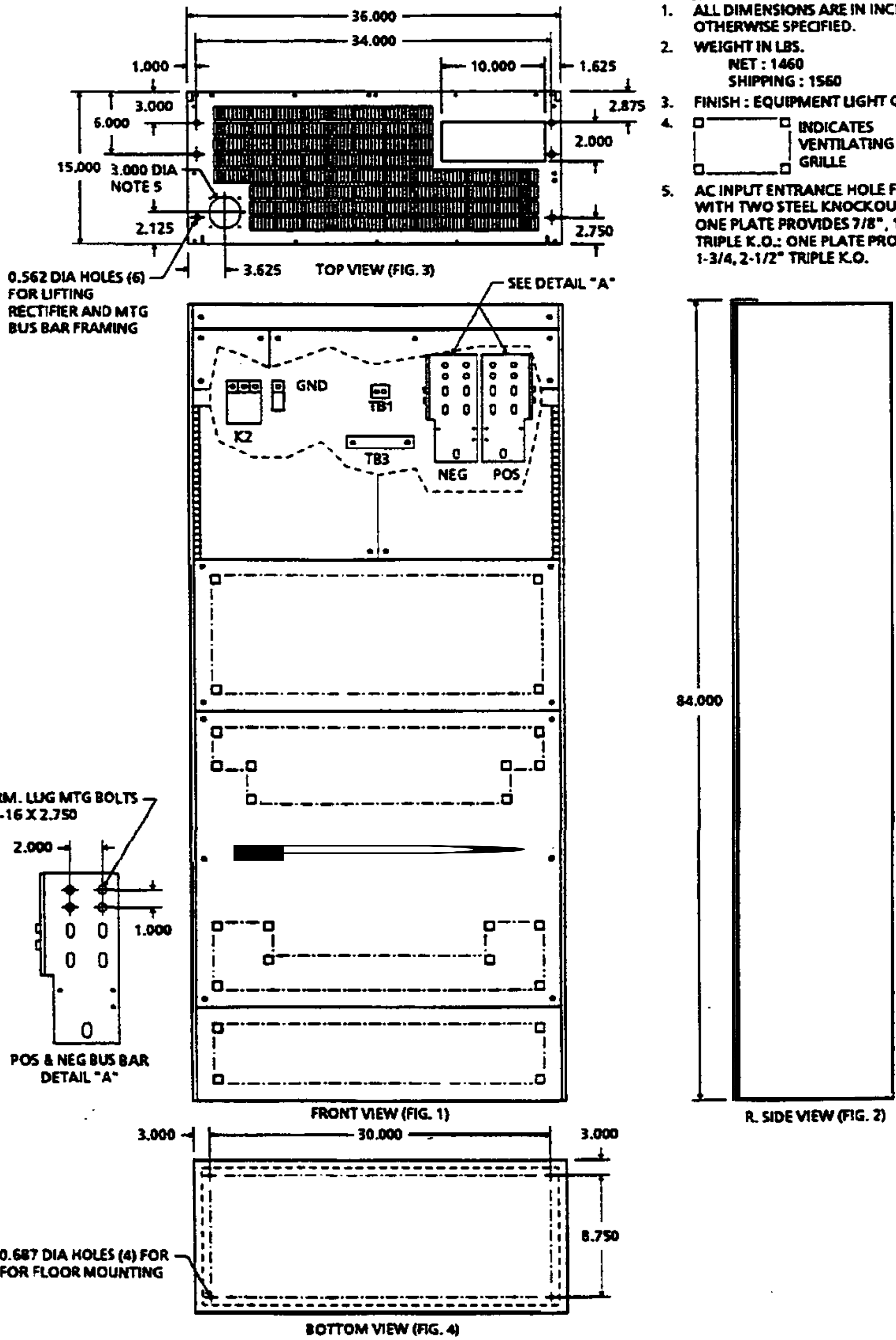
1.7.2 Wiring Diagram: T548502500

1.7.3 Instructions: Section 4367

1.6 SPECIFICATION NOTES

1.8.1 This parameter is guaranteed by Engineering Design and is not production tested.

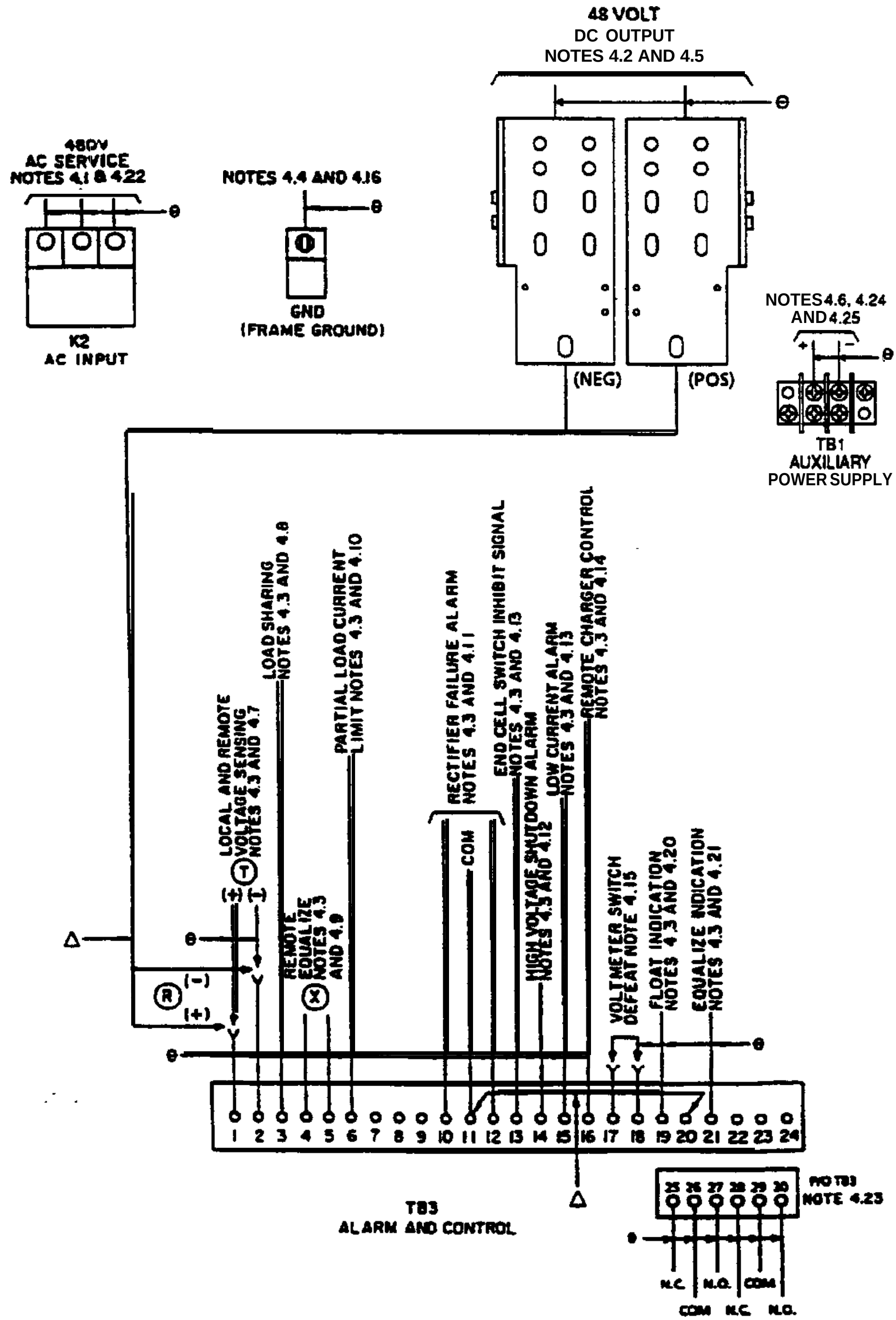
2. DIMENSIONS



NOTES :

1. ALL DIMENSIONS ARE IN INCHES UNLESS OTHERWISE SPECIFIED.
2. WEIGHT IN LBS.
   NET : 1460
   SHIPPING : 1560
3. FINISH : EQUIPMENT LIGHT GRAY.
4. ☐ INDICATES VENTILATING GRILLE
5. AC INPUT ENTRANCE HOLE FURNISHED WITH TWO STEEL KNOCKOUT PLATES. ONE PLATE PROVIDES 7/8", 1-3/8", 2" TRIPLE K.O.; ONE PLATE PROVIDES 1-1/8" 1-3/4, 2-1/2" TRIPLE K.O.

3. INSTALLER'S CONNECTIONS



4. INSTALLER'S INFORMATION NOTES

4.1

AC INPUT (K2)				
Terminals			Wire Size	Recm
Capacity	Type	Recm Torque		
I(6) Ga. to 3/0 Ga. per Phase	Solderless	250 In-Lbs	(1) 3 Ga. per Phase	100 Amp per Phase

4.2

DC OUTPUT				
Terminals			Loop Length FT. (Note 4.5)	Recm Wire Size
Capacity	Type	Recm Torque		
(3) 2 Ga. to 760 MCM per Polarity	Solderless Screw Type	500 In-Lbs	54 77 92 115	(3) 350 MCM (3) 500 MCM (3) 600 MCM (3) 7641 MCM

4.3

ALARM AND CONTROL (TB3)			
Terminals			Recm Wire Size
Capacity	Type	Recm Torque	
16 Ga. Max.	6-32 Screw	8 In-Lbs	16 Ga. Max.

4.4

FRAME GROUND (FR GND)			
Terminals			Recm Wire Size
Capacity	Type	Recm Torque	
14 - 1/0 Ga.	Solderless	50 In-Lbs	8 Ga.

4. INSTALLER'S INFORMATION NOTES

4.5 DC output wire size sufficient to restrict voltage drop to one-half volt or less at 110% of rated full load output current for the bop lengths shown. The loop length is the sum of the lengths of the positive and negative leads.

4.6 Wires sizes based on recommendations of National Electrical Code Table 310-16 for copper wire at 75°C conductor temperature, operating in ambient of 30°C. For operation in ambient higher than 30°C. apply derating factors listed in Table 310-16 of National Electrical Code.

4.7 For remote voltage sensing, remove jumpers (Ⓡ Option) and extend wires from terminals 1 and 2 to the battery (@Option). Extended wires should be fused at 1-1/3 ampere.

4.9 Connect this lead to the load sharing (paralleling) terminal on simii equipped LORAIN RL or RHM Series Rectifiers.

4.9 Extension of customer furnished circuit (Ⓧ Optii) from terminals 4 and 5 permits selection of the rectifier charge mode from a remote location. Closure of a circuit between terminals 4 and 5. while the FLOAT/EQUALIZE switch on the rectifier's in the FLOAT position. will cause the rectifier to supply equalize charge voltage.

4.10 Connection to this terminal permits partial load operation of the rectifier. When positive battery is applied to terminal 6. the rectifier will current limit its output to 66% of full rated current.

4.11 When this rectifier is operating normally, a positive battery rectifier normal indication is present at terminal 12. During a rectifier fail condition, positive battery is removed from terminal I2 and a positive battery rectifier fail indication is provided at terminal 10. If closed loop actuated alarms are desired, remove the jumper between terminals 11 and 20. During a rectifier failure condition, a circuit closes between terminals 10 to 11 and a circuit opens between terminals 11 to 12. The rectifier fail alarm circuit actuated by loss of AC input power, low current alarm, fuse alarm, fan fail or heatsink overtemperature alarm, partial load current limit operation, or manual turn off of the rectifier.

4.12 If the rectifier is shutdown by a high voltage condition, positive battery is furnished at terminal 14.

4.13 Low current alarm condition is indicated try removal of positive battery from terminal 13 (End Cell Switch Inhibit Signal) and positive battery at terminal 15.

4.14 Positive battery applied to terminal 16 when the rectifier POWER ON/OFF switch is in the ON position, will cause the rectifier to start. If remote start/stop is not required, connect a jumper from terminal 16 to terminal 20.

4.15 Voltmeter reads battery voltage with the rectifier turned off if terminals 17 and 18 are connected together.

4.16 This terminal must be connected to earth ground, <u>not</u> power system neutral. Equipment grounding conductor size based on recommendations of National Electrical Code Table 250-95 for copper wire. If aluminum or copper clad aluminum grounding conductor is used, refer to Table 250-95 for increased conductor size.

4.17 θ - indicates wires furnished and connected by the installer.

4.16 Δ - indicates wires furnished as a part of this rectifier.

4.19 Positiie battery is available at terminal 20 of terminal board TB3 for voltage actuated alarms.

420 Positive battery is supplied at terminal 19 of terminal board TB3 when the rectifier is in float mode of operation.

4. INSTALLER'S INFORMATION NOTES

4.21 Positive battery is supplied at terminal 21 of terminal board TB3 when the rectifier is in equalize mode of operation.

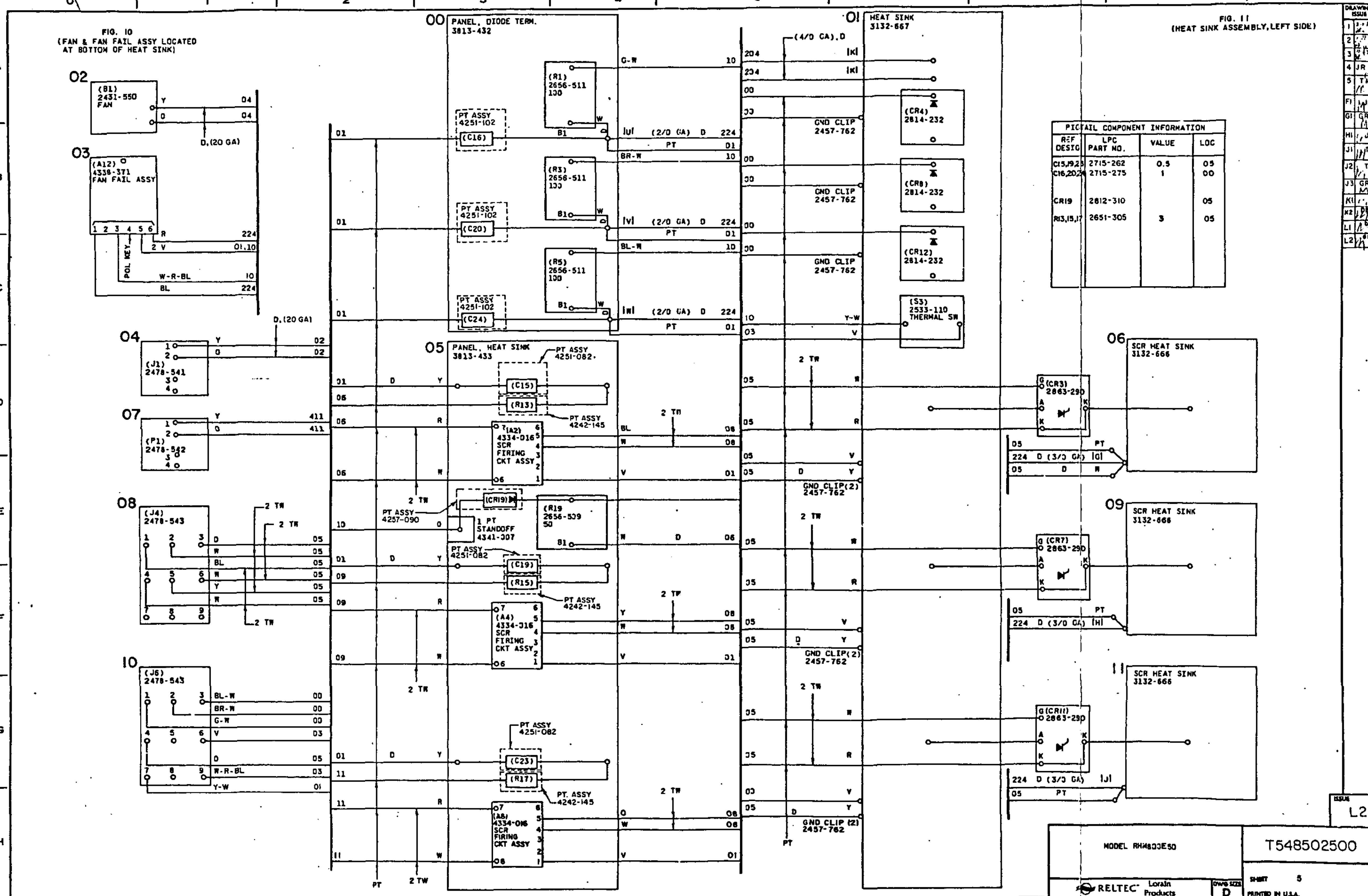
1.22 To shin the phase of the input voltage of the rectifier with respect to the AC line service to tower the cumulative distortion on the AC line when two or more rectifiers are operated in parallel, interchange any two input phases at input line contactor K2. When more than two rectifiers am operated in parallel, interchange any two AC input phases at input line contactor K2 on attemate rectifiers.

4.23 During a Phase Loss/Reduced Load Alarm condition rectifier output voltage and current are at a reduced level and external alarm contacts are activated to provided a closed loop circuits between terminals 26 and 27 and 29 to 30 and open loop circuits between terminals 25 to 26 and 26 to 29.

4.24

AUXILIARY DC POWER TERMINALS (TB1)				
Terminals			Loop Length FT. (Note 4.5)	Recm Wire Size
Capacity	Type	Recm Torque		
14 Ga.	6-32 Non-Captive screw	6 In-Lbs	30	14 Ga.

4.25 An optiil customer furnished 48 volt 10 ampere auxitii power supply can be connected to these two terminals 1 (+) and 2 (-). Connecting a functioning power suppty to these terminals will allow the rectifier to restart automatically after a prolonged AC input power failure. After a pmkmged AC input power failure the system battery may have discharged too low to hetp restart the rectifier. Also if the rectifier system does not include a battery the rectifier will not automatically restart without external power. If an auxiliary power supply is not connected to these terminals the rectifier will not restart automatically after an extended AC input power failure and a restart procedure will have to be performed.



PIGTAIL COMPONENT INFORMATION

REF DESIG	LPC PART NO.	VALUE	LOC
C15,19,23	2715-262	0.5	05
C16,20,24	2715-275	1	00
CR19	2812-310		05
R13,15,17	2651-305	3	05

SD-DRAWING ISSUES & T-DRAWING ISSUES AS FOLLOWS

SD 5485-025
1 2 3 D1 E1 E1 E1 F1 F2

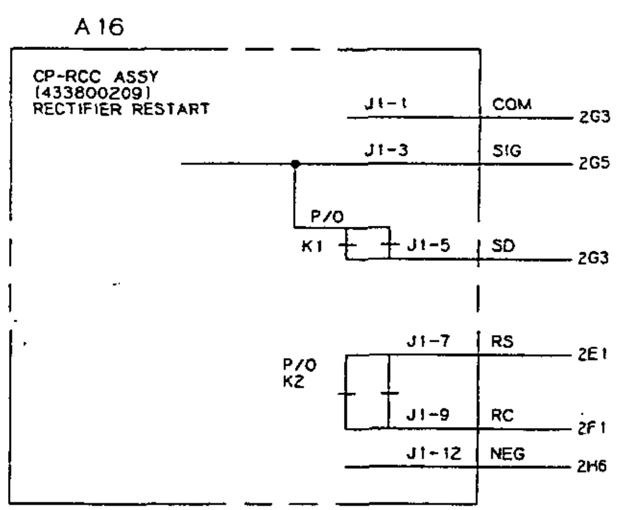
T 5485-025
1 2 3 4 E1 J1 J2 J3 K1 K2

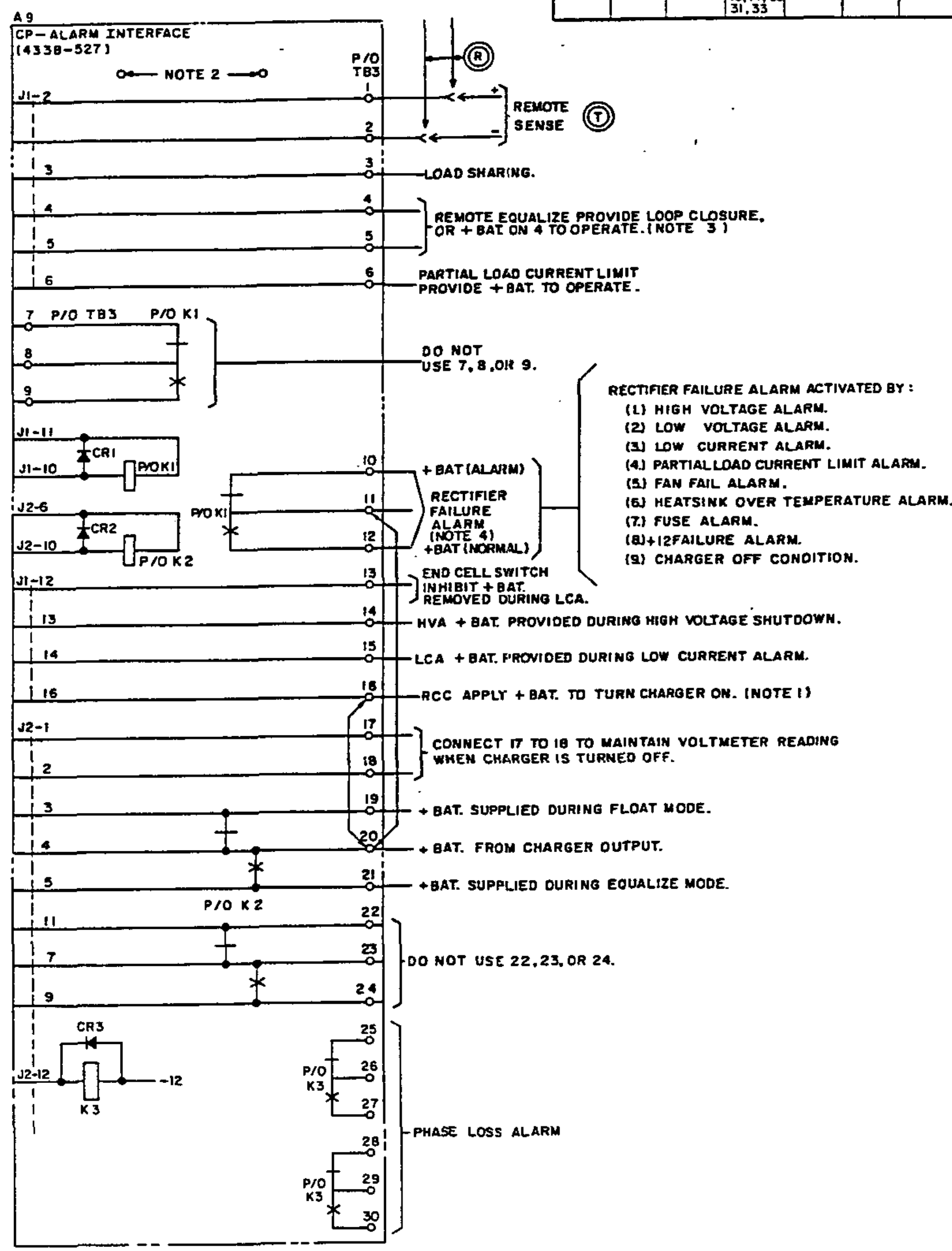
NOTES:

1. IF REMOTE CHARGER CONTROL (RCC) IS DESIRED, DISCONNECT THE JUMPER FROM A9-16 TO A9-20. PROVIDE + BAT ON A9-16 TO TURN CHARGER ON.
2. WHEN REMOTE SENSE (OPTION (T)) IS INSTALLED, STORE LOCAL SENSE WIRES ON THESE TERMINALS.
3. FLOAT / EQUALIZE SWITCH ON CHARGER MUST BE IN FLOAT POSITION FOR OPERATION OF REMOTE EQUALIZE.
4. IF FORM C DRY CONTACTS ARE DESIRED FOR LOOP CLOSURE OR OPENING DURING RECTIFIER FAILURE ALARM OPERATION, REMOVE THE JUMPER FROM A9-20 TO A9-11. WHEN THE RFA IS ACTIVATED, A9-10 TO A9-11 IS CLOSED AND A9-11 TO A9-12 IS OPEN.

CIRCUIT NOTES:

101. UNLESS OTHERWISE SPECIFIED, THE FOLLOWING OPTIONS ARE FURNISHED: (R)
102. FOR OPERATION WITHOUT BATTERY, (M) OPTION MUST BE INSTALLED.





INFORMATION NOTES:

201. UNLESS OTHERWISE SPECIFIED, RESISTANCE VALUES ARE IN OHMS, CAPACITANCE VALUES ARE IN MICROFARADS; VALUES PRECEDED SYMBOL + (PLUS) OR − (MINUS) ARE IN VOLTS.
202. CODES IN PARENTHESES, AS (4865-087) REPRESENT L.P.C. PART NO'S.
203. SEE WIRING DIAGRAM T 5485-025 FOR L.P.C. PART NO. OF COMPONENTS.
204. HIGHEST REF. DESIG. USED ON THIS DWG.

TP	DIODE	METER	CAP.	XFMR.	IND.	FAN	FUSE	CKT.BKR.	RELAY	P.C.ASSY	SWITCH	RESIST.	MOV	PW ASSY
TP2	CR28	M2	C38	T3	L2	B2	F6	CB1	K5	A14	S4	R28	RV3	A15
						NOT USED								
			13, 14, 30, 31, 33											

REVISIONS

1 NEW [illegible]

2 1838161 9-16-83 D.A.C. FAN FAILURE ALARM LED CIRCUITRY ADDED NOV 1 1983

3 1838508 4-17-84 T.F.M. C30, 31 & 33 REMOVED.

CONVERSION TO L.A.M.P.S.

D1 1839754 4-1-87 GRF A11 WAS 4865-644 AND A9 WAS 4338-362

E1 1832076 12-30-91 TJI ISSUE BLOCK UPDATED

F1 1837087 6-9-97 RAH RECTIFIER RESTART CIRCUIT (433800209) ADDED. JUN 16 1997

F2 1896352 6-26-97 DBC DRAWING ISSUES CORRECTED PER J. KIRPATRICK.

181-7241

SCHEMATIC DIAGRAM FOR MODEL RHM 800E50

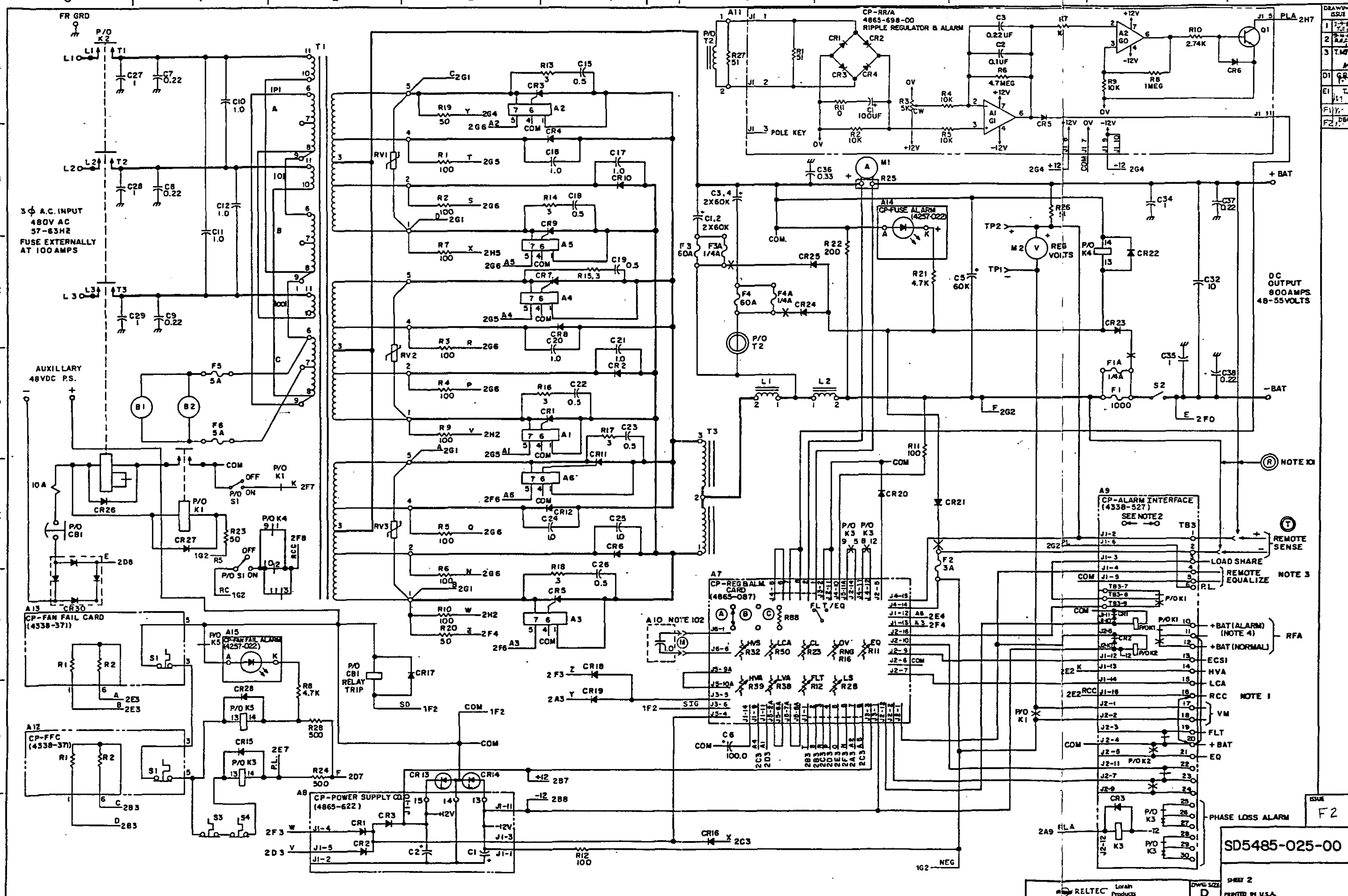
DESIGN J. RADER | ISS. F2
DRAWN BY T IVAN | DATE 2-9-83
CHECKED BY | DATE
APPROVED BY | DATE 4/4/83
RATING STANDARD

RELTEC Lorain Products

DWG SIZE D

SD5485-025-00

SHEET 1 OF 2


3Φ A.C. INPUT
480V AC
57-63HZ
FUSE EXTERNALLY
AT 100 AMPS
AUXILLARY
48VDC P.S.
FR GRD
CP-RR/A
4865-698-00
RIPPLE REGULATOR & ALARM
CP-FUSE ALARM
(4257-022)
DC
OUTPUT
800AMPS
48-55VOLTS
+BAT
-BAT
REG
VOLTS
NOTE 101
CP-ALARM INTERFACE
(4338-527)
SEE NOTE 2
REMOTE
SENSE
LOAD SHARE
REMOTE
EQUALIZE
NOTE 3
+BAT(ALARM)
(NOTE 4)
+BAT(NORMAL)
RFA
ECSI
HVA
LCA
RCC
NOTE 1
VM
FLT
+BAT
EQ
PHASE LOSS ALARM
CP-REG&ALM CARD
(4865-087)
A10 NOTE 102
CP-FAN FAIL CARD
(4338-371)
CP-FAN FAIL ALARM
(4257-022)
CP-FFC
(4338-371)
CP-POWER SUPPLY CD
(4865-622)
P/O CB1 RELAY TRIP
SD5485-025-00
ISSUE F2
SHEET 2
PRINTED IN U.S.A.
DWG SIZE D
RELTEC Lorain Products

COMPONENT LIST

RESISTOR

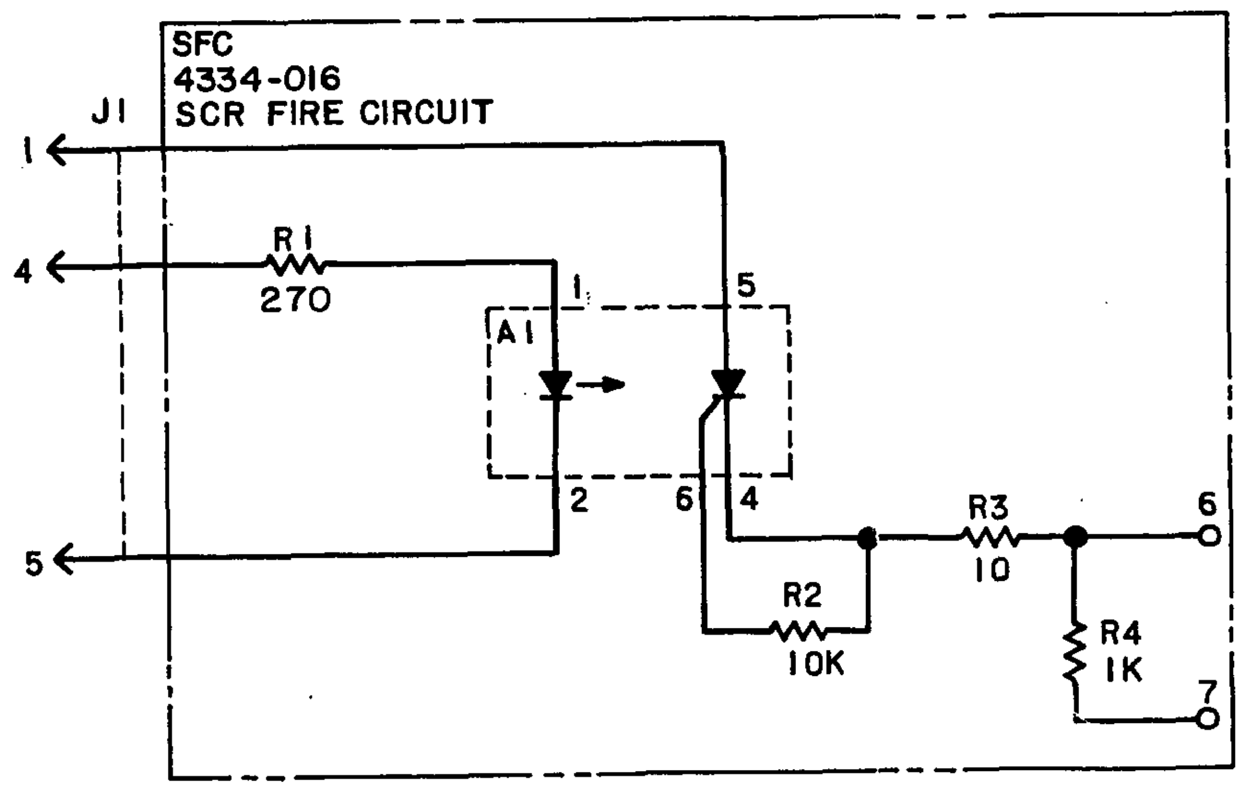
DESIG	CODE	
R1	(2615-249)	270 OHM, 1/2W
R2	(2615-287)	10K, 1/2W
R3	(2615-215)	10 OHM, 1/2W
R4	(2651-335)	1K, 3W

INTEGRATED CIRCUIT

DESIG	CODE
A1	(2857-106)

MANUFACTURING REFERENCE

CATEGORY	NUMBER
ASSEMBLY DRAWING	4334-016
P.W. BOARD	3158-178
CONNECTOR ON FRAME	2478-552



CIRCUIT DESCRIPTION

THIS CIRCUIT PROVIDES AN ISOLATED GATE SIGNAL FOR FIRING SCRS.
THE SIGNAL IS GENERATED BY A PHOTO SCR WHEN A CURRENT OF 20 MA IS PASSED THROUGH PINS 4 AND 5

NOTES:

1. UNLESS OTHERWISE SPECIFIED, RESISTANCE VALUES ARE IN OHMS.
2. CODES WITHIN PARENTHESES, AS (2615-257) REPRESENT LPC PART NUMBERS.

REVISIONS

ISS. NO.	CHGD BY / CHG SLIP NO.	DATE	DESCRIPTION
1			NEW
2	1835995 L.D.	5 3 76	CONNECTOR WAS 2465-612.
			R1 WAS 2615-257, 560 OHM ISS NO.3 M836293 D.S. 8-26-76
3	RM	4-8-81	D.A.C. SPELLING CORRECTION

DRAWN BY	J. REESE	DATE	2-17-76
CHECKED BY		DATE	2-18-76
APPROVED BY	D. J. Becker	DATE	2/23/76
APPROVED BY		DATE	2.23.76

SCR FIRE CIRCUIT

RELTEC Lorain Products

DWG SIZE B

SD-4334-016

SHEET 1 OF 1

PRINTED IN USA

LP428

REVISIONS

ISS NO.	CHG SLIP NO. CHGD BY	DATE	DESCRIPTION
1			NEW, WAS 181-7088, ISS. 1

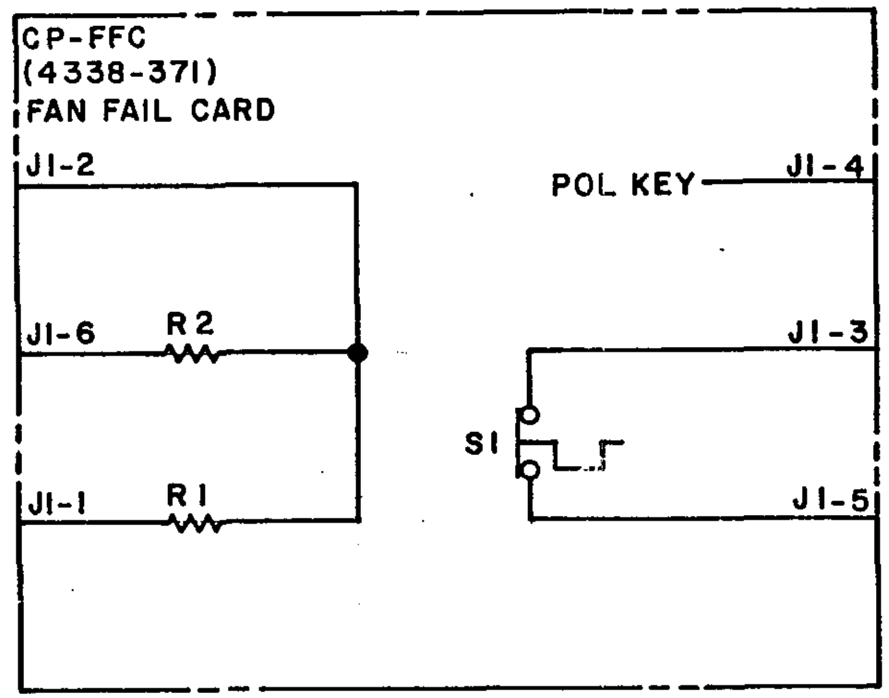
COMPONENT LIST

RESISTORS

	DESIG	CODE
(2)	R1,2	(2651-544)

SWITCH

DESIG	CODE
S1	(2573-106) THERMAL



CIRCUIT DESCRIPTION

APPLY APPROXIMATELY 60 VAC TO EACH RESISTOR, R1 AND R2.
WHEN AIR IS FLOWING OVER THE CIRCUIT BOARD, SWITCH S1 IS KEPT COOL. IF AIR FLOW CEASES, S1 IS HEATED TO ITS OPERATING TEMP. AND OPENS.
S1 IS RATED FOR .5 AMPS AT 120 VAC.

MANUFACTURING REFERENCES

CATEGORY	NUMBER
ASSEMBLY DRAWING	4338-371
P. W. BOARD	3155-634
CONNECTOR ON FRAME	2478-552

TOOL RECORD

LP329 78 PRINTED IN U.S.A.

FIRST USED ON	NEXT ASSY		SIZE B
	MODEL NO.		

RELTEC Lorain Products

SCHEMATIC DIAGRAM FOR FAN FAIL CARD

MATERIAL:

FINISH:

DESIGN	S. HUSSEY	6-25-79
DRAWN	J. TUTTLE	7-10-79
CHECKED	S. Hussey	7-20-79
CHECKED	S. Hussey	7-20-79
APPROVED	R P	7-20-79

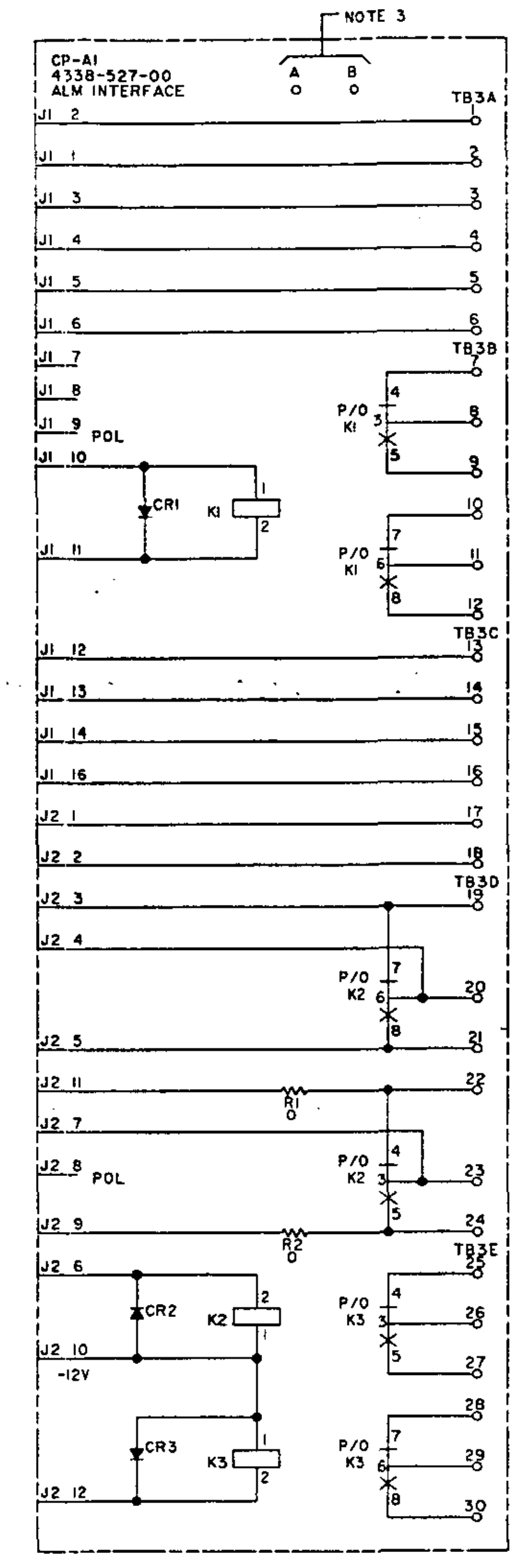
UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES TOLERANCE ON FRACTIONS ±1/32 DECIMALS ±0.031 ANGLES ±1.5°

DO NOT SCALE DWG SCALE: 0

SD 4338-371

SHEET 1 OF 1

UNIT QTY.	REF. DESIG.	PART NO.	PART DESCRIPTION
3	K1	2543-45900	RELAY, 12VDC
	K2	2543-45900	RELAY, 12VDC
	K3	2543-45900	RELAY, 12VDC
2	R1	2668-60100	0 1/4W
	R2	2668-60100	0 1/4W
3	CR1	2812-31000	1N4818
	CR2	2812-31000	1N4818
	CR3	2812-31000	1N4818



MANUFACTURING REFERENCES

CATEGORY	NUMBER
ASSEMBLY DRAWING	4338-527-00
P.W.BOARD	3156-26700
CONNECTOR ON FRAME	

ISSUE CHANGES			REVISIONS
A1	MAR 9 1987	BP	M

NOTES

1. UNLESS OTHERWISE SPECIFIED, RESISTANCE VALUES ARE IN OHMS, CAPACITANCE VALUES ARE IN MICROFARADS. VALUES PRECEDED BY THE SYMBOL +(PLUS) OR -(MINUS) ARE IN VOLTS
2. CODES SHOWN AS, 2534-524-00 REPRESENT LORAIN PART NUMBERS
3. TERMINALS A AND B ARE DEAD END TERMINALS.

1817414-002	CADD
SCHEMATIC DIAGRAM FOR ALARM INTERFACE	
RELTEC Lorain Products	D
L.IDEMOTO	A1
T.F.MAURER	12-10-86
T.F.MAURER	2-17-87
	3-7-87
	3/9/87
STANDARD	
SD4338-527-00	
SHEET 1 OF 1	

COMPONENT LIST

CAPACITOR

DESIG	CODE
C1	(2751-112) 22UF, 50V DC, ELECT.
(2)C4,10	(2713-224) 0.033UF, 200V DC
C5	(2713-132) 0.1UF, 100V DC
(2)C7,8	(2713-127) 0.047UF, 100V DC
C9	(2715-123) 1.5UF, 100V DC
(6)C11-18	(2713-246) 0.33UF, 200V DC
(2)C19,21	(2713-118) 0.01UF, 100V DC
C20	(2715-274) 1.0UF, 200V DC
(6)C22,25,26,33,36,37	(2724-137) 4700PF, 500V DC
C23	(2724-125) 220PF, 500V DC
C24	(2713-221) 0.022UF, 100V DC
(6)C27-32	(2724-139) 1000PF, 1000V DC
C35	(2713-152) 0.47UF, 100V DC
(4)C2,3,6,34	(2737-139) 22UF, 35V DC, ELECT.

DIODE

DESIG	CODE
(11)CR1,2,4,8-10,14-18	(2811-101)
(2)CR3,11	(2835-325) 6.2V, 0.4W, ZENER
CR5	(2835-543) 9.1V, 1W, ZENER
(3)CR6,7,12	(2812-310)
CR13	(2861-079)
(2)CR19,20	(2836-212) 12V, 1W, ZENER
CR21	(2834-525) 4.7V, 4W, ZENER
(2)LED1,2	(2818-124)
LED3	(2818-131)
LED4	(2818-141)

INTEGRATED CIRCUIT

DESIG	CODE	
(3)A1,2,3	(2871-205) QUAD COMPARATOR	
(3)A4,5,7	(2871-115) QUAD OP-AMP	
A6	(2871-119) OP-AMP	
A8	(2875-401) TRANSISTOR ARRAY	
A9	(2881-214) RESISTOR ARRAY, 75K, 1Ø	FOR 24V MODELS
A9	(2881-211) RESISTOR ARRAY, 100K, 3Ø	FOR 48V MODELS
A9	(2881-212) RESISTOR ARRAY 150K, 1Ø	FOR 48V MODELS
A10	(2881-212) RESISTOR ARRAY	
A11	(2881-209) RESISTOR ARRAY	
(2)A12,13	(2881-213) RESISTOR ARRAY	
A14	(2881-206) RESISTOR ARRAY	
A15	(2881-208) RESISTOR ARRAY	
A16	(2881-207) RESISTOR ARRAY	
(2)A17,18	(2871-103) OP-AMP	
A19	(2881-218) RESISTOR ARRAY	

RELAY

DESIG	CODE
K1	(2542-174)

RESISTOR

DESIG	CODE
R1	(2635-632) 1.43K, 1W, 1%
R2	(2635-556) 143 OHM, 1W, 1%
(2)R3,4	(2635-717) 100K, 1W, 1%
R5	(2635-703) 51.1K, 1W, 1%
R6	(2615-357) 8.2MEGO, 1/2W
R7	(2615-303) 47K, 1/2W
R8	(2615-225) 22 OHM, 1/2W
(2)R9,83	(2615-255) 470 OHM, 1/2W
R10	(2635-682) 16.2K, 1W, 1%
(3)R11,12,23	(2675-118) 5K, 1/2W, POT.
(3)R13,64,74	(2635-639) 2050 OHM, 1W, 1%
R14	(2615-335) 1 MEGO, 1/2W
(2)R15,53	(2635-610) 511 OHM, 1W, 1%
(3)R28,32,39	(2675-111) 500 OHM, 1/2W, POT.
R17	(2635-659) 5110 OHM, 1W, 1%
R18	(2635-744) 332K, 1W, 1%
R19	(2635-653) 3320 OHM, 1W, 1%
R20	(2635-563) 182 OHM, 1W, 1%
(3)R21,26,36	(2635-668) 8060 OHM, 1W, 1%
(2)R22,27	(2635-795) 1.47 MEGO, 1W, 1%
R24	(2615-271) 2.2K, 1/2W
R25	(2615-343) 2.2 MEGO, 1/2W
R29	(2615-247) 220 OHM, 1/2W
R30	(2615-273) 2.7K, 1/2W
R31	(2635-621) 665 OHM, 1W, 1%
R67	(2635-655) 3.92K, 1W, 1%
R34	(2615-267) 1.5K, 1/2W
(5)R35,57,58,59,63	(2615-263) 1K, 1/2W
R38	(2675-114) 2K, 1/2W, POT.
(2)R40,77	(2635-622) 825 OHM, 1W, 1%
(2)R41,45	(2615-319) 220K OHM, 1/2W
(4)R42,46,48,61	(2615-279) 4.7K, 1/2W

RESISTOR'S CONT.

DESIG	CODE
(3)R43,44,82	(2615-257) 560 OHM, 1/2W
R49	(2635-693) 27.4K, 1W, 1%
R50	(2675-120) 10K, 1/2W, POT.
R51	(2635-737) 255K, 1W, 1%
(2)R52,62	(2615-299) 33K, 1/2W
(2)R47,86	(2635-673) 10K, 1W, 1%
(3)R54,55,68	(2635-624) 1.0K, 1W, 1%
R37	(2635-623) 909 OHM, 1W, 1%
R60	(2615-275) 3.3K, 1/2W
(2)R65,69	(2635-633) 1.47K, 1W, 1%
R66	(2635-665) 6.81K, 1W, 1%
R70	(2615-311) 100K, 1/2W
R71	(2615-289) 12K, 1/2W
R72	(2635-702) 47.5K, 1W, 1%
(2)R73,76	(2615-287) 10K, 1/2W
R16	(2675-113) 1K, 1/2W, POT.
R75	(2635-501) 10, 1W, 1%
R56	(2635-696) 33.2K, 1W, 1%
R78	(2635-666) 7150 OHM, 1W, 1%
R80	(2635-632) 1.43K, 1W, 1%
R81	(2635-627) 1.1K, 1W, 1%
R84	(2635-626) 1.13K, 1W, 1%
(2)R33,85	(2635-638) 1.96K, 1W, 1%
R79	(2634-662) 18.2K, 1/4W, 1%

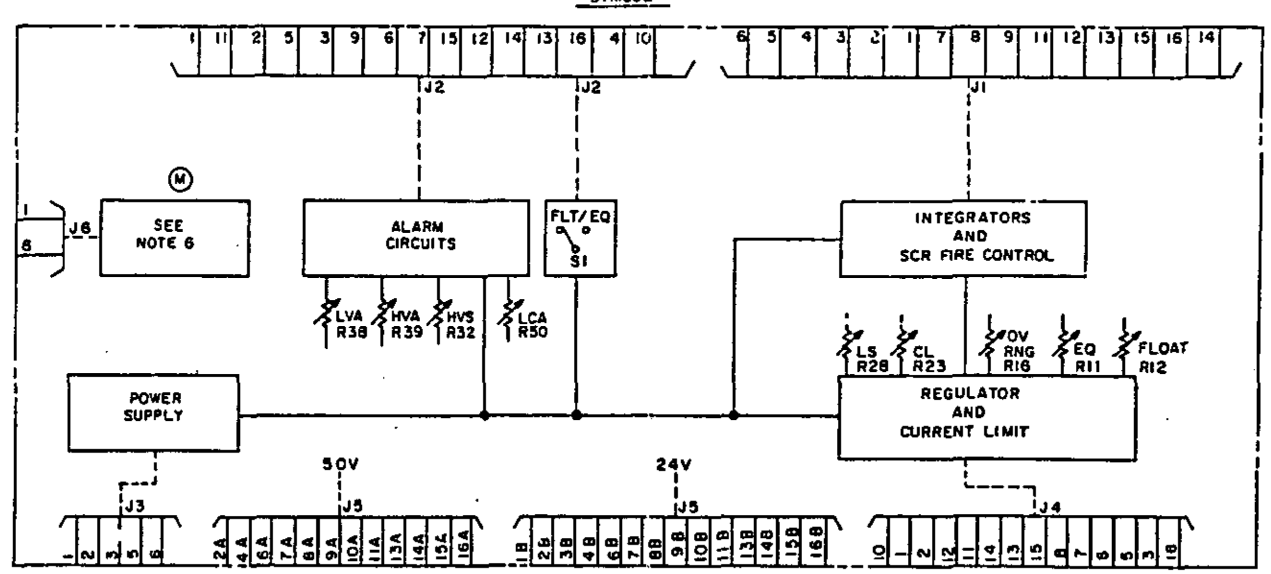
SWITCH

DESIG	CODE
S1	(2513-402)

TRANSISTOR

DESIG	CODE
Q1	(2844-005)
Q2	(2843-097)
(3)Q4-6	(2843-110)
(4)Q7,8,10,11	(2841-038)
Q9	(2841-100)
Q3	(2843-103)

SYMBOL



MANUFACTURING REFERENCES	
CATEGORY	NUMBER
ASSEMBLY DRAWING	4865-087
P.W. BOARD	3158-545
CONNECTOR ON FRAME	NONE
FF FIX. NO. 6787-502	

CIRCUIT DESCRIPTION

THIS CIRCUIT CONTAINS THE REGULATOR AND ALARM CIRCUITRY TO PROVIDE ALL REGULATOR AND ALARM FUNCTIONS FOR ALL 1Ø AND 3Ø RECTIFIERS.

THE REGULATOR CONTAINS VOLTAGE REGULATION CAPABILITY AND CURRENT LIMIT CIRCUITRY.

THE ALARMS CONSISTS OF: (A) HIGH VOLTAGE ALARM (B) LOW VOLTAGE ALARM. (C) LOW CURRENT ALARM AND (D) HIGH VOLTAGE SHUTDOWN.

THE VOLTAGE RANGES OF THE ALARMS AND REGULATOR ARE SELECTED WITH AN EXTERNAL PROGRAM PLUG (J5) AND A SELECTED RESISTOR NETWORK A9 TERMINALS OF J5A ARE USED WITH 24V RECTIFIERS.

NOTES:

1. UNLESS OTHERWISE SPECIFIED, RESISTANCE VALUES ARE IN OHMS, CAPACITANCE VALUES ARE IN MICROFARADS: VALUES PRECEDED BY THE SYMBOL +(PLUS) OR -(MINUS) ARE IN VOLTS.
2. CODES WITHIN PARENTHESES, AS (2737-139) REPRESENT LPC PART NUMBERS.
3. (A) JUMPER IS REMOVED WHEN EXTERNAL CONTROL OF THE K1 RELAY IS REQUIRED.
4. (B) JUMPER (STANDARD) IS FOR CIRCUIT FLEXABILITY.
5. (C) RESISTOR (STANDARD) IS FOR SELECTIVE HIGH VOLTAGE SHUTDOWN (REMOVAL WILL DEFEAT SELECTIVE HV).
6. (M) OFF BATTERY CAPACITOR ASSEMBLY OPTION. (4251-018).

REVISIONS

REV	DESCRIPTION
5	1837320, 1837527, 1837573 — CAPACITOR LIST UPDATED — JUL 21 1991
5 RM	11-5-81 J.R. — DESIGN. UPDATED ON SYMBOL — NOV 5 1981
6	1837755 3-2-82 D.A.C. — (C) OPTION CHANGED TO RESISTOR — MAR 11 1982
	CONVERSION TO LAMPS
G1	1839821 3-13-87 J.R. — K1 WAS 2543-405; R34 WAS 2615-269, 1.8K
H1	1830052 8/28/87 R.L. — S1 WAS 2513-453
J1	1831510 10-31-90 JR — Q2 WAS 2843-099
K1	1832745 1-29-93 TJ1 — K1 WAS 2543-437
K2	1893506 2-17-94 TJ1 — NOTE 3 CHANGED PER J. RADER — FEB 23 1994
L1	1834656 10-31-94 TJ1 — Q1 WAS 2843-102

PROJECT NO. 184-3422

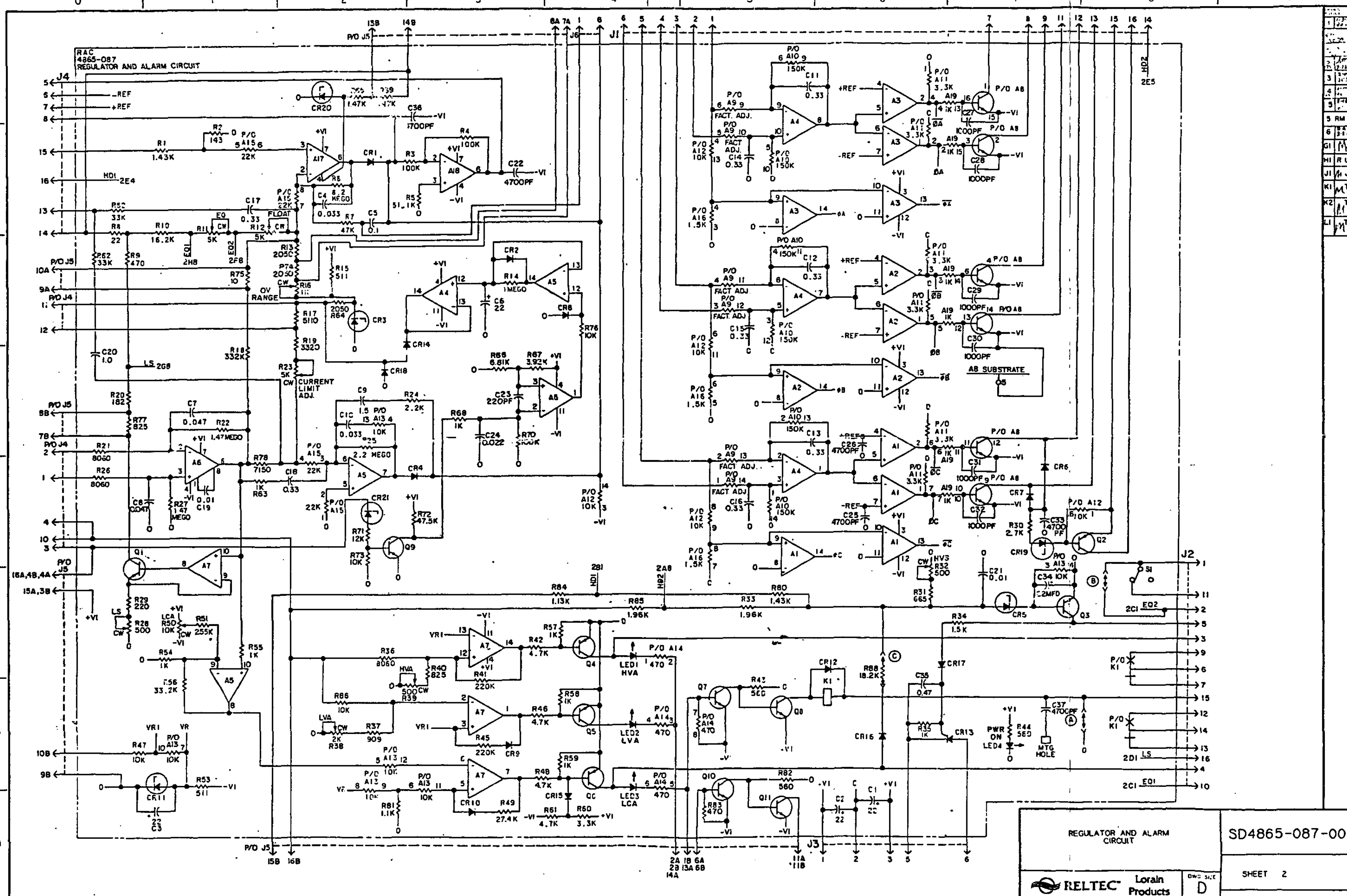
REGULATOR AND ALARM CIRCUIT

J. GIANCATERINO		L1
J. REESE		1-31-77
J.J.J.		3-11-77
GIANCATERINO		5-17-77
R. PLOW		5-19-77
STANDARD		

RELTEC Lorain Products — D

SD-4865-087-00

SHEET 1 OF 2


RAC
4865-087
REGULATOR AND ALARM CIRCUIT
REGULATOR AND ALARM CIRCUIT
SD4865-087-00
RELTEC
Lorain Products
DWG SIZE D
SHEET 2

UNIT QTY.	REFERENCE DESIGNATOR	PART NUMBER	PART DESCRIPTION	
3	13,14,15	245773200	MINI-PIN	
1	C1	273116700	330UF	50VDC,ELECT
1	C2	273122500	1100UF	40VDC,ELECT
3	CR1,CR2,CR3	281233000	1N4820	

MANUFACTURING REFERENCES

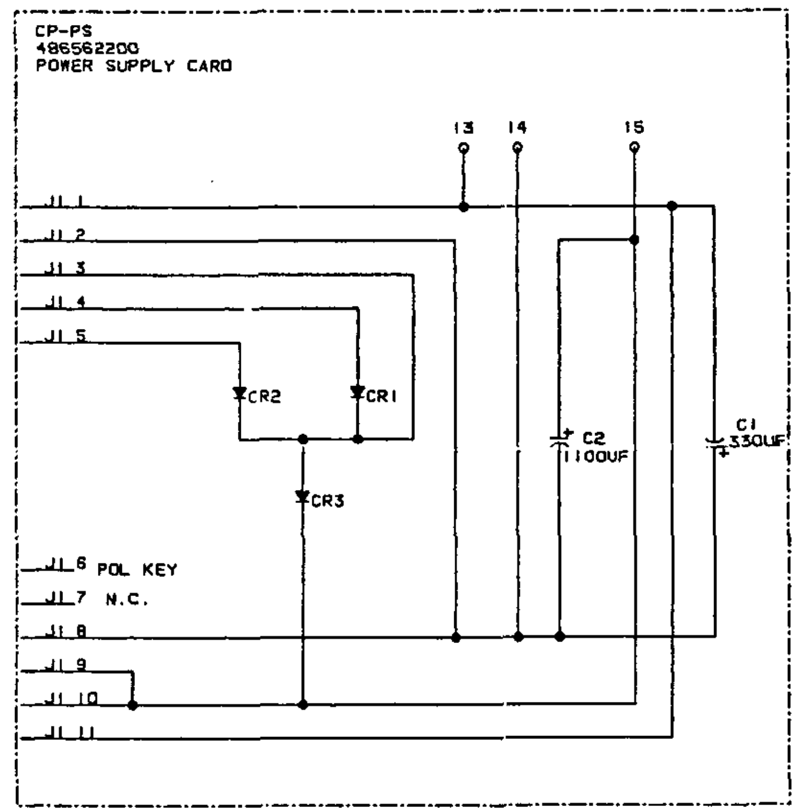
CATEGORY	NUMBER
ASSEMBLY DRAWING	486562200
P.W. BOARD	315619700
CONNECTOR ON FRAME	247855800

ISSUE CHANGES & REVISIONS

REV	CHG SLIP NO / CHKD BY	DATE	DESCRIPTION
1	(M) NEW	RM 5-19-77	CONVERSION TO LAMPS
A2	1883171	10-16-93 TJI	C1 DESCRIPTION CHANGED PER J.RADER. J.WAUGH 10-27-93 OCT 29,1993 BP (M)
B1	1836366	6-28-96 TJI	C1 WAS 2731-16600. DWG PUT ON CAD SYSTEM. LR Szabo 8-7-96 K Hummel 8-7-96 (PRN) AUG 07 1996 B 7/4

CPS-PS
(POWER SUPPLY)

SYMBOL
SHOWN IN DETAIL IN FS



CIRCUIT DESCRIPTION

THIS CARD CONTAINS RECTIFIERS AND FILTERS FOR A ±12V POWER SUPPLY.

NOTES

1. UNLESS OTHERWISE SPECIFIED, RESISTANCE VALUES ARE IN OHMS, CAPACITANCE VALUES ARE IN MICROFARADS, VALUES PRECEDED BY THE SYMBOL +(PLUS) OR -(MINUS) ARE IN VOLTS.
2. CODES SHOWN AS, 283462400 REPRESENT LORAIN PART NUMBERS.
3. PART DESCRIPTIONS ARE FOR REFERENCE ONLY AND REPRESENT ONE MANUFACTURER'S PART NUMBER. REFER TO LP PARTS SYSTEM FOR COMPLETE, CURRENT INFORMATION.

1817009	CADDST
DESIGN	J.GIANCATERINO
ISS	B1
DRAWN BY	D.CHEVALIER — DATE 2-17-77
CHECKED BY	JJJ — DATE 3-11-77
CHECKED BY	J.A.GIANCATERINO — DATE 3-14-77
APPROVED BY	R.PLOW — DATE 4-6-77
RATING	STANDARD

SCHEMATIC DIAGRAM
FOR
POWER SUPPLY CARD

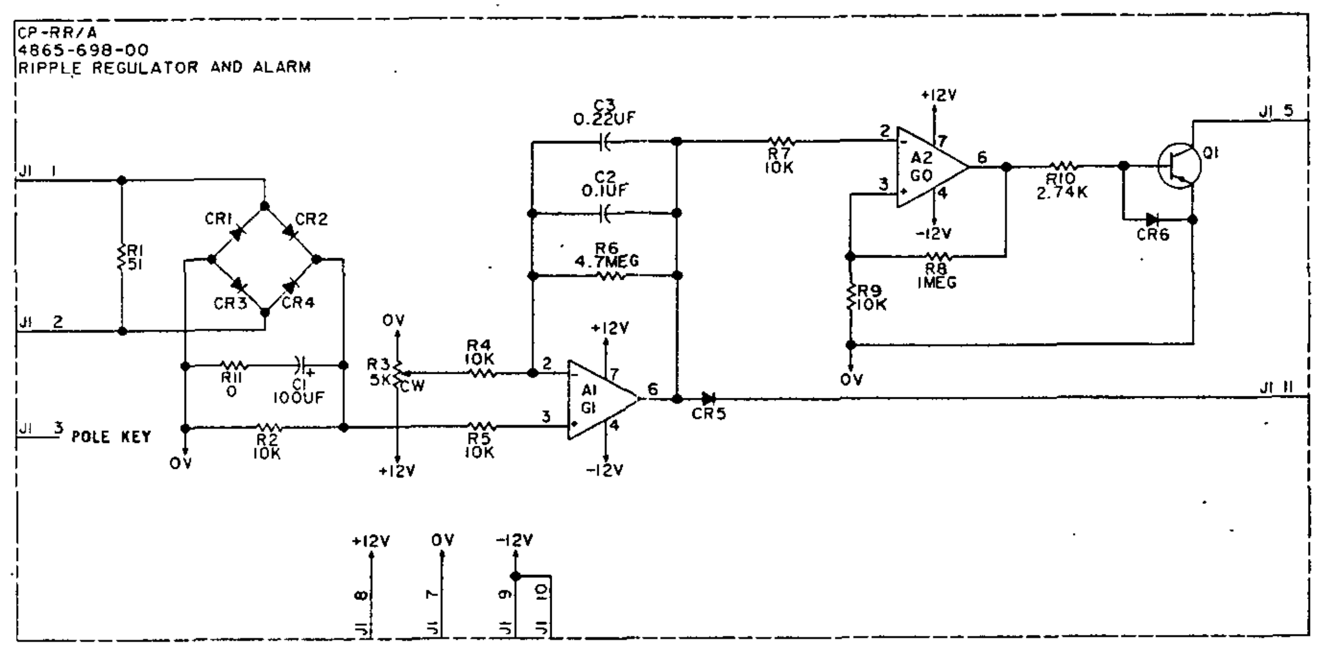
RELTEC Lorain Products

DWG SIZE D

SD486562200

SHEET 1 OF 1

UNIT QTY.	REF. DESIG.	PART NO.	PART DESCRIPTION	
1	R6	2615-35100	4.7MEG	1/2W
1	R10	2634-61900	2.74K	1/4W
5	R2	2634-64800	10K	1/4W
	R4	2634-64800	10K	1/4W
	R5	2634-64800	10K	1/4W
	R7	2634-64800	10K	1/4W
	R9	2634-64800	10K	1/4W
1	R8	2634-74500	1MEG	1/4W
1	R1	2651-14800	51	3W
1	R11	2658-60100	0	1/4W
1	R3	2675-11800	5K	1/2W. POT
1	C2	2724-50900	0.1UF	50VDC
1	C3	2724-59700	0.22UF	50VDC
1	C1	2731-13000	100UF	16VDC. ELECT.
6	CR1	2812-31000	1N4818	
	CR2	2812-31000	1N4818	
	CR3	2812-31000	1N4818	
	CR4	2812-31000	1N4818	
	CR5	2812-31000	1N4818	
	CR6	2812-31000	1N4818	
1	Q1	2843-11000	2N5400	
2	A1	2871-10300	741C	
	A2	2871-10300	741C	



MANUFACTURING REFERENCES

CATEGORY	NUMBER
ASSEMBLY DRAWING	4865-698-00
P.W.BOARD	3158-04200
CONNECTOR ON FRAME	

ISSUE CHANGES			REVISIONS
A1	MARCH 9 1987	BP	M

NOTES

1. UNLESS OTHERWISE SPECIFIED, RESISTANCE VALUES ARE IN OHMS, CAPACITANCE VALUES ARE IN MICROFARADS. VALUES PRECEDED BY THE SYMBOL +(PLUS) OR -(MINUS) ARE IN VOLTS
2. CODES SHOWN AS. 2615-351-00 REPRESENT LORAIN PART NUMBERS

1817414-CD1 CADD

SCHEMATIC DIAGRAM
FOR
RIPPLE REGULATOR AND ALARM

RELTEC Lorain Products

D

	L.IDEMOTO		A1
DRAWN BY	D.CHEVALIER	DATE	11-18-86
DESIGNED BY	T.F.MAURER	DATE	2-17-87
CHECKED BY	L.IDEMOTO	DATE	3-9-87
APPROVED	[signature]	DATE	3/9/87
	STANDARD		

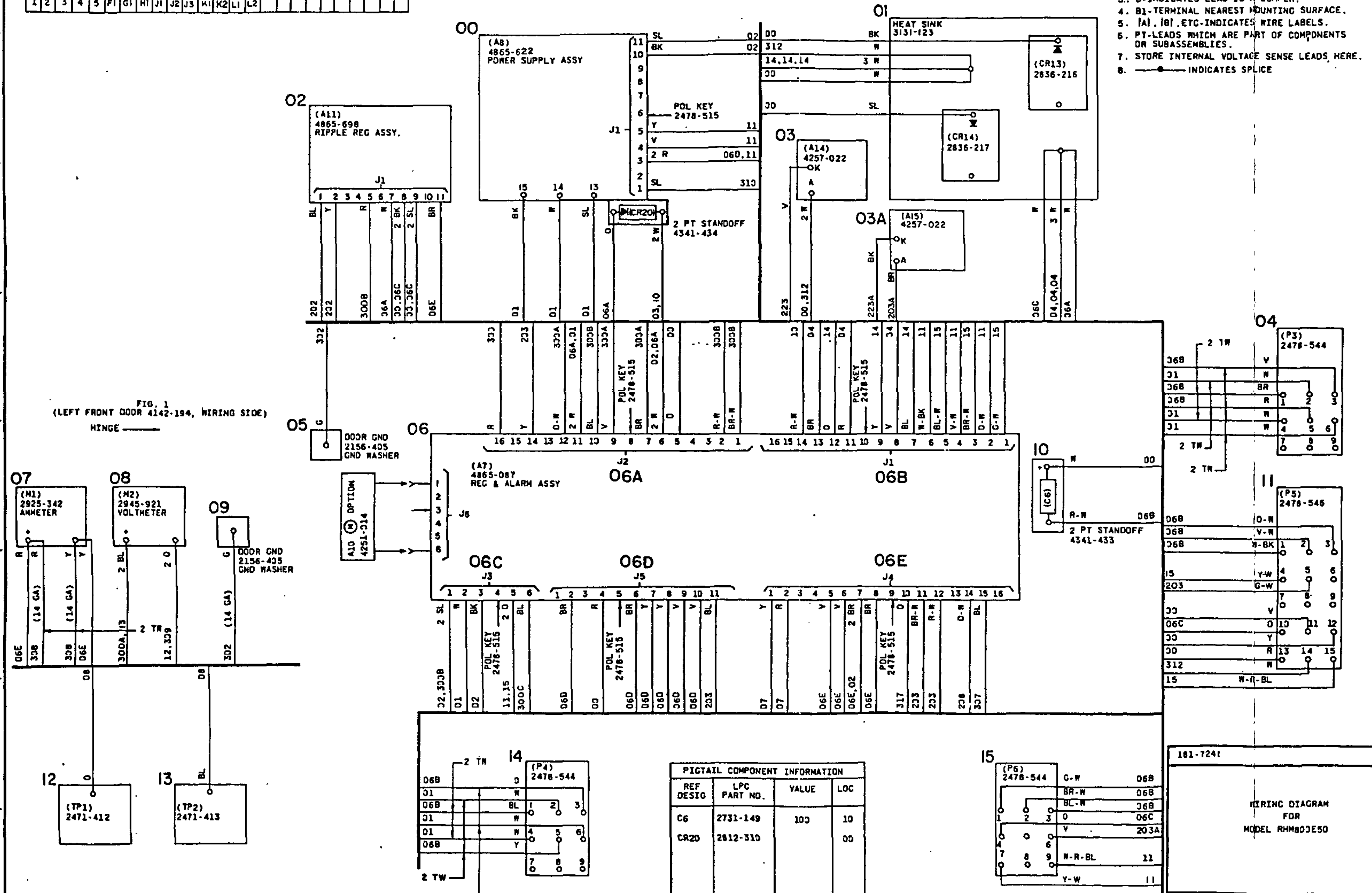
SD4865-698-00

SHEET 1 OF 1

SD-DRAWING ISSUES AND T-DRAWING ISSUES AS FOLLOWS:														
SD-DRAWING ISSUES														
1	2	2	3	3	D1	D1	D1	E1	E1	F1	F2	F2	F2	
T-DRAWING ISSUES														
1	2	3	4	5	F1	G1	H1	J1	J2	J3	K1	K2	L1	L2

FIG. 2
(RIGHT FRONT DOOR 4142-191, WIRING SIDE)

FIG. 1
(LEFT FRONT DOOR 4142-194, WIRING SIDE)



MANUFACTURING NOTES:
1. ALL WIRING TO BE 22 GA UNLESS OTHERWISE SPECIFIED.
2. UNLESS OTHERWISE SPECIFIED, RESISTANCE VALUES ARE IN OHMS, CAPACITANCE VALUES ARE IN MICROFARADS.
3. D-INDICATES LEAD IS A JUMPER.
4. B1-TERMINAL NEAREST MOUNTING SURFACE.
5. [A], [B], ETC-INDICATES WIRE LABELS.
6. PT-LEADS WHICH ARE PART OF COMPONENTS OR SUBASSEMBLIES.
7. STORE INTERNAL VOLTAGE SENSE LEADS HERE.
8. ——•—— INDICATES SPLICE

REVISIONS

L2 1896563 12-16-97 DGC
2561140000 WAS 263113900 SH1
PER B. KRANYIK.
JAN 13 1998

PIGTAIL COMPONENT INFORMATION			
REF DESIG	LPC PART NO.	VALUE	LOC
C6	2731-149	100	10
CR20	2812-310		00

181-7241

WIRING DIAGRAM
FOR
MODEL RHM800E50

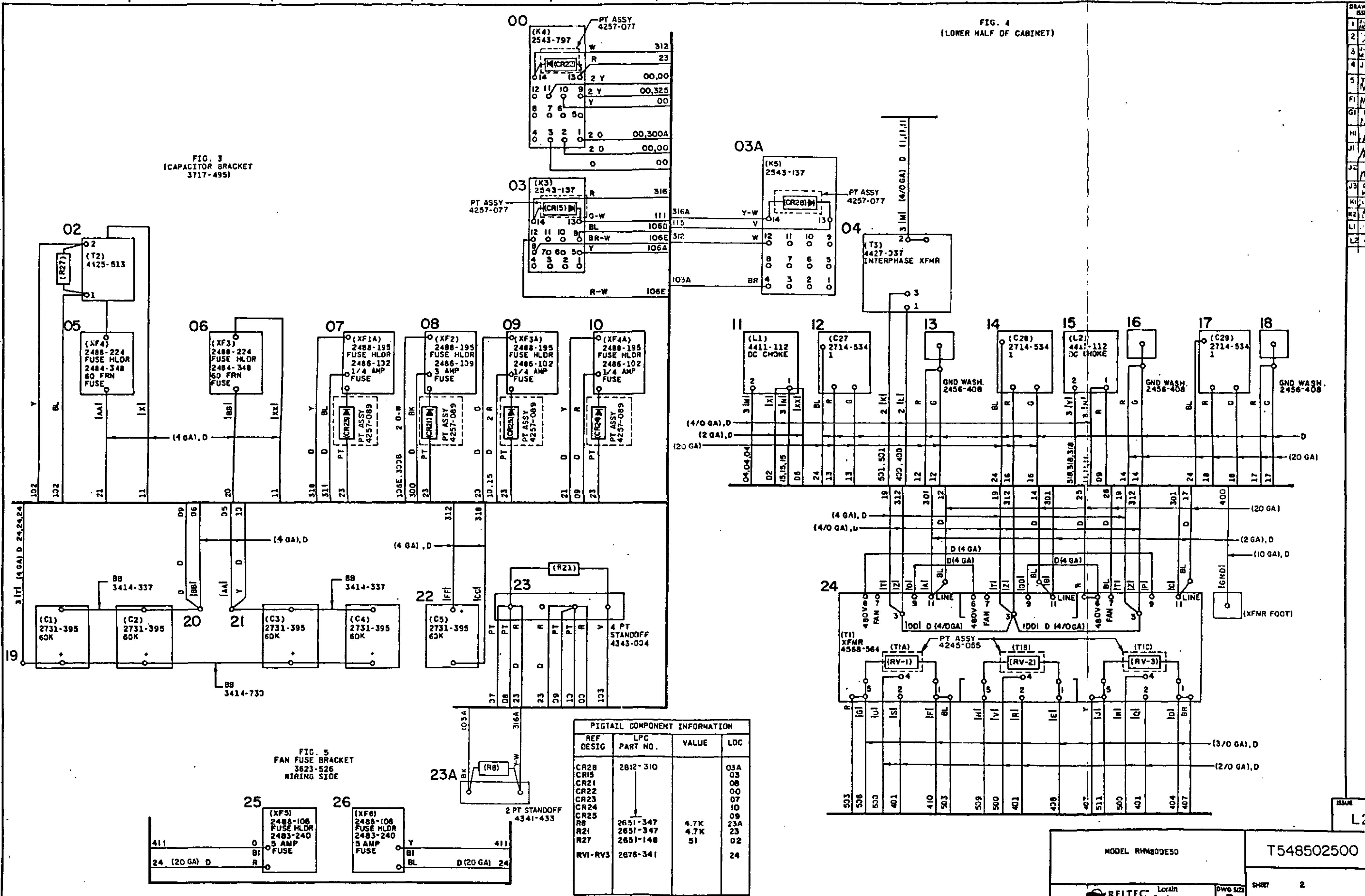
RELTEC Lorain Products

DESIGN D SPANGLER	L2
DRAWN BY J. REESE	DATE 2-10-83
CHECKED BY	DATE 2-15-83
CHECKED BY	DATE
APPROVED BY	DATE 4-4-83
RATING	STANDARD

DWG SIZE D

T548502500

SHEET 1 OF 5



PIGTAIL COMPONENT INFORMATION			
REF DESIG	LPC PART NO.	VALUE	LOC
CR28	2812-310		03A
CR15			03
CR21			08
CR22			00
CR23			07
CR24			10
CR25			09
R8	2651-347	4.7K	23A
R21	2651-347	4.7K	23
R27	2651-148	51	02
RV1-RV3	2676-341		24

MODEL RHM800E50

RELTEC Lorain Products

DWG SIZE D

T548502500

SHEET 2

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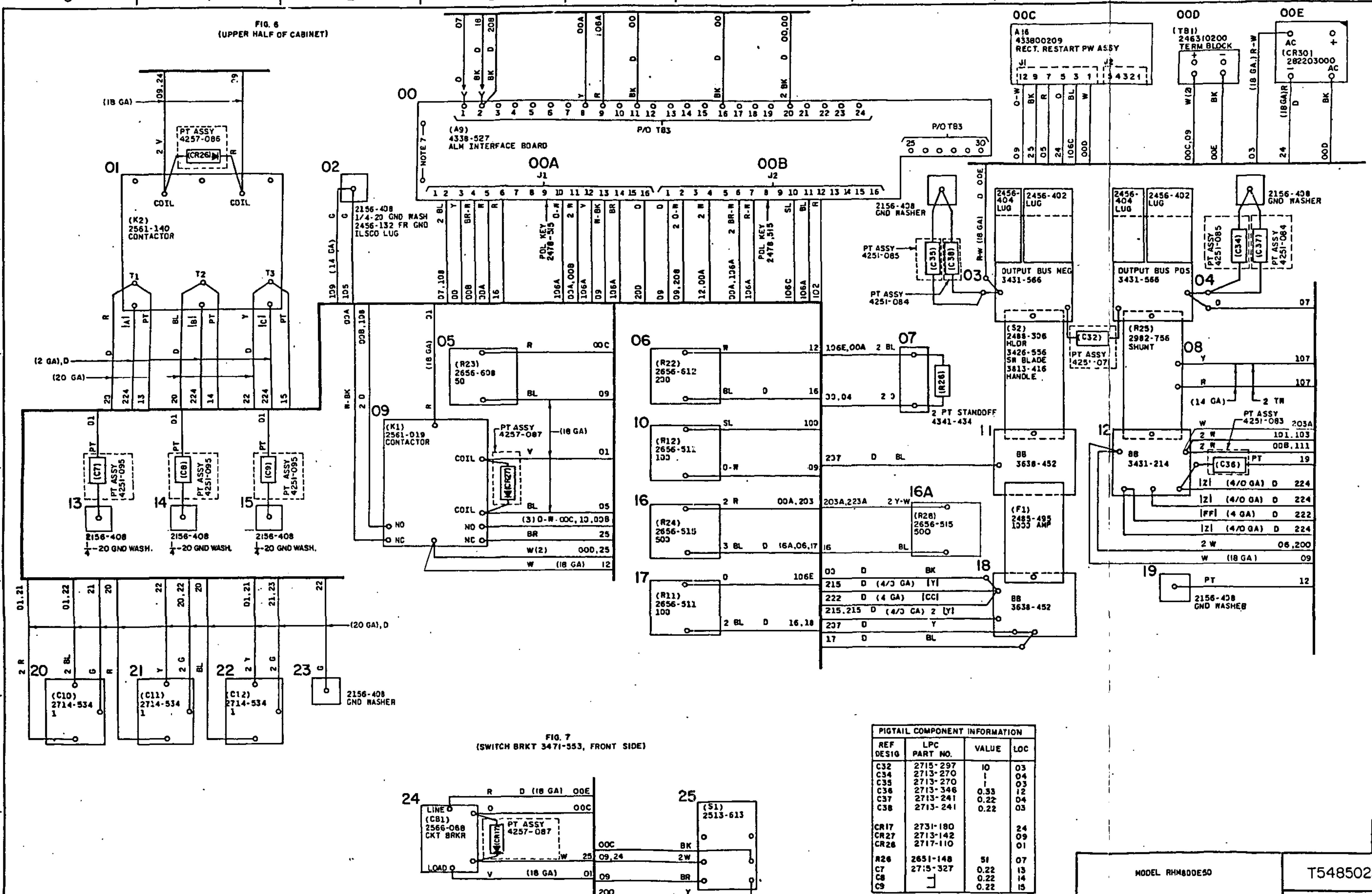
ISSUE L2



PIGTAIL COMPONENT INFORMATION			
REF DESIG	LPC PART NO.	VALUE	LOC
C32	2715-297	10	03
C34	2713-270	1	04
C35	2713-270	1	03
C36	2713-346	0.33	12
C37	2713-241	0.22	04
C38	2713-241	0.22	03
CR17	2731-180		24
CR27	2713-142		09
CR26	2717-110		01
R26	2651-148	51	07
C7	2715-327	0.22	13
C8	┘	0.22	14
C9		0.22	15

MODEL RHM800E50

RELTEC Lorain Products

DWG SIZE D

T548502500

SHEET 3

ISSUE L2

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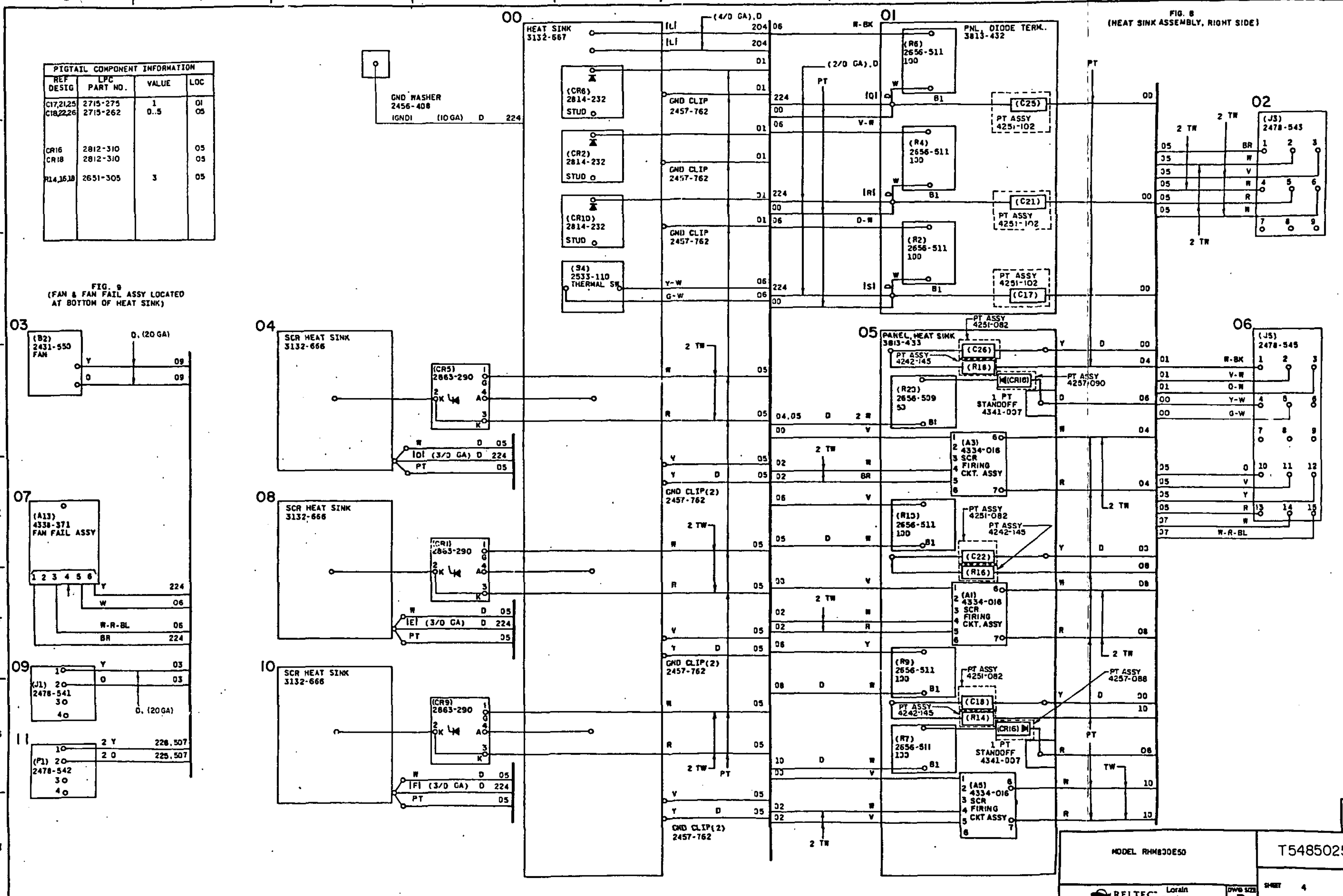

PIGTAIL COMPONENT INFORMATION			
REF DESIG	LPC PART NO.	VALUE	LOC
C17,21,25	2715-275	1	01
C18,22,26	2715-262	0.5	05
CR16	2812-310		05
CR18	2812-310		05
R14,16,18	2651-305	3	05

MODEL RHM830E50

T548502500

RELTEC Lorain Products

DWG SIZE D SHEET 4 ISSUE L2

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FAX: 519/631-0359

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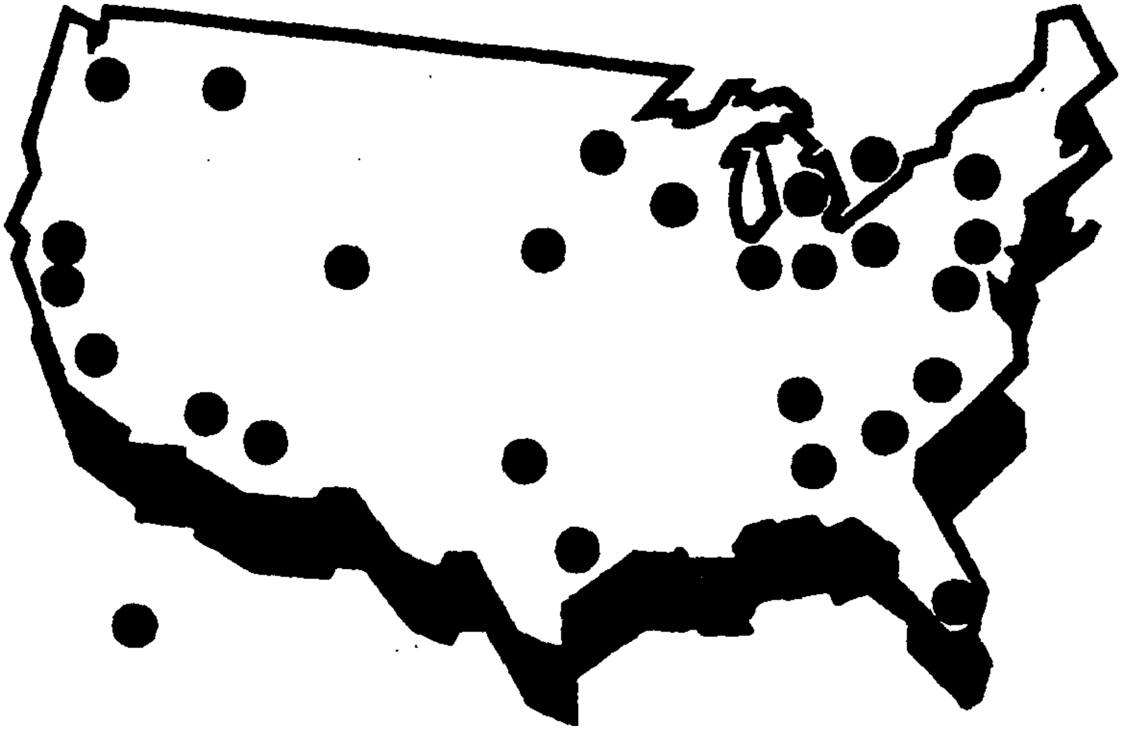

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