LORAIN® MODEL RHM200D50

FLOTROL” RECTIFIER

SPEC. NO. 5472-014-00 SERIAL NO._______

NOTE

FACTORY SETTINGS OF INPUT AND OUTPUT VOLTAGE AND IDENTIFICATION OF ALL OPTIONS AND/OR ACCESSORIES FURNISHED WITH THIS FLOTROL RECTIFIER ARE GIVEN ON AN ADHESIVE LABEL INSIDE THE RECTIFIER CABINET.

MARCONI COMMUNICATIONS INC. TERMS AND CONDITIONS OF SALE

1. Orders and Acceptance. All orders are subject to Marconi Communications Inc.'s acceptance. Unless otherwise stated, all sales transactions are expressly limited to the terms and conditions set forth below. All terms and conditions (including but not limited to additional and/or different terms and conditions) contained in any of Buyer's purchase orders or other documents submitted by Buyer are EXPRESSLY rejected. No waiver of these terms and conditions or acceptance of other terms and conditions shall be construed from Marconi's failure to object to the same. All sales are final. Goods cannot be returned without Seller's prior written consent

2. Quotations and Published Prices. All written quotations shall automatically expire on the expiration date listed on the quotation, but in no event later than ninety (90) days after issuance, and are subject to withdrawal by notice within that period. Marconi, at its sole option, may extend the effective date of written quotations up to six months. Oral quotations shall expire in thirty (30) days. Prices shown on published price lists and other literature issued by Marconi do not represent unconditional offers to sell, and are subject to change without notice. Marconi's prices do not include installation or final on-site adjustment.

3. Prepayment. In the event that Marconi, in its sole discretion, deems Buyer's financial condition unsatisfactory, Marconi may require full or partial payment in advance. Upon Buyer's failure to submit full or partial payment upon request, Marconi may cancel or delay any or all orders or adjust those prices in effect at the time of delayed shipment.

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5. Taxes. Marconi's prices do not include federal, state, or local taxes, including sales, use, property, import/export, value added, excise or similar tax payments. Marconi shall bill as a separate invoice line item all such taxes and Buyer agrees to pay and/or reimburse Marconi for any such applicable taxes.

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9. Shipping. Products shall be shipped F.O.B. Marconi's facility. Title to, and risk of loss, or damage to, the Products shall pass to Buyer upon Marconi's delivery of the Products to a carrier. Marconi's prices do not include shipping charges. Unless any order is marked "Ship Complete," Marconi may make partial shipments in its discretion. Partial shipment of an order will not constitute acceptance of an entire order. Marconi reserves the right to use its own discretion in the manner and routing of shipments.

10. Delivery/Access. All delivery/performance dates indicated on Marconi's documents are approximate and are based upon the prompt receipt of all necessary information from Buyer regarding Products and/or Services ordered. Marconi will use reasonable efforts to meet the indicated delivery/performance dates but shall not be held responsible for its failure to do so. In the event of any delivery delay caused by Buyer, Marconi will store and handle all Products ordered at Buyer's risk and will invoice the Buyer for the unpaid portion of the contract price plus storage, insurance and handling charges on or after the date on which the Products are ready for delivery. Buyer grants to Marconi and its subcontractors authority to enter the property upon which Marconi's Services are to be performed. In the event that existing conditions attributable to Buyer cause an increase in Marconi's costs pertaining to the provision of Services, then Buyer shall reimburse Marconi for such increased costs.

11. Security Interest. Until such time as Marconi is fully paid for Product shipped, Buyer shall grant to Marconi a purchase money security interest in the Products. Buyer will assist Marconi in taking necessary action to protect Marconi's security interest.

12. Default. Upon placing this instrument with an attorney for collection of past due payments or repossession of Product, Buyer shall reimburse Marconi for attorney's fees, court costs, and other expenses incurred by Marconi to enforce the terms and conditions stated herein.

13. Warranty. (a) Products. Marconi warrants to Buyer that Products manufactured and sold by Marconi shall be free from defects in material and workmanship for a period of one (1) year from shipment date except as follows: (1) DISC*S (Digital Loop Carrier System), UM2500, RLEM and R-96 Auxiliary Equipment - two (2) years from shipment date; (2) R-96 Plug-Ins and other Voice Frequency Products - five years from shipment date; (3) Lorain Products installed by Marconi - two (2) years from date of installation. (b). Services. Marconi warrants to Buyer that Services shall be performed in a workmanlike manner (according to industry standards) and free from defects in materials for a period of one (1) year from date of installation completion except as follows:(1) Field Services Repairs: ninety (90) days from completion of field services; (2) Flat Rate Repairs: one (1) year from F.O.B. shipment date; (3) Time and Material Repairs: ninety (90) days from date of installation completion. (c) ~~Other Supplier's Warranties.~~ The sole and exclusive warranty for other products and/or services sold by Marconi and provided by third party suppliers ("Other Suppliers") shall be limited to the Other Suppliers' express written warranty. Marconi's sole responsibility to Buyer for Other Suppliers' products and/or services shall be limited to the assignment of such warranties and assisting Buyer to enforce any such warranties. (d). ~~Buyer's Exclusive Remedy.~~ If Marconi's Products or Services fail to meet their respective warranty standard, Marconi will at its sole option either: (1) refund the amount received by Marconi for defective Products or Service, or (2) repair or replace any defective Product free of charge, or (3) reperform Services of the type originally performed free of charge. The foregoing is contingent upon Marconi receiving Buyer's written notice no later than ten days from the warranty period's expiration date and Buyer returning defective Products (F.O.B. to a location specified by Marconi). In the event Marconi determines the return of the Product to the factory to be uneconomical, Marconi will dispatch a service technician to the site to repair the equipment, as appropriate. The warranty set forth herein does not extend to any Product or Service (including Other Suppliers' product and service) which has been misused, modified, repaired, improperly installed or otherwise abused. (e). ~~Disclaimer of Implied Warranties; Sole Remedy.~~ EXCEPT AS PROVIDED IN THIS SECTION, MARCONI MAKES NO OTHER WARRANTY, EXPRESS OR IMPLIED. ALL WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE ARE HEREBY EXPRESSLY DISCLAIMED. THIS WARRANTY CONTAINS MARCONI'S SOLE LIABILITY AND BUYER'S SOLE AND EXCLUSIVE REMEDIES AND IS EXPRESSLY IN LIEU OF ALL OTHER REMEDIES BASED IN LAW OR EQUITY.

14. Patents. Marconi will defend or settle at its own expense any suit or action which may be brought against Buyer for alleged infringement of any U.S. patents or U.S. copyright of third parties by reason of Buyer's proper use of Marconi's Products and will indemnify and hold Buyer harmless from and against all damages and costs which may be adjudged or decreed against Buyer on account of such infringement in any such suit or action and actually paid by Buyer; provided, however, that Buyer shall have given prompt written notice to Marconi of any claim of such alleged infringement and of the commencement, or any written threat of commencement, of any such suit or action, and shall permit Marconi to have full control over the defense or settlement of the same; and provided further, that Buyer shall not settle or compromise any such suit or action without the prior written consent of Marconi. In the event that the use of any Product is enjoined, Marconi shall, at its option and at its own expense, either (1) procure for the Buyer the right to continue using such Product, or (2) replace the same with non-infringing Products, or (3) modify the same to become non-infringing, or (4) refund the associated amount paid by Buyer to Marconi for such Products. Notwithstanding the foregoing, Marconi shall not be liable for any damages or costs arising from an alleged infringement resulting from the use of Product provided by Marconi pursuant to custom specifications requested by Buyer or any third party. The remedies set forth in this Section 14 shall constitute Buyer's sole and exclusive remedy and Marconi's sole liability in connection with alleged infringement of any third party intellectual property rights.

15. Indemnity. Marconi shall indemnify and hold harmless Buyer from any and all claims, damages, losses or expenses, which are solely and directly caused by Marconi's negligence. Buyer shall indemnify and hold harmless Marconi, its affiliated companies and the officers, directors, employees, agents, representatives, subcontractors and suppliers

of the foregoing from any and all claims, damages, losses or expenses, including attorney's fees, and amounts paid in settlements of claims or suits, which are caused by or arise out of any act or omission of Buyer, or Buyer's agents, employees, subcontractors, and/or suppliers. Except as otherwise provided for above, Marconi shall not indemnify Buyer and/or any third party. Marconi shall not be subject to any liability, whether based in contract, warranty, tort (including negligence and strict liability) or otherwise arising out of assistance or advice provided by Marconi which is not expressly provided for in Marconi's quotation and Buyer's order. Any suit arising hereunder must commence within one (1) year from the date of the cause of action.

16. Limitation of Liability. MARCONI SHALL NOT BE LIABLE FOR ANY LOSS, CLAIM, EXPENSE OR DAMAGE CAUSED BY, CONTRIBUTED TO OR ARISING OUT OF THE ACTS OR OMISSIONS OF BUYER OR THIRD PARTIES, WHETHER NEGLIGENT OR OTHERWISE. IN NO EVENT SHALL MARCONI'S LIABILITY FOR ANY CAUSE OF ACTION WHATSOEVER EXCEED THE COST OF THE PRODUCT GIVING RISE TO THE CLAIM, WHETHER BASED IN CONTRACT, WARRANTY, INDEMNITY OR TORT (INCLUDING NEGLIGENCE AND STRICT LIABILITY) OR OTHERWISE. IN NO EVENT SHALL EITHER PARTY BE LIABLE FOR ANY SPECIAL, INCIDENTAL, CONSEQUENTIAL OR OTHER SUCH INDIRECT DAMAGES (INCLUDING, WITHOUT LIMITATION, LOSS OF REVENUES, PROFITS OR OPPORTUNITIES), WHETHER ARISING OUT OF OR AS A RESULT OF BREACH OF CONTRACT, WARRANTY, TORT (INCLUDING NEGLIGENCE), STRICT LIABILITY OR OTHERWISE.

17. Insurance. Buyer and Marconi shall maintain the following types and amounts of insurance coverage: (a) worker's compensation: statutory requirements, (b) employer's liability: One Million Dollars per occurrence, (c) Comprehensive Liability (personal injury and product liability): One Million Dollars combined single limit per occurrence. Each party shall provide a certificate of insurance upon receiving a written request to do so. Insurance coverage shall not be canceled or materially modified without 30 days prior written notice.

18. Software License. Marconi hereby grants Buyer a personal, non-transferable and non-exclusive right to use certain proprietary software and certain improvements or modifications thereof ("Software"), in whatever form recorded, sold separately pursuant to this Agreement or furnished to Buyer in connection with the sale and operation of Products for which payment has been received. All rights, title and interest in the Software and all copies thereof, shall remain the sole property of Marconi or its licensor, as applicable. The foregoing license does not entitle Buyer to the receipt, use of, or access to, Software source code or any right to reproduce the Software or the documentation related thereto. Buyer shall not decompile, reverse engineer or otherwise attempt to gain access to the Software source code. Any use of the Software other than that expressly provided for herein, or use of the Software in a country in which its use is not licensed shall terminate this license. Buyer is authorized to grant sublicenses to its customers to use the Software, provided that, such customers enter into written sublicense agreements with terms substantially similar to the terms of this Section 18, the form of which shall be approved by Marconi.

19. Force Majeure. Neither party shall be liable for any delay or failure to perform to the extent caused by (including but not limited to) fire; flood; explosion; war, riot; embargo; labor disputes; compliance with any laws, regulations, orders, acts or requirements from the government, civil or military authorities; acts of God or the public enemy, or any act or event of any nature reasonably beyond such party's control.

20. Waiver. No condoning, excusing or waiver by any party of any default, breach or nonobservance by any other party, at any time or times with respect to any covenants or conditions set forth herein shall operate as a waiver of that party's rights with respect to any continuing or subsequent default, breach or nonobservance, and no waiver shall be inferred from or implied by any failure to exercise any rights by the party having those rights.

21. Severability. Should any provision of these terms and conditions be declared by any court of competent jurisdiction to be invalid or unenforceable, the remaining provisions shall not be affected thereby, it being the intent of the parties that they would have executed the remaining portion without including any such part or portion which may for reason be declared invalid.

22. Governing Law. This Agreement shall be governed by and construed in accordance with the laws of the State of Ohio (excluding its conflict of laws provisions), including the provisions of the UCC in the State of Ohio. Any proceeding pertaining to any such claim shall be venued in Cleveland, Ohio.

23. Entire Agreement/Amendment. Marconi and Buyer agree that the terms and conditions set forth herein constitute their complete and exclusive agreement regarding the subject matter of Buyer's order and supersede any prior communications, representations or agreements of the parties, whether oral or written and cannot be altered, amended, or modified except in writing executed by an authorized representative of each party.

24. Assignability. Neither party may sell, assign, or transfer its rights, duties, or obligations under this Agreement without the prior written consent of the other; provided, however, that Marconi reserves the right to (a) assign its rights, duties and obligations to any party purchasing substantially all of Marconi's assets and (b) subcontract the manufacture of Products. To the extent that assignment is permitted, this Agreement shall inure to the benefit of and be binding upon each party and its permitted successors and assigns.

25. Headings. Captions or headings are inserted only for convenience and shall not be construed as part of the foregoing terms and conditions or as a limitation upon the scope of the particular section to which they refer.

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 temperature 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 procedurethen 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 05 alarms associated with the rectifier are disabled, if possible. If the extended alarms cannot be disabled at the remote location. the appropriate personnel should be notified to disregard any office al- 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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MODEL RHM100D50 FLOTROL® RECTIFIER
SPEC NO. 545401000
SPEC NO. 545401700
MODEL RHM200D50 FLOTROL® RECTIFIER
SPEC. NO. 547201400
SPEC. NO. 547201900
MODEL RHM400D50 FLOTROL® RECTIFIER
SPEC. NO. 548103800
SPEC. NO. 548104100

CONTENTS PAGE

1. DESCRIPTION

General

1.01 This FLOTROL® Rectifier is designed to operate from nominal 208 VAC or 240 VAC 60 Hz input, to maintain a battery in a fully charged condition while powering a load.

1.02 Float Charging: The RHM Series rectifiers provide constant output voltage; therefore, output current remains equal to load current as long 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.

1.03 Equalize Charging: If a higher DC voltage is required to equalize the charge on all battery cells. the FLOAT/EQUALIZE switch can be operated locally to obtain higher equalize charge voltage. The equalize function may also be controlled from a remote location if desired. Refer to the Power Data Sheet for details.

1.04 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.

1.05 Paralleling: The RHM Series rectifiers are equipped with an automatic current limiting circuit. This circuit enables the paralleling of an RHM Series rectifier with any other battery charger which can be adjusted to the same output voltage. In addition, a forced load sharing circuit is furnished which ensures proportional sharing of total load current between paralleled LORAIN® RL or RHM Series rectifiers of the same output voltage rating when interconnected with external load sharing wiring.

1.06 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 switch to disable rectifier output

2. TEST APPARATUS

2.01 The test equipment listed below is sufficient to perform any test or adjustment procedure detailed in this instruction manual.

Description	Model
Power Supply	Power Mate Model BP 60D (O-60 VDC at 1.2 amp), or equivalent
Test Load	Dependent upon rectifier current rating
Digital Multimeter	Fluke, Model 8022A, or equivalent
AC Ammeter	O-60 amps
Oscilloscope	Tektronix Model T921, or equivalent
Insulated Screwdriver	General Cement Type 8728A, or equivalent

3. INSTALLATION

Physical Considerations

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

3.02 Relay Rack Mounting (Models RHM100D50 and RHM200D50 only):

a) A 19 inch wide rectifier may be mounted in a relay rack with 1.75 inch multiple drilling, and a 23 inch wide rectifier may be mounted in a relay rack with either 1.0 inch or 1.75 inch multiple drilling.

b) Adapter plates to permit mounting of these rectifiers in 30 inch wide relay racks are available for all models except Models RHM100D50, Spec. No. 545401700 and RHM200D50, Spec. No. 547201900.

NOTE

There are two types of 30 inch relay racks in use. They are *Channel and Unistrut* type. The adopter plates for *each are not interchangeable.*

c) The Model RHM100D50 Rectifier, Spec. No. 545401700, and the Model RHM200D50 Rectifier, Spec. No. 547201900, are equipped with specially designed adapter plates which permit mounting of the rectifier in a Northern Telecom Inc. DMS-10 Power Bay. Refer to the Power Data Sheet for mounting details.

3.03 Wall Mountina: (Models RHM100D50 and RHMZOODSO only): The relay rack mounting angles furnished with these models may be positioned at the rear of the cabinet to form a 23 inch wide unit The unit may be mounted on any wall capable of supporting the load. Rectifier weights are listed in Table 3-1 for convenient reference:

Model	Weight
RHM100D50	205 lbs.
RHMZOODSO	460 lbs.

Table 3-l

3.04 Floor Mountina: The Model RHM400D50 Rectifier is designed exclusively for floor mounting. The base of this rectifier model is drilled to accommodate four mounting bolts to secure the rectifier in position. The Model RHM100D50 and RHMZOODSO Rectifiers may also be floor mounted by using accessory floor stands. Refer to the Power Data Sheet for further information.

3.05 Ventilation Requirements

a) Rectifiers should be mounted so ventilating openings are not blocked and air entering the cabinets does not exceed +50° C (+ 122" F).

b) If the rectifier is mounted above or between other heat producing equipment, a minimum spacing of 5.25 inches between units is required. Baffle plates between equipment cabinets may be necessary to avoid overheating. Heat dissipation of rectifiers covered in this manual is listed in Table 3-2 as follows:

Model	Heat Dissipation
RHM100D50	3185 BTU/hr
RHMZOODSO	5825 BTU/hr
RHM400D50	7400 BTU/hr

Table 3-2

Initial Startup and Checkout

3.06 When placing the rectifier into service, it should be adjusted and checked to assure proper operation. Use the following procedure:

a) Preparing to Start (Initially)

1) Operate the rectifier AC INPUT switch and BATTERY DISCONNECT circuit breaker CB1 (Models RHM100D50 and RHMZOODSO only) to the OFF position and operate the FLOAT/EQUALIZE switch to the FLOAT position.

NOTE

In the Model RHM400D50 Rectifier, the output disconnect device is not a circuit breaker but a removable link designated BATTERY DISCONNECT. This link should be removed before proceeding.

2) Insure that the proper fuse sizes are provided and removed from the rectifier. Refer to paragraph 4.14 for correct fuse sizes.

NOTE

The Model RHM400D50 rectifiers only are equipped with a DC OUTPUT fuse designated F1. This fuse is bolted into the unit and may be checked for proper fuse size without removing the fuse from the unit.

3) Make all installer connections in accordance with the Power Data (PD) Sheet furnished with this manual. Refer also to paragraph 3.07 through 3.19 for further reference information.

4) Insure that the rectifier power transformer tap adjustments are correct for the prevailing AC input voltage. Refer to paragraph 5.03 of this instruction for voltage tap adjustments.

b) Rectifier Startup and Checkout

1) Install all fuses, insure that the external AC distribution fuses are correct, and close the output disconnect device. On Models RHM100D50 and RHMZOODSO, operate the BATTERY DISCONNECT circuit breaker CB1 to the ON position. In the Model RHM400D50 Rectifier, install the BATTERY DISCONNECT link.

NOTE

If the rectifier is connected to battery, precharge the rectifier's DC output filter capacitors before operating BATTERY DISCONNECT Circuit Breaker CB1 (Models RHM100D50 and RHM200D50) or installing BATTERY DZSCONNECT link S2 (Model RHM400D50) by following the startup procedure detailed in Paragraph ?.I?.

2) Apply AC input power by closing the external AC distribution fuses or circuit breaker, and operating the AC INPUT switch on the rectifier to the ON position. The rectifier should start and the output voltage should be within the range of 48 to 54VDC.

3) Check the rectifier current limit circuitry by loading the rectifier to at (east 120% of the rated output of the unit If the existing load is less than rated load, a resistive test load may be connected to the DC output terminals of the rectifier. The rectifier should limit its output current at 110% of rated output. If adjustment is required, refer to paragraph 5.06 of this manual. Remove the test load after check or adjustment.

4) 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 counter-clockwise 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.

5) 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 equaize 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 counter-clockwise as necessary. Voltage should be monitored at the battery while adjusting equalize output, thereby allowing the rectifier to compensate for distribution losses.

6) Return the FLOAT/EQUALIZE switch to the FLOAT position. Before placing the rectifier into service, refer to Table 3-3 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 3-3 before placing the rectifier into service.

Adjustment	Factory Setting	Adj. Procedure Para. No.
Overvoltage Shutdown	55.0 volts DC	5.10
High Voltage Alarm	57.6 volts DC	5.08
Low Voltage Alarm	47.15 volts DC	5.07

Table 3-3. Shutdown and Alarm Levels

Electrical Connections

3.07 Wiring: All wiring and branch circuit protection should follow provisions of the current edition of the National Electric Code. Referenced to the 1987 edition for specific requirements are:

Article 240-6 Branch Circuit Rating

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

DANGER

All rectifiers covered by this instruction manual operate from AC voltage capable of producing severe, perhaps fatal, electrical shock. Before commencing installation, ensure that AC and DC sources are completely disconnected cr disabled.

3.08 General

MODELS RHM100D50 AND RHM200D50

To gain access to the installer input and output terminal blocks (TB1 and TB2) and the alarm-control terminal block TB3 of the rectifier, loosen the two twist-type fasteners on the front cabinet door and pivot the door outward on its hinge.

MODEL RHM400D50

To gain access to the installer input and output terminal blocks (TB1 and TB2) and the alarm-control terminal block TB3 of the rectifier, release the two twist-type fasteners on the access door at the top front of the rectifier cabinet and pivot the door downward on its hinge.

3.09 Input Connections: Connect the three phase AC 208/240 volt, 60 Hr. power leads at terminals L1, L2 and L3 on terminal block TB1.

3.10 Output Connections: Connect DC output leads to output terminals POS and NEG on terminal blockTB2.

3.11 Earth Ground (Green Wire) Connections: A frame ground lug (GND), located near terminal block TB1, 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 we correct polarity, terminal 1 (+) and 2 (–) on terminal block TB3.

3.12 Local or Remote Voltage Sensing: Terminals 1 (positive) and 2 (negative) on terminal block 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.

3.13 Load Sharina: This rectifier is equipped with a negative load sharing circuit which will enable it to divide the load in proportion to the output current ratings, with any other rectifier equipped with a compatible circuit. When both rectifiers have compatible load sharing circuits, a load sharing connection should be made between the load sharing terminals of each rectifier. The load sharing terminal of these rectifiers is located at terminal block TB3 terminal 3. Refer to the Power Data Sheet for recommended size of the load sharing lead and terminal block capacity. For proper operation, it is essential that each rectifier be adjusted per Paragraph 5.11.

3.14 Remote Equalize Control: The equalize mode of operation can be remotely controlled by providing a closed circuit between terminals 4 and 5 of TB3. An open circuit between these terminals restores operational mode control to the FLOAT/EQUALIZE switch on the rectifierfront panel.

3.15 Rectifier Fail Alarm: -During normal rectifier operation, positive battery is provided at TB3 terminals 9 and 12 to provide an external normal operation indication. If the rectifier is turned off, or in the event of low or high output voltage, loss of input power, or fan failure, positive battery is removed from TB3 terminals 9 and 12 and applied to TB3 terminals 7 and 10 to actuate external rectifier fail alarms.

NOTE

If closed loop actuated alarms are desired, disconnect and insulate the jumper leads from TB3 terminals 8 and 11. Closed loop rectifier fail alarms are then provided at TB3 terminals 7 to 8 and 10 to 11 during a rectifier fail condition.

3.16 Low Current Alarm: When the rectifier is operating normally and supplying greater than 3% of rated output current positive battery is provided at TB3 terminal 13 to provide an external normal operation indication. If rectifier output decreases below 0.5% of rated current, positive battery is removed from TB3 terminal 13 and applied to TB3 terminal 15 to actuate external low current alarms

NOTE

If closed loop actuated alarms are desired. disconnect and insulate the jumper lead from TB3 terminal 14. A closed loop low current alarm is then provided at TB3 terminals 14 to 15 during a low current alarm condition.

3.17 Phase Loss/Reduced Load Alarm: If for any reason the 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 T83, while open loop circuits are provided between terminals 25 to 26 and 28 to 29 of terminal block TB3. During normal operation, closed loop circuits are provide between terminals 25 to 26 and 28 to 29 of terminal block T83, while open loop circuits are provided between terminals 26 to 27 and 29 to 30 of terminal block TB3.

3.18 Voltmeter Switch Defeat: When furnished from the factory, the rectifier voltmeter will indicate zero volts when the rectifier is turned off. if battery voltage indication is desired with the rectifier off, connect a jumper to TB3 terminals 17 and 18.

3.19 Rectifier Charae Mode Indication: When this rectifier is operating in the float charge mode, positive battery is provided at TB3 terminal 19 to provide an external float charge indication. When the rectifier is operating in the equalize charge mode, positive battery is removed from T83 terminal 19 and applied to T83 terminal 21 to provide an external equalize charge indication.

NOTE

If closed loop charge mode indications are desired, disconnect and insulate the jumper lead connected at TB3 terminal 20. During float charge operation, a closed loop is provided at TB3 terminals 19 and 20. During equalize charge operation, a closed loop is provided at TB3 terminals 20 and 21.

4. OPERATION

Starting and Stoooinq

4.01 The rectifier may be started or stopped by operating the AC INPUT switch, located on the front door, to the ON or OFF position. respectively.

4.02 The rectifier will automatically restart after an AC power failure.

Controlsand Indicators

4.03 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) AC INPUT Switch: This switch starts or stops the rectifier when placed to the ON or OFF position. respectively.

b) BATTERY DISCONNECT Device: In Models RHM100D50 and RHM200D50, BATTERY DISCONNECT circuit breaker CB1 is placed to the OFF position to disconnect the rectifier from the battery. In Model RHM400D50, removal of the BATTERY *DISCONNECT* link adjacent to the DC output fuse disconnects the rectifier from the battery.

c) 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 Paragraph 4.05 through 4.07.

d) *POWER ON Indicator: Illuminates when the AC input voltage is present *and the AC INPUT* switch is in the ON position.

e) ‘HIGH VOLTAGE ALARM Indicator: Illuminates when the battery voltage increases to a predetermined adjustable high voltage alarm value. The high voltage alarm circuit monitors the battery voltage continuously; therefore, this alarm is operational even when the rectifier is turned off.

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

NOTE

The LOW VOLTAGE ALARM indicator may illuminate &ring 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.

g) *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.

h) 'FUSE ALARM Indicator: Illuminates if one or more fuses F1 through F4 or F7 (Model RHM400D50 only) should open. On Models RHM100D50 and RHM200D50, this indicator will illuminate if BATTERY DISCONNECT Circuit Breaker CB1 opens.

i) *FAN FAILURE ALARM Indicator (Model RHM400D50 only): Illuminates if cooling fans B1 or 92 should fail.

*During an AC power failure, low current alarm, high or low voltage alarm, failure of fuse F1 or F2, fan failure, or any time the rectifier is turned off either automatically or manually, positive battery is provided for external alarms. (Refer to Power Data Sheet for details.)

Metering

4.04 A DC ammeter and a DC voltmeter indicate rectifier output current and voltage, respectively. Pin jacks are also provided for connection of a portable voltmeter.

Float Charging

4.05 The RHM Series Rectifiers provide a constant output voltage; therefore, output current remains equal to load 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 load 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 Chaming

4.06 Higher charging voltage is sometimes required to equalize the charge of all battery cells. To obtain this voltage, operate the FLOAT/EQUALIZE switch to EQUALIZE position. To restore usual float operation, operate the switch to the FLOAT position.

4.97 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 rectfifier is disabled.

WARNING

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

Overvoltage Shutdown

4.08 If rectifier output voltage exceeds a preset adjustable overvoltage limit, the AC INPUT switch opens and automatic rectifier shutdown results. To restart the rectifier after an overvoltage shutdown, simply return the AC INPUT switch to the ON position.

4.09 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 causesthe overvoltage condition.

NOTE

In addition to the customer adjustable selective high voltage shutdown circuit, 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 wltage 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.

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

RippleRegulator Circuit

4.10 This rectifier is equipped with a ripple regulator circuit, located on circuit card All, which continuously monitors the ripple current across 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 ripple across the capacitors and 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 3.17 for details.

Battervless Operation (Ⓜ Option)

4.t 1 If rectifier operation off battery is required, a capacitor assembly, Part No. 425101400, should be installed on circuit card A7 to stabilize rectifier output voltage. See Figure 5-1.

Neqative Sense Loss (Ⓨ Option)

4.12 Under certain load conditions when two or more rectifiers are operating in parallel if the negative sense lead becomes disconnected the rectifier goes into high voltage shutdown. The sense loss option will prevent the rectifier from going into high voltage shutdown. The circuit does this by having a relay drop out, breaking the load sharing circuit which in turn stops back feeding and possible circuit malfunction.

Cooling Fans and Temperature Sensors:
(Model RHM400D50 only)

4.13 The Model RHM400D50 Rectifier is equipped with cooling fans and temperature sensors mounted on heat sink assemblies at the bottom of the cabinet The cooling fans circulate air through the cabinet to cool the rectifier, while the temperature sensors continually monitor both heatsink and air temperature. If air flow through the cabinet ceases or if heatsink temperature reaches +85° C (+185° F), output current 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 fan has failed, a red FAN FAILURE indicator will illuminate. When the temperature decreases and fans have been repaired, the rectifier returns to full load capability and the external rectifier fail alarm is cancelled.

Fuses

4.14 Table 4-l 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

4.15 To gain access to all fuses in Model RHM100D50 and RHM200D50 Rectifiers, simply open the front access door. To gain access to certain fuses in Model RHM400D50, remove the lower front access panel and open the hinged front panel.

Circuit Cards

416 Any of the following circuit cards can easily be replaced as individual assemblies if the need arises.

Circuit Card	Description
Al-A6 (433401600)	SCR Firing Circuit Card
A7 (486508700)	Regulator & Alarm Card
A8 (486562200)	Power Supply Card
A9 (433852700)	Alarm Interface Assy
Al 1 (486569800)	Ripple Regulator Card
A12-A13 (433837100) (RHM400D50 only)	Fan Failure Card
A14-A15 (425702200) (RHM400D50 only)	LED Assembly

Desig.	Model	Sue (Amps)	Type
F1	RHM400D50	600	Chase-Shawmut A25Z600 Type 4
F2	RHM100D50 RHM200D50 RHM400D50	3	Bussmann GMT
F3	RHM100D50	20	Bussmann NON
	RHM200D50 RHM400D50	60	
F4	RHM200D50	15	Lorain Part No. 2483-623-00
F4	RHM400D50	60	Bussmann NON
F5 & F6	RHM400D50	5	Bussmann MTH
F7	RHM400D50	15	Lorain Part No. 2483-623-00
F3A	RHM100D50	1/4	Bussmann GMT
F3A & F4A	RHM200D50	1/4	Bussmann GMT
F1A, F3A, F4A, & F7A	RHM400D50	114	Bussmann GMT

Table 4-1. Fuse Types and Sires

5. ADJUSTMENTS

General

5.01 The only adjustment that may be required before operating this rectifier is the input voltage adjustment This adjustment adapts the rectifier to operate from nominal 208 VAC. or 240 VAC input.

5.02 Various adjustment potentiometers are accessible on the front door of the rectifier and inside on Regulator and Alarm Circuit Card A7 and Ripple Regulator Circuit Card All. These potentiometers are factory adjusted and readjustment is not normally required.

WARNING

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

Input Voltage Range Adiustment

5.03 This rectifier can be operated from nominal 208V or 240V, three phase, 60 Hz AC service. To gain access to adjustment taps on Models RHM100D50 and RHM200D50 open the front access door. To gain access to adjustment taps on Model RHM400D50, remove the protective cover at the bottom front of the rectifier. Make the necessary tap adjustments for the desired AC input voltage as listed in Table 5-l.

DANGER

AC input voltages used in the rectifier can cause severe, perhaps fatal, electrical shock. Insure *that AC power* ***is completely*** *removed from the rectifier before attempting input tap* ***adjustments.***

Exercise care that no hardware is inadvertently *dropped into the rectifier interior during the* ***input*** *tap adjustment* ***procedure. Loose*** *hardware can* ***result*** *in* ***short*** *circuits* ***and*** *permanent* ***equipment*** *damage.*

Float Voltage Adiustment

5.04 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 counter clockwise.

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.

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

Model	Nominal Input Voltage	Connect Lead Labeled	to Transformer T1
RHM100D50 RHM200D50	20B	D E F	ØA Terminal 6 to ØB Terminal 7 ØB Terminal 6 to ØC Terminal 7 ØC Terminal 6 to OA Terminal 7
	240	D E F	ØA Terminal 6 to ØB Terminal 8 ØB Terminal 6 to ØC Terminal B ØC Terminal 6 to ØA Terminal B
RHM400D50	208	G H I	ØA Terminal 7 to OB Terminal 9 ØB Terminal 7 to ØC Terminal 9 ØC Terminal 7 to ØA Terminal 9
	240	G H I	ØA Terminal 6 to ØB Terminal 9 ØB Terminal 6 to ØC Terminal 9 ØC Terminal 6 to ØA Terminal 9

Table 5-1. Input Voltage Adjustment

***Unless otherwise specified, rectifier input taps are factory adjusted for 208 volt AC input.**

NOTE

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

Equalize Voltage Adiustment

5.05 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 been 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 voltage to stabilize at its new value.

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

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

Current Limit Adiustment

5.06 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 current limit 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 100% 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 100% load may werheat 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, an artificial load should be used to insure the amount of load exceeds the desired output current limit sening.

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

5.07 The low voltage alarm adjustment potentiometer R38, located on Regulator and Alarm Circuit Card A7, sets the value at which fight emitting diode LOW VOLTAGE ALARM illuminates and an external alarm 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 AC INPUT switch to the OFF position.

b) Open the front access door on Models RHM100D50 and RHM200D50 or front access panel on Model RHM400D50. Disconnect the rectifier from battery by operating BATTERY DISCONNECT circuit breaker CB1 on Models RHM100D50 and RHM200D50 to the OFF position, or by removing the BATTERY DISCONNECT link in Model RHM400D50.

DANGER

Exercise extreme caution when performing Step c). Hazardous DC voltage is present at the DC output terminals and the DC output fuse or circuit breaker.

c) Connect an adjustable DC supply capable of supplying 60 volts DC to the positive output terminal (+) and the rectifier side of fuse F1 (-) or circuit breaker CB1, 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 the DC supply 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 diode LOW VOLTAGE ALARM IL LUMINATES. Repeat Steps d) through g), if necessary, until the alarm is activated at the desired voltage.

h) Remove the external DC supply and reconnect the battery to the rectifier by operating BATTERY DISCONNECT circuit breaker CB1 to the ON position or inserting the removable BATTERY DISCONNECT link.

NOTE

Zf the rectifier is connected to battery, precharge the rectifier's DC output filter capacitors before operating BATTERY DISCONNECT Circuit Breaker CBZ (Models RHM100D50 and RHM200D50) or installing BATTERY DISCONNECT link S2 (Model RHM400D50) by following the startup procedure detailed in Paragraph 7.17.

High Voltage Alarm Adjustment

5.08 The high voltage alarm adjustment potentiometer R3.9, 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, observethefollowing procedure:

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

b) Open the front access door on Models RHM100D50 and RHM200D50 or front access panel on Model RHM400D50. Disconnect the rectifier from battery by operating BATTERY DISCONNECT circuit breaker CB1 on Models RHM100D50 and RHM200D50 to the OFF position, or by removing the BATTERY DISCONNECT link in Model RHM400D50.

DANGER

Exercise extreme caution when performing Step c). Hazardous DC voltage is present at the DC output terminals and the DC output fuse or circuit breaker.

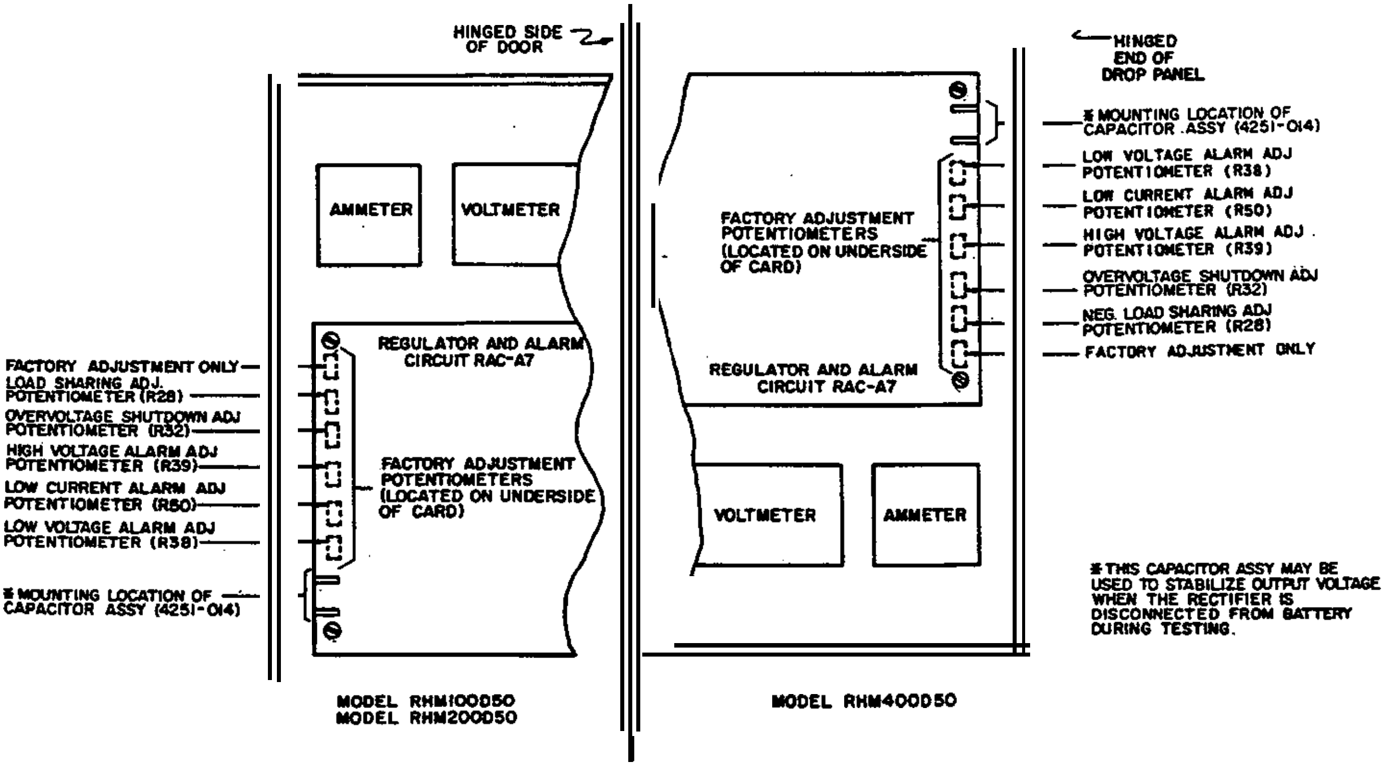


Figure 5-1. Adjustment Potentiometer Locations

c) Connect an adjustable DC supply capable of supplying 60 volts DC to the positive output terminal (+) and the rectifier side of fuse F1 (-) or circuit breaker CB1, observing proper polarity.

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

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

f) Slowly adjust potentiometer R39 counter-clockwise 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 emitting diode HIGH VOLTAGE ALARM should extinguish. Slowly increase the voltage until light emitting diode HIGH VOLTAGE ALARM illuminates. Repeat Steps d) through g), if necessary, until the alarm is activated at the proper voltage.

h) Remove the external DC supply and reconnect the battery to the rectifier by operating BATTERY DISCONNECT circuit breaker CB1 to the ON position or inserting the removable BATTERY DISCONNECT link.

NOTE

If the rectifier is connected to battery, precharge the rectifier's DC output filter capacitors before operating BATTERY DISCONNECT Circuit Breaker CB1 (Models RHM100D50 and RHM200D50) or installing BATTERY DISCONNECT link S2 (Model RHM400D50) by following the startup procedure. detailed in Paragraph 7.17.

Low Current Alarm Adjustment

5.09 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:

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

b) Disconnect the battery or load from the DC output terminals of the unit, and reconnect the remote voltage sensing leads to the output terminals of the rectifier.

c) Connect an ammeter and suitably sired variable resistive test load in series across the DC output terminals of the rectifier.

NOTE

The test load must be capable of being adjusted for 0.5% of full rated load of the rectifier.

d) Adjust potentiometer R50 fully counter-clockwise. Refer to Figure 5-1 for location.

e) Start the rectifier and adjust the test load for a reading of 0.5% full load on the ammeter. The LOW CURRENT ALARM should be extinguished.

f) Slowly adjust potentiometer R50 clockwise until the LOW CURRENT ALARM light emitting diode illuminates.

g) When the adjustment is complete, remove all test equipment, reconnect the load, and extend the remote voltage sensing leads if desired.

NOTE

If the rectifier is *connected to battery, precharge* the rectifier's *DC output filter* capacitors before *operating BATTERY DZSCONNECT Circuit Breaker CB1 (Models RHM100D50 and RHM200D50) or installing BATTERY DISCONNECT link S2 (Model RHM400D50) by following the startup procedure detailed in Paragraph 7.17.*

Overvoltage Shutdown Adjustment

5.10 This adjustment sets the limit at which the rectifier 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:

a) Turn the rectifier off by operating the AC INPUT switch S1 to the OFF position.

b) Open the front access door on Models RHM100D50 and RHM200D50 or front access panel on Model RHM400D50. Disconnect the rectifier from battery by operating BATTERY DISCONNECT circuit breaker CB1 on Models RHM100D50 and RHM200D50 to the OFF position, or in the case of the Model RHM400D50, removing the BATTERY DISCONNECT link.

DANGER

Exercise extreme caution when performing Step c). Hazardous DC voltage is present at the DC output terminals and the DC output fuse or circuit beaker.

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

WARNING

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

d) Install Ⓜ option capacitor assembly Al0 on circuit card A?.

e) Connect the test load to the positive output terminal and the rectifier side of fuse F1 or circuit breaker CB1. Adjust potentiometer R32 fully clockwise. Refer to Figure 5-l for location.

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

g) Connect a voltmeter 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 the input switch trips.

j) As a check, turn the FLOAT and/or the EQUAUZE ADJUST potentiometer down. Turn the input switch ON. Slowly increase the output voltage until the inputswitch trips at the propervoltage. Repeat, if necessary, until the input switch trips at the proper voltage.

k) Disconnect the test load, Ⓜ option assembly and the voltmeter. Disconnect the internal voltage sensing leads and store. Extend the remote voltage sensing leads to the load or battery observing proper polarity of connections. Connect load or battery by closing the BATTERY DISCONNECT circuit breaker or replacing the disconnect link.

NOTE

If the rectifier is connected to battery, precharge the rectifier's DC output filter capacitors before operating BATTERY DISCONNECT Circuit Breaker CBI *(Models RHM100D50* and *RHM200D50) or installing BATTERY DISCONNECT link S2 (Model RHM400D50) by following the startup procedure detailed in Paragraph 7.17.*

l) Turn on the rectifier by placing the AC input switch to the ON position.

m) Return the FLOAT/EQUALIZE switch to the FLOAT position and readjust the FLOAT potentiometer. Turn the FLOAT/EQUALIZE switch to the EQUALIZE position and readjust the EQUALIZE potentiometer. Return the FLOAT/EQUALIZE switch to the FLOAT position.

Load Sharina Adiustment

5.11 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 pova 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 8 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 the 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 load sharing voltage is 8 VDC.

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

Ripple Requlator Adiustment

5.12 This adjustment potentiometer is located on circuit card AI 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 filter capacitors reaches 15 amperes in Model RHM100D50 and 50 amperes in Models RHM200D50 and RHM400D50. Customer adjustment of this circuit under normal operating conditions is not recommended. The only time this adjustment should be made by the customer is when a replacement All circuit card has been installed in the rectifier. Circuit card Al 1 is located on the rear of the front access door in Models RHM100D50 and RHM200D50 and on the rear of the front access panel on Model RHM400D50. To adjust the ripple regulator circuit card, observe the following procedure:

DANCER

Voltages capable of producing severe, perhaps fatal, electrical shock me present within the rectifier. Insure that AC and DC sources are completely disconnected before performing this procedure; otherwise, hazardous voltages will be encountered in Steps a), b), d), e), and h) of the following procedure.

a) Turn off the rectifier by operating the AC INPUT switch to the OFF position, and disconnect battery or load from the output terminals. If remote voltage sensing leads are extended, (Ⓣ option) disconnect and insulate. Connect internal voltage sensing leads (Ⓡ option) to terminals 1(+) and 2(-) of T83.

b) install Ⓜ option capacitor assembly A10 on circuit card A?,

c) Connect a test load and adjust the load for at least 20 amperes of load when adjusting Model RHM100D50, and for at least 60 amperes of load when adjusting Models RHM200D50 or RHM400D50.

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 either O-20 amperes when adjusting Model RHM100D50, and g-60 amperes when adjusting Models RHM200D50 and RHM400D50 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 15 amperes of load for Model RHM100D50 or 50 amperes of load for Models RHM200D50 and RHM400D50 at the rectifier output terminals. Adjust potentiometer R3 on circuit card Al 1 until the output voltage starts to decrease. increase the load current at the rectifier output terminals and verify that the output voltaage decreases as the output current 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 f), 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

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

6.02 The description of the circuit is presented by functional blocks. Refer to Figure 6-1 for a rectifier block diagram.

AC Input Circuit

6.03 Commercial 208/240, 60 Hz, three phase AC power is applied through AC INPUT switch S1 connected to the primary of power transformer T1. Tap connections on the primary of transformer T1 permit selection of either of the two AC input voltages.

Power Supply Assembly A8

6.04 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 currentwalk-in circuit.

6.05 The +12 VDC output of this assembly is derived from AC voltage of phase 8 secondary winding of power transformer T1. The AC voltage is applied to the power supply circuit through resistors R4 and R8, or R7 and R8 in Model RHM400D50, respectively. The AC input is rectified by diodes CR1 and CR2 and a portion of the

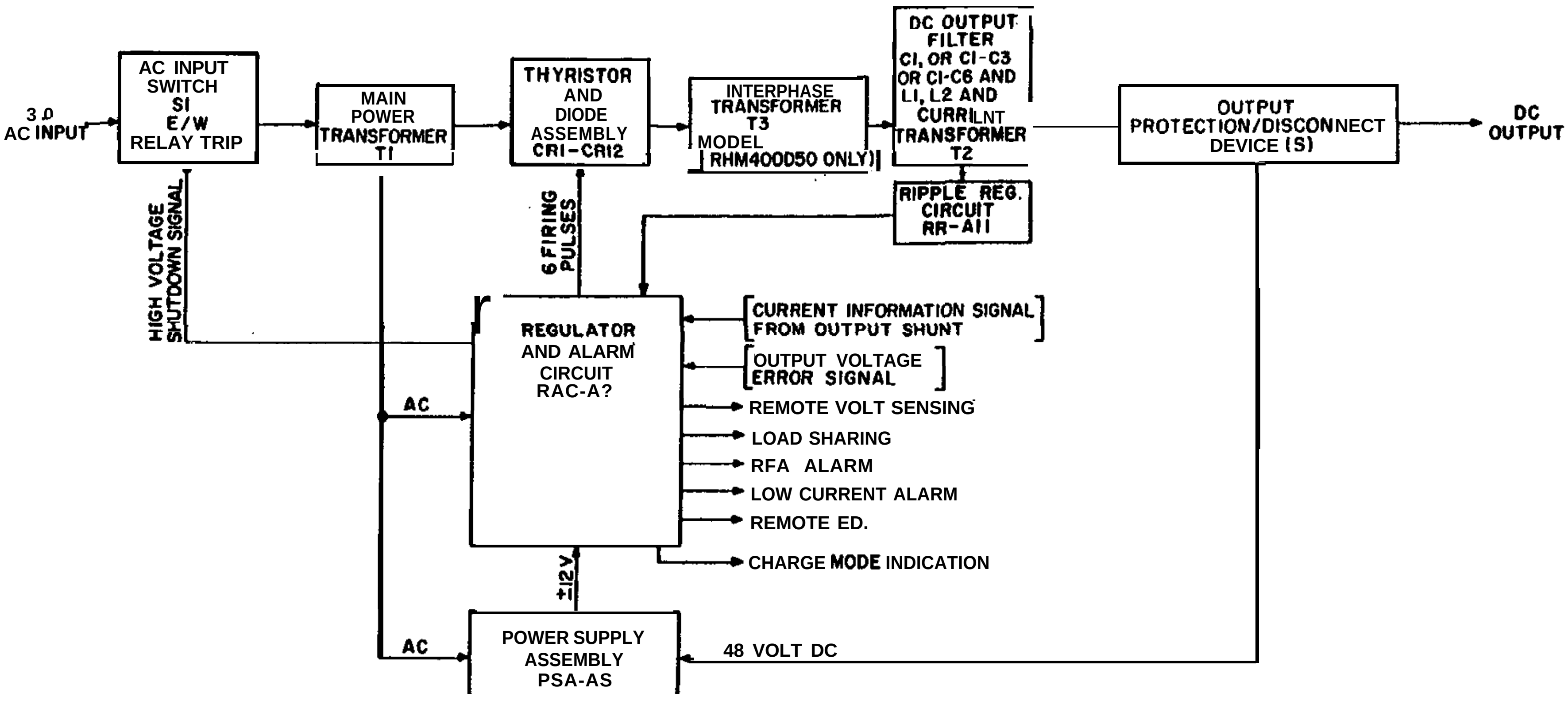


Figure 6-1. Functional Block Diagram

resultant DC is applied to the current walk-in circuit of the Regulator and Alarm Circuit Card A?. The remainder of the DC is passed through diode CR3 to the zener regulator. Zener diode CR14, in conjunction with filter capacitor C2, provides a regulated +12 VDC output which is applied to the Regulator and Alarm Circuit Card A?.

6.06 The -12 VDC output of this assembly is derived from negative battery voltage. Negative battery voltage is applied to the power supply through resistor R2 or R9 in Model RHM400D50. Zener diode CR15, in conjunction with filter capacitor Cl, produces the regulated -12 VDC output which is applied to the Regulator and Alarm Circuit Card A7.

Power Circuit

6.07 The six phase &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 drcuits are identical; therefore, one is described as typical. The conduction of the thyristor is controlled by a pulse circuit on drcuit card A7 which will be explained later. When the thyristor is not conducting, the output of the power transformer is supplied through the power diode only. When higher output voltage is required, a pulse fires the thyristor causing it to conduct. When the thyristor 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 thyristor was fired in relation to the phase of the AC input voltage. The output of each rectifier phase is combined and applied to the output circuit In the Model RHM400D50 rectifier only, the outputs of the rectifier drcuits 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 reduce 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 protection and battery disconnect device to output terminals.

Voltage and Current Regulation Circuitry

6.06 During normal rectifier operation, the voltage and current regulation functions of the rectifier are controlled by circuitry on Regulator and Alarm Circuit Card 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 drcuitry to perform the phase control regulation function. The regulation and phase control circuit monitors the output of the rectifier and ultimately 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, the output voltage increases. If the thyristor is gated later in the AC cycle, the output voltage decreases.

6.09 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 the voltage reference and error detection drcuit, the current sensing and current regulation drcuit, 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 voltage 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 RIO, EQUALIZE and FLOAT ADJUST potentiometers R11 and R12 respectively, resistors R13 and R74, and range potentiometer R16. Potentiometer R16 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 the positive sensing lead. The resistors in the resistor network mentioned above are proportioned such that the slider of potentiometer R12 is at ground potential when the 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 R12 becomes positive with respect to common, causing the output of amplifier Al7 to go negative. Diode CR1 at the output of amplifier Al7 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 A18, 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 from 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 R16. The voltage drop across the 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 voltage to both the low current alarm and load 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 and is removed from the circuit by a shorting jumper in Models RHM100D50 and RHM200D50. In Model RHM400D50 which is equipped with cooling fans, resistor R17 is normally shorted out by closed contacts of relay K1 which are connected at 14 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 (3-4) causes amplifier A5 to generate an error signal. The current limit error signal output of current 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 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 voltage regulator described previously. The firing drcuit 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 T1 secondary winding. The reference comparator utilizes this information to determine when to turn on the driver transistor. The synchronizing comparator provides clamping action to prevent firing of the thyristor when the thyristor is reverse biased.

6.15 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 typical. The cosine voltage is generated by an active integrator consisting of an operational amplifier A4, resistors A9 (6-9), Al0 (6-9), and capacitor C11. Resistors A9 (S-10) and Al0 (5-10) and capacitor Cl4 balance the input to amplifier A4. The cosine voltage 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 180° out of phase with each other, the cosine voltage is applied to the non-inverting input of one compartor of A3, and to the inverting input of the second compartor of A3. At this point, the positive and negative error signals generated by the regulator circuit are applied to the pulse generation circuit These error signals are equal in 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 voltage 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 damped to its negative power supply voltage which is sufficient to bias its respective driver transistor A8 off. During the negative half cycle, the first driver transistor is cut off and the second driver transistor conducts, generating a firing puke 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 voltage divided by resistors Al2 (4-13) and Al6 (3-4) and applied to the synchronizing comparators where the signal is referenced to common. The sampled voltage 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 voltage 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 half cycle, the output of one comparator is clamped 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 thyriston 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 powerfailures.

6.16 When the rectifier is started, a positive DC output fmm Power Supply circuit card A8 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 of the amplifier. This positive voltage is applied to voltage follower AS (12. 13, 14). The voltage follower charges capacitorC6 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 circuit card 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-in 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 Q1, 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 Q1 to conduct Conduction of Ql 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 voltage alarm, and an overvoltage shutdown alarm. The operation of each is described below.

a) 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 Al3 (8-9), Al3 (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 output signal from amplifier A7 at pin 7 is applied to the base of transistor Q6 through 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 Al4 (5-6). This voltage drives Q7 to conduction, thereby applying negative voltage to the base of transistor Q8 which is biased into cutoff. When QB 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 through resistor R43. This causes QB to conduct, providing negative voltage to relay K1 which energizes the coil.

b) High and Low Voltage Alarm: Since the operation of the high and low voltage alarms are 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, supplyingcommon to the anode of HIGH VOLTAGE ALARM LED1 which then illuminates. Positive voltage is also applied to the base of transistor Q10 through resistor Al4 (l-2) and jumpered pins 2A to 6A of J5. This voltage drives Q10 into conduction, supplying negative voltage to the base of transistor Qll which is biased into cutoff. When Q11 is cut off, the coil of alarm relay Kl on Alarm Interface circuit card A9 isdeenergized causing relay K1 to release. Contacts of relay Kl provide open and closed circuits at T83 for actuation of external rectifier failure alarms, if connected.

c) 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 junction 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 of input switch S1, resulting in rectifier shutdown.

Ripple Regulator Circuit Card All

6.22 This circuit card continuously monitors the ripple current through the rectifier DC output filter capacitors. During normal rectifier operation, the ripple current is within the adjustable limits set by the ripple 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 current setting of circuit card All, 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 filter capacitor is reduced to normal limits.

6.23 Current transformer T2 senses the ripple current through the DC filter capacitor and applies a voltage to ripple regulator circuit card All 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 ripple regulator circuit provides a signal to the regulation circuitry on circuit card A7. When the ripple current through the capacitor exceeds the ripple current setting of potentiometer R3, comparator Al provies a positive output signal through diode CR5 to the regulator and alarm circuit and to the alarm interface card to energize relay K3 and provide external alarms, if desired.

6.24 This positive signal is applied to the inverting input of voltage follower Al8 on drcuit 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

615 A fuse alarm circuit provides a visual alarm indication if fuse F1, F2, F3, F4, or F7 (RHM400D50 only) should open. On Models RHM100D50 and RHM200D50, this alarm indicator will also illuminate if BATTERY DISCONNECT Circuit Breaker CB1 opens. When any main fuse opens, the associated alarm fuse F1A, F3A, F4A, or F7A (RHM400D50 only) opens, and negative battery is applied through resistor R18, R17, R19, or R21 respectively. Light emitting diode FUSE ALARM illuminates providing a local fuse alarm indication. Opening of DC output fuse Fl or circuit breaker CB1 disables the rectifier, activating external alarms if connected.

Temperature Sensing circuit
(Model RHM400D50 Rectifier only)

6.26 The Model RHM400D50 Rectifier is equipped with cooling fans and fan failure and temperature sensors. The fan fail sensors are located on circuit cards Al2 and Al3 which are mounted on the top of the heat sinks, while the temperature sensors M3 and M4 are mounted on the bottom of the heat sinks. The fan fail circuits continuously monitor the presense of air flow through the cabinet, while temperature sensors M3 and M4 continuously monitor the temperature of the heat sinks. If the airflow through the cabinet ceases, relay K2 releases and illuminates indicator FAN FAILURE. In addition, if the air flow ceases or the temperature of the heat sink reaches +85° C (+185° F), relay K1 opens a set of contacts which reduce rectifier output current to 66% of full rated load and activate an external rectifier fail alarm, if connected.

6.27 Fan fail circuit cards Al2 and Al3 and temperature sensors M3 and M4 are connected in series with the coil of relay K1. In addition, fan fail circuit cards Al2 and Al3 are connected in series with the coil of relay K2. During normal operation, the temperature sensors and fan fail monitors are closed which energizes the coil of K1 and K2. Contacts of relay K1, energized, provide dosed 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 drcuit card R17 in the current limiting voltage divider circuit of circuit card A7, while the dosed circuit across J2-14 to J5-11 supplies voltage to hold rectifier fail relay K1 on alarm interface circuit card A9 energized. This inhibits the external rectifier fail alarms. With resistor R17 bypassed in the voltage divider, the current limiting circuit is adjusted by potentiometer R23 to provide full rated output current

During a fan failure condition, relay K2 releases and, through normally closed contacts, causes indicator FAN FAILURE to illuminate. During a fan failure or overtemperature condition, relay K1 is deenergired. removing the bypass across resistor R17 in the current limit circuit and opening the coil circuit of relay K1 on circuit card A9. Addition of resistor R17 into the current limit voltage divider alters the voltage in the divider which results in reducing the current limit setting of potentiometer R23. Insertion of resistor 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 circuit card A9 causes the relay to release, activating an external rectifier fail alarm circuit, if connected.

7. TROUBLESHOOTING

General

7.01 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.

7.02 Once trouble has been isolated to the rectifier, various visual and operational checks should be maae to eliminate obvious failure causes. Before starting any troubleshooting, check the following:

DANCER

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

a) Check to be sure AC input power is available to the rectifier.

b) Check all fuses and circuit breakers in the rectifier to assure that none are open.

Use of the Troubleshooting Chart

The flow chart which follows helps isolate malfunctions by giving the technician a yes or no option. Once the technician has arrived at block 'See Causes', he should refer to Para. 7.03 which contains the list of Most Probable Causes. When the trouble is isolated to a printed circuit card, the card should be replaced. No attempt should be made to troubleshoot or repair the circuit cards. if the trouble is suspected to be caused by an out of adjustment condition, the adjustment setting should be checked using the appropriate adjustment procedure. Certain trouble conditions may require no specific check procedures (e.g.. open fuses), therefore, no additional information is given. If a specific procedure is required to check certain trouble conditions, a repair procedure is contained in the rectifier repair procedures section of these troubleshooting instructions.

7.03 Most Probable Cause

1) Failed regulator circuit on circuit card A7 - see Procedure 4.

2) Failed thyristor - see Procedure 5, 6.

31 Failed alarm circuit on circuit card A?.

4) Failed power diode - see Procedure 2.

5) Failed auxiliary ±12V power supply on circuit card AB.

6) Failed power transformer T1.

7) Failed output capacitor-see Procedure 1.

8) Failed output inductor.

9) Misadjusted FLOAT/EQUALIZE potentiometers. (Refer to Paragraphs 5.04 and 5.05.)

10) Misadjusted current limit potentiometer. (Refer to Para. 5.06.)

11) Misadjusted low current alarm potentiometer. (Refer to Para. 5.09.)

12) Misadjusted high voltage shutdown potentiometer. (Refer to Para. 5.10.)

13) Loss of a single AC input phase.

14) Misadjusted load sharing potentiometer. (Refer to Para. 5.11.)

15) Misadjusted high voltage alarm potentiometer. (Refer to Para. 5.08.)

16) Misadjusted low voltage alarm potentiometer. (Refer to Para. 5.07.)

17) Open output protection device -see causes 1, 6, 9. 12.

18) Open reference leads-see Procedure 3.

19) Insufficient load.

20) Open resistor R1, R3, R5, R6, R7, or R9.

21) Input voltage not suited for tap setting.

22) Open load sharing lead.

23) Faulty Ripple Regulator Circuit card Al 1.

24) Failed SCR Fire Circuit card(s) A1-A6.

25) Open filter capacitor fuse.

NOTE

If fuse opens *during connection of* battery, *replace fuse only. If fuse opens during normal operation, replace fuse and* corresponding filter *capacitor.*

26) Open sense fuse F2.

Rectifier Repair Procedures

7.04 The repair procedures which follow are made with the unit under test disconnected from any power source, unless specifically stated otherwise in the test procedure.

7.05 Failed components may sometimes be found by a visual inspection of the rectifier circuitry. Obvious signs of trouble such as loose connections, overheated. discolored, or burned components, or burned and melted wire insulation should be corrected and thoroughly checked before proceeding with more detailed test and repair procedures.

7.06 Since it may be possible to locate a failed component without disconnecting it from the circuit, check each suspected component in the unit before disconnecting any leads. If the trouble cannot be determined in this manner, disconnect the leads and recheck the component. Replace any failed components.

707 As an identification aid, semiconductor device outlines are provided so that identification of various semiconductor terminations may easily be made.

DANGER

Do not connect grounded test equipment to any live component. This could result in damage to the equipment under test. At the same time, a personnel shock hazard exists since the chassis and case** of **ungrounded** test equipment **can** become energized to a **potentially** dangerous **voltage level above ground. Servicing personnel must exercise caution that they do not contact the test equipment chassis or** case and some **grounded object at the same time, when the test equipment *is* connected to *an operating* rectifier.

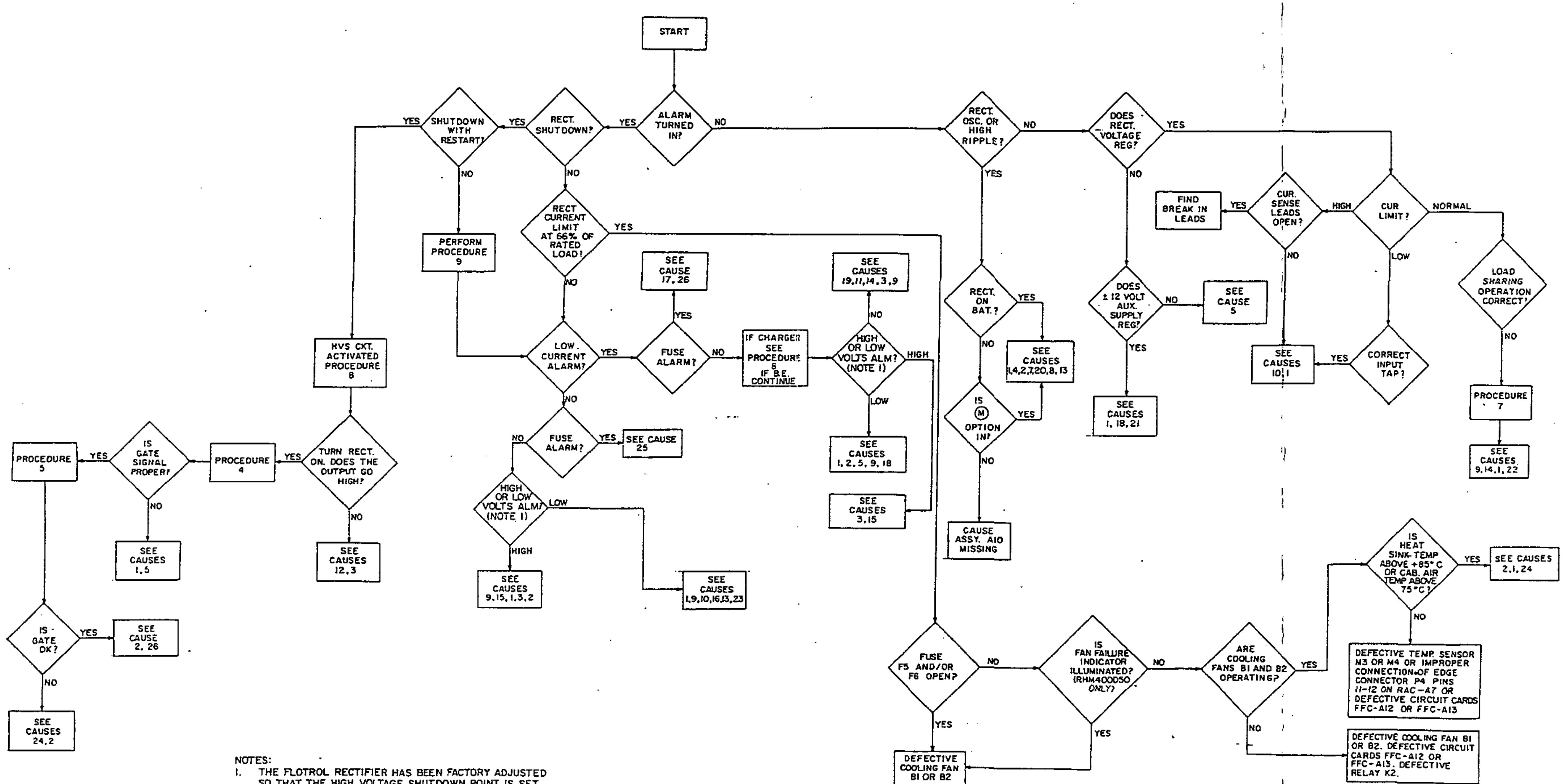
Test Procedures

7.06 The following test procedures are those referenced by number on the fault isolation chart By following one of the appropriate procedures, the servicing technician can 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 possibility of accidental electrical shock.

7.09 Test Procedure 1: Perform this test when checking a capacitor for opens or shorts.

NOTE

Refer to *Test* Procedure 8 before checking any DC *output* filter *capacitor* for opens or shorts.



NOTES:

1. THE FLOTROL RECTIFIER HAS BEEN FACTORY ADJUSTED SO THAT THE HIGH VOLTAGE SHUTDOWN POINT IS SET LOWER THAN THE HIGH VOLTAGE ALARM POINT; THEREFORE, A HIGH VOLTAGE ALARM IS ONLY POSSIBLE IF THE HIGH VOLTAGE ALARM POINT HAS BEEN CUSTOMER ADJUSTED FOR A VALUE LOWER THAN THE HIGH VOLTAGE SHUTDOWN SETTING.

Fault Isolation Chart

a) Place the AC INPUT switch to the OFF position. Insure that the external AC disconnect is opened and output circuit breaker CB1 or the BATTERY DISCONNECT link is opened.

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 multimeter (DMM) for ohmmeter function, using a high resistance range.

d) Momentarily short the capacitor leads or terminals to insure complete discharge. 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 any 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 properly connected.

g) If no further tests are required. return rectifier to normal operation. Refer to Test Procedure 9 for the startup procedure.

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

a) Place the AC INPUT switch to the OFF position. Insure that the external AC disconnect is opened and output circuit breaker CB1 or the BATTERY DISCONNECT link is removed.

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

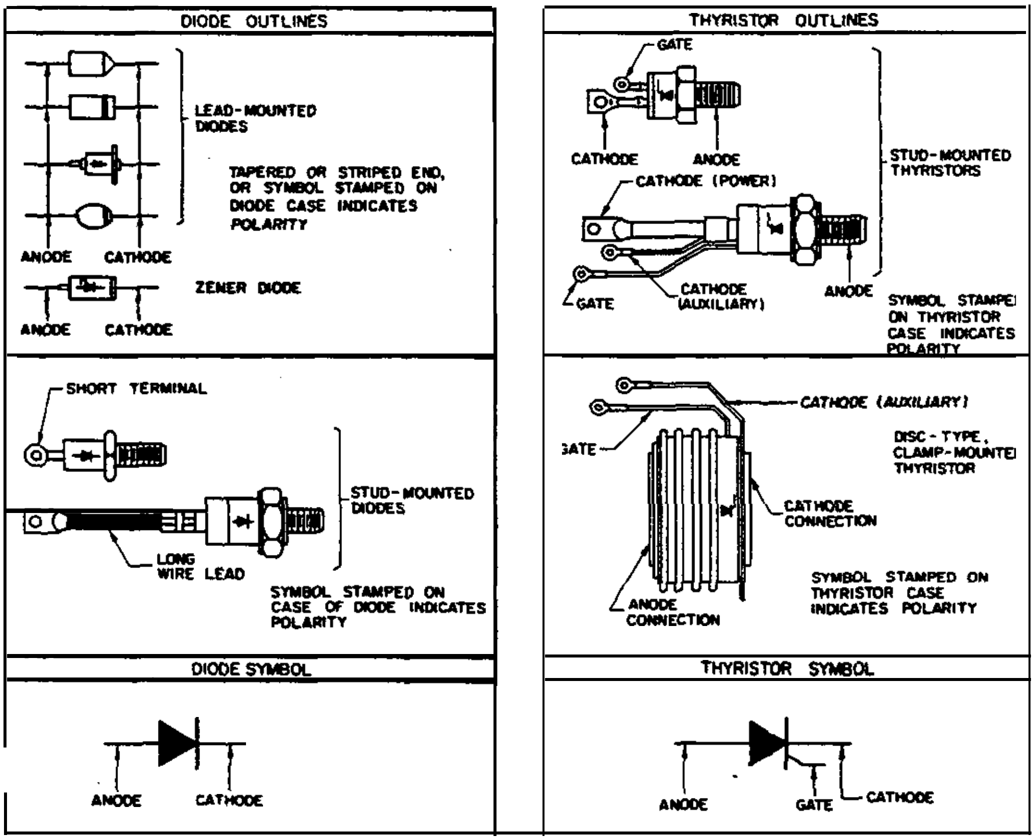


Figure 7-l. Semiconductor Outline Drawings

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 bad diode.

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) If no further tests are required, return rectifier to normal operation. Refer to Test Procedure 9 for the startup procedure.

7.11 Test Procedure 3: Perform this test when checking continuity ot extended voltage reference leads.

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

DANCER

AC power, capable of producing severe, perhaps fatal electrical shock is present at AC INPUT switch S1.

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 48 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.

7.12 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 gating 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 AC INPUT switch to the OFF position. Do not disconnect AC or DC power sources.

b) Open the front access door or remove the lower front panel from the rectifier to gain access to both heatsink assemblies and power transformer Tl. Locate firing circuit cards Al through A6. Part No. 433401600, on each heatsink assembly.

c) Adjust the vertical sensitivity of an oscilloscope for 5 volts per 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 some voltage level as the circuit under test. Servicing personnel must exercise caution thot simultaneous contact is not made with the test instrument chassis or case and some grounded object.

d) Remove the edge connector from 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.

e) Operate the AC INPUT switch to the ON position.

f) 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.

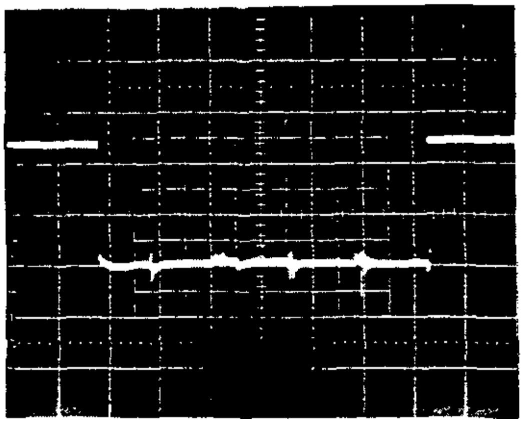


Figure 7-2. Oscilloscope Waveforms

g) After noting the firing waveform characteristics, place the AC INPUT switch to the OFF position. Disconnect the oscilloscope probe and replace the edge connector on its respective thyristor firing circuit card.

h) Repeat Steps d) through g) 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.

i) 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 circuit breaker or link was opened during repairs, refer to Test Procedure 9 for recommended startup procedure. If the battery was not disconnected from rectifier output, place the AC INPUT switch to the ON position. Check the meters and indicators on the rectifier to insure normal operation.

7.13 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 thyrirtor used in the rectifier, If any gating signal is missing or abnormal, the faulty firing circuit card, Part No. 433491600, 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 mat accidental contact is not made with my exposed electrical termination or with test equipment cabinets while me rectifier is operating.

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

b) Open the front access door or remove the lower front panel from the rectifier to gain access to both heatsink assemblies and power transformer T1. Locate the firing circuit cards, Al through A6, Part No. 433401600, on each heatsink assembly.

c) Adjust 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 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) 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.

e) Start the rectifier by operating the AC INPUT switch to the ON position.

f) 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 208 VAC input and 52 VDC output with SO% load.

g) After noting the firing waveform characteristics, place the AC INPUT switch to the OFF position. Disconnecttheoscilloscope probe leads from the circuit card under test

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

i) 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 circuit breaker or link was opened during repairs, refer to Test Procedure 9 for recommended startup procedure. If the battery was not disconnected from rectifier output, perform the following step.

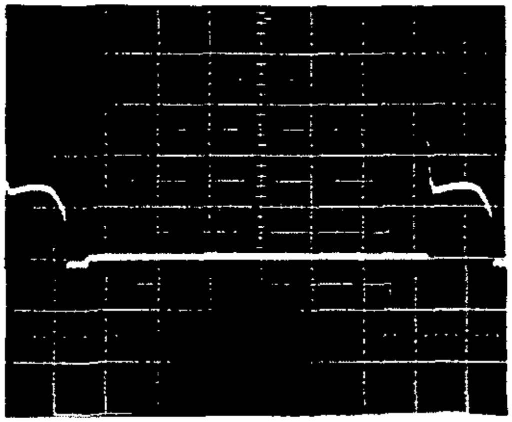


Figure 7-3. Oscilloscope Waveforms

j) Place the AC INPUT switch to the ON position. Check the meters and indicators on the rectifier to insure normal operation.

7.14 Test Procedure 6: Use the following general procedure when checking thyristors for an open or shorted condition. The AC INPUT switch must be placed to the OFF position, and AC and DC power sources disconnected before proceeding with the test

a) Disconnect the cathode and gate leads of any 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 thyristor 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 thyristor tester should be used to check for an anode-to-cathode open or short. If 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 thyristor 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 9 for rectifier startup following completion of repairs.

7.15 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 AC INPUT switch to the OFF position. Open the front access door 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 AC INPUT switch to the ON position. Since the load sharing circuit output voltage varies linearly with output current, circuit operation can be checked at various load levels as shown in Table 7-l.

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.

Percentage of Rated Rectifier Output Current (VDC)	Load Sharing Output Voltage
12.5	1
25	2
37.5	3
50	4
62.5	5
75	6
87.5	7
100	8

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

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 AC INPUT switch to the Off position.

7.16 Test Procedure 8: Use this procedure to discharge the DC output filter capacitors of the rectifier.

DANGER

This rectifier operates from AC voltage capable of producing fatal electrical shock. AC input voltage may be present at the AC input terminals of the rectifier. Battery voltage may be present at the DC output terminals and extended reference leads. Servicing personnel must observe all safety precautions normally associated oith maintenance of electronic equipment, and must avoid direct contact with any energized electrical termination. This rectifier produces high DC output current: therefore, Servicing personnel must remove watches, rings. or other jewelry before performing the following steps.

a) Turn off the rectifier by operating the AC INPUT Switch (S1) located on the front of the rectifier to the OFF position.

CAUTION

If input power to paralleled rectifiers are supplied by a single AC *disconnect device*, performing step b) will cause *loss* of power *to the batteries or load*.

b) Open the external AC disconnect device (fuse or circuit breaker) to remove all AC input power to the rectifier, and tag the disconnect device with an appropriate warning to assure that the disconnect device will not be closed while this procedure is in progress.

c) Open the rectifier's front access door by loosening the two captive fasteners. On Model RHM400D50 only, also remove the lower front access panel.

NOTE

All components are hand stamped within **the** *cabinet of the rectifier, or are shown on a parts location label located within the rectifier cabinet.*

DANGER

When performing Step d), ***exercise*** *extreme* ***caution*** *not* ***to*** *contact my* ***terminals*** *of* ***terminal*** *block* ***TB1.*** Hazardous AC voltages may be *present at terminal block* ***TB1.***

d) Locate the frame ground terminal lug located in the upper left corner of the rectifier cabinet adjacent to AC input terminal block TB1, and check that a green wire is connected from this terminal to earth ground. If not, make a permanent connection from the frame ground terminal lug to earth ground using a wire of the same gauge, or larger, as the AC input wiring to terminal block TB1.

DANGER

Do not proceed until the frame gmmd terminal lug has been connected to earth ground.

e) On Models RHM100D50 and RHM200D50 only, operate the BATTERY DISCONNECT Circuit Breaker CB1 to the OFF position. On Model RHM400D50 only. remove the BATTERY DISCONNECT link (S2).

f) The following three steps check for the presence of AC voltages at input terminal block TB1.

DANGER

Exercise *extreme caution* when *performing* Steps *g) through* 3. *Hazardous AC voltages may be present* at *terminal* block *TB1.*

g) Locate terminal block TB1, and the frame ground terminal lug.

h) Connect one lead of a multimeter which has been adjusted to indicate 120 volts AC to the frame ground terminal lug.

i) Connect the remaining meter lead to measure, in turn, the voltage at terminals L1, L2, and L3 of terminal block TB1. The meter should indicate 0 volts AC in all cases. If 120 volts is measured on any terminal, the AC input has not been completely disconnected. Find the source of the AC voltage and disconnect it before proceeding.

j) Remove the multimeter.

DANGER

Exercise *extreme* ***caution when performing*** *Step* ***k). Hazardous*** DC ***voltage*** (Battery) *moy* be ***present on the leads being disconnected.***

k) If remote voltage sensing leads are normally extended to the battery, disconnect and isolate there leads from terminals 1 and 2 of terminal block TB3, or from the battery. Insulate these leads to prevent contact of these leads with service personnel or the rectifier cabinet.

DANGER

Power transformer T1 adjacent to the bank of DC output **filter** ***capacitors*** **may** ***still*** **retain** ***enough heat*** *to* ***cause*** *turns to* ***exposed skin.*** *Check* ***transformer T1*** *before proceeding* ***and,*** **if hot** ***to touch,*** **either wait** ***until*** **the** ***transformer*** **cools** ***sufficiently or exercise*** **caution not to** ***contact*** *the* ***transformer*** *while performing the* ***following*** *steps. Exercise* ***extreme*** **caution** *when performing Steps* ***l) and m). Hazardous*** *DC* ***voltage*** *(Battery) may be present on the* **capacitor** ***leads.***

l) Locate the bank of DC output filter capacitors (Cl on Model RHMIOOD50; Cl through C3, and C4 on Model RHM200D50; or Cl through C3, C4 through C6, and C7 on Model RHM400D50) within the rectifier cabinet. In turn, connect the leads of a 10 ohm 25 watt, hi-inrush, flame proof resistor (LORAIN® Part No. 266371000, or equivalent) equipped with insulated dip leads across the positive (+) and negative (-) bus bars or terminals of these capacitors. Wait approximately 10 seconds, and then remove the resistor. Do the same for each separate capacitor, or group of capacitors connected by common bus bars.

DANGER

The resistor will get vann as the capacitors ore being discharged.

m) Check that the above capacitors are fully discharged by connecting a multimeter, adjusted to indicate 50 volts DC, across the positive (+) and negative (-) bus bars or terminals of these capacitors, observing proper polarity. Do this for each separate capacitor, or group of capacitors connected by common bus bars. The meter should indicate less than 1 volt DC in each case. If not, the capacitors were not completely discharged, or the remote voltage sensing leads have not been disconnected from the battery. Return to Step k) and assure that the remote sense leads are disconnected before proceeding. Repeat Steps l) and m) until the capacitors are completely discharged.

n) This procedure is now complete. To restore the rectifier to service, follow the steps outlined below.

DANGER

Exercise extreme caution when performing Step o). Hazardous DC voltage (Battery) may be present on the leads being connected.

o) If remote voltage sensing leads where disconnected in Step k), reconnect these leads to terminals 1 and 2 of terminal block TB3, or to the battery. observing proper polarity.

p) If the rectifier is connected to battery, precharge the DC output filter capacitors by placing the 10 ohm resistor described above across BATTERY DISCONNECT circuit breaker CB1 (Models RHM100D50 and RHM200D50 only) or BATTERY DISCONNECT link S2 (Model RHM400D50 only) wherever accessible. Wait approximately 10 seconds, and then remove the resistor.

DANGER

The resistor will get warm as the capacitors are being charged.

q) On Model RHMIOOD50 and RHM200D50 only, operate the BATTERY DISCONNECT circuit breaker CB1 to the ON position. On Model RHM400D50 only, re-install the BATTERY DISCONNECT link (S2).

r) On Model RHM400D50 only, replace the lower front access panel. Close the front access door.

s) Close the external protective device which provides AC power to the input terminals of the rectifier, then operate the AC INPUT switch (S1) to the ON position to restart the rectifier. The rectifier may now be returned to service.

7.17 Test Procedure 9: Observe the following procedure when starting the rectifier after performing tests or repairs which required disconnection from the battery.

DANGER

The following steps must be performed exactly as presented in these instructions. The rectifier must be started off battery to charge the filter capacitors before closing BATTERY DISCONNECT circuit breaker CB1 or installing BATTERY DISCONNECT link S2. Closing the BATTERY DISCONNECT circuit breaker or installing the disconnect link before charging the capacitors con result in personal injury, equipment damage, and blown fuses in the rectifier.

a) Ensure that the rectifier is connected for local or remote sense as required.

b) Close the external disconnect device that supplies AC input power to the rectifier. Place the AC INPUT switch (S1) to the ON position, and then quickly back to the OFF position. The AC INPUT switch may trip open during this step. Immediately after placing the AC INPUT switch to the OFF position, close the output circuit breaker or BATTERY DISCONNECT switch. Then place the AC INPUT switch to the ON position. The rectifier should start and deliver output voltage within the range of 48 to 54 VDC

c) Observe the front pane! meters and indicators. Verify that rectifier operation is normal after restart.

8. MODEL DATA

8.01 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 for the rectifiers covered by these instructions.

APPENDIX

RECORD OF INSTRUCTION CHANGES		
ISSUE OR DATE	PRN	DESCRIPTION OF CHANGE
12	183-7946	Output switch changed to circuit breaker on Models RHM100D50 and RHM200D50.
13	183-8161	Fan Failure LED added to Model RHM400D50.
		CONVERSION TO LAMPS
N1	-	Load Sharing clarified.
P1	183-9754	Phase Loss/Reduced Load Alarm added.
Q1	1830015	Capacitor C4 and Fuse F4 added to RHM200D50's.
R1	183-0364	Fuses F7, F7A added to Model RHM400D50.
S1	-	Table 5-2: Lead labels for RHM400D50 corrected.
T1	-	Test Procedure added for discharging DC output filter capacitors. Miscellaneous updates.
U1	183-0971	Added Para. 4.12 Y Option to Section 4 and renumbered section.
V1	183-3597	Added Note to Paragraph 7.03 Step 25). Step c) of Paragraph 7.17 revised.

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RELTEC”

I. SPECIFICATION

1.1 **GENERAL:** These FLOTROL® Rectifiers are designed to power a load while charging batteries in a positively grounded system.

1.2 **OUTPUT RATINGS**

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

1.2.2 Regulation:

(A) Static: Steady state output voltage remains within ± 112% 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 ranges specified below.

(B) Temperature Coefficient: Output voltage change does not exceed an average of 0.01% per degree Cwithinthe ambienttemperature range of 0° C to +50° C. Refer to Paragraph 1.8.1.

(C) Dynamic: For a step load change from 20% to 100% of full load on a 100 amp or 200 amp rectifier or 250 amps within the range of 5% to 100% of full load on a 400 amp rectifier, the maximum voltage transient does not exceed ±5% of the initial steady state voltage. Recovery to within steady state voltage regulation range does not exceed 200 milliseconds and all transient behavior disappears within 500 milliseconds. Refer to Paragraph 1.8.1.

1.23 Filtering: When connected to a battery rated in ampere-hours four times the full load current rating of the charger,

(A) voice band noise is less than 32 dbrn 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.

13.4 current

Model	Rating
RHM100D50	100 Amps
RHM200D50	200 Amps
RHM400D50	400 Amps

Table 1

PD548103800
PD547201400

ISSUE	CHG NO	DESCRIPTION
DA	183-3934	MAR 23 1994 BP M Paragraphs 1.4.3 (C) and 1.4.5 (C) and (D) updated to reference adjustment range listed *in* Table 4. John Jasko 3-23-94 (PRN)
CA	189-0703	Accessory Equalize Charge Timer Part No. changed. J. Jasko 8-28-91 AUG 28 1991 BP M

?728-2/82 REVISION

RELTEC™ Lorain Products

POWER DATA

THREEPHASE"RHM"SERIESFLOTROL®RECTIFIER
MODEL RHM100D50 SPEC. NO. 545401000
MODEL RHM200D50 SPEC. NO. 547201400
MODEL RHM400D50 SPEC. NO. 548103800

DR BY R Lash	DATE 3-15-82	GRP LDR B W Howald	DATE 3-25-82	PD545401000 0[illegible]
CH BY K Kurish	DATE 3-16-82	APP BY R Kurish	DATE 3-16-82	
ENGR BY J Giancaterino	DATE 3-17-82			4001

1. SPECIFICATION

1.3 INPUT RATING

1.3.1 **Voltage:** Taps provided for nominal 208/240 volts, three phase, 57 to 63 Hz, with ranges of 184 to 220 and 212 to 254 volts.

(A) Typical Input Data-Model RHM100D50

(1) 52.08 Volts DC at the Rectifier Output

Voltage and-Tap	Amount of Load	Input Current (Amperes)	Input VA	Input Watts	Input VAR	Efficiency %	Power Factor %
204 Volts on 208 Volt Tap	No Load	1.46	516	140	497	-	-
	Half Load	12.00	4240	2960	3036	88.0	69.8
	Full Load	22.80	8056	6140	5215	84.8	76.2
235 Volts 0” 240Volt Tap	No Load	1.26	513	160	487	-	-
	Half Load	10.00	4070	2960	2794	88.0	72.7
	Full Load	19.80	8059	6080	5290	85.6	75.4

(2) Maximum Input Current with 56.4 Volts Output at the Rectifier

Nominal Input	208V	240v
Input Voltage	204V	235V
Max. Input Current	24.6A	21.441

(B) Typical Input Data -Model RHM200D50

(1) At 52.08 Volts DC at the Rectifier Output

Voltage and-Tap	Amount of Load	Input Current (Amperes)	Input VA	Input Watts	Input VAR	Efficiency %	Power Factor %
204 Volts on 208 Volt Tap	No Load	1.8	636	168	613		
	Half Load	23.7	8374	5860	5982	88.9	70.0
	Full Load	46.8	16536	12120	11249	85.9	73.3
235 Volts on 240 Volt Tap	No Load	1.1	448	164	417	-	-
	Half Load	20.5	8344	5780	6018	90.1	69.2
	Full Load	40.6	16525	11920	11445	87.4	72.1

(2) Maximum Input Current with 56.4 Volts Output at the Rectifier

Nominal Input	208V	240v
Input Voltage	204V	235V
Max. Input Current	51.0A	44.0A

1. SPECIFICATION

1.3 INPUT RATING (CONT'D)

(C) Typical Input Data-Model RHM400D50

(1) 52.08 Volts DC at the Rectifier Output

Voltage and Tap	Amount of Load	Input Current (Amperes)	Input VA	Input Watts	Input VAR	Efficiency %	Power Factor %
208 Volts Tap	Half Load / No Load Full Load	36.1 / 3.5 73.9	13000 26620	13000 / 12060 23000	6515 13400	- 92.6 90.6	86.5 86.4
235 Volts on 240 Volt lap	No Load Half Load Full Load	3.4 31.7 63.6	1415 13180 26440	244 11260 23000	1390 6850 13040	 92.5 90.6	- 85.4 87.0

(2) Maximum Input Current with 56.4 Volts Output at the Rectifier

Nominal Input	208V	240V
Input Voltage	184V	212V
Max. Input Current	92.8A	81.0A

1.32 **Efficiency:** Greater than 85% from 50% load to full load at the design center input voltage of any tep at 60 Hz input and 50 volts output

1.3.3 **Displacement** Factor: For a 100 amp or 200 amp rectifier, the displacement factor is greater than 65% and for a 400 amp rectifier, is greater than 80% from 40% load to full load at the design center input voltage of any tap at 60 Hz input and 50 volts output.

13.4 Telephone Influence **Factor:** The IT product does not exceed the values in Table 2 for any normal input and output condition. Refer to Paragraph 1.8.1.

Model	IT Product
RHM100D50	7500
RHM200D50	15000
RHM400D50	35000

Table 2

1.3.5 **Distortion:** The peak to peak ● mpRtude of any distortion in the line to line AC voltage wave does not exceed 10% of the fundamental rms voltage if the AC source impedance produces no more than 2% voltage drop when the charger is delivering full load. Refer to Paragraph 1.8.1.

I. SPECIFICATION

1.4 STANDARD FEATURES

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

1.43 Input Protection: A three pole switch opens all three input liner

1.4.3 output Protection:

(A) Current Limiting: A circuit, adjustable from 90% to 110% of full rated load, limits DC output current Factory set at 110% of full load.

(B) Short Circuit: Protection devices listed in Table 3 are located in the negative output lead.

Model	Short Circuit Protection	Protection Device
RHM100D50	150 AMP	Circuit Breaker
RHM200D50	250 AMP	Circuit Breaker
RHM400D50	600 AMP	Fuse

Table 3

(C) Overvoltage Shutdown: A load protection circuit will cause rectifier shutdown should rectifier output voltage exceed a preset adjustable value while the rectifier is delivering at least 3% of rated output current Refer to Table 4 for adjustment range and factory setting.

Model	Low Voltage Alarm		High Voltage Alarm		High Voltage Shutdown	
	Adjustment Range	Factory Setting	Adjustment Range	Factory setting	Adjustment Range	Factory Setting
RHM100D50 RHM200D50 RHM400D50	39.1V to 52.8V	47.15V	52.8V to 60.0V	57.6V	52.8V to 60.0V	55V

Table 4

1.4.4 Local or Remote Voltage Sensing: Point of regulation may be extended to battery or power board terminals.

1.4.5 Alarms • Relay contacts are rated one ampere at 26 volts.

(A) RECTIFIER FAIL ALARM: If the rectifier is turned off manually, or automatiolly by a high voltage condition. or if the rectifier is diibled by loss of AC input power, an input overcurrent condition. fan failure (ii provided), or operation of output fuse F1 or reference fuse F2, positiie battery is provided for two external rectifier fail alarm circuits. A dosed loop actuated alarm is available as a wiring option.

PD548103800
PD547201400

I. SPECIFICATION

1.4 STANDARD FEATURE5 (CONT)

1.4.5 Alarms (CONT)

(B) LOW CURRENT ALARM (LED): If output current decreases below 0.5% of full load (known as charge failure), or if the rectifier is turned off, the Rectifier Fail Alarm circuit will activate, the yellow Low Current Alarm indicator will illuminate, and positive battery will be provided for an external low current alarm circuit A closed loop actuated alarm is available as a wiring option.

(C) HIGH VOLTAGE ALARM (LED): If output voltage increases above a preset adjustable level, the Rectifier Fail Alarm circuit will activate and the red High Voltage Alarm indicator will illuminate. Refer to Table 4 for adjustment range and factory setting.

(D) LOW VOLTAGE ALARM (LED): If output voltage decreases below a preset adjustable level, the Rectifier Fail Alarm circuit will activate and the red Low Voltage Alarm indicator will illuminate. Refer to Table 4 for adjustment range and factory setting.

(E) FUSE ALARM (LED): Operation of output fuse F1, reference fuse F2 or filter capacitor fuses F3, F4, or F7 (if furnished) causes a red alarm LED to turn on. Opening of fuses F1 and F2 will also activate the Rectifier Fail Alarm.

(F) FAN FAILURE ALARM (LED) (Model RHM400D50 Only): 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) POWER ON (LED): When the AC INPUT non-automatic circuit breaker (51) is in the ON position and AC input is present the green Power On indicator will illuminate.

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

1.4.8 Remote Equalize: Provision is made for remote control of Float-Equalize operation. Refer to Section 3. INSTALLER'S CONNECTIONS and Note 4.9.

1.4.9 End Cell Charging: The output voltage can be increased for any tap at its nominal voltage for charging three end cells by switching the DC output and leaving the reference connected across the main 23 cell string.

1.4.10 Phase Shift (466 amp only): Main power transformer shifts the phase of input current to lower line distortion when two units are operated in parallel. Refer to Paragraph 1.8.1.

1.4.11 Thermal Protection (400 amp only): Circuit is provided to reduce load carrying capability to 66% of full rated load and give a rectifier failure alarm when the temperature of air flow through the rectifier reaches +75° C (+167° F) or if tbetemperatureof the heatsink reaches +85° C (+ 185° F) in the 400 amp rectifier.

1.4.12 Current Walk-in: Output current will be gradually increased to no greater than 50% of full load in 2.5 seconds, 75% of full bad in 5.0 seconds and 90% of full load in a0 seconds.

1. SPECIFICATION

1.4 STANDARD FEATURES (CONT)

1.4.13 Meters: MODUTEC Type W (or equivalent). 3 112 inch rectangular type DC voltmeter and ammeter, ±2% accuracy at full scale with ranges as listed in Table 5.

Model	Meter Ranges	
	Ammeter	Voltmeter
RHM100D50	0-150 Amp	
[redacted]00D50	[redacted]00 Amp	0-75 V[redacted]
RHM400D50	0-600 Amp	

Table 5

1.4.14 Mounting: Angles are provided to mount the RHM100D50 on 19 inch /23 inch relay rack and the RHM200D50 on 23 inch relay rack only. The RHM400D50 is floor mounted only.

1.4.15 Output Disconnect: A disconnect is provided to open the negative DC output bus.

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

1.5 ENVIRONMENTAL RATING

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)

1.5.3 Humidity: This rectifier is capable of operating in an ambiint relative humidity of 10% to 95%, noncondcnsing.

1.5.4 Altitude: Thii rectifier is capable of operating at altitudes from sea level to 10,090 feet at ambient temperaturesof +45° C (+113° F) at 4800 feet and +40° C (+104° F) at 7000 feet.

1.5.5 Ventilation Requirements:

(A) Rectifier should be mounted so that ventilating openings are not blocked and air entering the cabinet does not exceed +50° C (+122°F).

(B) Relay Rack Spacing: It may be necessary to allow spacing listed in Table 6 and UK a baffle plate between this rectifier and other heat producing equipment

1.5 ENVIRONMENTAL RATING (CONT)

1.5.6 Heat **Dissipation:** Refer to Table 6.

Model	Heat Dissipation BTU/HR	Relay Rack Spacing	floor Mounting
RHM100D50	3185	S-l /4"	
RHM200D50	5825	5-1/4"	
RHM400D50	7400		Yes

Table 6

1.5.7 **EMI/RFI Suppression:** This unit conforms to the radiated and conducted noise requirements of FCC rules Part 15, Subpart J, for Class A computing devices. Models RHM100D50, RHM200D50 only: conducted EMI on the DC input and output leads conforms to the requirements of NEMA PE-7- 1985. Refer to Paragraph 1.8.1.

1.5.8 **Audible Noise:** The audible noise at any point five feet from any vertical surface of the rectifier does not exceed 60 dB 'A' weighting when measured with a General Radio 1551-C Sound Level Meter (or equivalent) conforming to ANSI 51.4. Refer to Paragraph 1.8.1.

I.S.9 Safety **Compliance:** This unit is UL listed to the requirements of UL power supply Standard 1012 for use as a power supply in electronic data processing equipment or telephone equipment in a controlled • nyhonmenL

1.6 ACCESSORIES AVAILABLE FOR USE WITH THIS RECTIFIER

1.6.1 **Mountings:**

(A) Adapter Plates for 30 inch Unistrut Relay Rack: RHM100D50 and RHM200D50:
(2) Part No. 347153300

(8) floor Stands (replace relay rack angles)
(1) RHM100D50: Part No. 377219000
(2) RHM200D50: Part No. 377218900

1.6 1 **Baffle Plates:**

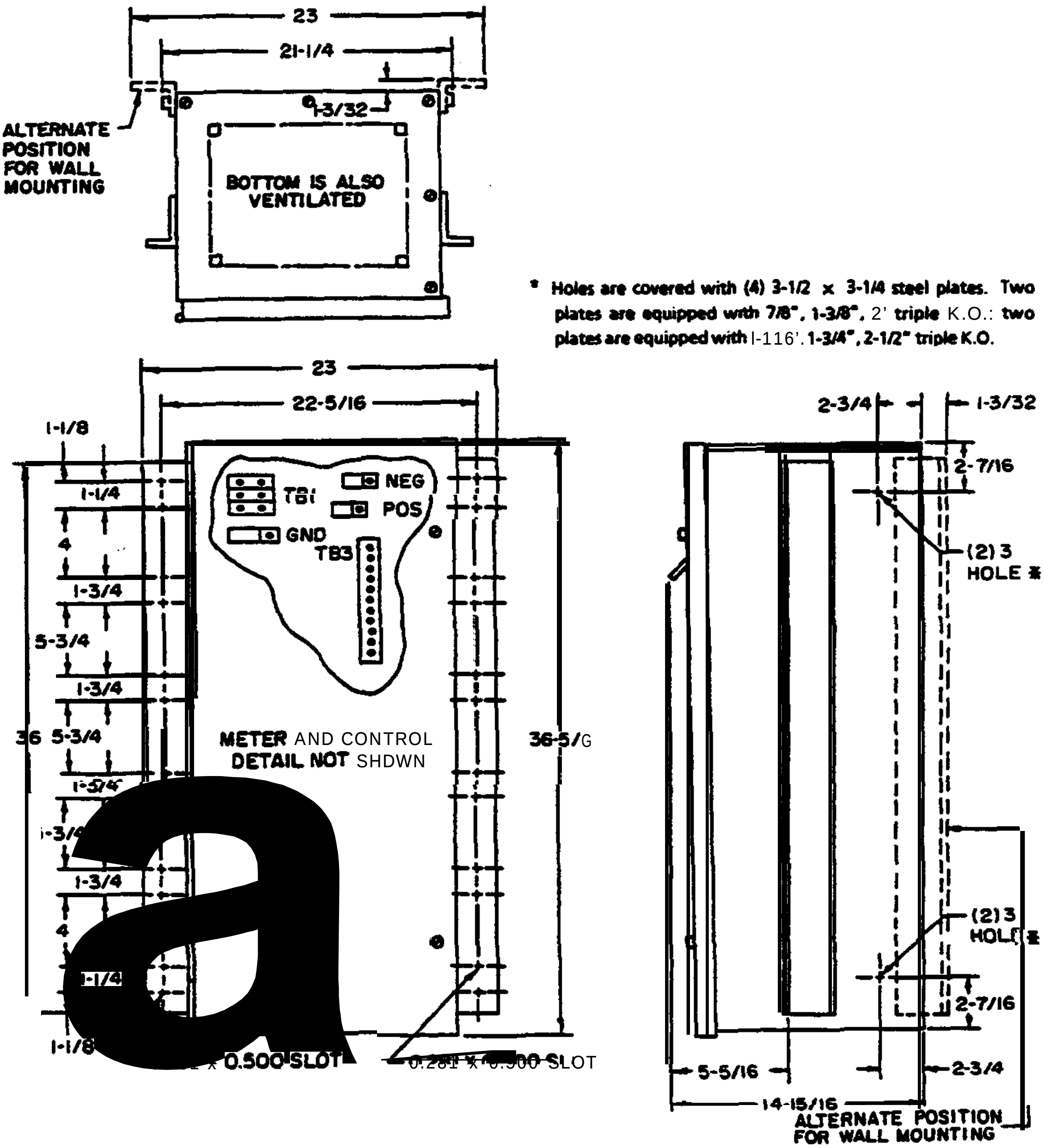
(A) 19 inch Baffle Plate. S-114 inch rack space: Pan No. 377761600

(8) 23 inch Baffle Plate, 5-1/4 inch rack space: Pan No. 377761700

1.6.3 **Equalize Charge Timer:** This timer automatically or manually controls the equalize function of the rectifier following a power failure and subsequent battery discharge. Part No. 484383500 is designed for 19 inch relay rack mounting. For 23 inch relay rack mounting, order Part No. 484383700.

PD548103800
PD547201400

2. DIMENSIONS -MODEL RHM200D50



* Holes are covered with (4) 3-1/2 x 3-1/4 steel plates. Two plates are equipped with 7/8", 1-3/8", 2' triple K.O.: two plates are equipped with I-116'. 1-3/4", 2-1/2" triple K.O.

NOTES:

1. ALL DIMENSIONS ARE IN INCHES UNLESS OTHERWISE SPECIFIED.
2. WEIGHT IN LGS.
   NET: 431
   SHIPPING: 457
3. FINISH: EQUIPMENT LIGHT GRAY.
4. ▭ INDICATES VENTILATING GRILLE

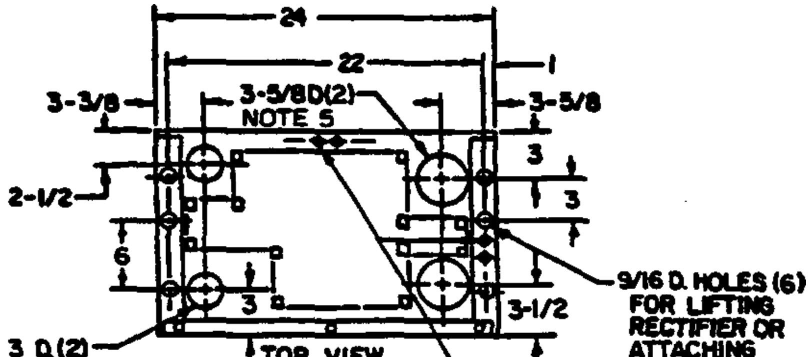
PD548103800
PD547201400

PD545401000

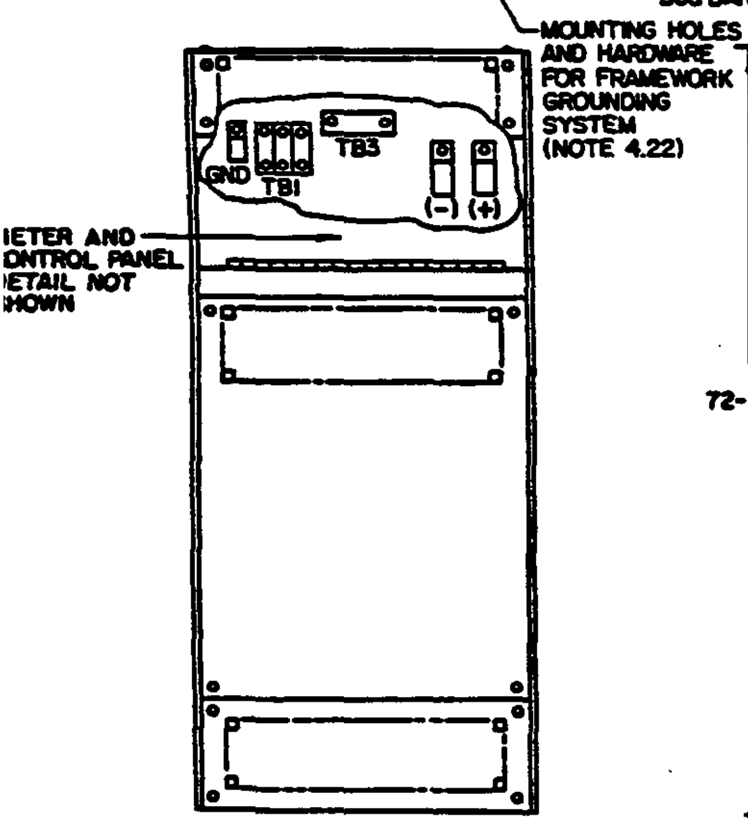
!. DIMENSIONS -RHM400D50

NOTES:

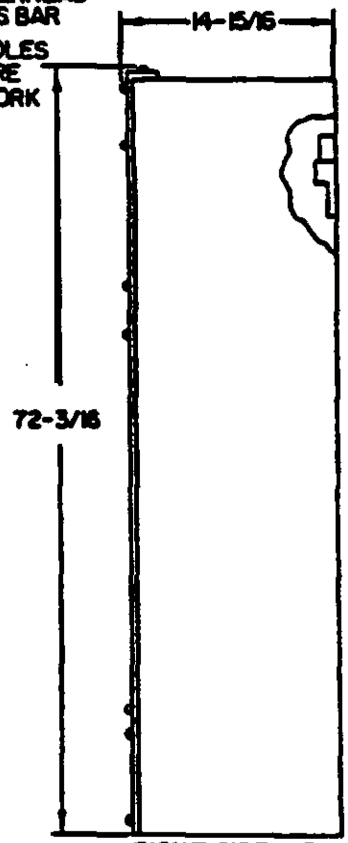
1. ALL DIMENSIONS ARE IN INCHES UNLESS OTHERWISE SPECIFIED.
2. WEIGHT IN LBS.
   NET: 647
   SHIPPING: 712
3. FINISH: EQUIPMENT LIGHT GRAY.
4. ☐ INDICATES VENTILATING GRILLE
5. DIA AC INPUT HOLES FURNISHED WITH 2 DIFFERENT KNOCKOUT PLATES, PROVIDING 7/8, 1-1/8, 1-3/8, 1-3/4, 2, 2-1/2 ENTRANCE HOLES 4" DIA DC OUTPUT HOLES FURNISHED WITH BLANK COVER PLATE.



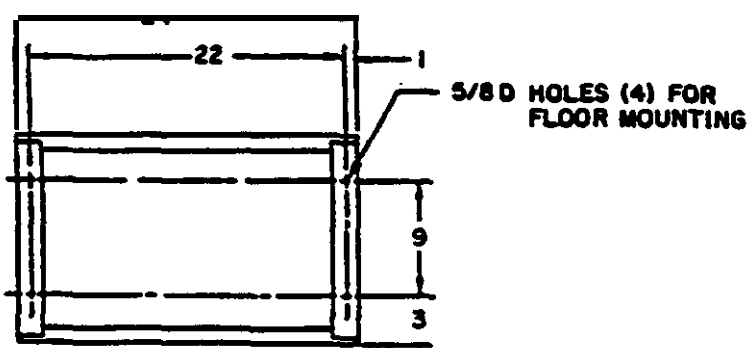
TOP VIEW
FIG 3



FRONT VIEW
FIG 1



RIGHT SIDE VIEW
FIG 2

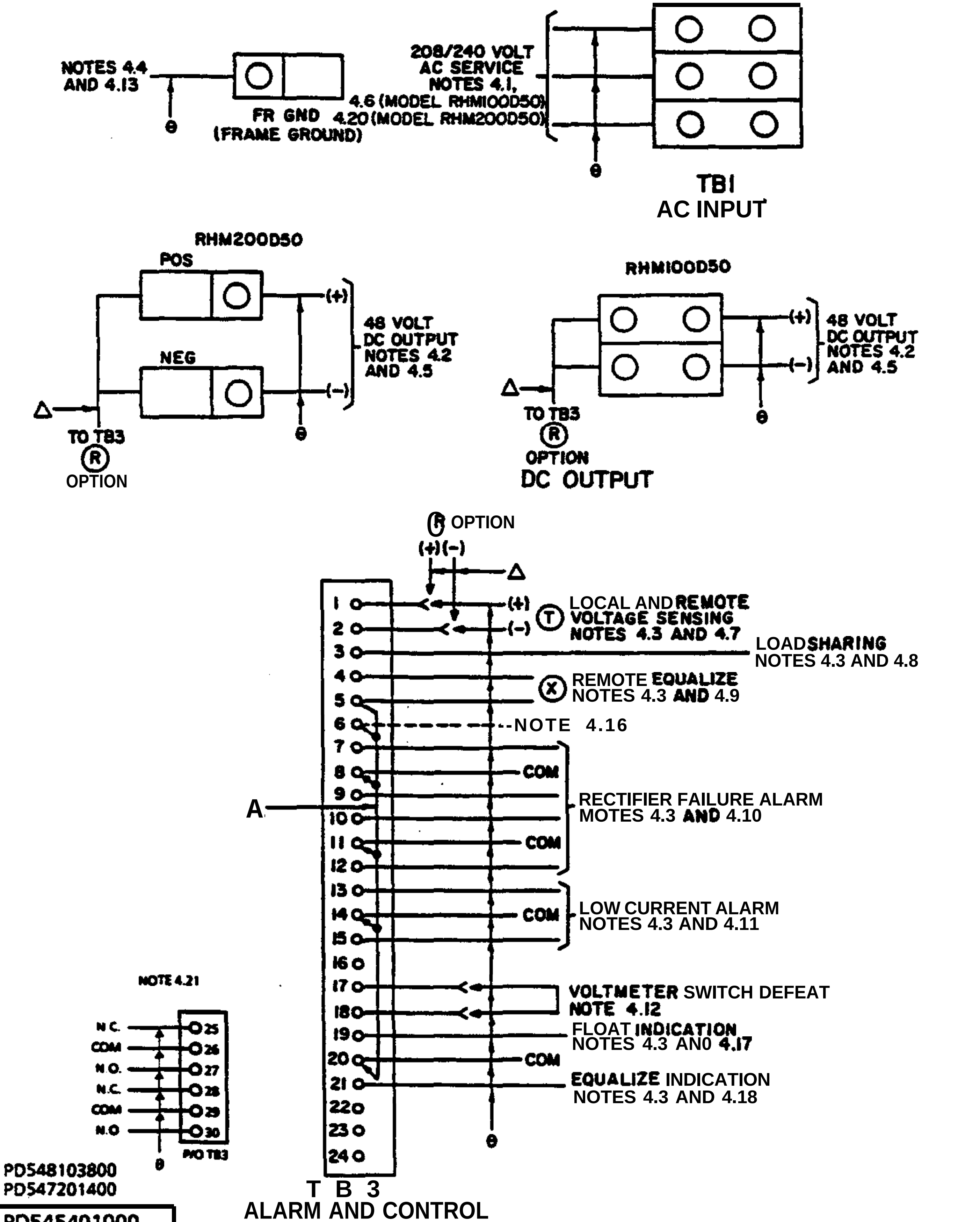


BOTTOM VIEW
FIG 4

PD548103800
PO547201400

PD545401000

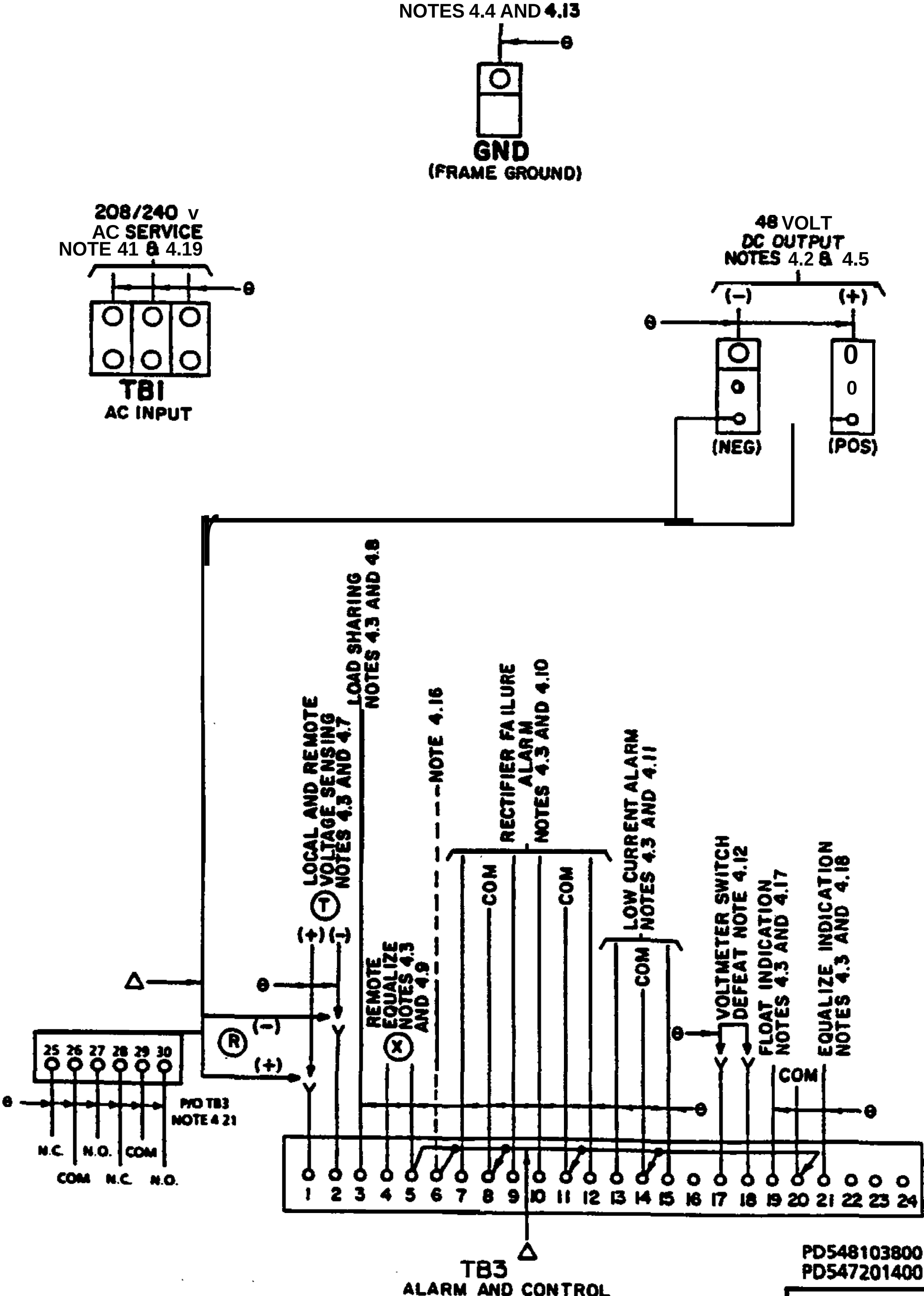
3. INSTALLER'S CONNECTIONS -RHM100D50, RHM200D50



PD548103800
PD547201400

PD545401000

3. INSTALLER'S CONNECTIONS -RHM400D50



PD545401000

4. INSTALLER'S INFORMATION NOTES

4.1

AC INPUT (TB1)					
Model	Terminals		Input Voltage	Recm wire Sue	Recm Fusing
	Capacity	Type			
RHM100D50	(1) 18 Ga. to 2 Ga. per Phase	Solderless	208 240	(1) 10 Ga. per Phase (Note 4.6)	30 Amp
RHM200D50			208 240	(1) 6 Ga. per Phase (Note 4.20)	60 Amp
RHM400D50	(1) 4 Ga. to 2/0 per Phase	Solderless	208 240	(1) 2 Ga. per Phase (Note 4.6)	100 Amp

4.2

DCOUTPUT				
Model	Terminals		Loop Length (Ft) (Note 4.5)	Recm Wire Size
	Capacity	Type		
RHM100D50	(1) 4 Ga. to 2/0 per Pole	screw	60 95 120	2 Ga. 110 2/0
RHM200D50	(1) 600 MCM to 2 Ga. per Pole	Solderless	75 95 112	3/0 4/0 250 MCM
RHM400D50	4-600 MCM or (2) 1/0 to 250 MCM		95 112	(2) 4/0 (2) 250 MCM

4.3

ALARM AND CONTROL (TB3)		
Terminals		Recm Wire Size
Capacity	Type	
16 Ga. Max.	6-32 Screw	18 Ga. Max

PD548103800
PD547201400

I. INSTALLER'S INFORMATION NOTES

4.4

FRAME GROUND (FR GND)			
Model	Terminals		Recm Wire Size
	Capacity	Type	
RHM100D50	6-14 Ga.	Solderless	10 Ga.
RHM200D50 RHM400D50	6-2 Ga.	Solderless	6 Ga.

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

4.6 Wire sizes based on recommendations of National Electric Code Table 310-16 for copper wire at +75°C conductor temperature. operating in 30°C ambient For operation above 30°C ambient, use derating factors shown in Table 310-16 of NEC.

4.7 For remote voltage sensing, remove jumpers (Option) and extend wires from terminals 1 and 2 to the battery (Ⓣ Option). Extended wires should fused at one ampere.

4.6 Connect this lead to the load sharing (paralleling) terminal on similarly equipped LORAIN RL or RHM Series FLOTROL Rectifii of the same output voltage rating.

4.9 Extension of customer furnished circuit (Ⓧ Option) from terminals 4 and 5 allows remote equalize mode of operation of the rectifier. Customer furnished circuit closure is required to place rectifier into equalize mode of operation,

4.10 if the rectifier is turned off, fan failure (if provided), low current, low output voltage, high output voltage, loss of input power, operation of the reference or output fuse is indicated by furnishing positive battery at terminals 7 and 10 of terminal board TB3.

4.11 Low current alarm condition is indicated by removing positive battery from terminal 13 (End Cell Switch Inhibit Signal) and furnishing positive battery at terminal 15 of terminal board TB3.

4.12 Voltmeter reads battery voltage with the rectifier turned off if terminals 17 and 16 are connected together.

4.13 Connect this wire to earth ground (green wire).

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

4.15 A - indicates wires furnished as a part of this rectifier.

4. INSTALLER'S INFORMATION NOTES

4.16 Positive battery is available at terminal 6 of terminal board TB3 for voltage actuated alarms.

4.17 Positive battery is supplied at terminal 19 of terminal board TB3 when tha rectifier is placed in float mode of operation.

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

4.19 To shift the phase of the input voltage of the rectifier with respect to the AC line service to lower the cumulative distortion on the AC line when two or more rectifiers are operated in parallel, simply interchange any two input phases at the input terminal block TB1. When more than two rectifiers are operated in parallel, interchange any two AC input phases at TB1 on alternate rectifier%

4.26 Wire sizes based on recommendations of National Electrical Code Table 310-16 for copper wire at + 90°C conductor temperature, operating in 30°C ambient For operation above 30°C ambient UK derating factors shown in Table 310-16 of tha National Electrical Code.

421 During Phase Loss/Reduced toad Alarm condition rectifier output voltage and current are at a reduced level and external alarm contacts an activated to provide a dosed loop circuits between terminals 26 to 27 and 29 to 30 and open loop circuits between terminals 25 to 26 and 28 to 29.

4.22 Ground washers and 1/4" - 20 X 1/2" thread forming screws are provided on the top rear and top right side of the rectifier cabinet for connection of the rectifier into a framework grounding system. Customer to provide a two hole lug designed for mounting on 0281' diameter holes with 0.625" centers. Note that the lug may be mounted to either location specified on the DIMENSIONS page.

PARTS LIST

REF DESIG.	DESCRIPTION	L.P.C. PART NO.	QTY. PER MODEL: RHM200D50	SPARE PARTS QTY. LEVEL: MINIMUM	ON-SITE	DEPOT
C1-C3	22,000MFD, 75VDC	2731-382	3	-	1	1
C8-C10	5MFD, 370VDC	2714-557-02	3	-	1	1
C11-C13	0.1MFD, 250VAC	2714-513	3	-	1	1
C27-C29	1.0MFD, 250VAC	2714-539	3	-	1	1
C14	100MFD 75VDC	2731-149	1			
C4	60,000MFD 75VDC	2731-415	1			
C15,17,19 21,23,25	0.1MFD, 600VDC	2715-250	6	-	1	1
C16,18,20 22,24,26, 30,31,32	1.0MFD, 600VDC	2715-275	9	-	1	1
				-	1	1
C33	10.0MFD, 100VDC	2715-157	1	-	1	1
				-	1	1*
CR14	12V ZENER	2836-216	1	-	1	1
CR15	12V ZENER	2836-217	1	-	1	1
CR1,3,5, 7,9,11	THYRISTORS	2863-066	6	-	2	3
CR2,4,6, 8,10,12	DIODES	2814-023	6	-	2	3
CR13,16	DIODE	2812-330	2	-	2	2
DS1	LED ASSY	4257-022	1	-	1	1
F2	GMT 3 AMP	2486-109	1	1	1	1
F3A,F4A	GMT 1/4 AMP	2486-102	2	2	2	2
F3	60 AMP	2483-525	1	1	1	1
F4	15 AMP	2483-623	1			
L2	INDUCTOR DC	4411-603	1	-	-	1
L1	INDUCTOR DC	4411-608	1	-	-	1
M1	0-300 A AMMETER	2924-873	1	-	-	1
M2	0-75V VOLTMETER	2944-864	1	-	-	1
R22 (Y)	100K OHM 1 WATT	2635-717	1	-	1	1
R1,R20, R3-R9	100 OHM 25 WATT	2656-511	9	-	1	1
R10-R15	3 OHM 3 WATT	2651-305	6	-	1	1
R16	300 AMP SHUNT	2982-749	1	-	1	1
R17-R19,21	4.7K OHM 3 WATT	2651-347	4	-	1	1
R2	100 OHM 50 WATT	2656-610	1	-	1	1
A1-A6	SCR. FIRE ASS'Y.	4334-016	6	-	1	1
A7	REG. & AL'M. ASS'Y.	4865-087	1	-	1	1
A8	POWER SUPPLY ASSY	4865-622	1	-	1	1
A8 (Y)	P.S. SENSE LOSS ASSY	4865-423	1	-	1	1
A9	ALARM INTERFACE	4338-527	1	-	1	1
A10 (M)	OFF. BAT. CAP. ASS'Y.	4251-014	1	-	1	1
A11	RIPPLE REG. ASS'Y.	4865-698	1	-	1	1
S1	100AMP 480VAC	2513-933	1	-	-	1
CB1	250 AMP 125 VDC CIRCUIT BREAKER	2566-239	1	-	1	1
T1	TRANSFORMER	4568-561	1	-	-	1
T2	TRANSFORMER	4425-513	1	-	-	1
RV-1,2, 3	VARISTOR	2676-341	3	-	1	1

* INDICATES THE PART OR ASSEMBLY IS LISTED MORE THAN ONCE. USE THE RECOMMENDED SPARE QUANTITY WHERE THE ITEM FIRST APPEARS.

• FOR REPLACEMENT ORDER 4832-038.

TABLE A

3 ϕ INPUT VOLTAGE	USE TB1'S	MODEL	INPUT VOLTS	T1 CONNECTIONS: WIRE (D)	WIRE (E)	WIRE (F)
208	L1-L2-L3	RHM200D50	208	6A-7B	6B-7C	6C-7A
240	L1-L2-L3		240	6A-8B	6B-8C	6C-8A

NOTES:

1. EQUIPMENT SUPPLIED WITH INTERNAL VOLTAGE SENSE LEADS BETWEEN TB3 REMOTE SENSE TERMINALS (1) AND (2) AND OUTPUT TERMINALS. REMOVE THESE LEADS WHEN EXTERNAL SENSE LEADS ARE USED.
2. STORE INTERNAL VOLTAGE SENSE LEADS HERE.
3. D-INDICATES LEAD IS A JUMPER.
4. (R) -(STANDARD) INTERNAL VOLTAGE SENSE.
5. (T) -REMOTE VOLTAGE SENSE OPTION.
6. (X) -REMOTE EQUALIZE OPTION.
7. (M) -REQUIRED FOR BATTERY-LESS OPERATION
8. -VOLTMETER SWITCH DEFEAT- THIS JUMPER IS REQUIRED IN ORDER TO READ BATTERY VOLTAGE WHEN S1 IS IN OFF POSITION.
9. -A LOOP CLOSURE IS REQUIRED TO PLACE RECTIFIER INTO EQUALIZE. (+) BATTERY IS SUPPLIED AT TB3-21 DURING EQUALIZE
10. (Y) -SENSE LOSS OPTION.
11. (Z) -(STANDARD) DISCONNECTED WHEN (Y) OPTION USED.

REVISIONS

1 M NEW, WAS 181-7080 ISS. I

2 M 1837012 12-5-79 D.A.C. F2 WAS 1-1/3 AMP (2486-107)

2 RM TI CONNECTIONS CORRECTED 6C-8A WAS 6C-8B

3 1837126 5-1-80 T.L. M S2 WAS 2513-861 BP MAY 2 1980

4 M 1837011 7-30-80 D.A.C. C4 REMOVED, L1 WAS 4411-603

5 M 1837392 11-25-80 J.R. C8-C10 WAS 2717-110 JAN 7 1981

5 RM 3-6-81 D.A.C. NOTE 8 CORRECTED

5 RRM 3-30-81 D.A.C. SH. 2 WIRE DESTINATION CORRECTED

5 RRRM 10-10-81 J.R. SPEC. NO. 5472-019 ADDED BP OCT 13 1981

6 1837833 9-1-82 TJI VARISTOR REF. DESIG. CHGD FROM MOV TO RV. A8 WAS 4865-648

7 1838074 5-16-83 T.F.M. C8-10 WERE 0.22UF 1KVDC, C32-37 ADDED, FOR R.F.I. SPEC.

8 1837946 8-26-83 B.E F1, F1A & S2 DELETED CB1 ADDED.

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

J1 1839754 3-23-87 GRF A11 WAS 4865-644 AND A9 WAS 4338-362.

K1 1830015 10-14-87 GRF ADDED C4, F4, F4A, AND R21. DEC 16 1987

L1 1830376 4-11-88 GRF ADDED EMI SUPPRESSION. MAY 27 1988 BP M

M1 1830971 9-13-89 TJI (Y) OPTION (4865-423) ADDED JAN 04 1990

N1 1835819 1-18-96 TJI C8,9 & 10 WERE 2714-557 JAN 22 1996 BP M

181-7080

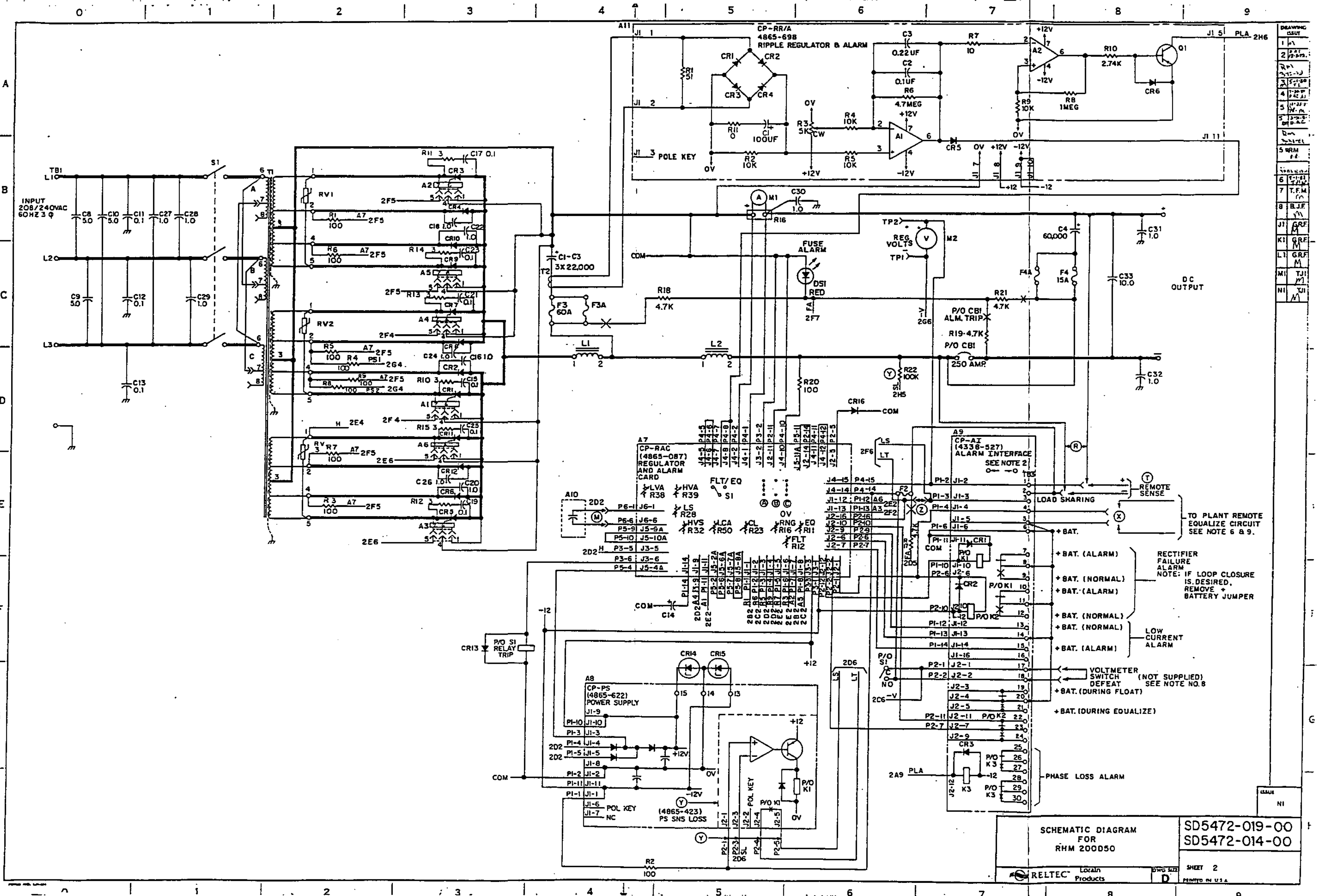
SCHEMATIC DIAGRAM FOR RHM 200D50

DESIGN	J. RADER
ISS.	N1
DRAWN BY	J. TUTTLE
DATE	12-18-78
CHECKED BY	
APPROVED BY	
RATING	STANDARD

SD5472-019-00
SD5472-014-00

RELTEC Lorain Products

DWG SIZE D — SHEET 1 OF 2



CP-RR/A
4865-698
RIPPLE REGULATOR & ALARM
POLE KEY
INPUT
208/240VAC
60HZ 3 Φ
TB1
S1
T1
RV1
RV2
C1-C3
3X22,000
F3
60A
F3A
R18
4.7K
FUSE
ALARM
DS1
RED
REG.
VOLTS
M1
M2
TP1
TP2
C4
60,000
F4
15A
F4A
C33
10.0
DC
OUTPUT
R21
4.7K
P/O CB1
ALM. TRIP
R19-4.7K
P/O CB1
250 AMP.
L1
L2
R22
100K
R20
100
CR16
COM
A7
CP-RAC
(4865-087)
REGULATOR
AND ALARM
CARD
FLT/EQ
S1
A9
CP-AI
(4336-527)
ALARM INTERFACE
SEE NOTE 2
REMOTE
SENSE
LOAD SHARING
TO PLANT REMOTE
EQUALIZE CIRCUIT
SEE NOTE 6 & 9.
+BAT.
+BAT. (ALARM)
+BAT. (NORMAL)
RECTIFIER
FAILURE
ALARM
NOTE: IF LOOP CLOSURE
IS DESIRED,
REMOVE +
BATTERY JUMPER
LOW
CURRENT
ALARM
VOLTMETER
SWITCH
DEFEAT
(NOT SUPPLIED)
SEE NOTE NO.8
+BAT. (DURING FLOAT)
+BAT. (DURING EQUALIZE)
PHASE LOSS ALARM
A10
P/O S1
RELAY
TRIP
CR13
A8
CP-PS
(4865-622)
POWER SUPPLY
POL KEY
NC
(4865-423)
PS SNS LOSS
SCHEMATIC DIAGRAM
FOR
RHM 200050
SD5472-019-00
SD5472-014-00
RELTEC
Lorain
Products
DWG SIZE
D
SHEET 2
PRINTED IN U.S.A.
ISSUE
N1

COMPONENT LIST

RESISTOR

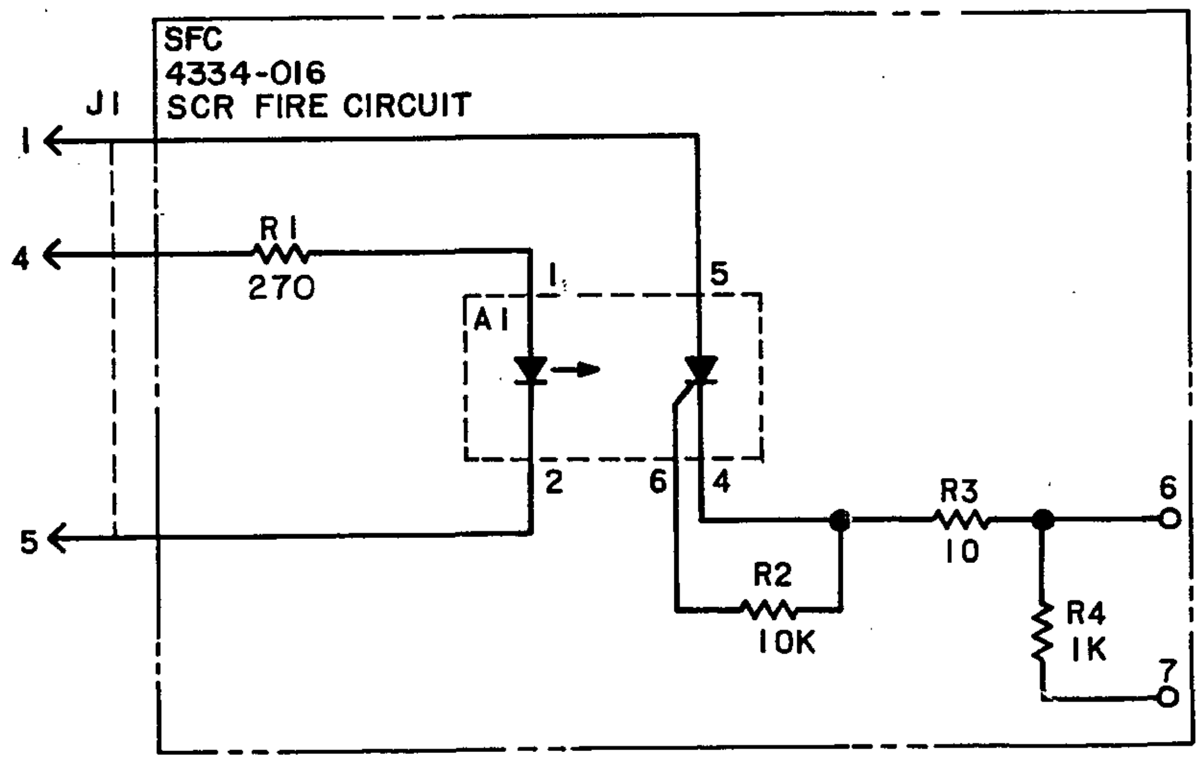
DESIG	CODE	
R1	(2615-249)	270 OHM, 1/2W
R2	(2615-287)	10K, 1/2W
R3	(2615-215)	10 OHM, 1/2W
R4	(2651-335)	1K, 3W

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		
3	1836293 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 2-13-76
APPROVED BY	DATE 2/23/76
APPROVED BY	DATE 2-23-76

SCR FIRE CIRCUIT

RELTEC Lorain Products

DWG SIZE B

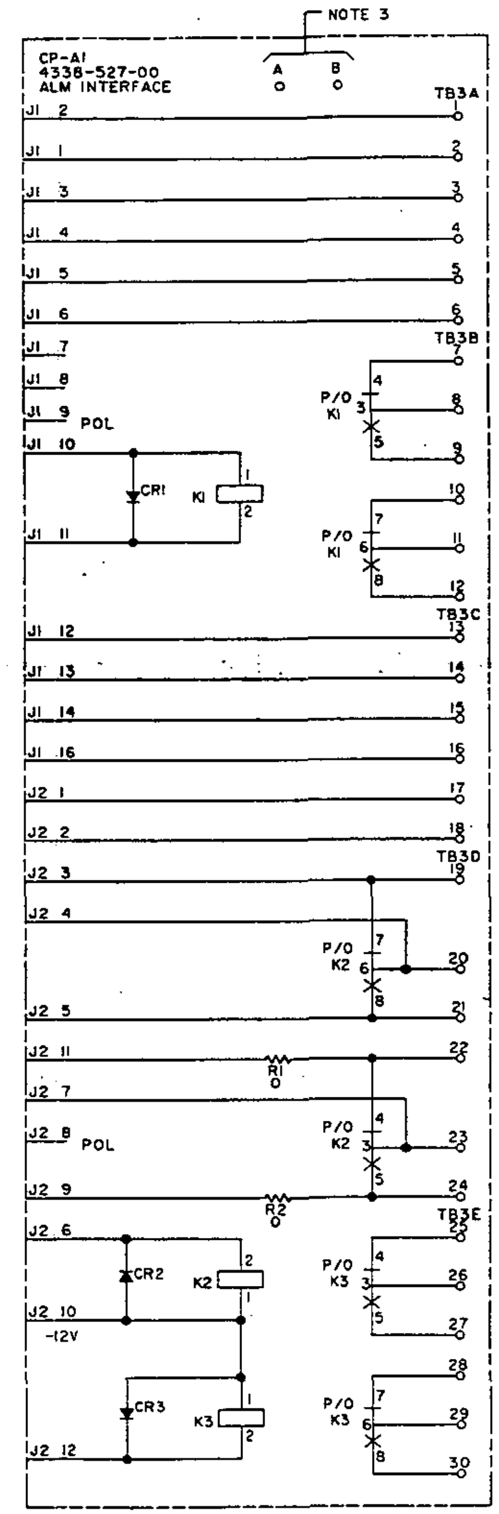
SD-4334-016

PRINTED IN USA

SHEET 1 OF 1

LP428

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, 2634-524-00 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
[signature]	3-9-87
[signature]	3/9/87
STANDARD	

SD4338-527-00

1 1

COMPONENT LIST

CAPACITOR

DESIG	CODE
C1	(2731-112) 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
(8)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	(2615-223) 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%
R88	(2634-662) 18.2K, 1/4W, 1%

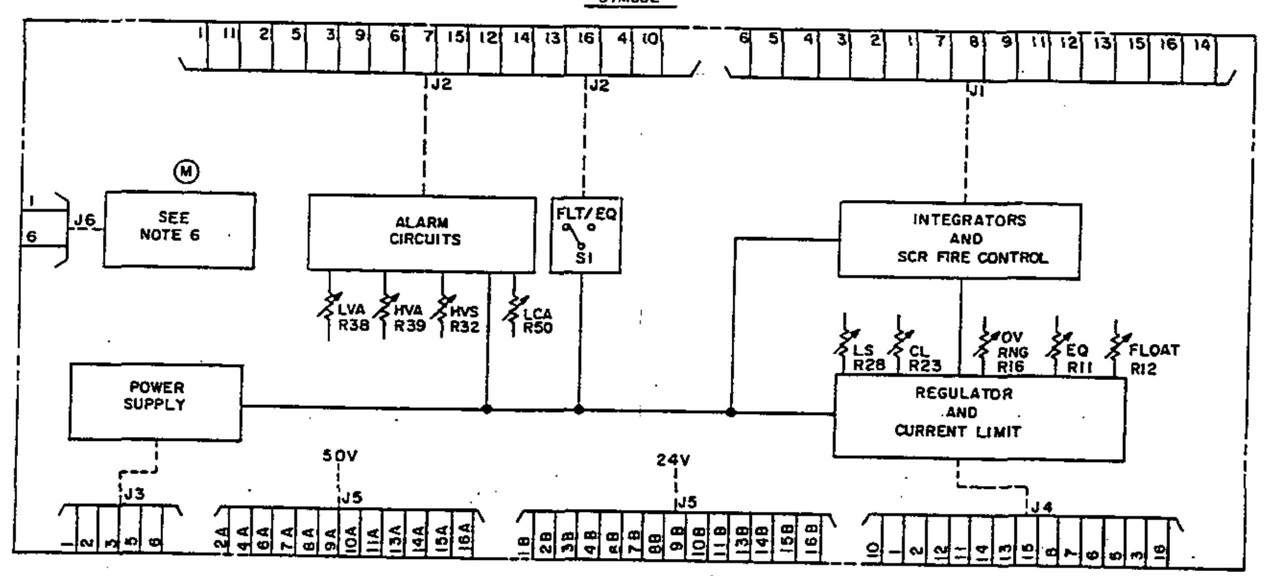
SWITCH

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



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. (4251-014).

MANUFACTURING REFERENCES

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

REVISION RECORD

REV	PRN NUMBER	DATE CHANGED	CHANGED BY
5	1837320 1837527 1837573	JUL 21 1981	
	CAPACITOR LIST UPDATED		
5 RM		11-5-81	J.R.
	[illegible] 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	NOV 7 1990	
K1	1832745	1-29-93	TJI
	K1 WAS 2543-437	OCT 29 1993	
K2	1893506	2-17-94	TJI
	NOTE 3 CHANGED PER J. RADER	FEB 25 1994	
L1	1834656	10-31-94	TJI
	Q1 WAS 2843-102	MAY 18 1995	

PROJECT NO. 184-3422

REGULATOR AND ALARM CIRCUIT

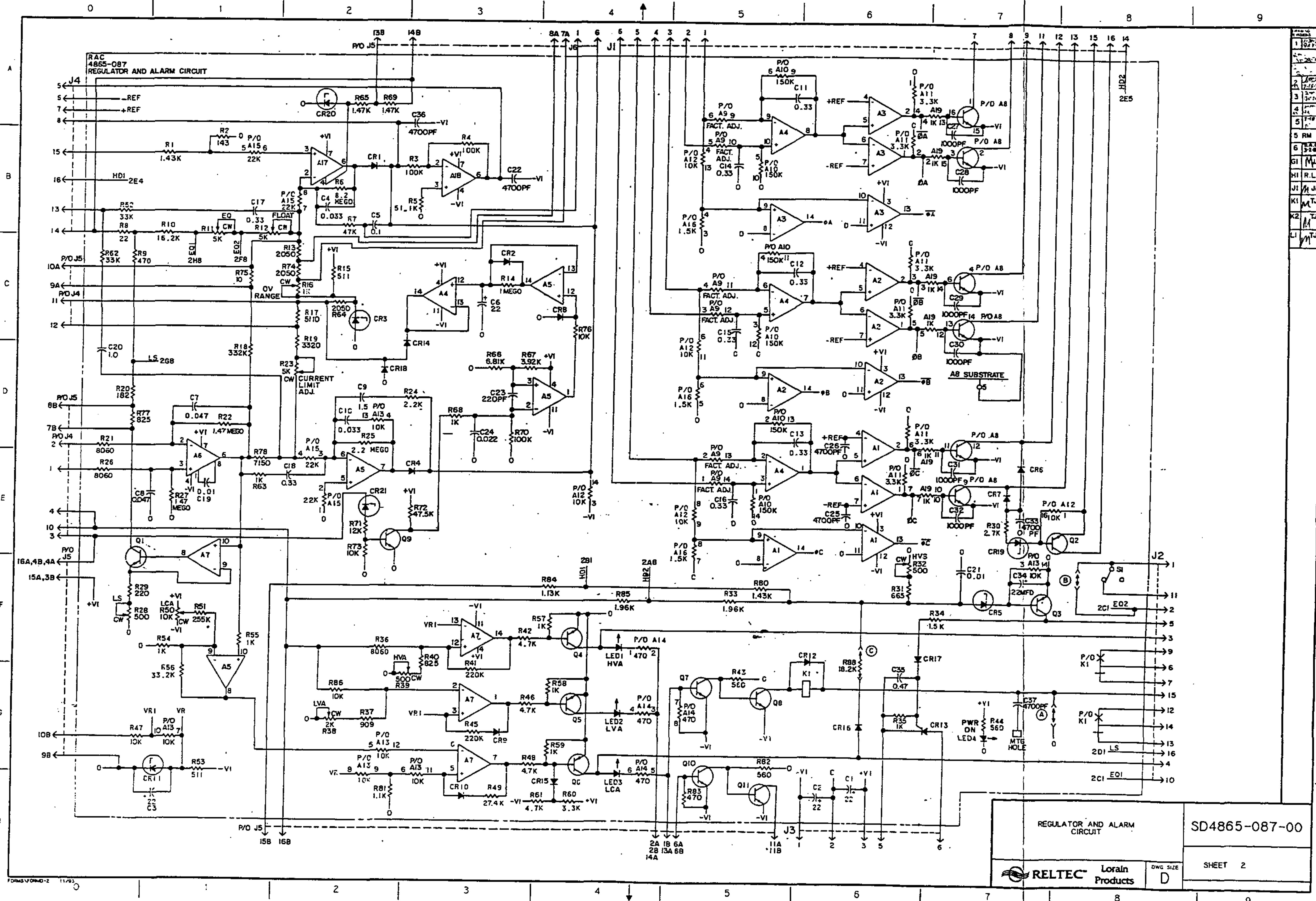
J. GIANCATERINO		L1
J. REESE		1-31-77
J.J.J.		3-11-77
GIANCATERINO		5-17-77
R. PLOW		5-19-77
STANDARD		

SD-4865-087-00

RELTEC Lorain Products

DWG SIZE D

SHEET 1 OF 2


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

UNIT QTY.	REFERENCE DESIGNATOR	PART NUMBER	PART DESCRIPTION	
3	13,14,15	246773200	MINI-PIN	
1	C1	273116700	330UF	50VDC,ELECT
1	C2	273122600	1100UF	40VDC,ELECT
3	CR1,CR2,CR3	281233000	1N4820	

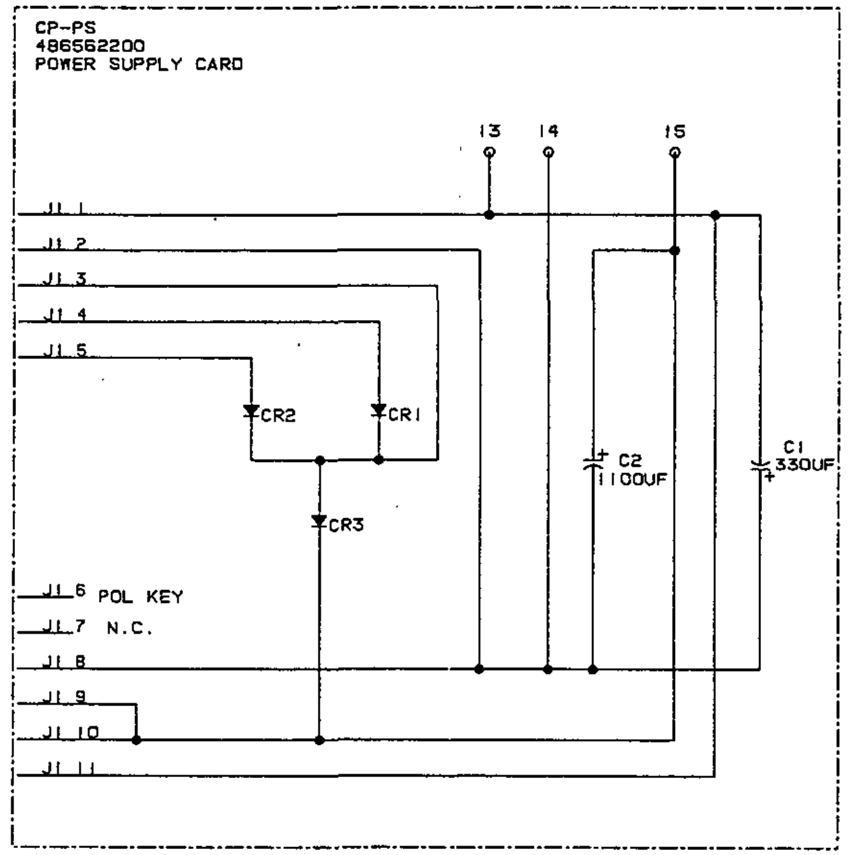
MANUFACTURING REFERENCES

CATEGORY	NUMBER
ASSEMBLY DRAWING	486562200
P.W. BOARD	315619700
CONNECTOR ON FRAME	247865800

ISSUE CHANGES & REVISIONS

REV	CHG SLIP NO. CHKD BY	DATE	DESCRIPTION
1 (M)	NEW	RM 5-19-77	
			CONVERSION TO LAMPS
A2	1893171	10-15-93 TJ1	C1 DESCRIPTION CHANGED PER J.RADER. J.WAUGH 10-27-93 OCT 29,1993 BP (M)
B1	1836366	6-28-96 TJ1	C1 WAS 2731-16600. DWG PUT ON CAD SYSTEM. LR Segal 8-7-96 K. Hummel 8-7-96 (PRM) AUG 07 1996 B P/B

CPS-PS
(POWER SUPPLY)



SYMBOL
SHOWN IN DETAIL IN FS

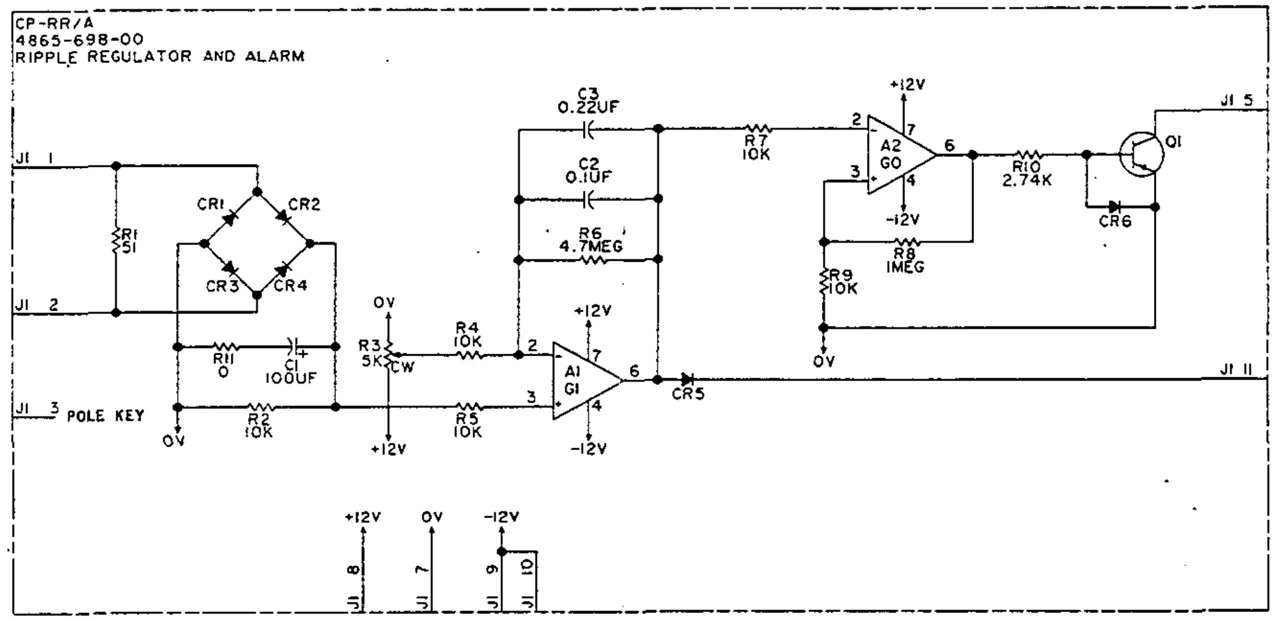
NOTES
1. UNLESS OTHERWISE SPECIFIED. RESISTANCE VALUES ARE IN OHMS, CAPACITANCE VALUES ARE IN MICROFARADS, VALUES PRECEDED BY THE SYMBOL +(PLUS) OR -(MINUS) ARE IN VOLTS.
2. CODES SHOWN AS, 263452400 REPRESENT LORAIN PART NUMBERS.
3. PART DESCRIPTIONS ARE FOR REFERENCE ONLY AND REPRESENT ONE MANUFACTURER'S PART NUMBER. REFER TO LP PARTS SYSTEM FOR COMPLETE, CURRENT INFORMATION.

CIRCUIT DESCRIPTION

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

1817009	CADDST	DESIGN J.GIANCATERINO · ISS B1
SCHEMATIC DIAGRAM FOR POWER SUPPLY CARD		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.PLON · DATE 4-5-77
		RATING STANDARD
		SD486562200
RELTEC Lorain Products	DWG SIZE D	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	2668-60100	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

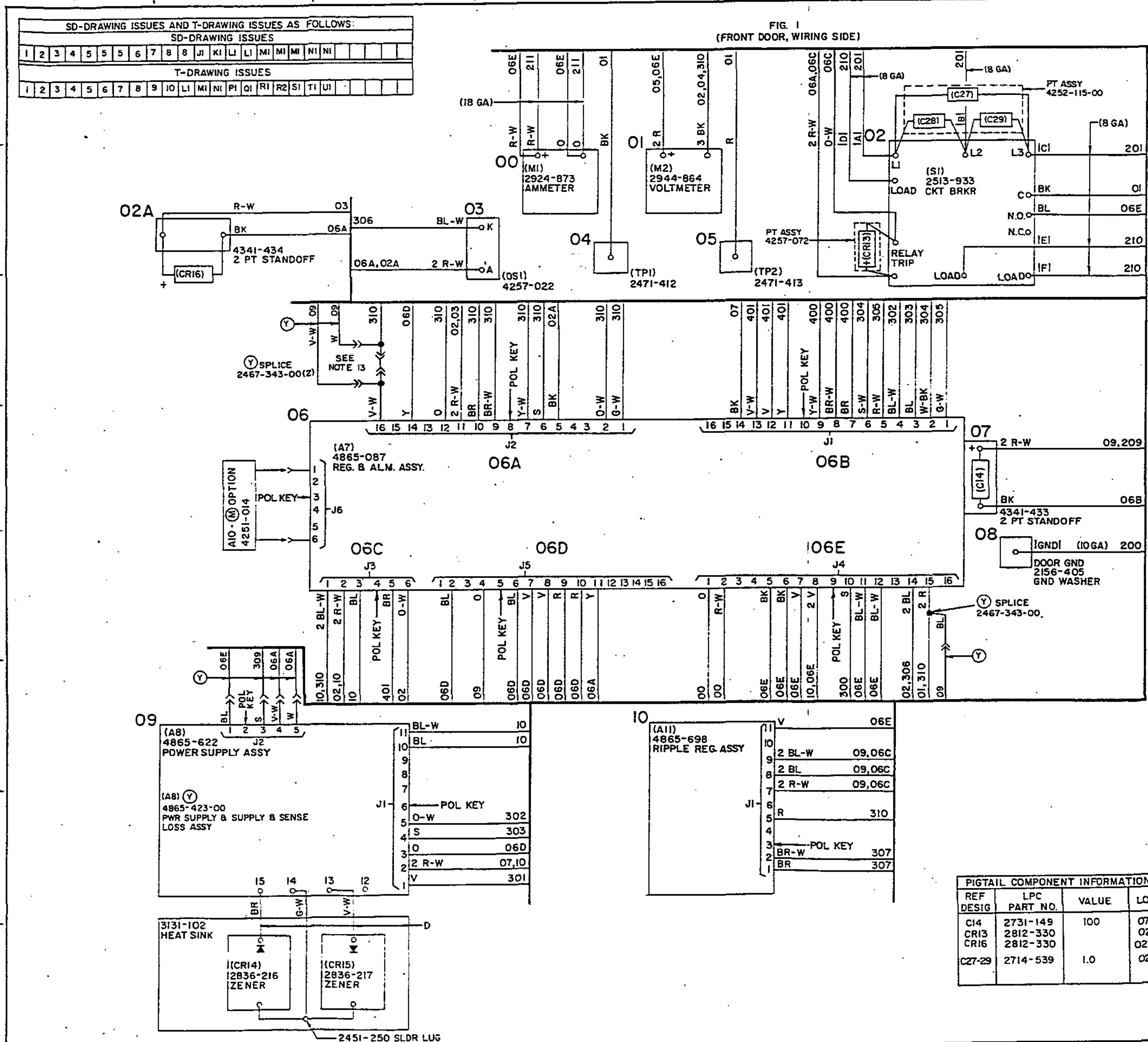
CATEGORY	NUMBER
ASSEMBLY DRAWING	4865-698-00
P.W.BOARD	3158-04200
CONNECTOR ON FRAME	

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

1817414-001	CADD	L.IDEMOTO	A1
		D.CHEVALIER	11-18-86
		T.F.MAURER	2-17-87
SCHEMATIC DIAGRAM FOR RIPPLE REGULATOR AND ALARM		L.IDEMOTO	3-9-87
		[signature]	3/9/87
		STANDARD	
RELTEC Lorain Products	D	SD4865-698-00	
		1	1



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. BI- 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 LEADS HERE WHEN NOT USED
8. 2 TW- INDICATES SPLICE
10. (R) (STANDARD) INTERNAL VOLTAGE SENSE
11. HI- WIRES RUN THROUGH HERE.
12. (Y) OPTION- REMOVE A2 CARD 4865-622-00 AND REPLACE WITH 4865-423-00 POWER SUPPLY AND SENSE LOSS ASSY.
13. CUT AND INSULATE PER (Y) OPTION.

REVISIONS

- R1 1830971 9-13-89 JR — ADDED 4865-423-00 (Y) OPTION. JAN 24 1990
- R2 1-15-90 JR — ADDED PT. NO 4865-423-00 TO A8 PER J. STIPE. JAN 29 1990
- S1 1832405 8-25-92 JR — WIRE COLORS CHGD AT LOC 304, 305 & 400. AUG 27 1992
- T1 1835819 1-18-96 TJI — C8, 9 & 10 WERE 2714-557-00 ON SHT 2. JAN 22 1996
- U1 1836286 5-15-96 TJI — SOLDER LUGS 2451-270 WERE 2451-268 AT LOC 302. MAY 23 1996

PIGTAIL COMPONENT INFORMATION

REF DESIG	LPC PART NO.	VALUE	LOC
C14	2731-149	100	07
CR13	2812-330		02
CR16	2812-330		02A
C27-29	2714-539	1.0	02

181-7080

WIRING DIAGRAM FOR MODEL RHM200D50

DESIGN C. BERG — ISS. U1
DRAWN BY J. REESE
CHECKED BY — DATE 10/30/79
APPROVED BY
RATING STANDARD

T547201900
T547201400

RELTEC Lorain Products

DWG SIZE D

SHEET 1 OF 4

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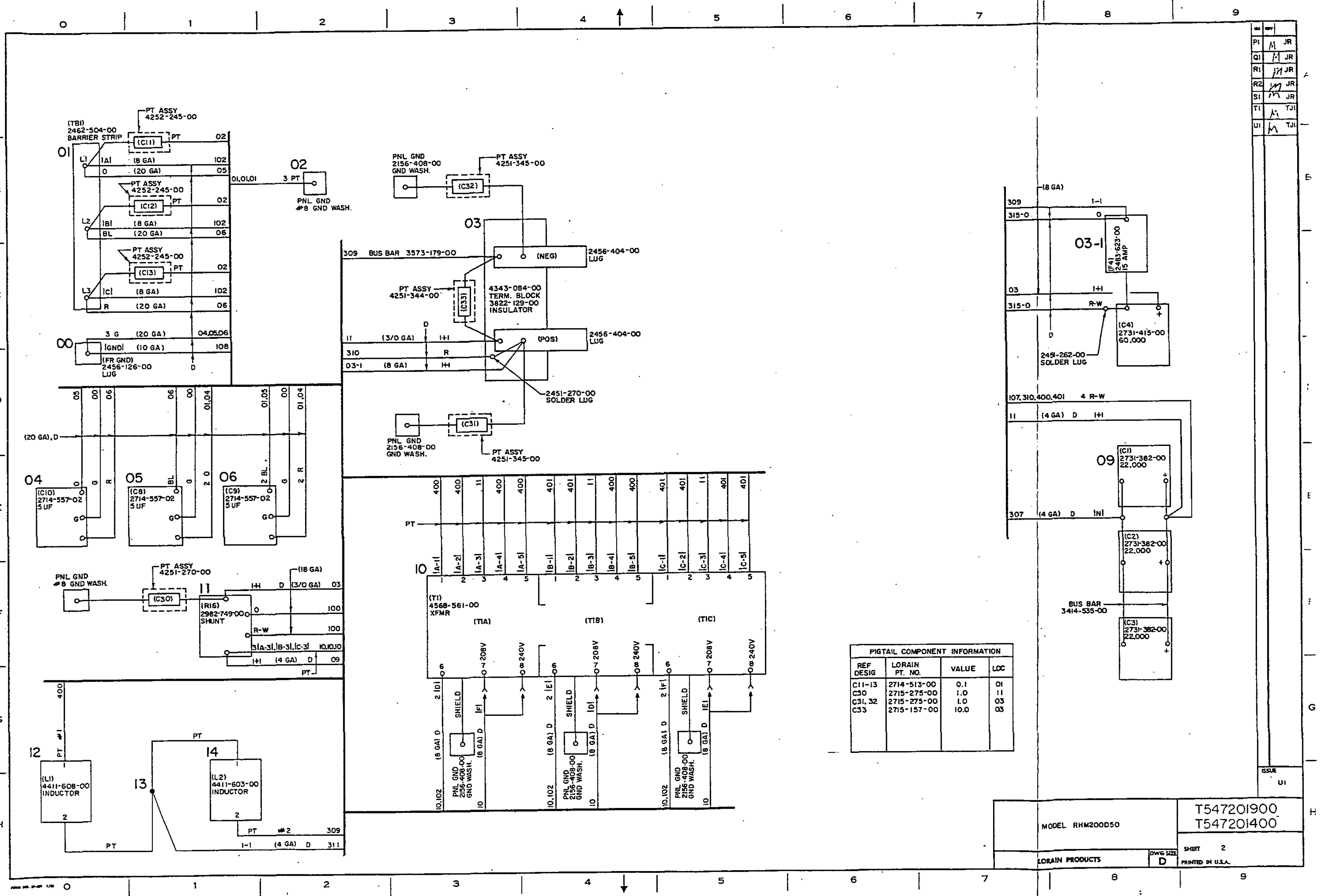

PIGTAIL COMPONENT INFORMATION

REF DESIG	LORAIN PT. NO.	VALUE	LOC
C11-13	2714-513-00	0.1	01
C30	2715-275-00	1.0	11
C31, 32	2715-275-00	1.0	03
C33	2715-157-00	10.0	03

ISSUE	
P1	JR
Q1	JR
R1	JR
R2	JR
S1	JR
T1	TJI
U1	TJI

ISSUE U1

MODEL RHM200D50

T547201900
T547201400

LORAIN PRODUCTS

DWG SIZE D

SHEET 2

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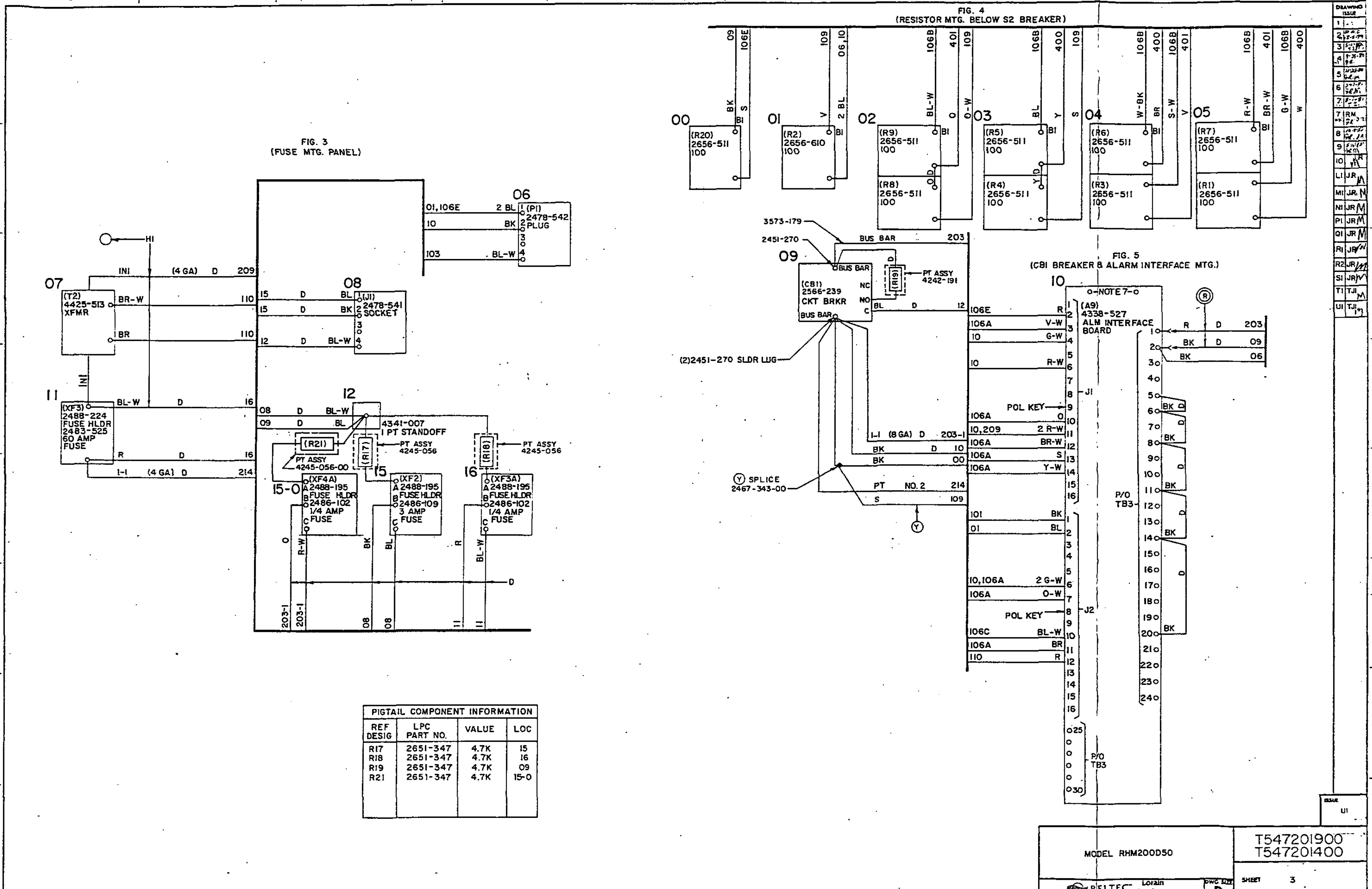

PIGTAIL COMPONENT INFORMATION			
REF DESIG	LPC PART NO.	VALUE	LOC
R17	2651-347	4.7K	15
R18	2651-347	4.7K	16
R19	2651-347	4.7K	09
R21	2651-347	4.7K	15-0

ISSUE U1

MODEL RHM200D50

T547201900
T547201400

RELTEC Lorain Products

DWG SIZE D

SHEET 3

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FIG. 6
(LEFT HEAT SINK ASSY)

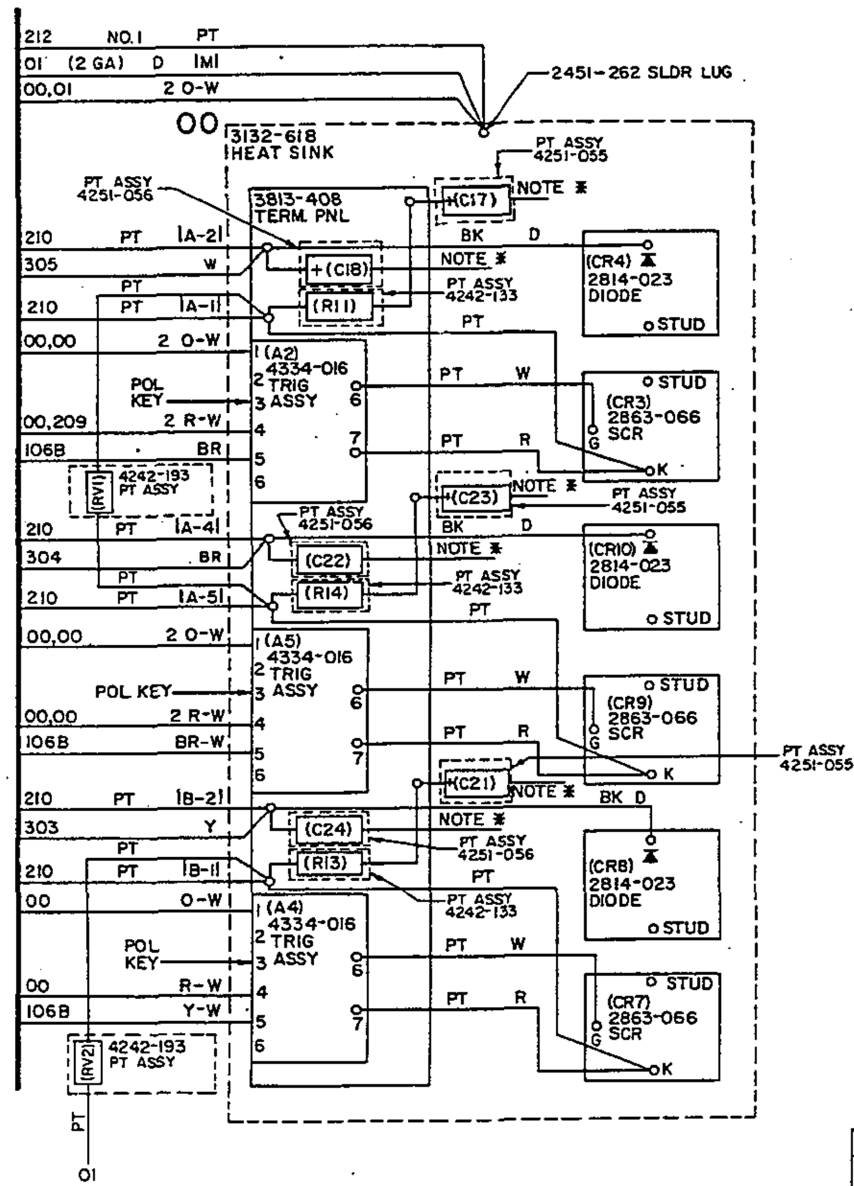
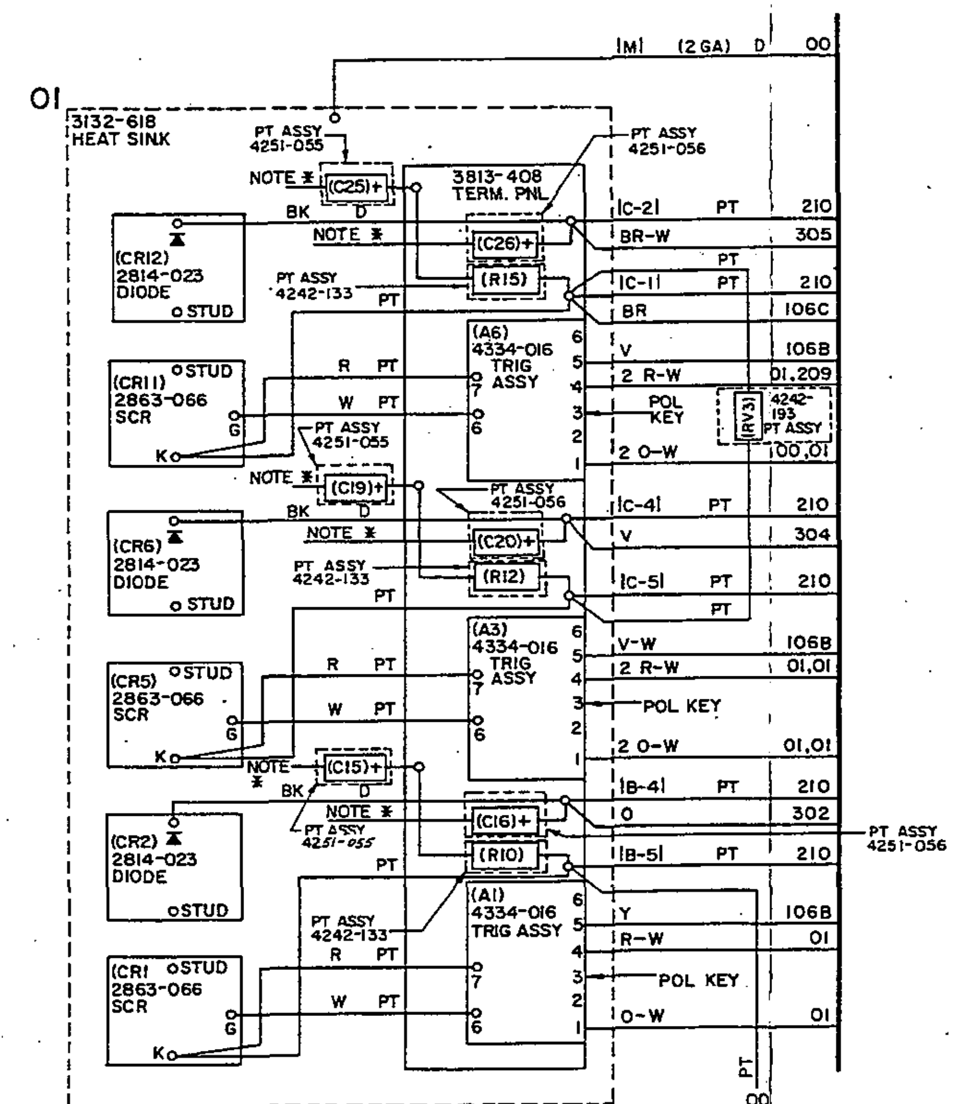


FIG. 7
(RIGHT HEAT SINK ASSY)



PIGTAIL COMPONENT INFORMATION

REF DESIG	LPC PART NO.	VALUE	LOC
C15, 19, 25	2715-250	0.1	01
C17, 21, 23	2715-250	0.1	00
C16, 20, 26	2715-275	1	01
C18, 22, 24	2715-275	1	00
R11, 13, 14	2651-305	3	00
R10, 12, 15	2651-305	3	01
RV1	2676-341		00
RV2			00
RV3			01

NOTE: * INSTALL 1/4 FASTON LUG (LPC PT. NO. 2453-664) ON CAPACITOR PT, THEN CONNECT THEM TO GND CLIP (LPC PT. NO. 2457-763), (6) ON SIDE OF HEAT SINK FIN.

ISSUE U1

MODEL RHM200D50

T547201900
T547201400

RELTEC Lorain Products

DWG SIZE D

SHEET 4

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  - Value-add Assessments: Site Profiles, Test&Turn-up Certifications, Battery Load Tests, PowerTherm® Thermographic Surveys
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Continuing Care Coverage is part of our family of single-source service solutions for communications power networks. Available as an up-front option with all Marconi DC power equipment orders, this service plan enhances your existing warranty through proactive annual maintenance inspections and 24-hour priority system response. Marconi technicians and service engineers are trained to identify potential problems before they occur and perform periodic adjustments to keep your equipment operation at peak performance. Available in one- two and three-year contracts, Marconi's Continuing Care Coverage includes:

- Annual preventative maintenance visit
  - Assessment of carrier network infrastructure, including end-to-end testing of batteries, chargers, DC distribution, inverters and environmental factors
  - Thennographic laser scanning of all power equipment and distribution systems to identify problem areas invisible to the eye
  - Full documentation, available at **www.marconi.com/freedomcare,** of each inspection, with a report of current network status as well as prioritized corrective action plans
- 24-hour system response, including on-site parts and labor by Marconi service engineers

When you purchase Continuing Care Coverage, you leave the scheduling, equipment history, maintenance, repairs, reporting and manpower to Marconi. As a result, Continuing Care provides time to focus on other responsibilities.

Key benefits

- Finds problems before they occur
- Reduces emergency repair situations
- Fixed maintenance costs
- Maximum efficiency
- Workforce productivity

Key Features

- Proactive services in the form of annual inspection and testing
- Coverage for on-site parts and labor in the event of equipment failure
- Priority 24-hour system response
- Extended on-site parts and labor coverage available for out-of-warranty equipment

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For More Information

To learn more about Continuing Care Coverage or other service offerings, please contact your Marconi sales representative, call **800-800-5260, email fss@marconi.com,** or visit **www.marconi.com/freedomcare.** When requesting information about Continuing Care Coverage, please reference code PFS-CONTCARE.

Continuing Care Registration

To register Marconi equipment for Continuing Care Coverage, simply till out the information below and mail, or create a secured access account to our **FreedomCare extranet** at **www.marconi.com/freedomcare.**
NOTE: You must provide the equipments installation location to activate the plan.

Installation Site

Company ______________________________

Street Address ______________________________

Floor/Suite ______________________________

City/State/Zip ______________________________

Site Code ______________________________

Equipment Inventory

Model ______________________________

Spec No. ______________________________

Serial No. ______________________________

Equipment Turn-on Date ______________________________

Site Contact Information

Last Name ______________________ First Name ______________________

Title ______________________________

Street Address ______________________________

Floor/Suite ______________________________

City/State/Zip ______________________________

Phone ______________________ E-mail ______________________

Detach on Dotted Line.

Fold in Half. Tape edges. Affix first c/ass postage.

Name ______________________________

Street ______________________________

City, State, Zip ______________________________

PLACE
FIRST
CLASS
STAMP
HERE

Marconi Services
ATTN: FSS
38683 Taylor Woods Industrial Parkway
North Ridgeville, OH 44039