INSTRUCTION MANUAL

FOR

REGULATED POWER SUPPLIES

LRS-56 SERIES

LAMBDA ELECTRONICS

MELVILLE, L.I., N.Y.

MAIN PLANT TELEPHONE: (516) 694-4200

IM-LRS-56

TABLE OF CONTENTS

SPECIFICATIONS AND FEATURES

DC OUTPUT — Voltage regulated for line and load. See table I for voltage and current ratings.

TABLE I
VOLTAGE AND CURRENT RANGES

MODELS	VOLTAGE RANGE	MAXIMUM CURRENT (AMPS) AT AMBIENT TEMPERATURE				INPUT POWER*
		40°C	50°C	60°C	71°C	
LRS-56-2	2V ± 5%	90	77	61	45	305W
LRS-56-5	5V ± 5%	90	77	61	45	630W
LRS-56-6	6V ± 5%	80	69	54	39	672W
LRS-56-12	12V ± 5%	47	41	34	21.9	769W
LRS-56-15	15V ± 5%	38	33	28	17.9	777W
LRS-56-20	20V ± 5%	29.5	27	22.0	13.8	805W
LRS-56-24	24V ± 5%	25	22.5	18.5	11.6	788W
LRS-56-28	28V ± 5%	22	20	16	10	809W
LRS-56-48	48V ± 5%	13	12	9.5	6.0	819W

*With output loaded to full current rating and input voltage at 95V AC.

Current range must be chosen to suit the appropriate maximum ambient temperature. Current ratings apply for entire voltage range.

REGULATED VOLTAGE OUTPUT

Regulation .... 0.1% line or load with input variations from 95-132 or 132-95 volts AC and load variations from no load to full load.

Ripple and Noise .... 10mV RMS, 35mV peak-to-peak for LRS-56-2, 5 and 6 volt models; 15mV RMS, 100mV peak-to-peak for LRS-56-12 thru LRS-56-28; 35mV RMS, 150mVp-p for LRS-56-48, with either positive or negative terminal grounded.

Temperature Coefficient .... Change in output voltage 0.03%/°C max.

Remote Programming

External Resistor .... Nominal 1000 ohms/volt output.

Programming Voltage .... One-to-one voltage change.

Remote Sensing .... Provision is made for remote sensing to eliminate effect of power output lead resistance on DC regulation.

Remote On/Off Control .... The DC output may be turned on and off remotely by means of digital command. (See page 6.)

HOLD-UP Time .... 2V, 5V and 6V models will remain within regulation limits for at least 16.7 msec, after loss of AC power, when operating at full load, maximum output voltage and 105 VAC input at 60 Hz.

OVERSHOOT — No overshoot under conditions of power turn-on, turn-off, or power failure.

INPUT

AC Input .... 95-132 VAC at 47-440 Hz. Input power: 819W max*. Input Current: 12.0A max*. For operation at frequencies above 440 Hz, consult factory Where applicable, regulatory agency approval applies only for input frequencies in the range 47-63 Hz. Leakage current in the ground connection may exceed the limits allowed by these agencies at frequencies above this range.

*With output loaded to full current rating and input voltage 95 VAC, 60 Hz.

DC Input .... 145 VDC ±10%. Input current: 6.3† Amperes.

†With output loaded to full current rating and input voltage 130 VDC.

SOFT START — The turn-on inrush current will not exceed 40 amps.

INPUT FUSE — Fuse F1 protects the input wiring to the power supply. Overload of power supply does not cause fuse failure.

OVERLOAD PROTECTION

Thermal .... Thermostat resets automatically when over-temperature condition is eliminated.

Electrical .... Automatic electronic current limiting circuit, limits output current to a preset safe value. Automatic current limiting protects the load and power supply when external overloads and direct shorts occur.

OVERVOLTAGE PROTECTION — All LRS-56 models include fixed non-crowbar built-in overvoltage protection circuits which prevent damage to the load caused by excessive power supply output voltage. See table on the following page for overvoltage protector firing ranges.

MODEL	OVERVOLTAGE PROTECTOR MAXIMUM TRIP POINT
LRS-56-2	4.2V
LRS-56-5	6.8V
LRS-56-6	7.5V
LRS-56-12	14.9V
LRS-56-15	19.0V
LRS-56-20	26.1V
LRS-56-24	31.2V
LRS-56-28	36.3V
LRS-56-48	59.8V

INPUT CONNECTIONS — Terminal block on front of chassis.

OUTPUT CONNECTIONS — 10/32 Threaded bus bars.

OPERATING AMBIENT TEMPERATURE RANGE AND DUTY CYCLE — Continuous duty from -10°C to 71°C ambient with corresponding load current ratings for all modes of operation.

STORAGE TEMPERATURE (non-operating) — -55°C to 85°C.

FUNGUS — All LRS-56 power supplies are fungus inert.

VDC ADJ. Control — 10-Turn voltage adjust control permits adjustment of DC output over entire operating range.

PHYSICAL DATA

Size .... 4-11/32" x 4-7/8" x 11-1/2"
Weight .... 9-1/2 lbs. net; 11 lbs. shipping
Finish .... Grey, FED. STD. 595 No. 26081

MOUNTING — One mounting surface and one mounting position.

ACCESSORIES

Rack adapters .... Rack adapters LRA-15, and LRA-17, used for ruggedized mounting with or without chassis slides, are available.

THEORY OF OPERATION

GENERAL

The LRS-56 Series consists of the following circuit elements:

- Input Circuit
- Pulse Width Modulated Inverter
- Auxiliary Rectifier and Filter
- Output Rectifier and Filter
- Regulator Control Integrated Circuit; consisting of a timing oscillator, pulse width modulator, output drive, undervoltage detect and shutdown, current limit and frequency shift.

FUNCTIONAL DESCRIPTION

Input Circuit

Single phase AC input power is applied to diode bridge circuit CR201-204 through EMI suppression chokes L201 and L202. Fuse F201 protects the power supply against excessive currents due to internal failure.

The input bridge and filter capacitors C201, C202 and C219 provide power to the power MOSFET switches and, via R101, C101 and CR101, to the regulator control integrated circuit, IC101. At turn-on C201, C202 and C219 charge through inrush current limiting resistor R203. When the AC input reaches approximately 95 Vac, the UV detect circuit will enable control IC101 to supply pulse width modulated drive to power MOSFET switches Q101 and Q102. As the Power MOSFET switches begin to conduct, the voltage on capacitor C218 will rise biasing Q201 into conduction and energizing the coil of relay K201. The subsequent closing of the relay contacts shorts out R203 thus completing the inrush current limiting cycle.

Pulse Width Modulated Inverter

The inverter is a single ended configuration using two power MOSFET switches, Q101 and Q102, in parallel. During the "on" time, a positive pulse is delivered to the gates of both power switches from integrated circuit controller IC101, pin 8, via C115. A positive pulse turns both Q101 and Q102 "on". During "off" time pin 8 shorts the gates of Q101 and Q102 to C101(-) and turns both Q101 and Q102 off. Switching action of Q101 and Q102 delivers positive and negative pulses to T1 primary.

Output Rectifier and Filter

The transistor "on" time primary pulse produces a positive secondary pulse which causes CR1A to conduct and deliver current to the load. Because output current is returned to T1 secondary through filter choke L1, energy is stored in L1 during Q101/Q102 "on" time. The Q101/Q102 "off" time primary pulse produces a negative secondary pulse which causes CR1A to turn off and CR1B to turn on. Energy stored in L1 is then delivered to the load through CR1B during Q101/Q102 "off" time. Output ripple attenuation is accomplished via the dual LC filter L1, L205, C208 and C209. Capacitors C206, C207, C203, C204, C205 and C220 furnish additional output noise suppression.

Regulator Control IC101

Timing oscillator section

IC101 pins 11, 12 and 13, R110 and R111 work in conjunction with C106 to set the main oscillator frequency, 50 kHz, and the maximum duty ratio; $T_{on}/(T_{on} + T_{off})$. R110, C106 set maximum "on" time T_{on}; R111, C106 set maximum "off" time T_{off}.

Pulse width modulator section

Pulse width modulation, necessary to control the output voltage, is determined by the feed-forward comparator. Changes in the output are sensed and divided down by R128 and R129. This signal is fed into the reference of IC103. IC103 controls the current through optical coupler diode OC101, which is optically coupled to the base of OC101 internal transistor. Collector voltage of OC101 transistor is fed into IC101 pin 18. This voltage, when compared to a ramp signal developed on C105 by R109 and R135, sets the pulse width of the output drive through IC101 pin 8, as required to maintain the desired output voltage. The ramp on C105 is automatically reset each switching cycle by IC101. The slope of the ramp is proportional to the voltage across input capacitors C201, C202 and C219.

Undervoltage detect; shutdown

Low input line detector comparator, IC101 pins 3 and 4, monitors changes in the input line. If the input line falls below approximately 95 VAC, the output drive will be inhibited.

At power up, C104, connected at IC101 pin 4, provides a delay before inverter operation to eliminate any secondary input inrush currents. At power down, C104 provides a delay at the undervoltage circuit to allow for hold-up time, where required.

Current limit and frequency shift

Current limit comparator IC101, pins 16 and 17, provide pulse termination current limit. When output current exceeds the preset safe value, the current-limit comparator disables the output drive, which remains disabled until the end of the switching cycle.

In order to maintain the foldback characteristic when both output voltage and current are decreasing, the comparator will parallel C107 with timer capacitor C106 increasing the discharge-time of C106. This increased discharge-time constant causes the operating frequency to decrease allowing a decreasing output current as the output voltage decreases. All LRS-56 units are designed with a current limit characteristic which presents constant current limiting from nominal output down to approximately 70% of Vo(nom). They then foldback to a current of approximately 90% full load at short circuit.

BASIC MODE OF OPERATION

This power supply operates as a constant voltage source provided the load current does not exceed the rated value at 40°C. For continuous operation, load current must not exceed the rating for each ambient temperature. When rated load current is exceeded, voltage decreases towards zero and the current at short circuit is held to a safe value.

CONNECTIONS FOR OPERATION

NOTE: Make all connections to the unit before applying input power.

Ground Connections. The supply can be operated either with negative or positive output terminal grounded. Both positive and negative ground connections are shown in the diagrams for all suggested output connections illustrated in this manual.

Connection Terminals. Make all connections to the supply at the terminal blocks and bus bars on the front of the supply. Apply input power to terminals 1 and 2; always connect the ungrounded (hot) AC or positive DC lead to terminal 1.

The supply positive terminal is brought out to terminal 6. The supply negative terminal is brought out to terminal 4. Recommended wiring of the power supply to the load and selection of wiring is shown in figures 1 through 10. Selection of proper wiring is made on the basis of load requirements. Make all performance checks and measurements of current or voltage at the front output terminals. Connect measuring devices directly to terminals or use the shortest leads possible.

Remote Turn-on/Turn-off. Make connections to Isolated pins 8 (+) and 9 (–), see figure 8.

Turn-off: Apply 2.8 → 5V (TTL "1") at terminals 8 and 9 observing polarity shown. There is an internal 1-KΩ limiting resistor in series with pin 8, causing approximately 2.8 → 5ma to be drawn from the TTL source.

Turn-on: Apply 0 → 0.4V (TTL "0") or open circuit at terminals 8 and 9.

SUPPLY LOAD CONNECTIONS

Connections for Operation as a Constant Voltage Source

The output impedance and regulation of the power supply at the load may change when using the supply as a constant voltage source and connecting leads of practical length are used. To minimize the effect of the output leads on these characteristics, remote sensing is used. Recommended types of supply-load connections with local or remote sensing are described in the following paragraphs.

Refer to figure 1 to determine voltage drop for particular cable length, wire size and current conditions. Lead lengths must be measured from supply terminals to load terminals as shown in figure 2.

Local Sensing Connection, Figure 3. Local sensing is the connection suitable for applications with relatively constant load or for applications with short power output leads.

Remote Sensing Connection, Figure 4. Remote sensing provides complete compensation for the DC voltage drops in the connecting cables. Sensing leads should be a twisted pair to minimize AC pick-up. A 2.5 mf elect., capacitor may be required between output terminals and sense terminals to reduce noise pick-up.

Programmed Voltage Connections, Using External Resistor, Figure 5. Discrete voltage steps can be programmed with a resistance voltage divider valued at a nominal 1000 ohms/volt change and a shorting-type switch as shown in figure 5. When continuous voltage variations are required, use a variable resistor with the same 1000 ohms/volt ratio in place of the resistive voltage divider and shorting-type switch. Use a low temperature coefficient resistor to assure most stable operation.

Before programming, adjust programming resistor for zero resistance and set voltage adjust control to the minimum rated output voltage. Output voltage of programmed supply will nominally be minimum output voltage plus 1 volt per 1000 ohms.

As shown in figure 5, voltages can be programmed utilizing either local or remote sensing connections, as desired.

Programmed Voltage Connections Using Programming Voltage, Figure 6. The power supply voltage output can be programmed with an externally connected programming power supply. The output voltage change of the programmed supply will maintain a one-to-one ratio with the voltage of the programming supply. If the output voltage control of the programmed supply is set to minimum output voltage, output voltage of the programmed supply will be minimum output voltage plus voltage of programming supply.

The programming supply must have a reverse current capability of 1 ma. minimum.

Alternatively, when supplies with less than 1 ma. reverse current capability are used, a resistor capable of drawing 1 ma. at the minimum programming voltage must be connected across the output terminals of the programming supply. This programming supply must be rated to handle all excess resistor current at the maximum programming voltage.

Connections For Series Operation, Figure 7.

The voltage capability of LRS-56 power supplies can be extended by series operation. Figure 7 shows the connections for either local or remote sensing in a series connection where the voltage control of each unit functions independently to control the output.

A diode, having a current carrying capability equal to or greater than the maximum current rating of the supply, must be used and connected as shown in figure 7. The diode blocking voltage should be at least twice the maximum rating output voltage of the supply. See table I, of SPECIFICATIONS AND FEATURES, for power supply current and voltage ratings.

OPERATION AFTER PROTECTIVE DEVICE SHUTDOWN

Thermostat Shutdown. The thermostat shuts down inverter operation only when the temperature of the MOSFET switch heat radiator exceeds a maximum safety value. The thermostat will automatically reset when the temperature of the heat sink decreases to a safe operating value.

Fuse Shutdown. Fuse will blow when the maximum rated current value for the fuse is exceeded. Fatigue failure of fuses can occur when mechanical vibrations from the installation combine with thermally induced stresses to weaken the fuse metal. Many fuse failures are caused by a temporary condition and replacing the blown fuse will make the fuse protected circuit operative.

Overvoltage Shutdown. When the power supply output voltage increases above the overvoltage limit, the non-crowbar overvoltage circuit will shut down inverter operation. After eliminating the cause(s) for overvoltage, resume operation of the supply by interrupting the AC input circuit for a period of sixty seconds.

MAINTENANCE

GENERAL

This section describes calibration and test procedures that are useful for servicing the Lambda power supply.

OPENING UNIT FOR TROUBLESHOOTING AND REPAIR

Whenever it is necessary to troubleshoot and repair the Lambda LRS-56 power supply, open the unit as follows:

1. Separate upper and lower enclosures by removing (5) 6-32 screws, see outline drawing, figure 11.
2. With unit resting on its 4-11/32" x 11-1/2" mounting surface, allow lower enclosure to drop down with PC board component side facing upward.
3. Power supply components are now accessible for troubleshooting and repair.

TROUBLE ANALYSIS

Whenever trouble occurs, systematically check all fuses, primary power lines, external circuit elements, and external wiring for malfunction before troubleshooting the equipment. Failures and malfunctions often can be traced to simple causes such as improper jumpers and supply-load connections or fuse failure due to metal fatigue.

Use the electrical schematic diagram and block diagram, figure 9, as an aid to locating trouble causes. The schematic diagram contains various circuit voltages that are averages for normal no load operation. Measure these voltages using the conditions for measurement specified on the schematic diagram. Use measuring probes carefully to avoid causing short circuits and damaging circuit components.

CHECKING CAPACITORS

The leakage resistance obtained from a simple resistance check of a capacitor is not always an indication of a faulty capacitor. In all cases the capacitors are shunted with resistances, some of which have low values. Only a dead short is a true indication of a shorted capacitor.

PRINTED CIRCUIT BOARD MAINTENANCE TECHNIQUES

1. If foil is intact, but not covered with solder, it is a good contact. Do not attempt to cover with solder.
2. Voltage measurements can be made from either side of the board. Use a needle-point probe to penetrate to the wiring whenever a protective coating is used on the wiring. A brass probe can be soldered to an alligator clip adapted to measuring instrument.

3. Always use a heat sink when soldering transistors; a transistor pad with mounting feet is an effective heat sink.

4. Broken or damaged printed wiring is usually the result of an imperfection, strain or careless soldering. To repair small breaks, tin a short piece of hook-up wire to bridge the break, and holding the wire in place, flow solder along the length of wire so that it becomes part of the circuitry.

5. When unsoldering components from the board never pry or force loose the part; unsolder the component by using the wicking process described below:

   a) Select a 3/16 inch tinned copper braid for use as a wick; if braid is not available, select AWG No. 14 or No. 16 stranded wire with 1/2 inch insulation removed.

   b) Dip the wick in liquid rosin flux.

   c) Place the wick onto the soldered connection and apply soldering iron onto the wick.

   d) When sufficient amount of solder flows onto the wick, freeing the component, simultaneously remove iron and wick.

PERFORMANCE CHECKS

Check the ripple and regulation of the power supply using the test connection diagram shown in figure 10. Use suggested test equipment or equivalent to obtain accurate results. Refer to SPECIFICATIONS AND FEATURES for minimum performance standards.

Set the differential meter, DC DVM (John Fluke Model 891A or equivalent) to the selected power supply operating voltage. Check the power supply load regulation accuracy while switching from the no load to load condition. Long load leads should be a twisted pair to minimize AC pick-up.

Use a Variac to vary the line voltage from 95-132 or 132-95 volts AC and check the power supply line regulation accuracy on the DVM differential meter.

Use a TVM, John Fluke Model 931B or equivalent, to measure rms ripple voltage of the power supply DC output. Use oscilloscope to measure peak-to-peak ripple voltage of the power supply DC output.

ADJUSTMENT OF CURRENT LIMIT CALIBRATION CONTROL R116

Whenever IC101, T101, CR104 or R117 are replaced, and voltage and current indications do not reflect maximum ratings, adjust R116 as follows. The adjustment procedure requires that the power supply is removed from associated equipment, is at an ambient temperature of 25-30°C, and is stabilized and not operating.

1. Remove AC power to the supply.

2. Break seal on wiper of R116 from resistor housing and turn to midrange position.

3. Operate power supply for constant voltage with local sensing connected as shown in figure 3, with no external load, and with AC input of 132 VAC, 60 Hz.

4. Turn voltage adjust control until maximum rated output voltage is obtained.

5. Apply load so that output current is 105% of 40°C rating for the unit. If output voltage drops, adjust R116 to allow V_{out} max. at 105% of 40°C rating.

6. Using an oscilloscope, Tektronix 503 or equivalent, observe output voltage while adjusting R116 in CCW direction. Adjust R116 until output ripple increases sharply and output voltage begins to decrease.

7. After adjustment is completed, remove AC power input to the supply and use glyptol sealant to seal wiper of R116 to resistor housing.

8. After sealing, check setting and repeat adjustment procedure if required.

ADJUSTMENT OF FEED FORWARD CONTROL R135

Whenever IC101 is replaced it may be necessary to readjust R135 as follows. The adjustment procedure requires that the power supply is removed from associated equipment, is at an ambient temperature of 25-30°C, and is stabilized and not operating.

1. Remove AC input power to the supply.

2. Break seal on wiper of R135 from resistor housing and turn to midrange position.

3. Adjust R116 fully CW.

4. Operate power supply for constant voltage with local sense connected as shown in figure 3. Apply external resistive load equal to the 40°C current rating, with voltage input of 115 VAC at 60 Hz.

5. Remove AC input power to the supply and open the positive sense connection. While monitoring output voltage, reapply AC input power.

6. Adjust R135 until output voltage reaches 110% of the maximum output voltage rating. To increase output voltage turn R135 CW; to decrease output voltage turn R135 CCW.

7. After adjustment is completed, remove AC power input to the supply and use glyptol sealant to seal wiper of R135 to resistor housing. Reconnect positive sense connection.

8. Readjust R116; refer to ADJUSTMENT OF CALIBRATION CONTROL R116.

SERVICE

When additional instructions are required or repair service is desired, contact the nearest Lambda office where trained personnel and complete facilities are ready to assist you.

Please include the power supply model and serial number together with complete details of the problem. On receipt of this information, Lambda will supply service data or advise shipping for factory repair service.

All repairs not covered by the warranty will be billed at cost and an estimate forwarded for approval before work is started.

PARTS ORDERING

Standard components and special components used in the Lambda power supply can be obtained from the factory. In case of emergency, critical spare parts are available through any Lambda office.

The following information must be included when ordering parts:

1. Model number and serial number of power supply and purchase date.

2. Lambda part number.

3. Description of part together with circuit designation.

4. If part is not electronic part, or is not listed, provide a description, function, and location, of the part.

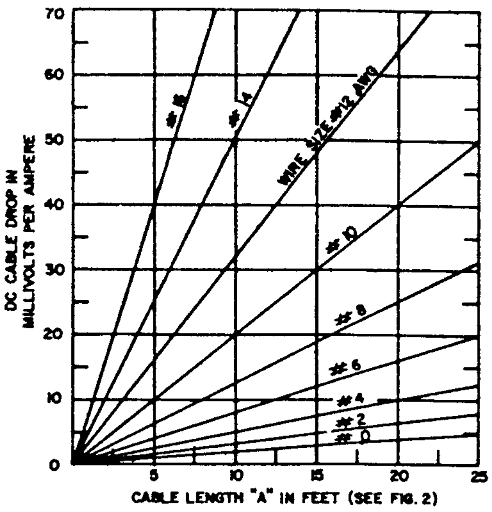


Figure 1. Cable Connection Chart.

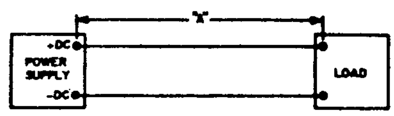
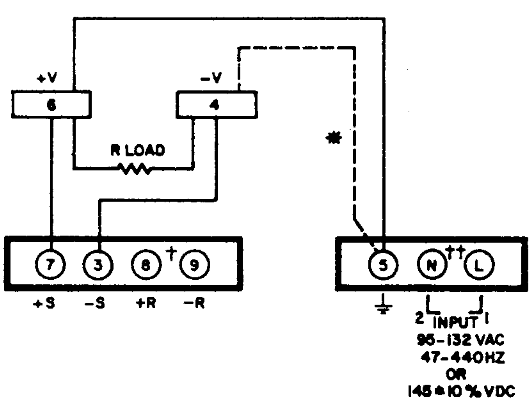
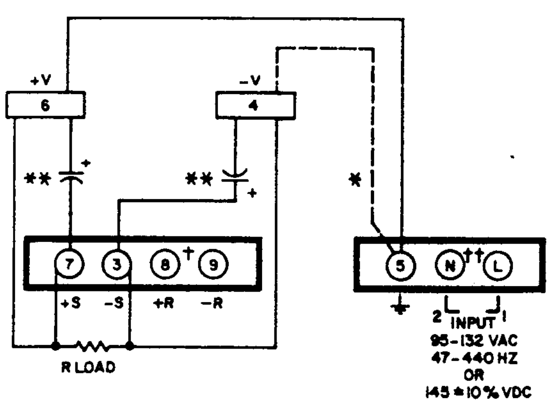


Figure 2. Cable Length "A" in Feet.



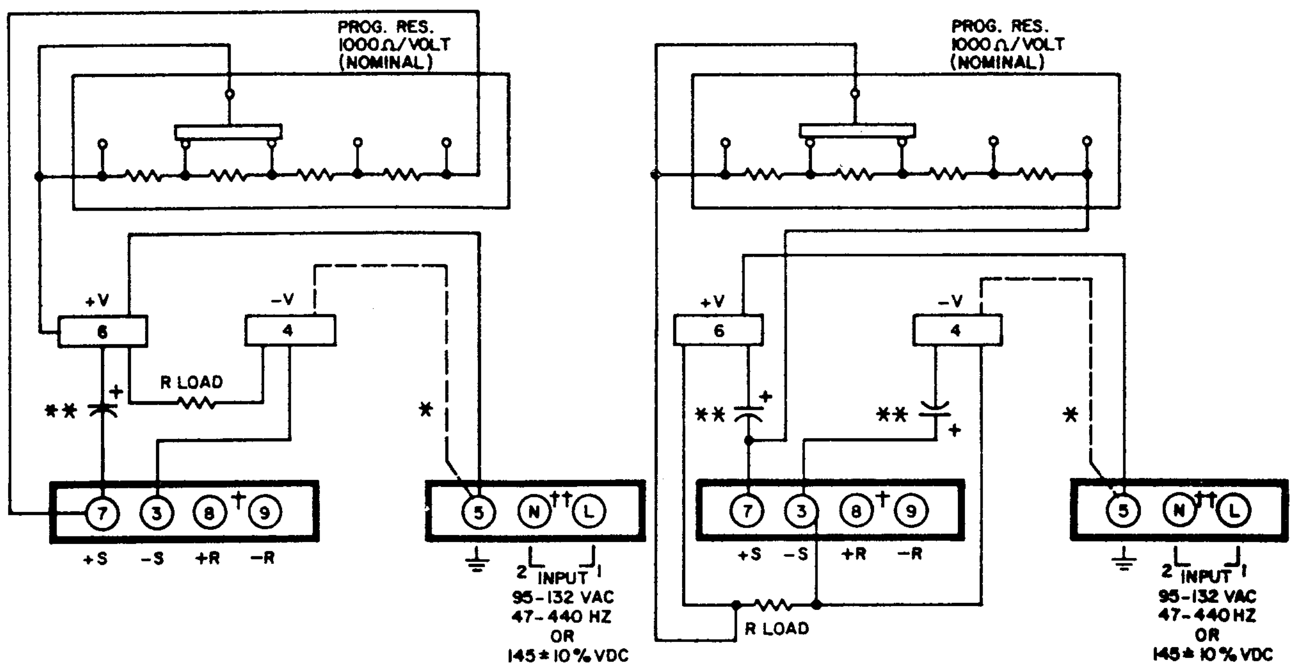
NOTE
* FOR NEGATIVE GROUND, DISCONNECT JUMPER FROM TERMINALS 5 AND 6 AND RECONNECT TO TERMINALS 5 AND 4.
† REMOTE ON/OFF TERMINALS; REFER TO FIGURE 8 FOR PROPER CONNECTION.
†† ALWAYS CONNECT UNGROUNDED (HOT) LEAD TO TERMINAL "L".

Figure 3. Local Sensing Connections.



NOTE
* FOR NEGATIVE GROUND, DISCONNECT JUMPER FROM TERMINALS 5 AND 6 AND RECONNECT TO TERMINALS 5 AND 4.
** A 2.5 MF, ELECT., CAP. MAY BE REQUIRED.
† REMOTE ON/OFF TERMINALS; REFER TO FIGURE 8 FOR PROPER CONNECTION.
†† ALWAYS CONNECT UNGROUNDED (HOT) LEAD TO TERMINAL "L".

Figure 4. Remote Sensing Connections.



(A) LOCAL SENSING

(B) REMOTE SENSING

NOTES:

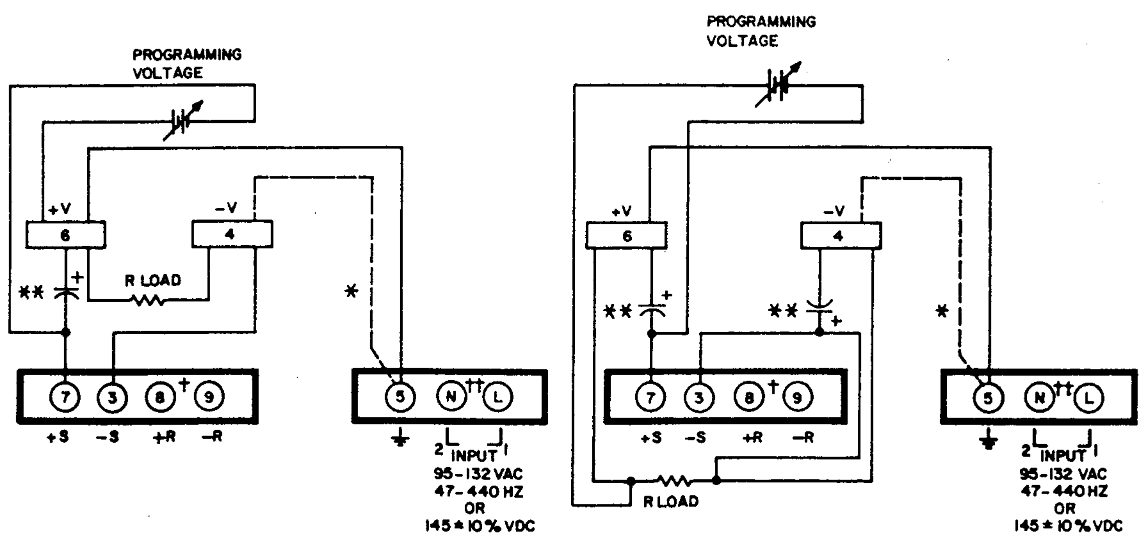
* FOR NEGATIVE GROUND, DISCONNECT JUMPER FROM TERMINALS 5 AND 6 AND RECONNECT TO TERMINALS 5 AND 4.

** A 2.5 MF, ELECT., CAP. MAY BE REQUIRED.

† REMOTE ON/OFF TERMINALS; REFER TO FIGURE 8 FOR PROPER CONNECTION.

†† ALWAYS CONNECT UNGROUNDED (HOT) LEAD TO TERMINAL "L".

Figure 5. Programmed Voltage, With External Resistor.



(A) LOCAL SENSING

(B) REMOTE SENSING

NOTES:

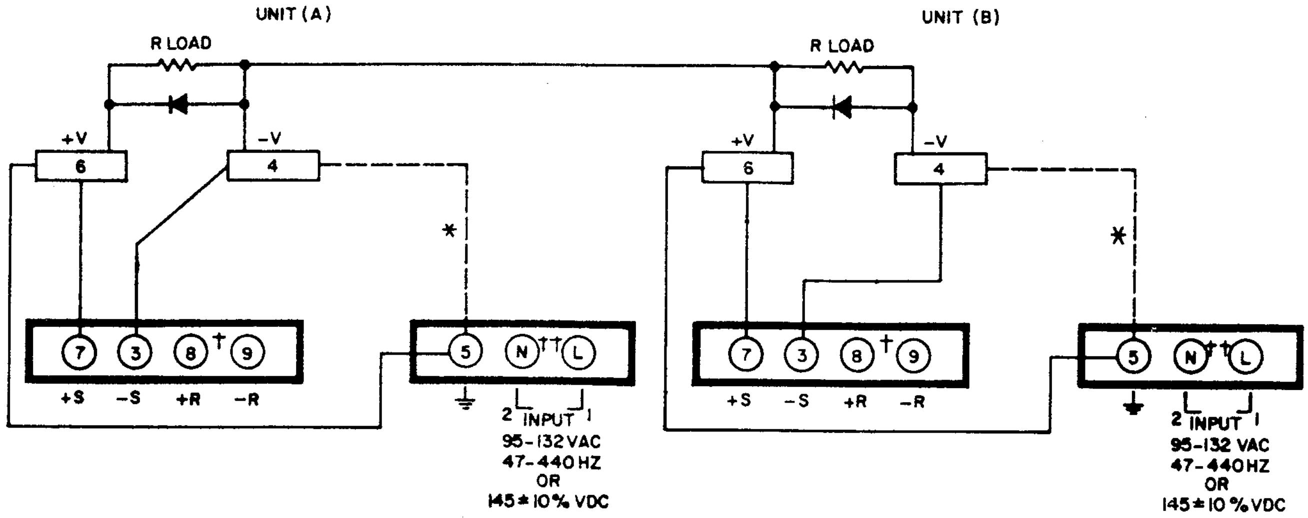
* FOR NEGATIVE GROUND, DISCONNECT JUMPER FROM TERMINALS 5 AND 6 AND RECONNECT TO TERMINALS 5 AND 4.

** A 2.5 MF, ELECT., CAP. MAY BE REQUIRED.

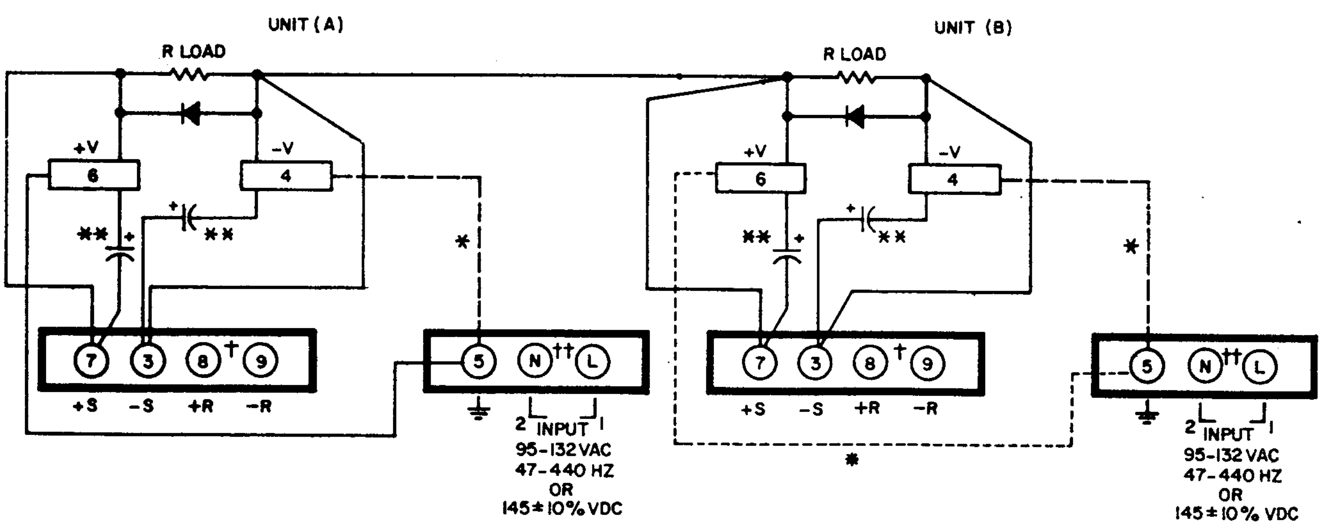
† REMOTE ON/OFF TERMINALS; REFER TO FIGURE 8 FOR PROPER CONNECTION.

†† ALWAYS CONNECT UNGROUNDED (HOT) LEAD TO TERMINAL "L".

Figure 6. Programmed Voltage, With External Programming Voltage Source.



(A) LOCAL SENSING



(B) REMOTE SENSING

NOTES:

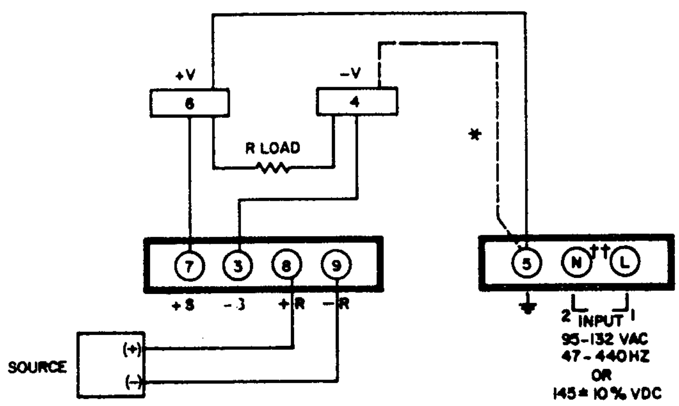
* MAKE ONLY ONE GROUND CONNECTION FOR SERIES COMBINATION. TO CHANGE GROUND AS SHOWN, REMOVE JUMPER FROM TERMINALS 5 AND 6 ON UNIT (A) AND CONNECT ANY ONE OF THE OTHER JUMPERS AS SHOWN IN DOTTED LINE.

** A 2.5 MF, ELECT., CAP. MAY BE REQUIRED.

† REMOTE ON/OFF TERMINALS; REFER TO FIGURE 8 FOR PROPER CONNECTION.

†† ALWAYS CONNECT UNGROUNDED (HOT) LEAD TO TERMINAL "L".

Figure 7. Series Connection.



* FOR NEGATIVE GROUND, DISCONNECT JUMPER FROM TERMINALS 5 AND 6 AND RECONNECT TO TERMINALS 5 AND 4.

†† ALWAYS CONNECT UNGROUNDED (HOT) LEAD TO TERMINAL "L".

Figure 8. Remote Turn-on/Turn-off.

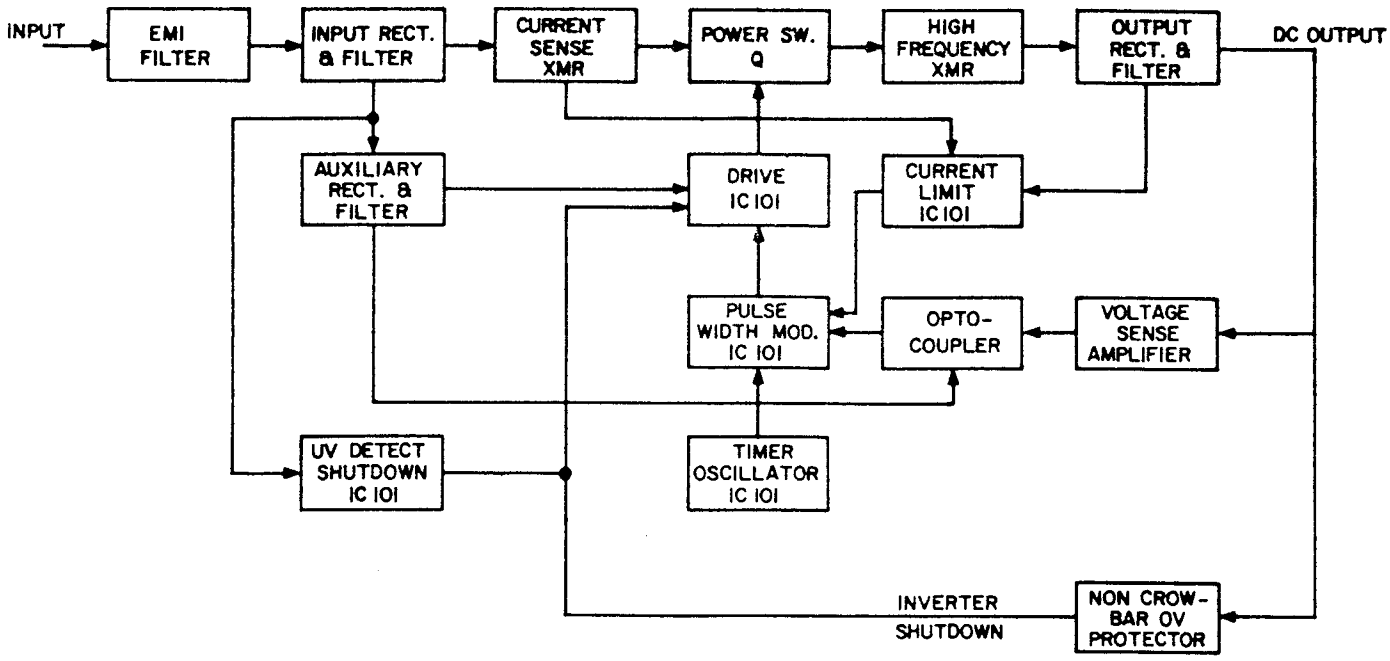
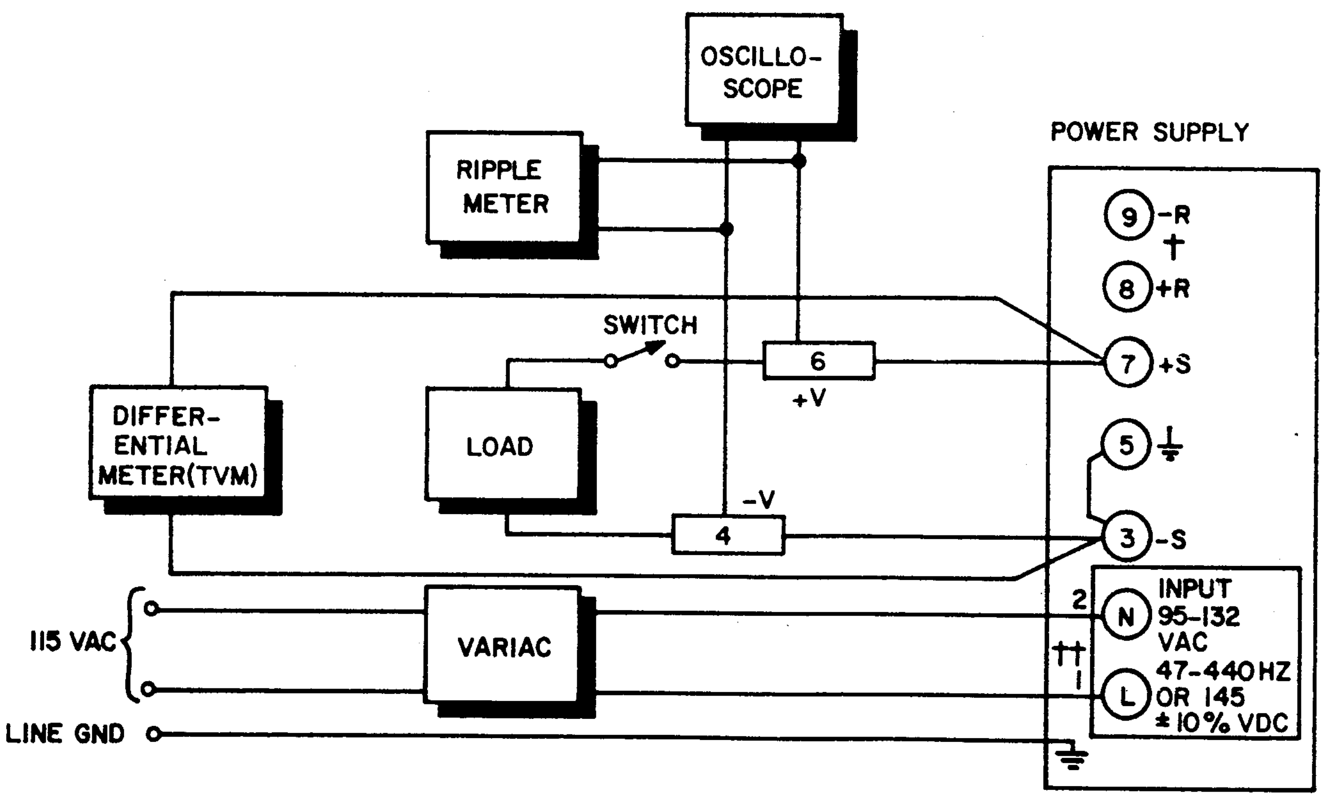


Figure 9. Typical Block Diagram.

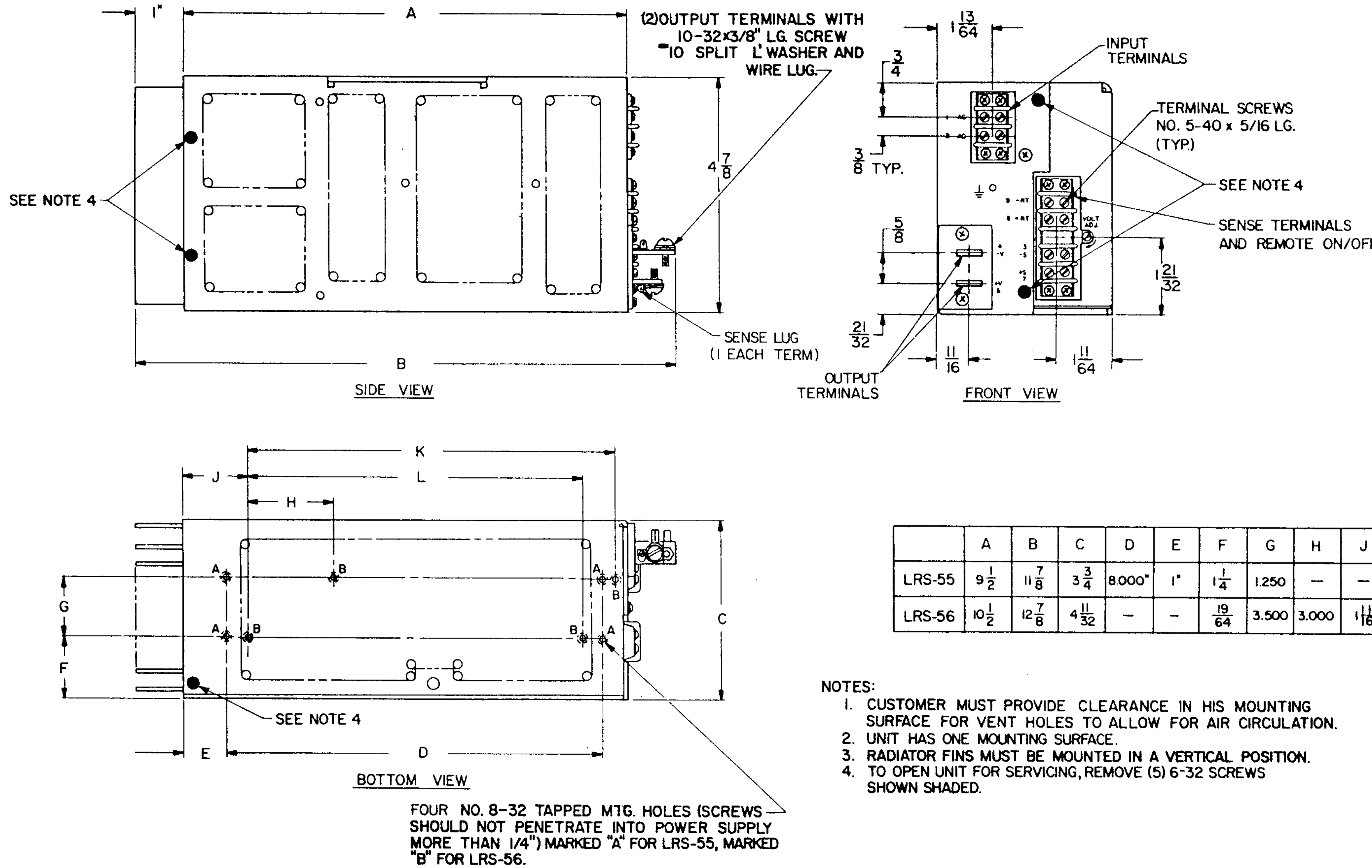


NOTES:

1. REGULATION AND RIPPLE CHECK METERS MUST NOT BE GROUNDED THROUGH THREE WIRE LINE CORD TO GROUND.
2. PERFORM CHECKS WITH LOCAL SENSING CONNECTION ONLY.

† REMOTE ON/OFF TERMINALS; REFER TO FIGURE 8 FOR PROPER CONNECTION.

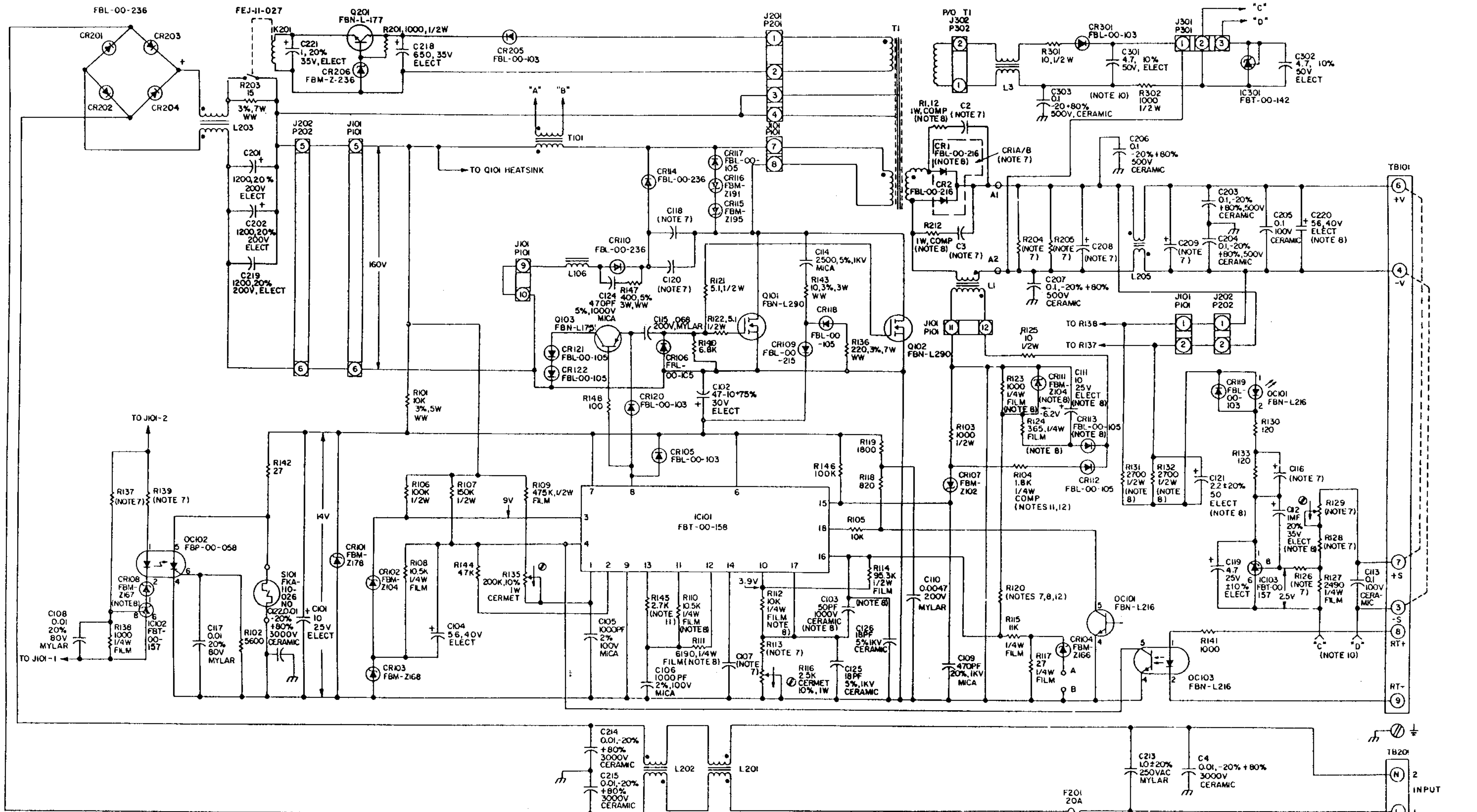
†† ALWAYS CONNECT UNGROUNDED (HOT) LEAD TO TERMINAL "L".



	A	B	C	D	E	F	G	H	J	K	L
LRS-55	9 1/2	11 7/8	3 3/4	8.000"	1"	1 1/4	1.250	—	—	—	—
LRS-56	10 1/2	12 7/8	4 11/32	—	—	19/64	3.500	3.000	1 11/16	7.343	7.125

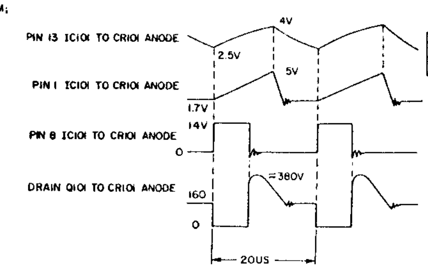
NOTES:
1. CUSTOMER MUST PROVIDE CLEARANCE IN HIS MOUNTING SURFACE FOR VENT HOLES TO ALLOW FOR AIR CIRCULATION.
2. UNIT HAS ONE MOUNTING SURFACE.
3. RADIATOR FINS MUST BE MOUNTED IN A VERTICAL POSITION.
4. TO OPEN UNIT FOR SERVICING, REMOVE (5) 6-32 SCREWS SHOWN SHADED.

Figure 11. Outline Drawing.



NOTES:

1. RESISTORS ARE 1/4W CARB. FILM WITH VALUES IN OHMS UNLESS OTHERWISE NOTED.
2. CAPACITOR VALUES ARE IN MICROFARADS UNLESS OTHERWISE NOTED.
3. RESISTOR TOLERANCES: COMP. ±10% CARB. FILM ±5%, WIREWOUND ±5%, FILM ±1%.
4. CAPACITOR TOLERANCES ELECTROLYTIC -10 + 100%, CERAMIC ±20%, MYLAR ±10% MICA ±5% UNLESS OTHERWISE NOTED.
5. SYMBOLS:
   - ▭ INDICATES ACTUAL UNIT MARKING
   - ↑ INDICATES CLOCKWISE ROTATION OF SHAFT.
   - —⊖— INDICATES TERMINAL ON PRINTED WIRING BOARD OR TERMINAL BOARD
   - ⊘ INDICATES ADJUSTMENT OR CALIBRATION CONTROL
   - * SEE INSTRUCTION MANUAL.
6. DESIGNATIONS ARE LAMBDA PART NO.
7. SEE TABLE II FOR COMPONENT VALUES.
8. R131, R132, C121, CR1, CR2, L2 ONLY USED ON 48V UNIT; C111, R123, R124, R120, R114, CR111, CR113, CR121, CR122, C220 NOT USED ON 48V; C112 IS 0.15 MF, 10%, 35V ELECT, R1 AND R2 ARE EACH 68 OHMS, 2W, R110 IS 11.8K, 1/4W FILM, C103 IS 18 PF 5%, R111 IS 5,360 OHMS, R112 IS 2,740 OHMS ON 48V UNIT; R132 AND CR108 ARE JUMPERED ON ALL MODELS OTHER THAN 48 UNIT.
9. CONDITIONS FOR VOLTAGE MEASUREMENTS:
   VIN = 115 VAC (60HZ) I_O = 25% OF 40°C RATING.
   NOMINAL OUTPUT VOLTAGE, +S AND +V SHORTED -S AND -V SHORTED. INDICATED VOLTAGE ARE TYPICAL VALUES AND ARE DC UNLESS OTHERWISE NOTED. DC MEASUREMENTS ARE TAKEN WITH A MINIMUM 20,000 OHM/VOLT VOLTMETER AND ARE REFERENCED TO C201 NEGATIVE OR CR101 ANODE UNLESS OTHERWISE INDICATED.
   FOLLOWING WAVEFORMS CAN BE OBSERVED AT POINTS INDICATED (NOTE - OBSERVE NORMAL SAFETY PRECAUTIONS, ALL PRIMARY CIRCUITRY IS AT AC LINE POTENTIAL WITH RESPECT TO CHASSIS).
10. JUMPER "C" TO "D" ON ALL MODELS EXCEPT 2V UNITS; R301, R302, C301, C302, C303, L3, CR301, IC301 ONLY USED ON 2V UNIT
11. ON 2V, 5V AND 6V UNITS R104 IS 3.3K OHMS CARB. FILM; ON 2V UNITS R112 IS 28.7K OHMS. ON 2V, 5V AND 6V UNITS R145 NOT USED.
12. ON 20V, 24V & 28V UNITS WITH SERIAL NO. PREFIX A, R104 IS 1.8K ±10%, 1/4W COMP, R120 IS 150K ±1%, 1/4W FILM; ON UNITS WITH SERIAL NO. PREFIX B ON 20V AND 24V UNITS R104 IS 1K ±10%, 1/4W COMP, ON 28V UNIT, R104 IS 68 ±10%, 1/4W COMP.



FOR WIRING OF POWER SUPPLY TO LOAD, REFER TO LOAD WIRING DIAGRAMS. DOTTED CONNECTIONS SHOWN AT OUTPUT TERMINALS INDICATE JUMPERS IN PLACE FOR LOCAL SENSING CONNECTIONS.

THIS SCHEMATIC COVERS UNITS WITH SERIAL NUMBER PREFIXES A-C

SCHEMATIC DIAGRAM REGULATED POWER SUPPLY LRS-56

LAMBDA ELECTRONICS
MELVILLE, NEW YORK
DIVISION OF VEECO INSTRUMENTS INC

TABLE II
SCHEMATIC DATA REFERENCES MODELS LRS-56-2—LRS-56-48

MODELS	Schematic Components													
	C2, C3	C107	C116	C118, C120	C208, C209	CR1A, CR1B	R113	R126	R128	R129	R137	R204, R205	R120	R139
	±10% 3,000 vdc CERAMIC	±10% 80 vdc MYLAR	±20% 35 vdc ELECT	±5% 1,000 vdc MICA	±20% ELECT	*FBL-00	±1% 1/4W FILM	±5% 1/4W CARB. FILM	±1% 1/4W FILM	±10% 3/4W VAR CEMENT	±1% 1/4W FILM	±3% 3W WW	±1% 1/4W FILM	±5% 1/2W CARB. FILM
LRS-56-2	.02 mf ±20% 1,400 vdc	.022 mf	NOT USED	10,000 pf	25,000 mf 7.5 vdc	-268	3,970	6,800	1,620	2,000	619	3.5 ±2% ††NOT USED	150K	47
LRS-56-5	.02 mf ±20% 1,400 vdc	.022 mf	NOT USED	10,000 pf	25,000 mf 7.5 vdc	-268	3,010	6,800	2,000 ±2%	2,000	1,620	25 ±5%	150K	47
LRS-56-6	.02 mf ±20% 1,400 vdc	.022 mf	NOT USED	10,000 pf	25,000 mf 7.5 vdc	-268	4,750	6,800	2,000 ±2%	5,000	1,910	33 ±10% 2.5W	150K	47
LRS-56-12	.002 mf	.022 mf	.47 mf ±20% 50 vdc CERAMIC	10,000 pf	15,000 mf 20 vdc	-265	5,360	10,000	7,500	5,000	4,700	150	150K	180
LRS-56-15	.002 mf	.022 mf	.47 mf ±20% 50 vdc CERAMIC	10,000 pf	15,000 mf 20 vdc	-265	4,750	10,000	10,000	5,000	6,340	250	150K	180
LRS-56-20	.002 mf	.022 mf	1 mf	4,700 pf	10,000 mf 28 vdc	-265	6,190**	10,000	15,000	5,000	9,090	470	220K ±10% 1/4W COMP†	390
LRS-56-24	.002 mf	.022 mf	1 mf	4,700 pf	10,000 mf 28 vdc	-265	6,810**	10,000	18,200	10,000	11,000	650	330K†	390
LRS-56-28	.002 mf	.047 mf	1 mf	4,700 pf	8,200 mf 35 vdc	-265	6,810**	10,000	22,000	10,000	13,000	650	470K ±5% CARB. FILM†	390
LRS-56-48	.001 mf ±20%	.047 mf	1 mf	3,600 pf	4,800 mf 55 vdc	NOT USED	10,000	1,000	40,200	20,000	22,000	1,200 ±2%	NOT USED	390

*Lambda Part No.
**On 24V and 28V units with serial no prefixes A&B, R113 is 5.36K, ±1-1/2%, 1/4W film and on 20V unit R113 is 3.97K ±1/2%, 1/4W film.
†On 20V, 24V and 28V units with serial no. prefix A, R120 is 150K ±1%, 1/4W film.
††R205 not used on LRS-56-2.