INSTRUCTION MANUAL

FOR

REGULATED POWER SUPPLY

MODELS 25, 28

Manufactured By

LAMBDA ELECTRONICS CORP.

CORONA, NEW YORK

Model No. 25

Serial No. 5733

Model 25

Model 28

INSTRUCTION MANUAL
for
Regulated Power Supply
Models 25, 28

I. General Description

1. General Description

The power supplies described herein are designed for use in industry, laboratory, radio station and school to supply power to electronic and other equipment. The DC output voltage is electronically regulated and is practically independent of external load (within limits) and normal line voltage fluctuations, and is also substantially free from hum and noise. Quality components, careful construction and conservative ratings are employed to insure long and dependable service.

To meet a variety of needs the power supplies are available in the following styles having identical electrical specifications:

Model 25 Compact and portable bench type. Functionally designed for maximum convenience and utility as a general purpose power supply.

Model 28 Compact unit for mounting in standard 19 inch racks. Designed for use with associated equipment in permanent and semi-permanent installations.

2. Electrical Characteristics of Models 25, 28

Input: 105-125 Volts AC, 50-60 cycles, 120 watts.

DC Output: Continuously variable from 200 to 325 Volts DC regulated from 0 to 100 ma max. Either positive or negative side of supply may be grounded.

AC Output: 6.3 Volts AC center-tapped at 3A unregulated.

DC Voltage Regulation: Output constant to better than 1% for loads from zero to full load and line voltage variations from 105 to 125 volts.

Internal Impedance: Approximately 10 ohms.

Noise and Ripple Output: Less than 10 millivolts rms for above ratings.

Tube Complement: 5V4G rectifier, 2-6Y6G series control tubes, 6SJ7 DC amplifier, OA3/VR-75 comparison voltage source.

3. Mechanical Specifications

Model 25 Cabinet Dimensions
Height: 8 inches
Width: 14 inches
Depth. 6 inches
Weight: 17 pounds
Finish: Grey ripple enamel.

Model 28 Standard 19" Rack Mounting
Panel Height: 5¼ inches
Panel Width: 19 inches
Depth behind Panel: 7½ inches
Weight. 17 pounds
Panel Finish: Black or gray (Munsell 4.5) ripple enamel.

II. Operating Instructions Models 25, 28

MODEL 25

1. Model 25 Front Panel Operating Controls and Terminals

a) The "AC ON" toggle switch is in the transformer primary circuit and controls power to the supply. The adjacent pilot light indicator having a green jewel is illuminated when the switch is in the ON position. The adjacent extractor type fuseholder marked "1.5A" is designed for a 1.5 ampere type 3AG fuse.

b) The "DC ON" toggle switch is in the transformer secondary center-tap circuit and permits the DC output to be turned off leaving the power supply in a "standby" condition. The adjacent pilot light indicator having a red jewel is illuminated when the switch is in the ON position. The adjacent fuseholder marked "0.125A" is designed for a 0.125 ampere type 3AG fuse.

c) The "DC OUTPUT VOLTAGE" control is a wirewound rheostat which permits the d-c output voltage to be set at any value between 200 and 325 volts d-c. The calibrated scale indicates the output voltage and is accurate to within 5%. For reasons of manufacturing and component tolerances it is necessary to leave a small portion at each end of the range of this control uncalibrated. When the control is set in these regions, the output voltage will be either slightly less than 200 volts or slightly greater than 325 volts d-c. The supply may be operated in this condition but loads drawing more than 70 ma are not recommended if regulation and hum-level ratings are to be maintained.

d) OUTPUT TERMINALS. The output terminals are sturdy, insulated "captive head" binding posts which can be used in a number of ways and are rugged enough to take a substantial amount of handling and abuse. They will accept "wrap-around" wire connections, "alligator" clips, banana plugs, spade lugs, and wire as large as #12 AWG for permanent feed-through clamping. The d-c output terminal pair and the 6.3 VAC output terminal pair are each spaced on ¾ inch centers so that they will accept standard double banana plugs.

DC OUTPUT CONNECTIONS. The DC output connections marked "200-325 VDC" supply the regulated DC output voltage. The positive connection is brought out through the red binding post. The negative connection is brought out through the black binding post. In most applications it is usual for the negative terminal to be at ground potential. In some cases it may be desired to place the positive terminal at ground potential. Still other application may require that neither positive nor negative be at ground potential. In such cases where either the positive or negative output connections are to be at ground potential, the appropriate terminal should be connected by means of a jumper wire to the binding post marked "GND." This latter post is connected to the power supply chassis.

AC OUTPUT CONNECTIONS. The AC output connections marked "6.3VAC 3A" supply unregulated voltage for vacuum tube heater circuits. The center-tap of this connection is brought out to the binding post marked "CT."

2. Placing Model 25 into Operation

a) Both "AC-ON" and "DC-ON" toggle switches should be in the OFF position.

b) Plug power cord into source of 115 volts AC, 50-60 cps.

c) Throw the left-hand toggle switch to the "AC-ON" position. The green pilot light should be illuminated. 6.3 Volts AC will be present at the terminals so marked. No output will be present at the DC output terminals. Allow the supply to warm up for a minute or so.

d) Set the "DC OUTPUT VOLTAGE" control to the desired voltage.

e) Throw the right-hand toggle switch to the "DC-ON" position. Regulated DC voltage will be present at the terminals so marked. The power supply is now in full operating condition.

f) If it is desired to turn off only the d-c output, use the d-c toggle switch, leaving the a-c toggle switch in the ON position. In this manner, the supply will be in a standby condition and ready for instant use.

NOTE: Should the supply be turned on by means of the "AC-ON" switch while the "DC-ON" switch is in the ON position, inherent protection is afforded by the circuit design to prevent the d-c output voltage from exceeding the voltage indicated by the "DC OUTPUT VOLTAGE" control.

3. Model 25 Fuse Protection

a) INPUT CIRCUIT. The 1.5 ampere 3AG fuse in the input circuit is mounted on the front panel and is marked "1.5A". Its principal function is to offer protection against overloads of the 6.3 VAC circuit or against short-circuits within the power supply itself.

b) D-C OUTPUT CIRCUIT. The 0.125A 3AG fuse in the d-c output section is mounted on the front panel and is marked "0.125A". Its principle function is to protect the regulator section, rectifier, power transformer and filter choke from severe overload and short-circuit conditions in the external circuit. This fuse will "blow" at approximately 140 ma. The fuse will also protect an external milliammeter if one is used with the supply.

A special note is in order with regard to the output circuit fuse. In the course of some laboratory experimental and developmental procedures, a large uncharged capacitor, e.g. 4 to 10 mf, is shunted across the d-c output connections while full d-c voltage is present. Since the capacitor is uncharged a relatively high transient current (practically equivalent to a short circuit current) will be demanded from the power supply with the resultant "blowing" of the fuse. In such cases one of the following procedures is suggested:

1) Throw d-c switch to OFF position. Connect external capacitor. Then throw d-c switch to ON position. This procedure results in a marked reduction in the peak transient current due to the fact that the supply itself requires a fraction of a second to build up its own output voltage.

Or 2) Replace the 0.125A fuse with a 0.125A "slo-blo" type. The "slo-blow" fuses permit a severe *temporary* overload without "blowing." They are relatively expensive and are not as commonly available as the fuses supplied with the unit.

Or 3) Replace the fuse with one of higher current-carrying capacity.

4. Model 25 Noise and Ripple Output

The noise and ripple output of the supply should be less than 10 millivolts rms at all voltages and load conditions within the specifications. This level will be present when the supply is regulating within the 1% specified. Measurement of this level may be made with an AC VTVM capable of reading 10mv rms.

It is recommended that either the positive or negative terminal be connected by a jumper wire to the "GND" terminal for minimum ripple output.

5. Model 25 Output Impedance

The output impedance of the supply for d-c is approximately 10 ohms. A 2 mfd oil-filled paper capacitor is in shunt with the d-c output circuit for two purposes: 1) to maintain this low value of output impedance at audio and at low and medium radio frequencies; 2) to provide a reservoir to supply transient currents of short duration having peak values greater than 100 ma.

An additional external capacitor shunted across the d-c output will provide even lower a-c output impedance and allow even higher peak transient currents to be drawn. For low impedance to high frequency RF currents, the common practice is to use a mica capacitor shunt close to the RF unit.

MODEL 28

1. Model 28 Operating Controls and Terminals

a) The a-c toggle switch, mounted on the front panel, is in the transformer primary circuit and controls power to the supply. The adjacent pilot light indicator having a red jewel is illuminated when the switch is in the ON position. The adjacent extractor type fuseholder marked "1.5A" is designed for a 1.5 ampere type 3AG fuse.

b) The d-c output voltage control is a screw-slot adjusting potentiometer accessible at the rear of the unit adjacent to the output terminal strips. This control is uncalibrated and should be used in conjunction with an external voltmeter to set the output voltage at the desired value (within the specified limits of 200 to 325 VDC) For reasons of manufacturing and component tolerances it will be found possible to obtain output voltages of less than 200 volts and greater than 325 volts. When the control is set in the latter regions loads drawing more than 70 ma are not recommended if regulation and hum level ratings are to be maintained.

c) The regulated DC output connections are brought out to a terminal strip marked "DC plus" and "DC minus" at the rear of the unit. In most applications it is usual for the negative terminal to be at ground potential. In some cases it may be desired to place the positive terminal at ground potential. Still other applications may require that neither positive nor negative be at ground potential. In such cases where either the positive or negative output connections are to be at ground potential, the appropriate terminal should be connected by means of a jumper wire to the terminal marked with the ground symbol. This latter terminal is connected to the power supply chassis.

d) The AC output connections are brought out to a terminal strip marked "6.3 VAC 3A" at the rear of the unit. These terminals supply unregulated voltage for vacuum tube heater circuits. The center-tap of this connection is brought out to the terminal marked "CT"

2. Placing Model 28 into Operation

a) Plug power cord into source of 115 VAC, 50-60 cps.

b) Throw toggle switch to "AC-ON" position. The pilot light should be illuminated. Allow the supply to warm up for about a minute or so.

c) Set output voltage with an external voltmeter. The power supply is now in full operating condition.

3. Model 28 Fuse Protection

Because of the permanent or semi-permanent nature of installation and use of Model 28 only a primary fuse is provided. This fuse is of the 1.5 ampere 3AG type and is mounted on the front panel.

4. Model 28 Noise and Ripple Output

See Model 25 "Noise and Ripple Output" notes above.

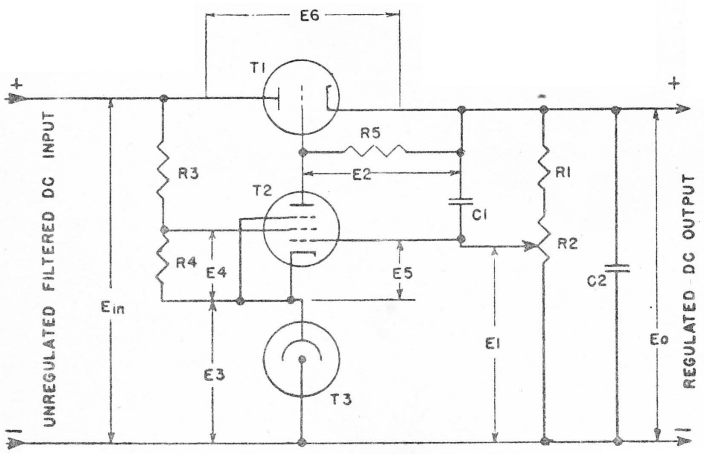
5. Model 28 Output Impedance

See Model 25 "Output Impedance" notes above.

III. Theory of Operation

Reference: Terman, Radio Engineering Handbook, P. 614.

The theory of operation of the series type electronically regulated power supply has been described in great detail in the literature. To review, reference is made to the simplified schematic diagram shown below:



SERIES TYPE ELECTRONIC VOLTAGE REGULATOR

This regulating system operates in such a way as to make the output voltage, Eo, substantially independent of the load connected across Eo, or of the d-c voltage Ein. This circuit operates as follows: Any fluctuation in output voltage, Eo, due to change in load, or Ein, produced by line voltage variation, will vary the potential E1. Hence the grid-cathode potential of T2 will change, since the action of T3, a gas-filled voltage regulator tube, is such that a practically constant voltage drop, E3, is maintained independent of current through T3. The change in grid-cathode potential of T2 is amplified by T2 and affects E2, the grid-cathode potential of T1 in such a manner as to produce a change in voltage drop, E6, through T1 that tends to compensate for the change in output voltage, Eo.

The steady state plate current through T2 determines E2 and therefore the voltage drop through T1. Hence the output voltage, Eo, (which the system attempts to maintain) is determined by the potential E1. Thus this output voltage Eo is determined by the setting of potentiometer R2.

When the screen grid voltage of T2 is obtained from a voltage divider, R3 and R4 across the unregulated supply voltage, Ein, additional compensation is obtained. Any fluctuation of Ein will vary the current through R4 and hence the screen-cathode potential, E4. This affects the voltage drop, E6, so as to compensate Eo for a change in Ein.

Since the output potential, Eo, tends to be independent of the load on the system, Eo acts as though it had a very low impedance source. If R4 is made a potentiometer and E4 is adjustable, it is possible to provide such compensation as to reduce the effective internal impedance of the regulator system to zero or even to a negative value, i. e., Eo will increase with an increase in load current. For maximum stability the 6SJ7 screen voltage potentiometer in the Model 25 and 28 regulated power supplies is set at the factory so that at an Eo of 270 volts there will be a voltage drop of 1 volt from no load to full load. With this adjustment Eo will not vary more than 1 volt with a line voltage fluctuation of 105-125 volts.

The internal impedance of the regulated supply is low from DC through audio frequencies and is a function of the response of T1, T2, T3 and their associated circuits.

A capacitor, C2, is shunted across the output to maintain the supply impedance at a low value for higher frequencies, and to serve as a reservoir for high peak transient currents. C1 increases the response of the regulator system to hum voltage and serves to reduce the ripple content of Eo.

IV. Maintenance Models 25, 28

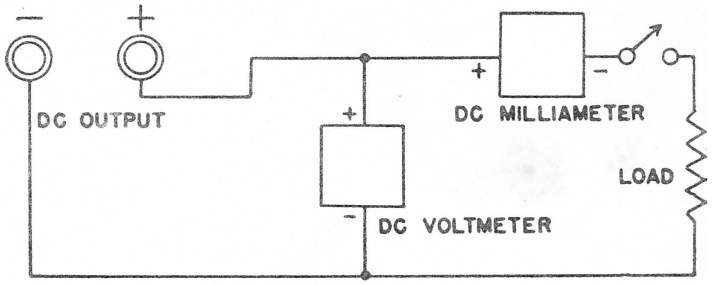
Under normal conditions no special maintenance of the Models 25 and 28 power supplies is required except for occasional tube replacement.

1. Models 25 and 28 Tube Replacement

The tubes are secured in their sockets by spring-type retaining clamps. The retaining clamps must be depressed into and held in a flattened position before removing tubes from their sockets.

Special attention is called to replacement of the 6SJ7 DC amplifier tube and the OA3/VR-75 voltage reference tube. Due to tube manufacturing tolerances, it may be necessary to check the operation of the supply when these tubes are changed if the power supply specifications are to be maintained. Checking and recalibration procedures are outlined in detail in paragraphs 2 and 3 below.

2. Model 25 Operational Check and Recalibration Procedures



RAPID CHECK SETUP

a) RAPID CHECK (see diagram). An approximate check of the power supply regulation and calibration may be made with a DC voltmeter having a voltage range at least to 300 volts (usually a 0-500 VDC meter or preferably a multi-range meter), a 0-100 ma DC milliameter (optional), and a load resistance capable of loading the supply to 100 ma and capable of dissipating the appropriate amount of heat, e. g., 2500 ohms 25 watts at an output voltage of 250 VDC.

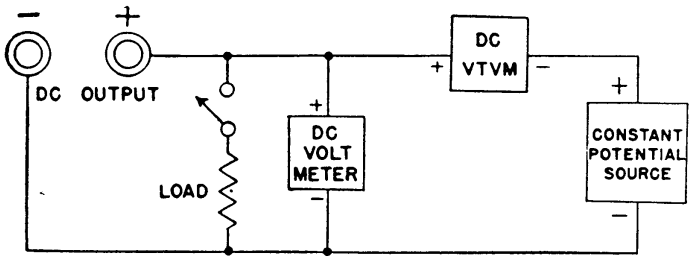
Allow the supply to warm up for a few minutes. Adjust the "DC OUTPUT VOLTAGE" control so that the voltmeter reads 250 VDC. Connect the load resistor. The milliameter should read 100 ma. While carefuly observing the voltmeter, alternately connect and disconnect the load resistor. The voltage under load should not decrease more than approximately 2 volts from the no-load voltage. It may be difficult to accurately judge a 1 or 2 volt change but the meter needle should perceptibly move in the decreasing direction when the load is applied. If this condition is satisfied, the power supply regulation is proper.

If, under load, a decrease of more than 2 volts or a *rise* in voltage is noticed, adjustment of the internal controls is necessary. Remove the dust cover. A tube and control location diagram will be found on the inside of the dust cover. The "Screen Volt Adj." screw-slot potentiometer will be found near the filter choke. Adjust this potentiometer a little bit at a time and repeat the above regulation check each time until proper operation is obtained. Secure the potentiometer shaft in position with a drop of Duco or glyptal cement.

With the output voltmeter reading 250 volts, note the setting of the "DC OUTPUT VOLTAGE" control. If it does not read 250 volts, the following recalibration procedure is used.

The calibration of the "DC OUTPUT VOLTAGE" control should be made *after* the regulation adjustment has been completed. Turn the "DC OUTPUT VOLTAGE" knob to its extreme clockwise position. The knob pointer should be opposite the radial line on the scale indicating the limit of physical rotation. Reset this knob if necessary. Turn the knob so that the pointer is set to the center

of the calibration dot at 250 volts. Adjust the "Range Set" screw-slot potentiometer (located near the power transformer) until the meter reads 250 VDC. Secure the potentiometer shaft with a drop of Duco or glyptal cement.



PRECISE CHECK SETUP

b) PRECISE REGULATION CHECK (see diagram above). For precise check of the power supply regulation it is necessary to have a means of measuring voltage changes of the order of 1%. The set-up suggested requires a suitable load to draw 100 ma from the supply; a monitoring voltmeter (optional); a constant potential source ,such as a set of 6 45-volt "B" batteries (270 VDC) or a regulated power supply (set at 250 VDC); and a high impedance voltmeter. It is suggested that this latter voltmeter be of the vacuum tube type to prevent meter burnout.

Allow the supply to warm up for a few minutes. Set the power supply to about 3 volts higher than the constant potential source, as indicated by a reading of plus 3 volts on the DC VTVM. Proceed with the regulation and calibration check as outlined in paragraph (a) above, setting the regulation at 1 volt decrease from no load to full load at either 250 or 270 volts depending on which is used in the above checking procedure.

c) ADJUSTING FOR CLOSER REGULATION. It should be noted that the regulation of the supply may be adjusted to near zero. The same adjusting procedure may be used as outlined in paragraph (b) above. When regulation near zero is desired and set, it is recommended that the range of output voltage over which the supply is to be used be kept small or better still the supply be used at the voltage at which the regulation adjustment was made, if stable operation is to be assured.

3. Model 28 Operational Check

The procedures outlined in paragraph 2 for Model 25 are in general applicable to the Model 28. The following differences should be noted:

a) The screen voltage adjustment potentiometer, marked "SCREEN ADJ" is of the screw-slot adjusting type and is located near the 5V4G rectifier tube.

b) The DC output voltage control potentiometer will be found next to the output terminal strips. The range of this potentiometer will be greater than the specified range of 200 to 325 VDC. It is recommended that the supply be used within the specified range.

c) No range setting control is provided.

4. Miscellaneous Maintenance Notes Models 25 and 28

a) A schematic diagram for Model 25 will be found on the inside surface of the chassis bottom plate.

b) A schematic diagram for Model 28 will be found on the inside surface of the top cover plate.

c) The pilot light indicator lamps on the front panel are of the 6-8 volt #47 bayonet type. They are accessible from the front panel by merely unscrewing the pilot light assembly jewel.

d) The fuse holders are of the finger-grip extractor type, permitting easy replacement of the fuses from the front.

5. Voltage Table Models 25, 28

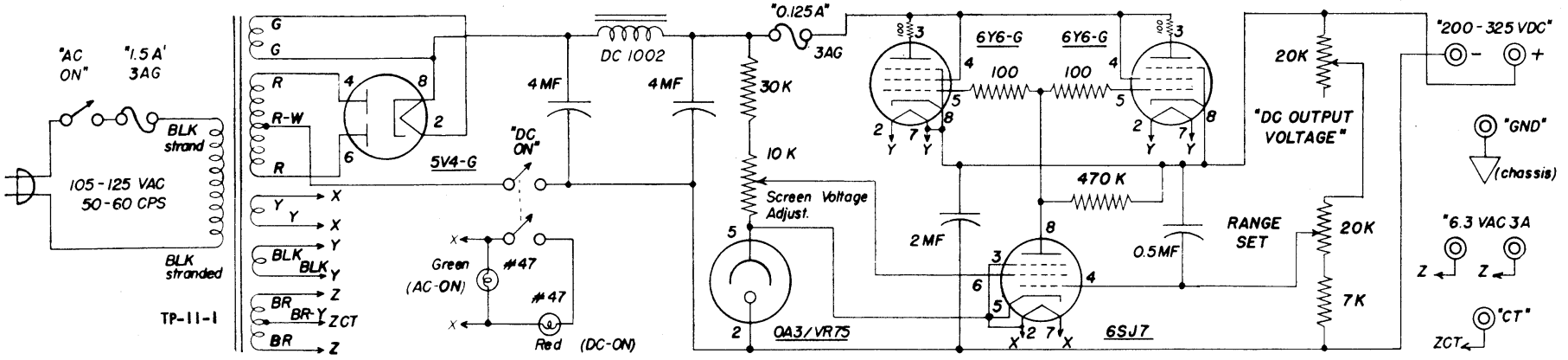
The following voltages are typical with the power supply operating with 115 VAC input, with an output of 250 VDC, and no load on the output. The measurements may be made with a voltmeter having a sensitivity of 1000 ohms per volt except where indicated otherwise. Voltages are measured between the indicated tube-pin and the negative output terminal, except for measurement of tube heater voltages.

Pin Number	5V4G	OA3/VR-75	6SJ7	6Y6G (Either)
1	—	—	0	—
2	535	0	77	250
3	—	—	77	530
4	425VAC	—	72	530
5	—	77	77	187 (b)
6	425VAC	—	80 (a)	187 (b)
7	—	—	77	250
8	535	—	187 (b)	250
2 & 7	5.0VAC (c)	—	6.3VAC	6.3VAC

a) *May vary from 50 to 125 volts*
b) *Measured with 20,000 ohms per volt meter*
c) *Measured between pins 2 & 8*

Safety Notice

DANGEROUS VOLTAGES EXIST IN THIS EQUIPMENT. OBSERVE THE USUAL SAFETY PRECAUTIONS WHEN OPERATING OR SERVICING THE EQUIPMENT TO AVOID SEVERE SHOCK OR INJURY.

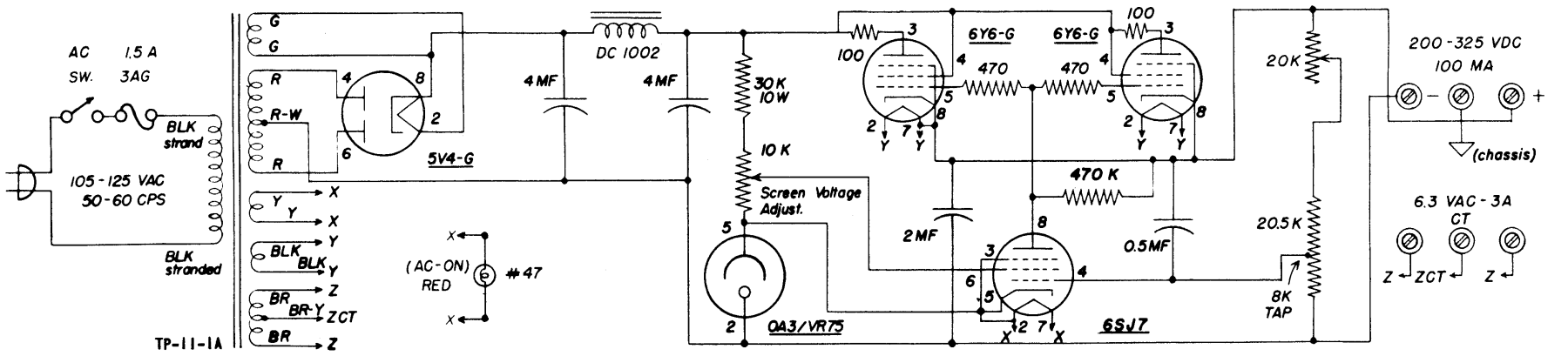


SCHEMATIC DIAGRAM

LAMBDA ELECTRONICS CORP.
CORONA, NEW YORK

MODEL 25

REGULATED POWER SUPPLY
BENCH MODEL



SCHEMATIC DIAGRAM

LAMBDA ELECTRONICS CORP.
CORONA, NEW YORK

MODEL 28

REGULATED POWER SUPPLY
RACK MODEL

NS-60-28B

W A R R A N T Y

We warrant each instrument manufactured by us, and sold by us or our authorized agents, to be free from defects in material and workmanship; our obligation under this warranty being limited to repairing or replacing any instrument or part thereof, which shall, within one year after delivery to the original purchaser, be returned to us with transportation charges prepaid, prove after our examination to be thus defective.

We reserve the right to discontinue instruments without notice, and to make modifications in design at any time without incurring any obligation to make such modifications to instruments previously sold.

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