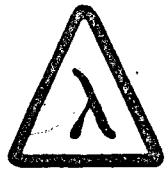
INSTRUCTION MANUAL

FOR

REGULATED POWER SUPPLY

MODELS 32, 32-C AND 34



Manufactured By

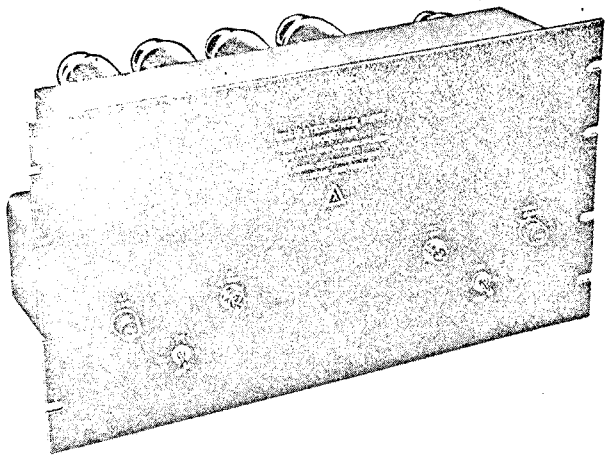
LAMBDA ELECTRONICS CORP.

COLLEGE POINT, NEW YORK

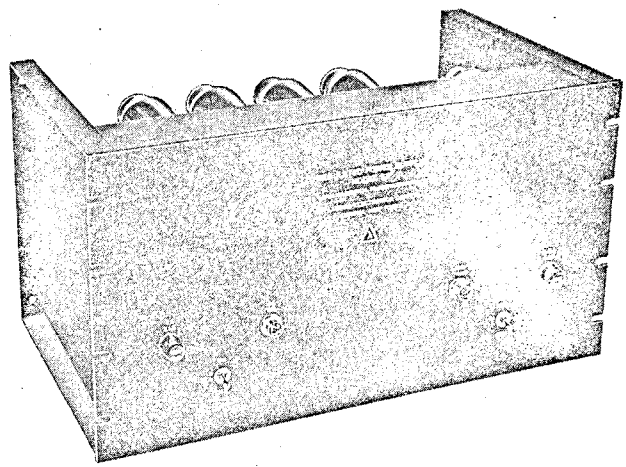
Model No. .....

Serial No. .....

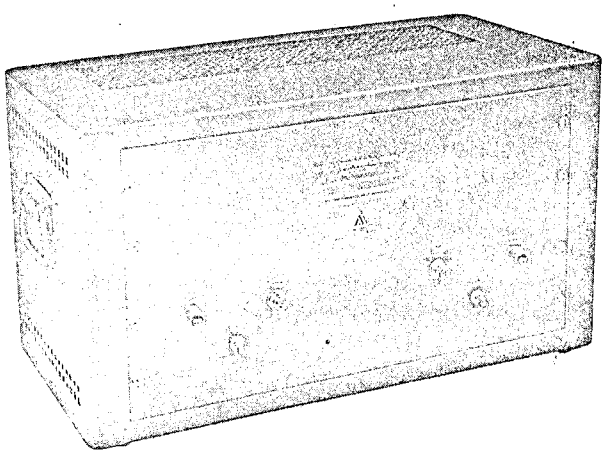
MCB-50-101-H-A



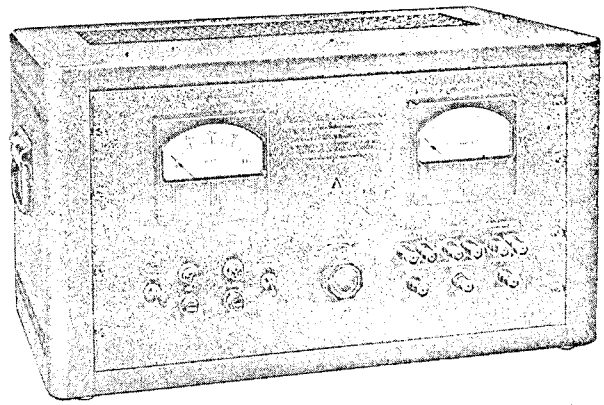
Model 32



Model 32 is supplied mounted in sturdy, removable steel side brackets. These brackets serve as protective supports during shipment. They also serve as convenient supports for occasional or temporary bench use of Model 32. The side brackets are removed when Model 32 is mounted into a rack.



Model 32-C



Model 34

INSTRUCTION MANUAL
for
Regulated Power Supply
Models 32, 32-C and 34

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 32 Compact heavy duty unit for mounting in standard 19" relay racks. Designed for use with associated equipment in permanent or semi-permanent installations. Removable end support brackets permit temporary use on the laboratory bench.

Model 32-C Model 32 (above) mounted in a specially designed compact cabinet for bench use.

Model 34 Heavy duty bench model. Two 4" panel meters for output voltage and current, front panel binding posts, rear access output terminals, panel controls, and a specially designed compact cabinet provide maximum convenience and utility as a general purpose power supply.

2. Electrical Characteristics of Models 32, 32-C, 34

Input: 105-125 volts AC, 50-60 cycles, 380 watts.

DC Output: Continuously variable from 200 to 325 Volts DC regulated from 0 to 300 ma. maximum. Either the positive or the negative side of the supply may be grounded.

AC Output: Two 6.3 Volts AC center tapped winding rated at 5 amperes each (unregulated). The windings may be connected in series to supply 12.6 Volts AC at 5 amperes or in parallel to supply 6.3 Volts AC at 10 amperes.

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 4 ohms.

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

Tube Complement: 2-5R4GY rectifiers, 6-6L6G series control tubes, 6SJ7 DC amplifier, OA3/VR-75 reference voltage source.

3. Mechanical Specifications

Model 32 Standard 19" Rack Mounting
Panel Height: 10½ inches
Panel Width: 19 inches
Depth behind panel: 9 inches (End support brackets removed)
Weight: 43 pounds
Panel Finish: Black or gray (Munsell 4.5) ripple enamel

Model 32-C Cabinet Dimensions
Height: 12¼ inches
Width: 22¼ inches
Depth: 10 inches
Weight: 58 pounds
Finish: Black ripple enamel

Model 34 Cabinet Dimensions
Height: 12¼ inches
Width: 22¼ inches
Depth: 10 inches
Weight: 60 pounds
Finish: Black ripple enamel

II. Operating Instructions Models 32, 32-C, 34

MODEL 32

1. Model 32 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 indicator having a green jewel is illuminated when the switch is in the ON position. The adjacent fuseholder marked "4A 3AG" is designed for a 4 ampere type 3AG fuse.

b) The "DC ON" toggle switch is in the DC output circuit of the supply and permits the DC output to be disconnected from the output terminals 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 fuse holder marked "⅜A 8AG" is designed for a ⅜ ampere type 8AG fuse.

c) The "OUTPUT VOLTAGE CONTROL" is a screw-slot adjusting potentiometer accessible at the rear of the unit above 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 200 ma are not recommended if regulation and hum level ratings are to be maintained.

d) 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 connection is 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.

e) The AC output connections are brought out to two terminal strips marked "6.3 VAC 5A" at the rear of the unit. These terminals provide two independent sources of unregulated voltage for vacuum tube heater circuits. The center-tap of each AC output is available at the center terminal of each terminal strip and is marked "CT". The AC output terminals may be connected in series to provide 12.6 VAC at 5 amperes or in parallel to provide 6.3 VAC at 10 amperes. An AC voltmeter, should be employed to insure proper "phasing". These AC voltage sources are not connected internally to any other circuit of the power supply.

2. Placing Model 32 into Operation

NOTE: The two end support brackets fastened to each end of the chassis are designed to provide shipping protection and provide a support for the Model 32 for temporary bench use. Before installing the Model 32 into a rack, the end brackets must be removed. Each bracket is fastened to the chassis by **4 hex-head self-tapping screws.**

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) Throw the right-hand toggle switch to the "DC-ON" position. The red pilot light should be illuminated. Regulated DC voltage will be present at the rear chassis terminals so marked. Set the output voltage with an external voltmeter by means of the "OUTPUT VOLTAGE CONTROL" located above the DC output terminal strip. The power supply is now in full operating condition.

e) 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 previously set by the "OUTPUT VOLTAGE CONTROL".

3. Model 32 Fuse Protection

a) INPUT CIRCUIT. The 4 ampere 3AG fuse in the primary circuit of the power transformer is mounted on the front panel and is marked "4A 3AG". Its principal function is to offer protection against overloads or short circuits within the power supply itself.

b) DC OUTPUT CIRCUIT. The ⅜ ampere 8AG fuse in the DC output circuit is mounted on the front panel and is marked "⅜A 8AG". Its principal function is to protect the regulator section, rectifier, power transformer, and filter choke from severe overload and short-circuit conditions in the external circuit. The fuse also protects an external milliammeter if used with the Model 32.

c) AC OUTPUT CIRCUITS. A 10 ampere 3AG fuse is in each 6.3 Volt 5 ampere AC output circuit. Both fuses are located on the rear of the chassis adjacent to the "OUTPUT VOLTAGE CONTROL". Their principal function is to protect the 6.3 Volt windings against severe external overloads or short circuits.

4. Model 32 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 32 Output Impedance

The output impedance of the supply for d-c is approximately 4 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 300 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 32-C

Operating instructions for the Model 32-C are identical to those for Model 32 preceding with the one exception. Since the Model 32 is supplied in a cabinet, no end support brackets are furnished.

MODEL 34

1. Model 34 Operating Controls and Terminals

a) The "AC-ON" toggle switch is in the transformer prmiary 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 "4A 3AG" is designed for a 4 ampere type 3AG fuse.

b) The "DC-ON" toggle switch is in the DC output circuit of the supply and permits the DC output to be disconnected from the output terminals leaving the power supply in a "stand-by" position. The adjacent pilot light indicator having a red jewel is illuminated when the switch is in the ON position. The adjacent fuseholder marked "⅜A 8AG" is designed for a ⅜ ampere type 8AG fuse.

c) The "DC OUTPUT VOLTAGE" control is a wirewound rheostat on the front panel which permits the DC output voltage, as indicated on the "OUTPUT VOLTAGE" voltmeter, to be set at any value between 200 and 325 volts DC. 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. The supply may be operated in these regions but loads drawing more than 200 ma. are not recommended if regulation and hum-level ratings are to be maintained.

d) OUTPUT TERMINALS

Front Panel 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 DC output terminal pair and each of the 6.3 VAC output terminal pairs are spaced on ¾ inch centers so that they will accept standard double banana plugs.

Rear Chassis Terminals. The output terminals on the rear of the chassis are available through the rear access door of the cabinet. They consist of three, screw-type terminal strips interconnected with the binding posts on the front panel to provide access to the output voltages of the supply at the back of the equipment if desired.

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 on the panel, and the screw terminal marked "plus" on the rear chassis terminal strip. The negative connection is brought out through the black binding post on the panel, and the screw terminal marked "minus" on the rear chassis terminal strip.

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 connection is to be at ground potential the appropriate terminal on the panel should be connected by means of a jumper wire to the binding post marked "CHASSIS GND". When connections are made to the rear chassis terminals, the appropriate terminal on the DC output terminal strip should be connected by means of a jumper wire to the center terminal of the DC output strip marked with the schematic symbol for "ground".

AC Output Connections. The AC output connections marked "6.3 VAC 5A" provide two independent sources of unregulated voltage for vacuum tube heater circuits. The center-tap of each AC output is available at the binding post marked "CT" on the front panel, or the center terminal marked "CT" of the rear chassis terminal strips. The AC output terminals may be connected in series to provide 12.6 VAC at 5 amperes or in parallel to provide 6.3 VAC at 10 amperes. When the AC output voltages are connected in series or in parallel; or both panel and rear chassis terminals are used simultaneously, an AC voltmeter should be employed to insure proper "phasing" and to avoid short circuits.

2. Placing Model 34 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 front panel binding posts and the rear chassis 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) Throw the right-hand toggle switch to the "DC ON" position. Regulated DC voltage will be present at the front-panel binding posts and the rear-chassis terminals so marked, and will be indicated on the DC voltmeter marked "OUTPUT VOLTAGE". Set the "DC OUTPUT VOLTAGE" control to the desired voltage. The power supply is now in full operating condition. The external load current drain will be indicated on the DC milliameter marked "OUTPUT CURRENT".

e) 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 standy 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 previously set by the "DC OUTPUT VOLTAGE" control.

3. Model 34 Fuse Protection

See "Model 32 Fuse Protection" notes above.

4. Model 34 Noise and Ripple Output

See "Model 32 Noise and Ripple Output" notes above.

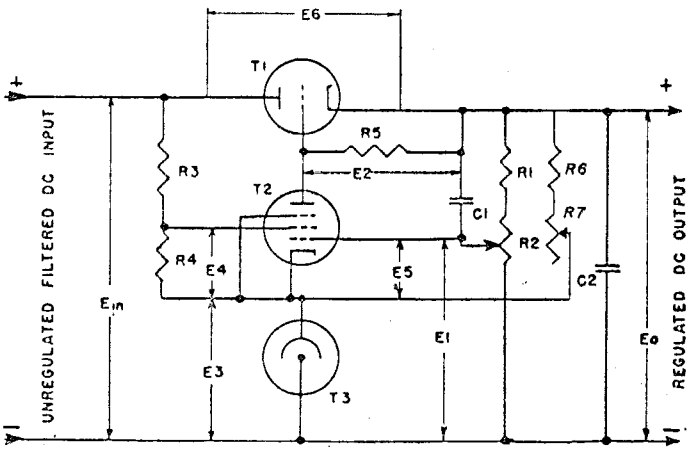
5. Model 34 Output Impedance

See "Model 32 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 Models 32, 32-C and 34 regulated power supplies is set at the factory so that at an Eo of 250 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.

The network R6, R7 serves to provide the proper operating current for the voltage regulator tube T3. In the Models 32, 32-C and 34, R7 is made variable and ganged with R2 to maintain essentially constant current through T3 regardless of the value of Eo.

IV. Maintenance Models 32, 32-C, 34

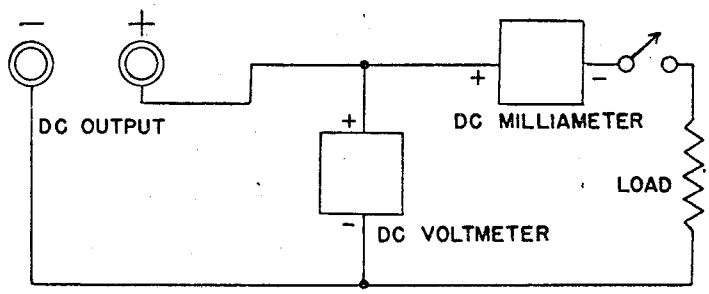
Under normal conditions no special maintenance of the Models 32, 32-C and 34 power supplies is required except for occasional tube replacement.

1. Models 32, 32-C and 34 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 32, 32-C Operational Check

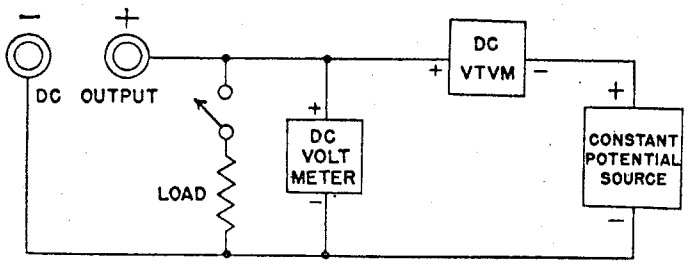


RAPID CHECK SETUP

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 of at least 300 volts (usually a 0-500 VDC meter or preferably a multi-range meter), a 0-300 ma DC milliameter (optional), and a load resistance capable of loading the supply to 300 ma and capable of dissipating the appropriate amount of heat, e. g. 830 ohms 75 watt at an output voltage of 250 VDC.

Allow the supply to warm up for a few minutes. Adjust the "OUTPUT VOLTAGE CONTROL" so that the voltmeter reads 250 VDC. Connect the load resistor. The milliameter should read 300 ma. While carefully 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. The "SCREEN ADJUSTMENT" 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.



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 300 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 later 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 34 Operational Check and Recalibration Procedure

The procedure outlined in paragraph 2 above for Models 32 and 32-C are generally applicable to Model 34 except that voltage and current meters are available on the unit. The following additional check should be made *after* the procedures outlined in paragraph 2 are completed.

Turn the "DC OUTPUT VOLTAGE" control to its full clockwise position. Note the reading on the "OUTPUT VOLTAGE" meter. If it is not within plus or minus 10 volts of 350 volts, adjust the "RANGE SET" control on the rear of the chassis above the terminal strips until the meter reads 350 volts. Secure the control shaft in position with a drop of Duco or Glyptal cement.

4. Miscellaneous Maintenance Notes Models 32, 32-C and 34

a) An additional schematic diagram for Models 32, 32-C and 34 will be found on the inside surface of the panel.

b) 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.

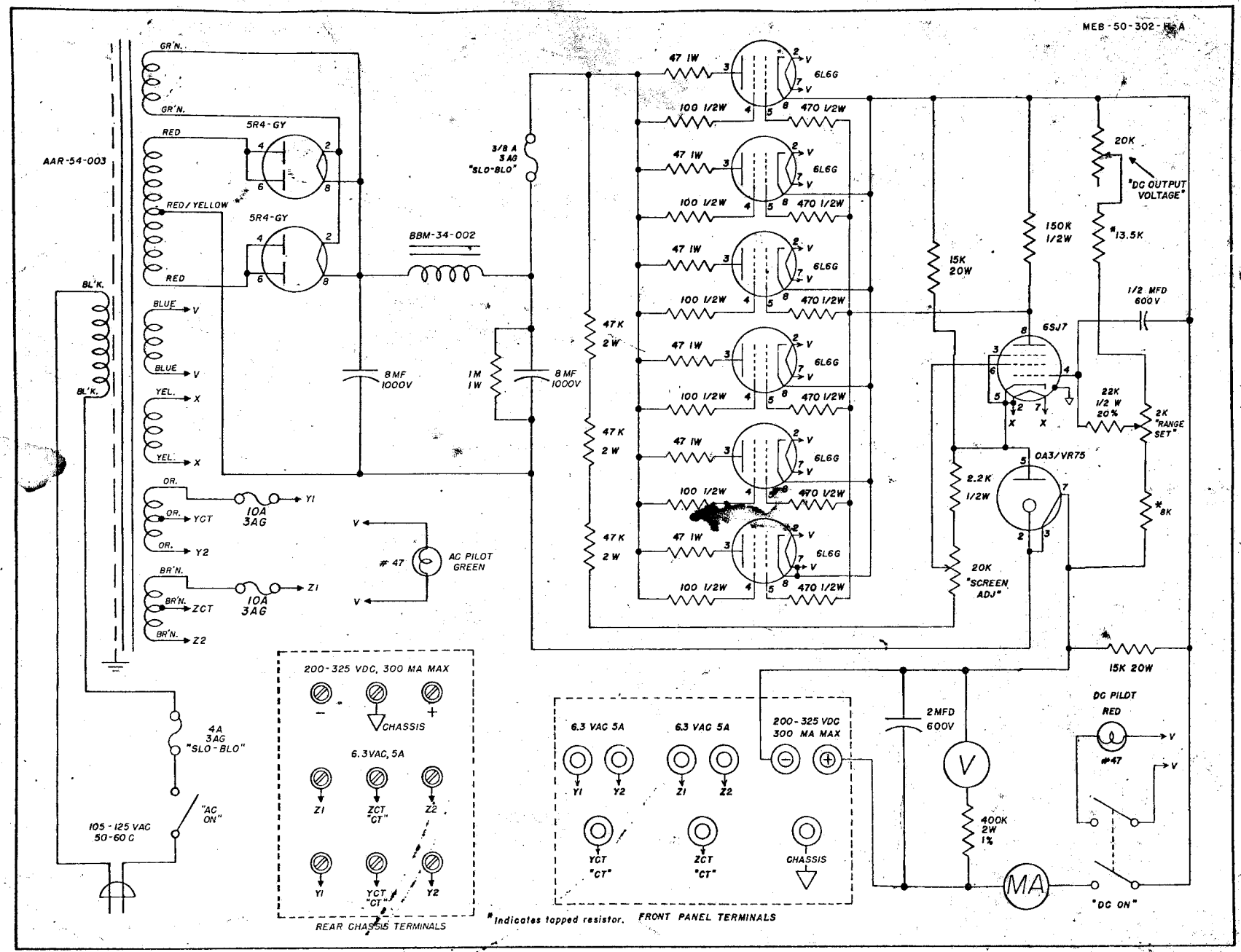
c) The fuse holders are of the finger-grip extractor type, permitting easy replacement of the fuses from the front.

5. Voltage Table Models 32, 32-C, 34

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

Pin Number	5R4GY (Either)	OA3/VR75	6SJ7	6L6G (Any)
1	—	—	0	—
2	750	0	77	250
3	—	0	77	745
4	550VAC	—	73	745
5	—	77	77	175
6	550VAC	—	120 (a)	175
7	—	0	77	250
8	750	—	175	250
2 & 7	—	—	6.3VAC	6.3VAC
2 & 8	5.0VAC	—	—	—

a) May vary from 90 to 150 volts



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COLLEGE POINT, NEW YORK

REGULATED POWER SUPPLY
MODEL 34