

711A POWER SUPPLY

OPERATING AND SERVICE MANUAL



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OPERATING AND SERVICE MANUAL

(HP PART NO. 00711-90001)

MODEL 711A
POWER SUPPLY

SERIALS PREFIXED: 102-

Appendix C, Manual Backdating Changes,
adapts this manual to instruments with
serial numbers other than those prefixed
102-

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-hp- Model 711A Power Supply

SPECIFICATIONS

OUTPUT VOLTAGES:

DC Regulated High Voltage: 0 to 500 volts (without switching), 100 ma maximum load.

AC Unregulated: 6.3 volts, 6 amps maximum load; 12.6 volts center tap, 3 amps maximum load.

REGULATION: For line voltage 115/230 volts $\pm 10\%$, less than 0.5% change or 1.0 volt change, whichever is greater; from no load to full load, change of less than 0.5% or 1.0 volt (whichever is greater).

RIPPLE: Less than 1.0 mv.

METERING:

Current Meter: 0 to 100 ma; 0 to 10 ma with pushbutton.

Voltage Meter: 0 to +500 volts; 0 to +50 volts with pushbutton.

TERMINALS: Either positive or negative dc regulated high voltage terminal may be grounded.

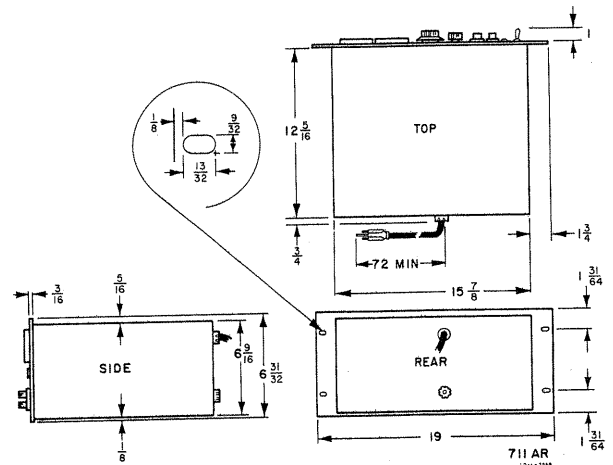
OVERLOAD PROTECTION: Ac line fused. Overload relay prevents dc output from greatly exceeding current rating of output milliammeter thus protecting instrument from overload conditions including short circuit output.

POWER: 115/230 volts $\pm 10\%$, 50-1000 cps. Approximately 145 watts depending on load and line voltage.

SIZE:

Cabinet Mount: 7-3/8 inches wide, 11-1/2 inches high, 14-1/4 inches deep.

Rack Mount:



WEIGHT:

Cabinet Mount: Net, 20 lbs, shipping 26 lbs.

Rack Mount: Net, 24 lbs, shipping 35 lbs.

SECTION I GENERAL DESCRIPTION

CAUTION

- - Dangerous voltages are present at the terminals and within this instrument - -

1-1 GENERAL DESCRIPTION

The Model 711A Power Supply is a general-purpose low-power dc and ac voltage supply particularly suited to powering experimental setups.

By means of the facilities provided by the Model 711A the following voltages are made available at the output terminals on the control panel:

Unregulated ac:

- 6.3 volts, 3 amperes maximum load current (two supplies) or
- 6.3 volts, 6 amperes maximum load current (one supply) or
- 12.6 volts, 3 amperes maximum load current (one supply, tapped at 6.3V).

Regulated dc:

- 0 to 500 volts, continuously variable; maximum output load current, 100 ma.

NOTE: Insulation within the Model 711A permits operating the dc output voltage as much as 500 volts from chassis ground so that two Model 711A Power Supplies may be operated in series to obtain 1000 volts dc output while each instrument chassis remains at ground potential.

The dc output of the Model 711A has high stability; for line voltage variations within rated limits, the

level of the regulated output will vary less than 0.5% or 1 volt (whichever is greater), and from no load to full load the level of the output will vary less than 0.5% or 1 volt (whichever is greater). Ripple will be less than 0.001 volt.

While the internal impedance of the Model 711A will vary both with the dc load current and the frequency of any reflections from the equipment being powered, the internal impedance of the Model 711A will be less than 10 ohms with any load current and at any frequency up to a few megacycles.

The dc output is continuously monitored by two meters, a voltmeter and a milliammeter. A low and high range are provided for each meter so that low values of voltage and current may be read accurately.

The power supply is protected from input or output overload by (1) a fuse in the line-voltage input circuit and (2) a relay, in the main positive bus, which operates at overload current to interrupt conduction through the regulator.

1-2 INSPECTION

This instrument was thoroughly tested and inspected before being shipped, and is ready for use when received.

After the instrument is unpacked, it should be inspected carefully for damage received in transit. If any shipping damage is found, see the warranty on the inside front cover of this manual.

1-3 POWER CABLE

The three-conductor power cable supplied with this instrument is terminated in a polarized three-prong male connector recommended by the National Electrical Manufacturers' Association. The third contact is an offset round pin added to a standard two-blade connector which grounds the instrument chassis when used with an appropriate receptacle. To use this connector with a standard two contact receptacle, an adapter should be used to connect the NEMA connector to the two-contact system. When the adapter is used, the third contact is terminated in a short lead from the adapter which can then be connected to the outlet mounting box in order to ground the instrument chassis.

1-4 230-VOLT OPERATION

This instrument is normally shipped from the factory with the dual 115 volt primary windings of the transformer connected in parallel for operation from a nominal 115 volt source. If operation from a nominal 230 volt source is desired, the windings may easily be reconnected in series.

Refer to the schematic drawing for details.

The power fuse (F1) must be changed from a 1.6 ampere slow-blow fuse to a 0.8 ampere slow-blow fuse.

SECTION II

OPERATING INSTRUCTIONS

2-1 CONTROLS AND TERMINALS

All controls and terminals except the fuseholder are mounted on the front panel. The fuseholder is mounted on the rear plate of the instrument.

Voltmeter -

This single-scale, two-range (0 to 500 volts; 0 to 50 volts) voltmeter indicates the voltage level at the output of the main regulator. With the DC VOLTAGE switch at ON, the level of voltage at the DC VOLTAGE output terminals is indicated by the voltmeter. Normally the meter indicates on the 0 to 500 volt range; with the 50 VOLTS FULL SCALE pushbutton depressed, the meter indicates on the 0 to 50 volt range.

Milliammeter -

This single-scale, two-range (0 to 100 milliamperes; 0 to 10 ma) milliammeter indicates the value of the dc load current. Up to 100 ma can flow in the load circuit without overloading the milliammeter. Normally the meter indicates on the 0 to 100 ma range; with the 10 MA FULL SCALE pushbutton depressed, the meter indicates on the 0 to 10 ma range.

50 VOLTS FULL SCALE -

When operated (depressed), this SPDT pushbutton opens the high-range series multiplier resistor and inserts the low-range multiplier.

10 MA FULL SCALE -

This pushbutton, which is connected for DPST operation, controls the proportion of current diverted by the respective shunts across (1) the milliammeter and (2) the protective relay in series with the milliammeter. When the 10 MA FULL SCALE pushbutton is depressed, the protective relay operates at between 11 and 17 ma to interrupt conduction through the regulator and thereby to interrupt the flow of current through the milliammeter.

With pushbutton at normal, the protective relay operates at between 110 and 170 ma.

D. C. VOLTS ADJ.

Adjustment of the regulated dc voltage to the desired level is by means of the FINE and COARSE control mounted under the D. C. VOLTS ADJ. designation. The level of voltage obtained at any given setting of the controls is indicated by the voltmeter, and the resulting flow of current in the load circuit is indicated by the milliammeter.

COARSE -

Operation of the COARSE control (1) adjusts the setting of a 1-megohm variable resistor, R11, and (2) operates two microswitches, S1A and S1B.

a. Variable resistor R11 is part of the voltage divider in the circuit which controls the level of the regulated dc output voltage.

b. The microswitches make connection to various taps on the power transformer secondary winding which furnishes voltage for the main dc supply circuit. At the low-voltage position (ccw) of the COARSE control, the main dc supply circuit is fed by the low-voltage section of the winding. As the control is turned cw, the microswitches are actuated to complete connection to the higher voltage taps.

FINE -

Operation of the FINE control varies the setting of variable resistor R12. This resistor also is part of the voltage divider in the circuit which controls the level of the regulated dc output voltage.

Indicator Lights -

There are two indicator lights on the control panel:

AC VOLTAGE - This red indicator light glows to indicate that power is applied to the instrument circuits.

DC VOLTAGE - The operating circuit of this indicator light is controlled by the DC VOLTAGE switch, and the light glows red when the switch is at ON to indicate that voltage is applied to the DC VOLTAGE output terminals.

AC VOLTAGE Switch -

This SPST toggle switch is in the primary circuit of the power transformer. With the AC VOLTAGE switch at ON, line voltage is connected to power transformer T1.

DC VOLTAGE Switch -

There is no voltage on the DC VOLTAGE output terminals until the DC VOLTAGE switch is at the ON position. When operated, this DPST toggle switch: (1) connects the positive dc bus to the DC VOLTAGE output terminals and (2) closes the circuit to the DC VOLTAGE indicator light.

Output Terminals -

Both the AC VOLTAGE and DC VOLTAGE output terminals are of the binding-post type, will accommodate either a banana plug or wire, and are so arranged that banana plugs with 3/4-inch spacing may be used.

AC VOLTAGE -

There are two pairs of output terminals associated with the ac voltage supply. Depending on how the terminal connections are made (see paragraph 2-3), the Model 711A may be arranged to supply the following ac voltages:

- 6.3 volts at 3 amperes (two circuits), or
- 6.3 volts at 6 amperes (one circuit), or
- 12.6 volts at 3 amperes (one circuit, tapped at 6.3 V).

DC VOLTAGE -

There is one pair of output terminals for the regulated dc voltage supply: + and -. The binding-post nuts for the + and - terminals are insulated. Neither the + nor the - terminal is connected to the chassis within the instrument so that the dc supply may be operated either above or below ground by appropriate external connection to ground.

On the same mounting plate with the + and - terminals is a terminal (G) which is connected to the instrument chassis. The G terminal is connected to earth ground when the power-cable connector is plugged into a grounded female connector.

FUSE -

The fuseholder, which is mounted on the rear plate of the instrument, contains the time-delay cartridge fuse which protects the input circuit. Before starting to install a new fuse, check that the power cable is disconnected from the line. Replacement fuses must be of the slow-blow type: 1.6-ampere fuse for 115-volt operation or a 0.8-ampere fuse for 230-volt operation.

2-2 OPERATING PROCEDURE

Be sure the Model 711A is so placed that nothing can obstruct the ventilating louvers in the sides of the cabinet. Safe operating temperatures with the cabinet depend upon free air flow through the louvers.

- a. Before operating the instrument for the first time, see paragraph 4-7, Meter Zero Adjustment.

NOTE: If the Model 711A is to be operated from a 230-volt source, check (1) that power transformer T1 is strapped for 230-volt operation (strapping options are shown on the schematic diagram), and (2) that fuse F1 is a 0.8-ampere slow-blow fuse. See paragraph 4-8.

- b. Check that both the AC VOLTAGE and DC VOLTAGE switches are in the off position. After the Model 711A has been plugged into a power source of specified voltage and frequency, turn the AC VOLTAGE switch to ON, and allow a two-minute warmup period.

With the DC VOLTAGE switch still in the off position, connect the load. For connection arrangements for the various options, see paragraph 2-3.

- c. Check that the COARSE control is in its maximum counterclockwise (low-voltage) position. Turn the DC VOLTAGE switch to ON.

- d. To obtain the desired level of dc voltage, adjust the COARSE and FINE controls. The voltmeter indicates the level of the dc voltage being supplied to the + and - output terminals. If the level of the dc supply is below 50 volts, the voltmeter may be operated on the 50-volt range by depressing the 50 VOLTS FULL SCALE pushbutton during the voltage adjustment procedure.

2-3 OUTPUT OPTIONS

AC Options - (Figure 2-1)

The ac supply may be arranged for any one of three options:

Two 6.3-volt, 3-ampere supplies (Figure 2-1A)

One 6.3-volt, 6-ampere supply, by connecting the two 6.3-volt supplies in parallel (Figure 2-1B)

One 12.6-volt, 3-ampere supply, by connecting the two 6.3-volt supplies in series (Figure 2-1C)

DC Options -

Among the operating options for which the dc voltage supply terminations may be arranged are the following:

0 to 500 volts, positive or negative with respect to chassis ground.

0 to 500 volts, neither side grounded. (It is recommended that the instrument chassis be grounded whenever both d-c terminals are operated at a potential above or below ground.)

Up to 1000 volts, by connecting two Model 711A's in series.

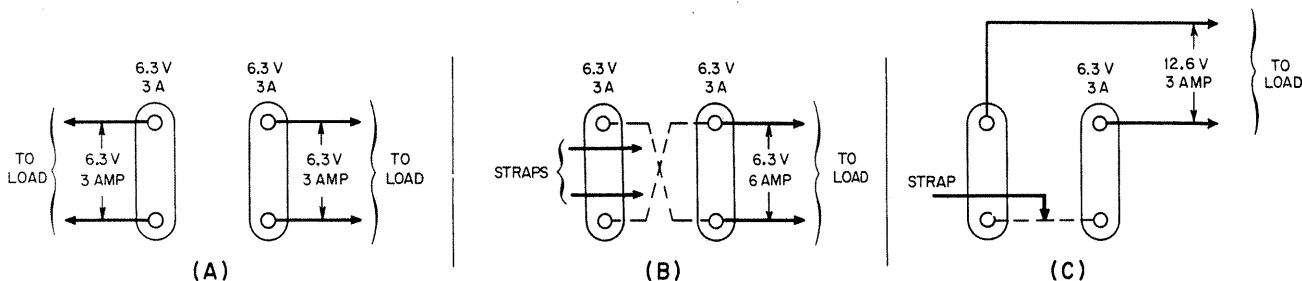


Figure 2-1. Model 711A Connection Arrangements for AC Supply Options

NOTES

SECTION III CIRCUIT DESCRIPTION

3-1 GENERAL DESCRIPTION

The Model 711A Power Supply furnishes a regulated variable dc voltage (HV supply) and an unregulated ac voltage. Regulation of the HV supply is obtained by means of a main regulator, which regulates the voltage supplied to the DC VOLTAGE output terminals, and a secondary regulator which regulates the voltage which supplies the reference voltage and most of the operating potentials for the regulator circuits. Arrangement of the main components of the dc supply circuit is indicated in block diagram form in Figure 3-1, and detailed circuitry of the Model 711A is shown in the schematic diagram, Figure 4-8.

On the schematic, Figure 4-8, and the Voltage and Resistance Diagram, Figure 4-7, voltages shown for the main series regulator, main control tube, cathode follower, secondary regulator (V3A and V3B) and secondary regulator voltage supply are with reference to chassis ground (\perp). The

reference voltage bus, shown on schematic is approximately 200 volts negative with respect to the main negative bus.

Power from an external source is applied to the Model 711A through power transformer T1. Voltage for the HV supply is taken from a T1 secondary winding which is tapped for various output voltages and, by means of connections through microswitches operated by the COARSE control, provides an input which is variable (paragraph 3-4b). Voltage from the tapped secondary feeds selenium rectifiers CR2, CR3, and capacitors C2, C3 connected as a voltage doubler.

From the doubler, the positive bus is brought through the winding of overload relay K1 (para. 3-5), the series regulator, V1 and V2 (para. 3-3), the DC VOLTAGE switch, and the milliammeter, to the DC VOLTAGE + output terminal. The voltmeter is connected across the main positive and negative busses. With the output circuit so arranged, there is continuous

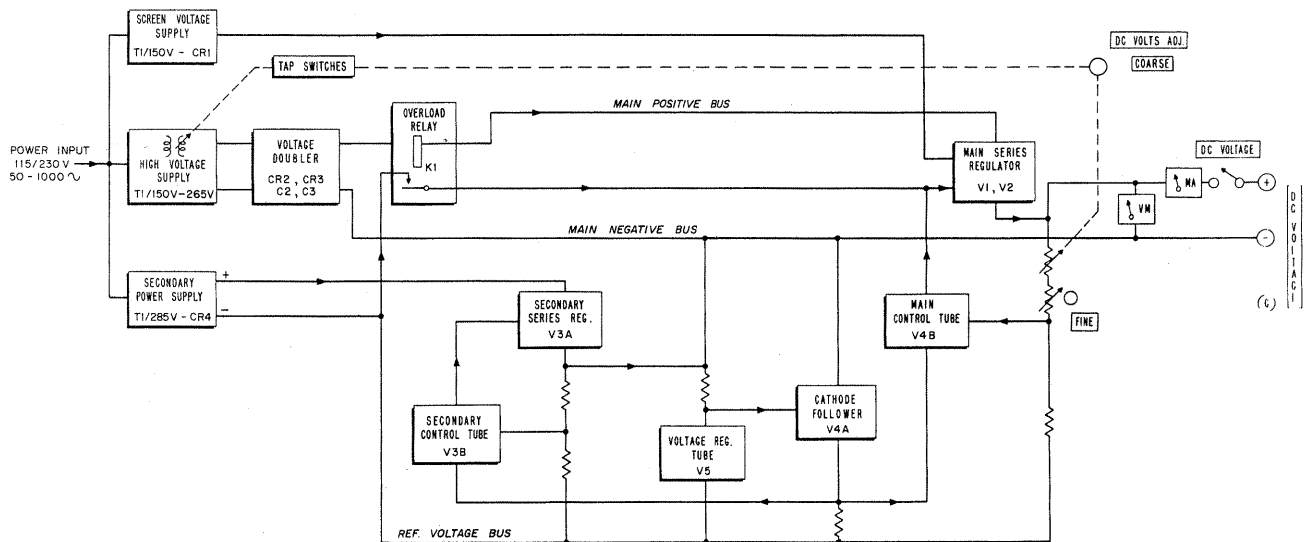


Figure 3-1. Model 711A Power Supply Block Diagram

indication of the level of the voltage between the DC VOLTAGE + and - output terminals and of current flow through the load. The Model 711A circuit is discussed in greater detail in the following paragraphs.

3-2 INPUT

Line voltage is applied to the primary of power transformer T1 through fuse F1 and AC VOLTAGE switch S5. To accommodate operation from either a 115-volt or a 230-volt source, the primary of transformer T1 is arranged in two sections. For operation from a 115-volt source the two sections are strapped in parallel, and for operation from a 230-volt source, the sections are strapped in series. The schematic diagram shows the primary windings strapped for 115-volt operation, the standard factory strapping.

Indicator light DS1 is connected across one of the filament windings of transformer T1 to give indication as soon as the transformer is energized.

3-3 REGULATION

Regulation of the Model 711A dc output voltage is obtained by using two electronic regulators which are designated main and secondary in the following

discussion. The cathodes of the control tubes are maintained at a constant level by a voltage-reference tube/cathode follower combination, a circuit designed to accommodate the current through the cathodes of both control tubes. The regulator circuits are shown in Figure 3-2, a partial schematic.

a. **Main Regulator** - The control tube of the main regulator compares a sample of the output voltage with a reference voltage, and any difference between the two results in a compensating adjustment in the amount of resistance inserted in series with the main positive bus.

Pentode V4B is the control tube and the series regulator is pentodes V1 and V2 connected in parallel. A portion of the output voltage, sampled with respect to the reference voltage bus, is applied to the grid of control tube V4B, the cathode of which is held at a constant potential. The plate of V4B is tied to the grids of the series regulator tubes. With the circuit so arranged, any rise or drop in the level of the output voltage will cause a change in the potential on the grid of the control tube, and also will result in a change (in the reverse direction) in the potential on the grids of the series regulator tubes. By means of this circuitry, the series regulator becomes a variable resistance which is electronically actuated to increase or decrease as required to maintain the output voltage at a constant level.

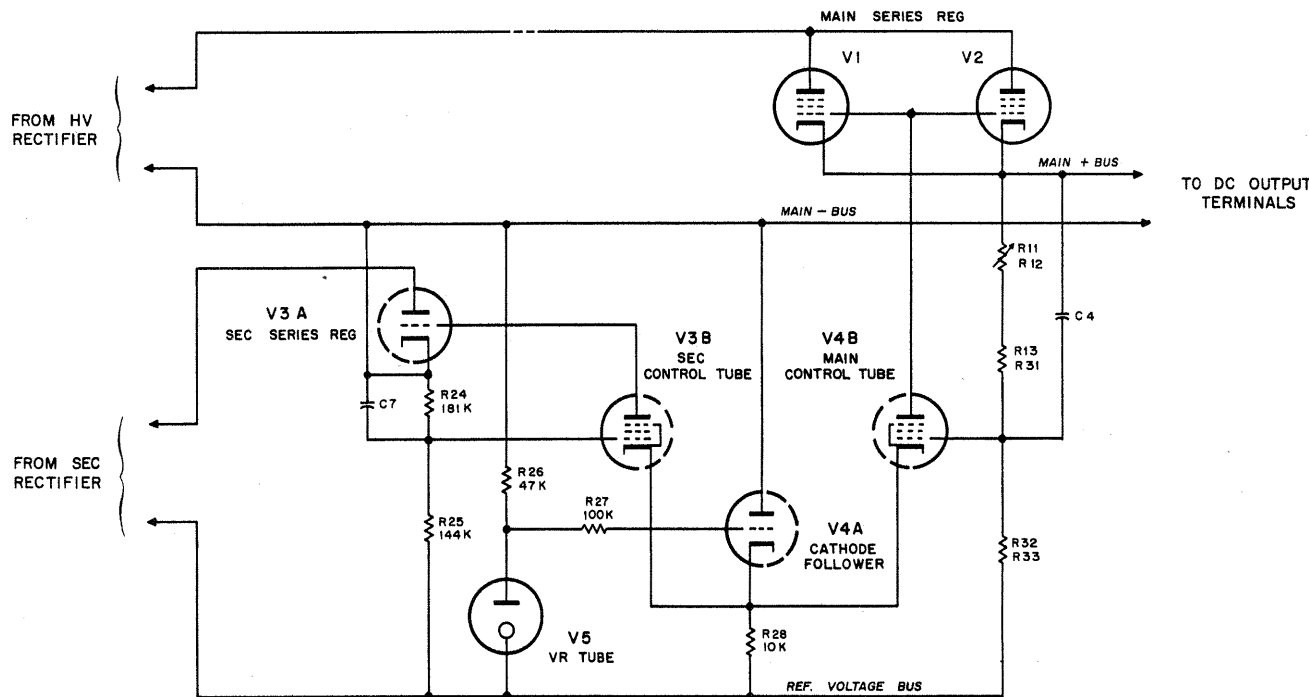


Figure 3-2. Model 711A Main and Secondary Regulator Circuits Partial Schematic

For example, if there is a drop in the level of the dc output voltage, the potential on the grid of control tube V4B becomes more negative by comparison with the reference voltage on the V4B cathode, and conduction in V4B will be cut down. As a result, the potential on the plate of V4B and on the grids of series regulator tubes V1 and V2 will rise. As conduction through V1 and V2 increases, their plate resistances drop, with a resulting decrease in the voltage drop across the series regulator and rise in the level of the dc output voltage.

The voltage divider through which the output voltage is sampled is discussed in paragraph 3-4, below.

Any ripple in the output voltage is coupled by capacitor C4 to the grid of control tube V4B.

The pentode connection for beam power amplifiers V1 and V2 gives a series regulator which furnishes high gain at moderate power cost. The separate screen voltage supply for V1 and V2 is fed by rectifier CR1 connected across the 150-volt secondary winding of transformer T1.

b. Secondary Regulator - To regulate the low end of the 0 to 500 volt range, potentials applied to the electrodes of the main control tube must be negative with respect to the main negative bus. The secondary regulator, fed by the 285-volt secondary winding of transformer T1 and full-wave selenium rectifier CR4, is arranged to provide this supply of regulated negative voltage. In conjunction with the voltage-reference tube/cathode follower combination (see paragraph c, below), the secondary regulator also provides the reference voltage for the Model 711A circuits.

The circuit of the secondary regulator is similar to and functions in the same manner as the main regulator. Triode V3A is the series regulator and is in series with the positive side of the secondary power supply. Pentode V3B is the control tube; its cathode is held at a constant potential, a portion of the output voltage is applied to its grid, and its plate is tied to the grid of series regulator V3A. The output voltage is sampled with respect to the reference-voltage bus by a voltage divider which consists of precision resistors R24 and R25. The values selected for R24 and R25 are such that the level of the reference-voltage bus is established at approximately 200 volts below that of the main negative bus. Any ripple in the output is coupled to the grid of V3B by capacitor C7.

c. Reference-Voltage Supply for Control Tube Cathodes - The amount of current through the cathodes of control tubes V3B and V4B is greater than the current capacity of voltage-reference tube V5. Therefore a voltage-reference tube/cathode

follower combination is used to maintain the potential on the cathodes of the control tubes at a constant level.

Arrangement of the reference-voltage supply for the control tube cathodes is indicated in Figure 3-2. The cathode circuits of the control tubes and the cathode follower are connected to the reference-voltage bus through a common resistor, 10,000-ohm R28, and therefore a change in the amount of current through the cathode of one tube also will effect a change in the potential on the cathode of the other control tube and the cathode follower. However, by connecting the grid of cathode follower V4A to voltage-reference tube V5, the V4A grid is maintained at a constant potential, and thus a change in the V4A cathode potential causes such change in V4A conduction that the IR drop across R28 is maintained at a constant value.

For example, if the potential on the grid of main control tube V4B goes negative, conduction in V4B will be cut down, the drop across R28 will be less, and cathode potential will drop. Since the grid of V4A is held at a constant potential and the potential on its cathode is now more negative, there is less difference in potential between grid and cathode, and V4A conduction will increase. The increase in current through the V4A cathode will compensate for the decrease in current through the V4B cathode, the drop across R28 will be returned to proper value, and potential on the cathode of each control tube will be maintained at a constant level regardless of changes in the amount of current flowing through the tube.

3-4 SETTING OF OUTPUT VOLTAGE LEVEL

a. General - The level of the dc output voltage may be varied from 0 to 500 volts by adjusting the level of the potential applied to the grid of main control tube V4B. This adjustment is obtained by operation of the COARSE and FINE controls.

If the HV supply input were the same for all outputs from 0 to 500 volts, the excessive power dissipated in the series regulator tubes would shorten their life. Therefore the design of the Model 711A includes a variable input for the HV supply.

The required variation in HV input is obtained by operation of the COARSE control.

The arrangement of (1) the variable input and (2) the voltage divider through which potential is applied to the grid of main control tube V4B are discussed in the following paragraphs.

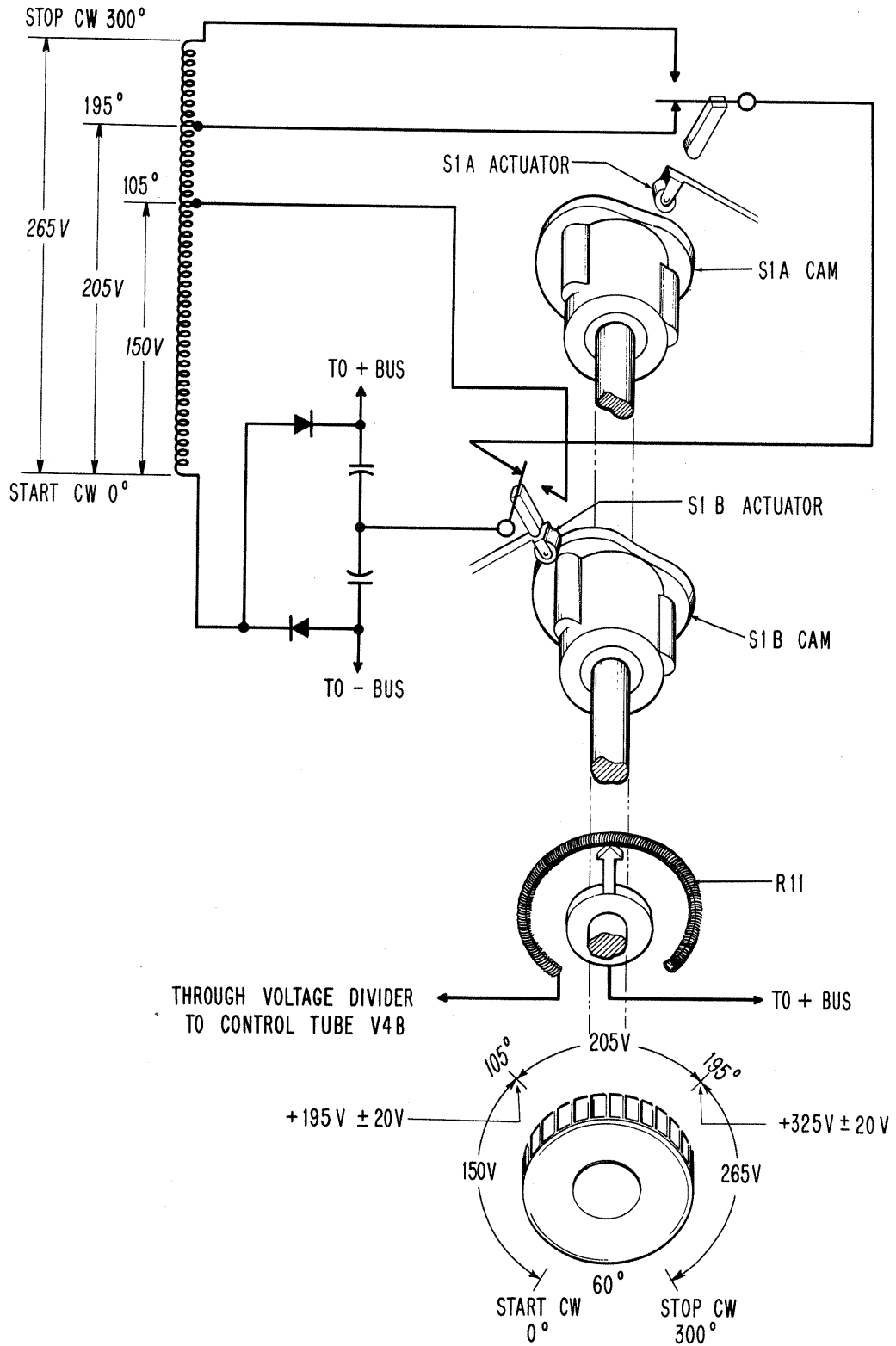


Figure 3-3. Model 711A Arrangement of Tap Switch Actuators and Cams on COARSE Control Shaft FINE Control (not shown) at Electrical Center

b. Tap Switching Arrangement, HV Supply -

The T1 secondary winding which feeds the high-voltage supply is tapped for 150, 205, and 265 volts, and the taps are brought out to contacts on two snap-action, cam-actuated, SPDT microswitches, S1A and S1B. So that S1B will operate before S1A, and will be held operated during the time S1A is operated, the periphery of the high side of the S1B cam is made longer than the periphery of the high side of the S1A cam. Both cams are mounted on an extension of the shaft of the COARSE control. Arrangement of the COARSE control shaft, the cams and switch actuators, the switch contacts, and connections to the tapped winding of T1 are indicated in Figure 3-3.

Through approximately 105° of COARSE control travel, the low side of each cam is toward its respective switch actuator, therefore neither switch is operated, and the voltage-doubler connection is to the 150-volt tap on the transformer secondary winding. In this condition of the circuit (shown on the schematic) with both switches at normal, the level of the voltage doubler output will be approximately 400 volts.

For the next approximately 90° of control travel, the high side of the S1B cam is engaging the S1B actuator, and operated S1B completes connection to the 205-volt tap. In this condition (indicated in Figure 3-3), with S1B operated and S1A at normal, the level at the voltage doubler output will be approximately 560 volts. With the FINE control set at electrical center, at the point of change-over from the 150-volt to the 205-volt connection, the panel voltmeter indication will be approximately 195 volts.

Through the remaining travel of the COARSE control, the high side of the S1A cam is engaging the S1A actuator and, with both switches operated, connection is completed to the 265-volt tap. In this condition of the supply circuit, the level at the output of the voltage doubler will be approximately 715 volts. With the FINE control set at electrical center, at the point of change-over from the 205 volt to the 265 volt tap, the panel voltmeter indication will be approximately 325 volts.

c. Main Control Tube - The potential on the grid of main control tube V4B is applied through a voltage divider which is connected between the main positive bus and the reference-voltage bus. The divider includes four variable resistors, two of which (R31 and R33) are adjusted at the factory and for

the purposes of this discussion, therefore, may be considered fixed. Adjustments for the other two variables (R11 and R12) are brought out to the front panel as the COARSE and FINE controls. The magnitude of the potential on the control tube grid, therefore, varies not only with the level of the voltage on the main positive bus but also with the amount of resistance in the variable arm of the voltage divider, as fixed by the setting of the COARSE control and, to a lesser extent, of the FINE control.

As explained in paragraph 3-3, the level of the dc output voltage is increased or decreased as the potential on the grid of V4B becomes more negative or more positive with respect to the reference voltage on the V4B cathode.

If it is necessary to replace control tube V3B or V4B, and after tube replacement it is not possible to get rated output, it is probable that the setting of R31 and R33 will require readjustment. Procedure for adjusting R31 and R33 after tube replacement is given in paragraph 4-3C.

3-5 OVERLOAD RELAY

To protect the milliammeter, the Model 711A circuit is so arranged that if current flow in the main positive bus reaches a value that can damage the meter, a high negative voltage will be applied to the grids of the series regulator tubes. Arrangement of the circuit which protects the milliammeter is shown in Figure 3-4, a partial schematic.

Overload relay K1 is equipped with a set of make-break contacts: the make contact is connected to the reference-voltage bus, and the movable member is tied to the grids of the series regulator tubes; the break contact is unconnected, the positive bus is brought through the winding of relay K1. The operating circuit of K1 is so designed that until the current in its winding reaches such value that the meter can be damaged, relay K1 remains unoperated. At meter-overload value (approximately 180 ma), however, relay K1 operates and, through its make contacts, applies approximately -200 volts to the grids of V1 and V2. Cut off of the series regulator tubes opens (1) the circuit to the meter and (2) the operating circuit of K1. With the restoration of K1, the high negative potential on the grids of V1 and V2 is removed, and normal conduction through the series regulator is resumed. As long as overload current is flowing, however, relay K1 will continue to oper-

ate intermittently, interrupting conduction through the series regulator until the overload condition is corrected.

Operation of the 10 MA FULL SCALE switch opens the approximately 82 ohms(150 ohms and 180 ohms,

in parallel) arm of the shunt across the winding of relay K1. This effectively increases the resistance of the shunt, a greater proportion of current therefore will flow through the winding of relay K1, and K1 operates when current flow in the main positive bus is between approximately 12 and 18 ma.

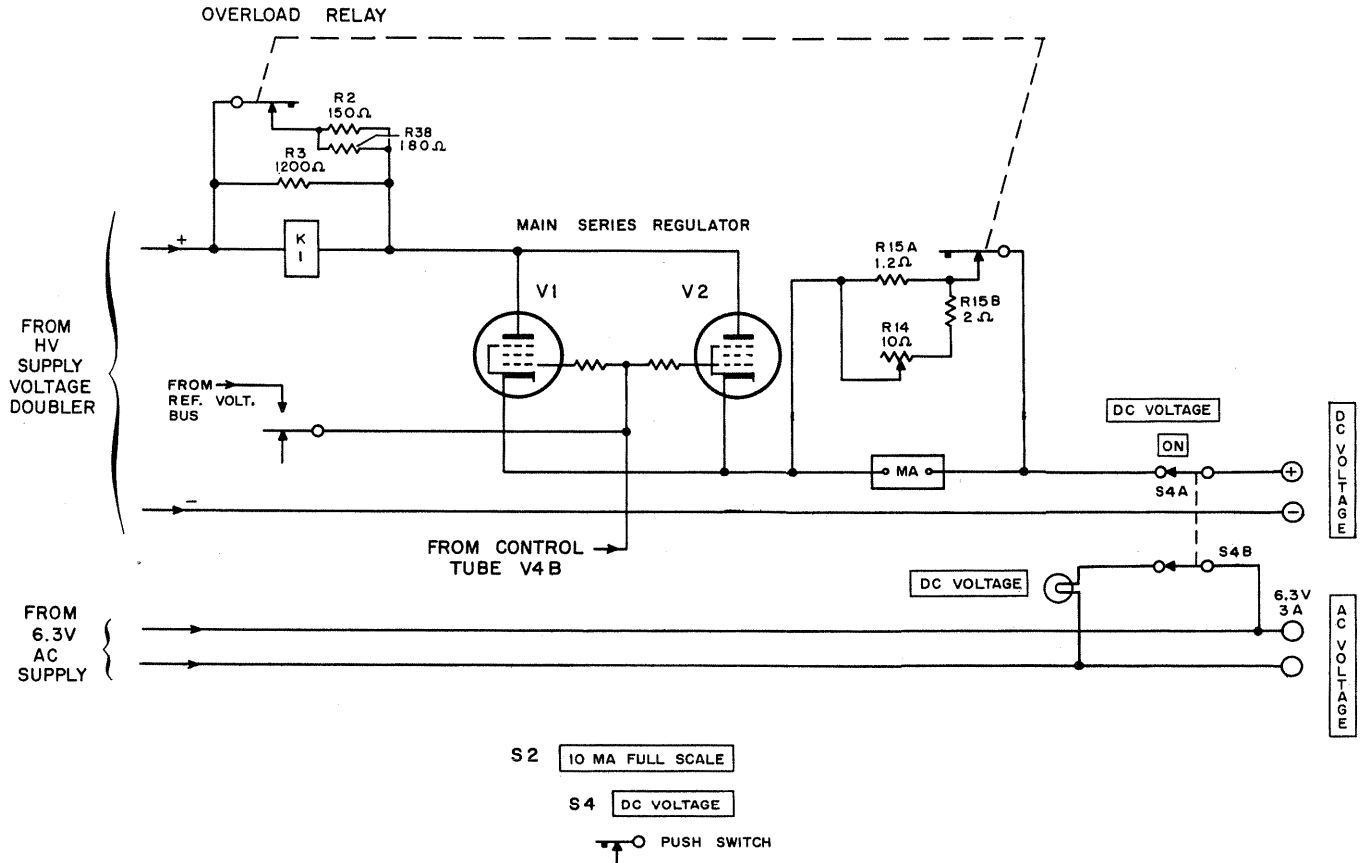


Figure 3-4. Model 711A Arrangement of positive Bus showing Overload Relay, Milliammeter, and Associated Switches - Switch S4 shown Operated Partial Schematic

SECTION IV MAINTENANCE

4-1 GENERAL

The Model 711A Power Supply is designed conservatively for long component life, and it is probable that tube replacement will correct a majority of the difficulties which may develop. Tube replacement instructions are given in paragraph 4-3.

The maintenance data provided in this section assumes that maintenance personnel are familiar with the operating procedures and circuit theory given in Sections II and III, respectively.

As a guide in tracing the cause of substandard operation, a troubleshooting chart is provided in paragraph 4-9. The chart indicates causes and remedies for certain specific troubles. Where the cause of the trouble is of a more obscure nature than the possibilities covered by the chart, the instrument should be tested to localize the failure to the section in trouble. General data on localization procedures is given in paragraph 4-10.

After locating the source and eliminating the cause of trouble, the instrument should be tested and adjusted. Rated performance specifications are given at the front of this manual.

4-2 COVER REMOVAL

The cover is fastened to the rear of the chassis, on the cabinet model, with two screws. To remove the cover, remove the screws, and slide the cover to the rear and off the instrument.

On the rack mount model, in addition to removing two screws at instrument rear, remove two screws on the front panel (see Figure 4-1).

NOTE: When replacing the cover, pull the power cable through the opening in the rear of the cover. Be sure the cable is free of the cover along the entire length of the cable so that it cannot get caught between chassis and cover as the cover is slid onto the instrument.

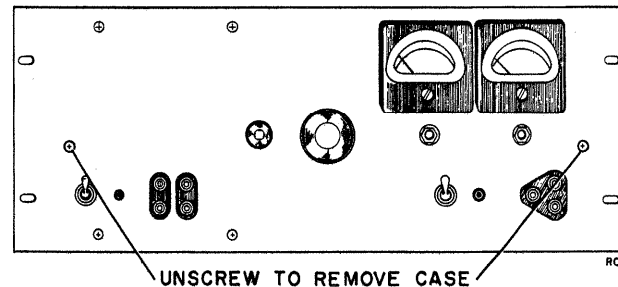


Figure 4-1. Cover Removal

4-3 TUBE REPLACEMENT

A. GENERAL. Any tube in the Model 711A may be replaced by a tube which has corresponding standard EIA characteristics. In general, neither checks or adjustments are required when tubes are replaced except in the case of the main and secondary control tubes, V3B and V4B.

B. REPLACEMENT OF V3 AND V4. After replacement of either of these tubes, check the low end and the high end of the dc output-voltage range and, if required, adjust R31 and/or R33 to bring the output within rated limits.

C. LOW-END AND HIGH-END ADJUSTMENTS. The adjustments for R31 and R33 are brought out to the upper side of the deck, and are identified in Figure 4-5.

- 1) Check low end of range:
 - a. Turn FINE and COARSE control maximum counterclockwise.
 - b. Note voltmeter indication; if not zero volts, adjust variable resistor R31 to obtain zero volts.
- 2) Check high end of range:
 - a. Turn FINE and COARSE control maximum clockwise.
 - b. Note voltmeter indication; if not 500 volts, adjust variable resistor R33 to obtain 500v.

SERVICING ETCHED CIRCUIT BOARDS

Excessive heat or pressure can lift the copper strip from the board. Avoid damage by using a low power soldering iron (50 watts maximum) and following these instructions. Copper that lifts off the board should be cemented in place with a quick drying acetate base cement having good electrical insulating properties.

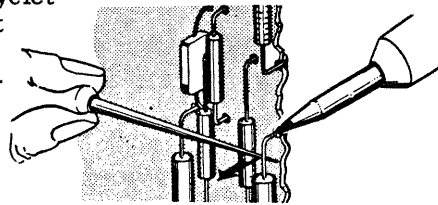
A break in the copper should be repaired by soldering a short length of tinned copper wire across the break.

Use only high quality rosin core solder when repairing etched circuit boards. NEVER USE PASTE FLUX. After soldering, clean off any excess flux and coat the repaired area with a high quality electrical varnish or lacquer.

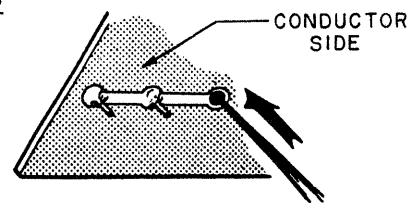
When replacing components with multiple mounting pins such as tube sockets, electrolytic capacitors, and potentiometers, it will be necessary to lift each pin slightly, working around the components several times until it is free.

WARNING: If the specific instructions outlined in the steps below regarding etched circuit boards without eyelets are not followed, extensive damage to the etched circuit board will result.

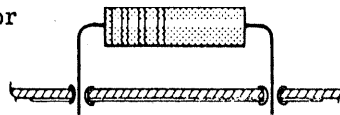
1. Apply heat sparingly to lead of component to be replaced. If lead of component passes through an eyelet in the circuit board, apply heat on component side of board. If lead of component does not pass through an eyelet, apply heat to conductor side of board.



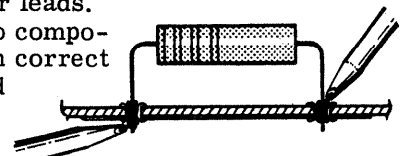
2. Reheat solder in vacant eyelet and quickly insert a small awl to clean inside of hole. If hole does not have an eyelet, insert awl or a #57 drill from conductor side of board.



3. Bend clean tinned lead on new part and carefully insert through eyelets or holes in board.

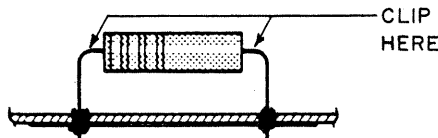


4. Hold part against board (avoid overheating) and solder leads. Apply heat to component leads on correct side of board as explained in step 1.

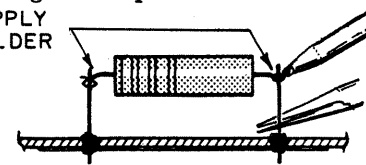


In the event that either the circuit board has been damaged or the conventional method is impractical, use method shown below. This is especially applicable for circuit boards without eyelets.

1. Clip lead as shown below.



2. Bend protruding leads upward. Bend lead of new component around protruding lead. Apply solder using a pair of long nose pliers as a heat sink.



This procedure is used in the field only as an alternate means of repair. It is not used within the factory.

Figure 4-2. Servicing Etched Circuit Boards

3) Check low end of range again:

- a. If zero volts not obtained, adjust R31 to obtain zero volts, and then check high end of range and adjust R33 to obtain 500 volts.
- b. The settings of R31 and R33 are interdependent. Continue to adjust for zero and 500 volts until they are obtained simultaneously.

allen wrench loosen the two setscrews and remove the knob. With 1/2" socket wrench, remove hex nut and flat washer on front of control panel, and two lockwashers on rear.

f. Remove R11 from chassis.

4-4 REPLACEMENT OF ELECTROLYTIC CAPACITORS

The electrolytic capacitors in this instrument are high quality units which have a useful life of from five to ten years. Do not replace these capacitors unless they are proved defective by accurate tests.

4-5 REPLACEMENT OF VARIABLE RESISTORS

A. VARIABLE RESISTOR R11. Connections to variable resistor R11 are indicated in Figure 4-4 and location of R11 on the chassis is shown in Figure 4-6.

To remove the defective R11 and install a new one, the instrument should be so placed that the bottom is upper-most. For convenience of maintenance personnel, all instructions in the following are with respect to the instrument in this upsidedown position. Front and rear are with respect to the control panel. Cams are identified in Figure 4-6.

1) Removal: The cams which actuate the microswitches are mounted on an extension of the shaft of variable resistor R11, one (S1B) immediately in front of the switch mounting plate, the other immediately behind the mounting plate. The shaft of R11 and the extension are connected by means of a flexible mechanical coupler. To remove R11, it will be necessary to reposition the S1B cam and to disconnect the coupler from the R11 shaft. The procedure follows:

- a. Unsolder the three leads connected to the two R11 terminals.
- b. Disconnect the coupler from the R11 shaft. With No. 6 allen wrench, loosen the two setscrews which fasten the front collar on the coupler to the shaft of resistor R11.
- c. Reposition the S1B cam. With No. 8 allen wrench, loosen the two setscrews which fasten the cam to the shaft. Slide the cam toward the control panel.
- d. Slide the shaft extension toward the rear of the instrument.
- e. Remove COARSE control knob. With No. 8

2) Installation:

- a. Install assembly in reverse of removal order. NOTE: Do not fasten S1B cam to shaft at this time.
- b. Solder leads to R11 terminals. Connections are shown in Figure 4-4.

3) Adjustment:

- a. Coarse positioning of cams: With No. 8 allen wrench, loosen setscrews on S1A (blue) cam immediately to rear of switch mounting plate.

Turn COARSE control maximum counterclockwise. Position each cam with low side of cam toward switch actuator so that neither switch is operated.

Turn COARSE control maximum clockwise. See that high side of each cam is engaging respective switch actuator so that both switches are operated.

Tighten setscrews sufficiently to hold cams in position on shaft.

- b. Set FINE control at electrical center, and COARSE control maximum counterclockwise.
- c. Turn on instrument, and allow two minute warm-up.
- d. Fine positioning of S1B (black) cam: Turn COARSE control until panel voltmeter indicates 195 volts.

Loosen setscrews and so position S1B (black) cam that (1) as COARSE control is turned clockwise, switch S1B operates as voltmeter indication is between 195 volts and approximately 200 volts; (2) as COARSE control is turned counterclockwise, switch S1B releases as voltmeter indication is between 190 volts and approximately 195 volts.

Lock setscrews.

- e. Fine positioning of S1A (blue) cam: Turn COARSE control until panel voltmeter indicates 325 volts.

Loosen setscrews and so position S1A cam that (1) as COARSE control is turned clockwise

switch S1A operates as voltmeter indication is between 325 and approximately 330 volts; (2) as COARSE control is turned counter-clockwise, switch S1A releases as voltmeter indication is between 320 and approximately 325 volts.

Lock setscrews. Recheck high and low voltage limits (see paragraph 4-3C).

B. VARIABLE RESISTOR R14. Variable resistor R14, which is part of the shunt network across milliammeter M2, is mounted on resistor board 75B. Connections to R14 are indicated in Figure 4-4, and the location of R14 on the chassis is shown in Figure 4-5.

To adjust R14 after replacement, the use of a standard milliammeter is required. The following adjustment procedure is recommended.

- 1) Connect a standard milliammeter and a load, in series, across the DC VOLTAGE + and - output terminals.
- 2) Adjust the COARSE control to obtain a reading of 80 ma on the reference milliammeter.
- 3) If the Model 711A milliammeter does not indicate 80 ma, adjust R14 to bring the 711A milliammeter pointer right on 80.

4-6 REPLACEMENT OF RECTIFIERS

Connections to the rectifiers are shown in Figure 4-4 and their locations on the chassis in Figure 4-6.

After replacement of any rectifier, voltage at the output of the associated filter should be measured. If the output is not within the limits specified in the next paragraph, the replacement rectifier does not meet specifications and should be replaced.

Measurements should be made with a 20,000 ohms-per-volt or better voltmeter, a line input of exactly 115 (or 230) volts, and no load connected to the output terminals.

CR1: connect voltmeter to capacitor C1 terminals 1 and 2; meter indication should be 200 volts $\pm 10\%$.

CR2-

CR3: connect voltmeter to terminal 1 of capacitor C3 and to terminal 2 of capacitor C2.

- 1) With COARSE control at maximum counter-

clockwise, meter indication should be 400 volts $\pm 10\%$.

- 2) With COARSE control at maximum clockwise, meter indication should be 715 volts $\pm 10\%$.

CR4: connect voltmeter to capacitor C6 terminals 1 and 2; meter indication should be 350 volts $\pm 10\%$.

4-7 METER ZERO ADJUSTMENT

When the voltmeter is received from the factory, the position of the voltmeter and milliammeter pointers should be checked, and if the respective pointer does not indicate exactly on zero, the pointer should be reset to zero. The adjustment should be made before the voltmeter is connected to a power source.

The adjust screw is in the meter frame at a midpoint immediately below the meter face. The adjustment is made properly only when pointer adjust travel is in the opposite direction to the turn of the adjust screw. Though the adjust screw may be turned in either direction, a practical procedure is to turn the screw in a clockwise direction until the pointer starts to swing back toward zero. Then, still turning the screw clockwise, bring the pointer (now traveling counterclockwise) back to zero.

NOTE: For accurate positioning of the pointer, the resetting must be done with power disconnected from the instrument circuits. If during the life of the voltmeter it is necessary to reposition the pointer, wait at least fifteen minutes after disconnecting the power before resetting the pointer on zero.

4-8 POWER TRANSFORMER PRIMARY CONNECTIONS

Connections from the primary winding of power transformer T1 are brought out to a terminal strip mounted on under side of the deck, at the rear of the instrument.

The two sections of the power transformer primary are strapped at the factory for 115-volt operation. If the instrument is to be operated from a 230-volt power source, perform the following:

- 1) Change the strapping to connect the two sections of the primary in series, as indicated for 230-volt operation on the schematic diagram.

- 2) Replace 1.6-ampere fuse F1 with a 0.8 ampere cartridge fuse of the same slow-blow type (see F1 description in Table 5-1, Replaceable Parts).

4-9 TROUBLESHOOTING CHART

Table 4-1 lists various symptoms of trouble and for each indicates the part or parts of the circuit which should be checked. In the main, for purposes of simplification, only tubes are referenced, but remember that components associated with referenced tubes also are failure possibilities. When using Table 4-1, perform checks in the order given since it is assumed throughout a procedure that the parts checked previously are functioning properly.

When testing the Model 711A, it is recommended that line voltage be applied to the instrument through a variable transformer, and that the transformer be adjusted to deliver a voltage at the low end of the rated 103- to 127-volt range. An instrument in good condition operates satisfactorily from any line voltage within rated range, but where there is marginal operation (from weak tubes, etc.) weaknesses become easier to trace at low line voltages.

Table 4-1. Troubleshooting Chart (Sheet 1 of 3)

SYMPTOM AND POSSIBLE CAUSE	TEST PROCEDURE
<p>1. Instrument NOT operating; AC voltage indicator light NOT lighted.</p> <p>a. Fuse open due to defective fuse or overload in power supply.</p>	<p>a. Replace fuse. If this fuse blows:</p> <p>(1) Remove all tubes and K1; again replace fuse.</p> <p>(2) If this fuse does not blow:</p> <p>A. Check voltage across C1, C2-3 (with COARSE control max ccw), C6 (from terminal 3 to 1).</p> <p>1. If output voltages are somewhat higher than those shown on the schematic, proceed to step B.</p> <p>2. If output from any rectifier less than normal, check rectifier and associated electrolytic capacitor.</p> <p>B. Replace V3, V4, V5.</p> <p>1. If fuse does not blow, proceed to step C.</p> <p>2. If fuse does blow:</p> <p>a. Check tubes by substituting tubes known to be good.</p> <p>b. If trouble is not in tubes, check resistors, capacitors, and wiring in secondary regulator and V4B circuits; tolerances given in Table of Replaceable Parts.</p> <p>C. Check that no load is connected to dc output terminals. Reinstall V1 and V2, but not K1.</p> <p>1. If fuse does not blow, replace K1.</p> <p>2. If fuse does blow, check V1 and V2 by removing one 6L6 and leaving other in circuit.</p> <p>3. If fuse blows when K1 is installed, K1 may be defective and arcing to ground.</p> <p>(3) If 2nd fuse does blow, localize as follows:</p> <p>A. Disconnect rectifiers from their respective T1 secondary windings: one grey T1 lead from CR1, red T1 lead from CR3, one green T1 lead from CR4. Replace fuse.</p> <p>1. If fuse does not blow, proceed to step B.</p> <p>2. If fuse does blow, short is in the primary or a filament winding. Disconnect green lead from pin 2, V2, and replace fuse. If fuse does not blow, trouble is in V1-V2 filament supply. If fuse blows, trouble probably is in V3-V4 filament supply, though it can be in ac supply, indicator light circuits, or primary.</p>

Table 4-1. Troubleshooting Chart (Sheet 2 of 3)

SYMPTOM AND POSSIBLE CAUSE	TEST PROCEDURE
<p>1. Instrument NOT operating; AC voltage indicator light NOT lighted.</p> <p>a. Fuse open due to defective fuse or overload in power supply. (CONT' D.)</p> <p>b. Poor connection to line voltage.</p>	<p>B. Reconnect green T1 lead to CR4.</p> <ol style="list-style-type: none"> 1. If fuse does not blow, proceed to step C. 2. If fuse blows: <ol style="list-style-type: none"> a. Check CR4 and associated wiring; if OK. b. Disconnect green T1 lead from CR4, replace fuse, and measure ac voltage across CR4-supply winding: <ol style="list-style-type: none"> 1) Input voltage: exactly 115 (or 230)V, 50-1000ν. 2) Voltmeter: high impedance, average-responding VTVM - such as an Φ Model 400D. 3) Rated rms voltage: $285 \pm 3\%$ (VTVM connection may be made to disconnected lead and SR4 lug which terminates other green T1 lead). <p>C. Reconnect green T1 lead to CR1.</p> <ol style="list-style-type: none"> 1. If fuse does not blow, proceed to step D. 2. If fuse does blow: <ol style="list-style-type: none"> a. Check CR1 and associated wiring; if OK. b. Disconnect grey T1 lead from CR1, replace fuse, and measure ac voltage across CR1-supply winding: <ol style="list-style-type: none"> 1) See B2b (1), (2), above. 2) Rated rms voltage: $150 \pm 3\%$. <p>D. Check CR2, CR3, and associated wiring. If rectifiers and wiring are OK, measure ac voltage across HV-supply winding:</p> <ol style="list-style-type: none"> 1. See B2b (1), (2) above. 2. Turn COARSE control max cw. 3. VTVM may be connected to red T1 lead, unsoldered from CR3, and S1A lug which terminates blue T1 lead. 4. Rated rms voltage: $265 \pm 3\%$. <p>b. Check power cable, and connections of both ends of cable.</p>
<p>2. Instrument NOT operating; AC voltage indicator light lighted.</p> <p>a. Secondary power supply and regulator not operating properly.</p> <p>b. Defective tube in main regulator.</p>	<p>a. Check voltage at output of secondary regulator:</p> <ol style="list-style-type: none"> (1) Dc output voltage should be $200V \pm 10\%$. If dc output not $200V \pm 10\%$, check V3, V4, and V5, CR4, and then other components of secondary regulator. <ol style="list-style-type: none"> A. Connect voltmeter to pin 8 of V3 and pin 4 of V5. B. Use 20,000 ohms-per-volt voltmeter or better. (2) Ac voltage should not be more than 0.002V. If ripple exceeds 0.003V, check V3. <ol style="list-style-type: none"> A. Connect as in (1) A. B. Use high impedance, average-responding VTVM such as Φ Model 400D. <p>b. Check V4, V1, V2.</p> <ol style="list-style-type: none"> (1) Check V4 by substituting 6U8 known to be good, and by checking potentials on tube pins; should be within $\pm 10\%$ of values shown in Figure 4-7.

Table 4-1. Troubleshooting Chart (Sheet 3 of 3)

SYMPTOM AND POSSIBLE CAUSE	TEST PROCEDURE
<p>b. Defective tube in main regulator. (CONT'D.)</p> <p>c. Potential applied to tube pins not of proper values.</p> <p>d. Relay K1 held operated.</p>	<p>(2) Check V1, V2 as follows:</p> <p>A. Check that no load is connected to dc output terminals.</p> <p>B. Remove one 6L6 and leave other in circuit. If trouble clears with one 6L6 out of circuit, replace that 6L6.</p> <p>c. Check dc voltage on pins of all tube sockets: should be within $\pm 10\%$ of those shown in Figure 4-7.</p> <p>d. Check that no load is connected to dc output terminals. Remove K1. If voltmeter indicates the removal of K1 has corrected the trouble:</p> <p>(1) Check contacts on switch S2 (Figure 4-5)</p> <p>(2) Check for open resistor R2.</p> <p>(3) Check K1 by substituting relay known to be good.</p>
<p>3. Instrument operating, but output voltage is not at proper level.</p> <p>a. Control tube V4B not operating properly.</p> <p>b. Defective component in voltage divider.</p>	<p>a. Check V4 by substituting 6U8 known to be good, and by checking potentials on tube pins; should be within $\pm 10\%$ of values shown in Figure 4-7.</p> <p>b. Turn COARSE and FINE controls from max ccw to max cw, and note voltmeter indication:</p> <p>(1) At max ccw, vm should read less than zero.</p> <p>(2) At max cw, vm should read more than 500. Refer to paragraph 4-3C for adjustment.</p>
<p>4. Level of output cannot be adjusted lower than 175-225 volts.</p> <p>a. Short in V1 and/or V2.</p>	<p>a. Check that no load is connected to dc output terminals, remove one 6L6, and leave other in circuit. If zero output can be obtained with one 6L6 out of circuit, replace that 6L6.</p>
<p>5. When relay K1 is operated (current at overload), resistor R2 burns out.</p>	<p>5. R2 burns out because of intermittent arc or permanent short between K1 pin 7 (+400 to +700V) and pin 6 (-200V) when relay K1 is operated.</p>

4-10 TROUBLE LOCALIZATION

When the cause of instrument failure or substandard operation is of a more obscure nature than the possibilities covered by the trouble-shooting chart, the failure should be localized to a section of the circuit, and then isolated within the section. Basic sections of the circuit are defined in Figure 4-3. It is

recommended that testing to localize trouble start with the secondary regulator.

After isolating trouble to a section of the circuit which includes more than one tube, the next step is to determine the tube circuit involved. A replacement tube should be tried before attempting

any other tests. If trouble persists, voltage and resistance measurements should be made. Typical d-c voltages and resistances to ground from tube socket pins are given in Figure 4-7. Variations from these values do not necessarily indicate trouble, as the values will vary somewhat between instruments, with variations in line voltages, and with

component tolerances. Generally a variation of $\pm 10\%$ is to be expected and even higher variations may be within the normal range. As a guide to the order of variation that may be considered normal, consult the Table of Replaceable Parts in Section V of this manual; the Table includes tolerances for most resistors and capacitors.

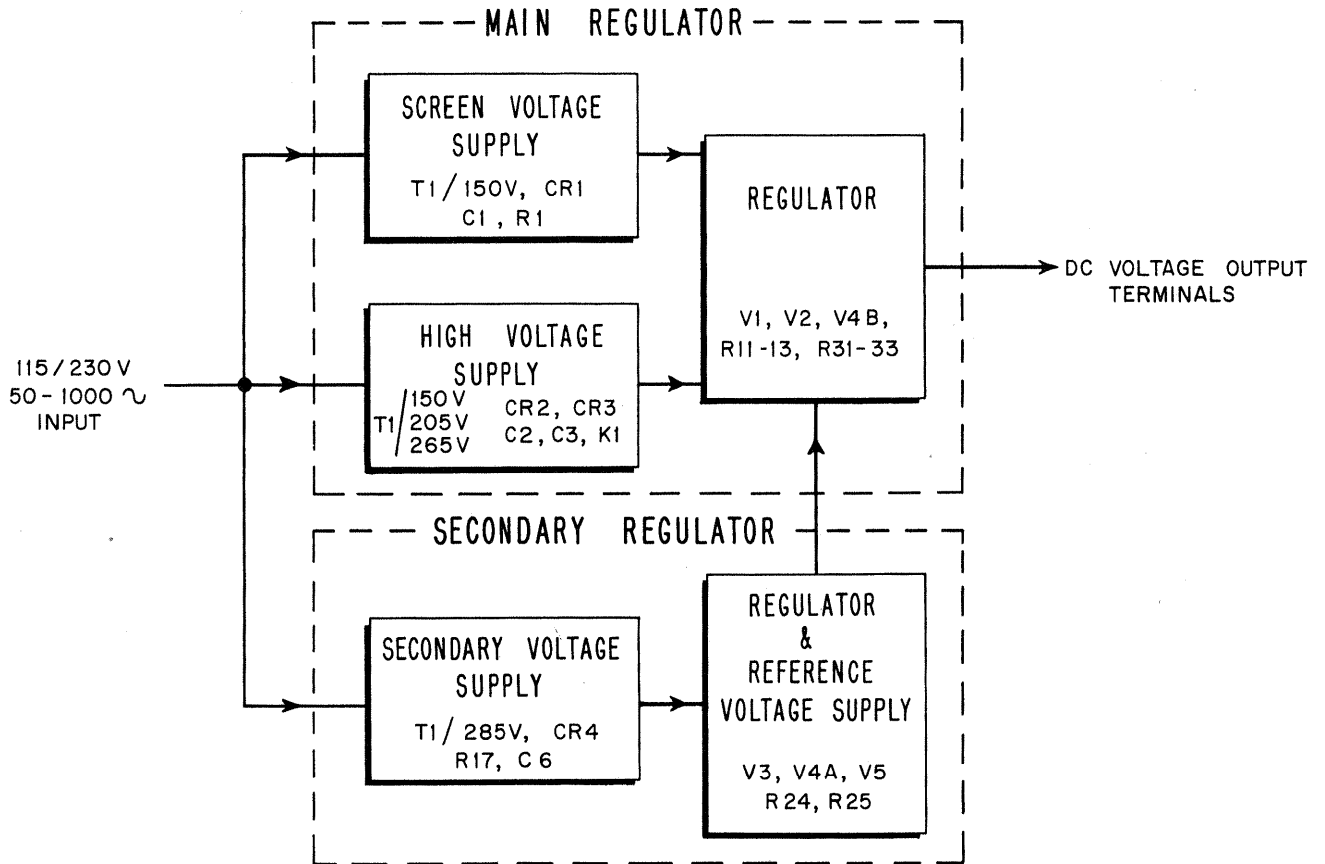


Figure 4-3. Model 711A Sectionalization Diagram

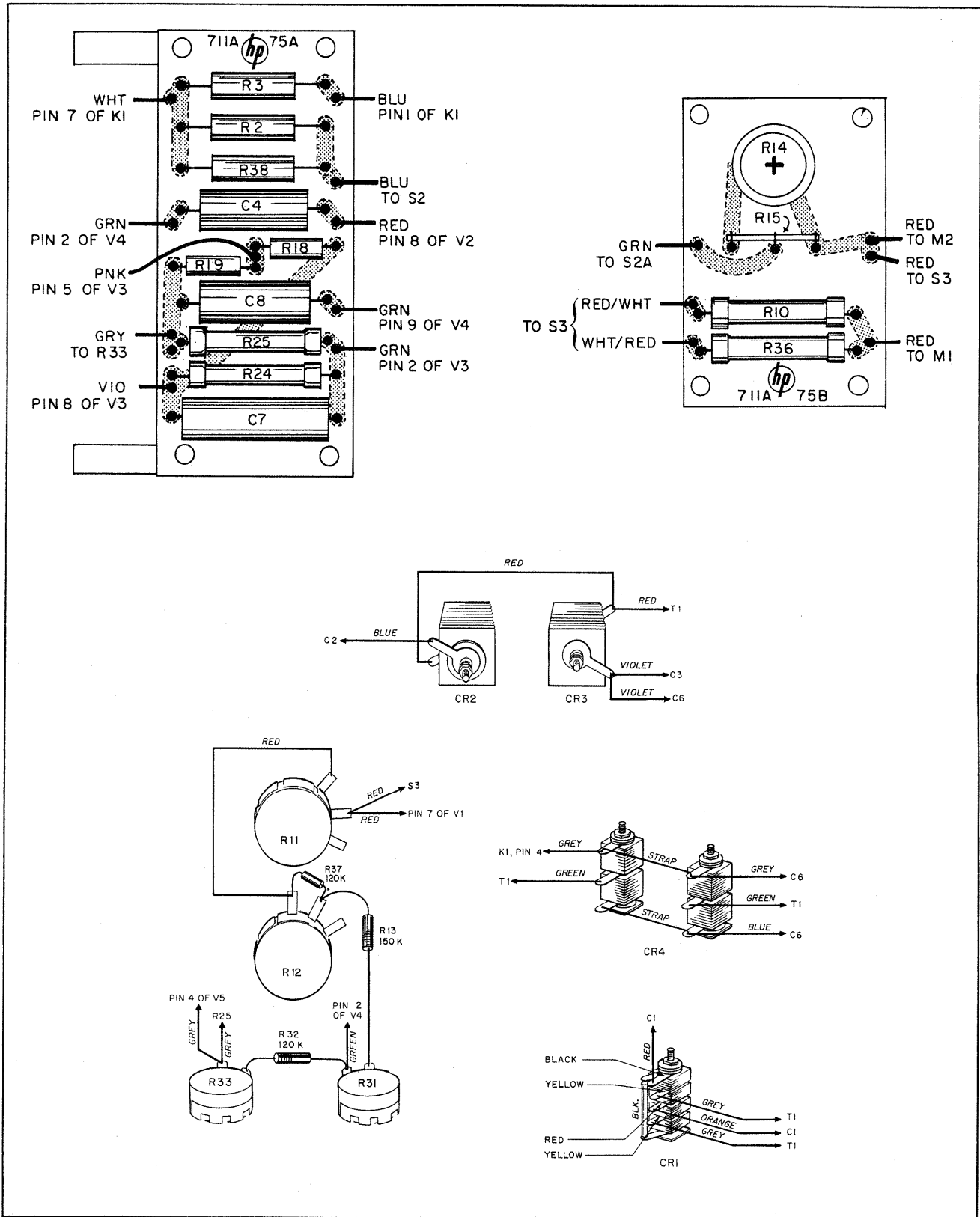


Figure 4-4. Model 711A Resistor Board and Rectifier Detail

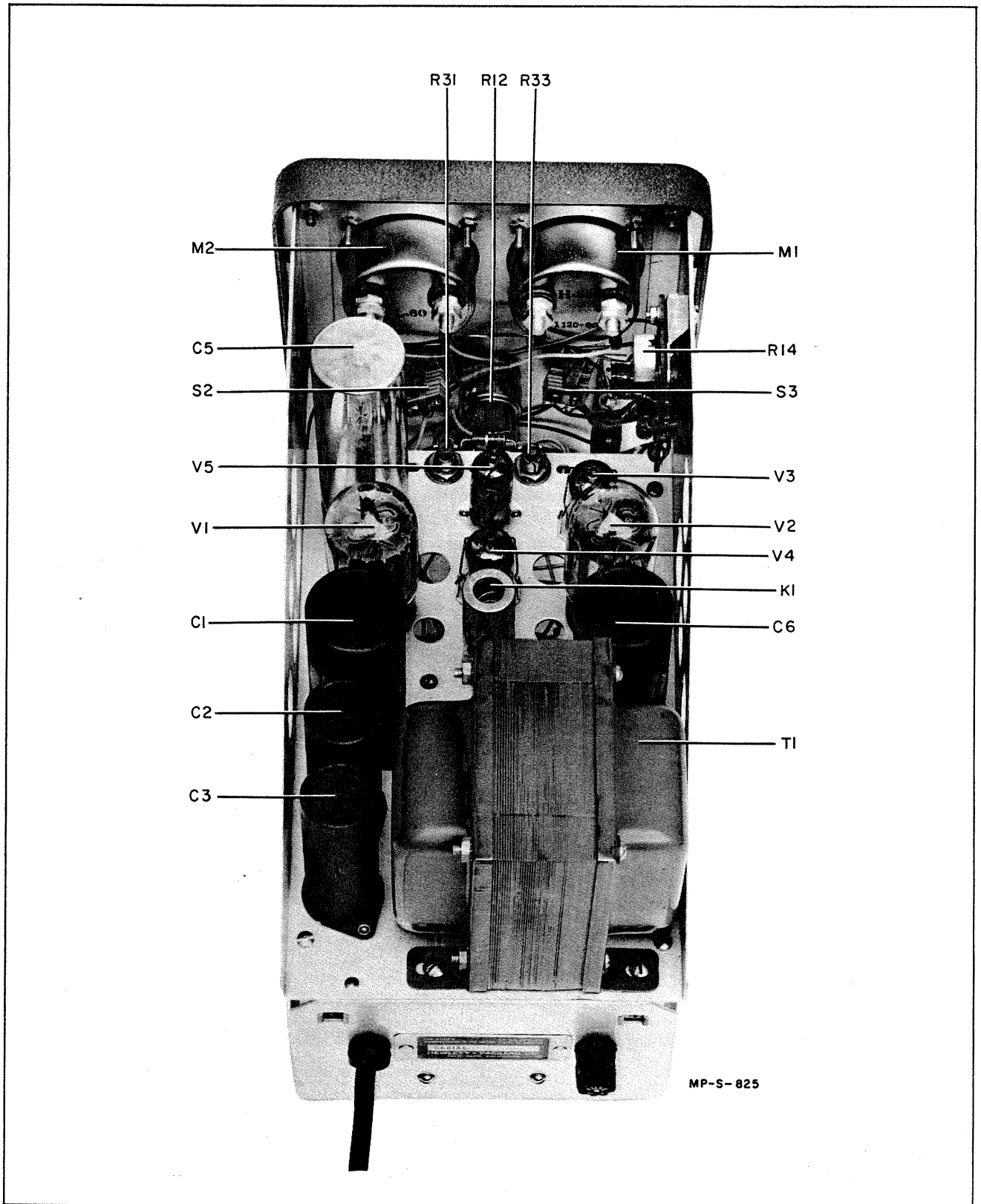


Figure 4-5. Model 711A Top View Cover Removed

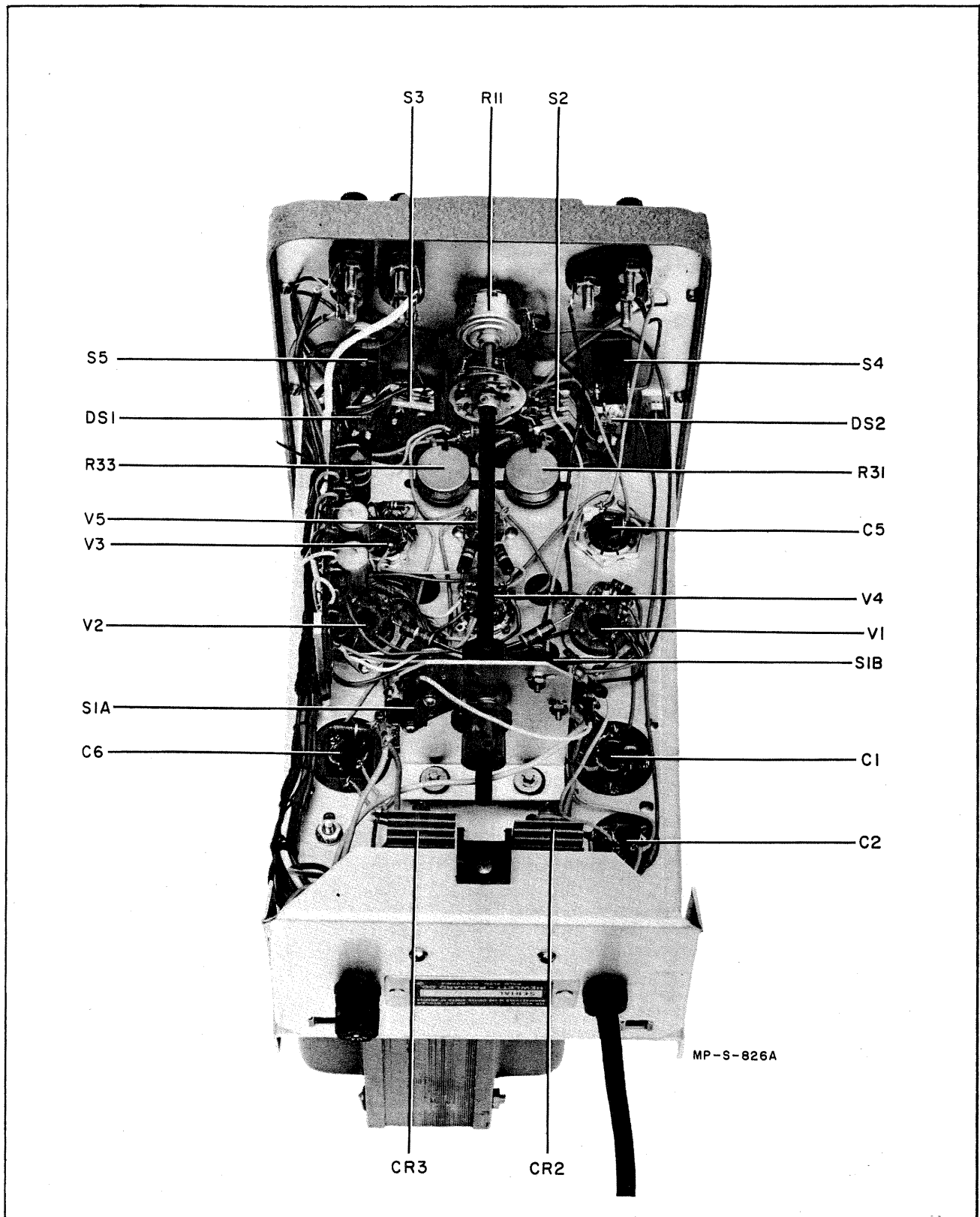


Figure 4-6. Model 711A Bottom View Cover Removed

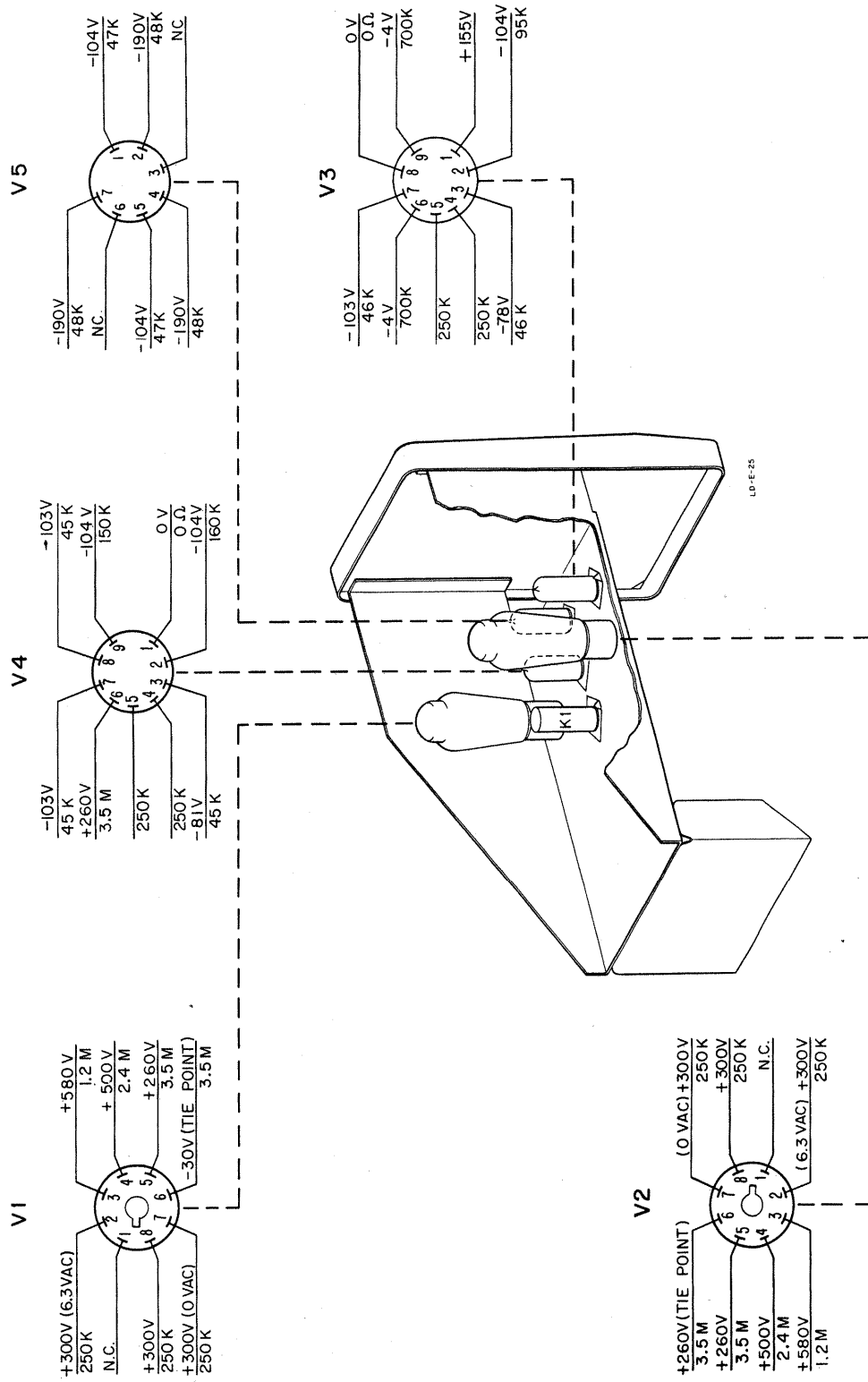
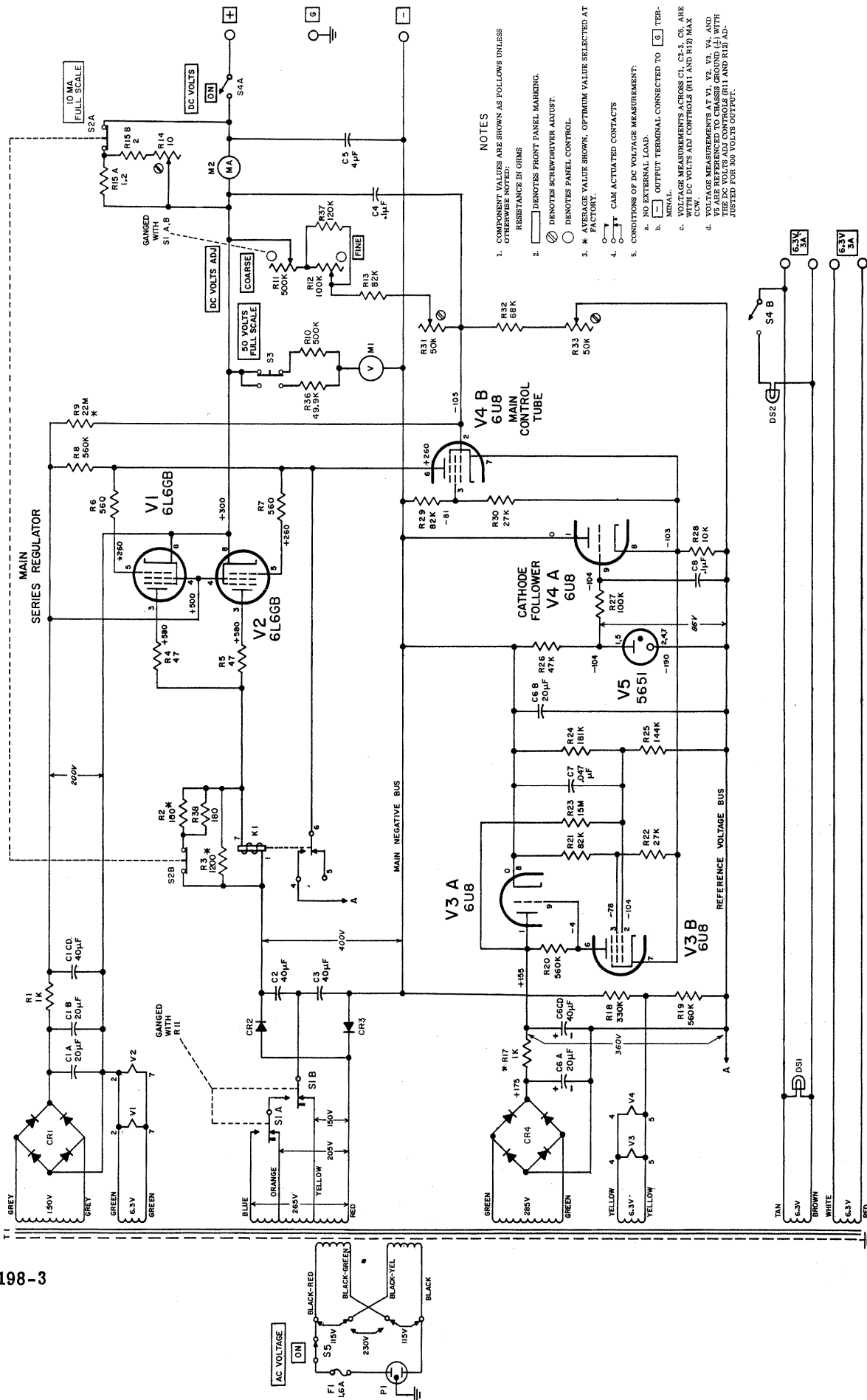


Figure 4-7. Model 711A Voltage and Resistance Diagram



- NOTES**
1. COMPONENT VALUES ARE SHOWN AS FOLLOWS UNLESS OTHERWISE NOTED:
RESISTANCE IN OHMS
 2. DENOTES FRONT PANEL MARKING.
 3. DENOTES PANEL CONTROL.
 4. * INVERSE VALUE SHOWN. OPTIMUM VALUE SELECTED AT FACTORY.
 5. CAM ACTUATED CONTACTS
- CONDITIONS OF DC VOLTAGE MEASUREMENT:**
- a. NO EXTERNAL LOAD.
 - b. OUTPUT TERMINAL CONNECTED TO TERMINAL.
 - c. VOLTAGE MEASUREMENTS ACROSS C1, C2-5, C6 ARE FOR DC VOLTS AD CONTROLS (R11 AND R12) MAX CCW.
 - d. VOLTAGE MEASUREMENTS AT V1, V2, V3, V4, AND V5 ARE REFERENCED TO CHASSIS GROUND () WITH THE POSITIVE LEAD OF METER AND R11 ADJUSTED FOR 50 VOLTS OUTPUT.

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Figure 4-8. Model 711A Power Supply

00198-3

NOTES

SECTION V REPLACEABLE PARTS

5-1 INTRODUCTION

This section contains information for ordering replacement parts for the Model 711A Power Supply. Table 5-1 lists replaceable parts in alpha-numerical order of their reference designators. Detailed information on a part used more than once in the instrument is listed opposite the first reference designators applying to the same part refer to the initial designator. Miscellaneous parts are included at the end of the list. Detailed information includes the following:

- 1) Reference designator.
- 2) Full description of the part.
- 3) Manufacturer of the part in a five-digit code; see list of manufacturers in Appendix A.
- 4) Hewlett-Packard part number.

- 5) Total quantity used in the instrument (TQ col).

5-2 ORDERING INFORMATION

To order a replacement part, address order or inquiry to your local -hp- Sales and Service Office. (See Appendix B for office locations.) Identify parts by their -hp- part number(s).

5-3 NON-LISTED PARTS

To obtain a part that is not listed, include:

- 1) Instrument model number.
- 2) Instrument serial number.
- 3) Description of the part.
- 4) Function and location of the part.

Table 5-1. Replaceable Parts (Sheet 1 of 5)

Ckt Ref	Description	Mfr	hp Part No.	TQ			
C1A-D	Capacitor: fixed, electrolytic, 4 section, 20 μ f/sect., 450 vdcw	56289	0180-0025	2			
C2, 3	Capacitor: fixed, electrolytic, 40 μ f, 450 vdcw	56289	0180-0024	2			
C4	Capacitor: fixed, mylar, 0.1 μ f \pm 20%, 600 vdcw	09134	0170-0022	2			
C5	Capacitor: fixed, paper, 4 μ f \pm 10%, 600 vdcw	72758	0160-0077	1			
C6A-D	Same as C1A-D						

Table 5-1. Replaceable Parts (Sheet 2 of 5)

Ckt Ref	Description	Mfr *	Part No.	TQ*			
C7	Capacitor: fixed, paper, .047 μ f \pm 10%, 600 vdcw	56289	0160-0005	1			
C8	Same as C4						
F1	Fuse: 1.6A, for 115 V operation, 125 V, slow-blow	71400	2110-0005	1			
	Fuse: 0.8 A, for 230 V operation, slow-blow	71400	2110-0020				
DS1, 2	Lamp, incandescent: 6-8 V 2 pin base, GE#12	24455	2140-0012	2			
K1	Relay: SPDT	77342	0490-0010	1			
M1	Meter: voltmeter, 0-500 V	77221	1120-0055	1			
M2	Meter	28480	1120-0105	1			
P1	Cable, power	70903	8120-0015	1			
R1	Resistor: fixed, composition, 1000 ohms \pm 10%, 1 W	01121	0690-1021	2			
R2	Resistor: fixed, composition, 150 ohms \pm 10%, 1 W Optimum value selected at factory Average value shown	01121	0690-1511	1			
R3	Resistor: fixed, composition, 1200 ohms \pm 10%, 1 W Optimum value selected at factory Average value shown	01121	0690-1221	1			
R4, 5	Resistor: fixed, composition, 47 ohms \pm 10%, 1 W	01121	0690-4701	2			
R6, 7	Resistor: fixed, composition, 560 ohms \pm 10%, 1/2 W	01121	0687-5611	2			
R8	Resistor: fixed, composition, 560,000 ohms \pm 10%, 1 W	01121	0690-5641	2			
R9	Resistor: fixed, composition, 22 megohms \pm 10%, 1/2 W Optimum value selected at factory. Average value shown.	01121	0687-2261	1			
R10	Resistor: fixed, deposited carbon, 500,000 ohms \pm 1%, 1 W	19701	0730-0156	1			
R11	Resistor: variable, composition, 500,000 ohms \pm 20%, 2 W	01121	2100-0097	1			
R12	Resistor: variable, composition, 100,000 ohms \pm 10%, 2 W	01121	2100-0045	1			

* See introduction to this section

Table 5-1. Replaceable Parts (Sheet 3 of 5)

Ckt Ref	Description	Mfr *	Ⓟ Part No.	TQ*			
R13	Resistor: fixed, composition, 82,000 ohms $\pm 10\%$, 1 W	01121	0690-8231	1			
R14	Resistor: variable, wirewound, linear taper, 10 ohms $\pm 20\%$, 1 W	71450	2100-0259	1			
R15A, B	Resistor: fixed, wirewound, 2 section 1.2 ohms, 2 ohms	28480	711A-26A	1			
R16	Not assigned						
R17	Same as R1 Optimum value selected at factory. Average value shown.						
R18	Resistor: fixed, composition, 330,000 ohms $\pm 10\%$, 1/2 W	01121	0687-3341	1			
R19	Resistor: fixed, composition, 560,000 ohms $\pm 10\%$, 1/2 W	01121	0687-5641	1			
R20	Same as R8						
R21	Resistor: fixed, composition, 82,000 ohms $\pm 10\%$, 1/2 W	01121	0687-8231	2			
R22	Resistor: fixed, composition, 27,000 ohms $\pm 10\%$, 1/2 W	01121	0687-2731	2			
R23	Resistor: fixed, composition, 15 megohms $\pm 10\%$, 1/2 W	01121	0687-1561	1			
R24	Resistor: fixed, deposited carbon, 181,000 ohms $\pm 1\%$, 1 W	19701	0730-0077	1			
R25	Resistor: fixed, deposited carbon, 144,000 ohms $\pm 1\%$, 1 W	19701	0730-0074	1			
R26	Resistor: fixed, composition, 47,000 ohms $\pm 10\%$, 1 W	01121	0690-4731	1			
R27	Resistor: fixed, composition, 100,000 ohms $\pm 10\%$, 1/2 W	01121	0687-1041	1			
R28	Resistor: fixed, composition, 10,000 ohms $\pm 10\%$, 1 W	01121	0690-1031	1			
R29	Same as R21						
R30	Same as R22						
R31	Resistor: variable, composition, 50,000 ohms $\pm 20\%$, 1/3 W	71450	2100-0157	2			

* See introduction to this section

Table 5-1. Replaceable Parts (Sheet 4 of 5)

Ckt Ref	Description	Mfr *	Part No.	TQ*			
R32	Resistor: fixed, composition, 68,000 ohms $\pm 10\%$, 1 W	01121	0690-6831	1			
R33	Same as R31						
R34, 35	Not assigned						
R36	Resistor: fixed, deposited carbon, 49,900 ohms $\pm 1\%$, 1 W	19701	0730-0155	1			
R37	Resistor: fixed, composition, 120,000 ohms $\pm 10\%$, 1 W	01121	0690-1241	1			
R38	Resistor: fixed, composition, 180 ohms $\pm 10\%$, 1 W Optimum value selected at factory. Average value shown.	01121	0690-1811	1			
S1A, B	Switch, micro: SPDT	91929	3102-0004	1			
S2	Switch, push: DPDT	82389	3101-0010	1			
S3	Switch, push: SPDT	82389	3101-0004	1			
S4	Switch, toggle: DPST	88140	3101-0003	1			
S5	Switch, toggle	04009	3101-0001	1			
CR1	Diode, selenium: 180V rms 40 ma dc max	77638	1882-0004	1			
CR2, 3	Diode, selenium: 585V rms max 120 ma dc max	03508	1880-0008	2			
CR4	Diode, selenium: 192V rms max 25 ma dc max	77638	1883-0005 (two re- quired)	2			
T1	Transformer, power	28480	9100-0067	1			
V1,2	Tube, electron: 6L6GB	80131	1923-0035	2			
V3,4	Tube, electron: 6U8	80131	1933-0004	2			
V5	Tube, electron: 5651	80131	1940-0001	1			

* See introduction to this section

Table 5-1. Replaceable Parts (Sheet 5 of 5)

Ckt Ref	Description	Mfr *	Part No.	TQ*			
	<u>MISCELLANEOUS</u>						
	Binding post assembly: black	28480	AC-10C	1			
	Binding post assembly: red	28480	AC-10D	1			
	Fuseholder	75915	1400-0084	1			
	Insulator, binding post: 2 post	28480	G-83A	1			
	Insulator, binding post: 3 post	28480	G-83D	1			
	Jewel, pilot light	72765	1450-0020	1			
	Knob: FINE	28480	G-74C	1			
	Knob: COARSE	28480	G-74R	1			
	Lampholder, 2 pin base	72765	1450-0022	2			

* See introduction to this section

APPENDIX CODE LIST OF MANUFACTURERS (Sheet 2 of 2)

Code No.	Manufacturer	Address	Code No.	Manufacturer	Address	Code No.	Manufacturer	Address	Code No.	Manufacturer	Address
81349	Military Specification	85474	R.M. Bracamonte & Co.	San Francisco, Calif.	93929	G. V. Controls	Livingston, N. J.	98220	Francis L. Mosley	Pasadena, Calif.
81415	Wilkor Products, Inc.	Cleveland, Ohio	85660	Koiled Kords, Inc.	New Haven, Conn.	93983	Insuline-Van Norman Ind., Inc.	Manchester, N.H.	98278	Microdot, Inc.	So. Pasadena, Calif.
81453	Raytheon Mfg. Co., Industrial Components Div., Industr. Tube Operations	Newton, Mass.	85911	Seamless Rubber Co.	Chicago, Ill.	94137	General Cable Corp. Electronic Division	Bayonne, N. J.	98291	Sealectro Corp.	Mamaroneck, N.Y.
81483	International Rectifier Corp.	El Segundo, Calif.	86197	Clifton Precision Products	Clifton Heights, Pa.	94144	Raytheon Mfg. Co., Industrial Components Div., Receiving Tube Operation	Quincy, Mass.	98405	Carad Corp.	Redwood City, Calif.
81541	The Airpax Products Co.	Cambridge, Mass.	86579	Precision Rubber Products Corp.	Dayton, Ohio	94145	Raytheon Mfg. Co., Semiconductor Div., California Street Plant	Newton, Mass.	98731	General Mills	Minneapolis, Minn.
81860	Barry Controls, Inc.	Watertown, Mass.	86684	Radio Corp. of America, RCA Electron Tube Div.	Harrison, N.J.	94148	Scientific Radio Products, Inc.	Loveland, Colo.	98821	North Hills Electric Co.	Minnetonka, N.Y.
82042	Carter Parts Co.	Skokie, Ill.	87216	Philco Corporation (Lansdale Division)	Lansdale, Pa.	94154	Tung-Sol Electric, Inc.	Newark, N.J.	98925	Clevite Transistor Prod. Div. of Clevite Corp.	Waltham, Mass.
82142	Jeffers Electronics Division of Speer Carbon Co.	Du Bois, Pa.	87473	Western Fibrous Glass Products Co.	San Francisco, Calif.	94187	Curtiss-Wright Corp., Electronics Div., East Paterson, N.J.	Lester, Pa.	98978	International Electronic Research Corp.	Burbank, Calif.
82170	Allen B. DuMont Labs, Inc.	Clifton, N.J.	87664	Van Waters & Rogers Inc.	Seattle, Wash.	94222	Southco Div. of S. Chester Corp.	Chicago, Ill.	99109	Columbia Technical Corp.	New York, N.Y.
82209	Maguire Industries, Inc.	Greenwich, Conn.	87930	Tower Mfg. Corp.	Providence, R. I.	94310	Tru Ohm Prod. Div. of Model Engineering and Mfg. Co.	Chicago, Ill.	99313	Varian Associates	Palo Alto, Calif.
82219	Sylvania Electric Prod. Inc. Electronic Tube Div.	Emporium, Pa.	88140	Cutler-Hammer, Inc.	Lincoln, Ill.	94330	Wire Cloth Products Inc.	Chicago, Ill.	99515	Marshall Industries, Electron Products Division	Pasadena, Calif.
82376	Astron Co.	East Newark, N.J.	88220	Gould-National Batteries, Inc.	St. Paul, Minn.	94682	Worcester Pressed Aluminum Corp.	Worcester, Mass.	99707	Control Switch Division, Controls Co. of America	El Segundo, Calif.
82389	Switchcraft, Inc.	Chicago, Ill.	88598	General Mills, Inc.	Buffalo, N.Y.	95023	Philbrick Researchers, Inc.	Boston, Mass.	99800	Delevan Electronics Corp.	East Aurora, N.Y.
82647	Metals and Controls, Inc., Div. of Texas Instruments, Inc., Spencer Prods.	Attleboro, Mass.	89231	Graybar Electric Co.	Oakland, Calif.	95236	Allies Products Corp.	Miami, Fla.	99848	Wilco Corporation	Indianapolis, Ind.
82866	Research Products Corp.	Madison, Wis.	89462	Waldes Kohinoor, Inc.	Cambridge, Mass.	95238	Continental Connector Corp.	Woodside, N.Y.	99934	Renbrandt, Inc.	Boston, Mass.
82877	Rotron Manufacturing Co., Inc.	Woodstock, N.Y.	89473	General Electric Distributing Corp.	Schenectady, N.Y.	95264	Lercro Electronics, Inc.	Burbank, Calif.	99942	Hoffman Semiconductor Div. of Hoffman Electronics Corp.	Evanston, Ill.
82893	Vector Electronic Co.	Glendale, Calif.	89636	Carter Parts Div. of Economy Baler Co.	Chicago, Ill.	95265	National Coil Co.	Sheridan, Wyo.	99957	Technology Instrument Corp of Calif.	Newbury Park, Calif.
83053	Western Washer Mfr. Co.	Los Angeles, Calif.	90179	U.S. Rubber Co., Mechanical Goods Div.	Passaic, N.J.	95275	Vitramon, Inc.	Bridgeport, Conn.	THE FOLLOWING H-P VENDORS HAVE NO NUMBER ASSIGNED IN THE LATEST SUPPLEMENT TO THE FEDERAL SUPPLY CODE FOR MANUFACTURERS HANDBOOK.		
83058	Carr Fastener Co.	Cambridge, Mass.	90370	Bearing Engineering Co.	San Francisco, Calif.	95278	Gordas Corp.	Bloomfield, N.J.			
83086	New Hampshire Ball Bearing, Inc.	Peterborough, N.H.	91260	Connor Spring Mfg. Co.	San Francisco, Calif.	95348	Methode Mfg. Co., Inc.	Chicago, Ill.	J0000	Winchester Electronics, Inc.	
83125	Pyramid Electric Co.	Darlington, S.C.	91345	Miller Dial & Nameplate Co.	El Monte, Calif.	95354	Dage Electric Co., Inc.	Franklin, Ind.	J000P	Malco Tool and Die	Los Angeles, Calif.
83148	Electro Cords Co.	Los Angeles, Calif.	91418	Radio Materials Co.	Chicago, Ill.	95387	Wackeser Co.	Chicago, Ill.	J000M	Western Coil Div. of Automatic Ind., Inc.	Redwood City, Calif.
83186	Victory Engineering Corp.	Springfield, N.J.	91506	Augat Brothers', Inc.	Attleboro, Mass.	95607	Huggins Laboratories	Sunnyvale, Calif.	J000O	Ty-Car Mfg. Co., Inc.	Holliston, Mass.
83298	Bendix Corp., Red Bank Div.	Red Bank, N.J.	91637	Dale Electronics, Inc.	Columbus, Nebr.	96095	Hi-Q Division of Aerovox	Olean, N.Y.	J000Z	Willow Leather Products Corp.	Newark, N.J.
83315	Hubbell Corp.	Mundelein, Ill.	91662	Elco Corp.	Philadelphia, Pa.	96256	Thordarson-Meissner Div. of Maguire Industries, Inc.	Mt. Carmel, Ill.	J000A	British Radio Electronics Ltd.	Washington, D.C.
83330	Smith, Herman H., Inc.	Brooklyn, N.Y.	91737	Grenar Mfg. Co., Inc.	Wakelield, Mass.	96330	Solar Manufacturing Co.	Los Angeles, Calif.	J000B	ETA	England
83385	Central Screw Co.	Chicago, Ill.	91827	K F Development Co.	Redwood City, Calif.	96341	Microwave Associates, Inc.	Burlington, Mass.	J000C	Indiana General Corp., Elect. Div.	Indiana
83501	Gavitt Wire and Cable Co., Div. of Amerace Corp.	Brookfield, Mass.	91929	Minneapolis-Honeywell Regulator Co., Microswitch Div.	Freeport, Ill.	96501	Excel Transformer Co.	Oakland, Calif.	J000B	Precision Instrument Components Co.	Van Nuys, Calif.
83594	Burroughs Corp., Electronic Tube Div.	Plainfield, N.J.	91961	Nahn-Bros. Spring Co.	Oakland, Calif.	97979	Reon Resistor Corp.	Danvers, Mass.	J000M	Rubber Eng. & Development	Hayward, Calif.
83740	Eveready Battery	New York, N.Y.	92180	Tru-Connector Corp.	Peabody, Mass.	98141	Axel Brothers Inc.	Yonkers, N.Y.	J000N	A "N" D Manufacturing Co.	San Jose 27, Calif.
83777	Model Eng. and Mfg., Inc.	Huntington, Ind.	92196	Universal Metal Prod., Inc.	Bassett Puente, Calif.	98159	Rubber Teck, Inc.	Jamaica, N.Y.	J000Q	Coaltron	Oakland, Calif.
83821	Loyd Scruggs Co.	Festus, Mo.	92367	Elgeet Optical Co., Inc.	Rochester, N.Y.				J000S	Control of Elgin Watch Co.	Burbank, Calif.
84171	Arco Electronics, Inc.	New York, N.Y.	92607	Tinsolite Insulated Wire Co.	Tarrytown, N.Y.				J000W	California Eastern Lab.	Burlingame, Calif.
84396	A.J. Glesener Co., Inc.	San Francisco, Calif.	93332	Sylvania Electric Prod. Inc., Semiconductor Div.	Woburn, Mass.				J000Y	S.K. Smith Co.	Los Angeles 45, Calif.
84411	Good All Electric Mfg. Co.	Ogallala, Neb.	93369	Robbins and Myers, Inc.	New York, N.Y.						
84970	Sarkes Tatzian, Inc.	Bloomington, Ind.	93410	Stevens Mfg. Co., Inc.	Mansfield, Ohio						
85454	Boonton Molding Company	Boonton, N.J.	93788	Howard J. Smith Inc.	Port Monmouth, N. J.						
85471	A.B. Boyd Co.	San Francisco, Calif.									

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hp MANUAL BACKDATING CHANGES

MODEL 711A

POWER SUPPLY

Manual Serial Prefixed: 102-
-hp- Part No. 00711-90001

This manual backdating sheet makes this manual applicable to earlier instruments. Instrument-component values that differ from those in the manual, yet are not listed in the backdating sheet, should be replaced using the part number given in the manual.

Instrument Serial Prefix	Make Manual Changes	Instrument Serial Prefix	Make Manual Changes
1 to 238	1, 2, 3		
239 to 002-1389	1, 2		
002- and 029-01569	1		
All other 029-	Manual applies		

CHANGE #1

Table 5-1:

- M2: Change -hp- Part No. to 1120-0054.
- R16: Add 12 ohms $\pm 10\%$, 1/2 W; -hp- Part No. 0687-1201.
- R10: Change to 526 K $\pm 1\%$, 1 W; -hp- Part No. 0730-0094.
- R36: Change to 51.6 K $\pm 1\%$, 1 W; -hp- Part No. 0730-0052.
- R14: Change -hp- Part No. to 2100-0033.

Figure 4-4:

Resistor board assemblies; replace with the following assembly drawings:

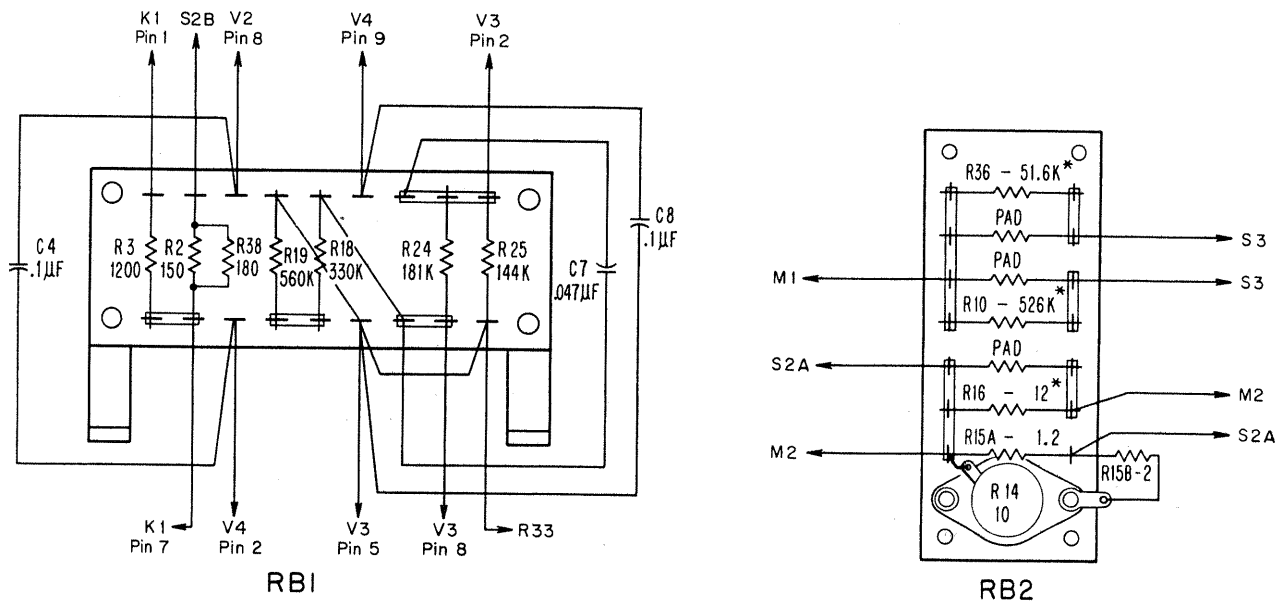


Figure 4-8:

Add R16 in parallel with M2 through S2A as shown on Backdating Schematic.
Change R10 to 526 K* and R36 to 51.6 K* as shown on Backdating Schematic.

CHANGE #2:

Table 5-1:

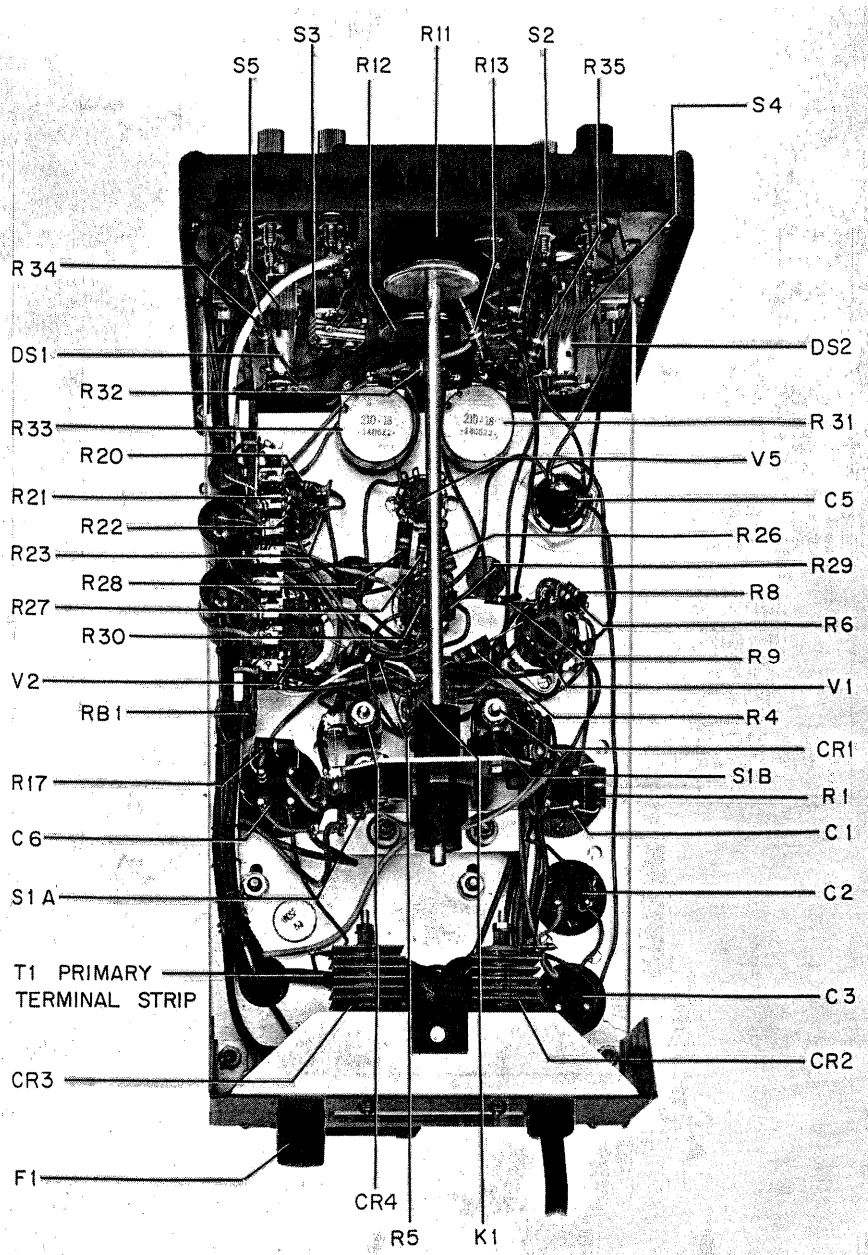
DS1, DS2: Change to Lamp, incandescent: 6-8 V, GE #47; -hp- Part No. 2140-0009.
 R34, R35: Add 33 ohms $\pm 10\%$, 1 W; Mfr 01121.

Figure 4-8:

Add R34 and R35 in series with DS1 and DS2 respectively as shown on Backdating Schematic.

Figure 4-6:

Replace with following view of chassis bottom:



CHANGE #3

S4A: Connect to input lead of M2 instead of output lead of M2 after R11 junction but before R15 junction as shown on Backdating Schematic.

hp MANUAL CHANGES

MODEL 711A

POWER SUPPLY

Manual Serial Prefixed 102-
Manual Printed 6/61

To adapt this manual to instruments with other serial prefixes check for errata below, and make changes shown in tables.

Instrument Serial Prefix	Make Manual Changes	Instrument Serial Prefix	Make Manual Changes
102-	1, 2, 3		

CHANGE #1

Table 5-1, Miscellaneous:

Change Insulator; hp Stock No. 1400-0084, to read:

Fuseholder; hp Stock No. 1400-0084.

CHANGE #2

Figure 4-6:

Change C2 to read C1 and C3 to read C2.

CHANGE #3

Table 5-1:

R26: Change to Resistor, fixed, composition, 47,000 ohms
±10%, 1W; hp Stock No. 0690-4731; Mfr. 01121

SR4: Change description to read: "Rectifier, selenium:
192V rms max, 25 ma dc max."

MODEL 711A REVISIONS

Please make the following changes to the parts list and schematic:

<u>Circuit Ref. No.</u>	<u>From</u>	<u>To</u>
C7	.047 μ f, 600V HP#0170-0005	.047 μ f, 600V, 148P47306
R1-5, 8, 13, 17, 26, 28, 32, 37, 38	1W, AB, \pm 10% HP#0630-_____	1W, AB, \pm 5% HP#0689-_____
R6, 7, 9, 18-23, 27, 29, 30	1/2W, AB \pm 10% HP#0687-_____	1/2W, AB \pm 5% HP#0686-_____
R24	181K, \pm 1%, 1/2W Oar film HP # 0730-0077	182K, \pm 1% 1/2w Met. film HP # 0757-0311
S4	250V, 3A DPST HP#3101-0003	250V, 1A DPDT Carling #316B-62
S5	250V, 3A SPST HP#3101-0001	250V, 3A, SPST Carling #T-110-62
Line Cord	HP # 8120-0015	6', 18-3 Slate Grey, Plug PH151 Type SJT JP10, Stripped & Tinned Belden # KH-4629
Insulator, tube	HP # 1220-0001	Delete