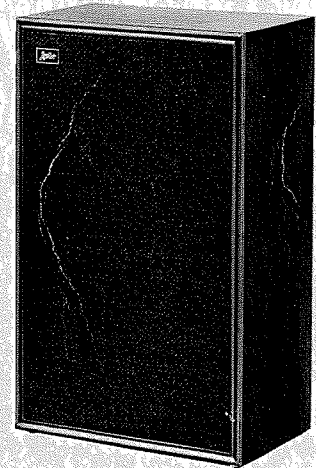
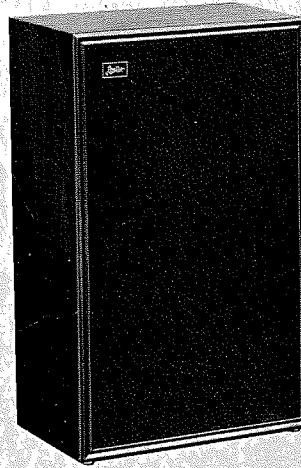
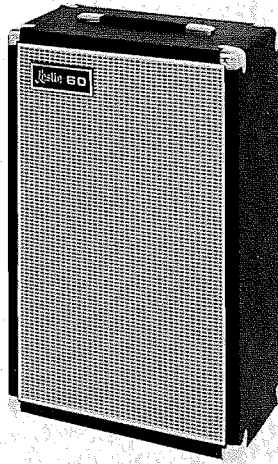
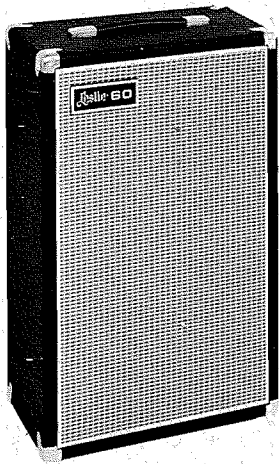




SPEAKER SYSTEM MODELS 60/70

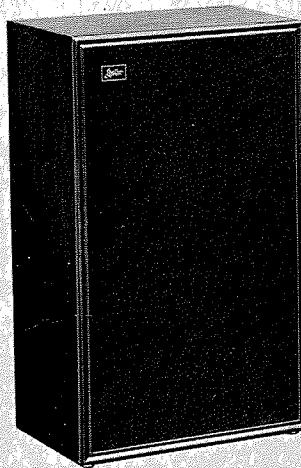
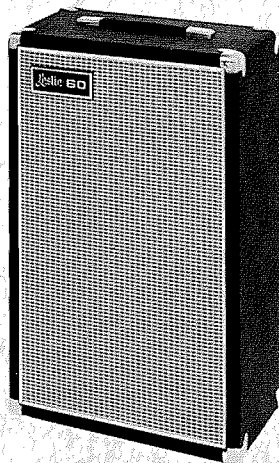
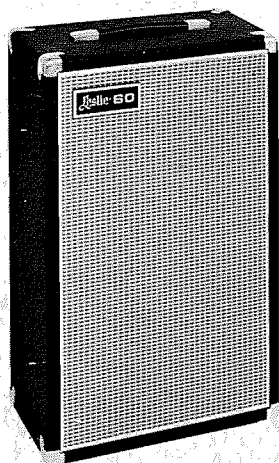


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SERVICE MANUAL



SPEAKER SYSTEM MODELS 60/70



Vintage Vibe
of Everment Ltd.
Wharton, NJ 07885
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SERVICE MANUAL

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INTRODUCTION

LESLIE Speaker System Model 60/70, a set of two speakers, was originally created for use with electronic pianos. This highly-desirable supplementary equipment lends body and overtones to the piano output, giving it a particularly beautiful sound. The two speakers, used together, create a stereophonic effect. The speaker system may also be used with other instruments, such as the guitar, organ, and accordion.

Model 70 is functionally identical to model 60; its cabinet is wood, to blend with home furnishings.

Information and illustrations apply to both models unless otherwise noted.

No rotor is needed in this completely new design; the special sound quality is achieved electronically through the operation of circuits incorporating a programmable unijunction transistor.

The main cabinet contains the major operating components, consisting of the power supply, amplifier assembly, space generator and drive assembly (hereafter called the space generator), and speaker. Input and output connectors are located on the power supply. Major components are identified in figure 1 and their functional relationships are shown in figure 2.

The satellite cabinet contains the second speaker and provides a storage space for lines and connections. A control assembly links the instrument with the model 60/70 system and provides a means of regulating the performance of the equipment.

Plastic covers are provided with the model 60 to protect the speakers when they are being moved or are not in use.

All components are described in other portions of this manual; parts lists and servicing information are given for each.

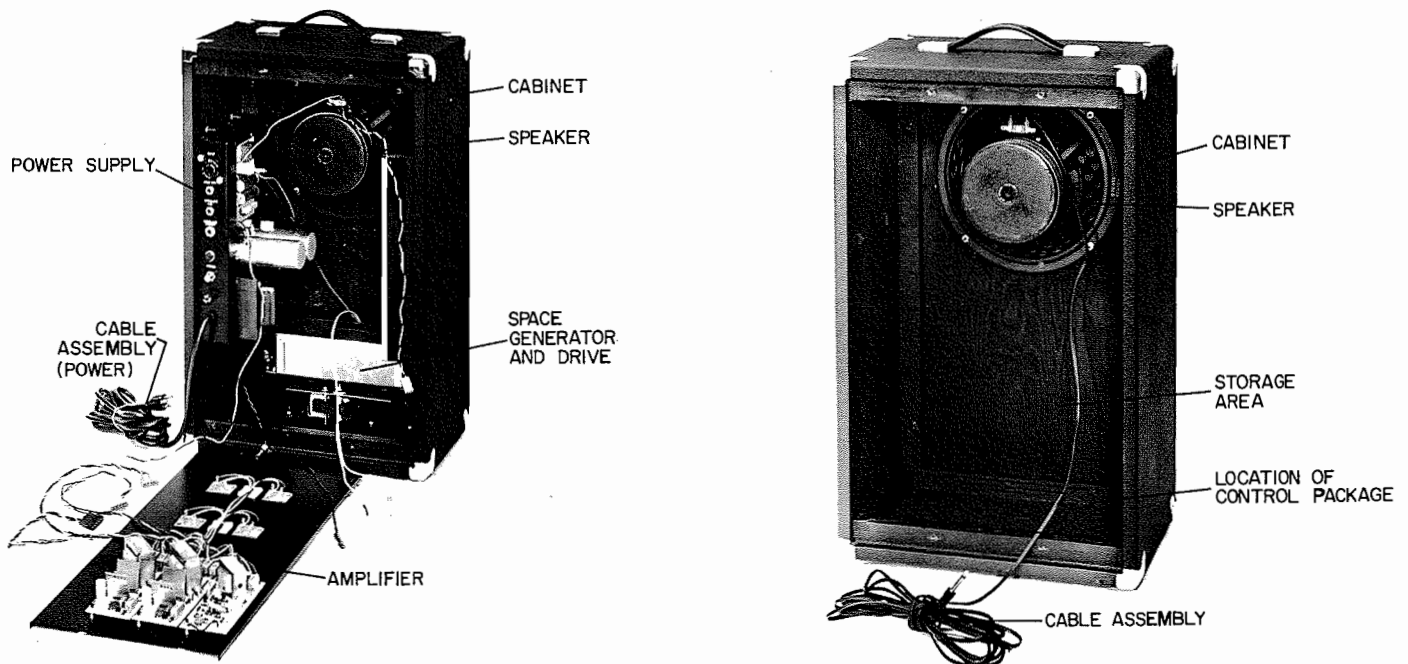


Figure 1. Model 60 System Major Components

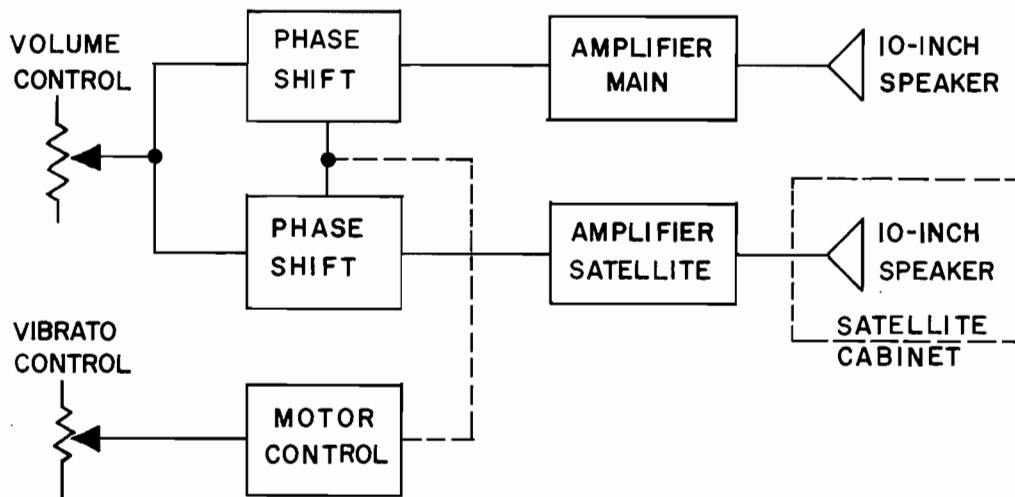


Figure 2. Functional Block Diagram

SPECIFICATIONS

Cabinet Finish 60: Cabinets covered with Black Levant Leatherette; grill cloth blue highlights on silver and black cloth. Edge trim of Nychrome.

70: Walnut or other specified wood finish.

Cabinet Dimensions height: 24-7/8 inches
width: 15-5/8 inches
depth: 10 inches

Speakers Two 10-inch diameter permanent magnet speakers. Impedance 4 ohms at 400 Hz ($\pm 10\%$).

Output Power Each cabinet 50 watts.

Weight Complete system, ready for shipping, 96 lb.
Main cabinet 55 lb.
Satellite cabinet 33 lb.

Fuses* 2 1/2 amps, 125 V, slo-blo.
3 amps, 125 V,
wired into power supply.

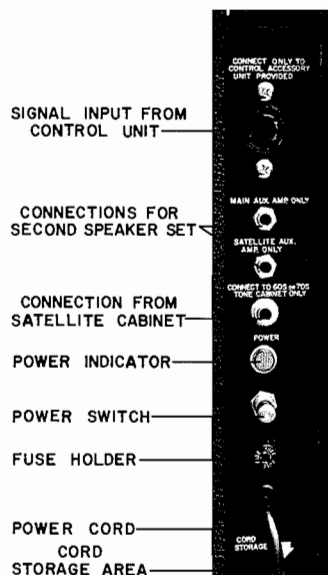


Figure 3. Power Supply Panel, Showing Connections

SECTION I. USER'S INFORMATION

PREPARING THE SPEAKER FOR USE

Unpacking

After opening the box which contains the two speakers, remove the foam inserts which hold the cabinets securely in place. Lift the speakers out one at a time. (The main speaker is heavy! You will note that the plastic covers are packed one on each side of the carton, between the cabinet and the side of the carton.

Model 70 cabinets are mounted on skids, which should be removed at this time.

The control unit and cord are packed inside the satellite cabinet. Remove the back panel by taking out the six screws. (Keep the screws.) Follow the unpacking instructions on the panel, being careful not to let the control unit drop.

Different control units and supplementary components are provided to properly link the LESLIE Speaker System Model 60/70 to various makes and models of electronic pianos, organs, etc.

Connecting

Individualized instruction sheets accompany the equipment for each particular use, and these should be followed for proper installation.

The connection points on the main cabinet are shown in figure 3.

LOCATING THE SPEAKERS

One of your first considerations will be where to place the speakers for best effect. As with stereophonic speakers, the two cabinets should be placed so that the pattern of sound focuses on the area where the listener will be located. The lengths of the interconnecting cords allow considerable variation in the spacing and location of the individual cabinets. Your own experience and taste are the best guides for placing the speakers.

ADDING SPEAKERS

If you desire to use a second set of amplifiers and speakers with your piano plug the second set of amplifiers into the MAIN AUX and SATELLITE AUX jacks provided on the back of the first main cabinet.

MOVING AND SHIPPING

The speakers are easily moved individually, since each is just the size of a large suitcase. Model 60 cases are provided with a handle on the top.

Disconnect the cord from the satellite cabinet jack on the main speaker and gather it loosely together. Put the cord into the satellite cabinet through the opening in the back panel.

Remove the control by following the instructions which accompanied the control. The control and its cords may also be stored inside the satellite cabinet. (Wrapping the control in paper or cloth will prevent its being marred by moving about and will also protect the speaker.)

Unfasten the line cord from the power outlet on the wall. Wrap the cord compactly and place it in the opening at the lower left of the back of the main cabinet. (See figure 1.) The speaker system is now ready to move.

If the speakers are to be shipped by truck, rail, or air, it is recommended that they be placed in a protective box or crate and be marked for careful handling.

CLEANING THE CABINETS

You can use saddle soap, a mild detergent, or hot water to clean the outside surface of the model 60 cabinets. Use a sponge and clean thoroughly. Then wipe off excess moisture and let the cabinets air dry.

Do not use strong chemicals such as acetone or ammonia. They will permanently mar the luster of the covering material.

Treat your model 70 LESLIE speaker cabinet just as you would any other piece of fine wood furniture. Dusting is all the care normally needed; if desired it may be treated with a furniture polish or wax. A vacuum cleaner may be used on the grille cloth.

LINE VOLTAGE

Operating voltage is 117 V, 60 Hz (nominal). If voltage should drop below 100 V distortion will result. A voltage regulator should be used if line voltage is subject to fluctuation below this limit or over 140V.

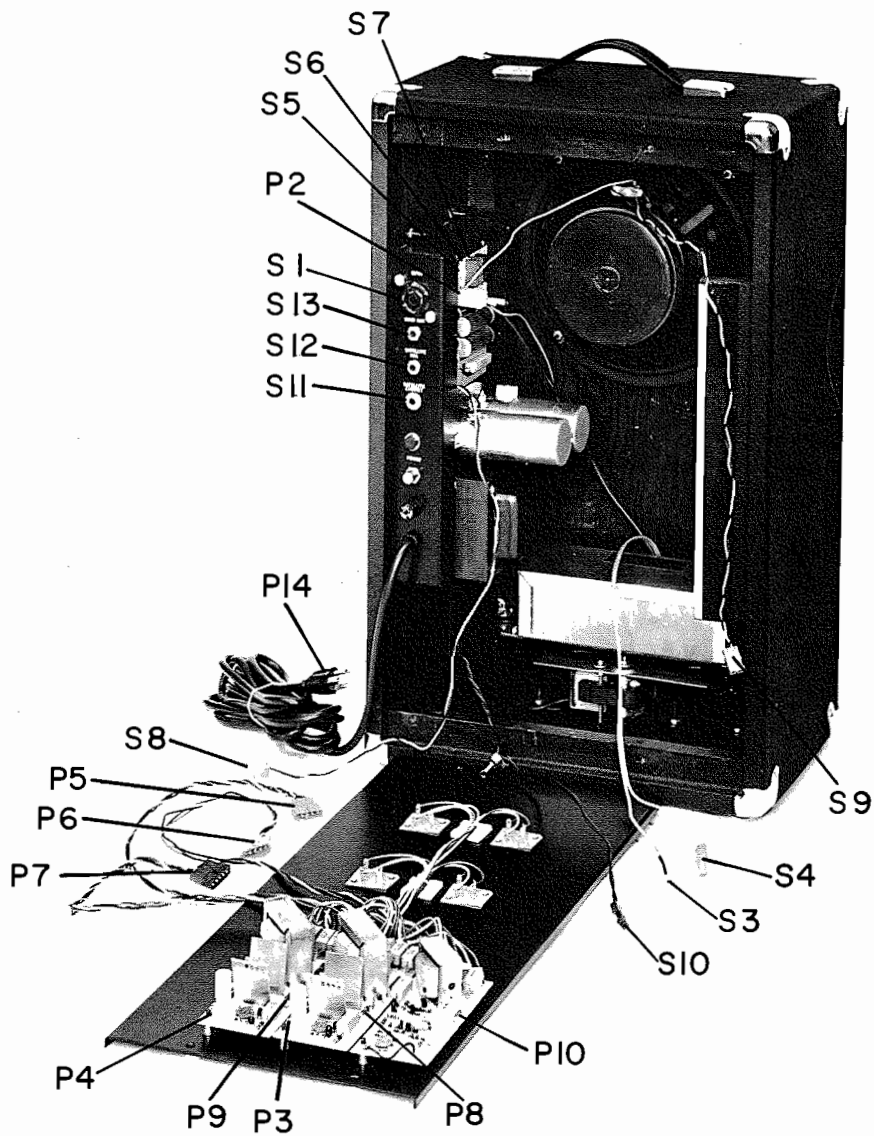


Figure 4. Connector Identification

CONNECTORS			
<i>Location</i>	<i>Plug</i>	<i>Socket</i>	<i>Location</i>
control unit	P1	S1	main cabinet SIGNAL INPUT
space generator	P2	S2	power supply
amplifier satellite channel	P3	S3	space generator
amplifier main channel	P4	S4	space generator
amplifier satellite channel	P5	S5	power supply
amplifier main channel	P6	S6	power supply
amplifier motor control board	P7	S7	power supply
amplifier satellite channel	P8	S8	power supply
amplifier main channel	P9	S9	main speaker
amplifier motor control board	P10	S10	space generator (motor)
satellite cabinet	P11	S11	main cabinet SATELLITE CABINET input
		S12	main cabinet SATELLITE AUX input
		S13	main cabinet MAIN AUX input
power supply	P14		AC outlet

SECTION II. SERVICE INFORMATION

GENERAL

AMPLIFIER CIRCUIT BOARDS

The two amplifier circuit boards (figure 7) are identical in circuitry. If one speaker fails to operate, the leads to the circuit boards may be switched. If the inoperative speaker then functions properly, check the amplifier circuit board to which it was previously connected, for defective parts.

To check the amplifier operation while the amplifier is connected to the speaker circuitry, remove the screws which hold the amplifier to the cabinet, unwrap the tape from the amplifier lead wires, and lean the amplifier against the edge of the cabinet. (The amplifier will not lay flat while the connections are in place.)

CAUTION: Do not short the leads of the printed circuit boards in order to discharge voltage. Damage to the components or board may result.

VOLTAGE CHECKS

Voltage may be checked at various points relative to the portion of the circuit being examined. Input and output values are shown on circuit board drawings and on the schematic. Measurements should be made with a 20,000-ohms-per-volt meter. Values may vary $\pm 10\%$ from those listed, under normal no-signal operating conditions.

REPAIR OF CIRCUIT BOARDS

The circuit boards in the space generator assembly are fairly complex, and field repair may be difficult. If desired, the entire circuit board assembly may be replaced. Refer to the wiring diagrams for proper connections when installing new boards.

TRANSISTOR REPLACEMENT

If it is necessary to replace a transistor it is best to obtain the replacement part through a LESLIE speaker dealer. In some cases parts must

be selected from factory lots by testing each for its operating characteristics. See PARTS ASSEMBLY for detailed instructions on transistor installation.

TROUBLESHOOTING

The model 60 circuits have been engineered for durability and trouble-free operation. Trouble may occasionally develop after the equipment has been moved, or after long use. Always check the connections to be sure that they are properly located and that solid contact is made between plug and socket.

Use the troubleshooting table as a guide to possible trouble causes and remedies. Voltages indicated on the schematic at the rear of the manual may be used to check the operation of the circuits at various key points.

If replacement of individual parts is required, consult the appropriate photographs and parts lists for numbers and values. Rewiring after disassembly may require reference to the wiring diagrams.

REMOVAL OF MAJOR COMPONENTS

If troubleshooting has indicated that replacement of parts is necessary, the major components may be removed to facilitate repair.

WARNING

Disconnect the power cable before opening the cabinet.

Amplifier

The amplifier parts are mounted on the back panel of the main speaker cabinet (fig. 1). To expose the parts for service remove the four screws that hold the panel to the cabinet. Support the panel while removing the screws. Wires connected internally may be torn loose if the panel is permitted to fall.

TROUBLE	POSSIBLE CAUSE	REMEDY OR NEXT CHECK
a. Sound distortion	Volume too high or wrong range.	Check control settings.
	Improper line voltage.	Check voltage. Install regulator if necessary.
b. Speaker crackling	Defective speaker.	Replace speaker.
	Defective input transistor Q11 on satellite channel amplifier circuit board.	Replace Q11.
	Faulty plug or loose connection on phone plug of connector unit.	Unscrew cover of plug; check wiring.
c. Neither speaker emits tremolo sound	Defective speaker.	Replace speaker.
	Faulty space generator circuit board assembly.	Check rotary capacitor carbon button for solid contact. Check Q3 and Q7.
	Power supply inoperative.	Check input voltage. Check fuses.
d. Motor not running	Motor inoperative.	Go to "d."
	Belt off pulley.	Replace belt on pulley.
	Belt stretched or broken.	Install new belt.
e. Fuse blows	Motor defective.	Repair or replace motor.
	Lead not connected.	Check leads.
	Motor control board component defective.	Check T4. Perform point to point check. Check transistors Q29 and Q30.
	Shorted power transformer.	Replace transformer.
	Shorted diode in bridge rectifier circuit.	Replace diode.
	Shorted output transistor.	Replace transistor.

When the screws are out, tip the panel away from the top of the cabinet, reach inside, and disconnect sockets S8, S10, S3, S4, and S9 (figure 4) from the upper portion of the circuit boards. Then disconnect plugs P5, P6, and P7 from the power supply. The panel will now lay flat.

Power Supply

The power supply may be removed while the cabinet is in the upright (normal) position or the cabinet may be laid on its side before the nuts are loosened.

First remove the amplifier, as previously described. Disconnect plug P2 (figure 4). Remove all plugs from the inputs at the left of the cabinet rear (on the side of the power supply chassis). Disconnect the single orange wire from the dot-coded terminal of the speaker.

It may be convenient to remove the L-shaped bracket which is mounted on the bottom of the cabinet, below the power supply. This will provide more space in which to work. If desired, the space generator may also be removed.

WARNING

The power supply is heavy and could cause injury or damage if permitted to fall.

Remove the four nuts which hold the power supply to the screws on the side of the cabinet. Loosen the nuts alternately, supporting the assembly while doing so. Move the power supply straight out away from the screws, and out of the cabinet.

Speaker (Main)

Remove the amplifier, as previously described. Disconnect the lead between the power supply and the speaker at the speaker terminal. Remove four nuts which hold the speaker to the cabinet, and remove the speaker.

Space Generator

Remove the amplifier, as previously described. Loosen and remove the three wing nuts that hold the assembly to the U bracket at the bottom of the cabinet. Retain the screws (and bushings, if removed) and wing nuts for reassembly. The space generator may now be lifted out of the cabinet.

Speaker (Satellite)

Remove the four screws that hold the back panel in place and remove the panel. The speaker may be taken out without disconnecting the wires, if desired. Remove the nuts and washers, and the cable clamp, to release the speaker from the cabinet.

REPLACEMENT OF MAJOR COMPONENTS

In general, major components may be replaced in their cabinets by reversing the removal procedure. Observe the following instructions as well.

NOTE: When replacing components in the main speaker cabinet be sure to reconnect all plugs and sockets correctly on the amplifier. (See figure 4.)

Speaker (Main)

Place the speaker so that the terminals point upward (red dot to the right as you see it). If the wires were removed from the speaker terminals, connect the single wire (orange) from the power supply to the dot-coded terminal. The orange wire of the twisted black-and-orange pair from the amplifier (terminating in S9) also goes to the dot-coded terminal. The black wire goes to the other terminal.

Power Supply

After fastening the power supply in place, insert P2. Reconnect the single orange wire to the dot-coded terminal of the speaker. If the L-shaped bracket at the bottom of the cabinet was removed, replace it at this time.

Amplifier

Lay the back panel down behind the cabinet so that the circuit boards will be at the top when the panel is fastened. (See figure 4.) Lift the

top part of the panel until the panel is at an angle of about 45 degrees. Now connect all plugs and sockets. Close the panel and fasten it in place.

Speaker (Satellite)

Place the speaker so that the terminals point to the right (as you see it). If the cable assembly has been removed, connect the smooth wire to the dot-coded terminal and the ribbed wire to the other terminal on the speaker. Replace the cabinet back.

DISASSEMBLY DETAILS

Where no special instructions are given, remove the parts in the order listed.

AMPLIFIER

When the screws that hold a circuit board to the amplifier have been removed the board may be lifted on one end and moved around to gain access to the circuits and parts, for testing. To remove the board entirely, unsolder the wires from the terminals at the ends.

PARTS IDENTIFICATION

Figures 5 through 18 indicate the locations of the individual parts in each major assembly, and the accompanying lists identify each part by number and give its description.

Commonly-used replacement parts may be obtained from the factory. Bulk items and those readily obtainable through local stores are not listed. Where possible the parts are listed in disassembly order.

Basic parts lists reflect the 117-V, 60-Hz model; parts which are found only in the 220-V or 240-V models are indicated by footnote symbols.

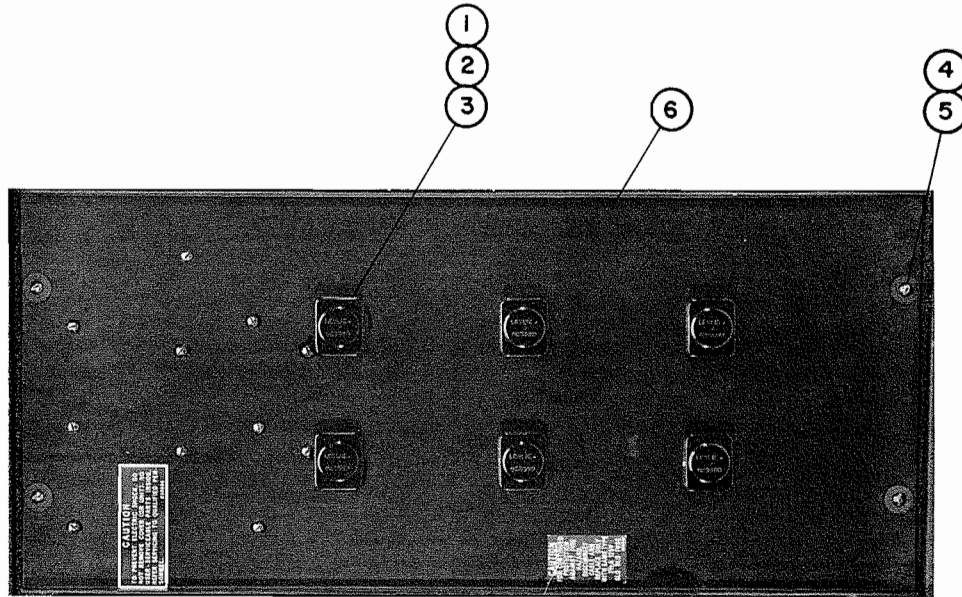


Figure 5. Amplifier 109620 Parts (Outside View)

Item	Description	Part No.
1	Cover, transistor	023580
2	Transistor, 2N3055	023762
3	Washer, insulating, mica	023176
4	Screw, machine, 10-24 x 7/8, round head	030155
5	Washer, flat, .194 x 3/4 x 1/16	031716
6	Heat sink (with or without louvres)	109610

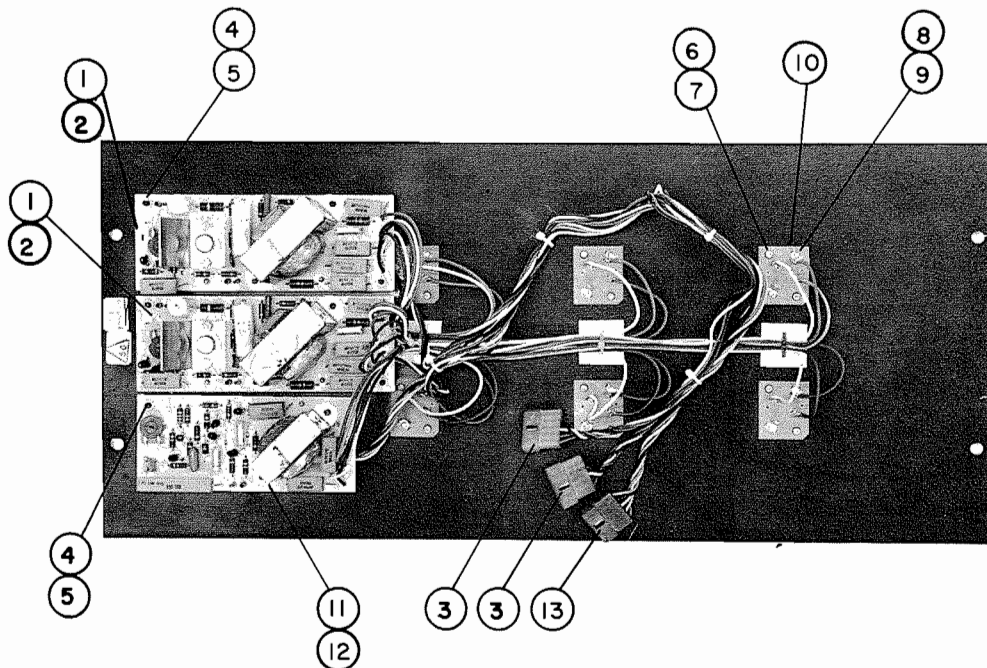


Figure 6. Amplifier Parts (Inside View)

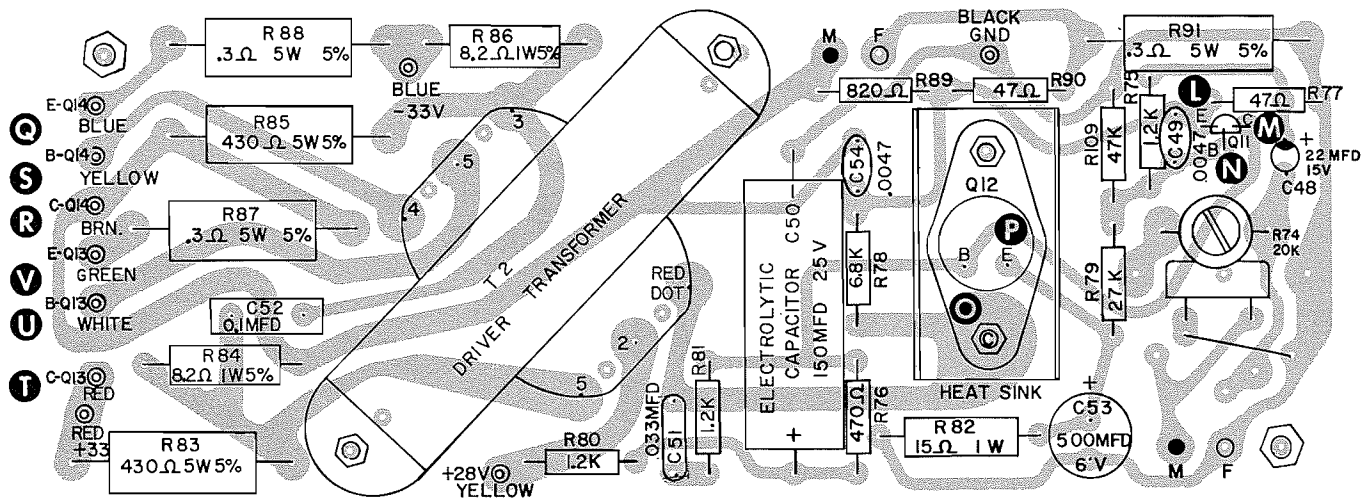


Figure 7. Circuit Board Assembly 031781 (Amplifier)

Reference Designation	Description	Part No.	Reference Designation	Description	Part No.
C48	Capacitor, tantalum, 22 mfd, 15V	062638	R82	Resistor, 15 ohms, 1W, 10%	031823
C49	Capacitor, .0047 mfd	028431	R83	Resistor, wire wound, 430 ohms, 5W, 5%	023648
C50	Capacitor, electrolytic; 150 mfd, 25V	031294	R84	Resistor, 8.2 ohms, 1W, 5%	031807
C51	Capacitor, .033 mfd	028654	R85	Resistor, wire wound, 430 ohms, 5W, 5%	023648
C52	Capacitor, 0.1 mfd	022251	R86	Resistor, 8.2 ohms, 1W, 5%	031807
C53	Capacitor, electrolytic; 500 mfd, 6V	055483	R87, R88	Resistor, wire wound, 0.3 ohm, 5W, 5%	023218
C54	Capacitor, .0047 mfd	028431	R89	Resistor, 820 ohms, 1/2 W, 10%	028373
Q11	Transistor, MSPS 4382	026237	R90	Resistor, 47 ohms, 1/2 W, 10%	016311
Q12	Transistor, 2N3054	023754	R91	Resistor, wire wound, 0.3 ohm, 5W, 5%	023218
R74	Potentiometer, 20K	023119	R109	Resistor, 47K, 1/2 W, 10%	028506
R75	Resistor, 1.2K, 1/2 W, 10%	018036	T2	Transformer, driver	023770
R76	Resistor, 470 ohms, 1/2 W, 10%	028068		Circuit Board, etched	022848
R77	Resistor, 47 ohms, 1/2 W, 10%	016311			
R78	Resistor, 6.8K, 1/2 W, 10%	016501			
R79	Resistor, 27K, 1/2 W, 10%	020834			
R80, R81	Resistor, 1.2K, 1/2 W, 10%	018036			

(KEY TO FIGURE 6)

Item	Description	Part No.	Item	Description	Part No.
1	Circuit assembly, driver amplifier (orange)	031542	7	Eyelet, 1/8 x 1/32, SE47	030429
2	Circuit Board Assembly	031781	8	Screw, machine, 6-32 x 3/8, round head	027979
3	Cable Assembly, driver amplifier (orange)	031773	9	Washer, lock, #6 x 9/32 x .018	028993
4	Screw, machine, 6-32 x 3/8, hex washer head	113780	10	Socket, transistor	023168
5	Standoff, 6-32 x .375	113760	11	Circuit assembly, motor control (red)	109820
6	Screw, thread cutting, 3-28 x 1/2, round, Phillips head	023812	12	Circuit Board Assembly, motor control	109810
			13	Plug, Cable, and Housing Assembly, 5-circuit (red)	109790

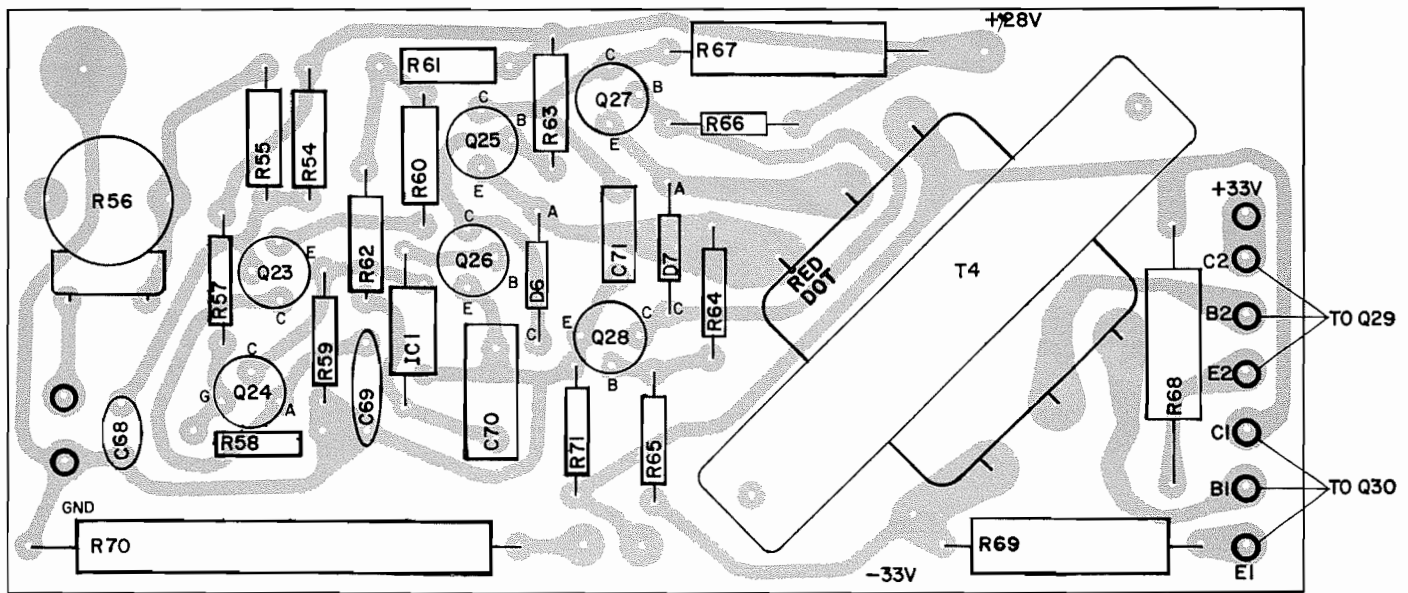


Figure 8. Circuit Board Assembly 109810 (Motor Control)

Reference Designation	Description	Part No.	Reference Designation	Description	Part No.
C68	Capacitor, disc, .0047 mfd, 100V, 10%	028431	R59	Resistor, 47 ohms, 1/2 W, 10%	016311
C69	Capacitor, mylar, .033 mfd, 100V, 10%	028654	R60	Resistor, 100K, 1/2 W, 10%	028498
C70, C71	Capacitor, polypropylene, 0.1 mfd, 200V, 20%	022251	R61	Resistor, 68 ohms, 1/2 W, 10%	038661
D6, D7	Diode, 30 P.I.V., 500 mW	041616	R62	Resistor, 2.2K, 1/2 W, 10%	028571
IC1	Integrated Circuit, toggle flip-flop	109690	R63	Resistor, 4.7K, 1/2 W, 10%	028555
Q23	Transistor, TZ-554, PNP	033589	R64	Resistor, 220 ohms, 1/2 W, 10%	028381
Q24	Transistor, programmable unijunction	109700	R65	Resistor, 10K, 1/2 W, 10%	028548
Q25 th Q28	Transistor, 2N3414, NPN	030254	R66	Resistor, 4.7K, 1/2 W, 10%	028555
R54	Resistor, 15K, 1/2 W, 10%	048157	R67	Resistor, wire-wound, 430 ohms, 5W, 5%	023648
R55	Resistor, 33K, 1/2 W, 10%	028522	R68, R69	Resistor, wire-wound, 0.5 ohm, 5W, 5%	023200
R56	Potentiometer, 20K	023119	R70	Resistor, wire-wound, 2.2 ohms, 10W, 10%	110160
R57, R58	Resistor, 10K, 1/2 W, 10%	028548	R71	Resistor, 2.2K, 1/2 W, 10%	028571
			T4	Transformer, driver, high frequency	023788

(KEY TO FIGURE 10)

Item	Description	Part No.
1	Nut, hex, 8-32 x 11/32 x 1/8	026773
2	Washer, lock, 8 x 5/16 x .020	026765
3	Washer, flat, 8 x 3/8 x 1/32	037325
4	Lug, ground, #8	029355
5	deleted	
6	Washer, lock, 3/8 x 11/16 x .035	020396
7	Nut, hex, 3/8-32 x 1/2 x 3/32	020388
8	Jack, phone, 2-circuit	039602
9	Resistor, 47 ohm, 1/2 W, 10% (R115, R116)	016311
10	Resistor, 1K, 1/2 W, 10% (R114)	023713
11	Washer, flat, .385 x .625 x .063	109670
12	Washer, shoulder, .385 x .500 x .625	109680
13	Lamp, pilot, red, 117V	014720
14	Lamp, pilot, red, 220V	014738*
15	Switch, push, SPST	026435
16	deleted	
17	Nut, hex 15/32 x 9/16 x 1/16, nickel plated	044776
18	Washer, lock, 1/2 x 7/8 x .030	020958
19	Fuse, 2 1/2 amp, 125V, slo-blo (FZ2)	113480†
19	Fuse, 4 amp, 250V, (FZ1)	113470
19	Fuse, 1 1/2 amp, 125V, slo-blo	021766*
20	Fuseholder	055178
21	Bushing, strain relief, 6P3-4	037986
22	Screw, sheet metal, 12 x 3/8, Phillips head (2)	022095

23	Socket, 5-contact, with plate	055756
24	Chassis Assembly	110820

* Used on 220-V and 240-V power supplies.
 † Only on 117-V power supplies.

(KEY TO FIGURE 9)

Item	Description	Part No.
1	Transformer, power (T1)	030437
2	Power Cable, AC 12-foot	030445*
2	Power Cable, AC 12-foot, 220-V	039636
3	Capacitor, electrolytic, 5000 mfd, 50V (C64, C65)	015040*
4	Clamp, capacitor mounting	022962
5	Screw, machine, 10-32 x 1 1/2, Phillips head	023010
6	Nut, square, 10-38 x 3/8	025544
7	Screw, sheet metal, 6 x 1/4, HWH	031872
8	Cable and Housing Assembly	026666
9	Connector, tab, female	109770
9	Connector, tab, female	029389
10	Circuit Board Assembly	109720
11	Screw, machine, 6-32 x 3/8, hex washer head	113780
12	Standoff, 6-32 x .875	113770

* Used on 220-V and 240-V power supplies.

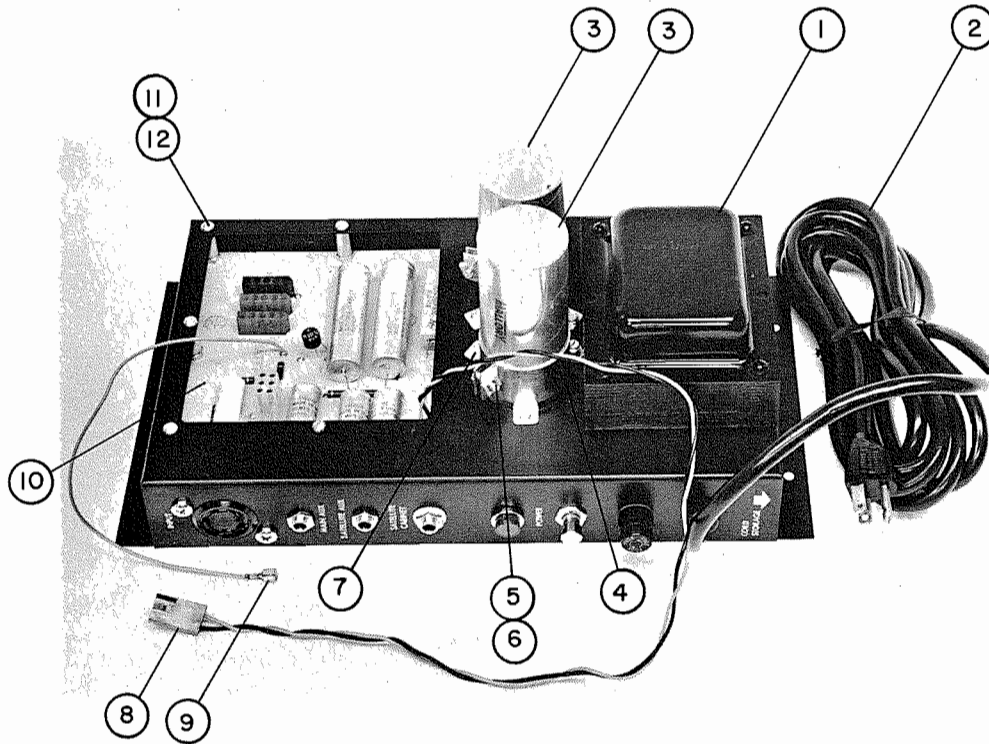


Figure 9. Power Supply 109710 (110650, 110660) Parts (Upper Side)

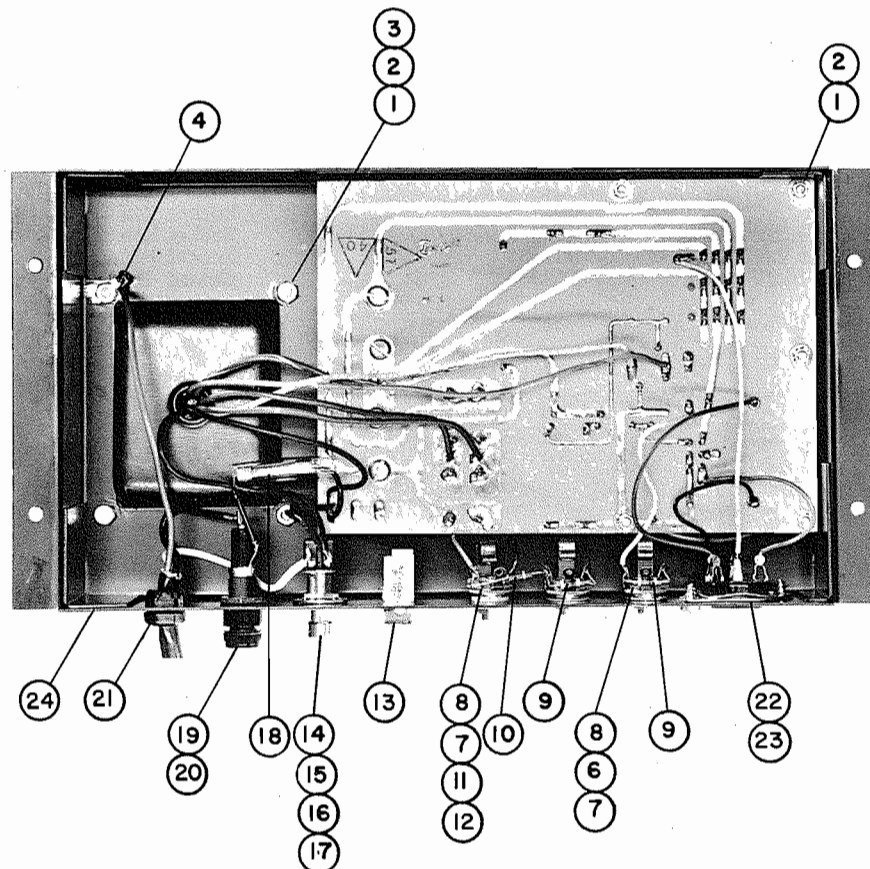


Figure 10. Power Supply Parts (Lower Side)

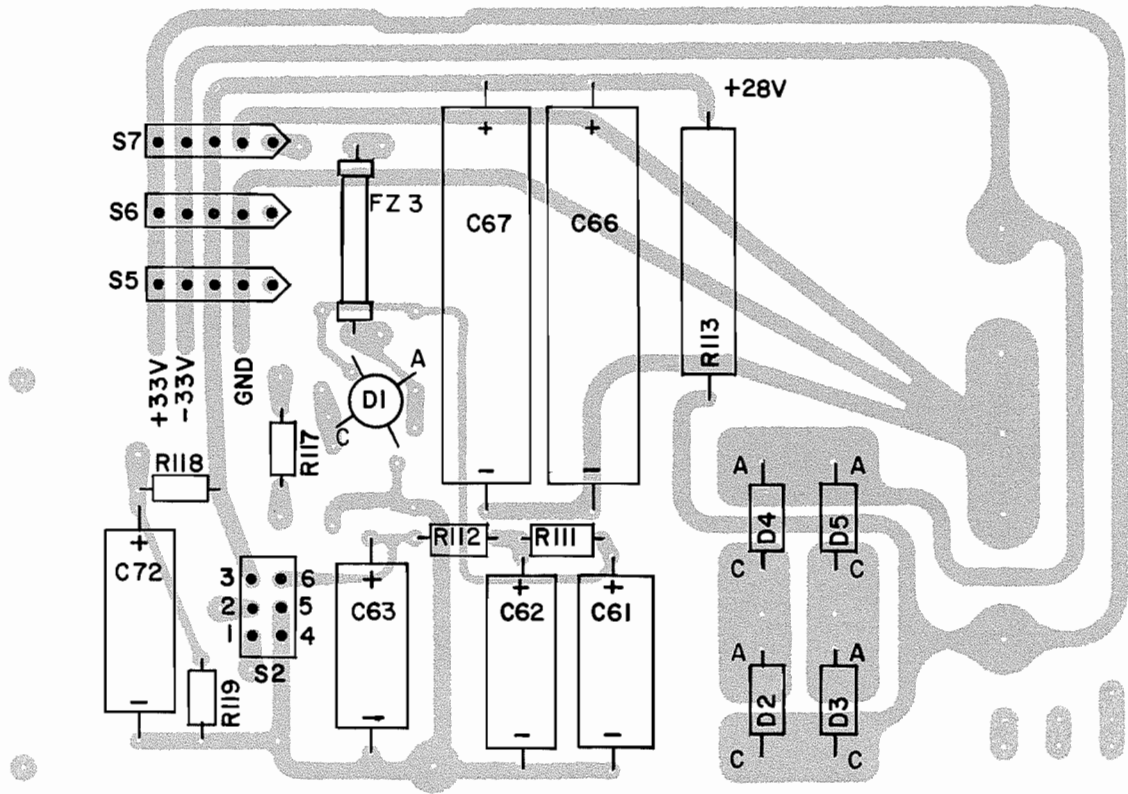
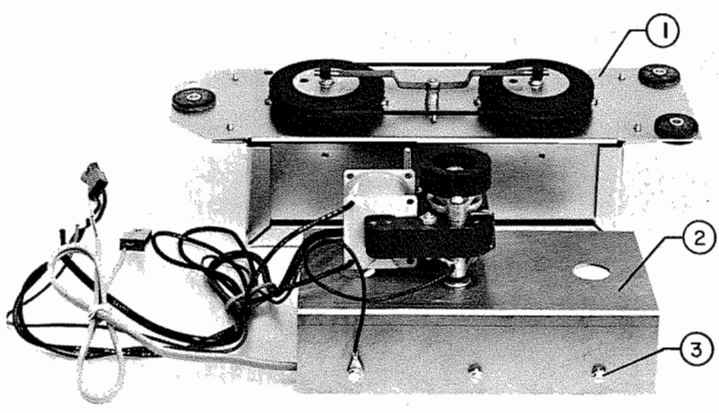


Figure 11. Circuit Board Assembly 109720 (Power Supply)

Reference Designation	Description	Part No.	Reference Designation	Description	Part No.
C61, C62, C63	Capacitor, electrolytic, 10 mfd, 250V	018093	R111, R112	Resistor, 2.2K, 1/2W, 10%	028571
C66, C67	Capacitor, electrolytic, 1000 mfd, 35V	023507	R113	Resistor, wire-wound, 8 ohms, 10W, 10%	010934
C72	Capacitor, electrolytic, 250 mfd, 35V	065086	R117, R118	Resistor, 1K, 1/2W, 10%	023713
D1	Diode, single-phase bridge	104790	R119	Resistor, 3.3K, 1/2W, 10%	024141
D2 th D5	Diode, 200 P.I.V., 3 amp	031450	S2	Socket housing, 6-circuit, white	023267
FZ3	Fuse, 1 amp, 250V	113460	S5, S6	Socket housing, 5-circuit, orange	109250
			S7	Socket housing, 5-circuit, red	109260
				Circuit Board, etched	109640



Item	Description	Part No.
1	Space Generator Assembly	109860
2	Motor Assembly, one-speed	110690
3	Screw, machine, 6 x 1/4, hex washer head	026666

Figure 12. Space Generator 109850 Main Parts

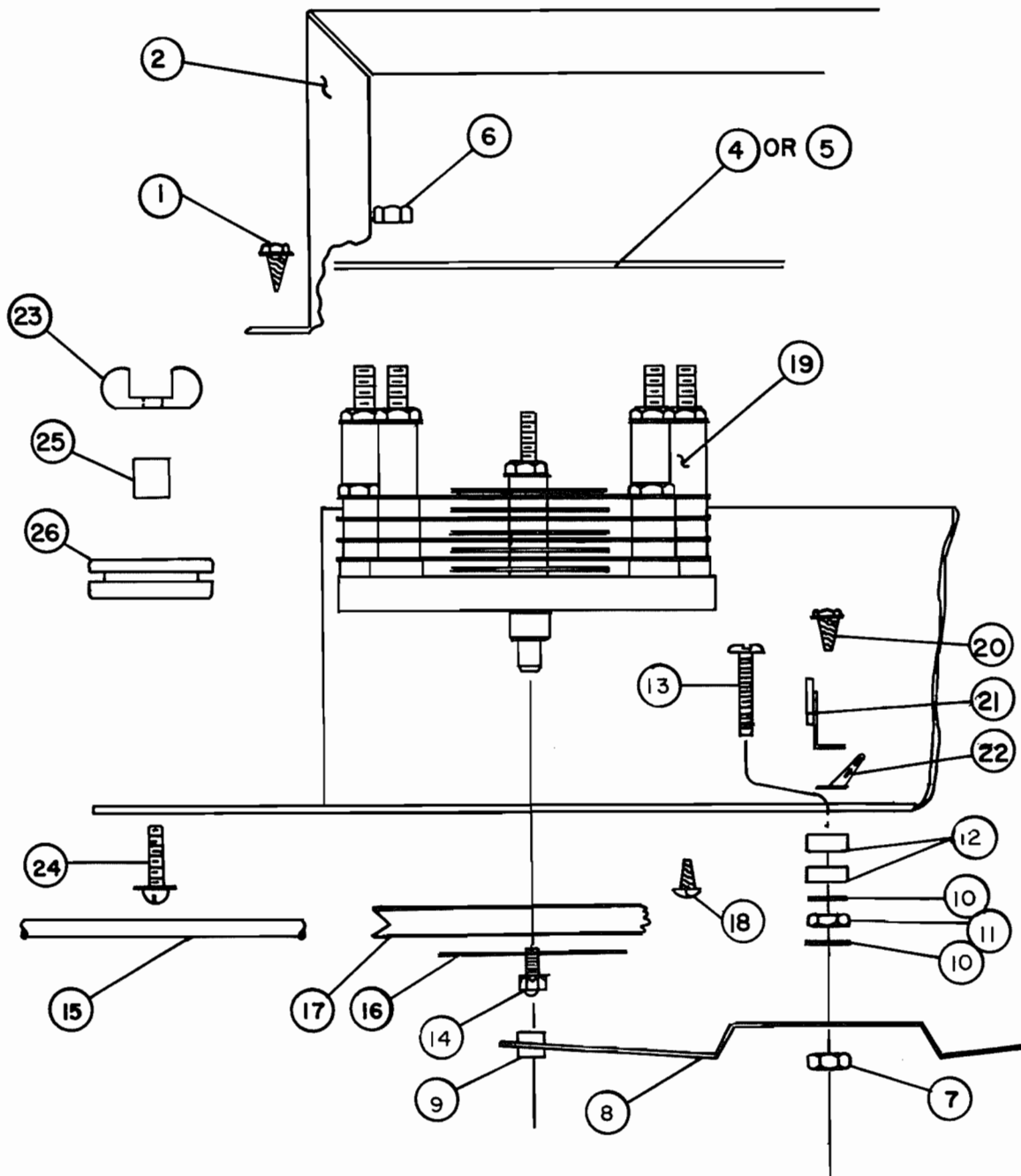


Figure 13. Space Generator Parts

Item	Description	Part No.	Item	Description	Part No.
1	Cover, chassis	022293	15	O-ring (belt)	111090
2	Chassis, generator box	022285	16	Washer, flat, 8 x 1-1/2 x .025	112750
3	Screw, sheet metal, 6 x 1/4, hex washer head	026666	17	Pulley drive	109780
4	Circuit Board Assembly	023598	18	Screw, sheet metal, 8 x 3/8, Phillips head	029348
5	Circuit Board Assembly	109830	19	Rotary capacitor	062976
6	Nut, hex, 10-32 x 3/8 x 1/8	027953	20	Screw, sheet metal, 6 x 1/4, hex washer head	026666
7	Nut, hex, 6-32 x 5/16 x 7/64	012930	21	Terminal strip, one-lug	055319
8	Retainer, contact	112760	22	Ground lug, #8	029355
9	Contact, carbon	012088	23*	Wing nut, 10-24	050625
10	Washer, lock, 6 x 9/32 x .018	028993	24*	Screw, machine, 10-24 x 5/8, with lockwasher	025445
11	Nut, hex, 6-32 x 5/16 x 7/64	012930	25	Bushing, .196 x .312 x .325	051060
12	Bushing, .193 x .312	013656	26	Grommet	050641
13	Screw, machine, 6-32 x 5/8, Phillips head	029348			
14	Screw, machine, 8-32 x 1/4, hex washer head	112740			

* Not part of this assembly.

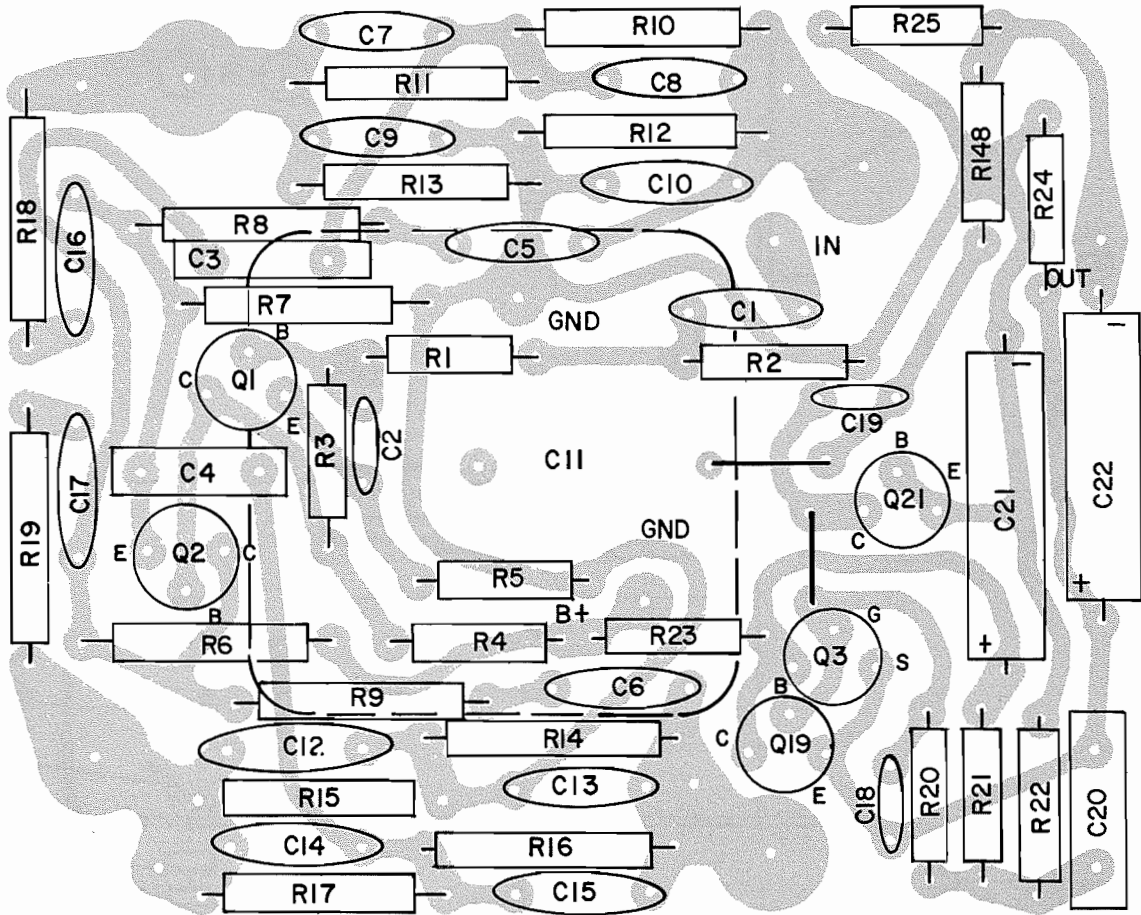


Figure 14. Circuit Board Assembly 023598 (Space Generator)

Reference Designation	Description	Part No.	Reference Designation	Description	Part No.
C1	Capacitor, mylar, .033 mfd, 100V, 10%	028654	Q3	Transistor, FET 2N5163	023606
C2	Capacitor, disc, 4700 pf, 100V, 10%	028431	Q19, Q21	Transistor, NPN, 2N3859A	061366
C3, C4	Capacitor, poly, 0.1 mfd, 200V, 20%	022251	R1	Resistor, 47K, 1/2W, 10%	028506
C5	Capacitor, mica, 2700 pf, 500V, 5%	024059	R2	Resistor, 220K, 1/2W, 10%	013615
C6	Capacitor, mica, 600 pf, 500V, 5%	024034	R3	Resistor, 1 megohm, 1/2W, 10%	024125
C7	Capacitor, mica, 100 pf, 500V, 5%	024000	R4	Resistor, 220K, 1/2W, 10%	013615
C8	Capacitor, mica, 450 pf, 500V, 5%	024026	R5	Resistor, 10K, 1/2W, 10%	028548
C9	Capacitor, mica, 200 pf, 500V, 5%	024018	R6, R7	Resistor, 47.5K, 1/2W, 1%	024109
C10, C12	Capacitor, mica, 900 pf, 500V, 5%	024042	R8, R9	Resistor, 165K, 1/2W, 1%	024091
C13	Capacitor, mica, 200 pf, 500V, 5%	024018	R10, R11	Resistor, 1 megohm, 1/2W, 1%	024075
C14	Capacitor, mica, 450 pf, 500V, 5%	024026	R12 th R15	Resistor, 499K, 1/2W, 1%	024083
C15	Capacitor, mica, 100 pf, 500V, 5%	024000	R16, R17	Resistor, 1 megohm, 1/2W, 1%	024075
C16	Capacitor, mica, 600 pf, 500V, 5%	024034	R18, R19	Resistor, 165K, 1/2W, 1%	024091
C17	Capacitor, mica, 2700 pf, 500V, 5%	024059	R20	Resistor, 4.7 megohms, 1/2W, 10%	013623
C18, C19	Capacitor, disc, 200 pf, 1000V, 20%	023622	R21, R22	Resistor, 1 megohm, 1/2W, 10%	024125
C20	Capacitor, mylar, 0.33 mfd, 75V, 10%	028647	R23	Resistor, 150K, 1/2W, 10%	028357
C21, C22	Capacitor, electrolytic, 5 mfd, 50V	028589	R24	Resistor, 15K, 1/2W, 10%	048157
Q1, Q2	Transistor, RCA40321	022939	R25	Resistor, 33K, 1/2W, 10%	028522
			R148	Resistor, 4.7 megohms, 1/2W, 10%	013623
				Circuit Board, etched	022921

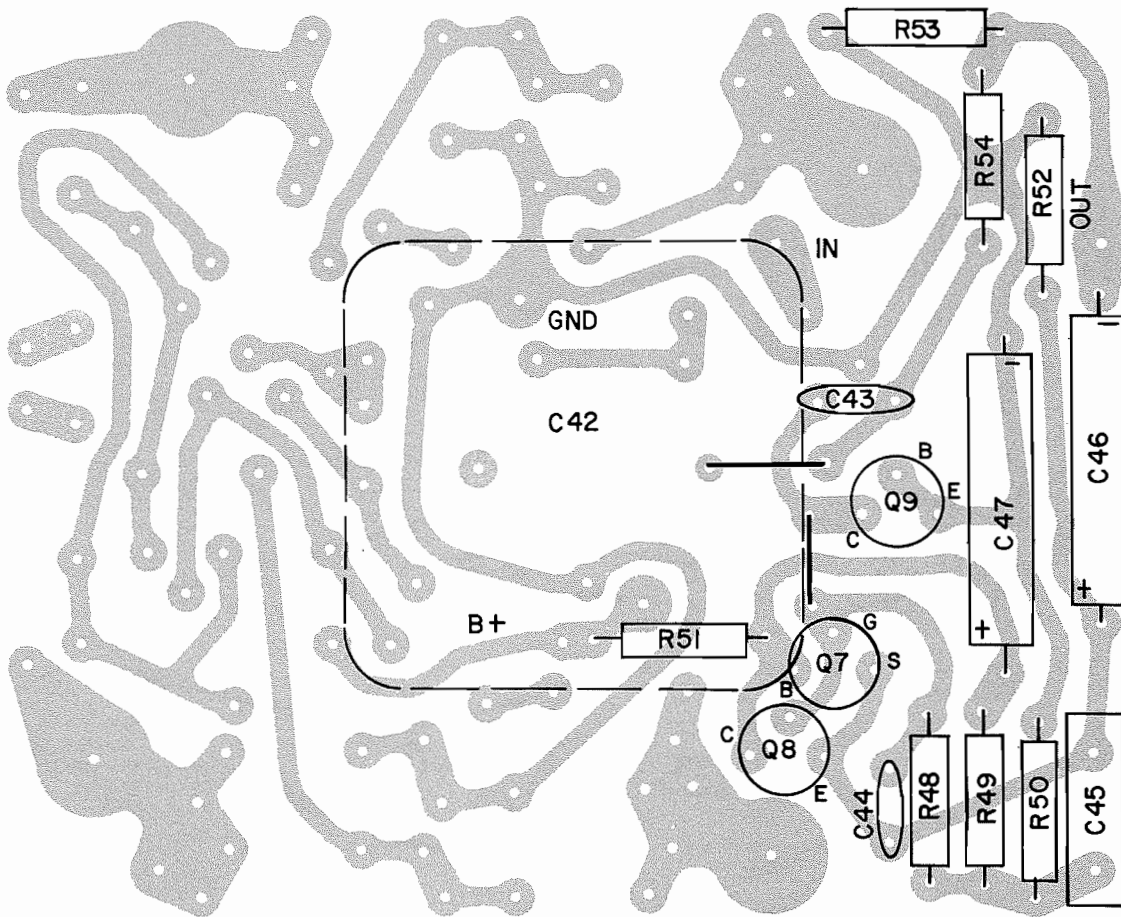


Figure 15. Circuit Board Assembly 109830 (Space Generator)

Reference Designation	Description	Part No.
C43, C44	Capacitor, disc, 200 pf, 1000V, 20%	023622
C45	Capacitor, mylar, 0.33 mfd, 75V	028647
C46, C47	Capacitor, electrolytic, 5mfd, 50V	028589
Q7	Transistor, FET, 2N5163	023606
Q8, Q9	Transistor, NPN, 2N3859A	061366
R48	Resistor, 4.7 megohms, 1/2 W, 10%	013623
R49, R50	Resistor, 1 megohm, 1/2 W, 10%	024125
R51	Resistor, 150K, 1/2 W, 10%	028357
R52	Resistor, 15K, 1/2 W, 10%	048157
R53	Resistor, 33K, 1/2 W, 10%	028522
R54	Resistor, 4.7 megohms, 1/2 W, 10%	013623
	Circuit Board, etched	022921

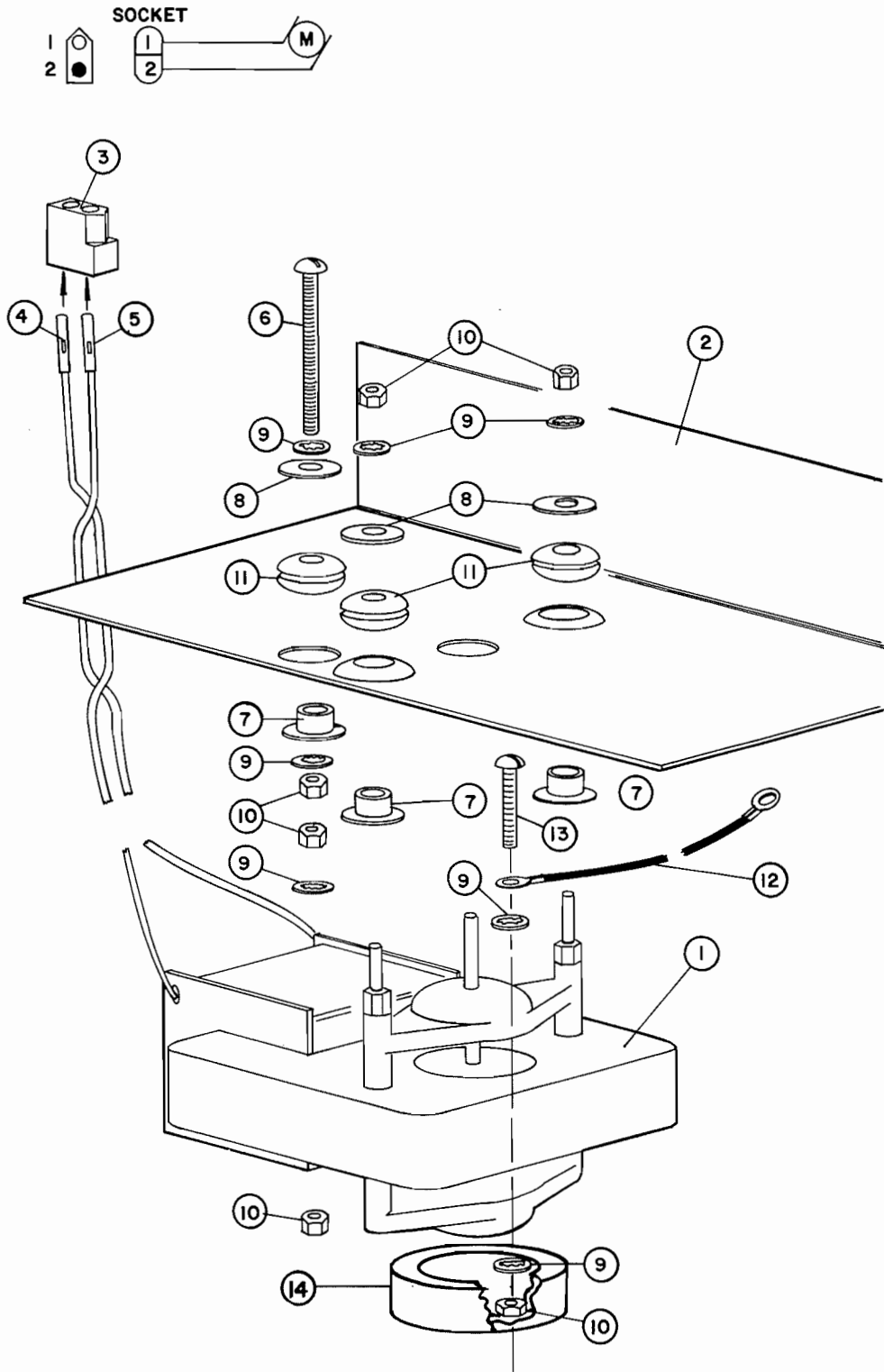
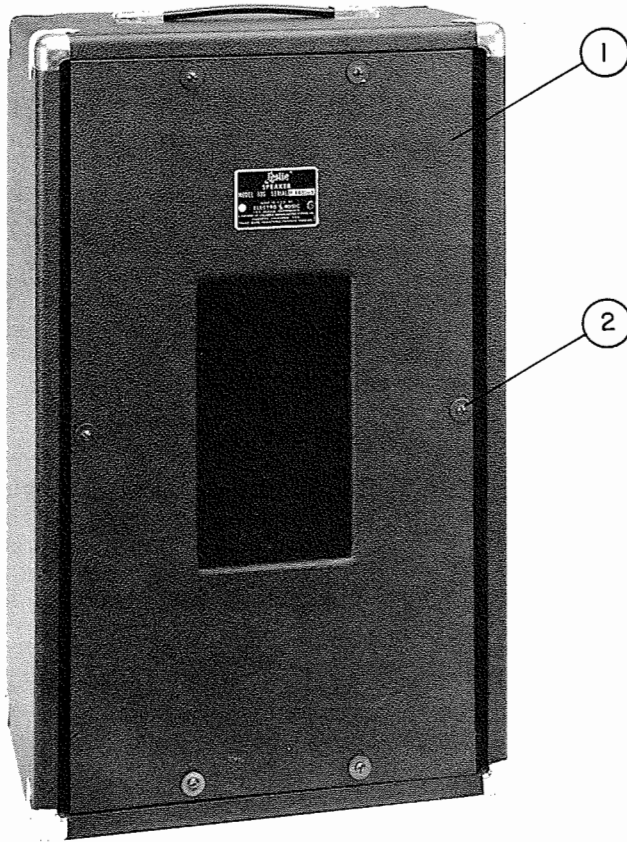


Figure 16. Motor Assembly 110690 Parts

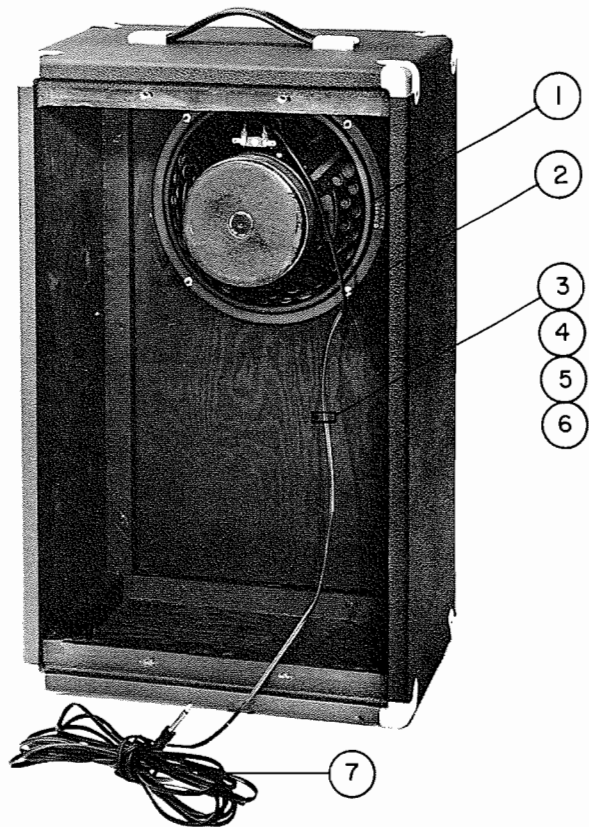
Item	Description	Part No.	Item	Description	Part No.
1	Motor	110720	8	Washer, flat, 6 x 9/16 x 3/64	025981
2	Bracket, motor mounting shield	110700	9	Washer, lock, 6 x 9/32 x .018	028993
3	Housing, socket, 2-circuit, red	037127	10	Nut, hex, 6-32 x 5/16 x 7/64	012930
4	Contact, male insert	023309	11	Grommet, .625 x .438 x .250	014084
5	Contact, female insert	023556	12	Cable Assembly, ground, black	105560
6	Screw, machine, 6-32 x 2-1/4	026674	13	Screw, machine, 6-32 x 7/8	025486
7	Bushing, shoulder	048983	14	Bumper, motor guard	113130



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Figure 17. Satellite Cabinet Exterior Parts

Item	Description	Part No.
1	Cabinet Back	109550
2	Screw, machine, with flat washer, 10-24 x 1 5/8	029066



Item	Description	Part No.
1	Speaker, 10-inch, 4-ohm	026955
2	Nut, hex, 8-32	026773
3	Clamp, cable, 3/16	058255
4	Screw, machine, 8 x 5/8, Phillips head	025627
5	Washer, flat, 8 x 3/8 x 1/32	037325
6	Washer, lock, 8 x 5/16 x .020	026765
7	Cable Assembly, phone plug	110730

Figure 18. Satellite Cabinet Interior Parts

PARTS ASSEMBLY

Areas which need special care or could cause difficulties when assembly is attempted are noted below. Most parts are readily removed or replaced by normal shop procedures.

Avoid excessive heat and the use of excess solder where printed circuits are located close together, or circuits may be incorrectly cross-connected by solder flow.

Assembly Details

CIRCUIT BOARDS

When replacing circuit boards be careful not to pinch the wires against nuts, bushings, or any sharp projection. A cut in the insulation could cause grounding or impaired performance.

ELECTROLYTIC CAPACITORS

Electrolytic capacitors should be properly positioned with regard to positive and negative terminals. These are indicated on the parts layouts. If capacitors are replaced use glue between the body of the capacitor and the circuit board, to help hold the capacitor in its position.

TRANSISTORS

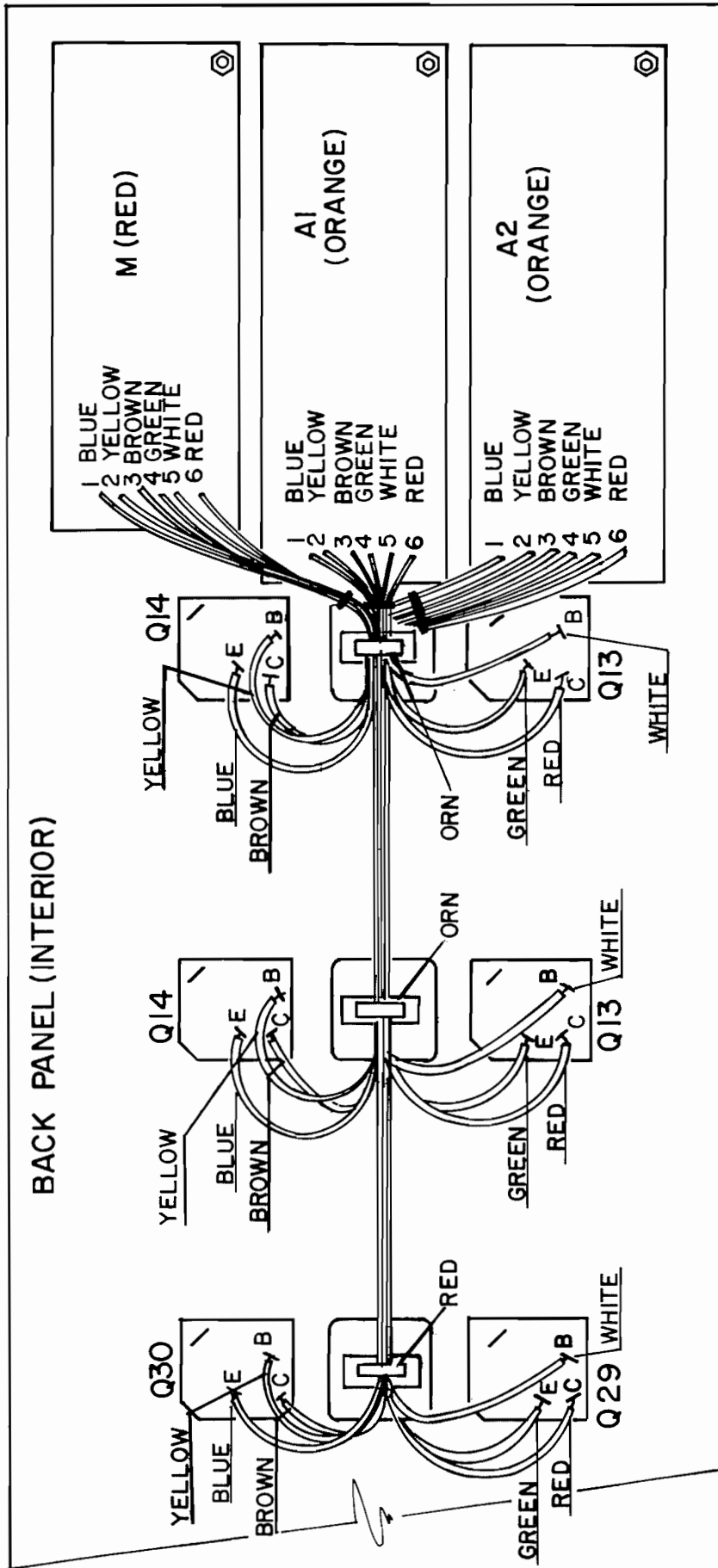
Transistors on the amplifier must fit snugly against their mountings to insure proper heat dissipation. Use a thin, smooth layer of silicone compound (part no. 047639) on both surfaces of the mica washer which separates the transistor from the heat sink. Make certain there are no air bubbles. If the heat is not dissipated the transistors will quickly deteriorate.

CAUTION: A clip-on heat sink must be used between the body of the transistor and a lead being soldered. The heat necessary to melt the solder may damage the transistor.

When replacing other transistors be sure that the base, emitter, and collector leads are properly positioned, as shown in the parts layout.

WIRING

To facilitate the proper reassembly of the model 60 system after part replacement the wiring of major assemblies is illustrated and described in figures 19 through 22, with their wire lists. Reference may also be made to the complete electrical schematic located in the back of this manual.



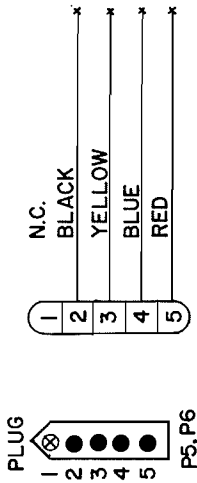
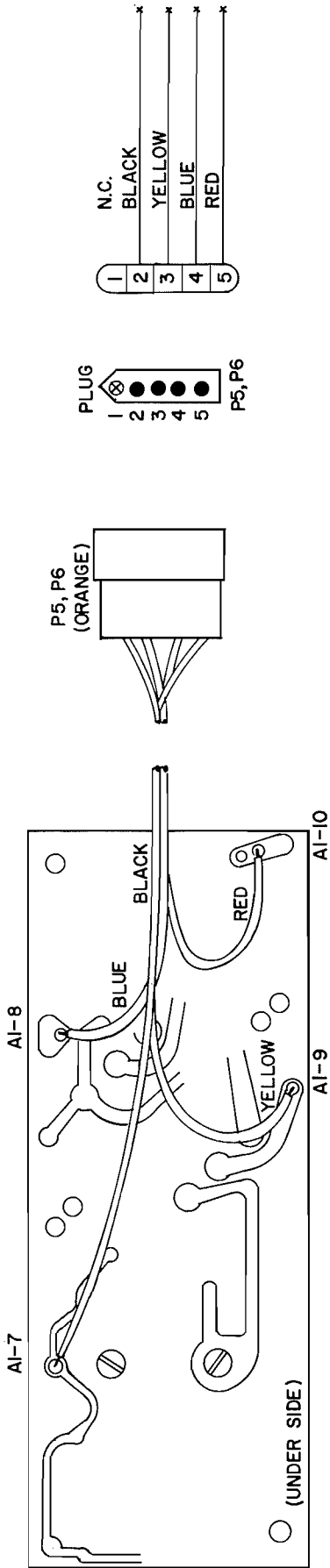
BACK PANEL (INTERIOR)

Figure 19. Amplifier Wiring Diagram

AMPLIFIER WIRING LIST

From*	To	Color	From*	To	Color	To*
M-1	Q30 E	blue	A1-7	Q30 B	black	P5-2 ground
M-2	Q30 B	yellow	A1-8	Q30 C	blue	P5-4 -33V
M-3	Q30 C	brown	A1-9	Q29 E	yellow	P5-3 +28V
M-4	Q29 E	green	A1-10	Q29 B	red	P5-5 +33V
M-5	Q29 B	white	A2-7	Q29 C	black	P6-2 ground
M-6	Q29 C	red	A2-8	Q14 E	blue	P6-4 -33V
A1-1	Q14 E	blue	A2-9	Q14 B	yellow	P6-3 +28V
A1-2	Q14 B	yellow	A2-10	Q14 C	red	P6-5 +33V
A1-3	Q14 C	brown	M-7	Q13 E	black	P7-2 ground
A1-4	Q13 E	green	M-8	Q13 B	blue	P7-4 -33V
A1-5	Q13 B	white	M-9	Q13 C	green	P7-1 signal in
A1-6	Q13 C	red	M-10	Q13 B	yellow	P7-3 +28V
A2-1	Q14 E	blue	M-11	Q13 C	red	P7-5 +33V
A2-2	Q14 B	yellow				
A2-3	Q14 C	brown				
A2-4	Q13 E	green				
A2-5	Q13 B	white				
A2-6	Q13 C	red				

*A1 is amplifier board 1 (orange)
 *A2 is amplifier board 2 (orange)
 M is motor control board (red)
 Note: A1 and A2 are interchangeable.
 Note: P5 and P6 are interchangeable.



(NOTE: A2 SAME AS A1)

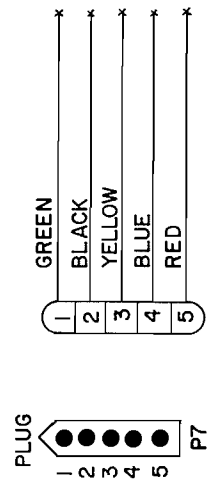
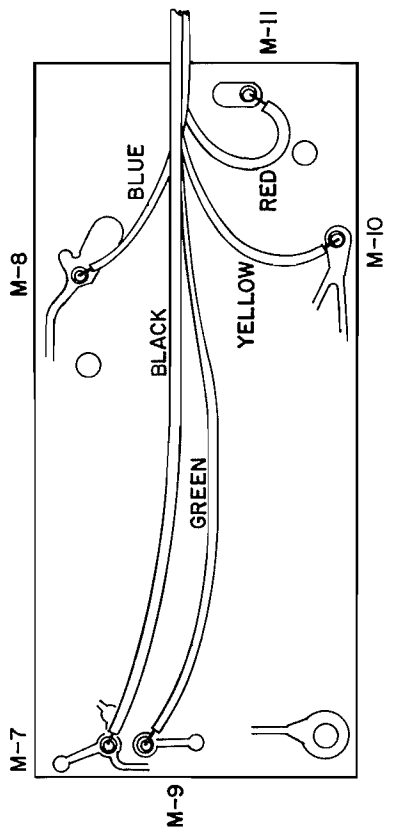
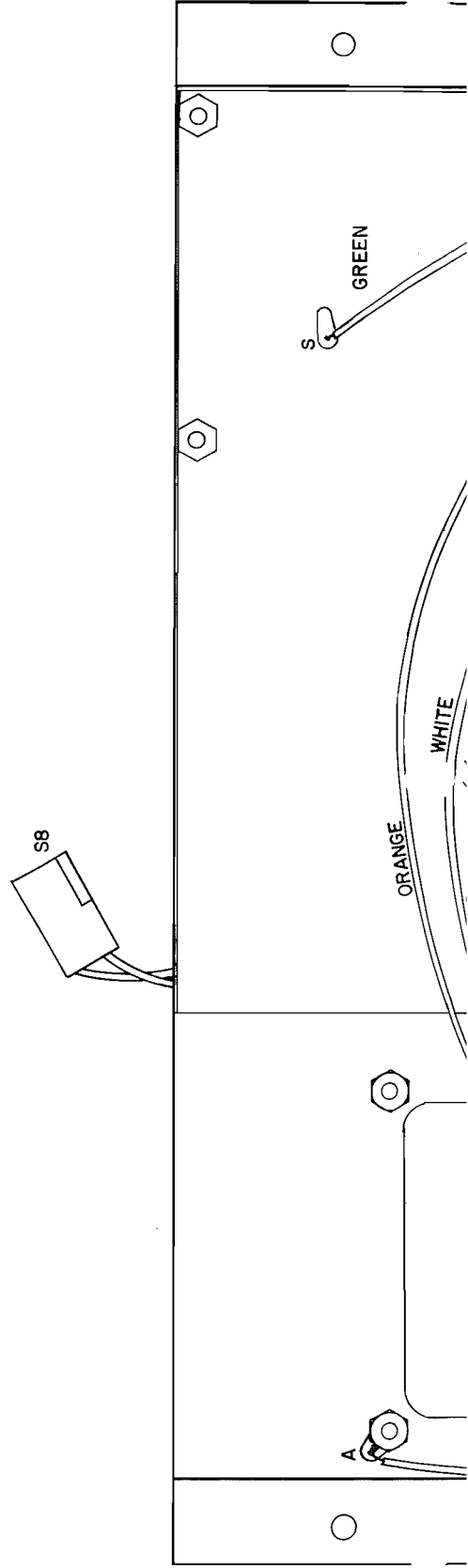


Figure 20. Amplifier Circuit Board Wiring Diagram



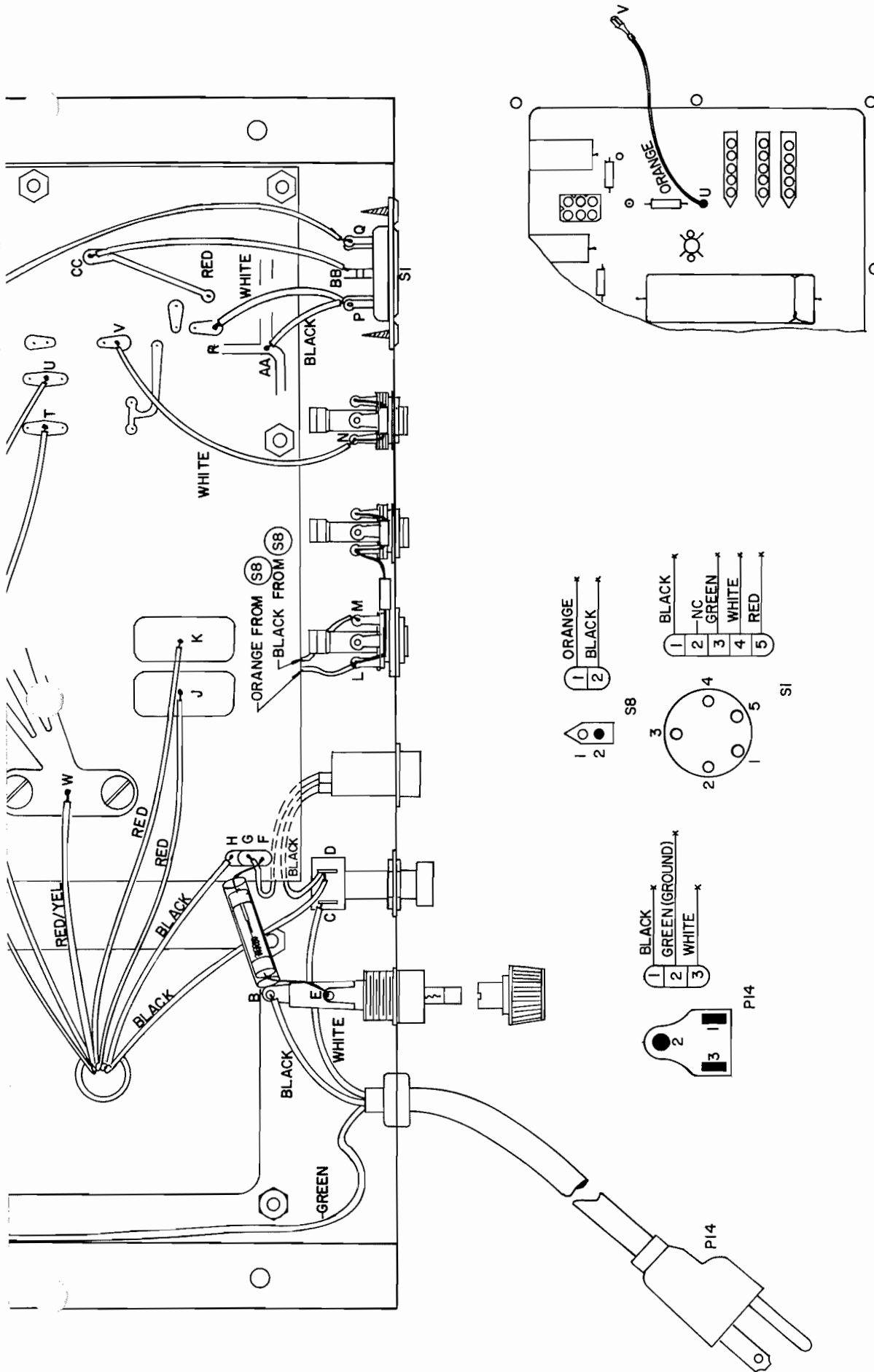


Figure 21. Power Supply Wiring Diagram

240-V POWER SUPPLY

Same as for 117-V version except:

H	black	T1 primary (fuse side)
E	fuse	F
E	black	F
H	red/black	T1 primary (fuse side)
DD	black/yellow	T1

POWER SUPPLY WIRING LIST

From	To	Color	From	To	Color
A	P14 ground	green	E	F	fuse
B	P14 either AC	black	G	PL1	black
C	P14 either AC	white	D	PL1	black
D	P14 primary (switch side)	black	L	S8 (tip)	orange
H	T1 primary (fuse side)	black	M	S8 (sleeve)	black
J	T1 secondary	red	N	V	white
K	T1 secondary	red	P	R	white
W	T1 secondary ground	red/yellow	P	AA	black
T	T1 secondary	white	Q	AA	black
U (top)	T1 secondary	orange	BB	S	violet
	V (to speaker)	orange		CC	red

WIRETYPE 1000
 9 H...
 W...
 WWW...

SPACE GENERATOR WIRING

From*	To*	Color
5-C	4-B	violet
5-D	4-A	violet
5-A	4-D	violet
5-B	4-C	violet
B (5)	X	red
B (4)	X	red
GND (5)	Y	black
GND (4)	Y	black
OUT (5)	Z	red
OUT (4)	Z	clear
SHIELD on OUT (5 & 4)	Z	white
IN (4)	Z	white
SHIELD on IN (4)	Z	red
X		red

*5: circuit board assy 109830
 *4: circuit board assy 023598

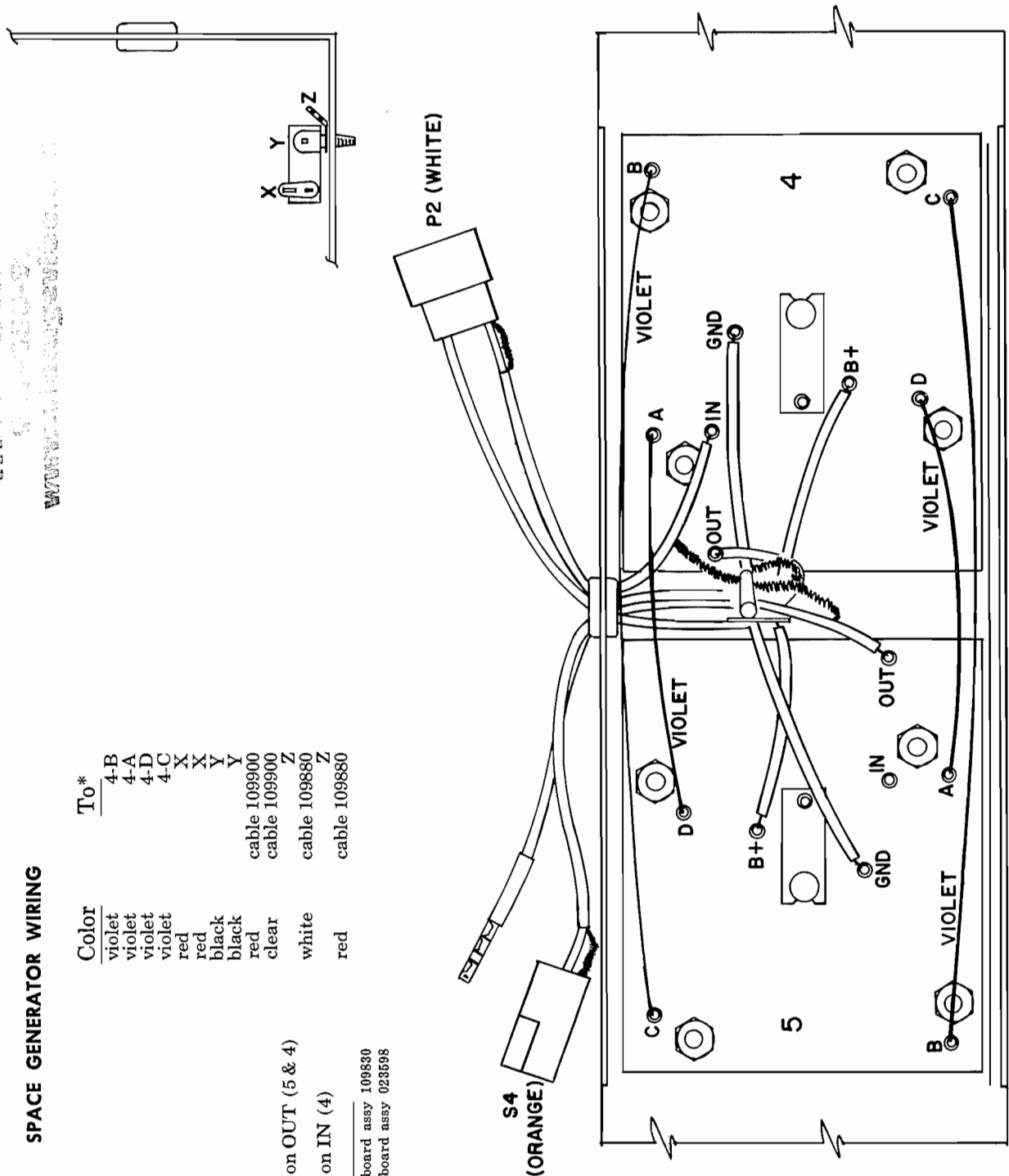


Figure 22. Space Generator Wiring Diagram

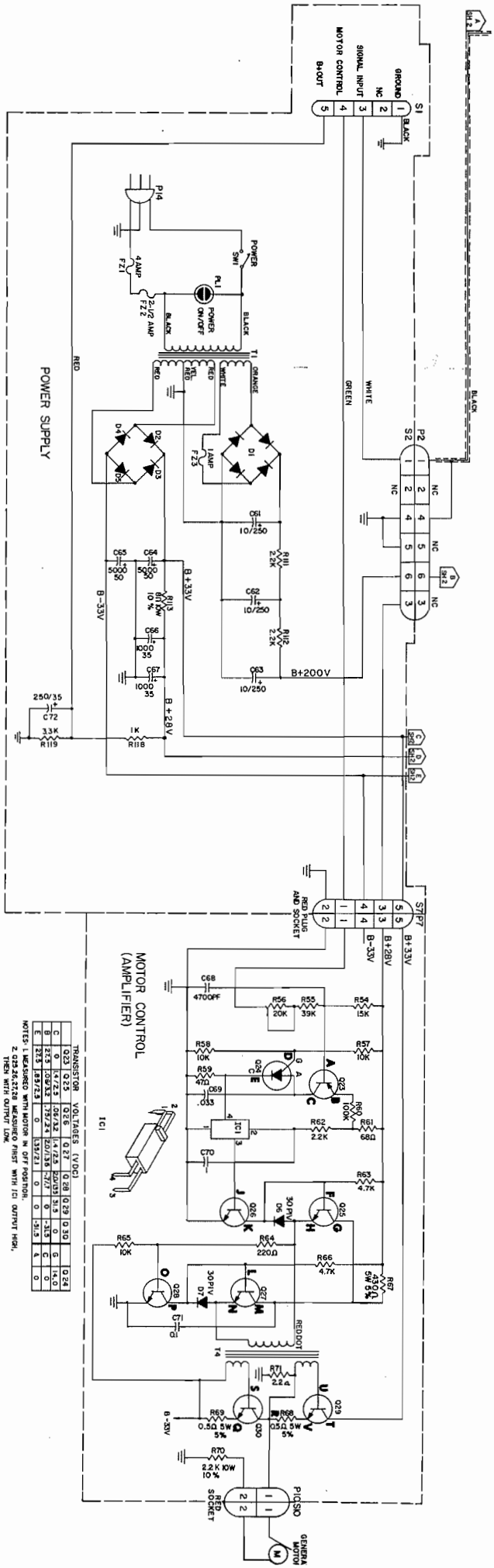


Figure 23. Schematic, Model 60 System (Sheet 1 of 2)

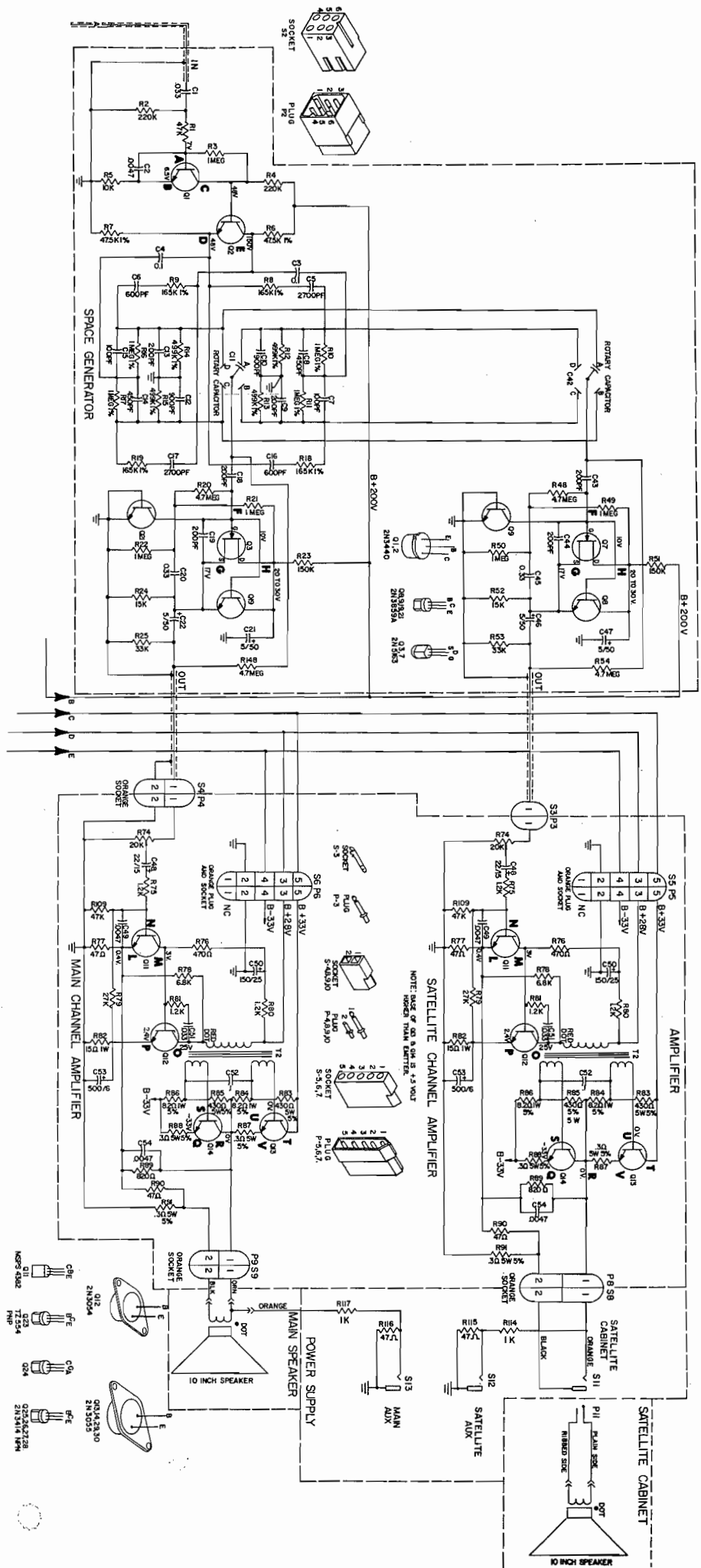
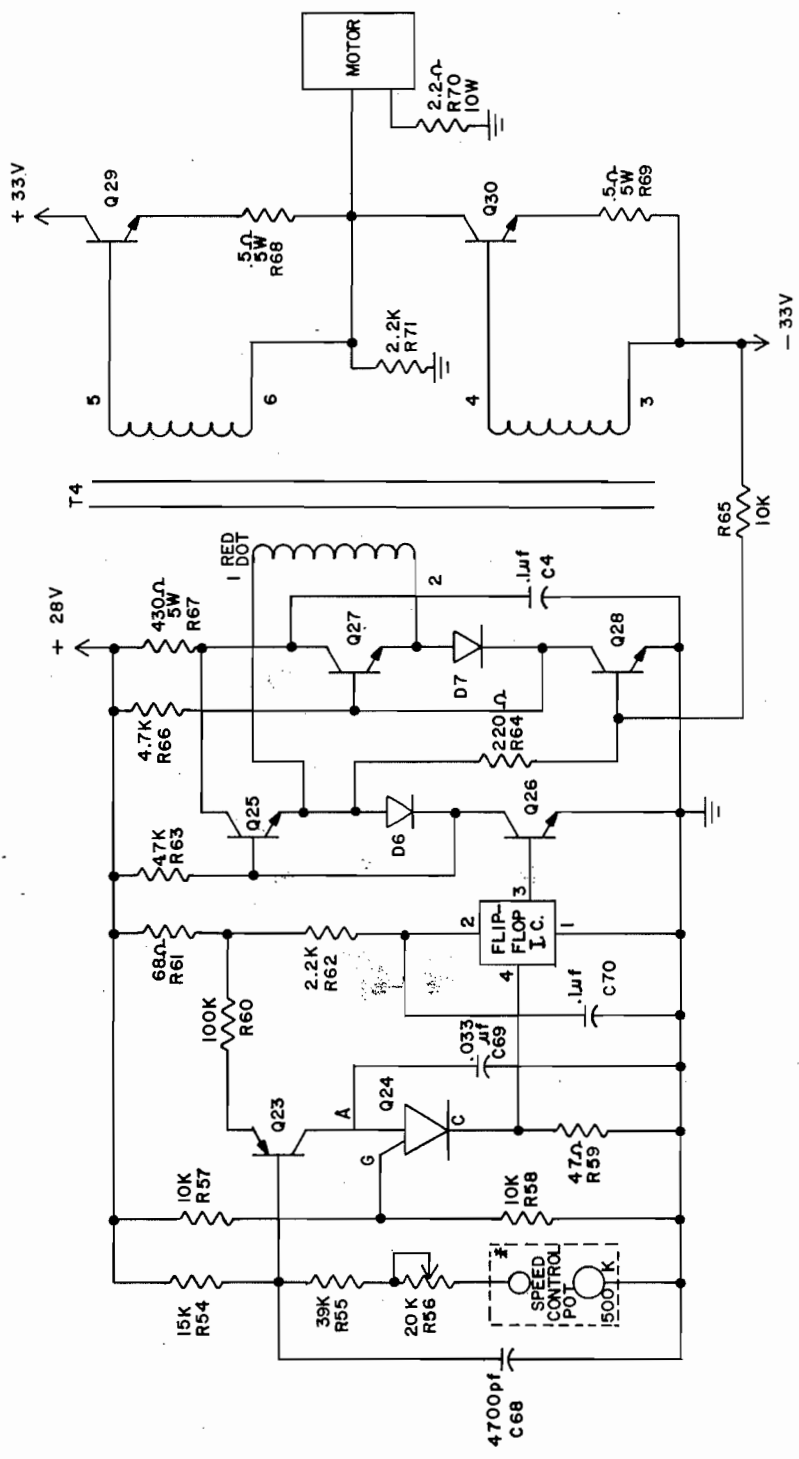


Figure 23. Schematic, Model 60 System (Sheet 2 of 2)



Space Generator Circuits

SPACE GENERATOR CIRCUITS OPERATION

The distinctive feature of the model 60/70 system is the use of electronic circuits to produce a vibrato effect. In reality the vibrato exists only when the sound from two (or three) loudspeakers is heard. The circuits take what we may call the basic tone from the organ or other instrument and create from it *two* tones, one higher in pitch (frequency) and the other correspondingly lower, than the original. The amount of change depends upon the speed of the motor which operates the rotary capacitors.

Motor Control

The motor control circuit uses a signal modified by controls consisting of a range switch and a tremolo control (potentiometer). Referring to the control circuit schematic (figure 24), the potentiometer shown there is located in the control assembly, while the other circuitry is physically located on the motor control circuit board mounted on the model 60/70 amplifier. The motor speed control signal enters the model 60/70 cabinet through pin 4 of socket S1 (on the power supply). It is routed through socket S7 and plug P7 to the motor control circuit.

Operation of the circuitry is as detailed in subsequent paragraphs. The output signal passes through plug P10 and socket S10 to the motor of the space generator (located on the floor of the main cabinet).

Space Generator

In the space generator circuit the signal provided from the piano or other instrument is used to create two signals, one higher in frequency than the original, and one lower. The incoming signal from the instrument is received via the control assembly through pin 3 of socket S1, and passes through socket S2 and plug P2 to the space generator circuit. The processes within this circuit are also detailed below. Output from one portion of the space generator circuit goes to the main channel amplifier, through socket S4 and plug P4; the output from the other portion goes to the satellite channel amplifier through S3 and P3. After amplification each signal powers its respective loudspeaker. (If the connections were reversed the musical effect would be the same.)

The incoming musical signal (from the instrument) passes through transistor Q1 and is amplified. Its phase is also inverted. Transistor Q2 does not amplify the signal but acts in a phase splitter circuit; signals at D and E being 180 degrees out of phase with each other. These oppositely phased signals then enter the broad-band phase-shift networks (circuitry shown above and below C11). These four networks provide four signals, each 90 degrees out of phase with the next, over the bandwidth of interest. (The phase of these four signals cannot be directly related to the phase of the original signal fed to the networks.)

*Letters in parentheses refer to the partial schematics.

The sets of components making up each phase shift network are [1] C6,R9 / C15,R16 / C13,R14 [2] C6,R9 / C14,R17 / C12,R15 [3] C5,R8 / C8,R10 / C10,R12 [4] C5,R8 / C7,R11 / C9,R13. Their outputs are tied to the four stators of the two rotary capacitors C11 and C42.

The action of the rotary capacitors is not to provide a capacitance change, since the total capacitance between the stators and rotor is very nearly steady; there is also only a small reduction in signal amplitude. However, as the rotor sweeps past the stators a phase shift is induced. If the rotor were turned at one time per second there would be a 360 degrees-per-second change in the signal; in other words one cycle per second would be added to or subtracted from the signal supplied to the capacitor. Faster motor speeds produce greater shift and increase or decrease in the signal.

The circuits shown to the right of the phase-shift network constitute a FET (field effect transistor) follower. Transistors Q19 and Q21 are protective in nature; they are able to handle static discharges and various unusual voltages that might destroy Q3.

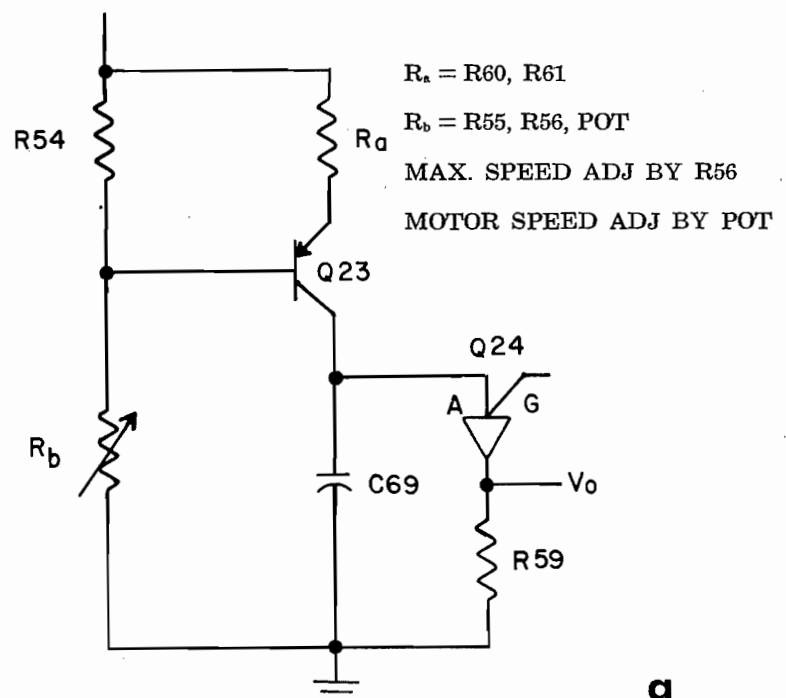
The output of this circuitry is amplified and becomes the audio output of the whole system.

Resistors R148 and R54, with capacitors C18 and C43, respectively, eliminate microphonic effects in the rotary capacitors. DC is shunted to ground through R148 and R25 or R54 and R53.

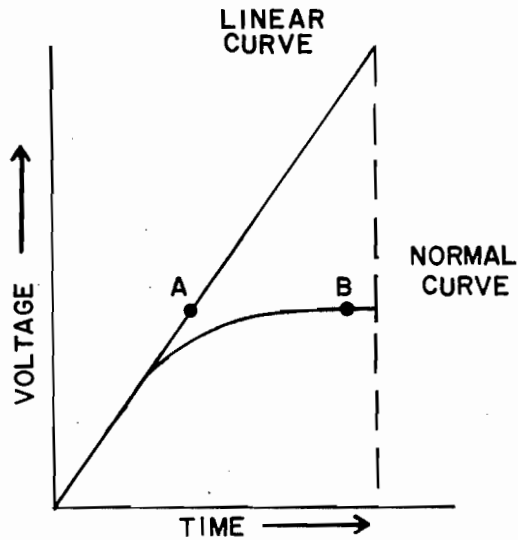
Variable-speed Motor Control Circuit Description

CONSTANT CURRENT SOURCE/LINEAR VOLTAGE RAMP GENERATOR (a)*

With R_b set to a high resistance, Q23 is biased off; therefore C69 is not being charged. As R_b is reduced by changing the setting of the variable resistor, Q23 is turned on, permitting C69 to start charging at a constant current.



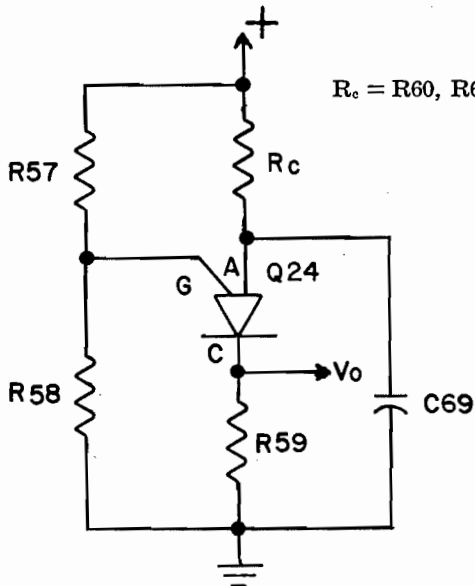
Because C69 is charged with a constant current the voltage across the capacitor rises linearly. Point A (b) is more repeatable than point B, on the normal charging curve, although both are at the same value. (I.e., it takes less time to reach the given voltage value along the linear curve than along the normal charging curve; therefore, that value can be reached more often in any stated time period.)



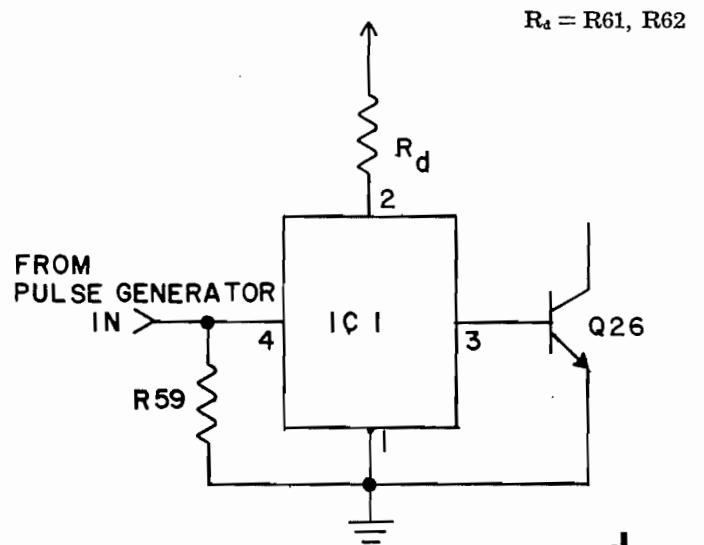
b

PULSE GENERATOR (c)

The voltage at the gate of Q24 is determined by R57 and R58, which form a voltage divider. When the voltage across C69 equals the voltage at the gate of Q24, Q24, which is a programmable unijunction transistor, conducts. The full voltage on C69 is discharged across R59, producing an output pulse. As a result of the slow charging and rapid discharge of C69, the waveform at V_o is of a sawtooth shape. When C69 has discharged through R59, Q24 returns to its non-conducting state and C69 starts charging again to repeat the process.



c



d

FLIP-FLOP (d)

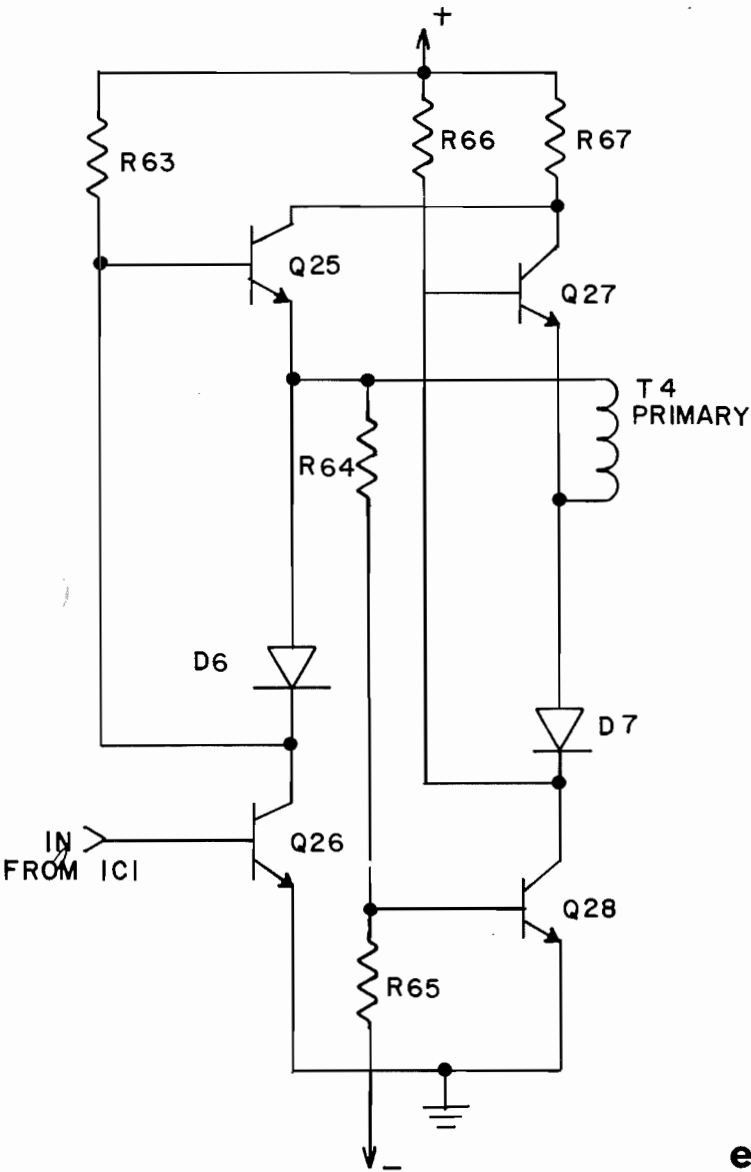
The pulses developed across R59 are applied to the input of the flip-flop, IC 1. With each input pulse the output changes state. This turns Q26 alternately on and off. With this type of arrangement the on-time of Q26 is equal to its off-time. Thus, the frequency of the pulse generator is divided by two.

SWITCH CIRCUIT (e)

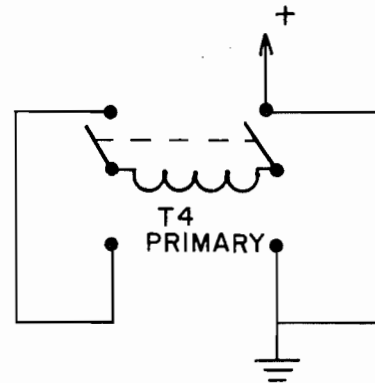
This circuit functions as a double-pole double-throw switch. (Figure f illustrates an equivalent circuit.) When Q26 is off because the flip-flop output is at a low state, R63 and D6 are able to bias Q25 on, as well as Q28, due to the ratio of R64 and R65. Q27 is biased off because its base voltage is below its emitter potential, due to D7. Current flows through R67, Q25, the primary of T4, through D7, and Q28.

When Q26 is switched on by the flip-flop, Q25 is turned off due to its base voltage being pulled below its emitter potential. Q28 also is cut off because of the loss of base drive through R64, with R65 pulling the base negative. When Q28 is off D7 is reverse-biased through R66. Thus, Q27 turns on and the current through T4 reverses direction.

(continued)



e

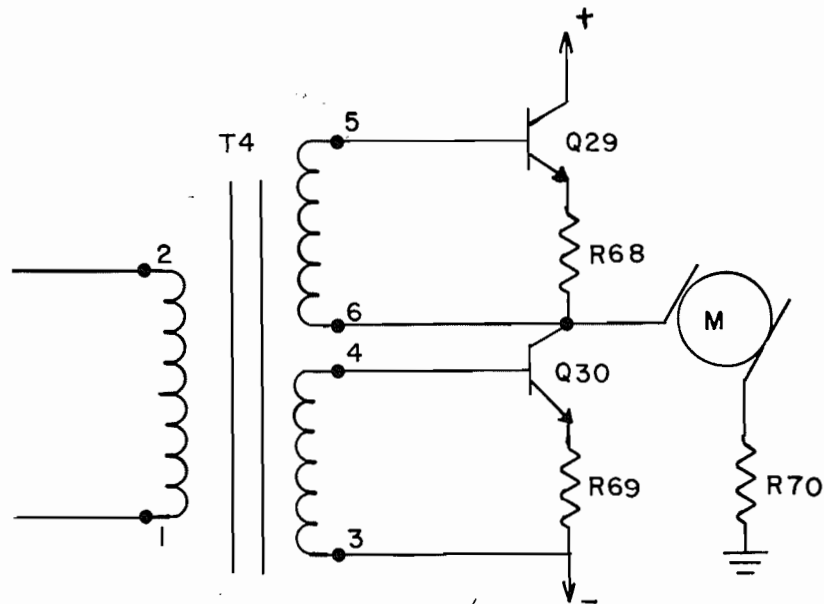


f

OUTPUT STAGE (g)

The direction of current flow in the primary of T4 determines whether Q29 or Q30 will be turned on by the coupling of the transformer's secondary windings. When the primary reaches a steady-state value, the field within T4 begins to collapse, which turns the transistor off. This gives rise to the unusual wave form across the motor at low frequencies. A square wave is produced at the output at higher frequencies because the primary current is reversed prior to the field collapsing in T4.

The motor has a low voltage coil winding (approximately 26 VAC). R70 increases the DC resistance of the winding, thus decreasing the power consumption at low frequency.



GUARANTEE

These speakers are guaranteed against defects in manufacturing or material for a period of one year following their original purchase from a franchised LESLIE speaker dealer, when guarantee card is correctly filled out and returned to Electro Music. Defective parts returned to Electro Music, prepaid, within one year of the date of original sale will be repaired or replaced through the LESLIE speaker dealer. This guarantee excludes belt, speaker cones, and components which may have been damaged due to improper handling or service.