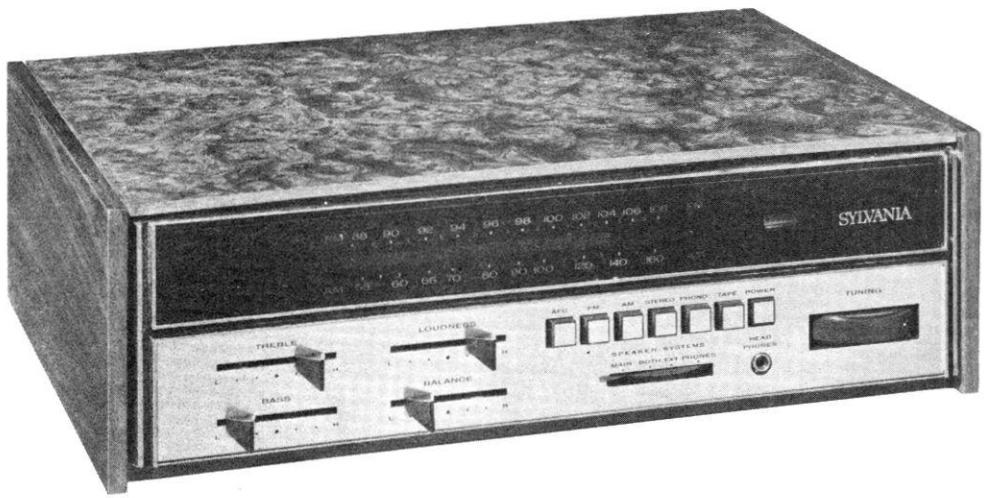
GTE SYLVANIA INCORPORATED

STEREO HI-FI
BULLETIN: R49-3

FACTORY PREPARED
TECHNICAL SERVICE DATA

MODEL: CR280

SERVICE PUBLICATIONS DEPARTMENT
Entertainment Products Group - Sylvania Electric Products Inc.- 700 Ellicott Street - Batavia, N.Y.



MODEL: CR280
CHASSIS: R49-3

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CHASSIS IDENTIFICATION

Chassis Identification consists of two blocks of numbers. In all correspondence relating to a specific model, both blocks of numbers, plus the cabinet model number should be given. To associate a chassis with its proper schematic, refer to the number breakdown described below:

CHASSIS IDENTIFICATION NUMBER

R49 03 00 — 1812100

- R49: CHASSIS AND SCHEMATIC TYPE
- 03: ENGINEERING VARIATION (1 or 01 thru 99)
- 00: CODE CHANGE
- 1812100: FACTORY INFORMATION

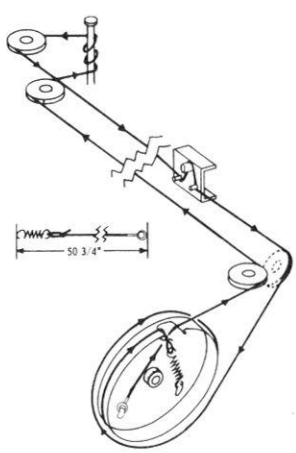
CODE CHANGES

To assist in identifying changes in electrical components, a system of adding a suffix number to the schematic parts coding number is used. All parts changes are indicated on either partial or complete schematics, and also in the parts list. For example, a part coded "R100" on the initial production chassis changes to "R100-1" when first revised in value; "R100-2" on the second revision, and so on.

CHASSIS REMOVAL

1. Remove two (2) screws from bottom of cabinet near sides.
2. Remove six (6) screws securing back cover to cabinet.
3. Remove four (4) slide control knobs by pulling straight away from escutcheon.
4. Control escutcheon is secured to cabinet by spring clips. Remove by pulling away from cabinet at slide control end.
5. Remove four (4) screws at outer corners of chassis securing chassis to cabinet.
6. Remove chassis and back cover as one unit from front of cabinet.

DIAL STRINGING



LAMP REPLACEMENT

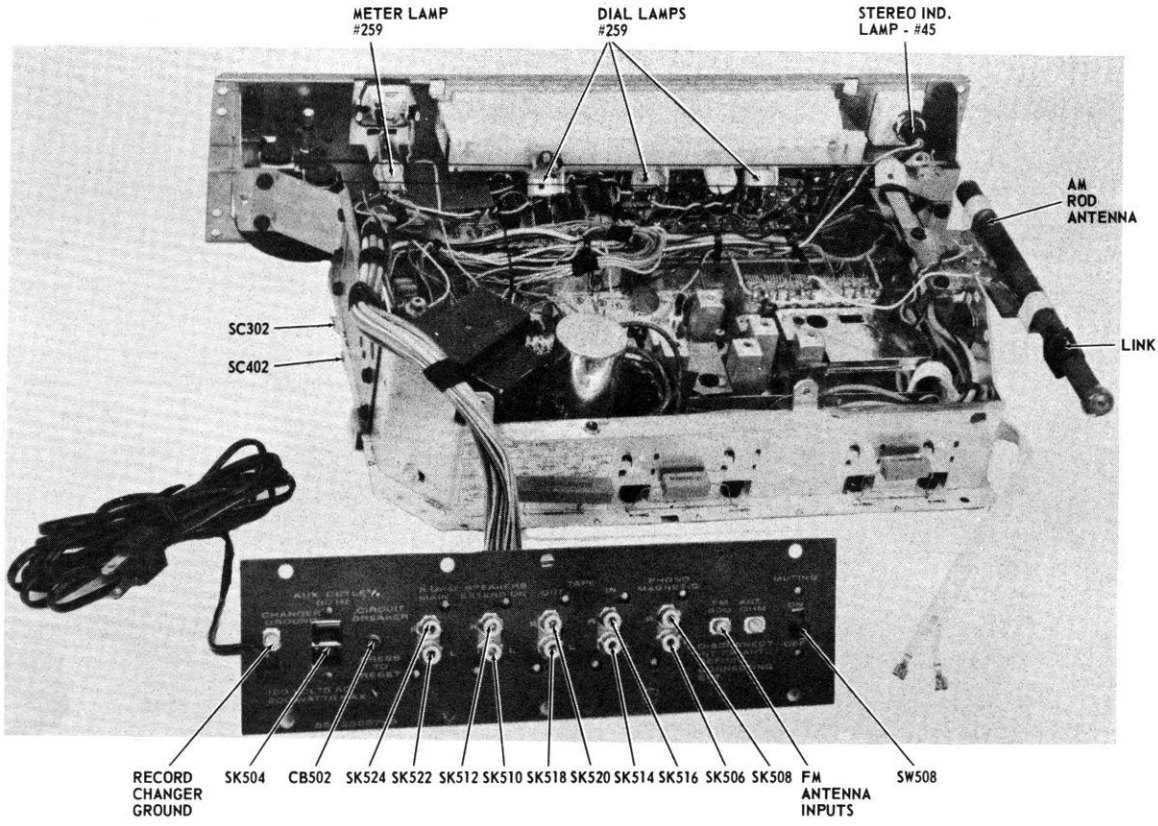
Remove chassis. Use #259 bulb, Sylvania Part #30-26288-1 for dial lamp and tuning meter lamp replacement.

Use #45 bulb, Sylvania Part #30-62495-45 for Multiplex lamp replacement.

IMPORTANT: Always use genuine Sylvania replacement parts and tubes.

Price $1.50

CHASSIS PARTS IDENTIFICATION



SERVICING THE STEREO HI-FI AMPLIFIER

Stereo Hi-Fi Amplifier circuits are much easier to service than many other circuits, inasmuch as there are two identical amplifiers right before you for comparison. Use the function switches and controls to locate the trouble area, then pinpoint the defective component within the area.

As an aid to parts identification, blocks of numbers have been assigned to circuits in this chassis - ie:
0-200 Block - AM/FM - MULTIPLEX tuner.
300 Block - Left Channel Phono Preamp.
400 Block - Right Channel Phono Preamp.
500 Block - Items common to both L & R Channels.
600 Block - Left Channel Preamp and Tone Circuits.
700 Block - Right Channel Preamp and Tone Circuits.
800 Block - Left Channel Power Amplifier Circuit.
900 Block - Right Channel Power Amplifier Circuit.

Tuner pins and wire connections are labeled with a single letter whenever possible.

Left and right channel audio amplifier connections are double lettered, with the first letter indicating the channel, ie: LB (Left) or RB (Right).

Visual inspection of components will often disclose overheated parts. A good magnifying glass will be very helpful when checking the printed circuit panel for cracked foil or poor solder joints. Thermal noise may be generated by resistors or transistors that "look like new" as well as other components. Use a heat lamp and aerosol cooler to isolate these troubles.

Remember that schematic voltages are not absolute - they will vary due to normal production tolerances. The primary AC supply (120V, 60Hz) will influence B plus greatly. Compare voltages for the right and left channels when suspecting trouble in a certain amplifier stage. The use of a modern, high impedance VOM, or preferably, a VTVM is a 'must' for checking transistor voltages. Be very careful with your instrument probes when working on transistor circuits - even a momentary short between Base and Collector can destroy the transistor.

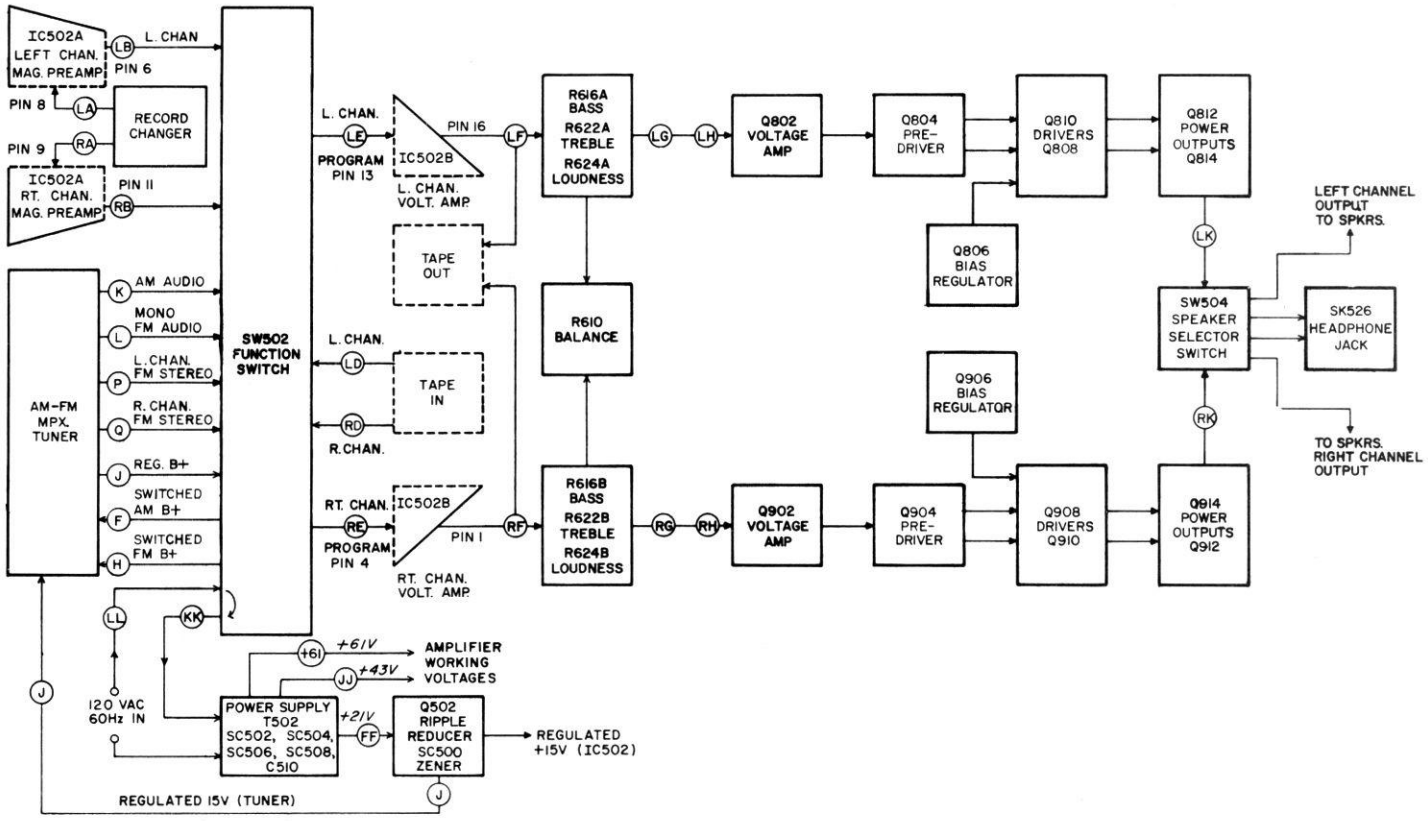
Stage gain may be checked by touching the Collector and then the Base of a transistor with your finger. You will hear a hum from the Collector, and an appreciably louder hum when you touch the Base. Bear in mind that there is no AC voltage gain in the driver and output stages of this amplifier, and also that an inoperative transistor will often pass some signal, but without gain.

A word about replacing solid state devices in these tuner and amplifier circuits - whenever possible, we give the E.I.A. number PROVIDING that the "off-the-shelf" part will restore operation of the instrument to meet factory specifications. However, Sylvania part numbers only are given whenever the transistors or diodes are specifically "paired", or selected for Beta, P.I.V., low noise, etc., and replacement by any "off-the-shelf" item may, or may not, restore operation to meet factory 'specs'.

When servicing Solid State amplifier and tuner circuits, always observe the following rules:

1. BE SURE all test equipment is free from leakage and isolated from the power line.
2. Use non-inductive dummy loads of at least 3 ohms total resistance - 8 ohm loads are nominal. NEVER use single speakers or combinations of speaker systems of less than 3 ohms total impedance. Momentarily shorted or open outputs will not damage the output stages of this amplifier. However, a continuous shorted output condition can cause serious damage within a relatively short period of time.
3. Always unplug the power cord from the 120VAC, 60Hz supply before replacing components.
4. Use a low wattage, pencil type iron to ensure minimum heat application. Heat sink each lead on solid state devices. An alligator clip will serve quite well as a heat sink in most cases.
5. Be sure that mounting surfaces for power transistors are clean and free from burrs. Use silicon grease liberally (both sides of mica insulators when used) when mounting power transistors. Be sure that power transistors are positioned so that the mounting surface is in full, snug contact with the heat sink and that leads clear adjacent chassis or heat sink metal.

AMPLIFIER BLOCK DIAGRAM



CIRCUIT DESCRIPTION (AMP)

POWER SUPPLY

T502 (power transformer) provides necessary line isolation for this chassis, and also furnishes stepped-down voltages for the bridge rectifier circuit, plus 6.3 volts for dial, meter and stereo lamp operation. All DC working voltages for the amplifier and tuner circuits are supplied by the bridge circuit.

RIPPLE REDUCER

Q502 is used in a "ripple reducer" circuit which removes the B+ ripple caused by load current. With a Zener diode (SC500) establishing a 15.6 volt reference for Q502, the circuit output is a clean, constant 15VDC supply for the magnetic preamplifiers (IC502A), the voltage amplifiers (IC502B) and the AM-FM-MULTIPLEX tuner circuits.

INTEGRATED CIRCUIT

This R49 amplifier features a monolithic integrated circuit which contains four operational amplifiers. Each section consists of a Darlington input circuit, a differential amplifier, three output transistors, diodes for voltage stability and temperature compensation, plus several resistors.

Two sections of this integrated circuit are used in Left and Right channel magnetic preamp. circuits preceding the function switch. The balance of IC502 serves as Left and Right channel voltage amplifier following the function switch.

It is strongly recommended that the integrated circuit be removed from its' socket before checking associate components for 'shorts', 'opens' or value changes to prevent possible damage to internal IC components.

CONTROLS

R616 (BASS) and R622 (TREBLE) are dual ganged slide-type controls of the conventional passive type used in a normal cut-boost tone circuit. These controls permit adjustment of Bass or Treble response of left and right channels simultaneously, while passing the mid-range frequencies (around 1kHz) almost unchanged. Tone control center position gives "as recorded, or transmitted" reproduction.

R610 (BALANCE) control is also of the slide type. It shunts a selected portion of the audio signal to ground, thus equalizing left and right channel outputs.

Design of the dual ganged LOUDNESS slide-type control (R624) with tap compensation is in accordance with the Fletcher-Munson studies, which indicate a definite hearing deficiency at lower frequencies in all average persons, especially at lower listening levels.

POWER AMPLIFIER SECTION:

From the loudness control, the audio signal enters the Power Amplifier panel, and is AC coupled to the Base of a Voltage Amplifier (Q802, Q902). AC and DC feedback from the output stage is applied to the emitter of this voltage amplifier through R806 or R906 to ensure good frequency response with minimal distortion.

BIAS REGULATOR:

The purpose of Q806 is to provide proper bias for the complementary drivers (Q808, Q810) and power output transistors (Q812, Q814), as well as ensuring thermal circuit stability under varying operating conditions. Basically, Q806, R812, R814 and R816 function as a variable diode. Proper bias adjustment consists of adjusting R814 for a reading of 10 to 20 mV across R828 with the loudness control at MINIMUM (to ensure a "no-signal" condition).

When troubleshooting this circuit, NEVER power the circuit without the bias regulator (Q806, Q906) in the circuit. Without the limiting diode action of the bias transistor, the resistor dividing network will supply a voltage of sufficient amplitude to ensure instant destruction of driver (Q808, Q810) and output (Q812, Q814) transistors.

CIRCUIT DESCRIPTION (AMP CONT'D)

PRE-DRIVER, DRIVER AND OUTPUT STAGES:

Q804 (pre-driver) drives Q808 and Q810 simultaneously. An audio signal of one polarity increases collector voltage of Q804, which in turn increases conduction of the Q808 driver and Q814 output combination. During this half-cycle, Q810 driver and Q812 output combination remain at an idle. The opposite half-cycle reduces collector voltage of Q804, increases conduction of Q810 and Q812 while Q808 and Q814 remain at an idle.

With both driver and output stages biased in class AB, the correct idle current is most important for proper amplifier performance. Insufficient idle current will cause crossover distortion. High idle current will cause low amplifier output.

C806 is a bootstrap capacitor for the pre-driver (Q804) collector. It reduces hum and distortion within the circuit, and also allows the output signal to swing closer to the supply voltage, thus providing slightly higher output.

PERFORMANCE ANALYSIS

Maintain line at 120V, 60Hz for all tests.

8 ohm, 50 watt resistive load to be connected across each channel output before any of the following performance checks are made.

Adjust bias pots (R814, R914) for 15mV±10% across R828, R928 with loudness control set at minimum to ensure "no signal" condition.

SENSITIVITY - PHONO:
CHASSIS equivalent impedance is 330K, 10% resistor with 330 ohm divider.

Adjust controls as follows:
Loudness - Maximum.
Bass & Treble - Mechanical Center.
Balance - Mechanical Center.
Select "PHONO" and "STEREO" functions.

Connect a 600 ohm impedance audio generator to both PHONO inputs through correct equivalent impedance.

This chassis requires 6mV ±3db at 1kHz for an output level of 1 watt (2.8V - R.M.S. - measures across 8 ohm load resistor). Channel output difference shall be 4 db or less.

SENSTIVITY - TAPE:
Connect a 600 ohm impedance audio generator to both TAPE inputs through 10K, 10% resistors. Adjust controls as under Phono sensitivity.
Select "TAPE" and "STEREO" functions.

This chassis required 55mV ±3db at 1kHz for an output level of 1 watt (2.8V - R.M.S. - measured across 8 ohm load resistor).

TONE CONTROL RANGE:
Connect a 600 ohm impedance audio generator to both PHONO inputs through correct equivalent impedance (See SENSITIVITY - PHONO).
Adjust controls as follows:
Loudness - Maximum.
Balance - Mechanical Center.
Bass & Treble - Mechanical Center, initially.
Select "PHONO" and "STEREO" functions.

CONTROL, GEN. FREQ.	CUT	BOOST
Bass - 100Hz	-9db, ±3db	+10db, ±3db
Treble - 10kHz	-13db, ±3db	+9db, ±3db

POWER OUTPUT:
Connect a 600 ohm impedance audio generator to both PHONO inputs through correct equivalent impedance (See SENSITIVITY - PHONO).
Adjust controls as follows:
Loudness - Maximum.
Bass & Treble - Mechanical Center.
Balance - Adjust for equal R & L channel output.
Select "PHONO" and "STEREO" functions.

Adjust generator for amplifier output of 8 watts (8 volts - R.M.S. - measured across 8 ohm load resistor) at each frequency specified.

100Hz - 2% Total Harmonic Distortion (Nominal).
1000Hz - 2% Total Harmonic Distortion (Nominal).
10kHz - 2% Total Harmonic Distortion (Nominal).

CHANNEL SEPARATION:
Apply signal to one phono input, with opposite phono input terminated with appropriate impedance (See SENSITIVITY - PHONO).
Adjust controls as follows:
Loudness - Maximum.
Bass & Treble - Mechanical Center.
Balance - Mechanical Center.
Select "PHONO" and "STEREO" functions.

Adjust signal generator for amplifier output of 3 watts (5V - R.M.S. - measured across 8 ohm load resistor) on driven channel at each frequency noted below. Measure crosstalk from right into left amplifier, then from left into right.

FREQUENCY	CROSSTALK LIMITS
100Hz	40db - typical
1000Hz	30db - typical
10kHz	20db - typical

HUM AND NOISE:
Terminate both phono inputs with appropriate impedances (See SENSITIVITY - PHONO).
Adjust controls as follows:
Bass & Treble - Mechanical Center.
Balance - Mechanical Center.
Select "PHONO" and "STEREO" functions.

Measure hum and noise across 8 ohm load resistors.

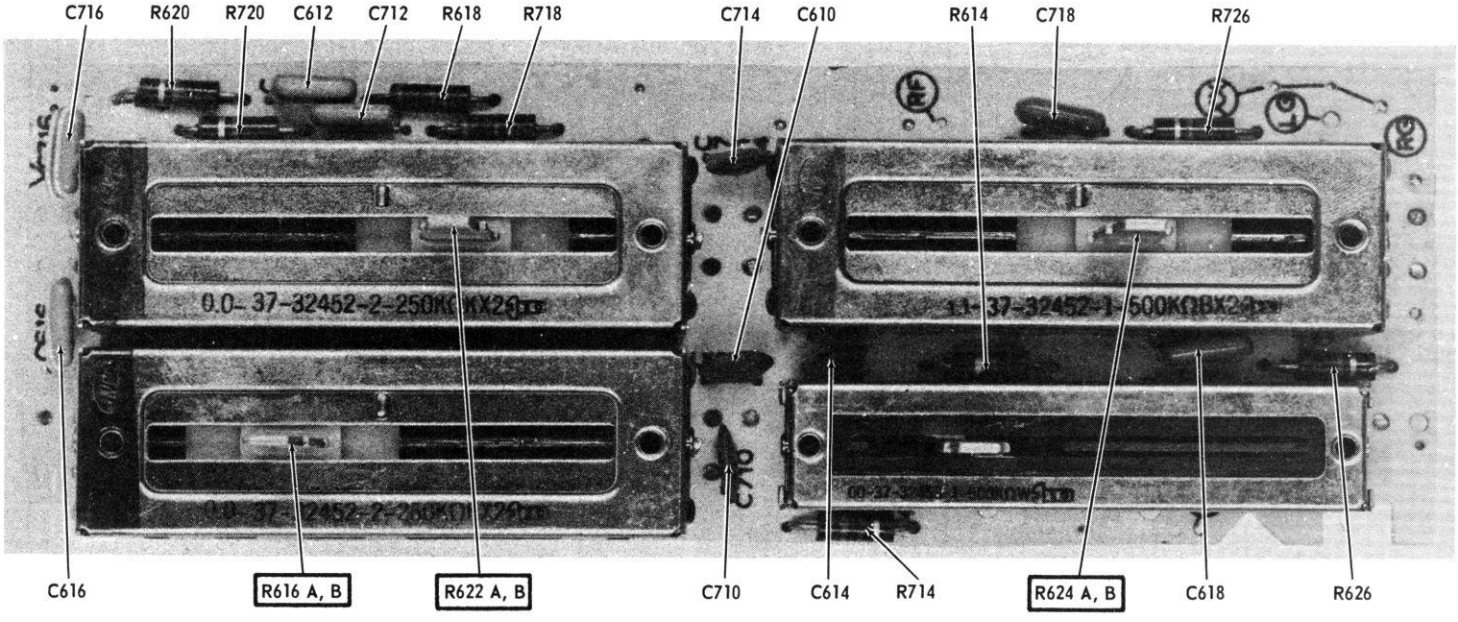
Loudness control MINIMUM - 1.5mV - Typical.
Loudness control MAXIMUM - 25mV - Typical.

Terminate both TAPE inputs with 10K, 10% resistors - select "TAPE" and "STEREO" functions.

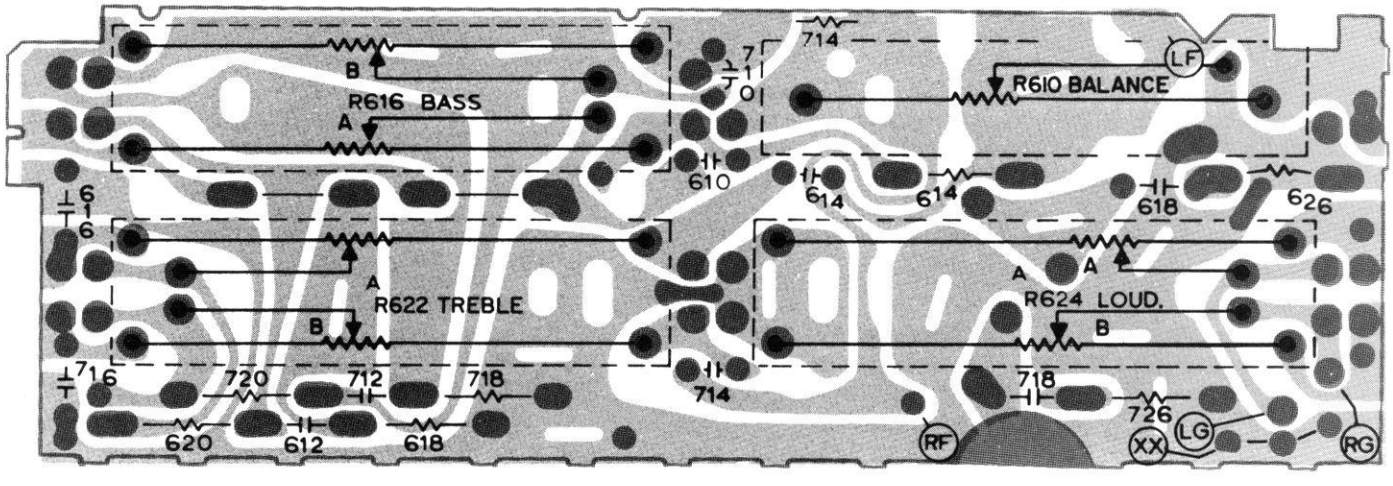
Balance, Bass and Treble controls at mechanical center.

Loudness control MAXIMUM - 25mV typical across 8 ohm loads.

CONTROL PANEL

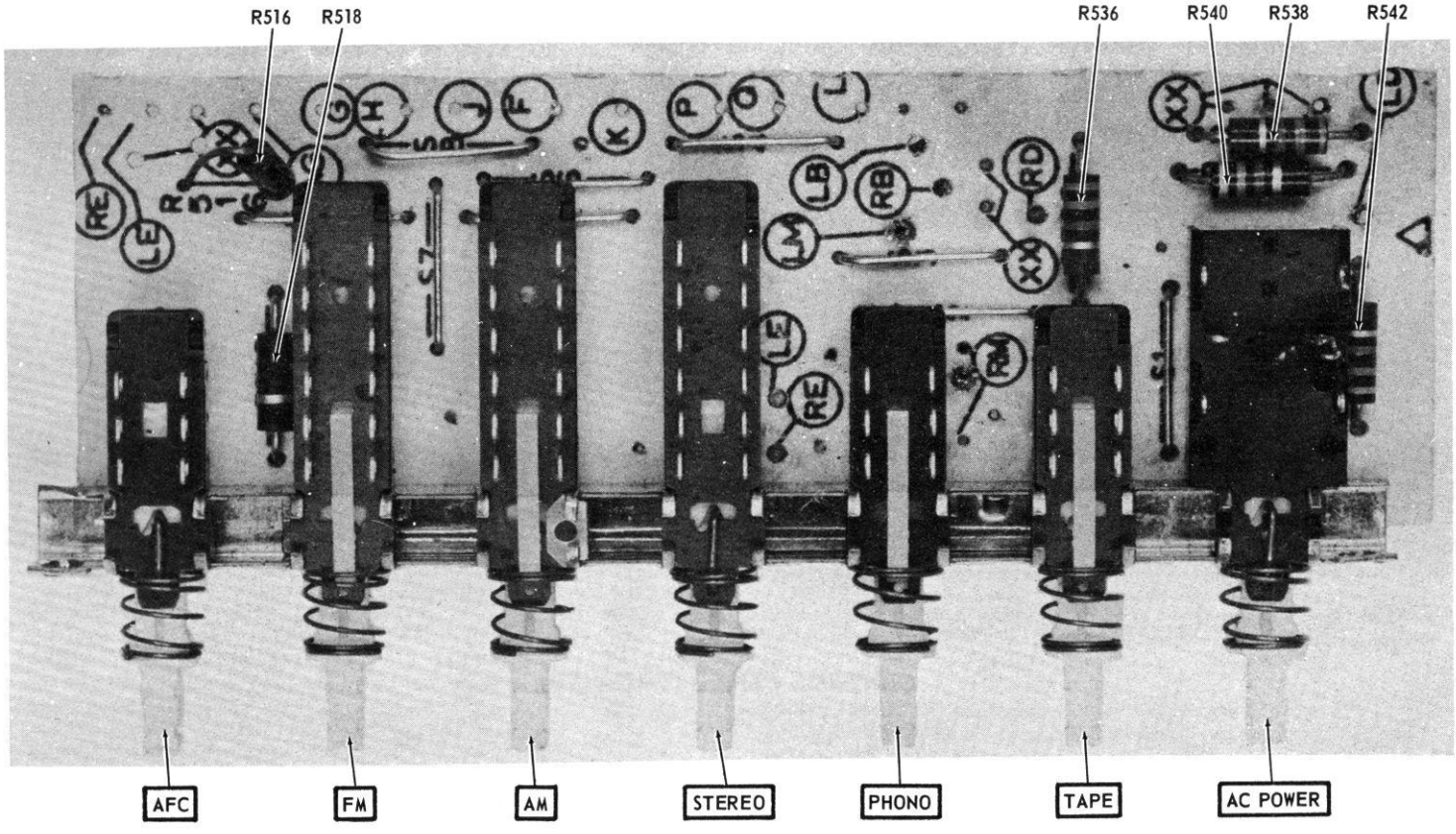


CONTROL PANEL (TOP VIEW)

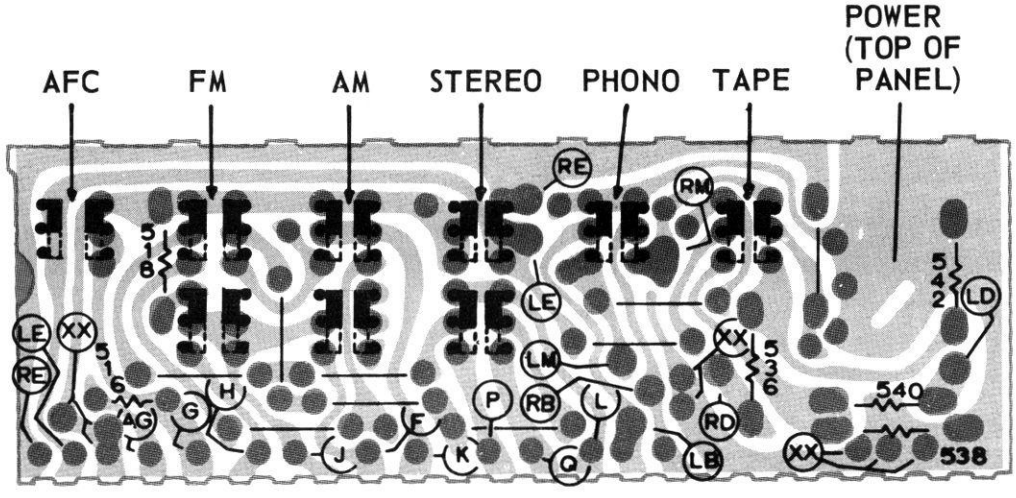


CONTROL PANEL (BOTTOM VIEW)

FUNCTION SWITCH

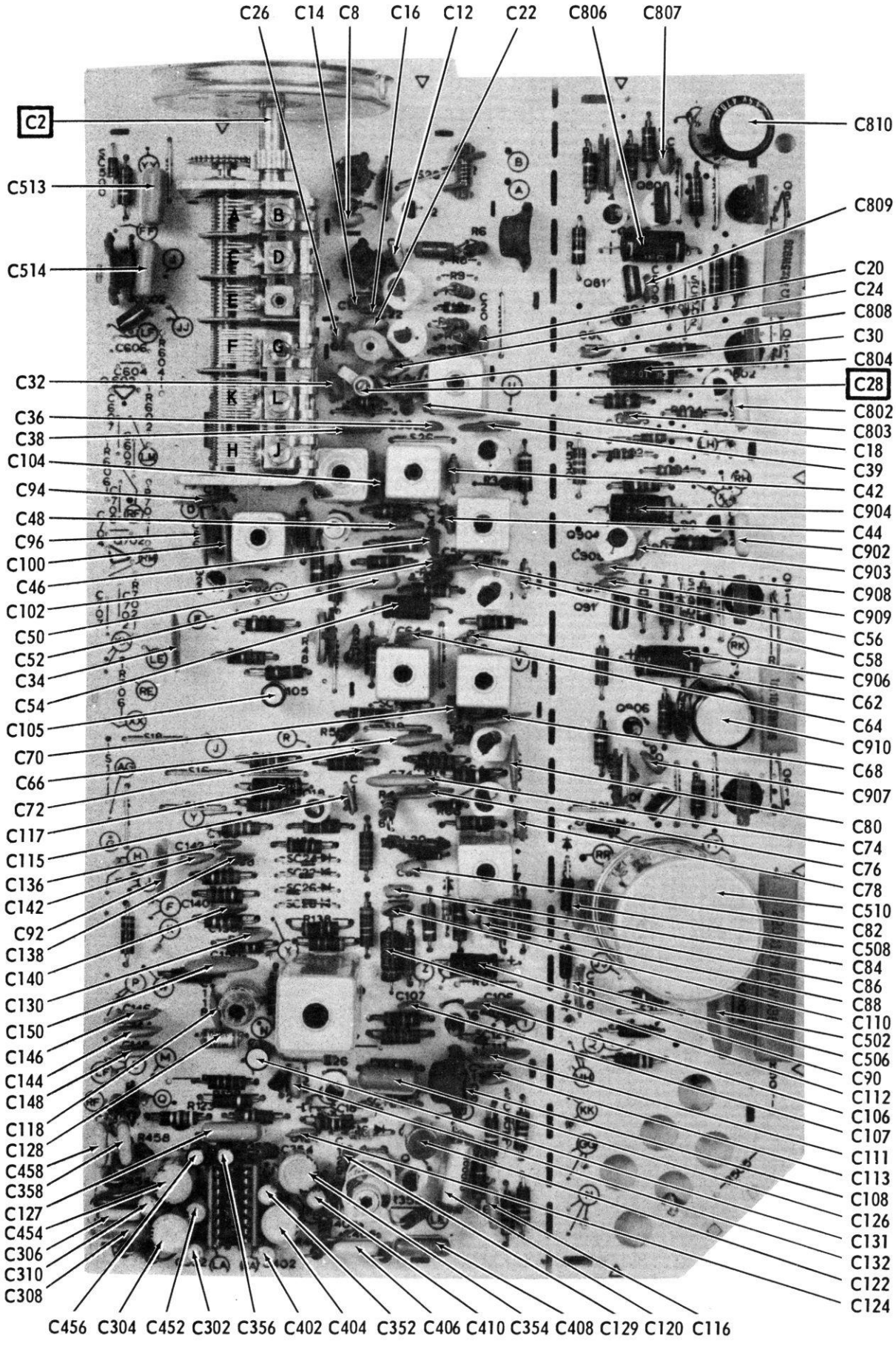


FUNCTION SWITCH (TOP VIEW)



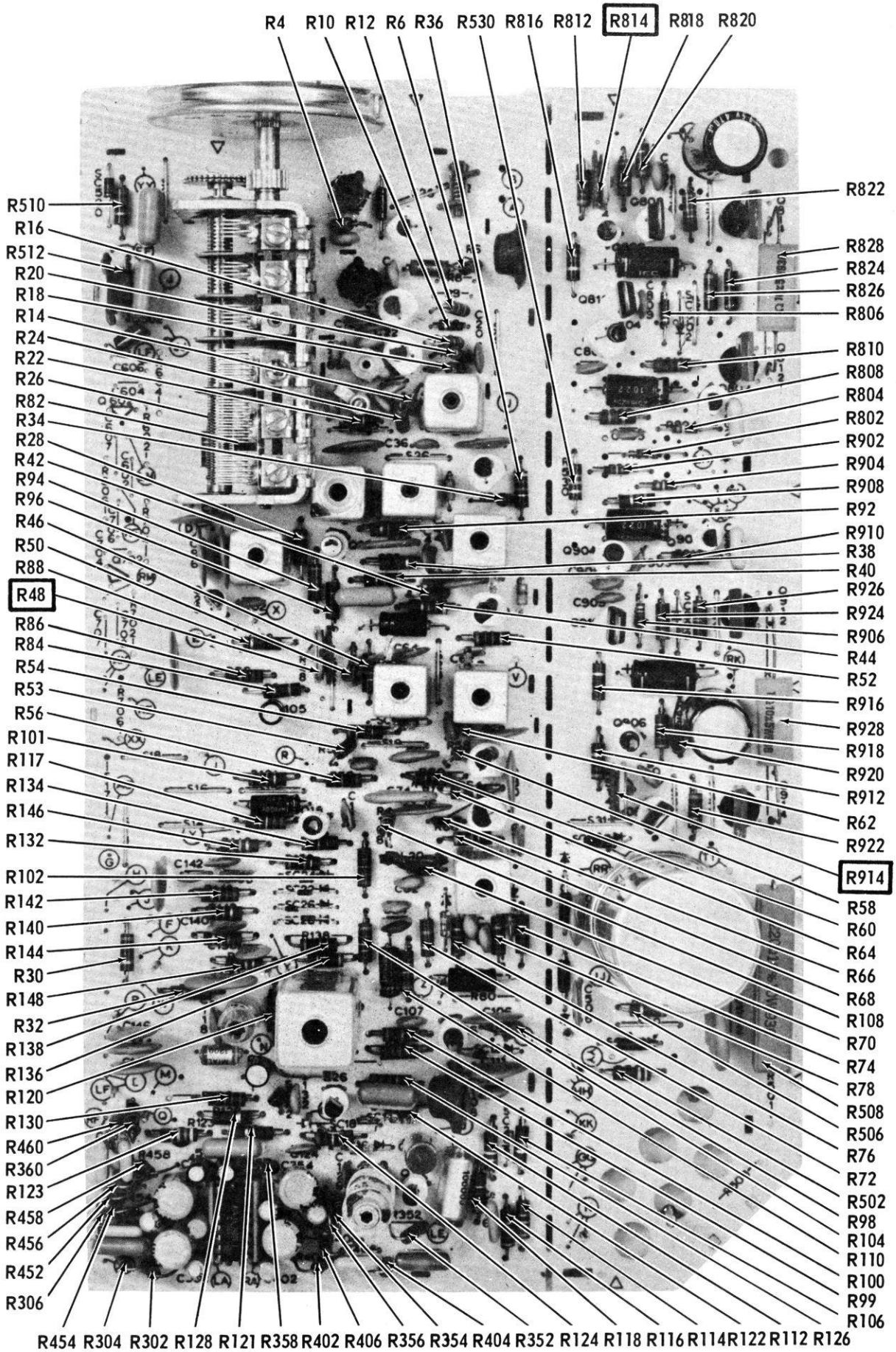
FUNCTION SWITCH (BOTTOM VIEW)

MAIN PANEL ASSEMBLY



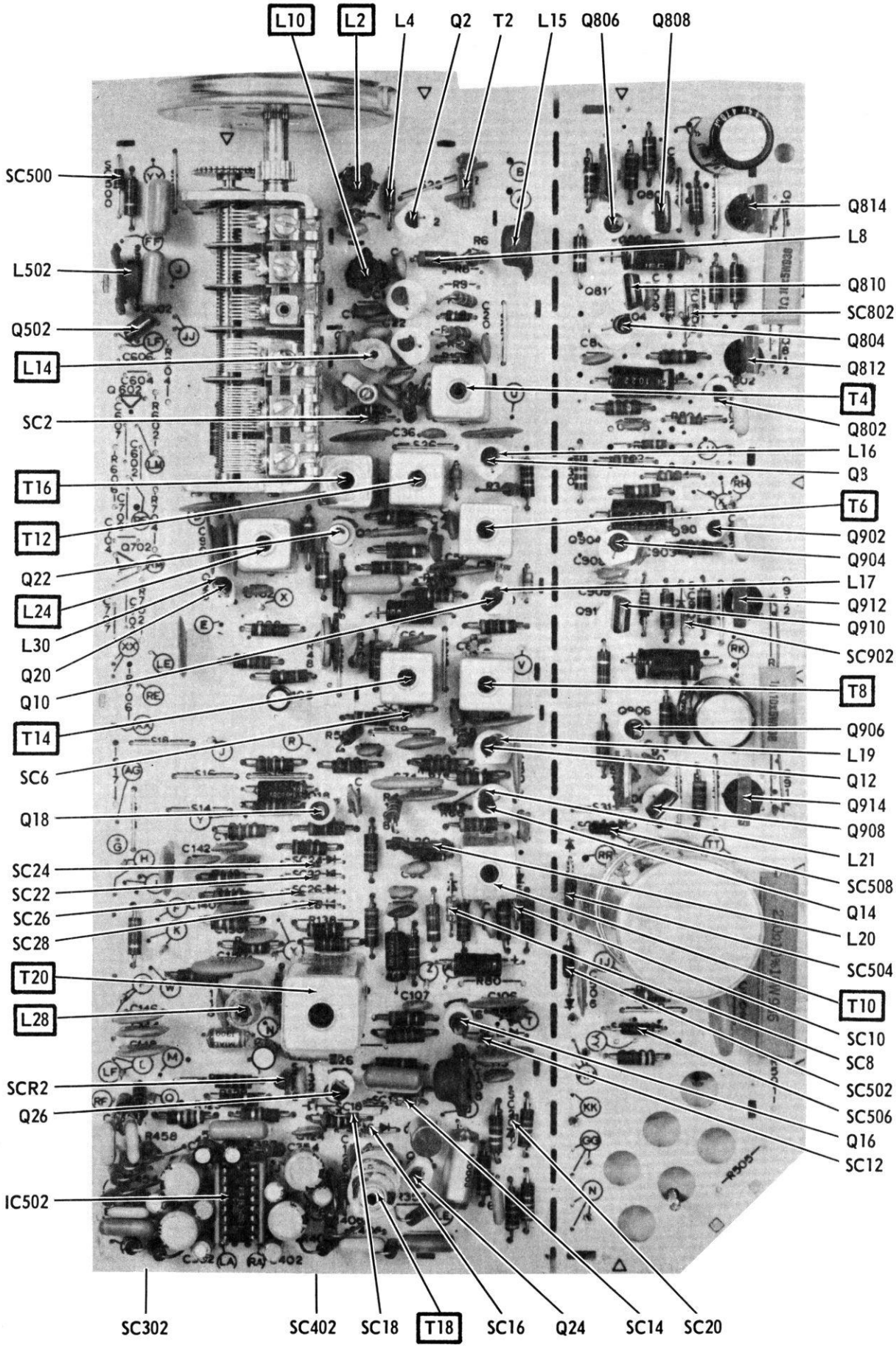
CAPACITORS

MAIN PANEL ASSEMBLY

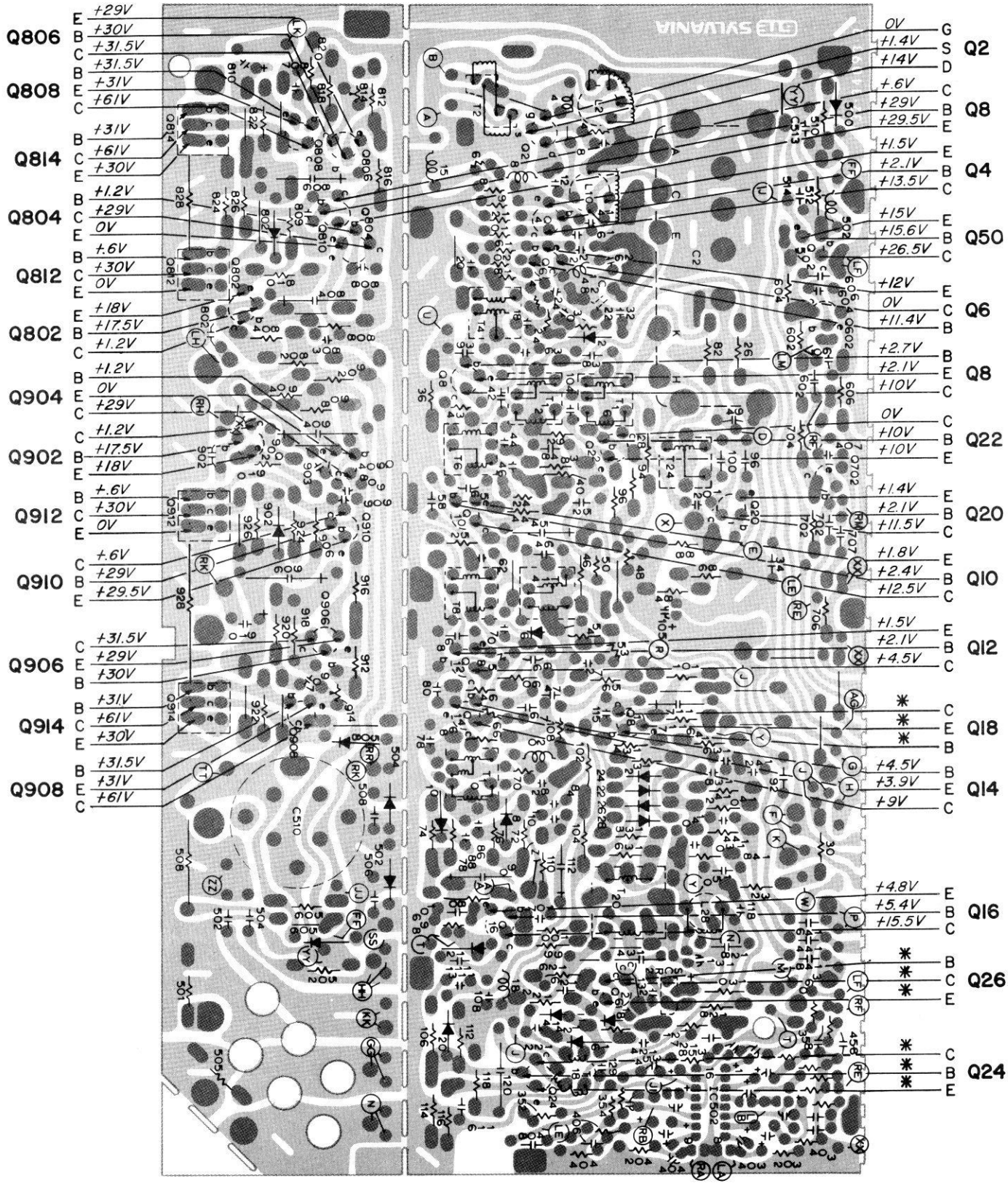


RESISTORS

MAIN PANEL ASSEMBLY

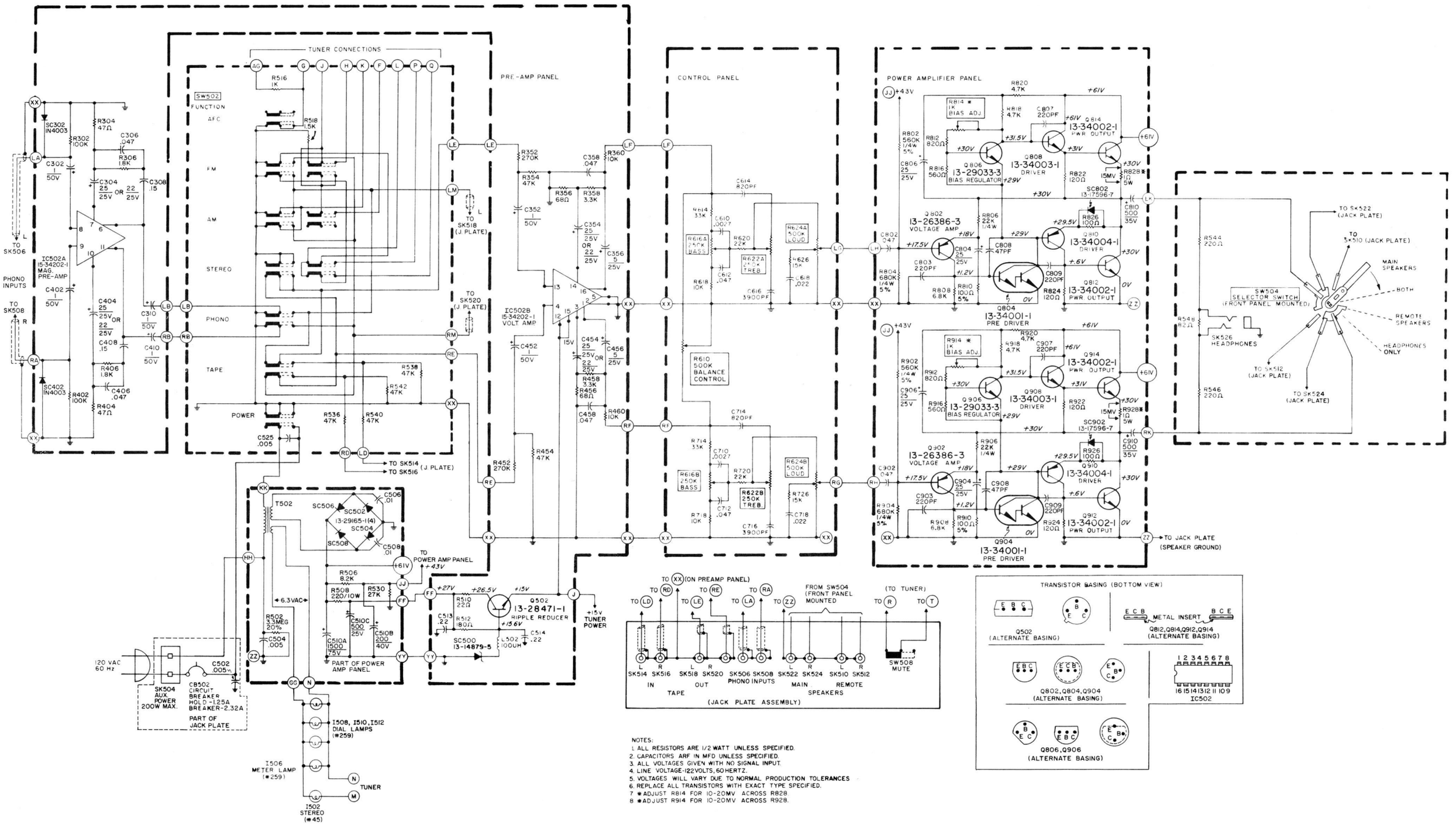


MISCELLANEOUS


Q806 E +29V B +30V C +31.5V
Q808 B +31.5V E +31V C +61V
Q814 B +31V C +61V E +30V
Q804 B +1.2V C +29V E 0V
Q812 B +.6V C +30V E 0V
Q802 E +18V B +17.5V C +1.2V
Q904 B +1.2V E 0V C +29V
Q902 C +1.2V B +17.5V E +18V
Q912 B +.6V C +30V E 0V
Q910 C +.6V B +29V E +29.5V
Q906 C +31.5V E +29V B +30V
Q914 B +31V C +61V E +30V
Q908 B +31.5V E +31V C +61V
Q2 G 0V S +1.4V D +14V
Q8 C +.6V B +29V E +29.5V
Q4 E +1.5V B +2.1V C +13.5V
Q50 E +15V B +15.6V C +26.5V
Q6 E +12V C 0V B +11.4V
Q8 B +2.7V E +2.1V C +10V
Q22 C 0V B +10V E +10V
Q20 E +1.4V B +2.1V C +11.5V
Q10 E +1.8V B +2.4V C +12.5V
Q12 E +1.5V B +2.1V C +4.5V
Q18 C * E * B *
Q14 B +4.5V E +3.9V C +9V
Q16 E +4.8V B +5.4V C +15.5V
Q26 B * C * E *
Q24 C * B * E *
* SEE SCHEMATIC

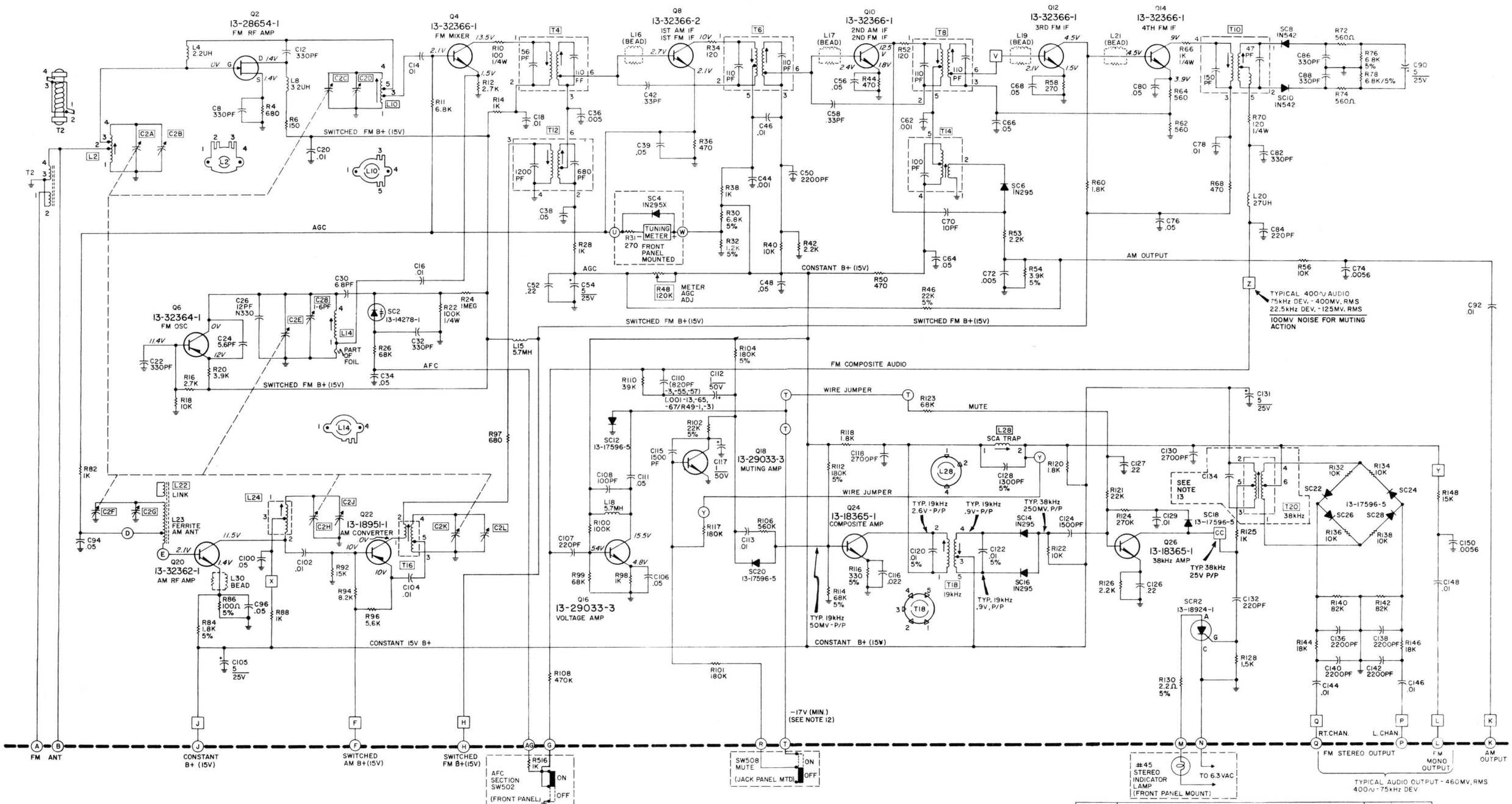
BOTTOM VIEW

SCHEMATIC DIAGRAM (AMP)



NOTES:
1. ALL RESISTORS ARE 1/2 WATT UNLESS SPECIFIED.
2. CAPACITORS ARE IN MFD UNLESS SPECIFIED.
3. ALL VOLTAGES GIVEN WITH NO SIGNAL INPUT.
4. LINE VOLTAGE-122VOLTS, 60 HERTZ.
5. VOLTAGES WILL VARY DUE TO NORMAL PRODUCTION TOLERANCES.
6. REPLACE ALL TRANSISTORS WITH EXACT TYPE SPECIFIED.
7. *ADJUST R814 FOR 10-20MV ACROSS R828.
8. *ADJUST R914 FOR 10-20MV ACROSS R928.

SCHEMATIC DIAGRAM (TUNER)

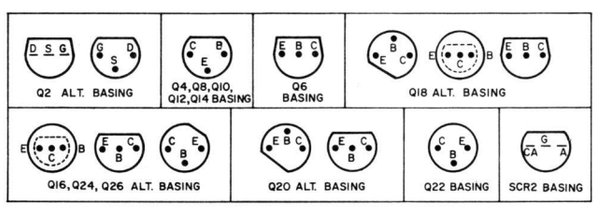


CATHODE BAND

DIODE POLARITY

COLOR DOT

TYPICAL TRANSFORMER BASING



NOTES

1. ALL RESISTORS ARE 1/2WATT, 10% CARBON UNLESS SPECIFIED.
2. ALL CAPACITOR VALUES IN MFD, UNLESS SPECIFIED.
3. MAINTAIN LINE AT 120V, 60Hz FOR ALL MEASUREMENTS, 122VAC ON R49 TUNERS.
4. ALL VOLTAGES MEASURED TO CHASSIS GROUND.
5. SET TUNED TO OFF-STATION FOR VOLTAGE MEASUREMENTS, EXCEPT AS NOTED.
6. SELECT AM FUNCTION TO CHECK AM VOLTAGES.
7. SELECT FM FUNCTION TO CHECK FM VOLTAGES.
8. ALL VOLTAGES WILL VARY DUE TO NORMAL PRODUCTION TOLERANCES.
9. COIL BASING AND TRANSISTOR BASING DIAGRAMS SHOW BOTTOM VIEW.
10. SQUARE WIRE PINS [J] ARE TEST POINTS AND WIRE WRAP CONNECTIONS.
11. ROUND CONNECTIONS (J) ARE WIRE CONNECTIONS ONLY.
12. FOR PROPER MUTE OPER; -17V MUST BE PRESENT UNDER NO SIGNAL CONDITIONS AT THE JUNCTION OF SC12 & C111 WITH MUTE SWITCH IN THE "OFF" POSITION.
13. C134 IS 3300PF, 5%, USED WITH 50-26579-2 TRANSFORMER
    C134 IS 5600PF, 5%, USED WITH 50-32591-1 TRANSFORMER

		FM MUTING SWITCHED "OFF"						FM MUTING SWITCH "ON"	
		NO FM SIGNAL	FM SIGNAL	LOW FM-MONO SIGNAL	HIGH FM-MONO SIGNAL	LOW FM-STEREO SIGNAL	HIGH FM-STEREO SIGNAL	NO FM SIGNAL	FM SIGNAL
Q18	E	0V	0V					0V	0V
	B	+.62V	+.62V					-1.4V	+.62V
	C	+.1V	+.1V					+15.5V	+.1V
Q24	E	+1.9V	+1.9V					+2.55V	+1.9V
	B	+2.55V	+2.55V					+3.20V	+2.55V
	C	+9.9V	+9.9V					+8V	+9.9V
Q26	E	0V		0V	+1.8V	0V	+2.7V	0V	+2.7V
	B	-.90V		-3.0V	+2.4V	-2.5V	+3.4V	-9V	+3.4V
	C	+15.5V		+15.5V	+15.5V	+15.5V	+15.5V	+15.5V	+15.5V

Q18,Q24,Q26 OPERATING VOLTAGES

REPLACEMENT PARTS LIST

SCHEMATIC CODING	SERVICE PART NO.	DESCRIPTION
CAPACITORS (All in MFD, unless otherwise specified)		
C2	42-32806-2	Main Tuning Gang
C8		330PF
C12		330PF
C14		.01
C16		.01
C18		.01
C20		.01
C22		330PF
C24		5.6PF
C26		12PF, N330
C28	42-18146-1	1-6PF Ceramic Trimmer
C30		6.8PF
C32		330PF
C34		.05
C36		.005
C38		.05
C39		.05
C42		33PF
C44		.001
C46		.01
C48		.05
C50		2200PF
C52		.22
C54	41-23765-5	5/25V Electrolytic
C56		.05
C58		.33PF
C62		.001
C64		.05
C66		.05
C68		.05
C70		10PF
C72		.005
C74		.0056
C76		.05
C78		.01
C80		.05
C82		330PF
C84		220PF
C86		330PF
C88		330PF
C90	41-23765-5	5/25V Electrolytic
C92		.01
C94		.05
C96		.05
C100		.05
C102		.01
C104		.01
C105	41-29270-5	5/25V Electrolytic
C106		.05
C107		220PF
C108		100PF
C110		.001
C111		.05
C112	41-23765-16	1/50V Electrolytic
C113		.01
C115		1500PF
C116		.022
C117	41-23765-16	1/50V Electrolytic
C118		2700PF
C120	40-10285-8	10,000PF, 5% - 125V
C122	40-28121-1	10,000PF, 5% - 125V
C124		1500PF
C126		.22
C127		.22
C128	40-10285-32	1300PF, 5% - 125V
C129		.01
C130		2700PF
C131	41-29270-5	5/25V Electrolytic
C132		220PF
C134	40-10285-13	3300PF, 5% - 125V (use w/50-26579-2 Xfmr.)
C134	40-10285-40	5600PF, 5% - 125V (use w/50-32591-1 Xfmr.)

SCHEMATIC CODING	SERVICE PART NO.	DESCRIPTION
CAPACITORS (CONT'D)		
C136		2200PF
C138		2200PF
C140		2200PF
C142		2200PF
C148		.01
C150		.0056
C302	41-32477-85	1/50V Electrolytic
C304	41-32477-37	100/15V Electrolytic (Early Prod.)
C304	41-32477-48	25/25V Electrolytic
C306		.047
C308		.15
C310	41-32477-85	1/50V Electrolytic
C352	41-32477-85	1/50V Electrolytic
C354	41-32477-38	250/16V Electrolytic (Early Prod.)
C354	41-32477-48	25/25V Electrolytic
C356	41-32477-46	5/25V Electrolytic
C358		.047
C402	41-32477-46	1/50V Electrolytic
C404	41-32477-37	100/15V Electrolytic (Early Prod.)
C404	41-32477-48	25/25V Electrolytic
C406		.047
C408		.15
C410	41-32477-85	1/50V Electrolytic
C452	41-32477-85	1/50V Electrolytic
C454	41-32477-38	250/16V Electrolytic (Early Prod.)
C454	41-32477-48	25/25V Electrolytic
C456	41-32477-46	5/25V Electrolytic
C458		.047
C502	43-98665-6	.005/150VAC
C504	43-98665-5	.005/150VAC
C506		.01
C508		.01
C510	41-32934-1	1500 x 500 x 200 Electrolytic
C513		.22
C514		.22
C525	43-97665-6	.005/150VAC
C610		.0027
C612		.047
C614		820PF
C616		3900PF
C618		.022
C710		.0027
C712		.047
C714		820PF
C716		3900PF
C718		.022
C802		.047
C803		220PF
C804	41-23765-7	25/25V Electrolytic
C806	41-23765-7	25/25V Electrolytic
C807		220PF
C808		47PF
C809		220PF
C810	41-32477-67	500/35V Electrolytic
C902		.047
C903		220PF
C904	41-23765-7	25/25V Electrolytic
C906	41-23765-7	25/25V Electrolytic
C907		220PF
C908		47PF
C909		220PF
C910	41-32477-67	500/35V Electrolytic
RESISTORS (All Carbon, 1/2W, 10% unless otherwise specified)		
R4		680
R6		150
R10		100, 1/4Watt
R11		6.8K
R12		2.7K
R14		1K
R16		2.7K

REPLACEMENT PARTS LIST (CONT'D)

SCHEMATIC CODING	SERVICE PART NO.	DESCRIPTION
RESISTORS		
R18		10K
R20		3.9K
R22		100K, 1/4Watt
R24		1 meg.
R26		68K
R28		1K
R30		6.8K, 10%
R31		270
R32		1.2K, 5%
R34		120
R36		470
R38		1K
R40		10K
R42		2.2K
R44		470
R46		22K, 5%
R48	37-14576-11	120K Thumbwheel - AGC, Meter Adj.
R50		470
R52		120
R53		2.2K
R54		3.9K, 5%
R56		10K
R58		270
R60		1.8K
R62		560
R64		560
R66		1K, 1/4Watt
R68		470
R70		120, 1/4Watt
R72		560
R74		560
R76		6.8K, 5%
R78		6.8K, 5%
R82		1K
R84		1.8K, 5%
R86		100, 5%
R88		1K
R92		15K
R94		8.2K
R96		5.6K
R97		680
R98		1K
R99		68K
R100		100K
R101		180K
R102		22K, 5%
R104		180K, 5%
R106		560K
R108		470K
R110		39K
R112		180K, 5%
R114		68K, 5%
R116		330, 5%
R117		180K
R118		1.8K
R120		1.8K
R121		22K
R122		10K
R123		6.8K
R124		270K
R125		1K
R126		2.2K
R128		1.5K
R130		2.2 ohms, 5%
R132		10K
R134		10K
R136		10K
R138		10K
R140		82K
R142		82K
R144		18K
R146		18K
R148		15K

SCHEMATIC CODING	SERVICE PART NO.	DESCRIPTION
RESISTORS (CONT'D)		
R302		100K
R304		47
R306		1.8K
R352		270K
R354		47K
R356		68
R358		3.3K
R360		10K
R402		100K
R404		47
R406		1.8K
R452		270K
R454		47K
R456		68
R458		3.3K
R460		10K
R502		3.3 meg, 20%
R505		10 ohm
R506		8.2K
R508	36-62455-57	220, 10 Watt
R510		22
R512		180
R516		1K
R518		1.5K
R530		18K (Early Prod.)
R530		27K
R536		47K
R538		47K
R540		47K
R542		47K
R544		220
R546		220
R548		82
R610	37-32453-1	500K Balance Control
R614		33K
R616	37-32452-2	250K Dual Bass Control
R618		10K
R620		22K
R622	37-32452-2	250K Dual Treble Control
R624	37-32452-1	500K Dual Loudness Control
R626		15K
R714		33K
R718		10K
R720		22K
R726		15K
R802		560K, 1/4 Watt - 5%
R804		680K, 1/4 - 5%
R806		22K, 1/4 Watt
R808		6.8K
R810		100, 5%
R812		820
R814	37-14576-5	1K Thumbwheel Pot - Bias Adjust
R816		560
R818		4.7K
R820		4.7K
R822		120
R824		120
R826		100
R828	36-62454-1	1 ohm, 5 Watt
R902		560K, 1/4 Watt - 5%
R904		680K, 1/4 Watt - 5%
R906		22K, 1/4 Watt
R908		6.8K
R910		100, 5%
R912		820
R914	37-14576-5	1K Thumbwheel Pot - Bias Adjust
R916		560
R918		4.7K
R920		4.7K
R922		120
R924		120
R926		100
R928	36-62454-1	1 ohm, 5 Watt

SOLID STATE DEVICES

SCHEMATIC CODING	SERVICE PART NO.	DESCRIPTION
IC502	15-34005-1	Dual Channel IC - Early Prod.
IC502	15-34202-1	Dual Channel IC
L16	22-28072-2	Ferrite Bead
L17	22-28072-2	Ferrite Bead
L19	22-28072-2	Ferrite Bead
L21	22-28072-2	Ferrite Bead
L30	22-28072-2	Ferrite Bead
Q2	13-28654-1	FM RF Amp.
Q4	13-32366-1	FM Mixer
Q6	13-32364-1	FM Oscillator
Q8	13-32366-2	1st AM/1st FM IF
Q10	13-32366-1	2nd AM/2nd FM IF
Q12	13-32366-1	3rd FM IF
Q14	13-32366-1	4th FM IF
Q16	13-29033-3	Voltage Amp
Q18	13-29033-3	Muting Amp
Q20	13-32362-1	AM RF Amp.
Q22	13-18951-1	AM Converter
Q24	13-18365-1	Composite Amp
Q26	13-18365-1	38kHz Amp
Q502	13-28471-1	Ripple Reducer
Q802	13-26386-3	Voltage Amplifier
Q804	13-34001-1	NPN Darlington
Q806	13-29033-3	Bias Regulator
Q808	13-34003-1	Driver
Q810	13-34004-1	Driver
Q812	13-34002-1	Power Output
Q814	13-34002-1	Power Output
Q902	13-26386-3	Voltage Amp
Q904	13-34001-1	NPN Darlington
Q906	13-29033-3	Bias Regulator
Q908	13-34003-1	Driver
Q910	13-34004-1	Driver
Q912	13-34002-1	Power Output
Q914	13-34002-1	Power Output
SC2	1N3182	Diode - Varicap
SC4	1N295	- Meter Protection
SC6	1N295	- AM Detector
SC8,SC10	1N542MP	- Ratio Det. (MATCHED PAIR)
SC12	13-27596-5	- Rectifier
SC14	1N295	- 19kHz Doubler
SC16	1N295	- 19kHz Doubler
SC18	13-17596-5	- Clamp
SC20	13-17596-5	- Muting Switch
SC22	13-17596-5	- Multiplex Matrix
SC24	13-17596-5	- Multiplex Matrix
SC26	13-17596-5	- Multiplex Matrix
SC28	13-17596-5	- Multiplex Matrix
SC302	13-17596-5	- Overload Protect.
SC402	13-17596-5	- Overload Protect.
SC500	13-14879-5	- Zener
SC502	13-29165-1	- Rectifier
SC504	13-29165-1	- Rectifier
SC506	13-29165-1	- Rectifier
SC508	13-29165-1	- Rectifier
SC802	13-17596-7	- Bias
SC902	13-17596-7	- Bias
SCR2	13-18924-1	- S.C.R.
	72-27200-3	Large 3 pin Transistor Socket
	86-28669-1	Power Xistor - Mica Insulator
	72-28852-1	- Socket
	70-28659-1	- Mounting Clip
	72-27200-1	Small 3 pin Transistor Socket

COILS AND TRANSFORMERS

L2	50-26574-14	Coil - FM RF
L4	50-10260-4	- 2.2UH
L8	50-11378-5	- 3.3UH
L10	50-26574-15	- FM Interstage
L14	50-26574-19	- FM Oscillator
L15	50-18789-3	- 5.7mH Choke
L16	22-28072-2	Ferrite Bead

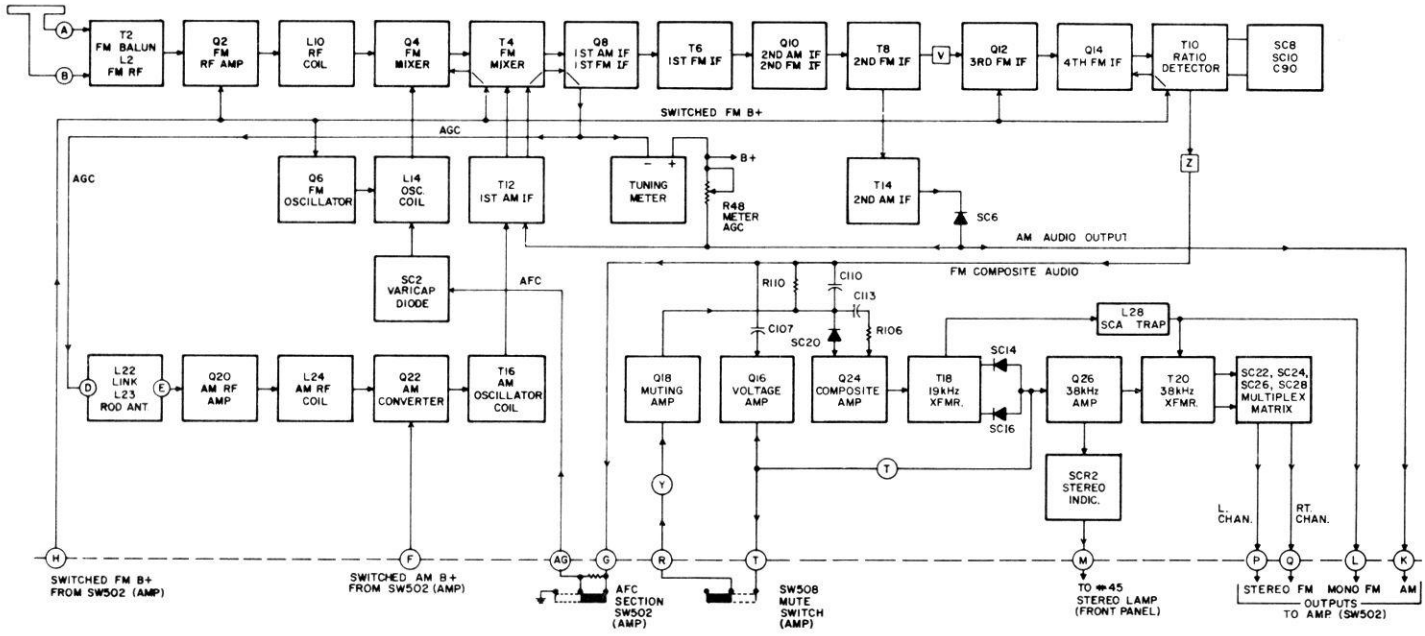
COILS & TRANSFORMERS (CONT'D)

L17	22-28072-2	Ferrite Bead
L18	50-18789-3	5.7mH Choke
L19	22-28072-2	Ferrite Bead
L20	50-15318-1	27UH Choke
L23	27-32358-1	Loop - Iron Core AM (Early Prod.)
L23	27-32358-3	- Iron Core AM
L24	50-28413-1	Coil - AM RF
L28	50-32367-1	- SCA Trap
L30	22-28072-2	Ferrite Bead
L502	50-26001-3	100UH Choke
T2	50-26573-1	FM Balun
T4	50-26580-8	Transformer - 1st FM IF
T6	50-26580-9	- 2nd FM IF
T8	50-26580-10	- 3rd FM IF
T10	50-26584-1	- Ratio Detector
T12	50-26583-3	- 1st AM IF
T14	50-26583-4	- 2nd AM IF
T16	50-28411-1	- AM Oscillator
T18	50-26575-1	- 19kHz
T20	50-26579-2	- 38kHz (use w/3300PF Cap.)
T20	50-32591-1	- 38kHz (use w/5600PF Cap.)
T502	55-32972-1	- Power

MISCELLANEOUS PARTS

CB502	29-33346-8	Circuit Breaker (1.25A)
SK504	73-15073-1	Socket - Aux. Power
SK506,SK508	73-98079-2	Dual Phono Socket - PHONO IN
SK510,SK512	73-98079-2	- REM. SPKRS.
SK514,SK516	73-98079-2	- TAPE IN
SK518,SK520	73-98079-2	- TAPE OUT
SK522,SK524	73-98079-2	- MAIN SPKRS.
SK526	73-26338-3	Headphone Jack
SW502	33-28756-1	Complete Function Switch Asm.
	33-28756-105	AFC Switch Section Only
	33-28756-104	AM or FM SwitchSection Only
	33-28756-100	ON-OFF/AUTO Switch Section Only
	33-28756-102	PHONO or TAPE Switch Section Only
	33-28756-101	STEREO Switch Section Only
SW504	89-14500-1	Lever Switch Asm. - Speaker Select.
SW508	33-26638-1	MUTE Slide Switch
	73-26931-2	Antenna Terminals - FM
	73-33071-41	Cord - AC Power
	70-99257-4	Dial - Clip (tape-to-carriage)
	77-34029-1	- Drive Spring
	86-28943-1	- Light Box
	74-28921-2	- Light Diffuser
	74-28922-5	- Tape (Tuning Indicator)
	77-28439-1	- Tape Drive Spring
	86-28436-2	- Tape Holder
	86-28433-1	- Tape Roller
	86-28434-1	- Tape Roller Holder
	85-28937-9	Jack Plate
	30-26288-1	Lamp - Dial & Meter (#259)
	30-62495-45	- Multiplex Ind. (#45)
	73-28247-7	Socket - Dial Lamp
	73-32463-1	- Meter Lamp
	73-26694-1	- Multiplex Lamp
	70-84346-25	- Mounting Ring (mpx. & meter lamp)
	25-22604-4	Tuning Meter - Early Prod.
	25-22604-7	- Later Prod.
	70-26679-1	- Mounting Nut
	74-28923-1	Tuning Thumbwheel - w/Metal Shaft
	70-14098-1	- Nylon Bearing

TUNER BLOCK DIAGRAM



CIRCUIT DESCRIPTION (TUNER)

This tuner shares a printed circuit panel with the amplifier circuits. The R49 tuner covers both the AM broadcast band (540 - 1610kHz) and FM broadcast band (87.9 - 108.5MHz).

Especially noteworthy from a servicing standpoint are the top and bottom roadmaps on the printed circuit panel and the use of socket mounted transistors throughout.

The tuner supply voltage (plus 15V) is taken from the amplifier supply and applied to the tuner through a ripple reducer circuit (Q502) and regulated by SC506, a Zener diode.

Q8, Q10, Q16, Q18, Q20, Q24 and Q26 receive power (plus 15V) whenever the amplifier is switched on. Q2, Q4, Q6, Q12 and Q14 receive power only when the FM function is selected; Q22 receives power only when the AM function is selected.

As the FM pushbutton is depressed, the rear D.P.D.T. portion of the switch applies power to selected circuits as outlined above. Simultaneously, the front D.P.D.T. portion of the FM switch removes ground from pin L (FM MONO output). FM audio travels through the STEREO/MONO switch (rear section) through the FM switch (front section), through the TAPE switch (front section), to pins LE (left channel input) and RE (right channel input). The Stereo FM outputs (pins P and Q) remain floating.

Stereo FM reception is very similar, except that pins P and Q are connected to the circuit through the rear section of the STEREO/MONO switch when the switch is depressed, and pin L remains floating.

FM PERFORMANCE

Useable FM Sensitivity (I.H.F.) @ 106MHz	2.5uV
20db Quieting (106MHz)	1.6uV
Image Rejection @ 106MHz	60db
Distortion at 75kHz deviation (400Hz) 1100uV Input	0.6%
Maximum FM S/N ratio (75kHz dev., 1100uV Input)	60db
Stereo Separation (1kHz)	28db
Maximum Output (100% modulation @ 400Hz	.47V-RMS

FM RF, OSCILLATOR and MIXER STAGES

RF Signals pass through the FM balun (T2) to the first tuned circuit formed by L2 and the first section of the main tuning gang. The tank circuit is a frequency selective circuit which allows only a small band of frequencies to pass. The selected frequencies are then applied to the gate of Q2, a N channel field effect transistor, for amplification. The output of Q2 passes through a second tuned circuit (C2C, L10) which gives even more frequency selectivity. The signal is then AC coupled to the base of Q4 - the FM Mixer stage. A locally generated unmodulated signal is produced in the FM oscillator circuit of Q6. The oscillator frequency is determined by the tank circuit formed by L14 and the third section of the tuning gang C2E. The oscillator signal is AC coupled to the emitter of Q4. Mixing or heterodyning of the RF and oscillator frequencies in Q4 produce the 10.7 mc IF frequency. Correction of minor frequency drift is the function of the varicap diode. A variation in the detected signal, which contains a DC component as well as audio frequencies, changes the bias on SC2, and thus effectively changes the capacity across L14.

FM IF and DETECTION

There are four FM IF stages in the R19 chassis, two of which share transistors with the AM portion of the receiver. T4, T6 and T8 are tuned to 10.7MHz - the IF frequency. Note the Beads, L16, L17, L19 and L21 shown on the Base leads of the IF amplifiers. Although drawn as a R/L circuit, they are small Ferrite Beads which are slipped over the transistor Base leads before the transistors are inserted in their sockets. At normal IF frequencies, these 'beads' have no effect on the circuit. However, they effectively trap out high frequency parasitic oscillations.

The output of the last IF is applied to the primary of the Ratio Detector (T10). With a frequency modulated signal, audio frequencies will develop in the tertiary winding of T10, and will appear at pin Z.

MONO FM OUTPUT

Composite audio takes two separate paths upon leaving the ratio detector (pin Z). The primary path is through R110, C110 and to the Base of the composite amplifier (Q24). The composite signal is amplified by Q24, passes through the primary of T18 and then through the SCA trap. Note that this trap (L28)

is tuned at 72kHz for optimum performance. The audio, now with SCA information removed, travels to the tuner output (pin L) through a deemphasis network.

Some of the detected signal is shunted through the AFC switch section (SW502) to a low pass filter formed by R108 and C34. The detected signal contains audio frequencies as well as a DC component and the low pass filter (C34, R108) filters out all audio from the detected signal. The remaining DC component is used to vary the bias on SC2 - see FM RF, OSCILLATOR and MIXER. There should be no audio present at SC2.

AUTOMATIC STEREO SWITCHING

As a transmitted FM signal grows weaker, the background noise level increases. When the noise level reaches 100mV at pin Z, stereo FM reproduction becomes objectionably noisy due to circuit requirements, although Mono FM reproduction is still clear. Therefore, the composite signal is also AC coupled to the Base of Q16. With at least 100mV of noise at pin Z, the noise portion of the composite audio is amplified by Q16, rectified by SC12 and applied to the Base of Q26. The output of Q16 varies the Base voltage of Q26 from -9V (no signal, all noise) to plus 3.4V (good, solid signal). Therefore, under weak signal conditions, Q26 is biased off and there is no 38kHz signal to switch the multiplex diodes off. The FM MONO signal applied at the center tap of T20 passes through the multiplex matrix and appears at output pins P and Q (FM Stereo Outputs).

A marginal Stereo FM signal level could cause this receiver to switch back and forth between Mono and Stereo. SC18 rectifies the 38kHz signal at the collector of Q26 and increases the 15 volts at C129 to approximately 30 volts. This increased voltage further biases Q26 on, which in turn would require a higher output from Q16 to turn Q26 off again. SC18, therefore, ensures that automatic MONO/STEREO switching will not take place with less than a 2.9uV signal.

FM MUTING

The FM muting circuit has no adjustments. The circuit is completely disabled when the FM muting switch is in the "OFF" position. Switching FM muting "ON" will reduce FM off-station noise by 25 to 30db.

With the receievr tuned off-station, there is a large amount of random noise presented to Q16 for amplification. This amplified noise is rectified by SC12, producing a negative 17VDC at the MUTE switch. Closing this switch (SW508) applies this negative DC voltage to the Base of Q18 (Muting Amp). With Q18 biased off, R102 is, in effect, removed from the circuit. This causes the DC voltage on the anode of SC20 to increase. With SC20 reverse biased, the noise must now pass through C113 and R106 - resulting in attenuation of the noise. The Base voltage of Q24 rises, which is reflected by a decrease to 8 volts of the potential at point Y.

Upon tuning to a station with 3uV or greater signal strength, the background noise is reduced, so that Q18 turns on. SC20 now switches on and passes unattenuated audio to the Base of Q24. The Base voltage of Q24 now drops, which is reflected by the point Y voltage rising to 9.9V. This results in Q18 being turned on still harder. Due to the voltage action at point Y, marginal signal levels will not cause the FM muting circuit to switch in and out with minor signal strength variations.

C115 and C117 slow down the muting action to prevent speaker "pop". Q16 and SC12 are the key components for correct muting action.

STEREO INDICATOR LAMP

A 19kHz signal is present only during a stereo broadcast - See STEREO FM. A portion of the 38kHz signal present at the Collector of Q26 is AC coupled to the Gate of a Silicon Controlled Rectifier, SCR2. The anode of this SCR is connected to 6.3VAC through a #45 Stereo Indicator Lamp.

With approximately 16V(P/P) of 38kHz signal at the collector of Q26, the SCR is switched on, causing the Stereo Indicator Lamp to light.

AGC AND TUNING METER

AM AGC is developed from the IF signal at T14 secondary.

FM AGC is obtained from a "sampling" of the 10.7 IF at the collector of Q10 by C70.

The AM or FM signal is rectified by SC6 and applied to the base of Q8 through T12 and T4 secondary.

AGC adjustment consists of adjusting R48 so that the tuning meter needle rests on the first dot on the low end of the scale with no signal input.

With the AGC correctly set, the negative voltage from SC6 varies in direct proportion with the received signal strength. A strong signal will reduce the voltage on the base of Q8, reducing FM stage gain, and also cause Q8 emitter voltage to drop. The decrease in emitter voltage causes the tuning meter needle to deflect up-scale, and is also applied to the base of Q4 (FM Mixer) for further FM gain control.

With the receiver in the AM mode of operation, the rectified FM signal controls Q8, and the Q8 emitter voltage is applied to the base of Q20 (AM RF Amplifier), resulting in stage gain reduction under strong signal conditions.

AM PERFORMANCE

Sensitivity for 20db S plus N/N @ 1400kHz	110uV/M
Sensitivity for 50mV output @ 1400kHz	80uV/M
Image Rejection @ 1400kHz	82db

AM OPERATION

RF signals are picked up by the first tuned circuit formed by the Ferrite rod antenna (L23) and the AM RF tuning gang section, C2F. This tank circuit is frequency selective, and allows only a narrow band of frequencies to pass. These selected frequencies are directly coupled to the Base of Q20, the AM RF amplifier. The output of Q20 passes through a second tuned circuit (C2H, L24) which gives even more frequency selectivity. This signal is then AC coupled to the Base of Q22, AM converter.

Q22 also acts as an oscillator, with frequency determined by a tank circuit consisting of T16 and C2K. The selected incoming frequency is mixed with the oscillator frequency to produce the 455kHz "difference" frequency for the first AM IF stage. The selected frequency is amplified by two IF stages, detected by SC6 and coupled through C92 to the audio amplifier.

CABINET REPLACEMENT PARTS LIST

DESCRIPTION	SERVICE PART NO.
Bezel - Control	74-28947-2
- Control Overlay	74-28946-3
- Dial	74-28944-1
- Mounting Clip	70-28855-1
- Pushbutton	74-32308-4
- Pushbutton Insert	74-34084-1
- Slide Button	74-28751-1
Cabinet - Back Cover	85-32326-3
- Foot, Plastic	86-91119-3

ALIGNMENT PROCEDURE

GENERAL

This receiver has been factory aligned with precision laboratory equipment. The circuits are quite stable, and not normally subject to drift. Therefore, check all circuits for malfunctions before attempting realignment. Realign ONLY when absolutely necessary.

Maintain line voltage at 120V, 60Hz during alignment.

All R.F. shields must be in place during alignment.

ALWAYS KEEP ALIGNMENT SIGNALS AT THE LOWEST USEABLE LEVEL DURING ALIGNMENT. During FM alignment maintain input signal below tuner limiting level. Note the generator attenuator setting at which further input signal increase does not increase the output. Keep the input signal below this point.

8 ohm, 50 watt non-inductive loads are required for L & R channel amplifier output terminals if speaker systems are disconnected.

Set tuning dial indicator at zero (0) on the logging scale with tuning capacitor (C2) set at maximum capacity. NOTE: Readjusting tuning dial indicator after AM or FM alignment will make RF realignment (AM & FM) necessary for correct station calibration.

Adjust tuning meter needle to first dot on the low end of the scale (no signal input) with thumbwheel pot R48 before beginning alignment.

FM RF and IF sections must be properly aligned before beginning multiplex FM alignment.

EQUIPMENT REQUIRED:

AM:

AM signal generator capable of 400Hz, 30% modulated, accurate signals from 455kHz to 1610kHz.

50 ohm IF probe - see probe #1, pg. 22.

AC VTVM or general purpose scope capable of indicating approximately .05 volt, 400Hz audio.

FM:

FM signal generator capable of 400Hz, 30% (22½kHz deviation) modulated, accurate signals from 87.9MHz to 108.5MHz.

IF sweep generator, capable of sweeping 300kHz, 10.7MHz center frequency.

Accurate markers for 10.6, 10.7 and 10.8MHz.

50 ohm IF probe - see probe #2, pg. 22.

Detector probe - see probe #3, pg. 22.

Matching 300 ohm balun or pad for RF input, unless FM signal generator has balanced 300 ohm output. See pg. 22.

VTVM with low DC scale.

General purpose scope capable of displaying IF response curve of approximately 40mV.

MULTIPLEX FM:

Multiplex generator with the following capabilities:
1. 72kHz (SCA) modulated signal.
2. Standard multiplex signal, 400Hz modulation.

Oscilloscope - preferably dual trace.

Matching 300 ohm balun or pad for RF input unless multiplex generator has balanced 300 ohm output. See pg. 22.

AM ALIGNMENT

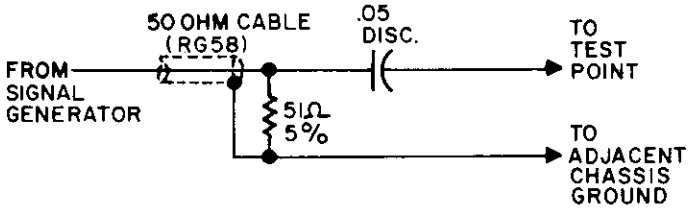
STEP	TUNING CAPACITOR SETTING	TEST EQUIPMENT HOOK-UP	GENERATOR FREQUENCY	ADJUSTMENT POINT	ADJUST FOR
1	At point of no interference.	Generator to Pin [X] through probe #1. Scope or VTVM to AM output - Pin [K].	455kHz modulated 30% with 400Hz.	[T14] [T12] Bottom [T12] Top	Maximum 400Hz Output.
NOTE: [T12] resonates at two core positions. Tune both cores to outer peaks. Repeat until further adjustment does not increase output.					
2	1400kHz	Radiate RF signal from generator. Scope or VTVM to AM output - Pin [K].	1400kHz modulated 30% with 400Hz.	[C2L]	Correct tuning dial reading at 1400kHz.
3	600kHz		600kHz modulated 30% with 400Hz.	[T16]	Correct tuning dial reading at 600kHz.
Repeat steps 2 and 3 until proper tracking is achieved.					
4	1400kHz	Radiate RF signal from generator. Scope or VTVM to AM output - Pin [K].	1400kHz modulated 30% with 400Hz.	[C2J] [C2G]	Maximum 400Hz Output.
5	600kHz		600kHz modulated 30% with 400Hz.	[L24] [L22] Link	Maximum 400Hz Output.
Repeat steps 4 and 5 until further adjustments do not increase output. When correctly aligned, this receiver will tune through a carrier at 540kHz and 1610kHz.					

FM ALIGNMENT

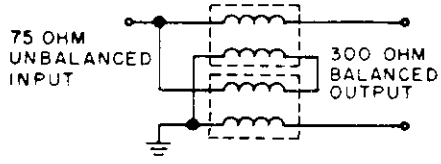
STEP	TUNING CAPACITOR SETTING	TEST EQUIPMENT HOOK-UP	GENERATOR FREQUENCY	ADJUSTMENT POINT	ADJUST FOR
NOTE: T10, T8, T6 and T4 resonate at two core positions - Tune all cores to OUTER peaks.					
1	Point of no interference.	Sweep Generator - to base of Q8 through probe #2. Use 10.6, 10.7 and 10.8MHz markers. Scope - to Pin V through probe #3.	10.7MHz sweep and markers.	T8 Bottom T8 Top T6 Bottom T6 Top	Maximum gain, proper markers. See Fig. A.
2		Sweep Generator - to base of Q4 through probe #2. Use 10.6, 10.7 and 10.8MHz markers. Scope - same as step #1.		T4 Bottom T4 Top	
3		Sweep Generator - same as step #2. Use 10.7 marker only. Scope - to Pin Z - Ratio Detector output.		T10 Bottom	Maximum gain of "S" curve.
				T10 Top	Marker centering on "S" curve. See Fig. B.
DC Voltage at Pin Z should be Zero with no signal input. Readjust top core of T10 SLIGHTLY to obtain zero, if necessary.					
4	106MHz	Signal Generator - to FM antenna terminals Use 300 ohm pad or balun, if necessary, for balanced input. Scope - to Pin L - Mono FM output.	106MHz modulated 30% (22½kHz dev.) at 400Hz.	C28	Maximum output (400Hz) at 106MHz.
5	90MHz		90MHz modulated 30% (22½kHz dev.) at 400Hz.	L14	Maximum output (400Hz) at 90MHz.
Repeat steps 4 and 5 until proper tuning dial tracking is achieved.					
6	106MHz	Signal Generator - same as step 4. Scope - same as step 4.	Same as step 4.	C2D C2B	Maximum 400Hz Output.
7	90MHz		Same as step 5.	L10 L2	Maximum 400Hz Output.
Repeat steps 6 and 7 until further adjustment does not increase output.					
The AFC should "pull in" a FM station equally well on both sides of the center frequency when switched on. If it does not do so, recheck alignment.					
8	Off-station.	Scope to Pin L - Mono FM Output Operate SW508 - Mute switch. Noise signal will drop 25-30db with muting action.			
When correctly aligned, this receiver will tune through a carrier at 87.9MHz and 108.5MHz.					

MULTIPLEX ALIGNMENT

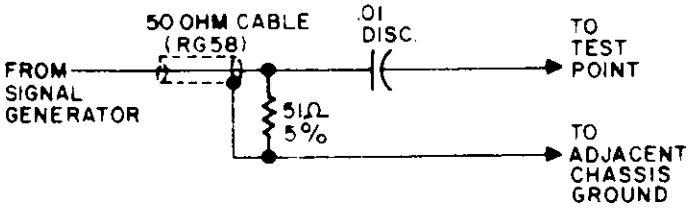
STEP	TEST EQUIPMENT HOOK-UP	GENERATOR FREQUENCY	ADJUSTMENT POINT	ADJUST FOR
SCA TRAP ALIGNMENT				
1	Multiplex Generator to Antenna Terminals - Use 300 ohm pad or balun if needed. Scope to Pin [Y].	72kHz	[L28]	MINIMUM RESPONSE
19kHz PILOT ALIGNMENT				
2	Multiplex Generator - same as step #1. Scope to Pin [CC].	10% 19kHz Pilot, modulation off.	[T18] Bottom [T18] Top [T20]	MAXIMUM 38kHz, see schematic.
NOTE: [T18] resonates at two core positions. Tune both cores to OUTER peaks.				
MULTIPLEX SWITCHING				
3	Multiplex Generator - same as step #1. Scope to Pins [P] and [Q]. Use input signal level of 200uV.	Full Multiplex signal, one channel modulated.	[T20]	Best channel separation.



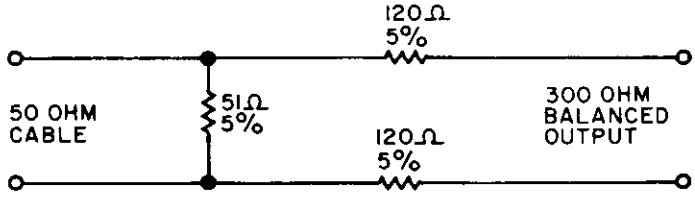
Probe #1 - 50 Ohm I.F. Probe (AM)



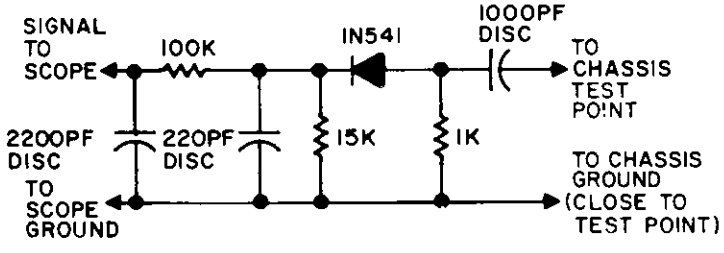
Matching 300 Ohm Balun



Probe #2 - 50 Ohm I.F. Probe (FM)



Matching 300 Ohm Pad



Probe #3 - Detector Probe

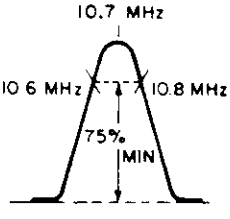


Figure: A

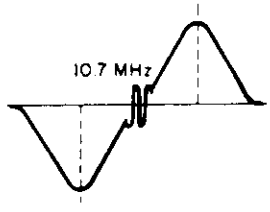


Figure: B