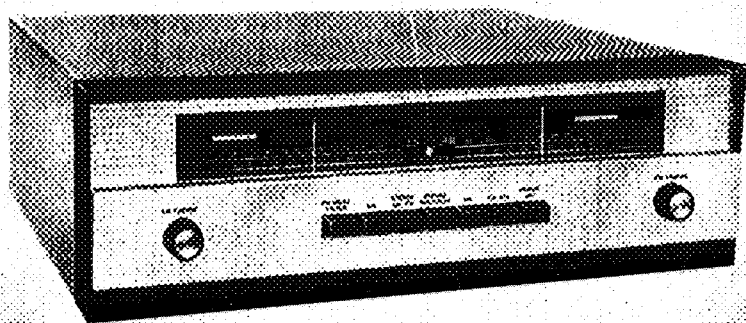


harman kardon

The Madrigal

MODEL ST350



PROFESSIONAL MONOPHONIC AM OR FM,
STEREOPHONIC AM-FM SIMULTANEOUS AND
STEREOPHONIC FM MULTIPLE TUNING



THIS IS THE HARMAN-KARDON STEREO SYMBOL.
IT IS YOUR ASSURANCE OF SUPERB STEREO PERFORMANCE.

FUR
SWITCH
SETT

INSTRUCTION MANUAL

MODEL ST350

It is important you carefully read this manual prior to installing your high fidelity stereo system. You have invested in an extremely fine electronic instrument into which many advanced and excellent engineering features have been incorporated, and each is important for the proper operation of this tuner.

A few minutes taken now may save considerable time later. It is relatively simple to operate the ST350 and this booklet clearly covers every point of installation and operation.

Keep the booklet available at all times. It contains indispensable technical and service information.

GENERAL DESCRIPTION

The Madrigal, Model ST350 is a professional tuner in every respect. A new type push button selector function switch assures positive, easy to select action with minimum effort. Specially balanced and counterweighted flywheel tuning for pinpoint station accuracy and rapid sweep of the entire AM and FM bands. Noise level and sensitivity that approaches theoretical maximum, limited only by the noise from outer space, called "Galactic Noise." Advanced circuitry reduces distortion to less than $\frac{1}{2}\%$. The first tuner to provide space for a plug-in FM multiplex adapter on its chassis under the cage.

The Model ST350 may be used in any of the following ways:

1. Monophonic AM or FM tuner for regular broadcast reception.
2. Stereophonic AM-FM tuner for simulcast reception.
3. Stereophonic FM Multiplex tuner for stereo reception when used with the Model MA350 plug-in multiplex adapter.

UNPACKING

Unpack the tuner carefully. Do not discard the packing material until you are certain you have all of the required accessories packed with the set. The carton should contain the following items:

- 1 Stereophonic tuner, Model ST350
- 1 Instruction Booklet
- 1 Warranty Card
- 1 Package of Mounting Hardware

After unpacking The Madrigal inspect it for signs of transit damage. The unit was subjected to many inspections and tests at the factory prior to final packing and it should therefore be in perfect condition. If damage is visible, notify your dealer at once. If the unit was shipped to you, notify the transportation company without delay.

INSTALLATION PROCEDURE

Ventilation:

The ST350 tuner is well ventilated in itself. Great care has been given to the design and chassis layout to insure proper component placement. The power transformer is extra heavy duty to reduce heat build up. It is necessary, however, to allow sufficient space around the tuner to permit proper air flow. Install the tuner in a manner to allow for unrestricted circulation. When mounting into a cabinet cut holes to the rear and above the tuner to allow the hot air to escape. Also allow at least 3" of space above the tubes. Do not place books or other objects on the cage or in the immediate vicinity of the tuner when installing on a bookshelf or table. This will reduce the air flow and may cause damage to the tubes and components.

One further word of caution. When installing the tuner into a cabinet do not place it directly over the amplifier. Allow as much room as possible between the two instruments. The heat generated by the amplifier may cause deterioration of tuner components and performance.

Power Requirements:

Plug the AC cord into any outlet furnishing 117 volts, 50 or 60 cycle, AC current. The voltage may vary between 105 and 125 volts.

An AC convenience receptacle is located on the rear panel of the tuner. You may use it as a power source for your tape player or phonograph. The total wattage is not to exceed 200 watts.

Connecting The ST350 To An Amplifier:

There are two output receptacles on the right rear of the tuner chassis. They are used to connect the ST350 to your monophonic or stereophonic amplifier. All connection between the tuner and amplifier must be made with low-capacity shielded cable to prevent hum and noise pickup. Any length up to 50 feet may be used as the ST350 has a special cathode follower output.

Monophonic Connection:

Attach a shielded cable between the tuner or auxiliary input of your monophonic amplifier and either the left or right output receptacle on the rear panel of the ST350 tuner.

Stereophonic Simulcast And FM Multiplex Connection:

Attach a shielded cable between each of the two outputs on the ST350 and the two tuner or auxiliary inputs of your stereophonic amplifier. The usual procedure is to connect the FM STEREO output to the left tuner or auxiliary input on your amplifier and the AM STEREO output to the right tuner or auxiliary amplifier input.

This permits AM-FM simulcast reception or FM-Multiplex reception if the Harman-Kardon Model MA350 plug-in multiplex adapter is used with the tuner.

AM Antenna:

The AM swivel loopstick antenna on the rear of the ST350 chassis comprises all the antenna required for normal signal areas. In more remote locations an additional outdoor antenna may be required. This should consist of a single wire,

as long as is reasonably practical. It must be kept away from large metal objects, power lines or electrical machinery to insure reception without extraneous noise. Attach external antenna to rear terminal strip marked "AM." The loopstick antenna may be swiveled as required for custom and bookshelf installation. If the metal cage is used, the loopstick should be moved down and away from the cage to prevent cancellation of the AM signals.

FM Antenna:

Due to the exceptionally high FM sensitivity of the ST350, the 48" piece of wire supplied with the tuner will be sufficient antenna for all but the most difficult locations. One end of this wire should be stripped of insulation and attached to the rear screw terminal marked "FM" on the Antenna Terminal Strip located on the rear of the ST350 chassis. The other end of the wire should be extended horizontally along the cabinet or table. Horizontal placement of the antenna wire offers maximum polarization for optimum reception.

If an outdoor antenna is required to "reach" for distant stations use a special folded dipole or Yagi cut specifically for the FM band. A homemade 300 ohm "T" type antenna is not entirely satisfactory and should not be used as a substitute for the 48" piece of wire supplied with the tuner. The "T" type antenna has a tendency to pick up extraneous noise.

TV antennas are rarely satisfactory as they are not cut for the FM band and have a tendency to introduce ignition noise into the tuner. They are not recommended except under unavoidable circumstances. Usually better results can be obtained with the 48" piece of wire.

When using an outdoor antenna, attach the 300 ohm lead-in wire (twisting it 4-5 times for each running foot) to the antenna terminals on the rear of the ST350 marked FM and G.

Grounding:

It is not generally recommended to separately ground the ST350 tuner to your companion amplifier. This may cause a ground loop and induce hum.

OPERATING INSTRUCTIONS

Front Panel Controls:

The ST350 incorporates the following operating controls located on the front panel. Viewing the tuner from left to right you will note the AM TUNING control, PUSH BUTTON FUNCTION SWITCH (AM Noise Filter, AM, Stereo AM-FM, Stereo Multiplex, FM, FM-AFC, Power Off), and FM Tuning control.

To Receive Monophonic AM Broadcasts:

Depress the AM push button to turn the tuner on and to select the AM broadcast band. Tune to the desired station with the AM TUNING control. To insure proper tuning a unique electronic eye tuning indicator has been incorporated into the AM circuit. Tune for minimum dark space between the green bars.

To receive noisy or distant AM stations depress the AM NOISE FILTER push button. A special electronic filter will eliminate the interference that generally accompanies long range AM reception.

To Receive Monophonic FM Broadcasts

Depress the FM push button to turn the tuner on and to select the FM broadcast band. Tune to the desired station with the FM TUNING control. To insure proper tuning tune for minimum dark space between the green bars on the electronic tuning eye. Now depress the FM-AFC push button to retune the station by a ratio of ten to one. AFC action will be discussed in a later paragraph.

To Receive Stereophonic Simulcast AM-FM Broadcasts:

Depress the AM push button to turn the tuner on and to select the AM broadcast band. Tune to the desired AM station with the AM TUNING control.

Depress the FM push button and turn the FM TUNING control to the same station you just selected on the AM band. You will now have the same station on AM and FM. Now depress the STEREO AM-FM push button to operate the AM and FM bands simultaneously. The AM portion of the simulcast should appear in one speaker and the FM portion in the other to recreate the stereophonic broadcast. AFC is automatically applied when the push button is in the STEREO AM-FM position.

To Receive Stereophonic Multiplex Broadcasts:

For this type reception the special Harman-Kardon MA350 multiplex adapter must be plugged into the receptacle provided for on the tuner chassis.

Reception of FM Multiplex broadcasts using the Crosby multiplex method of transmission is uncomplicated. Most of the work is done for you by the ST350 tuner. Depress the FM push button and tune to the desired multiplex station. Tune for minimum deflection of the electronic tuning indicator. Now depress the STEREO MULTIPLEX push button and adjust the DIMENSION control (located on the lower lip of the front panel) for maximum stereo effect. You will note when this control is turned to the extreme counterclockwise position, monophonic reception results. As the DIMENSION control is turned in a clockwise direction, the stereophonic effect will be introduced and will reach a maximum. After reaching this point, the stereo effect will diminish, and the tonal character of the program will change. The setting for stereo effect is fairly broad and may vary for different stations.

TECHNICAL EXPLANATION OF THE CONTROLS

Push Button Selector Switch:

This unique function selector switch has seven positions.

1. AM NOISE FILTER to eliminate extraneous noise for clear long distance reception.
2. AM selects the AM band for monophonic reception.
3. STEREO AM-FM selects both the AM and FM band for simulcast stereophonic reception.
4. STEREO MULTIPLEX selects stereophonic FM when the Model MA350 multiplex adapter is plugged into the tuner.

5. FM selects the FM band for monophonic reception.

6. FM-AFC selects the FM band for monophonic reception with the addition of a powerful Automatic Frequency Control circuit to help retune the station by a tuning ratio of 10:1.

7. POWER OFF when depressed turns the tuner off. To turn the tuner on merely depress any other push button.

Automatic Frequency Control:

FM Broadcasting, by its very nature, eliminates almost all natural and man-made static. However, the characteristics of FM which makes this possible also causes specific problems in tuning. The Madrigal, Model ST350 incorporates a special electronic circuit known as AFC (Automatic Frequency Control) that overcomes these problems and insures proper tuning even if the manual tuning is not accurately done. Therefore AFC always keeps the station in the center of the channel and eliminates distortion caused by inaccurate tuning.

It should be pointed out that AFC is not a means to eliminate tuner drift. A fine piece of electronic equipment as the ST350 will not drift on any FM push button position whether on FM or FM-AFC.

The following experiment will lead to an understanding of AFC, and the fuller enjoyment of the ST350 tuner.

Tune across the FM band with the push button selector switch in the FM-AFC position. Note how the stations "pop" into place. Now tune to any station, preferably one with a musical program. Defeat the AFC circuit by depressing the FM pushbutton, and tune slowly through the station from left to right. Notice there are three distinct points where the station sounds clear, interspersed with points of distorted sound. The middle clear-sounding point is the proper tuning position for the best tone quality with minimum noise and interference. Detune the station so that the sound is distorted. Now depress the FM-AFC push button and notice how the sounds clear up. The tuning has been readjusted by the operation of the AFC circuit, which automatically retunes the electronic circuits to the center of the station channel.

In order to take advantage of the benefits of AFC, it is suggested that fine tuning be done with the push button selector in the FM position. When the push button selector is then depressed to the FM-AFC position the automatic frequency control circuit will improve your careful tuning by a tuning factor of 10:1. The procedure is especially recommended when a weak station is being tuned on a channel adjacent to a stronger one. This will prevent the AFC from reaching for the more powerful signal thereby skipping over the weaker one. Whenever a weak station is tuned, the AFC circuit should be defeated.

ADJUSTMENTS

In some installations, hum may be encountered due to a voltage difference between the amplifier, tuner and record player chassis. This may be eliminated by reversing one or all of the AC power cords. Simply reverse one at a time until improvement is experienced.

It is recommended to test the tubes of this tuner approximately every twelve months. When a tube is changed it may be necessary to have the tuner realigned to insure optimum performance.

Fuse:

The ST350 is fused in the AC primary to prevent the damage of tubes or components. The value of the fuse is 3A-3AG and should be replaced only with one of the same rating. Replacing with a fuse of higher rating will not protect the tuner, and may result in severe damage, which will not be covered by the factory warranty.

MAINTENANCE AND REPAIRS

If your tuner should not perform properly during the first year after date of purchase, contact the factory for instructions. Do not have it repaired locally without first checking with Harman-Kardon. Authorized factory warranty stations are located in most major cities. For the address of the station nearest you, or for any other information concerning your tuner or other Harman-Kardon products, please write directly to the Customer Service Department, Harman-Kardon, Inc., 520 Main Street, Westbury, L. I., New York. Be sure to include the model number and serial number of the unit in question. A brief description of the other components in your high fidelity installation is often of help in answering your questions. We are always happy to be of service to you.

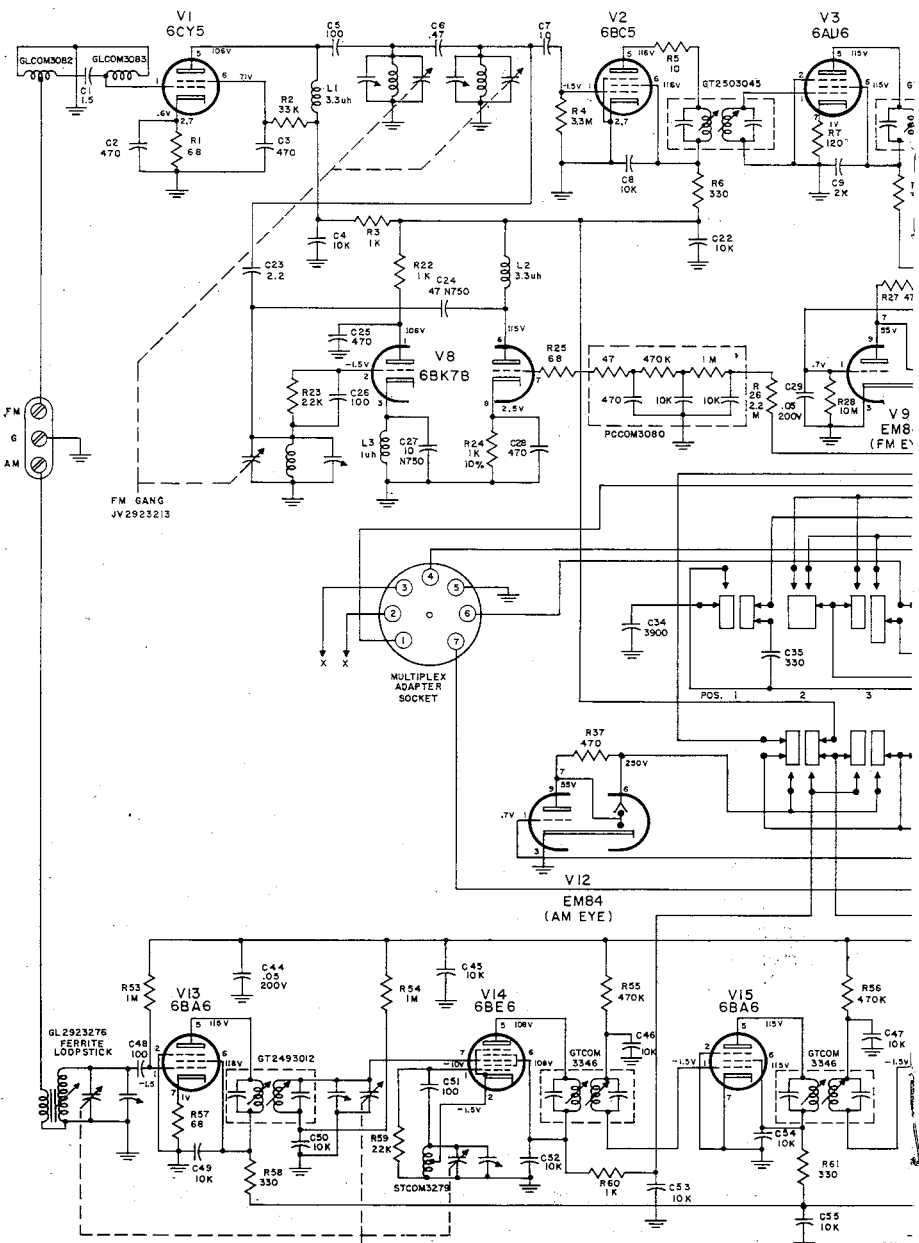
WARRANTY POLICY

We urge you to completely fill in your warranty card and mail it to the factory without delay to protect your rights under warranty. The warranty cards are carefully filed for reference and should you require information on the use of this high fidelity unit, or repair service, we will be able to immediately identify your set and reply quickly.

NOTE: It is necessary to receive factory authorization before returning a set for warranty repair either to the factory or to an authorized station. Repairs are to be returned on an Express Prepaid basis. A letter describing the exact difficulty must be included with the set upon return.

We warrant this instrument to be free from defects in material and workmanship under normal use and service, and in accordance with the conditions herein below set forth, for a period of one year from date of delivery to the original purchaser, and agree to replace or repair any part or parts, with the exception of tubes which are covered by manufacturer's 90 day warranty, returned to us within said one year with transportation prepaid, and which our examination shall disclose to our satisfaction to have been thus defective. This warranty does not include free labor, nor is it applicable to any instrument which shall have been repaired or altered in any way so as in our judgment to affect its stability or reliability nor which has been subject to misuse, neglect, abuse, negligence or accident, nor which has had the serial number altered, effaced or removed. Neither shall this warranty apply to any instrument which has been connected otherwise than in accordance with the instructions furnished by us.

This warranty is expressly in lieu of all other warranties, express or implied, and of all other obligations or liabilities on our part, and we neither assume nor authorize any representative or other person to assume for us any other liability in connection with the sale of this instrument.



FM GANG
JV2923213

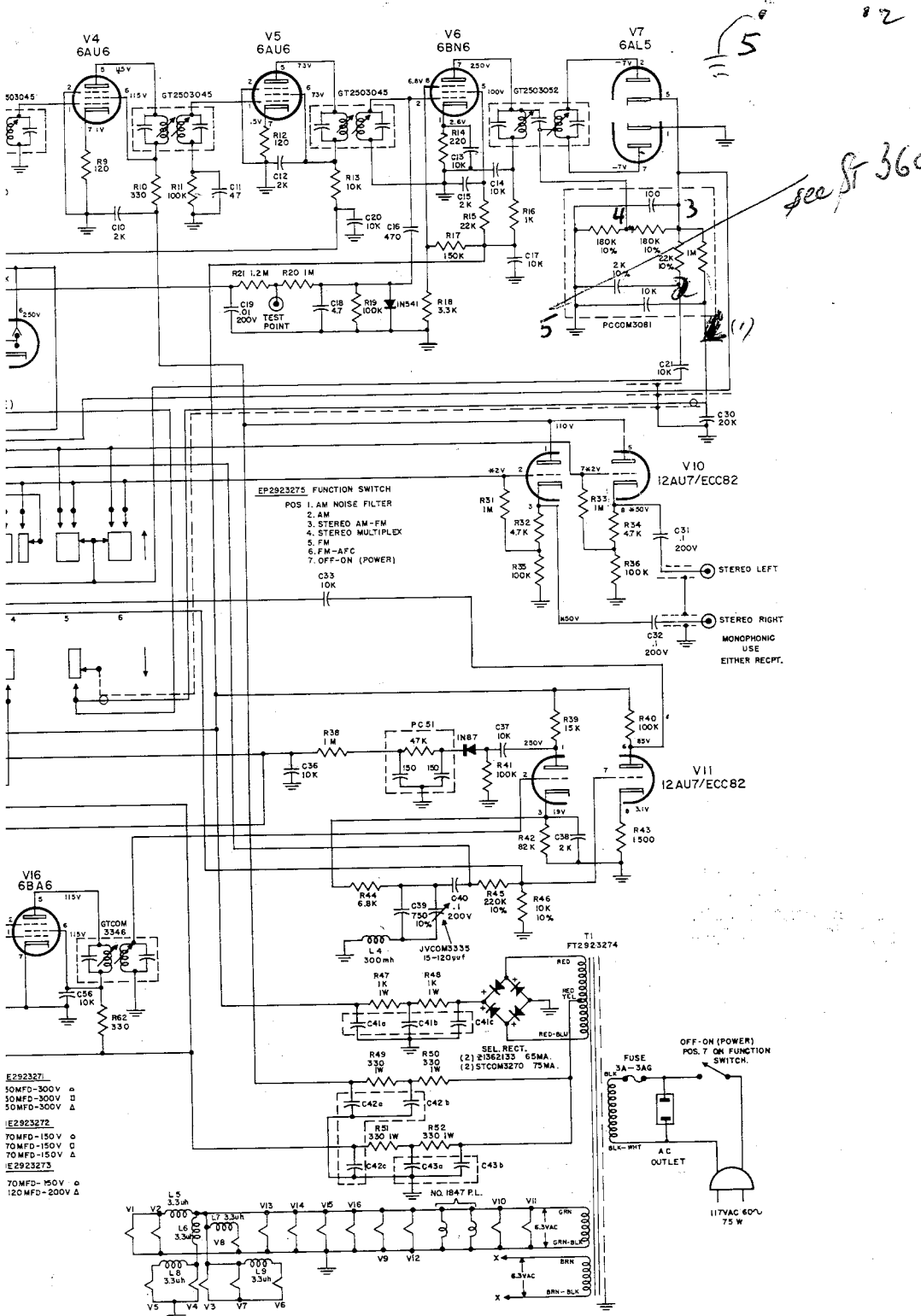
AM GANG
JV2923214

RESISTANCE CHART

TUBE	1	2	3	4	5	6	7	8	9
V1 6CY5	0	68	—	—	20K	20K	68	—	—
V2 6BC5	3.3M	—	—	—	20K	20K	0	—	—
V3 6AU6	0	0	—	—	20K	20K	120	—	—
V4 6AU6	0	0	—	—	20K	20K	120	—	—
V5 6AU6	100K	0	—	—	20K	20K	120	—	—
V6 6BNG	220	0	—	—	20K	3.3K	20K	—	—
V7 6AL5	0	100K	—	—	180K	—	100K	—	—
V8 6BK7B	20K	22K	0	—	—	20K	500K	1K	—
V9 EM84	10M	—	0	—	—	20K	500K	—	500K
V10 12AU7	20K	1.1M	105K	—	—	20K	1.1M	105K	—
V11 12AU7	30K	0	82K	—	—	120K	10K	1500	—
V12 EM84	1M	—	0	—	—	20K	500K	—	500K
V13 6BA6	1M	0	—	—	20K	20K	68	—	—
V14 6BE6	22K	0	—	—	20K	20K	1M	—	—
V15 6BA6	470K	0	—	—	20K	20K	0	—	—
V16 6BA6	470K	0	—	—	20K	20K	0	—	—

NOTE:
UNLESS OTHERWISE SHOWN:
ALL RESISTORS 1/2 WATT 20%
ALL CAPACITORS WITHOUT DECIMAL
TO BE GENERAL PURPOSE CERAMICS
500VDC 20% IN MMF
ALL CAPACITORS WITH DECIMAL
TO BE PAPER IN MFD.
ALL VOLTAGES ARE DC
ALL RESISTANCES ARE IN OHMS.
VOLTAGES OF V10 MARKED * ARE
MEASURED WITH RESPECT TO CATHODE.

C41b -
C41c -
C42a -
C42b -
C42c -
C43a -
C43b -



see p 360

5

EP2923275 FUNCTION SWITCH
 POS 1. AM NOISE FILTER
 2. AM
 3. STEREO AM-FM
 4. STEREO MULTIPLEX
 5. FM
 6. FM-AFC
 7. OFF-ON (POWER)

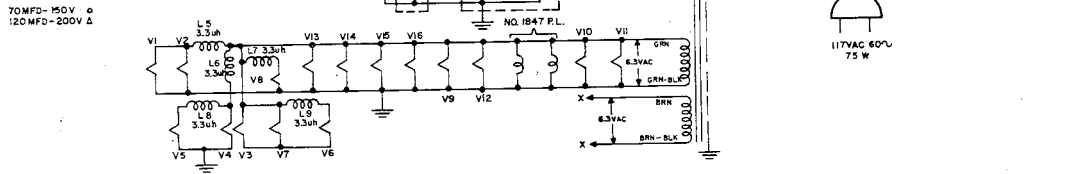
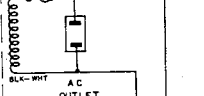
V10 12AU7/ECC82
 STEREO LEFT
 STEREO RIGHT
 MONOPHONIC USE EITHER RECP.

V11 12AU7/ECC82

- E2923271
- 50MFD-300V
- 50MFD-300V
- 50MFD-300V
- E2923272
- 70MFD-150V
- 70MFD-150V
- 70MFD-150V
- E2923273
- 70MFD-150V
- 120MFD-200V

SEL. RECT.
 (2) 21562133 65MA
 (8) STCOM3670 75MA.

OFF-ON (POWER)
 POS. 7 ON FUNCTION SWITCH.



SPECIFICATIONS

FM

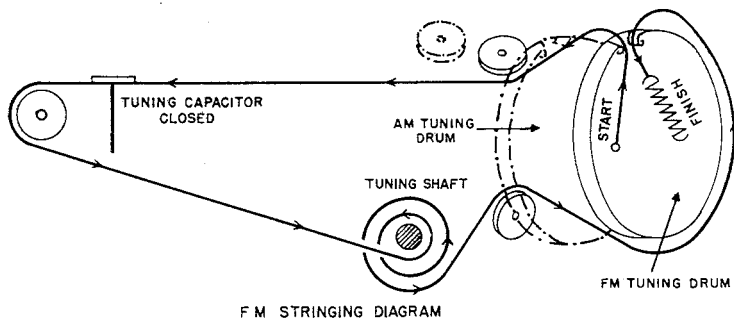
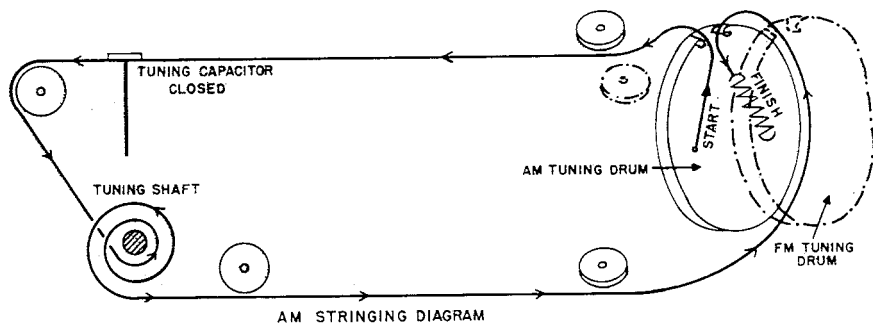
Circuits:	Armstrong circuit with zero time constant Gated Beam Limiter, Foster-Seeley Discriminator, Automatic Frequency Control and Bar Type Tuning indicator. The RF section consists of a Shaded Grid Low Noise, High Gain VHF Tetrode, High Gain Pentode Mixer followed by three Wide Band IF stages, Limiter, Wide Band (0.6 MC) Discriminator and Cathode Follower Output.
Sensitivity:	0.95 microvolts. (20 db quieting). 1.9 microvolts. (30 db quieting).
Selectivity:	240 KC Bandwidth: 6 db down.
Discriminator Peak to Peak Separation:	0.6 megacycles.
Frequency Range:	88-108 M.C.
Drift:	± 20 KC AFC off; $\pm 2\frac{1}{2}$ KC AFC on.
Image Rejection:	40 db
IF Rejection:	70 db
Limiter:	Gated beam, constant output.
Antenna Input:	300 ohms
Distortion:	Less than 0.1% IM at 30% modulation. Less than 0.5% IM at 100% modulation.
Frequency Response:	$\pm \frac{1}{2}$ db 20-20,000 c.p.s. including standard 75 micro-second de-emphasis.
Hum Level:	60 db below 100% modulation.
Radiation:	Within FCC requirements.
Output Level:	1.5 volts for 100% modulation. 5 volts for 30% modulation.

AM

Circuits:	Low noise, High Gain RF Pentode followed by a Pentagrid converter, two broad band IF stages, infinite impedance detector and 10 KC whistle filter. Separate AVC circuit avoids overloading of detector improving linearity. Exclusive noise filter for noise-free long distance reception.
Sensitivity:	20 microvolts per meter. Terminal sensitivity 4 microvolts.
Selectivity:	16 KC Bandwidth: 6 db down.
Frequency Range:	530-1640 KC
Image Rejection:	55 db
IF Rejection:	55 db
Antenna Input:	Built in Ferrite Loopstick with low impedance Terminal for external antenna.
Distortion:	Less than 0.8% harmonic.
Frequency Response:	± 3 db 20-8,000 cycles.
Hum Level:	55 db below 88% modulation.

REPLACEMENT PARTS FOR MODEL ST350

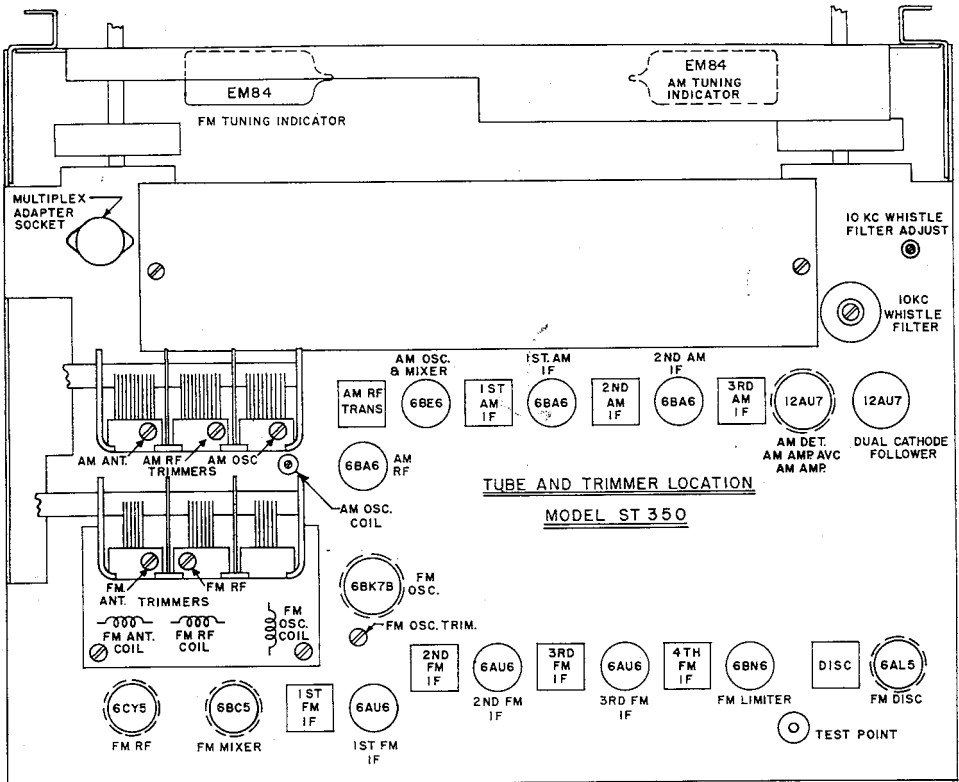
Part No.	Description	List Price
1362133	SEL RECTIFIER 65 MA	1.65
STCOM3270	SEL RECTIFIER 75 MA	1.75
2923271	LYTIC	3.00
2923272	LYTIC	2.60
2923273	LYTIC	2.50
2923274	POWER TRANSFORMER	12.00
2923275	FUNCTION SWITCH	7.50
2923276	LOOPSTICK ANTENNA	2.25
2923267	DIAL GLASS	1.00
HC33901	FUSE HOLDER	.75
ZCOM3291	3 AG 3 AMP FUSE	.10
STCOM3279	AM OSC COIL	.75
GT2493012	RF TRANSF.	1.50
GT2503045	1st, 2nd, 3rd, 4th FM IF TRANSF.	1.50
GT2503052	DISC TRANSF.	2.00
GTCOM3346	IF TRANSF.	1.50
JV2923213	FM TUNING CAPACITOR	5.35
JV2923214	AM TUNING CAPACITOR	5.85



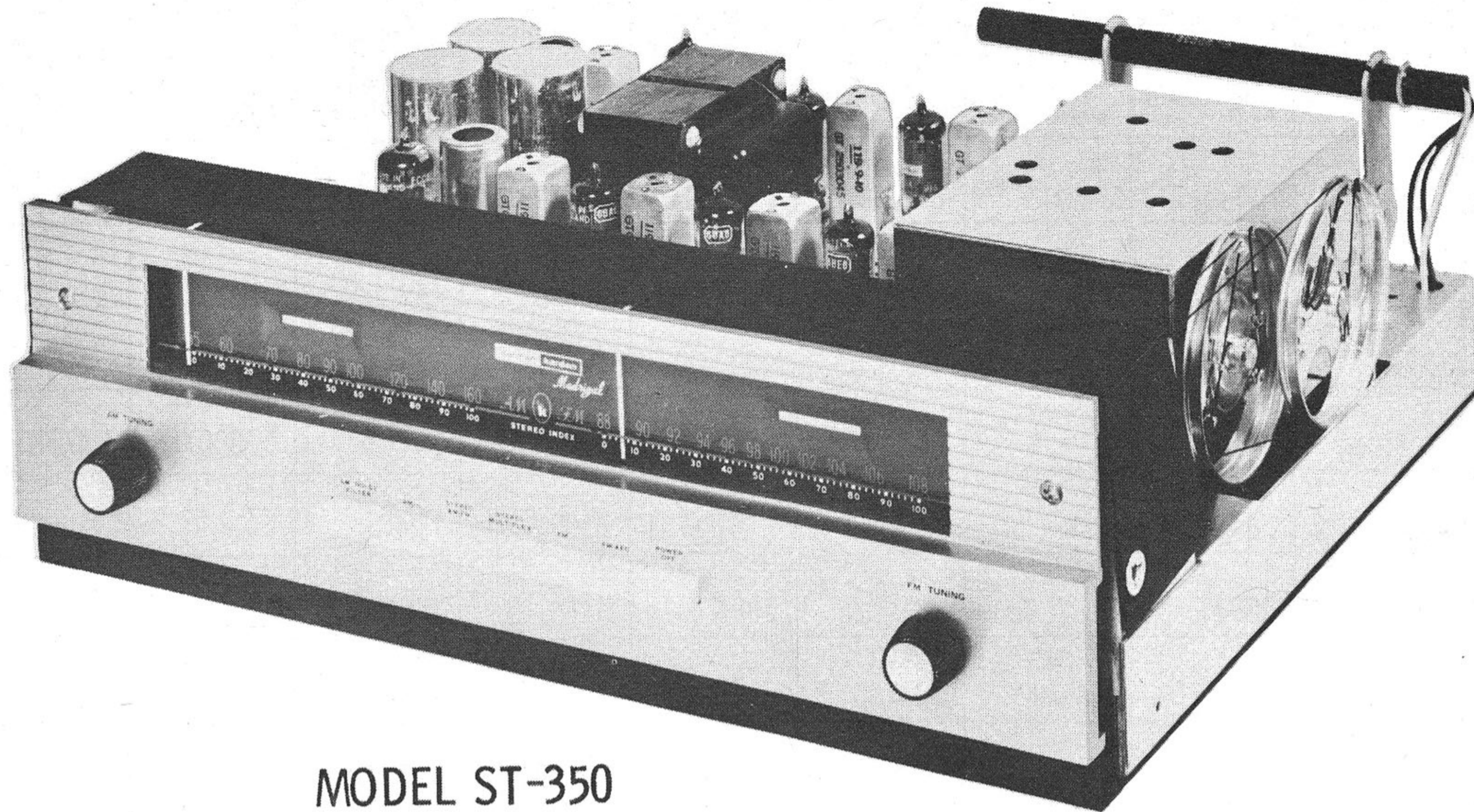
ALIGNMENT PROCEDURE

FUNCTION SWITCH SETTING	SIGNAL GENERATOR		SIGNAL INPUT POINT	OUTPUT INDICATOR	CONNECT INDICATOR TO:	DIAL SETTING	ADJUST	OUTPUT INDICATION
	FREQ.	MOD.						
FM	10.7 MC	300 KC FM 60 CPS	FM MIXER GANG	AC-VTVM OR SCOPE	TEST POINT		1, 2, 3 & 4 FM IF TRANS. DISCR. TRANS.	MAX GAIN & SYMMETRY S PATTERN OF MAX GAIN & SYMM.
FM	10.7 MC	300 KC FM 60 CPS	FM MIXER GANG	AC-VTVM OR SCOPE	TUNER OUTPUT			
FM	106 MC	300 KC FM 60 CPS	FM ANT. TERMINAL	AC-VTVM OR SCOPE	TEST POINT	106 MC	106 MC OSC RF. MIXER TRIMMERS	MAXIMUM OUTPUT
FM	90 MC	300 KC FM 60 CPS	FM ANT. TERMINAL	AC-VTVM OR SCOPE	TEST POINT	90 MC	OSC. RF. MIXER COILS	MAXIMUM OUTPUT

FUNCTION SWITCH SETTING	SIGNAL GENERATOR		SIGNAL INPUT POINT	OUTPUT INDICATOR	CONNECT INDICATOR TO:	DIAL SETTING	ADJUST	OUTPUT INDICATION
	FREQ.	MOD.						
AM	455 KC	30% AM	AM RF GANG	AC-VTVM OR SCOPE	TUNER OUTPUT	1600 KC	1, 2 & 3 AM IF TRANS.	MAXIMUM OUTPUT
AM	1400 KC	30% AM	AM ANT. TERM.	AC-VTVM OR SCOPE	TUNER OUTPUT	1400 KC	OSC. ANT & RF TRIMMERS	MAXIMUM OUTPUT
AM	600 KC	30% AM	AM ANT. TERM.	AC-VTVM OR SCOPE	TUNER OUTPUT	600 KC	OSC COIL LOOPSTICK & RF TRANS	MAXIMUM OUTPUT
AM	1400 KC				REPEAT STEP 2			
AM	455 KC	110 KC 30%	AM RF GANG	AC-VTVM OR SCOPE	TUNER OUTPUT	1600 KC	10 KC WHISTLE FILTER	MAXIMUM OUTPUT



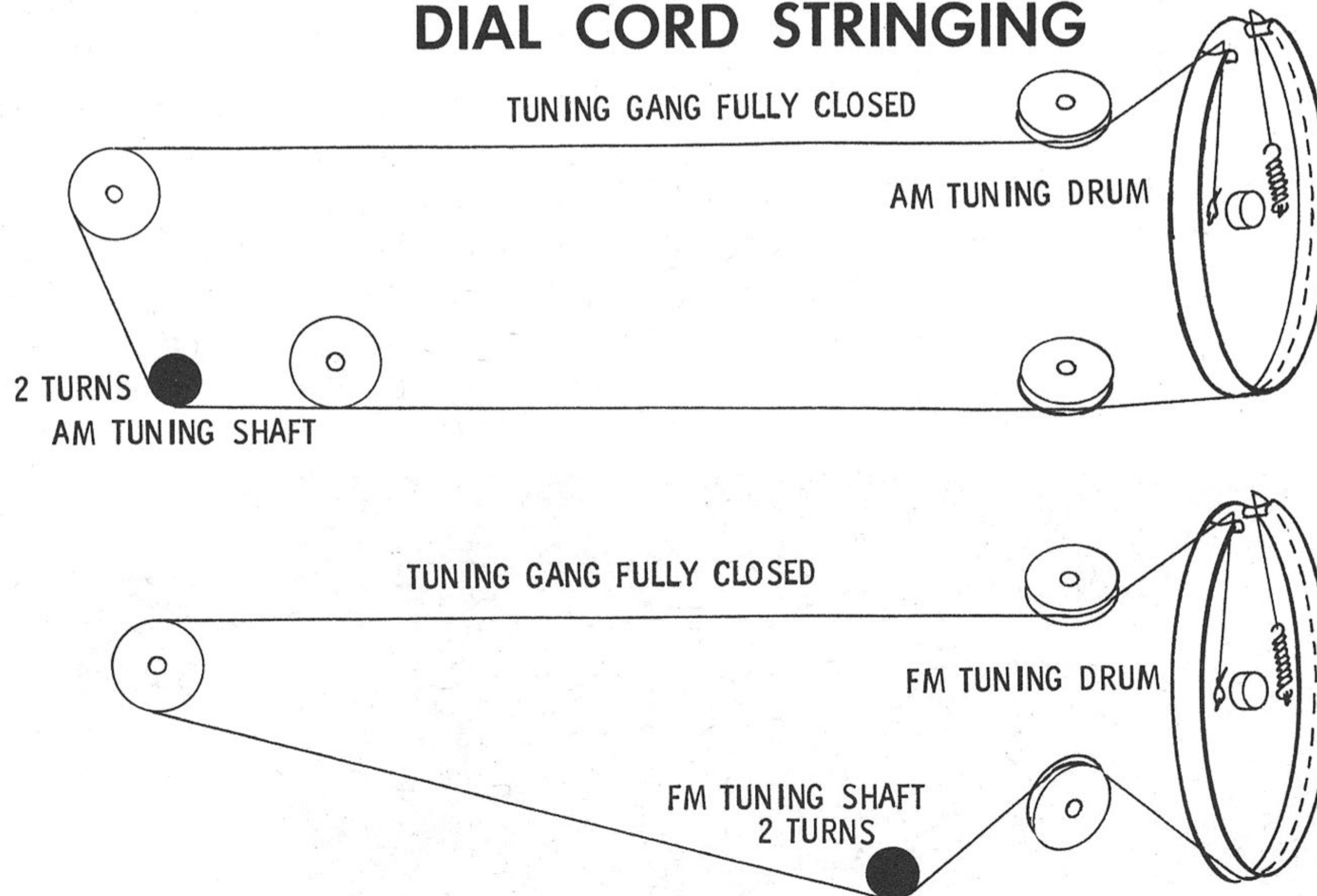
**HARMAN-KARDON
MODELS ST-350, ST-360**



MODEL ST-350

TRADE NAME	Harman-Kardon Models ST-350, ST-360 (The Madrigal)		
MANUFACTURER	Harman-Kardon, Inc., 520 Main Street, Westbury, L. I., N. Y.		
TYPE SET	AC Operated 16 Tube FM-AM Tuner		
POWER SUPPLY	105-125 Volts AC, 60 Cycles	RATING	51 Watts, .5 Amp. @ 117 Volts AC
TUNING RANGE	BROADCAST 530 - 1640KC	FREQ. MOD.	88 - 108MC

DIAL CORD STRINGING



RESISTANCE MEASUREMENTS

ITEM	TUBE	Pin 1	Pin 2	Pin 3	Pin 4	Pin 5	Pin 6	Pin 7	Pin 8	Pin 9
V1	6CY5	.1 Ω	68 Ω	.2 Ω	0 Ω	▲ 1700 Ω	▲ 35K	68 Ω		
V2	6BC5	3.3meg	0 Ω	0 Ω	.2 Ω	▲ 1000 Ω	▲ 1000 Ω	0 Ω		
V3	6BK7B	▲ 1700 Ω	22K	.1 Ω	0 Ω	.2 Ω	▲ 660 Ω	■ 4.7meg 3.6meg	1000 Ω	0 Ω
V4	6AU6	.6 Ω	0 Ω	.2 Ω	0 Ω	▲ 1000 Ω	▲ 1000 Ω	120 Ω		
V5	6AU6	.6 Ω	0 Ω	.2 Ω	0 Ω	▲ 1000 Ω	▲ 1000 Ω	120 Ω		
V6	6AU6	100K	0 Ω	.2 Ω	0 Ω	▲ 11K	▲ 11K	120 Ω		
V7	EM84	1.8meg	† 2000 Ω	0 Ω	0 Ω	.1 Ω	† 2000 Ω	† 470K	† 2000 Ω	† 470K
V8	6BN6	220 Ω	.6 Ω	0 Ω	.2 Ω	† 25K	3300 Ω	† 24K		
V9	6AL5	0 Ω	180K	.1 Ω	0 Ω	360K	0 Ω	180K		
V10	6BA6	▲ 2.5meg	0 Ω	0 Ω	.1 Ω	▲▲ 1000 Ω	▲▲ 1000 Ω	120 Ω		
V11	6BE6	22K	.5 Ω	0 Ω	.1 Ω	▲▲ 1000 Ω	▲▲ 1000 Ω	▲ 2.5meg		
V12	6BA6	▲ 1.5meg	0 Ω	0 Ω	.1 Ω	▲▲ 1000 Ω	▲▲ 1000 Ω	0 Ω		
V13	6BA6	▲ 1.5meg	0 Ω	.1 Ω	0 Ω	▲▲ 1000 Ω	▲▲ 1000 Ω	0 Ω		
V14	ECC82	† 17K	9 Ω	82K	.1 Ω	.1 Ω	† 100K	22K	1500 Ω	0 Ω
V15	EM84	1meg	† 2000 Ω	0 Ω	0 Ω	.1 Ω	† 2000 Ω	† 470 Ω	† 2000 Ω	† 470 Ω
V16	ECC82	660 Ω	550K ◆ 1.1meg	105K	.1 Ω	.1 Ω	▲ 660 Ω	550K ◆ 1.1meg	105K	0 Ω

ALL MEASUREMENTS TAKEN IN "FM" POSITION UNLESS OTHERWISE DESIGNATED.

† MEASURED FROM OUTPUT OF M2.

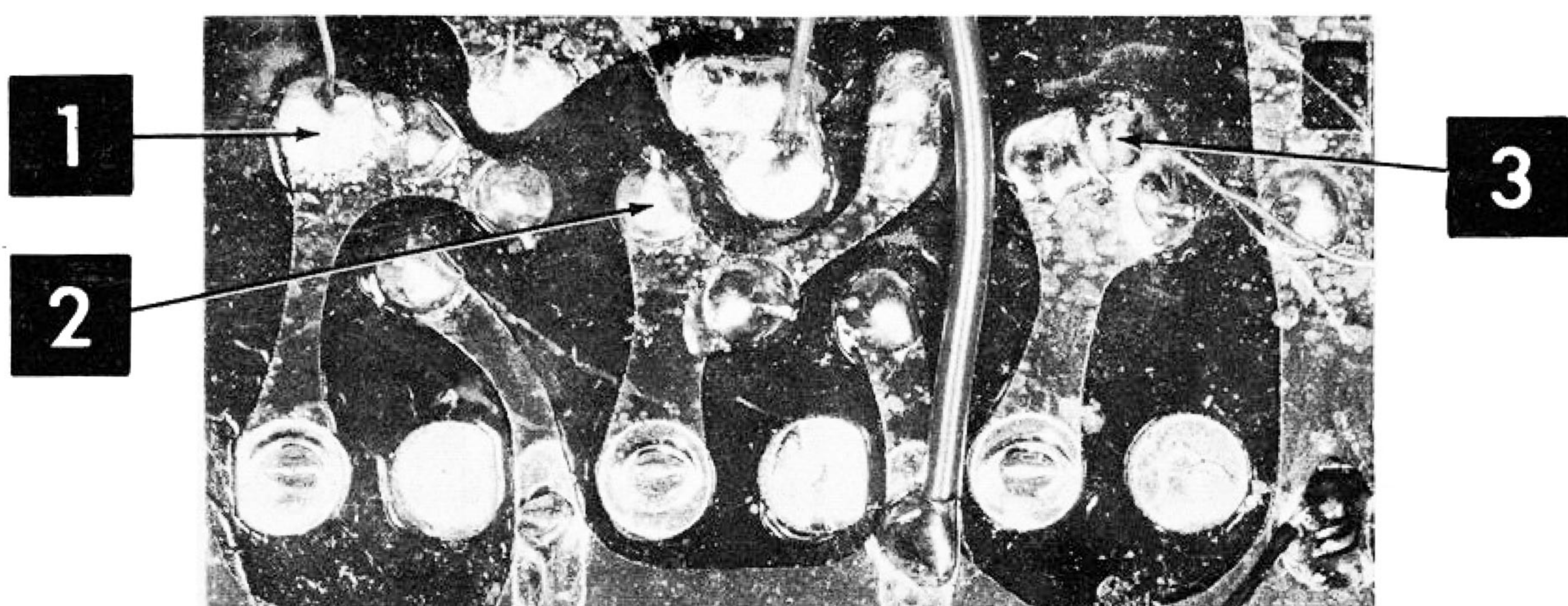
▲ MEASURED IN "AM" POSITION.

■ MEASURED IN "FM-AFC" POSITION.

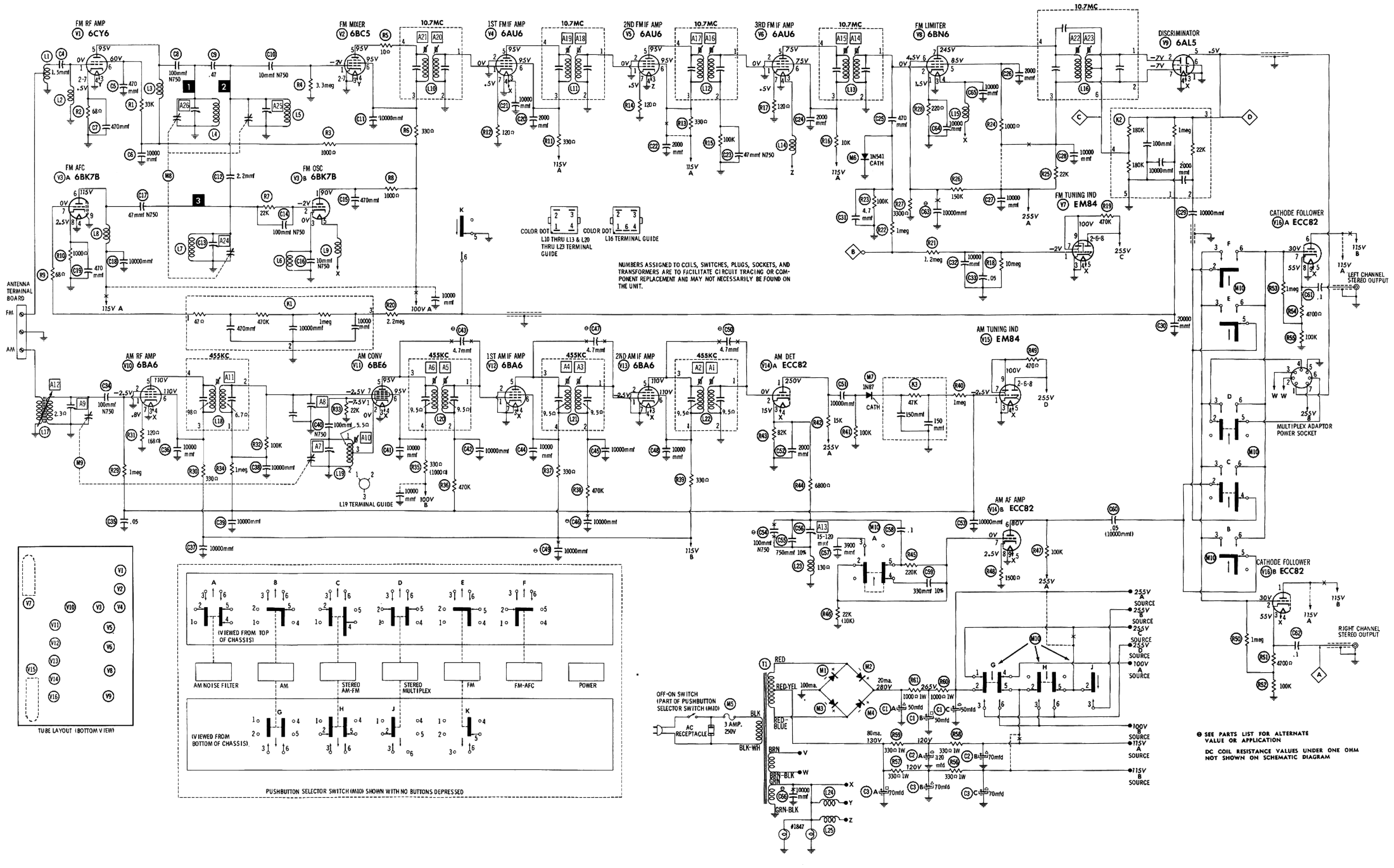
▲▲ MEASURED FROM JUNCTION OF R57 AND C2A.

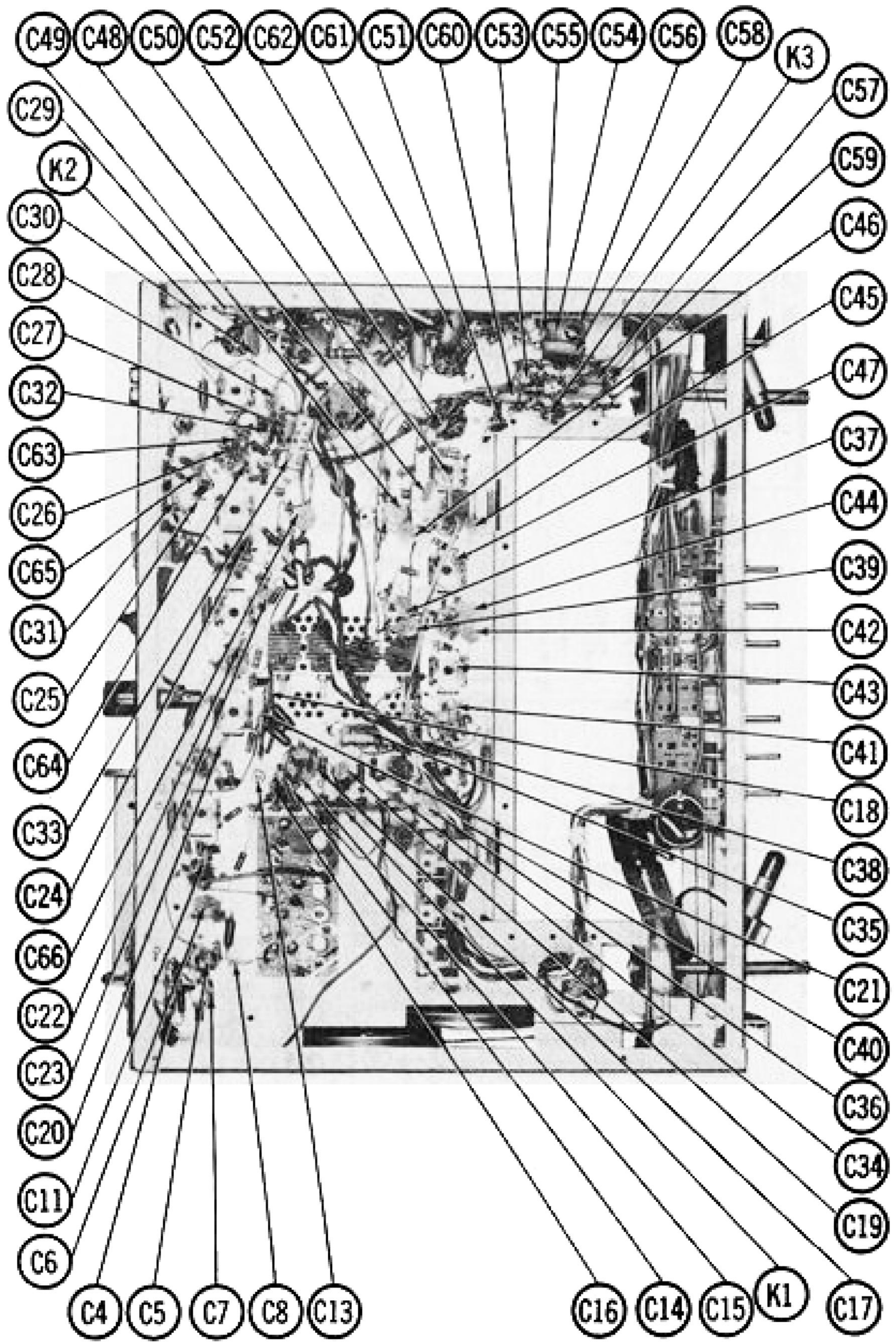
◆ MEASURED IN "STEREO AM-FM" POSITION.

1. DC voltage measurements taken with vacuum tube voltmeter; AC voltages measured at 1000 ohms per volt.
2. Socket connections are shown as bottom views.
3. Measured values are from socket pin to common negative.
4. Line voltage maintained at 117 volts for voltage readings.
5. Nominal tolerance on component values makes possible a variation of $\pm 15\%$ in voltage and resistance readings.

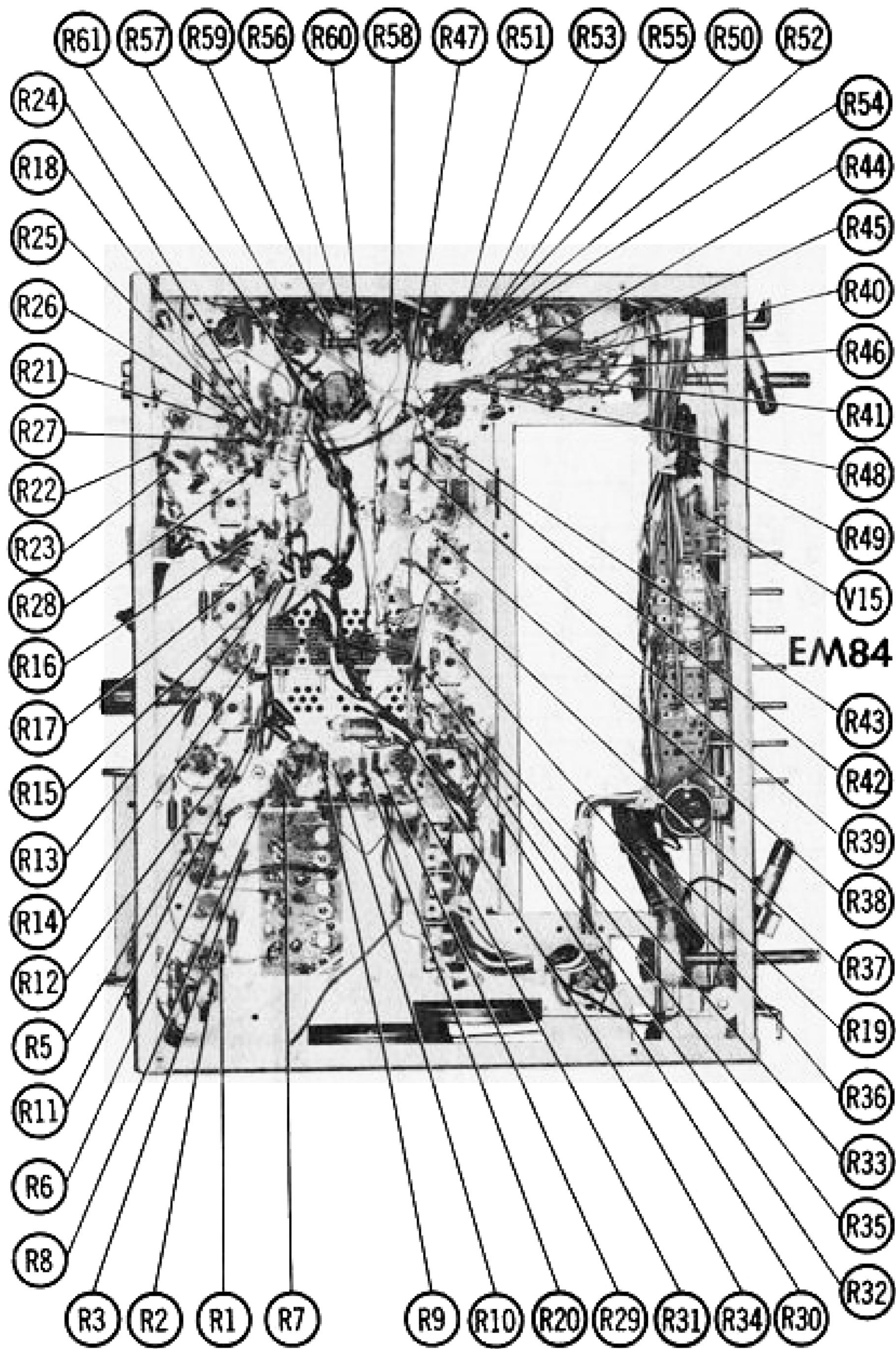


PRINTED BOARD



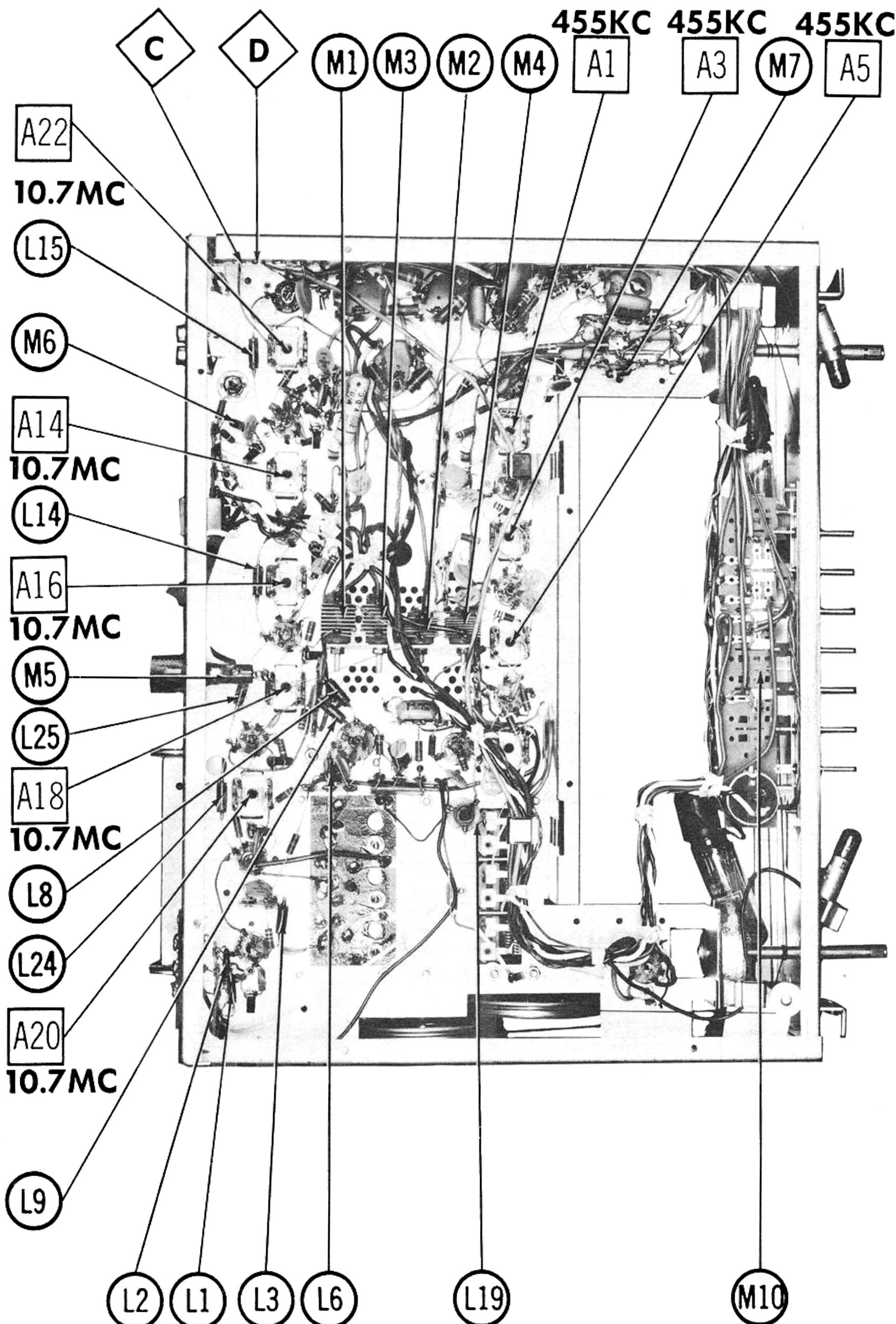


CHASSIS BOTTOM VIEW-CAPACITOR IDENTIFICATION

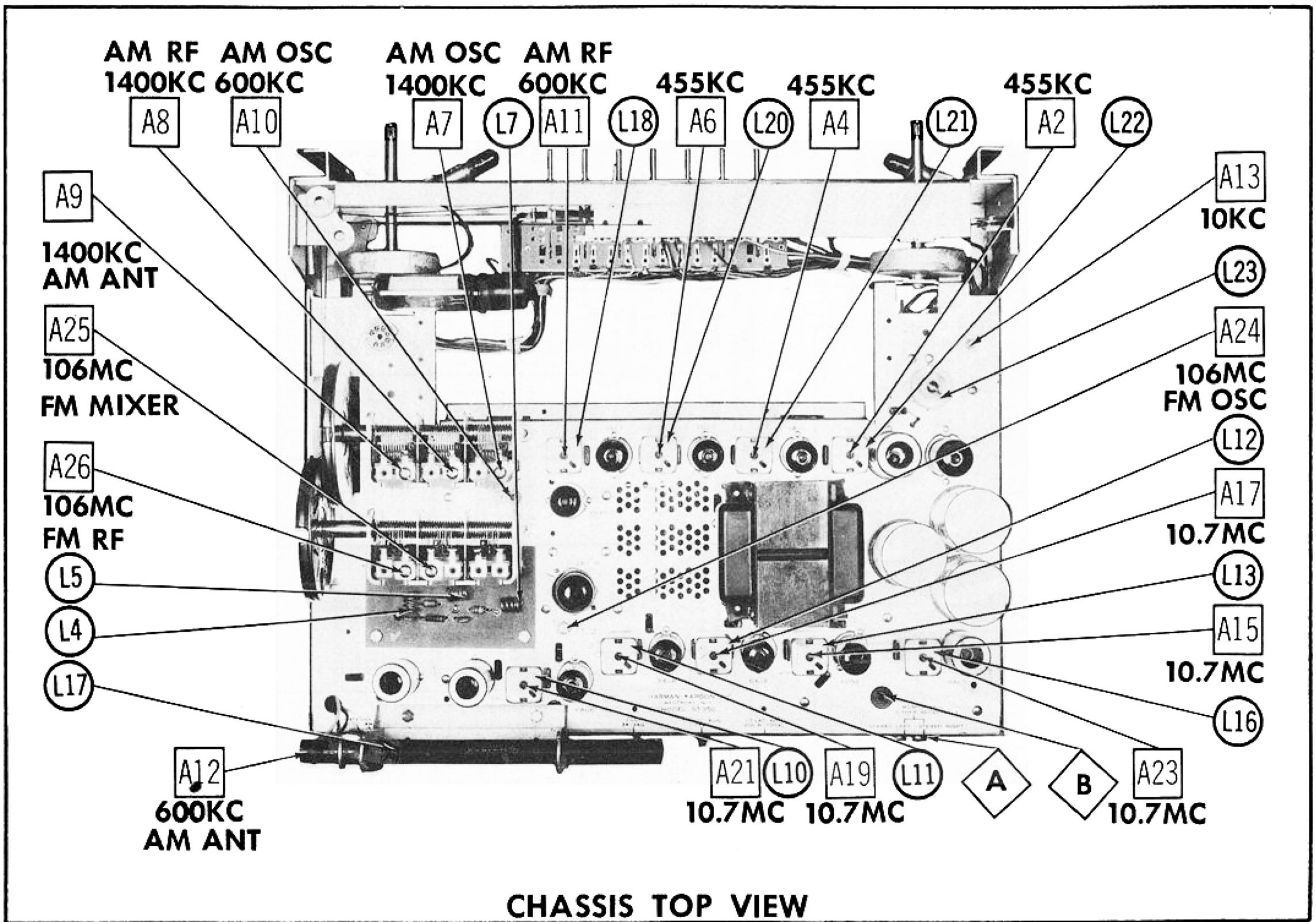
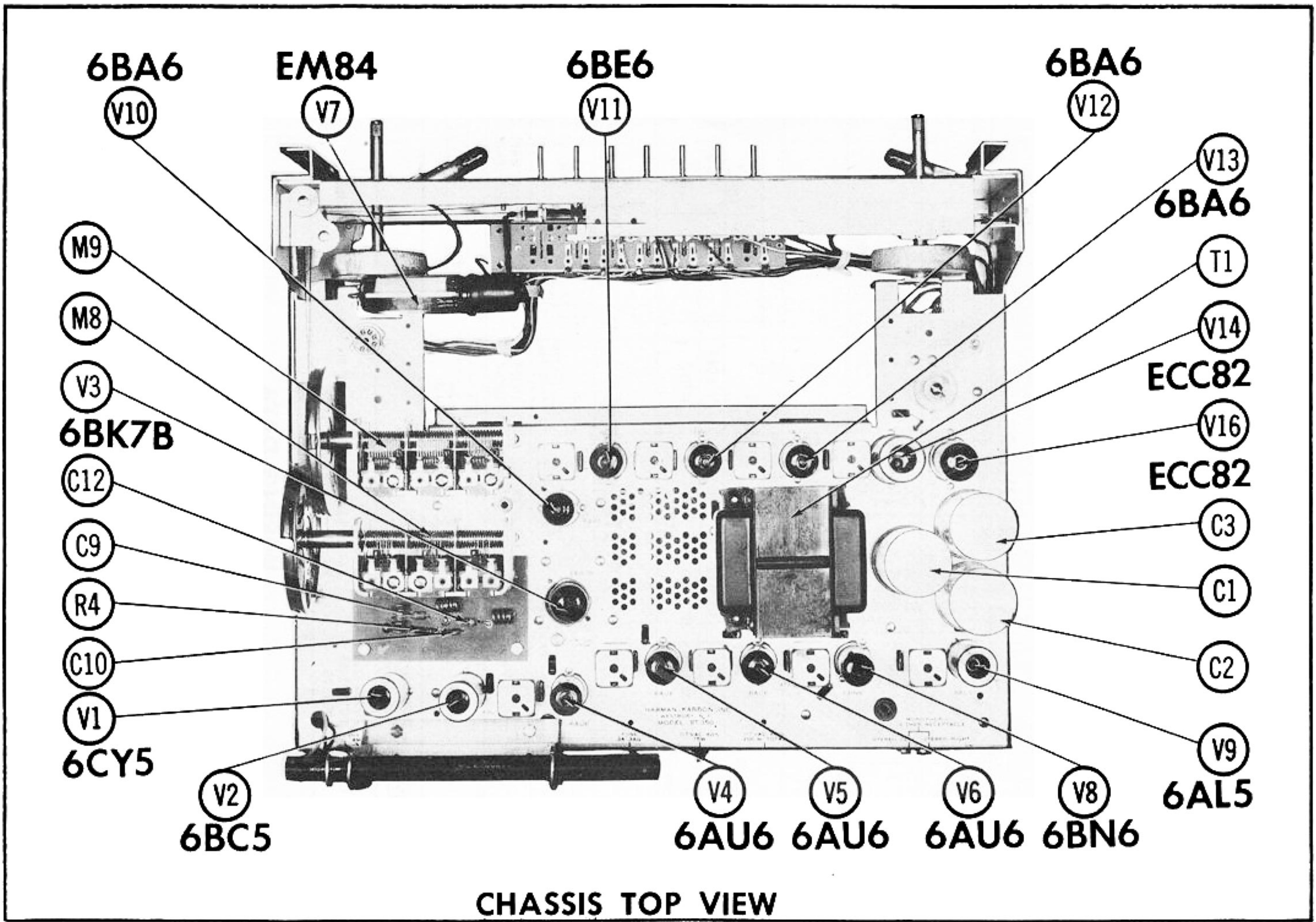


EM84

CHASSIS BOTTOM VIEW-RESISTOR IDENTIFICATION



CHASSIS BOTTOM VIEW - ALIGNMENT, INDUCTOR & MISC. IDENT.



ALIGNMENT INSTRUCTIONS

PRE-ALIGNMENT INSTRUCTIONS

Use only enough generator output to provide a usable indication on VTVM.

Suggested Alignment Tools: A1 thru A6, A11, A14 thru A23 GENERAL CEMENT #5097, 8727
 WALSCO #2515
 A7, A8, A9, A24, A25, A26 GENERAL CEMENT #5004, 5008, 5009
 WALSCO #2520
 A10 GENERAL CEMENT #8282, 8606, 8606-L, 9295, 9440
 WALSCO #2526, 2543, 2544, 2545
 A13 GENERAL CEMENT #8721, 8722
 WALSCO #2519

AM ALIGNMENT - SELECTOR IN AM POSITION

	SIGNAL GENERATOR COUPLING	SIGNAL GENERATOR FREQUENCY	RADIO DIAL SETTING	CONNECT VTVM	ADJUST	REMARKS
1.	High side thru .01mfd to AM RF stator lug of AM tuning gang. Low side to chassis.	455KC (400% 30% AM)	AM tuning gang fully open	AC probe to point (A). Common to chassis.	A1, A2, A3, A4, A5, A6	Adjust for maximum deflection.
2.	High side thru .01mfd to AM antenna terminal. Low side to chassis.	1400KC	1400KC	"	A7, A8, A9	"
3.	"	600KC	600KC	"	A10, A11, A12	Adjust for maximum deflection. Repeat step 2.
4.	Same as Step 1.	455KC (10KC 30% AM)	1600KC	"	A13	Adjust for MINIMUM deflection.

FM IF ALIGNMENT USING AM SIGNAL GENERATOR AND VTVM - SELECTOR IN FM POSITION

	SIGNAL GENERATOR COUPLING	SIGNAL GENERATOR FREQUENCY	RADIO DIAL SETTING	CONNECT VTVM	ADJUST	REMARKS
5.	High side thru .001mfd to FM RF stator lug of tuning gang. Low side to chassis.	10.7MC (Unmod.)	FM point of non-interference	DC probe to point (B). Common to chassis.	A14, A15, A16, A17, A18, A19, A20, A21	Adjust for maximum deflection.
6.	"	"	"	DC probe thru 1meg to point (C). Common to chassis.	A22	"
7.	"	"	"	DC probe to point (D). Common to chassis.	A23	Adjust for zero reading. A positive and negative reading will be obtained on either side of the correct setting.

FM IF ALIGNMENT USING FM SIGNAL GENERATOR AND OSCILLOSCOPE - SELECTOR IN FM POSITION

Use frequency modulated signal with 60% modulation and 450KC sweep. Use 120v sawtooth voltage in scope for horizontal deflection.

	SIGNAL GENERATOR COUPLING	SIGNAL GENERATOR FREQUENCY	RADIO DIAL SETTING	CONNECT SCOPE	ADJUST	REMARKS
5.	High side thru .001mfd to FM RF stator lug of FM tuning gang. Low side to chassis.	10.7MC (450KC swp)	FM point of non-interference	Vert. Amp. to point (B). Common to chassis.	A14, A15, A16, A17, A18, A19, A20, A21	Adjust for maximum gain and symmetry of response similar to Fig. 1.
6.	"	"	"	Vert. Amp. thru 27K to point (C). Low side to chassis.	A22	"
7.	"	"	"	Vert. Amp. to point (D). Low side to chassis.	A23	Adjust to place marker at the center of crossover lines similar to Fig. 2. SLIGHTLY retouch A22 for maximum amplitude and straightness of crossover lines.

FM RF ALIGNMENT - SELECTOR IN FM POSITION

Coils not containing adjustable cores are adjusted by expanding or compressing coil turns.

	SIGNAL GENERATOR COUPLING	SIGNAL GENERATOR FREQUENCY	RADIO DIAL SETTING	CONNECT VTVM	ADJUST	REMARKS
8.	High side thru 270Ω to FM antenna terminal. Low side to chassis.	106MC (Unmod.)	FM 106MC	DC probe to point (B). Common to chassis.	A24, A25, A26	Adjust for maximum deflection.
9.	"	90MC	90MC	"	L7, L5, L4	"

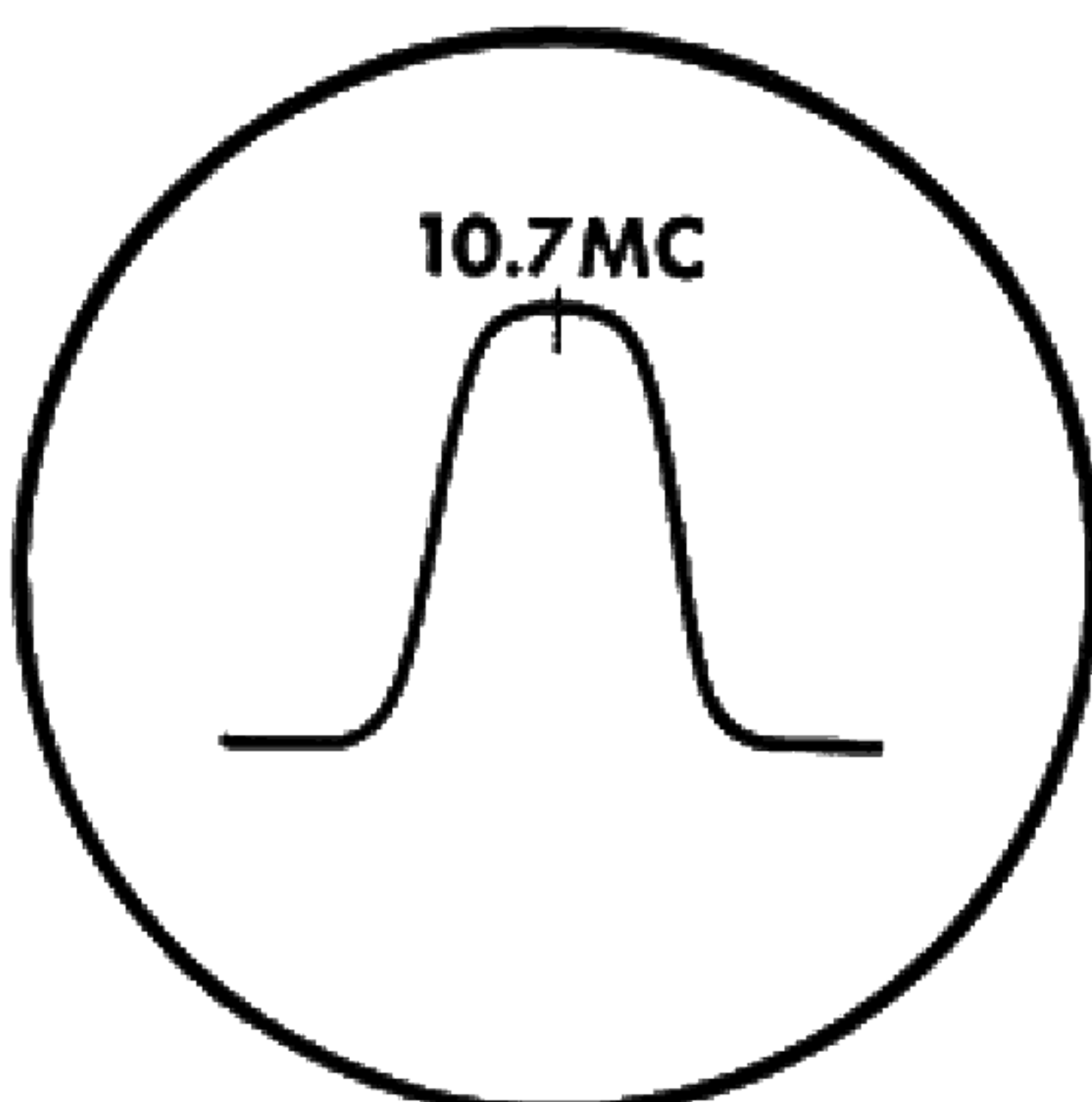


FIG. 1

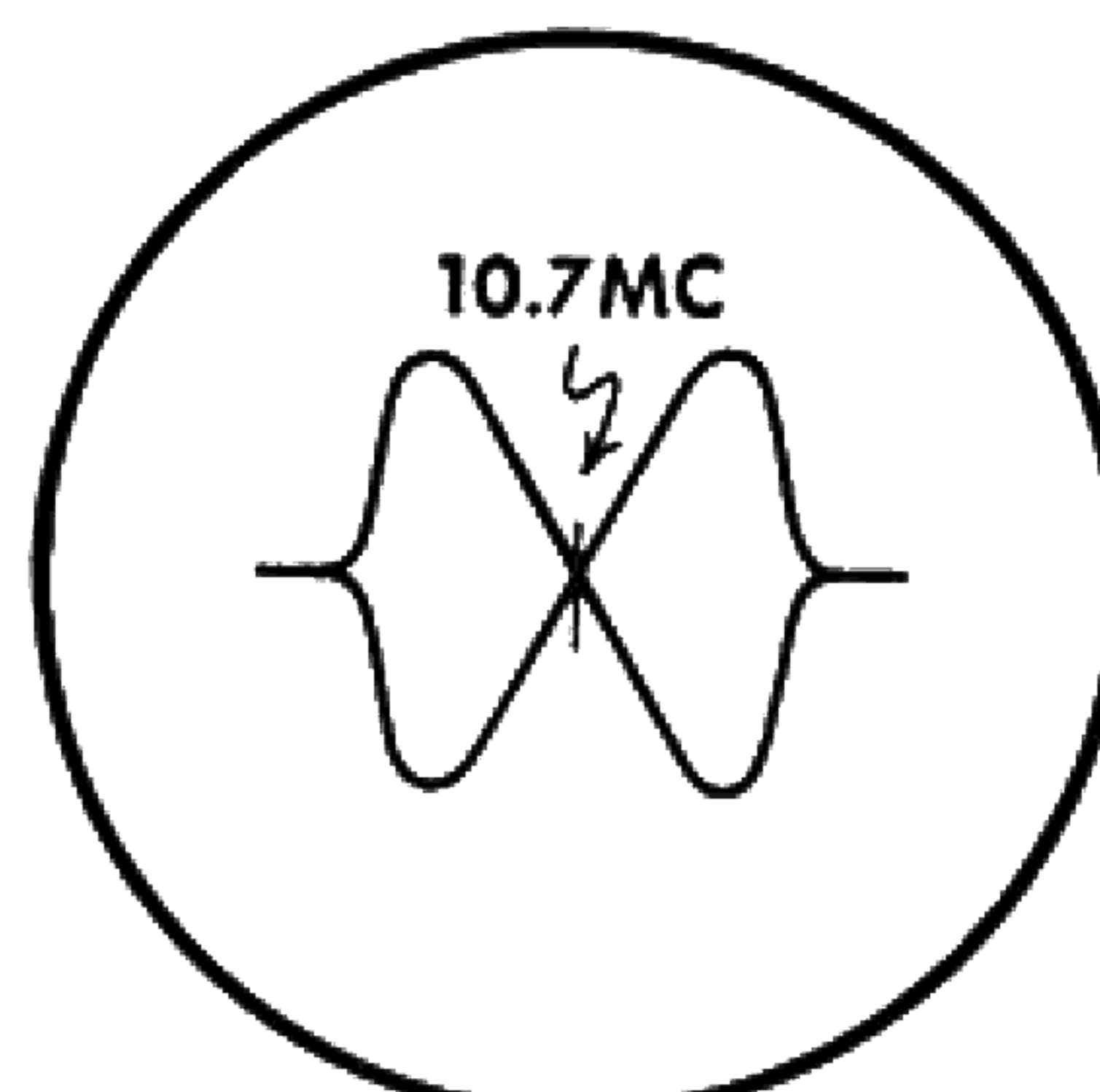


FIG. 2

PARTS LIST AND DESCRIPTIONS

TUBES

CBS		GENERAL ELECTRIC		RAYTHEON		SYLVANIA	
ITEM No.	USE	TYPE	ITEM No.	USE	TYPE	ITEM No.	USE
V1	FM RF Amplifier	6CY5	V9	Discriminator	6AL5	V16	Cathode Follower
V2	FM Mixer	6BC5	V10	AM RF Amplifier	6BA6	V13	2nd AM IF Amplifier
V3	FM AFC - FM Osc.	6BK7B	V11	AM Converter	6BE6	V14	AM Det. - AM AF Amp.
V4	1st FM IF Amplifier	6AU6	V12	1st AM IF Amplifier	6BA6	V15	AM Tuning Indicator
V5	2nd FM IF Amplifier	6AU6	V13	2nd AM IF Amplifier	6BA6	V16	Cathode Follower
V6	3rd FM IF Amplifier	6AU6			ECC82 (12AU7) *		
V7	FM Tuning Indicator	EM84			EM84		
V8	FM Limiter	6BN6			ECC82 (12AU7) *		

* Alternate

ELECTROLYTIC CAPACITORS

ITEM No.	RATING		REPLACEMENT DATA						NOTES
	CAP.	VOLT.	Harman-Kardon PART No.	AEROVOX PART No.	CORNELL-DUBILIER PART No.	MALLORY PART No.	PYRAMID PART No.	SPRAGUE PART No.	
CLA	50	300	JE2923271A	AFH4-02-10	D022			TVLS-3580.7*	
B	50	300							
C	50	300							
C2A	120	200	JE2923273A	AFHS2-24-20	XB0194	FP335	TMT-15	TVL-2464	
B	70	150							
C3A	70	150	JE2923272A	AFH3-21	XC0123		TMQ-34	TVL-3448	
B	70	150							
C	70	150							

* Not normally in distributor's stock. Available thru distributor on order to manufacturer.

FIXED CAPACITORS

Capacity values given in the rating column are in mfd. for Paper Capacitors, and in mmfd. for Mica and Ceramic Capacitors.

ITEM No.	RATING	REMARKS	REPLACEMENT DATA					
			AEROVOX PART No.	CENTRALAB PART No.	CORNELL-DUBILIER PART No.	ELMENCO PART No.	MALLORY PART No.	SPRAGUE PART No.
C4	1.5		NPO-SI 1.5	TCZ-1R5	C10V15C	CCD-471	CNO-515	10TCC-V15
C5	470		BPD-00047	DD-471	BYA10T47	CCD-471	GP347	10TS-T47
C6	10000		BPD-01	DD-103	BYA10S1	CCD-103	GP110	5HK-S10
C7	470		BPD-00047	DD-471	BYA10S1	CCD-471	GP347	10TS-T47
C8	100 N750		N750-DI 100	DTN-100	C10TIU	CCTN-101	CN7-310	10TCU-T10
C9	.47		NPO-SI 5	TCZ-R5				
C10	10 N750		N750-DI 10	DTN-10	C10QIU	CCTN-100	CN7-410	10TCU-Q10
C11	10000		BPD-01	DD-103	BYA10S1	CCD-103	GP110	5HK-S10
C12	2.2		NPO-SI 2.2	TCZ-2R2	C10V22C	CCTO-2R2	CNO-522	10TCC-V22
C13								
C14	100 N750		N750-DI 100	DTN-100	C10TIU	CCTN-101	CN7-310	10TCU-T10
C15	470		BPD-00047	DD-471	BYA10T47	CCD-471	GP347	10TS-T47
C16	10 N750		N750-DI 10	DTN-10	C10QIU	CCTN-100	CN7-410	10TCU-Q10
C17	47 N750		N750-DI 47	DTN-47	C10Q47U	CCTN-470	CN7-447	10TCU-Q47
C18	10000		BPD-01	DD-103	BYA10S1	CCD-103	GP110	5HK-S10
C19	470		BPD-00047	DD-471	BYA10T47	CCD-471	GP347	10TS-T47

FIXED CAPACITORS (cont)

ITEM No.	RATING	REMARKS	REPLACEMENT DATA					
			AEROVOX PART No.	CENTRALAB PART No.	CORNELL-DUBILIER PART No.	ELMENCO PART No.	MALLORY PART No.	SPRAGUE PART No.
C20	2000		BPD-002	DD-202	BYA10D2	CCD-202	GP220	5HK-D20
C21	10000		BPD-01	DD-103	BYA10S1	CCD-103	GP110	5HK-S10
C22	2000		BPD-002	DD-202	BYA10D2	CCD-202	GP220	5HK-D20
C23	47 N750		N750-DI 47	DTN-47	C10Q47U	CCTN-470	CN7-447	10TCU-Q47
C24	2000		BPD-002	DD-202	BYA10D2	CCD-202	GP220	5HK-D20
C25	470		BPD-00047	DD-471	BYA10T47	CCD-471	GP347	10TS-T47
C26	2000		BPD-002	DD-202	BYA10D2	CCD-202	GP220	5HK-D20
C27	10000		BPD-01	DD-103	BYA10S1	CCD-103	GP110	5HK-S10
C28	10000		BPD-01	DD-103	BYA10S1	CCD-103	GP110	5HK-S10
C29	10000		BPD-01	DD-103	BYA10S1	CCD-103	GP110	5HK-S10
C30	20000		BPD-02	DD-203	BYB6S2	CCD-203	GP120	5HK-S20
C31	4.7		NPO-SI 4.7	TCZ-4R7	C10V47C	CCTO-4R7	CN7-547	10TCC-V47
C32	10000		BPD-01	DD-103	BYA10S1	CCD-103	GP110	5HK-S10
C33	.05 200V		P288N-05	DD-503	CUB285	4DP-3-503	GEM-415	2TM-S5
C34	100 N750		N750-DI 100	DTN-100	C10TIU	CCTN-101	CNO-310	10TCU-T10
C35	.05 400V		P488N-05	DD-503	CUB485	4DP-3-503	GEM-415	4TM-S5
C36	10000		BPD-01	DD-103	BYA10S1	CCD-103	GP110	5HK-S10
C37	10000		BPD-01	DD-103	BYA10S1	CCD-103	GP110	5HK-S10
C38	10000		BPD-01	DD-103	BYA10S1	CCD-103	GP110	5HK-S10
C39	10000		BPD-01	DD-103	BYA10S1	CCD-103	GP110	5HK-S10
C40	100 N750		N750-DI 100	DTN-100	C10TIU	CCTN-101	CN7-310	10TCU-T10
C41	10000		BPD-01	DD-103	BYA10S1	CCD-103	GP110	5HK-S10
C42	10000		BPD-01	DD-103	BYA10S1	CCD-103	GP110	5HK-S10
C43	4.7	Note 1	NPO-DI 4.7	TCZ-4R7	C10V47C	CCTO-4R7	CNO-547	10TCC-547
C44	10000		BPD-01	DD-103	BYA10S1	CCD-103	GP110	5HK-S10
C45	10000		BPD-01	DD-103	BYA10S1	CCD-103	GP110	5HK-S10
C46	10000	Note 1	BPD-01	DD-103	BYA10S1	CCD-103	GP110	5HK-S10
C47	4.7	Note 1	NPO-SI 4.7	TCZ-4R7	C10V47C	CCTO-4R7	CNO-547	10TCC-V47
C48	10000		BPD-01	DD-103	BYA10S1	CCD-103	GP110	5HK-S10
C49	10000	Note 1	BPD-01	DD-103	BYA10S1	CCD-103	GP110	5HK-S10
C50	4.7	Note 1	NPO-SI 4.7	TCZ-4R7	C10V47C	CCTO-4R7	CNO-547	10TCC-V47
C51	10000		BPD-01	DD-103	BYA10S1	CCD-103	GP110	5HK-S10
C52	2000		BPD-002	DD-202	BYA10D2	CCD-202	GP220	5HK-D20
C53	10000		BPD-01	DD-103	BYA10S1	CCD-103	GP110	5HK-S10
C54	100 N750	Note 1	N750-DI 100	DTN-100	C10TIU	CCTN-101	CN7-310	10TCU-T10
C55	750 10%		DI-750	DD-751	IR5T75	CCD-751	GP375	10TS-T75
C56	15-120	#JVCOM3335				302-M		
C57	3900		SI 4000	DD-392	L10D39	CCD-392	GP239	10TS-D39
C58	.1 400V		P488N-1	DF-104	CUB4P1	4PI-3-104	GEM-401	4TM-P1
C59	330 10%		DI-330	DD-331	L10T33	CCD-331	GP333	10TS-T33
C60	.05 400V	(10000mmf) *	P488N-05	DD-503	CUB485	4DP-3-503	GEM-415	4TM-S5
C61	.1 400V		P488N-1	DF-104	CUB4P1	4DP-3-104	GEM-401	4TM-P1
C62	.1 400V		P488N-1	DF-104	CUB4P1	4DP-3-104	GEM-401	4TM-P1
C63	10000	Note 1	BPD-01	DD-103	BYA10S1	CCD-103	GP110	5HK-S10
C64	10000		BPD-01	DD-103	BYA10S1	CCD-103	GP110	5HK-S10
C65	10000	Note 1	BPD-01	DD-103	BYA10S1	CCD-103	GP110	5HK-S10
C66	10000	Note 1	BPD-01	DD-103	BYA10S1	CCD-103	GP110	5HK-S10

Note 1. Not used in some versions.

Harman-Kardon Part Number.

* Alternate Value.

PARTS LIST AND DESCRIPTIONS (Continued)

RESISTORS

All wattages 1/2 watt, or less, unless otherwise listed.

ITEM No.	RATING	REMARKS	ITEM No.	RATING	REMARKS	ITEM No.	RATING	REMARKS
R1	33K		R22	1meg		R43	82K	
R2	68Ω		R23	100K		R44	6800Ω	
R3	1000Ω		R24	1000Ω		R45	220K	
R4	3.3meg		R25	22K		R46	22K	(10K) *
R5	10Ω		R26	150K		R47	100K	
R6	330Ω		R27	3300Ω		R48	1500Ω	
R7	22K		R28	220Ω		R49	470Ω	
R8	1000Ω		R29	1meg		R50	1meg	
R9	68Ω		R30	330Ω		R51	4700Ω	
R10	1000Ω		R31	120Ω	(68Ω) *	R52	100K	
R11	330Ω		R32	100K		R53	1meg	
R12	120Ω		R33	22K		R54	4700Ω	
R13	330Ω		R34	1meg		R55	100K	
R14	120Ω		R35	330Ω	(1000Ω) *	R56	330Ω 1W	
R15	100K		R36	470K		R57	330Ω 1W	
R16	10K		R37	330Ω		R58	330Ω 1W	
R17	120Ω		R38	470K		R59	330Ω 1W	
R18	10meg		R39	330Ω		R60	1000Ω 1W	
R19	470K		R40	1meg		R61	1000Ω 1W	
R20	2.2meg		R41	100K				
R21	1.2meg		R42	15K				

* Alternate Value.

COILS (RF-IF)

ITEM No.	USE	REPLACEMENT DATA						NOTES
		Harman-Kardon PART No.	Gromer PART No.	Meissner PART No.	Merit PART No.	Miller PART No.	Ram PART No.	
L1	FM Antenna Coil	GLCOM3082						2uh
L2	RF Choke	GLCOM3083						3. Sub
L3	RF Choke							
L4	FM RF Coil							
L5	FM Mixer Coil							
L6	Cathode Choke		19-1000	19-1000	BC-561	4802		1uh
L7	FM Osc. Coil							
L8	RF Choke							3. Sub
L9	Fil. Choke							3. Sub
L10	1st FM IF Trans.	GT2503045	16-3487	16-3487	FM-254	1463		
L11	2nd FM IF Trans.	GT2503045	16-3487	16-3487	FM-254	1463		
L12	3rd FM IF Trans.	GT2503045	16-3487	16-3487	FM-254	1463		
L13	4th FM IF Trans.	GT2503045	16-3487	16-3487	FM-254	1463		
L14	Fil. Choke							3. Sub
L15	Fil. Choke							3. Sub
L16	Discriminator	GT2503052	17-3494	17-3494	FM-253	1464		
L17	Loopstick	GL2923276			BC-418 †			
L18	AM RF Trans.	GT2493012						
L19	AM Osc. Coil	STCOM3279				70 OSC		
L20	1st AM IF Trans.	GTCOM3348	16-6758	16-6758	BC-352	12-C1	RF-1	
L21	2nd AM IF Trans.	GTCOM3348	16-6758	16-6758	BC-353	12-C2	RF-2	
L22	3rd AM IF Trans.	GTCOM3348	16-6758	16-6758	BC-353	12-C2	RF-2	
L23	10KC Filter							300MH
L24	Fil. Choke							3. Sub
L25	Fil. Choke							3. Sub

† Use original mounting brackets.

TRANSFORMER (POWER)

ITEM No.	RATING			REPLACEMENT DATA						
	PRI	SEC. 1	SEC. 2	Harman-Kardon PART No.	Haldorson PART No.	Merit PART No.	Ram PART No.	Stancor PART No.	Thorderson PART No.	Triad PART No.
T1	117V Ⓢ .5A	280VCT Ⓢ .100A	6.3V Ⓢ 4.5A	FT2823274B						
	SEC. 3	SEC. 4	SEC. 5							
	6.3V Not used									

COMPONENT COMBINATIONS

ITEM No.	USE	DESCRIPTION	Harman-Kardon PART No.	REPLACEMENT DATA
K1	FM AFC Filter	470mmf, 10000mmf, 10000mmf, 47Ω, 470K, 1meg	PCCOM3080	Sprague V-21
K2	Discriminator Network	100mmf, 2000mmf, 10000mmf, 22K, 180K, 180K, 1meg	PCCOM3081	Sprague C-8
K3	AM Detector-Audio Filter	150mmf, 150mmf, 47K	P781599	Aerovox PA-98 Centralab PC-51 Cornell-Dubilier 111TM2 Sprague D-2

RECTIFIERS

ITEM No.	RATING	REPLACEMENT DATA					NOTES
	CURRENT (Measured)	Harman-Kardon PART No.	INTERNATIONAL PART No.	ITT PART No.	SARKES TARZIAN PART No.	SYLVANIA PART No.	
M1	.050A	STCOM3270 *	RS085 *	1234AH *	65A *	SR200 *	* Selenium Type
M2	.050A	STCOM3270 *	RS085 *	1234AH *	65A *	SR200 *	* Silicon Type
M3	.010A	1362133 *	RS085 *	1234AH *	65 *	SR200 *	
M4	.010A	1362133 *	RS085 *	1234AH *	65 *	SR200 *	

FUSES

ITEM No.	TYPE	RATING	REPLACEMENT DATA					
			Harman-Kardon PART No.		LITELFUSE PART No.		BUSS PART No.	
			FUSE	HOLDER	FUSE	HOLDER	FUSE	HOLDER
M5	3AG	3A 250V	ZCOM3291	HC33901	312003 (3AG 3A 250V)	342001	AGC3	HKP

CRYSTAL DIODES

ITEM No.	ORIG. TYPE	REPLACEMENT DATA				NOTES
		Harman-Kardon PART No.	CBS PART No.	RAYTHEON PART No.	SYLVANIA PART No.	
M6	1N541		1N636	1N295	1N295	FM Tuning Ind. Rect. (Pigtail)
M7	1N87		1N636	1N295	1N295	AM Tuning Ind. Rect. (Pigtail)

MISCELLANEOUS

ITEM No.	PART NAME	Harman-Kardon PART No.	NOTES
M8	FM Tuning Cap.	JV2923213	3 Gang
M9	AM Tuning Cap.	JV2923214	3 Gang (Ant. 24-381mmf, RF 20-390mmf, Osc. 15-90mmf)
M10	Switch	2923275	Function (Pushbutton Type)

WIRING DATA

General-use Unshielded Hook-up Wire Use BELDEN No. 8530 (Solid) Available in Ten Colors
8524 (Stranded) Available in Ten Colors
Power Cord Use BELDEN No. 1785-B (6 Ft. Length)
1725-K (7½ Ft. Length)