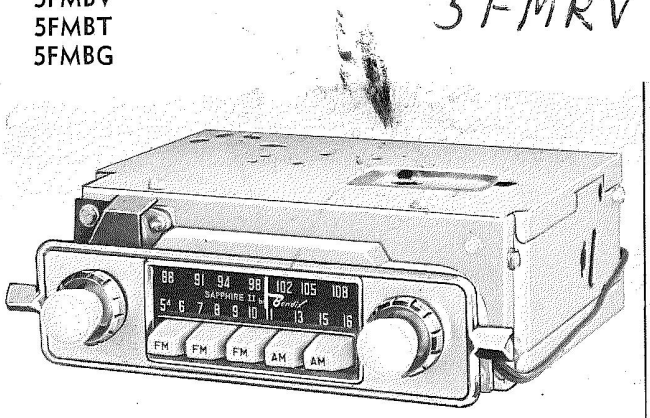
AUTO RADIO SERVICE MANUAL

1965 SAPPHIRE II FM-AM All Transistor Radio

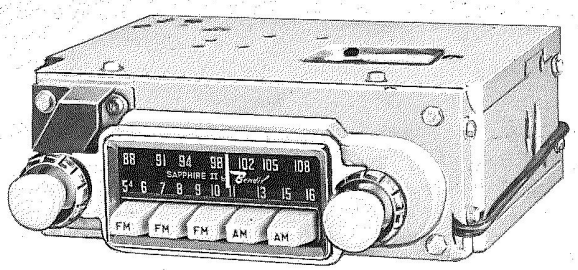
Bendix Models
5FMBV
5FMBT
5FMBG

5FMRV

Serial Number Prefix
5FMBV



VOLKSWAGEN SEDAN — 5FMBV



VOLKSWAGEN TRANSPORTER — 5FMBT
KARMANN GHIA — 5FMBG

WARRANTY SERVICE PROCEDURE

Warranty service for the SAPPHIRE II radio and accessories will be handled by the Bendix Radio Division through its authorized service dealers.

GENERAL INFORMATION

TYPE:--The 1965 Sapphire II by Bendix Radio is a fully transistorized combination FM-AM receiver. The radio circuits are switched to FM or AM by a function switch (S1) which is actuated by the pushbuttons. The Sapphire II uses a total of eleven transistors, one zener diode, one varactor diode, and four signal diodes.

TUNING RANGE:--
FM—88 to 108.5 mc AM—540 to 1605 kc

INTERMEDIATE FREQUENCY:
FM—10.7 mc and 21.4 mc AM—262.5 kc

POWER INPUT:--6 volt electrical system, negative ground.
Rated at 7.2 VDC, 1.1 Amp.

AUDIO OUTPUT:--2 watts.

SPEAKER IMPEDANCE:--6 ohms.

TO SET PUSHBUTTONS

1. Turn on the radio and allow it to warm up for 5 minutes. Extend the antenna to a height of 38 inches.

2. FM Pushbuttons—Press in firmly any one of the three pushbuttons marked FM to switch the radio circuits for FM reception. Pull out the pushbutton to be set to unlock the pushbutton mechanism. Carefully tune in the desired FM station with the manual tuning knob. After the station is clearly tuned in, push the button straight in until it stops, and then release it. Repeat this procedure for the two remaining pushbuttons.

3. AM Pushbuttons—Press in firmly either of the two AM pushbuttons to switch the radio circuits for AM reception. Pull out the pushbutton to be set to unlock the pushbutton mechanism. Carefully tune in the desired AM station with the manual tuning knob. After the station is clearly tuned in, push the button straight in until it stops, and then release it. Repeat this procedure for the remaining pushbutton.

CIRCUIT DESCRIPTION

FM (See Fig. 1, Functional FM Schematic Diagram)
The FM front end section of the receiver uses a common base RF amplifier (Q1), a common emitter

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AUTOMOTIVE PRODUCTS DEPARTMENT
Part No. 2093399-11 Price 50 cents Printed in U.S.A. 11-64

mixer (Q2) and a Colpitts type oscillator (Q3) which operates at a frequency 10.7 mc higher than the station being received. AFC voltage (either positive or negative) is applied to the anode of varactor diode D1, which is connected so that part of its capacitance adds to C11 and C12 in the oscillator tank circuit. The capacitance of the varactor varies approximately inversely with the applied voltage. In this way, the varactor compensates for small errors in tuning and for any oscillator drift. Zener diode D6 regulates the A+ voltage to the "front end" at approximately 4.7 VDC.

The 10.7 mc IF output from the mixer is amplified by four IF stages (Q4, Q5, Q6 and Q7), is limited by the limiter stage (Q8), and finally is detected by the Foster Seely Discriminator. Stage Q7 functions as a frequency doubler since its output transformer (T6) is resonate at 21.4 mc, the second harmonic of the IF. Thus, the limiter and discriminator operate at 21.4 mc. Diode D2, when receiving FM, serves no purpose other than to complete the DC path for the base biasing network of transistor Q1. When switch S1B is in the FM position, R19 is shorted to ground. This decreases the base voltage of Q5, causing it to conduct more than when receiving AM.

AM (See Fig. 2, Functional AM Schematic)

The AM section of the receiver consists of an RF amplifier (Q4), a converter stage (Q5), an IF amplifier (Q6), an AGC circuit, and an Audio Detector. Although the FM IF transformer T4 and T5 remain in series with the AM IF transformers when receiving AM, the FM transformers have no effect except to complete the DC ground paths for the transistors.

On strong signals, the AGC diode D2 rectifies some of the IF signal which in turn causes the AGC voltage to increase in a positive direction. The AGC voltage controls the gain of the RF amplifier (Q4), and to a lesser extent, the IF amplifier (Q6).

AUDIO (See Fig. 3, Functional Audio Schematic)

The three stages composing the audio amplifier are common to both the FM and AM sections of the receiver. A high degree of current stability for the power transistor is achieved by means of direct coupling and negative DC feedback.

The circuit operates as follows: Resistors R47 and R48 form a bleeder network which provides the base of transistor Q9 with a fixed ratio of the power source voltage. The voltage at the emitter of this transistor is dependent on the current drawn in output (Q11) stage. An increase in Q11 emitter current would reduce the forward bias on Q9, which would reduce the base current of Q11. Since the current gain of the audio amplifier is high, the voltage at Q9 emitter cannot vary more than a few hundredths of a volt (relative to the power supply voltage). Consequently, the power transistor (Q11) current level is well stabilized. Capacitors C45A, C45B and resistor R49 serves as a filter network to supply transistors Q4 through Q9 with a well filtered A+ voltage.

TROUBLE SHOOTING HINTS

Helpful preliminary information may sometimes be gained by checking a defective radio for both f.m. and a.m. reception. A radio that plays satisfactorily on a.m. but not on f.m. would probably be defective in the f.m. r.f. section, the limiter stage or the discriminator. A radio that plays equally bad on f.m. and a.m. could be defective in the audio section.

TRANSISTOR FAILURE

The transistors that are soldered to the printed circuit board normally should not be checked by the substitution method. The majority of transistor (and stage) failures will alter the normal transistor currents and these failures can be diagnosed by the d.c. method described below. Only when the less common symptoms of noise and intermittent conditions are encountered is it necessary to substitute a transistor to check it, and this should only be done if the d.c. method fails to reveal the trouble.

D. C. Method of Trouble Shooting Transistors

OBJECTIVE

A) To determine if each transistor stage is conducting at a normal level.

B) To determine whether the transistor or the biasing circuit is defective if the current level is abnormal.

PROCEDURE

A) Measure the voltage drop across the resistor or component specified in the table for the stage in question. Compare measured value with normal range given under "Voltage" in table. See "TROUBLE SHOOTING PRECAUTIONS".

B) If measured voltage is within given range, assume that stage is functioning normally.

C) If measured voltage is not within given range, that stage is definitely not operating properly.

TRANSISTOR	COLLECTOR CURRENT (I_C) MADC	VOLTAGE DROP VDC → MEASURED ACROSS
Q1 (Germ. PNP)	0.5 to 1.5	0.06 to 0.18 — R1, 820 ohms
Q2 (Germ. PNP)	0.75 to 1.5	0.09 to 0.18 — R6, 120 ohms
Q3 (Germ. PNP)	0.6 to 1.4	0.9 to 2.1 — R10, 1.5K ohms
Q4 (Germ. PNP)	0.9 to 1.8*	1.1 to 2.2* — R17, 1.2K ohms
Q5 (Germ. PNP)	0.8 to 1.5*	1.8 to 3.3* — R22, 2.2K ohms
Q6 (Germ. PNP)	1.5 to 2.4	0.4 to 0.8 — R28, 330 ohms
Q7 (Germ. PNP)	1.5 to 2.4	0.4 to 0.8 — R32, 330 ohms
Q8 (Germ. PNP)	2.0 to 4.0	0.65 to 1.3 — R35, 330 ohms
Q9 (Germ. PNP)	0.8 to 1.5	Cannot be measured directly.
Q10 (Silicon NPN)	8.0 to 22.0	Cannot be measured directly.
Q11 (Germ. PNP)	900 to 1250	Current meter in series with radio A+ lead

*Measured with FM-AM Selector Switch (S1) in FM position.

To determine if the transistor is defective, proceed as follows:

1) Calculate the collector current (I_C) by dividing the measured voltage drop by the value of the resistor.

$$I_C\ (ma) = \frac{V\ (volts)}{R\ (K\ ohms)}$$

2) Measure the base voltage of that transistor with respect to the emitter (VBE). Use a meter of at least 20,000 ohms per volt.
3) Plot the VBE and I_C from 1 and 2 above on the applicable curve (PNP or NPN) of the graph, Fig. 4, TRANSISTOR CONDUCTION CHARACTERISTICS.
4) If plotted point falls on or near curve, transistor is not defective and abnormal I_C is caused by circuit defects external to the transistor. Plotted points not in region of curve indicate transistor is defective.

NOTE: If I_C is much greater than the range given in table and the plotted point falls to the left of the PNP curve or to the right of the NPN curve, the transistor may be saturated. Saturated transistors are not defective—the VBE is abnormally high in the forward direction. This would probably be due to a defect in the base biasing circuit.

TROUBLE SHOOTING PRECAUTIONS

The following precautions and practices should be observed when trouble shooting the Bendix Sapphire II FM-AM Radio:

a. Measure all d-c voltages with a 20,000-ohms-per-volt meter and disconnect any antenna to assure a true no-signal condition. See notes on schematic diagram.
b. When signal injecting, use a d-c blocking capacitor in series with one of the generator leads if there is any doubt about the condition (or existence) of such a capacitor in the generator. Use a 0.1-mf capacitor for the r-f and i-f circuits and 10 mf capacitor or larger for injecting 400-cycle signals in the audio stages.
c. Always connect the radio power (A+) lead to the power supply through a 2-ampere SLO-BLO fuse.
d. NEVER SERVICE THE RADIO WITH UNGROUNDED A-C POWERED EQUIPMENT.

REPLACING PARTS

When soldering to the printed circuit board, be careful not to overheat the printed conductors. Transistors and diodes are quite heat sensitive and should be soldered with a heat sink attached to the lead between the solder joint and the component. (Flat nose MINI-CLIPS are excellent for this purpose.) Always wait until the iron is fully heated before starting to solder and apply heat only long enough to produce a smooth solder joint.

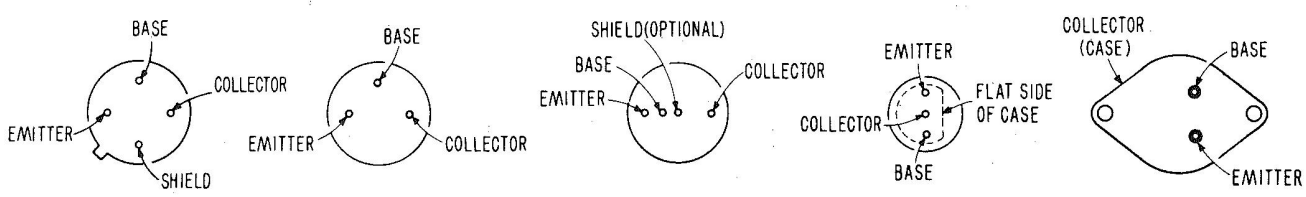
When replacing the power transistor Q11, apply a coating of silicon grease to both sides of the insulating disc and retighten the two mounting screws securely. If improperly mounted, the transistor may overheat and be damaged.

Defective transistors should always be replaced with identical units bearing the same Bendix part number (or an equivalent Bendix number). Universal type transistor replacements are not recommended. Under no circumstances should the silicon transistor (Q10) be replaced by a germanium transistor.

CRITICAL LEAD DRESS

When replacing any of the three printed circuit boards or tuner assemblies, the connecting leads should be redressed as closely as possible to their original positions. Special attention should be paid to the following leads which are critical:

a. The short green lead connecting base of transistor Q9 to PC3C. Dress this lead well away from the A line choke (L8), to prevent generator "purr" interference.
b. The white and the green tuner leads from L4 should be twisted together and dressed away from the other tuner leads.
c. The brown transmission line connecting the FM-RF printed circuit board to switch S1 and jack J1 should be dressed under metal clip on tuner shield and in notch of FM-RF printed circuit board.



TRANSISTOR LEAD IDENTIFICATION
BOTTOM VIEW

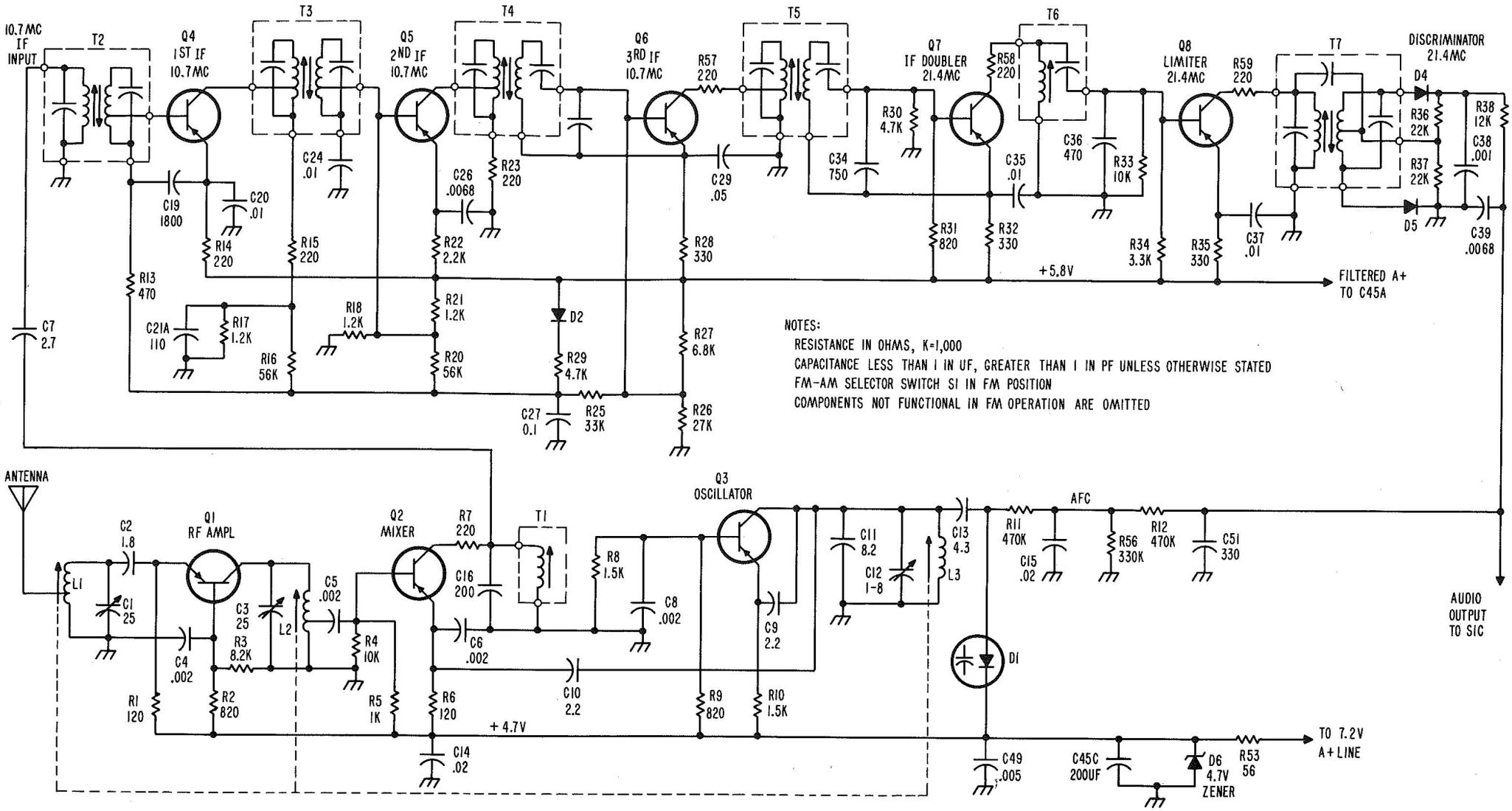
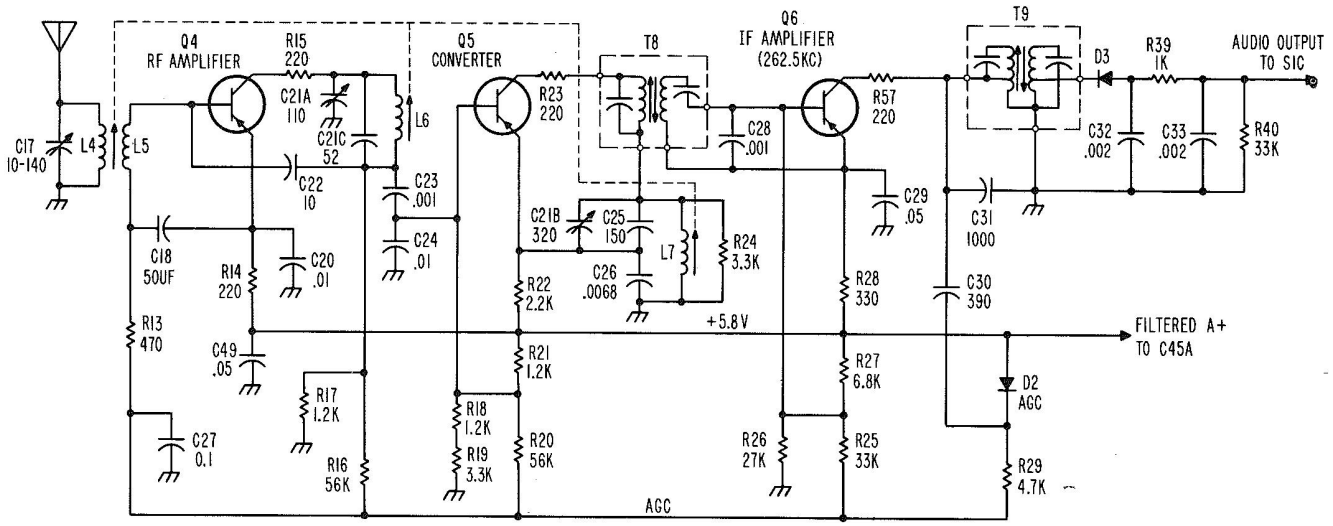
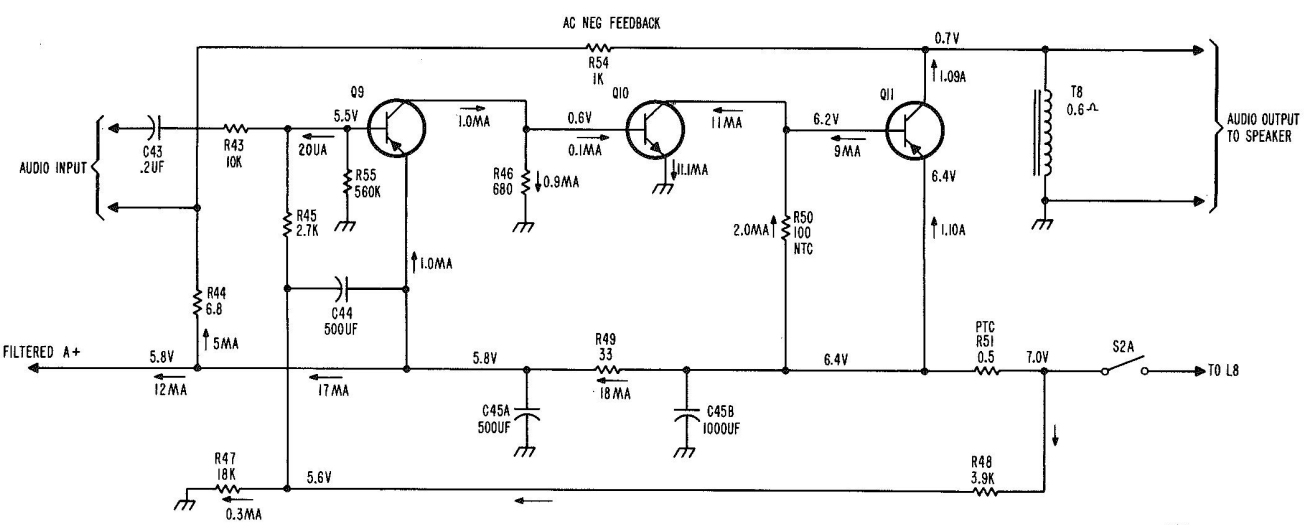


Fig. 1 Functional FM Schematic



NOTES:
RESISTANCE IN OHMS, K=1,000
CAPACITANCE LESS THAN 1 IN UF, GREATER THAN 1 IN PF UNLESS OTHERWISE STATED.
FM-AM SELECTOR SWITCH S1 IN AM POSITION.
COMPONENTS NOT FUNCTIONAL IN AM OPERATION ARE OMITTED.

Fig. 2 Functional AM Schematic



RESISTANCE IN OHMS; OTHER VALUES AS SPECIFIED.
NOMINAL CURRENT VALUES ARE SHOWN TO AID IN UNDERSTANDING OPERATION OF CIRCUIT.
INPUT VOLTAGE: +7.2V

Fig. 3 Functional Audio Schematic

1965 BENDIX MODELS 5FMBV, 5FMBT, 5FMBG VOLKSWAGEN SEDAN, VOLKSWAGEN TRANSPORTER, AND KARMANN GHIA, RESPECTIVELY, PUSHBUTTON FM-AM RADIO REPLACEMENT PARTS LIST

CAPACITORS

Symbol No.	Description	Part No.	Unit List Price	Symbol No.	Description	Part No.	Unit List Price
C1,C3	FM-Ant., RF trimmer, 4-50 mmf	2093115-0702	.50	C26,C39	6800 mmf 10%, mylar, 100 V	2090207-0037	.50
C2	1.8 mmf 10%, ceramic, 100 V	2093231-2189	.35	C27	.1 mf 20%, mylar, 100 V	2093615-0701	.50
C4,C5,C6,C8	2000 mmf 20%, ceramic, 100 V	2093135-0709	.35	C28,C31	1000 mmf 10%, mica, 100 V	2090926-0717	.45
C7	2.7 mmf 5%, ceramic, 500 V	2093231-2279	.35	C29	.05 mf 10%, mylar, 100 V	2090207-0050	.50
C9,C10	2.2 mmf 10%, ceramic, 100 V	2093135-0705	.35	C30	390 mmf 10%, mica, 100 V	2090926-0721	.45
C11	8.2 mmf 10%, ceramic, 100 V	2093135-0711	.35	C32,C33	.002 mf 20%, ceramic, 100 V	2093030-0745	.50
C12	FM OSC. trimmer assy., 1-7 mmf	2093105-0001	.50	C34	750 mmf 10%, mica, 100 V	2090926-0716	.45
C13	4.3 mmf 10%, ceramic, 100 V	2093135-0706	.35	C36	470 mmf 10%, mica, 100 V	2090926-0714	.45
C14,C15	.02 mf 20%, ceramic, 100 V	2093135-0710	.35	C38	.001 mmf 20%, ceramic, 100 V	2093030-0010	.50
C16	200 mmf 10%, mica, 100 V	2090926-0719	.45	C40	.022 mf 20%, ceramic, 100 V	2090207-0776	.50
C17	AM-Ant. trimmer, 10-140 mmf	219083-0007	1.25	C41	.033 mf 20%, mylar, 25 V	2093615-0715	.35
C18	50 mf, electrolytic, 3 V	2093386-0702	1.70	C42	.02 mf 20%, ceramic, 100 V	2093030-0016	.50
C19	1800 mmf 10%, ceramic, 100 V	2093030-0039	.50	C43,C50	0.2 mf 20%, ceramic, 10 V	2090150-0006	.50
C20,C35,C37	.01 mf 20%, ceramic, 100 V	2093030-0002	.50	C44	500 mf, electrolytic, 3 V	2093386-0701	1.70
C21A,B,C	AM-RF, OSC. trimmer, A-90-130 mmf, B-280-350 mmf, C-52 mmf	2092422-0706	1.60	C45A,B,C	A-500 mf, B-1000 mf, C-200 mf, electrolytic	220353-0037	3.00
				C46,C48	375 mmf, spark plate	2093050-0703	.10
C22	10 mmf 10%, ceramic, 100 V	2093030-0742	.50	C47	275 mmf, spark plate	2093050-0002	.10
C23	1000 mmf 10%, mica, 100 V	2090926-0718	.45	C49	.005 mf 20%, ceramic, 100 V	2093229-0719	.35
C24	.01 mf 10%, mylar, 100 V	2090207-0767	.50				
C25	150 mmf 5%, ceramic, 100 V	2093030-0030	.50				

DIODES AND TRANSISTORS

Symbol No.	Description	Part No.	Unit List Price	Symbol No.	Description	Part No.	Unit List Price
D1	Silicon, Variable Capacitance	2092055-0003	2.25	Q3,Q4,Q5	FM-OSC, IF: AM-RF, Converter, PNP	2092418-0712	2.50
D2,D3	Germanium	2092055-0001	.60				
D4,D5	Germanium	2092055-0711	.60	Q6,Q7,Q8	FM-IF, Doubler, Limiter: AM-IF, PNP	2092418-0712	2.50
D6	Silicon, Zener	2092055-0004	1.50				
				Q9	Audio Pre-Driver, PNP	2090924-0008	2.00
Q1	FM-RF, PNP	2092417-0707	5.00	Q10	Audio Driver (Silicon), NPN	2092609-0002	2.00
Q2	FM-Mixer, PNP	2092417-0708	5.00	Q11	Audio Output, PNP	2091859-0717	4.00

SWITCHES AND TRANSFORMERS

Symbol No.	Description	Part No.	Unit List Price	Symbol No.	Description	Part No.	Unit List Price
S1A,B,C	Switch assembly, FM-AM	2092702-0005	2.75	T4	FM-IF 10.7mc	2093149-0703	2.50
S2A,B	ON-OFF (Part of Volume-Tone Control R41)	2091258-0003	3.75	T5	FM-IF 10.7mc	2093149-0704	2.50
				T6	FM-Doubler 21.4mc	2093149-0705	2.50
				T7	FM-Discriminator 21.4mc	2093216-0701	2.50
T1	FM-IF 10.7mc	2093149-0706	2.50	T8	AM-IF input 262.5kc	2092419-0709	2.50
T2	FM-IF 10.7mc	2093149-0708	2.50	T9	AM-IF output 262.5kc	2092419-0710	2.50
T3	FM-IF 10.7mc	2093149-0707	2.50	T10	Audio Output Choke	2092138-0711	3.85

RESISTORS

Symbol No.	Description	Part No.	Unit List Price	Symbol No.	Description	Part No.	Unit List Price
R1,R6	120 ohms 10%, ½ W comp.	2093232-2121	.20	R28,R32,R35	330 ohms 10%, ½ W comp.	2093232-2331	.20
R2,R9,R31	820 ohms 10%, ½ W comp.	2093232-2821	.20	R29,R30	4.7K ohms 10%, ½ W comp.	2093232-2472	.20
R3	8.2K ohms 10%, ½ W comp.	2093232-2822	.20	R36,R37	22K ohms 5%, ½ W comp.	2093232-1223	.30
R4,R33,R43	10K ohms 10%, ½ W comp.	2093232-2103	.20	R38,R42	12K ohms 10%, ½ W comp.	2093232-2123	.20
R5,R54	1.0K ohms 10%, ½ W comp.	2093232-2102	.20	R39	1.0K ohms 20%, ½ W comp.	2093232-3102	.15
R7,R15	220 ohms 20%, ½ W comp.	2093232-3221	.15	R41A,B,S2	Volume Control, Tone Control, ON-OFF Switch	2091258-0003	3.75
R8,R10	1.5K ohms 10%, ½ W comp.	2093232-2152	.20				
R11,R12	470K ohms 10%, ½ W comp.	2093232-2474	.20	R44	6.8 ohms 5%, ½ W comp.	2093232-1689	.30
R13	470 ohms 20%, ½ W comp.	2093232-3471	.15	R45	2.7K ohms 10%, ½ W comp.	2093232-2272	.20
R14	220 ohms 10%, ½ W comp.	2093232-2221	.20	R46	680 ohms 5%, ½ W comp.	2093232-1681	.30
R16,R20	56K ohms 10%, ½ W comp.	2093232-2563	.20	R47	18K ohms 5%, ½ W comp.	2093232-1183	.30
R17	1.2K ohms 10%, ½ W comp.	2093232-2122	.20	R48	3.9K ohms 5%, ½ W comp.	2093232-1392	.30
R18,R21	1.2K ohms 5%, ½ W comp.	2093232-1122	.30	R49	33 ohms 5%, ½ W comp.	2093232-1330	.30
R19	3.3K ohms 5%, ½ W comp.	2093232-1332	.30	R50	100 ohms 10%, Thermistor	220629-0012	.75
R22	2.2K ohms 10%, ½ W comp.	2093232-2222	.10	R51	0.45 ohms 10% @25°C, 2 W, WW	2090948-0027	.45
R23,R57	220 ohms 20%, ½ W comp.	2093232-3221	.15	R52	80 ohms 20%, 2 W (Fader Control)	2092415-0001	2.60
R24,R34	3.3K ohms 10%, ½ W comp.	2093232-2332	.20	R53	56 ohms 10%, 2 W, WW	2093141-2560	.45
R25,R40	33K ohms 10%, ½ W comp.	2093232-2333	.20	R55	560K ohms 20%, ½ W comp.	2093232-3564	.15
R26	27K ohms 10%, ½ W comp.	2093232-2273	.20	R56	330K ohms 10%, ½ W comp.	2093232-2334	.20
R27	6.8K ohms 10%, ½ W comp.	2093232-2682	.20	R58,R59	220 ohms 20%, ½ W comp.	2093232-3221	.15

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MISCELLANEOUS ELECTRICAL

Symbol No.	Description	Part No.	Unit List Price	Symbol No.	Description	Part No.	Unit List Price
E1	Lampholder and lead assembly	287353-0003	.40	J5	Cap, fuseholder	221633-0003	.10
F1	Fuse, 5 amperes (AGA 5)	2091811-0009	.15		Contact and lead assembly, fuse cap	221633-0008	.25
I1	Lamp, dial (1908X)	2091877-0009	.30	J6,P3	Fuseholder and lead assembly	2090932-0508	.50
J1	Receptacle, antenna	2092553-0001	.20	J7	Lead and receptacle assembly, lamp	2091852-0003	.30
J2	Lead and receptacle assembly, front speaker	2090731-0013	.30	L1,L2,L3	Part of FM tuner assembly		
				L4,L5,L6,L7	Part of AM tuner assembly		
J3,J4	Lead and receptacle assembly, fader control	2090613-0012	.30	L8	Choke, "A" line filter	2092424-0002	1.35

TUNER PARTS

Symbol No.	Description	Part No.	Unit List Price		Description	Part No.	Unit List Price
	GIC				Clutch assembly, manual (less mtg. bracket)	2090133-0060	1.80
	Tuner assembly, FM-AM (complete with pushbuttons)	2093142-0704	29.50		De-clutch gate	2091807-0004	.50
	Tuner assembly, FM (incls. mtg. bracket)	2093394-0707	7.00		Spring, de-clutch gate return	2091808-0007	.15
L1,L2,L3	Coil assembly, FM tuner	Order complete FM tuner			Bracket, manual clutch retaining	2091197-0016	.20
					Pointer and arm assembly	2090129-0033	1.00
L4,L5,L6,L7	Coil assembly, AM	2090131-0086	3.10		Spring, pointer backlash	2090130-0017	.15
	Switch assembly, FM-AM slide	2092702-0005	2.75		Shuttle gate (actuates slide switch)	2092706-0003	.90
	Coupling rod assembly (actuates FM tuner)	2092703-0005	.25		Clamp, coupling rod retaining	2092705-0003	.20
					Pushbutton, FM	2092397-0003	.35
					Pushbutton, AM	2092397-0004	.35

MISCELLANEOUS PARTS

	Description	Part No.	Unit List Price		Description	Part No.	Unit List Price
	Escutcheon and calibrated dial glass assembly	2092167-0502	5.50		Shaft assembly, manual drive	2092168-0502	.60
					Shield, fishpaper (mts. over Q11)	2092277-0001	.15
	Dial glass, calibrated	2092404-0003	.95		Shield, A line choke	2093566-0001	.20
	Sub-dial	2092227-0001	.65		Spring, tuner ground	2091341-0002	.10
	Printed circuit board assy., Main (incls. transistors Q4 thru Q10)	2093378-0508	65.00		Spring, coil (mts. on fader shaft)	2092414-0001	.05
					Spacer, transistor	2093436-0701	.15
	Printed circuit board assy., FM (incls. transistors Q1 thru Q3)	2093378-0510	24.50		Spring, manual drive shaft torque	2092232-0001	.15
					Bolt, ¼-20 x 23/32 radio mounting	H2091298-0002	.10
	Printed circuit board, small VC	2093217-0002	.10		Nut, ¼-20 hexagon	H2093220-1210	.03
	Bracket, FM tuner support	2093146-0001	.45		Screw, #6 x 3/16 hex. hd. S.T.	H2090040-0003	.02
	Bracket, Main PC board support	2092401-0001	.25		Screw, #6-20 x ½ clutch pan hd. S.T. (Q11 mounting)	H2091944-0002	.03
	Bracket, transistor retaining (Q11)	2091917-0002	.15				
	Bracket, PC board support (small)	2093147-0001	.10		Screw, #8-18 x ⅜ hex. washer hd. S.T.	H2092150-0001	.02
	Cover, bottom	2093143-0001	.85				
	Cover, top	2093144-0002	.85		Screw, #8-18 x ¼ hex. washer hd. S.T.	H2092151-0001	.02
	Insulator, transistor retaining bracket (Q11)	2091918-0001	.10				
					Screw, #8-32 x ¼ hex. hd. S.T.	H2090772-0204	.02
	Insulator, transistor case (Q11) (NOTE: Do not use a substitute)	2090882-0003	.20		Screw-washer assy., #8 x ⅜ S.T.	H2090814-0001	.04
					Screw-washer assy., #8 x ½ S.T.	H2090814-0003	.04
	Plate, tuner mounting	2092409-0003	.50		Stud, Nylon, P.C. Mounting	2092252-0001	.05
	Receptacle, pilot lamp leads	2090603-0001	.10				

INSTALLATION PARTS

Quantity V*	Quantity T*	Quantity G*	Description	Part No.	Unit List Price	Quantity V*	Quantity T*	Quantity G*	Description	Part No.	Unit List Price
1	1		Antenna assembly	2093003-0701	5.00	1			Gasket, chip board, (6" spk. baffle)	2091212-0001	.15
		1	Antenna assembly	2091408-0002	6.95		1		Grille cloth	2092240-0001	.40
1			Speaker and baffle assy., 6" PM	2091246-0004	8.40		1		Plastic foam cushion (½ x 6¾")	2091203-0004	.20
	1		Speaker and baffle assy., 6" PM	2091247-0004	8.50	2	2	2	Disc, tone control	[2092235-0001]	.75
1	1		Speaker assy., 6" PM, 6 ohms	2092255-0002	7.00	2	2	2	Knob assy., tuning or volume	[2091244-0503]	.50
		1	Speaker assy., 5" PM, 6 ohms	2093455-0702	4.50	4	4		Screw-washer assy., #8 x ⅝ S.T.	H2090814-0002	.04
1			Baffle, 6" speaker	2091211-0001	.75		4		Screw-washer assy., #8 x ½ S.T.	H2090814-0003	.04
	1		Baffle, 6" speaker	2091219-0001	.80	4			Screw, #8-15 x ⅜ rd. hd. S.T.	H295609-0006	.03

*V—Denotes Volkswa gen Sedan *T—Denotes Volkswagen Transporter *G—Denotes Karmann Ghia

1965 BENDIX MODELS 5FMBV, 5FMBT, 5FMBG VOLKSWAGEN SEDAN, VOLKSWAGEN TRANSPORTER, AND KARMANN GHIA, RESPECTIVELY, PUSHBUTTON FM-AM RADIO REPLACEMENT PARTS LIST (Cont.)

INSTALLATION KITS

Quantity V*	Quantity T*	Quantity G*	Description	Part No.	Unit List Price	Quantity V*	Quantity T*	Quantity G*	Description	Part No.	Unit List Price
x			Installation kit (complete)	2092715-0052	5.75		1		Lead assy., antenna extension	2092431-0001	.70
	x		Installation kit (complete)	2092715-0053	5.00	1			Plate, radio mounting	2092237-0001	.40
		x	Installation kit (complete)	2092715-0054	5.00	2	2	2	Nut, ½ x 28 hexagon	H2093220-1219	.10
1			Bracket, radio mounting	2092399-0003	.20	1	1	2	Nut, ¼ x 20 hexagon	H274247-0002	.03
	1		Bracket, radio mounting	2092403-0001	.15			4	Nut, lock, for #8A Screw	H295360-0006	.05
		1	Bracket, radio mounting	2092426-0001	.15			4	Screw, #8-18 x ½ hex. S.T.	H2092150-0003	.02
1			Bezel	[2092234-0001]	2.50			1	Screw, #¼-20 x ½ Machine	H2093228-0702	.05
	1	1	Bezel	[2092236-0001]	1.75		2		Screw, #10-12 x ⅜ S.T.	H295609-0007	.03
1	1	1	Capacitor, generator	2092427-0001	.70						
2	2	2	Static collector assembly, wheel	2092270-0001	.45	1	1	1	Owner's manual	2094104-0001	N/C
1			Seal, bezel air	2092238-0001	.20	1			Installation Instructions	2094105-0001	N/C
		1	Seal, light (4¾" rubber band)	2090971-0001	.15		1		Installation Instructions	2094105-0003	N/C
1	1	1	Fuseholder and lead assy.	2090932-0508	.50			1	Installation Instructions	2094105-0002	N/C
1	1	1	Fuse, 5 amperes (AGA 5)	2091811-0009	.15	1			Drilling template, antenna mtg.	2093452-0001	N/C
1	1	1	Adapter, terminal	2092257-0001	.10		1		Drilling template, antenna mtg.	2093453-0001	N/C
		3	Insulator tubing (¼ x 1½")	2093045-0002	.02			1	Drilling template, antenna mtg.	2091296-0002	N/C
1			Insulator tubing (⅓ x 1½")	2093045-0001	.02						

AUXILIARY SPEAKER KIT PARTS

Quantity Per Kit	Description	Part No.	Unit List Price	Quantity Per Kit	Description	Part No.	Unit List Price
1	Housing and speaker assy., (Gray)	2091640-0510	7.85		(4) Nut, speed (grille cloth)	H2091643-0001	.02
	Includes following items (5):				(1) Seal, decorative	2092262-0001	.30
	(1) Speaker assy., 5" rd. PM (6 ohms)	2093455-0702	4.50	1	Lead assembly, speaker (180")	2092264-0002	1.15
				2	Screw, #10-16 x ½ pan hd. S.T.	H2090139-0008	.02
	(1) Housing, speaker (Gray)	2091635-0005	3.00	1	Installation Instructions	2092116-0002	N/C
	(1) Grille cloth, speaker housing	2091641-0001	.25				

*V—Denotes Volkswagen Sedan *T—Denotes Volkswagen Transporter *G—Denotes Karmann Ghia

[ ]—Furnished for replacement parts purposes only, in limited quantities.
Quantity orders will be honored only on a part for part exchange basis.

PRICES SUBJECT TO CHANGE WITHOUT NOTICE

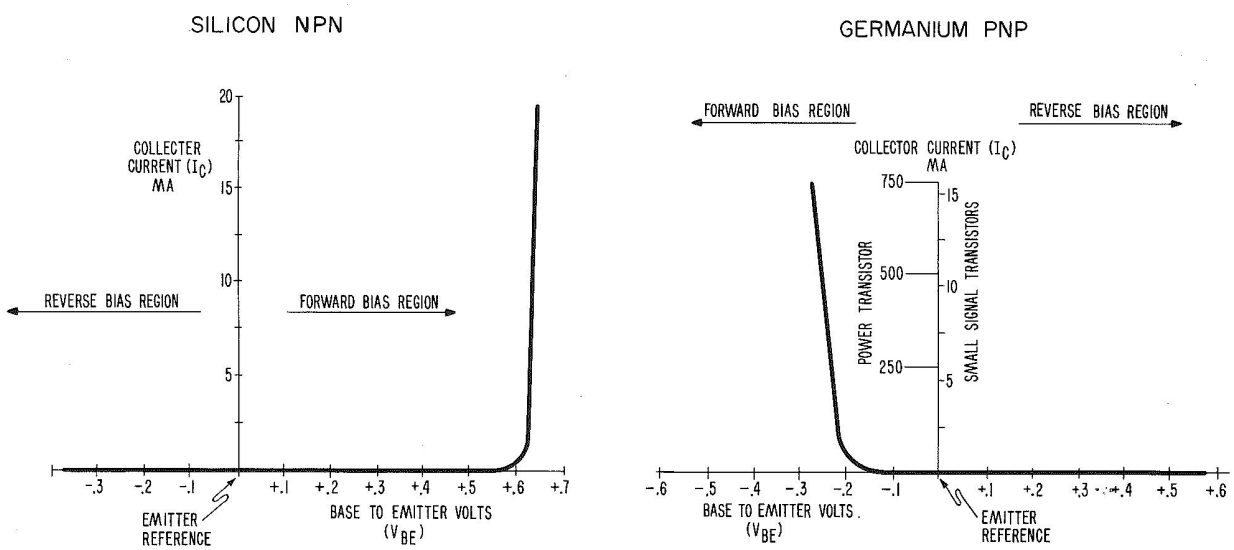
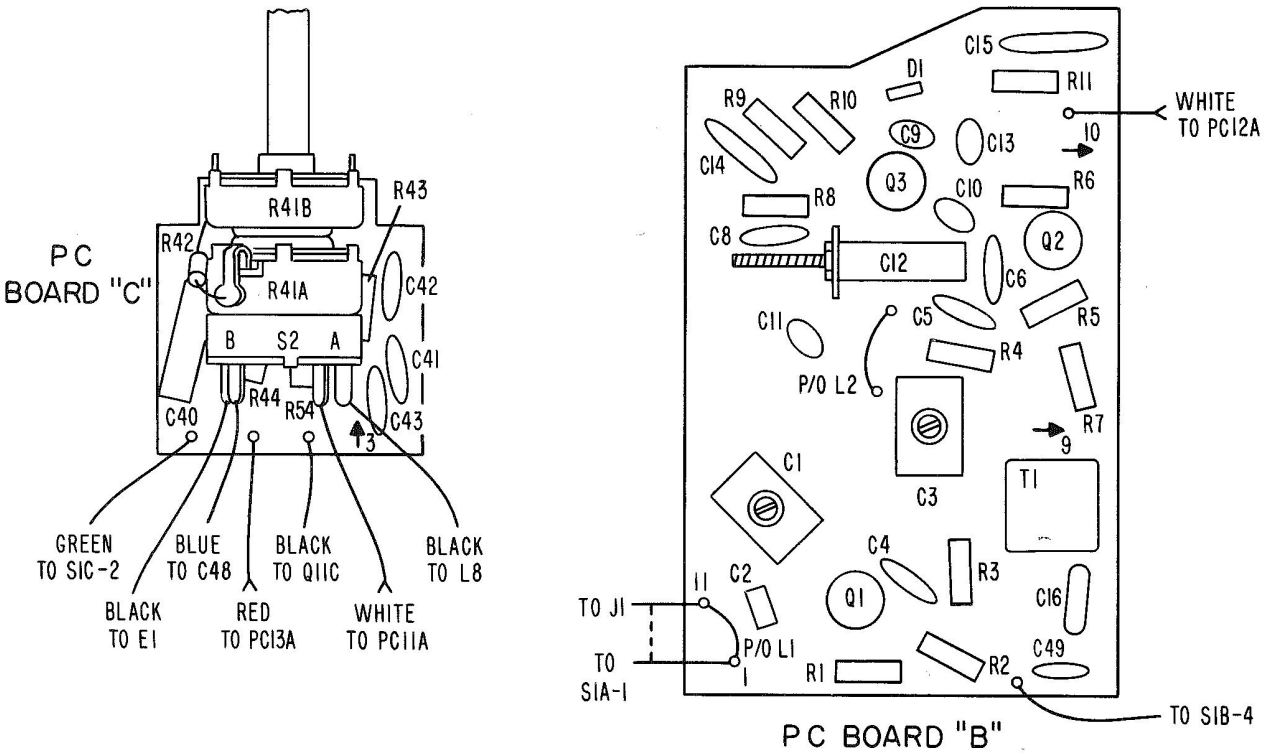
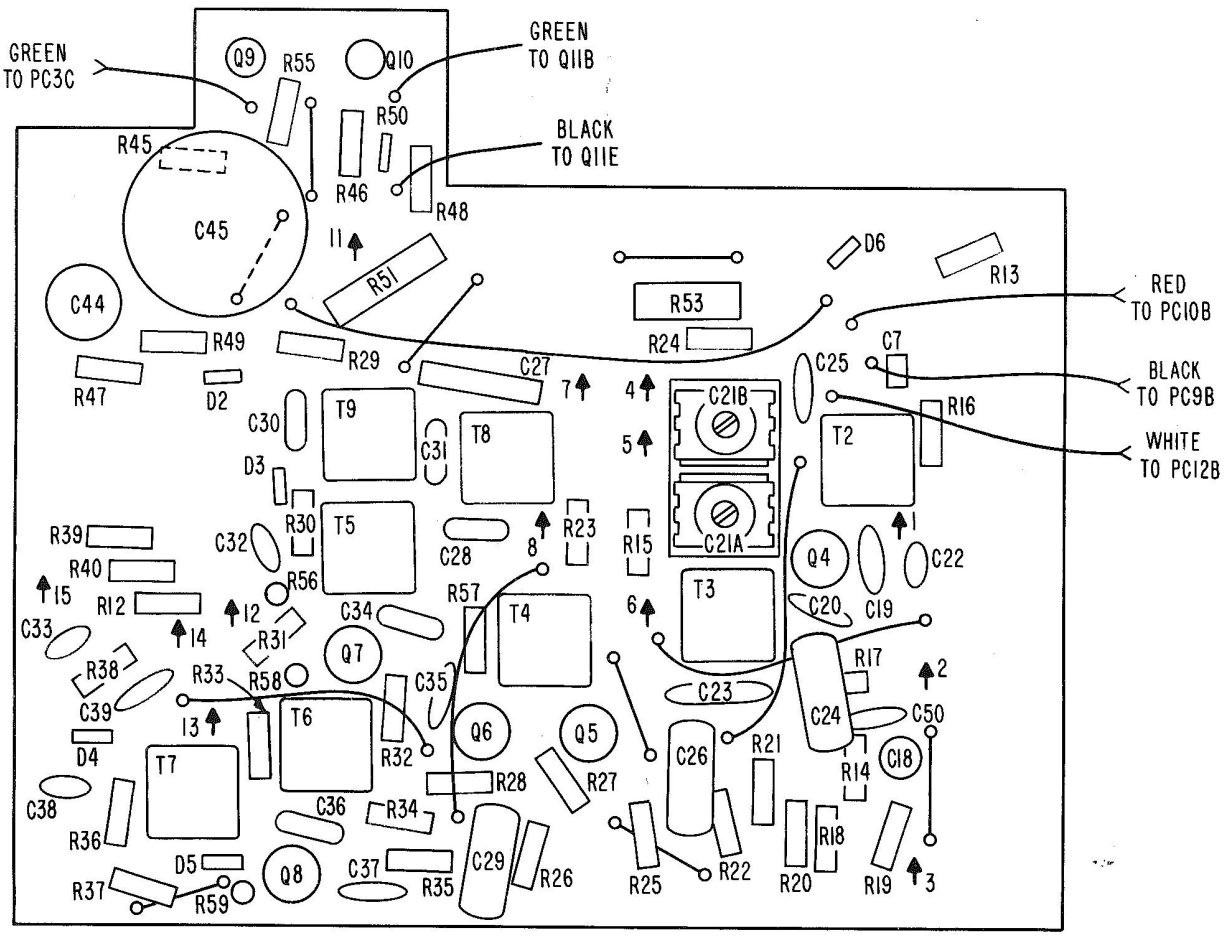


Fig. 4 Transistor Conduction Characteristics

TOP VIEW OF PRINTED CIRCUIT BOARDS

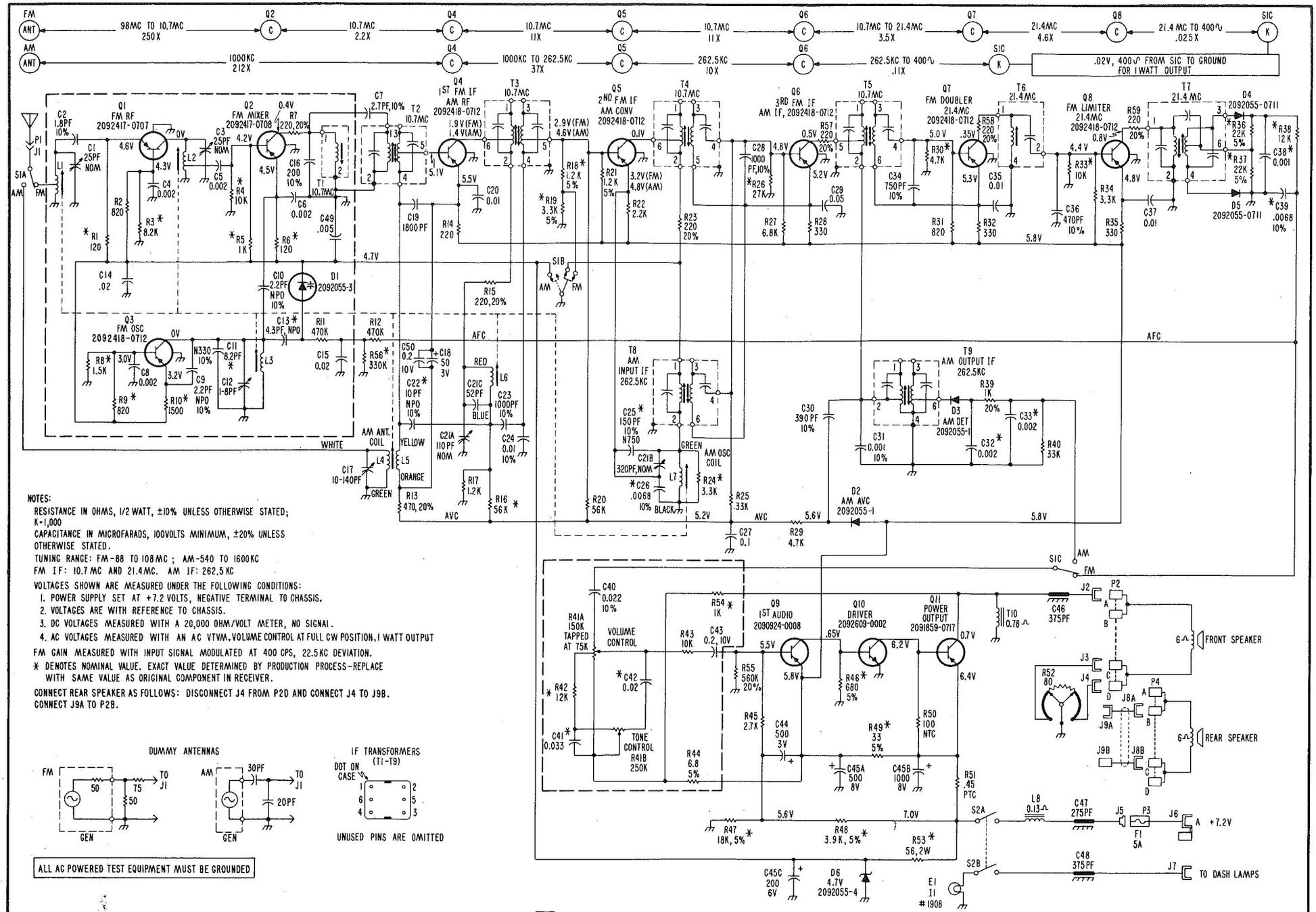




INDICATES MALE PC CONNECTOR

INDICATES FEMALE PC CONNECTOR

PC BOARD "C"



NOTES:

RESISTANCE IN OHMS, 1/2 WATT, ±10% UNLESS OTHERWISE STATED; K=1,000

CAPACITANCE IN MICROFARADS, 100VOLTS MINIMUM, ±20% UNLESS OTHERWISE STATED.

TUNING RANGE: FM-88 TO 108MC ; AM-540 TO 1600KC

FM IF: 10.7 MC AND 21.4MC. AM IF: 262.5 KC

VOLTAGES SHOWN ARE MEASURED UNDER THE FOLLOWING CONDITIONS:

1. POWER SUPPLY SET AT +7.2 VOLTS, NEGATIVE TERMINAL TO CHASSIS.
2. VOLTAGES ARE WITH REFERENCE TO CHASSIS.
3. DC VOLTAGES MEASURED WITH A 20,000 OHM/VOLT METER, NO SIGNAL.
4. AC VOLTAGES MEASURED WITH AN AC VTVM, VOLUME CONTROL AT FULL CW POSITION, 1 WATT OUTPUT

FM GAIN MEASURED WITH INPUT SIGNAL MODULATED AT 400 CPS, 22.5KC DEVIATION.

* DENOTES NOMINAL VALUE. EXACT VALUE DETERMINED BY PRODUCTION PROCESS-REPLACE WITH SAME VALUE AS ORIGINAL COMPONENT IN RECEIVER.

CONNECT REAR SPEAKER AS FOLLOWS: DISCONNECT J4 FROM P2D AND CONNECT J4 TO J9B. CONNECT J9A TO P2B.

DUMMY ANTENNAS

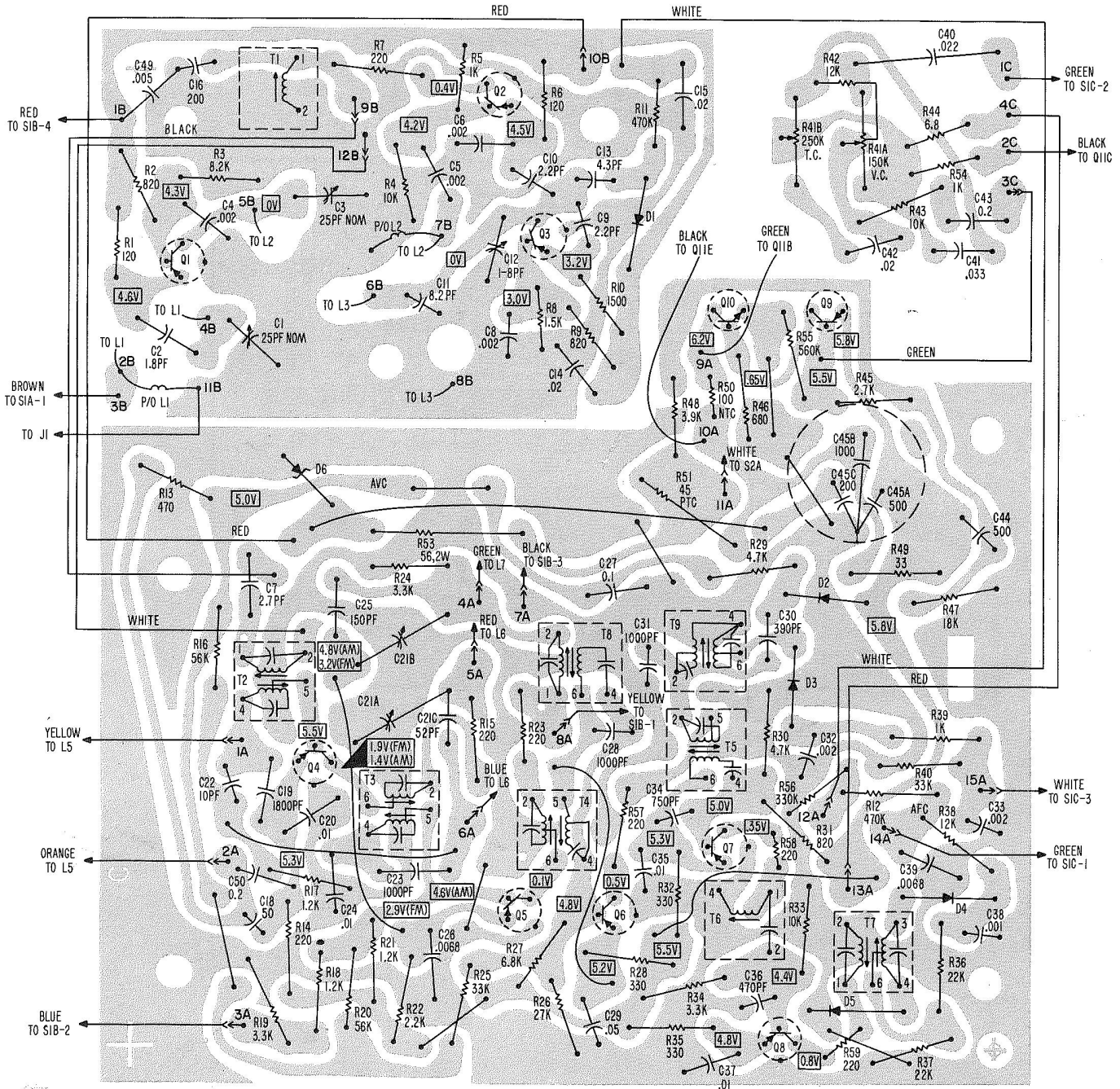
IF TRANSFORMERS (T1-T9)

UNUSED PINS ARE OMITTED

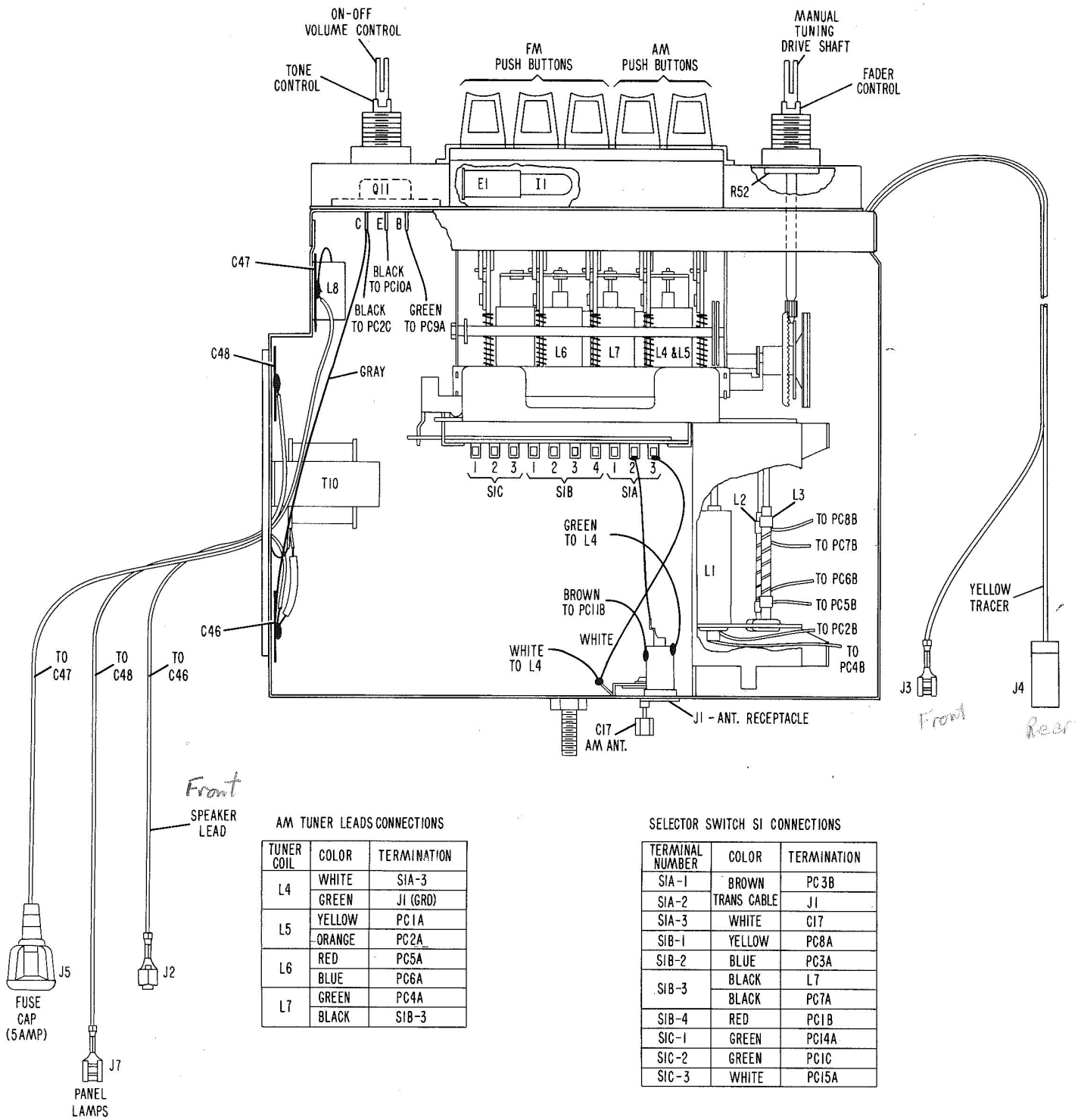
ALL AC POWERED TEST EQUIPMENT MUST BE GROUNDED

5FM8V, 5FM8G, 5FM8T

TRACK SIDE OF PRINTED CIRCUIT BOARDS



NOTES:
RESISTANCE IN OHMS, 1/2 WATT, UNLESS OTHERWISE STATED. K=1,000
CAPACITANCE IN UF UNLESS OTHERWISE STATED
VOLTAGES SHOULD NOT VARY MORE THAN 20% FROM VALUES SHOWN
WHEN INPUT IS 7.2V, MEASURED WITH 20,000 OHM/VOLT METER, NO SIGNAL
ISSUE "C" P C BOARD



AM TUNER LEADS CONNECTIONS

TUNER COIL	COLOR	TERMINATION
L4	WHITE	SIA-3
	GREEN	J1 (GRD)
L5	YELLOW	PC1A
	ORANGE	PC2A
L6	RED	PC5A
	BLUE	PC6A
L7	GREEN	PC4A
	BLACK	SIB-3

SELECTOR SWITCH S1 CONNECTIONS

TERMINAL NUMBER	COLOR	TERMINATION
SIA-1	BROWN TRANS CABLE	PC3B
SIA-2		J1
SIA-3	WHITE	C17
SIB-1	YELLOW	PC8A
SIB-2	BLUE	PC3A
SIB-3	BLACK	L7
	BLACK	PC7A
SIB-4	RED	PC1B
SIC-1	GREEN	PC14A
SIC-2	GREEN	PC1C
SIC-3	WHITE	PC15A

FM ALIGNMENT

The FM section of the receiver has been accurately aligned at the factory using laboratory type equipment and normally will not require re-alignment. However, should major repairs or parts replacement necessitate re-alignment, either of the following procedures can be used. If a good FM signal generator is available, the second method is recommended.

IMPORTANT

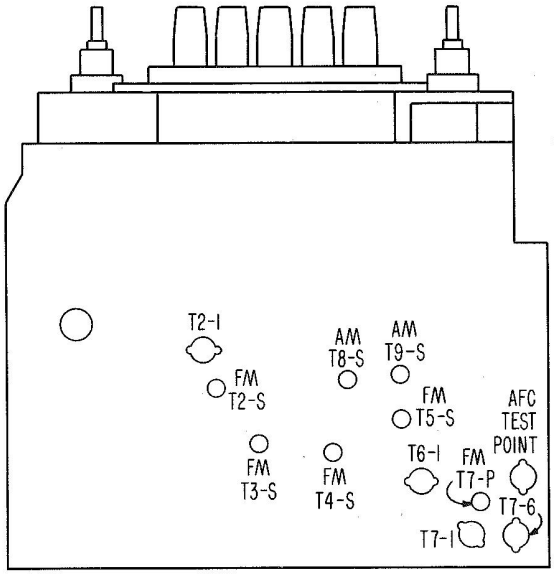
Covers must be in place during all steps of the alignment procedure.

METHOD 1: USING UNMODULATED SIGNAL GENERATOR.

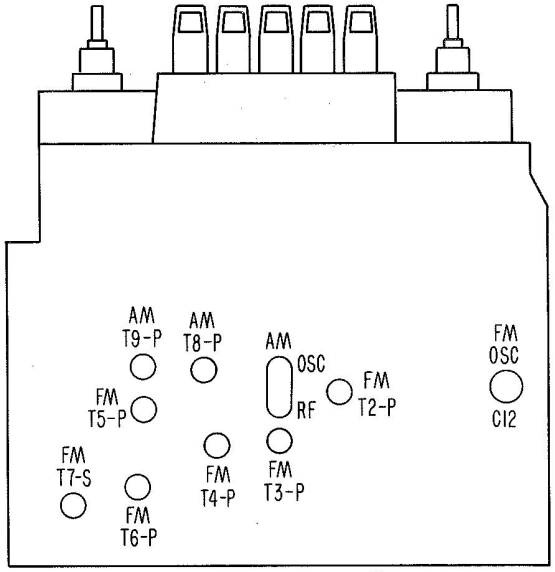
NOTES:

1. See Fig. 5 for identification of alignment access holes in covers.
2. Set tuner to 88 mc (low end stop) unless otherwise noted.
3. AFC voltage measured with DC VTVM at AFC test point.
4. Detector probe may be constructed from Fig 6. Probe voltage must be read with DC VTVM.

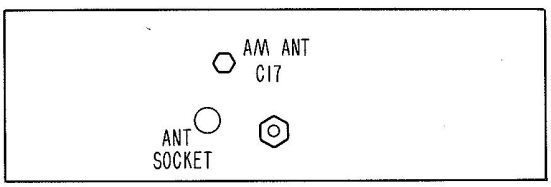
STEP	GENERATOR CONNECTION	GENERATOR FREQUENCY	ADJUST	PROCEDURE
1	FM INJECTION POINT	10.7 MC Unmodulated	T7-S, T7-P	Use high (100 KUV) generator voltage. Adjust T7-S, then T7-P for max. negative AFC voltage.
2	Same as step 1	Same as step 1	T6, T5-S, T5-P, T4-S, T4-P, T3-S, T3-P, T2-S, T2-P, T1, T7-P, T7-S	Keep generator adjusted to a level that produces between —1.5V to —2.5V at AFC test point. Peak IF and disc. slugs in order shown for max. AFC voltage. If two peaking positions are found, use outermost position. Repeat peaking procedure.
3	Not Used	No Signal	T7-S	Carefully adjust T7-S for zero AFC voltage. A positive and negative indication will be obtained on either side of zero setting.
4	DUMMY ANTENNA (See schematic diagram)	108.5 MC	FM-OSC (C12)	Set tuner to high end stop (108 mc). With generator set at approximately 1 KUV, adjust C12 for zero AFC voltage.
5	DUMMY ANTENNA	Same as step 4	FM-RF (C3) FM-ANT (C1)	Leave tuner and generator frequency set exactly as in previous step. Connect detector probe to T6-1 (pin 1) and detector ground clip to cover. Use minimum signal generator output that will override noise level. Adjust FM-RF (C3) and FM-ANT (C1) for max. probe voltage. NOTE: Adjust FM-RF (C3) to first peak from full clockwise position.



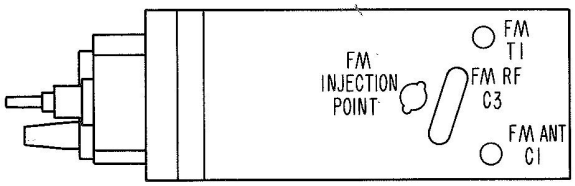
TOP VIEW



BOTTOM VIEW



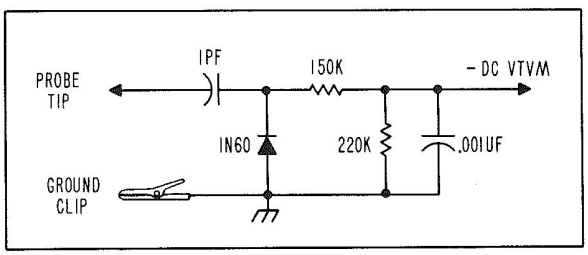
BACK VIEW



SIDE VIEW

FM-AM ALIGNMENT GUIDE

Fig. 5



DETECTOR PROBE

Fig. 6

METHOD 2: USING MODULATED FM SIGNAL GENERATOR.

NOTES:

1. See Fig. 5 for identification of alignment access holes in covers.
2. Set tuner to 88 mc (low end stop) unless otherwise noted and set tone control to max. clockwise position.
3. Audio output voltage is measured with AC meter connected to speaker terminals or 6-ohm dummy load. AFC voltage measured with DC VTVM at AFC test point.
4. Detector probe may be constructed from Fig. 6. Probe voltage must be read with DC VTVM.

STEP	GENERATOR CONNECTION	GENERATOR FREQUENCY	ADJUST	PROCEDURE
1	FM INJECTION POINT (Junction of L2 and C5)	10.7 MC Modulated at 400 cps 75 KC Deviation	T6, T5-S, T5-P, T4-S, T4-P, T3-S, T3-P, T2-S, T2-P, T1	Connect detector probe to T6-1 (pin #1). Use minimum signal generator output that will override noise level. Peak IF slugs in order shown for max. probe voltage. Repeat adjustment of IF slugs. NOTE: Signal generator must be kept below limiting level, which is less than 1 KUV at this point. (Limiting level is generator voltage when output drops 6 db from max. value.)
2	Not used	No Signal	T7-S	Adjust T7-S for zero voltage at AFC test point. A positive and negative indication will be obtained on either side of zero setting.
3	Same as step 1	10.7 MC Modulated at 400 cps 250 KC Deviation	T7-P	Set signal generator level at 100 KUV. Adjust volume control for 1 watt (2.4 VRMS) audio output. Adjust T7-P for max. audio output. Reset volume control for 1 watt output if necessary.
4	Repeat steps 2 and 3			
5	Same as step 1	Same as step 1	T6	Disconnect detector probe from T6. Use minimum signal generator output that will override noise level. Adjust T6 for max. audio output. With set "Limiting" reset volume control for 1 watt output.
6	DUMMY ANTENNA (See schematic diagram)	108.5 MC Modulated at 400 CPS 75 KC Deviation	FM-OSC (C12) FM-RF (C3) FM-ANT (C1)	Set tuner to high end stop (108 MC). Adjust C12 for max. audio output. Reduce generator output until audio output falls off approximately 3 db and readjust C12. Keeping signal generator adjusted to lowest level that will override noise level, adjust C1 and C3 for max. audio output. Limiting level (LO db drop in audio) should now be less than 20 UV. NOTE: Adjust C3 to first peak from full clockwise position.
7	Same as step 6	98 MC Modulated at 400 CPS 75 KC Deviation	T7-P	Set signal generator level at 1 KUV. Carefully tune receiver for max. audio output. If AFC voltage measures more than +0.5 VDC, rotate T7-P¼ turn counterclockwise and retune receiver for max. audio. Repeat procedure if AFC voltage is still greater than +0.5 VDC. If AFC voltage is greater than —0.5 VDC, repeat above procedure, only rotate T7-P slug clockwise instead of counterclockwise. Max. audio should occur within ±0.5 VDC.

AM ALIGNMENT

NOTES:

1. Output voltage measured with AC meter connected to speaker terminals or 6-ohm dummy load.
2. Set volume control to maximum, set tone control to full on position, and keep generator level adjusted to produce between 1 and 3 volts output.
3. Set tuner to high end stop unless otherwise noted.
4. Set signal generator for 30% modulation at approximately 400 cps.
5. Do not remove covers from radio for alignment. See Fig. 5 for identification of alignment access holes in covers.

IMPORTANT

Back IF tuning slugs out of coil and adjust to first peak going into coil.

STEP	GENERATOR CONNECTION	GENERATOR FREQUENCY	SET TUNER TO	ADJUST	REMARKS
1	Thru 0.1 mf cond. to antenna receptacle.	262.5 KC	HI-END STOP	T9-S, T9-P, T8-S, T8-P	Adjust for maximum meter indication.
2	Thru DUMMY ANT. to ANT. RECEPT.	1605 KC	HI-END STOP	AM-OSC (C21B) AM-RF (C21A) AM-ANT (C17)	Adjust in order for maximum meter indication.
3	With radio installed in car and antenna properly adjusted to 38 inches from tip to base, tune in a weak station near 1400 kc. Readjust ANT. (C17) for maximum volume.				
	IF A TUNING COIL OR CORE HAS BEEN REPLACED, PROCEED AS FOLLOWS:				
4			HI-END STOP	L4, L6, L7	Back cores out of coils to where they just remain in coil form.
5	Thru DUMMY ANT. to ANT. RECEPT.	1605 KC	HI-END STOP	AM-OSC (C21B) AM-RF (C21A) AM-ANT (C17)	Adjust in order for maximum meter indication.
6	Thru DUMMY ANT. to ANT. RECEPT.	1000 KC	0.400 inch carriage movement from hi-end stop	L7, L6, L4	Adjust cores in order for maximum meter indication.
7	REPEAT STEPS 5 & 6 UNTIL NO FURTHER GAIN CAN BE OBTAINED.				