

MOTOROLA MODEL 12VF4R

TRADE NAME	Motorola, Models 10T2, 10VK12, 10VK22, 10VT10, 10VT24 (Ch. TS14, A, B), 12K1, 12K2, 12T1, 12VF4, 12VF26, 12VK11, 12VT23 (Ch. TS23, A, B)	
MANUFACTURER	Motorola Inc., 4545 Augusta Blvd., Chicago 51, Illinois	
TYPE SET	Television Receiver (Model 12VF4R Also Has AM-FM Radio Chassis HS-178)	
TUBES	Nineteen ("TV Only" Models) Twenty Five (Model 12VF4R)	
POWER SUPPLY	110-120 Volts AC-60 Cycle	
TUNING RANGE	Channels 2 thru 13	RATING 1.35 Amp. at 117 Volts AC (TV Only).

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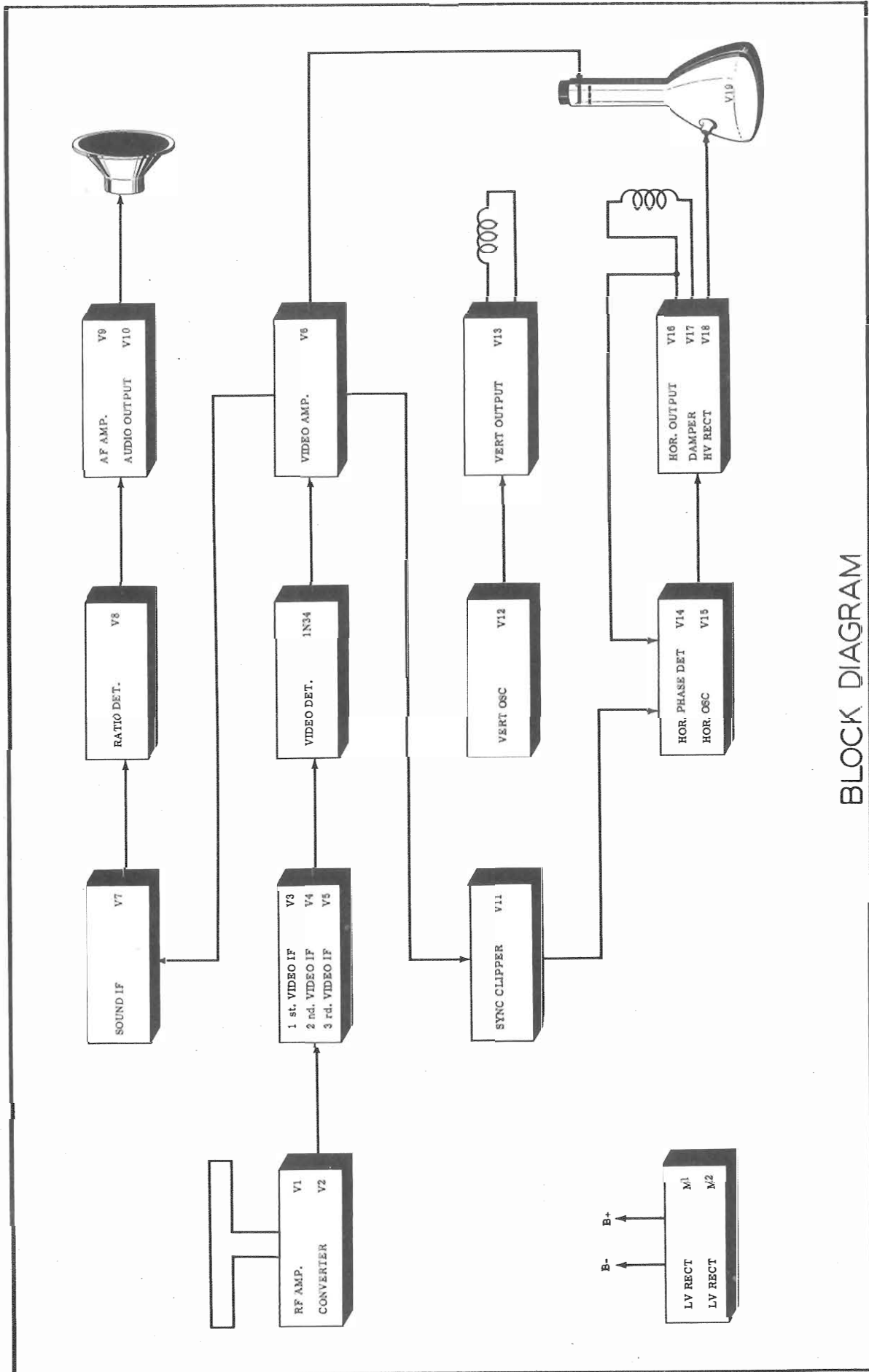
FOR SERVICE INFORMATION ON RADIO CHASSIS HS-190, A SEE CHASSIS HS-178 PHOTOFACT SET #88 - FOLDER #7

HOWARD W. SAMS & CO., INC. • Indianapolis 1, Indiana

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MOTOROLA MODELS 10T2, 10VK12, 10VK22, 10VT10, 10VT24, 12VF4, 12VK11, 12VT13



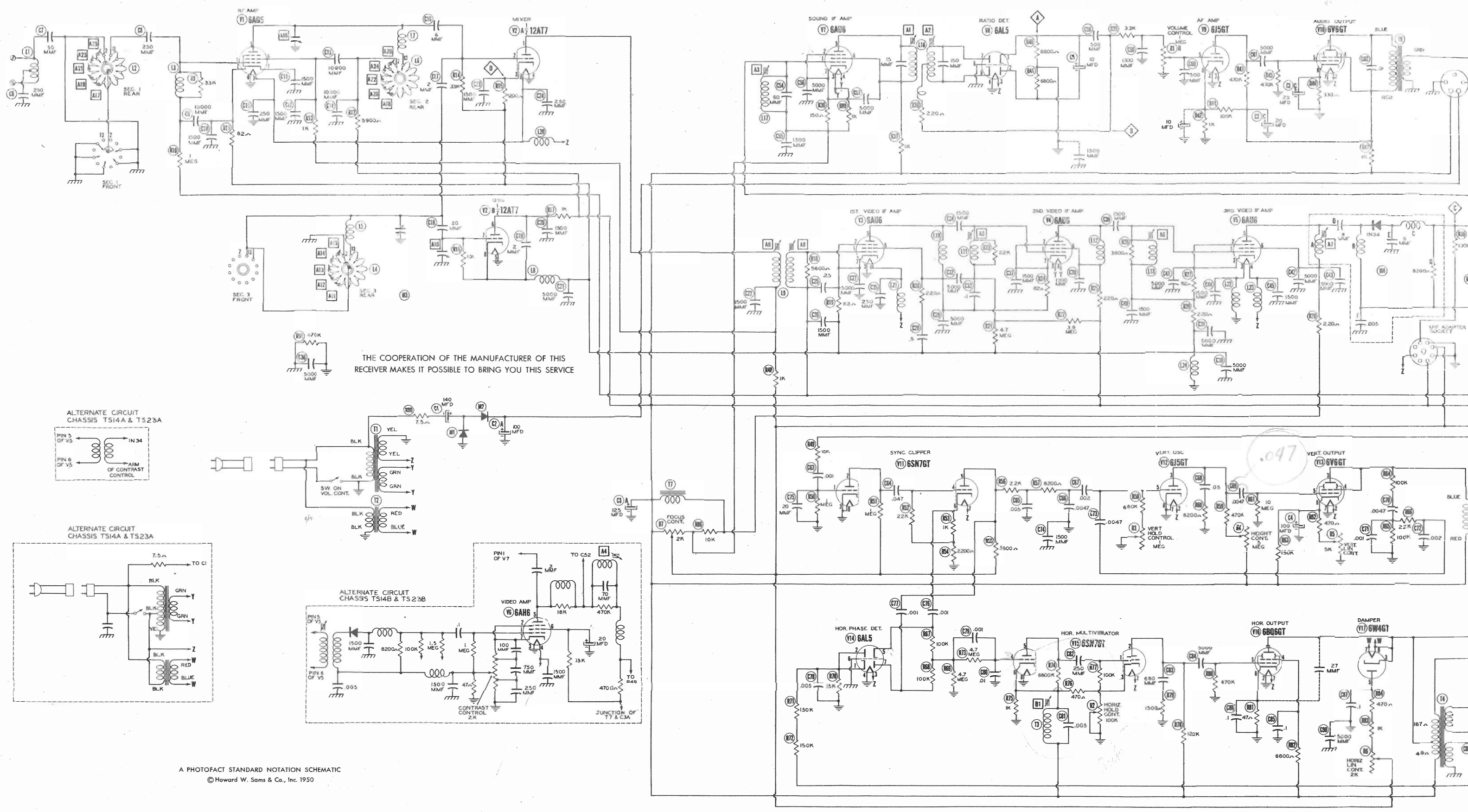
BLOCK DIAGRAM

VOLUME ON-OFF

TONE C PHONO SW

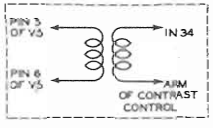
TRADE NAME
MANUFACTURER
TYPE SET
TUBES
POWER SUPPLY
TUNING RANGE
Alignment Instructions
Block Diagram
Disassembly Instructions
Horiz. Frequency
Parts List and Photographs
Cabinet-Ready
Capacitor Identification
FOR SERVICE

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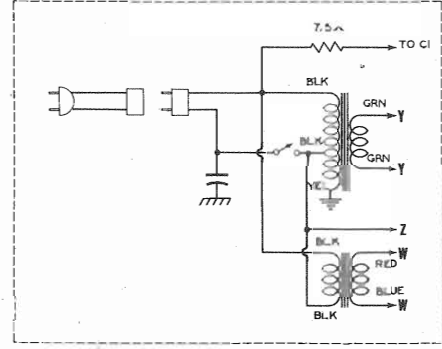


THE COOPERATION OF THE MANUFACTURER OF THIS RECEIVER MAKES IT POSSIBLE TO BRING YOU THIS SERVICE

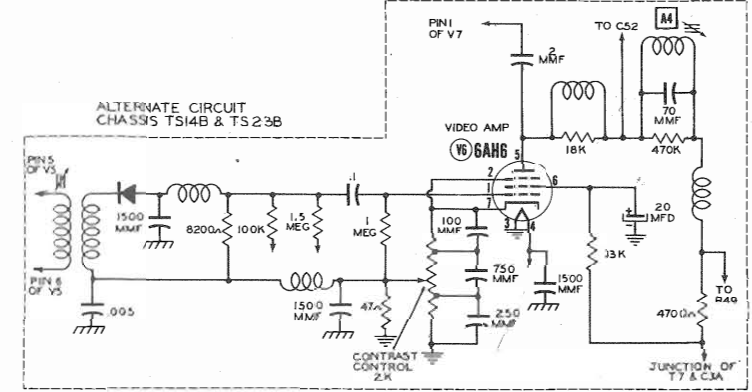
ALTERNATE CIRCUIT CHASSIS TS14A & TS23A



ALTERNATE CIRCUIT CHASSIS TS14A & TS23A

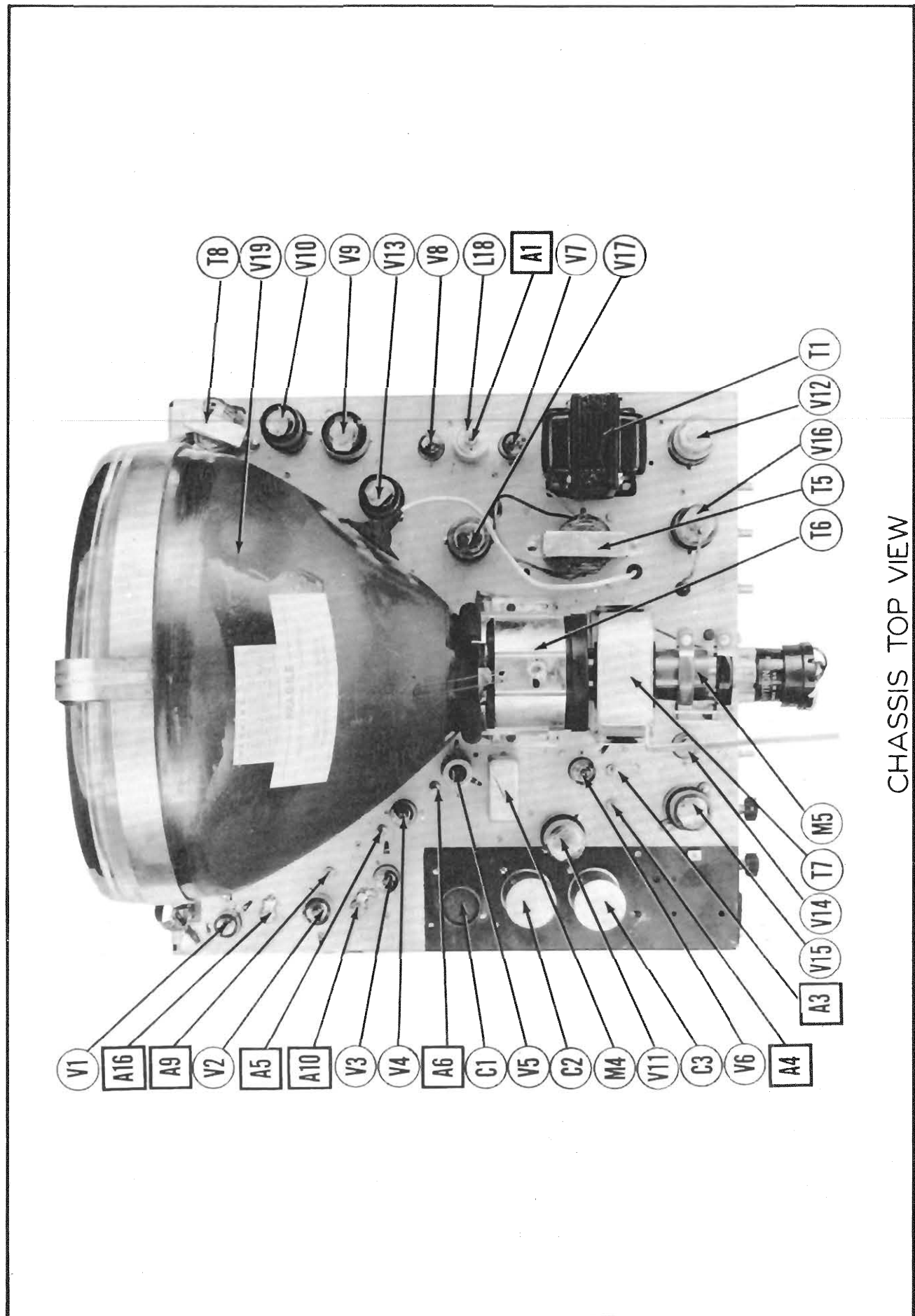
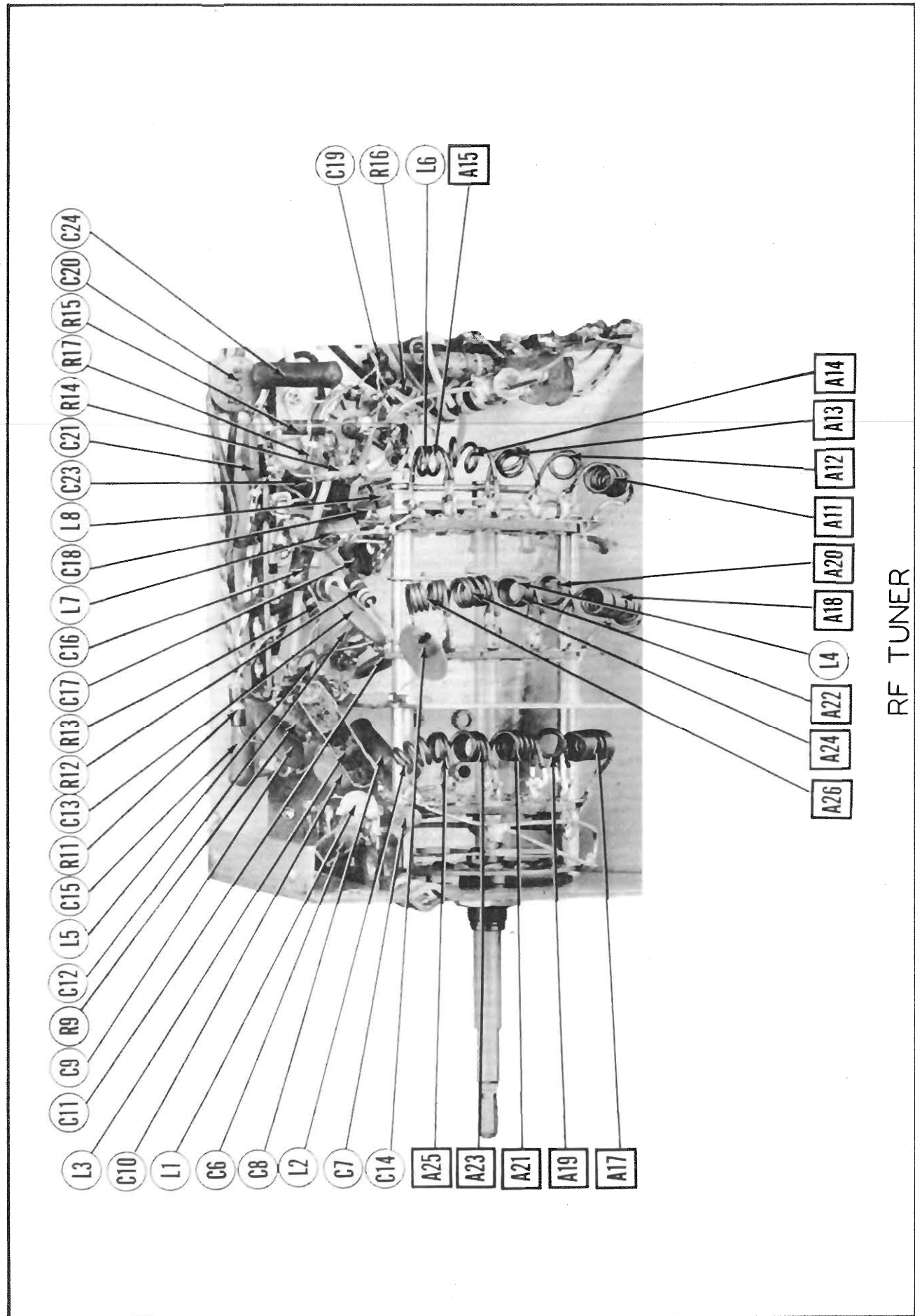


ALTERNATE CIRCUIT CHASSIS TS14B & TS23B



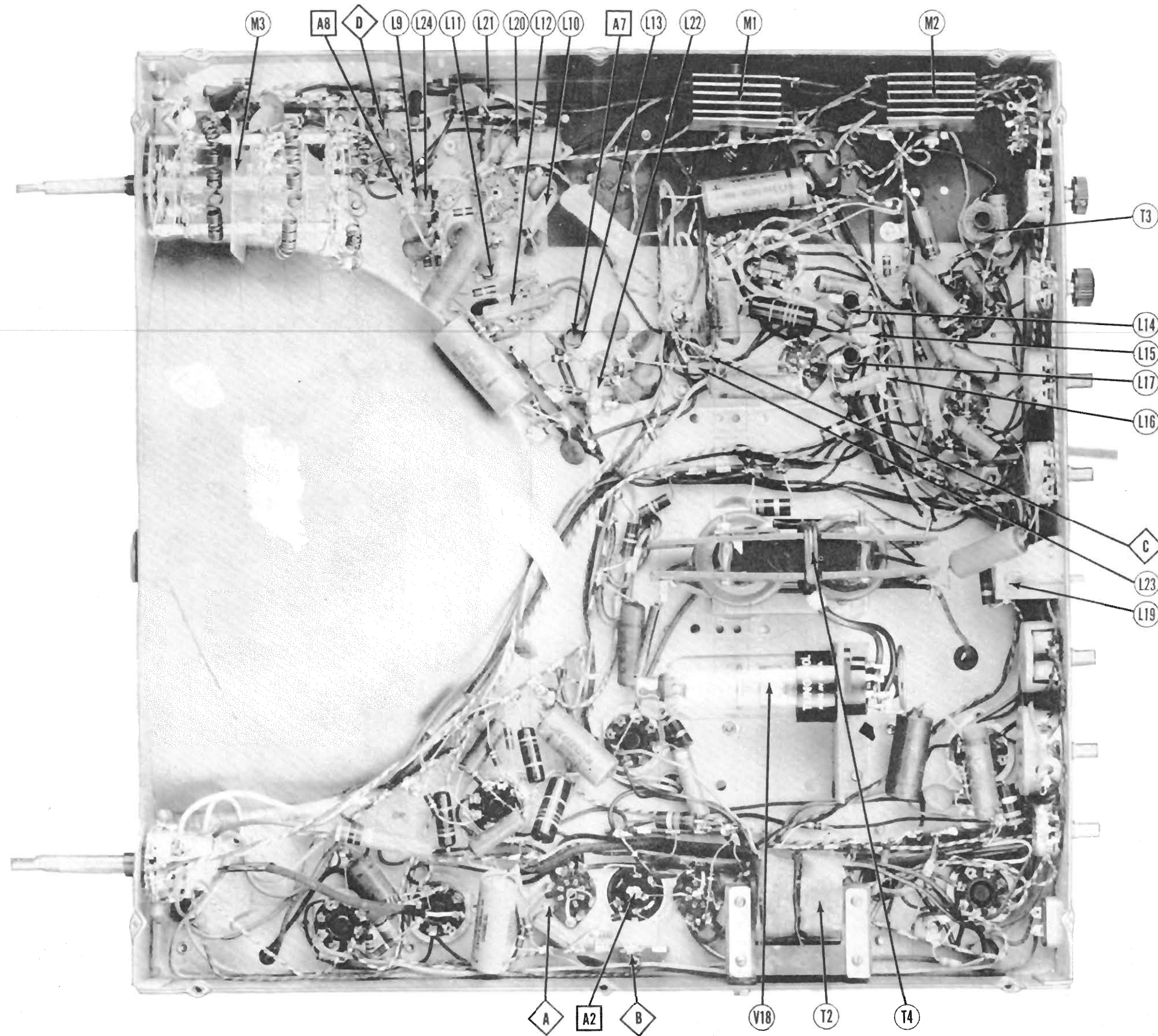
A PHOTOFAC STANDARD NOTATION SCHEMATIC  
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MOTOROLA MODELS 10T2, 10VK12, 10VK22,  
10VT10, 10VT24, 12VF4, 12VK11, 12VT13  
VIEW TOP SISSACHC





MOTOROLA MODELS 10T2, 10VK12, 10VK22,  
 10VT10, 10VT24, 12VF4, 12VK11, 12VT13

CHASSIS BOTTOM VIEW-TRANS., INDUCTOR AND ALIGNMENT IDENTIFICATION

VOLTAGE AND RESISTANCE MEASUREMENTS

VOLTAGE READINGS

Item	Tube	Pin 1	Pin 2	Pin 3	Pin 4	Pin 5	Pin 6	Pin 7	Pin 8	Pin 9
V 1	6AG5	-2VDC	1.1VDC	6.3VAC	0V.	183VDC	180VDC	1.1VDC		
V 2	12AT7	183VDC	-6VDC	5.6VDC	0V.	230VDC	230VDC	1-7.3VDC	1VDC	6.3VAC
V 3	6AU6	-2VDC	6.3VDC	0V.	6.3VAC	135VDC	135VDC	8VDC		
V 4	6AU6	-2.2VDC	6.3VDC	4.2VDC	210VDC	100VDC	100VDC	6VDC		
V 5	6AU6	3.2VDC	4.5VDC	0V.	6.3VAC	187VDC	187VDC	4.5VDC		
V 6	6AU6	0V.	5.4VDC	6.3VAC	0V.	205VDC	220VDC	5.4VDC		
V 7	6AL5	4.0	4.4	4.2VDC	210VDC	43VDC	43VDC	4.4VDC		
V 8	6AL5	3VDC	1VDC	6.3VAC	0V.	0V.	0V.	0V.		
V 9	6J5GT	0V.	0V.	42VDC	0V.	0V.	0V.	6.3VAC	2.4VDC	
V 10	6V6GT	0V.	0V.	195VDC	200VDC	0V.	0V.	0V.	10VDC	
V 11	6SN7GT	-2.4VDC	11VDC	0V.	10VDC	165VDC	16VDC	6.3VAC	0V.	
V 12	6J5GT	1VDC	6.3VAC	140VDC	0V.	-17VDC	-24VDC	0V.	0V.	
V 13	6V6GT	0V.	6.3VAC	235VDC	285VDC	0V.	162VDC	0V.	5VDC	
V 14	6AL5	0V.	0V.	6.3VAC	0V.	8VDC	0V.	-4VDC		
V 15	6SN7GT	-1.2VDC	13VDC	8VDC	0V.	215VDC	7.6VDC	6.3VAC	0V.	
V 16	6BQ6GT	0V.	0V.	140VDC	-13VDC	130VDC	6.3VAC	5.1VDC		TOP CAP
V 17	6W4GT	0V.	0V.	270VDC	60VDC	45VDC	0V.	270VDC		
V 18	1B3GT									
V 19	12LP4	6.3VAC	0V.	270VDC	160VDC	0V.				

\* DO NOT MEASURE.

5 TAKEN WITH VACUUM TUBE VOLTMETER.

6 6.3VAC MEASURED ACROSS FILAMENTS.

7 MEASURED FROM PIN 4 OF V1.

8 MEASURED FROM PIN 6 OF V1.

RESISTANCE READINGS

Item	Tube	Pin 1	Pin 2	Pin 3	Pin 4	Pin 5	Pin 6	Pin 7	Pin 8	Pin 9
V 1	6AG5	2.5 Meg.	82Ω	.1Ω	0Ω	14.5KΩ	14KΩ	82Ω		
V 2	12AT7	13KΩ	33KΩ	1.2KΩ	0Ω	11000Ω	10KΩ	3.5Ω		.1Ω
V 3	6AU6	2.5 Meg.	82Ω	0Ω	.1Ω	.2Ω	.01	82Ω		
V 4	6AU6	2 Meg.	.82Ω	.1Ω	.0Ω	1280Ω	1280Ω	.82Ω		
V 5	6AU6	220Ω	300Ω	0Ω	.1Ω	12KΩ	12KΩ	300Ω		
V 6	6AU6	1 Meg.	1000Ω	.1Ω	0Ω	12KΩ	15KΩ	1000Ω		
V 7	6AU6	1000Ω	1.2KΩ	.0Ω	.1Ω	1.1KΩ	1.1KΩ	41.2KΩ		
V 8	6AL5	6.8KΩ	6.8KΩ	.1Ω	0Ω	1 Meg.	0Ω	1 Meg.		
V 9	6J5GT	470KΩ	0Ω	1470KΩ	Inf.	13Ω	Inf.	.1Ω	1000Ω	
V 10	6V6GT	Inf.	.1Ω	11.5KΩ	1.1KΩ	470KΩ	0Ω	0Ω	330Ω	
V 11	6SN7GT	1 Meg.	11 Meg.	0Ω	24KΩ	17.8KΩ	3.2KΩ	.1Ω	0Ω	
V 12	6J5GT	470KΩ	.1Ω	1500KΩ	Inf.	1.6Meg.	Inf.	0Ω	0Ω	
V 13	6V6GT	130KΩ	.1Ω	1800Ω	1800Ω	10 Meg.	136KΩ	0Ω	5.5KΩ	
V 14	6AL5	15KΩ	15KΩ	.1Ω	0Ω	4.8 Meg.	0Ω	4.8 Meg.		
V 15	6SN7GT	109KΩ	1150KΩ	1.5KΩ	9.5 Meg.	17KΩ	1000Ω	.1Ω	47Ω	
V 16	6BQ6GT	Inf.	0Ω	Inf.	16.8KΩ	470KΩ	1.2 Meg.	.1Ω	130Ω	TOP CAP 150Ω
V 17	6W4GT	Inf.	Inf.	1130Ω	15KΩ	15.5KΩ	Inf.	130Ω	Inf.	
V 18	1B3GT	Inf.	Inf.	Inf.	Inf.	Inf.	Inf.	Inf.	Inf.	TOP CAP 1300Ω
V 19	12LP4	.1Ω	0Ω	100Ω	50KΩ	0Ω				

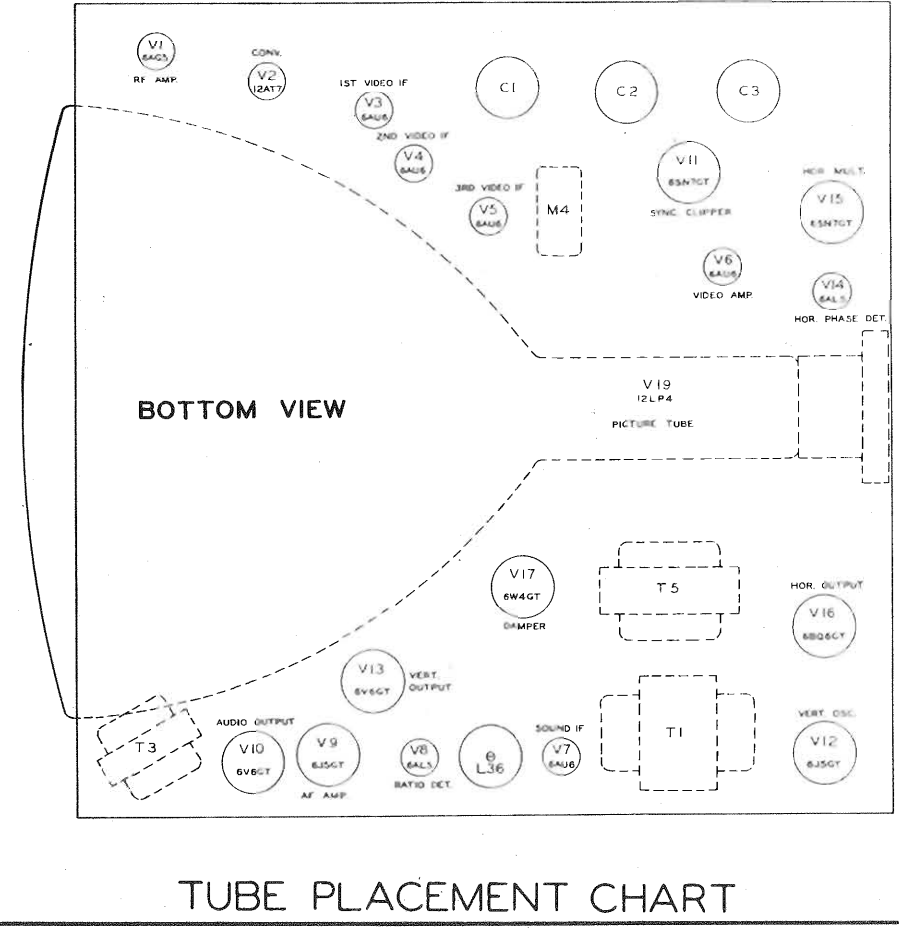
† MEASURED FROM OUTPUT OF M1.

• MEASURED FROM PIN 6 OF V3.

▲ MEASURED FROM PIN #4 OF V4.

- DC Voltage measurements are at 20,000 ohms per volt, AC Voltage measured at 1,000 ohms.
- Pin numbers are counted in a clockwise direction on bottom of socket.
- Measured values are from socket pin to common negative unless otherwise stated.

- Line voltage maintained at 117 volts for voltage readings.
- Front panels controls set at minimum.
- Where readings may vary according to the setting of the service controls, both minimum and maximum readings are given.



MOTOROLA MODELS 10T2, 10VK12, 10VK22, 10VT10, 10VT24, 12VF4, 12VK11, 12VT13

# ALIGNMENT INSTRUCTIONS

# ALIGNMENT INSTRUCTIONS (CONT.)

**ALIGNMENT INSTRUCTIONS—READ CAREFULLY BEFORE ATTEMPTING ALIGNMENT**  
 Use an isolation transformer to protect the test equipment.  
 The high voltage shock hazard may be eliminated by removing the horizontal oscillator tube (V15) from its socket.

**SOUND IF ALIGNMENT USING AM SIGNAL GENERATOR AND VTVM**

DUMMY ANTENNA	SIGNAL GENERATOR COUPLING	SIGNAL GENERATOR FREQUENCY	CHANNEL	CONNECT VTVM	ADJUST	REMARKS
1. 1000MMF	High side to pin 1 (Grid) of 6AU6 (V7). Low side to B-.	4.5MC (Unmod.)	Any channel not used locally	DC Probe thru 10KΩ to Point Ⓢ. Common to B-.	A1	Adjust for maximum deflection.
2. 1000MMF	"	"	"	DC Probe thru 10KΩ to Point Ⓢ. Common to B-.	A2	Adjust for zero reading. A positive and negative reading will be obtained on either side of the correct setting.
3. 1000MMF	High side to pin 1 (Grid) of 6AU6 (V6). Low side to B-.	"	"	DC Probe thru 10KΩ to Point Ⓢ. Common to B-.	A3	Adjust for maximum deflection.

**SOUND IF ALIGNMENT USING FM SIGNAL GENERATOR AND OSCILLOSCOPE**  
 Use frequency modulated signal with 60% modulation and 450KC sweep. Use 120% sawtooth voltage in scope for horizontal deflection.

DUMMY ANTENNA	SIGNAL GENERATOR COUPLING	SIGNAL GENERATOR FREQUENCY	MARKER GENERATOR FREQUENCY	CHANNEL	CONNECT SCOPE	ADJUST	REMARKS
1. 1000MMF	High side to pin 1 (Grid) of 6AU6 (V6) Low side to B-.	4.5MC (450KC SWP)	4.5MC	Any channel not used locally	Vert. Amp. thru 10KΩ to Point Ⓢ. Low side to chassis.	A1, A3	Disconnect stabilizer capacitor C5. Adjust for maximum amplitude and symmetry as per Fig 1.
2. 1000MMF	"	"	"	"	Vert. Amp. thru 10KΩ to Point Ⓢ. Low side to B-.	A2, A1	Reconnect capacitor C5. Adjust A2 so 4.5MC occurs at center of crossover lines as per Fig 2. SLIGHTLY retouch A1 for maximum amplitude and straightness of crossover lines. Continue with step 4.

**4.5MC TRAP ADJUSTMENT**

Construct a detector probe as shown in figure 3.

DUMMY ANTENNA	SIGNAL GENERATOR COUPLING	SIGNAL GENERATOR FREQUENCY	CHANNEL	CONNECT VTVM	ADJUST	REMARKS
4. 1000MMF	High side to pin 1 (Grid) of 6AU6 (V6). Low side to B-.	4.5MC (400% Mod.)	Any channel not used locally	DC Probe thru crystal detector (Fig 3) to pin 11 (cathode) of picture tube (V19). Common to B-.	A4	Adjust for MINIMUM deflection.

**VIDEO IF ALIGNMENT**

Connect the negative lead of a 3 volt battery through 4700Ω to the junction of C25 and C26, connect the positive lead to B-.  
 Unsolder one end of the oscillator cathode choke (L8) to disable the local oscillator.  
 Set the contrast control to slightly less than maximum clockwise.

DUMMY ANTENNA	SIGNAL GENERATOR COUPLING	SIGNAL GENERATOR FREQUENCY	MARKER GENERATOR FREQUENCY	CHANNEL	CONNECT SCOPE	ADJUST	REMARKS
5. .01MFD	High side to pin 1 (Grid) of 6AU6 (V3). Low side to AGC line (opposite end of R18).	24.6MC (10MC SWP)	22.9MC 26.3MC	Any	Vert. Amp. to Point Ⓢ. Low side to B-.	A5	Adjust for maximum amplitude near 26MC
6. .01MFD	"	"	"	"	"	A6	Adjust for maximum amplitude near 24.6MC
7. .01MFD	"	"	"	"	"	A7	Adjust to place 22.9MC marker at 50% on the low frequency side of response curve as shown in Fig 4.
8. .01MFD	"	"	"	"	"	A5	Adjust to place in Fig 4 marker at 50% on high side of response curve.
9. .01MFD	High side to pin 2 (Grid) of 12AT7 (V2). Low side to B-.	"	23.1MC 26.1MC	"	"	A8, A9	Turn both cores fully out (counter-clockwise) then turn both in simultaneously until 23.1 MC marker and 26.1MC marker appear at 50% response as shown in Fig 5. If a dip occurs in the response curve, it should not exceed 10%.

**OSCILLATOR ALIGNMENT**

Set the fine tuning control to the mid-position of its range.  
 Reconnect the oscillator cathode choke (L8).  
 The signal generator output lead should be terminated with its characteristic impedance, usually 50 ohms.

DUMMY ANTENNA	SIGNAL GENERATOR COUPLING	SIGNAL GENERATOR FREQUENCY	CHANNEL	CONNECT VTVM	ADJUST	REMARKS
10. Two 120Ω carbon res.	Across antenna terminals with 120Ω in each lead.	170.5MC (Unmod.)	10	Vert. Amp. thru 10KΩ to Point Ⓢ. Low side to B-.	A10	Adjust for zero beat on scope face as indicated by a narrow trace between two wide traces as the circuit is tuned thru resonance.
11. "	"	188.15MC 182.15MC 176.15MC 164.15MC 158.15MC 152.15MC	13 12 11 9 8 7	"	L7	Check all high band channels to see if zero beat occurs within 45% of the mid position of the fine tuning control range. If necessary expand or compress the coil turns of L7 to obtain optimum results. If L7 is changed repeat steps 10 and 11
12. "	"	109.35MC	6	"	A11	Expand or compress coil turns as explained in step 10.
13. "	"	103.35MC	5	"	A12	"
14. "	"	93.35MC	4	"	A13	"
15. "	"	87.35MC	3	"	A14	"
16. "	"	81.35MC	2	"	A15	"

**ANTENNA AND RF ALIGNMENT**

The sweep generator output lead should be terminated with its characteristic impedance usually 50 ohms.  
 Unsolder one end of the oscillator cathode choke (L8).

DUMMY ANTENNA	SIGNAL GENERATOR COUPLING	SIGNAL GENERATOR FREQUENCY	MARKER GENERATOR FREQUENCY	CHANNEL	CONNECT SCOPE	ADJUST	REMARKS
17. Two 120Ω carbon res.	Across antenna terminals with 120Ω in each lead.	195MC (10MC SWP)	193.25MC 197.75MC	10	Vert. Amp. thru 10KΩ to Point Ⓢ. Low side to B-.	A16	Expand or compress coil turns for response curve similar to Fig 6.
18. "	"	213MC (10MC SWP) 207MC (10MC SWP) 201MC (10MC SWP) 189MC (10MC SWP) 183MC (10MC SWP) 177MC (10MC SWP)	211.25MC 215.75MC 205.25MC 209.75MC 199.25MC 203.75MC 187.25MC 191.75MC 181.25MC 185.75MC 175.25MC 179.75MC	13 12 11 9 8 7	"	L5	Check all high band channels for response similar to Fig 6. If necessary expand or compress turns of coil L5 for proper response on channels 11, 12 and 13. If L5 is altered repeat steps 10 and 11.
19. "	"	85MC (10MC SWP) 79MC (10MC SWP) 69MC (10MC SWP) 63MC (10MC SWP) 57MC (10MC SWP)	83.25MC 87.75MC 77.25MC 81.75MC 71.75MC 61.25MC 55.75MC 49.75MC	6 5 4 3 2	"	A17 A18 A19 A20 A21 A22 A23 A24 A25 A26	Expand or compress coil turns for response curve similar to Fig. 7.  Note that the antenna coil affects the position of the video marker and the RF coil affects the position of the sound marker.

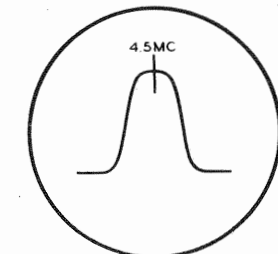


FIG. 1

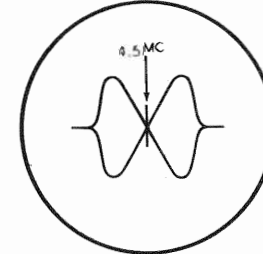


FIG. 2

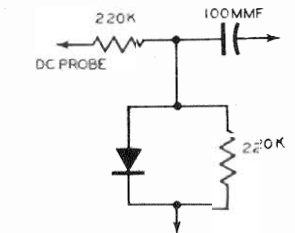


FIG. 3

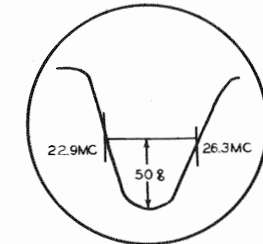


FIG. 4

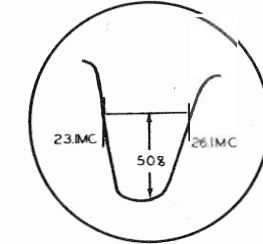


FIG. 5

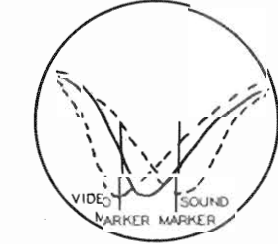


FIG. 6

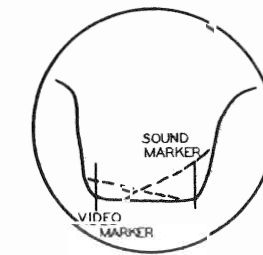
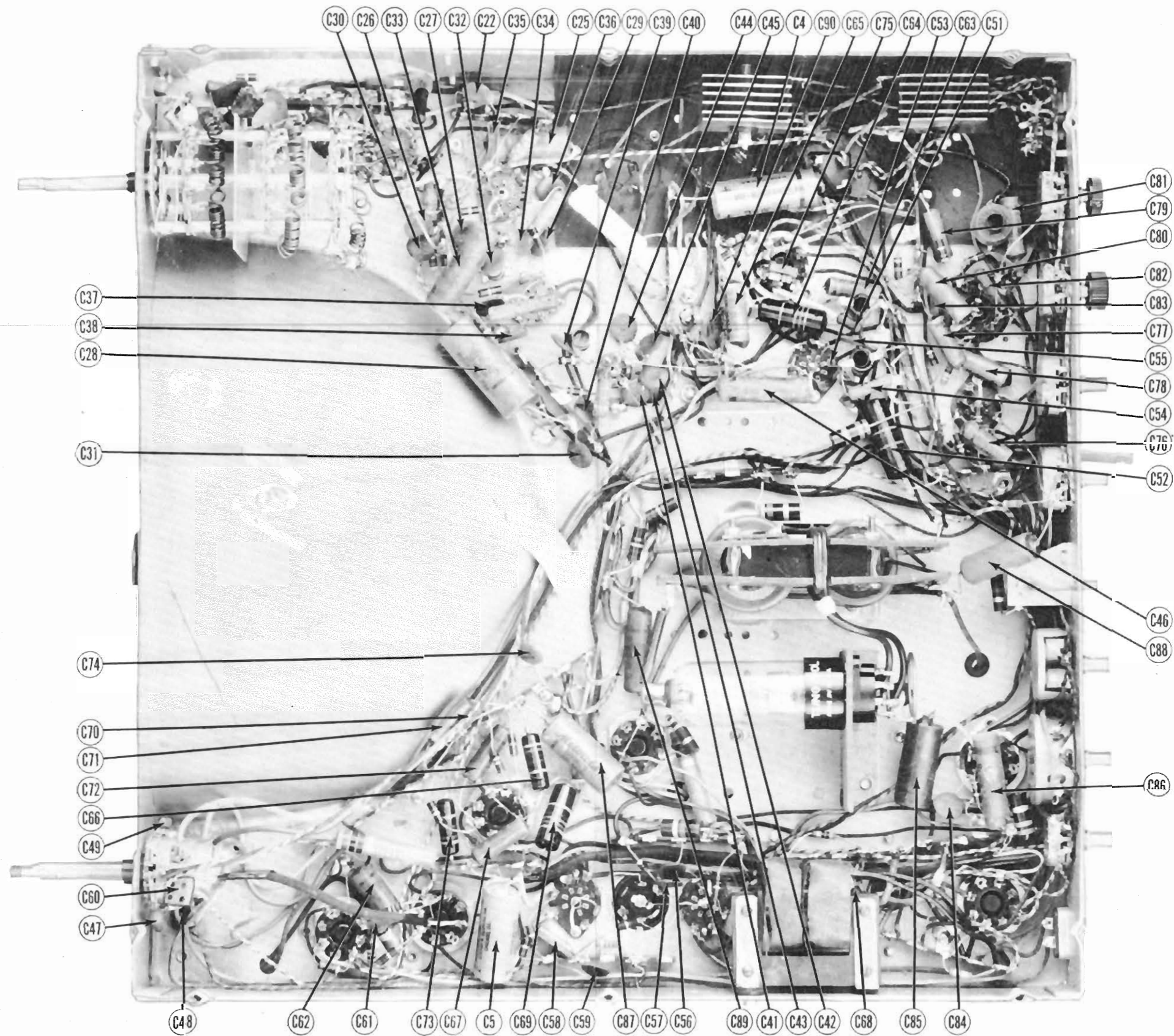


FIG. 7

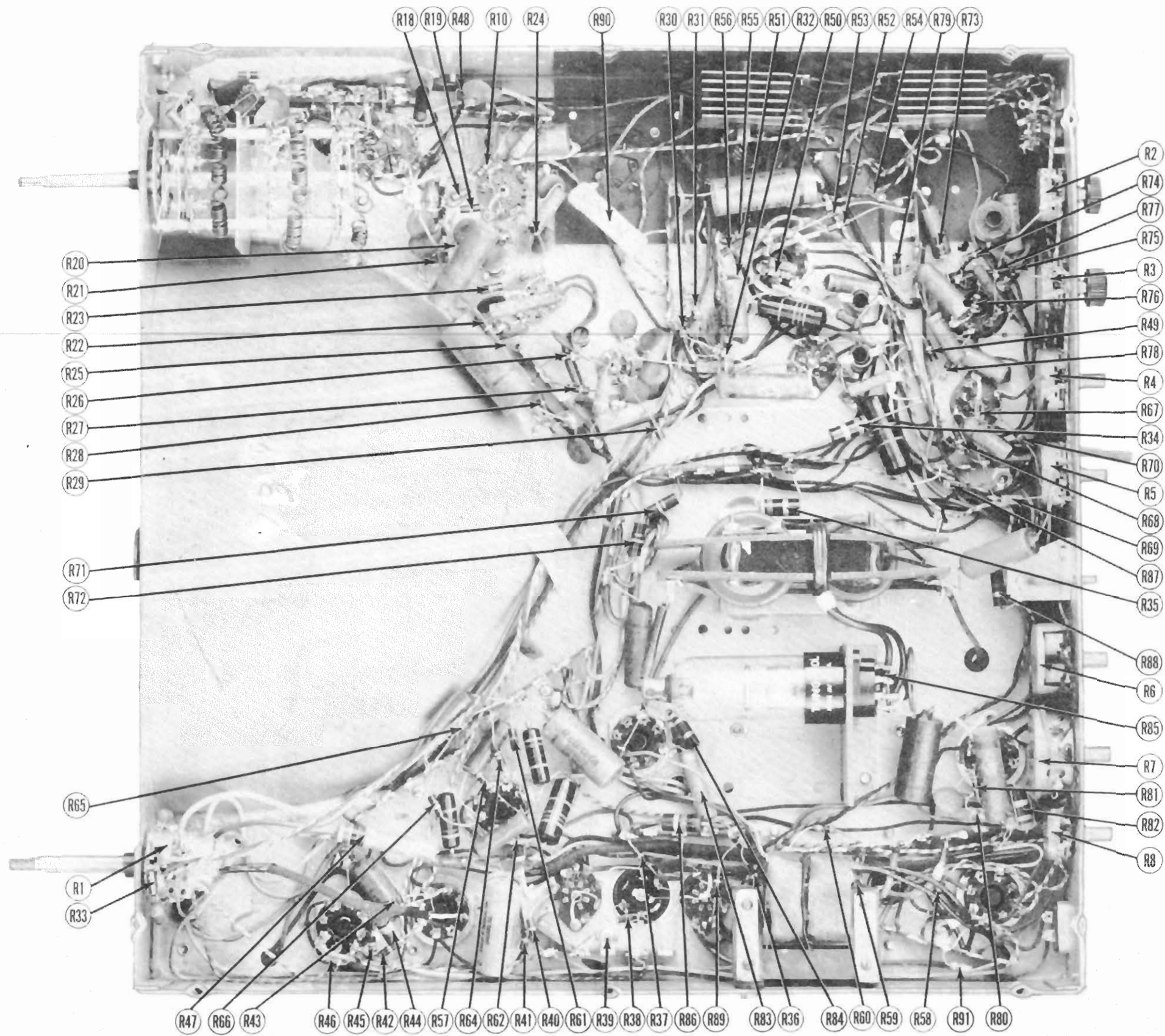
MOTOROLA MODELS 10T2, 10VK12, 10VK22, 10VT10, 10VT24, 12VF4, 12VK11, 12VT13





CHASSIS BOTTOM VIEW-CAPACITOR IDENTIFICATION

MOTOROLA MODELS 10T2, 10VK12, 10VK22,  
 10VT10, 10VT24, 12VF4, 12VK11, 12VT13



CHASSIS BOTTOM VIEW-RESISTOR IDENTIFICATION

MOTOROLA MODELS 10T2, 10VK12, 10VK22,  
 10VT10, 10VT24, 12VF4, 12VK11, 12VT13

## PARTS LIST AND DESCRIPTIONS (Continued)

### COILS (RF-IF)

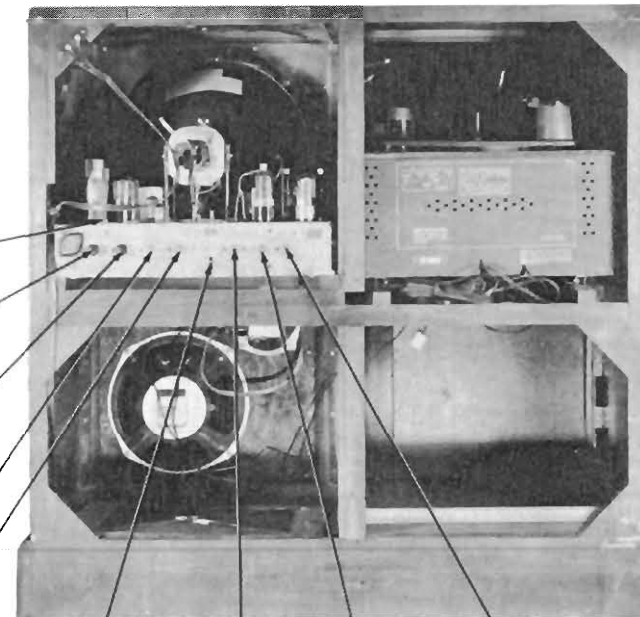
ITEM No.	USE	DC RES.		REPLACEMENT DATA		NOTES
		PRI.	SEC.	MOTOROLA PART No.	MEISSNER PART No.	
L1	Ant. Input Trans.	0Ω		24A790033		
L2	Ant. Coils	0Ω		24C790535		Part of tuner.
L3	RF Choke	8Ω		24K791446		10 microhenries
L4	RF Coils	0Ω		24K790536		Part of tuner.
L5	RF Coil	0Ω		24K790607		Channel #13
L6	Osc. Coils	0Ω		24K790537		Part of tuner.
L7	Osc. Coil	0Ω		24K790606		Channel #13
L8	RF Choke	2.5Ω		24K780128		2 microhenries
L9	1st Video IF	.3Ω	.2Ω	24K791134		Less tuning cores.
L10	RF Choke	4.5Ω		24K790035		5.6 microhenries
L11	2nd Video IF	.2Ω		24K791433		Less tuning core and clip.
L12	RF Choke	4.5Ω		24K790035		5.6 microhenries
L13	3rd Video IF	.2Ω		24K791433		Less tuning core and clip.
L14	4.5MC Trap	1Ω		24A470159		Less tuning core and clip.
L15	Peaking	9Ω		24A790579		Wound on 10KΩ resistor, green dot.
L16	Peaking	10Ω		24A790594		Yellow dot.
L17	Sound IF	1Ω		24A470159		Less core and clip.
L18	Ratio Det. Trans.	3Ω	.5Ω	24B790125		Includes cores and clips but less shield.
L19	Width. Cont.	24Ω		24B791170		Complete with core and clip.
L20	Fil. Choke	2Ω		24K790145		.47 microhenries
L21	Fil. Choke	2Ω		24K790145		.47 microhenries
L22	Fil. Choke	2Ω		24K790145		.47 microhenries
L23	Fil. Choke	2Ω		24K790145		.47 microhenries
L24	RF Choke	2Ω		24K790145		.47 microhenries

### SELENIUM RECTIFIER

ITEM No.	RATING CURRENT	REPLACEMENT DATA		NOTES
		MOTOROLA PART No.	SYLVANIA PART No.	
M1	.225A	46B780584	NF-5	
M2	.225A	46B780584	NF-5	

### MISCELLANEOUS

ITEM No.	PART NAME	MOTOROLA PART No.	NOTES
M3	RF Tuner	1X780177	Channel selector switch, fine tuning, trimmer and coils assy.
M4A	4th Video IF	24A790175	Less core and clip.
B	RF Choke	24K791446	10 microhenries
C	RF Choke	24B790129	
D	Video Coupling	21K478234	
E	Video Det. Filter		Video Detector Panel Assembly
F	RF Bypass	21A470790	
G	Video Det. Load	6R2004	
H	Video Detector	48A90173	
M5	Ion Trap	24B484822	
	Core	46K480256	Permanent magnet type
	Core	46A470310	Iron and screw (L9 secondary)
	Core	46A70023	Iron and screw (L9 primary and L17)
	Core	46A470302	Iron and screw (L18 primary)
	Core	46K471143	Iron and screw (L18 secondary)
	Core	46A791119	Iron and screw (T3)
	Core	1X780382	With slide adjustment (L19)
	Corona Shield	9A790685	V18
	Socket	16F790486	Picture tube (octal)
	Cabinet	16K790487	Model 10VT10, Brown mahogany table model
	Cabinet	16F790601	Model 10VT10R, red mahogany table model.
	Cabinet	16K790595	Model 10VK12, brown mahogany console
	Cabinet	16E791045	Model 10VK12R, red mahogany console
	Cabinet	16K791047	Model 12VT13, brown mahogany table models.
	Cabinet	16K791046	Model 12VT13B limed oak table model.
	Cabinet	16F790664	Model 12VT13R, red mahogany table model.
	Cabinet	16K790666	Model 12VK11 Brown mahogany console
	Cabinet	16K790665	Model 12VK11B, limed oak console
	Safety Glass	16K790665	Model 12VK11R, red mahogany console
	Safety Glass	61K790408	Models 10VT10, 10VT10R, 10VK12, 10VK12R
	Safety Glass	61K790653	Models 12VT13, 12VT13B, 12VT13R, 12VK11, 12VK11B, 12VK11R
	Knob	13D790718	Models 12VT13, 12VT13B, 12VT13R
	Knob	36B790506	Channel selector, all models.
	Knob	36B790505	Contrast all models
	Knob	36K790621	Off-volume, fine tuning, models 10VT10, 10CK12, 12VT13, 12VK11
	Knob	36A790507	Off-volume, fine tuning, models 10VT10R, 10VK12R, 12VT13R, 12VK11R



CABINET-REAR VIEW

### HORIZONTAL FREQUENCY AND LINEARITY ADJUSTMENTS

Turn the set on and tune in a TV station. Turn the horizontal hold control to the mid-position of its range. Adjust the horizontal frequency slug (B1) to the center of the range over which the picture synchronizes horizontally.

Adjust the horizontal size lever (B2) until the picture fills the mask horizontally. Adjust the horizontal linearity control until picture is symmetrical from left to right.

### DISASSEMBLY INSTRUCTIONS (MODEL 12VF4R)

1. Remove six push-on type control knobs from TV and radio.
2. Remove twelve screws holding rear cover of radio section. Remove cover.
3. Remove ten screws holding rear cover of TV section. Disconnect TV power plug and remove cover.
4. Loosen antenna terminal screws. Remove built-in antenna leads.
5. Remove two screws holding antenna terminal strip.
6. Remove speaker plug.
7. Remove six 1/4" hex head bolts holding TV chassis. Remove chassis.
8. Remove two screws holding AM loop antenna. (Receiver rear cover.) Pull out and remove antenna plugs. Remove cover.
9. Disconnect phono motor power plug and pick-up plug.
10. Remove speaker plugs.
11. Remove two screws holding power interlock plug.
12. Remove phillips head screw holding phono motor power plug clamp. Remove clamp.
13. Remove three 1/4" hex head bolts holding AM-FM chassis. Remove chassis. (It is necessary to turn chassis to various positions for removal.)

### DISASSEMBLY INSTRUCTIONS (MODEL 10VK22)

1. Remove two push-on type control knobs.
2. Remove eight screws holding rear cover. Remove cover.
3. Remove speaker plug.
4. Loosen two antenna terminal screws. Remove built-in antenna.
5. Remove two screws holding antenna terminal strip.
6. Remove five 1/4" hex head bolts holding chassis. Remove chassis.
7. Remove four 5/16" hex nuts holding speaker. Remove speaker.

MOTOROLA MODELS 10T2, 10VK12, 10VK22, 10VT10, 10VT24, 12VF4, 12VK11, 12VT13



# PARTS LIST AND DESCRIPTIONS

## TUBES (SYLVANIA or Equivalent)

ITEM No.	USE	REPLACEMENT DATA			RMA BASE TYPE	NOTES
		MOTOROLA PART No.	STANDARD REPLACEMENT			
V1	RF Amp.	6AG5	6AG5	7BD		
V2	Converter	12AT7	12AT7	9A		
V3	1st Video IF	6AU6	6AU6	7BK		
V4	2nd Video IF	6AU6	6AU6	7BK		
V5	3rd Video IF	6AU6	6AU6	7BK		
V6	Video Amp.	6AU6	6AU6	7BK		
V7	Sound IF Amp.	6AU6	6AU6	7BK		
V8	Ratio Det.	6AL5	6AL5	6BT		
V9	AF Amp.	6J5GT	6J5GT	6Q		
V10	Audio Output	6V6GT	6V6GT	7AC		
V11	Sync. Clipper	6SN7GT	6SN7GT	8BD		
V12	Vert. Osc.	6J5GT	6J5GT	6Q		
V13	Vert. Output	6V6GT	6V6GT	7AC		
V14	Hor. Phase Det.	6AL5	6AL5	6BT		
V15	Hor. Multivibrator	6SN7GT	6SN7GT	8BD		
V16	Hor. Output	6BQ6GT	6BQ6GT	6AM		
V17	Damper	6W4GT	6W4GT	4CG		
V18	HV Rectifier	1B3GT	1B3GT	3C		
V19A	Picture Tube	12LP4	12LP4	12D		
B	Picture Tube	10BP4	10BP4	12D		

## CAPACITORS (CONT.)

ITEM No.	RATING CAP. VOLT	REPLACEMENT DATA				IDENTIFICATION CODES AND INSTALLATION NOTES
		MOTOROLA PART No.	AEROVOX PART No.	ERIE PART No.	SPRAGUE PART No.	
C68	.05 600	8R9873	P688-05		TM-15	Vert. Discharge
C69	.047 400	8R9873	P488-047		TM-15	Vert. Sweep Coupling
C70	.0047 600	8R9869	P688-0047	GP2M-005	TM-25	Vert. Sweep Coupling
C71	.001 600	8R9866	P688-001	GP2L-001	TM-21	Voltage Divider
C72	.002 600	8R9867	P688-002	GP2M-002	TM-22	Integrator Net.
C73	.0047 600	8R9869	P688-0047	GP2M-005	TM-25	Vert. MV Feedback
C74	1500	21A470790	GP1500M	GP2L-0015	29C3	RF Bypass
C75	20	2K470522	GP20K	NPOK-20	MS-42	1st Sync. Clipper Grid Bypass #
C76	.051 600	2K470790	P688-001	GP2L-001	TM-21	Hor. Sync. Coupling †
C77	.001 600	2K470790	P688-001	GP2L-001	TM-21	Hor. Sync. Coupling †
C78	.005 600	8R9870	P688-005	GP2M-005	TM-25	AFC Filter
C79	.001 600	8R9866	P688-001	GP2L-001	TM-21	AFC Filter
C80	.01 600	8R9870	P688-01	GP2-335-01	TM-11	AFC Filter
C81	.005 600	8R9869	P688-005	GP2M-005	TM-25	Fixed Trimmer
C82	250	21K77375	GP250M	GP2K-250	1FM-325	Hor. MV Feedback
C83	680 500	21R2741	GP680K	GP2K-680	1FM-37	Hor. Discharge
C84	5000	21A470789	BPD-5	811-005	29C1	Hor. Sweep Coupling
C85	.1 600	8R9874	P688-1		TM-1	Hor. Output Cathode Bypass
C86	.1 100	8R9806	P288-1		TM-1	Hor. Output Cathode Bypass
C87	.1 600	8R9874	P688-1		TM-1	Damper Filter
C88	.05 600	8R9819	P688-05		TM-15	Linearity Cap.
C89	.02 600	8R9872	P688-02		TM-12	Hor. Sweep Coupling
C90	5000	21A470789	1467-005	811-005	29C1	RF Bypass #

\* Some models use 5000MMF in this application.  
† Some models use 1500MMF in this application.  
# Not used in all models.

## RESISTORS (CONT.)

ITEM No.	RATING RESISTANCE WATTS	REPLACEMENT DATA		IDENTIFICATION CODES
		MOTOROLA PART No.	IRC PART No.	
R60	8200Ω	6R2004	BTS-8200	Vert. Peaking
R61	10 Meg. 20%		BTS-10 Meg.	Vert. Output Grid-See Note 3
R62	470Ω	6R6090	BTS-470	Vert. Output Cathode
R63	150KΩ	6R6398	BTS-150K	Voltage Divider-See Note 4
R64	100KΩ	6R6031	BTS-100K	Voltage Divider
R65	100KΩ	6R6031	BTS-100K	Voltage Divider
R66	22KΩ	6R6397	BTS-22K	Integrator Network
R67	100KΩ	6R6031	BTS-100K	Horiz. Phase Det. Load
R68	100KΩ	6R6031	BTS-100K	Horiz. Phase Det. Load
R69	4.7 Meg.	6R6446	BTS-4.7 Meg.	Horiz. Phase Det. Load
R70	15KΩ	6R6477	BTS-15K	Feedback Network
R71	150KΩ 5%	6R5721	BTA-150K-5%	Feedback Network
R72	150KΩ 5%	6R5721	BTA-150K-5%	Feedback Network
R73	4.7 Meg.	6R6446	BTS-4.7 Meg.	Horiz. AFC Filter Network
R74	6800Ω	6R6428	BTS-6800	Horiz. MV Plate
R75	1000Ω	6R6229	BTS-1000	Horiz. MV Cathode
R76	470Ω	6R6090	BTS-470	Horiz. MV Cathode
R77	100KΩ	6R6031	BTS-100K	Horiz. MV Grid
R78	120KΩ		BTS-120K	Horiz. MV Plate-See Note 5
R79	1500Ω	6R6038	BTS-1500	Horiz. Peaking
R80	470KΩ	6R6377	BTS-470K	Horiz. Output Grid
R81	47Ω	6R5550	BW-J-47	Horiz. Output Cathode
R82	6800Ω	6R5690	BT-2-6800	Horiz. Output Screen
R83	1000Ω	6R3922	BT-2-1000	Damper Filter
R84	470Ω		BTA-470	Damper Filter-See Note 4
R85	3.3Ω	17K485412		HV Rect. Filament
R86	10KΩ	6R6299	BT-2-10K	Focus Coil Shunt
R87	47KΩ	6R6048	BTS-47K	Voltage Divider
R88	10KΩ	6R6320	BTA-10K	Horiz. Size Coil Shunt
R89	1000Ω	6R6229	BTS-1000	Voltage Equalizer
R90	7.5Ω	17A791166		Surge Limiter-Wire Wound
R91	470KΩ	6R6377	BTS-470K	Isolation

Note 2. Some models use 220Ω resistor in this application.  
Note 3. Some models use 2.2 Meg. resistor in this application.  
Note 4. Not used in all models.  
Note 5. Some models use 150KΩ resistor in this application.  
Note 6. Used in chassis TS-14 and TS-23 only.

## CAPACITORS

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

ITEM No.	RATING CAP. VOLT	REPLACEMENT DATA				IDENTIFICATION CODES AND INSTALLATION NOTES
		MOTOROLA PART No.	AEROVOX PART No.	ERIE PART No.	SPRAGUE PART No.	
C1	140	23B484097	AFH28D		D6282	Voltage Doubler Cap.
C2A	100	23B790147	AFH20G124F		D14966	Filter
B	60	250				Filter
C	20	250				Decoupling
C3A	125	23B790148	AFH24G4FA		D7205	Filter
R	20	250	20B			V. Amp. Decoupling
C	20	25				Output Cathode Bypass
D	100	15				Not used
C4	100	30	PRS50/100		TVA-17	Vert. Output Cathode Bypass
C5	10	50	PRS50/10		TVA-14	Stabilizing Cap.
C6	250		21K77375	GP2K-250		Ant. Isolation
C7	50		21K77373	GP50M		RF Coupling
C8	250		21K77375	GP250M		RF Coupling
C9	10000		21K482726	BPD-10	821-01	AVC Filter
C10	1500		21A470790	GP1500M	29C3	RF Cathode Bypass *
C11	1500		21A470790	GP1500M	29C3	RF Cathode Bypass *
C12	1500		21A470790	GP1500M	29C3	RF Screen Bypass *
C13	10000		21K482726	BPD-10	821-01	RF Plate Decoupling
C14	10000		21K482726	BPD-10	821-01	RF Plate Decoupling
C15	250		21K77375	GP250M	36C1	RF Filament Bypass
C16	6		21K470324	GP2K-250		RF Coupling
C17	2		21K478280			Osc. Coupling
C18	20		21K470322	GN20JNPO		Osc. Grid Cap.
C19	2		21K478280			Osc. Feedback
C20	1500		21A470790	GP1500M	29C3	Osc. Plate Bypass *
C21	5000		21A470789	BPD-5	29C1	RF Bypass
C22	1500		21A470790	GP1500M	29C3	Mixer Plate Decoupling
C23	1500		21A470790	GP1500M	29C3	Mixer Cathode Bypass
C24	250		21K77375	GP250M		Mixer Filament Bypass
C25	.25		8R9810	P288-25		AGC Filter
C26	1500		21A470790	GP1500M	29C3	AGC Filter
C27	5000		21A470789	BPD-5	29C1	1st V. IF Cathode Bypass
C28	5		8R9822	P288-5	7C-5	1st V. IF Decoupling
C29	5000		21A470789	BPD-5	29C1	1st V. IF Decoupling
C30	5000		21A470789	BPD-5	29C1	RF Bypass
C31	5000		21A470789	BPD-5	29C1	RF Bypass
C32	5000		21A470789	BPD-5	29C1	RF Bypass
C33	.1		8R9806	P288-1	7M-1	AGC Filter †
C34	1500		21A470790	GP1500M	29C3	AGC Filter
C35	250		21K77375	GP250M	1FM-325	IF Coupling
C36	5000		21A470789	BPD-5	29C1	1st V. IF Fil. Bypass
C37	1500		21A470790	GP1500M	29C3	RF Bypass
C38	1500		21A470790	GP1500M	29C3	2nd V. IF Cath. Bypass *
C39	1500		21A470790	GP1500M	29C3	2nd V. IF Decoupling *
C40	1500		21A470790	GP1500M	29C3	IF Coupling
C41	5000		21A470789	BPD-5	29C1	AGC Filter
C42	5000		21A470789	BPD-5	29C1	3rd V. IF Cath. Bypass
C43	5000		21A470789	BPD-5	29C1	3rd V. IF Decoupling
C44	1500		21A470790	GP1500M	29C3	3rd V. IF Fil. Bypass
C45	1500		21A470790	GP1500M	29C3	3rd V. IF Fil. Bypass
C46	.1		8R9806	P288-1	7M-1	Video Coupling
C47	1000		21K478410	GP1000M	29C3	V. Amp. Cathode Bypass
C48	750		21K780598	GP750M	1FM-375	V. Amp. Cathode Bypass
C49	250		21K77375	GP250M	1FM-325	V. Amp. Cathode Bypass
C50	5000		21A470789	BPD-5	29C1	V. Amp. Decoupling †
C61	70		21K470328		4M5-47	Fixed Trimmer
C52	.1		8R9874	P488-1	TM-1	Video Coupling
C53	2		21K478280		MS-46	Fixed Trimmer
C54	80		21K790693		MS-46	Fixed Trimmer
C55	1500		21A470790	GP1500M	29C3	Sound IF Decoupling *
C56	5000		21A470789	BPD-5	29C1	Sound IF Cathode Bypass
C57	5000		21A470789	BPD-5	29C1	Sound IF Decoupling
C58	500		21R6590	1468-005		Diode Load Cap.
C59	1500		21A470790	GP1500M	29C3	De-emphasis
C60	500		21R6590	1468-005		AF Grid Bypass
C61	5000		21A470789	BPD-5	29C1	Audio Coupling
C62	.01 600		8R9834	P688-01	TM-11	Output Plate Decoupling
C63	.001 600		8R9866	P688-001	TM-21	Sync. Coupling
C64	.047 400		8R9873	P488-047	TM-15	Sync. Coupling
C65	.005 600		21A470789	P688-005	TM-25	Integrator Net.
C66	.0047 600		21A470789	P688-0047	TM-25	Integrator Net.
C67	.002 600		8R9867	P688-002	TM-22	Vert. Sync. Coupling

## CONTROLS

ITEM No.	RATING RESISTANCE WATTS	REPLACEMENT DATA			INSTALLATION NOTES
		MOTOROLA PART No.	IRC PART No.	CLAROSTAT PART No.	
RIA	2000Ω	18A790166			Contrast control, tapped at 1000Ω and 1500Ω
B	1 Meg.				Volume control and switch
R2	100KΩ	18A791574	Q11-128	M-49-S	Horiz. hold control-See note 1
R3	1 Meg.	18A90147	Q11-137	M-61-S	Vert. hold control
R4	5 Meg.	18A90145	Q11-141	M-85-S	Height control
R5	5000Ω	18A791132	Q11-114	M-19-S	Vert. linearity control
R6	2000Ω	18A790146	W-2000	43-2000	Horiz. linearity control-Wire Wound
R7	2000Ω	18A790162		10-2000	Focus control, Wire Wound
R8	1 Meg.	18A90147	Q11-137	M-61-S	Brightness control

Note 1. Some models use 50KΩ control, Part No. 18A790167, in this application.

## RESISTORS

ITEM No.	RATING RESISTANCE WATTS	REPLACEMENT DATA		IDENTIFICATION CODES
		MOTOROLA PART No.	IRC PART No.	
R9	33KΩ	6R6410	BTS-33K	RF Choke Shunt
R10	1 Meg. 20%	6R6046	BTS-1 Meg.	Bias Network
R11	82Ω	6R2035		RF Cathode
R12	3900Ω	6R5659	BTS-3900	RF Plate Decoupling
R13	1000Ω	6R6229	BTS-1000	RF Screen Decoupling
R14	33KΩ	6R6410	BTS-33K	Conv. Grid
R15	1200Ω	6R6393	BTS-1200	Conv. Cathode
R16	10KΩ	6R6320		Osc. Grid
R17	1000Ω	6R6229	BTS-1000	Osc. Plate Decoupling
R18	5600Ω	6R6117	BTS-5600	1st Video IF Transformer Shunt
R19	82Ω	6R2035		1st Video IF Cathode
R20	220Ω	6R6270		1st Video IF Decoupling
R21	4.7 Meg.	6R6446	BTS-4.7 Meg.	Voltage Divider
R22	3.9 Meg.	6R49010	BTS-3.9 Meg.	Voltage Divider
R23	22KΩ	6R6397		2nd Video IF Grid
R24	82Ω	6R2035		2nd Video IF Cathode
R25	220Ω	6R6270		2nd Video IF Decoupling
R26	3900Ω	6R5659	BTS-3900	3rd Video IF Coil Shunt
R27	82Ω	6R2035		3rd Video IF Cathode
R28	220Ω	6R6270		3rd Video IF Cathode
R29	220Ω	6R6270		3rd Video IF Decoupling
R30	100KΩ	6R6031	BTS-100K	Voltage Divider
R31	1.5 Meg.	6R6460	BTS-1.5 Meg.	Bias Network
R32	1 Meg. 20%	6R6046	BTS-1 Meg.	Video Amp. Grid
R33				