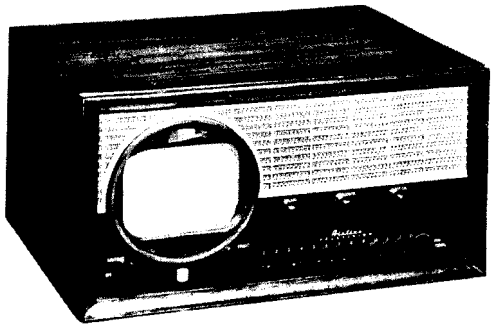


GENERAL DESCRIPTION

This unit is a table model television receiver employing a 7-inch diameter picture tube for a 23 square inch picture area. Thirteen pre-tuned channels, selected by push button control, are provided to cover the present channels assigned for television service. Fine tuning is provided for an exact tuning adjustment on each channel.

The front panel or operating controls provide for adjustment of the picture contrast and brightness, sound volume, horizontal and vertical picture syncronization as well as the channel selection and fine tuning adjustments. The rear chassis or non-operating controls permit the adjustment of the picture height and width, horizontal and vertical picture position and focus.

Antenna requirements are covered by any of the commercially built television antenna systems employing a 300-ohm transmission line.

The sound is supplied by the Inter-carrier Sound System. Detection of the audio signal is accomplished by the ratio detection method.

The anode potential for the kinescope tube is provided by a radio frequency oscillator and rectifier with the minimum of filter capacity to reduce the high voltage hazard.

Electrostatic deflection is used for both the horizontal and vertical sweep.

CARE OF THE KINESCOPE WINDOW

Certain cleaning solutions will fog the clear plastic window located in front of the kinescope tube. Clean the window with a soft dry cloth only. In the event the plastic is fogged accidently, it may be readily replaced.

HIGH VOLTAGE WARNING

Operation of the receiver chassis outside of the cabinet involves a shock hazard. An interlock in the line cord disconnects the power when the cabinet back is removed. When operating the chassis outside of the cabinet, keep in mind the chassis is connected to one side of the a-c line and must be isolated from ground unless the power plug is correctly polarized so that the chassis is at ground potential with respect to the power source. The HIGH VOLTAGE supply while of low current capacity operates at a 4700 VOLT potential. Exercise all normal HIGH VOLTAGE precautions while working with this equipment.

ELECTRICAL SPECIFICATIONS

Power Supply . . . . . 105-125 volts AC 60 cycles, 135 watts.

Antenna. . . . . Provision for external antenna using a 300-ohm transmission line.

Picture Area . . . . . 23 square inches

Frequency Range . . . . . Thirteen pre-set channels.

Channel No.	Frequency (mc)	Channel No.	Frequency (mc)
1	44-50	7	174-180
2	54-60	8	180-186
3	60-66	9	186-192
4	66-72	10	192-198
5	76-82	11	198-204
6	82-88	12	204-210
		13	210-216

Intermediate Frequency. . . Picture carrier . . . .26.25 mc.
Sound carrier . . . .21.75 mc.
Inter-carrier sound system . . . . . 4.5 mc.

Tube Complement . . . . . 6AG5 RF Amplifier
6AG5 Mixer
6C4 Oscillator
6SH7 1st IF Amplifier
6SH7 2nd IF Amplifier
6SH7 3rd IF Amplifier
6H6 Video Detector
6SH7 Video Amplifier
12SN7GT Video Output, Sync. Separator and DC Restorer
12SN7GT Horizontal Oscillator
12SN7GT Horizontal Amplifier
12SN7GT Vertical Oscillator
12SN7GT Vertical Amplifier
7JP4 Kinescope
6SH7 Audio IF Amplifier
6AL5 FM Detector
6SH7 Audio Amplifier
25L6GT Audio Power Amplifier
6C4 High Voltage Supply Oscillator
1B3GT High Voltage Rectifier
25Z6GT Rectifier
6X5GT Rectifier

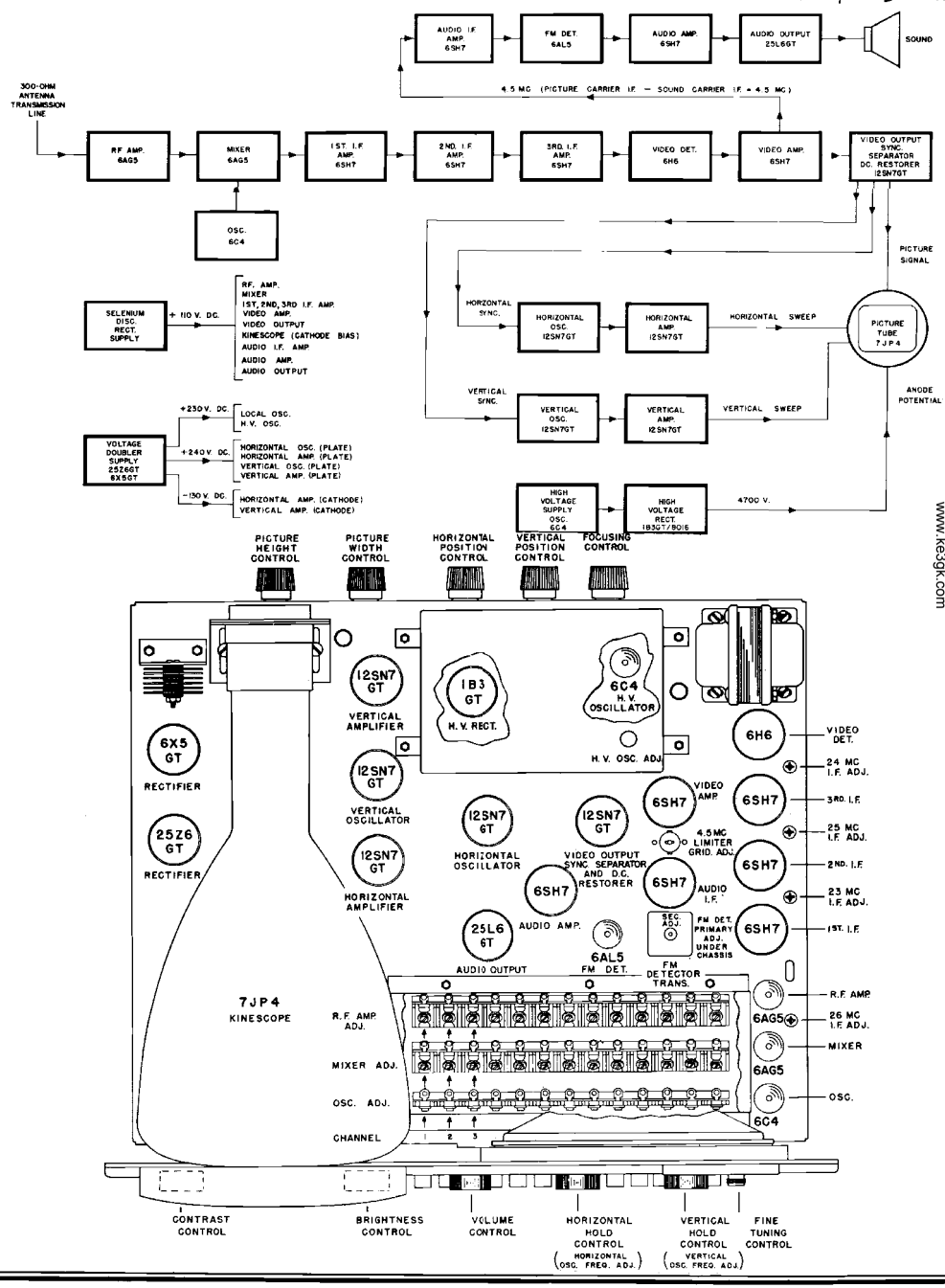
Speaker. . . . . 5 X 7-inch PM

Voice Coil Impedance . . . 3.2 ohms

KINESCOPE HANDLING PRECAUTIONS

The kinescope housing provides adequate protection against possible tube implosure while in the cabinet. Do not expose the kinescope or handle it in any way without providing personal protection in the form of shatterproof goggles and heavy gloves. The kinescope tube should be handled by qualified personnel only.

The kinescope envelope encloses a high vacuum and with the large surface area of glass involved, the stresses set up, particularly at the front rim of the tube, are considerable. An abnormal handling stress, accidental blow at a highly stressed surface, or even a scratch on the surface of the tube could cause it to implode or collapse with destructive violence.



DISMANTLING FOR KINESCOPE TUBE REPLACEMENT OR ALIGNMENT ADJUSTMENTS

1. Remove the five front panel control knobs. They pull straight off their shafts.
2. Remove the back cover. It is fastened with wood screws. The line cord and half of the interlock connector will come along with the back cover.
3. Detach the cabinet half of the interlock connector fastened to the cabinet with two wood screws.
4. Release the chassis by removing the four mounting screws at the bottom of the cabinet and pull the chassis clear of the cabinet. The kinescope tube may now be removed for replacement. When installing a new tube, the two screws holding the tube socket to the mounting bracket, may have to be loosened to permit rotation of the tube for picture alignment. Caution - The rubber escutcheon on the kinescope tube should be left on the tube for additional protection.
5. Reconnect the interlock connector for power while making adjustments on the bench and the receiver is ready for alignment.

HIGH VOLTAGE SUPPLY OSCILLATOR ADJUSTMENTS

The following methods of measuring and setting the high voltage supply potential must be used to obtain the correct anode potential for the picture tube. The anode potential should be checked and adjusted, if necessary, whenever tubes V-13, V-21 and V-22 are changed or service work is done on any of the associated high voltage circuits.

CAUTION HIGH VOLTAGE

Do not use hand held flexible test leads when making the following measurement. Tack solder the resistor string in place and keep the hands clear of the circuit while making measurements or adjustments.

5000 V. potential exists in this circuit. Exercise all normal high voltage precautions while working with this circuit.

1. Connect a 50-megohm resistor string in series with a 0-150 microampere meter across the .001 mfd 6000 V. filter condenser (C-82). The resistor string should be made up of 10-megohm resistors or less to provide a safety factor for voltage breakdown. If 10-megohm resistors are used, a total of five will be required to obtain the 50-megohms required. Connect the meter on the ground side of the string.

2. A meter reading of 95 microamperes (4700 V.) should be obtained under normal conditions. To obtain the desired voltage adjust the H.V. OSC. TRIMMER through the adjustment hole in the top of the H.V. power supply housing with a non-metallic screwdriver. The trimmer is a compression type condenser, hence should be set on the maximum capacity side of oscillator resonance, i.e., increasing trimmer capacity decreases the supply voltage. The BRIGHTNESS control must be set at minimum or full counter-clockwise when making the high voltage adjustment.

ALIGNMENT

EQUIPMENT REQUIRED

Signal generator covering 4 mc to 30 mc.

Signal generator covering 40 mc to 215 mc.

Electronic voltmeter.

Two 150-ohm carbon resistors.

One 0.01 mfd. 600 V. tubular paper condenser.

F-M SOUND CHANNEL I-F ALIGNMENT

1. Connect the low frequency signal generator output between the control grid (pin 4) of the 6SH7 VIDEO AMP. tube (V-11) and chassis ground.

2. Connect the electronic voltmeter between pin 7 of the 6AL5 FM DET tube (V-2) and chassis ground.

3. With the signal generator (unmodulated) set at 4.5 mc, set the 4.5 mc LIMITER GRID ADJ. and FM DET. PRIMARY ADJ. for maximum d-c voltage as measured by the electronic voltmeter. Adjust the limiter grid coil (L-23) before adjusting the FM detector transformer (T-1) primary. Use just enough signal generator output to obtain approximately 1 volt at the electronic voltmeter.

4. Connect the electronic voltmeter across the 1000 mmf condenser (C-22) at the output of the FM detector stage and adjust the SEC. ADJ. of the FM detector transformer (T-1) for the null.

5. Shift the frequency of the signal generator either side of 4.5 mc and touch up the FM DET. PRIMARY ADJ. for approximately equal peaks. Use just enough signal generator output to obtain one volt peaks for best results.

I-F AMPLIFIER ALIGNMENT

1. Connect the electronic voltmeter across the 5600-ohm resistor (R-43) in the 6H6 VIDEO DET. (V-10) plate circuit.

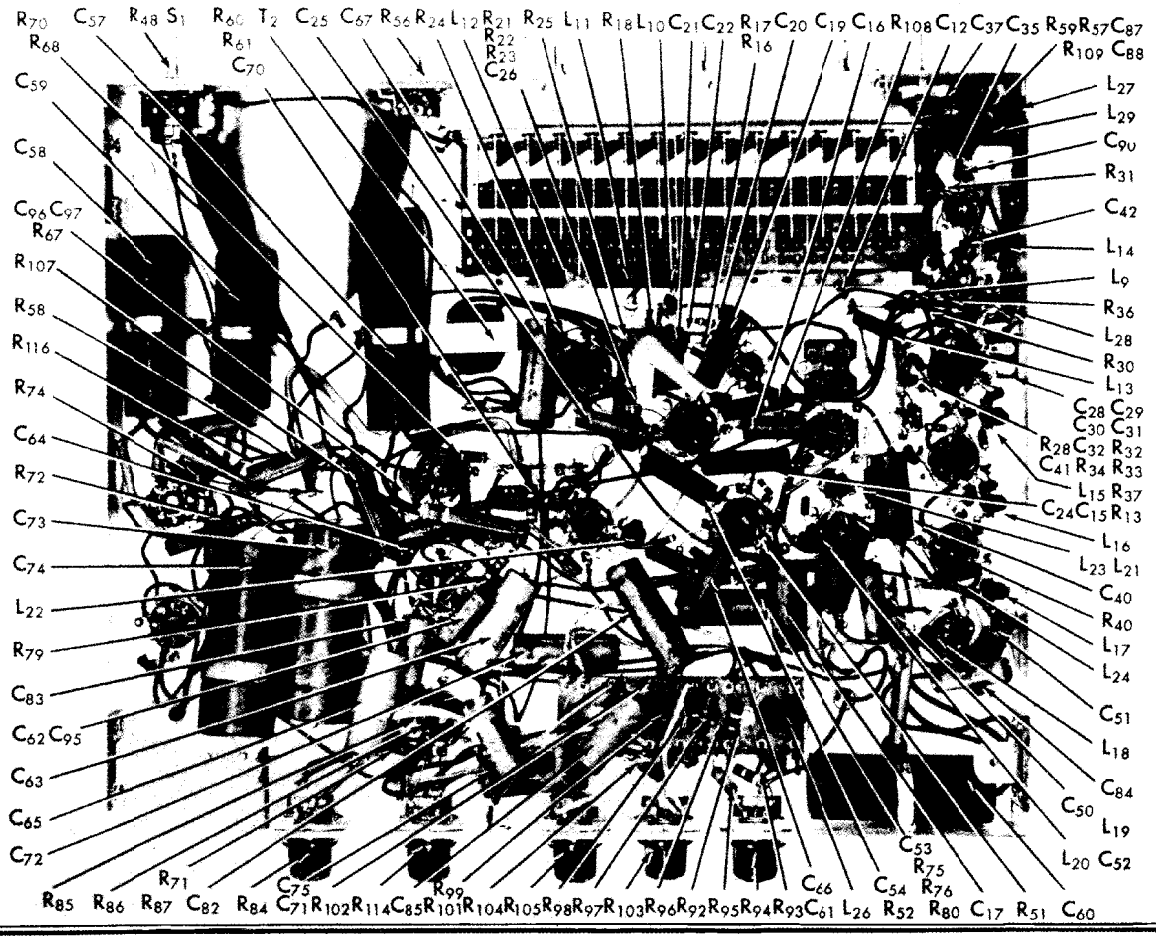
2. Connect the low frequency signal generator output to the receiver's antenna transmission line through two 150-ohm carbon resistors, one connected in each side of the transmission line.

3. Use just enough signal generator output (unmodulated) to develop about a volt at the electronic voltmeter and adjust the four i-f amplifier coils, according to the following chart, for maximum d-c voltage as measured by the electronic voltmeter. To avoid the effects of the local oscillator when feeding the i-f signal through the mixer stage, disable the oscillator by triggering out all of the pushbuttons. Do not leave all the buttons out longer than necessary as resistors R-58 and R-116 dissipate more heat than normal with the oscillator disabled.

4. With the local oscillator disabled, check the i-f amplifier frequency response by tuning the signal generator from 21 mc through 26.25 mc and observing the change in d-c voltage at the electronic voltmeter. If the signal generator output is set for an electronic voltmeter reading of 1.5 volts at the peak i-f amplifier response, the d-c voltage should not drop below 1 volt between the two peaks normally obtained with this i-f amplifier. Should the two peaks be unequal in amplitude, the 25 MC IF ADJ. slug may be readjusted slightly to equalize them.

I-F AMPLIFIER ALIGNMENT CHART

Signal Generator Frequency (No Modulation)	Adjustment (Refer to Fig. 2)	Stage Adjusted
24 mc	24 MC IF ADJ.	Video detector
25 mc	25 MC IF ADJ.	2nd IF amp.
23 mc	23 MC IF ADJ.	1st IF amp.
26 mc	26 MC IF ADJ.	Mixer



Check the two carrier i-f responses, 21.75 mc and 26.25 mc. The 21.75 mc response will be approximately 20 db below the peak response and the 26.25 mc response will fall approximately 6 db below the peak.

The average i-f amplifier sensitivity when feeding the signal generator in through the antenna input as described above will run approximately 8000-10,000 microvolts for the 1.5 volt d-c peaks measured at resistor R-43.

STATION CHANNEL ALIGNMENT

1. Due to the broad frequency response of the i-f amplifier, it is necessary to use a 24.5 mc signal generator or oscillator (unmodulated) as a beat frequency oscillator (BFO) to locate the center frequency of the i-f amplifier response for the correct local oscillator adjustment. This "BFO" generator should be loosely coupled by means of a wire from the generator output placed in close proximity to the 6H6 VIDEO DET. tube (V-10).

2. Connect the high frequency signal generator output to the receiver's antenna transmission line through two 150-ohm carbon resistors, one connected in each side of the transmission line.

3. Connect the electronic voltmeter across the 5600-ohm resistor (R-43) in the 6H6 VIDEO DET. (V-10) plate circuit.

4. Alignment of the individual channels is carried out as follows: Each channel may be aligned independently without affecting the alignment of the others.

(a) Set the FINE TUNING control condenser in the center of its capacity range.

(b) Press the channel button corresponding to the channel number to be aligned.

(c) Set the "BFO" generator at 24.5 mc (no modulation).

(d) Set the high frequency signal generator per the alignment chart. (Generator unmodulated).

(e) Clip on a 0.01 mfd. condenser between pin 3 of the 12SN7GT VIDEO OUTPUT tube, (V-13) and pin 4 of the 6SH7 AUDIO AMP tube (V-3) and adjust the OSC. ADJ. trimmer corresponding to the channel being aligned for a rough audio beat note using the speaker output as a detector.

(f) Disconnect the 0.01 mfd. condenser, shut off the "BFO" signal generator, and adjust the MIXER ADJ. and RF AMP. ADJ. trimmers for maximum d-c voltage as measured by the electronic voltmeter. Use just enough signal generator output to obtain approximately one volt at the electronic voltmeter. This completes the alignment of any one channel, and all other channels may be treated alike.

CHANNEL ALIGNMENT CHART

Channel No.	Channel Freq. (mc)	H.F. Signal Generator Freq. (No modulation)	Channel No.	Channel Freq. (mc)	H.F. Signal Generator Freq. (No modulation)
1	44-50	47 mc	7	174-180	177 mc
2	54-60	57 mc	8	180-186	183 mc
3	60-66	63 mc	9	186-192	189 mc
4	66-72	69 mc	10	192-198	195 mc
5	76-82	79 mc	11	198-204	201 mc
6	82-88	85 mc	12	204-210	207 mc
			13	210-216	213 mc

The overall sensitivity for the receiver will run approximately 200-400 microvolts for 1 volt DC at resistor R-43 when measured in the above manner.

Ref. No.	Part No.	Description
CONDENSERS		
C-1	44B357	Trimmer assembly, osc. stage, 13 sections
C-2,3	44B358	Trimmer assembly, mixer and r-f amp. stage, 13 sections
C-4,7,9,11, 36,78	47A160-6	4.7 mmf. 500 V., bakelite
C-5,49	47A160-11	10 mmf. 500 V., bakelite
C-6,8,96, 97	47A160-5	3.3 mmf. 500 V., bakelite
C-10	47A160-4	2.2 mmf. 500 V., bakelite
C-12,13,14	47B20390K5	39 mmf. 500 V., ceramic
C-15,48,55, 68,69	47B20101K5	100 mmf. 500 V., ceramic
C-16,21,26	46AU203J	.02 mfd. 200 V., tubular
C-17,40,52, 53	46AT254J	.25 mfd. 200 V., tubular
C-18,22,28, 29,33,34, 41,42,43, 44,45,46, 56,79,86, 87,88,89, 90,91,92, 93,94	47B20A102N1	1000 mmf. 150 V., ceramic
C-19,54	45A109	5 mfd. 50 V., electrolytic
C-20	47B0331K5	330 mmf. 500 V., ceramic
C-23,24, 51,66	46AU503J	.05 mfd. 200 V., tubular
C-25	46AU103J	.01 mfd. 200 V., tubular
C-27	47A160-2	1 mmf. 500 V., bakelite
C-30,31	47B20470K5	47 mmf. 500 V., ceramic
C-33	47A160-3	1.5 mmf. 500 V., bakelite
C-35	47A160-1	0.68 mmf. 500 V., bakelite
C-37	48A199	Trimmer, FINE TUNING
C-38,39,47	47B20500K5	50 mmf. 500 V., ceramic
C-50,83,84	46AU104J	.1 mfd. 200 V., tubular
C-57	45B126	60-30 mfd. 300-450 V., electrolytic
C-58	45B125	40-40 mfd. 300 V., electrolytic
C-59	45B123	30-30 mfd. 200 V., electrolytic
C-60	45B124	100-100 mfd. 150 V., electrolytic
C-61,62	46AU502J	.005 mfd. 200 V., tubular
C-63,65,67, 76,77	46AX254J	.25 mfd. 600 V., tubular
C-64,75,85	46AY104J	.1 mfd. 600 V., tubular
C-70	CM20A681M	680 mmf. 500 V., mica
C-71,72	46A145	.0005 mfd. 6000 V., tubular
C-73,74	46B144	.05 mfd. 6000 V., tubular
C-80	44A359	Trimmer, adjustable, HV oscillator
C-81,82	46A146	.001 mfd. 6000 V., tubular
C-95	46AZ103J	.01 mfd. 600 V., tubular

RESISTORS

R-1		1000 ohms 1 watt, carbon, part of coil L-12	
R-2		2200 ohms 1 watt, carbon, part of coil L-11	
R-3		3300 ohms 1 watt, carbon, part of coil L-10	
R-4		3300 ohms 1 watt, carbon, part of coil L-8	
R-5		2200 ohms 1 watt, carbon, part of coil L-7	
R-6		3300 ohms 1 watt, carbon, part of coil L-6	
R-7		1 megohm 1 watt, carbon, part of coil L-4	
R-8		1 megohm 1 watt, carbon, part of coil L-3	
R-9		1 meguhm 1 watt, carbon, part of coil L-2	
R-10		1 megohm 1 watt, carbon, part of coil L-9	
R-11		1 megohm 1 watt, carbon, part of coil L-5	
R-12		1 megohm 1 watt, carbon, part of coil L-1	
R-13,55,91	RC20AE154M	150,000 ohms ½ watt, carbon	
R-14,18,21, 52,62,76	RC20AE333M	33,000 ohms ½ watt, carbon	
R-15	RC20AE123K	12,000 ohms ½ watt, carbon	
R-16,17	RC20AE103J	10,000 ohms ½ watt, carbon	
R-19	25B721	1 megohm, VOLUME control	
R-20,26, 27	RC20AE151M	150 ohms ½ watt, carbon	
R-22,83	RC20AE684M	680,000 ohms ½ watt, carbon	
R-23	RC20AE104M	100,000 ohms ½ watt, carbon	
R-24	RC20AE474M	470,000 ohms ½ watt, carbon	
R-25	RC30AE101M	100 ohms 1 watt, carbon	
R-28,32,88	RC20AE225M	2.2 megohms ½ watt, carbon	
R-29	RC20AF103M	10,000 ohms ½ watt, carbon	
R-30,36, 37,38,57	RC20AE101M	100 ohms ½ watt, carbon	
R-31,44, 49,66	RC20AE105M	1 megohm ½ watt, carbon	
R-33,39,40	RC20AE273M	27,000 ohms ½ watt, carbon	
R-34,35	RC20AE124K	120,000 ohms ½ watt, carbon	
R-41		1 megohm ½ watt, carbon, part of coil L-19	
R-42	RC20AE564M	560,000 ohms ½ watt, carbon	
R-43,89, 111,113	RC20AE562K	5600 ohms ½ watt, carbon	
R-45		68,000 ohms 1 watt, carbon, part of coil L-20	
R-46		1 megohm 1 watt, carbon, part of coil L-21	
R-47	RC20AE822M	8200 ohms ½ watt, carbon	
R-48	25B739	1000 ohms WW, CONTRAST control	
R-50,54	RC20AE334M	330,000 ohms ½ watt, carbon	
R-51	RC20AE823M	82,000 ohms ½ watt, carbon	
R-53	RC20AE682M	6800 ohms ½ watt, carbon	
R-56	25B722	25,000 ohms, BRIGHTNESS control	
R-58,116	RC40AE682M	6800 ohms 2 watts, carbon	
R-59	RC20AE223M	22,000 ohms ½ watt, carbon	
R-60,77, 85,86	RC30AE104M	100,000 ohms 1 watt, carbon	
R-61,68,79	RC30AE473M	47,000 ohms 1 watt, carbon	
R-63,81	RC30AE681M	680 ohms 1 watt, carbon	
R-64	25B720	500,000 ohms, HORIZONTAL control	
R-65	RC20AE334M	270,000 ohms ½ watt, carbon	
R-67	RC40AE473M	47,000 ohms 2 watts, carbon	
R-69,70	RC20AE475M	4.7 megohms ½ watt, carbon	
R-71	RC20AE224M	220,000 ohms ½ watt, carbon	
R-72	RC40AE681M	680 ohms 2 watts, carbon	
R-73	RC40AE180M	18 ohms 2 watts, carbon	
R-74	RC30AE122M	1200 ohms 1 watt, carbon	
R-75	RC20AE471M	470 ohms ½ watt, carbon	
R-78	RC20AE155M	1.5 megohm ½ watt, carbon	
R-80	RC20AE472M	4700 ohms ½ watt, carbon	
R-82	25B720	500,000 ohms, VERTICAL control	
R-84	25B724	2.5 megohms, HEIGHT control	
R-87	RC30AE272M	2700 ohms 1 watt, carbon	
R-90	RC30AE124K	120,000 ohms 1 watt, carbon	
R-92,93	RC30AE395M	3.9 megohms 1 watt, carbon	
R-94	25B723	5 megohms, FOCUS control	
R-95,96, 100,106	RC30AE475M	4.7 megohms 1 watt, carbon	
R-97,98 101,102	RC30AE335M	3.3 megohms 1 watt, carbon	
R-99,104	RC30AE565M	5.6 megohms 1 watt, carbon	
R-103	25B723	5 megohms, VERTICAL POSITION control	
R-105	25B723	5 megohms, HORIZONTAL POSITION control	
R-107	24BG180E	18 ohms 10 watts, WW	
R-108	RC40AE680M	68 ohms 2 watts, carbon	
R-109	RC30AE470K	47 ohms 1 watt, carbon	
R-110	RC30AE390K	39 ohms 1 watt, carbon	
R-112		33,000 ohms 1 watt, carbon, part of coil L-18	
R-114	25B724	2.5 megohms, WIDTH control	
R-115		470 ohms 1 watt, carbon, part of coil L-22	

TRANSFORMERS AND COILS

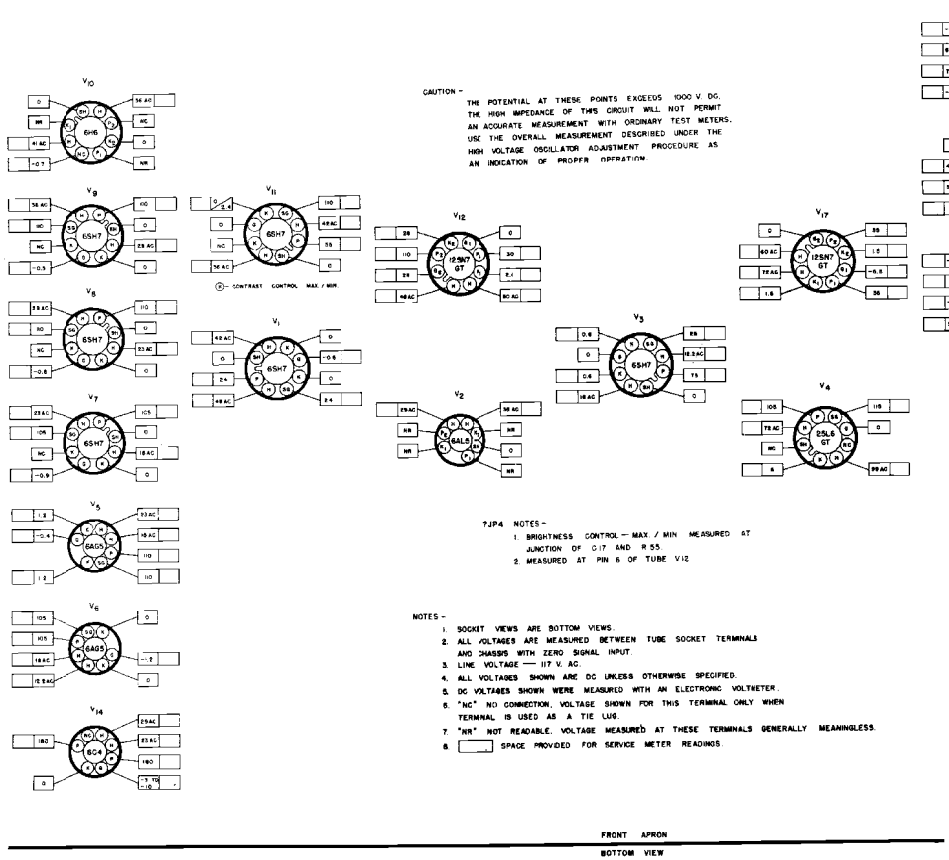
T-1	50B406	Transformer, FM sound detector
T-2	55B080-3	Transformer, audio output
T-3	51B1038	Transformer, H.V. osc.
L-1	51A1041	Coil, oscillator stage
L-2	51A1042	Coil, oscillator stage
L-3	51A1043	Coil, oscillator stage
L-4	51A1044	Coil, oscillator stage
L-5	51A1045	Coil, mixer stage
L-6	51A1046	Coil, mixer stage
L-7	51A1047	Coil, mixer stage
L-8	51A1048	Coil, mixer stage
L-9	51A1049	Coil, r-f amp. stage
L-10	51A1050	Coil, r-f amp. stage
L-11	51A1051	Coil, r-f amp. stage
L-12	51A1052	Coil, r-f amp. stage
L-13,24, 29	53B008	Choke, RF (Red color code)
L-14,15 16,17	50A372	Coil, i-f amplifier
L-18	51A1053	Coil, video peaking, video detector
L-19	51A1054	Coil, video peaking, video detector
L-20	51A1055	Coil, video peaking, video amp.
L-21	51A1057	Coil, video peaking, video amp.
L-22	51B1040	Coil, sync, shaping
L-23	51B1037	Coil, 4.5 mc sound trap
L-25	56C093	Choke, filter
L-26	53A134	Choke, dual winding, HV oscillator
L-27	53A133	Choke, dual winding, 6C4 oscillator fil.
L-28	51A1039	Antenna coil

PLUGS AND SOCKETS

PL-1	6A296 Socket, octal (tube)
SO-2	6A297 Socket, miniature (tube)
PL-3	6B298 Socket, kinescope (tube)
	87B1668-1 Line cord and plug PLZ
	10A286 Connector, line cord
	87A1670 Connector and cord assembly, speaker

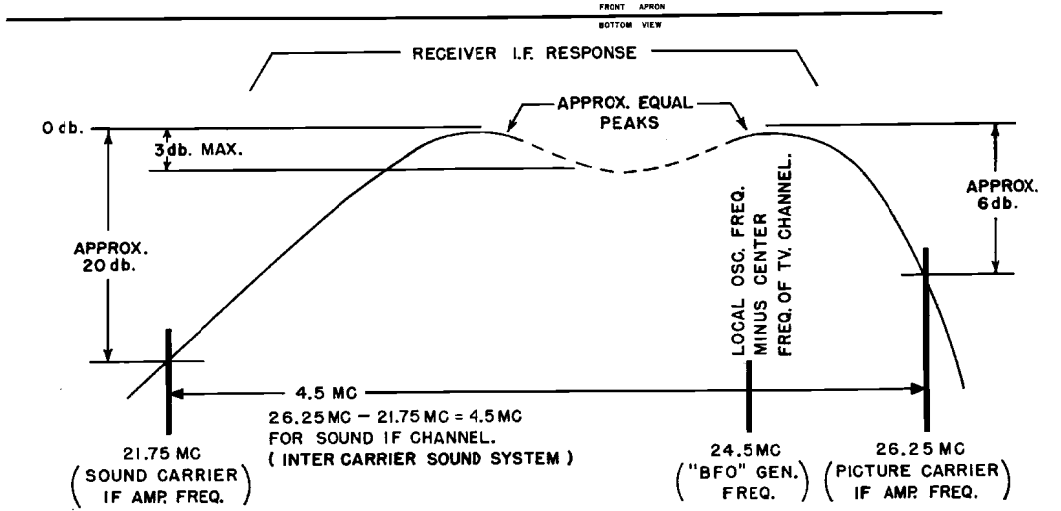
MISCELLANEOUS

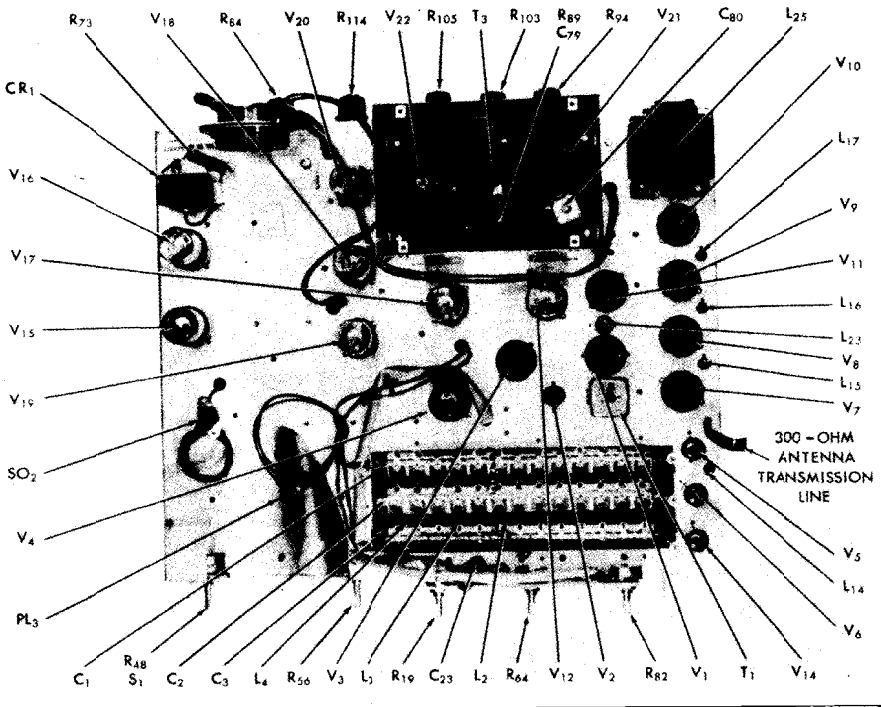
LS-1	41X11203 Channel selector assembly complete (Includes PB switch, trimmers, coils, etc.)
	85B070 Speaker assembly
	8A786 Mounting board, chassis apron controls
	8B788 Mounting board, front panel controls
	8A787 Insulating board, mtg. foot brackets
	67A797 Bracket, mounting foot
	67A807 Bracket, selenium rectifier mounting
	87A809 Bracket, kinescope tube mounting
	76A393 Ring, kinescope tube mtg.
	88A574 Terminal board, resistor mounting
	69C225 Shield, H.V. power supply shield
	66B440 Bottom cover, H.V. power supply shield
	66B440-1 Top cover, H.V. power supply shield
	67B808 Bracket, pushbutton switch mounting
	63A336-1 Plate, power cord receptacle mounting
	15B141 Knob, rear chassis controls
	15B068-3 Knob, front panel controls
	17A041-1 Knob, push button & FINE TUNING
	7D071-1 Escutcheon, kinescope tube
	22B206 Window, escutcheon
	32D456 Cabinet back



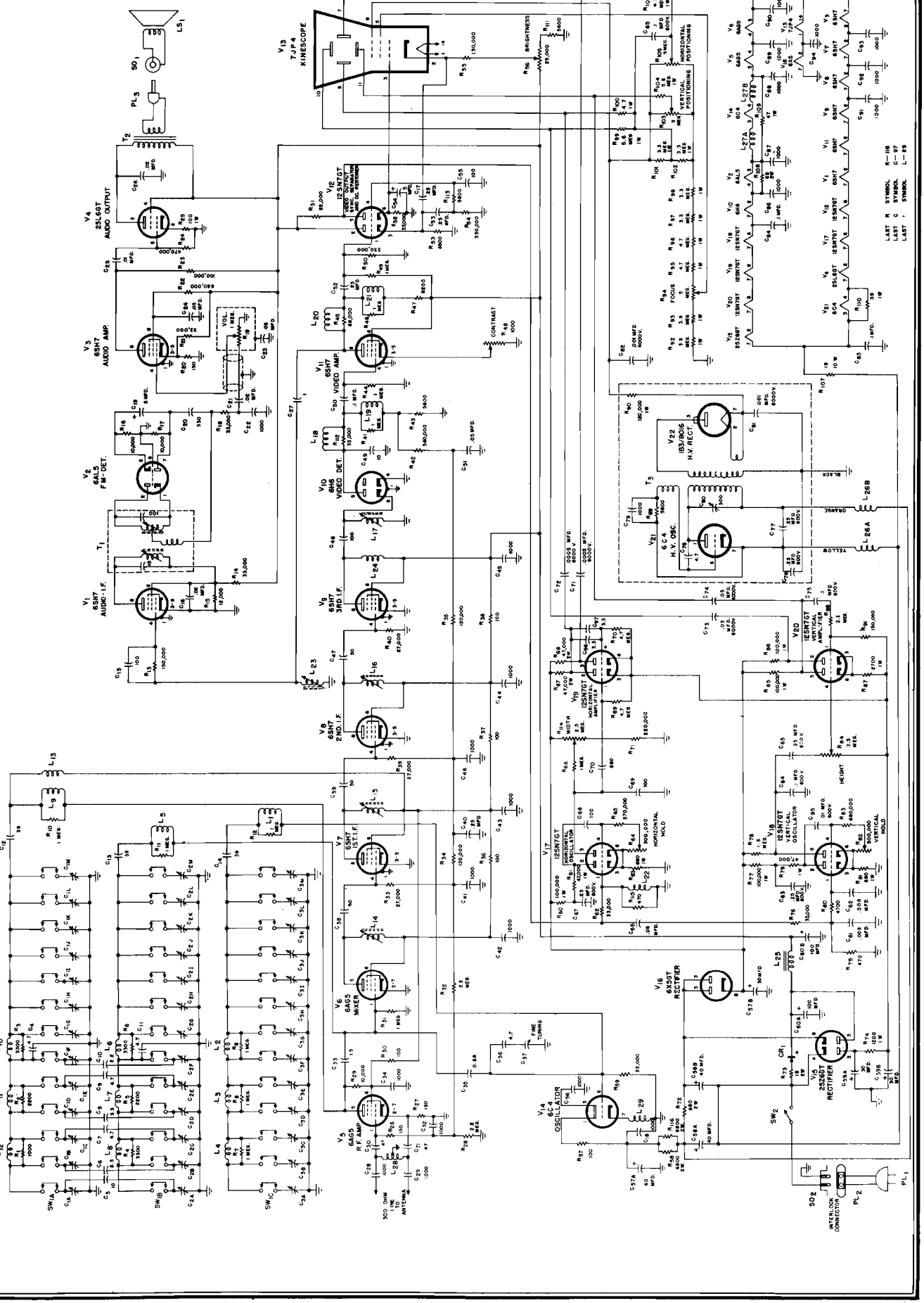
CARRIER vs I-F FREQUENCY CHART

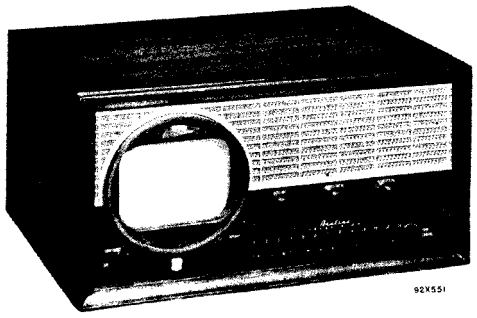
Channel No.	Channel Freq. (mc)	Picture Carrier Freq. (mc)	Sound Carrier Freq. (mc)	Receiver Osc. Freq. (mc)
1	44-50	45.25	49.75	71.5
2	54-60	55.25	59.75	81.5
3	60-66	61.25	65.75	87.5
4	66-72	67.25	71.75	93.5
5	76-82	77.25	81.75	103.5
6	82-88	83.25	87.75	109.5
7	174-180	175.25	179.75	201.5
8	180-186	181.25	185.75	207.5
9	186-192	187.25	191.75	213.5
10	192-198	193.25	197.75	219.5
11	198-204	199.25	203.75	225.5
12	204-210	205.25	209.75	231.5
13	210-216	211.25	215.75	237.5





MODEL 8HA-3002A





Tube Complement . . . . . 6AG5 RF Amplifier
6AG5 Mixer
6C4 Oscillator
6AU6 1st IF Amplifier
6AU6 2nd IF Amplifier
6AU6 3rd IF Amplifier
6H6 Video Detector
6AU6 Video Amplifier
12SN7GT Video Output, Sync. Separator and DC Restorer
12SN7GT Horizontal Oscillator
12SN7GT Horizontal Amplifier
12SN7GT Vertical Oscillator
12SN7GT Vertical Amplifier
7JP4 Kinescope
6AU8 Audio IF Amplifier
6AL5 FM Detector
6AV6 Audio Amplifier
25L6GT Audio Power Amplifier
6C4 High Voltage Supply Oscillator
1B3GT High Voltage Rectifier
25Z6GT Rectifier
6X5GT Rectifier

Speaker. . . . . 5 X 7-inch PM

Voice Coil Impedance . . . 3.2 ohms

GENERAL DESCRIPTION

This unit is a table model television receiver employing a 7-inch diameter picture tube for a 23 square inch picture area. Thirteen pre-tuned channels, selected by push button control, are provided to cover the present channels assigned for television service. Fine tuning is provided for an exact tuning adjustment on each channel.

The front panel or operating controls provide for adjustment of the picture contrast and brightness, sound volume, horizontal and vertical picture syncronization as well as the channel selection and fine tuning adjustments. The rear chassis or non-operating controls permit the adjustment of the picture height and width, horizontal and vertical picture position and focus.

Antenna requirements are covered by any of the commercially built television antenna systems employing a 300-ohm transmission line.

The sound is supplied by the Inter-carrier Sound System. Detection of the audio signal is accomplished by the ratio detection method.

The anode potential for the kinescope tube is provided by a radio frequency oscillator and rectifier with the minimum of filter capacity to reduce the high voltage hazard.

Electrostatic deflection is used for both the horizontal and vertical sweep.

Power Supply . . . . . 105-125 volts AC 60 cycles, 135 watts.

Antenna. . . . . Provision for external antenna using a 300-ohm transmission line.

Picture Area . . . . . 23 square inches

Frequency Range . . . . . Thirteen pre-set channels.

Channel No.	Frequency (mc)	Channel No.	Frequency (mc)
1	44-50	7	174-180
2	54-60	8	180-186
3	60-66	9	186-192
4	66-72	10	192-198
5	76-82	11	198-204
6	82-88	12	204-210
		13	210-216

CARE OF THE KINESCOPE WINDOW

Certain cleaning solutions will fog the clear plastic window located in front of the kinescope tube. Clean the window with a soft dry cloth only. In the event the plastic is fogged accidently, it may be readily replaced.

HIGH VOLTAGE WARNING

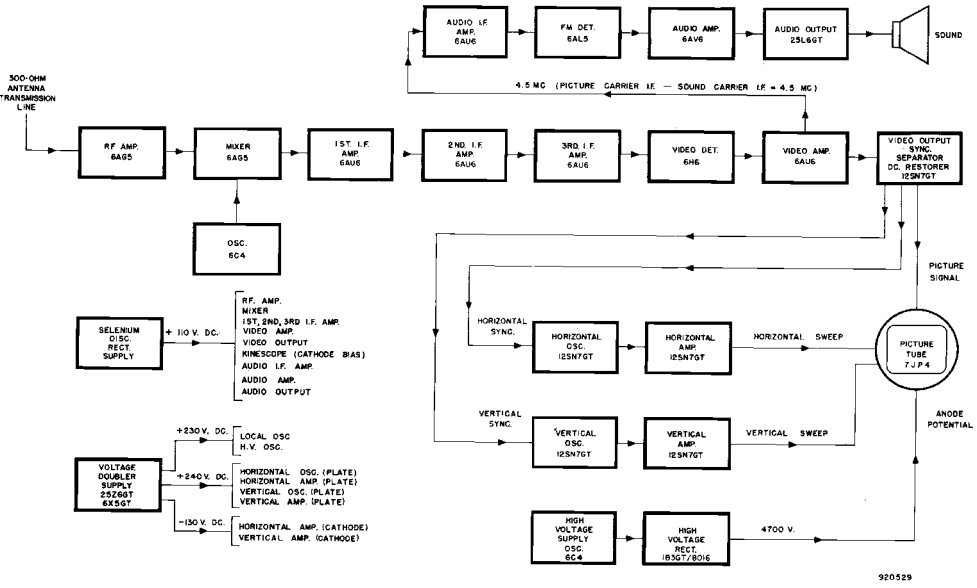
Operation of the receiver chassis outside of the cabinet involves a shock hazard. An interlock in the line cord disconnects the power when the cabinet back is removed. When operating the chassis outside of the cabinet, keep in mind the chassis is connected to one side of the a-c line and must be isolated from ground unless the power plug is correctly polarized so that the chassis is at ground potential with respect to the power source. The HIGH VOLTAGE supply while of low current capacity operates at a 4700 VOLT potential. Exercise all normal HIGH VOLTAGE precautions while working with this equipment.

KINESCOPE HANDLING PRECAUTIONS

The kinescope housing provides adequate protection against possible tube implosure while in the cabinet. Do not expose the kinescope or handle it in any way without providing personal protection in the form of shatterproof goggles and heavy gloves. The kinescope tube should be handled by qualified personnel only.

The kinescope envelope encloses a high vacuum and with the large surface area of glass involved, the stresses set up, particularly at the front rim of the tube, are considerable. An abnormal handling stress, accidental blow at a highly stressed surface, or even a scratch on the surface of the tube could cause it to implode or collapse with destructive violence.

DISMANTLING FOR KINESCOPE TUBE REPLACEMENT OR ALIGNMENT ADJUSTMENTS



1. Remove the five front panel control knobs. They pull straight off their shafts.

2. Remove the back cover. It is fastened with wood screws. The line cord and half of the interlock connector will come along with the back cover.

3. Detach the cabinet half of the interlock connector fastened to the cabinet with two wood screws.

4. Release the chassis by removing the four mounting screws at the bottom of the cabinet and pull the chassis clear of the cabinet. The kinescope tube may now be removed for replacement. When installing a new tube, the two screws holding the tube socket to the mounting bracket, may have to be loosened to permit rotation of the tube for picture alignment. Caution - The rubber escutcheon on the kinescope tube should be left on the tube for additional protection.

5. Reconnect the interlock connector for power while making adjustments on the bench and the receiver is ready for alignment.

HIGH VOLTAGE SUPPLY OSCILLATOR ADJUSTMENTS

The following methods of measuring and setting the high voltage supply potential must be used to obtain the correct anode potential for the picture tube. The anode potential should be checked and adjusted, if necessary, whenever tubes V-13, V-21 and V-22 are changed or service work is done on any of the associated high voltage circuits.

CAUTION HIGH VOLTAGE

Do not use hand held flexible test leads when making the following measurement. Tack solder the resistor string in place and keep the hands clear of the circuit while making measurements or adjustments.

A 5000 V. potential exists in this circuit. Exercise all normal high voltage precautions while working with this circuit.

1. Connect a 50-megohm resistor string in series with a 0-150 microampere meter across the .001 mfd 6000 V. filter condenser (C-82). The resistor string should be made up of 10-megohm resistors or less to provide a safety factor for voltage breakdown. If 10-megohm resistors are used, a total of five will be required to obtain the 50-megohms required. Connect the meter on the ground side of the string.

2. A meter reading of 95 microamperes (4700 V.) should be obtained under normal conditions. To obtain the desired voltage adjust the H.V. OSC. TRIMMER through the adjustment hole in the top of the H.V. power supply housing with a non-metallic screwdriver. The trimmer is a compression type condenser, hence should be set on the maximum capacity side of oscillator resonance, i.e., increasing trimmer capacity decreases the supply voltage. The BRIGHTNESS control must be set at minimum or full counter-clockwise when making the high voltage adjustment.

ALIGNMENT

EQUIPMENT REQUIRED

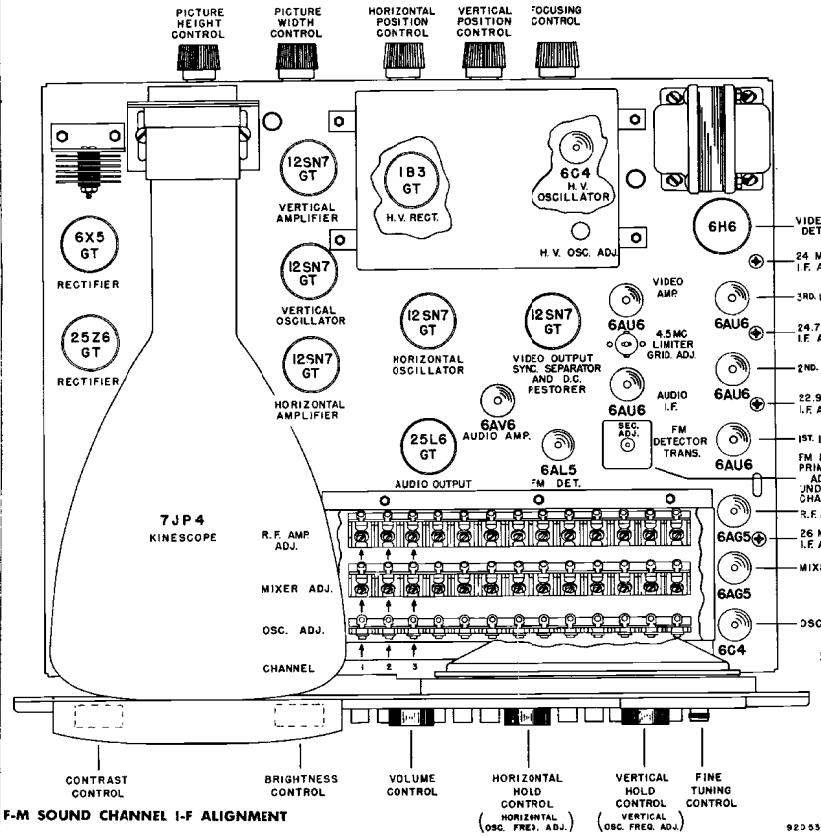
Signal generator covering 4 mc to 30 mc.

Signal generator covering 40 mc to 215 mc.

Electronic voltmeter.

Two 150-ohm carbon resistors.

One 0.01 mfd. 600 V. tubular paper condenser.



F-M SOUND CHANNEL I-F ALIGNMENT

1. Connect the low frequency signal generator output between the control grid (pin 1) of the 6AU6 VIDEO AMP. tube (V-11) and chassis ground.

2. Connect the electronic voltmeter between pin 7 of the 6AL5 FM DET tube (V-2) and chassis ground.

3. With the signal generator (unmodulated) set at 4.5 mc, set the 4.5 mc LIMITER GRID ADJ. and FM DET. PRIMARY ADJ. for maximum d-c voltage as measured by the electronic voltmeter. Adjust the limiter grid coil (L-23) before adjusting the FM detector transformer (T-1) primary. Use just enough signal generator output to obtain approximately 1 volt at the electronic voltmeter.

4. Connect the electronic voltmeter across the 1000 mmf condenser (C-22) at the output of the FM detector stage and adjust the SEC. ADJ. of the FM detector transformer (T-1) for the null.

5. Shift the frequency of the signal generator either side of 4.5 mc and touch up the FM DET. PRIMARY ADJ. for approximately equal peaks. Use just enough signal generator output to obtain one volt peaks for best results.

I-F AMPLIFIER ALIGNMENT

1. Connect the electronic voltmeter across the 5600-ohm resistor (R-43) in the 6H6 VIDEO DET. (V-10) plate circuit.

2. Connect the low frequency signal generator output to the receiver's antenna transmission line through two 150-ohm carbon resistors, one connected in each side of the transmission line.

3. Use just enough signal generator output (unmodulated) to develop about a volt at the electronic voltmeter and adjust the four i-f amplifier coils, according to the following chart, for maximum d-c voltage as measured by the electronic voltmeter. To avoid the effects of the local oscillator when feeding the i-f signal through the mixer stage, disable the oscillator by triggering out all of the pushbuttons. Do not leave all the buttons out longer than necessary as resistors R-58 and R-116 dissipate more heat than normal with the oscillator disabled.

4. With the local oscillator disabled, check the i-f amplifier frequency response by tuning the signal generator from 21 mc through 26.25 mc and observing the change in d-c voltage at the electronic voltmeter. If the signal generator output is set for an electronic voltmeter reading of 1.5 volts at the peak i-f amplifier response, the d-c voltage should not drop below 1 volt between the two peaks normally obtained with this i-f amplifier. Should the two peaks be unequal in amplitude, the 24.7 MC IF ADJ. slug may be readjusted slight to equalize them.

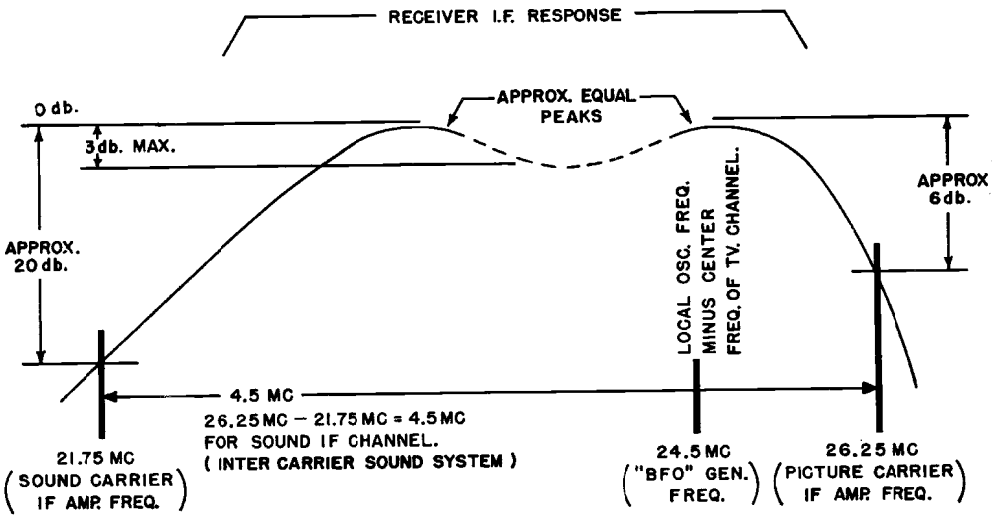
CHANNEL ALIGNMENT CHART

Channel No.	Channel Freq. (mc)	H.F. Signal Generator Freq. (No modulation)
1	44-50	47 mc
2	54-60	57 mc
3	60-66	63 mc
4	66-72	69 mc
5	76-82	79 mc
6	82-88	85 mc
7	174-180	177 mc
8	180-186	183 mc
9	186-192	189 mc
10	192-198	195 mc
11	198-204	201 mc
12	204-210	207 mc
13	210-216	213 mc

The overall sensitivity for the receiver will run approximately 200-400 microvolts for 1 volt DC at resistor R-43 when measured in the above manner.

I-F AMPLIFIER ALIGNMENT CHART

Signal Generator Frequency (No Modulation)	Adjustment	Stage Adjusted
24 mc	24 MC IF ADJ.	Video detector
24.7 mc	24.7 MC IF ADJ.	2nd IF amp.
22.9 mc	22.9 MC IF ADJ.	1st IF amp.
26 mc	26 MC IF ADJ.	Mixer



Check the two carrier i-f responses, 21.75 mc and 26.25 mc. The 21.75 mc response will be approximately 20 db below the peak response and the 26.25 mc response will fall approximately 6 db below the peak.

The average i-f amplifier sensitivity when feeding the signal generator in through the antenna input as described above will run approximately 8000-10,000 microvolts for the 1.5 volt d-c peaks measured at resistor R-43.

STATION CHANNEL ALIGNMENT

1. Due to the broad frequency response of the i-f amplifier, it is necessary to use a 24.5 mc signal generator or oscillator (unmodulated) as a beat frequency oscillator (BFO) to locate the center frequency of the i-f amplifier response for the correct local oscillator adjustment. This "BFO" generator should be loosely coupled by means of a wire from the generator output placed in close proximity to the 6H6 VIDEO DET. tube (V-10).

2. Connect the high frequency signal generator output to the receiver's antenna transmission line through two 150-ohm carbon resistors, one connected in each side of the transmission line.

3. Connect the electronic voltmeter across the 5600-ohm resistor (R-43) in the 6H6 VIDEO DET. (V-10) plate circuit.

4. Alignment of the individual channels is carried out as follows: Each channel may be aligned independently without affecting the alignment of the others.

(a) Set the FINE TUNING control condenser in the center of its capacity range.

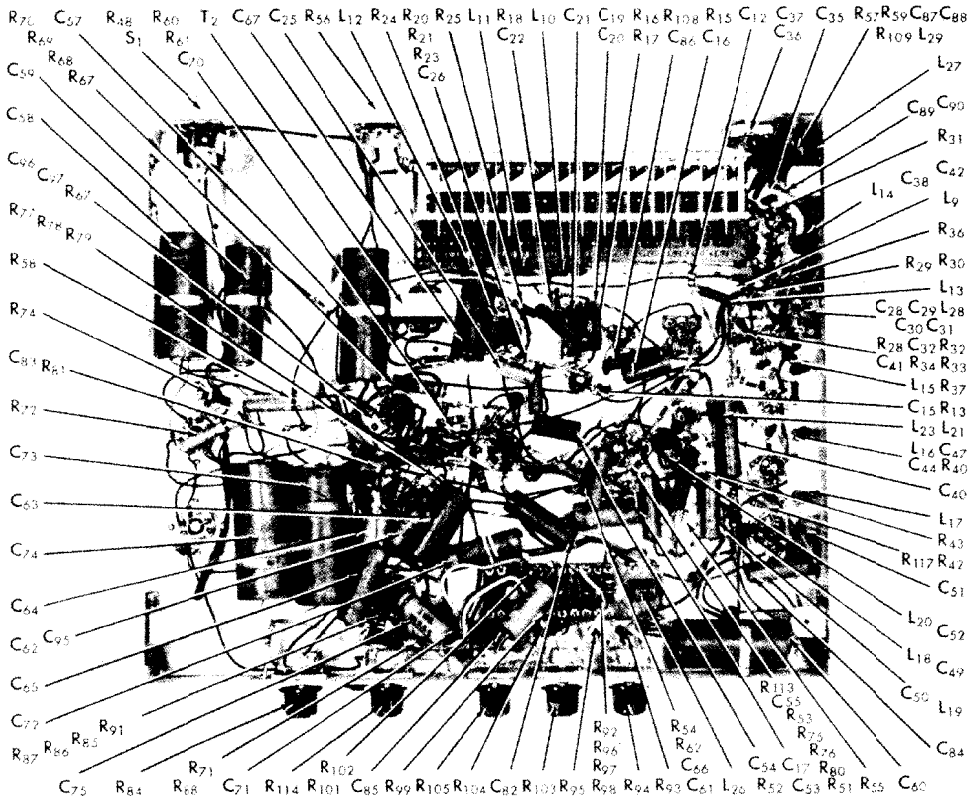
(b) Press the channel button corresponding to the channel number to be aligned.

(c) Set the "BFO" generator at 24.5 mc (no modulation).

(d) Set the high frequency signal generator per the alignment chart. (Generator unmodulated).

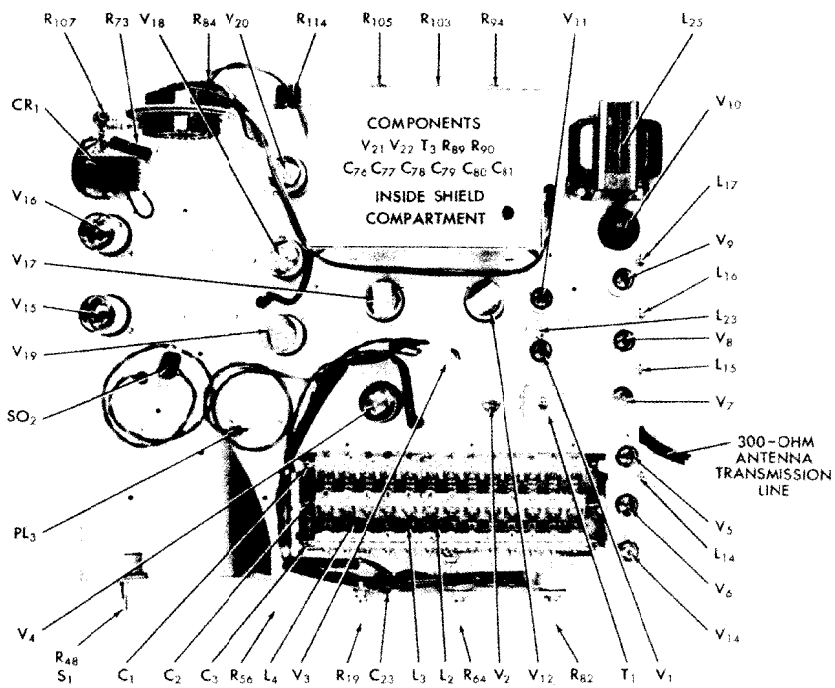
(e) Clip on a 0.01 mfd. condenser between pin 3 of the 12SN7GT VIDEO OUTPUT tube, (V-12) and pin 1 of the 6AV6 AUDIO AMP tube (V-3) and adjust the OSC. ADJ. trimmer corresponding to the channel being aligned for a rough audio beat note using the speaker output as a detector.

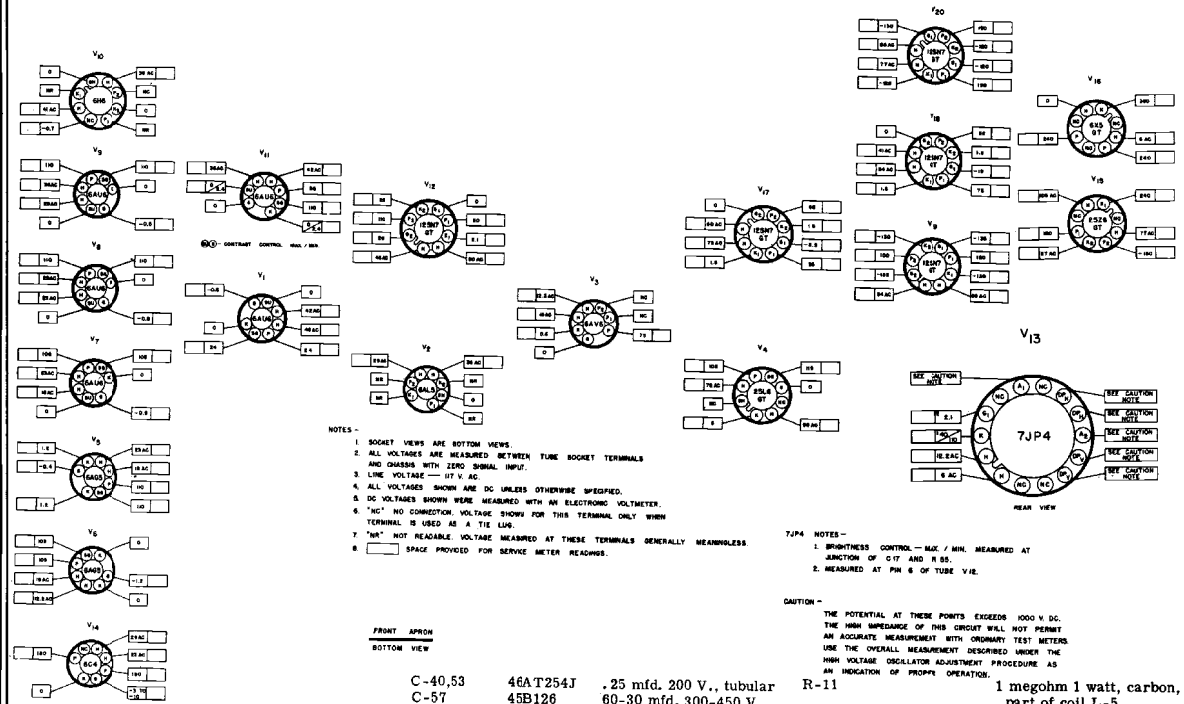
(f) Disconnect the 0.01 mfd. condenser, shut off the "BFO" signal generator, and adjust the MIXER ADJ. and RF AMP. ADJ. trimmers for maximum d-c voltage as measured by the electronic voltmeter. Use just enough signal generator output to obtain approximately one volt at the electronic voltmeter. This completes the alignment of any one channel, and all other channels may be treated alike.



CARRIER vs I-F FREQUENCY CHART

Channel No.	Channel Freq. (mc)	Picture Carrier Freq. (mc)	Sound Carrier Freq. (mc)	Receiver Osc. Freq. (mc)
1	44-50	45.25	49.75	71.5
2	54-60	55.25	59.75	81.5
3	60-66	61.25	65.75	87.5
4	66-72	67.25	71.75	93.5
5	76-82	77.25	81.75	103.5
6	82-88	83.25	87.75	109.5
7	174-180	175.25	179.75	201.5
8	180-186	181.25	185.75	207.5
9	186-192	187.25	191.75	213.5
10	192-198	193.25	197.75	219.5
11	198-204	199.25	203.75	225.5
12	204-210	205.25	209.75	231.5
13	210-216	211.25	215.75	237.5





NOTES –
1. SOCKET VIEWS ARE BOTTOM VIEWS.
2. ALL VOLTAGES ARE MEASURED BETWEEN TUBE SOCKET TERMINALS AND CHASSIS WITH ZERO SIGNAL INPUT.
3. LINE VOLTAGE — 117 V. AC.
4. ALL VOLTAGES SHOWN ARE DC UNLESS OTHERWISE SPECIFIED.
5. DC VOLTAGES SHOWN WERE MEASURED WITH AN ELECTRONIC VOLTMETER.
6. "NC" NO CONNECTION. VOLTAGE SHOWN FOR THIS TERMINAL ONLY WHEN TERMINAL IS USED AS A TIE LUG.
7. "NR" NOT READABLE. VOLTAGE MEASURED AT THESE TERMINALS GENERALLY MEANINGLESS.
8. [ ] SPACE PROVIDED FOR SERVICE METER READINGS.

7JP4 NOTES –
1. BRIGHTNESS CONTROL — MAX. / MIN. MEASURED AT JUNCTION OF C-17 AND R-85.
2. MEASURED AT PIN 6 OF TUBE V-12.

CAUTION –
THE POTENTIAL AT THESE POINTS EXCEEDS 1000 V. DC. THE HIGH IMPEDANCE OF THIS CIRCUIT WILL NOT PERMIT AN ACCURATE MEASUREMENT WITH ORDINARY TEST METERS. USE THE OVERALL MEASUREMENT DESCRIBED UNDER THE HIGH VOLTAGE OSCILLATOR ADJUSTMENT PROCEDURE AS AN INDICATION OF PROPER OPERATION.

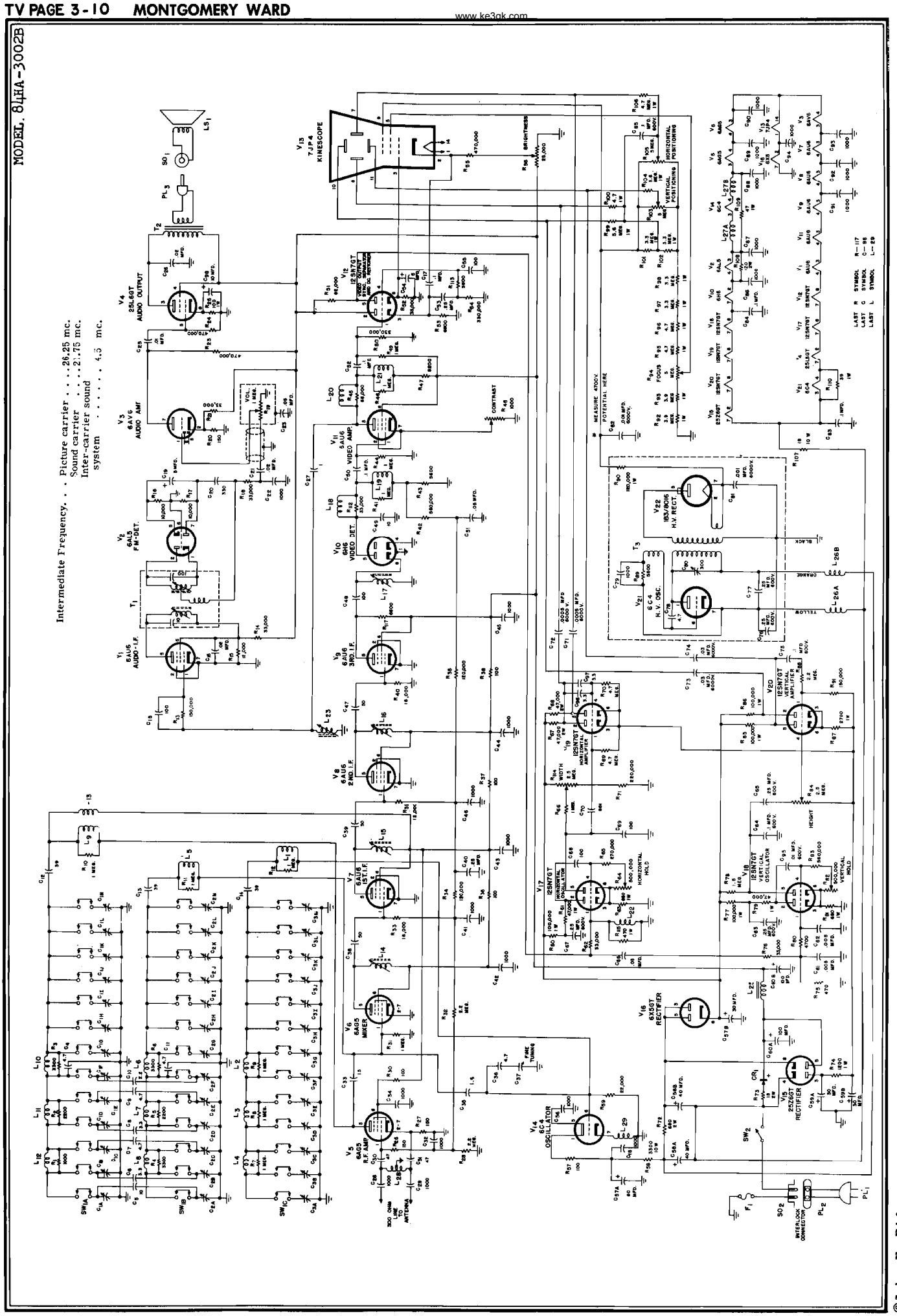
REPLACEMENT PARTS LIST

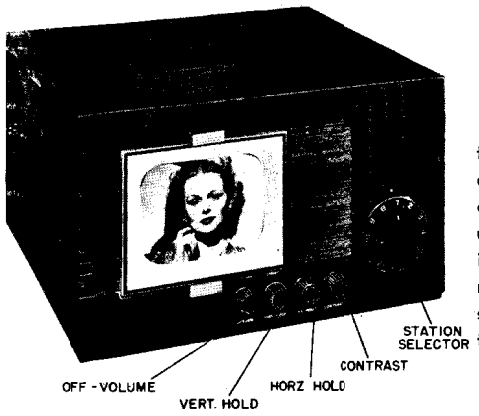
Ref. No.	Part No.	Description
CONDENSERS		
C-1	44B357	Trimmer assembly, osc. stage, 13 sections
C-2,3	44B358	Trimmer assembly, mixer and r-f amp. stage, 13 sections
C-4,7,9,11, 36,78	47A160-6	4.7 mmf. 500 V., bakelite
C-5,49	47A160-11	10 mmf. 500 V., bakelite
C-6,8,96, 97	47A160-5	3.3 mmf. 500 V., bakelite
C-10	47A160-4	2.2 mmf. 500 V., bakelite
C-12,13,14	47B20390K5	39 mmf. 500 V., ceramic
C-15,48,55, 68,69	47B20101K5	100 mmf. 500 V., ceramic
C-16,21,26	46AU203J	.02 mfd. 200 V., tubular
C-17,50,52, 83,84	46AU104J	.1 mfd. 200 V., tubular
C-18,22,28, 29,32,34, 41,42,43, 44,45,46, 56,79,86, 87,88,89, 90,91,92, 93,94	47B20A102N1	1000 mmf. 150 V., ceramic
C-19,54	45A109	5 mfd. 50 V., electrolytic
C-20	47B0331K5	330 mmf. 500 V., ceramic
C-23,51, 66	46AU503J	.05 mfd. 200 V., tubular
C-25	46AU103J	.01 mfd. 200 V., tubular
C-27	47A160-2	1 mmf. 500 V., bakelite
C-30,31	47B20470K5	47 mmf. 500 V., ceramic
C-33,35	47A160-3	1.5 mmf. 500 V., bakelite
C-37	48A199	Trimmer, FINE TUNING
C-38,39,47	47B20500K5	50 mmf. 500 V., ceramic
C-40,53	46AT254J	.25 mfd. 200 V., tubular
C-57	45B126	60-30 mfd. 300-450 V., electrolytic
C-58	45B125	40-40 mfd. 300 V., electrolytic
C-59	45B123	30-30 mfd. 200 V., electrolytic
C-60	45B124	100-100 mfd. 150 V., electrolytic
C-61,62	46AU502J	.005 mfd. 200 V., tubular
C-63,65,67, 76,77	46AX254J	.25 mfd. 600 V., tubular
C-64,75,85	46AY104J	.1 mfd. 600 V., tubular
C-70	CM20A681M	680 mmf. 500 V., mica
C-71,72	46A145	.0005 mfd. 6000 V., tubular
C-73,74	46B149	.03 mfd. 6000 V., tubular
C-80	44A359	Trimmer, adjustable, HV oscillator
C-81,82	46A146	.001 mfd. 6000 V., tubular
C-95	46AZ103J	.01 mfd. 600 V., tubular
RESISTORS		
R-1		1000 ohms 1 watt, carbon, part of coil L-12
R-2		2200 ohms 1 watt, carbon, part of coil L-11
R-3		3300 ohms 1 watt, carbon, part of coil L-10
R-4		3300 ohms 1 watt, carbon, part of coil L-8
R-5		2200 ohms 1 watt, carbon, part of coil L-7
R-6		3300 ohms 1 watt, carbon, part of coil L-6
R-7		1 megohm 1 watt, carbon, part of coil L-4
R-8		1 megohm 1 watt, carbon, part of coil L-3
R-9		1 megohm 1 watt, carbon, part of coil L-2
R-10		1 megohm 1 watt, carbon, part of coil L-9
R-11		1 megohm 1 watt, carbon, part of coil L-5
R-12		1 megohm 1 watt, carbon, part of coil L-1
R-13,91	RC20AE154M	150,000 ohms ½ watt, carbon
R-14,18,21, 52,62,76	RC20AE333M	33,000 ohms ½ watt, carbon
R-15,39	RC20AE123K	12,000 ohms ½ watt, carbon
R-16,17	RC20AE103J	10,000 ohms ½ watt, carbon
R-19	25B721	1 megohm, VOLUME control
R-20,26, 27	RC20AE151M	150 ohms ½ watt, carbon
R-23	RC20AE104M	100,000 ohms ½ watt, carbon
R-24,55	RC20AE474M	470,000 ohms ½ watt, carbon
R-25	RC30AE101M	100 ohms 1 watt, carbon
R-28,32,88	RC20AE225M	2.2 megohms ½ watt, carbon
R-30,36, 37,38,57	RC20AE101M	100 ohms ½ watt, carbon
R-31,44, 49,66	RC20AE105M	1 megohm ½ watt, carbon
R-33,40	RC20AE183K	18,000 ohms ½ watt, carbon
R-34,35	RC20AE124K	120,000 ohms ½ watt, carbon
R-41		1 megohm ½ watt, carbon, part of coil L-19
R-42,83	RC20AE564M	560,000 ohms ½ watt, carbon
R-43,89, 113	RC20AE562K	5600 ohms ½ watt, carbon
R-45		68,000 ohms 1 watt, carbon, part of coil L-20
R-46		1 megohm 1 watt, carbon, part of coil L-21
R-47	RC20AE822M	8200 ohms ½ watt, carbon
R-48	25B739	1000 ohms WW, CONTRAST control
R-50,54	RC20AE334M	330,000 ohms ½ watt, carbon
R-51	RC20AE823M	82,000 ohms ½ watt, carbon
R-53,117	RC20AE682M	6800 ohms ½ watt, carbon
R-56	25B722	25,000 ohms, BRIGHTNESS control
R-58	24BG332E	3300 ohms 10 watts, WW
R-59	RC20AE223M	22,000 ohms ½ watt, carbon

REPLACEMENT PARTS LIST (Cont.)

Ref. No.	Part No.	Description
R-60,77, 85,86	RC30AE104M	100,000 ohms 1 watt, carbon
R-61,79	RC30AE473M	47,000 ohms 1 watt, carbon
R-63,81	RC30AE681M	680 ohms 1 watt, carbon
R-64	25B720	500,000 ohms, HORIZONTAL control
RESISTORS (Cont.)		
R-65	RC20AE334M	270,000 ohms ½ watt, carbon
R-67,68	RC40AE473M	47,000 ohms 2 watts, carbon
R-69,70	RC20AE475M	4.7 megohms ½ watt, carbon
R-71	RC20AE224M	220,000 ohms ½ watt, carbon
R-72	RC40AE681M	680 ohms 2 watts, carbon
R-73	RC40AE180M	18 ohms 2 watts, carbon
R-74	RC30AE122M	1200 ohms 1 watt, carbon
R-75	RC20AE471M	470 ohms ½ watt, carbon
R-78	RC20AE155M	1.5 megohm ½ watt, carbon
R-80	RC20AE472M	4700 ohms ½ watt, carbon
R-82	25B720	500,000 ohms, VERTICAL control
R-84	25B724	2.5 megohms, HEIGHT control
R-87	RC30AE272M	2700 ohms 1 watt, carbon
R-90	RC30AE124K	120,000 ohms 1 watt, carbon
R-92,93	RC30AE395M	3.9 megohms 1 watt, carbon
R-94	25B723	5 megohms, FOCUS control
R-95,96, 100,106	RC30AE475M	4.7 megohms 1 watt, carbon
R-97,98 101,102	RC30AE335M	3.3 megohms 1 watt, carbon
R-99,104	RC30AE565M	5.6 megohms 1 watt, carbon
R-103	25B723	5 megohms, VERTICAL POSITION control
R-105	25B723	5 megohms, HORIZONTAL POSITION control
R-107	24BG180E	18 ohms 10 watts, WW
R-108	RC40AE121M	120 ohms 2 watts, carbon
R-109	RC30AE470K	47 ohms 1 watt, carbon
R-110	RC30AE390K	39 ohms 1 watt, carbon
R-112		33,000 ohms 1 watt, carbon, part of coil L-18
R-114	25B724	2.5 megohms, WIDTH control
R-115		470 ohms 1 watt, carbon, part of coil L-22
TRANSFORMERS AND COILS		
T-1	50B405	Transformer, FM sound detector
T-2	55B080-3	Transformer, audio output
T-3	51B1038	Transformer, H.V. osc.
L-1	51A1041	Coil, oscillator stage
L-2	51A1042	Coil, oscillator stage
L-3	51A1043	Coil, oscillator stage
L-4	51A1044	Coil, oscillator stage
L-5	51A1045	Coil, mixer stage
L-6	51A1046	Coil, mixer stage
L-7	51A1047	Coil, mixer stage
L-8	51A1048	Coil, mixer stage
L-9	51A1049	Coil, r-f amp. stage
L-10	51A1050	Coil, r-f amp. stage
L-11	51A1051	Coil, r-f amp. stage
L-12	51A1052	Coil, r-f amp. stage
L-13,29	53B008	Choke, RF (Red color code)
L-14,15 16,17	50A372	Coil, i-f amplifier
L-18	51A1053	Coil, video peaking, video detector
L-19	51A1054	Coil, video peaking, video detector
L-20	51A1055	Coil, video peaking, video amp.
L-21	51A1057	Coil, video peaking, video amp.
L-22	51B1040	Coil, sync. shaping
L-23	51B1037	Coil, 4.5. mc sound trap
L-25	56C093	Choke, filter
L-26	53A134	Choke, dual winding, HV oscillator
L-27	53A133	Choke, dual winding, 6C4 oscillator fil.
L-28	51A1039	Antenna coil
PLUGS AND SOCKETS		
	6A296	Socket, octal (tube)
	6A297	Socket, miniature (tube)
	6B298	Socket, kinescope (tube)
PL-1	87B1668-1	Line cord and plug PL2
SO-2	10A286	Connector, line cord
PL-3	87A1670	Connector and cord assembly, speaker
	6A287	Receptacle, fuse
MISCELLANEOUS		
	41X11203	Channel selector assembly complete (Includes PB switch, trimmers, coils, etc.)
LS-1	85B070	Speaker assembly
	8A786	Mounting board, chassis apron controls
	8B788	Mounting board, front panel controls
	8A787	Insulating board, mtg. foot brackets
	67A797	Bracket, mounting foot
	67A807	Bracket, selenium rectifier mounting
	67A809	Bracket, kinescope tube mounting
	76A393	Ring, kinescope tube mtg.
	88A574	Terminal board, resistor mounting
	69C225	Shield, H.V. power supply shield
	66B440	Bottom cover, H.V. power supply shield
	66B440-1	Top cover, H.V. power supply shield
	67B808	Bracket, pushbutton switch mounting
	63A336-1	Plate, power cord receptacle mounting
	15B141	Knob, rear chassis controls
	15B068-3	Knob, front panel controls
	17A041-1	Knob, push button & FINE TUNING
	7D071-1	Escutcheon, kinescope tube
	22B206	Window, escutcheon
	32D456	Cabinet back
F-1	39A307	Fuse, 2 amp. type 3AG

MODEL 84HA-3002B





GENERAL DESCRIPTION

The Model 94BR-3017A Television Receiver is an 18-tube, direct-view, 7-inch table model which may be operated on either alternating or direct current. The receiver is complete in one unit and is operated by the use of five front-panel controls. Features of the receiver include; complete coverage of all 12 television channels; FM sound system; and reduced-hazard high voltage supplying 5000 volts to the second anode of the picture tube.

SPECIFICATIONS

Sensitivity at the Antenna
Video—100 microvolts (400 with full contrast)
Audio—100 microvolts for 50-milliwatt output

Power-Supply Rating
105-125 volts, 50-60 cycle AC or DC, 100 watts

Audio Power Output Rating
Undistorted—1.2 watts
Maximum—2 watts

Antenna Impedance Requirements
Balanced 300-ohm

Speaker
Type—4-inch P. M.
Voice Coil Impedance (400 cycles)—3.2 ohms

Picture Size
5 1/2 x 4 1/4 inches

Dimensions
Cabinet—17" x 10" x 16 1/2"
Chassis — 15" x 8 1/2" x 14 3/4"

Tube Complement

6BH6, R-F Amplifier
6J6, Oscillator-Converter
25L6, Audio Output
19T8, Discriminator and Audio Amplifier
12AU6, Limiter
6BA6, I-F Amplifier
6BA6, I-F Amplifier
6BA6, I-F Amplifier
6AL5, 2nd Detector
12AU6, Sync Separator
12AU6, Video Amplifier
12SN7, Horizontal Multivibrator
50L6, Horizontal Output
12SN7, Vertical Multivibrator
12SN7, Vertical Output
50L6, High-Voltage Oscillator
1B3/8016, High-Voltage Rectifier
7JP4, Picture Tube

TELEVISION FREQUENCY RANGES

(All figures represent megacycles)

Channel	Channel Frequencies	Picture Carrier Frequency	Sound Carrier Frequency	Receiver RF Oscillator Frequency
Low Band				
2	54-60	55.25	59.75	12
3	60-66	61.25	65.75	88
4	66-72	67.25	71.75	94
5	76-82	77.25	81.75	104
6	82-88	83.25	87.75	110
High Band				
7	174-180	175.25	179.75	202
8	180-186	181.25	185.75	208
9	186-192	187.25	191.75	214
10	192-198	193.25	197.75	220
11	198-204	199.25	203.75	226
12	204-210	205.25	209.75	232
13	210-216	211.25	215.75	238

OPERATION OF THE RECEIVER

FUNCTIONS OF THE CONTROLS

All the controls normally used in tuning in a program — both picture and sound — are located on the front of the receiver. On the rear of the set are several controls which are preset at the factory and may need slight re-adjustment at the time of installation. After installation, they should need no further adjustment, unless required by replacement or aging of tubes, variations in power-line voltage, or other external conditions. The functions of each of the controls is described below.

On Front of Set

(See page 1)

Volume-Off — Turns set on or off and adjusts sound volume.

Vert. Hold—Stops pictures from moving up or down.

Horz. Hold—Stops pictures from moving left or right.

Contrast—Varies contrast between light and dark portions of picture.

Station Selector Knob—Tunes set to desired channel (station). May be turned in either direction.

On Rear of Set

(See page 9)

Brightness—Controls brilliance of picture.

Vert. Size — Changes size of picture vertically. Does not affect horizontal size.

Horiz. Size—Changes size of picture horizontally. Does not affect vertical size.

Focus—Focuses picture on face of picture tube.

H. Centering—Moves entire picture horizontally

V. Centering—Moves entire picture vertically.

TUNING PROCEDURE

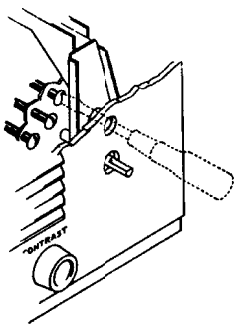
1. Turn the VOLUME control clockwise to turn the set on. Allow one-half minute for the set to warm up.
2. Set the station selector knob to the desired channel.
3. Turn the CONTRAST control fully counter-clockwise.
4. Turn the BRIGHTNESS control (on the rear of the set) fully clockwise, and then turn it slowly counter-clockwise until the picture tube just becomes dark. *For any particular installation this adjustment need be made only the first time a station is tuned in, unless required by replacement of tubes.*
5. Adjust the CONTRAST control until the proper contrast between blacks and whites is obtained.
6. Adjust the VOLUME control for the desired sound level.
7. When switching from one station to another, it may be necessary to readjust the CONTRAST control.

ADJUSTMENT OF STATION SELECTOR

The station selector has been partially pre-set at the factory, but readjustment of the settings may have to be made at the time of the initial installation.

For each station which can be received with the set, adjust the station selector in the following manner. The adjustment must be made at a time when the station is transmitting either its regular program or a test pattern.

1. Turn the set on. Allow the set to warm up for 20 minutes.
2. Turn the contrast control fully counter-clockwise.
3. Turn the brightness control (on the rear of the set) to its extreme clockwise position.* Then turn it slowly counterclockwise until the picture tube just becomes dark.
4. Turn the contrast control approximately two-thirds toward its full clockwise position.
5. Turn the volume control to mid-position .
6. Set the station selector knob to the desired channel.
7. Grasp the station selector knob around its edge and, while rocking it, *pull* it off its shaft.
8. Insert a screwdriver into the hole above the station selector knob shaft (see illustration). Turn the screw slowly counter-clockwise (and then clockwise, if necessary) until maximum sound is heard. This may require several turns in one direction or the other. Adjust the volume control if necessary. (Do not at any time force the screw in either direction if it becomes difficult to turn. The screw has then reached the end of its travel in that direction and its direction should be reversed.)



9. When the sound is at maximum, the picture** will appear on the screen but "sound bars" (dark horizontal bars of varying width) will be seen traveling vertically from bottom to top across the picture. With the screwdriver, turn the station selector screw counter-clockwise *only far enough to remove the sound bars from the picture.*
10. The station selector has now been properly adjusted for this particular channel. Replace the station selector knob and repeat the procedure for all other stations within range of the receiver.

* If the set is being operated on direct current, and at this time the picture tube does not light up, reverse the line plug in the electric outlet. Then wait 15 minutes before proceeding.
** If a steady picture is not obtained, adjust the H. HOLD and V. HOLD controls.

TELEVISION ANTENNAS

Because the antenna is such an important factor in the proper operation of a television receiver, it is thought that a brief general discussion of television antennas might properly be included here.

HEIGHT

The characteristics of transmission at the high frequencies assigned to television differ considerably from those encountered at the lower frequencies. The most important difference is that the straight-line travel of television signals, called line-of-sight propagation, does not follow the curvature of the earth as do broadcast signals. Television transmission can thus be intercepted by a hill or other obstruction, preventing reception by a receiving antenna located behind the obstruction. For this reason it is necessary that the antenna be located high enough to clear intervening obstructions.

GHOSTS

Another peculiarity of television transmission is that re-radiations from conducting structures act as secondary transmissions and may arrive at the receiving antenna at different times, thus repeating video modulation already broadcast. These repetitions appear as "ghosts" or multiple images offset slightly to the right of the true image on the face of the picture tube. When ghosts are caused by reflections from directions other than an angle close to the source of transmission, it is possible to minimize the condition by proper orientation of the receiving antenna.

LEAD-IN

The antenna is connected to the receiver through a transmission line having a characteristic impedance equal to the impedance of the antenna and to the input impedance of the receiver. Improper termination matching of a transmission line will cause reflections of energy to travel back and forth, causing ghosts if the line is long enough. However, even a short length of mismatch transmission line will cause poor definition of the picture and increase energy-transfer losses.

The 300-ohm transmission line used with this receiver is balanced to ground and should be kept as far as possible away from metal objects, including the mast of the antenna structure itself. Also, to reduce the amount of noise pick-up, the lead-in should have the shortest possible horizontal runs and should be twisted about one turn per foot. While the attenuation in this transmission line is fairly low (about 1 db per 100 feet at 90 megacycles), it is recommended that the line be kept as short as possible, with the excess cut off.

Lengths of Folded Dipole Antennas (Air Dielectric) Required at Various Frequencies

Channel	Frequency (mc)	Folded Dipole Total Length (ft.)
Low Band		
2	54-60	7.8
3	60-66	7.0
4	66-72	6.4
5	76-82	5.6
6	82-88	5.2
High Band		
7	174-180	2.51
8	180-186	2.42
9	186-192	2.35
10	192-198	2.28
11	198-204	2.21
12	204-210	2.15
13	210-216	2.09

CIRCUIT DESCRIPTIONS

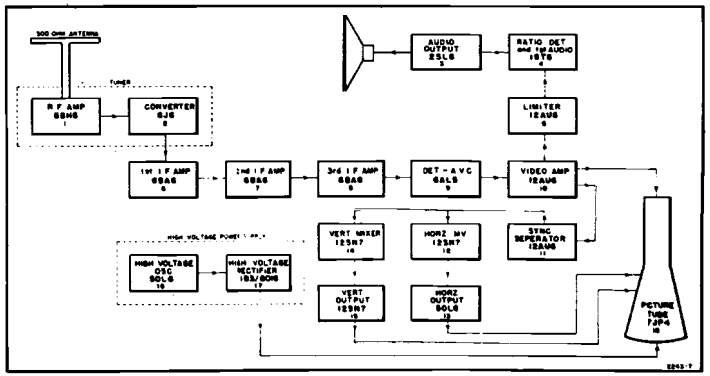


Figure 1. Complete Block Diagram

TUNER

The tuner uses a 6BH6 r-f amplifier and a 6J6 oscillator-converter. Coil L1 is an impedance-matching coil which matches the 300-ohm balanced antenna lead-in to the 6BH6, between grid and cathode.

Coils T1 and T2 are low- and high-band plate coils tuned with iron cores to the proper r-f frequencies corresponding to channel positions. These coils are coupled, by capacitors C117, C118, and C6, to converter grid coils T3 and T4, which are also tuned to the same r-f frequency. This gives an overall r-f response of 6 megacycles at 6 db down which covers the complete channel being tuned.

Coils T5 and T6 are low- and high-band oscillator coils tuned in the same manner to 22.25 megacycles above the sound carrier frequency. The signal is coupled to the converter grid, thru capacitor C13, giving a converter output of 22.25 megacycles at sound carrier and 26.75 megacycles at picture carrier.

Voltage and Resistance Readings from Tube-Socket Terminals to Ground

Tube	Terminal				
	1	2	5	6	7
1	0 100K	.7 68	80 (LB) 125 (HB) > 500K	122 500K	0 5600
2*	105 > 500K	95 > 500K	—1 10K	0 10K	2 220

*Voltage readings on pins 2, 5, and 7 taken thru an r-f choke similar to Coil L7.

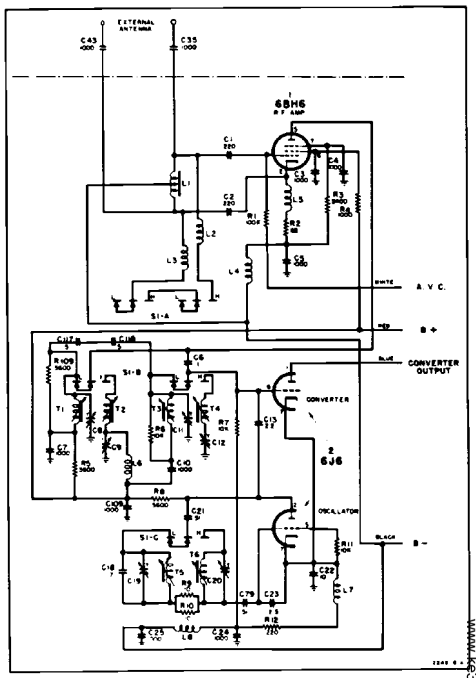


Figure 2. Tuner

INTERCARRIER SOUND SYSTEM

The intercarrier sound system utilizes the beat frequency (4.5 megacycles) between the picture carrier and the sound carrier as transmitted. Three tubes are used, a 12AU6 limiter, a 19T8 ratio detector and first audio amplifier, and a 25L6 audio output tube. Coil T9, tuned to 4.5 megacycles, picks the intercarrier sound off of the video output tube. This is fed thru capacitor C40 to the grid of limiter tube 5, the output of which is applied to the primary of the ratio detector coil T8, also tuned to 4.5 megacycles.

The dynamic limiter circuit is made up of coil L9 (self-resonant to 4.5 megacycles), capacitor C115, and

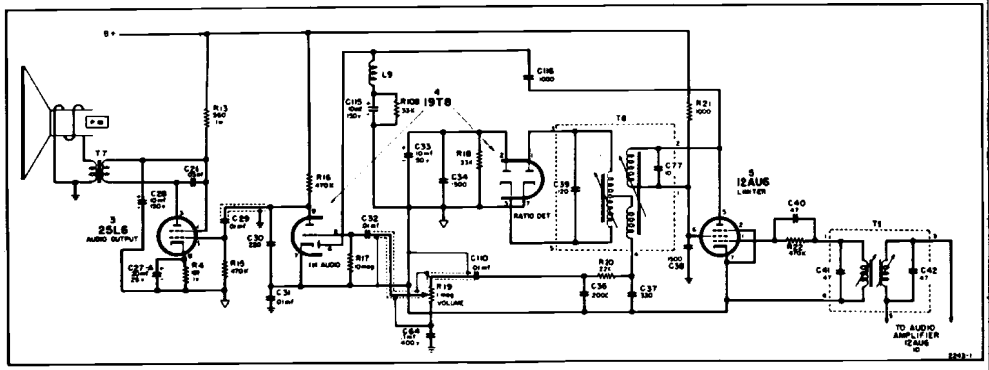


Figure 3. Intercarrier Sound System

resistor R108, coupled to the plate of the limiter tube thru capacitor C116 and back to the diode plate (pin 6) of tube 4. The limiter operates as a variable-threshold voltage regulator to maintain the instantaneous peak carrier voltage constant at its average level. This varies the damping introduced by the diode as the carrier level varies.

The double-diode section of tube 4 is used as a conventional ratio detector with the audio coming off the tertiary winding of coil T8. Capacitor C37 is the balancing capacity and resistor R20 and capacitor C36 make up the de-emphasis network. Resistor R19 is a 1-megohm tapered volume control in the grid circuit of the first audio triode portion of tube 4. This triode has a large plate load, R16, giving sufficient output to drive a conventional 25L6 output tube. The speaker is a 4-inch P.M. type with a 3.2-ohm voice coil.

The separate B+ filter to output tube 3, consisting of resistor R13 and capacitor C28, keeps audio ripple out of the B+ line. The shields around the long audio leads running to the volume control and between the two audio tubes are used to reduce hum pickup.

Voltage and Resistance Readings from Tube-Socket Terminals to Ground

Tube	Terminal								
	1	2	3	4	5	6	7	8	9
3			100 30K	100 30K	0 470K			8 180	
4	0 Inf.	0 30K	0 Inf.			0 33K	0 0	0 10 Meg.	40 500K
5	0 500K	0 0			115 30K	115 30K	0 0		

I-F SYSTEM AND DETECTOR

The i-f system uses three 6BA6 amplifiers and one 6AL5 detector. The four stagger-tuned coils—T15, T10, T11, and T12—give an overall response at 6 db of 3.5 megacycles.

Stage 1 (T15), or converter output, is tuned to 23.0 megacycles.
Stage 2 (T10) is tuned to 24 megacycles.
Stage 3 (T11) is tuned to 26.4 megacycles.
Stage 4 (T12) is tuned to 25.45 megacycles.

AVC voltage is obtained across R39, thru capacitor C66, from the second half of tube 9. This AVC voltage is fed to the first two i-f tubes and to the r-f tube in the tuner. Resistors R40 and R42 constitute an AVC delay of approximately 3 volts.

Voltage and Resistance Readings from Tube-Socket Terminals to Ground

Tube	Terminal				
	1	2	5	6	7
6	0 230K	1 6000	105 30K	105 30K	1 80
7	0 47K	1 6000	105 30K	105 30K	1 80
8	0 0	1 6000	105 30K	105 30K	1 70
9	0 0	0 100K	3 3300		0 5000

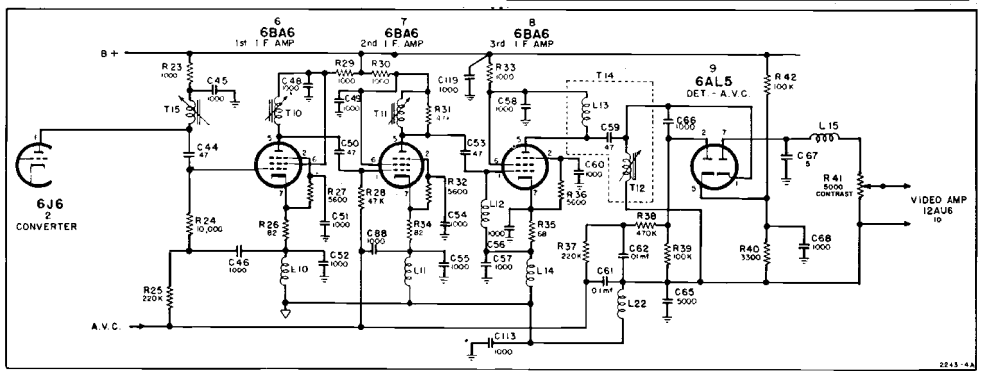


Figure 4. I-F System

VIDEO AMPLIFIER, SYNC SEPARATOR, AND D-C RESTORATION

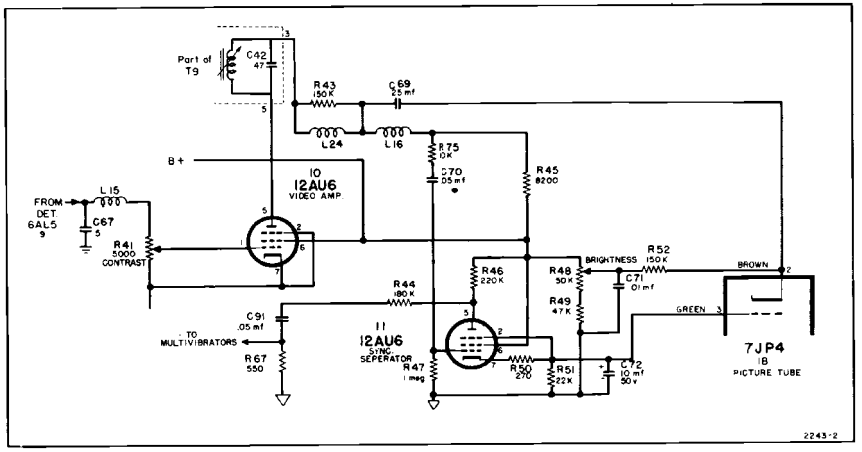


Figure 5. Video Amplifier and Sync Separator

The video amplifier uses a 12AU6 tube (10) which drives the cathode of the picture tube. This requires negative-going sync on the grid of the video tube, which provides noise clipping. Bias for the video tube is obtained from the diode load, contrast control R41. Coils L15, L24, and L16 are peaking coils which in conjunction with load resistor R45 and damping resistor R43 give a response flat to within 3 db out to 3 megacycles.

The sync separator, which separates the video information from the sync pulses, also uses a 12AU6 tube coupled to the video output tube thru capacitor C70 in series with resistor R75. The 10,000-ohm resistance isolates the capacity present in the sync clipper. The high value of resistor R51 is used to bias the tube toward cutoff to improve the capability of the tube in handling positive sync pulses present on the grid. The large value of plate resistor R46, 220,000 ohms, limits the maximum plate current, which clips the sync off above the pedestal. Unbypassed cathode resistor R50 provides sufficient degeneration to stabilize the gain of the tube.

The bypassed cathode resistor R51 and capacitor C72 give a d-c voltage which is a function of the average value of the signal. This potential is applied to the picture tube grid to re-insert the d-c component. Brightness control is accomplished by applying dc from a B+ bleeder (R48 and R49) thru isolation resistor R52 to the cathode of the picture tube.

The amplitude of the sync pulse on the plate of the sync separator tube 11 is quite high, approximately 60 volts peak to peak, so it is divided down thru resistors R44 and R67 to provide a small voltage for triggering the multivibrators.

The 4.5-megacycle sound carrier is also taken from the plate of the video amplifier tube by coil T9. The primary winding is in series with the plate lead and is tuned to 4.5 megacycles. Its effect upon the video response was taken into consideration and compensated for in coils L24 and L16.

Voltage and Resistance Readings from Tube-Socket Terminals to Ground

Tube	Terminal				
	1	2	5	6	7
10	1 max. 5000 max.	0 0	65 40K	125 30K	0 0
11	0 800K	4 20K	85 30K	125 30K	4 22K

MULTIVIBRATOR AND SWEEP CIRCUITS

The horizontal multivibrator uses a 12SN7 tube (12) and is of the conventional cathode-coupled type. Sync pulses at point A are differentiated by capacitor C90 and resistor R66 and trigger the multivibrator. Capacitor C94 and resistors R65 and R64 cause the second half of tube 12 to act as a discharge tube to form a sawtooth wave. The horizontal size control, R64, changes the amplitude of this sawtooth voltage by varying the plate load. The horizontal hold control, R69, changes the natural frequency of the multivibrator by varying the time constant of resistors R69 and R70 and capacitor C92.

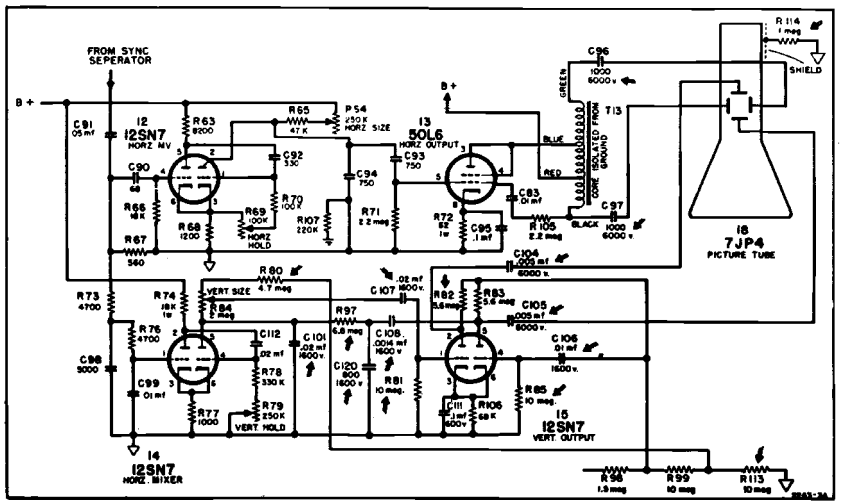


Figure 6. Multivibrator and Sweep Circuit

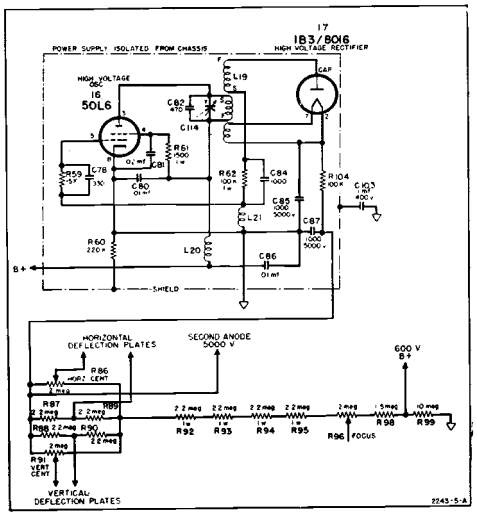


Figure 7. High-Voltage Power Supply

The multivibrator output is fed to the 50L6 output tube (13) which has a center-tapped auto-transformer in its plate circuit. This, in addition to the tube gain, provides a sufficient voltage step-up for horizontal deflection. Some distortion is introduced but is compensated for by the feedback network, capacitor C83 and resistor R105, giving a final output which is linear.

The vertical multivibrator also uses a cathode coupled 12SN7 tube (14). Sync voltage is fed to the first grid thru the integrating circuit made up of R73, C98, R76, and C99. The output is a discharge sawtooth voltage, across capacitor C101, whose amplitude is varied by vertical size control R84. The natural frequency of the multivibrator is varied by vertical hold control R79.

The discharge half of tube 14 gets its plate voltage from the high-voltage bleeder, giving a more linear discharge curve. The output of this half of the tube is fed to a 12SN7 paraphase amplifier (tube 15) which gets its phase inversion for the second grid by taking a small amount of voltage from the output of the first section thru capacitor C106. Some distortion is also introduced here which is compensated for by the feedback network consisting of resistor R97 and capacitor C108.

Voltage and Resistance Readings from Tube-Socket Terminals to Ground

Tube	Terminal						
	1	2	3	4	5	6	8
12	0 200K	50 200K	3 12K	0 18K	100 30K	3 12K	
13			120 30K	120 30K	0 2.2 Meg.		1 62
14	0 10K	80 30K	2 1000	0 400K	30 30K	2 1000	
15	0 4.7 Meg.	200 10 Meg.	15 68K	0 4.7 Meg.	200 10 Meg.	15 68K	

HIGH-VOLTAGE SUPPLY

The high-voltage supply combines the high-voltage oscillator, rectifier, and filter in a separate chassis mounted on the main chassis. This assembly uses a 50L6-GT/G tube (16) as an oscillator plate-tuned to approximately 250 kilocycles. The voltage is stepped up to 5000 by the secondary of coil L19 and is rectified by the 1B3/8016-GT rectifier. Filament voltage for the rectifier is obtained from a separate coil coupled to the oscillator tank. Since there is no way to measure the r-f current in the filament, a visual test must be used comparing the brilliance with that obtained by the use of a 1.2-volt battery on a similar tube.

The complete supply is mounted on insulated shoulder washers, isolating it from the main chassis and thus reducing r-f hum. B minus is connected to the shield thru 220,000 ohms (R60) to bleed off any static charge that may build up. The shield is connected to the main chassis thru capacitor C103; this helps to reduce r-f radiation from the high-voltage shield.

Resistor R104 and capacitors C85 and C87 constitute a filter network which removes the rf from the d-c output.

The power supply works into effectively a 13-megohm load and delivers approximately 400 microamperes, part of the load being the vertical output tube and one-half the vertical multivibrator. Trimmer C114 tunes the oscillator tank and can adjust the output to more than 5000 volts. For proper operation this should be reduced to 5000 volts by a clockwise rotation of the trimmer after peaking.

Voltage and Resistance Readings from Tube-Socket Terminals to Ground

Tube	Terminal					
	2	3	4	5	8	Cap.
16		127 3000	100 1500	0 15K	0 0	
17	5000 13 Meg.					0 100K

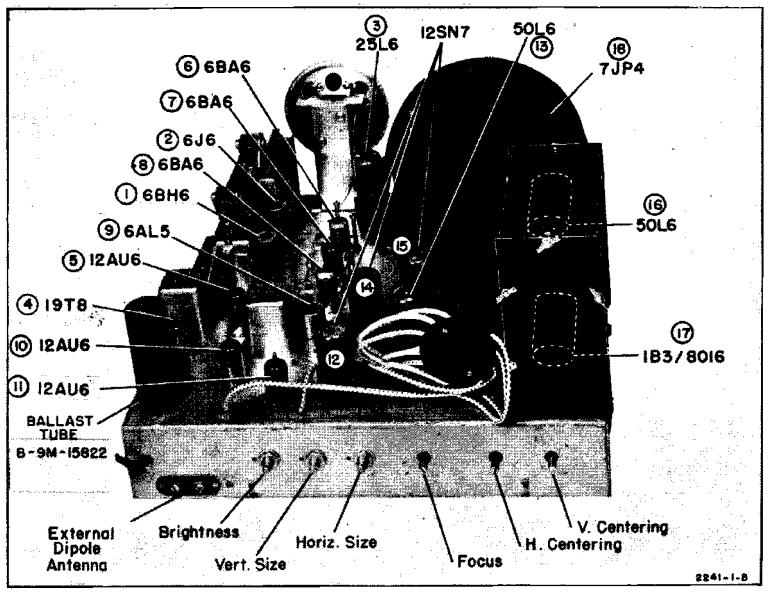


Figure 8. Location of Tubes and Rear Controls

ALIGNMENT PROCEDURES

VIDEO I-F ALIGNMENT

Equipment Required: DC vacuum-tube voltmeter (Volt-ohmyst or equivalent) equipped with high-frequency probe.
Signal generator (4.5 to 220 mc)
Sweep generator (4.5 to 220 mc with 10-mc sweep)
Oscilloscope (2.5-mc bandwidth)

1. Connect the signal generator, thru a 47-mmf capacitor, to the converter. Ground the generator to the tuner cover. The converter connection may be made thru a hole in the tuner cover (figure 9).
2. Connect the voltmeter across contrast control R41. Turn the contrast control full on.
3. Switch the tuner to the high band.
4. With the signal generator set at the specified alignment frequencies, tune the corresponding coils for maximum response on the output meter, as indicated below. All the coils are slug tuned. (See figure 9.)

Stage	Frequency (mc)	Adjustment
1st IF (Converter)	23.0	T15
2nd IF	24.0	T10
3rd IF	26.4	T11
4th IF (Diode)	25.45	T12

5. Connect a sweep generator to the converter and an oscilloscope in place of the meter. (See figure 10.) Check the peaks of the response for symmetry.

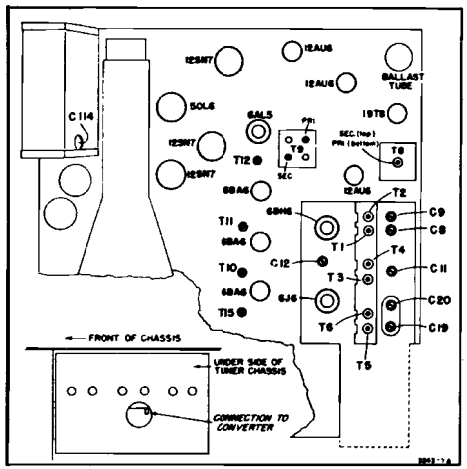


Figure 9

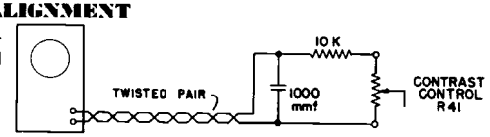


Figure 10

Re-adjust T12 if necessary. (The signal generator and meter may be used for this purpose.)

6. With the signal generator and meter, check the IF sensitivity. At peak response this should be 1000 microvolts ±50% for .5 volt dc on the meter.
7. Check the IF video-carrier to sound-carrier ratio. Make the measurement as follows: At maximum response, determine the average sensitivity between peaks and valley of the response curve, for an output of .5 volt. Next set the generator input to twice this sensitivity figure and detune the generator, in the high frequency direction, until the meter reading returns to .5 volt. Record this generator input, the "video carrier sensitivity." Now decrease the frequency of the signal generator 4.5 megacycles and again adjust the generator input to give a meter reading of .5 volt. This input is the "sound-carrier sensitivity." The ratio of sound carrier sensitivity to video-carrier sensitivity should be between 5:1 and 10:1.

   In the event the signal generator output is not calibrated in microvolts, the following procedure may be employed: Short the AVC to B- by connecting a clip lead in shunt with capacitor C61. Adjust the signal generator to a frequency corresponding to the average output level between the peaks and valley. Adjust the signal generator output level to produce 4 volts dc across the contrast control. Next detune the signal generator in the high frequency direction until the meter reading falls to 3.4 volts. Now decrease the frequency of the signal generator 4.5 megacycles and note the dc voltage across the contrast control. The dc voltage should be between 1-½ and 2-½ volts, which corresponds to a ratio of between 5:1 and 10:1.
8. Connect the sweep generator to the antenna terminals. (If the sweep generator available does not have a balanced output, connect it as shown in figure 11.) Check channels 2, 4, 6, 7, 9, 13 for overall response, keeping the generator output at a level which will provide approximately a 2-volt peak-to-peak output. If the set does not track properly,* refer to the tuner alignment procedure.
9. Connect the signal generator (see figure 11) to the antenna terminals and the voltmeter in place of the oscilloscope.
10. Check the overall sensitivity. At a frequency corresponding to the average response, the sensitivity, for a .5-volt output across the diode load, should be between 200 and 800 microvolts for the low band and between 200 and 1200 microvolts for the high band.
11. Check the overall video-carrier to sound-carrier ratio. Use the procedure described in step 7, except that the generator should be detuned in the *low* frequency direction for the video carrier and the frequency should be *increased* from there for the sound carrier. The overall ratio should be between 5:1 and 15:1.

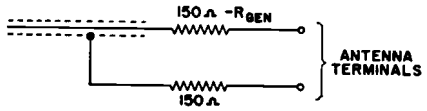


Figure 11

* See step 9 of tuner alignment procedure.

SOUND I-F ALIGNMENT

1. Connect the CW signal generator across the contrast control. Turn the contrast control on full. Turn volume control on full. Short the antenna input.
2. Connect the voltmeter from pin 8 of tube 19T8 to B- (negative side to B-).
3. With the generator apply a 4.5-megacycle CW signal. Adjust the input for a meter reading of approximately .5 volt.
4. Turn the slug in the secondary of ratio detector transformer T8 all the way out.
5. Tune primary and secondary of pick-off coil T9 for maximum reading on the meter.
6. Connect the oscilloscope in place of the meter and the sweep generator in place of the CW generator.
7. Apply a signal which will sweep 500 kilocycles above and below 4.5 megacycles. (The sound IF selectivity response curve of coil T9 will be seen.)
8. Turn in the slug of the ratio detector secondary (T8) until the ratio detector curve appears. Adjust this slug for maximum linearity.
9. Adjust the primary of ratio detector transformer T8 for symmetry of the ratio detector curve about the 4.5-megacycle center.

TUNER ALIGNMENT

1. Acjust the tuning cores to the positions shown in figure 12.
2. Pre-set the trimmers approximately to the dimensions shown in figure 13. Measurements are made from shoulder of screw head to chassis.
3. Switch to channel 6 on the low band and set the channel 6 station selector screw out 1 turn from its maximum "in" position.
4. Connect an oscilloscope across contrast control R41, as shown in figure 10. Turn the contrast control on full.
5. Connect a sweep generator to the antenna terminals and adjust the generator until a response curve (may vary considerably from figure 14) appears on the oscilloscope screen. The generator should have a balanced output; if it does not, connect it as shown in figure 11.
6. Alternately adjust r-f trimmers C8 and C11 for maximum response with symmetrical peaks.

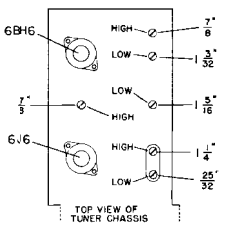


Figure 13

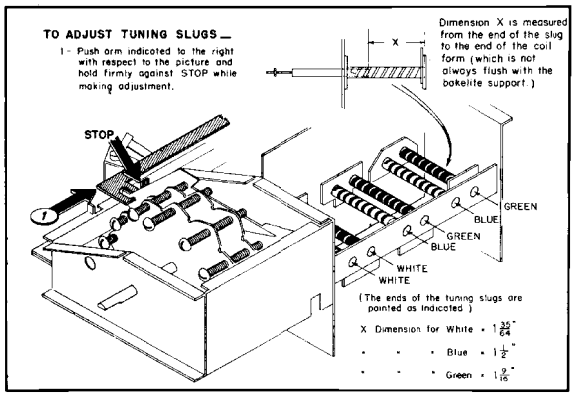


Figure 12. Tuner Core Adjustment
(On later models, green-painted cores have been changed to red.)

7. Connect a signal generator (see figure 11) to the antenna terminals and apply an 83.25-megacycle signal (channel 6 video-carrier frequency). A marker should appear on the oscilloscope (see figure 14).
8. Adjust oscillator trimmer C19 until the marker is 50% down on the low-frequency slope. It may be necessary to repeat step 6.
9. Switch to each of the other channels on the low band and check the symmetry of the response curve for each switch position. (The sweep generator will have to be reset for each channel). Use trimmers C8 and C11 to effect a compromise which will give the best overall response across the band. The important thing is that deviations from a flat top be kept to a minimum. This may mean that the response for some channels will have to be improved at the expense of others.
10. Switch to channel 2, apply a 55.25-megacycle signal, and note the position of the marker on the response curve. If the marker can be moved to the 50% point by adjustment of the channel 2 station-selector screw (with the screw still at least 2 turns in from its maximum "out" position), the alignment of the low band has been properly completed.
11. Switch to channel 13 on the high band and set the channel 13 station selector screw out ¾ turn from its maximum "in" position.
12. Re-adjust the sweep generator so that the response curve appears on the screen.
13. Adjust r-f trimmers C9 and C12 alternately for maximum response with symmetrical peaks.
14. With the signal generator, apply a 211.25-megacycle signal (channel 13 video-carrier frequency).
15. Adjust oscillator trimmer C20 until the marker is 50% down on the low-frequency slope. It may be necessary to repeat step 13.
16. Switch to each of the other channels on the high band and check the symmetry of the response curve for each switch position. (The sweep generator will have to be reset for each channel.) Use trimmers C9 and C12 to effect a compromise which will give the best overall response curve across the band. (See step 9 for definition of "best".)
17. Switch to channel 7, apply a 175.25-megacycle signal, and note the position of the marker on the response curve. If the marker can be moved to the 50% point by adjustment of the channel 7 station-selector screw (with the screw still at least one turn in from its maximum "out" position), the alignment of the high band has been properly completed.

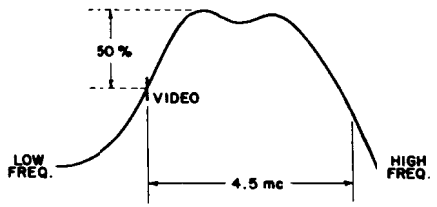


Figure 14. Ideal Response Curve

TROUBLE-SHOOTING

Trouble	*Probable Location*	*Reference*
No raster **Sound normal**	a. Improper high voltage (approximately 5000 volts is normal). b. Check voltage between grid and cathode of picture tube; should be only about 40 volts dc. c. Check output of tubes 13 an 15. d. Defective picture tube.	a. Fig. 7 c. Fig. 6
No picture **No sound** **Raster normal**	a. Defective antenna or lead-in connections. b. Defective tubes 1, 2, 5 thru 10. c. Defective band switch. d. Check resistances and voltages at sockets of tuner and i-f tubes. e. Check alignment.	a. Page 4 b. Fig. 8 c. Fig. 2 d. Pages 5, 6 e. Pages 10, 11, 12
No sound **Picture normal**	a. Defective tubes 3, 4, 5. b. Check coil T9 for continuity. c. Check alignment of ratio detector coil T8 and pick-off coil T9.	a. Fig. 8 b. Fig. 3 c. Page 11
No picture **Sound normal** **Raster normal**	a. Defective capacitor C69.	a. Fig. 5
No sync.	a. Defective tubes 11, 12, 14. b. Defective resistors R44, R46, R73, R76 or capacitor C91. c. Check voltages and resistances at sockets of tubes 11, 12, 14.	a. Fig. 8 b. Figs. 5, 6 c. Pages 7, 8
No vertical sync. **Picture normal**	a. Defective tube 14. b. Defective resistors R73, R76, R77 or capacitors C98, C99, C112. c. Check resistances and voltages at socket of tube 14.	a. Fig. 8 b. Fig. 6 c. Page 8
No horizontal sync.	a. Defective tube 12. b. Defective resistors R66, R67, R68 or capacitor C90. c. Check resistances and voltages at socket of tube 12.	a. Fig. 8 b. Fig. 6 c. Page 8
No vertical sweep	a. Improper high voltage (should be approximately 5000 volts). b. Defective tube 15. c. Check output of tube 14. d. Defective capacitors C104, C106, C107.	a. Fig. 7 b. Fig. 8 c. Fig. 6 d. Fig. 6
No horizontal sweep	a. Defective tube 13. b. Check output of tube 12. c. Defective capacitors C93, C96, C97.	a. Fig. 8 b. Fig. 6 c. Fig. 6
Bunching at side of picture	a. Defective tube 13. b. Defective capacitors C83, C95 or resistor R105.	a. Fig. 8 b. Fig. 6
Bunching at top or bottom of picture	a. Defective tube 15. b. Defective resistors R82, R83, R97 or capacitors C106, C108.	a. Fig. 8 b. Fig. 6
Audio in picture	a. Check ratio measurements. b. Check alignment.	a. Page 10 b. Pages 10, 11, 12
Picture cannot be centered vertically	a. Check range of vertical centering control R91. b. Defective resistors R88, R90. c. Leakage in capacitors C104, C105.	a. Fig. 7 b. Fig. 7 c. Fig. 6
Picture cannot be centered horizontally	a. Check range of horizontal centering control R86. b. Defective resistors R87, R89. c. Leakage in capacitors C96, C97.	a. Fig. 7 b. Fig. 7 c. Fig. 6
Insufficient vertical sweep size	a. Check voltage at junction of resistors R98 and R99; should be between 600 and 700 volts. b. Defective tubes 14 and 15. c. Defective resistors R82, R83.	a. Fig. 7 b. Fig. 8 c. Fig. 6

Insufficient horizontal sweep size	a. Defective tubes 12 and 13. b. Defective capacitors C93, C96, C97. c. Check resistances and voltages at sockets of tubes 12 and 13.	a. Fig. 8 b. Fig. 6 c. Page 8
Inability to focus picture	a. Check voltage range on focus control; should be between 1500 and 2000 volts. b. Defective picture tube.	a. Fig. 7
Streaks in picture	a. Check lead dress in high-voltage supply to prevent corona or arcing. b. Check antenna system to minimize effects of external electrical disturbances. c. Noisy or gassy tubes. d. Check rubber insulation on rear picture-tube support.	a. Page 4
High voltage below normal	a. Defective tubes 16, 17. b. Defective capacitors C85, C87 or resistor R61.	a. Page 8 b. Fig. 7
RF in Picture	a. Check for short between r-f power supply shield and chassis.	a. Page 9

REPLACEABLE PARTS LIST

Ref. Symbol	Part No.	Description
Capacitors		
C1-2-14-15-16-17	C-8G-16045	220 mmf, 20%
C3-4-5-7-10-24-25-109	C-8G-13201	1000 mmf
C6	A-8G-12495-2	1.0 mmf
C8-9-11-12-19-20	B-201-15142	Trimmer capacitor
C13	A-8G-12495-4	2.2 mmf
C18	C-8G-15224	7 mmf, ±1/2 mmf
C21-79	C-8G-11891	51 mmf, ±5%
C22	C-8G-11789	10 mmf, ±10%
C23	C-8G-15737	2.5 mmf, ±20%
C117-118	A-8G-12495-7	.5 mmf
Resistors		
R1	C-9B1-86	100,000 ohms, 1/2 watt, 10%
R2	C-9B1-48	68 ohms, 1/2 watt, 10%
R3-5-8-109	C-9B1-71	5600 ohms, 1/2 watt, 10%
R4	C-9B1-13	1000 ohms, 1/2 watt, 20%
R6-7-11	C-9B1-74	10,000 ohms, 1/2 watt, 10%
R9-10	C-9B1-38	10 ohms, 1/2 watt, 10%
R12	C-9B1-54	220 ohms, 1/2 watt, 10%
Coils		
L1	A-201-15676	Antenna coil

Ref. Symbol	Part No.	Description
TUNER		
L2-3		No. 18 tinned copper wire, straight, bare
L4-5-6-7-8	A-16A-16637	RF choke
T1-3	B-13E-12046	RF coil, low band
T2-4	A-201-15675 or	RF coil, high band (uses core with green end)
	B-13D-12155	RF coil, high band (uses core with red end)
T5	B-13D-12155	Oscillator coil, low band
T6	A-13D-12045	Oscillator coil, high band
Miscellaneous		
	A-15C-10717	Tube socket, 7-prong, miniature
	A-51A-15713	Iron core, for coils T5, T6
*	A-51A-15714	Iron core, for coils T2, T4 (green end)
*	A-51A-16391	Iron core, for coils T2, T4 (red end)
	A-51A-15715	Iron core, for coils T1, T3
	A-2M-16276	Core mounting clip
	A-2J-11593	Switch contact, sliding
	B-5F-11592	Contact holder, Bakelite
	B-2L-15894	Switch lever (shipped assembled to stud, part number A-3C-15505)
	A-2M-15504	Leaf spring
	A-49A-15977	Coil spring
	C-5M-15487	Treadle bar, Bakelite
	B-200-15987	Tuner shaft assembly
	A-49A-15837	Detent spring
POWER SUPPLY		
Capacitors		
C78	C-8F3-119	330 mmf, 500 volts, 10%, mica
C80	C-8D-11738	.01 mf, 200 volts
C81	C-8D-11304	.02 mf, 200 volts
C82	C-8F3-121	470 mmf, 500 volts, 10%, mica
C84	C-8G-13201	1000 mmf, ceramic
C85-87	B-8D-13523	1000 mmf, 6000 volts
C86	A-8G-16019	.01 mf, ceramic
C114	A-8E-15555	Trimmer
Resistors		
R59	C-9B1-76	15,000 ohms, 1/2 watt, 10%
R60	C-9B1-27	220,000 ohms, 1/2 watt, 20%
R61	C-9B2-66	2200 ohms, 1 watt, 10%
R62	C-9B2-25	100,000 ohms, 1 watt, 20%
R104	C-9B1-25	100,000 ohms, 1/2 watt, 20%
Miscellaneous		
L19	B-201-15557	High-voltage oscillator coil
L20	B-16A-13524	RF choke coil
L21	A-201-15556	Grid choke coil assembly
	A-15B-10440	Tube socket, octal

REPLACEABLE PARTS LIST (continued)

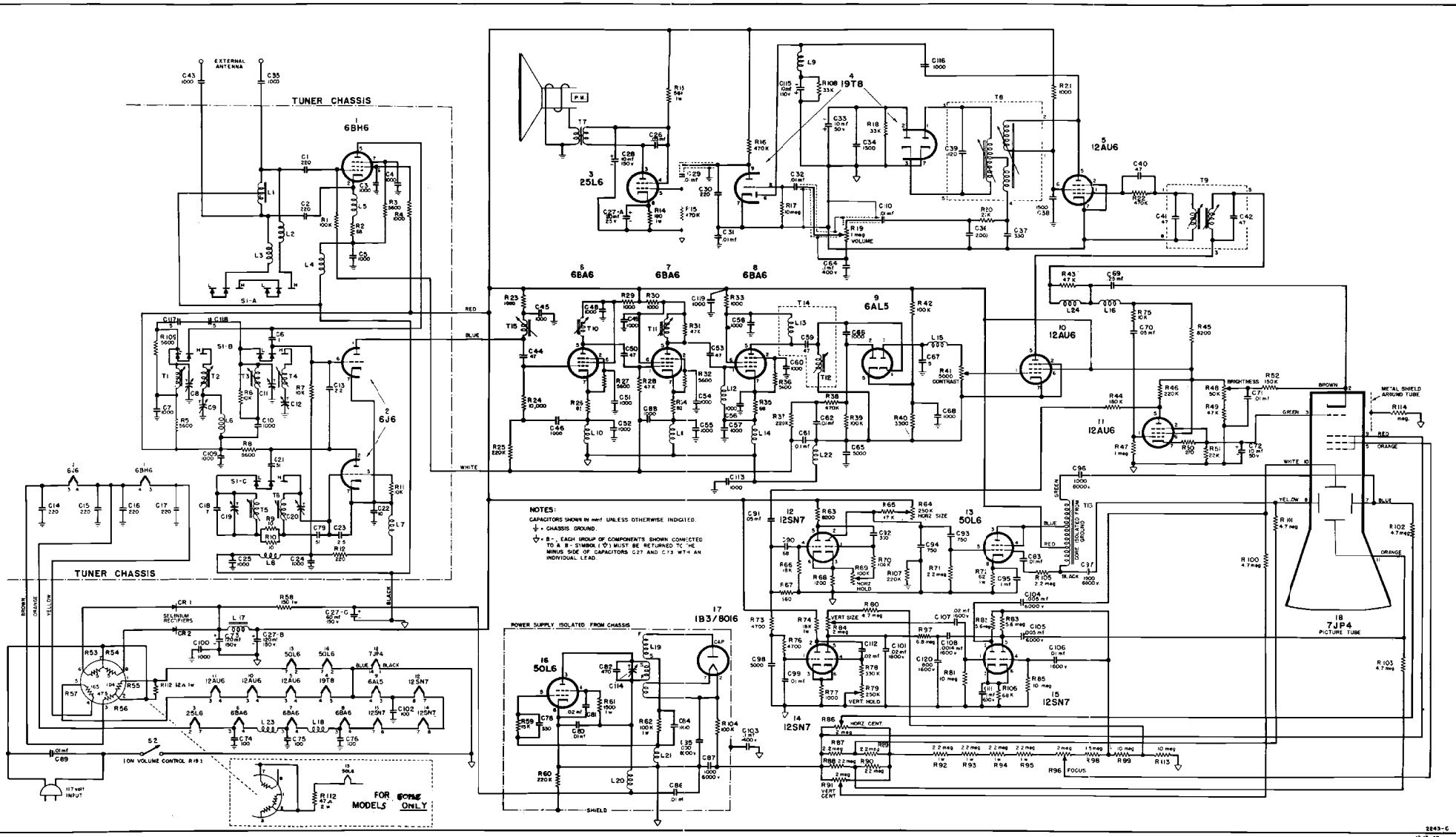
Ref. No.	Part No.	Description
Coils and Transformers		
L9	A-201-16379	Choke coil
L10-11-14-18-22-23	A-16A-16637	Filament choke coil
L12	A-201-15608	Plate choke coil
L13	A-201-15608	Plate choke coil (part of coil T14)
L15	A-201-16170	Peaking coil No. 1
L16	A-201-16172	Peaking coil No. 3
L17	C-16A-15624	Filter choke
L24	A-201-16171	Peaking coil No. 2
T7	B-12C-10074-4	Output transformer
T8	C-201-15717	IF transformer assembly (includes capacitor C39 [120 mmf] and C77 [10 mmf])
T9	C-201-16155	Sound pick-off coil assembly (includes capacitors C41 and C42, 47 mmf each)
T10-11-'5	B-201-15612	Stagger tuned coil assembly
T12	B-201-15612	Stagger tuned coil (part of coil T14)
T13	B-12M-15662	Horizontal deflection transformer
T14	B-201-15945	Last IF coil assembly

Ref. No.	Part No.	Description
Miscellaneous		
	A-15B-10440	Tube socket, 8-prong
	A-15C-13174	Tube socket, 7-prong, miniature
	A-15C-16297	Tube socket, 9-prong, miniature
	B-15B-13785	Electrolytic mounting plate
	B-14M-11085-1	Line cord and plug
	B-21J-15661	Selenium rectifier
	B-18A-15618	Speaker, 4-inch, P.M.
	A-200-15732	Strap assembly for front of picture tube
	B-200-16300	Strap assembly for rear of picture tube
	B-15B-15622	Cable assembly and socket for picture tube
	B-9M-15822	Ballast tube (includes resistors R53 thru R57)
	A-51A-16693	Iron core for stagger tuned coil assembly (part No. B-201-15612)
	A-25B-10736	Rubber foot for cabinet
	C-2M-15904-2	Escutcheon mask
	C-30M-15905	Safety glass
	B-5B-15782-57	Knob (4 used on front)
	B-5B-15759-57	Knob for station selector

MAIN CHASSIS

Ref. No.	Part No.	Description
Capacitors		
C26	C-8D-10992	.03 mf, 200 volts, 20%
C27-A, -B, -C	B-8C-15948	Electrolytic, 20 mf-25 volts, 120 mf-150 volts, 60 mf-150 volts
C28-115	A-8C-11495	Electrolytic, 10 mf-150 volts
C29-31-32-62-71-83-89-99-110	C-8D-11738	.01 mf, 200 volts, 20%
C30	C-8G-11733	220 mmf, ceramic
C33-72	A-8C-13132	Electrolytic, 10 mf-50 volts
C34-38	C-8G-11731	1500 mmf, ceramic
C35-43-45-46-48-49-51-52-54-55-56-57-58-60-66-68-88-100-113-116-119	C-8G-13201	1000 mmf, ceramic
C36	C-8D-10778	.002 mf, 600 volts +40—15%
C37-92	C-8F3-119	330 mmf, 500 volts, 10%, mica
C39		See transformer T8
C40-44-50-53	C-8F3-109	47 mmf, 500 volts, 10%
C41-42		See coil assembly T9
C59	C-8G-12198	47 mmf (part of coil T14)
C61-95	C-8D-10771	.1 mf, 200 volts, +30%—10%
C64-103	C-8D-10760	.1 mf, 400 volts, +30%—10%
C65	A-8G-13962	.005 mf, ceramic
C67	C-8G-12166	5 mmf, ceramic
C69	C-8D-10775	.25 mf, 200 volts, +30—10%
C70-91	C-8D-10770	.05 mf, 200 volts, 20%
C73	B-8C-15664	Electrolytic, 120 mf, 150 volts
C74-75-76-102	C-8G-11734	100 mmf, ceramic
C77		See transformer T8
C90	C-8F3-111	68 mmf, 500 volts, 10%, mica
C93-94	C-8F3-246	750 mmf, 300 volts, 5%, mica
C96-97	B-8D-13523	.001 mf, 6000 volts
C98	C-8D-10935	.005 mf, 600 volts, +40%—10%
C101, 107	C-8D-16578	.02 mf, 1600 volts, 10%
C104-105	B-8D-16574	.005 mf, 6000 volts,
C106	B-8D-16577	.01 mf, 1600 volts
C111	C-8D-10983	.1 mf, 600 volts, +30%—10%
C108	B-8D-16576	.0014 mf, 1600 volts, 10%
C112	C-8D-11304	.02 mf, 200 volts, 20%
C120	B-8D-16575	800 mmf, 1600 volts
Resistors		
R13	C-9B2-59	560 ohms, 1 watt, 10%
R14	C-9B2-53	180 ohms, 1 watt, 10%
R15-16-22-38	C-9B1-94	470,000 ohms, 1/2 watt, 10%
R17-81-85-99-113	C-9B1-37	10 megohms, 1/2 watt, 20%
R18-108	C-9B1-80	33,000 ohms, 1/2 watt, 10%
R19	A-10A-15666	Volume control and switch (1 megohm)
R20-51	C-9B1-78	22,000 ohms, 1/2 watt, 10%
R21-23-29-30-33	C-9B1-13	1000 ohms, 1/2 watt, 20%
R24-75	C-9B1-19	10,000 ohms, 1/2 watt, 20%
R25-37-46-107	C-9B1-27	220,000 ohms, 1/2 watt, 20%
R26-34	C-9B1-133	82 ohms, 1/2 watt, 5%
R27-32-36	C-9B1-71	5600 ohms, 1/2 watt, 10%
R28-34-43-49-65	C-9B1-82	47,000 ohms, 1/2 watt, 10%
R35	C-9B1-131	68 ohms, 1/2 watt, 5%
R39-42-70	C-9B1-86	100,000 ohms, 1/2 watt, 10%
R40	C-9B1-68	3300 ohms, 1/2 watt, 10%
R41	A-10B-15272	Contrast control (5000 ohms)
R52	C-9B1-26	150,000 ohms, 1/2 watt, 20%
R44	C-9B1-89	180,000 ohms, 1/2 watt, 10%
R45-63	C-9B1-73	8200 ohms, 1/2 watt, 10%
R47, 114	C-9B1-31	1 megohm, 1/2 watt, 20%
R48	A-10B-15672	Brilliance control (50,000 ohms)
R50	C-9B1-55	270 ohms, 1/2 watt, 10%
R53 thru R57		See "Ballast tube" under "Miscellaneous"
R58	C-9B2-8	150 ohms, 1 watt, 20%
R64	A-10B-15614	Horizontal size control (250,000 ohms)
R66	C-9B1-77	18,000 ohms, 1/2 watt, 10%
R67	C-9B1-59	560 ohms, 1/2 watt, 10%
R68	C-9B1-161	1200 ohms, 1/2 watt, 5%
R69	B-10B-15670	Horizontal hold control (100,000 ohms)
R71-87-88-89-90-105	C-9B1-102	2.2 megohms, 1/2 watt, 10%
R72	C-9B2-130	62 ohms, 1 watt, 5%
R73-76	C-9B1-70	4700 ohms, 1/2 watt, 10%
R74	C-9B2-77	18,000 ohms, 1 watt, 10%
R77	C-9B1-159	1000 ohms, 1/2 watt, 5%
R78	C-9B1-92	330,000 ohms, 1/2 watt, 10%
R79	B-10B-15671	Vertical hold control (250,000 ohms)
R80-100-101-102-103	C-9B1-35	4.7 megohms, 1/2 watt, 20%
R83-82	C-9B1-249	5.6 megohms, 1/2 watt, 5%
R84	A-10B-16250	Vertical size control (2 megohms)
R86-91-96	B-10B-15627	Horizontal centering, vertical centering, and focus controls (2 megohms each)
R92-93-94-95	C-9B2-239	2.2 megohms, 1 watt, 5%
R97	C-9B1-108	6.8 megohms, 1/2 watt, 5%
R98	C-9B2-235	1.5 megohms, 1 watt, 5%
R106	C-9B1-84	68,000 ohms, 1/2 watt, 10%
R112	C-9B2-130	62 ohms, 1 watt, 10%
R112	C-9B4-5	47 ohms, 2 watts, 20%

*Order core with same color end as the one being replaced.



Schematic Diagram