CIRCUIT DESCRIPTION

This table model Television Receiver is designed to provide complete Television and FM broadcast reception of the 12 Television channels and the FM band. The chassis incorporates twenty-one tubes including rectifiers and a 10-inch, direct viewing picture tube which provides a 52 square inch picture area. Other features include: Automatic picture synchronizer; brilliant, clear picture free from image distortion; FM sound system with high fidelity audio and automatic bass compensation; 7" x 5" oval P.M. speaker; simplified controls mounted on front panel; and non-hazardous high voltage power supply.

Approximate dimensions of the cabinet are: 20½" wide, 9$\frac{1}{16}$" deep, and 13½" high.

The weight of the receiver is as follows: Shipping weight, including picture tube, 92 lbs.; net weight 76.5 lbs.

1.01 Electrical Specifications:

Power Requirements: 117 volts, 60 cycle a.c.

Power Consumption: 235 watts—television
185 watts—FM

Audio Power Output: 4 watts maximum

Receiver Antenna Input Impedance: 73 ohms unbalanced

TUBE COMPLEMENT:

Symbol	Tube Type	Function
V-101	6J6	R.F. Amplifier
V-102	6AK5	R.F. Mixer
V-103	6J6	R.F. Oscillator
V-1	6AG5	1st Video I.F. Amplifier
V-2	6AG5	2nd Video I.F. Amplifier
V-3	6AG5	3rd Video I.F. Amplifier
V-4	6AL5	Video Detector and Sync Limiter
V-5	12AU7	1st and 2nd Video Amplifier
V-6	10BP4	Picture Tube (Models 9-403M and 9-413B)
V-6	10FP4	Picture Tube (Models 9-403M2 and 9-413B2)
V-7	6AU6	1st Sound I.F. Amplifier
V-8	6AU6	2nd Sound I.F. Amplifier
V-9	6T8	Sound Det. and 1st Audio Amplifier
V-10	6V6GT	Audio Output
V-11	6SN7GT	Sync. Amplifier and Separator
V-12	6SN7GT	Vertical Oscillator and Output
V-13	6SN7GT	Horizontal Osc. and Sync Guide
V-14	6BG6G	Horizontal Output
V-15	5V4G	Damper
V-16	1B3GT	High Voltage Rectifier
V-17	5Y3GT	Low Voltage Rectifier
V-18	5Y3GT	Low Voltage Rectifier

Picture Size: 8½" x 6⅝"

Picture I.F. Frequencies:

Picture Carrier Frequency.....26.4 mc
Adjacent Channel Sound Trap.....27.9 mc
Accompanying Sound Trap.....21.9 mc
Video Trap..... 4.5 mc

Sound Carrier Frequency:.....21.9 mc

Sound band width (between peaks).....200 kc min.

Video Response:.....To 4 mc

Focus:.....Magnetic

Deflection:.....Magnetic

Horizontal Scanning Frequency: ...15,750 cps.

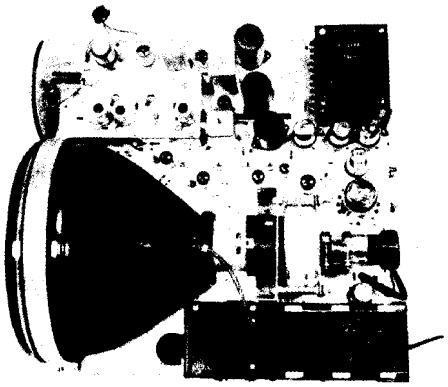


Figure 1. Chassis View

Vertical Scanning Frequency:.....60 cps.
Frame Frequency:.....30 cps.
Scanning:.....Interlaced, 525 lines

1.02 Controls:

Front Panel (Operating Controls):

Tuning.....from 44 to 216 mc

On-off switch, sound volume—varies audio level

Contrast, Brightness } Dual Control { Varies video gain; Adjusts picture background

Selection switch....Selects FM or Television

Rear of Chassis:

Focus
Vertical Hold
Horizontal Hold
Vertical Linearity
Height
Horizontal Lock-in Range, Horizontal Frequency, Horizontal Drive } Mica Trimmer Adjustments

Rear Top of Chassis:

Horizontal Linearity
Width

Adjustment of ion trap, focus coil, and deflection yoke positions are made by wing screws and nuts.

The focus coil is used to center the picture horizontally and vertically.

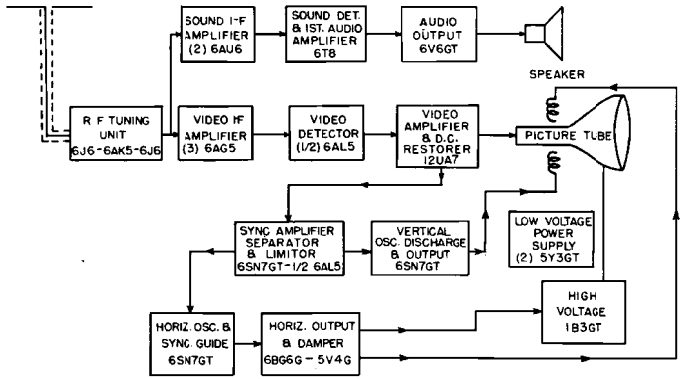


Figure 2. Receiver Block Diagram

2.01 R. F. Unit Circuit:

A 73 ohm, low-loss transmission line (co-axial cable) is used to conduct the signals picked up by the antenna to the input circuit of the R. F. unit. The inductance L106, in parallel with the antenna input, provides a high pass, radio frequency filter to suppress broadcast band or other low frequency, cross modulation interference which may arise in locations where the television receiver is operated in an extremely intense field of a local AM broadcast station. The 73 ohm co-axial transmission line is capacitively coupled to the receiver through C101 to the cathode of V101. This tube operates as a grounded-grid R. F. amplifier. Connected in this manner, V101 provides an unbalanced input at a constant impedance of 73 ohms to match the 73 ohm co-axial transmission line. The plates of the 6J6 R.F. amplifier V101 are coupled to the grid of the 6AK5 high gain pentode mixer V102 by means of a broadband coupling network, 6 megacycles wide.

The R.F. tuning assembly consists of a double tuned closely coupled pair of variable inductors in the R.F. circuit and a single variable inductor for the local oscillator circuit, mounted on a common shaft.

L101-L102A and L102B-L104 tune to the desired frequency in conjunction with the associate tube capacities and the coupling network consisting of C105, C106 and C107. The three resistors R102, R103 and R104 are used to load the circuit in order for the coupling network to maintain the 6 megacycle wide band pass.

A continuous range of 44 to 216 mc, is covered by this double tuned circuit, while the third variable inductance circuit covers the same range at 21.9 mc higher in frequency, and is used as the tuning circuit for the local oscillator.

The high frequency oscillator utilizes one section of the 6J6 twin triode V103, in a modified Colpitts Oscillator circuit, the interelectrode capacity of the oscillator tube being used to couple the feed-back voltage. The oscillator frequency is controlled by adjusting the tap on the coil L102C which shortcircuits a portion of the coil.

The oscillator circuit is factory aligned to track with the signal circuits located in the plate of the R.F. amplifier V101 by adjusting the inductance of L105 and the capacitance of C111.

The capacitor C112 couples the output of the oscillator to the grid of V102. The incoming signal from the antenna and the local oscillator are both fed into the grid of the mixer V102. The output of V102 has a wide band of frequencies. It includes both the video and sound intermediate frequencies which are fed into the first video I.F. transformer.

2.02 Video I. F. Amplifier Circuits:

The video I.F. amplifier consists of three stages using 6AG5 high gain, sharp cutoff pentodes, V1, V2 and V3. The grids of V1 and V2 are returned to a variable negative bias provided by the contrast control, VR2, thus varying the gain of the I.F. amplifier.

Each video I.F. coupling network consists of two adjustable coils which are resonant with their respective tube capacities and coupling networks. Shunt inductive coupling is utilized in the first I.F. coupling network while the third I.F. network is a specially terminated "M" derived bandpass filter network.

Two parallel resonant traps L7, C10 and L8, C12 in the series arm of the pie network of the third coupling network provide a high degree of attenuation to the sound carrier of the station being received and to the sound carrier of the adjacent channel.

HIGH VOLTAGE WARNING

Operation of this receiver with the interlock by-passed, or the chassis removed from the cabinet involves a shock hazard from the receiver power supplies. Work on the receiver should not be attempted by anyone not thoroughly familiar with the precautions necessary when working on high voltage equipment. When handling the high voltage lead to the picture tube the receiver power plug should be disconnected from the power receptacle.

The output of the fourth video I.F. coupling network is fed into one diode section of the video detector 6AL5 (V4A). The cathode of the 6AL5 video detector V4A being at R.F. ground potential the rectified signal through the diode load (L13-R17) that appears at the grid of the first video amplifier V5, is of a negative pulse phase, i.e. black is negative.

2.03 Video Amplifier:

The video amplifier consists of two stages using a 12AU7 dual triode V5. The function of this section of the receiver is to amplify the video output of the second detector sufficiently that full contrast on the picture tube may be obtained. The inductor L14 provides the shunt peaking type of high frequency compensation. L15 and C19 make up the 4.5 mc trap, and series peaking high frequency compensation.

R22 and R23 are the load resistors of the second video amplifier.

2.04 D. C. Restorer:

As the video amplifier is an A.C. amplifier, the D.C. component must be reinserted to obtain the maximum variation of background illumination needed to match the original picture being transmitted.

D.C. restoration is obtained by grid-leak bias resistor R20 in the grid of the second video amplifier V5. Each arriving line pulse varies the grid leak bias. As a result the plate voltage of V5, and also the grid voltage of the picture tube, is varied so as to hold the black level constant.

2.05 Picture Tube:

The picture tube, V6, is a ten inch direct viewing tube (type 10PB4 in Models 9-403M and 9-413B; type 10FP4 in Models 9-403M2 and 9-413B2). Electromagnetic deflection is used for both deflection and focus. The high voltage for the second anode is furnished by the H.V. power supply at approximately 8 kilovolts.

The Brightness control VR1 varies the cathode potential and thus the tube illumination. The capacitor C20 by-passes the cathode to ground for all video signal voltages. The permanent magnet beam bender (used on 10BP4 tubes only) must be properly positioned on the neck of the picture tube for maximum brightness, with best focus.

2.06 Sync Amplifier, Separator & Limiter:

Horizontal and vertical sync pulses and a portion of the combined video signal are taken from the 2nd. video amplifier load at the junction of R22 and R23 and fed through the capacitor C46 to the signal grid of the sync amplifier V11. The first section of V11 is the sync amplifier where the composite signal is amplified and fed through the load resistor R44 to the plate of the sync separator (the second half of V11), and through capacitor C48 to the plate of the diode sync limiter V4B. Negative bias for the sync amplifier is provided by a voltage divider tap between R98 and R62.

The negative bias voltage obtained from the diode V4B plus the operating voltage applied to the plate and the grid of the sync separator section of V11 causes the negative portion of the signal to be cut off. In this way the video information is removed from the signal appearing at the cathode of the sync separator. The sync level is limited by the action of the diode V4B so that the amplitude of each recurring pulse is at a common level. The sync signal is taken from the cathode to obtain a low impedance output of the correct polarity.

2.07 Integrating Network:

To separate the horizontal sync from the vertical sync, an integrating network composed of R47, R48, R49, C49, C50 and C51 is used. This RC network acting as a low pass filter will pass the low frequency of the vertical sync, while the higher frequency of the horizontal sync is attenuated.

2.08 Vertical Oscillator, Discharge & Output:

The purpose of these curcuits is to provide a sawtooth current of the proper amplitude and frequency to move the scanning beam across the picture tube screen slowly (16,000 μs) from top to bottom during the time the image is being placed on the screen and rapidly (250 μs) from the bottom to the top during retrace time. A blocking oscillator and discharge curcuit is formed by the first section of the 6SN7GT dual triode V12 and its associated components. The operating frequency of this oscillator is determined by C52, R96 and VR7, when no sync pulse is present. The vertical hold control VR7, adjusts the free running frequency of the blocking oscillator. When the grid wave form goes negative the tube is held at cutoff and C55 is charged at a rate determined by C55, VR6 and R53. When the grid wave form goes positive and plate current begins to flow, C55 discharges more rapidly, the rate of discharge being determined primarily by the plate resistance of the conducting tube and C55. This slow charging and rapid discharging of C55 generates a sawtooth voltage.

The peaking action of R53 provides a sharp negative pulse to insure that the second half of V12 will remain cut off during retrace time. By controlling the charging rate of C55 the amplitude of the sawtooth voltage is varied; this is accomplished by adjusting the height control VR6.

Although the voltage on the plate of the vertical oscillator is of the basic shape to produce a sawtooth current in the vertical deflection coil, it must be amplified in the second section of V12 to obtain sufficient power.

The plate of the vertical output tube (second section of V12) is coupled to the vertical output transformer T5 that matches the impedance of the vertical deflection coils to the plate impedance of the tube.

The vertical linearity control VR8 varies the cathode bias of the vertical output tube V12, so that the position of the applied sawtooth voltage is shifted along its operating characteristic. The vertical linearity control and height control have a considerable amount of interaction and any change in adjustment of one must be accompanied by a change in the other.

2.09 Horizontal Oscillator & Sync Guide:

A 6SN7GT dual triode V13, is used in this circuit for the horizontal oscillator and sync guide. One triode section (pins 4, 5 and 6) is a blocking oscillator with grid coupling capacitor C66 and the grid leak R75 and R73. The capacitor C67 and the resistor R76 in the B + circuit, connected to the tap on T7, form a sawtooth voltage. The oscillator frequency is adjusted by C63B connected from the junction of R75 and R73 to ground. A capacity divider formed by C68 and C63C varies the amplitude of the sawtooth that reaches the grid of the output tube V14. The horizontal drive capacitor C63C provides this means of variation, at the same time affecting the horizontal linearity as well as the width of the picture and also the second anode voltage of the picture tube.

The output of the sync separator section of V11 is fed to the grid of the horizontal sync guide through the capacitors C60 and C62. The sync guide grid actually receives three voltages, one from the sync amplifier, one from the kickback pulse from the horizontal output stage through the capacitor C73 and the resistor R87, and the third voltage from T7 through R67. The amplitude of these combined voltages is varied by the trimmer C63A. The horizontal hold control VR5 varies the plate voltage of the sync guide and also has a slight effect on the frequency of the oscillator.

2.10 Horizontal Output, Damper & High Voltage Rectifier:

The purpose of the horizontal output tube V14 is to amplify the output of the horizontal oscillator so that sufficient current of the proper wave form is available to excite the horizontal deflection coils in order to provide horizontal scanning of the picture tube.

The damper tube V15 helps to provide a linear trace by damping out oscillations of the energy stored in the horizontal deflection coil T6B during the trace. Other functions of these circuits is to utilize the energy stored in the horizontal deflection coil to provide the high voltage required to accelerate the electron beam in the picture tube V6 and to furnish retrace. Some of the energy from the yoke is recovered by the damper circuit, and is used to help supply the plate power requirements of the output tube.

During the return trace of the sweep the current, which was flowing in the horizontal deflection coil, reverses. The induced voltage pulse in the primary winding of the horizontal output transformer T8 appears in the form of a very sharp positive pulse. This pulse is increased in amplitude by auto-transformer action in the primary winding and is rectified by the high voltage rectifier V16. The rectified energy that is stored in the high voltage capacitor C76 is used to accelerate the electron beam in the picture tube.

The horizontal damping tube critically dampens the ringing in the horizontal deflection yoke which occurs just at the end of the line retrace period. Part of the energy so absorbed is utilized to boost the plate voltage of V14 by feeding the "B" supply in series with the voltage developed across C71 and C72 by the damper tube V15.

The horizontal linearity network consisting of L19, C71 and C72 is used to shift the phase of the booster voltage. By shifting the phase of this booster voltage with respect to the plate current requirements of V14, variations of sweep linearity are obtained.

2.11 Sound I.F. Amplifier:

The sound I.F. amplifier consists of two stages using 6AU6 high gain sharp cut off pentodes. The composite video and audio I.F. frequencies is applied through the coupling capacitor C23 to the primary of T1 the 1st sound I.F. transformer resonating at 21.9 mc., thus separating the sound frequencies from the video frequencies. The sound I.F. transformers are tuned to 21.9 megacycles by shunt capacitors and iron cores in a double tuned circuit. The second I.F. stage feeds into an FM detector V9 which converts frequency deviations of the I.F. carrier to audio frequencies and suppresses amplitude modulation interference.

The sound taken from the diode cathode (pin 3 of V9) is fed through the de-emphasis network composed of R38 and C40 through the volume control and C37 to the grid pin 8 of the triode audio amplifier section of V9.

The audio amplifier consists of two stages, the triode section of V9 and the output stage V10.

2.12 Low Voltage Power Supply:

The low voltage power supply of the television receiver is obtained from a pair of 5Y3GT rectifiers connected for full wave rectification, with conventional filtering.

2.13 Focus Coil:

The focus coil, L17, is in series with the section of the power supply which delivers 225 volts to most of the circuits. The current drain of these circuits provides more than sufficient current for proper focus. The focus current is adjusted to bring the picture tube to precise focus by means of the focus control VR4 which is a variable resistor with R64 in series, both being shunted across the focus coil.

3.01 Unpacking:

This cabinet is shipped in first class condition with considerable attention given to protecting the finish. **Handle with care.** Remove the cabinet back. Remove the cardboard shipping strip between the focus and deflection coils. Replace cabinet back.

3.02 Location of the Receiver:

The receiver should be located to permit viewing from the proper distance. For best results in detail, the picture should be observed from a distance of three to five feet. Locate the receiver where no bright light will fall directly on the picture. Care should be taken not to block the ventilating holes in the bottom, back or sides of the cabinet, as this may cause the receiver to overheat. The back of the cabinet should be kept at least an inch away from a wall or other obstructing surface.

This television receiver has been designed to operate from an unbalanced transmission line (coaxial cable) with a characteristic impedance of 73 ohms. This shielded type of cable, when properly utilized, may provide a greater degree of noise immunity than a parallel wire balanced type of transmission line.

The inner conductor of the 73 ohm co-axial cable is connected to the antenna input terminal marked "A" and the shield is connected to the terminal marked "G". In order to avoid discontinuity in the transmission line it is important to bring the shielded cable as close to the terminals as possible, cutting back only enough of the shield (not over ½ inch,) to make the connection and keeping the ground lead as well as the center lead as short as possible (not over ½ inch).

4. SERVICE NOTES

The receiver is adjusted at the factory and is ready for operation after being connected to the antenna and proper power supply. To set the receiver in operation, follow the procedure outlined below under "Normal Operation."

4.01 Normal Operation:

1. Turn the sound volume control to the right about one-half of its range, thus turning on the receiver.
2. Set the SELECTOR SWITCH to the television position.
3. Turn the BRIGHTNESS CONTROL almost completely clockwise and the CONTRAST CONTROL completely counter-clockwise.
4. Adjust the BRIGHTNESS CONTROL for moderate brightness, below the point where the raster size increases due to excessive drain on the high voltage power supply.

   NOTE: If normal brilliance is not obtained at this point, it may be necessary to adjust the ion trap on models using 10BP4 picture tube. For ION TRAP adjustment, see the second paragraph under **Adjustment of Non-Operating Controls,** this page.

5. Turn the BRIGHTNESS CONTROL counter-clockwise until the raster just becomes invisible. Rotate the tuning control knob until the channel number of your local television station is centered in either the upper or lower portion of the dial window. Move the dial slowly over this point until the station is heard. It is possible to receive the station at three different positions of the dial (very close together). However, on either side of the center tuning point the signal will be distorted and low in volume. Tune the receiver very carefully to the center tuning point for best quality and minimum sound distortion.

   NOTE: Owing to the standards of transmission used in television broadcasting, it is normal that the receiver when tuned properly for sound, shows about half the picture sensitivity which is available when tuning for maximum picture output.

6. Turn the CONTRAST CONTROL to the right until the proper contrast is obtained. Readjust the BRIGHTNESS CONTROL if necessary for proper blanking.
7. Adjust sound VOLUME CONTROL to the desired level.

4.02 Adjustment of Non-Operating Controls:

All controls are accessible without removing the chassis from the cabinet. The back of the cabinet must be removed to adjust the HORIZONTAL LINEARITY and WIDTH controls. These are screwdriver adjustments.

In Models 9-403M and 9-413B, an ion trap is used. If adjustment of the ion trap is necessary, loosen the thumb screws which secure it to the neck of the picture tube, and adjust for maximum brightness on the tube screen by moving it forward or backward and at the same time rotating it slightly around the neck of the tube. Adjust the FOCUS CONTROL for greatest clarity of the lines at the center of the raster. If necessary, readjust the ion trap for maximum brightness on the picture tube consistant with good focus, and no shadow on raster.

If the picture rolls or jumps vertically, adjust the Vertical Hold Control until the picture remains stationary.

Each receiver should be checked for Horizontal Frequency and Lock-in alignment with a normal picture at the time of installation. To check the Horizontal Frequency and Lock-in alignment, turn the HORIZONTAL HOLD CONTROL to the extreme clockwise position. The picture should remain in horizontal sync. Tune completely off the station with the tuning dial and then return to the station. Normally the picture will be out of synchronism with a number of black bars running diagonally across the screen. The number of black bars will decrease when the HORIZONTAL HOLD CONTROL is turned counter-clockwise. Turn the control until only three bars remain. The picture will fall into synchronism with a slight additional counter-clockwise rotation of the control. This should occur when the control is approximately ¼ turn from the extreme clockwise position and the picture should remain in sync for an additional ¼ turn counter-clockwise. The picture should fall out of sync with the control in the extreme counter-clockwise position and should show one blanking bar in the picture.

The final setting of the HORIZONTAL HOLD CONTROL should be made with the CONTRAST CONTROL turned to a point where the picture is very weak. Then while rotating the dial on and off the station, set the HORIZONTAL HOLD CONTROL so that the picture returns completely in sync. If the receiver checks within these limits the HORIZONTAL FREQUENCY and LOCK-IN adjustments are correctly set. If the receiver does not check within these limits, HORIZONTAL FREQUENCY AND LOCK-IN adjustments must be made (See **Horizontal Frequency and Lock-in Range Adjustment,**).

Set the VERTICAL HOLD CONTROL in the middle of its lock-in range if readjustment is needed.

NOTE: Unstable vertical sync may be caused by the Vertical Hold Control being too close to one end. To overcome this, it may be necessary to change the value of R96 by reducing it to one megohm. If this does not correct the trouble, try replacing V11 and V12 tubes.

If the picture is not centered in the frame, vertical or horizontal centering may be obtained by adjusting the FOCUS COIL by means of the three nuts ("B" Fig. 4) that hold the focus coil in place.

Adjust the HEIGHT CONTROL so that the height of the picture equals the height of the picture frame opening. Readjust the Focus coil to center picture. Adjust the horizontal size of the picture with the width control; this is a screw driver adjustment on the top rear of the chassis. When properly adjusted the width of the picture should equal the width of the picture frame. A slight readjustment of the Focus coil may be necessary.

Observe any non-linear sweep distortions and determine if either the horizontal or vertical sweeps, or both, need adjustment.

The HORIZONTAL DRIVE CONTROL is a trimmer adjustment and has the effect of spreading or compressing the left side of picture with respect to the right side of the picture. This control has been preset at the factory on a special test pattern and should not require field alignment. If it is found that adjustment is necessary, turn the HORIZONTAL DRIVE control counter-clockwise toward minimum capacity until pattern starts to stretch on left side.

The HORIZONTAL LINEARITY adjustment has the effect of expanding or compressing the middle portion of the picture with respect to the sides. Readjust the WIDTH adjustment after the HORIZONTAL DRIVE or HORIZONTAL LINEARITY has been changed. The VERTICAL LINEARITY CONTROL has the effect of expanding the picture at an increasing rate from the bottom to the top of the picture. Adjustment of this control has the greatest effect on the top portion of the picture, some effect on the middle of the picture, and very little effect on the bottom of the picture. The HEIGHT CONTROL and the FOCUS COIL may need readjustment as a result of the change in position of the VERTICAL LINEARITY CONTROL.

4.03 Removal of Chassis From Cabinet:

1. Remove the knobs on the front panel. The knobs are "push-on" type.
2. Remove the screws fastening the back to the cabinet.
3. Disconnect speaker socket.
4. Without turning the cabinet on its side or on its back, remove the four bolts fastening the receiver chassis to the bottom panel of the cabinet.
5. Turn the receiver so that the back of the cabinet can be observed and slide the chassis until it is fully removed from cabinet.
6. To reinsert the television receiver into the cabinet repeat the above steps in the reverse order.

4.04 Removal and Replacement of the Picture Tube:

Handling precautions:—*Do not remove or handle the picture tube in any manner unless heavy gloves and protective goggles are worn.* Persons not so equipped should be kept away while handling picture tube. Keep the tube away from the body while handling.

1. Remove the television chassis from the cabinet as outlined above.
2. Disconnect the socket and high voltage lead from the picture tube. On models 9-403M and 9-413B remove the ion trap.
3. Remove the screws that fasten the picture tube strap to the chassis.
4. Grasp the picture tube firmly with both hands along the outer edge and gently slide it out of the focus and deflection coils.

CAUTION

NEVER GRASP THE PICTURE TUBE BY ITS NECK OR ALLOW PRESSURE TO BE EXERTED ON THE NECK.

5. Place the picture tube face down, on a flat surface covered by a clean soft cloth, in a location where it will not be disturbed.
6. When the picture tube is ready to be replaced in the receiver chassis, slide the tube gently back into the deflection coils until the center of its face surface extends about ⅛" beyond the front edge of the chassis. Slide the deflec-

tion coil bracket forward until the rubber bumper and the two grounding springs rest against the tube. Slide the deflection coil forward as far as possible. Bottom of tube should rest on the rubber bumper over cutout in chassis. Also, see that the neck of the tube is centered in the focus coil. This centering must be accomplished by proper seating of the front part of the picture tube. *Do not allow pressure to be exerted on the neck of the tube.*

7. Replace the tube strap.
8. On Models 9-403M and 9-413B replace the ion trap.
9. Replace anode connector and tube socket to base of tube.

4.05 Removal and Replacement of the Inputuner:

1. Unsolder four power leads coming out of the inputuner to the receiver chassis. DO NOT CUT THE LEADS; KEEP THEM FULL LENGTH. Record the color coding of the wires and the terminals from which the wires were removed.
2. Unsolder the inputuner antenna cable leads at the antenna terminals.
3. Remove the three hex head screws which fasten the inputuner to the chassis.
4. Lift the inputuner from the chassis.
5. To put in the new inputuner, reverse the steps above. This may require a slight readjustment of the first I.F. coil. End of shaft should be 2⅝" from front of chassis apron.

4.06 Test Equipment:

Equipment Needed	Required Characteristics
A. *Trouble Shooting* Oscillograph	Very high input impedance. Must readily synchronize with "Y" axis signal. Amplifier response must be satisfactory up to at least two megacycles. Must not compress input signal until a reasonably sized wave-form appears. Wide range input attenuator.
Voltage Calibrator	Suitable for calibrating the amplitude of the wave shapes on the "Y" axis of the oscillograph.
Electronic Voltmeter	Very high input impedance for d.c. voltage measurements.
B. *I.F. and Video Alignment* Wobbulator or Sweep Generator	Center frequency of 25 megacycles (approx.); sweep width of 10 megacycles (adjustable); output voltage up to 0.10 volt; adjustable attenuator; frequency range from 20 to 100 mc. minimum.
Marker or Signal Generator	Frequency calibration reliable to better than 100 kc. per dial division. Attenuator should be adjustable and very accurate; modulation up to 30%.
Probe Detector	For connecting scope to circuits ahead of second detector (see Fig. 3 for schematic diagram).
Oscillograph	A high gain "Y" axis amplifier with good square wave 60 cycle response.

4.07 R.F. Unit Alignment:

For R.F. unit alignment, see R.F. response curve in bulletin No. 368, page 8.

4.08 Average Sensitivity and Stage Gains:

4.081 Video I.F. System:

The following table indicates the signal input required at various points to produce the indicated output. The signal generator is to be 30% modulated at 400 cycles.

Connect Signal Generator	*Signal Generator Frequency*	*Oscillograph Connected To*	*Output*	*Microvolts Input*
Pin 1 V3	24 mc.	Pin 2 V6	10 v p-p	45,000
Pin 1 V2	24 mc.	Pin 2 V6	10 v p-p	7,500
Pin 1 V1	24 mc.	Pin 2 V6	10 v p-p	750
Pin 1 V102	24 mc.	Pin 2 V6	10 v p-p	81
*Antenna Terminals	79.65 mc.	Pin 2 V6	10 v p-p	100

* The signal generator is to be connected to the receiver with sufficient series resistance to make the generator impedance match 73 ohms. The receiver is to be tuned to channel 5.

4.082 Sound I.F. System:

The following table indicates the signal input required at various points to produce ½ watt output across a 3.2 ohm resistor connected in place of the voice coil. The audio gain control shall be at maximum with the selector switch in the FM position.

The FM signal generator shall be deviated ± 22.5 kc. with 400 cycle modulation.

Connect Signal Generator	*Signal Generator Frequency*	*Microvolts Input for 0.5 watts output*
Pin 1 V8	21.9 mc.	30,000
Pin 1 V7	21.9 mc.	1,500
Pin 1 V1	21.9 mc.	200
Pin 1 V102	21.9 mc.	23
*Antenna Terminals	100 mc.	25

* The signal generator is to be connected to the receiver with sufficient series resistance to make the generator impedance match 73 ohms. The receiver is to be tuned to 100 mc.

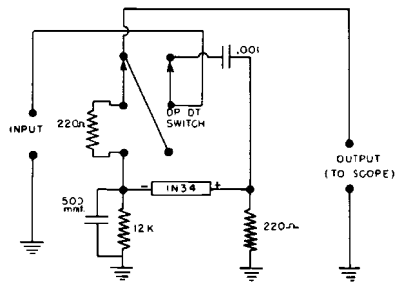


Figure 3. Probe Detector

4.09 Possible Failures:

NOTE: The following failures and possible solutions will aid the servicemen to locate and remedy troubles.

Tubes should be changed first and if this will not remedy the trouble, check voltages.

1. PICTURE BUT NO SOUND:
   a. Audio tubes (V10, V9).
   b. Sound I.F. tubes (V8, V7).
   c. Defective speaker or plug.
   d. Misaligned R.F. oscillator.
   e. Weak signal in antenna.
   f. Video I.F. misaligned. Check for proper curve and marker positions.
2. SOUND BUT NO PICTURE WITH RASTER PRESENT:
   a. Open choke (L12).
   b. Weak signal.
   c. Video and Video I.F. tubes (V5, V4, V3, V2).
3. NO SOUND OR PICTURE:
   a. V1 tube.
   b. R.F. unit.
   c. Antenna lead in.
4. NO VERTICAL DEFLECTION:
   a. Open Vert. Osc. Transformer T4.
   b. Shorted C54 or C55.
   c. Vert. output T5 (Open).
   d. Open deflection coil T6A.
   e. V12 Tube.
5. NO HORIZONTAL DEFLECTION:
   a. Open deflection coil T6B.
6. MICROPHONICS (picture):
   a. V2, V3, V103 tubes.
7. MICROPHONICS (sound):
   a. V103, V10, V9, V102, V7 tubes.
   b. Loose slugs in sound I.F.
8. NO RASTER OR SOUND BUT TUBES LIGHT UP:
   a. V18, V17 rectifier tubes.
9. NO RASTER WITH SOUND PRESENT:
   a. No high voltage caused by 1B3 rectifier, T8 output transformer, V15, V14, V13 tubes.
   b. Open L19 Hor. Linearity control.
   c. Defective picture tube.
   d. Open C46.
   e. Ion trap misplaced on model 9-403M or 9-413B.
10. CORONA:
    a. C76 leaky.
    b. Ungrounded picture tube shield.
11. SIGNAL BUT NO VERTICAL SYNC:
    a. C54 open.
    b. C52 shorted.
    c. Defective T4.
    d. V12 tube.
    e. R47, R48, R49, R96, VR7 bad.
    f. C49, C50 or C51 defective.
12. SIGNAL BUT NO HORIZONTAL SYNC:
    a. C46 shorted.
    b. T8 defective.
    c. V13 tube.
13. SIGNAL BUT NO VERT. OR HOR. SYNC:
    a. V4 or V11 tubes.
14. SHADOWS IN CORNERS OF PICTURE:
    a. Misadjusted focus coil.
    b. Ion trap adjustment in 9-403M or 9-413B.
15. SMALL PICTURE:
    a. Bad contact in selector switch.
    b. Low line voltage.
    c. V15 tube.
16. PICTURE WITH VERT. LINES AND HORIZONTAL NON LINEARITY:
    a. V15 tube.
    b. R87 resistor.
    c. C71 or C69 capacitor.
    d. Misadjusted hor. drive control.
17. BARKHAUSEN: (vertical bars on left side of raster) Tune the receiver to channel 13 and adjust horizontal drive trimmer counter-clockwise until black bar on left side of raster disappears.

4.10 Alignment and Adjustment Notes:

1. The sound IF and video IF carriers in this model television receiver are 21.9 megacycles and 26.4 megacycles, respectively.
2. When the television receiver is repaired or aligned, always turn the chassis on its side so that the power transformer is located on the top. Never turn the receiver on its end or other side.
   Never disconnect the loudspeaker while the power is turned on unless the sound volume control is turned to minimum. If it is necessary to operate the receiver without the loudspeaker, remove the audio output tube V10, to prevent damage to the output transformer.
3. If the television receiver must be operated with the picture tube removed from the chassis, tape or cover the exposed end of the high voltage lead.
4. On a metal top work bench, always mount the television receiver chassis so that good contact between the receiver chassis and the metal top is maintained. Connect the metal cabinets or all test equipment to the metal work bench by means of heavy ground wires, as short as possible.
5. All lead connections from the signal generators and wobbulators must be shielded. Keep the exposed ends and ground leads as short as possible (about one inch).
6. Always locate the ground lead connections as close as possible to their respective "hot" leads in the television receiver chassis.
7. The wobbulator, signal generator output, and contrast control must be kept low enough to prevent overloading the television receiver circuits. The limiting action produced by overloading causes incorrect response curves.
8. The alignment procedure must be followed in the order shown in the alignment chart.
9. Do not move the two blue leads going to the sound detector plates unless it is necessary to obtain the correct discriminator response curve.
10. To obtain the best compromise between ring and smear after I.F. alignment, it may be necessary to make a slight readjustment of L4, L5, L6, or L9.

4.11 Adjustments:

1. The cathode ray tube should be located so that the center of its face is 1⅜" in front of the chassis apron, and rotated so that the anode cap is on top.
2. The tuner should be located so that the end of the shaft is 2 5/32" in front of the chassis apron.
3. **I.F. Alignment:** (see alignment chart)
4. **Deflection Yoke:** The deflection yoke is positioned as far forward as possible on the cathode ray tube and rotated so as to make the top of the picture paralell with the top of the chassis.
5. **Focus Coil:** The focus coil should be adjusted to be approximately perpendicular to the cathode ray tube axis, with the front surface

of the focus housing approximately 15/32" from the rear surface of the deflection and focus mounting bracket.

6. **Ion Trap:** The ion trap (used on receivers using the 10BP4 picture tube) is then positioned for maximum brightness (with low setting of brightness control), and for no shadow on the raster.
7. **Centering Picture:** Center the picture by adjusting the focus coil mounting nuts (B) see fig. 4. Any readjustment of the focus coil for centering may require readjustment of the ion trap to eliminate shadow on the raster.
8. **Size Adjustment:** Picture size is adjusted to 8¾" x 6⅞" by the height control and by the width adjustment on L18.
9. **Horizontal Frequency and Lock-in Range Adjustment:**

   a. *Horizontal Frequency Adjustment:** Turn the HORIZONTAL HOLD CONTROL to the extreme counter-clockwise position. Tune in a television station and adjust the HORIZONTAL FREQUENCY adjustment (rear of chassis) until the picture is just out of sync and the horizontal blanking bar appears in the picture.

   b. *Horizontal Lock-in Range Adjustment:* Set the HORIZONTAL HOLD CONTROL to the full clockwise position. Remove the signal by tuning off the station and then return to the signal. Picture normally should be out of sync. Slowly turn the HORIZONTAL HOLD CONTROL counter-clockwise and note the least number of blanking bars that appear on the picture tube just before the picture falls into sync. If more than three bars are present, adjust the HORIZONTAL LOCK-IN trimmer (rear of chassis) slightly clockwise; if less than three bars are present, adjust the trimmer slightly counter-clockwise. Repeat the above procedure until the three blanking bars appear on the picture tube as the picture falls into sync.

   As the Lock-in Range Adjustment affects the Horizontal Frequency, the adjustments of both Horizontal Frequency and Lock-in Range Trimmers must be repeated until the conditions outlined above are realized.

   The final setting of the HORIZONTAL HOLD CONTROL should be made with a very weak picture. Rotate the dial on and off the station, and set the HORIZONTAL HOLD CONTROL so that the picture returns completely in sync.
10. **Vertical Hold Adjustment:** The Vertical Hold Control is adjusted with a very weak picture.
11. **Linearity Adjustments:** Linearity is adjusted by the Vertical Linearity Control and by the Horizontal Linearity Adjustment on L19. This may necessitate readjustment of the Width, Height and Horizontal Drive controls.
12. **Focus Control Adjustment:** Focus control is adjusted for best focus of horizontal and vertical wedges at center. If there is any astigmatism, the focus should be set to favor the vertical wedge. If corner focus is poor, check position of deflection coil and ion trap.

***NOTE:**

In most cases the correct adjustment will be obtained with the Horizontal Frequency Trimmer close to minimum capacity. In some cases, it may not be possible to pull the picture out of sync when the Horizontal Frequency Trimmer is in the minimum capacity position. However, if the correct "lock-in" checks are obtained and the picture is stable on the final setting, the adjustment can be assumed to be correct.

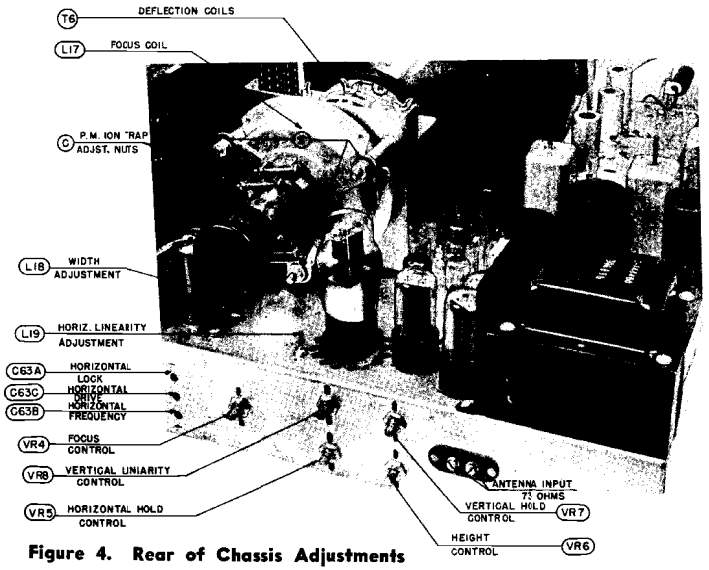


Figure 4. Rear of Chassis Adjustments

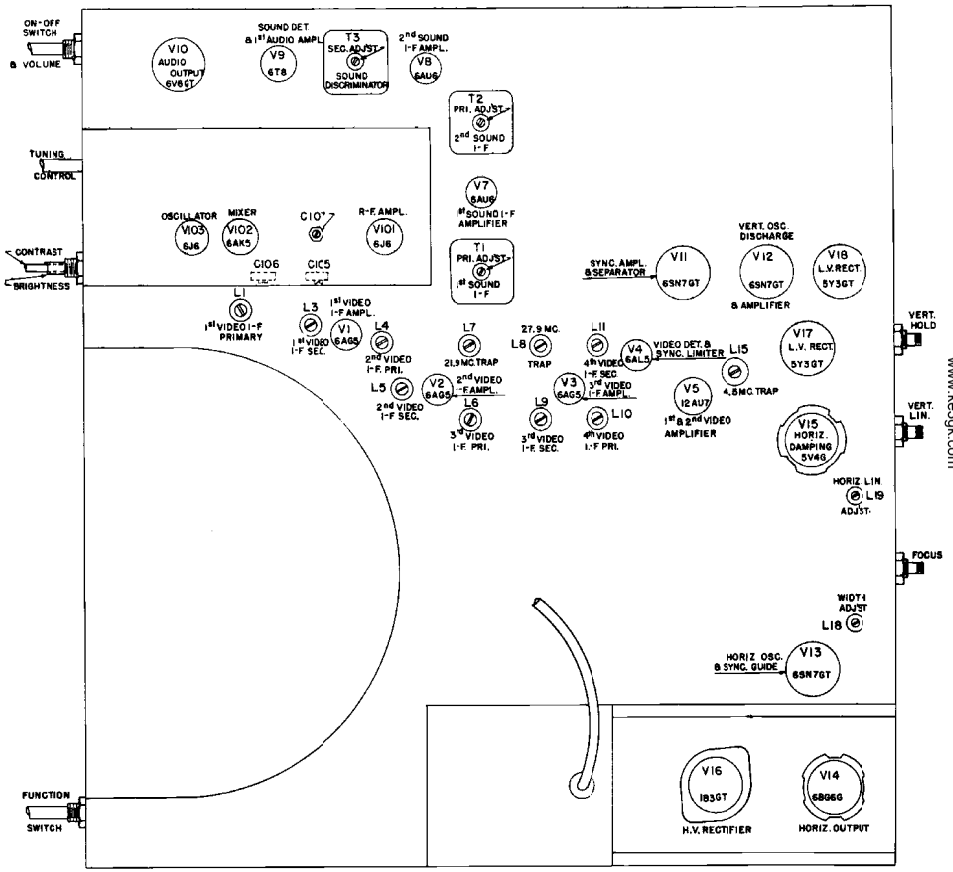


Figure 6. Chassis Top View Showing Tube and Alignment Locations

TABLE OF VOLTAGES

Symbol	Tube Type	Pin 1	Pin 2	Pin 3	Pin 4	Pin 5	Pin 6	Pin 7	Pin 8	Pin 9
V101	6J6	125	125	0	*6 3	0	0	1 9		
V102	6AK5	-1 2	0 15	0	*6 3	210	55	0 15		
V103	6J6	152	0	*6 3	0	0	-8 6	0		
V1	6AG5	0	1 0	*6 3	0	150	150	1 0		
V2	6AG5	0	1 0	*6 3	0	150	150	1 0		
V3	6AG5	0	1 0	*6 3	0	150	150	1 0		
V4	6AL5	-3	-9	*6 3	0	0	0	-3 3		
V5	12AU7	115	-3 2	0	*6 3	*6 3	70	-10	-90	0
V6	10BP4 or 10FP4	135	70						(Pin 10) 310	(Pin 11) 175
V7	6AU6	<0 1	0	0	*6 3	215	150	1 0		
V8	6AU6	<0 1	0	0	*6 3	215	68	0 3		
V9	6T8		-0 6	0	*6 3	0	-0 6	0	-1 0	65
V10	6V8GT		0	215	230	0		*6 3	11	

The following voltages taken with a signal and contrast control at maximum with an attenuator in the antenna input circuit to produce a normal picture with the CONTRAST at maximum and 3.6 volts D. C. on the grid of the 1st Video Amplifier.

V4	6AL5	-2 9	-74	*6 3	0	0	0	3 7		
V5	12AU7	125	-3 6	0	*6 3	*6 3	96	-10	-88	0
V6	10BP4 or 10FP4	135	96						(Pin 10) 310	(Pin 11) 105
V11	6SN7GT	-4 0	140	0	-74	225	1 7	*6 3	0	
V12	6SN7GT	-80	220	-78	-110	18	-90	*6 3	0	
V13	6SN7GT	-75	27	-72	-150	47	-90	*6 3	0	
V14	6BG6G		*6 3	-60		-90		0	180	
V15	5V4G		(Pin 2 to 8) *5		270		270		(Pin 2 to 8) *5	
V16	1B3GT									
V17	5Y3GT		280		*380		*380		280	
V18	5Y3GT		280		*380		*380		280	

NOTES:

1. These voltages may vary depending on the setting of the various controls.
2. Voltages measured with an electronic voltmeter from socket lug to chassis with no signal, maximum CONTRAST, minimum BRIGHTNESS, and SELECTION SWITCH in the Television position.
3. Supply voltage 117 volts, 60 cycle A.C.
4. *Denotes A.C. voltages.
5. < —less than.

All replacement parts and service information for Model 9-403MA are identical to Models 9-403M, 9-413B, 9-403M-2, and 9-413B-2 except the parts listed below.

REPLACEMENT PARTS LIST — MODEL 9-403MA

Part No.	Description
* 144701	Cabinet
AB-146328	Escutcheon
C-144997-4	Knob (Tuning)
C-144599-13	Knob (Off-On-Volume)
C-143553-3	Knob (Brightress)
C-143422-4	Knob (Contrast)
C-144599-12	Knob (Selector Switch)

* When the supply of Model 9-403M cabinets is exhausted the Model 9-403MA cabinet, which carries the same part number, will be shipped.

Figure 5. Alignment Wave Forms

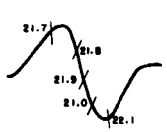


FIG. 5A

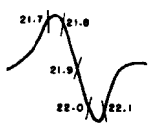


FIG. 5B

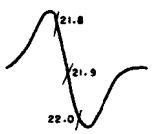


FIG. 5C

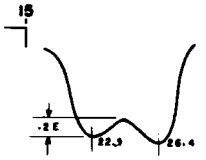


FIG. 5D

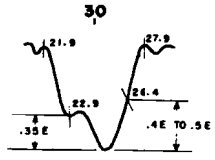


FIG. 5E

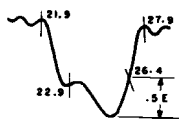


FIG. 5F

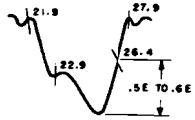


FIG. 5G

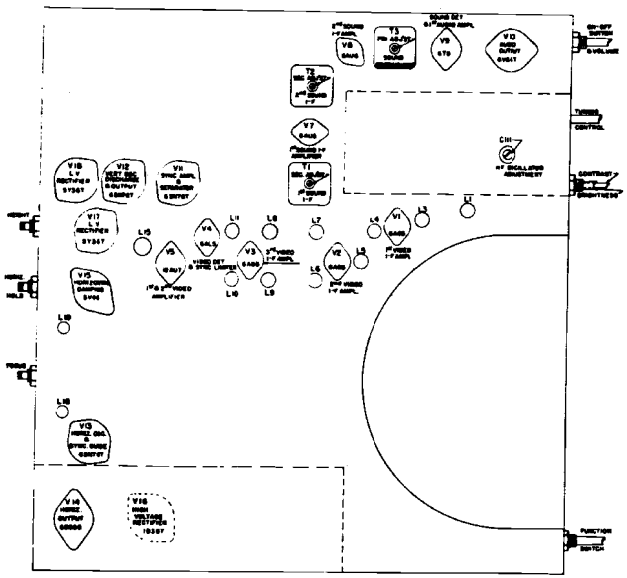


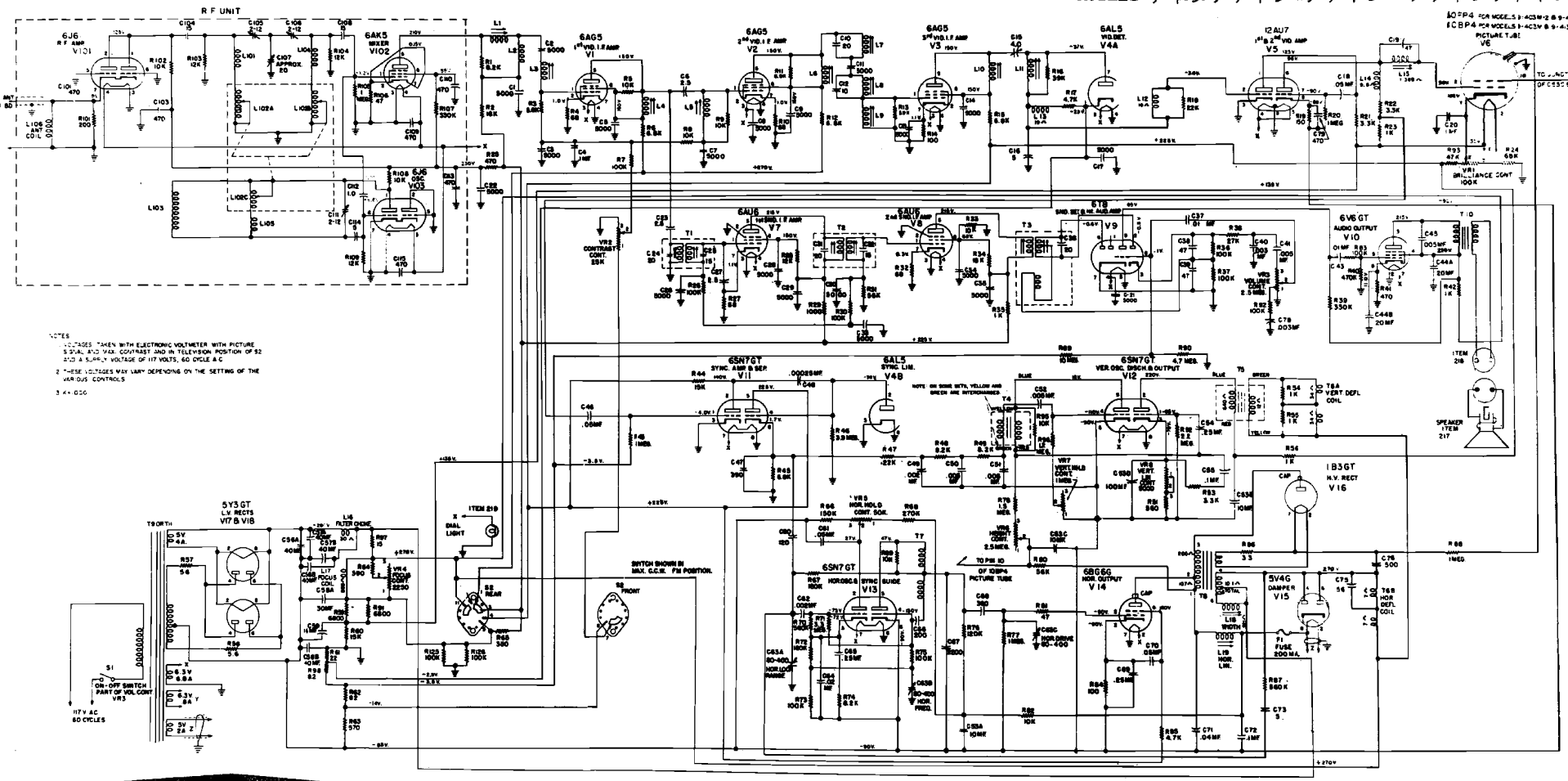
Figure 7. Chassis Bottom View Showing Tube Socket and Alignment Locations

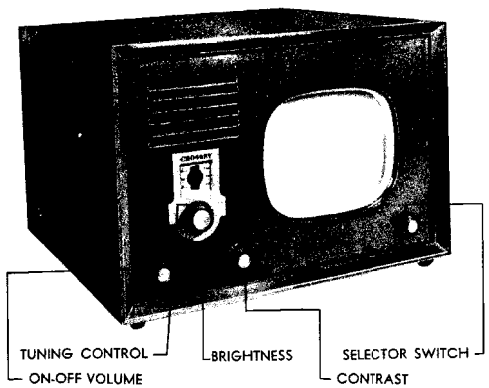
ALIGNMENT TABLE

ALIGNMENT SEQUENCE	ADJUST COIL (See note 2)	TYPE OF SIGNAL INPUT REQUIRED	CONNECT GENERATOR LEADS ACROSS (See notes 1 & 2)	CONNECT VERTICAL INPUT OF SCOPE ACROSS (See notes 1-2-3)	ADJUST COILS TO RESPONSE CURVE (See page 10a)	REMARKS
1	4.5 mc trap L15	4.5mc R.F. 30% modulation at 400 cyc.	Grid (pin 1) of V8 and chassis	To grid (pin 2) of V6 Crystal in		Adjust L15 for minimum 400 cyc. response on scope.
2	4th video I.F. Pri. & Sec. L10 & L11	Sweep and R.F. signal as marker	Grid (pin 1) of V8 and chassis	Junction of 4700 ohm resister R17 & detector shunt peaking coil L13 low side to chassis Crystal out	5D	Set contrast control at maximum counter-clockwise.
3	3rd video I.F. Pri. & Sec. L6 & L9 21.9mc trap L7 27.9 mc trap L8	Sweep & R.F. signal as marker R.F. sig. 21.9mc R.F. sig. 27.9mc	Grid (pin 1) of V2 & Chassis	Junction of R17 & L13 low side to chassis. Crystal out	5E	Set contrast contro at max. clockwise. Adjust L7 & L8 for min. deflection of scope. Obtain straightest slope of curve on 26.4 mc side of curve.
4	2nd video I.F. Pri. & Sec. L4 & L5 Pri. of T1 (top)	Sweep & R.F. signal as marker R.F. sig. 21.9mc	Grid (pin 1) of V1 and chassis	Junction of R17 & L13 low side to chassis. Crystal out	5F	Set contrast control clockwise to avoid overload. Obtain straightest slope of curve on 26.4 mc side of curve. Adjust T1 top for min. deflection of scope.
5	1st video I.F. Pri. & Sec. L1 & L3	Sweep & R.F. signal as marker	Osc. tube pulled sig. input to pin 6 of osc. socket V103 (see note 5)	Junction of R17 & L13 low side to chassis Crystal out	5G	Set contrast control clockwise to avoid overload. Obtain straightest slope of curve on 26.4 mc side of curve.
6	Discriminator Primary T3 top	21.9 mc R.F. signal	Grid (pin 1) of V8 and chassis	(Use VT voltmeter instead of scope) Connect across pin 6 or V10 & chassis		Align for zero meter reading. Meter will swing from pos. to neg. through zero. Voltmeter should be set on lowest D.C. scale. Volume control set at minimum.
7	Discriminator secondary T3 bottom	Sweep & R.F. signal as marker	Grid (pin 1) of V8 and chassis	Pin 6 of V10 & chassis Crystal out	5A	Set contrast control at max. counter-clockwise. Set for min. AM response at 21.9 mc. Adjust for max. symmetry. See note 4.
8	2nd sound I.F. Pri. & Sec. T2 top & bottom	Sweep & R.F. signal as marker	Grid (pin 1) of V7 and chassis	Pin 6 of V10 & chassis Crystal out	5B	Set contrast control at max. counter-clockwise. Set scope vertical gain control to max. Align for symmetrical curve & gain.
9	1st sound I.F. secondary only of T1 (bottom)	Sweep & R.F. signal as marker	Grid (pin 1) of V2 and chassis	Pin 6 of V10 & chassis Crystal out	5C	Keep curve below overload reducing contrast. Adjust for max. balanced S curve & min. AM response at 21.9 mc. Slope should be straight from 21.8 mc to 22.0 mc, retouch T2 top if necessary.

NOTES:

1. Place all ground lead connections as close as possible to their respective "hot" leads.
2. To identify exact position of coils for all alignments see top and bottom chassis views Fig. 6 and Fig. 7, also rear of chassis adjustments Fig. 4.
3. See Fig. 3 page 8, for diagram of crystal probe.
4. Do not move the two blue leads on the sound detector plates unless necessary to obtain proper curve. Dress left blue lead against chassis and the other blue lead clear of parts and chassis. After discriminator alignment, recheck steps 7 and 8 for balanced symmetrical curve and gain.
5. Remove 6J6 oscillator tube (V103). Insert short piece of solid wire in pin No. 6 (counter-clockwise looking at top of socket) and connect generator "hot" lead to it.





MISCELLANEOUS REPLACEMENT PARTS

C-135038-67	Strip, Terminal (¾", 2 Lugs)
C-135038-83	Strip, Terminal (1⅛", 3 Lugs)
C-135038-40	Strip, Terminal (1⅞", 5 Lugs)
C-135038-59	Strip, Terminal (2¼", 6 Lugs)
C-135038-66	Strip, Terminal (1½", 4 Lugs)
C-135038-28	Strip, Terminal (1⅛", 3 Lugs)
C-135038-68	Strip, Terminal (1⅞", 5 Lugs)
C-135038-69	Strip, Terminal (3", 8 Lugs)
C-135038-70	Strip, Terminal (1⅛", 3 Lugs)
C-135038-71	Strip, Terminal (3⅜", 9 Lugs)
C-135038-73	Strip, Terminal (1⅞", 5 Lugs)
W-144629	Support, Anode Cable
C-144381	Supp't., Defl. & Focus Coil
AR-144879-1	Tuner, R. F.

ELECTRICAL REPLACEMENTS PARTS LIST—R. F. TUNER, MODELS 9-403M, 9-413B

Ref. No.	Part No.	Description
	AR-144879-1	R. F. Tuner (Complete)
C-101	W-160633-20	Capacitor, Mica, 470 mmf., 500 v.
C-103	W-160082	Capacitor, Ceramic, 470 mmf., 350 v.
C-104	W-160080	Capacitor, Ceramic, 15 mmf., 500 v.
C-105	W-160247	Capacitor, Var. Ceramic, 2-12 mmf.
C-106	W-160247	Capacitor, Var. Ceramic, 2-12 mmf.
C-107	W-160040	Capacitor, Var. Air., Approx. 20 mmf.
C-108	W-160080	Capacitor, Ceramic, 15 mmf., 500 v.
C-109	W-160082	Capacitor, Ceramic, 470 mmf., 350 v.
C-110	W-160082	Capacitor, Ceramic, 470 mmf., 350 v.
C-111	W-160247	Capacitor, Var. Ceramic, 2-12 mmf.
C-112	W-137398-2	Capacitor, Ceramic, 1.0 mmf., 500 v.
C-113	W-160633-20	Capacitor, Mica, 470 mmf., 500 v.
C-114	W-160084	Capacitor, Ceramic, 5 mmf., 500 v.
C-115	W-160633-20	Capacitor, Ceramic, 470 mmf., 500 v.
R-101	39375-32	Resistor, 200 ohm, ½ w., 5%
R-102	39374-213	Resistor, 10,000 ohm, 2 w., 10%
R-103	39374-38	Resistor, 12,000 ohm, ½ w., 10%
R-104	39374-38	Resistor, 12,000 ohm, ½ w., 10%
R-105	39374-61	Resistor, 1 megohm, ½ w., 10%
R-106	39374-9	Resistor, 47 ohm, ½ w., 10%
R-107	39374-55	Resistor, 330,000 ohm, ½ w., 10%
R-108	39374-213	Resistor, 10,000 ohm, 2 w., 10%
R-109	39374-38	Resistor, 12,000 ohm, ½ w., 10%
L-101	AW-160218	Inductor, Band Pass Input
L-102A	D-144760	Inductor, Tuning (Three Section)
L-102B		Inductor, Tuning (Three Section)
L-102C		Inductor, Tuning (Three Section)
L-103	AW-160225	Inductor, Band Pass Output
L-104	AW-160054	Inductor, Oscillator Shunt
L-105	AW-160217	Inductor, Band Pass Osc.
L-106	AW-160018	Coil, Antenna

MODELS 9-403M, 9-403MA,
9-403M-2, 9-413B, 9-413B-2

ELECTRICAL REPLACEMENT PARTS LIST—MAIN CHASSIS, MODELS 9-403M, 9-413B

Ref. No.	Part No.	Description
C-1	B-144675-2	Capacitor, Ceramic, 5000 mmf., 500 v., 10%
C-2	B-144675-2	Capacitor, Ceramic, 5000 mmf., 500 v., 10%
C-3	B-144675-2	Capacitor, Ceramic, 5000 mmf., 500 v., 10%
C-4	39001-19	Capacitor, Paper, .1 mfd., 600 v.
C-5	B-144675-2	Capacitor, Ceramic, 5000 mmf., 500 v., 10%
C-6	AW-144848	Capacitor, Trans. Line, 2.5 mmf., 10%
C-7	B-144675-2	Capacitor, Ceramic, 5000 mmf., 500 v., 10%
C-8	B-144675-2	Capacitor, Ceramic, 5000 mmf., 500 v., 10%
C-9	B-144675-2	Capacitor, Ceramic, 5000 mmf., 500 v., 10%
C-10	C-137727-81	Capacitor, Ceramic, 20 mmf., 500 v., 5%
C-11	B-144675-2	Capacitor, Ceramic, 5000 mmf., 500 v., 10%
C-12	C-137727-85	Capacitor, Ceramic, 10 mmf., 500 v., 5%
C-13	B-144675-2	Capacitor, Ceramic, 5000 mmf., 500 v., 10%
C-14	B-144675-2	Capacitor, Ceramic, 5000 mmf., 500 v., 10%
C-15	AW-144859	Capacitor, Trans. Line, 4 mmf., 10%
C-16	W-160084	Capacitor, Ceramic, 5 mmf., 500 v., 10%
C-17	B-144675-2	Capacitor, Ceramic, 5000 mmf., 500 v., 10%
C-18	39001-17	Capacitor, Paper, .05 mfd., 600 v.
C-19	W-160081	Capacitor, Ceramic, 47 mmf., 500 v., 10%
C-20	39001-19	Capacitor, Paper, .1 mfd., 600 v.
C-21	B-144675-2	Capacitor, Ceramic, 5000 mmf., 500 v., 10%
C-22	B-144675-2	Capacitor, Ceramic, 5000 mmf., 500 v., 10%
C-23	W-160078	Capacitor, Ceramic, 2.5 mmf., 500 v., 10%
C-24	C-137727-81	Capacitor, Ceramic, 20 mmf., 500 v., 10%
C-25	C-137727-27	Capacitor, Ceramic, 15 mmf., 500 v., 10%
C-26	B-144675-2	Capacitor, Ceramic, 5000 mmf., 500 v., 10%
C-27	W-160068	Capacitor, Ceramic, 2.5 mmf., 500 v.
C-28	B-144675-2	Capacitor, Ceramic, 5000 mmf., 500 v., 10%
C-29	B-144675-2	Capacitor, Ceramic, 5000 mmf., 500 v., 10%
C-30	B-144675-2	Capacitor, Ceramic, 5000 mmf., 500 v., 10%
C-31	C-137727-81	Capacitor, Ceramic, 20 mmf., 500 v., 10%
C-32	C-137727-27	Capacitor, Ceramic, 15 mmf., 500 v., 10%
C-33	B-144675-2	Capacitor, Ceramic, 5000 mmf., 500 v., 10%
C-34	B-144675-2	Capacitor, Ceramic, 5000 mmf., 500 v., 10%
C-35	B-144675-2	Capacitor, Ceramic, 5000 mmf., 500 v., 10%
C-36	Part of T-3	Capacitor, Ceramic, 20 mmf., 500 v., 10%
C-37	39001-13	Capacitor, Paper, .01 mfd., 600 v.
C-38	W-160081	Capacitor, Ceramic, 47 mmf., 500 v., 10%
C-39	W-160081	Capacitor, Ceramic, 47 mmf., 500 v., 10%
C-40	39001-76	Capacitor, Ceramic, .003 mfd., 600 v.
C-41	39001-11	Capacitor, Paper, .005 mfd., 600 v.
C-43	39001-13	Capacitor, Paper, .01 mfd., 600 v.
C-44A	B-144521	Capacitor, Elect., 20 mfd., 350 v. \ Two
C-44B		Capacitor, Elect., 20 mfd., 25 v. / Section
C-45	39001-11	Capacitor, Paper, .005 mfd., 600 v.
C-46	39001-17	Capacitor, Paper, .05 mfd., 600 v.
C-47	B-137498-28	Capacitor, Mica, 390 mmf., 500 v.
C-48	39001-73	Capacitor, Paper, .00025 mfd., 600 v.
C-49	39001-74	Capacitor, Paper, .002 mfd., 600 v.
C-50	39001-11	Capacitor, Paper, .005 mfd., 600 v.
C-51	39001-11	Capacitor, Paper, .005 mfd., 600 v.
C-52	39001-11	Capacitor, Paper, .005 mfd., 600 v.
C-53A	B-144294	Capacitor, Elect., 10 mfd., 450 v. \
C-53B		Capacitor, Elect., 10 mfd., 450 v. \ Four
C-53C		Capacitor, Elect., 10 mfd., 450 v. / Section
C-53D		Capacitor, Elect., 100 mfd., 25 v. /
C-54	39001-87	Capacitor, Paper, .25 mfd., 600 v.
C-55	39001-19	Capacitor, Paper, .1 mfd., 600 v.
C-56A	B-144293	Capacitor, Elect., 40 mfd., 450 v. \ Two
C-56B		Capacitor, Elect., 40 mfd., 450 v. / Section
C-57A	B-144293	Capacitor, Elect., 40 mfd., 450 v. \ Two
C-57B		Capacitor, Elect., 40 mfd., 450 v. / Section
C-58A	B-144292	Capacitor, Elect., 30 mfd., 450 v. \ Two
C-58B		Capacitor, Elect., 40 mfd., 150 v. / Section
C-59	B-144989	Capacitor, Elect., 16 mfd., 400 v.
C-60	B-137498-17	Capacitor, Mica, 120 mmf., 500 v.
C-61	39001-17	Capacitor, Paper, .05 mfd., 600 v.
C-62	39001-74	Capacitor, Paper, .002 mfd., 600 v.
C-63A	B-132386-15	Capacitor, Trimmer, 80-400 mmf. \ Three
C-63B		Capacitor, Trimmer, 80-400 mmf. / Section
C-63C		Capacitor, Trimmer, 80-400 mmf. /
C-64	39001-80	Capacitor, Paper, .02 mfd., 600 v.
C-65	39001-87	Capacitor, Paper, .25 mfd., 600 v.
C-66	B-137498-45	Capacitor, Mica, 200 mmf., 500 v.
C-67	B-137498-42	Capacitor, Mica, 2200 mmf., 500 v.
C-68	B-137498-28	Capacitor, Mica, 390 mmf., 500 v.
C-69	39001-87	Capacitor, Paper, .25 mfd., 600 v.
C-70	39001-17	Capacitor, Paper, .05 mfd., 600 v.
C-71	B-144862-2	Capacitor, Paper, .04 mfd., 400 v., 10%
C-72	B-144862-1	Capacitor, Paper, .1 mfd., 400 v., 10%
C-73	W-160084	Capacitor, Ceramic, 5 mmf., 500 v.
C-75	B-137498-15	Capacitor, Mica, 56 mmf., 500 v.
C-76	B-137477-1	Capacitor, Ceramic, 500 mmf., 10 kv.
C-78	39001-76	Capacitor, Paper, .003 mfd., 600 v.
C-79	160633-20	Capacitor, Mica, 470 mmf., 500 v.
R-1	39375-71	Resistor, 3,200 ohm, ½ w., 5%
R-2	39374-40	Resistor, 18,000 ohm, ½ w., 10%
R-3	39375-67	Resistor, 5,600 ohm, ½ w., 5%
R-4	39374-11	Resistor, 68 ohm, ½ w., 10%
R-5	39375-73	Resistor, 10,000 ohm, ½ w., 5%
R-6	39374-211	Resistor, 5,800 ohm, 2 w., 10%
R-7	39374-49	Resistor, 100,000 ohm, ½ w., 10%
R-8	39374-37	Resistor, 10,000 ohm, ½ w., 10%
R-9	39375-73	Resistor, 10,000 ohm, ½ w., 5%
R-10	39374-11	Resistor, 68 ohm, ½ w., 10%
R-11	39375-69	Resistor, 6,800 ohm, ½ w., 5%
R-12	39374-211	Resistor, 6,800 ohm, 2 w., 10%
R-13	39375-63	Resistor, 3,900 ohm, ½ w., 5%
R-14	39374-13	Resistor, 100 ohm, ½ w., 10%
R-15	39374-211	Resistor, 6,800 ohm, 2 w., 10%
R-16	39375-87	Resistor, 39,000 ohm, ½ w., 5%
R-17	39375-65	Resistor, 4,700 ohm, ½ w., 5%
R-18	39374-41	Resistor, 22,000 ohm, ½ w., 10%
R-19	39374-15	Resistor, 150 ohm, ½ w., 10%
R-20	39374-61	Resistor, 1 megohm, ½ w., 10%
R-21	39374-31	Resistor, 3,300 ohm, ½ w., 10%
R-22	39375-209	Resistor, 3,300 ohm, ½ w., 5%
R-23	39375-49	Resistor, 1,000 ohm, ½ w., 5%
R-24	39374-47	Resistor, 68,000 ohm, ½ w., 10%
R-25	39374-21	Resistor, 470 ohm, ½ w., 10%
R-26	39374-49	Resistor, 100,000 ohm, ½ w., 10%
R-27	39374-11	Resistor, 68 ohm, ½ w., 10%
R-28	39374-38	Resistor, 12,000 ohm, ½ w., 10%
R-29	39374-25	Resistor, 1,000 ohm, ½ w., 10%
R-30	39374-49	Resistor, 100,000 ohm, ½ w., 10%
R-31	39374-46	Resistor, 56,000 ohm, ½ w., 10%
R-32	39374-11	Resistor, 68 ohm, ½ w., 10%
R-33	39374-37	Resistor, 10,000 ohm, ½ w., 10%
R-34	39374-128	Resistor, 18,000 ohm, 1 w., 10%
R-35	39374-25	Resistor, 1,000 ohm, ½ w., 10%
R-36	39374-49	Resistor, 100,000 ohm, ½ w., 10%
R-37	39374-49	Resistor, 100,000 ohm, ½ w., 10%
R-38	39374-42	Resistor, 27,000 ohm, ½ w., 10%
R-39	39374-55	Resistor, 330,000 ohm, ½ w., 10%
R-40	39374-57	Resistor, 470,000 ohm, ½ w., 10%
R-41	39374-109	Resistor, 470 ohm, 1 w., 10%
R-42	39374-201	Resistor, 1,000 ohm, 2 w., 10%
R-43	39374-61	Resistor, 1 megohm, ½ w., 10%
R-44	39374-39	Resistor, 15,000 ohm, ½ w., 10%
R-45	39374-35	Resistor, 6,800 ohm, ½ w., 10%
R-46	39374-75	Resistor, 3.9 megohm, ½ w., 10%
R-47	39374-41	Resistor, 22,000 ohm, ½ w., 10%
R-48	39374-36	Resistor, 8,200 ohm, ½ w., 10%
R-49	39374-36	Resistor, 8,200 ohm, ½ w., 10%
R-51	39374-22	Resistor, 560 ohm, ½ w., 10%
R-52	39374-69	Resistor, 2.2 megohm, ½ w., 10%
R-53	39374-31	Resistor, 3,300 ohm, ½ w., 10%
R-54	39374-25	Resistor, 1,000 ohm, ½ w., 10%
R-55	39374-25	Resistor, 1,000 ohm, ½ w., 10%
R-56	39374-25	Resistor, 1,000 ohm, ½ w., 10%
R-57	39304-13	Resistor, 5.6 ohm, 1 w., 10%
R-58	39304-13	Resistor, 5.6 ohm, 1 w., 10%
R-59	39374-211	Resistor, 6,800 ohm, 2 w., 10%
R-60	39374-215	Resistor, 15,000 ohm, 2 w., 10%
R-61	39374-5	Resistor, 22 ohm, ½ w., 10%
R-62	39374-188	Resistor, 82 ohm, 2 w., 10%
R-63	W-144457	Resistor, 570 ohm, 11 w., wire wound
R-64	39374-196	Resistor, 390 ohm, 2 w., 10%
R-65	W-144456	Resistor, 350 ohm, 6.6 w., wire wound
R-66	39374-51	Resistor, 150,000 ohm, ½ w., 10%
R-67	39374-51	Resistor, 150,000 ohm, ½ w., 10%
R-68	39374-54	Resistor, 270,000 ohm, ½ w., 10%
R-69	39374-37	Resistor, 10,000 ohm, ½ w., 10%
R-70	39374-58	Resistor, 560,000 ohm, ½ w., 10%
R-71	39374-73	Resistor, 3.3 megohm, ½ w., 10%
R-72	39374-52	Resistor, 180,000 ohm, ½ w., 10%
R-73	39374-49	Resistor, 100,000 ohm, ½ w., 10%
R-74	39374-36	Resistor, 8,200 ohm, ½ w., 10%
R-75	39374-49	Resistor, 100,000 ohm, ½ w., 10%
R-76	39374-50	Resistor, 120,000 ohm, ½ w., 10%
R-77	39374-61	Resistor, 1 megohm, ½ w., 10%
R-78	39374-65	Resistor, 1.5 megohm, ½ w., 10%
R-80	39374-46	Resistor, 56,000 ohm, ½ w., 10%
R-81	39374-9	Resistor, 47 ohm, ½ w., 10%
R-82	39374-37	Resistor, 10,000 ohm, ½ w., 10%
R-83	39374-49	Resistor, 100,000 ohm, ½ w., 10%
R-84	39374-101	Resistor, 100 ohm, 1 w., 10%
R-85	39374-121	Resistor, 4,700 ohm, 1 w., 10%
R-86	39303-14	Resistor, 3.3 ohm, ½ w., 10%
R-87	39374-58	Resistor, 560,000 ohm, ½ w., 10%
R-88	39374-61	Resistor, 1 megohm, ½ w., 10%
R-89	39374-85	Resistor, 10 megohm, ½ w., 10%
R-90	39374-77	Resistor, 4.7 megohm, ½ w., 10%
R-91	39374-211	Resistor, 6,800 ohm, 2 w., 10%
R-92	39374-49	Resistor, 100,000 ohm, ½ w., 10%
R-93	39374-45	Resistor, 47,000 ohm, ½ w., 10%
R-95	39374-37	Resistor, 10,000 ohm, ½ w., 10%
R-96	39374-65	Resistor, 1.5 megohm, ½ w., 10%
R-97	39374-91	Resistor, 15 ohm, 1 w., 10%
R-98	39303-19	Resistor, 8.2 ohm, ½ w., 10%
R-125	39374-137	Resistor, 100,000 ohm, 1 w., 10%
R-126	39374-137	Resistor, 100,000 ohm, 1 w., 10%
L-1	AW-145208	Coil (21.9 mc.), 1st Video I. F. Primary
L-2	AW-160020	Coil (Coupling), 1st Video I. F.
L-3	AW-160155	Coil (21.9 mc.), 1st Video I. F. Secondary
L-4	AW-160155	Coil (21.9 mc.), 2nd Video I. F. Primary
L-5	AW-160155	Coil (21.9 mc.), 2nd Video I. F. Secondary
L-6	AW-160155	Coil (21.9 mc.), 3rd Video I. F. Primary
L-7	AW-145195	Trap (21.9 mc.) Video I. F.
L-8	AW-145195	Trap (21.9 mc.) Video I. F.
L-9	AW-160161	Coil (21.9 mc.), 3rd Video I. F. Secondary
L-10	AW-145328	Coil (21.9 mc.), Video Det. Primary
L-11	AW-145209	Coil (21.9 mc.), Video Det. Secondary
L-12	AW-144864	Coil, Detector Peaking
L-13	AW-160023-2	Coil, Detector Peaking
L-14	AW-160023-1	Coil, Video Amp. Peaking
L-15	AW-160160	Coil, 4.5. mc. Trap
L-16	B-144546	Choke, Filter
L-17	144301	Coil, Focus
L-18	AW-145139	Coil, Width
L-19	AW-144551	Coil, Horizontal Linearity
T-1	AC-160008	Transformer, 1st I. F. (Sound)
T-2	AC-160008	Transformer, 2nd I. F. (Sound)
T-3	AC-160010	Transformer, Discriminator
T-4	B-144559	Transformer, Vertical Blocking Osc.
T-5	B-145498	Transformer, Vertical Output
T-6A	AB-144904	Yoke, Vertical Deflection \ Assy.
T-6B		Yoke, Horizontal Deflection /
T-7	AW-144564	Transformer, Horizontal Osc.
T-8	B-144724	Transformer, Horizontal Deflection
T-9	B-144460	Transformer, Power
T-10	B-138131-2	Transformer, Audio Output
VR-1	C-144343	Control, Brilliance \ Two
VR-2		Control, Contrast / Section
VR-3	B-144342	Control, Volume (Sound)
VR-4	B-144258	Control, Focus
VR-5	B-144261	Control, Horizontal Hold
VR-6	B-144259	Control, Height
VR-7	B-144262	Control, Vertical Hold
VR-8	B-144260	Control, Vertical Linearity
S-1	Part of Ref. VR-3	Switch AC Power
S-2A	C-144401	Switch, Function \ Two
S-2B		Switch, Function / Section
F-217	W-144898	Fuse, 200 MA.
	145087	Speaker
218	AW-144860	Speaker Cable and Plug
219	AW-138437-1	Bulb (Dial), Type 47, 6.3 v., .15 amp.
	D-144545	Back, Cabinet
	W-160041	Board, Terminal (Antenna)
	W-160128	Bracket (R. F. Tuner)
	AW-160124-1	Bracket & Stud Assy., Gear (Mounted with washers)
	AW-145397	Bracket & Stud Assy.
	AB-144853	Bracket Assy., Deflection Yoke
	R-144701	Cabinet (9-403M)
	R-144907	Cabinet (9-413B)
	C-132300-6	Cable & Plug Assy., Power
	AW-144845	Cable, H. V.
	W-144413-1	Channel, Rubber (8⅝ inches)
	W-130860	Clamp, Tube
	W-136117-2	Clamp, Electrolytic
	C-138648-5	Clip, Coil Mtg. (T-1, T-2, T-3)
	C-138648-4	Clip, Coil Mtg. (L-1, L-3, L-4, L-5, L-6, L-7, L-8, L-9, L-10, L-11)
	C-138648-2	Clip, Coil Mtg. (L-18, L-19)
	W-138488	Connector, Anode
	39012-85	Core, Iron (Used on Ref. T-1, T-2)
	W-160426	Core, Iron (Used on Ref. L-1, L-3, L-4, L-5, L-6, L-9, L-11)
	39012-91	Core, Iron (Used on Ref. L-15)
	39012-92	Core, Iron (Used on Ref. L-18)
	39012-96	Core, Iron (Used on Ref. L-19)
	W-160128-6	Cushion, Rubber (18 inches)
	W-160362-1	Cushion, Rubber (2 9/16 inches, curved)
	W-160362-2	Cushion, Rubber (4 1/4 inches, curved)
	W-160128-7	Cushion, Rubber (5 inches)
	144723	Decal (Off-On-Volume, Brightness-Contrast)
	144722	Decal (Tel-F. M.)
	AB-144455	Dial, Main
	AB-144424	Dial, Vernier
	AB-144958	Escutcheon
	W-160119	Gear, Pinion (R. F. Tuner)
	AW-160153-1	Gear & Pinion Assy.
	B-144470	Glass, Safety
	W-45580	Grommet, Focus Coil
	W-160202-2	Insulator, Stand Off (R. F. Tuner)
	W-138090-2	Insulator, Stand Off
	C-144997-3	Knob, Tuner \
	C-144599-1	Knob, On-Off Volume \
	C-143553-1	Knob, Brightness / 9-403M
	C-143422-1	Knob, Contrast \
	C-144599-2	Knob, Selector Switch /
	C-144997-2	Knob, Tuner \
	C-144599-3	Knob, On-Off Volume \
	C-143553-2	Knob, Brightness / 9-413B
	C-143422-2	Knob, Contrast \
	C-144599-4	Knob, Selector Switch /
	W-144315	Magnet, Ion Trap
	D-145671	Mask, 10"
	39033-19 CP	Nut, ¼, 28 Hex. (Defl. Yoke)
	W-160138	Plate, Ground (R. F. Tuner)
	W-139900	Plug, Interlock
	AD-144901	Power Supply, H. V.
	W-160243-2	Retaining Ring (Gear Bracket)
	144769	Rubber Foot (Cabinet)
	W-160112-2	Rubber Mtg., Focus Coil
	160606-17	Screw No. ¼-28 x 2½ Fil. Hd. Mch. (Defl. Yoke)
	W-144957	Screw—No. 8-32 x ⅜, Thumb
	39155-5 CP	Screw, Chassis Mtg.
	39008-73	Shielding, Spiral Wire
	W-160204	Shield, Long (Tube)
	W-160205	Shield, Short (Tube)
	W-160137	Shield, Dial Light
	W-144906	Socket, Tube (1B3GT/8016)
	W-160065-2	Socket, Tube (6J6, 6AK5)
	W-210860-9	Socket, Tube (5V4G)
	W-160514	Socket, Tube (6AU6, 6AG5, 6AL5)
	39437-1	Socket, Tube (6V6, 6SN7, 5Y3)
	39388	Socket, Tube (6BG6)
	W-144732	Socket, Tube (6T8, 12AU7)
	B-138203-2	Socket & Cable Assy., Picture Tube
	D-136565-28	Socket, Dial Light
	W-144668	Spring, Compression (Defl. Yoke Assy.)
	C-144382	Strap, Picture Tube