MOTOROLA INC.

MODEL VT71
CHASSIS TS-4

GENERAL INFORMATION

GENERAL DESCRIPTION

Model VT71 is a 14 tube, direct viewing, table model Television Receiver with a 7" cathode ray picture tube. It is operated by means of 3 front-panel controls. Features of this receiver include: simplified operation, stabilized performance, full thirteen channel coverage, high usable sensitivity, 300 ohm balanced or 75 ohm coaxial input, an automatic brightness stabilizer and an automatic gain control.

FREQUENCY RANGE IN MEGACYCLES

CHANNEL NUMBER	CHANNEL FREQUENCY	PICTURE CARRIER FREQ.	SOUND CARRIER FREQ.	RECEIVER R.F. OSC. FREQUENCY
1	44-50	45.25	49.75	71.7
2	54-60	55.25	59.75	81.7
3	60-66	61.25	65.75	87.7
4	66-72	67.25	71.75	93.7
5	76-82	77.25	81.75	103.7
6	82-88	83.25	87.75	109.7
7	174-180	175.25	179.75	152.4
8	180-186	181.25	185.75	158.4
9	186-192	187.25	191.75	164.4
10	192-198	193.25	197.75	170.4
11	198-204	199.25	203.75	178.4
12	204-210	205.25	209.75	182.4
13	210-216	211.25	215.75	188.4

STATION SELECTOR SWITCH

This receiver is provided with an 8 position STATION SELECTOR SWITCH. While there are 13 television channels, the allocation is such that no more than 8 will be normally available in any one locality. This receiver can be aligned for reception of those 8 stations.

ANTENNA INPUT IMPEDANCE

The three terminals on the back of the chassis provide for a 300 ohm balanced or 75 ohm unbalanced input. See Figure 1 for proper connection.

POWER SOURCE

This receiver is designed for operation on 115 volts, 60 cycle A.C. only. Power consumption is 110 watts. A safety interlock disconnects the power cord from chassis whenever the protective back is removed from the cabinet.

MODEL VT71 MOTOROLA INC.

I. F. FREQUENCIES

Picture I. F. carrier Frequency:	Channels 1 through 6 - 26.4 mc. Channels 7 through 13 - 22.5 mc.
Sound I. F. carrier Frequency:	Channels 1 through 6 - 21.9 mc. Channels 7 through 13 - 27.0 mc.
Audio Discriminator Band Width:	250 kc between peaks

VIDEO RESPONSE (3 db down)

Up to 3.5 mc.

FOCUS, SWEEP DEFLECTION AND SCANNING

Focus and sweep deflection are both electrostatic. The horizontal scanning is 15,750 c.p.s. and the vertical scanning frequency is 60 c.p.s. Since interlaced scanning is used, the frame frequency is 30 c.p.s.

LOW VOLTAGE POWER SUPPLY (Block No. 1 of Figure 2).

The low voltage power supply provides filament and plate voltages for all of the circuits except those few portions supplied by the high voltage circuit. The filament string is a series - parallel circuit arranged to provide for both .3 amp tubes and the .6 amp required by the cathode ray tube. The 6S8GT (V-7) filament is placed in series with the cathode ray tube filament next to B minus so as to reduce audio hum. Since it is a .3 amp tube, it is necessary to put a 22 ohm resistor (R-80E) in parallel with the 6S8GT filament. See Figure 3.

The plate supply is a voltage doubler system using selenium rectifiers.

NOTE: Since there is no power transformer, plugging this unit into a d-c supply will not damage it. However, with no doubling action, the set will not operate. Also, with no transformer, B- cannot be grounded to chassis because of Underwriter's requirements.

It is to be noted that two separate D.C. voltage busses are used. One (B+) is at approximately 125 volts and the other (B++) is at approximately 250 volts above (B-). (NOTE: For convenience, all points on schematic diagrams that connect to B- are marked ⏚). Thus we have what amounts to a three-wire system with the tubes requiring 125 volts being connected between B- and B+ or B+ and B++, while those requiring 250 volts are connected between B- and B++. To keep B+ half way between B- and B++, the loads are distributed approximately equal on either side of B+. See Figure 3.

Tubes V1, V4, V6, V9B and V11A are connected between B+ and B++. Tubes V5, V7, V9A, V10B, V11B and V13 are connected between B- and B++. V2 and V3 are cascaded between B- and B++. V10A and V12 are connected between B- and B+. Tube V8 receives its plate voltage from the cathode ray tube high voltage supply.

Total current drain is approximately 110 ma.

MOTOROLA INC. MODEL VT71

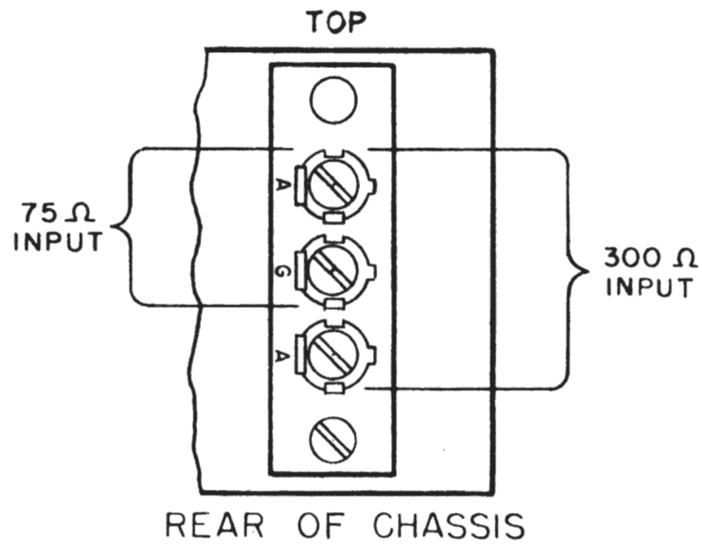


FIG. 1. ANTENNA INPUT CONNECTIONS

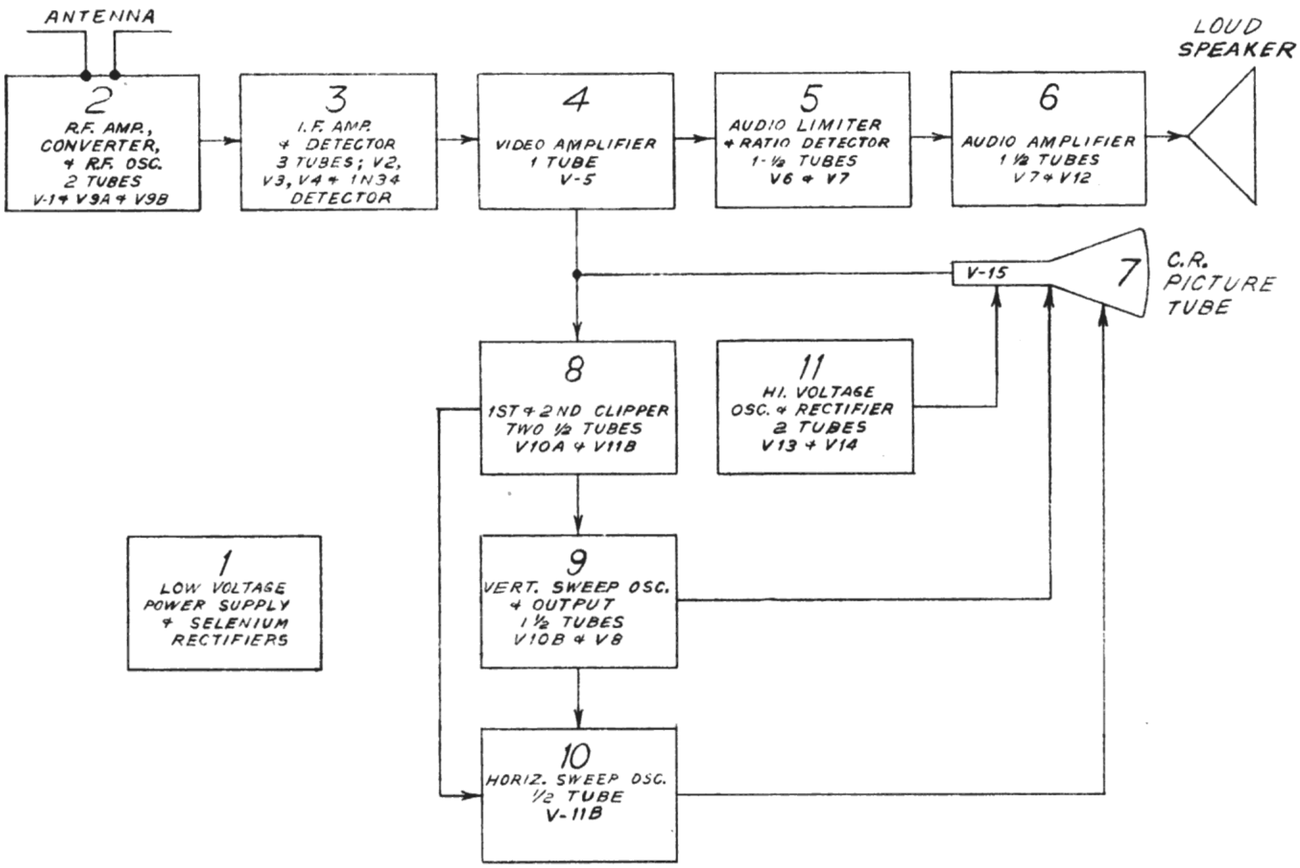


FIG. 2. FUNCTIONAL BLOCK DIAGRAM

MODEL VT71

MOTOROLA INC.

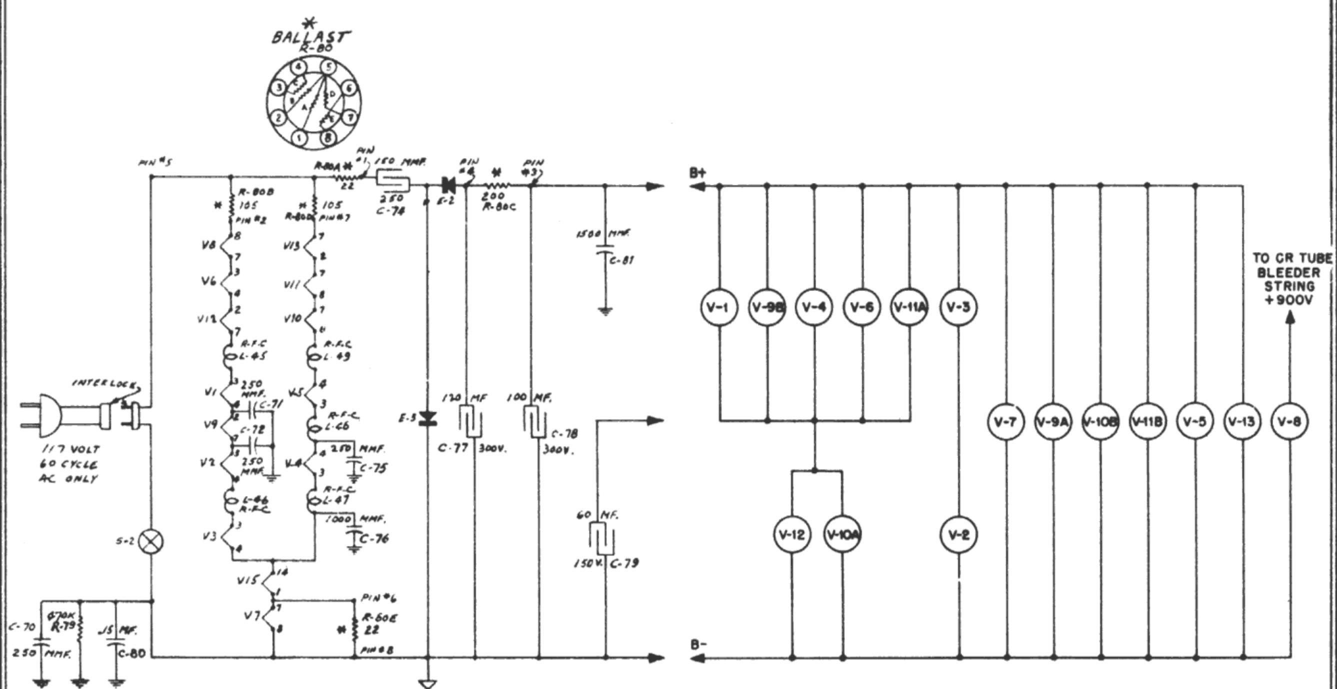


FIG. 3. LOW VOLTAGE POWER SUPPLY & PLATE POWER DISTRIBUTION

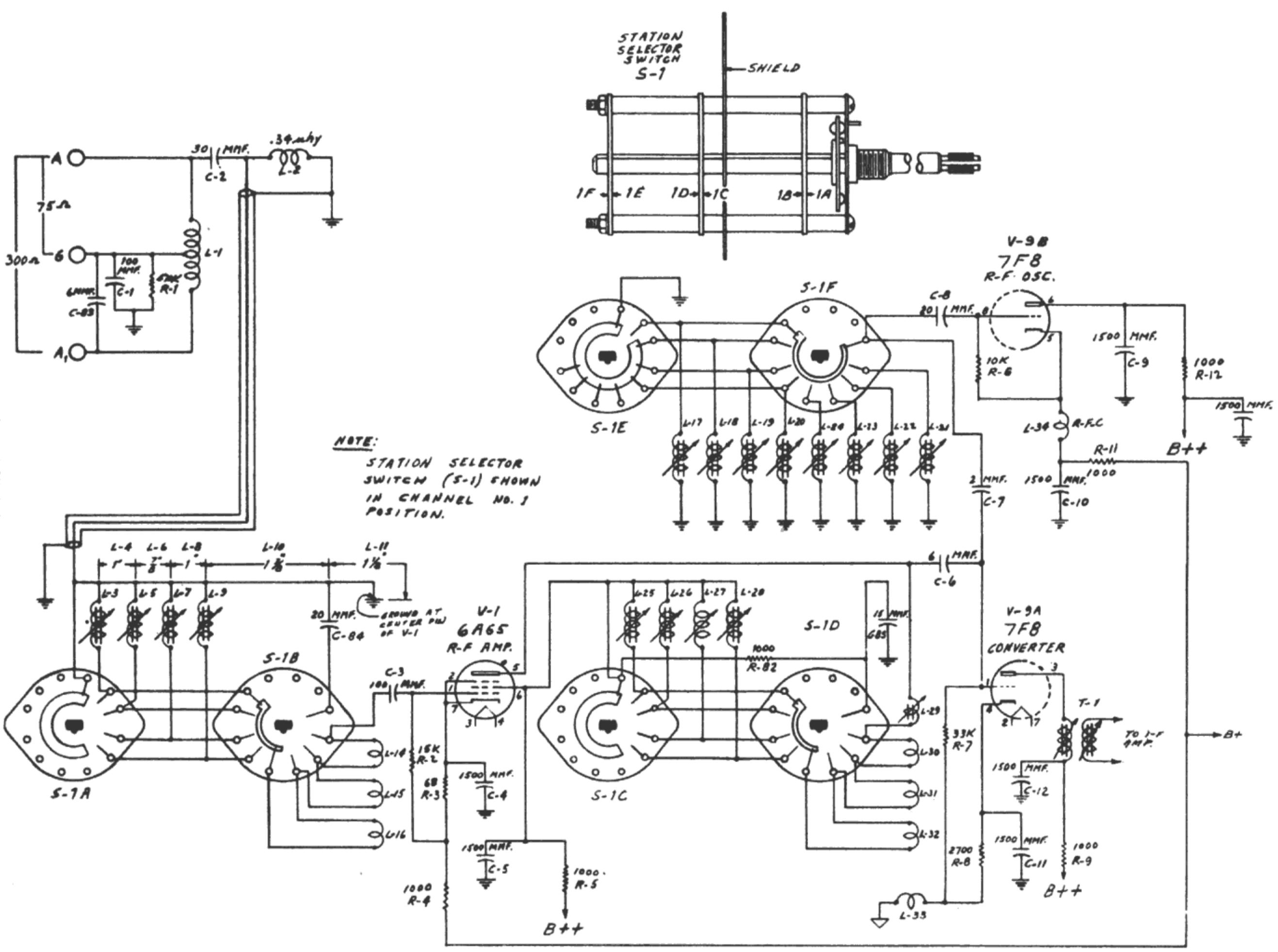


FIG. 4. ANTENNA INPUT & R.F. CIRCUIT DIAGRAM

ANTENNA INPUT

To provide for versatility in the use of antennas for this receiver, two antenna input impedances are provided; one for 300 ohms and the second for 75 ohms. Junctions "A-A", are used for 300 ohms and Junctions "A-G", for 75 ohms. See Figure 4. L-1, C-2 and L-2 form a high pass filter operating into a section of 75 ohm coaxial cable. The cut-off frequency of this filter is approximately 35 mc and is designed to provide high rejection for frequencies close to that of the I.F. C-83 is used to provide uniform response on the high channels.

R. F. UNIT (Block No. 2)

The R.F. unit consists of a 6AG5 R.F. Amplifier and a 7F8 dual triode; one section of which is the R.F. oscillator and the other the converter. Switching is accomplished by means of a three-wafer 8 position Station Selector Switch. These 8 positions will give complete coverage on any of the 13 channels, which will be available in a single locality, as given in Section on Alignment Procedure. See Circuit Diagram Figure 4.

Coils L-3 to L-16, inclusively, mounted to Switch wafer S-1A & B, function to provide the correct impedance match of the antenna input circuit to the 6AG5 R.F. amplifier and to provide channel selectivity. Since the input impedance of the R.F. amplifier decreases inversely as the square of the frequency, this impedance becomes comparatively low for channels 7-13. The Q of the circuit is of the order of 6 and therefore, the bandwidth is of the order of 25 mc. The bandwidth being so great, there is no tuning necessary and none is provided. V-1 is an R.F. amplifier with the tuned coils of wafer S-1C & D providing plate load. Capacitor C-85 is inserted in series with coils L-29 to L-32 so as to permit a large inductance for proper tuning on the higher frequency channels. Each coil of wafer S-1A & B is tuned at the video carrier of its channel while the corresponding coil of wafer S-1C & D is tuned at the audio carrier of the channel for the lower channels only. This results in a flat topped input response of the proper bandwidth. Coil L-29 is tuned to center of channels 12 or 13. The output of V-1 is fed to the grid of the converter tube V-9A through capacitor C-6. Some typical response curves are shown in Figure 5.

V-9B, in conjunction with the coils of wafer S-1E & F, provides the proper oscillator frequencies to give the intermediate frequency. Optimum oscillator injection is provided by means of capacitor C-7.

To prevent undesirable suck-out action, a contact is provided on switch wafers S-1A, B, C & D to short circuit all unused coils of lower frequency than the one being used. This is done on coils covering channels 1 to 6 only. The oscillator has all unused coils shorted out.

I. F. AMPLIFIER (Block No. 3)

The I. F. Amplifier departs considerably from the conventional coupled system. To obtain wide-band with adequate gain, three stages of I.F. amplification are used. The converter plate utilizes a tuned transformer and each successive I.F. amplifier utilizes one tuned circuit each. See Figure 6. The transformer and following plate coils are tuned to different frequencies to obtain

MODEL VT71

MOTOROLA INC.

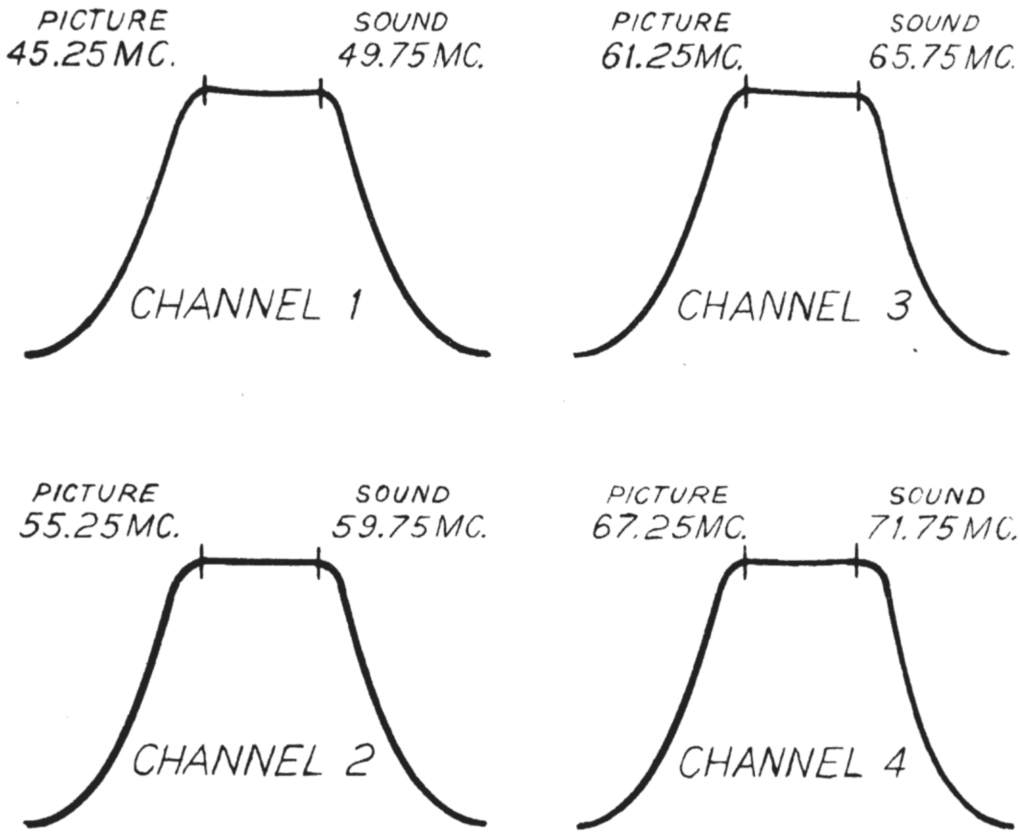


FIG. 5. TYPICAL R.F. RESPONSE CURVES

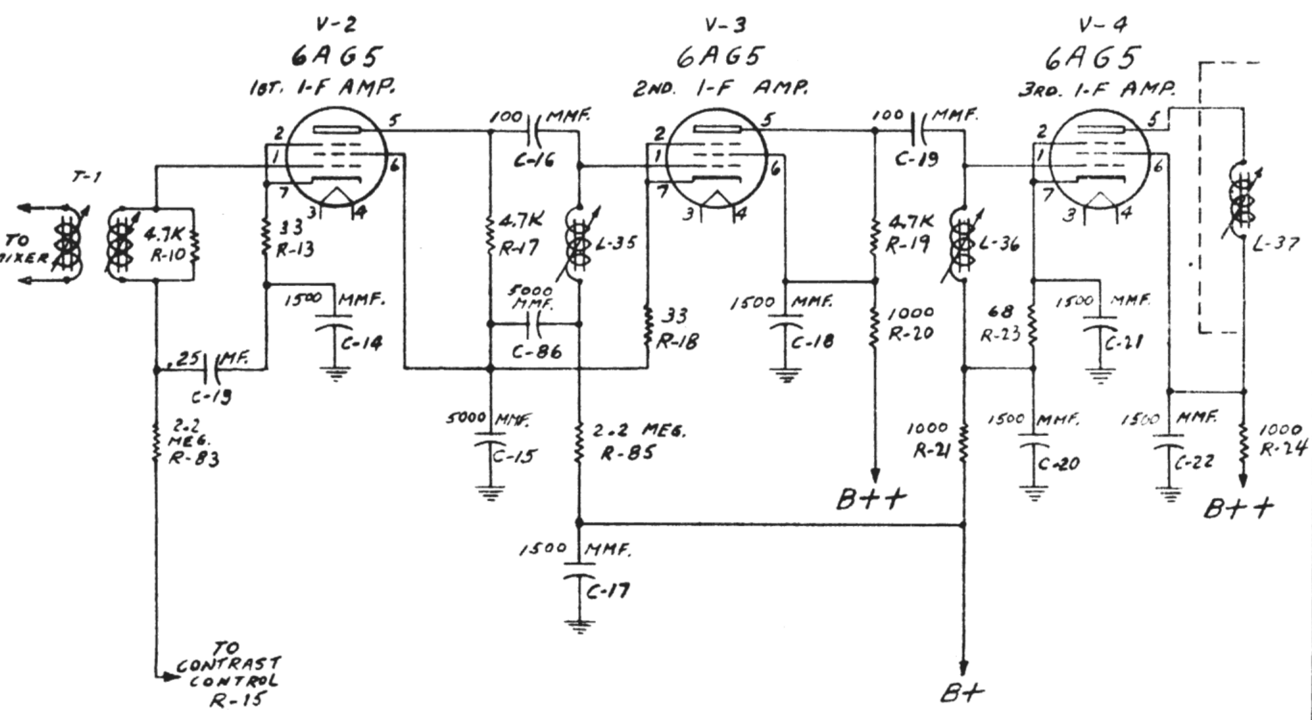


FIG. 6. I.F. AMPLIFIER CIRCUIT DIAGRAM

adequate gain and bandwidth. The I. F. coils are tuned as a group for bandpass curve. The converter transformer is an over-coupled bandpass transformer also covering the same bandwidth.

In order to keep the I.F. bandwidth constant for all setting of the gain (contrast) control, it is necessary to maintain the input capacity of the controlled tubes relatively constant. This is done by using unbypassed cathode resistors in stages V-2 and V-3. Connecting these controlled tubes in series from B- to B++ provides a simple means to prevent disturbing the load distribution between the two buses. While the D-C paths for current flow are connected to the B-, B+ & B++ buses, it should be noted, however, that as far as R.F. and I.F. are connected, the chassis is ground. A typical response curve is shown in Figure 7.

CONTRAST CONTROL

The contrast control R-15 varies directly the bias of the 1st and 2nd I.F. amplifiers V-2 and V-3. This is done by connecting the two tubes in series between B++ and B-, providing current flow through both tubes as a group, and returning the grid of V-3 to B+ or a fixed voltage. As the grid voltage of V-2 is made more negative, the cathode potential of V-3 rises proportionately effectively causing the grid of V-3 to become more negative. Thus R-15 controls manually the output of V-2, V-3 and consequently, the output of the video amplifier.

Reference to Figure 8 will show the automatic gain control (AGC) used in this receiver. For providing automatic gain control in the receiver, a circuit is provided for applying a variable bias to the grid of the first video frequency amplifier tube V-2. This circuit comprises resistor R-84, potentiometer R-15 and resistor R-86, all connected in series from the high voltage side of the detector load resistor R-25 to the grid of the clipper V-10A. The potentiometer R-15 has its movable contact connected through resistor R-83 to the grid of tube V-2. A condensor C-13 bypasses radio frequency currents so that the automatic gain control is not affected thereby.

Considering now the operation of the automatic gain control circuit, it is well known that the voltage appearing across the detector load resistor R-25 depends upon the light content of the video signal. This voltage is always negative and varies from maximum value for a solid black picture to a minimum voltage on a solid white picture. The voltage on the grid of the clipper V-10A, however, varies in the opposite manner, that is the voltage is a minimum for a black picture and maximum for a white picture. This is because the clipper is connected through resistor R-39 and biases itself back from the peaks of the sycchronization pulses which are in the black region and, therefore, the signal is maximum for a white picture. Resistors R-84 and R-86 and potentiometer R-15 connected between load resistor R-25 and the grid of the clipper tube form a voltage divider with each of the voltages having some affect on the voltage at any point on the divider. It is obvious that at some point along this voltage divider the variations in the diode load voltage will balance the variations in the clipper input voltage so that a voltage will be produced which is substantially independent of the light content of the picture being received, or the picture characteristic of the video signal. In actual practice the diode load voltage will have an average value of the order of 1 to 1-1/2 volts and the clipper grid will be held at an average voltage ranging from 10 to 18 volts. In each case, the voltage is negative and it has been found that by proper choice

MODEL VT71 MOTOROLA INC.

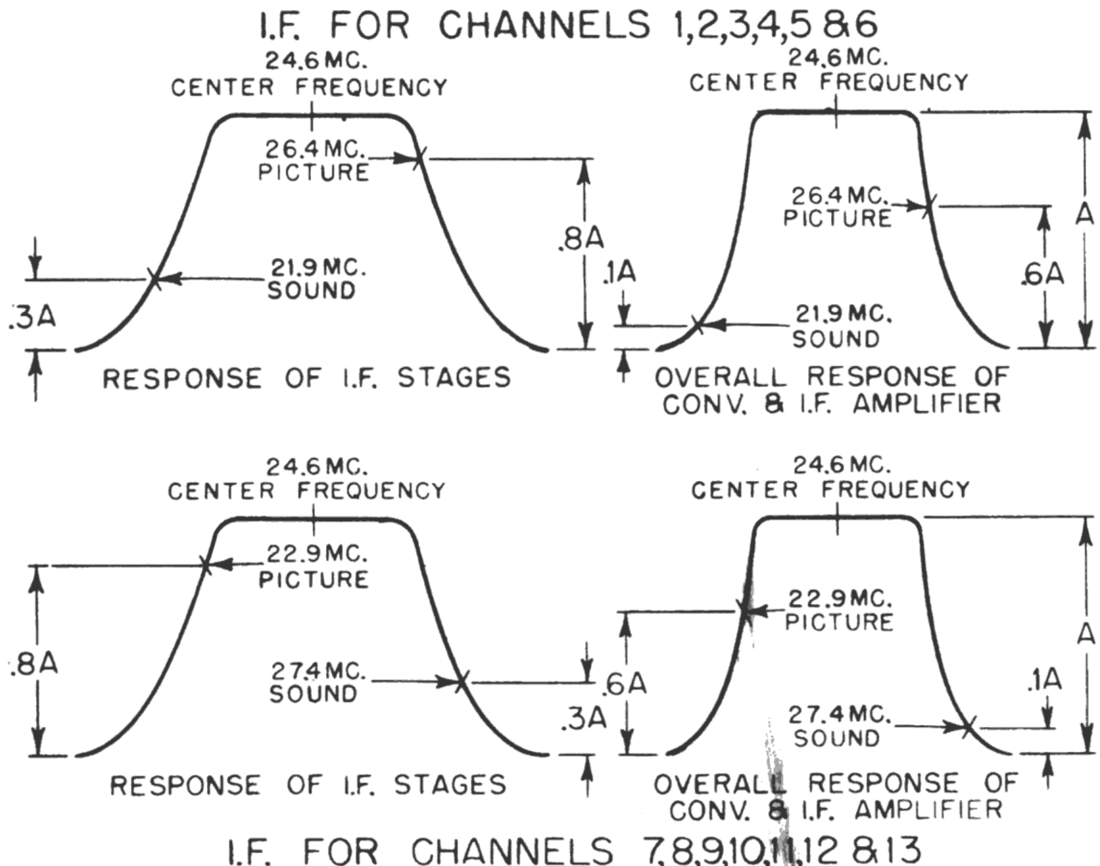


FIG. 7. TYPICAL I.F. RESPONSE CURVES

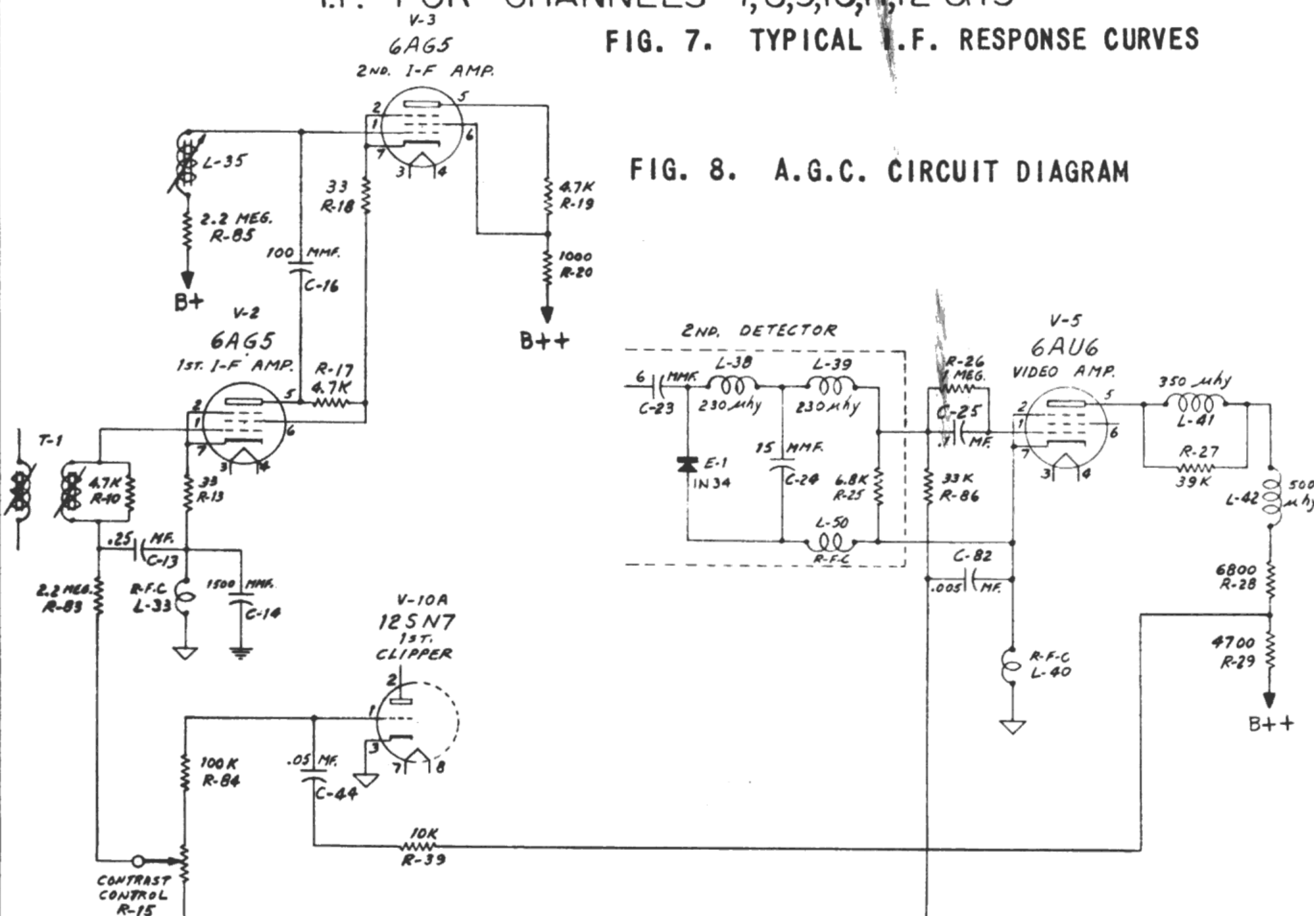


FIG. 8. A.G.C. CIRCUIT DIAGRAM

of the decoupling resistors R-84 and R-86 and the potentiometer R-15 the light characteristic of the picture signal will be substantially balanced out at a point having a potential of about-2 to 3 volts. This AGC potential is applied through resistor R-83 to the control grid of V-2 and is adequate for controlling the gain of the video frequency amplifier. It is to be pointed out that for weak radio frequency signals the voltage across both the lead resistor R-25 and the clipper will be less and the automatic gain control voltage will be less so that the gain of the video frequency amplifier will be increased. For stronger signals the automatic gain control voltage will be increased, thus decreasing the gain of the video frequency amplifier. Thus the automatic gain control circuit overcomes difficulties caused by both slow and fast fading and also facilitates switching of the receiver from one station to another, making such switching possible without changing the volume or contrast control.

SECOND DETECTOR

The detector is a highly efficient half-wave rectifier using a germanium rectifier E-1 (1N34) connected to produce a video signal of the proper polarity. See Figure 9. It also acts as a converter providing the difference frequency between the video I.F. and the audio I.F. Specifically, it produces a 4.5 mc FM audio signal.

L-38 and L-39 together with C-24 form a low pass filter to filter out I.F. harmonics. It is necessary to shield this entire assembly carefully to prevent regeneration.

Capacitor C-35 and resistor R-26 provide a small biasing voltage for the video amplifier and prevent contact potential of the video amplifier from biasing off the crystal and causing a loss of sensitivity on weak signals.

Choke L-50 and capacitor C-89 prevent the possibility of regeneration.

VIDEO AMPLIFIER (Block No. 4)

The function of this section of the receiver is to amplify the video output of the second detector and pass on the audio signal to the audio section of the curcuit. One stage only, employing V-5, a 6AU6 tube, is used. See Figure 9. This tube also is connected so that it acts as a noise limiter. The output of the 2nd detector is in a negative direction and noise peaks drive V-5 beyond cut-off, thus being clipped. The video output is taken through filter network L-41, R-27 and fed to the cathode of the cathode ray picture tube. (Feeding the cathode is equivalent to feeding the grid due to the high CR tube plate resistance. The CR tube must be fed this way because the output of the video amplifier V-5, is positive.) This filter tends to provide uniform gain of the stage at the higher frequencies. The video signal is also fed through L-41, L-42 and resistor R-39, and capacitor C-44 to the grid of the 1st clipper tube V-10A. The audio I.F. is fed through capacitor C-29 to the first audio tuned circuit consisting of C-31 and L-43.

This voltage E is thus determined by the carrier amplitude. At the resonant or mean carrier frequency the voltage el or 32 is then equal to $\frac{E}{2}$.

Now if the signal frequency is changed as occurs under modulation, the voltages E_1 and E_2 will become unequal and the voltages e_1 and e_2 will similarly be unequal, but they will still add up to the voltage E. Since the rectified voltage el changes with modulation, this change occurs at the modulation frequency and thus provides a source of audio voltage.

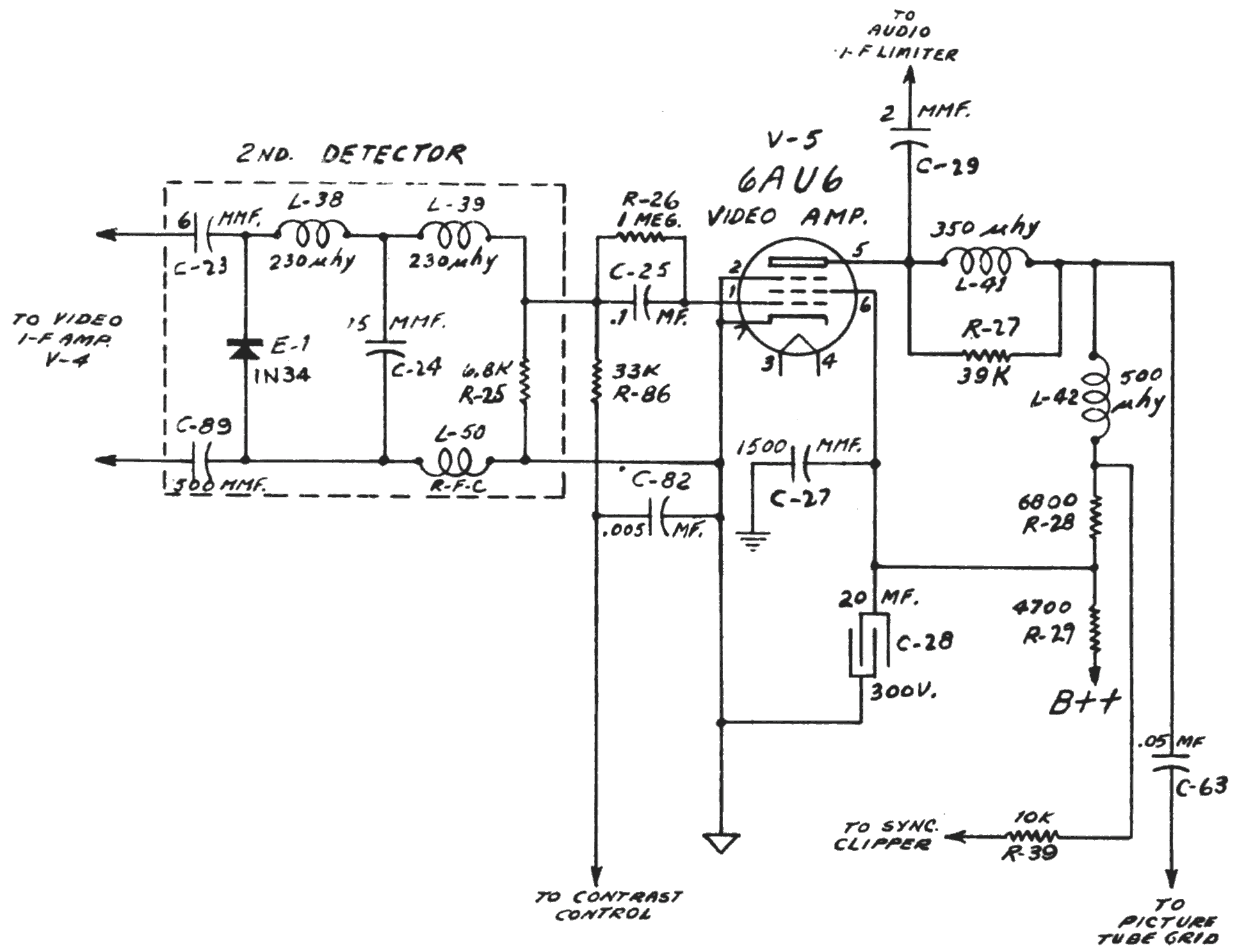


FIG. 9. SECOND DETECTOR & VIDEO AMPLIFIER CIRCUIT DIAGRAM

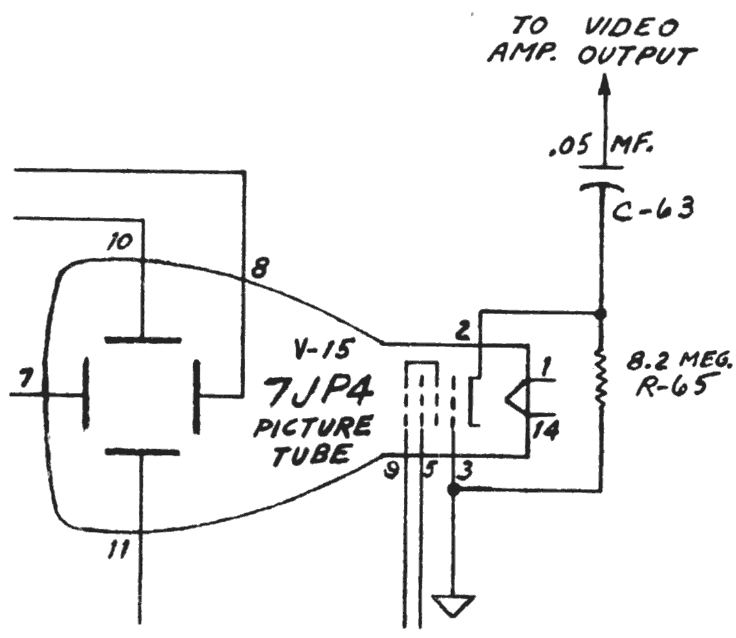


FIG. 10. STABILIZED BRIGHTNESS CIRCUIT DIAGRAM

To understand the lack of response to amplitude modulation, consider the signal to be at a frequency off resonance. Voltages e1 and e2 will be unequal and capacitor C-34 will be charged to voltage E. Now if amplitude modulation is applied to the signal, the amplitude of the diode signal voltages E_1 and E_2 will increase on the positive half of the amplitude modulating cycle and will tend to increase the current through the diodes and increase the charge on capacitor C-34. Since capacitor C-34 is large and is charged through the resistance of the diodes, it cannot charge very rapidly, so very little change of voltage across C-34 will occur before the negative half of the amplitude modulating cycle is reached and the amplitude of E_1 and E_2 decrease below the unmodulated carrier amplitude. The diodes will then stop conducting because of the negative voltage on their plates maintained by the voltage E across capacitor C-34 and capacitor C-34 will tend to discharge through resistor R-32.

Thus the slight increase in charge occuring during the positive half of the amplitude modulating cycle is lost during the negative half of the same cycle producing essentially a constant voltage E across the lead. Since capacitors C-35 and C-36 are also across capacitor C-34 their individual charges e1 and e2 will remain constant and independent of the changes in amplitude of E_1 and E_2 due to amplitude modulation. This, of course, is not true for changes in E_1 and E_2 due to FM.

The choice of resistor R-32 is a compromise. If it is too small, the sensitivity of the circuit will be low and if it is made too large, interference or ignition noise will cause the capacitor C-34 to charge up to a voltage greater than that of the signal and thereby produce distortion or noise.

AUDIO AMPLIFIER & AUDIO OUTPUT

The audio amplifier and audio output stages of this receiver are conventional and are shown in Figure 12.

CATHODE RAY PICTURE TUBE (Block No. 7)

The cathode ray picture tube is a 7" tube employing a medium persistence fluorescent screen material that provides a black and white picture. It uses electrostatic deflection and focusing. Heater voltage is 6.3 volts ± 10% a-c or d-c and current drain is 0.6 amps. Its overall length is approximately 14-1/2 inches. It uses a 14 pin medium shell di-heptal base.

NOTE: Connections to the cathode ray tube are made through individual leads. Care should be used to see that the numbered leads are connected to the correspondingly numbered pins on the cathode ray tube base. The pins are numbered in the same manner as standard receiving tubes i.e., number one pin is just to the left of the locating key and the numbering continues in a clockwise manner.

STABILIZED BRIGHTNESS CONTROL

Instead of using the d-c component of the video signal to govern the average illumination of any scene, a unique system of a-c brightness stabilization is used. See Figure 10. Self bias is developed on the picture tube by the beam current flowing through R-65. The total picture tube cathode current develops a bias voltage across resistor R-65 which automatically sets the correct picture tube bias for line voltage and HV variations. The bias is also independent of picture contrast. The video signal is coupled capacitively to the cathode of the picture tube through C-63. Thus the instantaneous average potential developed on the tube varies about the average value of the video signal. The contrast control is set for the most pleasing picture.

MOTOROLA INC.

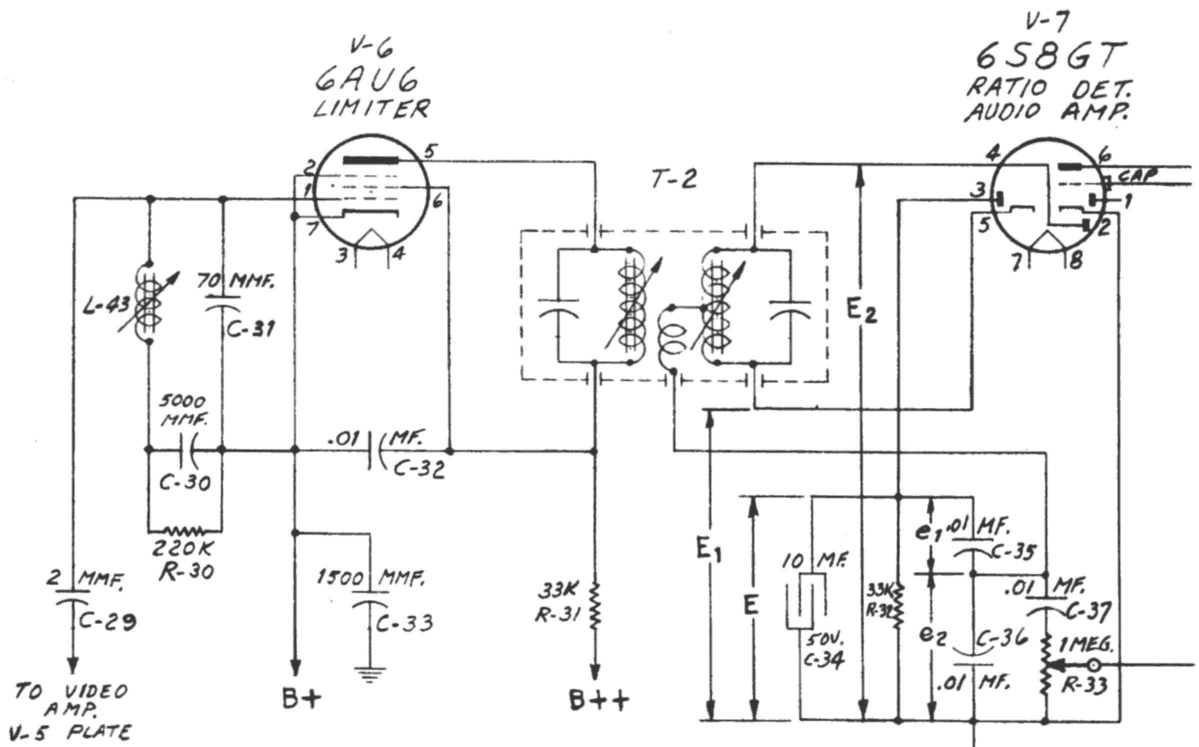


FIG. 11. LIMITER & RATIO DETECTOR CIRCUIT DIAGRAM

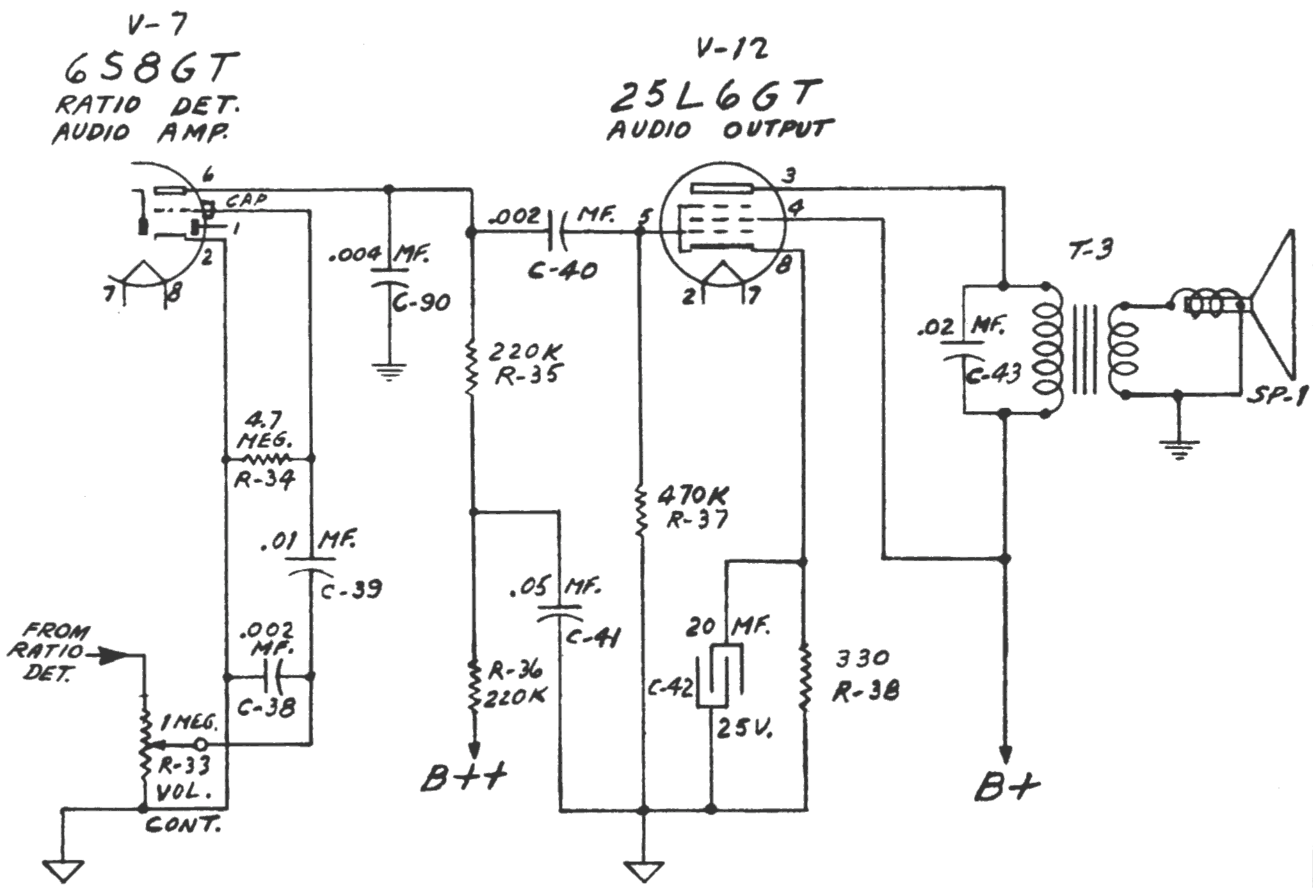


FIG. 12. AUDIO AMPLIFIER & AUDIO OUTPUT CIRCUIT DIAGRAM

AUDIO LIMITING AMPLIFIER & RATIO DETECTOR (Block No. 5) See Figure 11.

A second audio I.F. frequency (4.5 mc) is obtained from the second detector which acts as a converter for the video (26.4 mc) and audio (21.9 mc) I.F. frequencies. This signal is amplified by the video amplifier V-5 and removed from the video plate through C-29, L-43 and C-31, acting as a band-pass filter. L-43 is used to peak the filter to 4.5 mc. C-30 and R-30 provide grid-leak bias for the limiting amplifier tube V-6. This tube also provides amplification of the 4.5 mc audio I.F.

THE RATIO DETECTOR

In this receiver the FM sound I.F. signal is converted to audio by means of a Ratio Detector arrangement.

The ratio detector circuit used is that shown in Figure 11. A discriminator coil is used similar to that in a conventional FM detector; however, it will be noted that the diodes are connected in series rather than in opposition. The detector load represented by R-32 has a value of 33,000 ohms. This load is by-passed by a capacitor C-34 which is quite large and has a value of 10 mfd. The load is also shunted by two small capacitors C-35 and C-36. The audio voltage is derived from the voltage variation across capacitor C-36. The third winding shown is used to introduce a voltage into the secondary circuit which is 90° out of phase with the voltage developed across the secondary winding at the resonant frequency. This is the same requirement as for the conventional discriminator and as can be found in any reference book on FM discriminators. It is the change of phase of this voltage with respect to the voltage across the secondary as the signal frequency changes that produces the unequal signal voltages on the two diodes and a resultant audio output voltage. The diode signal voltages are represented by E_1 and E_2. These are equal at the resonant frequency and unequal at all other frequencies. The voltages e1 and e2 are the rectified signal voltages to which C-35 and C-36, respectively, are charged, and are proportional to the signal voltages E_1 and E_2. The sum of the two voltages e_1 and e_2 is the voltage E, the rectified signal voltage across the load.

The audio voltage produced by the FM is obtained as follows: When the carrier frequency is at the resonant frequency of the secondary the diode signal voltages E_1 and E_2 are equal; hence the rectified voltages e_1 and e_2 are equal and add up to the voltage E, the voltage across the load and the voltage to which capacitor C-34 is charged.

MODEL VT71

MOTOROLA INC.

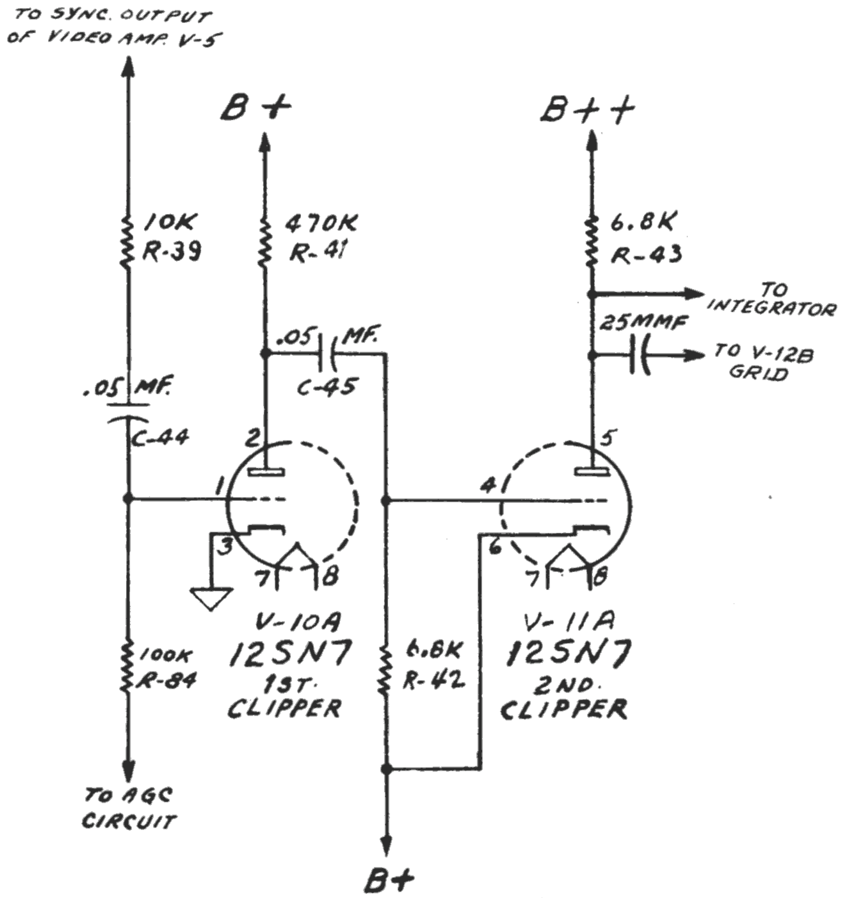


FIG. 13. CLIPPER CIRCUIT DIAGRAM

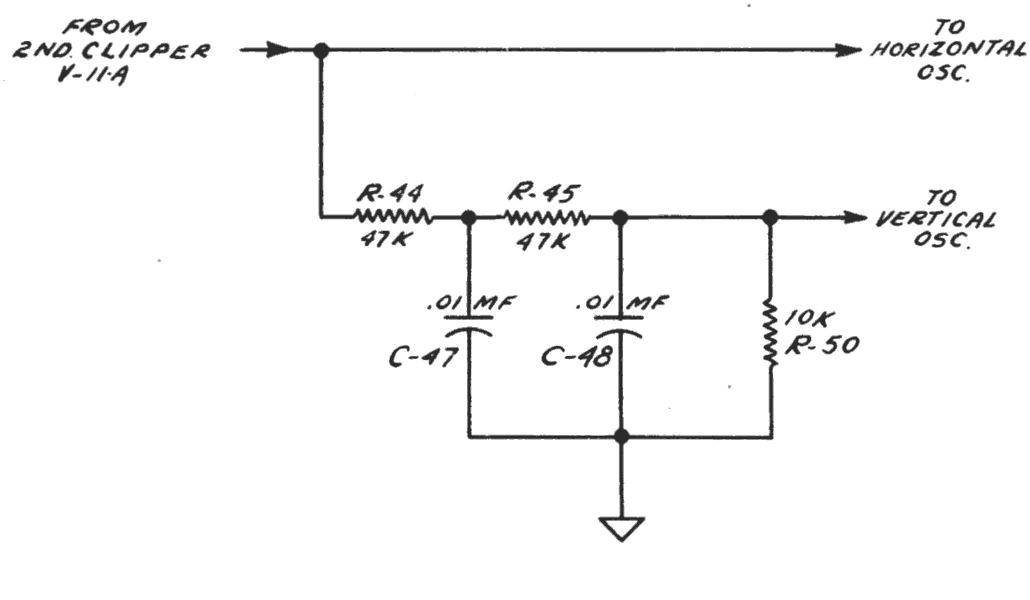


FIG. 14. INTEGRATING NETWORK CIRCUIT DIAGRAM

1st & 2nd CLIPPERS (Block No. 8)

The function of this section is to separate the horizontal and vertical synchronizing pulses from the video signal and apply them to the horizontal and vertical sweep oscillators. The purpose of the synchronizing pulses is to properly trigger the oscillators at the correct moment and keep the receiver scanning in synchronism with the transmitter. See Figure 13. The initial sync separation takes place in this clipper section. The video signal is taken from the output of the video amplifier V-5 and fed through resistor R-39 and capacitor C-44 to the grid of the 1st clipper V-10A. Here, a triode V-10A (one-half of a 12SN7) is used. With no signalapplied, the tube has zero bias. With the signal applied, the positive polarity sync pulse voltage causes the grid to become positive and draw grid current. This charges the coupling capacitor C-44 negatively causing a steady bias voltage to develop across resistor R-84, and the 2 meg contrast control R-15. The biasing voltage developed in this manner prevents plate current from flowing except on the positive synchronizing pulses. An amplified current, controlled by these pulses, develops in turn, sync pulses across the load resistors R-41 and R-42. This output then is applied to the grid of the V-11A where clipping of the outward peaks is accomplished so that double clipping results for better syncing of the picture under adverse signal conditions. The 2nd clipper V-11A grid resistor R-42 is made low so as to maintain wide band response of the sync pulses at this point. Zero bias is used so that the pulses always go negative beyond cutoff for clipping the irregular envelope and noise peaks.

INTEGRATING NETWORK

The function of this network is to separate the vertical synchronizing pulses from the horizontal synchronizing pulses and to feed them to the vertical sweep oscillator. Since separation of these pulses is based on their frequency and not amplitude, their separation is simply a matter of using a filter network of proper time constants. See Figure 14.

VERTICAL SWEEP OSC. & OUTPUT (Block No. 9)

The function of these circuits is to provide a sawtooth of voltage of the proper frequency to perform the vertical scanning for the cathode ray picture tube. See Figure 15. The circuit used to produce this sawtooth wave is known as a blocking oscillator and operates as follows:

Blocking Oscillator Operation

Transformer T-5 is used to provide positive feedback of energy from plate to grid and thus any change that takes place in the plate circuit will induce a voltage in the grid circuit which will act to aid this change. With the grid becoming more positive than at initial starting, more plate current flows and results in an even greater induced voltage on the grid. As a result, grid current flows and rapidly charges capacitor C-52. The plate current builds up very rapidly until it is limited by saturation. At this point the voltage induced across the grid winding is zero and the charge voltage on C-52 is suddenly placed on the grid biasing it beyond cutoff. The condenser now slowly discharges through R-51 and R-52. This negative biasing action continues until

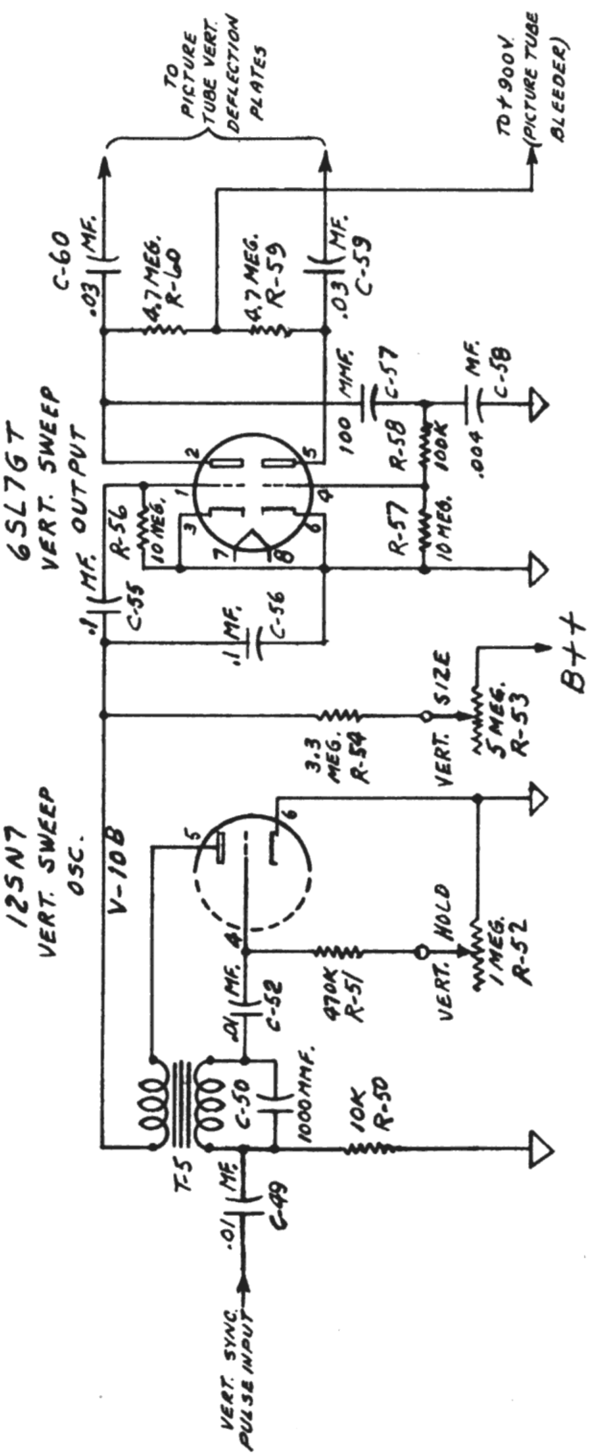


FIG. 15. VERTICAL SWEEP OSCILLATOR & OUTPUT CIRCUIT DIAGRAM

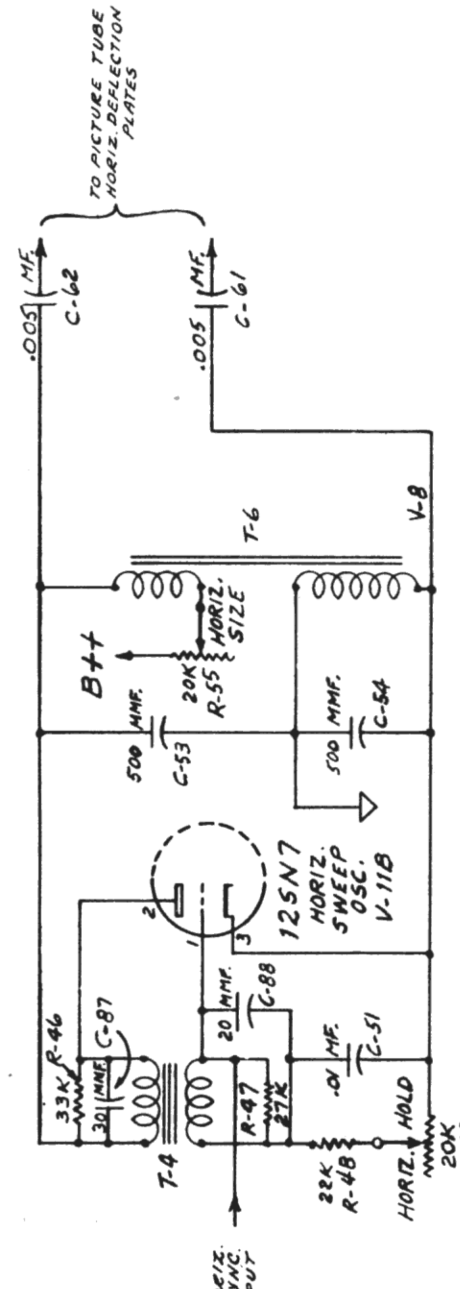


FIG. 16. HORIZONTAL SWEEP OSCILLATOR CIRCUIT DIAGRAM

C-52 is almost completely discharged after which time the negative bias becomes less and tube V-10B begins conducting again. As plate current rises, the grid is again driven positive and the process repeats itself.

The frequency of oscillation is controlled primarily by C-52, R-51 and R-52. The other R's and C's also have some effect. With a sync pulse applied, it is set to place the free-running period of oscillation just slightly longer than the time between the standard sync pulses. The incoming pulse reaches the grid just before the tube would "trip" in its free-running cycle. The magnitude of the pulse is sufficient to drive the tube to conduction and thus effectively controls the period of oscillation.

Resistor R-52 is made variable in order to provide adjustment of the oscillator frequency. It is commonly known as the "VERTICAL HOLD CONTROL" since it can be varied until the frequency of the blocking oscillator is held in synchronism with the incoming pulses.

To obtain clean triggering action and a steady picture, the integrated vertical sync pulse is passed through a differentiating circuit (C-49 and R-50). This circuit removes the very low frequencies which cause an unsteady picture.

The sawtooth voltages appear on the plate of V-10A due to the slow charging and rapid discharging of C-56. Throughout the time when no plate current is flowing, C-56 charges, since one side of it is connected to B+ through R-54 and R-53 and the other side to B-. The charge then is of a positive polarity on the plateside of the capacitor. When plate current does flow, it is only for a short interval and tube resistance becomes very low. C-56 then discharges through this low tube resistance. At the end of the plate current pulse, the grid is very negative and the tube is again non-conducting. Thus B+ again acts to charge C-56 and the process repeats itself.

Resistor R-53 is made variable in order to permit adjustment of the height of the picture. As its resistance is increased, the amount of charging current reaching C-56 is lessened, with a subsequent decrease in the voltage developed across C-56 before it is discharged. With this means, the voltage at the deflecting plate is made variable, resulting in control of the size of the picture on the viewing screen. This control is appropriately labeled the "VERTICAL SIZE" control.

VERTICAL OUTPUT AMPLIFIER

Since the output of the blocking oscillator is of insufficient amplitude to sweep the beam over the entire picture tube screen, it is then fed through C-55 to tube V8, acting as a push-pull amplifier, and coupled through C-59 and C-60 to the vertical deflecting plates.

It is necessary to use the "hard" (higher sweeping voltage) deflecting plates for the vertical deflection because the sides of the picture would be in the shadow of the "soft" plates if the former were used for horizontal deflection. The B+ supply is insufficient to provide the necessary voltage to give a linear vertical sweep over the range which it is required to swing the output tube. V-8 is, therefore, made part of the high voltage bleeder string with approximately 900 volts being applied at the positive end of the plate load resistors.

MODEL VT71

MOTOROLA INC.

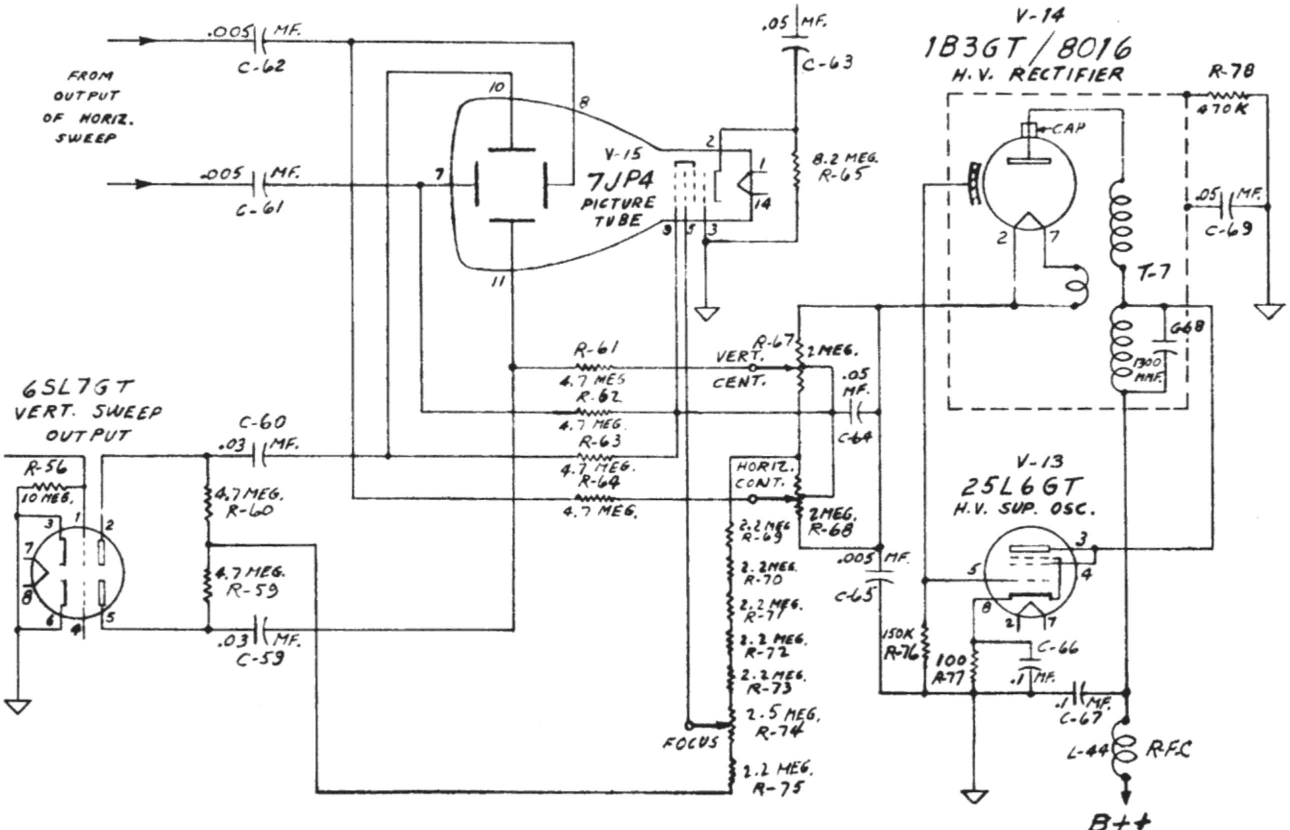


FIG. 17. HIGH VOLTAGE POWER SUPPLY & ASSOCIATED CIRCUITS

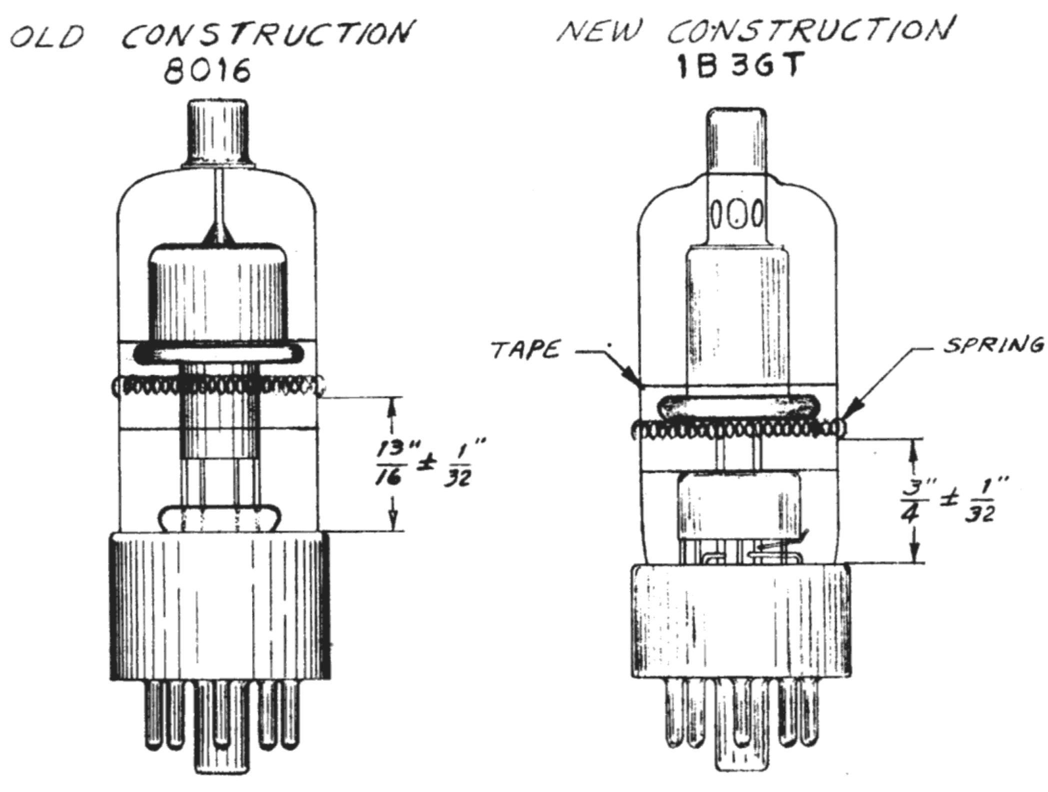


FIG. 18. POSITION OF FEED-BACK COIL SPRING

HORIZONTAL SWEEP OSCILLATOR (Block No. 10)

The purpose of this stage is to produce the sawtooth of voltage of the proper frequency to perform the horizontal scanning for the cathode ray picture tube. The proper waveform is generated in Tube V-11B and its associated components. See Figure 16. Tube V-11B operating as a blocking oscillator, similar to that of the vertical oscillator described above, acts like a low impedance switch which is opened and closed at the line repetition rate of 15,750 lines per second. The open time corresponds to the sweep on the picture tube. During this time capacitor C-53 receives a constant current and charges in a positive direction, while capacitor C-54 receives this same constant current and charges in a negative direction. Current is supplied through resistor R-55 and transformer T-6. T-6 is connected series aiding so that when the switch is closed, each winding presents a very high impedance and all current supplied to tube V-11B is drawn from charged capacitors C-53 and C-54.

The closing of the switch, or conduction in tube V-11B, occurs when the three elements of the tube, the grid, plate and cathode arrive at suitable voltages. The horizontal and closing line frequency is controlled by the grid constants R-48, R-49 & C-51. Resistor R-49 is variable. It is capable of being varied until the frequency of the blocking oscillator is held in synchronism with the incoming pulses. With an incoming signal applied to the grid of V-11B, R-49 is set to place the natural frequency of the oscillator just slightly longer than the time between the pulses so the pulse will again trip the tube as explained in the vertical oscillator section. R-49 then is the "HORIZONTAL HOLD CONTROL".

Resistor R-55 is made variable in order to permit adjustment of the width of the picture. As its resistance is reduced, the amount of current reaching C-53 and C-54 is reduced, with a subsequent decrease in the voltage developed across these capacitors before they are discharged. With this means the voltage at the deflecting plates is made variable, resulting in control of the size of the picture on the screen. This control is appropriately labeled the "HORIZONTAL SIZE" control.

HIGH VOLTAGE POWER SUPPLY (Block No. 11)

The high voltage power supply differs from ordinary power supplies, in that instead of using A-C line power to provide the initial energy for step-up and reactification, a separate high-voltage oscillator is used. See Figure 17. The oscillator (25L6GT), connected as a triode, generates a frequency of approximately 140 KC. The RF plate voltage is stepped up to a peak voltage of slightly over 6000 volts through an auto transformer. The primary is roughly tuned to the natural frequency of the high Q secondary. The 6000 peak volts appearing on the secondary coil is applied to the plate of a high voltage rectifier tube 1B3GT/8016. Current drain is approximately 350 ua. Due to peak rectification the DC output of the rectifier remains close to peak plate voltage. The .005 mfd condenser maintains the plate voltage substantially constant for low frequency load variations. Feed-back to the oscillator grid is obtained by a capacitive coupling device consisting of a coil spring mounted around the rectifier tube 1B3GT/8016 envelope. The position of this coil spring is critical and should be held as per Figure 18. The bias voltage across R-76 read with a 20,000 ohm volt meter through a 100 K decoupling resistor should be about 100-150 volts. If the spring is too low on the tube, the H.V. will either not start or build up over approximately 1000 volts.

In the voltage divider network, two 2-megohm potentiometers provide beam centering adjustment while an additional 2.5 megohm potentiometer is employed for focusing. Second anode voltage for the cathode ray picture tube is taken from the common center taps of the centering controls. The bleeder resistors are of the small carbon type with a 1 watt dissipation rating. Note that the negative end of the bleeder system is not connected directly to B- but rather through the plates of the vertical sweep output tubes to B-.

MODEL VT71 MOTOROLA INC.

ALIGNMENT PROCEDURE

SERVICE NOTES

Cutouts in the bottom of the cabinet are provided to make it possible to do some servicing of the receiver without removing the chassis. To do so, remove the bottom cover plate by sliding it out through the back of the cabinet. If the receiver is serviced in the cabinet, a soft pad should be placed under the cabinet when it is inverted, in order to avoid scratching the surface.

If necessary to remove the chassis from the cabinet, remove the back cover, knobs and bottom mounting screws, disconnect the speaker leads and cathode ray tube socket connections and remove the chassis from the back of the cabinet.

The cathode ray picture tube and speaker are mounted securely to the cabinet. Picture adjustments may be made with the chassis out of the cabinet by placing the chassis and cabinet back to back and connecting the socket terminals to the cathode ray tube pin terminals. Speaker checks may be similarly made by using clip leads for speaker connections. This arrangement eliminates the need for removing either speaker or cathode ray tube from the cabinet while servicing the receiver.

NOTE: Whenever the cabinet back is removed, the power cord circuit is broken by the interlock so it will be necessary to obtain an extra power cord with the female interlock receptacle for making a convenient power connection to the Receiver. Order Motorola Part No. 1X

Should it be necessary to do a complete realignment job due to replacements of parts, it may be most easily carried out with the chassis out of the cabinet and the cathode ray picture tube and speaker disconnected. This procedure not only provides easy access to the cores but also makes it less possible to damage the cabinet and cathode ray tube since the cabinet may be carefully placed aside while working on the chassis.

SPECIAL PRECAUTIONS

In performing alignment with the chassis out of the cabinet, it will be necessary to insert a 10 ohm 5 watt resistor in pin sockets #1 and #14 of the 7JP4 cathode ray tube. These are the heater terminals of the CR tube. Continuity is necessary to operate the complete receiver.

To eliminate high voltage when it is not needed or used, remove the 25L6GT tube, V-13, high voltage supply oscillator. When this is done, it will be necessary to insert a 75 ohm 10 watt resistor in socket connections #2 and #7 to operate the receiver. It is recommended that the high voltage be cut off while aligning to eliminate the shock hazard.

It is highly recommended that an isolation transformer be used between the receiver and the A-C line when alignment is being performed or any testing where an oscilloscope is used. This precaution is extremely important if grounded test equipment is used. NEVER GROUND THE RECEIVER CHASSIS DURING TESTING OPERATIONS OR INSTALLATION. HOWEVER, A GROUNDED COAX LINE MAY BE CONNECTED TO THE ANTENNA TERMINAL BOARD MARKED "G".

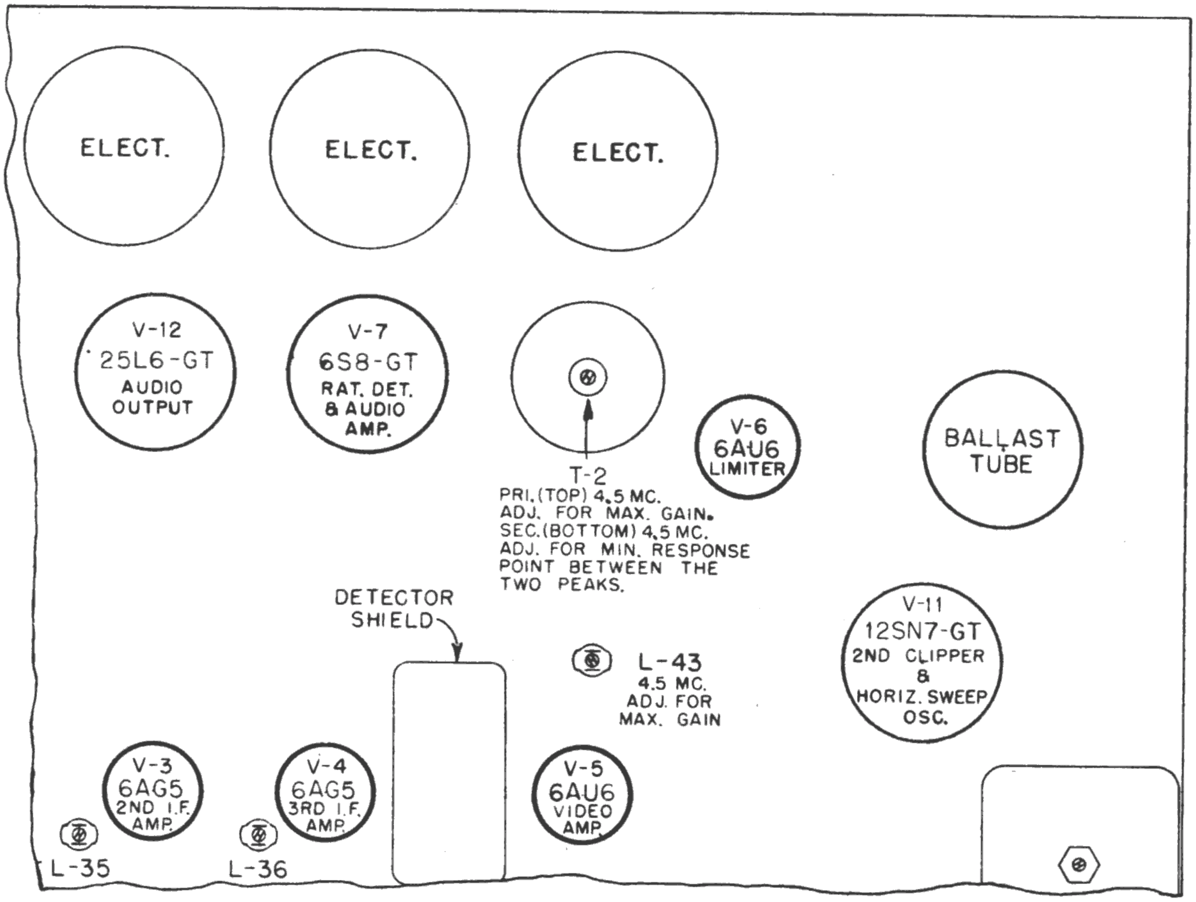


FIG. 19. AUDIO ALIGNMENT ADJUSTMENTS LOCATIONS

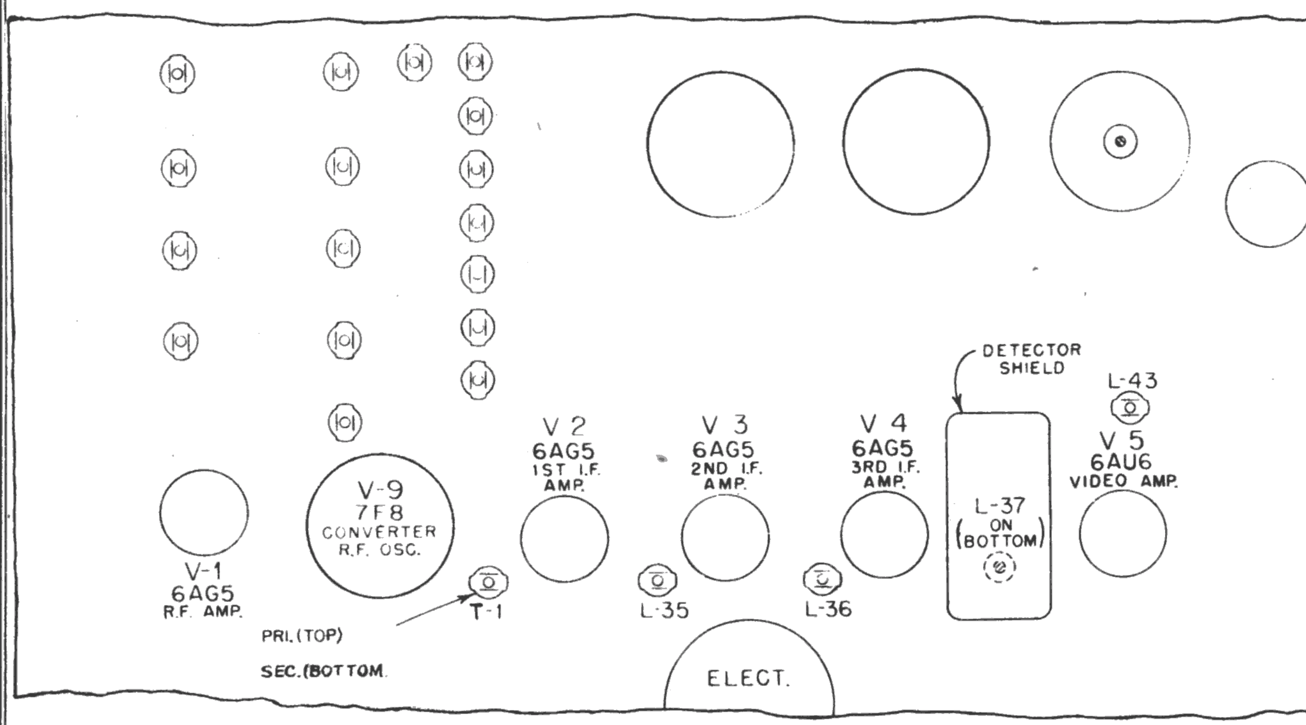


FIG. 20. I.F. ALIGNMENT ADJUSTMENTS LOCATIONS

ORDER OF ALIGNMENT

A complete receiver alignment can be most conveniently performed in the following order:

1. Audio Limiter & Ratio Detector.
2. I. F. Coils (1st, 2nd and 3rd I.F. Plate Coils).
3. Converter Transformer.
4. Osc., Ant., & R.F. Coils.

AUDIO LIMITER & RATIO DETECTOR ALIGNMENT

EQUIPMENT REQUIRED:

Signal Generator:	Accurately calibrated at 4.5 mc. 400 cycle AM modulated Adjustable output
Output Meter:	Low range A.C.

PROCEDURE:

Refer to Figure 19 for location of adjustments.

1. Set the signal generator to 4.5 mc, 400 cycle AM Modulation and the output to 1 volt. Connect the high side of the signal generator to video amplifier (V-5) control grid (pin #1) and the low side to B-. Connect output meter across output transformer T-3 secondary.
2. Detune T-2 secondary by screwing the bottom core out a few turns.
3. Peak L-43 for maximum reading on output meter.
4. Peak T-2 primary (top core) for maximum reading on output meter.
5. Adjust T-2 secondary (bottom core) for minimum response on output meter. The correct adjustment is the sharply defined minimum response between the two peaks.

NOTE: As the adjustments are brought to resonance, it is advisable to reduce signal generator output to prevent overloading.

6. Then adjust plate coil, L-37, to provide a flat top to the response waveform obtained. If the base line is not flat, add a .25 mfd capacitor across C-25 in the video amplifier V-5 grid circuit.

NOTE: It may be necessary to repeat procedure to obtain proper waveform.

I. F. AMPLIFIER ALIGNMENT

EQUIPMENT REQUIRED:

R. F. Sweep Generator meeting the following requirements:

18 to 30 mc., approximately 6 mc sweep width. Output constant and adjustable to at least one volt maximum and with adjustable markers. Markers should be calibrated occasionally by checking against an accurate signal generator.

5" Cathode-Ray Oscilloscope: Preferably, one with a calibrated input attenuator.

NOTE: When aligning the I.F. Amplifier Strip, if difficulty is experienced in observing the markers when using Dumont Oscilloscope Model 241, change to an ordinary oscilloscope having about 50 kc response.

PROCEDURE:

Refer to Figure 20 for location of alignment adjustments.

1. Connect the sweep oscillator with the "hot" side of the oscillator connected to grid (pin #1) of V-2 and the "grounded" side at the junction of R-13 and C-14. Set the center frequency of the sweep oscillator to about 25 mc and adjust the sweep bandwidth to approximately 6 mc. Connect the oscilloscope hot side to the cathode ray picture tube cathode and the low side to B-. Connect a 1000 mmf capacitor across the oscilloscope input terminals. This 1000 mmf capacitor is added across the oscilloscope to provide a sharp marker signal. Contrast control and band switch may be set in any position.

CAUTION: Do not reduce the oscilloscope gain and increase signal input so that the top of the curve is flattened by limiting the video or scope amplifiers.

2. Peak the 3rd I.F. plate coil, L-37, initially, for maximum response at about 25 mc.

3. Tune the 2nd I.F. plate coil, L-36, initially, for peak response at about 23 mc.

4. Adjust the 1st I.F. plate coil, L-35, to place a 26.8 mc marker signal 50% (1/2) the way up the high side of the response waveform.

5. Adjust the 2nd I.F. plate coil, L-36, to place a 22.1 mc marker signal 50% (1/2) the way up the low side of the response waveform. Refer to Figure 24 for marker positions on waveform obtained.

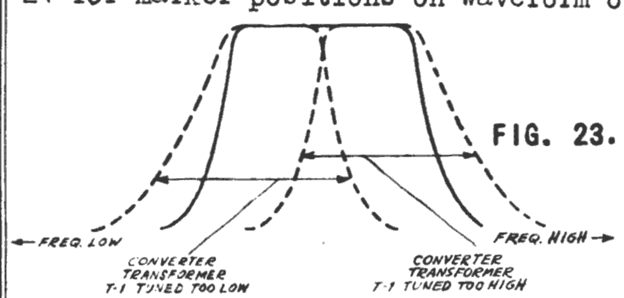


FIG. 23. WAVEFORM - CONVERTER TRANSFORMER T-1

I. F. SENSITIVITY MEASUREMENT

Comparative measures of sensitivity for the last three stages of I.F. are as follows:

1. Using an RCA High Frequency Sweep Generator Model No. 709B, connected as during I.F. Alignment, set the two COARSE attenuators at 16 and 16 and the FINE attenuator at 7.

Using a Dumont Oscilloscope Model No. 241, set the Attenuator at 10 to 1 and the Y- Gain Control to 60. With these settings, the output as read on the oscilloscope should be at least 20 divisions high.

2. Using a signal generator set at 24.5 mc connected to the grid of V-2 and the Junction of R-13 and C-14, the signal required to produce 1 volt across the diode load resistor R-25 should be approximately 800 microvolts.

NOTE: Short out the a-g-c circuit by shorting out C-82, when making this check.

CONVERTER TRANSFORMER ALIGNMENT

Move the sweep oscillator to the grid of V-9A converter tube. Connect it across Resistor R-7. Set contrast control at about 80% rotation toward maximum gain. Adjust primary of T-1 until 26.5 mc marker is 50% (1/2) way up the high frequency slope. Adjust the secondary of T-1 so 22.4 mc marker is 50% (1/2) way up the low frequency slope. Correct waveform is shown in Figure 24.

CAUTION: In aligning the three I.F. coils, each coil is adjusted individually, but when adjusting the primary and secondary of the converter transformer, T-1, the adjustments should be made simultaneously. The important point to keep in mind, is to obtain as flat and as wide a response curve as possible with as much gain as possible. Simultaneous adjustment of the primary and secondary is the easiest way to obtain this result. It is suggested that both cores be tuned in for moving the transformer curve bodily to a lower frequency by tuning clockwise as viewed from top and bottom of the chassis, or vice versa for tuning the transformer to a higher frequency. The transformer is tuned for the same pass band as the 3 staggered circuits; see Figure 23. The only difference in the waveform should be that the sides of the sides of the overall curve (Figure 24) should be steeper. Constant use of the 50% response marker signals to show the bandwidth of the response curve should be resorted to, since it is absolutely necessary to obtain the proper curve.

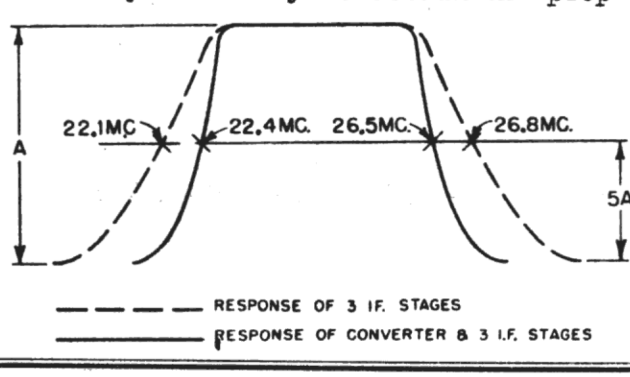


FIG. 24. WAVEFORM - CONVERTER & I.F. AT 50% RESPONSE

OVERALL I.F. SENSITIVITY MEASUREMENTS

Comparative measures of sensitivity for the entire I.F. section including the converter transformer are as follows:

1. Using an RCA High Frequency Sweep Generator Model 709B, connected as during alignment, set the two COARSE attenuators to 32 and 32 and the FINE attenuator at 2.

Using a Dumont Oscilloscope Model No. 241, set the attenuator at 10 to 1 and the Y- Gain control to 60.

With these settings the output as read on oscilloscope should be at least 20 divisions high.

2. Using any signal generator set at 24.5 mc connected to the grid of V-9A and B-, with the A-G-C circuit shorted out by shorting out C-82, the signal required to produce 1 volt across the diode load resistor R-25 should be approximately 250 microvolts.

REGENERATION CHECK

After the above I.F. and converter transformer alignment has been made, a check for regeneration in the I.F. amplifier strip should be made. This is done by observing the output response curve on the oscilloscope, as taken across the cathode of the CR tube and B-. Set the contrast control to maximum gain. Decrease the input signal until the output signal shows a marked decrease. Any regeneration present will be indicated by sharp peaks on the overall response curve. Checks to eliminate regeneration should then be made per Section on Service Hints.

ANTENNA R.F. AND OSCILLATOR ALIGNMENT

EQUIPMENT REQUIRED:

Signal Generator:	Frequency range 40-75 mc; 10 mc sweep. Output constant and adjustable. Adjustable markers (markers should be calibrated occasionally by checking against an accurate signal generator.
Oscilloscope:	Preferably one with a calibrated input attenuator.
Signal Generator:	Frequency range 70 to 225 mc Accurately calibrated AM modulated, 400 cycle

TO WHAT CHANNELS RECEIVER SHOULD BE ALIGNED

As previously stated, this receiver is capable of reception on all present thirteen television channels. However, due to geographical frequency allocation, it has been constructed to receive only 8 channels at any one time.

Therefore, in aligning the Antenna, R.F. and Oscillator coils of this receiver, you will align for only those channels available in your immediate locality. In general, for N.Y. area align for channels 1, 2, 4, 5, 7, 9, 11 and 13; for Philadelphia area, align for channels 1, 2, 3, 6, 8, 10 and 12.

These groups vary throughout the U.S. For specific information on channel allocations in your vicinity obtain FCC communication reports from the Superintendent of Public Documents in Washington, D.C.

ANTENNA & R.F. COIL ALIGNMENT PROCEDURE

1. Connect the sweep generator to upper terminal "A" & center "G" of the antenna input terminal strip.

2. Make the following circuit changes:

a. Return the 33,000 ohm resistor R-7 to the cathode of the converter tube V-9A instead of one end of L-33.

b. Remove the 1000 ohm resistor R-9 from B+ and connect it to B.

c. Open the 1000 ohm resistor R-11 at either end to stop the oscillator.

d. Connect the low side of the oscilloscope to B and probe or high side to junction C-12 and R-9.

e. Refer to Figure 25 for location of adjustments.

3. Set the station Selector Switch to Channel No. 1. Set the center frequency of the sweep generator to the center of channel No. 1, sweep width to 10 mc, and adjust coil L-3 and then coil L-25 for correct bandwidth and uniformity of response. Carefully check the band-pass of this coil against the curves shown on Figure 5 by observing marker positions on the response curve.

4. Continue this same procedure for the remaining antenna and R.F. coils of the first 4 channels only, using the following table as a guide: Note that the antenna coils are tuned first to the Picture Carrier Frequency and then the R.F. is tuned to the Sound carrier frequency.

CAUTION: Be sure to turn station selector switch to correct channel before adjusting coils for that channel.

SET RECEIVER TO CHANNEL	SET GENERATOR CENTER FREQUENCY TO MC.	ADJ. ANT. COIL	MARKER SET TO MC.	ADJ. R.F. COIL	MARKER SET TO MC.
1	47	L-3	45.25	L-25	49.75
2	57	L-5	55.25	L-26	59.75
3	63	L-7	61.25	L-27	65.75
or 4	69	L-7	67.25	L-27	71.75

See Figure 5 for typical R.F. response curves for these channels.

5. Channels 5 and 6 are aligned with the AM signal generator in place of the sweep generator. Use 400 cycle 30% modulation; peak for maximum amplitude on oscilloscope screen. Circuit changes made when aligning channels 1 through 4, also apply here.

SET RECEIVER TO CHANNEL	GENERATOR SET TO MC	ADJ. ANT. COIL	GENERATOR SET TO MC	ADJ. R.F. COIL
5	77.25	L-9	81.75	L-28
or 6	83.25	L-9	87.75	L-28

6. No adjustment of the antenna coils for operation on channels 7 through 13 is required.

7. The R. F. coils for channels 7 through 13 are adjusted as follows, using an AM signal generator, oscilloscope and circuit revisions outlined previously:

a. If channels 1, 2, 3 & 6 had been set up, then coil L-29 is adjusted for proper operation of channels 8, 10 & 12 by peaking it for maximum response at 207 mc.

b. If channels 1, 2, 4 & 5 had been set up, then coil L-29 is adjusted for proper operation of channels 7, 9, 11 & 13 by peaking it for maximum response at 213 mc.

This completes the antenna & R.F. Coil adjustments. Now proceed with the oscillator adjustments as outlined below:

OSCILLATOR ALIGNMENT - Proceed as follows:

a. Reconnect the 1000 ohm resistor R-11 to put oscillator back in circuit.

b. Connect the signal generator to the low side of coupling capacitor C-3 and chassis.

c. Leave the oscilloscope connected as for alignment of the Antenna, & R.F. coils, but set the gain control at maximum. Do not use the 6 db pad when using Measurements Corp. Sig. Gen. Model No. 80. Synchronize the oscilloscope to 60 cycles or a harmonic of 60 cycles.

d. Set the generator to the following frequencies, in order, with no modulation, and adjust each coil, following the table below, for zero beat as viewed on the oscilloscope.

e. Refer to Figure 25 for location of adjustments.

CAUTION: Be sure to turn Station Selector Switch to each channel before adjusting the coil for that channel.

CHANNEL	GEN. FREQ. MC.	ADJ. COIL	GEN. INPUT
1	71.7	L-17	30 millivolts
2	81.7	L-18	50 millivolts
3	87.7	L-19	50 millivolts
or			
4	93.7	L-19	50 millivolts
5	103.7	L-20	50 millivolts
or			
6	109.7	L-20	50 millivolts
7	152.4	L-24	50 millivolts
8	158.4	L-23	50 millivolts
or			
9	164.4	L-23	50 millivolts
10	170.4	L-22	40 millivolts
or			
11	176.4	L-22	30 millivolts
12	182.4	L-21	20 millivolts
or			
13	188.4	L-21	10 millivolts

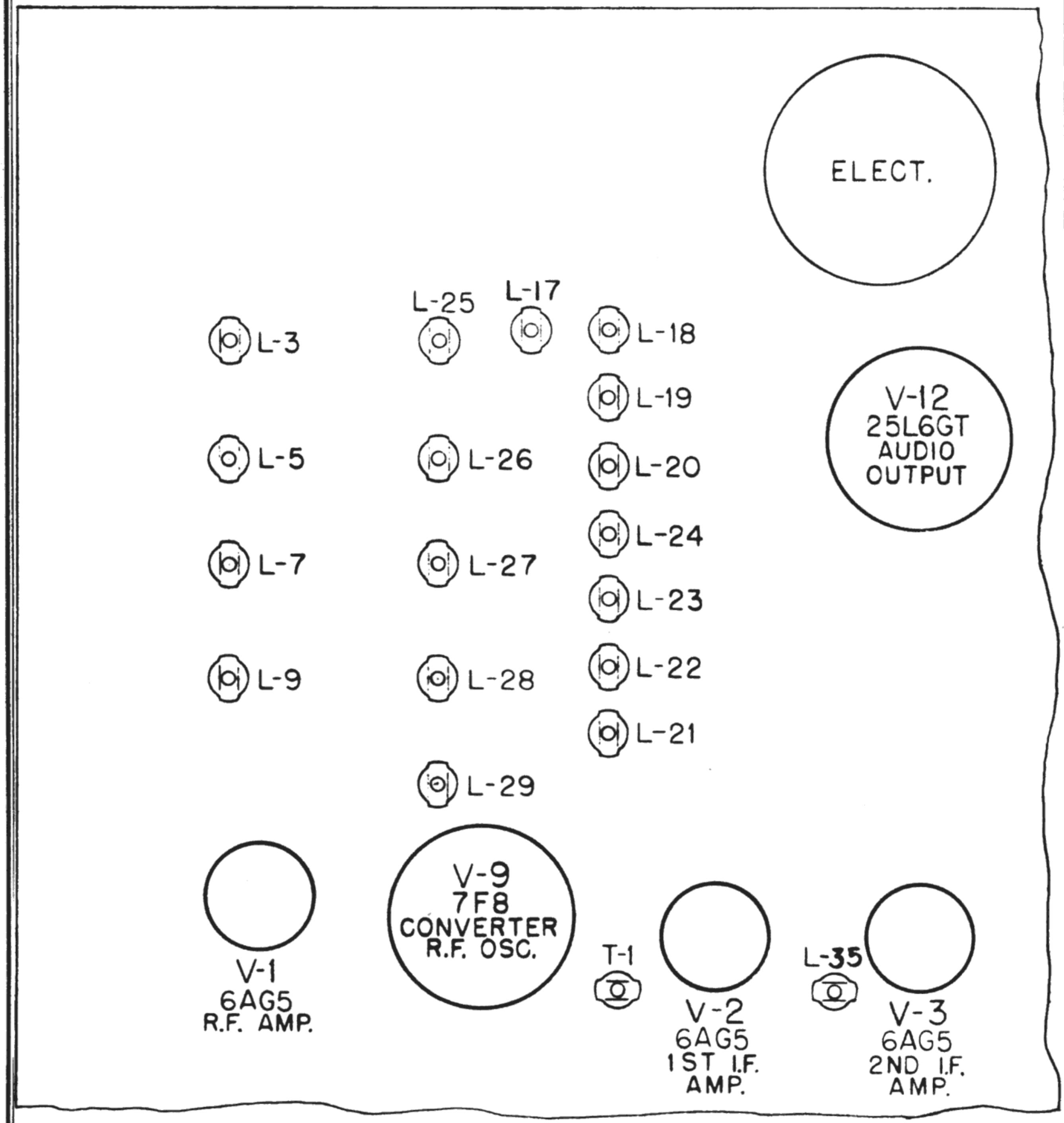


FIG. 25. ANTENNA, R.F. & OSCILLATOR ADJUSTMENTS LOCATIONS

Particular attention should be paid to being sure each coil is adjusted correctly. To do so, tune through the zero beat point and then back again to obtain the exact setting. Also, it is advisable, when close to the zero beat setting, to vary the signal generator input voltage so as to obtain maximum response on the oscilloscope. However, before making the final coil core setting, reduce the generator input to as low as possible so as to reduce the lock-in range and obtain a sharp zero beat setting.

f. Disconnect all the circuit changes made for the Antenna, R.F. and Oscillator Coil alignment and restore the circuit to its original and operating condition.

HOW TO GET MAXIMUM PERFORMANCE FROM WEAK STATIONS

Refer to Oscillator Frequency Touch-Up Adjustments.

WAVEFORM PHOTOGRAPHS

These are the waveforms that can be seen with a cathode ray oscillograph when an RMA standard video signal is fed into the set. This may be a regular telecast signal fed into the antenna or the video signal from a monoscope and sync generator fed into the grid of the first video tube. (Pins #1 and 2 of V5). The signal should be adjusted to give 1.5V peak to peak at grid of first video amplifier or approximately 1 volt average DC. The composite video signal has components appearing at both the vertical (60 CPS) and the horizontal (15,750 CPS) repetition rates. Due to the great difference in frequency, the details of both of these types of waves cannot be seen simultaneously. In the photographs below, the waveforms labeled "Vertical" are those seen with the oscillograph sweep rate set at the vertical frequency and those labeled "Horizontal" are those seen with the oscillograph sweep rate set at the horizontal frequency. At certain points, only the vertical (or horizontal) frequency wave form is significant and in this case only one is shown.

CAUTION: It is highly recommended that an isolation transformer be used between the receiver and the A-C line when alignment is being carried out or any testing done where an oscilloscope is used.

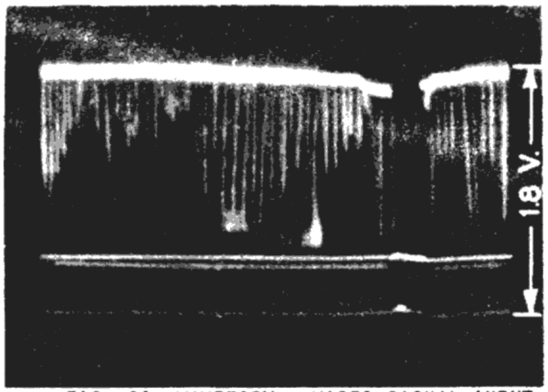


FIG. 26. WAVEFORM - VIDEO SIGNAL INPUT TO VIDEO AMPLIFIER (PIN #1 & #2 OF V-5) VERTICAL.

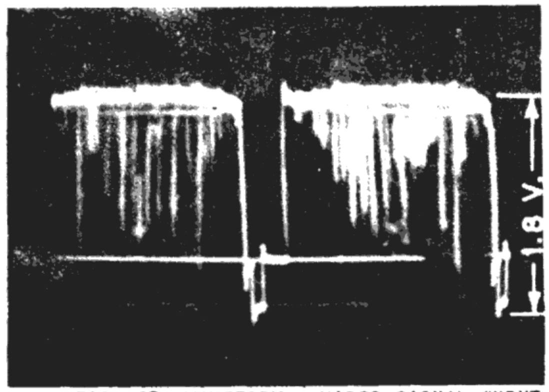


FIG. 27. WAVEFORM - VIDEO SIGNAL INPUT TO VIDEO AMPLIFIER (PIN #1 &#2 OF V-5) HORIZONTAL

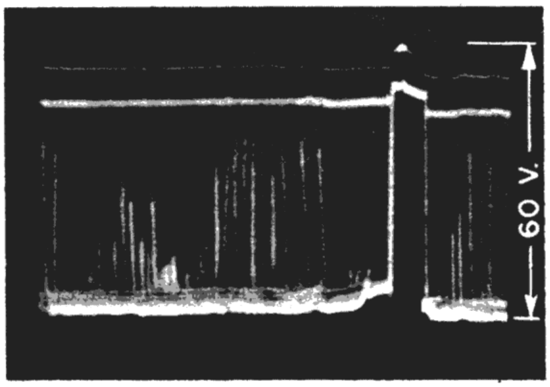


FIG. 28. WAVEFORM - OUTPUT OF VIDEO AMPLIFIER (PIN #5 OF V-5 & B-) VERTICAL.

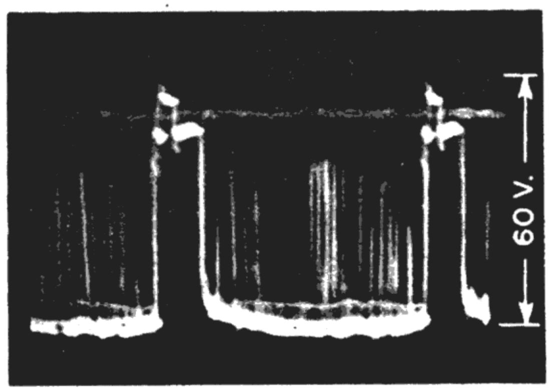


FIG. 29. WAVEFORM - OUTPUT OF VIDEO AMPLIFIER (PIN #5 OF V-5 & B-) HORIZONTAL.

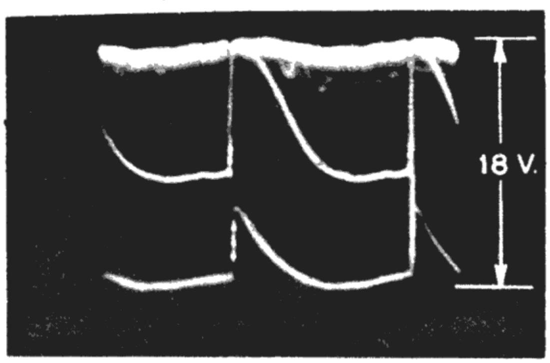


FIG. 30. WAVEFORM - OUTPUT OF 1ST CLIPPER (PIN #4 & #6 OF V-11A) VERTICAL.

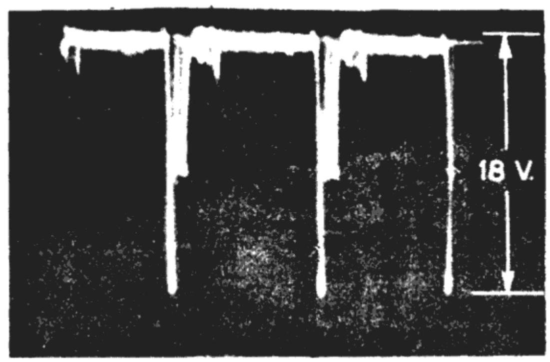


FIG. 31. WAVEFORM - OUTPUT OF 1ST CLIPPER (PIN #4 & #6 OF V-11A) HORIZONTAL.

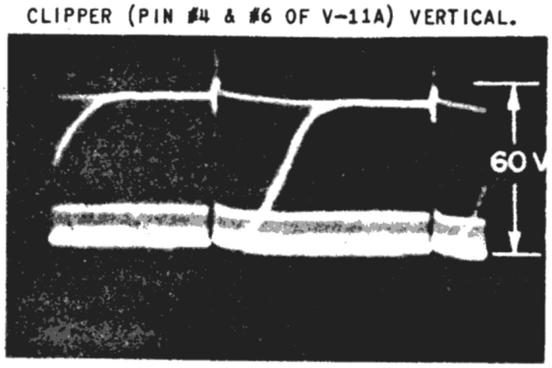


FIG. 32. WAVEFORM - OUTPUT OF 2ND CLIPPER (PIN #5 OF V-11A & B-) VERTICAL.

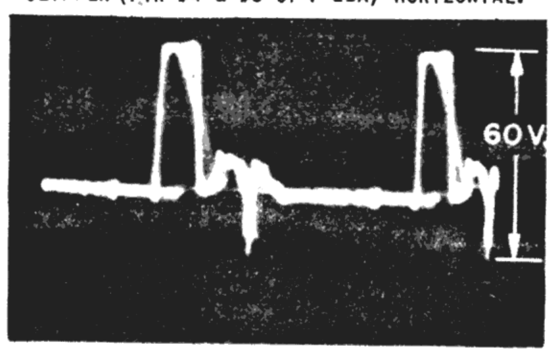


FIG. 33. WAVEFORM - OUTPUT OF 2ND CLIPPER (PIN #5 OF V-11A & B-) HORIZONTAL.

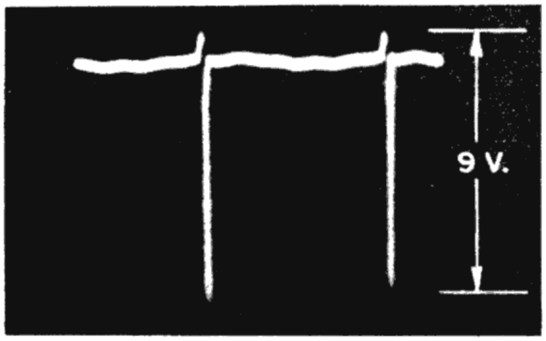


FIG. 34. WAVEFORM – OUTPUT OF VERTICAL INTEGRATING NETWORK (JUNCTION OF C-50 AND R-50 AND B-)

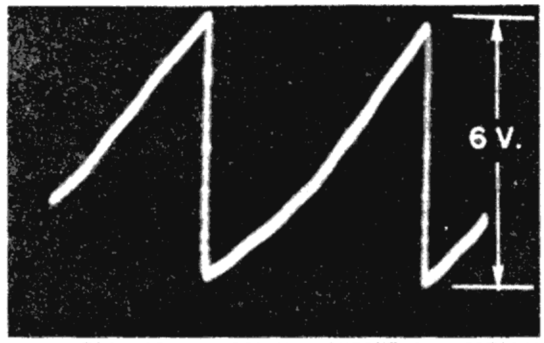


FIG. 35. WAVEFORM – OUTPUT OF VERTICAL OSCILLATOR TUBE (JUNCTION OF R-54 AND C-55 AND B-)

FIG. 36. WAVEFORM – OUTPUT OF VERTICAL OSCILLATOR AMPLIFIER TUBE – ONE HALF (PIN #2 OF V-8 AND B-)

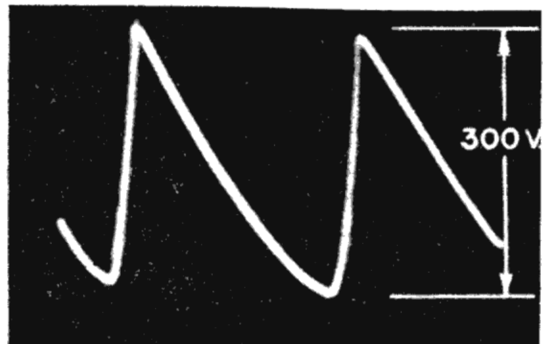


FIG. 37. WAVEFORM – OUTPUT OF VERTICAL OSCILLATOR AMPLIFIER TUBE – ONE HALF (PIN #5 OF OF V-8 AND B-)

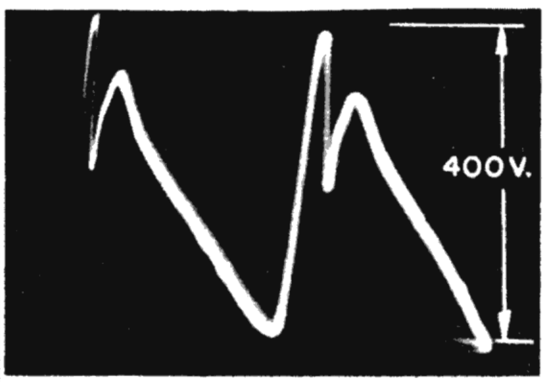


FIG. 38. WAVEFORM – INPUT TO HORIZONTAL OSCILLATOR (JUNCTION OF C-46 AND R-47 AND B-)

FIG. 39. WAVEFORM – OUTPUT OF HORIZONTAL OSCILLATOR – UPPER HALF (JUNCTION OF R-46 AND C-53 AND B-)

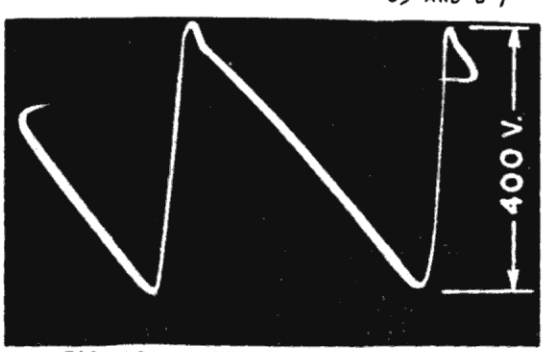


FIG. 40. WAVEFORM – OUTPUT OF HORIZONTAL OSCILLATOR – LOWER HALF (JUNCTION OF C-53 AND C-54 AND B-)

SERVICE HINTS

Though every attempt has been made to make this receiver as simple as possible from an operating and servicing standpoint, and to make it to conform to standard radio practices in manufacture, troubles peculiar to the circuits used may occur. Indiscriminate replacement of component parts is definitely to be discouraged. Every attempt should be made to replace all components with their exact duplicates and to insert them just as they originally were in the receiver.

Whereas, in sound receivers, the speaker is most generally used as the guiding factor in analyzing receiver defects, a television receiver has an additional operational indicator, the cathode ray picture tube. Since the eye is more critical than the ear, it is easier to reveal defects in a television receiver than comparable defects in a sound receiver. The cathode ray picture tube, then, should be used as the criterion in determining whether or not the receiver is operating correctly. Familiarity with a good and bad picture and all other visual factors that go to make a good picture, will tend to simplify the servicing problem. An oscilloscope and the waveforms provided in this manual are very good means for analyzing circuit defects.

CAUTION: It is highly recommended that an isolation transformer be used between the receiver and the A-C line when alignment is being carried out or any testing done where an oscilloscope is used.

Some of the possible troubles that may be encountered, with their effects and causes, are listed below.

NOTE: The cathode ray tube, which comes with the receiver, should be used in servicing operations involving vertical or horizontal size adjustments, rather than a lab service tube, because of the considerable variation in deflection sensitivity from one CR tube to another.

TROUBLES - EFFECTS AND CAUSES

No tubes lit

Defective power switch.
Open ballast resistors.
Open V-15 (7JP4) heater.
Open V-7 (6SQ7) heater.
Heater-cathode shorts in 25L6GT tubes (V-12 or V-13).
Open 22 ohm R-80E resistor (this would cause V-7 heater to burn out).

One Heater String Out

Open 105 ohm resistor (R-80B or R-80D, depending upon which string is out).
Open heater in any tube.
Open heater choke in either string.
Heater-cathode shorts in 25L6GT tubes (V-12 or V-13).

No B++ or B+

Open ballast tube resistor R-80A (37 ohms) or R-80C (200 ohms).
Open or shorted rectifiers, E-2 or E-3.
Defective electrolytic condensers C-74, C-77, C-78.
Intermittent short in wiring.

Low B++ Voltage (normal value 230-240V)

Low capacity electrolytics, C-74, C-77 (check 140V. on C-74).
Defective rectifiers E-2 or F-3.
Abnormal load in set (check voltage drop across R-80C-Normally 22-24V).

High or Low B+ Voltage (normally 120V).

Defective tube V-12 (25L6GT).
Heater to cathode short in tube V-9 (7F8).
Defective tube in upper series of tubes

No B- in R.F, I.F. Section

Open L-33 choke coil.

Power Switch Locks On or Off

Replace volume control

Defective Selenium Rectifiers

Set load too heavy (measure voltage drop across R-80C-should be 22-24V).

Defective electrolytic condensers C-74, C-77, C-78.

A defective rectifier may overheat and pop after the set has been turned on for a few minutes. Repeated pops and a disagreeable odor from the rectifier indicates that it should be replaced.

No Raster on Cathode Ray Picture Tube

No high voltage - check V-14 (1B3GT/8016) and V-13 (25L6GT) tubes and circuits.
Open L-44 choke coil, causing no B++ on V-13.
Open or shorted turns on high voltage transformer T-7.
Improper setting of feed back spring on V-14 (1B3GT).
Shorted C-65.
Poor V-15 (7JP4) cathode emission, or no heater voltage.
Brightness control set at one end.

No Vertical Deflection

Note: Unless there is high voltage on the cathode ray tube, tube V-8 (6SL7GT) will not have any output, since it received B+ from the high voltage supply.

Defective V-10B (12SN7GT) - replace tube.
Defective V-8 (6SL7GT) - replace tube.
Defective blocking osc. transformer T-5.
Defective vertical hold or vertical size controls (R-52, R-53).
Defective charging capacitor C-56.
Defective coupling capacitor C-55.
Defective grid coupling capacitor C-52.

MODEL VT71 MOTOROLA INC.

Small Raster - Vertical

- Defective V-8 (6SL7GT).
- Defective vertical size control R-53.
- Insufficient output from V-8 (6SL7GT) - replace tube.
- Defective voltage dividing capacitors C-57 or C-58.
- Open coupling capacitor C-59 or C-60.
- Excessive heater voltage on V-8 (6SL7GT), due to shorted ballast resistor R-80B.

No Horizontal Deflection

- Defective V-11B (12SN7GT) - replace tube.
- Defective blocking osc. transformer T-4 - check windings.
- Defective horizontal output transformer T-6.
- Defective horizontal hold or horizontal size control (R-49, R-55).
- Shorted C-53, C-54.

Small Raster - Horizontal

- Defective V-11 (12SN7GT) - replace tube.
- Defective horizontal size control R-55.
- Insufficient output from V-11B (12SN7GT) - replace tube.
- Open capacitor C-51.
- Open coupling capacitor C-61 or C-62.
- Remove C-87 and C-88 - not used on later sets.
- Low heater voltage on V-11 (12SN7GT) - check R-80B.

Raster, But No Image

- Open C-63 connections (in this case sound will still be present).
- Open coils, L-38, L-39, L-42.
- Intermittent contacts in miniature tube sockets, especially V-5 (6AU6) socket
- Defective I.F. strip, 2nd detector or video amplifier (check tubes, D.C. voltage, resistances, and signal path).
- Defective R.F. converter or oscillator stages. Repeat procedure given above.
- Defective input coil L-1.

No Synchronization

- Defective clipper tubes V-10A (12SN7GT) or V-11A (12SN7GT).
- Open coupling capacitors C-44, C-45, C-46.
- Shorted C-47 or C-48 or open C-49 (affects vertical sync. only).

Poor Vertical Synchronization

- Check for corona arcing.
- Open C-47 or C-48.
- Vertical jitter - readjust vertical hold control R-52.
- Defective C-49 or C-52.

Picture Stable But Poor Resolution

- Defective video amplifier tube V-5 (6AU6).
- Open compensating coil L-41.
- Poor crystal E-1.
- Misalignment of I.F. strip.
- Local oscillator off frequency.
- Defective input coil L-1.
- Lead open to pin #9 on picture tube.
- Focus range incorrect.

Vertical Bars on Left Half of Picture

- Defective C-87, C-88, R-46, R-47.

Low Contrast and Video Signal

- Weak input signal.
- Oscillator tuned too high.
- Low gain in receiver.
- Weak crystal E-1.
- Open L-41
- Weak video tube V-5 (6AU6) - check 80V. drop across R-28.

Low Contrast and Video Signal

- Brightness too high.
- Contrast circuit open thru R-86.
- Defective contrast control(R-15).
- Weak I.F. Amplifier tubes.
- Open antenna input circuit.
- Open R.F. coils.
- Low D.C. voltage in receiver.

Contrast Always Too High Or Contrast Control Ineffective

- Defective R-84.
- Defective R-83.
- Defective C-13.
- Defective 1st I.F. tube V-2 (6AG5) - replace tube.

Picture Size Too Large, Both Horizontal and Vertical, and Brightness Low

- Low high voltage on picture tube - check V-13 (25L6GT) and V-14 (1B3GT/8016).

Shadow at Right Side of Picture

- Interchange connections to pins #7 and #8, also to #10 and #11, on picture tube V-15 (7JP4), and turn tube over 180°.

For test patterns see back of Manual

Random Black Lines Horizontally in Raster

Corona on 6 K.V. points in chassis and on tube base connections - paint with insulating compound, Motorola Part No. 11M476072.
Corona in picture tube - replace tube.
Check clearances of all 6 K.V. leads - 3/8" minimum spacing to other wires or chassis.
Defective C-59, C-60, C-61, C-62.

Horizontal White Line in Center of Raster

Reduce brightness slightly.
If white line moves up or down when vertical centering control is turned, replace V-8 (6SL7GT) with RCA type.
If white line does not move with vertical centering adjustment, it is burned on the screen of the CR tube. Replace V-15 (7JP4).

High Voltage Flashover

Check items above.
Outside turn on T-7 winding arcs to bottom turns - redress lead.
Check spacing of high voltage bleeder resistors to chassis.
Occurs when V-8 (6SL7GT) is removed from socket before V-13 (25L6GT) cathode has cooled sufficiently. (Allow all tubes to cool for five minutes before replacing V-8).

Corona Noise

Check items above.

Arcing at Horizontal and Vertical Centering Controls

Dress high voltage rectifier heater leads away from chassis.
Check leads to C-59 and C-60.

Tear Out to Left in Picture

Low capacity in filter condensers C-77, C-78, C-79.

Fold Over on Left Side of Picture

Horizontal hold control not set correctly.
C-53 or C-54 too high in value.

Poor Vertical Linearity

Defective tube V-8 (6SL7GT) - replace with RCA.
R-98 or R-99 incorrect values.

Poor Horizontal Linearity

Defective capacitors C-53, C-54.

R.F. Interference from Receiver H.V. Power Supply in Picture

Open high voltage filter capacitor C-65.
High voltage shield not tightly closed.
High voltage shield grounded to chassis or to C.R. tube mounting shield.
Open by-pass capacitor C-102 or C-66, or poor connection to capacitors.
Tube neck shields removed or not grounded.
Loose mounting nuts on top or bottom of T-7.

Low Sensitivity

Defective converter tube V-9 (7F8).
Open or short at antenna terminal board.
I.F. Gain low - check I.F. tubes.
Open antenna, R.F. or I.F. coils
Dirty contacts on station selector switch.
Contacts on selector switch shorted to chassis.
Open coil L-1.

Intermittent Station Selector Switch

Dirty contacts - clean with carbon tetrachloride!

Sound Bars in Picture

Oscillator tuned too high.
Microphonic tubes 6AG5, 7F8, 12AT7 - tap set at minimum volume and observe steady bars.
Filter condenser C-79 low in capacity.
In early sets remove resistor R-85, 2.2 Meg., in grid of 2nd I.F. tube V-3, and replace with two 4.7 Meg resistors, R-85 and R-87, wired as per latest schematic.

Picture OK but Troubles in Sound System

This is a conventional FM sound system with 4.5 mc. I.F. Difficulties which may be encountered, and their remedies are, in general, the same as for any AC-DC FM receiver.

Hum in Audio

Capacitor C-41 open.
Reset audio tuning adjustment.
Heater-cathode leakage in V-12 (25L6GT).

60 Cycle Audio Hum at Minimum Volume Control Setting

Open condenser C-41.
Defective tube V-7 (6SQ7).
Low capacity filter condenser C-79.

Audio Hum at High Volume Control Settings

Turn station selector switch to unused channel - if hum remains, replace V-16 (6AL5).
Poor ground connections on shielded volume control cable.
If hum on all stations, check filter condensers C-77, C-78.
If hum on one station only, may be diathermy (observable in picture) or may be station hum.

Synchronization Buzz in Audio

(Buzz or hum in the audio system may occur if the video amplifier is overloaded, causing 60 cycle cross modulation between the vertical sync. pulses and the 4.5 Mc audio signal. Overloading may be due to a defective video tube or very high video modulation at the transmitter).
Video tube V-5 (6AU6) weak - check for minimum of 80V., across R-28. (Normal voltage is 100V. or more).

Synchronization Buzz in Audio (continued)

Brightness control too high, so that video tube limits.
Oscillator tuned too high on low channels, and too low on high channels.
Limiter grid coil L-43 off tune.
Ratio detector T-2, secondary off tune.
Ratio detector circuit unbalanced - check R's, C's, T-2, V-16 and tuning of L-43 and primary of T-2.

Motorboating at Minimum Contrast

Check R-83, C-13, R-86 connection to R-25.

Speaker Dead

Defective voice coil in speaker.
Open winding on transformer T-3.
Loose tips on speaker leads.
Tips loose in speaker clips.

Audio Distortion

Ratio detector coil T-2, secondary off tune.
Oscillator not tuned correctly.
Defective tubes V-7 (6SQ7) or V-12 (25L6GT).

Low Volume

Video I.F. curve too narrow - realign.
Ratio detector off tune.
Oscillator off tune.
Heater open on V-7 (6SQ7).
Open ratio detector transformer T-2.
Defective ratio detector tube V-16 (6AL5).

CRITICAL LEAD DRESS & REGENERATION

Dimensions and wire dressing are especially critical in those portions of the circuit carrying R.F. and I.F. This is particularly true of all connections to the station selector switch. In case any coils or leads are removed, they should be replaced with the exact replacement coils, in the same position and with the same wire size.

Improper bypassing, connections and/or wire dressings can cause regeneration which, in extreme cases, may develop into oscillation. Also, if during alignment, all I.F. coils were accidentally set near, or at, the same frequency, the I.F. may break into oscillation.

Regeneration may be caused by defective bypass capacitors. Any bypass capacitors which are replaced, must be replaced with exact duplicates. Lead lengths must be kept the same and the capacitor must be grounded to the same point from which it was removed. Another possible cause of regeneration is not grounding the center pin of the I.F. and R.F. tube sockets. Poorly soldered joints can cause difficulties. When feeding a signal into the 1st I.F. tube or any prior stages, the shield can on the 2nd detector assembly should not be removed.

Similar lead dress precautions should be followed when working with the high voltage R.F. Power Supply. All leads carrying high voltage should be kept as short as possible and as far away from all lower voltage points as possible.

HIGH VOLTAGE MEASUREMENT

High voltage measurements may be made with a 20,000 ohms-per-volt meter by using an external multiplier, consisting of ten 10 megohm resistors in series, connected to the 5000 volt terminal on the meter. The meter sensitivity then becomes 10,000 volts, full scale.

The normal high voltage output from the rectifier tube V-14 is 5400V. to 6600 V. Always measure the high voltage with the T-7 shield can in place, because of its effect on the tuning of T-7.

CRYSTAL, E-1, CHECKING

Forward resistance 100 to 150 ohms, on X1 scale of Simpson, Model 260 meter. Backward resistance 200,000 ohms minimum, on X10,000 scale of Simpson, Model 260 meter. Resistance readings made on any other type of ohmmeter will differ from the values given above. When replacing, observe polarity marking.

CAUTION: Do not apply signal generator or any power leads to grid of video tube V-5 without first removing green lead from pin #1. Crystal may be permanently damaged by application of A.C. or condenser surge voltages to green lead. Do not solder closer than 1/4" to crystal.

MISCELLANEOUS INSTALLATION & SERVICE ADJUSTMENTS

ANTENNAS

The choice of an antenna depends entirely on the location of the receiver with respect to all television station transmitting antennas in any locality. Maximum pick-up is obtained when the receiving antenna is directly in line of sight with the transmitting antenna.

In areas relatively free of obstructions and reflections, within reasonable proximity to television transmitters, Motorola Antenna #1 will prove satisfactory. In fringe areas, where signal strength is low, Motorola Antenna #2 should be used. The above antennas have a relatively small band coverage. If it is desired to receive stations on channels of widely separated frequencies, Motorola Antenna #3, which covers all thirteen television channels should be used. In using Antenna #2, the reflector should be behind the folded section which faces the transmitting antenna. Location of antenna should be decided upon from the standpoint of maximum pick-up. In general, the higher the antenna, the better is the pick-up.

In residential sections, it may be possible to mount the antenna in the attic of homes.

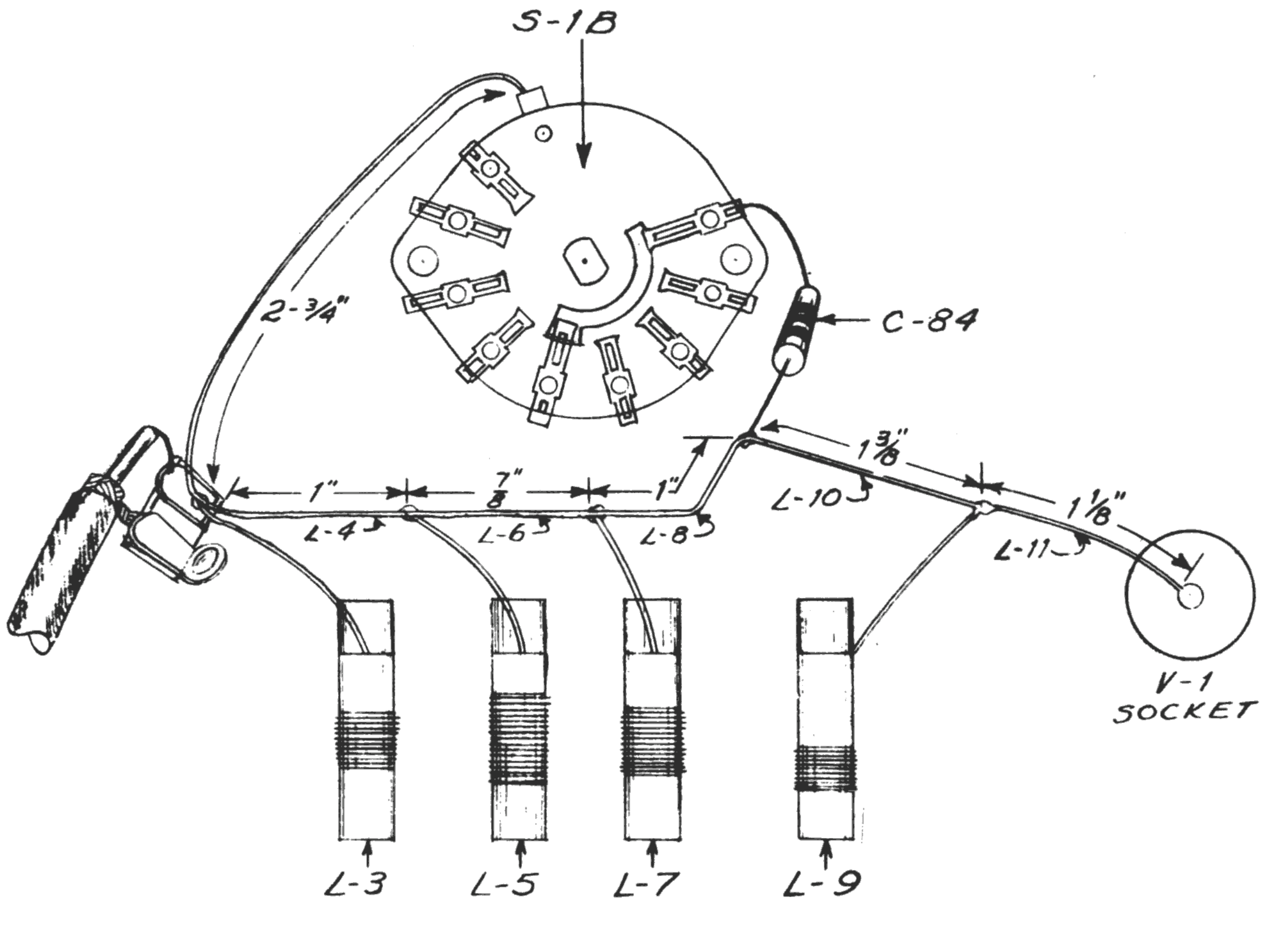


FIG. 41. CRITICAL LEAD LENGTHS (ANTENNA SECTION)

The antenna pick-up is maximum when the antenna is broadside to the transmitting antenna.

Care should be exercised not to have metal beams, conduit, etc., in the path close to the receiving antenna when an internal receiving antenna location is used. This would reduce signal pick-up.

Choice of orientation and location should be made bearing the above mentioned facts in mind. Also keep the antenna at least 1/4 wave length (at least 6 feet) away from other antennas, metal roofs, gutters or other metal objects.

LEAD-IN

For connecting the antenna to the receiver either twin lead or co-axial cable may be used. If the area, in which the installation is made, is close to sources of man-made interference, which may be picked up on the lead-in, better results will be obtained by using coaxial cable such as RGU, since it is shielded and, therefore, immune to noise pick-up. In noise-free areas the twin line lead-in can be used. If coaxial cable is used, the connection at the receiver should be to the 75 ohm input terminals. The 300 ohm input should be used for the twin line. The twin line lead-in should be supported and secured on stand-off insulators allowing enough slack to prevent breakage. It should be kept away from grounded metal objects such as gutter, drain pipes, etc. See Figure 1.

REFLECTIONS

Reflections are caused by signals reaching the receiving antenna via two or more different paths. It is obvious, therefore, that the direction of the receiving antenna should be chosen with respect to maximum signal pick-up and minimum reflection pick-up. Often times movement of the antenna a few feet, or rotation of a few degrees may affect a considerable difference in picture reception and eliminate reflections. Reception of a signal via a reflected path is to be avoided, generally, since the nature of reflecting surfaces may vary with weather conditions and as a result provide unstable reception. When, however, only reflected signals are available, the signal providing the best picture should be used.

INTERFERENCE

Auto ignition, street cars, electrical machinery and diathermy apparatus may cause interference which spoils the picture. To avoid such interference, locate the antenna and transmission line as far away as possible from highways, hospitals, doctors' offices and all similar sources of interference.

LIGHTNING ARRESTOR

When using an external antenna, whenever possible, ground the antenna mast and use an Underwriters approved lightning arrestor.

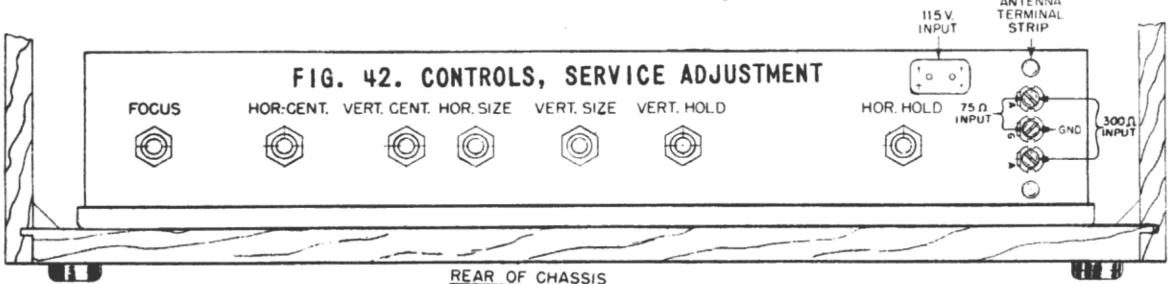


FIG. 42. CONTROLS, SERVICE ADJUSTMENT

CONTROLS, SERVICE ADJUSTMENT

Normally, the receiver is adjusted at the factory so that none other than the front panel operating instructions need be followed in putting the receiver in operation. However, to provide for any misadjustment of the rear panel controls, due to handling, the following instructions are in order. See Figure 42 for location of service adjustment controls.

FOCUS

The focus control R-74 should be adjusted until the fine horizontal structure of the raster is clearly visible over the picture area. The control should be turned through the correct point several times so that the optimum focus is obtained. The balance of the service adjustments should be made with a test pattern or a televised picture on the picture tube screen. Refer to Figures 45 to 60 for photo representations of the effects of improper adjustments of operating controls and some conditions of reception.

VERTICAL HOLD

Adjust the Vertical Hold Control R-52 until the pattern stops vertical movement. The control should be approximately centered in its lock-in range after the receiver has warmed up.

HORIZONTAL HOLD

Adjust the Horizontal Hold control R-49 until a single stationary picture appears on the picture tube screen. The control should be approximately centered in its lock-in range after the receiver has warmed up.

VERTICAL SIZE

Adjust the vertical size control R-53 until the picture fills the entire picture area vertically (4-1/2 inches).

VERTICAL CENTERING

While adjusting the vertical size control should it appear that the pattern will not fill the picture area, adjust the vertical centering control R-67 until the center of the pattern is in the center of the picture area. Then, if necessary, readjust the vertical size control as given above.

HORIZONTAL SIZE

Adjust the horizontal size control R-55 until the pattern fills the entire picture area horizontally (6 inches). In doing so note that you are including all the pattern and not just the center of it. Some test patterns include small circles in each of the four corners of the picture area. Familiarity with all station test patterns in your area will simplify size adjustments.

HORIZONTAL CENTERING

While adjusting the horizontal size control should it appear that the picture will not fill the entire area, adjust the Horizontal Centering Control R-68 until the center of the pattern is in the center of the picture area.

NOTE: There is a slight reaction between the Vertical Hold and Vertical Size controls and between the Horizontal Hold and Horizontal size controls. It, therefore, may be necessary to readjust the controls slightly to provide a symmetrical stationary picture.

After all the above controls are adjusted, carefully inspect the pattern for symmetry and correct aspect ratio. If necessary, carefully re-adjust the Horizontal and Vertical size controls to get a correct pattern.

OSCILLATOR FREQUENCY TOUCH-UP ADJUSTMENT

The oscillator tuning adjustments may require touch-up when the receiver is installed in the customer's home or when new stations come on the air. This adjustment is made directly on a station signal. In weak signal areas, this adjustment may improve performance considerably.

PROCEDURE:

The following adjustments are described for tuning the oscillator from the bottom of the receiver by removing the plug buttons which conceal the adjustment holes. See Figure 43 for location of adjustments. Use a 1/4" diameter non-metallic screwdriver. Pick up a station on the channel that is to be adjusted and operate the receiver at about 1/2 of normal contrast so variation can be easily observed.

a. Channels 1 through 6

Turn core corresponding to channel of received station in a counterclockwise direction (core moves out of coil) till picture contrast rises to maximum. You will note that the sound may decrease slightly as picture contrast rises to maximum. Then turn the core clockwise until picture contrast decreases about 5 to 10% and best resolution of the vertical wedge pattern of a test signal is obtained. (on the first 6 channels the oscillator is adjusted to set its frequency above that of the incoming signal and to place the video carrier on the high frequency slope of the I.F. response curve).

b. Channels 7 through 13.

Turn core corresponding to channel of received station in a clockwise direction (cores move into coil) till picture contrast rises to maximum. You will note that the sound may decrease slightly as picture contrast rises to maximum. Then turn the core counterclockwise until picture contrast decreases about 5 to 10% and best resolution of the vertical wedge pattern of a test signal is obtained. On channels 7 through 13 the oscillator is adjusted to set its frequency below that of the incoming signal and to place the video carrier on the low frequency slope of the I.F. response curve.

NOTE: In general, when the tough-up oscillator adjustment is made, you should tune for best picture resolution as seen on a transmitted test pattern or picture. As contrasted with usual receivers, don't tune this receiver for best audio, but for good picture resolution. If above steps are followed carefully, the accompanying sound will be satisfactory. If the sound is too weak under this condition, the 4.5 mc system may not be operating correctly or the video I.F. pass band is too narrow so that not enough audio I.F. signal comes through. Refer to I.F. Alignment.

HUM BALANCE ADJUSTMENT

The hum balance adjustment is inserted in the new circuit to eliminate the necessity of a manual tuning control.

Hum can occur in the audio system if the video amplifier is overloaded, causing 60 cycle cross-modulation of the vertical sync pulses and the 4.5 mc audio signal. Overloading can be caused by improper setting of the contrast control (contrast set higher than necessary for a picture of good contrast) or if the transmitter runs very high video modulation.

A correct setting of the Hum Balance Adjustment core (see Figure 43 for its location on bottom of receiver) will reduce hum to a minimum. The Hum Balance Adjustment is the secondary of ratio detector transformer T-2 and should be adjusted for minimum hum when the contrast control is set slightly higher than normal.

CONTROLS-OPERATING

See Figure 44 for locations of the following front panel operating controls:

1 - On-Off Switch & Sound Volume
2 - Station Selector - 8 position
3 - Contrast Control

RECEIVER OPERATING INSTRUCTIONS

1. Turn the receiver "ON" and rotate the "VOLUME" control clockwise to approximately one-half total rotation.

2. Turn the "STATION SELECTOR" to the desired channel.

3. Allow the receiver to warm up and then adjust the "CONTRAST" control for suitable picture contrast. NOTE: See Page 45 for effects of improper adjustments of controls and some conditions of reception.

4. Adjust the "VOLUME" control for suitable volume.

5. In switching from one station to another, it may be necessary to readjust the contrast control.

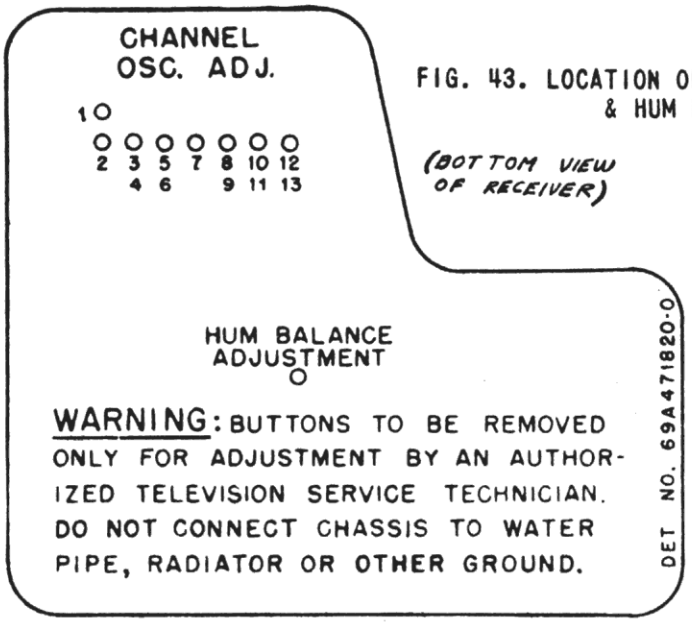


FIG. 43. LOCATION OF OSCILLATOR TOUCH-UP ADJUSTMENTS & HUM BALANCE ADJUSTMENTS

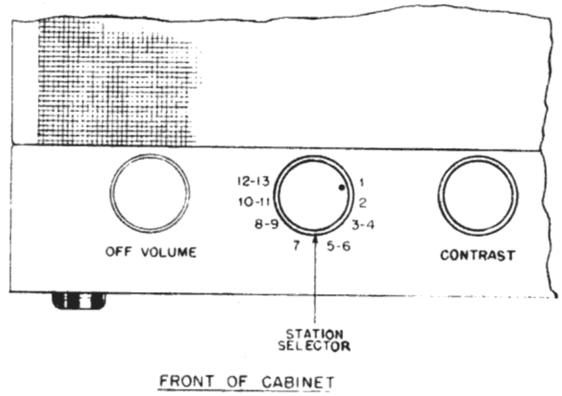


FIG. 44. CONTROLS, FRONT PANEL OPERATING

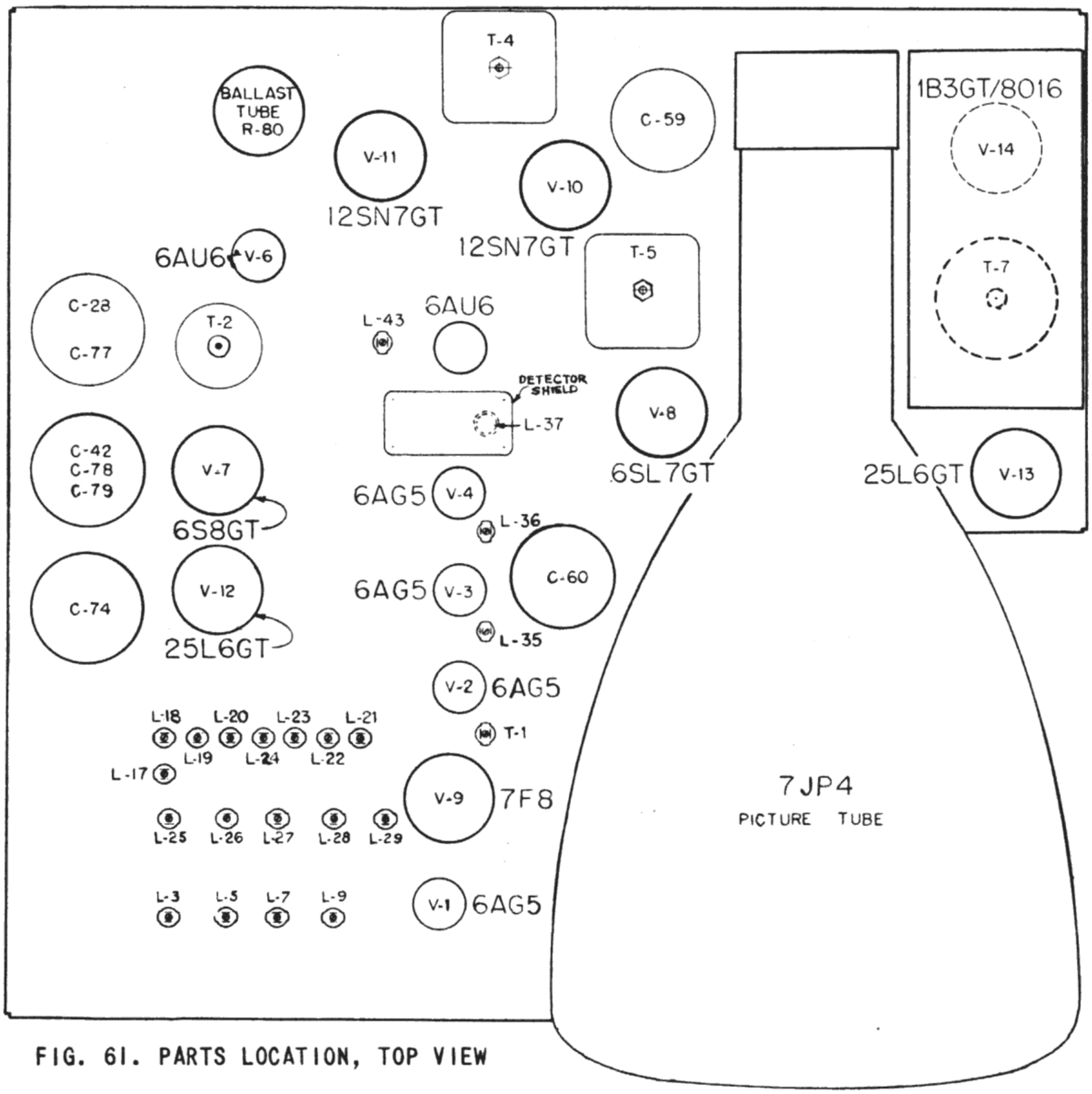


FIG. 61. PARTS LOCATION, TOP VIEW

MOTOROLA INC.

REPLACEMENT PARTS LIST
FOR
TELEVISION MODELS VT71, VT71B, VT71M, VT71MB

CAPACITORS

Ref. No.	Part No.	Description
C-1	21R6631	Mica: 100 mmf 300V
C-2	21K470329	Molded: 30 mmf
C-3	21R6631	Mica: 100 mmf 300V
C-4	21A470790	Ceramic: 1500 mmf - Disc. type
C-5	21A470790	Ceramic: 1500 mmf - Disc. type
C-6	21K470324	Molded: 6 mmf
C-7	21K478280	Molded: 2 mmf
C-8	21K478287	Molded: 20 mmf
C-9	21A470790	Ceramic: 1500 mmf - Disc. type
C-10	21A470790	Ceramic: 1500 mmf - Disc. type
C-11	21A470790	Ceramic: 1500 mmf - Disc. type
C-13	8A471356	Paper: .25 mf 200 V.
C-14	21A470789	Ceramic: 5000 mmf - Disc. type
C-15	21A470789	Ceramic: 5000 mmf - Disc. type
C-16	21K478410	Ceramic: 1000 mmf - Disc. type
C-18	21A470790	Ceramic: 1500 mmf - Disc. type
C-19	21K478410	Ceramic: 1000 mmf - Disc. type
C-20	21A470790	Ceramic: 1500 mmf - Disc. type
C-21	21A470790	Ceramic: 1500 mmf - Disc. type
C-22	21A470790	Ceramic: 1500 mmf - Disc. type
C-23	21K478234	Molded: 8 mmf
C-24	21K470323	Molded: 15 mmf
C-27	21A470789	Ceramic: 5000 mmf - Disc. type
C-29	21K470326	Molded: 2 mmf
C-31	21K470328	Molded: 70 mmf
C-32	21A470789	Ceramic: 5000 mmf - Disc. type
C-40	21A470789	Ceramic: 5000 mmf - Disc. type
C-41	8A471151	Paper: .05 mf 600V
C-43	8A471152	Paper: .02 mf 600V
C-44	8A471151	Paper: .05 mf 600V
C-45	8A471151	Paper: .05 mf 600V
C-46	21K470321	Molded: 25 mmf
C-47	8A471153	Paper: .01 mf 600V
C-48	8A471153	Paper: .01 mf 600V
C-49	8A471153	Paper: .01 mf 600V
C-50	21K478410	Ceramic: 1000 mmf - Disc. type
C-51	8A471153	Paper: .01 mf 600V
C-52	8A471153	Paper: .01 mf 600V
C-53	21R6579	Mica: 500 mmf 10% 500V
C-54	21R6579	Mica: 500 mmf 10% 500V
C-55	8A471151	Paper: .05 mf 600V
C-56	8A471149	Paper: .1 mf 600V
C-57	21A471211	Ceramic: 100 mmf 10% 500V
C-58	8A471156	Paper: .004 mf 600V
C-59	8A471348	Paper, oil impregnated: .005 mf 6000V
C-60	8B470055	Paper, oil impregnated: metal case; .005 mf 6000V
C-61	8A478235	Paper, oil impregnated: .0005 mf 6000V
C-62	8A478235	Paper, oil impregnated: .0005 mf 6000V
C-63	8A471151	Paper: .05 mf 600V
C-65	8A471348	Paper, oil impregnated: .005 mf 6000V
C-66	8A471151	Paper: .05 mf 600V
C-68	21R2738	Mica: 1300 mmf 5% 500V
C-72	21K478410	Ceramic: 1000 mmf - Disc. type
C-74	23B90135	Electrolytic: 150 mf 250V
C-75	21R6648	Mica: 250 mmf 500V
C-76	21R6648	Mica: 250 mmf 500V
C-77A	23B90134	Electrolytic: 120 mf 300V (in same can as C-77B)
C-77B	23B90134	Electrolytic: 20 mf 300V (in same can as C-77A).
C-78A	23B90136	Electrolytic: 100 mf 300V (in same can as C-78B & C
C-78B	23B90136	Electrolytic: 60 mf 150V (in same can as C-78A & C)
C-78C	23B90136	Electrolytic: 20 mf 25V (in same can as C-78A & B)
C-80	8A471151	Paper: .05 mf 600V
C-81	21A470790	Ceramic: 1500 mmf - Disc. type
C-82	21A470789	Ceramic: 5000 mmf - Disc. type
C-83	21K470324	Molded: 6 mmf
C-84	21K470322	Molded: 20 mmf
C-85	21K470323	Molded: 15 mmf
C-86	21A470789	Ceramic: 5000 mmf - Disc. type
C-87	21K470323	Molded: 15 mmf
C-88	21K470322	Ceramic: 20 mmf
C-89	21A470790	Ceramic: 1500 mmf - Disc. type
C-90	21A470790	Ceramic: 1500 mmf - Disc. type
C-91	21R6648	Mica: 250 mmf 500V
C-92	21R6648	Mica: 250 mmf 500V
C-93	21R6648	Mica: 250 mmf 500V
C-94	21R6638	Mica: 1000 mmf 500V
C-95	21A470790	Ceramic: 1500 mmf - Disc. type
C-96	21A470789	Ceramic: 5000 mmf - Disc. type
C-97	21A470789	Ceramic: 5000 mmf - Disc. type
C-98	21A470790	Ceramic: 1500 mmf - Disc. type
C-99	8A471157	Paper: .002 mf 600V
C-100	21R2718	Mica: 300 mmf 500V

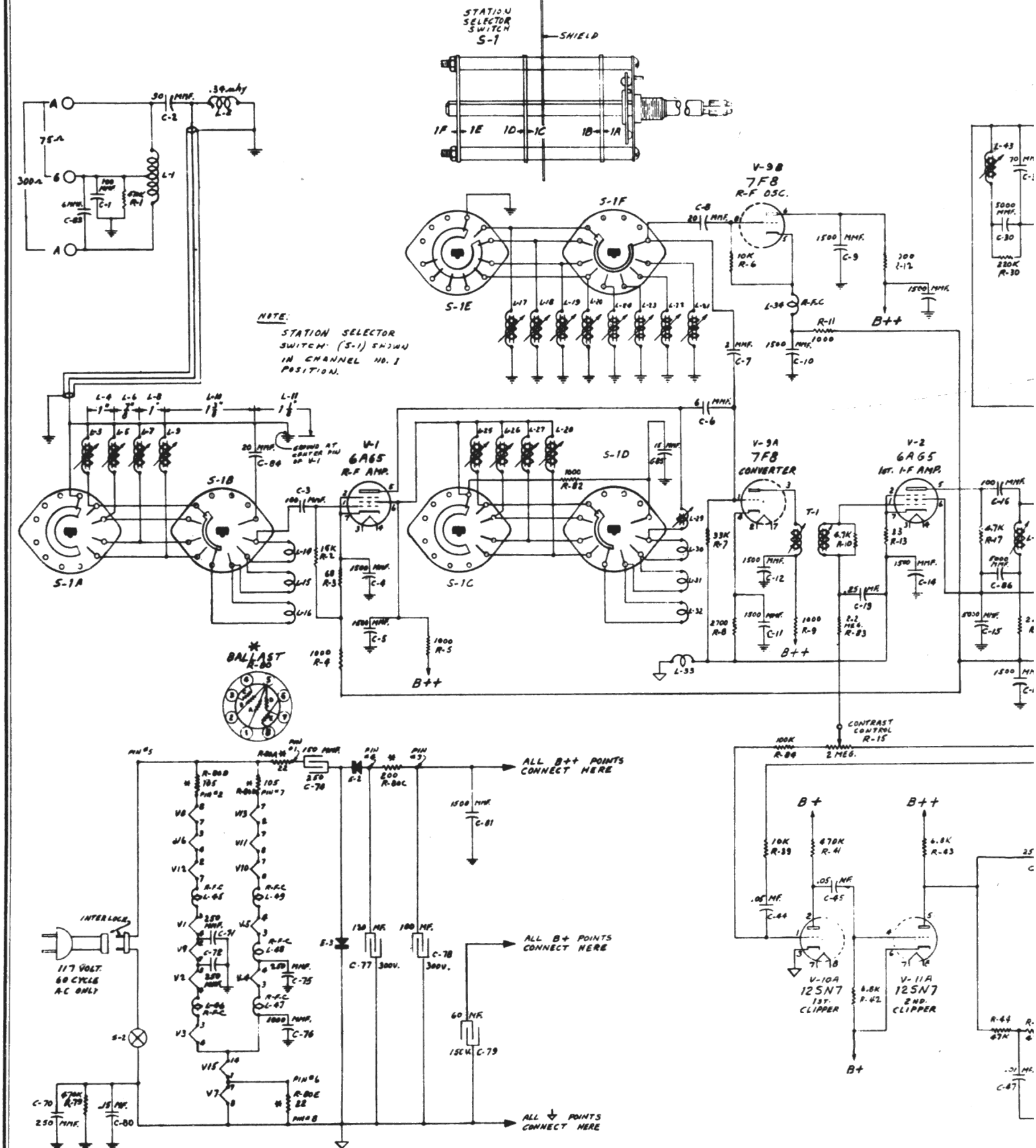
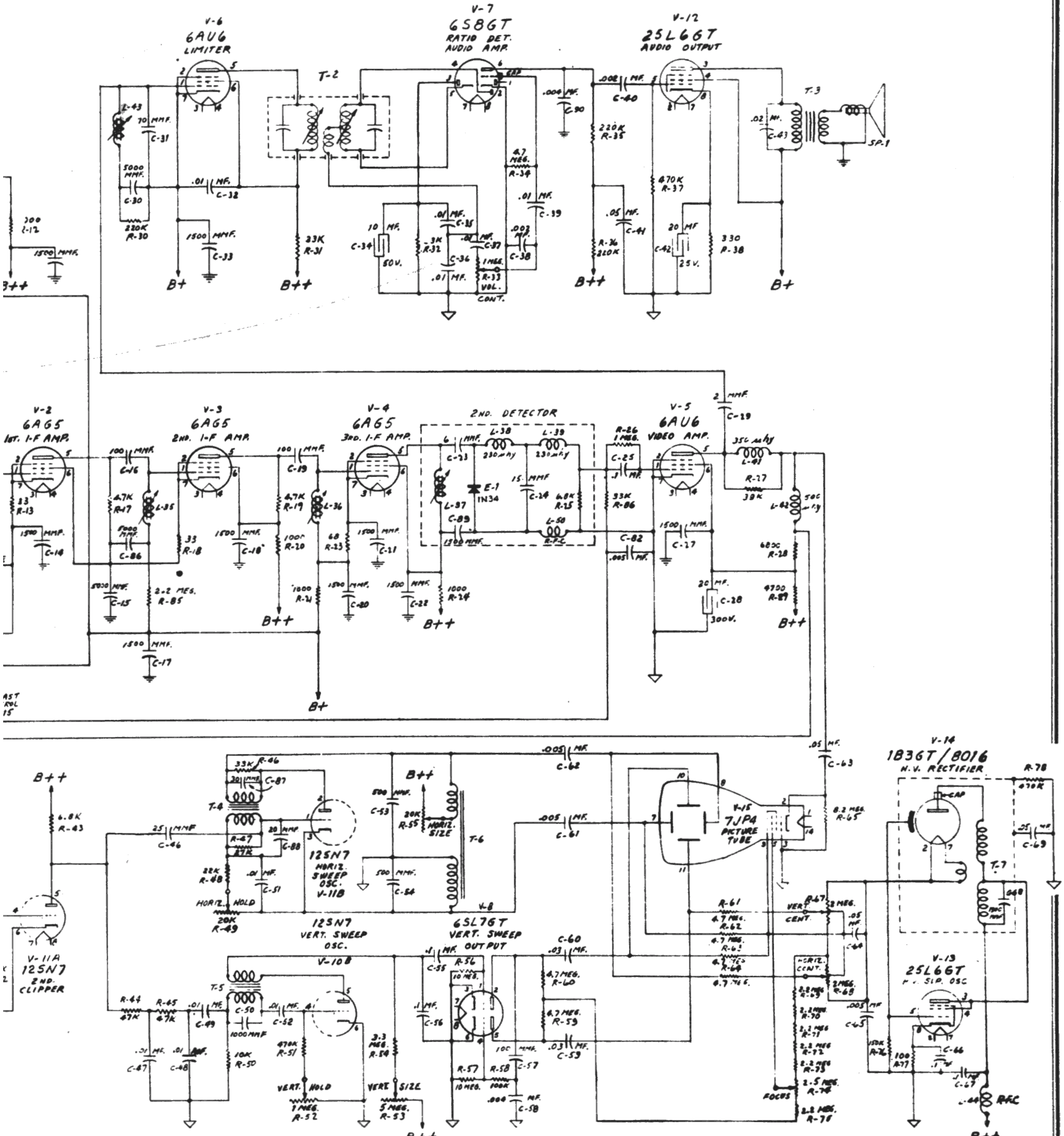


FIG. 62. CIRCUIT DIAGRAM

MOTOROLA INC.

MODEL VT71 early



CIRCUIT DIAGRAM, COMPLETE

For test patterns see back of manual

Ref. No.	Part No.	Description
C-101	23A90205	Electrolytic: 10 mf 50V
C-102	8A471355	Paper: .1 mf 200V
C-103	21A470789	Ceramic: 5000 mmf - Disc. type
C-104	21A470790	Ceramic: 1500 mmf - Disc. type
C-105	21K28816	Ceramic: 25 mmf
C-106	21K471425	Silver mica: 90 mmf

RECTIFIERS

Ref. No.	Part No.	Description
E-1	48A90173	1N34 germanium crystal
E-2	48B470395	Selenium type - half-wave
E-3	48B470395	Selenium type - half-wave

COILS

Ref. No.	Part No.	Description
L-1	24A471186	Impedance matching antenna input coil
L-2	24A90194	RF choke antenna input filter
L-3	24B90177	Antenna coil: channel #1; less core
L-5	24K90178	Antenna coil: channel #2; less core
L-7	24K90179	Antenna coil: channels #3 & 4; less core
L-9	24K90180	Antenna coil: channels #5 & 6; less core
L-14	24A471374	Antenna coil: channels #10 & 11 - loop of #18 bare wire
L-15	24A471374	Antenna coil: channels #8 & 9 - loop of #18 bare wire
L-16	24A471374	Antenna coil: channel #7 - loop of #18 bare wire
L-17	24K90187	Oscillator coil: channel #1; less core
L-18	24K90188	Oscillator coil: channel #2; less core
L-19	24K90189	Oscillator coil: channels #3 & 4; less core
L-20	24K90190	Oscillator coil: channels #5 & 6; less core
L-21	24A471369	Oscillator coil: channels #12 & 13; less form and core
L-22	24A471367	Oscillator coil: channels #10 & 11; less form and core
L-23	24A471368	Oscillator coil: channels #8 & 9: less form and core
L-24	24A471370	Oscillator coil: channel #7; less form & core
L-25	24K90182	RF coil: channel #1; less core
L-26	24K90183	RF coil: channel #2; less core
L-27	24K90184	RF coil: channels #3 & 4; less core
L-28	24K90185	RF coil: channels #5 & 6; less core
L-29	24A471372	RF coil: channels #12 & 13; less form & core.
L-30	24A471373	RF coil: channels #10 & 11 - loop of #18 bare wire
L-31	24A471373	RF coil: channels #8 & 9 - loop of #18 bare wire
L-32	24A471373	RF coil: channel #7 - loop of #18 bare wire
L-33	24A90064	RF choke, filament
L-34	24A90193	RF choke, osc. cathode
L-35	24K470313	1st IF plate coil: less core
L-36	24A90197	2nd IF plate coil: less core
L-37	24A470314	3rd IF plate coil: less core
L-38	24A90169	RF choke, 2nd detector
L-39	24A90169	RF choke, 2nd detector
L-41	24A470745	Video compensating coil: wound on 39,000 ohm resistor
L-42	24A470744	Video compensating coil
L-43	24A470159	Audio take-off coil
L-44	24A471242	RF choke, B+
L-46	24A90064	RF choke, filament
L-47	24A90064	RF choke, filament
L-48	24A90064	RF choke, filament
L-51	24A90064	RF choke, filament

RESISTORS

Note: All resistors are 1/2 watt, 20%, insulated type unless otherwise specified.

Ref. No.	Part No.	Description
R-1	6R6377	470,000 10%
R-2	6R6477	15,000 10%
R-3	6R2039	68 10%
R-4	6R6229	1000 10%
R-5	6R6229	1000 10%
R-6	6R6320	10,000 10%
R-7	6R6410	33,000 10%
R-8	6R5577	2700 10%
R-10	6R6080	4700 10%
R-11	6R6229	1000 10%
R-12	6R6229	1000 10%
R-13	6R2036	33 10%
R-15	18A90174	Contrast control - 2 meg
R-17	6R6080	4700 10%
R-18	6R2036	33 10%
R-19	6R6080	4700 10%
R-20	6R6229	1000 10%
R-21	6R6229	1000 10%
R-23	6R2039	68 10%
R-24	6R6229	1000 10%
R-25	6R6428	6800 10%
R-27	6R6487	39,000 10%
R-28	6R5725	8200 10% 2W
R-29	6R5671	4700 10% 2W
R-35	6R6407	220,000 10%
R-36	6R6407	220,000 10%

MODEL VT71

MOTOROLA INC.

Ref. No.	Part No.	Description
R-37	6R6377	470,000 10%
R-38	6R6022	330 10%
R-39	6R6320	10,000 10%
R-41	6R6046	1 meg 10%
R-42	6R6320	10,000 10%
R-43	6R5691	6800 10% 1W
R-44	6R6048	47,000 10%
R-45	6R6320	10,000 10%
R-46	6R5588	39,000 10% 1W
R-47	6R6434	27,000 10%
R-48	6R5591	18,000 10%
R-49	18A90144	Horizontal hold control: 20,000
R-50	6R6320	10,000 10%
R-51	6R6377	470,000 10%
R-52	18A90147	Vertical hold control: 1 meg
R-53	18A90145	Vertical size control: 5 meg
R-54	6R6497	3.3 meg 10%
R-55	18A90144	Horizontal size control: 20,000
R-56	6R5622	10 meg 10%
R-57	6R5622	10 meg 10%
R-58	6R6031	100,000 10%
R-59	6R476018	4.7 meg 10% 1W
R-60	6R476018	4.7 meg 10% 1W
R-61	6R6446	4.7 meg 10%
R-62	6R6446	4.7 meg 10%
R-63	6R6446	4.7 meg 10%
R-64	6R5622	10 meg 10%
R-65	6R6433	2.2 meg 10%
R-67	18A471189	Vertical centering control: 2 meg
R-68	18A471189	Horizontal centering control: 2 meg
R-69	6R2011	2.2 meg 10% 1W
R-70	6R2011	2.2 meg 10% 1W
R-71	6R2011	2.2 meg 10% 1W
R-72	6R2011	2.2 meg 10% 1W
R-73	6R5767	1 meg 10% 1W
R-74	18A90148	Focus control: 2.5 meg
R-75	6R5767	1 meg 10% 1W
R-76	6R6398	150,000 10%
R-77	6R3963	100 10% 2W
R-78	6R6377	470,000 10%
R-79	6R6377	470,000 10%
R-80	17A470303	Ballast tube
R-80A	(See R-80)	37 (in ballast tube shield)
R-80B	(See R-80)	105 (in ballast tube shield)
R-80C	(See R-80)	200 (in ballast tube shield)
R-80D	(See R-80)	105 (in ballast tube shield)
R-80E	(See R-80)	22 (in ballast tube shield)
R-82	6R6229	1000 10%
R-83	6R6433	2.2 meg 10%
R-84	6R6031	100,000 10%
R-85	6R6446	4.7 meg 10%
R-86	6R6410	33,000 10%
R-87	6R6446	4.7 meg 10%
R-88	6R2035	82 10%
R-89	6R6229	1000 10%
R-90	6R6022	330 10%
R-91	6R6410	33,000 10%
R-92	18A90142	Volume control: 1 meg; with SPST switch
R-93	6R6320	10,000 10%
R-94	6R6320	10,000 10%
R-95	6R6446	4.7 meg 10%
R-96	6R6022	330 10%
R-97	6R2036	33 10%
R-98	6R6446	4.7 meg 10%
R-99	6R476065	15 meg 10%
R-100	18A90147	Brightness control - 1 meg
R-101	6R2036	33 10%
R-102	6R5622	10 meg 10%
R-103	6R5622	10 meg 10%
SWITCHES		
S-1	1X471377	Station selector switch: 3 section; with shield plate & RF antenna coil loops
S-2	-	Power switch (part of volume control R-92)
SPEAKER		
SP-1	50B471322	Speaker: 6-1/2" PM; 3.2 ohm voice coil
TRANSFORMERS		
T-1	24B90192	Converter transformer assembly: less tuning cores
T-2	24B470316	Ratio detector transformer: complete with tuning cores and capacitors C-105 & C-106; less shield

MOTOROLA INC.

Ref. No.	Part No.	Description
T-3	25K470392	Audio output transformer
T-4	24B470154	Horizontal blocking oscillator transformer: less shield
T-5	24B470154	Vertical blocking oscillator transformer: less shield
T-6	25B90138	Push-pull transformer-horizontal sweep
T-7	24B90155	RF high voltage transformer and leads assembly: complete with leads and C-68

TUBES

Ref. No.	Part No.	Description
V-1	6AG5	RF amplifier
V-2	6AG5	1st IF amplifier
V-3	6AG5	2nd IF amplifier
V-4	6AG5	3rd IF amplifier
V-5	6AU6	Video amplifier
V-6	6AU6	Limiter
V-7	6SQ7	Audio amplifier
V-8	6SL7GT	Vertical sweep output
V-9	7F8	RF oscillator and converter
V-10	12SN7GT	1st clipper and vertical sweep oscillator
V-11	12SN7GT	2nd clipper and horizontal sweep oscillator
V-12	25L6GT	Audio output
V-13	25L6GT	H.V. supply oscillator
V-14	1B3GT/8016	H.V. rectifier
V-15	7JP4	Cathode ray tube
V-16	6AL5	Ratio detector

CHASSIS PARTS - MECHANICAL

Ref. No.	Part No.	Description
1	42K13135	Clamp, cable (ant, lead)
2	42A470832	Clamp, cable: 3/16"; plastic
3	42K471357	Clamp, cable: 1/4"; plastic
4	42K471358	Clamp, cable: 1/8"; plastic
5	42B70721	Clip, coil mounting (T-2 secondary)
7	46A470302	Core, iron and screw (T-2 secondary)
8	46A70023	Core, iron and screw (T-2 primary)
9	46A470310	Core, iron and screw (for coils L-3, 5, 17, 18, 19, 20, 25, 26, 35, 36, 37, 43 and top of T-1)
10	46K480256	Core, iron and screw (for bottom of T-1)
11	46A471363	Core, iron & copper and screw (L-7, 9, 21, 22, 23, 24, 27, 28 & 29
12	45A470708	Coupling, insulated shaft (for R-67, 68 & 74)
13	15K471329	Cover, bottom (H.V. shield)
14	1X470396	Detector Panel Assembly (including L-38, 39, C-23, 82, 24 & 89, E-1, R-96, 25 & 86
15	5S7855	Eyelet: .484 x .156 brass; solder plated (white speaker lead)
16	5S7820	Eyelet: .450 x .125 brass; solder plated black speaker lead)
17	5K471253	Grommet, insulating: 5/16" hole; black rubber
18	5K471264	Grommet, insulating: 1/2" hole; black rubber
19	29R5318	Lug, soldering: #6 hole
20	14K87179	Insulator, coil; T-2
21	9K471267	Insulator, electrolytic mtg: 4 lug
22	14A470727	Insulator, 2nd detector shield
23	4A90309	Insulating, sleeve: 1-1/2" x 3-1/4"; cardboard (electrolytic cap ins.)
24	14A470050	Insulator, socket mounting (for V-14 socket)
28	30A471218	Line, antenna coupling
29	3S7247	Lockscrew: 6-32 x 3/16 slotted hex head locking type machine screw; steel, cad. pl.
30	4S7650	Lockwasher: #6 internal; steel; cad. pl.
31	4S2635	Lockwasher: 1/2" internal; steel, cadmium plated (insulated shaft coupling)
32	4S7683	Lockwasher: #4 internal; steel, cad. pl
33	4S7655	Lockwasher: 3/8" internal; steel, cad. pl. (band switch)
34	29R5378	Lug, soldering: bent; #5 hole (tube socket gnd)
35	29R3009	Lug, soldering: bent; #2 hole (tube socket gnd)
36	29R5248	Lug, soldering: #6 hole (in H.V. supply compartment)
37	2S7005	Nut: 6-32 x 1/4 hex; steel; cad. pl.
38	2S7051	Nut: 3/8-32 x 9/16 Palnut; steel; cad. pl. (adjustable controls)
39	2S8397	Nut: 1/2-28 x 5/8" steel, zinc plated (insulated shaft coupling)
40	2S7050	Nut: 6-32 x 5/16 hex palnut
41	2S7019	Nut: 4-40 x 1/4 hex; steel, cad. pl.
42	2S7004	Nut: 3/8-32 x 9/16 hex; steel, cad. pl. (band switch)
43	2A470049	Nut, mounting (coil and core)
44	2B70703	Nut, special palnut (T-2 primary)
45	28K471323	Plug, line cord (2 pin)
46	42K471274	Ring, socket retainer (for V-14)
47	5S7706	Rivet: 1/8 x .122 steel; nickel plated
48	5S7707	Rivet: 5/32 x .122 steel; nickel plated (tube socket mtg)
49	5S7701	Rivet: 3/16 x .122 steel; nickel plated
50	5S7770	Rivet: 5/32 x .088 steel; nickel plated (tube socket mtg)
51	5S7771	Rivet: 3/16 x .088 steel; nickel plated
52	5S7703	Rivet: 7/32 x .122 steel; nickel plated (electrolytic insulator mounting)

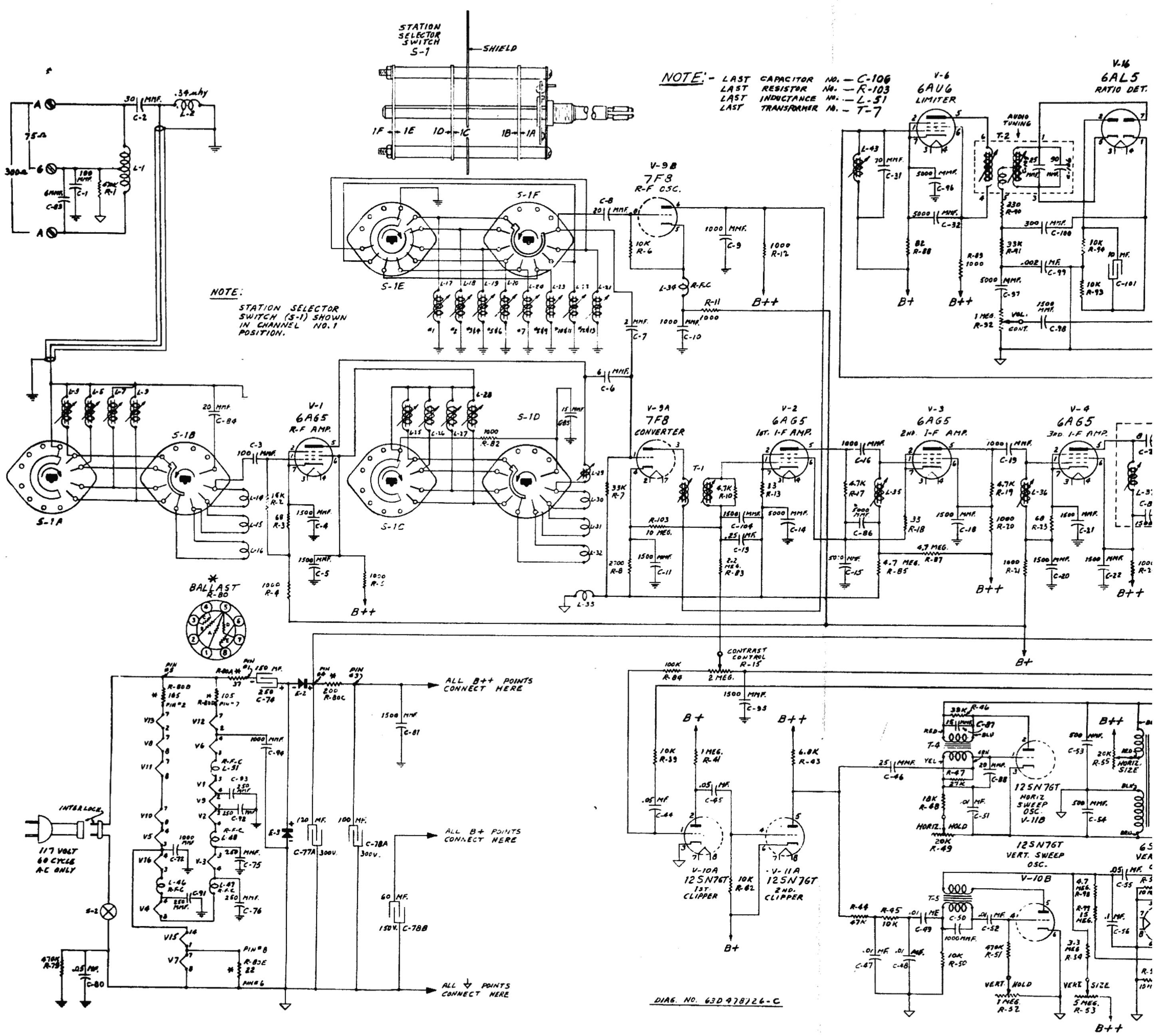
MODEL VT71

MOTOROLA INC.

Ref. No.	Part No.	Description
53	5S7708	Rivet: 9/32 x .122 steel; nickel plated (H.V. shield bottom cover)
54	3S476002	Screw: 6-32 x 1-5/8 slotted hex head machine screw; steel, cadmium plated (rectifier mtg).
55	3S3376	Screw: #6 x 1/4 PKZ slotted hex head sheet metal screw; cad. pl. (H.V. supply compartment
56	3S3369	Screw: 6-32 x 3/8 PKZ slotted hex head sheet metal screw; copper oxide finish (cable clamp)
57	47K470709	Shaft, insulated (for R-67, 68 & 74)
58	26B70107	Shield, coil (T-2)
59	1X470807	Shield, coil: includes spade bolts (T-4 & 5)
60	26K471331	Shield & top cover (H.V. supply compartment)
61	1X470742	Shield: includes spade bolts (2nd detector assembly)
62	26A90301	Shield, tube (miniature)
63	11M9517	Sleeving, saturated: #17 yellow
64	11M9532	Sleeving, saturated: #15 yellow
65	9K471270	Socket, tube: octal; black molded bakelite
66	9K471268	Socket, tube: loctal; tan molded bakelite
67	9A471344	Socket, tube: miniature; tan molded bakelite
68	9A471343	Socket, tube: miniature; includes tube shield base; tan molded bakelite
69	9A471273	Socket, tube: octal; tan molded bakelite (for V-14)
70	9D478261	Socket, di-heptal (picture tube)
71	1X478281	Socket, (di-heptal) and leads assembly (V-15 picture tube)
72	43A471241	Spacer, rectifier: stand-off
73	31A90167	Strip, antenna terminal
74	31K51251	Strip, terminal: 1 ins. lug, #1 gnd -3/8" spacing
75	31K76184	Strip, terminal: 2 ins. lugs, #1 gnd - 3/8" spacing
76	31K90044	Strip, terminal: 2 ins. lugs, #2 gnd - 3/8" spacing
77	31A470162	Strip, terminal: 2 ins. lugs, #2 hi mtg - 1/2" spacing
78	31K31223	Strip, terminal: 2 ins. lugs, end mtg - 1/2" spacing
79	31K37494	Strip, terminal: 4 ins. lugs, #3 gnd - 3/8" spacing
80	31A470387	Strip, terminal: 4 ins. lugs, #5 mtg - 3/8" spacing
81	31K90046	Strip, terminal: 5 ins. lugs, #4 gnd - 3/8" spacing
82	31A470388	Strip, terminal: 6 ins. lugs, #4 mtg - 3/8" spacing
83	31A470389	Strip, terminal: 6 ins. lugs, #1 & 9 hi mtg #8 no lug - 1/2" spacing
84	31A470390	Strip, terminal: 7 ins. lugs, #2 gnd, #8 mtg 3/8" spacing
85	3A470164	Strip, terminal: 8 ins. lugs, #2 & 7 gnd - 3/8" spacing
86	11M476073	Thinner, electrical insulation coating
87	11A471419	Tubing, extruded - vinel, #15 yellow
88	4S7625	Washer: 1/4 x .128 x .018 steel; cad. pl. (H.V. shield bottom cover)
89	4S7555	Washer: 1/4 x .128 x .033 steel; cad. pl
90	4S1720	Washer: 3/8 x .156 x .030 steel; cadmium plated (rectifier & cable clamp mtg)
91	14A471263	Washer, extruded; bakelite (H.V. shield bottom cover)
92	4K470939	Washer, insulating: 3/8 x .136 x .062; armite (electrol. insul. mtg)
6	11M476072	Coating, electrical insulation (black)
25	1X478237	Lead Assembly, shielded (volume control)
26	1X471193	Lead and Eyelet Assembly: black speaker lead
27	1X471192	Lead and Eyelet Assembly: white speaker lead

CABINET PARTS - MODELS VT71, VT71B, VT71M & VT71MB

Ref. No.	Part No.	Description
201	7A478272	Bracket, escutcheon rail
202	38A478267	Button, plug: statuary bronze finish (cabinet front)
203	38A10544	Button, plug: 1/4"; copper oxide finish (bottom shield)
204	16K471438	Cabinet, table model: Avidore (VT71B)
205	16K478257	Cabinet, table model: brown mahogany (VT71MB).
206	16K478258	Cabinet, table model: red mahogany (VT71M)
207	16F471286	Cabinet, table model: walnut (VT71)
208	7B471294	Clamp, cathode ray tube
209	13K471352	Cloth, grille
210	30B470756	Cord, line: with plug and receptacle
211	13D471288	Escutcheon and grille: plastic
212	37A12748	Foot, cabinet
213	32C471295	Gasket, rubber (cathode ray tube)
214	36K471545	Knob, control: plain; walnut plastic
215	36K471324	Knob, control: with dot; walnut plastic
216	36K478251	Knob, control: plain; mahogany plastic
217	36K478252	Knob, control: with dot; mahogany plastic
218	36K478201	Knob, control: plain; tan plastic
219	36K478202	Knob, control: with dot; tan plastic
220	4S7657	Lockwasher: #8 external; cadmium plated
221	29R5220	Lug, soldering: #8 (grounding lead)
222	2S7003	Nut: 8-32 x 5/16 hex; steel, cad. pl.
223	62K70581	Overlay, logotype
224	35K471282	Pad, asbestos (cabinet top)
225	35A471332	Pad, tube neck
226	1X471305	Screen and line cord assembly (cabinet back)
227	5A470755	Rivet, shoulder (line cord mtg)
228	64C471296	Screen, cabinet (rear)
229	64A471283	Screen, ventilation (on side of cabinet)
230	3K478241	Screw: 8-32 x 1-3/4 steel; copper oxide finish (speaker mounting)
231	3K27913	Screw: 8-32 x 1 steel; copper oxide finish (speaker mounting)
232	3S8312	Screw: #8 x 5/8 round head wood screw; ant. copper finish
233	3S1339	Screw: #6 x 5/8" flat head wood screw
234	3S7229	Screw: 6-32 x 3/8 slotted binderhead machine screw; cadmium plated
235	3S3365	Screw: #8 x 1" PKA slotted hex head sheet metal screw; black finish (chassis mtg)
236	3S7439	Screw: #4 x 1/2 slotted acorn head wood screw (rear screen)
237	3S3369	Screw: #6 x 3/8 PKA slotted hex head wood screw; antique copper finish (rear screen)
238	1K471435	Shield, cathode ray tube - aluminum
239	26D470752	Shield, chassis bottom
240	26A471293	Shield, tube neck
241	26B471393	Shield, tube: fish paper
242	4S1765	Washer: 1/2 x .147 x .015 steel; cad. pl.
243	4S8204	Washer: 1" x .203 x .067 steel (chassis mtg)



CATHODE RAY PICTURE TUBES HANDLING PRECAUTIONS

A cathode ray tube encloses a high vacuum and due to its large surface area is subjected to considerable air pressure. For these reasons, it must be handled with more care than ordinary receiving tubes.

Should it be necessary to replace the cathode ray tube in this set be sure to wear safety goggles and heavy gloves, when doing so. Keep the tube away from the body while handling it.

Care should be exercised not to strike or scratch the large end of the tube against any object or lift it by the neck. Do not subject the tube to any more than moderate pressure.

HIGH VOLTAGE WARNING

Operation of this receiver outside its cabinet or with covers removed involves a shock hazard from the power supplies. No work should be attempted on this receiver by anyone who is not thoroughly familiar with the precautions necessary when working on high-voltage equipment.

D

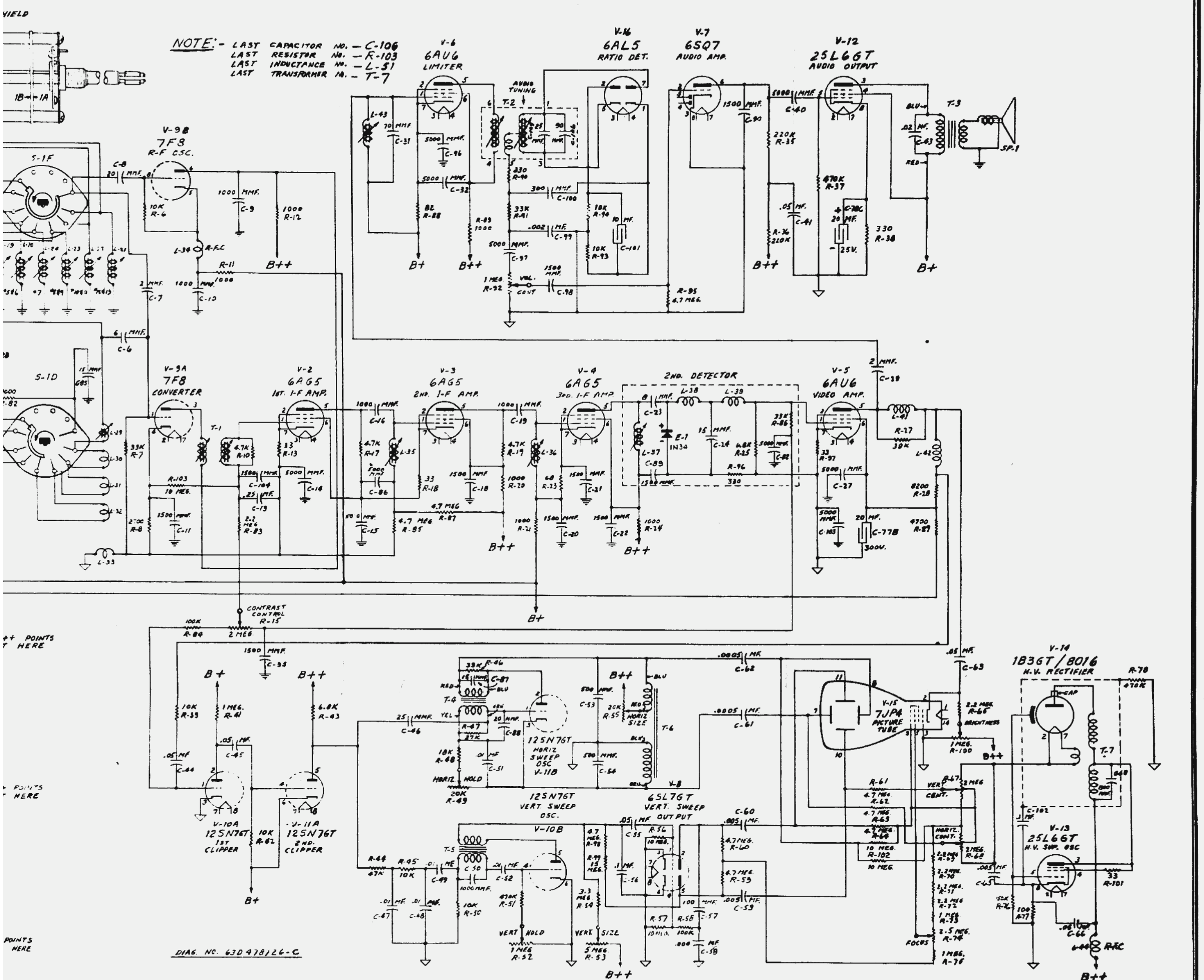
A

the antenn

I

receiver a

performed.



CATHODE RAY PICTURE TUBES HANDLING PRECAUTIONS

A cathode ray tube encloses a high vacuum and due to its large surface area is subjected to considerable air pressure. For these reasons, it must be handled with more care than ordinary receiving tubes.

Should it be necessary to replace the cathode ray tube in this set be sure to wear safety goggles and heavy gloves, when doing so. Keep the tube away from the body while handling it.

Care should be exercised not to strike or scratch the large end of the tube against any object or lift it by the neck. Do not subject the tube to any more than moderate pressure.

GROUND CONNECTION WARNING

Do not connect the chassis to ground at any time.

A grounded coaxial lead-in can be connected to terminal marked "G" on the antenna input terminal strip.

It is recommended that an isolation transformer be used between this receiver and the A.C. line whenever any testing or alignment operation are performed.