SERVICE MANUAL

for

THE NATIONAL MODEL NC-TV 10T

TELEVISION RECEIVER

Price $1.00

THE NC-TV 10T Television Receiver

a product of
NATIONAL COMPANY, INC.
MALDEN, MASS.

NATIONAL TELEVISION

Presents 2 ALL-NEW 1950 MODELS

YOU'LL BE SOLD ON *Sight*

Place these two new 1950 National Television receivers side by side with any other television receiver. Compare the large (12½") screen — compare the chassis — compare the picture quality — compare the cabinet styling. Because National Television is custom assembled — not mass-produced — there just *is* no comparison! Yet it costs no more.

Model TV-12W
Striking modern mahogany table model with 12½" tube and 2 six-inch oval speakers.
$269.95

Model TV-1225
A 12½" picture tube and a 10" speaker in a handsome mahogany console.
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Model TV-10W
Genuine mahogany table model with 10" screen and 2 six-inch oval speakers.
$229.95

Model TV-7W
Unbeatable TV dollar value. 7" screen with twin speakers. NC enlarging lens available, $16.95.
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Model TV-7M
Metal cabinet version of TV-7W. Ideal as "second set" for playroom, den or bedroom.
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(1) Latest flyback high voltage supply gives clear, bright pictures even in fringe areas. (2) Automatic frequency control locks picture in place. (3) Exceptionally wide video band-width for beautiful clarity of detail. (4) Front-of-panel focus control. (5) Coil switching assures equivalent of separate, high-Q tuned circuits for each channel. (6) Automatic gain control. (7) 3-stage 37 mc IF minimizes picture interference caused by other radio services. (8) Double-tuned RF bandpass circuits improve selectivity and image ratio. (9) Automatic Station Selector and fine tuning control.

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NATIONAL COMPANY, Inc.
MALDEN, MASSACHUSETTS

As advertised in *QST*, *CQ*, *Radio & Television News* and *Radio-Electronics*

SERVICE MANUAL
for the
NC-TV 10T
TELEVISION RECEIVER

SECTION 1. DESCRIPTION

1-1. General

The National model NC-TV 10 is a direct-viewing table model television receiver with a complement of 21 tubes, including a 10 inch picture tube and two rectifiers. The receiver tunes all twelve television channels by means of ten front panel mounted controls. An efficient circuit provides a well defined screen image bright enough for excellent visibility under all normal lighting conditions. The two six inch loud-speakers reproduce the F.M. sound in a realistic manner with more than ample volume.

1-2. Summary

The following tabulations list in brief the pertinent data on the NC-TV 10.

Tube Complement

Tube	Function
6AU6	R.F. Amplifier
6AG5	Mixer
6C4	Local Oscillator
6AU6	First Video I.F. Amplifier
6AU6	Second Video I.F. Amplifier
6AU6	Third Video I.F. Amplifier
6AL5	Video Detector-A.G.C. Diode
6AC7	Video Amplifier
12AU7	D.C. Restorer, Sync Clipper—Sync Amplifier Splitter
6AL5	Horizontal Phase Detector
6BA6	Sound I.F. Amplifier
6AU6	4.5 Mc. Ratio Detector Driver
6T8	Ratio Detector—Audio Amplifier
6V6/GT	Audio Output
6SN7/GT	Vertical Sweep Oscillator and Vertical Sweep Amplifier
6SN7/GT	Horizontal Sweep Oscillator
6BG6G	Horizontal Sweep Output
1B3GT/8016	High Voltage Rectifier
5V4G	Horizontal Damper
5U4G	Power Rectifier
10BP4	Picture Tube

Input Power Supply Rating
- 115 volts A.C. 60 cycles, 175 watts

Antenna Input Circuit Impedance
- 300 ohms balanced or 72 ohms unbalanced

Audio Output Power
- 2 watts

I.F. Frequency
- 35.85 Mc. (center frequency)

Loud-Speakers (2)
- Type — 6 inch P.M.

Fine Tuning Range
- 2 to 3 Mc. (Varies on each channel)

Front Panel Operating Controls
- On-Off Switch
- Tone Switch
- Volume Control
- Station Selector
- Fine Tuning — Dual Control
- Contrast
- Brightness
- Horizontal
- Vertical — Dual Control
- Focus Control

Non-Operating Controls and Adjustments

Vertical Size	Screwdriver adjustment at rear of chassis.
Vertical Linearity	Screwdriver adjustment at rear of chassis.
Horizontal and Vertical Centering	Wing nut adjustment on picture tube yoke.
Horizontal Size	Screwdriver adjustment at top of chassis.
Horizontal Linearity	Screwdriver adjustment at top chassis.
Automatic Frequency Control	Screwdriver adjustment at top of chassis.
Horizontal Drive	Screwdriver adjustment at top of chassis.
Focus	Wing nut adjustments on picture tube yoke.
Ion Trap-Beam Bender	Friction adjustment on neck of picture tube.

Overall Dimensions
- Width 20-1/4"
- Height 14-1/8"
- Depth 17-3/4"

Television Channel Frequencies

Channel	Freq. Mc.	Picture Carrier Freq. Mc.	Sound Carrier Freq. Mc.	Receiver Local Osc. Freq. Mc.
2	54 - 60	55.25	59.75	92.55
3	60 - 66	61.25	65.75	98.55
4	66 - 72	67.25	71.75	104.55
5	76 - 82	77.25	81.75	114.55
6	82 - 88	83.25	87.75	120.55
7	174.- 180	175.25	179.75	141.25
8	180 - 186	181.25	185.75	147.25
9	186 - 192	187.25	191.75	153.25
10	192 - 198	193.25	197.75	159.25
11	198 - 204	199.25	203.75	165.25
12	204 - 210	205.25	209.75	171.25
13	210 - 216	211.25	215.75	177.25

SECTION 2. INSTALLATION

2-1. General

Installation of a television receiver differs greatly from the procedure followed with a conventional A.M. or F.M. receiver. The first and main requirement to be considered is the "know-how" of the installing technician. He should be thoroughly familiar with the installation requirements of your Receiver in all its aspects or, failing this, possess enough radio knowledge to carry out the instructions in this section in a capable manner.

Installation consists mainly of three parts: the selection of an antenna, erection of the antenna and initial adjustments in the NC-TV 10. Each of the three foregoing parts is of paramount importance and each has a direct bearing on the performance of your television receiver. Instructions for installation in its entirety are given in Section 2-7. The sections prior to this discuss, in detail, individual parts of the installation procedure.

2-2. Precautions

Due to voltage requirements of the picture tube extremely high voltages exist in the receiver. Operation of the NC-TV 10 outside of its cabinet constitutes a dangerous shock hazard. The back of the cabinet is fitted with an interlock which, when the back is removed, automatically disconnects the A.C. line cord from the receiver, thereby removing all power and voltages from the receiver. Under NO condition should any one except qualified technicians attempt to defeat the purpose of this interlock by connecting power to the receiver with the back or cabinet removed. Precautions are required also in regards to the picture tube. Since the picture tube bulb has a large area and contains a high vacuum, considerable air pressure is exerted on the surface of the bulb. For this reason never handle the picture tube unless it is absolutely necessary and then only when wearing shatter proof glasses and heavy gloves. The bulb of the tube (particularly the large end) must never be struck, scratched or subjected to any pressure. In the receiver, the picture tube is amply protected by a shock resistant mounting and a pane of shatter-proof safety glass in front of the viewing surface. If the picture tube is ever removed from the receiver make sure it is replaced properly. (See service data section.)

2-3. Selection of the Antenna

There are many good types of antennas commercially available. A specific type of antenna cannot be recommended since the antenna type should be determined by the location of the receiving antenna with respect to the transmitting antenna of the station or stations to be received. There are three main factors to be considered when selecting an antenna:

a. The directional characteristic of the antenna.
b. The gain or sensitivity of the antenna.
c. The frequency for which the antenna is designed.

Antennas are available which are uni-directional, bi-directional or omni-directional and with

various degrees of gain. Select an antenna with as restricted a directional characteristic as possible. For example, if all transmitting antennas in the area are located in one direction, the uni-directional type should be preferred. However, bearing in mind the line-of-sight propagation of the television signals, the antenna must be receptive towards all directions in which television transmitting antennas are located and the bi-directional or omni-directional type may be called for in some areas.

The gain of the selected antenna should not be in excess of what is required. For example, in metropolitan areas where the antenna is in close proximity to transmitting antennas, a high-gain antenna would not improve reception, but rather be detrimental because too strong a signal at the input of the receiver will cause overload. Conversely, in areas where the transmitting antennas are far removed, a high-gain antenna must be used for good reception.

Closely allied with the gain of the antenna is the frequency for which the antenna has been designed. An antenna designed for the lower frequency television band will have better gain at the designed frequency than on the higher frequency television band and vice versa. An antenna designed for both bands will give fair gain on both bands. After learning the frequency of the television stations in the area, an antenna may be selected which covers all the desired stations, or possibly is designed to favor a remote station against a station fairly close to the receiving antenna.

It should be noted, from the preceding discussion, that all three factors which enter into the selection of an antenna are closely interrelated and have a direct bearing on the efficiency of reception. Therefore, each factor must be considered equally and none can be neglected. In summation, determine the antenna requirements of the installation and select an antenna which most nearly meets all these requirements.

An all-band antenna worthy of consideration is the "High-Low" type. This type has two sets of antenna elements, one stacked above the other, with one set designed for the low-frequency television band, the other for the high-frequency. A unique feature of this antenna is that each set of elements may be oriented, as desired, independent of each other. Antennas of this type are currently being manufactured by the Technical Appliance Co., (Taco), their type "E284", and the Ward Products Corp., their type "High-Low". Antenna manufacturers issue data sheets, on the various types of antennas, which should be of great assistance in selecting the antenna.

2-4. *Erection of the Antenna*

Theoretically, the ideal installation would have the antenna mounted high enough so that there would be a clear unobstructed path for the television signal to travel from the transmitting antenna to the receiving antenna. However, in this case the ideal is not usually possible nor practical. In general, the antenna should be mounted high enough to clear obstructions such as buildings, hills etc., in the immediate vicinity. Mount the antenna at least 6 feet (1/4 wavelength) above ground or any adjacent conducting structure. Make sure the antenna is firmly mounted to support its own weight and to withstand strong winds. The position of the antenna elements with respect to the transmitting antenna depends on the directional characteristic of the antenna and the receiving area. Only by trial can the antenna be positioned properly. The elements should be positioned so that all stations in the area are well received and that "ghosts" (multiple images) are absent from the viewing screen. Ghosts are generally encountered when secondary emission of the transmitted signal from nearby buildings etc. cause a signal to arrive at the receiving antenna a fraction of time later than the fundamental signal.

Ghosts are sometimes produced by mismatch between antenna and receiver whereby a secondary signal is reflected back from the receiver to the antenna and back again to the receiver. This effect can be minimized by proper matching of antenna to receiver and by keeping the antenna feeders as short as possible with no excess length. The antenna input circuit of the NC-TV 10 is designed for a 300 ohm balanced line or a 72 ohm unbalanced line. The impedance of television antennas will be found to be one or the other. Select a transmission line to match the antenna and connect it to the matching terminals on the receiver. See Section 2-7 for instructions. Bring the transmission line out perpendicular from the antenna elements and keep it as far away as possible from metal objects in its travel to the receiver. In installations where the transmission line is, of necessity, very long, put a gradual twist in the line about once every foot to minimize the possibility of "ghost" production.

Installations may be encountered where, due to the restricted location for the antenna and-or the length of the transmission line, it is impossible to eliminate "ghosts". A possible solution in this case is to place the antenna in the

same room with the receiver, thereby, changing the antenna location and shortening the transmission line to a minimum. An inside-the-room antenna is feasible only in receiving areas fairly close to the transmitting antennas. This type of antenna is usually a folded dipole, constructed of 300 ohm twin-lead, fastened to the wall or laid on the floor out of the way.

2-5. *Lightning Precaution*

If the antenna is mounted outdoors in a high exposed location, it is advisable to provide some protection against damage which might occur if lightning were to strike the antenna. Ample protection can be obtained by attaching a lightning arrestor to the antenna elements and in addition providing a direct path to ground for the mast.

2-6. *Initial Adjustments*

The NC-TV 10 is carefully aligned at National Company laboratories and ordinarily requires no readjustment before being placed in operation.

The R.F. unit is calibrated so that nine of the twelve television channels are tuneable by the Station Selector switch. Each receiver is tagged to indicate whether the R.F. unit has been calibrated to tune either the odd or even higher-frequency channels i.e., 8, 10 and 12 or 9, 11 and 13. Receivers are shipped to areas with stations corresponding to the channels pre-set in the NC-TV 10. The occasion may arise when it is desired to change from the odd to even, or even to odd channels. Instructions follow to take care of this eventuality. The following adjustments of L-4 and L-6 can be made after removal of the right-hand perforated metal cover plate on the bottom of the cabinet.

Equipment required:

R.F. Sweep Generator with a 10-12 Mc. sweep width.

Marker generator with the required frequencies (see below).

Oscilloscope (RCA type WO-60 or equivalent).

1. Remove local oscillator tube.

2. Unsolder the mixer, 6AG5, blue plate lead from the terminal board located just outside the R.F. compartment. See Figure No. 13. Connect the plate lead to B plus (junction of R-11 and C-3) through a 4700 ohm resistor.

3. Connect oscilloscope to the junction of the mixer plate lead and the 4700 ohm resistor (see step 2) and chassis.

4. Connect the sweep generator to the antenna input terminals. If the sweep generator is terminated in a 50 ohm single-ended output, connect the output lead to one of the A terminals and the ground lead to terminal G.

5. Connect the A.C. line cord of the receiver to a 115 volt, 60 cycle A.C. supply source.

6. Turn the receiver On.

7. To adjust the receiver for the odd channels, set the Station Selector switch on channel 9; for the even channels set the Station Selector switch on channel 8.

8. Adjust the sweep generator to cover channel 8 or 9 corresponding to the setting of the Station Selector switch.

9. Adjust the marker generator to insert markers at the picture carrier and sound carrier frequencies of the channel being aligned. The picture carrier frequency of channel 8 is 181.25 mc., of channel 9, 187.25; the sound carrier frequency of channel 8 is 185.75, of channel 9, 191.75.

10. Adjust L-4 and L-6 for an approximately flat topped response curve located equal distance between the markers. See Figure No. 8 for location of L-4 and L-6. Check the response curve against that shown on the R.F. alignment table for channel 8 or 9. (Page 14).

11. Check the response curves on the two higher frequency channels. There is no individual adjustment for the higher channels and if the response curve is not correct, a compromise might be made in the adjustment made on channel 8 or 9.

12. Restore the receiver to its original condition by replacing the oscillator tube, removing the 4700 ohm resistor and soldering the mixer plate lead back to its original location. Remove all test equipment and replace the cover plate on the cabinet bottom.

2-7. *Installation Procedure*

The NC-TV 10 is installed as follows:

1. Install the antenna as recommended in Section 2-4.

2. Place the receiver in its operating position, preferably with the viewing screen facing away from a strong light source, such as a window, etc.

The receiver should be positioned in a manner to permit adequate circulation of air through the ventilation openings provided on the receiver. These openings are at the bottom, top and back of the receiver and circulation through each opening can be provided as follows:

a. Bottom — Place the receiver on a table with cutouts corresponding to the cutouts in the bottom of the cabinet. Tables of this type are commercially available.

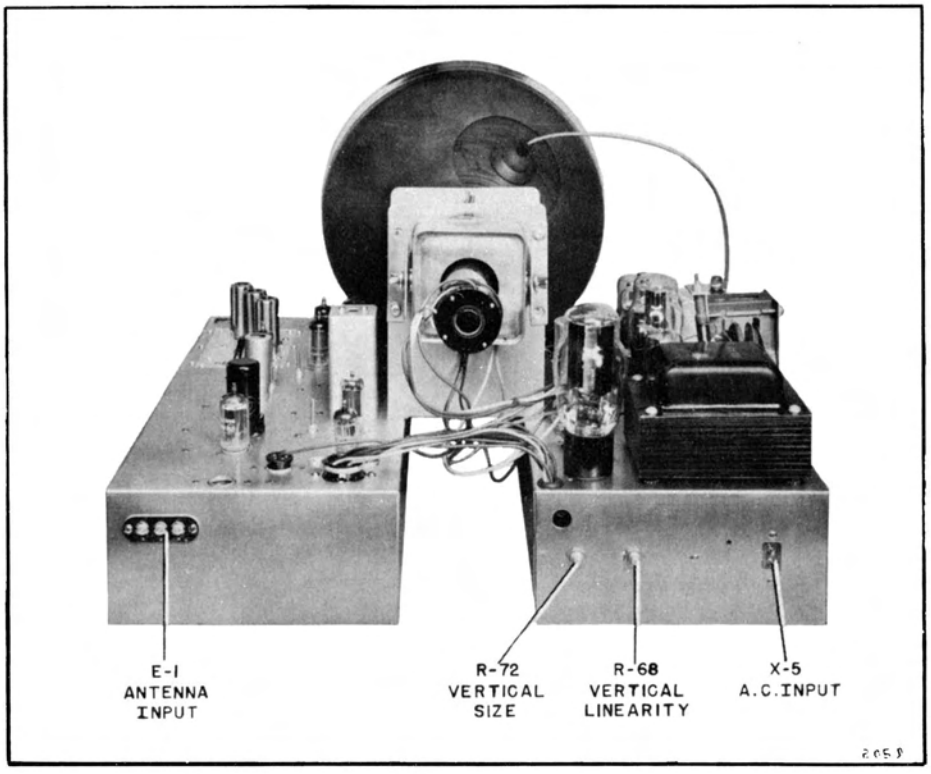


Figure No. 1. Rear View of Receiver (cabinet removed)

b. Back — Position the receiver so that there is adequate air space at the back, that is, not directly against a wall.

c. Top — Do not place scarfs or similar objects over the openings in the top of the cabinet.

3. Connect the transmission line from the antenna to the posts on the antenna terminal board, E-1. Connect 300 ohm balanced line to terminals A and A; connect the inner conductor of 72 ohm unbalanced line to one A terminal and the shield braid to terminal G.

4. Connect the A.C. line cord of the receiver to a 115 volt, 60 cycle, A.C. source of supply.

5. Set controls as recommended in Section 3 for the reception of signals.

SECTION 3. OPERATION

3-1. Operating Instructions

The NC-TV 10 is placed in operation by adjustment of the controls as follows:

1. Turn the Power Off-On switch to the On position. Allow about 30 seconds for the receiver to reach normal operating condition.

2. Set the Station Selector switch to a channel on which there is no television broadcast.

3. Turn the Contrast control fully counterclockwise.

4. Turn the Brightness control clockwise until a glow appears on the viewing screen, then slowly counterclockwise to the setting where the glow first disappears.

5. Reset the Station Selector switch to a channel having a television broadcast. Initial tuning is best accomplished when the test pattern is being broadcast.

6. Turn the Contrast control clockwise until the picture is seen on the screen.

7. Adjust the Vertical control to a setting where all vertical movement on the picture stops.

8. Adjust the Horizontal control to a setting providing the clearest picture.

9. Adjust the Focus control for best definition.

10. Adjust the Tuning control for the sharpest and clearest picture. Proper tuning is indicated when all lines on the test pattern are

straight, when circles are round, and when there is a visible distinction between black, white and intermediate shades of gray.

11. Adjust the Contrast control for suitable contrast. The correct setting is indicated by the range of tones visible on the test pattern. The tones should range from white thru various shades of gray to black.

Readjust the brightness control, if necessary to produce a better picture.

12. Readjust the volume control for the desired volume.

13. Set the Tone switch at the setting providing the desired range of tones. The High position provides normal receiver audio reproduction in which an average tonal output is achieved. The low position provides an output in which the higher tones are subdued emphasizing the lower tones.

14. To turn off the Receiver set the Off-On switch at Off without disturbing any of the other control settings. Thus, when the set is turned on again, the controls will not require readjustment. If settings of the controls are changed, it is recommended that steps 1 thru 13 be repeated. When switching from station-to-station it may be necessary to reset steps 10 and 11. If any difficulty is encountered in making the adjustment in steps 7 and 8, change the setting of the Contrast control by turning slightly counterclockwise.

3-2. Non-Operating Controls

These controls are not normally used when operating the receiver and need not be adjusted unless there is evident indication that adjustment is required. The controls and their functions are as follows:

Vertical Size — Adjusts vertical size.
Vertical Linearity — Adjusts vertical linearity.

Further adjustments are discussed in Alignment section and should be accomplished only by qualified technicians.

SECTION 4. CIRCUIT DESCRIPTION

4-1. General

This section discusses in detail the circuit employed in the NC-TV 10. Figure No. 2 is a block diagram of the receiver and the following discussion is divided up into sections as shown thereon. It is suggested that the schematic diagram at the back of this manual be unfolded so that it is completely visible, for ready reference, while reading this section.

4-2. R.F. Unit

The R.F. unit functions to select the desired signal, to amplify and convert the signal to provide an output at the plate of the mixer, consisting of heterodyned frequencies as follows:

Channels	Picture Carrier	Sound Carrier
2 thru 6	37.3 mc.	32.8 mc.
7 thru 13	34.0 mc.	38.5 mc.

The input circuit of the R.F. amplifier tube is designed for a 72 ohm unbalanced line or a 300 ohm balanced line. The input signal is fed to the grid of the tube through a coupling network and multi-tapped coil L-3. Switching of coils is accomplished by S-2. The coupling network is made up of a tapped coil, L 1, capacitor C-92, resonant line, W-2, tapped coil, L-2, and capacitor, C-91. The plate circuit of the R.F. tube is resonated by an adjustable, brass core coil, L-4 in series with a multi-tapped coil, L-5, on channels 2 through 11 and by L-4 on channels 12-13. Switching of coils is accomplished by S-3. A.G.C. voltage is applied to the grid of the R.F. tube. Coupling to the mixer grid is accomplished through the capacitor, C-5, on channels 7 through 13, the coupling is inductive on the lower channels.

The mixer circuit employs a 6AG5 pentode, V-2, with grid leak bias. The grid of the mixer is resonated in the same manner as the plate circuit of the R.F. amplifier tube. L-6 tunes channel 12-13 and L-6 in series with L-7 tunes the lower channels. The switch associated with the mixer stage is S-4.

The local oscillator, V-3, employs a 6C4 triode in a modified ultra-audion circuit. B plus is fed to the plate of the tube through a 2200 ohm resistor, R-7. Each channel has a separate inductor made adjustable by a movable iron core. Switches S-5 and S-6 select the proper inductor for each channel. A variable capacitor, C-14, connected in the grid of the oscillator, is the fine tuning adjustment. The oscillator operates on the high side of the picture carrier on channels 2 through 6 and on the low side of the picture carrier on the higher frequency channels.

4-3. I.F. Amplifier — Video Detector

The NC-TV 10 employs the intercarrier sound system. It differs mainly from the conventional system in that the heterodyning frequency which

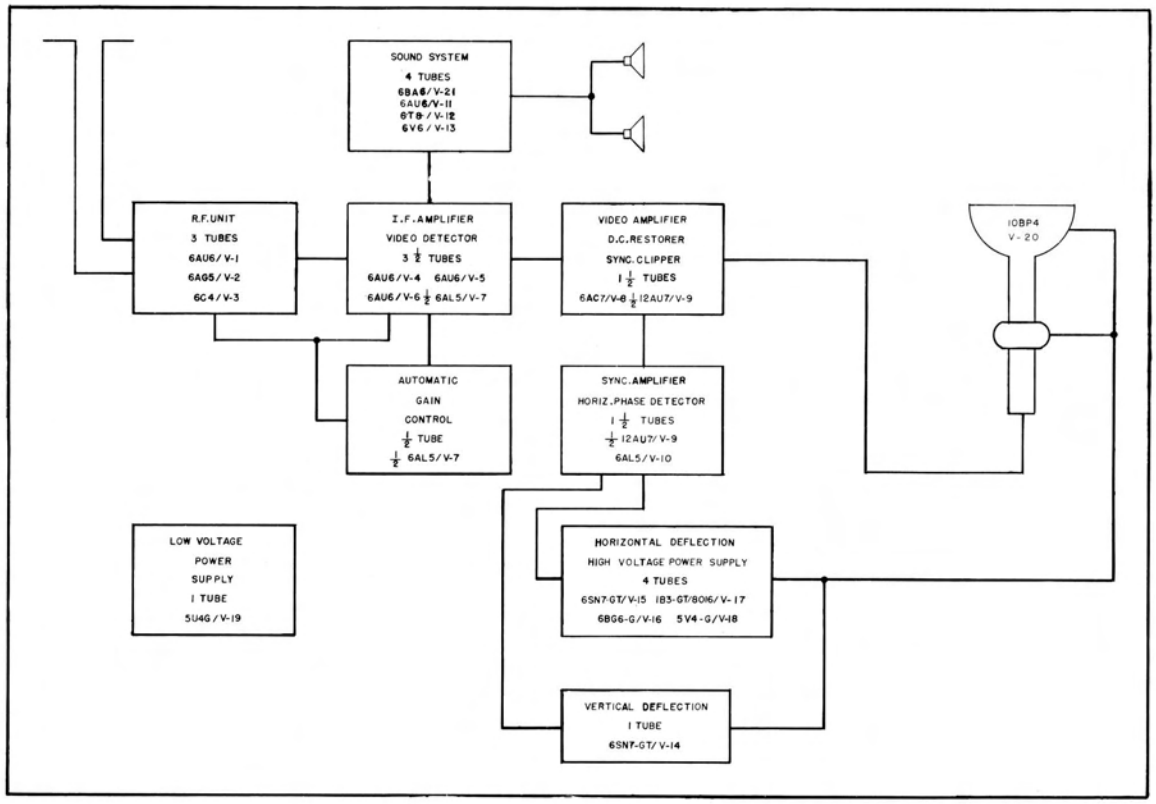


Figure No. 2. Block Diagram of Receiver

determines the sound I.F. frequency is the video carrier, and the F.M. sound carrier is not separated until it reaches the cathode of the 6AL5 detector (V-7). The intercarrier sound is relatively independent of local oscillator tuning because the sound I. F. frequency is determined at the transmitter and not in the receiver. The I.F. system consists of three stages of symmetrical I.F. amplification and four stagger-tuned circuits with two alignment frequencies. Traps are not required in the I.F., thereby simplifying the alignment procedure.

The three I.F. stages are similar for the most part. Tuning is accomplished by means of adjustable iron core coils. The alignment frequency of L-18 and L-21 is 34.8 megacycles, of L-19 and L-23, 36.9 megacycles. The I.F. bandpass characteristic is shown in Figure No. 3 by use of the symmetrical curve, the local oscillator is operarated on the low side for the high frequency channels to maintain oscillator stability. The plate supply to I.F. tubes V-5 and V-6 is shunt fed through R.F. chokes. This is done in the case of V-6 to keep the resistance in series with the I.F. plate and diode detector small. It is done in the case of V-5 to keep the impedance in the V-6 grid low to prevent bias from developing on this grid due to noise pulses which are of sufficient amplitude to draw grid current. If bias were produced, the gain would be reduced for a

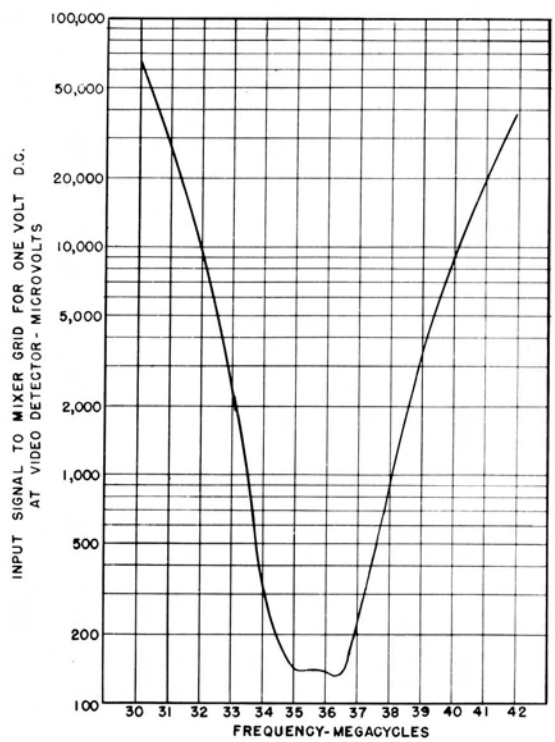


Figure No. 3. I.F. Amplifier Characteristic Curve

time following each noise pulse. Each noise pulse, which modulates the carrier towards the black level, is followed by a white tail which would prove objectionable on the picture. A.G.C. voltage is applied to the grids of the first and second I.F. tubes.

The video detector is a conventional diode. The video signal is applied to the diode plate of one-half of V-7. The rectified result is a positive signal which is applied to the grid of the video amplifier V-8. The negative portion has been eliminated. The output of this detector is fed through a series peaking coil L-24 and a shunt peaking coil L-25 before being applied to V-8. These peaking coils form a low pass filter, while at the same time maintain a good frequency response to 3 1/2 megacycles. See Figure No. 4 for the video frequency response characteristic at the output of the detector.

4-4. *Automatic Gain Control*

The automatic gain control circuit utilizes one-half of a type 6AL5 tube, V-7. A.G.C. action in television receivers is comparable to that of A.V.C. in conventional A.M. receivers. A.G.C. voltage is applied to the first two I.F. amplifier tubes as well as the first R.F. amplifier to keep the contrast level of the picture fairly constant with different input signal levels. This permits the operator to switch from station-to-station without having to reset the Contrast control each time. Component values in the input time constant circuit of C-26 and R-20 have been chosen to minimize loading effect on the last video I.F. Cathode and the delay bias varies with different settings of the Contrast control. The delay bias varies from zero with minimum contrast to about 2.5 volts with maximum contrast. The resultant is that the varying A.G.C. voltage causes the output of the detector to be reduced as the gain of the video amplifier is reduced and conversely, increased with increased amplifier gain. Thus, on weak signals delay is present so that sensitivity is not reduced by A.G.C. bias, and on strong signals little or no delay is present to reduce the likelihood of overload in the last I.F. stage.

Two time constants are used: C-26 and R-20 is the first with a time constant approximately one picture line long; R-21 and C-29 is the other and is considerably longer, dependent also on setting of Contrast control. Due to the small amount of energy stored in C-26 it discharges quickly, even though it may charge to the peak of an interfering noise pulse, thereby minimizing the affect of relatively long noise pulses. The longer time constant of C-29 and R-21 filters out the A.C. component caused by the vertical sync pulses.

4-5. *Video Amplifier, D.C. Restorer, Sync Clipper*

This system employs a 6AC7 video amplifier and one triode of a 12AU7. A sync-positive signal is applied to the grid of the video amplifier, V-8 from the video detector by means of D.C. coupling and is capacitively coupled to grid No. 2 of the picture tube. The signal is positive at the V-8 grid and negative at its plate. The video amplifier stage is so designed that with a full contrast picture the top of the sync signal will be about cutoff and noise signals above this level will drive the stage beyond cutoff and be clipped. The contrast control, in addition to varying the A.G.C. delay bias, provides variable A.C. degeneration and bias, as well as a gain control of the video stage, and also provides the correct cathode bias to offset the positive voltage developed across the diode load resistor which otherwise would be applied to the control grid of the 6AC7. Thus, the clipping level and maximum output from the weakest to strongest signal remains practically constant. The contrast control is tapped and C-31 is connected from tap to cathode and C-32, is connected from tap to ground. At zero resistance, or full gain in the 6AC7, no boost is obtained but as the slider is moved nearer the tap the gain in the video stage is reduced more for the low frequencies than the high. At the tap the 60 cycle gain is near half of that of the 3 mc. gain, further reduction in gain holds constant at near 1 to 2. This results in a contrast control giving approximately constant boost of the high frequencies for signals above the level where receiver noise is important and diminishing for weaker signals. In return, we get a resultant improvement in all video detail readily apparent when the picture is viewed from a normal viewing distance. Peaking coils L-26 and L-27 are placed in the plate of the tube to extend the output to 3 1/2 megacycles. See Figure No. 4. A 4.5 megacycle trap is inserted in the output of the video amplifier to insure sound carrier rejection from the picture intelligence.

One-half of the 12AU7 dual triode tube V-9 is used as a D.C. Restorer and Sync Clipper. To describe the operation of this circuit, the grid and cathode comprise a diode which develops a positive voltage across R-35. This resistor determines the amount of sync clipped off the composite signal. The voltage across this resistor is applied to the grid of the picture tube and is pro-

portional to the average value of the input signal. Thus, we have a re-insertion of the D.C. component of the signal. A small positive voltage is applied to the plate of this tube. During tube conduction periods its voltage drops to approximately that of the grid at which point excess electrons go to the grid resulting in zero potential at the plate. This clips the sync on the other side. The separated and clipped sync signals are then coupled to the grid of the other triode section of the 12AU7 used as a phase splitter and sync amplifier.

4-6. *Sync Amplifier — Horizontal Phase Detector*

The other triode section of V-9 functions as a phase splitter for the horizontal automatic frequency control phase detector and as a sync amplifier for the vertical blocking oscillator. The polarity of the sync signal at the output of the sync clipper is negative, but positive sync is required to trip the vertical blocking oscillator. This positive sync signal is obtained from the plate of this triode., Approximately equal voltages are taken from the plate and cathode circuits for application to the 6AL5 phase detector. In this detector, the phase of the synchonizing pulse is compared with the phase of a sawtooth voltage which is derived from the pulses across the secondary of the horizontal output transformer. If there is a phase difference, the 6AL5 phase detector will give a correcting voltage to the input of the horizontal amplifier, or should

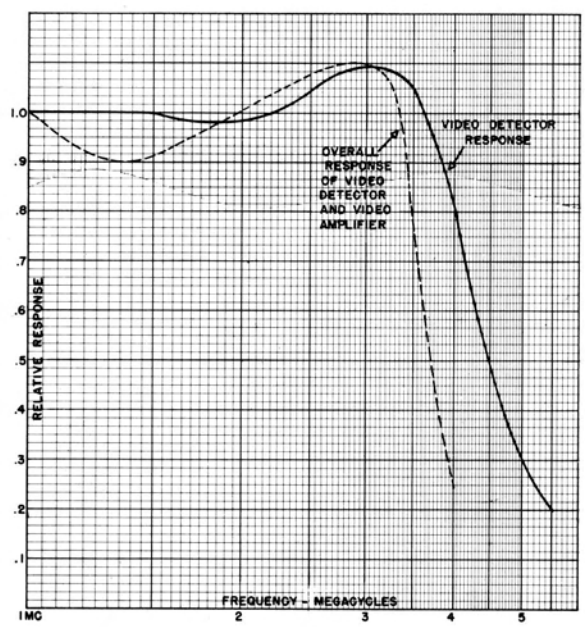


Figure No. 4. Response of Video Output Circuits

phase relations be similar no phase discrimination will take place in this tube. The resistor R-88 and Capacitor C-89 are an integrating network and C-88 serves to block the D.C. The D.C. control voltage is available at the junction of R-94 and R-95. In case of failure of the tube (V-10) a 4.7 megohm resistor R-93 is placed in the circuit providing a D.C. return for the horizontal sweep oscillator grid. Capacitor C-90 and R-92 comprise an A.F.C. filter. The result of using this phase detector insures complete lock-in of the horizontal sweep with a resultant steady picture on the picture tube. The picture is not affected by sudden line voltage changes which otherwise would effect picture steadiness.

4-7. *Horizontal Sweep Circuit — Kinescope Anode Supply*

The output of the horizontal oscillator is a sawtooth plus a peaking component. It has a reasonably fast return time, but peaking is necessary to obtain adequate high voltage. It is obtained by feeding back part of the pulse component from the secondary of the horizontal output transformer to the grid of the 6BG6-G through an 18 mmf. capacitor C-84. The sawtooth pulses are the driving power for the high voltage transformer, the high voltage rectifier and the damping tube. During the trace period the voltage across the deflection coils is constant producing a linearily rising sawtooth current in the coils. In the horizontal deflection transformer the retrace interval produces a large voltage. This pulse voltage is rectified by tube V-17 a 1B3-GT/8016 type tube.

As the negative pulse of the applied wave reaches the grid of the output tube, V-16, it is driven deep into cut-off thereby cutting off plate current quickly. The magnetic field which has been built up in the output transformer begins to collapse. The system is shocked into oscillation by this sudden cut-off of plate current. The rate of collapse insures a sufficient short retrace period. Voltage generated by the collapsing field is negative on the damping tube V-18, a 5V4G, thus preventing it from conducting. This is done for one-half of the cycle at the end of which the coil current reaches a maximum value in the reverse direction. The coil voltage now reverses polarity and the damping tube begins to conduct and places a heavy load across the deflection coil stopping it from further oscillation. This sequence of events is repeated each cycle. When the positive pulse appears on the primary of the output transformer, due to plate current cut-off in the output tube, V-16, it is stepped up, transferred to the secondary and rectified by the

1B3-GT/8016 diode V-17.

4-8. Vertical Oscillator — Amplifier

The vertical-deflection circuit uses a 6SN7, V-14. One triode is used as a blocking oscillator and sawtooth generator; the other triode as the vertical deflection output. The oscillator is used as a blocking type rather than a multivibrator because experience has indicated that interlace is more easily and reliably produced. A positive sync signal from the sync amplifier is fed to the vertical blocking transformer. The necessary feedback from plate to grid is accomplished in this transformer. C-67 is used as a blocking capacitor. Due to the slow discharge of this capacitor it tends to give a large negative bias to the grid of the oscillator which accumulates electrons. By way of a resistor network these electrons pass off causing negative bias to lessen. Electrons from the cathode once more reach the plate, plate current starts, quickly reaches its high value, drives the grid positive and the process repeats itself. A means of vertical linearity has been inserted in the amplifier by way of a variable control of bias on the cathode. A filter eliminating high frequency horizontal pulses from T-2 is of the low pass variety composed of R-61 and R-62 and C-64, C-65 and C-66. The frequency of the oscillator is controlled by R-65A, by its adjustment lock-in of the incoming positive pulse is obtained.

4-9. Sound System

Coupling from the video detector to the sound system is accomplished through capacitor, C-100, whose small value of 1 mmf. minimizes any possible effect on the gain of the video amplifier below 4.5 mc. A trap inductance, L-38, with an adjustable iron core, is made resonant at 4.5 mc. acting as a trap for sound in the video detector and providing a high impedance input for the 6BA6 sound I.F. amplifier. The 4.5 mc. signal is inductively coupled to a 6AU6 ratio driver stage which drives a conventional ratio detector using the triple diode section of a 6T8. The triode section of this tube functions as an audio amplifier followed by the output tube. This output tube functions also as a series regulator tube as explained under the low voltage power supply section

4-10. Low Voltage Power Supply

The low voltage power supply furnishes at its output voltages of plus 360 and negative 2.5 volts. It is a conventional transformer power supply employing a 5U4-G full wave rectifier. Filtering is obtained from filter choke L-31 and focus coil L-33.

The R.F./I.F. and audio circuits in general operate at + 140 volts. Part of the audio circuits are connected in series with the R.F. and I.F. circuits saving a substantial amount of B current. The R.F. and I.F. cathodes return to ground, or chassis, and the plates and screens are at a plus 140 volt potential. The cathodes of the audio tubes are at the same plus 140 volts. These tubes operate on a difference of +140 and +360 volts or 220 volts. Resistance is used in series with the 6V6G output tube which, together with the 40 mfd. capacitor returning to the cathode of the 6V6G acts as a filter to keep its current variations from modulating the B+ supply.

This 6V6G also acts as a series regulator tube to maintain the + 140 volts relatively constant. Its grid is connected to a divider running from + 360 volts to ground. Any change in the +140 volts, due to current variations of the I.F. and R.F. circuits will result in a change of the effective grid cathode voltage of the 6V6G providing a substantial amount of automatic voltage regulation.

SECTION 5. ALIGNMENT

5-1. General

Instructions for complete alignment of the NC-TV 10 Receiver are given in this section. Alignment is divided into five sub-sections, each independent of the other. Alignment of any one sub-section does not necessitate alignment of any other sub-section.

(a) Video I.F. Amplifier Alignment.
(b) Sound System Alignment.
(c) R.F. Amplifier and Mixer Alignment.
(d) Local Oscillator Alignment.
(e) Adjustment of the non-operating controls

The efficiency of alignment will depend in great measure upon the accuracy of the test equipment employed. The test equipment required to effect alignment is as follows:

1. Cathode-ray oscilloscope — Preferably a 5 inch tube such as the RCA type WO-58A or equivalent.

2. Marker Generator — Accurate calibration is a must. The frequency range should be from 40

mc. to 215 mc.

3. Sweep Generator -- A 10-12 mc. sweep width is required with a frequency range of from 40 to 220 mc.

4. Signal Generator — Here the accuracy of a crystal-controlled device and adjustable attenuation are recommended. The frequencies required are 4.5 mc., 34.8 mc. and 36.9 mc.

5. Vacuum tube voltmeter -- A good high-impedance voltmeter such as the RCA type "Voltohymst" or equivalent.

6. Heterodyne Frequency Meter — Frequencies required range from 82 mc. to 180 mc. Crystal controlled accuracy is preferable. (Used only in local oscillator alignment.)

5-2. Accessibility of Alignment Adjustments

The performance of the alignment adjustments in this section necessitates the removal of the top center portion of the cabinet and the right-hand plate attached to the bottom of the cabinet. This is accomplished as follows:

a. Remove the perforated metal back of the cabinet by withdrawing the screws holding it in place.

b. Remove the top center portion of the cabinet by withdrawing the two screws on the underside of the back brace.

c. Remove the right-hand plate attached to bottom of the cabinet by withdrawing the screws holding it in place.

d. Connect power to the receiver by temporarily replacing the back and its attached A.C. plug.

While working on the top and-or bottom of Receiver, due caution must be exercised to avoid bodily contact with high voltage points. Particularly, the top of chassis contains two high voltage points that are at either end of the high-voltage wire running from chassis to the second anode of the picture tube. Contact to the end at the tube is possible only if the rubber-cased plug is jarred or pulled out and this will not happen with careful handling.

5-3. Video I.F. Amplifier Alignment

The preliminary procedure for alignment of the video I.F. stages in the NC-TV 10 is as follows:

1. Remove the local oscillator tube, V-3.

2. Connect a negative supply of 2 volts to the A.G.C. bus (junction of C-15 and R-4) and chassis. This supply can be obtained by connecting two 1-1/2 volt batteries in series as shown on Figure No. 5.

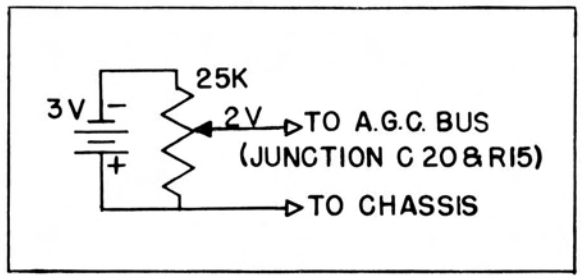


Figure No. 5. Test Voltage Supply

3. Connect the signal generator through a 0.01 mfd capacitor to channel 5 contact of S-4A and chassis. (Junction of L-7D and L-7E, see Figure No. 8.)

4. Connect the vacuum tube voltmeter to the junction of L-24-R-25 and junction R-23-R-22.

After the preceding connections have been made proceed as follows:

Step 1. Turn the receiver on.

Step 2. Set the vacuum tube voltmeter to the lowest voltage scale (5 volts.).

Step 3. Set the signal generator at 34.8 mc. with an output of approximately 0.3 volts

Step 4. Adjust L-18 and L-21 for maximum reading on the voltmeter. Retard the output of the generator, as necessary, to keep an on-scale reading on the voltmeter. See Figure No. 7 for location of L-18 and L-21.

Step 5. Set the signal generator at 36.9 mc.

Step 6. Adjust L-19 and L-23 for maximum reading on the voltmeter.

Step 7. Repeat steps 3, 4, 5 and 6 to check accuracy of the alignment.

Step 8. Disconnect the signal generator and connect the sweep generator in its place. Adjust the sweep generator to sweep the I.F. frequencies.

Step 9. Disconnect the vacuum tube voltmeter and connect the oscilloscope in its place.

Step 10. Adjust the marker generator for an

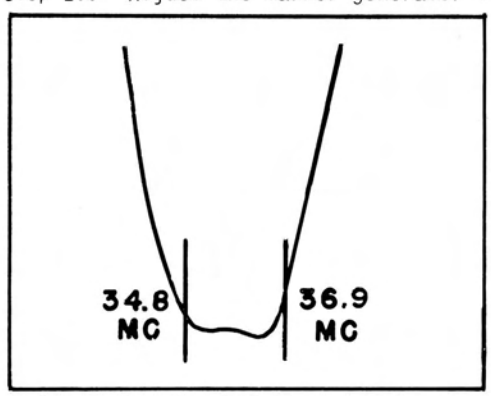


Figure No. 6. I.F. Response Curve

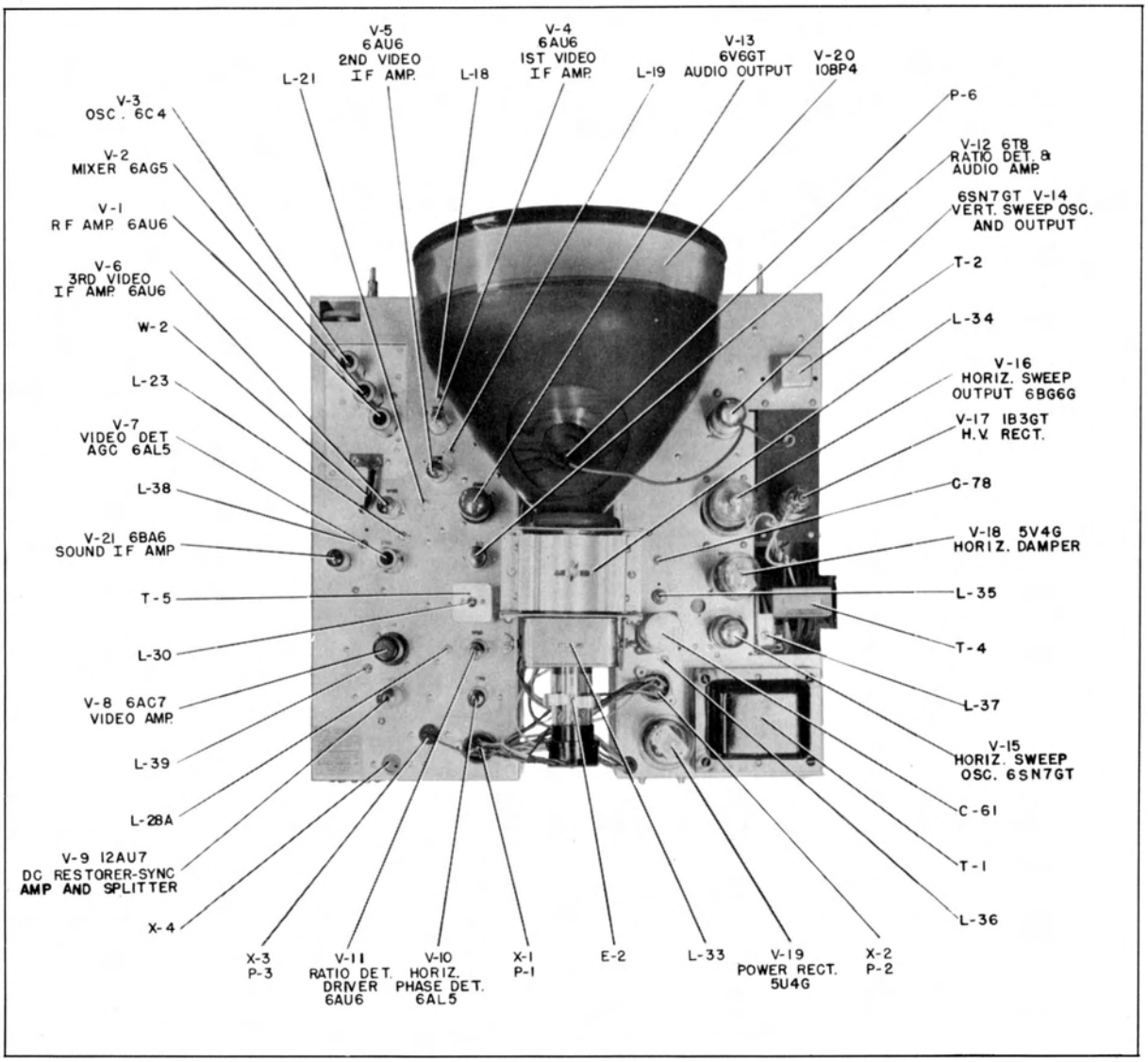


Figure No. 7. Top View of Receiver (cabinet and power supply cover removed)

output of 34.8 and 36.9 mcs.

Check the response curve on the oscilloscope against the curve shown on Figure No. 6.

5-4. Sound System Alignment

The preliminary procedure for alignment of the sound system is as follows:

1. Remove all test equipment pertaining to I.F. amplifier alignment.

2. Connect the output lead of the signal generator to the cathode of the video detector tube, through a 0.01 mfd. capacitor and connect the ground lead to chassis.

3. Connect the vacuum tube voltmeter between pins 2 and 7 of the ratio detector tube, V-12.

4. Set the Contrast control on the receiver full on — extreme clockwise position.

Proceed as follows:

Step 1. Turn the receiver on.

Step 2. Set the voltmeter on its lowest voltage scale (5 volts).

Step 3. Set the signal generator at 4.5 mc. with output of 1.0 volt (reduce to keep on scale).

Step 4. Adjust in turn L-38, L-28A and L-28B for maximum reading on voltmeter.

Step 5. Adjust L-29 (bottom of chassis) for maximum reading on voltmeter.

Step 6. Repeat steps 4 and 5 for accuracy.

Step 7. Adjust the output of the signal generator for an output of 5 volts on the voltmeter.

Step 8. Move the voltmeter connection to junction of C-45 - R-49 and pin 7 of V-12.

Step 9. Adjust L-30 (top of chassis) for a reading of 2.5 volts on the voltmeter.

Step 10. Move the voltmeter connection back to pins 2 and 7 of V-12 and repeat step 5.

Step 11. Repeat steps 7, 8 and 9.

Step 12. Connect signal generator set at 4.5 mcs. to pin 1 of V-7 and chassis. Connect voltmeter between pins 2 and 7 of V-12. Remove V-21 tube and connect a 0.001 mfd. capacitor between P-3 and pin 5 of V-21. Adjust L-39 for minimum voltage reading on voltmeter.

5-5. *R.F. Amplifier and Mixer Alignment*

The order in which R.F. alignment is accomplished is important and the order outlined in the Alignment Table must be followed since adjustment of the higher frequency channels affects those lower.

The preliminary procedure is as follows:

1. Remove the local oscillator tube, 6C4.
2. Connect a jumper across coil L-3-F.
3. Unsolder the mixer, 6AG5, blue plate lead from the terminal board located just outside the R.F. compartment. See Figure No. 13. Connect the plate lead to B plus (junction of R-11 and C-3) through a 4700 ohm resistor.
4. Connect the oscilloscope to the junction of the mixer plate lead and the 4700 ohm resistor (see step 3) and chassis.
5. Connect the sweep generator to the antenna input terminals. If the sweep generator is terminated in a 50 ohm single-ended output, connect the output lead to one of the A terminals and the ground lead to terminal G.

After the preceding steps have been taken alignment is effected as shown on the R.F. Alignment Table. Adjustment of the two coil sections involved for any one channel are made simultaneously. The adjustments consist of varying the spacing between the turns of each coil and the coupling between the two coils. See Figure Nos. 8 and 9 for location of inductors. Note that two sets of frequencies are listed for the high frequency channel inductors. They should all be adjusted for either the odd or even channels; odd and even high-frequency channels cannot be intermixed.

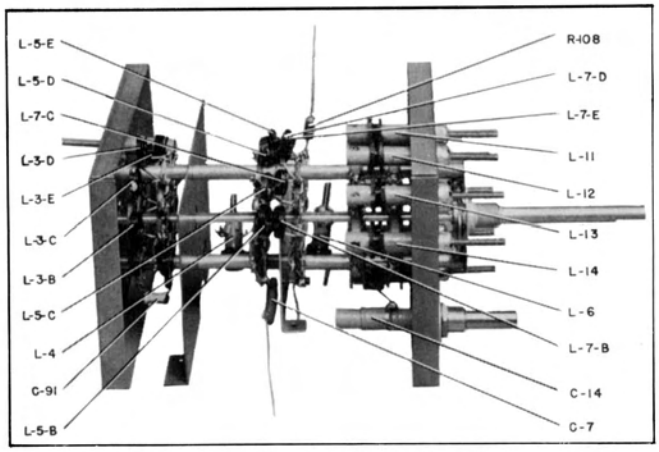


Figure No. 8. Detail of R.F. Unit Switch Assembly

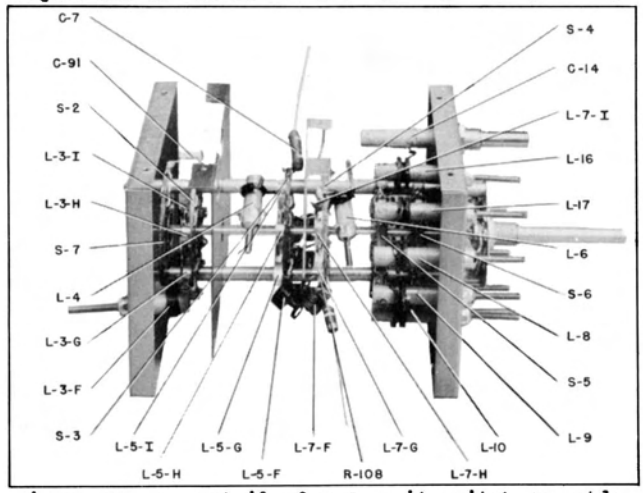


Figure No. 9. Detail of R.F. Unit Switch Assembly

R.F. Alignment Table

Channel	Set Marker Generator At:		Set Sweep Generator For:	Adjust	Response Curve
	Picture Carrier Mc.	Sound Carrier Mc.			
13 See Note A	211.25	215.75	12 Mc. width	L-4, L-6	
12 See Note B	205.25	209.75	12 Mc. width	L-4, L-6	
11 See Note A	199.25	203.75	12 Mc. width	L-5-I, L-7-I	
10 See Note B	193.25	197.75	12 Mc. width	L-5-I, L-7-I	
9 See Note A	187.25	191.75	12 Mc. width	L-5-H, L-7-H	
8 See Note B	181.25	185.75	12 Mc. width	L-5-H, L-7-H	

Note A: When aligning the Receiver to the odd high-frequency channels, namely channels 13, 11 and 9, do not perform the adjustments listed for channels 12, 10 and 8.

Note B: When aligning the Receiver to the even high-frequency channels, namely channels 12, 10 and 8, do not perform the adjustments listed for channels 13, 11 and 9.

R.F. Alignment Table (continued)

Channel	Set Marker Generator At:		Set Sweep Generator For:	Adjust	Response Curve
	Picture Carrier Mc.	Sound Carrier Mc.			
7	175.25	179.75	10 Mc. width	L-5-G, L-7-G	
6	83.25	87.75	10 Mc. width	L-5-F, L-7-F	
5	77.25	81.75	10 Mc. width	L-5-E, L-7-E	
4	67.25	71.75	10 Mc. width	L-5-D, L-7-D	
3	61.25	65.75	10 Mc. width	L-5-C, L-7-C	
2	55.25	59.75	10 Mc. width	L-5-B, L-7-B	

After completion of the foregoing alignment, procede with alignment of the R.F. amplifier grid coil as follows:

1. Remove the jumper connected across L-3-F.

2. The adjustments for grid coil, L-3, are similar to that for L-5 and L-7 shown on the preceding Alignment Table except that the order of adjustment is different and that L-3-F is adjustable by means of an iron core. The order of adjustment and the coil sections adjusted are shown below. Set the frequencies of the generators and adjust the coil sections for the response curves as shown on the preceding table for the applicable channels.

Channel	Adjust
6	L-3-F
5	L-3-E
4	L-3-D
3	L-3-C
2	L-3-B
7	L-3-G
8	L-3-H
9	L-3-H
10	L-3-I
11	L-3-I

5-6. *Local Oscillator Alignment*

Alignment is effected as follows:

1. Replace the 6C4 oscillator tube.

2. Loosely couple the probe of the heterdyne frequency meter to the local oscillator in the receiver.

3. Turn the Receiver On and adjust the inductors listed on the Alignment Table to obtain a local oscillator frequency the same as that listed for the setting of the frequency meter.

The oscillator tuning inductors are accessible after removal of the channel tuning dial and knob from the front of the cabinet. See Figure No. 10 for identification of the inductors. Note that two possible frequencies are listed for L-8, L-16 and L-17, the high-frequency channel inductors. As is the case in R.F. alignment they should all be adjusted for either the odd or even channels; odd and even high-frequency channels cannot be intermixed.

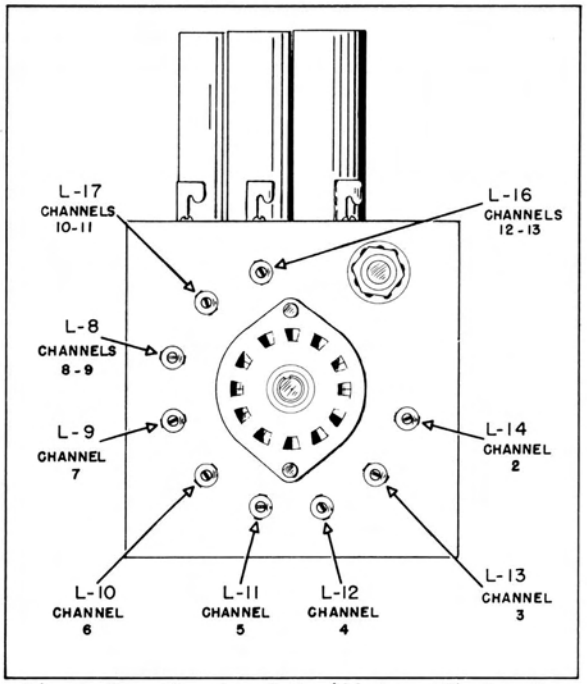


Figure No. 10. Local Oscillator Adjustments

Local Oscillator Alignment Table

Channel	Set Station Selector Switch At Channel:	Set Heterodyne Frequency Meter At:	Adjust
2	2	92.55 Mc.	L-14
3	3	98.55 Mc.	L-13
4	4	104.55 Mc.	L-12
5	5	114.55 Mc.	L-11
6	6	120.55 Mc.	L-10
7	7	141.25 Mc.	L-9
8 See Note B	8-9	147.25 Mc.	L-8
9 See Note A	8-9	153.25 Mc.	L-8
10 See Note B	10-11	159.25 Mc.	L-17
11 See Note A	10-11	165.25 Mc.	L-17
12 See Note B	12-13	171.25 Mc.	L-16
13 See Note A	12-13	177.25 Mc.	L-16

Note A: When aligning the Receiver to the odd high-frequency channels, namely channels 13, 11 and 9 do not perform the adjustments listed for channels 12, 10 and 8.

Note B: When aligning the Receiver to the even high-frequency channels, namely channels 12, 10 and 8, do not perform the adjustments listed for channels 13, 11 and 9.

5-7. Alignment of Non-Operating Controls and Adjustments

The alignment of the non-operating controls and adjustments is effected in the following manner and sequence. Two controls are accessible from the rear of the cabinet, the Vertical Size, R-72, and the Vertical Linearity, R-68. All other adjustments are accessible after removal of the center portion of the cabinet as discussed in 5-2 of this section, after these steps have been taken the following adjustments may be made as necessary.

Step 1. Set the Ion Trap on the neck of the picture tube so that the magnet is approximately on the bottom of the tube. Slide the magnet backward or forward and at the same time rotate it slightly around the neck of the picture tube for brightest raster on the screen. Set the Brightness control, R-40, to obtain somewhat above average brilliance and set the Focus control, R-59 to bring out lines clearly on the raster. Readjust Ion Trap for maximum brilliance as above.

Step 2. Before proceding with the following electrical adjustments make sure that the Focus Coil is centered vertically about the neck of the picture tube. If adjustment is required, loosen the four screws mounting the Focus Coil bracket and center the coil, then tighten the screws.

Adjust the Focus Coil, L-33, by loosening wing nuts on each side and sliding coil backward or forward and tilting it, as necessary, until the entire raster is visible. Tighten the wing nuts without changing the position of the coil

Step 3. Before proceding with the following electrical adjustment, make sure that the Deflection Yoke assembly is centered vertically about the neck of the picture tube. If adjustment is required, loosen the two screws at each side of the coil assembly, center the coil and then tighten the screws.

To adjust the Horizontal and Vertical assembly, L-34, loosen the two long bolts on the sides and the wing nut at the top of the assembly. Rotate the coil about the picture tube until the scanning lines are horizontal, that is, parallel with the top and bottom of the mask. Tighten the wing nut and the two bolts without changing the position of the coil assembly.

Note: The remaining non-operating control steps must be adjusted while using a television station test pattern on the picture tube.

Step 4. Adjust the Vertical Size control, R-72, for the correct vertical picture size. Adjust the Vertical Linearity control, R-68, for good vertical linearity. It may be necessary to readjust R-72 for the correct vertical size.

Step 5. Adjust the Horizontal Size trimmer, L-37, to obtain full width of the picture. Adjust Horizontal drive capacitor, C-78, until the picture starts to crowd up on the side. Repeat the Horizontal Size trimmer adjustment. Adjust the Horizontal Linearity trimmer, L-36, for best horizontal linearity. A further adjustment of the Horizontal Drive capacitor may be necessary for correct picture linearity.

Step 6. To adjust the Automatic Frequency Coil set the Horizontal control, R-65B, at the center of its range and adjust the A.F.C. trimmer, L-35, until picture holds in correct symmetrical horizontal position. This setting may be checked by turning Off the receiver and turning it On again. No change should take place, the picture should have correct horizontal position without readjusting the controls.

SECTION 6. SERVICE DATA

6-1. General

The data in this section is presented to aid the Technician in event servicing of the NC-TV 10 is required. Contained herein is a Trouble Shooting Chart and tube socket to chassis voltage readings. A normal test pattern is shown in Fig. 11.

Note: Care should be exercised to make sure that the peaking coils and coupling capacitors in the video circuits are kept up and away from the chassis in event their position is changed.

6-2. Removal and Replacement of Receiver Chassis

To remove the NC-TV 10 chassis proceed as follows:

Note: During the following operations DO NOT tip the receiver on its side.

Step 1. Remove preforated back from the cabinet.

Step 2. Remove the top center portion of the cabinet by withdrawing the two screws at underside of the back brace.

Step 3. Remove the eight screws from bottom of the cabinet which fasten the chassis to the cabinet. Do this by letting the front and then the back of the cabinet overhang the bench to permit access to the screws, NOT by tipping the receiver on its side.

Step 4. Disconnect the loud-speaker plug from the chassis socket; disconnect the socket from the base of the picture tube; disconnect the anode clip from the side of the picture tube; remove all control knobs from the front of the cabinet; remove the ion trap from the neck of the picture tube.

Step 5. Remove the bezel from the front of the cabinet by withdrawing the two screws from top inside of the cabinet. Removal of the bezel allows access to the screws securing the cushion mounts for the front of the picture tube. Loosen the screws enough to release the picture tube.

Step 6. Withdraw the chassis from the cabinet to a point just before the picture tube contacts the back brace on the cabinet.

Step 7. Remove the picture tube by carefully drawing the tube towards the front of the cabinet without exerting any pressure upwards until the base of the tube is completely clear of the deflection coil assembly, then lift the tube up and out of the cabinet.

Step 8. The chassis may now be completely withdrawn from the cabinet and those items replaced, as necessary, to perform the required servicing.

Step 9. Replace the chassis by following the preceding steps in reverse manner. Care should be taken to position the four cushion mounts securely about the tube.

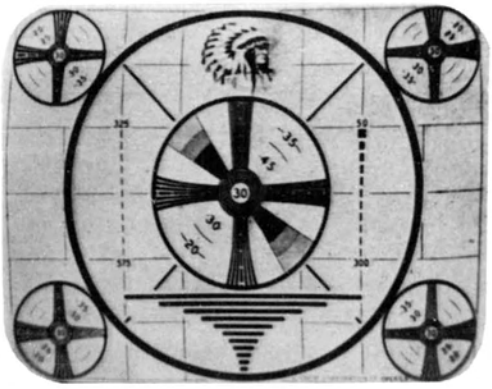
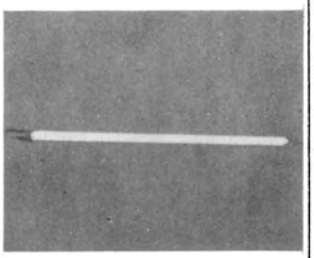
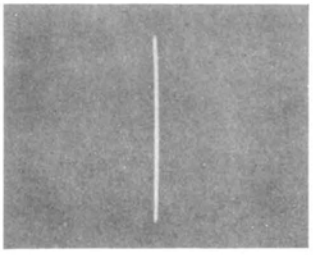
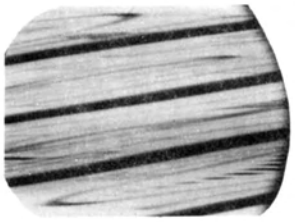
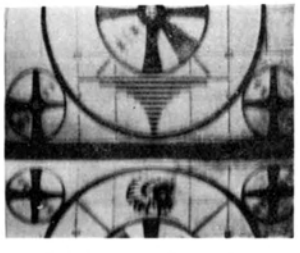


Figure No. 11. Normal Test Pattern

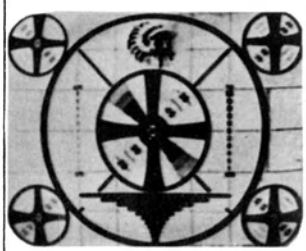
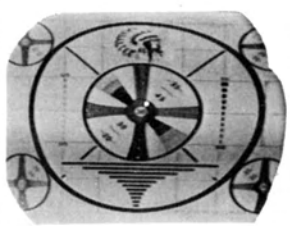
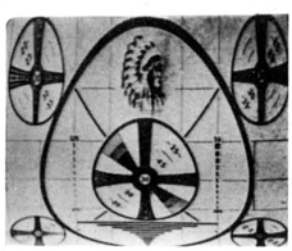
Trouble Shooting Chart

Trouble	Probable Cause
No raster, sound normal	1. Ion trap magnet improperly set. 2. Check waveform on grid of V-16; a sawtooth pattern is correct. 3. Check waveform on grid (pin 1) of V-15; a sinewave pattern is correct. 4. Check continuity of T-4 windings. 5. Check tubes, V-16, V-17, V-18. 6. Check high voltage-corona ring to ground, approximately 8500 volts. 7. If high voltage normal-check picture tube. 8. Check Horizontal control, R-40.
No vertical sweep 	1. Check tube V-14. 2. Check socket voltages of V-14. 3. Check continuity of T-2 and T-3 windings. 4. Check continuity of L-34A, vertical deflection coils. 5. Check capacitors C-71A and C-68, for short.
Picture unstable	1. Check setting of contrast control, R-27, to make sure it is not advanced too far. 2. Check socket voltages of V-7 and V-8. 3. Loose connections in the receiver or in the external antenna system may cause instability, also, strong noise pulses may produce this conditions. 4. The transmitter may be at fault, check by tuning to another station.

Trouble Shooting Chart (Continued)

Trouble	Probable Cause
No horizontal sweep 	1. Check tubes V-15, V-16 and V-18. 2. Check waveform at grids of V-15 and V-16. 3. Check socket voltages of V-15, V-16 and V-18. 4. Check continuity of T-4 and L-34B.
Raster and Sound Normal—No Picture	1. Check tubes V-8 and V-9. 2. Check socket voltages of tubes V-8 and V-9. 3. Check grid connection at pin 2 of picture tube socket and at socket X-3. 4. Check capacitors C-35 and C-34.
No sound-raster and picture normal	1. Check tubes V-11, V-12, V-13 and V-21 2. Check socket voltages of above tubes. 3. Check audio output circuits by connecting audio signal to junction of C-47 and R-49. Set volume control full on. 4. Check alignment of sound system.
No horizontal sync 	1. Check alignment of L-35. See Section 5-7. 2. Check tubes V-10 and V-15. 3. Check socket voltages of above tubes. 4. Check capacitors C-72, C-73, C-74, C-75 and C-76. 5. Check for open R-65B or L-35.
No vertical sync 	1. Check tubes V-9 and V-14 and their socket voltages. 2. Check integrating network C-64, C-65, C-66, R-61 and R-62. 3. Check continuity of T-2. 4. Check capacitors C-67, C-68, C-69 and C-70. 5. Check for open R-65A.

Trouble Shooting Chart (Continued)

Trouble	Probable Cause
Small raster	1. Check rectifier tube V-19. 2. Check B+ of low voltage supply. May be measured at junction of L-33 and C-63—normal reading is 380 volts. 3. Check filter capacitors C-61A, C-61B and C-63.
Picture stable but detail poor 	1. Check tubes V-7, V-8 and V-9. 2. Check focus control, R-59 for operation on each side of proper focus. 3. Check resistance across peaking coils, L-24, L-25, L-26 and L-27. Normal resistance of L-24 is 3 ohms, L-25, 10. ohms, L-26, 4. ohms and L-27, 7.5 ohms. 4. Check R.F. and I.F. alignment.
Improper Horizontal Linearity 	1. Check continuity adjustment of Linearity control, L-36. 2. Try new V-18 or V-16 tube. 3. Check for correct settings of controls affecting Horizontal size, L-37, and C-78 (see step 5 of section 5-7). 4. Check capacitors, C-82, C-83 and C-73.
Improper Vertical Linearity. 	1. Check voltages of V-14. 2. Check waveforms at grid and plate of V-14. 3. Check continuity of T-3. 4. Check for open R-68. 5. Check capacitors C-71A, C-68, C-69 and C-70.

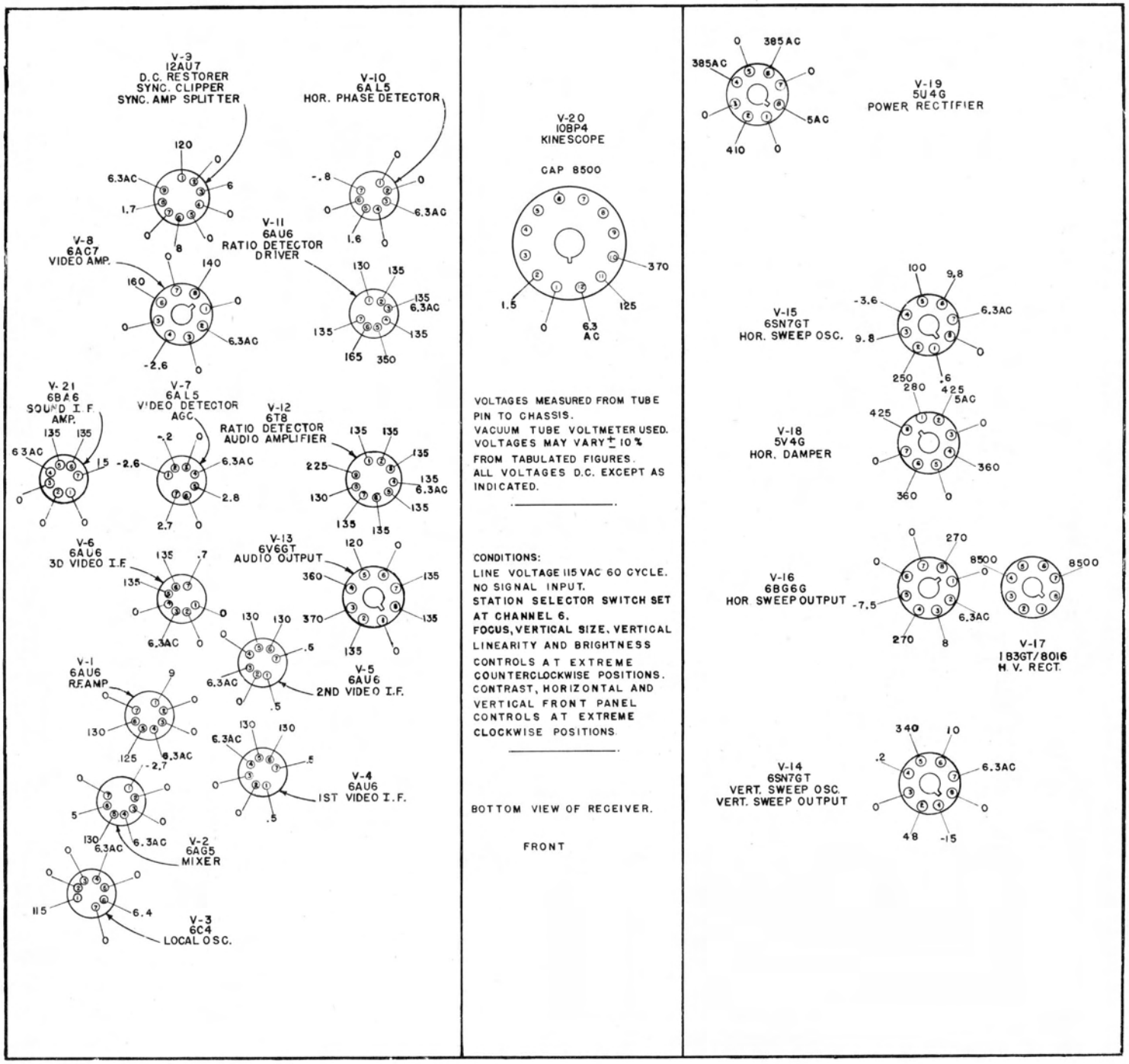


Figure No. 12. Tube Socket Voltages

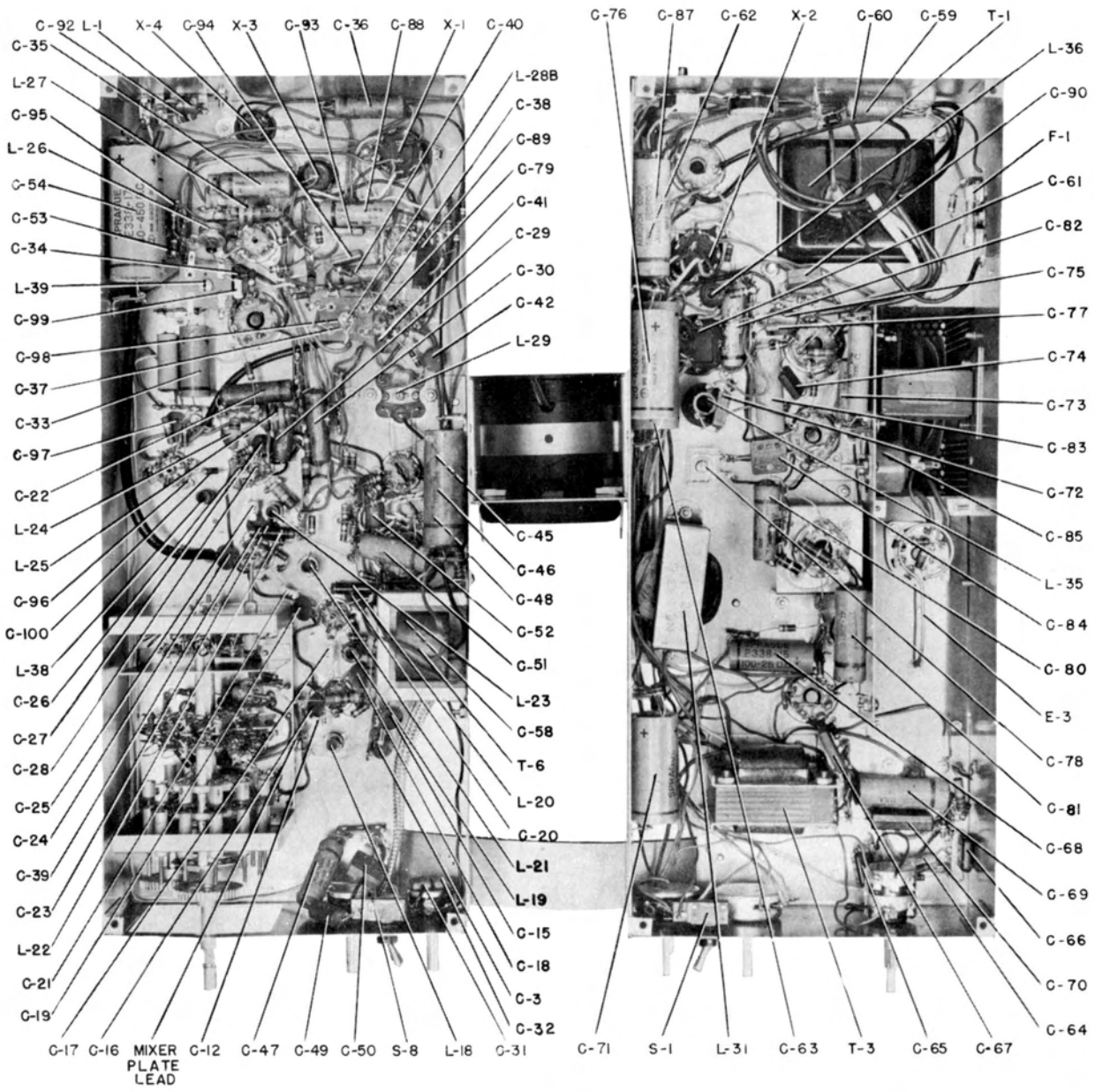


Figure No. 13. Capacitor and other component Locations — Bottom of Receiver

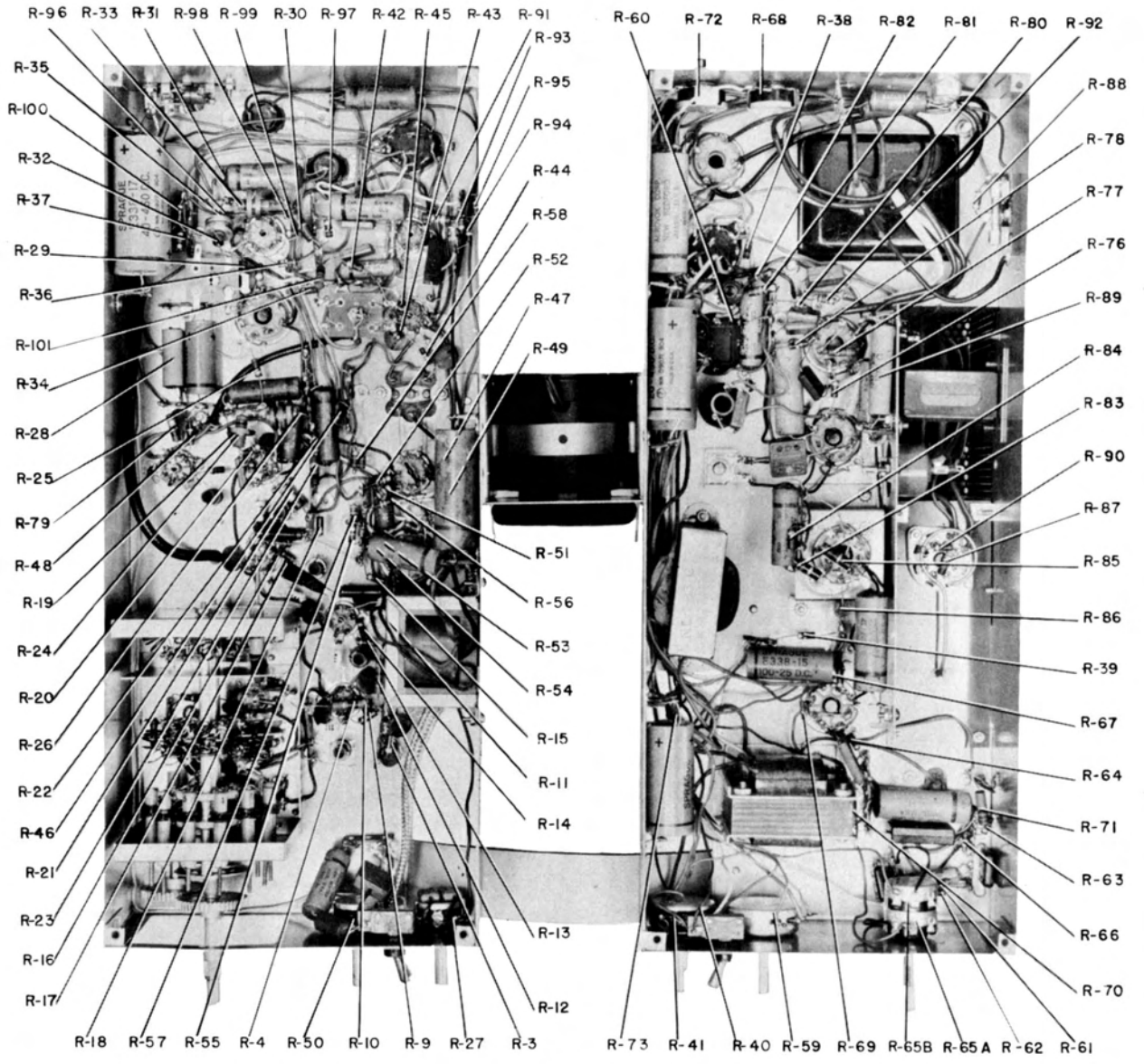


Figure No. 14. Resistor Locations — Bottom of Receiver

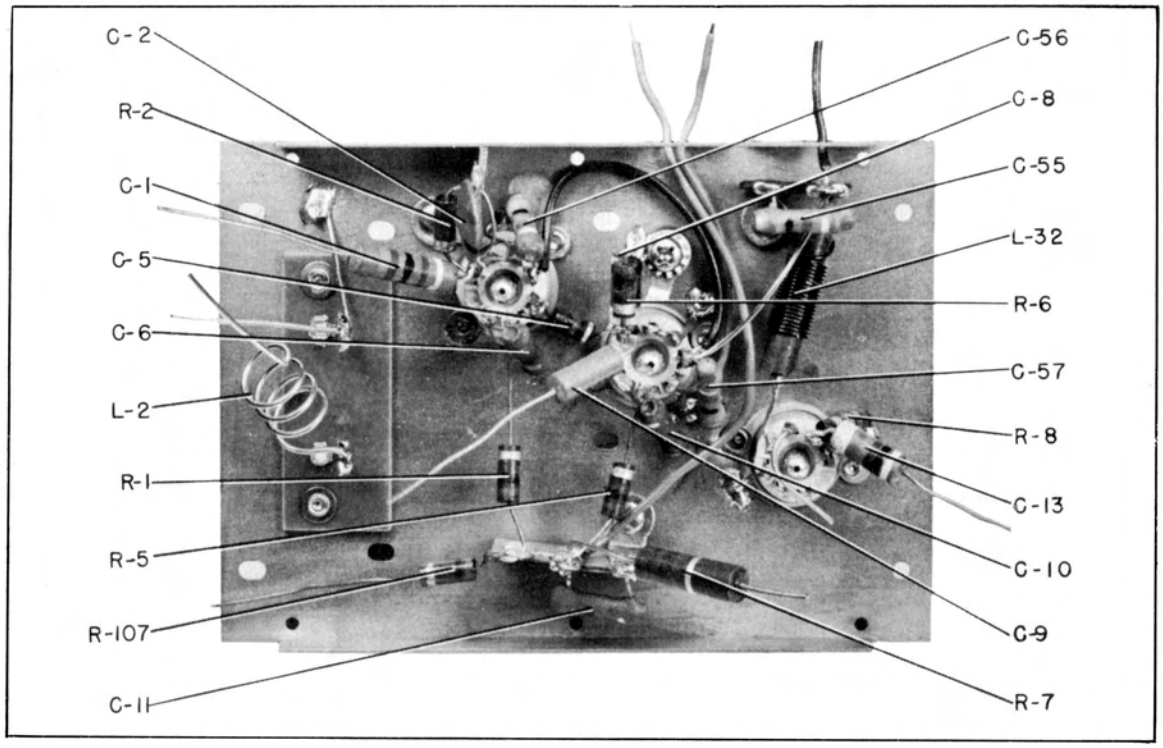


Figure No. 15. Bottom View of R.F. Unit (switch assembly removed)

PARTS LIST

Symbol	Description	National Co. Type
	CAPACITORS	
C-1	Ceramic, 100 mmf., ±10%, 500 vdcw	F913-2
C-2	Ceramic, 5000 mmf., 450 vdcw	K946-1
C-3	Ceramic, 5000 mmf., 450 vdcw	K946-1
C-4	Ceramic, 5000 mmf., 450 vdcw	K946-1
C-5	Ceramic, 1 mmf., ±10%, 500 vdcw	L081-4
C-6	Ceramic, 360 mmf., 500 vdcw	K941-1
C-7	Ceramic, 360 mmf., 500 vdcw	K941-1
C-8	Ceramic, 22 mmf., ±10%, 500 vdcw	F912-10
C-9	Ceramic, 2 mmf, ±.5 mmf, 500 vdcw	F912-3
C-10	Ceramic, 360 mmf, 500 vdcw	K941-1
C-11	Ceramic, 360 mmf., 500 vdcw	K941-1
C-12	Ceramic, 100 mmf., 500 vdcw	D825D-421
C-13	Ceramic, 25 mmf., ±10%, 500 vdcw	F912-11
C-14	Variable, (special)	SA4980
C-15	Ceramic, 5000 mmf., 450 vdcw	K946-1
C-16	Ceramic, 5000 mmf., 450 vdcw	K946-1
C-17	Ceramic, 100 mmf. ±10%, 500 vdcw	D825D-421
C-18	Ceramic, 5000 mmf., 450 vdcw	K946-1
C-19	Ceramic, 5000 mmf., 450 vdcw	K946-1
C-20	Ceramic, 5000 mmf., 450 vdcw	K946-1
C-21	Ceramic, 100 mmf., ±10%, 500 vdcw	D825D-421
C-22	Paper, .1 mfd., 400 vdcw	D827-11
C-23	Ceramic, 5000 mmf., 450 vdcw	K946-1
C-24	Ceramic, 5000 mmf., 450 vdcw	K946-1

Symbol	Description	National Co. Type
	CAPACITORS (Continued)	
C-25	Ceramic, 100 mmf., ±10%, 500 vdcw	D825D-421
C-26	Mica, 120 mmf., ±10%, 500 vdcw	J665-35
C-27	Ceramic, 5000 mmf., 450 vdcw	K946-1
C-28	Ceramic, 5 mmf., ±1mmf., 500 vdcw	D825D-401
C-29	Paper, .01 mfd., 600 vdcw	D827-7
C-30	Paper, .1 mfd., 400 vdcw	D827-11
C-31	Mica, 680 mmf., ±10%, 300 vdcw	J665-63
C-32	Mica, 470 mmf., ±10%, 500 vdcw	J665-56
C-33	Elect. 10 mfd., 200 vdcw	E338-19
C-34	Ceramic, 22 mmf., ±10%, 500 vdcw	K940-3
C-35	Paper, .1 mfd., 400 vdcw	D827-11
C-36	Paper, .1 mfd., 400 vdcw	D827-11
C-37	Ceramic, 47 mmf, ±5 mmf, 500 vdcw	D825D-428
C-38	Ceramic, 47 mmf, ±5 mmf, 500 vdcw	D825D-428
C-39	Ceramic, 5000 mmf., 500 vdcw	K946-1
C-40	Paper, .02 mfd., 400 vdcw	D827-43
C-41	Ceramic, 5000 mmf., 450 vdcw	K946-1
C-42	Ceramic, 5000 mmf., 450 vdcw	K946-1
C-43	Ceramic, 10 mmf., ±1 mmf.500 vdcw	D825D-402
C-44	Ceramic, 75 mmf. ±10%, 500 vdcw	D825C-301
C-45	Mica, 1000 mmf.,±10%, 300 vdcw	J665-71
C-46	Paper, 1 mfd., 200 vdcw	D827-41
C-47	Paper, .05 mfd., 600 vdcw	D827-3
C-48	Paper, .01 mfd., 600 vdcw	D827-7

Symbol	Description	National Co. Type
	CAPACITORS (Continued)	
C-49	Paper, .01 mfd., 600 vdcw	D827-7
C-50	Paper, 5000 mmf., 600 vdcw	D827-27
C-51	Paper, .05 mfd., 600 vdcw	D827-3
C-52	Paper, .01 mfd., 600 vdcw	D827-7
C-53	Elect.40 mfd., 450 vdcw	E338-17
C-54	Elect. 40 mfd., 450 vdcw	E338-17
C-55	Ceramic, 400 mmf., 500 vdcw	K941-2
C-56	Ceramic, 400 mmf., 500 vdcw	K941-2
C-57	Ceramic, 400 mmf., 500 vdcw	K941-2
C-58	Ceramic, .005 mfd., 450 vdcw	K946-1
C-59	Paper, .01 mfd., 600 vdcw	D827-7
C-60	Paper, .01 mfd., 600 vdcw	D827-7
C-61	Elect. 40+40 mfd., 450 vdcw	K945-1
C-61A	Elect. 40 mfd., 450 vdcw	Part of C-61
C-61B	Elect. 40 mfd., 450 vdcw	Part of C-61
C-62	Elect. 500 mfd., 12 vdcw	E338-6
C-63	Elect. 40 mfd., 450 vdcw	E338-17
C-64	Paper, .002 mfd., 600 vdcw	D827-6
C-65	Paper, .005 mfd., 600 vdcw	D827-27
C-66	Paper, .005 mfd., 600 vdcw	D827-27
C-67	Mica, 4700 mmf., ±10%, 500 vdcw	J666-40
C-68	Elect. 100 mfd., 25 vdcw	E338-15
C-69	Paper, .25 mfd., 400 vdcw	D827-17
C-70	Paper, .1 mfd., 400 vdcw	D827-11
C-71	Elect. 10+10 mfd., 450 vdcw	L189-1
C-71A	Elect. 10 mfd., 450 vdcw	Part of C-71
C-71B	Elect. 10 mfd., 450 vdcw	Part of C-71
C-72	Mica, 3900 mmf., ±2%, 500 vdcw	J819-3
C-73	Paper, .05 mfd., 600 vdcw	D827-3
C-74	Mica, 270 mmf., ±10%, 500 vdcw	J665-47
C-75	Mica, 390 mmf., ±10%, 500 vdcw	J665-53
C-76	Elect. 20 mfd., 450 vdcw	E338-16
C-77	Mica, 270 mmf., ±10%, 500 vdcw	J665-47
C-78	Variable, 70-350 mmf.,	K923-2
C-79	Mica, 39 mmf., ±10%, 500 vdcw	J665-17
C-80	Paper, .05 mfd., 600 vdcw	D827-3
C-81	Paper, .25 mfd., 400 vdcw	D827-17
C-82	Paper, .035 mfd., 600 vdcw	D827-46
C-83	Paper, .1 mfd., 600 vdcw	D827-13
C-84	Mica, 18 mmf., ±10%, 1500 vdcw	J666-65
C-85	Ceramic, 500 mmf., 10,000 vdcw	K891-2
C-86	Mica, 56 mmf., ±10%, 500 vdcw	J665-23
C-87	Paper, .25 mfd., 600 vdcw	D827-19
C-88	Paper, .05 mfd., 600 vdcw	D827-3
C-89	Paper, .01 mfd., 600 vdcw	D827-7
C-90	Paper, .005 mfd., 600 vdcw	D827-27
C-91	Ceramic, 21 mmf., 500 vdcw	D825D-410
C-92	Ceramic, 47 mmf., ±10%	J695-1
C-93	Mica, 1000 mmf., ±10%, 300 vdcw	J665-71
C-94	Mica, 1000 mmf., ±10%, 300 vdcw	J665-71
C-95	Paper, .01 mfd., 600 vdcw	D827-7
C 96	Ceramic, 47 mmf. ±5 mmf.,500 vdcw	D825D-428
C-97	Ceramic, 5000 mmf., 450 vdcw	K946-1
C-98	Ceramic, 5000 mmf., 450 vdcw	K946-1
C-99	Ceramic, 47 mmf. ±5 mmf. 500 vdcw	D825D-428
C-100	Ceramic, 1 mmf., ±10%, 500 vdcw	L081-4
	RESISTORS	
R-1	1,000 ohms, ±10%, 1/2 watt	J569-25
R-2	1,000,000 ohms, ±10%, 1/2 watt	J569-61
R-3	100 ohms, ±10%, 1/2 watt	J569-13
R-4	330 ohms, ±10%, 1/2 watt	J569-19
R-5	1,000 ohms, ±10%, 1/2 watt	J569-25
R-6	1,000,000 ohms, ±10%, 1/2 watt	K379-61
R-7	2,200 ohms, ±10%, 1 watt	J571-29
R-8	18,000 ohms, ±10%, 1/2 watt	J569-40
R-9	10,000 ohms, ±5%, 1/2 watt	J569-85
R-10	82 ohms, ±10%, 1/2 watt	J569-12
R-11	100 ohms, ±10%, 1/2 watt	J569-13
R-12	330 ohms, ±10%, 1/2 watt	J569-19
R-13	8,200 ohms, ±5%, 1/2 watt	J569-90
R-14	82 ohms, ±10%, 1/2 watt	J569-12
R-15	100 ohms, ±10%, 1/2 watt	J569-13
R-16	8,200 ohms, ±5%, 1/2 watt	J569-90
R-17	82 ohms, ±10%, 1/2 watt	J569-12
R-18	100 ohms, ±10%, 1/2 watt	J569-13
R-19	1,000,000 ohms, ±10%, 1/2 watt	J569-61
R-20	680,000 ohms, ±10%, 1/2 watt	J569-59
R-21	47,000 ohms, ±10%, 1 watt	J571-45
R-22	8,200 ohms, ±10%, 1/2 watt	J569-36
R-23	1,000 ohms, ±10%, 1/2 watt	J569-25
R-24	1,000,000 ohms, ±5%, 1 watt	K853-3
R-25	120 ohms, ±10%, 1/2 watt	J569-14
R-26	1,000,000 ohms, ±5%, 1 watt	K853-3
R-27	Var. 1,000 ohms, Tap at 250 ohms	K915-11
R-28	22,000 ohms, ±5 %, 5 watt	E959-19
R-29	22,000 ohms, ±10%, 1 watt	J571-41
R-30	5,600 ohms, ±10%, 1 watt	J571-34
R-31	27,000 ohms, ±5%, 5 watts	E959-20
R-32	18,000 ohms, ±10%, 1 watt	K853-4
R-33	1,000,000 ohms, ±5%, 1 watt	K853-3
R-34	2,200 ohms, ±10%, 1/2 watt	J569-29
R-35	270,000 ohms, ±10%, 1/2 watt	J569-54
R-36	820,000 ohms, ±10%, 1/2 watt	J569-60
R-37	47,000 ohms, ±10%, 1/2 watt	J569-45
R-38	1,000 ohms, ±10%, 1/2 watt	J569-25
R-39	220,000 ohms, ±10%, 1/2 watt	J569-53
R-40	Variable, 100,000 ohms, 1 watt	K915-12
R-41	10,000 ohms, ±10%, 1/2 watt	J569-37
R-42	1000 ohms, ±10%, 1/2 watt	J569-25
R-43	10,000 ohms, ±10%, 1/2 watt	J569-37

Symbol	Description	National Co. Type
	RESISTORS (Continued)	
R-44	100,000 ohms, ±10%, 1/2 watt	J569-49
R-45	470,000 ohms, ±10%, 1/2 watt	J569-57
R-46	1000 ohms, ±10%, 1/2 watt	J569-25
R-47	47,000 ohms, ±10%, 1/2 watt	J569-45
R-48	82 ohms, ±10%, 1/2 watt	J569-12
R-49	15,000 ohms, ±10%, 1/2 watt	J569-39
R-50	Variable, 250,000 ohms	K915-8
R-51	470,000 ohms, ±10%, 1/2 watt	J569-57
R-52	330,000 ohms, ±10%, 1/2 watt	J569-55
R-53	220,000 ohms, ±10%, 1/2 watt	J569-53
R-54	330,000 ohms, ±5%, 1/2 watt	J569-88
R-55	180,000 ohms, ±5%, 1/2 watt	J569-89
R-56	4,700 ohms, ±10%, 1/2 watt	J569-33
R-57	470,000 ohms, ±10%, 1/2 watt	J569-57
R-58	390 ohms, ±10%, 1 watt	J571-20
R-59	Var. 1,500 ohms, W.W., 4 watts	L268-1
R-60	15 ohms, ±10%, 1/2 watt	J569-3
R-61	8,200 ohms, ±10%, 1/2 watt	J569-36
R-62	8,200 ohms, ±10%, 1/2 watt	J569-36
R-63	6,800,000 ohms, ±10%, 1/2 watt	J569-71
R-64	1,000,000 ohms, ±10%, 1/2 watt	J569-61
R-65	Dual Variable	L285-1
R-65A	Variable, 1,000,000 ohms	Part of R-65
R-65B	Variable, 50,000 ohms	Part of R-65
R-66	100,000 ohms, ±10%, 1/2 watt	J569-49
R-67	560 ohms, ±10%, 1/2 watt	J569-22
R-68	Variable, 5,000 ohms	K915-9
R-69	2,200,000 ohms, ±10%, 1/2 watt	J569-65
R-70	3,300 ohms, ±10%, 1/2 watt	J569-31
R-71	1,500,000 ohms, ±10%, 1/2 watt	J569-63
R-72	Variable, 2,500,000 ohms	K915-10
R-73	6,800 ohms, ±10%, 1/2 watt	J569-35
R-74	560 ohms, ±10%, 1/2 watt	J569-22
R-75	560 ohms, ±10%, 1/2 watt	J569-22
R-76	5,600 ohms, ±10%, 1/2 watt	J569-34
R-77	1,500 ohms, ±10%, 1/2 watt	J569-27
R-78	100,000 ohms, ±10%, 1/2 watt	J569-49
R-79	1,000 ohms, ±10%, 1/2 watt	J569-25
R-80	270,000 ohms, ±10%, 1/2 watt	J569-54
R-81	22,000 ohms, ±10%, 1/2 watt	J569-41
R 82	56,000 ohms, ±10%, 1/2 watt	J569-46
R-83	68 ohms, ±10%, 1/2 watt	J569-11
R-84	1,000,000 ohms, ±10 1/2 watt	J569-61
R-85	82 ohms, ±10%, 1 watt	J571-12
R-86	(2) 10,000 ohms, ±10%, 2 watts	J572-37
R-87	3.3 ohms, ±10%, 1/2 watt W.W.	K097-42
R-88	4,700 ohms, ±10%, 1/2 watt	J569-33
R-89	(2) 12,000 ohms, ±5%, 10 watt	E959-21
R-90	1,000,000 ohms, ±10%, 1/2 watt	J569-61
R-91	27,000 ohms, ±10%, 1/2 watt	J569-42

Symbol	Description	National Co. Type
	RESISTORS(Continued)	
R-92	470,000 ohms, ±10%, 1/2 watt	J569-57
R-93	4,700,000 ohms, ±10%, 1/2 watt	J569-69
R-94	100,000 ohms, ±10%, 1/2 watt	J569-49
R-95	100,000 ohms, ±10%, 1/2 watt	J569-49
R-96	22,000 ohms, ±10%, 1/2 watt	J569-41
R-97	3,900 ohms, ±10%, 1/2 watt	J569-32
R-98	3,900 ohms, ±10%, 1/2 watt	J569-32
R-99	3,900 ohms, ±10%, 1/2 watt	J569-32
R-100	1,000,000 ohms, ±10%, 1/2 watt	J569-61
R-101	1,000 ohms, ±10%, 1/2 watt	J569-25
R-102	Not used	
R-103	Not used	
R-104	Not used	
R-105	Not used	
R-106	Not used	
R-107	1,000 ohms, ±10%, 1/2 watt	J569-25
R-108	3,900 ohms, ±10%, 1/2 watt	J569-32
	MISCELLANEOUS	
E-1	Terminal Panel, 3 Terminals	E259-3
E-2	Ion Trap-(Beam Bender)	L260
E-3	Corona Ring	L279-1
F-1	Fuse, 3 Amps., 250 volts	F135-9
L-1	Ant. Coupling coil, center tapped	SA5448
L-2	Ant. Coupling coil	L888-1
L-3	R.F. Amp. Grid Multi-tapped coil	SA5060-4
		SA5456
		K908-1
L-4	R.F. Amp. Plate Adjustable Brass-core coil	SA5059-2
L-5	R.F. Amp. Plate Multi-tapped coil	SA5055
		K908-1
L-6	Mixer Grid Adjustable Brass-core coil	SA5059-1
L-7	Mixer Grid multi-tapped coil	SA5060
		& K908-1
L-8	Osc. Tuning, channel 8-9 adjustable iron core coil	SA5054-6
L-9	Osc. Tuning, channel 7, adjustable iron-core coil	SA5054-5
L-10	Osc. Tuning, channel 6, adjustable iron-core coil	SA5054-4
L-11	Osc. Tuning, channel 5, adjustable iron-core coil	SA5054-4
L-12	Osc. Tuning, channel 4, adjustable iron-core coil	SA5054-3
L-13	Osc. Tuning, channel 3, adjustable iron-core coil	SA5054-2
L-14	Osc. tuning, channel 2, adjustable iron-core coil	SA5054-2
L-15	Not Used	

Symbol	Description	National Co. Type
	Miscellaneous (Continued)	
L-16	Osc. Tuning, channel 12-13, adjustable iron-core coil	SA5054-7
L-17	Osc. tuning, channel 10-11, adjustable iron-core coil	SA5054-7
L-18	1st. Video I.F. adjustable iron-core coil	SA5002
L-19	2nd. Video I.F. adjustable iron-core coil	SA5002
L-20	Choke coil	SA5069
L-21	3rd. Video I.F. adjustable coil	SA5002
L-22	Choke coil	SA5069
L-23	Video Detector input adjustable iron-core coil	SA5002
L-24	Video Detector, peaking coil	SA5489
L-25	Video Detector, peaking coil	SA5491
L-26	Video Amplifier peaking coil	SA5493
L-27	Video Amplifier peaking coil	SA5492
L-28	Sound I.F. Transformer	SA5498
L-28A	Adjustable iron-core coil	Part of L-28
L-28B	Adjustable iron-core coil	Part of L-28
L-29	T-5 Secondary adjustable iron-core coil	Part of T-5
L-30	T-5 primary adjustable iron-core coil	Part of T-5
L-31	Filter choke	K927-1
L-32	Filament choke	SA5057
L-33	Focus coil	L252-1
L-34	Deflection yoke	L251-1
L-34A	Vertical Deflection yoke	Part of L-34
L-34B	Horizontal Deflection yoke	Part of L-34
L-35	Horiz. A.F.C. iron-core coil	SA5487
L-36	Horiz. Linearity iron-core coil	L257 1
L-37	Horiz. Size iron-core coil	L256-1
L-38	4.5 mc. sound trap	SA5515
L-39	4.5 mc. sound trap	SA5515
LS-1	Loud-speaker 6"	K892-1
LS-2	Loud-speaker 6"	K892-1
P-1	Eleven Pin plug	L266-1
P-2	Eleven Pin plug	L266-1
P-3	Single Pin Plug	L264-1
P-4	Two Pin Speaker Plug	K294-1
P-5	Part of W-1	
P-6	HV Anode Plug	L-259-1
S-1	On-Off switch, toggle	E230-4
S-2	Antenna coil switch rotary, 2 pole	K900-1
S-2A	Single pole, 10 position	Part of S-2
S-2B	Single pole, 5 position	Part of S-2
S-3	R.F. Amp. Plate coil switch rotary, 2 pole	K900-1
S-3A	Single pole, 10 position	Part of S-3
S-3B	Single pole, 5 position	Part of S-3
S-4	Mixer Grid coil switch rotary, 2 pole	K900-1
S-4A	Single pole, 10 position	Part of S-4
S-4B	Single pole, 5 position	Part of S-4
S-5	Oscillator coil switch, rotary switch S.P. 9 position	K889-1
S-6	Oscillator coil switch, rotary switch S.P. 9 position	K889-1
S-7	Antenna Coupling Switch, Rotary Switch	K888-1
S-8	Tone Switch	E230-4
T-1	Power Transformer	L275-1
T-2	Vertical Osc. Transformer	L254-1
T-3	Vertical Output Transformer	L253-1
T-4	Horiz. Output-High Voltage Trans.	L255-1
T-5	Discriminator Transformer	SA4997
T-6	Audio Output Transformer	E450-1
V-1	R.F. Amplifier	6AU6
V-2	Mixer,	6AG5
V-3	Local Osc.	6C4
V-4	1st. Video I.F. Amp.	6AU6
V-5	2nd. Video I.F. Amp.	6AU6
V-6	3rd. Video I.F. Amp.	6AU6
V-7	Video Det.-A.G.C. Diode	6AL5
V-8	Video Amp.	6AC7
V-9	D.C. Restorer, Sync Clipper— Sync. Amp. Splitter	12AU7
V-10	Horizontal Phase Det.	6AL5
V-11	Ratio Detector Driver	6AU6
V-12	Ratio Det— Audio Amp.	6T8
V-13	Audio Output	6V6GT
V-14	Vert. Sweep Osc.-Vert. Sweep Amp.	6SN7GT
V-15	Horizontal Sweep Osc.	6SN7GT
V-16	Horizontal Sweep Output	6BG6G
V-17	High Voltage Rectifier	1B3-GT 8016
V-18	Horizontal Damper	5V4G
V-19	Power Rectifier	5U4G
V-20	Kinescope	10BP4
V-21	Sound I.F. Amplifier	6BA6
W-1	A.C. Line cord with two plugs	L284-1
W-2	Coaxial Cable, 14 1/2" long type RG-59U	SA5458
X-1	11 Pin Socket	L267-1
X-2	11 Pin Socket	L267-1
X-3	Single Pin Socket	L265-1
X-4	Two Pin Socket	K293-1
X-5	Two Pin Socket	L283-1

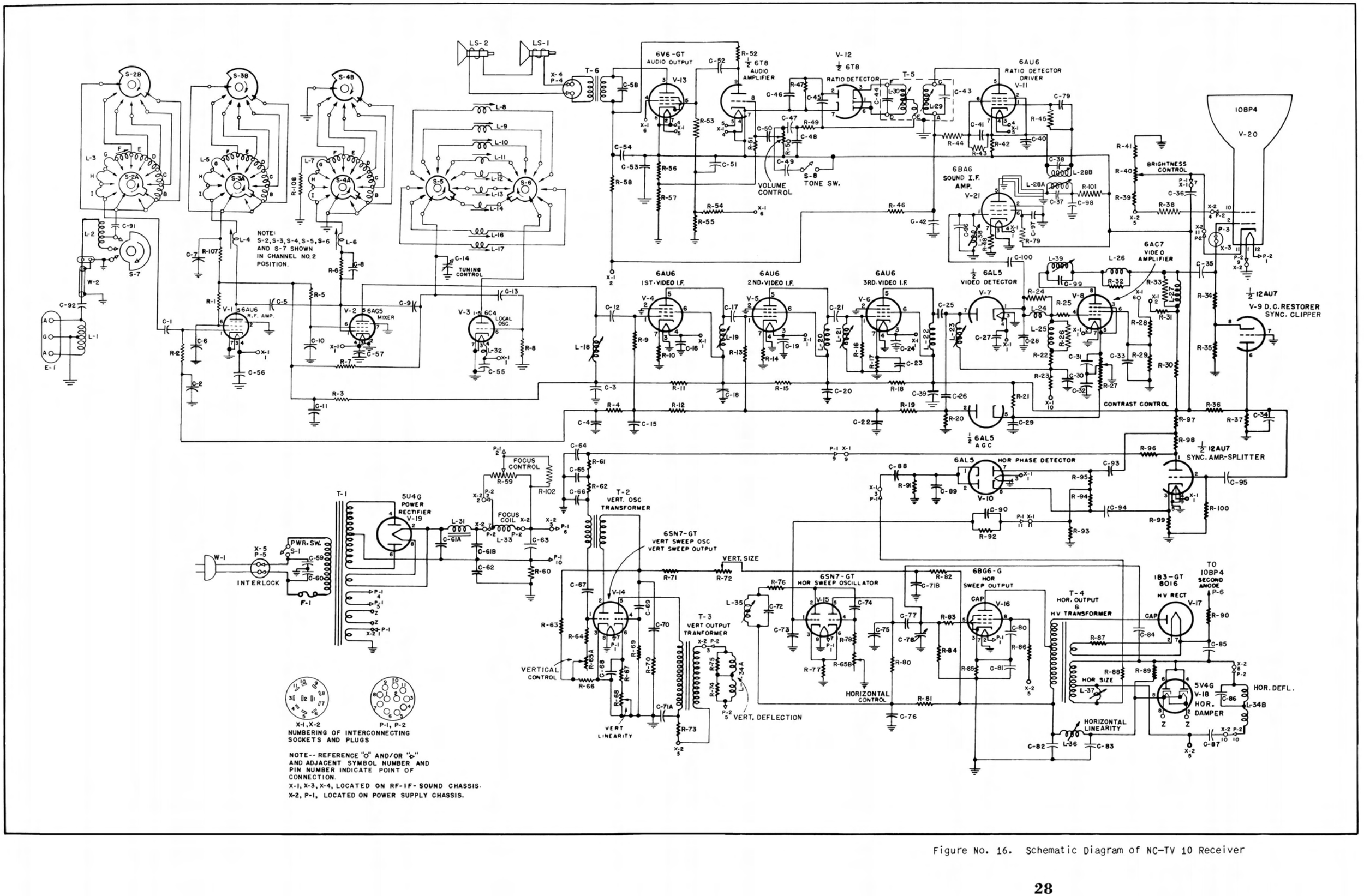


Figure No. 16. Schematic Diagram of NC-TV 10 Receiver

Standard Form Warranty

Adopted by the Radio Manufacturers Association, Inc.

This equipment is warranted to be free from defective material and workmanship and repair or replacement will be made of any part which under normal installation, use and service discloses defect, provided the unit is delivered by the owner to the manufacturer or through the authorized radio dealer or wholesaler from whom purchased, intact, for examination, with all transportation charges prepaid to the factory, within ninety days from the date of original shipment from the factory, and provided that such examination discloses in the manufacturer's judgment that it is thus defective.

This warranty does not extend to any radio products which have been subjected to misuse, neglect, accident, incorrect wiring, improper installation, or to use in violation of instructions furnished by the manufacturer, nor extend to units which have been repaired or altered outside of the factory, nor to cases where the serial number thereof has been removed, defaced or changed, nor to accessories used therewith of other manufacture.

Any part of a unit approved for remedy or exchange hereunder will be remedied or exchanged by the authorized radio dealer or wholesaler without charge to the owner.

This warranty is in lieu of all other warranties expressed or implied and no representative or person is authorized to assume for the manufacturer any other liability in connection with the sale of their radio products.

National Company, Inc. reserves the right to make any change in design or to make addition to, or improvements in, its products without imposing any obligations upon itself to install them in its products previously manufactured.

NATIONAL COMPANY, INC.
MALDEN, MASS.
U. S. A.

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