TAB BOOKS / No. 536

$5.95

GENERAL ELECTRIC VOL. ONE

COLOR TV SERVICE MANUAL VOL. ONE

VOLUME ONE

BY ROBERT L. GOODMAN

AN ALL-IN-ONE SERVICE MANUAL AND TROUBLE GUIDE FOR G.E. COLOR SETS

- Covers over 12 different chassis designations. CA; CB (21''); CB (23'' & 25'') C-1; HB; HC; H-1; G-1; KC (early model); KC (late model); KD; KE.
- Comprehensive service data, including trouble clues, field service changes, test procedures and alignment instructions.
- A unique combination service reference and troubleshooting guide—only one of its kind.

MODEL YEARS COVERED:

1965 through 1970

Contents

1 **HB & HC Porta-Color Chassis** 7
Color Section Trouble—Video Amplifier Trouble—Vertical Trouble—Horizontal Oscillator Trouble—CRT Deflection System—Setup Adjustments—Purity & Convergence Procedure—Color Demodulator—Color Difference Amplifiers—Keyed AGC—Sync Clipper—Vertical Circuits—Horizontal Oscillator & Phase Detector—Horizontal Output & High Voltage

2 **Color TV Service Tips** 16
Servicing ICs and Transistor Circuits—VDRs & TDRs—Horizontal Phase Detector—High Voltage Adjustment—Transistor Base Diagrams—1BC2 Corona

3 **Tuner Service & Alignment** 28
ET86X207, 218 & 221 Tuner Alignment—ET86X234 & 238 Alignment—ET86X281 Alignment—ET86X263, 287—UHF Tuner Alignment—ES86X265 Type Tuners

4 **CA Chassis Alignment & Adjustments** 45
Horizontal Hold Control—Centering Adjustment—Height & Vertical Linearity Adjustments—AGC Adjustment—Width & Horizontal Efficiency Adjustments—Degaussing & Purity Adjustments—Leveling the Picture—Color Temperature Adjustments—Overall Convergence Adjustment—Vertical Convergence Adjustment—Horizontal Convergence Adjustment—Receiver Disassembly—Alignment

5 **CB Chassis Alignment and Adjustments** 60
Initial Setup—Magic Memory Tuning—Centering Adjustment (21 inch)—Height & Vertical Linearity Adjustments—Focus—AGC Adjustment—Blue Droop Coil—Horizontal Hold Control—Low Voltage Circuit Protection—Width & Horizontal Efficiency Adjustments—Degaussing & Purity Adjustments—Color Temperature Adjustments—Overall Convergence Adjustments—21 Inch Receiver Disassembly—25 Inch Receiver Disassembly—Alignment—Equipment Terminations—Pincushion Correction for 25 Inch Receivers

6 **KC & KD Chassis Alignment & Adjustment** 72
Automatic Color Purifier—Installation—Magic Memory Tuning—Tuning Meter—Height & Vertical Linearity Adjustments—Focus—Centering Adjustments—AGC Adjustment—Blue Droop Coil—CRT Bias Adjustment—Horizontal Hold Control—Width & Horizontal Efficiency Adjustments—Low Voltage Circuit Protection—Degaussing & Purity Adjustments—Dynamic Convergence & Color Temperature—Overall Convergence Adjustment—Horizontal Convergence Adjustments—Top & Bottom Pincushion Correction—Receiver Disassembly

7 KE Chassis Alignment & Adjustments — 85

Automatic Color Purifier—Setup—"Color Minder" Controls—Height & Vertical Linearity Adjustments—Focus—Centering Adjustments—AGC Adjustment—Blue Droop Coil—CRT Adjustment—Horizontal Hold Control—Horizontal Efficiency Adjustment—Low Voltage Circuit Protection—High Voltage Circuit Protection—Insta-Color Operation Automatic Fine Tuning Control—Degaussing & Purity Adjustments—Color Temperature Adjustments—Overall Convergence Adjustments—Vertical Convergence Adjustments—Horizontal Convergence Adjustments—Top & Bottom Pincushion Correction—Tuner Removal—Chassis Removal—Signal Overload—Equipment Terminations—Horizontal Interference—Picture IF & Traps—Phase & Demodulator

8 G1 & H1 Chassis Alignment & Adjustments — 100

Service Adjustments—Demagnetizing—Horizontal Hold—Height & Vertical Linearity—Focus—AGC Adjustment—Purity & Convergence—Color Temperature Adjustments—Alignment—Phase & Demodulator—Clock Timer—High Voltage Transformer and Focus Resistor Disassembly

9 C1 Chassis Alignment & Adjustments — 111

Service Adjustments—Demagnetizing—Horizontal Hold—Vertical Size & Linearity—Focus—AGC—Degaussing & Purity Adjustments—Overall Convergence Adjustment—Color Temperature—Fuse & Electrolytic Capacitor Replacement—Secondary Control Replacement—Focus Tracking Components—Focus Rectifier—High Voltage Transformer Replacement—Alignment

10 CA & CB Case Histories — 119

Case Histories—Factory Service Tips & Modifications CA Chassis—Service Tips & Modifications CB Chassis

11 C1, G1, H1, HB & HC Case Histories — 123

C1 Chassis—Service Tips & Modifications C1 Chassis—HB Chassis—HC Chassis—Critical High Voltage Lead Dress HB, HC, H1 Chassis

12 KC Case Histories — 136

Case Histories—Service Hints & Modifications—Insufficient Width

13 KD Case Histories — 147

KD Case Histories

14 KE Case Histories — 151

Case Histories—Service Hints & Modifications—Modifications

Chapter 1

HB & HC Porta-Color Chassis

Because thousands of these little mini-color portables have been waltzing out of the TV dealers' showrooms during past years, there is no doubt that some (and eventually most) will come hobbling back to the service shop in need of repairs and adjustments. So let's look under the hood of this little number and see what makes it tick and what problems it can "come down with."

Remove six screws and slip the plastic cabinet off, thus exposing most of the components for ease in repairs and adjustments. The back view of the receiver (Fig. 1-1) reveals the service control locations. A top view, showing tube, component and adjustment locations (Fig. 1-2), makes you believe they had the service technician in mind during this set's design. Roadmapping is printed on the bottom of circuit board for easy part identification and circuit tracing.

An analysis of some of the unique circuits found in this set should be of interest, plus some circuits it does not have that may surprise you. For the complete schematic diagram of the General Electric Porta-Color HB chassis refer to fold-out Panel D. The following analysis and component designations refer to Panel D.

The convergence circuit board, shunt regulator tubes, and color killer circuits, who needs'em? This set doesn't. When the brightness control is adjusted or the picture tube draws more current because of picture information, the resultant loading effect on the anode HV supply is reflected back to the horizontal sweep section. Automatic width control and high-voltage stabilization (at approximately 15 KV) are provided by a diode (Y250) in series with the horizontal blanking pulse winding of T252, the sweep transformer. The diode is fed horizontal pulses from the blanking winding, causing C266 to charge to a certain value. The voltage developed across the capacitor, connected to the screen grid of V11 (horizontal output tube) through R266, will let V11 conduct more or less and regulate the HV sweep output.

The complicated waveshaping required for conventional horizontal convergence systems are eliminated by using deflection coils that are toroidally wound to precision. The horizontal dynamic convergence coils are connected in series with the horizontal deflection coils. This arrangement simplifies horizontal convergence.

A glance at the color circuits of this set makes us wonder where the color killer section is hid. How does GE do it? I guess you might say by eliminating other color tubes and circuits. And, an even closer scrutiny of the schematic shows that the 3.58-MHz color subcarrier oscillator is missing and the phase detector section seems to have gone astray also.

The grid of burst gate V7A is fed a pulse during retrace, thus a burst or reference signal is picked off. A 3.58-MHz series resonant trap (C506 and L500) is connected between V7A grid and ground; therefore, with respect to 3.58 MHz, the gate tube is functioning as a grounded-grid amplifier with the plate circuit tuned by the primary of T502 for maximum output as 3.58 HMz. The burst signal, which is capacitively coupled to the bifilar wound secondary ot T502 by C509, excites (or rings) the high Q resonant crystal circuit into sine-wave oscillation that results in a 3.58-MHz wave train. This series resonant circuit is then coupled to the grid of reference amplifier, V7C.

The tint control (C522), the transformer, and C519 tune the primary of transformer T503. The 3.58-MHz carrier in the primary of T503, shifted 90 degrees from burst, is inductively coupled to both secondary windings of the transformer. These in turn supply subcarrier information to the synchronous detector diodes Y502, Y503, Y504, and Y505.

While black-and-white pictures are transmitted and no color burst is present, you have automatic color killer action because the high Q resonant crystal circuit is not excited. Thus, no color information for the synchronous didoes to detect. Maybe gone are the days for having to zero-beat and adjust the 3.58-MHz reference oscillator section.

COLOR SECTION TROUBLE

Diodes Y502 and Y503 have been known to short, causing an over abundance of blue in the picture. If red or blue is missing in the color picture, check the appropriate synchronous diodes, as they may have opened up.

If gray-scale tracking cannot be obtained by the proper temperature adjustments, replace the 6AC10 color-difference amplifier tube. If this tube has shorted or otherwise becomes defective, test cathode resistors R527, R528, and R529 because they can change value and make gray-scale tracking impossible.

The synchronous detectors are of the balanced diode type. The two detectors have a balancing control to produce zero volts DC from the output of the detectors. If the TV screen temperature should vary in color from a black-and-white program to one in color, check and make sure that these detectors are in balance.

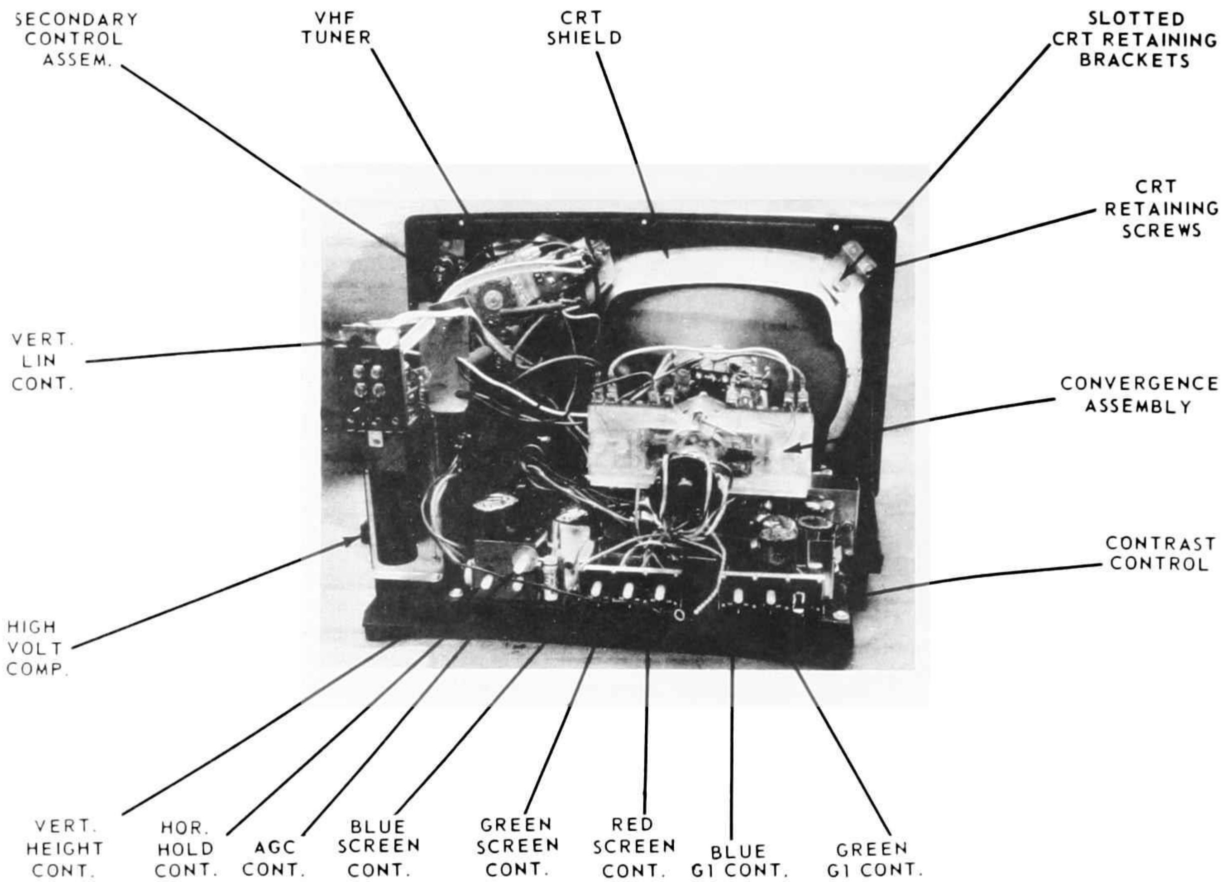


Fig. 1-1. Back view with the cabinet body removed.

VIDEO AMPLIFIER TROUBLE

Only one video amplifier (V6A) is found in this set, and the video signal is AC capacity-coupled through C183 to the parallel cathodes of the CRT.

A rare problem in the video stage has been found to be a defective delay line. With this defect the picture has a very bad ghost effect. The ghost is not tunable and looks very much like antenna trouble or a very strong reflected signal. Evidently, the delay line reflects back some of the video information. It looks somewhat like a peaking coil problem. This defective delay line did not affect the black-and-white or color picture coincidence; in fact, they still coincided.

VERTICAL TROUBLE

The vertical sweep uses an 11FY7 compactron (V9) which has two dissimilar triodes in one envelope. The triodes are connected in a basic plate-coupled multivibrator. There is one precaution to observe when adjusting the vertical height and linearity controls: Do not over scan the raster more than ¼ inch. If you do, the picture will have a tendency to roll when the brightness control is adjusted and the vertical lock will not be solid.

HORIZONTAL OSCILLATOR TROUBLE

A few Porta-color sets have developed horizontal oscillator problems. One of these sets had to warm up ten minutes before HV would develop. Investigation revealed (with the help of the trusty scope) that the horizontal oscillator (V10B ½6LT8) was not oscillating. A VTVM was to check all oscillator voltages and they appeared normal, except the plate voltage (pin 3); it measured a little low, about 265 volts B+. Plate load resistor R262 was checked with an ohmmeter and found to have increased in value to 60K. (It should be 47K.) I have found that the horizontal oscillator action is improved by changing the value of R262 to 33K.

A few cases of horizontal oscillator drift have been caused by a change in the value of C258, a 510-pfd capacitor. When problems are encountered in this circuit, it is recommended that both R262 and C258 be replaced for more stable operation.

THE CRT AND ITS DEFLECTION SYSTEM

The most unconventional part of the set is its CRT and deflection circuits. The CRT is a three-gun shadow-mask type, but its electron guns are placed in line on a horizontal plane and the guns scan in-

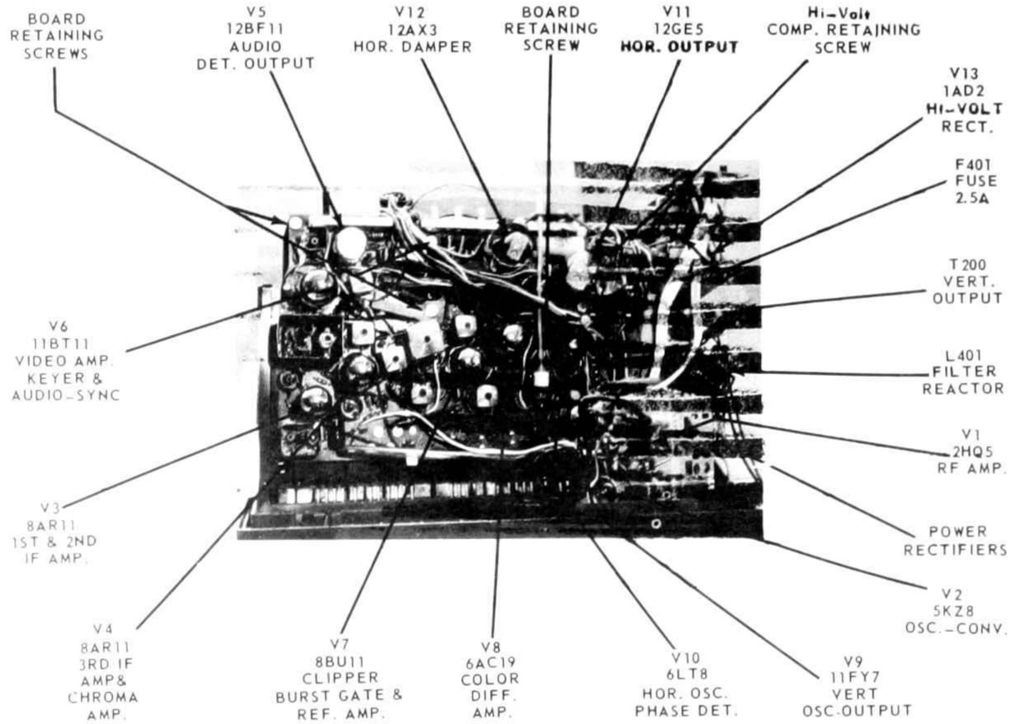
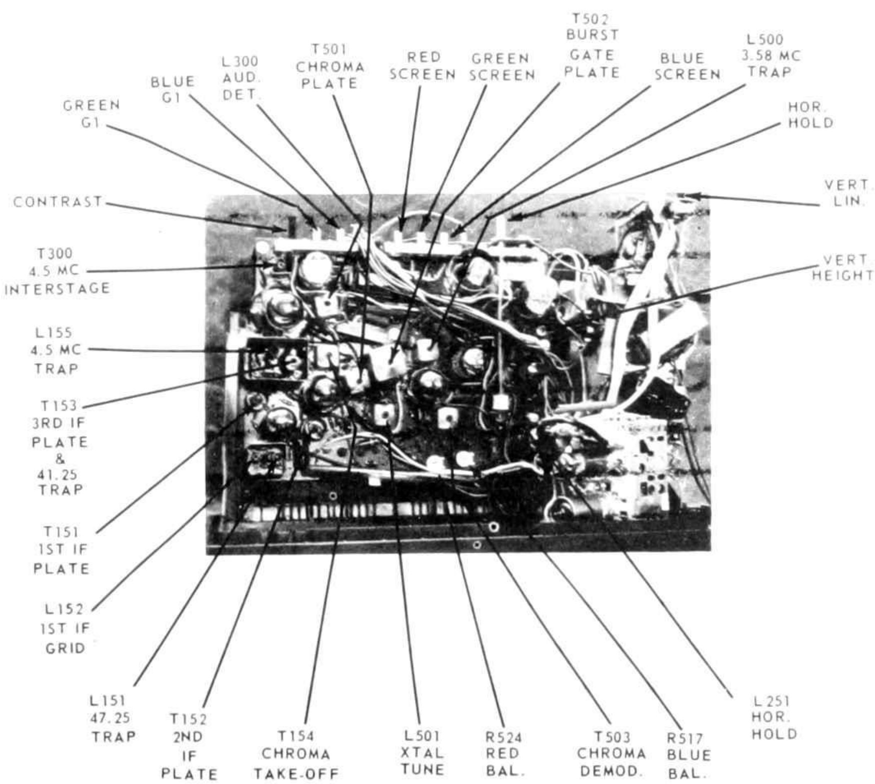


Fig. 1-2. Tube, component, and adjustment locations.



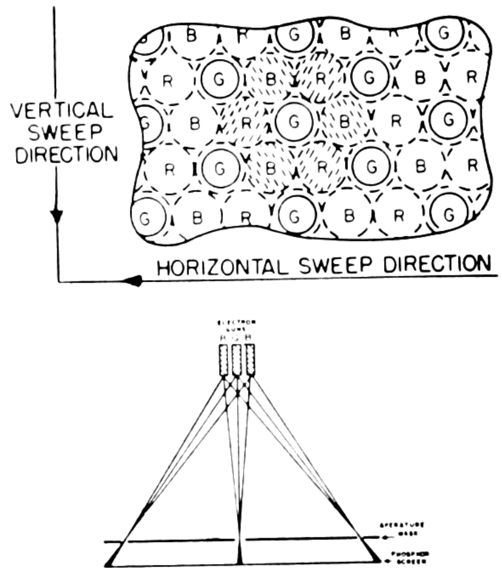


Fig. 1-3. The red, green, and blue light-emitting dots are arranged in a horizontal line (top) with the dot of each successive line staggered with respect to the previous line. Also, the three guns are aligned horizontally.

line rows of colored phosphor dots (red, green and blue) instead of the conventional three-colored triad dot groups.

The beams of the electron guns are deflected simultaneously by a yoke system which directs each beam to the desired color dot (see Fig. 1-3). With each of the beams properly registered on its color dot, three separate rasters result. These rasters are superimposed, one on top of the other, resulting in a single raster which can produce either a B & W or color picture under proper conditions.

This deflection arrangement, together with overall system considerations, leads to an unconventional convergence arrangement. In fact, the convergence system is simple, compared to that on a conventional color receiver. As indicated previously, the red, green and blue light-emitting dots, 19 mils in diameter, are arranged in a horizontal line with the dot of each successive line staggered with respect to the previous line as shown in Fig. 1-3. Located behind the dot pattern is a metal aperture mask which contains one third the number of 12-mil diameter holes as there are phosphor dots on the screen (see Fig. 1-3). The mask is positioned and shaped so the holes line up behind the green phosphor dot as shown. The distance of beam travel from the aperture hole to the phosphor dots allows approximately 14 mils of dot bombardment by the electron beam. The approximate attitude of the three electron beams, with respect to the phosphor dots and aperture mask, is also illustrated.

Each of the three electron guns is similar to a monochrome electrostatic-focus CRT gun. Although the aperture mask holes are behind the green dots, beams of the red and blue guns do not strike the green dots because the beam approach angle. The beam angle and the distance of the aperture mask from the tube screen are such that the beams strike only the proper phosphor dot.

It should be understood at this point that "purity" achieves illumination of each of the three color phosphor dots by the proper electron gun, and this does not necessarily mean that three beams are "converged." For the 11SP22 CRT, the green gun may be viewed as a reference for convergence because the gun is in the center of the gun cluster. A cylindrical metal metal shield is provided on the end of the green gun structure to reduce the effects of the magnetic field applied to each of the outside guns by the convergence assembly.

As illustrated in Fig.1-4, the convergence assembly is made up of two vertical and two horizontal magnet assemblies mounted on an elongated piece of clear plastic. This complete assembly is mounted on the neck of the CRT 1.5 inches from the socket end of the tube as shown. This places the vertical correction magnets over the C-shaped pole pieces on the red and blue guns and the horizontal magnets of the L-shaped pole pieces at the very front of the structure (viewed from the set's rear).

Each vertical magnet assembly has several turns of wire on the inside leg of an E-shaped core and with the coil connected in series with the vertical deflection coils a magnetic field is produced in this arm of the core. The field produced is coupled from this arm of the core through a movable permanent magnet to the U-shaped portion of the core where the direction of the field disperses to both ends of the core.

From here the field is coupled through the glass envelope of the CRT to the pole pieces of the red or blue gun, resulting in a vertical deflection of the beam as shown in Fig. 1-3. Since the permanent magnet is energized, the beam can be moved by rotating the magnet for static adjustment. The field produced by the vertical yoke current flowing through the coil on the core follows the same path as

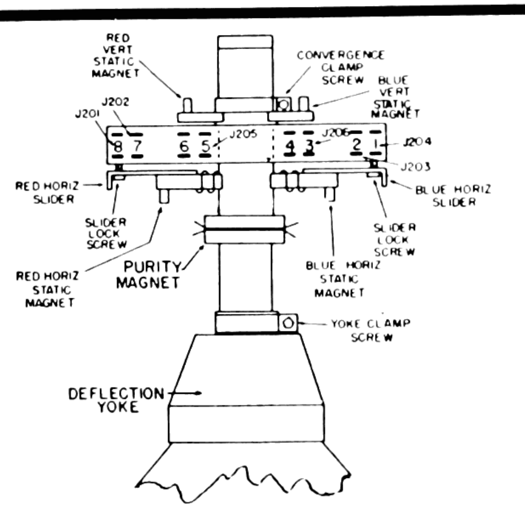


Fig. 1-4. Sketch of the convergence assembly, showing the correct position of components.

Chapter 11

C1, G1, H1, HB & HC Case Histories

Covered in this chapter are GE's "small screen" chassis: the C1, H1, HB and HC chassis. As before there are case histories as well as factory modifications.

C1 CHASSIS

Focus Circuit

To have good focus on the CRT, the high voltage must be properly regulated and must also track with the focus voltage. Let's look at the HV regulation and focus tracking of the C1 chassis.

High voltage is regulated by automatically varying the grid voltage of the horizontal output tube. This system is more efficient than a shunt regulation system because all of the current generated is used by the CRT.

A pulse from the HV transformer is coupled to regulator diodes 5Y252 and 5Y253 through 5C268. (See the schematic in the foldout section.) The amplitude of the flyback pulse varies with the high voltage. An increase in pulse amplitude indicates an increase in HV, so the larger pulse causes the diode to conduct, charging 5C268; therefore, the diode voltage becomes more negative.

The amount of charge on 5C268 is determined by the pulse amplitude and the DC voltage level applied to the diode cathodes. This DC level is variable by means of the HV adjust control, which is part of a voltage-divider network connected between the +280-volt source and chassis ground.

Between pulses, 5C268 discharges through 5R269, 5R271, 5R274, and 5R276. The negative voltage developed is applied to the horizontal output tube grid through 5R268. Since there would be no HV regulation without the diode action, two parallel diodes are used for a "back-up" safeguard. One diode will maintain regulation even if the other one should open. When performing service on this section of the receiver check both diodes to make sure they are good.

Each time the receiver is serviced, the regulation system should be checked for proper operation. Measure the HV while varying the control setting. If the voltage can be set to the proper value, and varies with different HV adjust control settings, the system is operating properly.

Focus Tracking Circuit

To obtain good focus of the CRT electron beam at all brightness levels, the focus voltage must vary with the second anode voltage. This is made possible by the use of resistors 7R283 and 7R284 connected in series between the top end of the HVT primary winding and the low end of the tertiary winding. The focus rectifier anode is connected to the junction of 7R284 and the tertiary winding.

As the CRT second anode current increases, the second anode voltage decreases; the increased current causes a larger voltage drop across the focus tracking resistors, lowering the voltage at the focus rectifier anode. The focus rectifier conducts less and focus voltage decreases. A decrease in the second anode current has the opposite effect; therefore, focus voltage tracks with high voltage. Capacitor 7C278 provides a low-impedance path for RF pulse voltages. A spark gap built into the capacitor operates when the voltage across 7R283 and 7R284 exceeds 2.5KV, thus protecting the resistors.

Focus Tracking Network Arc and Raster Bloom

Blooming raster problems are normally associated with high-voltage defects, but they can also be caused by excessive loading on the high-voltage system. In C1 chassis receivers, excessive CRT beam currents can create a large voltage drop across the focus tracking network resistors, 7R283, 7R284 (Fig. 11-1), causing the spark gap to arc continuously. This lowers the CRT second anode voltage so that the raster blooms.

Excessive beam currents are the result of improper CRT element voltages: the bias voltage between the control grids and the cathodes being the most critical. The control grids are normally 100 to 150 volts negative with respect to the cathodes. (The actual voltages are determined by the brightness control.) If this grid-to-cathode bias should drop to 50 volts or less, heavy beam currents will flow.

A reduction in the grid-to-cathode bias is most likely caused by a decrease in cathode voltage relative to chassis ground. Since the video amplifier is DC coupled from the video detector to the CRT cathodes, any of the following defects could cause the CRT cathode voltages to decrease:

1. Plate-to-cathode short in V5A.
2. V5A cathode-to-chassis short.
3. Shorted 4C179.
4. Shorted Q304.
5. Shorted Q301.
6. Open 3R169.

Should you service a C1 chassis with a focus tracking arc and raster bloom, be sure to check the CRT bias voltages. This will help you to determine whether the defect is in the high-voltage circuit or in the video amplifier circuit.

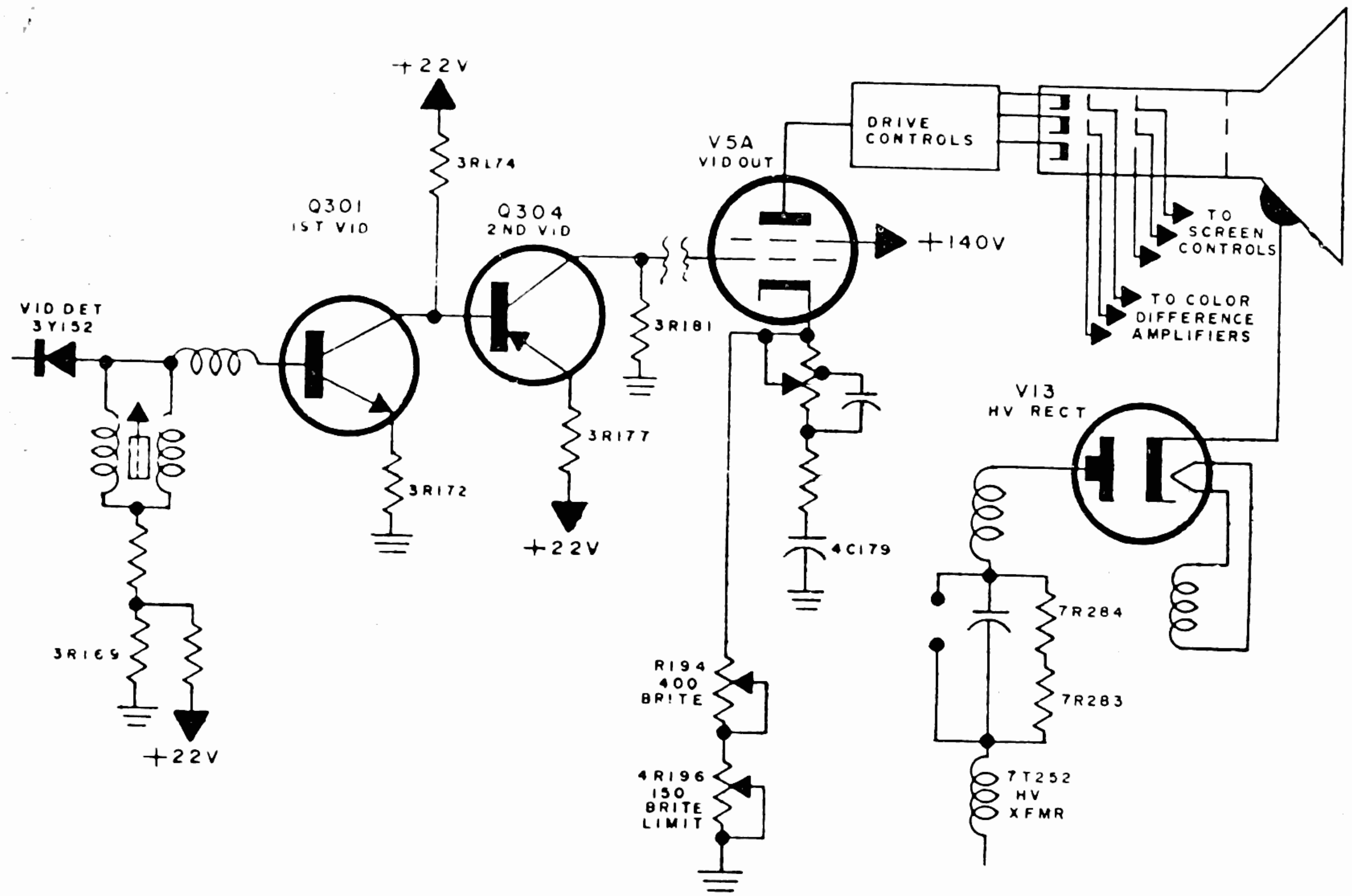


Fig. 11-1. Partial schematic of the video amplifier and CRT circuit.

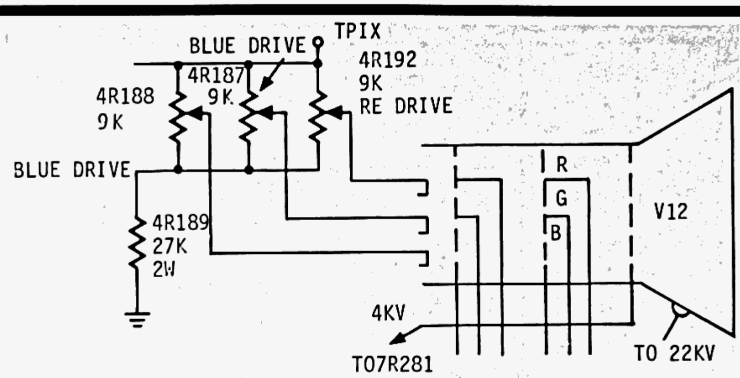


Fig. 11-2. Revised CRT drive circuit.

FACTORY SERVICE TIPS & MODIFICATIONS, C1 CHASSIS

New Picture Tube Type: 19JNP22

Some C1 chassis use a 19JNP22 picture tube instead of a 19HXP22. (The 19JNP22 has new gadolinium phosphors for improved picture brightness.) Receivers using the 19JNP22 will have three picture tube drive controls: a red drive control in addition to the existing blue and green drive controls. (See Fig. 11-2.)

The additional drive control necessitates changes in the color temperature adjustment procedure (see Chapter 8):

Set all drive controls to the center of their rotation span. Check to see that one of the drive controls is at its maximum clockwise position. If not, repeat the procedure, leaving the drive control of the weakest color fully clockwise.

NOTE: Not all C1 receivers with three drive controls use the 19JNP22; some use the 19HXP22 (also used in two-drive receivers). **Therefore, replacement of C1 picture tubes should always be as follows:**

a. A 19HXP22 should be replaced with a TC19HXP22

b. A 19JNP22 should be replaced with a TC19-JNP22

Chroma Noise

In receivers bearing the serial number 5G4------ and higher, resistor 4R544 has been changed from 2.7K to 1.2K to improve the signal-to-noise ratio of the G-Y difference amplifier and reduce chroma noise in medium to weak signal locations. If needed, this improvement can be made on earlier production sets by paralleling 4R544 with a 2.2K, ½-watt resistor on the bottom of the board. (See Fig. 11-3.)

Improved Degaussing

Some early production C1 chassis were subject to complaints of repeated purity problems. Manual degaussing would correct the impurity but the problem recurred after a short period of time. This has been attributed to the charge remaining in electrolytic capacitor 2C405 after the receiver is turned off.

Degaussing action has been improved in later production receivers by the addition of a 100K, ½-watt resistor connected in parallel with 2C405. The resistor is physically located adjacent to 404 on the

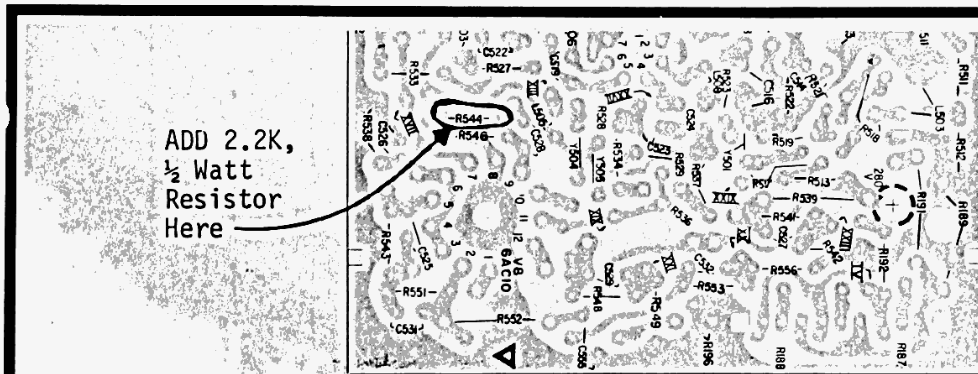


Fig. 11-3. Copper-side view of the video-audio-chroma circuit board.

CONDITION	HORZ.OUT. SIG.GRID P-P VOLTS	HORIZ.OUT. SIG.GRID DC VOLTS	HORIZ.OUT. SCREEN GRD. DC VOLTS	B+ BOOST VOLTS	HV,CRT 2nd ANODE	FOCUS VOLTS	JCT.5C268 T252A, P-P VOLTS
Normal receiver	270	-70	150-200	740	22KV	4KV	560
Convergence plug disconnected	280	-82	155-200	680	20KV	4KV	560
Yoke plug disconnected	250	-54	70-75	860	10-12 KV	3KV	380
Focus coil and rectifier disconnected	270	-76	160-200	725	25KV	68 volts	580
Jct. 5C268, T252A shorted to chassis	220	-44	90	625	20KV	5KV	0
5C268 open	240	-46	90	720	26KV	4.5KV	600
5C268 shorted	240	-46	90	700	26KV	4KV	600
7C280 shorted	270	-88	160-200	750	22KV	4KV	560
7C276 shorted	270	-74	155-200	700	22KV	4KV	520

Fig. 11-4. Typical voltages, horizontal output and high-voltage stages.

power supply board. Receivers bearing serial numbers 5D4---- and higher are equipped with this resistor. To improve performance, we recommend that the resistor be added to any early production C1 chassis which comes in for service.

Troubleshooting "No High-Voltage" Problems

"No high voltage" problems in C1 chassis can be easily solved if a systematic troubleshooting procedure is used and one important point is remembered. The point to remember is that the drive signal to the horizontal output tube grid cannot be measured with a DC voltmeter. The DC grid voltage is a combination of the voltage produced by grid rectification of the drive signal and the feedback voltage developed by the high-voltage regulation system. A fault in the horizontal output stage may result in less feedback voltage, and consequently, less DC voltage on the grid. Therefore, using this DC voltage as a measure of drive signal can lead to false conclusions.

The easiest troubleshooting method is to systematically isolate the horizonal output stage from its various load circuits, making use of the plugs and sockets incorporated in the design of the receiver. During this procedure, permanently connect a high-voltage meter to the CRT second anode so as to continuously monitor the high voltage. If disconnecting a component restores the high voltage, the trouble is obviously in that component or its associated circuitry.

Troubleshooting Procedure

1. Change the tubes; V10, horizontal output; V11, damper; V13, HV rectifier.
2. Disconnect the CRT socket. This checks the possibility of a shorted CRT. Leave the CRT socket disconnected while performing Step 3. Otherwise, should the high voltage be restored with the yoke disconnected, the undeflected beams may permanently damage the CRT screen.
3. Disconnect the yoke plug. With the yoke and CRT disconnected, the normal high voltage is 10-12KV. Boost voltage will remain normal at 750-860 volts. If the trouble is not in the yoke, reconnect the yoke and CRT.
4. Disconnect the convergence plug. If the problem is in the convergence assembly, all voltages will return to normal.
5. Check the drive voltage to the horizontal output tube with a scope. Use the junction of 5C264 and 5R268 on board 5. The peak-to-peak voltage should be 200 volts or more.
6. Check the screen voltage of the horizontal output tube. Use a socket adapter or measure at the terminal board adjacent to the socket. (The third terminal from the side of the receiver is the screen connection. It is accessible from the top of the chassis.) The voltage is normally 150-200 volts. It will drop to 70-90 volts if the yoke is disconnected or if the high-voltage regulation system is no longer operating.
7. Unsolder the focus coil and the focus rectifier. If the problem is in this circuit, all voltages will return to normal, except that there will be no focus voltage.

The above procedure has checked all of the major components in the horizontal output circuit except for the high-voltage transformer. Before concluding that the transformer is defective, check the miscellaneous small components in the circuit; capacitors, resistors, choke coils, etc.

The voltages in Fig. 11-4 were taken at the points indicated, using a normal receiver, with faults introduced as noted. It illustrates the effect that output circuit faults have upon horizontal output tube screen and control grid voltages, and may be an additional aid in troubleshooting C1 receivers.

Performance Check And Touch-Up Alignment With Vectorscope; C1, G1 & H2 Chassis

A vectorscope display of the R-Y and B-Y chroma signals provides a means of checking the overall operating condition of a receiver's chroma section and touching up the demodulator transformer alignment. A scope with a 500-kHz bandwidth is satisfactory for this check. The most important criteria are that the scope not load the signal source excessively, and that the gain of the vertical and horizontal amplifiers be equal. A suitable input cable network is shown in Fig. 10-1 (Chapter 10). Construct two indentical cables, placing the resistors and capacitors near the clip.

To calibrate the scope, connect the cables to the scope input terminals. Apply a 30-volt RMS signal to the vertical input cable and adjust the scope vertical gain controls for a 2-inch vertical line. Disconnect the vertical cable. Then apply the 30-volt RMS signal to the horizontal input cable, and adjust the scope horizontal gain controls for a 2-inch horizontal line. Disconnect the 30-volt RMS source. Do not readjust the gain controls after this calibration.

Overall Chroma Section Performance Check

Connect the horizontal input cable to the grid of the CRT blue gun (B-Y signal). Connect the vertical input cable to the grid of the CRT red gun (R-Y signal). Connect a keyed rainbow generator to the receiver, and adjust the receiver for a normal color bar pattern. Normal scope displays for various chassis are shown in Fig. 11-5. Adjust the receiver's control to vary the size of the scope display. DO NOT ADJUST THE SCOPE GAIN CONTROLS.

If the vector display appears to be inverted, check the vertical polarity switch on the scope (positive voltage should cause upward deflection) and the input cable connections (R-Y signal to vertical input and B-Y signal to horizontal input). The vectors should be properly positioned when the tint control is at, or near, the center of its range. Rotating the tint control through its range should cause the vectors to shift at least 40 degrees each way.

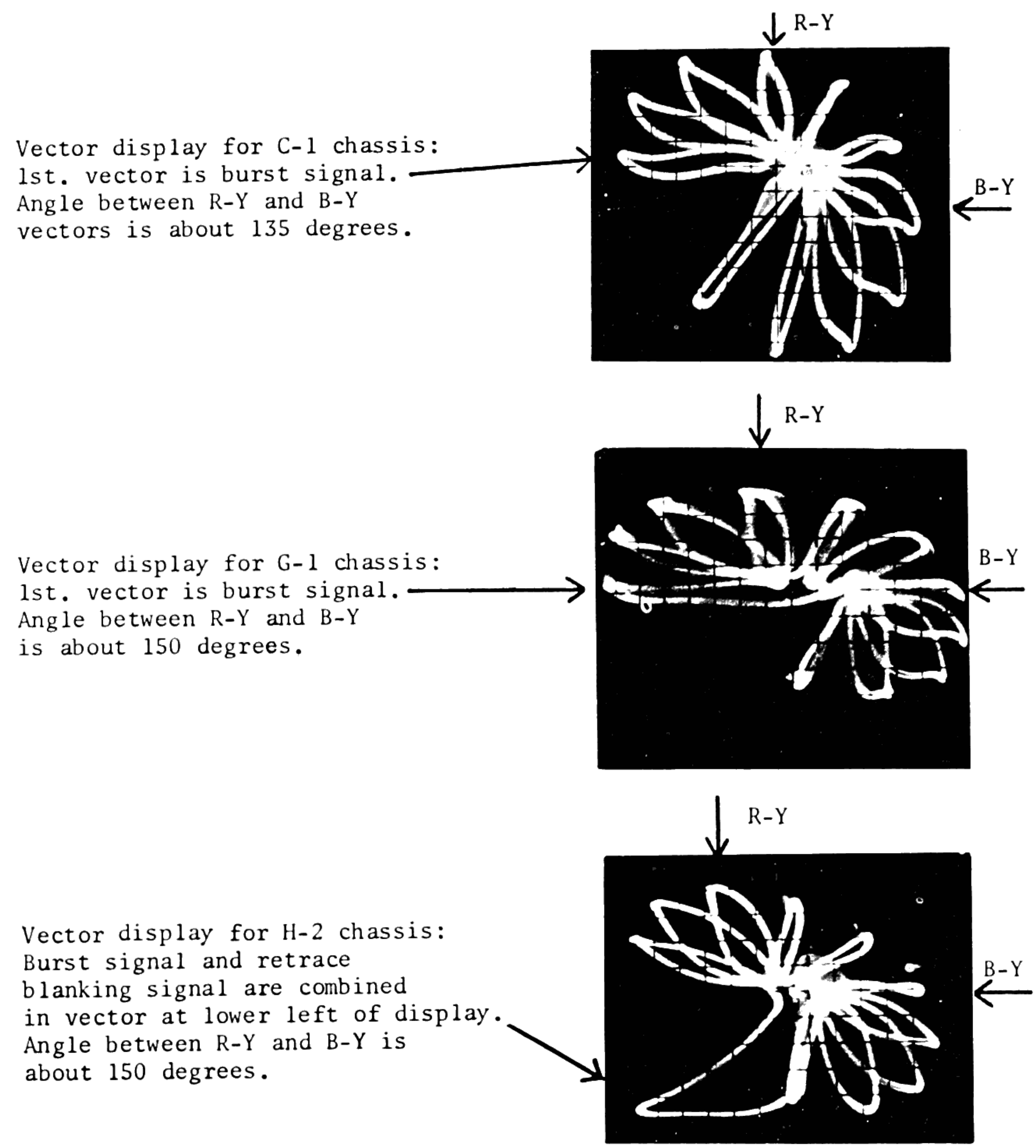


Fig. 11-5. Vector displays for the performance check.

Touch-up Alignment of Demodulator Transformer

Set the tint control to its center position. Adjust the demodulator transformer bottom core to place the B-Y vector properly. Adjust the top core to place the R-Y vector properly. There is some interaction between the two adjustments. Repeat the above steps as necessary to position the vectors properly.

NOTE: If extensive adjustment is necessary, align the subcarrier system using the service manual instructions, then recheck the placement. If the vector display looks good but the color-bar pattern on the picture tube does not, check the balance control adjustments, the G-Y amplifier circuit, and the picture circuit and adjustments.

G1 CHASSIS

Hum bars across the picture (intermittent) may be caused by a poor connection of the black lead (ground) from the vertical output transformer. Some chassis have this lead grounded on the same terminal board as the AC line choke.

Connect and re-solder the black ground lead to the top right side of the HV transformer cage. A poor contact may cause AC to modulate the vertical sweep, causing the intermittent hum bars.

CONDITION	HORZ.OUT. SIG.GRID P-P VOLTS	HORIZ.OUT. SIG GRID DC VOLTS	HORIZ.OUT. SCREEN GRD. DC VOLTS	BOOST DC VOLTS	SECOND ANODE DC VOLTS	HVT PIN 1 P-P
Normal receiver	225	-78	220	780	21KV	1500
Yoke horiz. windings disconnected	200	-40	100	750	12KV	1200
Wires to HVT pins 3 & 6 disconnected	200	-37	100	720	9KV	1200
C278 open	220	-75	185	800	19KV	1500
C278 shorted	220	-75	200	800	21KV	1400
L253 open	220	-75	200	800	21KV	1400
C272 open	220	-37	100	720	22KV	1500
C269 shorted	170	-35	140	210	0	100
C268 open	200	-37	100	560	15KV	920
R271 open	220	-85	230	425	5KV	500
R272 open	220	-80	220	620	14KV	620
C187 shorted	220	-50	185	720	20KV	1500
Center of pincushion coil shorted to chassis ground	200	-46	185	740	20KV	1400

Fig. 11-6. G1 chassis horizontal output and HV operating voltages.

Tweet Interference

In areas which have television stations on Channels 7, 8, or 9, a tweet interference may be noted when the receiver is tuned to these channels. This tweet interference can be eliminated by installing a choke, ES36X722, a capacitor, 800 pf, 500v ceramic, ET22X80, and a piece of copper ground strap, 1½" x ½". (See foldout Panel G.)

1. Remove from the board the wire jumper located between the shield of V6, 11CA11, and the shield of L501. Install the choke in place of the wire jumper.

2. Install the capacitor just to the right of R183, located between the shield of V6 and the rear of the board.

3. Solder the ground strap between the shield of L155 and the shield of V6 close to the top of the shields.

This modification has been added to later production receivers.

Prevention of F402 Nuisance Blowing

On G1 chassis marked EN85 and higher, the B+ wiring has been revised to eliminate nuisance blowing of the +280v fuse, F402. This wiring change places C402A on the supply side of F402 and allows transient pulses on the +280v line to be absorbed by C402A without going through F402.

1. Remove two red wires from C402A (half-moon terminal).

2. Remove two red wires from Terminal 1 of Terminal board 1 (mounted on the side of the high-voltage can).

3. Connect the two wires removed from C402A to Terminal 1 on Terminal board 1.

4. Connect the two wires removed from Terminal board 1 to C402A. It will be necessary to splice a 2-inch length of wire to one of these leads. Cover the splice completely and dress it so that there is no possibility of causing a short circuit.

We recommend that you make this change on any G1 chassis receiver that comes in for service to improve set reliability.

Color Temperature Adjustment

In the near future you will probably encounter some 15MP22 picture tubes which have yellow glass support rods inside the tube neck. Since the color of these support rods is our means of identification for proper color temperature (gray scale) adjustment, it is important that you are aware of these tubes. The electron guns in tubes with yellow support rods are the same as in tubes with green support rods. Color temperature adjustment is the same for both types. If the tube has **green or yellow** support rods, set the screen grids to +450 volts measured from TP XVII, XVIII, XIX to ground.

There have been several requests for a simplified color temperature adjustment procedure for the G1 chassis. Several alternate procedures have been investigated in the factory and rejected because of the possibility of drawing excessive picture tube beam current. This could result in aperture mask warpage in the picture tube, overheating of the horizontal output transformer, or premature failures of the horizontal output tube. The only sure way to prevent such damage is to set the picture tube grid voltages as specified. The important factor to keep in mind is the voltages on control grids and screen grids should never be set higher than specified.

If the color temperature is slightly off, the predominant color **screen grid** control may be turned counterclockwise to compensate. Never change the control grid (red, blue, green brightness) settings without using the meter adjustment procedure specified in the service manual.

High Voltage Regulation

High voltage is regulated by automatically controlling the grid voltage of the horizontal output tube, V11. This negative control voltage is the result of a high amplitude positive pulse from the horizontal output transformer, T252, being detected by the voltage-dependent resistor, R274. The amount of negative voltage developed in dependent upon pulse amplitude; that is, as pulse amplitude increases, the grid voltage becomes more negative; and as pulse amplitude decreases, grid voltage becomes less negative. Since the pulse amplitude is an indication of the loading on the transformer, it rises and falls directly with the high voltage.

Therefore, an increase in the pulse amplitude, indicating increasing high voltage, results in more negative voltage being developed at the grid of V11. As the grid voltage goes more negative, the plate current is reduced and high voltage returns to normal.

High-voltage adjustment R273 supplies a bucking voltage to the grid of V11 through R271 to prevent the negative control voltage from reaching too high a value which would seriously reduce both high voltage and sweep width. With 120v AC applied to the receiver, R273 should be adjusted to produce 22,000 volts at the CRT second anode with zero beam current (minimum brightness).

Troubleshooting High-Voltage Problems

High-voltage problems in G1 chassis receivers can be quickly diagnosed by disconnecting suspected components and checking certain key voltages. The following procedure indicates a convenient troubleshooting sequence and the results which should be obtained at each step. Continuously monitor the high voltage, during troubleshooting, by attaching a high-voltage probe to the CRT second anode. **If disconnecting a component restores the high-voltage the trouble is obviously in that component or its associated circuitry.**

1. Check, by substitution, V11 (horizontal output), V)2 (damper), and V)3 (high-voltage rectifier).

2. Remove the CRT socket. This eliminates the possibility of excessive beam currents or a shorted CRT.

3. Disconnect the leads to the deflection yoke horizontal windings, the red and blue leads equipped with push-on terminals and attached to Terminals 1 and 4 of the terminal board atop the pincushion coils. The high voltage should be about 12KV with the yoke disconnected.

4. Leave the yoke disconnected and check for a DC voltage at pin 3 or 6 of the HVT. If there is a DC voltage, the HVT yoke winding is probably shorted to the primary winding. Reconnect the yoke leads.

5. Connect a wire jumper across C278 (1.0 mfd, mounted on the yoke). The receiver should operate normally with the jumper in place except that the horizontal sweep will not be linear.

6. Bridge C268 (mounted on the power supply board) with a known good 0.1-mfd capacitor.

7. With a scope, check the waveform at the horizontal output tube control grid. The peak-to-peak voltage should be at least 200 volts.

8. Check the DC voltage at the horizontal output tube screen grid. This is normally 200-230 volts. If there is a defect in the yoke circuit or the high-voltage regulation circuit, the voltage will be about 90-100 volts.

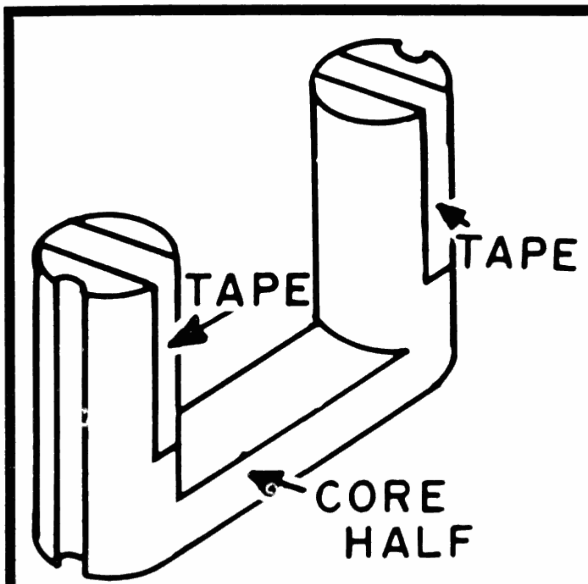


Fig. 11-7. HV transformer core showing air gaps.

9. Disconnect the leads from pins 3 and 6 of the HVT. This will check the pincushion coils (if used) and C187. Normal high voltage with these leads disconnected is about 9KV.

10. Disconnect C272. The receiver should operate normally except that the DC voltages at the horizontal output tube screen and control grids will be low and the CRT second anode voltage will be slightly high.

Using this procedure all the major components except the HVT have been checked. Before concluding that the HVT is defective, check the miscellaneous small components. The voltage in Fig. 11-6 were taken at the point indicated using a normal receiver, with faults introduced as noted. It indicates the effect that various faults have upon circuit voltages and waveforms and may be an additional aid in troubleshooting G1 chassis.

High-Voltage Transformer Squeal (14-inch chassis)

There have been some complaints of high-voltage transformer fundamental frequency squeal in G1 chassis. Receivers numbered EN433 and higher were manufactured with an increased HVT core air gap.

The air gap is controlled by special paper tape between the core halves. Originally, one thickness of tape was used to create this air gap. Now, two thickness of tape are used to create a 15 mil gap. The proper tape is Scotch Brand No. 280, which is available from your G.E. Parts Distributor under Catalog Number EP60X9.

To modify an early production receiver, dismantle the HVT and remove the original air gap tape from the core halves. There may be some versions with black plastic electrical tape used as pads between the core and high-voltage cage. Remove these pieces of tape also. Use four pieces of new tape approximately 1½ inches long. Attach the tape to **both** ends of both core halves as shown in Fig. 11-7. Be careful that the tape does not wrinkle or have foreign material stuck to it, as this air gap dimension is critical.

The second part of the modification is the elimination of the pincushion correction circuit. Remove the brass screws securing the pincushion transformer assembly to the HVT cage and clip the transformer winding leads close to the terminal board. Discard the pincushion transformer, but salvage the terminal board and insulating strip. Securely mount the terminal board and the fish paper insulator in the space formerly occupied by the transformer, using the same brass screws. Cut off any excess length of the screws. To restore continuity in the vertical yoke circuit, the green lead on the pincushion transformer terminal strip has to be moved one terminal to the rear which is a common ground point. This procedure leaves C275 (3 mfd) and R275 (22 ohms) out of the circuit on the power supply board. They can be left on the board or removed at your discretion.

To insure proper performance of the set, it is essential that **both** steps of this procedure are performed. Eliminating the pincushion transformer will not adversely affect receiver performance, but will decrease the load on the horizontal output tube, resulting in cooler operation and increased reliability. Apply power to the receiver and reset the high voltage to 21KV at zero beam current (minimum brightness) with a line voltage of 120v AC.

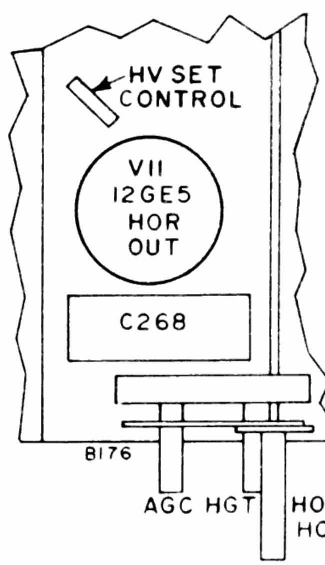


Fig. 11-8. Drawing showing the location of the HV set control.

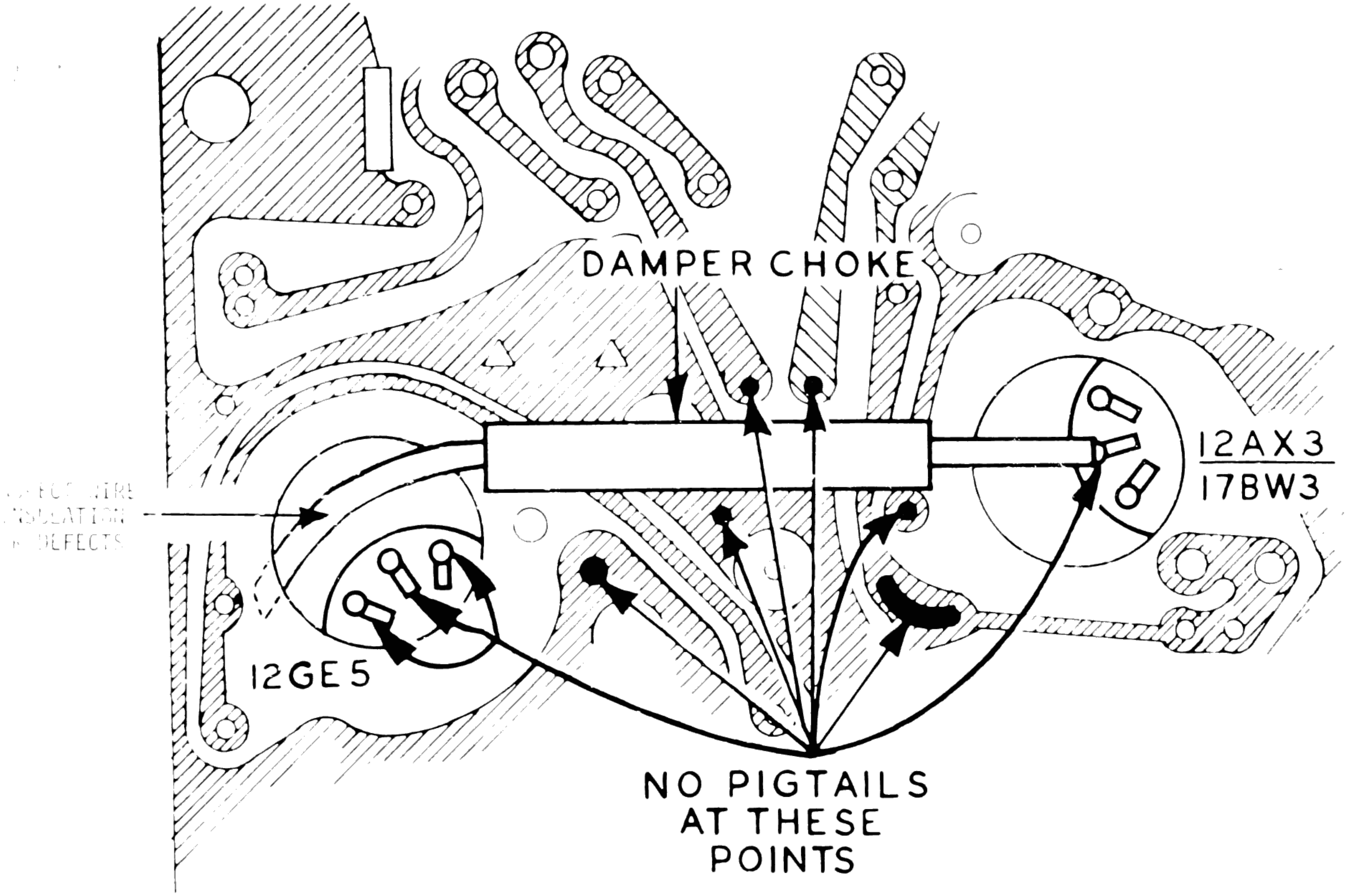


Fig. 11-9. Bottom view of the H chassis horizontal sweep board.

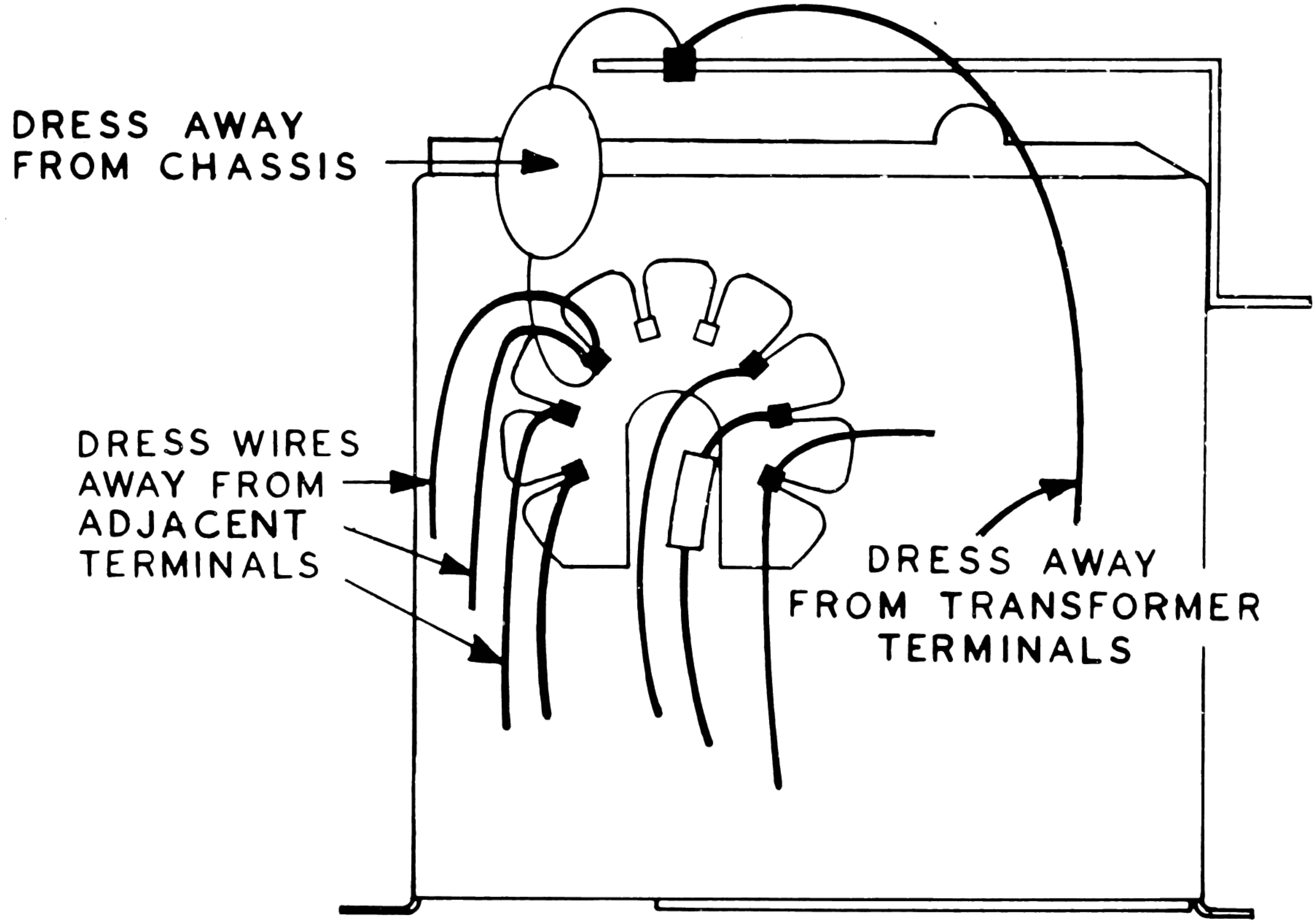


Fig. 11-10. Drawing showing HV transformer lead dress.

H1 CHASSIS

High-Voltage Compartment Doors

Late production H1 chassis use a high-voltage transformer with the tertiary encased in RTV silicone rubber (ES77X2). These transformers, which are easily recognized by the white, flame-retardant plastic cup around the tertiary, offer increased resistance to high temperature and humidity. To allow better air circulation around the transformer, we no longer use the door on the high-voltage can. This was made possible by the flame retardant properties of the new transformer.

Receivers which are equipped with the older, wax-impregnated transformers (ES77X89) **must** have a door on the high-voltage compartment. When servicing these receivers be sure that the door is securely fastened before reassembling the receiver. Do not install the wax type transformer (ES77X89) in an H1 receiver which does not have an HV compartment with a door.

High-Voltage Regulation

In the H3 chassis, the high voltage is regulated by controlling the power delivered to the high-voltage transformer. This power is controlled by the horizontal output tube plate current, which, in turn, is controlled by the horizontal output tube control grid bias voltage. The high-voltage regulation circuit monitors a voltage pulse from the high-voltage transformer and automatically adjusts the control grid bias voltage according to the amplitude of this pulse.

A voltage-dependent resistor, R272, and capacitor C275 are the principal components of the regulation circuit. The VDR acts as a diode in series with a resistor. When the voltage across the VDR is high (700-1000 volts), its internal resistance is about 700K. At lower voltages this resistance increases to about 5 meg.

From pin 6 of the high-voltage transformer, a positive-going pulse is supplied to the regulation circuit. The amplitude of this pulse varies with the high voltage; that is, as high voltage increased, pulse amplitude increases, and vice versa. This pulse, applied to the VDR through C275 and R274, causes the VDR to conduct and C275 becomes charged. Between pulses, C275 discharges through R274 and a parallel network made up of R265, R270 and R272, R273. The negative voltage developed by this discharge is coupled to the horizontal output tube control grid vis R264.

The charge developed across C275 can be increased by either raising the pulse amplitude or reducing the resistance of the VDR. Because of the VDR's characteristics, both of these changes occur at the same time. The result is that larger voltage changes are developed from small pulse amplitude changes than would be the case if the VDR was a simple diode.

Should the pulse amplitude increase (indicating a rise in high voltage), C275 will receive a greater charge and a more negative bias voltage will be developed and coupled to the control grid. Plate current through the horizontal output tube and the high-voltage transformer will be reduced, and the high voltage will return to normal.

The high-voltage set control, R273, limits the current flow through the regulation components and thus limits the charge impressed on C275. The control (shown in Fig. 11-8) should be adjusted to produce 17.2KV at the CRT second anode when the brightness is at minimum and the receiver is operating with a 120v AC line input. Increasing the line voltage to 130v AC should not cause the second anode voltage to exceed 17.8KV.

HB CHASSIS

No high voltage.

Open horizontal oscillator coil or defective solder connection. Replace or resolder the coil and check the circuit board for breaks and cracks.

HC CHASSIS

B+ voltage reads 100 volts but should be 135 volts.

Some 680-ohm resistors were used in place of the 300-ohm, 3-watt value for R402. This lower B+ voltage will produce an audio beat in the picture which varies with modulation. Make sure R402 is a 300-ohm, 3-watt resistor.

CRITICAL HIGH VOLTAGE LEAD DRESS: HB, HC, H1 CHASSIS

Several areas in the high-voltage and horizontal sweep section of the H chassis should be checked each time the chassis is serviced to reduce the possibility of corona and arcing problems. Refer to Figs. 11-9 and 11-10 for location as you check the following:

1. Remove all pigtails and sharp solder points from the socket pins indicated on the 12GE5 horizontal output and 12AX3-17BW3 damper tubes.

2. Check to be sure there are no sharp points or pigtails on the copper pattern in the area near the damper choke.

3. Make sure the special cardboard sleeve completely covers damper choke L252.

4. Inspect the damper choke wire lead where it passes through the opening in the circuit board. If the insulation appears deteriorated, nicked, or damaged in any way, replace the lead with high-voltage anode lead wire. Be certain you make a smooth connection at the damper choke and cover the solder joint with at least four layers of black plastic insulating electrical tape.

5. Dress all wire leads connected to the high-voltage transformer away from adjacent transformer terminals.

6. On HB and HC chassis the black ground wire attached to the terminal on the high-voltage com-

partment must be dressed away from all transformer terminals. Be sure the damper capacitor connected to Terminal 3 is dressed away from the metal chassis.

DIFFERENCES IN UHF TUNERS

Several UHF tuners used in these chassis look very much alike, but have several differences worth noting. Essentially, all the tuners were designed to one set of specifications, but two engineering groups were involved. The result was several subtle differences which prevent indiscriminate substitutions. These differences encompass the mounting brackets, antenna isolation, B+ dropping resistors, and tracking characteristics. To insure proper performance and safe operation of the equipment, it is best to use the exact replacement for the original: i.e., EP85X2, ES85X1, ET85X53, etc.

Some technecions are already aware of the antenna isolation differences, but because of the significance of this point, it is repeated here. In some sets that are transformer powered, the antenna circuit was not DC isolated from the receiver ground or common. Obviously, tuners designed for this application should not be used in transformerless television sets since the chassis ground or common point is, in reality, one side of the AC power line.

A further consideration is the possibility of installing a different VHF tuner than the original. Some VHF tuners have UHF B+ circuit dropping resistors inside the tuner, while others do not. The best way to determine if the proper total dropping resistance is correct is to simply measure the UHF B+ voltage at the UHF tuner itself. The voltage should be 22 volts on all recent models. For this check it is necessary to place the VHF channel selector in the UHF position.

The UHF tuner will function over a wide range of B+ voltages, but to insure that the tuner will meet FCC radiation specifications it is suggested that the tuner have 22 volts at the B+ terminal. Should the voltage be something other than 22 volts, the resistor which connects the VHF tuner to the UHF tuner B+ point should be changed in value to produce 22 volts at the UHF tuner. This resistor's value should be between 10,000 and 20,000 ohms on models that use a 150-volt B+ source.

After getting the replacement tuner installed and working properly, tracking of the channels should be checked; Channel 27 being received somewhere near 27 on the indicator and Channel 75 being received somewhere near 75 on the indicator. The different tuner designs require different indicators. The best way to avoid all the problems pointed out above is to use an exact replacement tuner when possible.