THE *Capehart*

CHASSIS	MODEL NO.
CX-33	3011-M
CX-33	3011-B
CX-33	3012-M
CX-33	3012-B
CX-33F	323-M

MAINTENANCE INFORMATION

FOR THE

TELEVISION CHASSIS

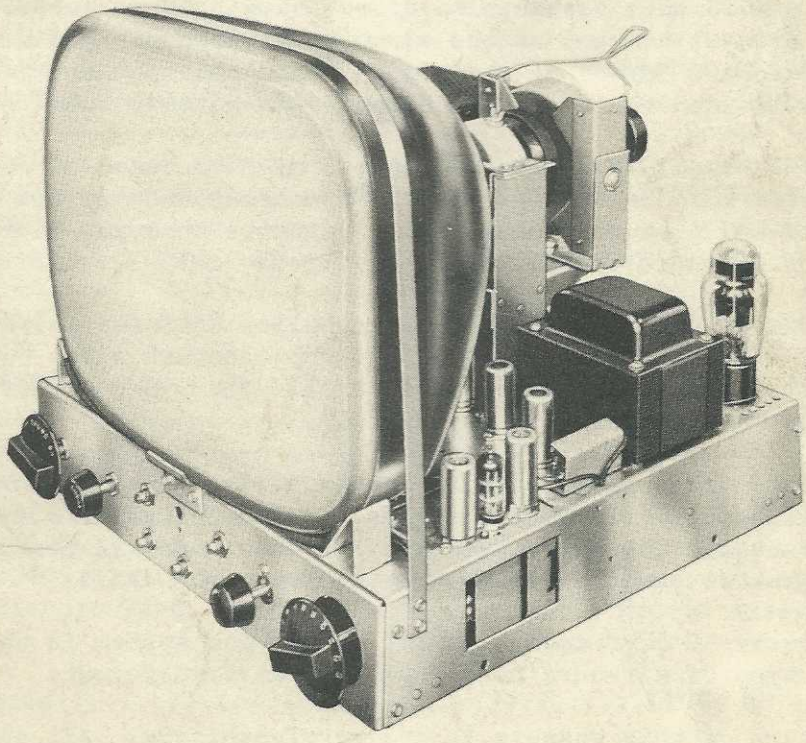
"CX-33"

Production No. C-281

and

"CX-33F"

Production No. C-286



ISSUED BY THE SERVICE DEPARTMENT

CAPEHART-FARNSWORTH CORPORATION

An IT&T Associate

FORT WAYNE, INDIANA

Price $1.00

C O N T E N T S

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GENERAL DESCRIPTION

The Capehart "CX-33" television receiver chassis is a 24 tube, self-contained unit for use with the new 16 inch rectangular direct-view picture tubes. The chassis features include several new and unique circuit developments and mechanical refinements. The Capehart "CX-33F" Chassis is identical to the "CX-33" except that it employs a 16 inch round (metal) direct-view picture tube.

The R-F tuner has a tuned R-F stage and a total of five tuned circuits for maximum gain and interference rejection. A new "Synchro-Sound" system provides synchronized sound and picture tuning. It eliminates annoying microphonic noise from the sound and prevents detuning effects due to local oscillator drift.

An amplified automatic gain control circuit supplies differential bias to the R-F and first two I-F amplifier stages to provide constant video output and eliminate the need for a manual contrast control. The video amplifier is entirely direct coupled for best possible noise immunity.

Exceptionally strong and positive-acting synchronizing circuits have been incorporated. The horizontal deflection circuits are controlled by a sync discriminator and reactance tube "Synchro-Lock" circuit, and the vertical multivibrator is temperature compensated to prevent frequency drift.

A new high-efficiency 70 degrees horizontal deflection system is used which incorporates a new type of air-core horizontal output transformer.

A particular feature of this chassis is its serviceability. All operating and secondary controls are conveniently located and are positive in their operation. This is particularly true of the "Joy Stick" positioning lever on the focus coil, and the width and horizontal linearity controls. The time required for installation and set-up has been reduced to a minimum.

SPECIFICATIONS

CAPEHART CX-33 TELEVISION CHASSIS.

Frequency Range;.....all channels, 2 through 13

R-F Input Impedence:.....balanced 300 ohm or unbalanced 72 ohm.

INTERMEDIATE FREQUENCIES:

Picture I-F carrier.....26.25 mc.

Sound I-F carrier.....21.75 mc.

TUBE COMPLEMENT:

Tube No.	Tube Type	Function
V101	6CB6	R. F. Amplifier
V102	6CB6	Mixer
V103	6AB4	Oscillator
V201	6AG5	1st I-F Amplifier
V202	6AG5	2nd I-F Amplifier
V203	6AG5	3rd I-F Amplifier
V204	6AL5	Video Detector and Sync Leveler
V205	6AH6	Video Amplifier
V207	6AU6	Sound I-F Amplifier
V208	6AL5	Ratio Detector
V209	6AV6	1st Audio Amplifier and Bias Clamp
V210	6K6	Audio Output
V212	12AU7	Pre-sync Separator A.G.C. Rectifier
V213	12AU7	A.G.C. Amplifier and Sync Amplifier
V214	6SN7	Sync Clipper and Vertical M. V.
V215	6K6	Vertical M.V. and Output
V216	6AL5	A.F.C. Detector
V217	6AU6	Reactance Tube
V218	6SN7	Horizontal Oscillator and Discharge Tube
V219	6BG6	Horizontal Output
V221	IB3/8016	H.V. Rectifier
V220	6W4GT	Damper
V222	5U4G	Rectifier
V211	Picture Tube - 16" rectangular, in all models except 323-M 16" round metal in Model 323-M	

Power Source.....115V, 60 cycles.

Power Consumption.....225 watts.

Audio Output.....2.5 Watts undistorted, 4.0 Watts maximum.

Speaker Size.....8 inch (Models 3011-M and 3011-B)
6 X 9 inch (Model 323-M)
12 inch (Models 3012-M and 3012-B)

INSTALLATION AND SET-UP INSTRUCTIONS

After the instrument has been unpacked the following inspection checks and adjustments should be made before placing the instrument in operation.

1. General appearance and condition of cabinet.

2. All tubes in place in their respective sockets.

3. Mechanical operation of controls.

4. Inter-connections, speaker cable, picture tube H.V. anode cap and socket connector.

5. Open the rear door of the receiver and remove the "Red" shipping bracket which secures the focus coil mount during shipment. Replace the two bracket mounting screws which also serve to fasten the cover of the H.V. Section.

POWER SOURCE

These instruments are designed to operate from an alternating current (AC) power source of from 105 to 125 volts at a frequency of 60 cycles per second. It is suggested in all cases that it be determined in advance that the power source available will meet the above requirements.

ANTENNA INSTALLATION

The subject model receivers are equipped with a "built-in" television antenna, which is designed for efficient signal pickup on all television channels. The mechanical elements of this antenna are mounted in the rear of the cabinet. An antenna "phasing" switch is located on the rear door of the cabinet. The antenna "phasing" switch provides variable antenna directivity without mechanical rotation of the elements. The built-in antenna will provide good reception in areas where signal strength is sufficient. If it is decided upon installation that signal strength in that particular area is not sufficient for proper operation without an adequate outdoor antenna, the built-in antenna system can be disconnected merely by removing the lead-in from the built-in antenna at the antenna terminals on the rear of the chassis. The lead-in from the outdoor antenna should then be connected to the antenna terminals. An effective antenna and transmission line system is a very important factor in obtaining good television reception in many areas, where signal strength is not great and where interference conditions exist. If the installation is not properly made, satisfactory reception cannot be expected. These receivers are designed to operate with 300 ohm transmission line. The antenna used may be of any practical configuration and type, and should be installed according to standard practice.

RECEIVER LOCATION

Selection of a suitable receiver location, in the home or other place of installation, should be decided upon only after the following factors have been taken into consideration;

1. The convenience of connecting both the AC line cord and the outdoor television antenna lead-in.

2. The location should be such that no strong direct light from lamps or windows will fall upon the picture screen or shine in the eyes of the viewers.

3. Sufficient space must be available in front of the receiver for the anticipated number of viewers. Normal viewing distance, with 12 or 16 inch direct view picture tube reproduction, is usually between 8 to 10 feet in front of the receiver.

4. It is desirable that the receiver not be placed close to sources of heat, such as hot air vents or radiators.

REMOVAL OF SAFETY GLASS ESCUTCHEON

Models 3011 and 3012

The safety glass escutcheon is removable from the front of the receiver. The glass is fitted into "slots" in the top and sides of the cabinet and is secured in place by two small supporting brackets which are fastened to either side of the cabinet. To remove the glass, first remove the supporting brackets. Refer to Figure 1a. Each bracket is held in place by two small wood screws. Remove the two small rubber cushions which are fitted in the cabinet slots just above the Mtg. Brackets. The rubber cushions are not visible with the glass in place, however their small spring metal holders can be seen after the Mtg. Brackets are removed. Grasp the lower edge of the glass firmly and slide the glass to either side and down slightly until the glass is free of the cabinet slots at the top and the opposite side. Tilt the glass outward slightly at the free side and slide the glass from the cabinet. To replace the glass, follow this procedure in reverse.

Model 323-M

The safety glass escutcheon in this model mounts in a similar manner as described above, with exception that the glass is held in place by a removable wooden panel across the lower edge of the glass. To remove the glass, first remove the wooden support panel which is held in place by two small screws, refer to Figure 1b. The glass can then be removed in a similar manner as in the other models.

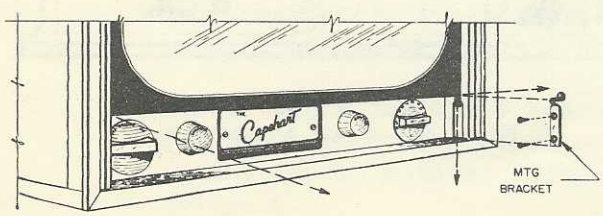


Fig. 1a, - Removal of Safety Glass in Models 3011 and 3012

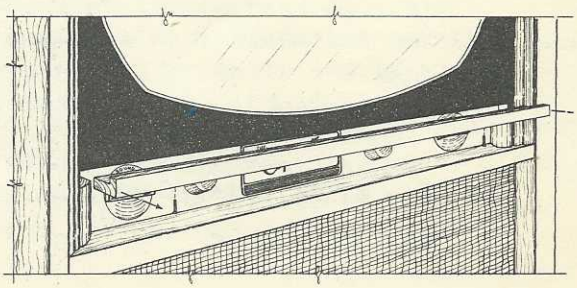


Fig. 1b, - Removal of Safety Glass in Model 323-M

LOCATION OF CONTROLS

There are four primary operating controls accessible from the front of these receivers. The controls are identified as Channel, Balance, Sound and Shading.

Located in back of the small Capehart Escutcheon plate, on the front panel of the receiver, are the following secondary operating controls: Height, Vertical Linearity, Vertical Hold, Focus and A.G.C. Set. These controls are made accessible by removing the small escutcheon which is held in place by two small screws. A small screwdriver should be used to adjust these controls.

Mounted on the rear chassis apron and accessible from the rear of the receiver are the Horizontal Linearity, Horizontal Oscillator Frequency, Horizontal Drive and Width adjustments. Horizontal Drive and Width are potentiometer controls, while Horizontal Frequency is a "screw-in" slug adjustment. The Horizontal Linearity is also a "slug" adjustment, however, it should be adjusted by loosening the wingscrew and sliding it along the slot provided. This arrangement provides a quick adjustment of the "slug" in the linearity coil. After the proper position is found tighten the wingscrew again.

For location of the above mentioned controls refer to Figures 2 and 3. Figure 2 shows the receiver front panel with the channel knob removed displaying the adjustment screws for the R-F Oscillator. For information on adjustment of the Oscillator, refer to "Oscillator Alignment Using a TV Signal."

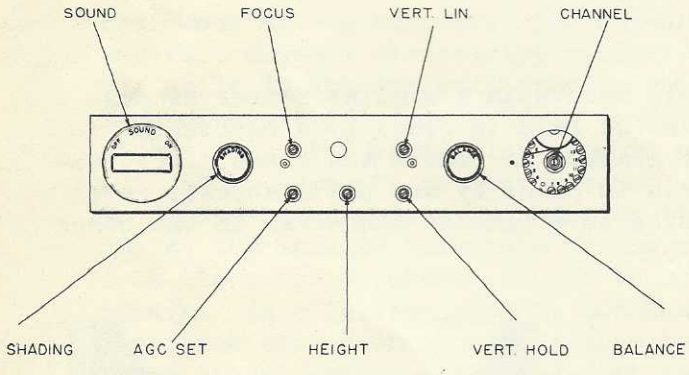


Fig. 2 - Front Panel Controls.

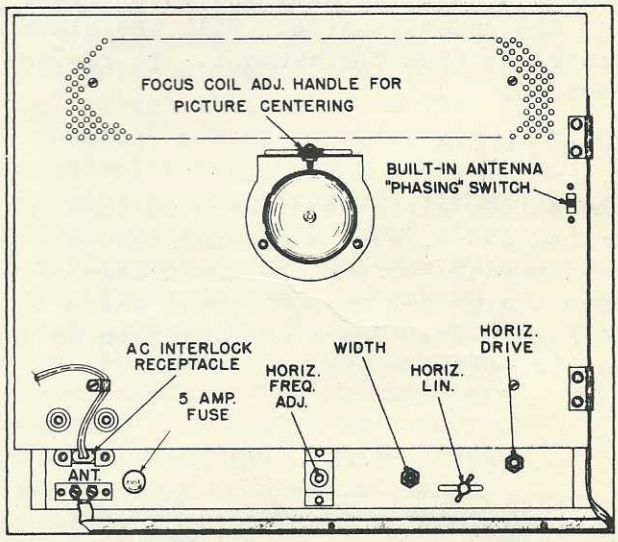


Fig. 3 - Rear Controls.

CHECK OF RECEIVER OPERATION

At the time of installation, a final operating check of the receiver should be made. Necessary final adjustment to the various non-operating controls should be made at this time to provide proper operation. The customer should be instructed in proper operation of the receiver and cautioned that the non-operating controls should be adjusted only by an experienced television serviceman.

PRELIMINARY CHECKS:

1. Untie the line cord at the rear of the cabinet and insert the plug into a 110 volt, 60 cycle AC outlet.

2. Turn the receiver on by rotating the SOUND control about halfway from either extreme.

3. Set the CHANNEL selector to a channel on which a television program is being transmitted.

4. Advance the SHADING control slightly clockwise and adjust the Ion Trap Magnet by sliding the magnet back and forth and rotating it about the neck of the picture tube until maximum brightness of the scanning lines is obtained.

   Check to see that the AGC SET control is approximately in the center of its mechanical range.

5. Adjust the BALANCE control to obtain the best reception. Tune for the sharpest detail in the picture, but not necessarily the brightest picture or loudest sound.

6. Re-adjust the SOUND control for average volume and check sound quality.

7. Adjust FOCUS control for the most clear (or sharp) picture.

8. Adjust the VERTICAL HOLD control to sync the picture, if the picture rolls vertically.

PICTURE CENTERING:

9. To center the picture in the mask, adjust the Focus coil by means of the attached handle. The coil can be tilted in either the horizontal or vertical plane to provide both vertical and horizontal centering. During shipment, the focus coil adjusting handle is concealed in the rear of the cabinet. The handle should be inserted through the slot in the rear door and attached by means of the furnished hardware to the bracket on the rear door. After the picture is centered properly the handle should be secured to the bracket to maintain the adjustment.

10. After adjusting the Focus coil, re-adjust the Ion Trap Magnet for the brightest picture. The flange around the sleeve of the magnet may be rotated independently and will act as a "fine" adjustment.

PICTURE SIZE AND LINEARITY:

11. Adjust the Width, Horizontal Drive and Horizontal Linearity controls to obtain the proper picture width and horizontal linearity. Due to interaction between these controls all three controls should be adjusted to obtain the overall results desired. Since the Drive control varies the amount of 2nd Anode voltage applied to the picture tube, it may have considerable effect on picture size and brightness, If a vertical white line (or lines) appears in the picture, reduce the Horizontal Drive slightly.

12. Adjust the Height and Vertical Linearity controls to obtain proper height and vertical linearity. It may be necessary to re-adjust the Vertical Hold control during these adjustments, if the picture rolls.

AGC ADJUSTMENT:

13. Adjust the A.G.C. Set control in conjunction with the shading control to obtain proper picture contrast. Adjust the receiver to all available television stations and check to see that contrast is not excessive or insufficient on any channel. Adjust the A.G.C. SET control to meet these conditions.

FINAL CHECK:

14. In sequence, set the CHANNEL selector to all channels on which reception is obtained. Adjust the receiver for operation as outlined in the Owner Operating Instruction Booklet. Check the quality of reception, picture and sound on all available TV stations in the area.

    Check to see that best reception is obtained, on all channels with the BALANCE control in approximately the same setting. This condition can be obtained by making the adjustments outlined under, "Oscillator Alignment Using a TV Signal In The Alignment Instructions Section."

    If a 60 cycle station buzz is heard in the sound refer to the section "Elimination Of 60 Cycle Station Buzz" which follows.

15. Instruct the customer in the proper operation of the receiver and call his attention to the Owner Operating Instruction Booklet which accompanies the receiver.

ELIMINATION OF 60 CYCLE STATION BUZZ

A 60 cycle buzz may be heard in the sound under conditions which cause the amplitude modulated synchronizing signals contained in the 4.5 mc. sound I.F. carrier to be of such an amplitude that they are not completely rejected in the F.M. sound ratio detector. This may be caused by operating conditions at the television transmitter, or by improper tuning of the receiver.

The Balance Control should be tuned for the sharpest and clearest picture detail. This tuning condition should occur simultaneously with the best sound. If the buzz is heard when the set is properly tuned, the following steps should be taken.

1. Turn set on and allow sufficient time for chassis to reach its normal operating temperature.

2. Tune set for normal picture and sound, advancing the sound control until the buzz is heard.

3. Carefully adjust the secondary (top) of the ratio detector transformer for best sound and minimum buzz level. Only a slight rotation in either direction will be required. This adjustment may be made using the knurled knob provided on the adjusting screw.

This adjustment will be required only once, and need not be repeated on different channels. The ratio detector transformer is located in front of the high-voltage supply shield, and may be reached from the rear of the cabinet without removing the chassis.

ADJUSTMENT OF HORIZONTAL A.F.C. CIRCUIT

There is no Horizontal Hold control provided in this chassis. The picture should look in synchronism automatically when switching from channel to channel. In the event, however, that adjustment of this circuit is required, because of tube or component replacement, the following procedure should be followed:

1. Remove V-216, 6AL5, from its socket and adjust the Horizontal Frequency (Fig. 3) until the picture is synchronized horizontally. When properly adjusted the picture will move slowly back and forth horizontally with one vertical blanking bar.

2. Replace the 6AL5 tube and the picture should immediately fall in sync.

3. If after making this frequency adjustment the picture does not immediately fall in sync, the A.F.C. detector phasing may require adjustment. This is the adjustment of T-209, the horizontal oscillator transformer, made underneath the chassis. This should be adjusted until there is 1/4 inch of blanking visible at the right hand edge of the picture.

4. If a considerable amount of change is required in the phasing adjustment, it may be necessary to re-adjust the horizontal frequency as in Step I, above.

CIRCUIT DESCRIPTION

R. F. TUNER

The R. F. tuner uses a 6CB6 R. F. Amplifier, a 6CB6 Mixer and a 6AB4 Oscillator. All twelve channels are covered.

There are five tuned circuits employed on any one channel for maximum gain and rejection of interference.

Channel switching is accomplished by a positive acting rotary type switch which changes coils for each channel. A vernier fine tuning control is provided.

The oscillator coils are slug tuned and adjustable from the front of the receiver to make all stations received fall in the center portion of the fine tuning range. No adjustment is provided for R. F. and Mixer alignment.

The mixer plate circuit is tuned, and this coil is a part of the tuner.

The tuner is designed for a 300 ohm balanced input, but may be used with 72 ohm coaxial transmission lines by connecting the inner coaxial conductor to one antenna terminal and the shield to chassis.

I. F. AMPLIFIER

The I. F. Amplifier Section employs three stagger-tuned stages using 6AG5 tubes in conjunction with "bi-filar" wound I. F. transformers. The I. F. stages are designed to provide a flat-topped response curve of the necessary width for proper I. F. band pass. No adjacent channel or co-channel traps are required. Automatic gain control provides a constant signal level at the video detector and eliminates the necessity for a contrast control. See, "Sync Separation and Automatic Gain Control."

VIDEO DETECTOR

The video detector is $\frac{1}{2}$ of a 6AL5 tube. In addition to its function of rectifying the video I. F. signal, this stage also produces a 4.5 mc. FM sound signal which is the beat (difference) frequency between the video I. F. and Sound I. F. signals.

VIDEO AMPLIFIER

A 6AH6 pentode is used in a video amplifier circuit which is completely direct coupled from video detector to the picture tube cathode. Bias for the 6AH6 is obtained from the rectified output of the video detector.

Because of the direct coupling feature a D. C. Restorer is not required. The 4.5 megacycle beat signal is removed from the plate circuit of the video amplifier through a double-tuned 4.5 megacycle I. F. transformer. The primary of this transformer acts as a trap to prevent the appearance of the 4.5 mc. beat in the picture.

SOUND

The sound section of the receiver consists of a single 6AU6 pentode (4.5 mc.) I. F. amplifier followed by a 6AL5 F. M. ratio detector. The 6AV6 first audio amplifier is also used as a clamp on the automatic gain control circuit. The 6K6 audio output stage has its cathode returned to the minus 90 v. circuit. Negative feedback is employed for extended audio frequency response.

SYNC SEPARATION AND AUTOMATIC GAIN CONTROL CIRCUIT.

A 12AU7, V212, is employed as a sync amplifier in which the first triode section is designed to amplify the vertical sync pulses and the second section to amplify the horizontal sync pulses and at the same time develop a negative bias which is proportional to the horizontal sync pulse amplitude. This bias is directly coupled to the AGC amplifier, V213, 12AU7 and is adjusted to the proper operating level by R244, the AGC Set control. The plate of the AGC amplifier is returned through a high resistance network to B plus but in operation is held at or slightly below ground potential by the bias on its grid and by the clamping action of the diode section of the 6AV6 first audio tube. The AGC bias developed is applied to the R. F. Amp. and the first two I. F. stages. The amplified horizontal and vertical sync pulses are recombined in the plate circuit of V212, and are further amplified by the sync amplifier V213, and shaped by the sync leveler V204B and sync clipper V214.

VERTICAL MULTIVIBRATOR AND OUTPUT

The vertical multivibrator stage employs one half of V214, 6SN7 and V215, a triode connected 6K6. The vertical sync pulses are received from the cathode of the sync clipper and applied to the grid of V214B through an integrator network. Frequency drift during warm up is prevented by the temperature compensating resistor R269 in the grid return of the 6SN7, V214B.

HORIZONTAL AUTOMATIC FREQUENCY CONTROL CIRCUIT.

The AFC circuit employs a 6AL5 as AFC detector, a 6AU6 reactance tube and a 6SN7 horizontal oscillator and discharge tube. Horizontal sync pulses are taken from the cathode of the sync clipper V214 and coupled to the center tap of the horizontal oscillator transformer, T209. The horizontal oscillator is free running at a frequency near the horizontal sync frequency. In operation the bias on the reactance tube will vary such that any difference in frequency between the horizontal oscillator and the horizontal sync pulses will cause the reactance presented by the tube to the grid circuit of the horizontal oscillator to change so that the frequency of the oscillator will be corrected and remain exactly the same as the horizontal sync rate. The discharge section of V218 is used to produce a saw-tooth form to drive the 6BG6 Horizontal Amplifier.

HORIZONTAL OUTPUT

The Horizontal Amplifier stage uses an air-core, series-type output transformer. The amplifier tube, the transformer and the horizontal deflection coils are all in series, and the 6W4 damper tube is effectively in shunt with the yoke. Since this arrangement places the damper tube cathode at a high positive potential, an isolation transformer is provided to protect this tube from failure. An inductive linearity control is provided and width is controlled by a variable resistance R305, which varies the impedence of the output circuit. The horizontal drive control varies the supply voltage to the horizontal discharge tube and thus changes the amplitude of the driving pulse. High voltage is developed by a flyback type power supply using a 1B3 tube, V221. This supply delivers a second anode potential of 11KV, for operation of the 16" picture tube.

LOW VOLTAGE POWER SUPPLY

The low voltage power supply uses a power transformer, T211, which furnishes all plate and heater voltages. A 5U4G rectifier is used with an inductance capacity type filter. The receiver is protected by a 5 ampere fuse in the primary circuit as well as a .25 amp. fuse in the plate supply for the horizontal amplifier and discharge tubes. A spare 5 ampere fuse is provided with each chassis for convenience. The power transformer is equipped with a copper shield passing completely around the winding and the core. This shield is designed to eliminate "snaking" in the picture which may be caused by a phase difference between the transmitted veritical sync frequency and the local power source frequency.

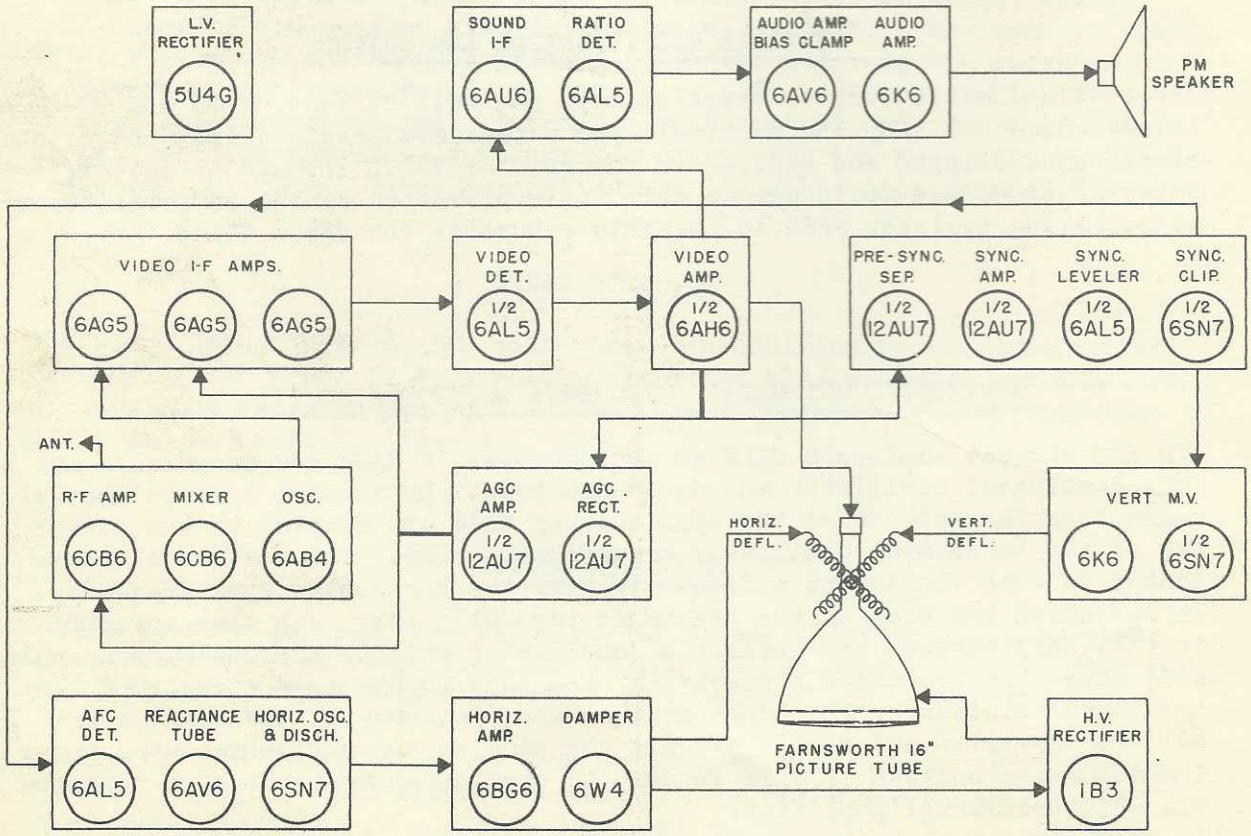


Fig. 4 - Functional Diagram

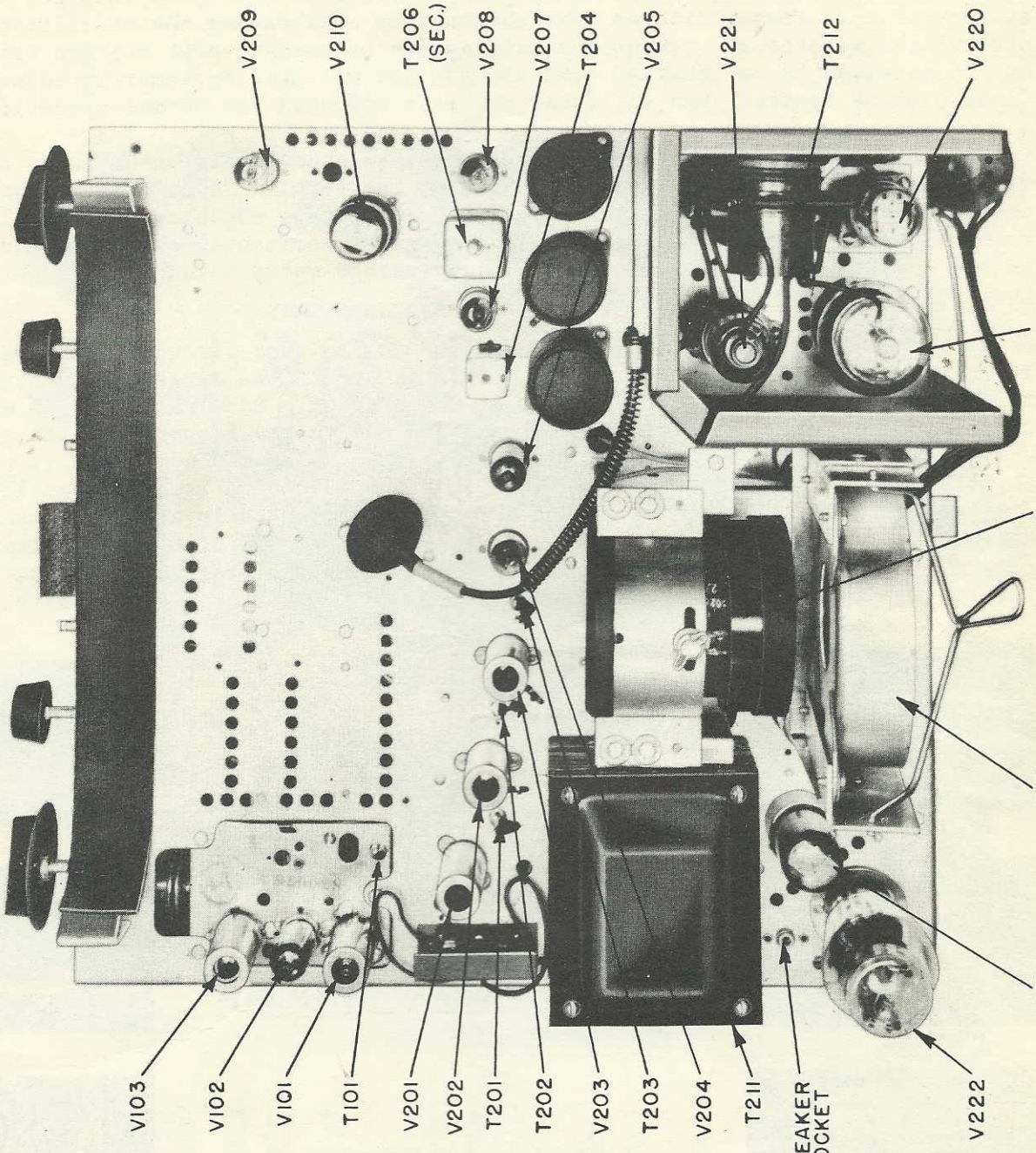


Fig. 5 - Chassis Top View

Waveform Analysis

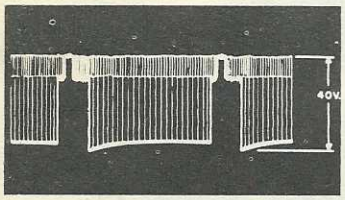
The following waveforms were obtained from a production run CX-33, Series "-2" receiver, with a standard transmitted picture signal connected to the input of the receiver.

The waveforms shown here have been sized for purposes of reproduction and they are not intended to show relative amplitudes. Approximate peak-to-peak voltages are shown on each waveform. These voltages were obtained by calibrating the oscilloscope used to observe the waveforms. The approximate values of peak-to-peak voltage are those that may be expected to be obtained with the AGC Set and Shading controls adjusted for optimum picture contrast and all other controls adjusted for normal operation.

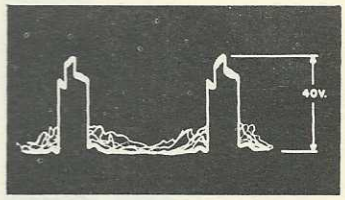
Two separate waveforms are shown at those points where it is intended to show both the vertical and horizontal pulses. For viewing the vertical sync pulse or waveforms in the vertical sweep circuits, the oscilloscope sweep is adjusted to one-half of the vertical sweep rate (30 c.p.s.). For viewing the horizontal sync pulse or waveforms in the horizontal sweep circuits, the oscilloscope sweep is adjusted to one-half the horizontal sweep rate (7875 c.p.s.).

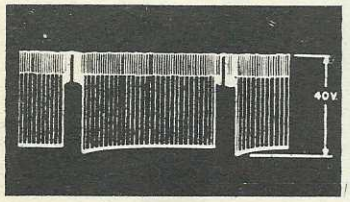
Slight variations in waveform may be noticed in the sync circuits when the receiver is switched to different TV stations. This is due to the slight variation which is tolerated in the transmitted waveform at the station. Some variation in waveform and in peak-to-peak voltage may also be expected due to the response of the particular oscilloscope used to observe the waveforms. When using the waveforms in trouble shooting, these factors should be taken into consideration to avoid possible incorrect conclusions. CAUTION - No waveforms are shown for points in the Horizontal Output Stage other than the control grid and cathode due to the high pulse voltages which exists in the output of this stage. DO NOT attempt to observe waveforms in the horizontal deflection yoke, Horizontal Damper or H. V. Rectifier circuits.

SYNC CIRCUITS

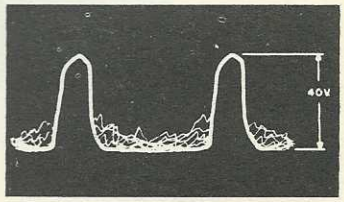


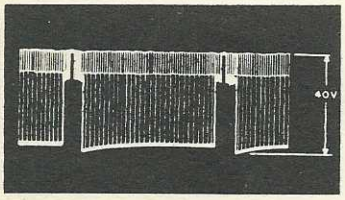
Picture Tube Cathode
(Pin 11 of V211)
Vertical ← → Horizontal



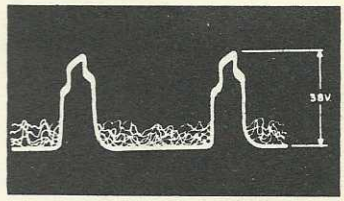


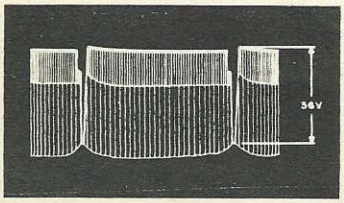
Input to Pre-Sync Separator
(Pin 7 of V212, ½12AU7)
Vertical ← → Horizontal



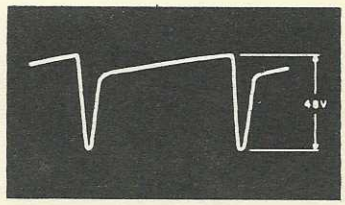


Input to AGC Detector
(Pin 2 of V212, ½12AU7)
Vertical ← → Horizontal





Input to Sync Amplifier
(Pin 2 of V213, ½12AU7)
Vertical ← → Horizontal



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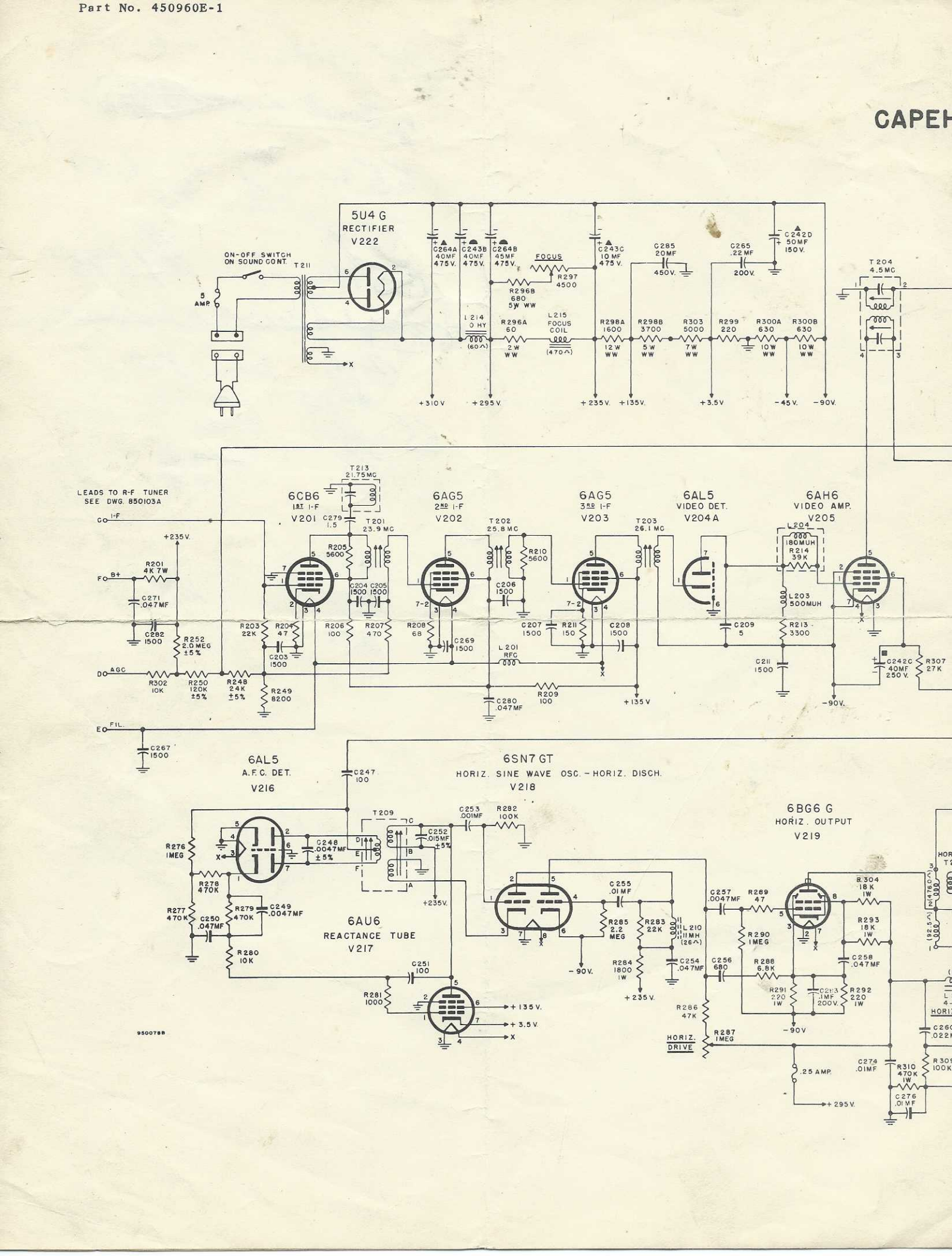
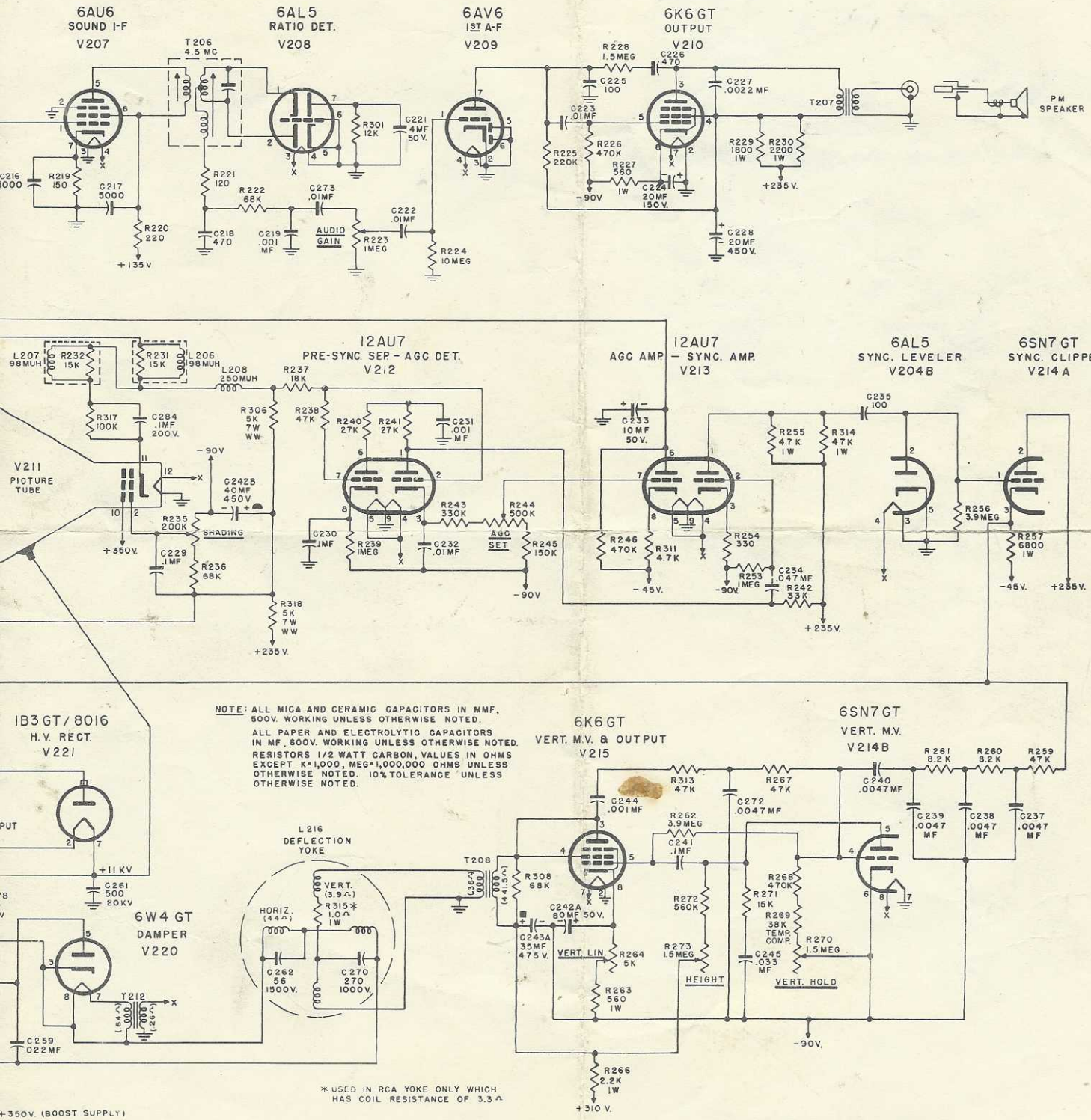


RT "CX-33" CHASSIS

THIS SCHEMATIC CORRECT FOR THE FOLLOWING CHASSIS:

CHASSIS NO.	PICTURE TUBE	PRODUCTION NO.	SERIES
"CX-33"	FARNSWORTH "160-AR"	C-281	-4
"CX-33F"	16GP4	C-286	-4



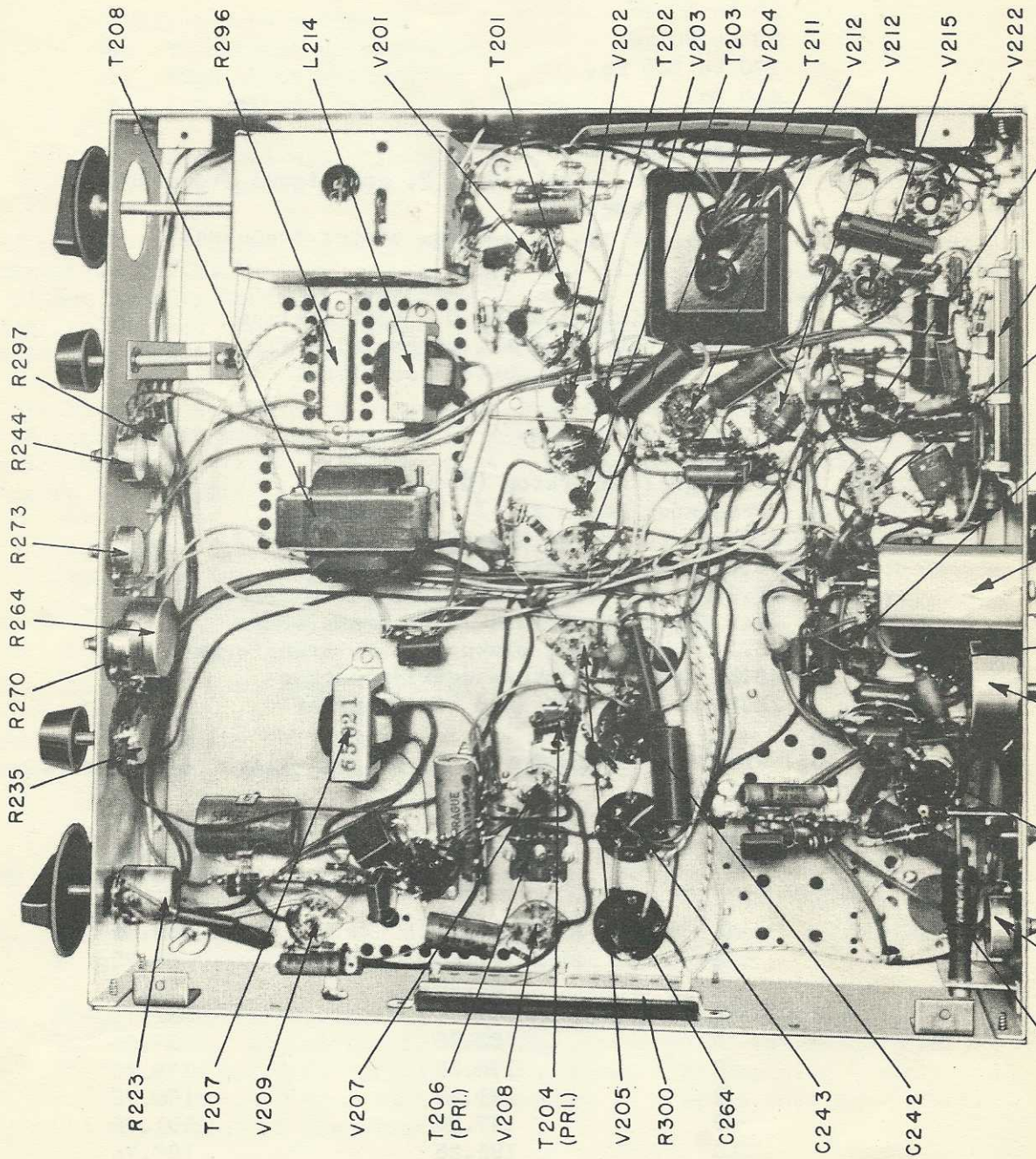


Fig. 8 - Chassis Bottom View

ALIGNMENT INSTRUCTIONS

EQUIPMENT NEEDED

The following units of test equipment are required for proper alignment of this receiver chassis. The equipment should meet the specifications stated.

1. R. F. Sweep Generator
   a. Center Frequency Ranges
      20 to 30 mc.
      50 to 90 mc.
      170 to 225 mc.
      4.5 mc.

   b. Sweep Width
      Variable to 10 mc. on I. F. and signal frequency ranges.
      Approx. 0.5 mc. at 4.5 mc. center frequency.

   c. Output
      Variable with at least 0.1 volt maximum.
      Constant output on all ranges with flat output at all attenuator positions.

2. R. F. Signal Generator (Modulated)
   a. Frequency Range for I. F. Alignment
      4.5 mc. for sound transformers
      23.5 mc. for converter output coil
      23.9 mc. for 1st, picture I. F. transformer
      25.9 for 2nd, picture I. F. transformer
      26.1 mc. for 3rd, picture I. F. transformer
      26.25 mc. for picture carrier marker
      23.25 mc. for 50% band limit marker

   b. Frequency Range for R. F. and Oscillator Adjustment.

Channel No.	Picture Carrier Freq. mc.	Sound Carrier Freq. mc.
2	55.25	59.75
3	61.25	65.75
4	67.25	71.75
5	77.25	81.75
6	83.25	87.75
7	175.25	179.75
8	181.25	185.75
9	187.25	191.75
10	193.25	197.75
11	199.25	203.75
12	205.25	209.75
13	211.25	215.75

c. Output
Variable with at least 0.1 volt maximum.

3. Cathode-Ray Oscilloscope
   a. Wide band vertical deflection.
   b. Vertical input provided with a calibrated attenuator.
   c. Low capacity probe.

4. Vacuum tube voltmeter
   a. Voltohmyst or equivalent
   b. High input resistance
   c. Low voltage range (3 volts dc.)

5. Crystal Detector Assembly
   a. see Sketch Figure 9.

Under normal conditions the only portion of the receiver which should require alignment is the R. F. local oscillator. All other circuits in the receiver are either broadly tuned or sufficiently stable that alignment should not be required unless the adjustments have been tampered with or unless major circuit components have been replaced.

The Chassis does not have to be removed from the cabinet to adjust the oscillator tuning, but must be removed to perform a complete alignment. When aligning the receiver it is recommended that the following sequence of adjustments be observed.

1. Sound I. F. take-off transformer
2. Sound Ratio Detector transformer
3. Picture I. F. transformers
   a. Proceed from video detector back toward front end.
4. Converter output coil
5. R. F. Oscillator Adjustment

No service adjustment is recommended for antenna and R. F. coils. These circuits are broad tuned and are not critical.

SOUND ALIGNMENT

1. Inject the 4.5 mc. sweep signal at pin 1 of the video amplifier V205, and chassis, through a 1500 uufd. capacitor.

2. Connect oscilliscope through crystal detector assembly to L207 and chassis. Adjust the bottom slug (primary) of the sound take-off transformer T204 for minimum response. The top slug (secondary) should be detuned to a higher frequency so that it does not affect the adjustment of the primary.

3. Remove crystal detector from L207 and connect to junction of R221, R222, and C218. The sweep input at the grid of the video amplifier should be kept low enough to prevent overloading as evidenced by a flattening of the response.

4. Adjust the secondary (top) of the take-off transformer for maximum symmetrical response.

5. Adjust the primary (bottom) of the ratio detector transformer for maximum symmetrical response.

6. Remove the crystal detector from the oscilliscope and connect the oscilliscope to the same point (junction of R221, R222, and C218) through a 10,000 ohm resistor.

7. Adjust the top slug of the Ratio detector transformer for the crossover to be at the 4.5 mc. marker as shown in the curve, Fig. 10. The sweep input should be kept as low as possible to prevent overloading.

8. If necessary, readjust bottom slug of T206 to make curve symmetrical.

Note: When properly adjusted the ratio detector "S curve" should have a symmetrical response with a linear range of approximately plus-or-minus 90 kc.

F. AND MIXER OUTPUT ALIGNMENT

1. Inject I. F. input signals at converter tube grid by slipping a tight-fitting ungrounded shield over the converter tube, or at the test point provided on top of the tuner housing. Use modulated R. F. signals for initial setting of I. F. transformers and converter output coil.

2. Connect a 500K potentiometer on clip leads between pins 6 and 8 of V213, and vary this control to set the d. c. bias on the I. F. grid return bus to -3 volts.

3. Connect both the oscilloscope and vacuum tube voltmeter across R213. The "high side" of the instruments should be connected to the junction of R213 and L203.

Note: The I. F. coils are to be adjusted for maximum response as indicated by the VTVM. The oscilloscope will indicate whether an overload condition exists due to too large a signal input.

4. Adjust input signal to 26.1 mc. Adjust 3rd I. F. transformer for maximum response as indicated on the vacuum tube voltmeter.

5. Adjust input signal to 25.9 mc. Adjust 2nd I. F. transformer for maximum response.

6. Adjust input signal to 23.9 mc. Adjust 1st I. F. transformer for maximum response.

7. Adjust input signal to 23.5 mc. Adjust converter output coil for maximum response.

8. Connect sweep generator to converter tube grid in same manner as in step 1 above, and set sweep to center of I. F. range and with sweep width of approximately 10 mc.

9. Observing band pass response on the oscilloscope, retouch the I. F. transformers to obtain a response curve similar to that shown in Figure 11. The converter coil and 1st I. F. transformer will correct the low frequency side of the curve and the 2nd and 3rd I. F. transformers will correct the high frequency side.

   Proper positioning of the picture carrier and 50% band limit markers at 26.25 mc. and 23.25 mc. respectively is important since no traps are used.

OSCILLATOR ALIGNMENT

The oscillator alignment is critical, and may be affected by a change of oscillator tubes. It is recommended, therefore, that a tube be selected in such a case which produces the smallest amount of change in oscillator alignment.

1. Connect the sweep generator to the antenna terminals. Adjust sweep for channel 13.

2. Loosely couple marker generator to antenna terminals and set marker at channel 13 video carrier frequency.

3. Unless it is already in place from a previous operation connect a 500K potentiometer between pins 6 and 8 of V213 and vary this control to set the d. c. bias on the I. F. grid return bus to -3 volts.

4. Connect oscilloscope to high side of R213 and ground.

5. Allow 15 minutes for receiver and test instruments to reach their normal operating temperatures.

NOTE WHEN ADJUSTING THE OSCILLATOR TUNING SLUGS BE CAREFUL NOT TO BACK THE SLUG OUT TOO FAR AS IT MAY FALL COMPLETELY OUT OF ITS MOUNTING.

6. Set the channel 13 oscillator slug to the approximate center of its range. Adjust the oscillator slug located directly above the channel 13 slug so that the video carrier marker falls at 50% point of the response curve. See Figure 11 for approximate curve shape and marker limits.

Note: The marker signal should also be moved to check the 21.75 sound carrier frequency. If these markers do not correspond with Figure 11 it may be necessary to perform the I. F. and Mixer Output Alignment above.

7. Repeat the above steps on channel 12, and progress through channel 2.

OSCILLATOR ALIGNMENT USING A TELEVISION SIGNAL

1. Turn set on and allow sufficient time for set to reach normal operating temperature.

2. Turn Channel selector to the highest channel received and adjust Shading and Volume controls for normal sound and picture. Set the Balance control to the mid point of its range.

3. Remove Channel knob and adjust the oscillator slug for that channel using a small non-metallic screwdriver. Channel numbers are stamped on the front of the tuner housing.

   Adjust oscillator slug for the clearest and sharpest detail in the picture. At this point the sound should be best, but not necessarily the loudest.

NOTE: BE CAREFUL NOT TO BACK THE SLUG OUT TOO FAR AS IT MAY FALL COMPLETELY OUT OF ITS MOUNTING.

4. Turn Channel selector to the next lower channel received and repeat steps 3 and 4 above.

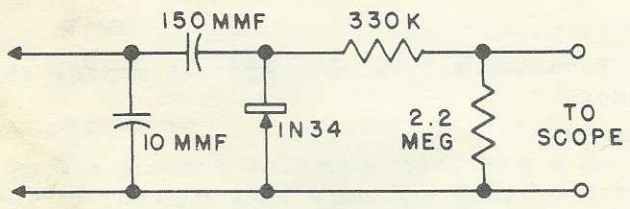


FIG. 9 CRYSTAL DETECTOR

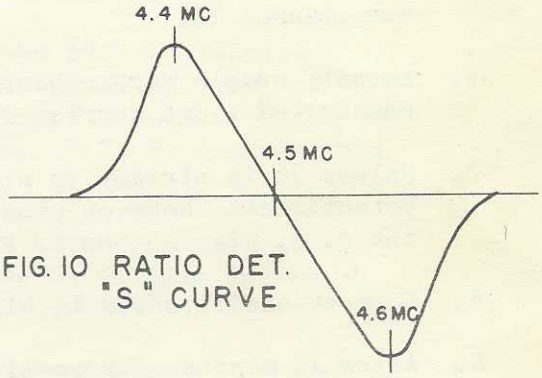


FIG. 10 RATIO DET. "S" CURVE

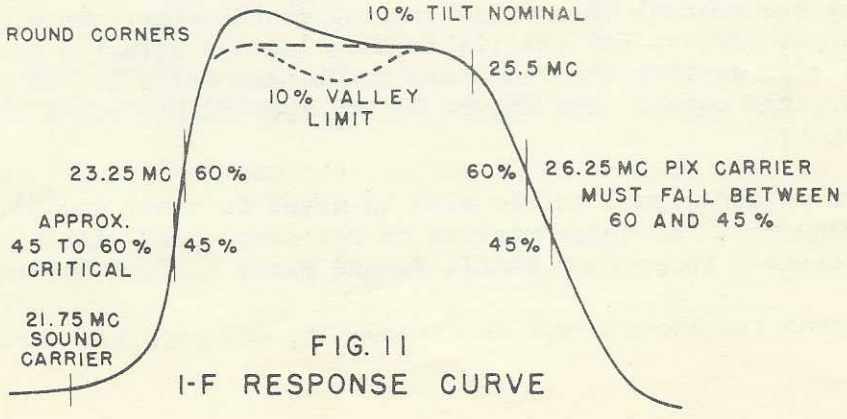


FIG. 11
I-F RESPONSE CURVE

TUBE SOCKET TERMINAL VOLTAGES

Voltages measured with voltohmyst or equiv. from indicated terminal to chassis.
No signal input, controls set to normal position except where noted.

TUBE NO.	TUBE TYPE AND FUNCTION	TUBE SOCKET TERMINAL NUMBERS									REMARKS
		1.	2.	3.	4.	5.	6.	7.	8.	9.	
V101 6CB6	R.F. Amp.	G_1 -.4 -18	K. 0	H. 6.3AC	H. 0	P. 235 / 95	G_2 225 / 85	G_3 0	---	---	
V102 6CB6	Mixer	G_1 0	K. 0	H. 0	H. 6.3AC	P. 230 / 180	G_2 120 / 100	G_3 0	---	---	
V103 6AB4	Oscillator	P. 200 / 180	N.C.	H. 0	H. 6.3AC	N.C.	G. -4.5	K. 0	---	---	Grid Voltage Varies On Different Channels.
	R.F. Tuner Term. Strips	Mixer Plate 230 / 175	Osc. B+ 235 / 210	H. 6.3AC	B+ 230 / 180	N.C.	Ant.	Ant.	A.G.C. -.4 -18	N.C.	10 -.4 -18 Note 1
V201 6AG5	1st Video I.F.	G_1 -.8 -8.0	K. & G_3 0.1 / 0.0	H. 0	H. 6.3AC	P. 115 / 112	G_2 115 / 112	K. & G_3 0.1 / 0.0	---	---	Note 1
V202 6AG5	2nd Video I.F.	G_1 -.8 -8.0	K. & G_3 0.4 / 0.0	H. 0	H. 6.3AC	P. 115 / 115	G_2 115 / 115	K. & G_3 0.4 / 0.0	---	---	Note 1
V203 6AG5	3rd Video I.F.	G_1 0	K. & G_3 1.1	H. 0	H. 6.3AC	P. 115 / 115	G_2 115 / 115	K. & G_3 1.1	---	---	Note 1
V204 6AL5	Video Det. & Sync Leveler	K_1 -90 -105	P_2 -5 -50	H. 0	H. 6.3AC	K_2 0	Shield 0	P_1 -85 -110	---	---	Note 1
V205 6AH6	Video Amp.	G_1 -90 -105	G_3 -90 -105	H. 0	H. 6.3AC	P. 60 / 35	G_2 25 / 5	K. -85 -108	---	---	Note 1 Note 2
V207 6AU6	Sound I.F.	G_1 0	G_3 0	H. 0	H. 6.3AC	P. 115 / 114	G_2 115 / 114	K. 0	---	---	Note 1
V208 6AL5	Ratio Detector	K_1 -1	P_2 -1	H. 6.3AC	H. 0	K_2 0	Shield 0	P_1 -2	---	---	
V209 6AV6	1st A.F. Amp. & A.G.C. Bias Cl.	G. -1	K. 0	H. 0	H. 6.3AC	P_{D1} -.02 -15	P_{D2} -.02 -15	P. 95 / 90	---	---	Note 1
V210 6K6GT	Audio Output	N.C.	H. 0	P. 205 / 180	G_2 210 / 185	G_1 -85 -100	N.C.	H. 6.3AC	K. & G_3 -80 -100	---	
V212 12AU7	Pre-Sync Sep. & A.G.C. Det.	P_1 210 / 195	G_1 60 / 35	K_1 70 / 45	H. 6.3AC	H. 6.3AC	P_2 200 / 190	G_2 60 / 35	K_2 60 / 45	$H_{c.t.}$ 0	Note 1
V213 12AU7	A.G.C. Amp. & Sync Amp.	P_1 100	G_1 0	K_1 2	H. 6.3AC	H. 6.3AC	P_2 -3.4 -34	G_2 -35 -75	K_2 -45	$H_{c.t.}$ 0	Note 1
V214 6SN7GT	Sync Clipper & Vertical M.V.	G_1 -3 -55	P_1 220 / 210	K_1 5 -45	G_2 -120 -210	P_2 100 / 20	K_2 -90 -105	H. 0	H. 6.3AC	---	Note 1
V215 6K6GT	Vert. M.V. & Output	N.C.	H. 0	P. 270 / 220	G_2 270 / 220	G_1 -75 -90	N.C.	H. 6.3AC	K & G_3 -40 -75	---	Note 1 Note 3
V216 6AL5	A.F.C. Detector	K_1 3.2	P_2 -35	H. 6.3AC	H. 0	K_2 0	Shield 0	P_1 -35	---	---	
V217 6AU6	Reactance Tube	G_1 2.4	G_3 0	H. 0	H. 6.3AC	P. 235 / 215	G_2 140 / 115	K. 4.2	---	---	Note 1
V218 6SN7GT	Hor. Sine Wave Osc. & Hor. Discharge	G_1 -14 -17	P_1 220 / 200	K_1 0	G_2 -135	P_2 135 0	K_2 -90 -105	H. 0	H. 6.3AC	---	Note 1 Note 6
V219 6BG6G	Horiz. Output	N.C.	H. 0	K. -70 -95	N.C.	G_1 -70 -125	N.C.	H. 6.3AC	G_2 215 / 190	---	Plate Cap. H.V. Pulse — Note 1 Note 6
V220 6W4GT	Damper	N.C.	N.C.	K. H.V.	N.C.	P. H.V.	N.C.	H. Heater Isolated From Chassis	H.	---	
V221 1B3GT/ 8016	H.V. Rectifier	N.C.	Fil. H.V. Pulse	N.C.	N.C.	N.C.	N.C.	Fil. H.V. Pulse	N.C.	---	Plate Cap. H. V. Pulse Approx. 11KV
V222 5U4G	L.V. Rectifier	N.C.	Fil. 300dc	N.C.	P_1 460ac	N.C.	P_2 460ac	N.C.	Fil. 300dc	---	
PICTURE TUBE SOCKET TERMINAL			1.	2.	10.	11.	12.	Button (H.V.)			
V211 160	Picture Tube		H. 0	G_1 35 -100	G_2 130	K. 105	H. 6.3ac	A_2 11 K.V.			Notes 2 and 4
					100 / 360	55 / 35					Notes 1, 2, 5 and 6

Note 1. Voltage varies with A.G.C. Set Control. Highest positive values are obtained with A.G.C. Set Control in maximum counter-clockwise position.
Note 2. Voltages vary with Shading Control setting.
Note 3. Voltages vary with Vertical Size, Linearity and Hold Controls.
Note 4. Picture tube socket removed from tube.
Note 5. Socket in place on picture tube.
Note 6. Varies with Horizontal Drive Control

SERVICE REPLACEMENT PARTS LIST

CAPEHART-FARNSWORTH TELEVISION CHASSIS

"CX-33" Production No. C-281 and "CX-33F" Production No. C-286

* * * * * *

CAPACITORS

REF. NO.	CAPACITY	DESCRIPTION	PART NO.	LIST
C202	270 uufd.	Mica 500V	650162A-5	$ .20
C203, 204, 205, 206, 207, 208, 211, 267, 269	1500 uufd.	Hi K Cer. D. 450V	450469-2	.25
C209	5 uufd.	Ceramic 500V	650030A-1	.20
C212, 216, 217	5000 uufd.	Hi K Cer D. 450V	450469-1	.25
C218, 226	470 uufd.	Mica 500V	25189	.25
C219, 231, 244, 257	.001 ufd.	*Mopt 600V	2248A-1020	.20
C221	4 ufd.	Elect. 50V	650228A-4	.95
C222, 223, 252, 255 271, 273, 274 276	.01 ufd.	*Mopt 600V	2248A-1030	.20
C224	20 ufd.	Elect. 150V	650228A-1	1.15
C225, 235, 247, 251	100 ufuf.	Mica 500V	25188	.20
C227,	.0022 ufd.	*Mopt 600V	2248A-22220	.20
C228	20 ufd.	Elect. 450V	650228A-2	1.50
C229, 230, 241	.1 ufd.	*Mopt 600V-	2248A-1040	.35
C233	10 ufd.	Elect. 50V	650228A-3	.95
C236	1500 uuf.	Hi K Cer. D. 450V	450469-2	.25
C234, 250, 254, 258	.047 ufd.	*Mopt 600V	2248A-4730	.25
C237, 238, 239, 240 249, 253, 272	.0047 ufd.	*Mopt 600V	2248A-4720	.20
C242A)	(80 ufd.	Elect. 50V)		
C242B)	(40 ufd.	Elect. 475V)	750090B-13	3.90
C242C)	(40 ufd.	Elect. 250V)		
C242D)	(50 ufd.	Elect. 150V)		
C243A)	(35 ufd.	Elect. 475V)		
C243B)	(40 ufd.	Elect. 475V)	750090B-12	3.75
C243C)	(10 ufd.	Elect. 475V)		
C245	.033 ufd.	*Mopt 600V	2248A-3330	.25
C248	.004 ufd.	*Mopt 600V	2248A-4725	.30
C252	.015 ufd.	*Mopt 400V	2247A-1535	.30
C256	680 uuf.	Mica 500V	25503	.30
C259, 260	.022 ufd.	*Mopt 5600V	2248A-2230	.25
C261	500 uuf.	Ceramic 20KV	650153B-2	1.90
C262	56 uuf.	Ceramic 1500V	450954A-2	1.35
C264A)	(40 ufd.	Elect. 475V)	750090B-14	3.45
C264B)	(45 ufd.	Elect. 475V)		
C265	.22 ufd.	*Mopt 200V	2246A-2240	.35
C270	270 uufd.	Mica 1000V	650162A-6	.30
C277	3 uufd.	Ceramic 500V	2241A-706	.20
C278	30 uuf.	Ceramic 6KV	450954A-3	.60
C283	.1 ufd.	*Mopt 200V	2246A-1040	.20

* Molded oil paper tubular capacitors.

RESISTORS

REF. NO.	DESCRIPTION	PART NO.	LIST
R201, 211, 219	150 ohm, ½W, 10% Ins. Carb.	3229A-151	$ .10
R202, 230, 266	2.2K, 1W, 10% Ins. Carb.	3232A-222	.10
R203, 271	15K, ½W, 10% Ins. Carb.	3229A-153	.10
R204	15 ohm, ½W, 10% Ins. Carb.	3229A-150	.10
R205	5.6K, ½W, 10% Ins. Carb.	3229A-562	.10
R206, 209	100 ohm, ½W, 10% Ins. Carb.	3229A-101	.10
R207	470 ohm, ½W, 10% Ins. Carb.	3229A-471	.10
R208	68 ohm, ½W, 10% Ins. Carb.	3229A-680	.10
R210, 249, 251, 260	8.2K, ½W, 10% Ins. Carb.	3229A-822	.10
R213, 261	3.3K, ½W, 10% Ins. Carb.	3229A-332	.10
R214	39K, ½W, 10% Ins. Carb.	Part of L204	
R215	10 ohm, ½W, 10% Ins. Carb.	3229A-100	.10
R220, 299	220 ohm, ½W, 10% Ins. Carb.	3229A-221	.10
R221	120 ohm, ½W, 10% Ins. Carb.	3229A-121	.10
R222, 308	68K, ½W, 10% Ins. Carb.	3229A-683	.10
R223	1 Meg. Pot. Audio Volume Control	450896B-1	1.00
R224	10 Meg. ½W, 10% Ins. Carb.	3229A-106	.10
R225	220K, ½W, 10% Ins. Carb.	3229A-224	.10
R226, 246, 272, 277, 278, 279,	470K, ½W, 10% Ins. Carb.	3229A-474	.10
R227, 263	560 ohm, 1W, 10% Ins. Carb.	3232A-561	.10
R228	1.5 Meg. ½W, 10% Ins. Carb.	3229A-155	.10
R229, 284	1.98K, 1W, 10% Ins. Carb.	3232A-182	.10
R231	15K, ½W, 10% Ins. Carb.	Part of L206	
R232	15K, ½W, 10% Ins. Carb.	Part of L207	
R235	50K, Pot. Shading	450898B-1	.70
R236, 307, 240, 241	27K, ½W, 10% Ins. Carb.	3229A-273	.10
R237	18K, ½W, 10% Ins. Carb.	3229A-183	.10
R238, 259, 267, 286 313	47K, ½W, 10% Ins. Carb.	3229A-473	.10
R239, 253, 276, 290	1 Meg. ½W, 10% Ins. Carb.	3229A-105	.10
R243	330K, ½W, 10% Ins. Carb.	3229A-334	.10
R244	500K, Pot. AGC Set	450897A-1	.70
R245	150K, ½W, 10% Ins. Carb.	3229A-154	.10
R248	24K, ½W, 5% Ins. Carb.	3228A-243	.10
R250	120K, ½W, 5% Ins. Carb.	3228A-124	.10
R252	2.4 Meg. ½W ± 5% Ins. Carb.	3228A-245	.10
R254	330 ohm, ½W, 10% Ins. Carb.	3229A-331	.10
R255, 314	47K, 1W, 10% Ins. Carb.	3232A-473	.10
R256, 262	3.9 Meg. ½W, 10% Ins. Carb.	3229A-395	.10
R257	6.8K, 1W, 10 % Ins. Carb.	3232A-682	.10
R283	22K, ½W, 10% Ins. Carb.	3229A-223	.10
R285	2.2 Meg. ½W, 10% Ins. Carb.	3229A-225	.10
R264	5K, Pot. Vert. Linearity	450893A-1	1.35
R281	1K, ½W, 10% Ins. Carb.	3229A-102	.10
R242	33K, ½W, 10% Ins. Carb.	3229A-333	.10

RESISTORS - Continued

REF. NO.	DESCRIPTION	PART NO.	LIST
R269	38K, ½W, Special Temp. Comp. Resistor	450917A-1	$ .45
R270, 273	1.5 Meg. Pot. Height & Vert. Hold	4590892A-1	.75
R280, 302	10K, ½W, 10% Ins. Carb.	3229A-103	.10
R282	560K, ½W, 10% Ins. Carb.	3229A-564	.10
R287	1 Meg. Pot. Hor. Drive	450894A-1	.75
R288	6.8K, ½W, 10% Ins. Carb.	3229A-682	.10
R289	47 ohm, ½W, 10% Ins. Carb.	3229A-470	.10
R291, 292	220 ohm, 1W, 10% Ins. Carb.	3232A-221	.10
R293, 304	18K, 1W, 10% Ins. Carb.	3232A-183	.10
R296A) R296B)	(60 ohms, 10% Wire Wound, 2W) (680 ohms 10% Wire Wound 5W)	650211A-1	.75
R297	4.5K, Pot. Focus Control	450891A-1	1.85
R298A) R298B)	(1600 ohm, 10% Wire Wound, 2W) (3700 ohm, 10% Wire Wound, 5W)	650212A-1	1.10
R300A) R300B)	(630 ohm, 10% Wire Wound 10W) (630 ohm, 10% Wire Wound 10W)	650213A-1	1.15
R303, 306	5K, 7W, 10% Wire Wound	650101A-8	.55
R305	250 ohm, Pot. Width Control	450966A-1	2.00
R268, 309	100K, ½W, 10% Ins. Carb.	3229A-104	.10
R310	470K, 1W, 10% Ins. Carb.	3232A-474	.10
R311	4.7K, ½W, 10% Ins. Carb.	3229A-472	.10
R312	1.2K, 1W 10% Ins. Carb.	3232A-122	.10
R315	1 ohm, 1W, 10% Wire Wound	650101A-10	.15

INDUCTANCES

REF. NO.	INDUCTANCE AND FUNCTION	PART NO.	LIST
L201	Heater Isolation Choke	38977	.10
L203	500 uh. Video Coupling Filter	650220A-1	.50
L204	180 uh. Video Coupling Filter	650219A-1	.35
L206, 207	98 uh. Video Coupling Filter	650219A-3	.40
L208	250 uh. Video Coupling Filter	650220A-3	.45
L210	11 uh. Hor. Osc. Peaking	650221A-1	.65
L212	4-27 mh. Hor. Linearity Control	450477A-1	1.20
L214	1 Hy. Power Supply Filter	650215A-1	2.20
L215	Focus Coil	750149B-1	10.55
L216	Defl. Yoke	750155A-G1	11.30

TRANSFORMERS

REF. NO.	FUNCTION	PART NO.	LIST
T201, 202, 203	Video I. F. Transformer	650218A-1	$ .80
T204	Sound I. F. Transformer	450518A-2	1.50
T2056	Ratio Det. Input	650235A-1	2.65
T207	Audio Output	650216A-1	2.35
T208	Vertical Scan Output	650238A-1	5.85
T209	Hor. Sine Wave Oscillator	650230A-1	2.70
T210	Hor. Scan Output	750163C-1	6.15
T211	Power Transformer	750144A-1	20.00
T212	Damper Tube Heater Isolation	650243A-1	4.05

MISCELLANEOUS

DESCRIPTION	PART NO.	LIST
R. F. Tuner	850078D-1	$57.50
Dial Cord (17")	92192	.10
Tension spring (2 required)	64411	
Special wafer socket for 1B3-GT	650033A-5	.10
Anode Connector, H. V.	650049A-3	.45
Rubber grommet, H. V.	62115	
Shield, Tube	450476B-1	.10
Socket, C. R. T.	650232A-1	.85
Mounting wafer, F. P. capacitors	54144	.10
Fuse, 0.25 ampere	450183A-1	.30
Fuse, 5.0 ampere	48006	.15
Ion trap magnet (Double Magnet)	650161A-4	1.80
Ion trap magnet (Single Magnet)	650276A-1	1.10
Line cord	22208-2	1.10
Fuse block	80454	.20
Fuse cover	450936A-1	.10
Receptacle, interlock	80489	.20
Retaining ring (E washer) for balance control shaft (2 used)	37333	.10
Speed nut ("U" type) for horizontal linearity control core	450374A-2	.10
Wingscrew (8-32 X 3/8) for horizontal linearity control	36548-4	.10
Rubber cushion for C. R. T.	450973A-1	.30

Cabinet Parts

Description	Part No.	List
Speaker Assembly, 8" PM (Models 3011-M and 3011-B)	750151A-1	$6.80
Speaker Assembly, 12" PM (Models 3012-M and 3012-B)	850082A-1	10.00
Speaker Assembly, 6" X 9" PM (Model 323-M)	750180A-1	8.45
Safety Glass Escutcheon (Models 3011-M and 3011-B)		
Clear Glass	850085B-2	8.75
Polatron Glass	850085B-4	20.95
Safety Glass Escutcheon (Models 3012-M and 3012-B)		
Clear Glass	850085B-1	9.20
Polatron Glass	850085B-3	21.60
Safety Glass Escutcheon (Model 323-M)		
Clear Glass	850112A-1	13.80
Polatron Glass	850112A-2	24.05
Picture Tube Mask (Models 3011-M and 3011-B)	850086B-2	4.45
Picture Tube Mask (Models 3012-M and 3012-B)	850086B-1	4.45
Picture Tube Mask (Model 323-M)	950073A-1	10.10
Bracket, Safety Glass Support (Models 3011-B and 3012-B)	450909A-2	.20
Bracket, Safety Glass Support (Models 3011-M and 3012-M)	450909A-1	.20
Knob, Balance (All Models listed)	650239A-3	.95
Knob, Shading "	650239A-4	.95
Knob, Channel "	650210B-3	1.80
Knob, Sound "	650210B-4	1.80
Antenna Switch "	90265	.30

PRICES SUBJECT TO CHANGE WITHOUT NOTICE.

NOTES

CHASSIS	MODEL NO.
CX-33L	320-M
CX-33	321-M
CX-33	321-B
CX-33	322-M
CX-33	324-M
CX-33	325-F
CX-33L	326-M
CX-33A	327-M
CX-33M	328-M
CX-33F	332-M
CX-33F	332-B
CX-33F	334-M
CX-33K	337-M

THE *Capehart*

"CX-33" TELEVISION CHASSIS

SUPPLEMENTARY

MAINTENANCE INFORMATION

SUPPLEMENT TO FORM SERV. 148

CHASSIS NO.	PRODUCTION NO.	PRODUCTION RUN
CX-33	C-281	Series "-3"
CX-33F	C-286	Series "-3"
CX-33A	C-285	Original
CX-33L	C-289	Original
CX-33M	C-290	Original
CX-33K	C-292	Original

Basic Differences Between Chassis

All of the above listed chassis are of similar design. The CX-33 is a complete unit using a 16 inch Rectangular picture tube; the CX-33F is a complete unit using a 16 inch round (Metal) picture tube and the CX-33L is a complete unit using a 17 inch Rectangular picture tube. The CX-33A is the basic chassis less the audio section (tubes V209 & V210) and using a 16 inch Rectangular picture tube. The CX-33M chassis is identical to the CX-33A chassis with exception that it employs a 17 inch Rectangular picture tube. The CX-33A chassis is used in model 327M in conjunction with C-284, an 11 tube AM chassis. The CX-33M is used in model 328M in conjunction with C-282, an 11 tube AM FM chassis, and C-243 (or C-295) a single tube phono pre-amplifier chassis. The CX-33K chassis is used in model 337M in conjunction with the C-282 radio chassis and C-295 phono pre amp chassis. For service information on these radio chassis, refer to their respective maintenance manuals, NOTE: models 327M & 328M are combination instruments employing the models "333A" and "333A-VR" record changers, respectively. For service information on these record changers, refer to the maintenance manual on Capehart record changer, models "333A" and "333A-VR".

The RF Tuner Part Number 850103A

The RF tuner used in this chassis employs two tubes: a 6AG5 RF Amplifier and a 6J6 Mixer Oscillator. The input circuit employed is a balanced 300 ohm tuned input type. The RF Amplifier circuit, using a 6AG5, has a double tuned bandpass coupling to the mixer grid. The Mixer stage employs one triode section of the 6J6 tube. Oscillator excitation is inductively coupled to the mixer grid. The oscillator section of the 6J6 tube is employed as a Grounded Cathode Colpitts type oscillator.

Tuning or channel selecting is accomplished in this tuner by switching inductances by means of a rotating turret. Channel sequence of tuning is progressive: channel 2 through 13, with clockwise rotation. The individual coils comprising the tuned circuits for each channel are fabricated on low-loss bakelite moldings which are held in position on the turret by a "key" and "latch spring" construction. All circuit switching in the tuner is accomplished by means of eleven spring pressure contacts. Vernier or "fine" tuning is accomplished by an auxiliary capacitor which is shunted across the plate section of the tank circuit. This capacitor is operated through a dial cord and pulley arrangement by the Balance Control. Average range of the fine tuning control on the low band is approximately + or - 0.5 mc and on the high band + or - 1.6 mc.

A single tuned inductance (tuned to 23.0 mc) in series with a 120 mmf capacitor form the resonant coupling circuit between the mixer plate and the grid of the 1st IF Amplifier.

This tuner is used in the CX-33 and CX-33F chassis starting with the series "-3" production run. The CX-33A, CX-33M, CX-33K, and CX-33L chassis employ this tuner exclusively.

ISSUED BY THE SERVICE DEPARTMENT
CAPEHART-FARNSWORTH CORPORATION
An IT&T Associate
FORT WAYNE, INDIANA

PRICE 25 CEN

Alignment Data

IF Amplifier

The IF Amplifier bandpass in these chassis has been increased from 3 mc to approximately 3.5 mc to provide improved picture definition. To accomplish this, the peaking of two of the IF coils in the stagger-tuned IF system have been changed. Therefore, when aligning any of the chassis listed on the front page of this supplement, the following important items should be noted:

1. T101, the coil in the mixer output stage (located on the RF tuner) should be peaked at 23.0 mc instead of 23.5 mc as stated in the CX-33 Maintenance Manual.

2. T202 should be peaked at 25.8 mc instead of 25.9 mc.

3. A co-channel sound tr p (T213) has been added in the plate circuit of the 1st IF Amplifier and is located directly in rear of the 1st IF Amplifier tube (V201). This trap should be set up by tuning it for minimum response (as indicated by a VTVM connected across R213) to a 21.75 mc signal at the mixer grid.

The bandpass of the IF stages is shown in figure 1 of this supplement.

RF and Mixer Alignment (RF tuner, Part no. 850103A-1)

1. Connect the sweep and signal generators to the receiver antenna terminals. To avoid distortion keep the output of the signal generator (pix and sound carrier markers) at a minimum, markers just barely visible on the curve.

2. Connect the oscilloscope to the RF test point (wire loop) on the RF tuner, through a 10 K resistor.

3. Connect a "jumper" from the AGC lead to the tuner, to chassis ground. Leave the jumper connected for all steps under RF and Mixer Alignment.

4. Set the Channel Selector to channel 12.

5. Adjust the sweep generator to sweep channel 12 and adjust the signal generator to provide marker signals at the picture and sound carrier frequencies for channel 12.

6. Adjust C104, C103, and C102 (shown in figure 2) for the curve shown in figure 3. Consistent with proper band width and marker location, the response curve should have maximum amplitude and "flat top" appearance.

7. Adjust the sweep and signal generators progressively for each channel. Check the response curve obtained on each channel against the curve shown in figure 3. If the response of a particular channel does not come within these limits, check to see that the correct coils for that channel are being used or try replacing the coils for that channel. As a final step, it is possible that a compromise can be made by re-adjusting C104, C103, and C102 to improve the response of the particular channel that is off. The response of all other channels then should be re-checked to determine the extent to which they were affected by the compromise.

RF Oscillator Alignment

1. Connect the sweep and signal generators to the antenna terminals. To avoid destroying the response curve (due to overloading in the video detector) maintain outputs of the sweep and signal (marker) generators at a bare minimum. The marker pips should just be barely visible.

2. Connect a 500K potentiometer (on clip leads) between pins 6 and 8 of V213 and vary the "pot" to set the DC bias at the junction of R248 and R249 to -3 volts.

3. Connect the oscilloscope across R213. Attach the "high side" of the oscilloscope to the junction of R248 and R249 to -3 volts.

4. Adjust the sweep generator to sweep channel 13 and adjust the signal generator to provide markers at the picture and sound carrier frequencies for channel 13. Before attempting alignment, allow 15 minutes for receiver and test equipment to reach normal operating temperature.

5. Check the response curve obtained against the ideal curve shown in figure 4. If the shape of the curve is not within these limits, it will be necessary to repeat the IF Amplifier Alignment. The IF Amplifiers must be correctly aligned before the oscillator adjustments can be correctly made.

6. Set the Balance Control at the center of its mechanical range and adjust the channel 13 oscillator slug (see figure 5) to approximately the center of its range. Use a non-metallic screwdriver with about a 1/8 inch blade for adjustment of the individual oscillator slugs. If one of the slugs should "fall into" the coil form, remove the coil segment from the turret, move the slug retaining spring aside, and tap the coil segment until the slug slips forward. Set the slug retaining spring in place again to secure the slug.

7. If, with the conditions stated in step 6, the picture and sound carrier markers are not within the limits shown in figure 4, adjust the overall oscillator trimmer C105 to bring them within limits.

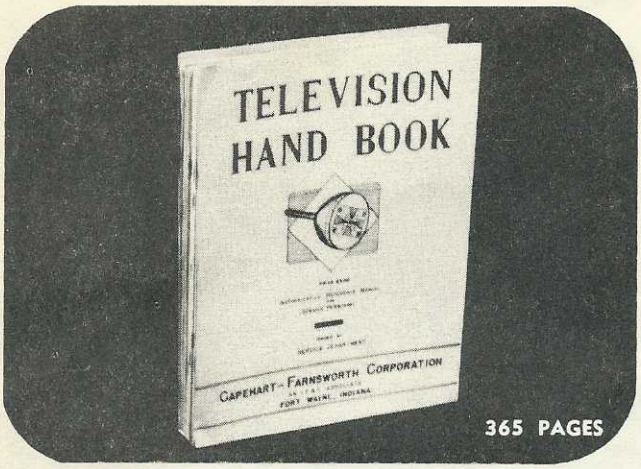
8. With the Balance Control adjusted to the center of its range, check the response curve on all channels for proper marker location. If adjustment is required on any channel use the individual channel oscillator slug to obtain the proper marker location.

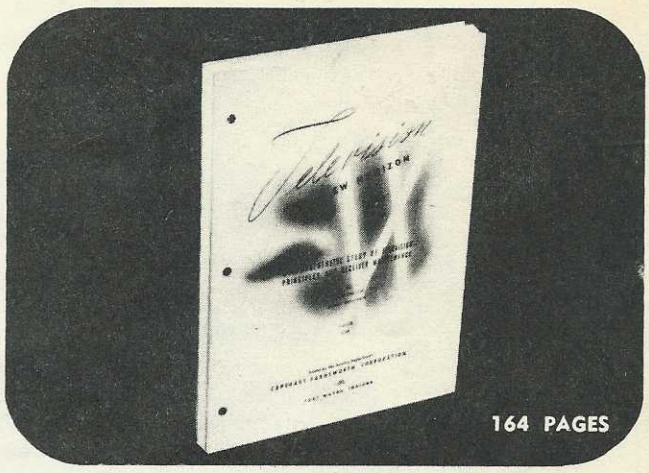
NOTE: The individual channel oscillator slugs are accessible from the front of the cabinet, therefore oscillator "touch up" on any channel can be accomplished without removing the chassis from the cabinet. For further information, refer to "Oscillator Alignment Using a TV Signal" on page 25 of the CX-33 Manual.

Capehart-Farnsworth

TECHNICAL PUBLICATIONS

USEFUL INFORMATION FOR THE STUDENT OR SERVICEMAN





TELEVISION HANDBOOK

Combining the complete contents of "Television – The New Horizon (described at right) with numerous other subjects, the "Television Handbook" represents an authoritative reference manual for service personnel. Included is the "Television—Let's Understand It" technical series covering such subjects as Television History, Terminology, TV and FM Antennas and Test Equipment, Smearing in TV, Damping Circuits, Cathode-Coupled Multivibrators and TV Reception Problems. Also included is data on TV Reception in fringe areas, Picture tubes, "Logic" in TV servicing, etc. A compilation of television material that is educational as well as helpful in everyday servicing.

Price, $3.00.

TELEVISION—THE NEW HORIZON

As a comprehensive study of television principles and receiver maintenance, "Television—The New Horizon" offers an indoctrination to "Television" covering numerous phases of the subject — telecasting equipment and processes, antennas, the generalized receiver, test equipment, and a Section on Color Television, with specific references being made to servicing Caphart-Farnsworth television receivers. Maintenance information and Schematic diagrams of all Capehart-Farnsworth TV receivers manufactured to date comprise a part of this technical discussion. A manual no Serviceman should be without.

Price, $2.50.

TV MAINTENANCE MANUALS

Capehart "CX-33" Chassis (Form Serv. 148).....$1.00
Models 3011-M, 3011-B, 3012-M, 3012-B and 323-M)

Capehart "CX-32" Chassis (Form Serv. 152).....$1.00
Models 3005-M and 3008-M

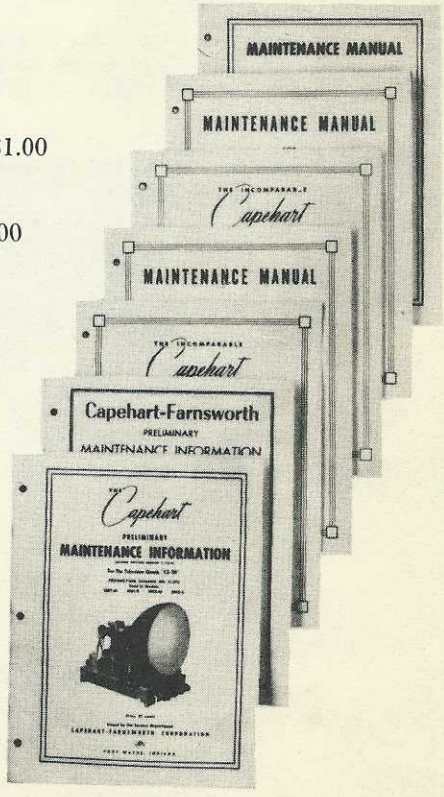
Capehart "CX-31" Chassis (Form Serv. 146).....$1.00
Models 3004-M, 3006-M, 4001-M and 4002-M

Capehart "CX-30" Chassis (Form Serv. 147).....$1.00
Models 3001-M and B, 3002-M and 3007-M and B

Capehart "U-12" Chassis (Form Serv. 129).....$0.50
Models 461P, 462P, 501P, 502P and 504P

Capehart Models 610P and 661P and Farnsworth Model 651P
(Form Serv. 127).....$0.50

Farnsworth Model GV-260 (Form Serv. 116).....$0.50



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CAPEHART-FARNSWORTH CORPORATION

PUBLICATIONS SECTION—SERVICE DEPT.

FORT WAYNE, INDIANA

FACTORY REPAIRS AND RETURNED GOODS POLICY

It should seldom, if ever, be necessary that a receiver chassis be returned for factory service repairs, since there are few parts which can become inoperative in the modern receiver which a competent radio serviceman cannot repair by first locating, then making substitution for, the defective part.

A great deal of time is lost as a result of merchandise being returned to us without authorization. Instruments arrive without any explanation of why they were returned . . . or what disposition is to be made. These indiscriminate returns seriously handicap our efforts toward PROMPT AND EFFICIENT SERVICE. Therefore:

1. No merchandise of any type is to be returned to the Capehart-Farnsworth Corporation without written authorization and issuance of R.G.A. (RETURNED GOODS AUTHORIZATION).
2. To facilitate the return of such merchandise, special forms are provided. These forms are issued only by the Capehart-Farnsworth Field Service Representative in your area.
3. Upon the request of the Capehart-Farnsworth Distributor, and if proper he will issue Returned Goods Authorization papers to accompany the return of material to the factory.
4. All merchandise returned to the factory must be properly packed to avoid damage in transit. We reserve the right to refuse adjustments on parts returned or to charge back for parts or equipment which are damaged in transit, and which upon inspection are found to have been caused by improper packing.
5. The Return Goods form supplied must accompany the merchandise.
6. The Returned Goods number must be plainly marked on the outside of the shipping container.
7. All merchandise must be shipped prepaid.

Form Serv.-148 (7-1-50)

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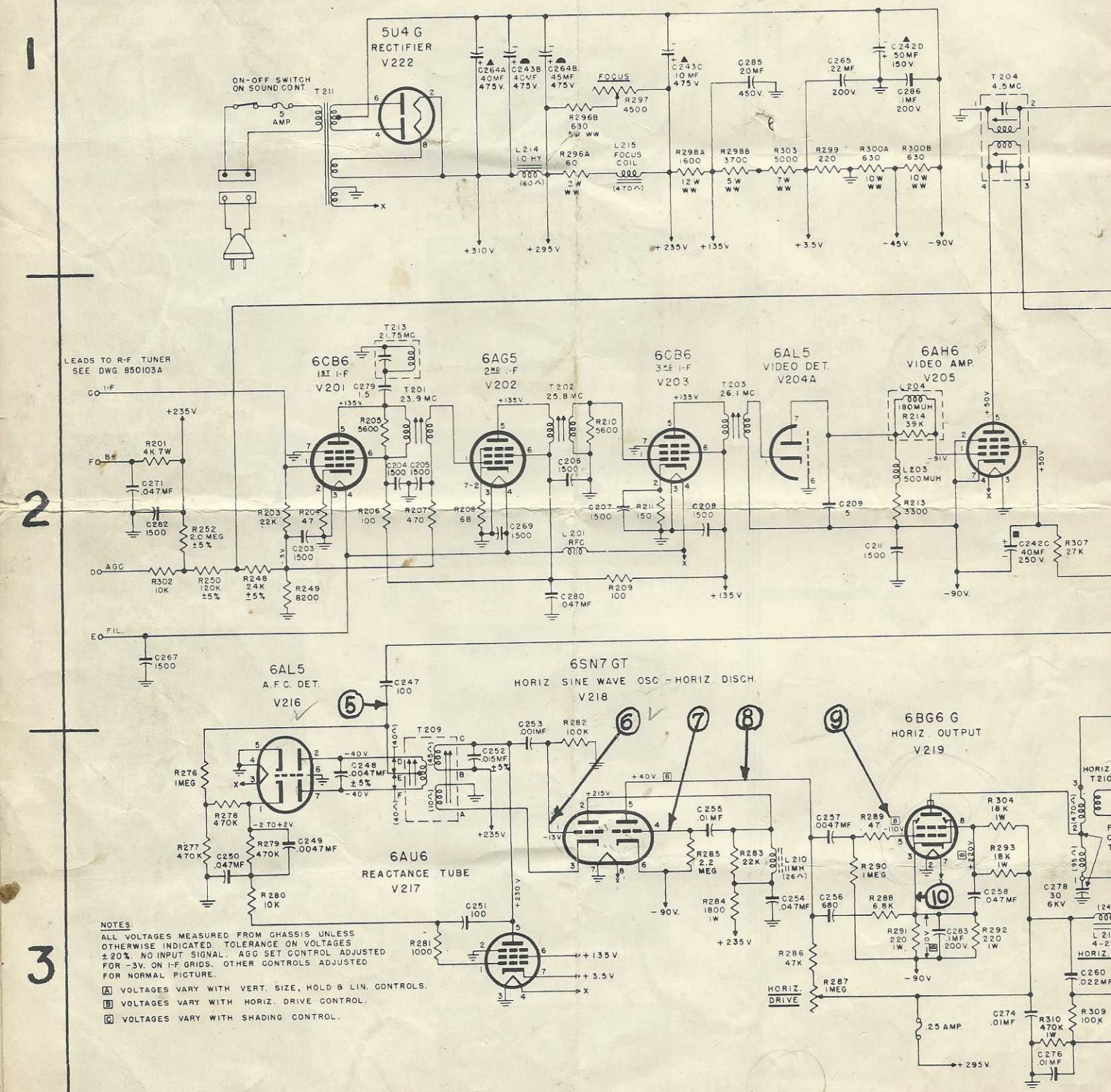
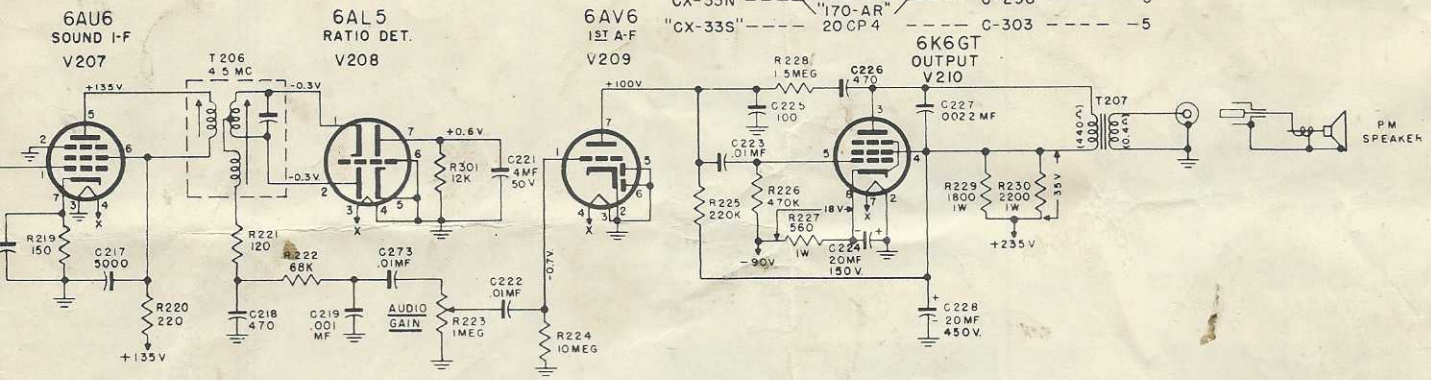
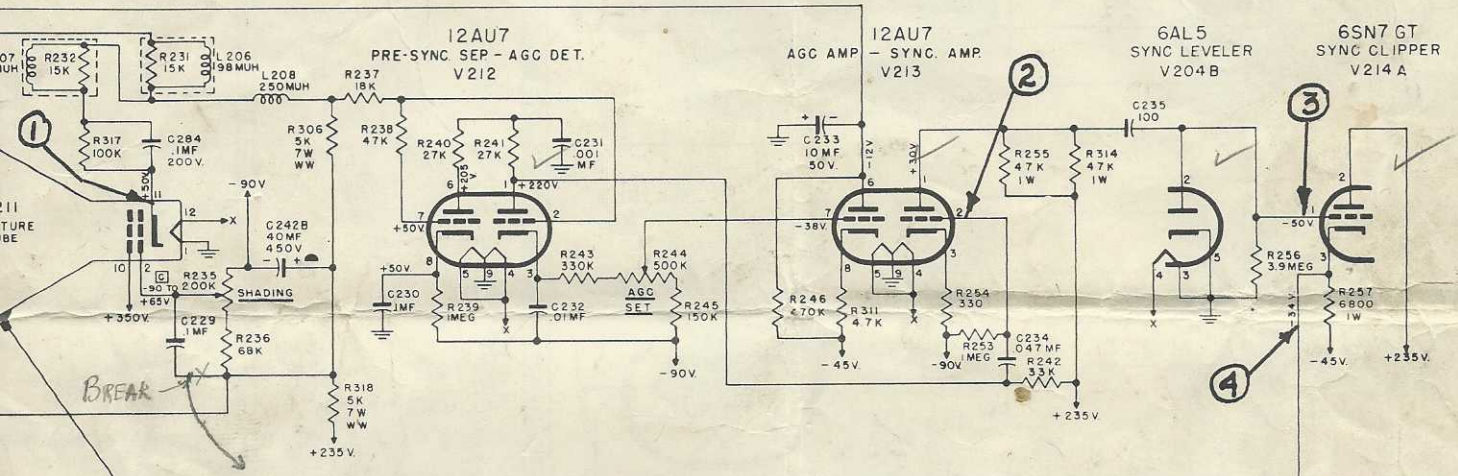


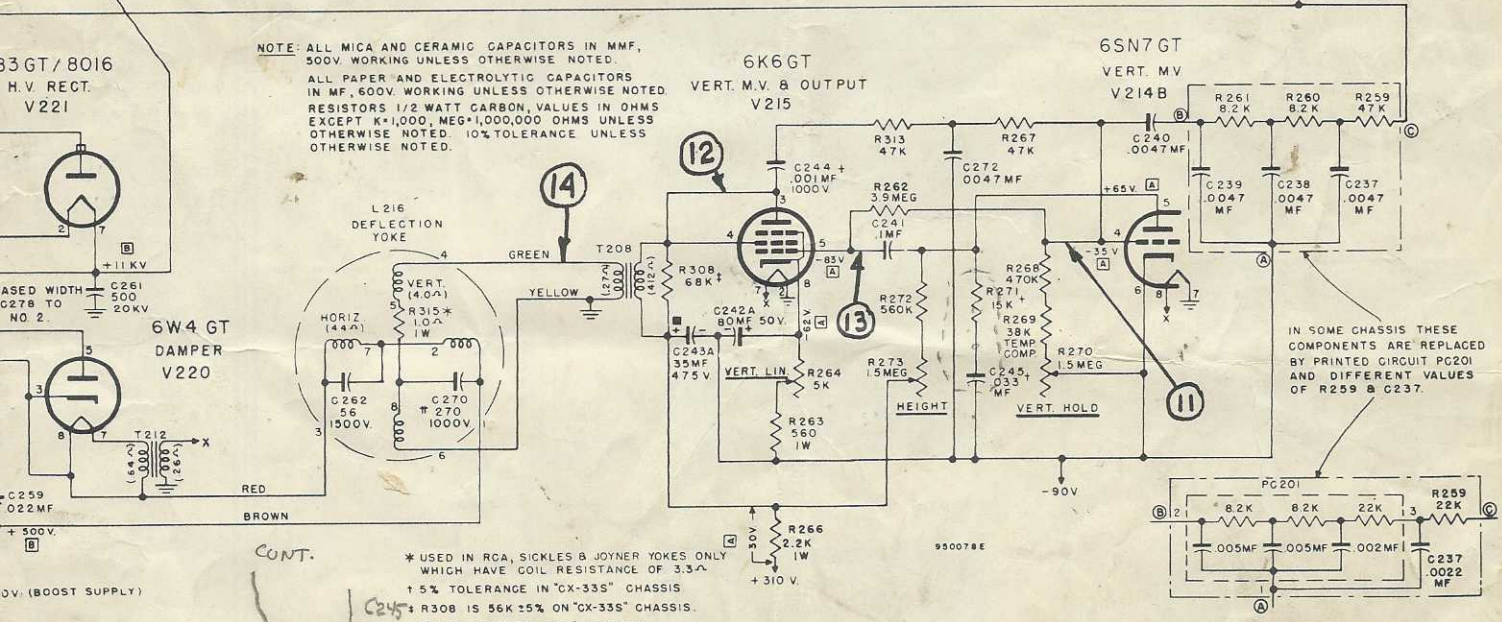
"CX-33" CHASSIS

THIS SCHEMATIC CORRECT FOR THE FOLLOWING CHASSIS:

CHASSIS NO.	PICTURE TUBE	PRODUCTION NO.	SERIES
"CX-33"	FARNSWORTH "160-AR"	C-281	-5
"CX-33F"	16GP4	C-286	-5
"CX-33L"	"170-AR"	C-289	-5
"CX-33LH"	"170-AR"	C-304	-5
"CX-33N"	"160-AR" / "170-AR"	C-298	-5
"CX-33S"	20CP4	C-303	-5







NOTE: ALL MICA AND CERAMIC CAPACITORS IN MMF, 500V. WORKING UNLESS OTHERWISE NOTED.
ALL PAPER AND ELECTROLYTIC CAPACITORS IN MF, 600V. WORKING UNLESS OTHERWISE NOTED.
RESISTORS 1/2 WATT CARBON, VALUES IN OHMS EXCEPT K=1,000, MEG=1,000,000 OHMS UNLESS OTHERWISE NOTED. 10% TOLERANCE UNLESS OTHERWISE NOTED.

IN SOME CHASSIS THESE COMPONENTS ARE REPLACED BY PRINTED CIRCUIT PC201 AND DIFFERENT VALUES OF R259 & C237.

* USED IN RCA, SICKLES & JOYNER YOKES ONLY WHICH HAVE COIL RESISTANCE OF 3.3Ω
† 5% TOLERANCE IN "CX-33S" CHASSIS.
‡ R308 IS 56K ±5% ON "CX-33S" CHASSIS.
# OMITTED ON "CX-33S" CHASSIS.

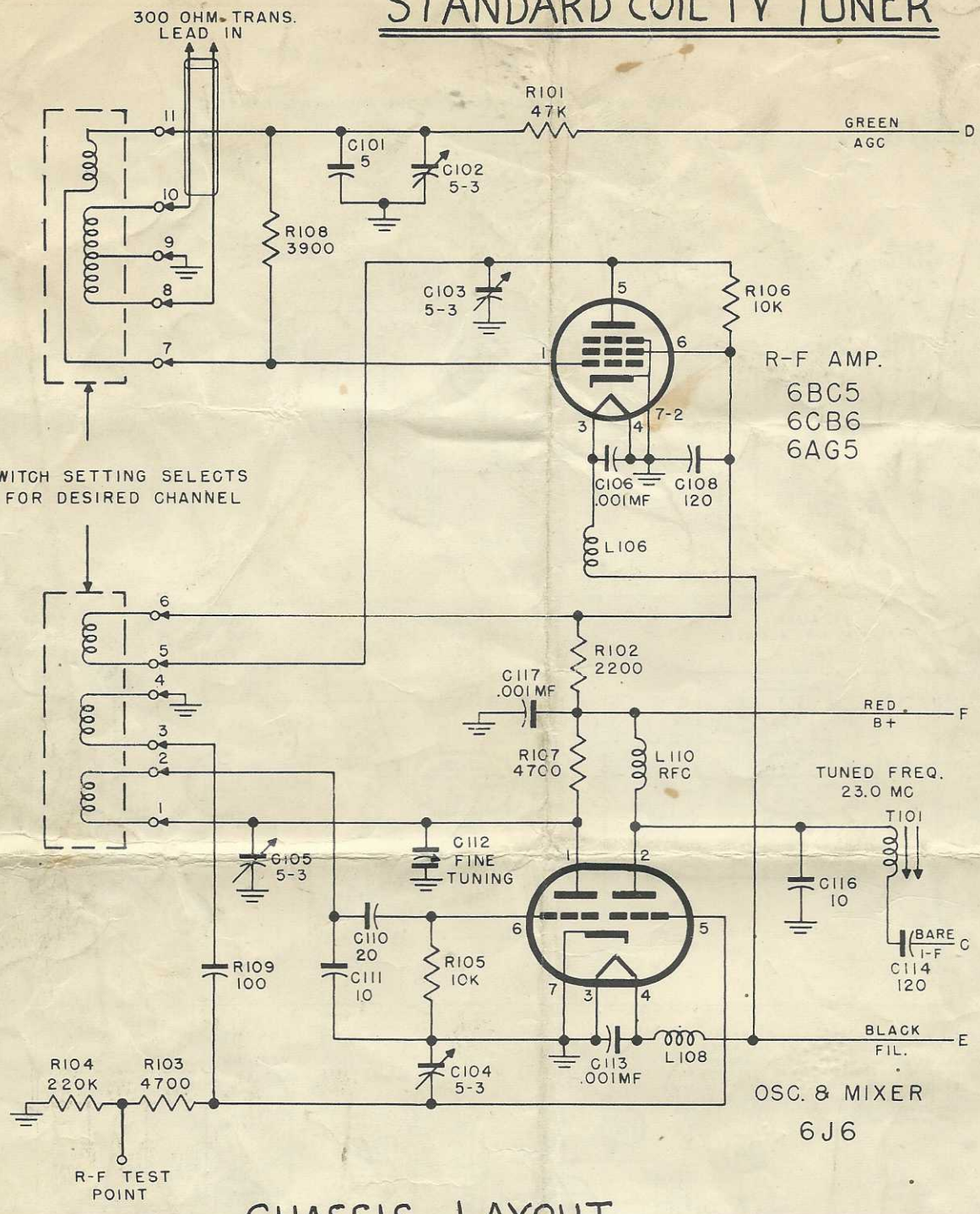
CONT.

C245 R271

REVERSE POSITIONING

950078E

STANDARD COIL TV TUNER



CHASSIS LAYOUT

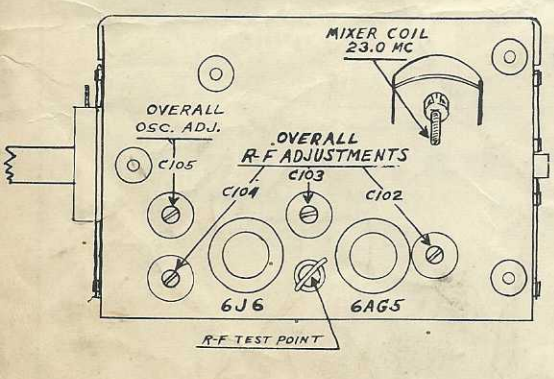
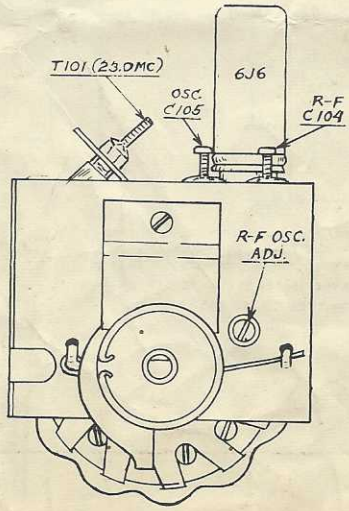
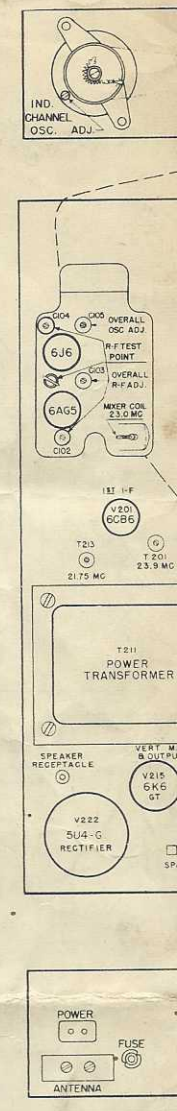


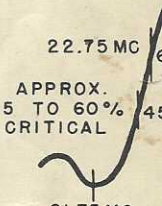
Fig. 2





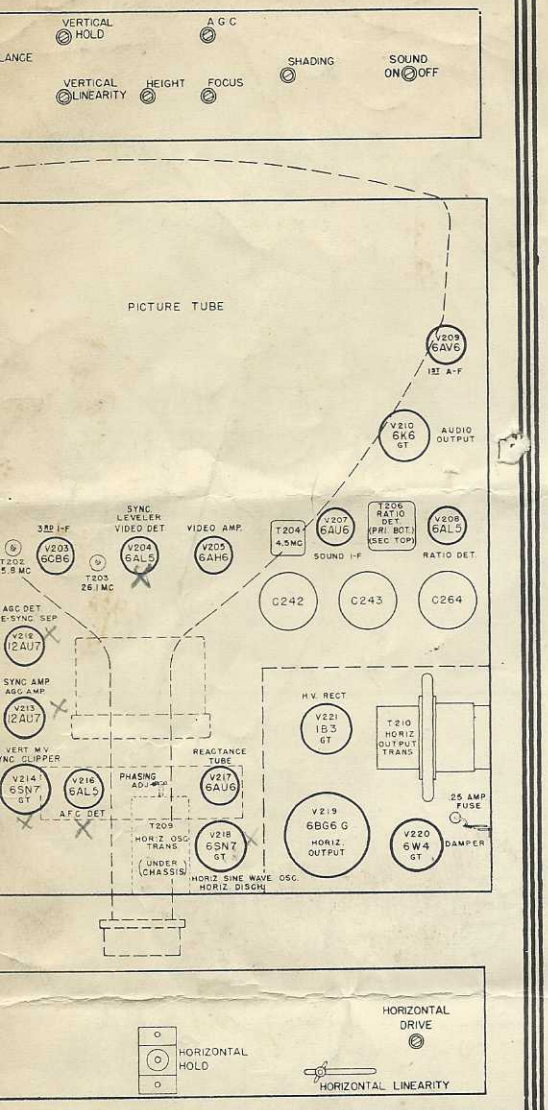
R-F

ROUND CORNER

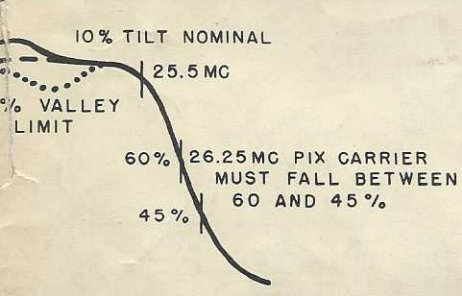


R-

3 CHASSIS LAYOUT

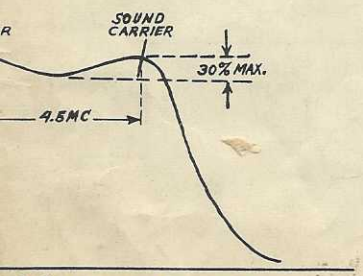


F RESPONSE CURVES



ESPONSE CURVE

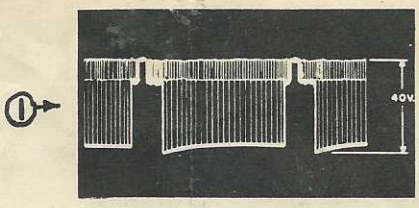
Fig. 1



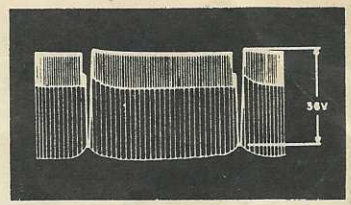
ESPONSE CURVE

Fig. 3

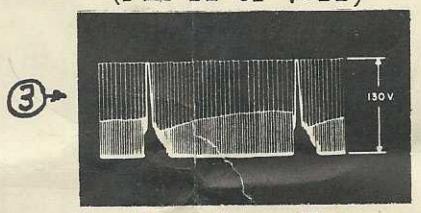
"KEY" WAVEFORMS



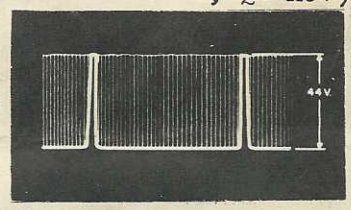
① Picture Tube Cathode †
(Pin 11 of V211)



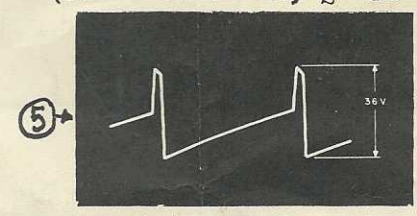
② Input to Sync Amplifier †
(Pin 2 of V213, ½12AU7)



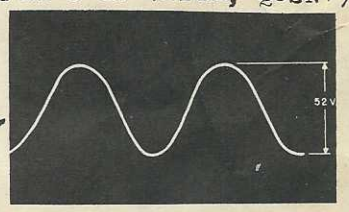
③ Input to Sync Clipper †
(Pin 1 of V214A, ½ 6SN7)



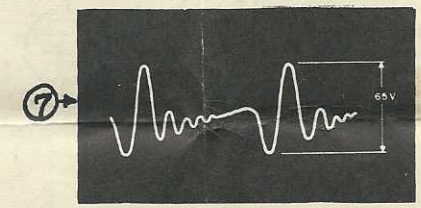
④ Cathode of Sync Clipper †
(Pin 3 of V214A, ½6SN7)



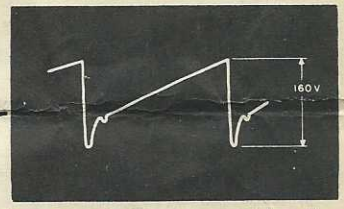
⑤ Input to AFC Detector ††
(Terminal E of T209)



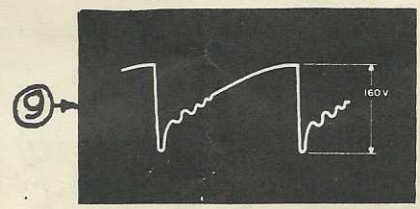
⑥ rid of Horiz. Oscillator ††
(Pin 1 of V218)



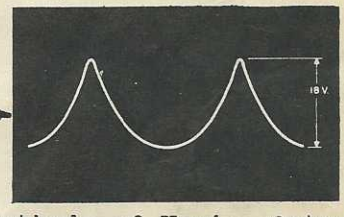
⑦ Grid of Horiz. Discharge ††
(Pin 4 of V218)



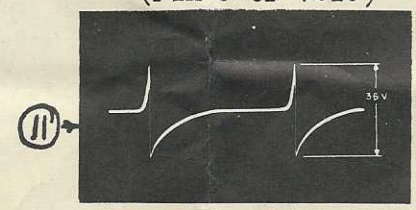
⑧ Output of Horiz. Discharge ††
(Pin 5 of V218)



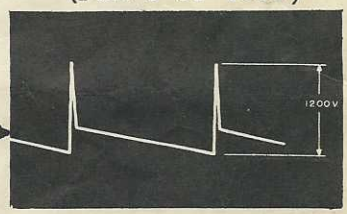
⑨ Input to Horiz. Output ††
(Pin 5 of V219)



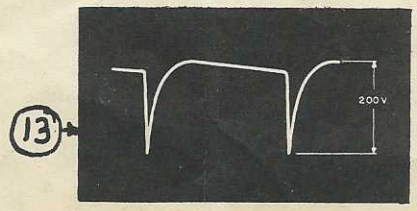
⑩ Cathode of Horiz. Output ††
(Pin 3 of V219)



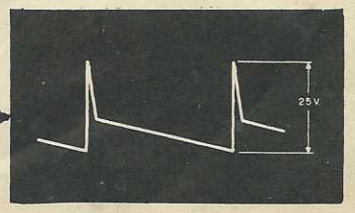
⑪ Grid of Vertical M. V. †
(Pin 4 of V214B, ½6SN7)



⑫ Output of Vert. M.V. & Output †
(Pin 3 of V215, 6K6)



⑬ Grid of Vert. M.V. & Output †
(Pin 5 of V215, 6K6)



⑭ Input to Vert. Defl. Coils †
(Green lead of L216)

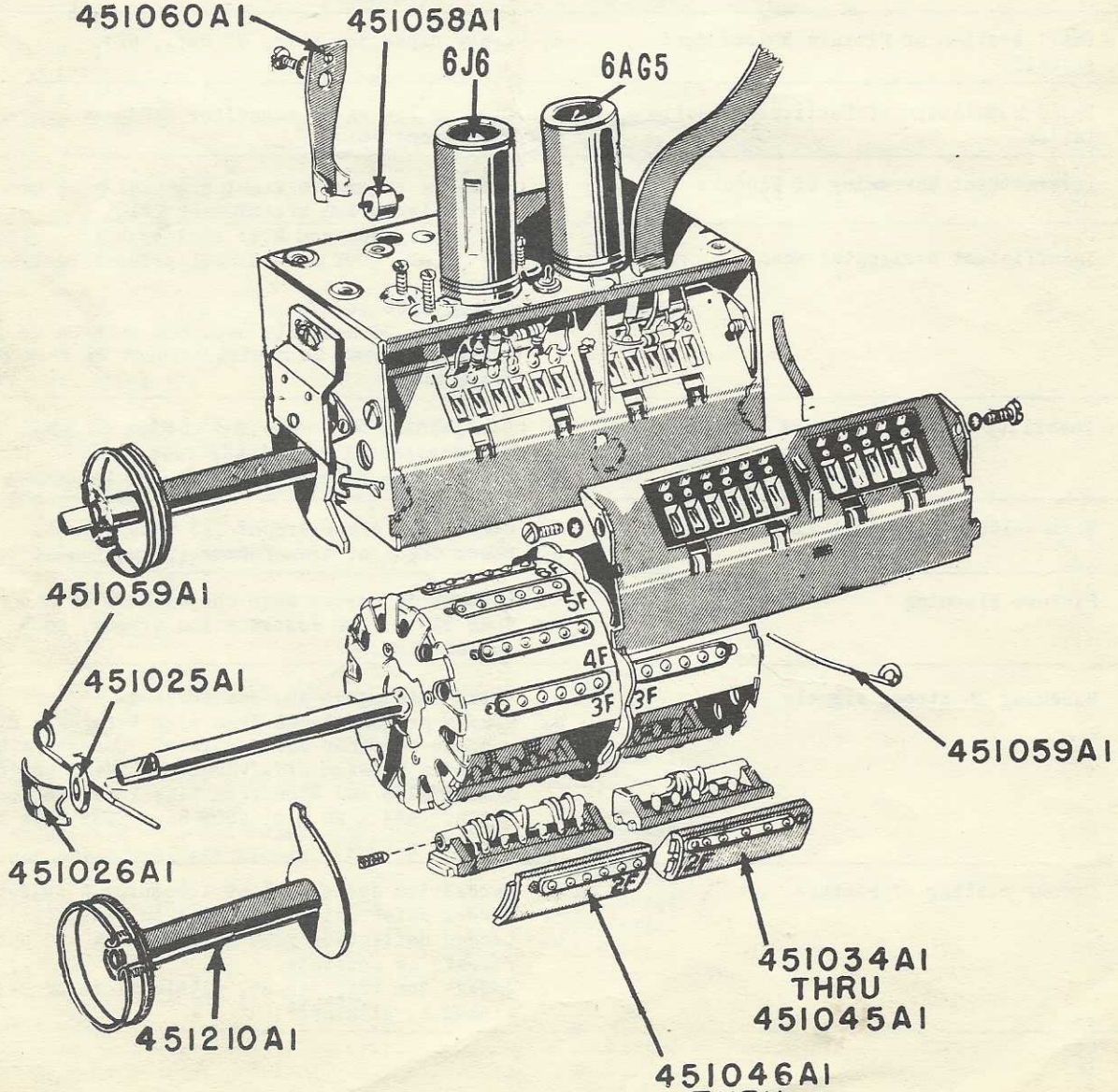
† SCOPE SWEEP - 30 C.P.S. †† SCOPE SWEEP - 7875 C.P.S.

SERVICING SUGGESTIONS

Following is a summary of service conditions which may be observed in the CX-33 chassis and their recommended corrections. These are included herein to assist the service technicians in troubleshooting this chassis.

	Condition	Correction
1.	"Whistle" in sound and/or lines in picture (similar to Barkhausen oscillation)	a. Additional bypassing may be needed in the B minus circuit. Add a .1 mfd, 200V cap. from -90V point to chassis ground (near 6BG6 tube, junction of R291 & R-290).
2.	Insufficient Vertical Scan	(if production run "2" or earlier) a. Change R262 from 2.2 meg to 3.9 meg. b. Connect R266 to 310V bus instead of 295V. c. Change R267 from 22K to 47K (any production run). d. Change 6K6 (Vert. output) to 6V6 or 6F6.
3.	Picture "Jitter" Vertical	a. Possibly "leaky" coupling cap. between Sync, Amp., & Sync Clipper C235 (100 mmf)
4.	Intermittent Vertical Sync Buzz	a. Over modulation at TV transmitter. b. Insufficient drive at ratio detector. Connect a 3 mmf cap. between terminals 2 and 4 of T204. Check sound alignment.
5.	Small section of Picture Shifts Horizontally	a. Leaky Capacitor C278, 30 mmf., 6KV.
6.	Sound Modulation of Horizontal Oscillation	a. Open or low value capacitor C228 b. R229 wrong value.
7.	Intermittent Narrowing of Picture	a. Possibly excessive winding capacity of Damper Tube heater isolation transformer T212.
8.	Insufficient Horizontal Scan	(if production run 2 or earlier) a. Add .1 mf, 200V across R291 cathode resistor of 6BG6 tube. b. Change R286 to 47K. c. Connect a 30 mmf, 6KV cap. 6W4 cathode to ground. If additional scan is needed connect it from 6BG6 plate to ground.
9.	Inability to Phase Picture Correctly	a. Change C253 to .001 mfd and R282 to 100K. b. Bad Horizontal Oscillator tube. C. C251 (100 uuf) open (on plate of Reactance tube).
10.	High Voltage Circuit Arcing or Corona	a. Check lead dress around 1B3 tube socket. b. Check dress of transformer (T210) leads.
11.	Picture Blooming	a. Connect in series with the cathode of the CRT (pin 11) a 100K resistor and .1 mfd, 200V cap. in parallel.
12.	Blocking on strong signals	a. Check setting of AGC set control. b. Remove present leads from plus terminals of C242B, connect together and insulate. Connect a 5K, 7W, ww resistor between plus terms. of C243C and C242B. Remove R236 and R306 from plus 135V and connect to C242B. Add a 20 mfd, 450V cap. from plus 135V to chassis ground.
13.	Corner cutting of Picture	a. Reposition focus coil by loosening 4 self-tapping screws which hold focus coil in bracket. b. Loosen deflection yoke Mtg. bracket and push yoke as forward as possible. c. Adjust ion trap magnet, within range of max. brilliance to eliminate.

14.	Unable to Properly Align Sound Take-Off Transformer (T204)	a. Possible that due to material variation the tuning range has drifted. If so, connect a 5 mmf cap. between terminals 3 & 4 of T204.
15.	Unable to Obtain Proper Focus	a. Check adjustment of focus control and position of focus coil. b. Check resistance of focus coil (should be 470 ohms) c. Connect a 2.2K, 2w resistor in parallel with R297 and R296B.
16.	Centering Lever too short to make adjustment with rear door closed.	a. Cabinet depth greater on models 332 & 334, therefore extension brackets have been made available. (2) brackets (#452345A-2) & (4) Screws (#2214A-020) required per instrument.
17.	Snow in Moderate signal areas.	a. Check value of R252, R250, & R248 must be within 5% tolerance. b. Replace R252 with a 2.2 meg. resistor, if snow still excessive use a 2.0 meg resistor.
18.	Vertical Instability	a. R269 (38K, Temp. Comp.) changes value. b. R256 decreases in value.
19.	Intermittent Horizontal Sync	a. C247 partially shorted.



Parts Identification R-F Tuner
Part No. 850103A-1

CX-33 CHASSIS PARTS LIST SUPPLEMENT

The following parts have been changed in value or added to sets coded production run "-3".

Ref. no.	Description	Part no.	list
R201	4K, 7w, 10% ww		
R203	22K, ½w, 10% Ins. Carb.	3229A-225	$ .10
R282	100K, ½w, 10% Ins. Carb.	3229A-104	.10
R272	540K, ½w, 10% Ins. Carb.	3229A-564	.10
R268	470K, ½w, 10% Ins. Carb.	3229A-474	.10
C253	.001 ufd MOPT 600V.	2248A-1020	.20
C257	.0047 ufd MOPT 600V.	2248A-4720	.20
C279	1.5 ufd Ceramic, 500V.	650030A-9	.30
T213	Co-channel Sound trap (21.75 mc).	650275A-1	1.05

Add the following to the Miscellaneous section of the CX-33 parts list.

T102	Antenna Coil (for RF tuner #850078D01).	451211A-1	1.55
T101	Converter Coil (for RF tuner #850078D-1).	451212A-1	.65
	Balance Control Shaft (used with RF tuner #850078D-1)	450913B-1	.25
	Balance Control Shaft (used with RF tuner #850103A-1)	452D20A-1	.30
	RF tuner (sub-chassis assembly-850103A-1).		52.85

PARTS LIST FOR RF TUNER PART NO. 850103A-1

L101	Antenna Coil Assembly		
"	for Channel 2.	451034A-1	1.25
"	" " 3.	451035A-1	1.25
"	" " 4	451036A-1	1.25
"	" " 5	451037A-1	1.25
"	" " 6.	451038A-1	1.25
"	" " 7.	451039A-1	1.25
"	" " 8	451040A-1	1.25
"	" " 9.	451041A-1	1.25
"	" " 10	451042A-1	1.25
"	" " 11	451043A-1	1.25
"	" " 12	451044A-1	1.25
"	" " 13	451045A-1	1.25
L102	RF and Oscillator Coil Assembly		
"	for Channel 2.	451046A-1	1.65
"	" " 3.	451047A-1	1.65
"	" " 4.	451048A-1	1.65
	" " 5.	451049A-1	1.65
"	" " 6.	451050A-1	1.65
"	" " 7.	451051A-1	1.65
"	" " 8.	451052A-1	1.65
"	" " 9.	451053A-1	1.65
"	" " 10	451054A-1	1.65
"	" " 11	451055A-1	1.65
"	" " 12	451056A-1	1.65
"	" " 13	451057A-1	1.65
L106	Choke, RF Heater.	451029A-1	.20
L108	Choke, Oscillator Heater.	451030A-1	.20
L110	Choke, RF.	451214A-1	.20
T101	Coupling Coil, Mixer.	451209A-1	.65
C101	Capacitor, 5 uuf, 10%, Zero Temp. Coeff.	451215A-1	.30
C102, C103)			
C104, C105)----	Ceramic Trimmer, .5 to 3 uuf.	451216A-1	
C106, C113, C117-	Capacitor, .001 ufd, min. Hi K.	451061A-1	.25
C108 & C114	Capacitor, 120 uuf, 5%, -750.	451064A-1	.30
C109	Capacitor, 100 uuf, 10%, -750.	451065A-1	.30
C110	Capacitor, 20 uuf, 10%, Zero Temp. Coeff.	451062A-1	.30
C111 & C116	Capacitor, 10 uuf, 5%, -750, Zero Temp. Coeff.	451063A-1	.30
C112	Capacitor, Fine Tuning (Part of #451210A-1) Detent Roller	451058A-1	.10
	Spring, Shaft retaining.	451059A-1	.10
	Balance (Fine Tuning) Assembly.	451210A-1	1.80
	Fibre Washer.	451025A-1	.10

CABINET PARTS
(For Models Listed on cover)

Description	Part no.	List price
Speaker Assemblies:		
8" PM used in models 320M, 320B, 321M, & 321B.	.750151A-1	$ 6.80
12" PM used in models 322M, 322B, 324M, 325M, 326M, 332M, 334M,	.850082A-1	10.00
12" PM used in Models 327M, 328M, 328B.	850105A-1	14.35
12" PM (2) used in model 337M.	.850123A-1	16.70
Safety Glass Escutcheons:		
Model 320M.	850116A-7	11.35
Model 320B.	850116A-8	11.35
Model 321M.	850085B-2	8.75
Model 321B.	850085B-5	8.75
Model 322M.	850085B-1	9.20
Model 322B.	850085B-7	10.80
Model 324M.	850116A-5	11.75
Model 325F.	850095A-3	10.30
Model 326M.	850116A-1	11.65
Model 327M.	850100A-1	9.05
Models 328M & 328B.	850114A-1	10.00
Model 332M.	850113A-3	15.00
Model 332B.	850113A-5	15.30
Model 334M.	850113A-1	15.10
Model 337M.	950079A-1	15.90
Picture Tube Masks		
Models 320M & 320B.	850115A-3	4.85
Models 321M & 321B.	850086B-2	4.45
Models 322M & 322B.	850086B-1	4.45
Model 324M.	850115A-2	4.60
Model 325F.	850093B-1	4.60
Model 326M.	850115A-1	4.40
Model 327M.	850099A-1	4.00
Models 328M & 328B.	850121B-1	4.70
Models 332M & 332B.	950073A-3	9.05
Model 334M.	950073A-2	9.05
Model 337M.	950082B-1	7.65
Safety Glass Support Brackets:		
Models 320M, 321M, 322M, 324M, 326M, 327M, 328M.	450909A-1	.20
Models 320B, 321B, 322B, 325F, 328B.	.450909A-2	.20
Metal Channel for Safety Glass:		
Models 320M, 320B, 322M, 322B, & 3012.	.452046C-2	.45
Models 321M, 321B, & 3011.	.452046C-1	.45
Models 324M & 325F.	452046C-3	.45
Models 326M.	.452046C-5	.65
Models 327M, 328M, 328B.	.452046C-4	.45
Knobs (Brown color, for all mahogany cabinets and model 328B)		
Balance Knob.	.650345A-1	.40
Shading Knob.	.650345A-2	.40
Channel Knob.	.650342A-1	.65
Sound Knob (not used on models 327M, 328M, 328B or 337M)	.650344A-1	.65
Focus Knob (used on model 327M, 328M, 328B, & 337M).	650344A-1	.65
Knobs (Green color, for all blonde cabinets except model 328B)		
Balance Knob.	.650345A-3	.65
Shading Knob.	.650345A-4	.40
Channel Knob.	.650342A-2	.65
Sound Knob.	.650344A-2	.65
Knobs (Gold Gilt, for fruitwood cabinet model 325F and early production models using gilt knobs)		
Balance knob.	.650239A-5	.65
Shading Knob.	.650239A-6	.65
Channel Knob (for tuner #850103A).	650287A-2	1.05
Channel Knob (for tuner #850078D-1).	650210B-5	1.05
Sound Knob.	.650210B-6	1.05
Focus Knob (for early 327 & 328 models only).	.650255A-2	1.05