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MODELS TV-127, 164, 167A, 191
12 1/2, 16 and 19 Inch Television and
Complete FM Radio

ELECTRICAL SPECIFICATIONS

POWER SUPPLY RATING
TV-127 - 185 watts on TV and 85 watts on FM
TV-164, TV-167A and TV-191 - 230 watts on TV and 105 watts on FM

AUDIO POWER OUTPUT RATING
TV-127 - 2.2 watts
TV-164, TV-167A and TV-191 - 2.5 watts

LOUDSPEAKER
TV-127 - 6"
TV-164 - 8", TV-167A and TV-191 - 12"
Voice Coil Impedance - 3.2 ohms at 400 cycles

RECEIVER ANTENNA INPUT IMPEDANCE
300 ohms balanced

TUBE COMPLEMENT See Figure 1.

TUNING RANGE
FM - 88-108 mc.
TV - Channels 2 - 6 (54-88 mc.)
Channels 7-13 (174-216 mc.)

ALIGNMENT DATA
Picture Carrier Frequency 25.75 mc.
Accompanying Sound Trap 21.25 mc.
Adjacent Sound Trap 27.25 mc.
Sound I.F. Frequency 4.5 mc.
FM First I.F. Frequency 10.7 mc.
FM Second I.F. Frequency 4.5 mc.
FM Second Oscillator Frequency 15.2 mc.
Sound Ratio Detector Band Width 225 kc. (between peaks)
Video Response to 4.0 mc.

FOCUS - Permanent Magnet
SWEEP DEFLECTION - Electromagnetic
OPERATING CONTROLS - See Figure 1
NON-OPERATING CONTROLS - See Figure 1
PHONO INPUT High Impedance
Plug - Type PL55 or equivalent
TV FRONT END

The TV front end is a separate sub-chassis of the receiver. Mounted on this chassis are the RF amplifier, converter and oscillator, bandswitch, all RF and oscillator coils and the converter plate. Referring to the schematic diagram, it will be noticed that there are three double triodes available in the front end. One section of each triode is used for high band tuning, and the other section of each triode is used for low band tuning. The switching comprises a changeover in the B+ and antenna coils. The two bands are otherwise completely independent.

With the chassis inverted and the tuning dials facing the operator, all components on the left side of the front end are associated with the low band and all components associated with the high band are located on the right side WITH THE EXCEPTION OF THE LOW AND HIGH BAND ANTENNA COILS WHICH ARE INVERTED IN THEIR LOCATION. The antenna terminates in a band-pass transformer for the low or high band respectively and is switched to the proper transformer when the bandswitch is set to the desired band. The trimmer T3 adjusts the high band circuit. Tuning in the plate circuit of the RF amplifier and grid circuit of the converter is accomplished through a band-pass transformer which is continuously tuned by means of the 3-gang variable condensers located on the top of the chassis directly above their respective coils. The low band interstage transformer is aligned by iron slug S2. The high band interstage transformer is aligned by iron slug S4 and trimmers T4 and T5. The RF oscillators are of the tickler feedback type, tuned over the bands by means of the rear sections of the variable condensers. The low band oscillator is adjusted by brass slug S1 and trimmer T2 and the high band oscillator by brass slug S3 and trimmer T6. The converter plate circuit, common to the low and high band, consists of an RF choke in parallel with the converter coil S5 which is mounted at the rear of the front end sub-chassis.

PICTURE I.F. AMPLIFIER AND DETECTOR

The picture I.F. amplifier is of the conventional stagger tuned type, with four stages of I.F. amplification. In order to obtain proper band-pass characteristics, the picture I.F. coils are tuned as follows:

1. Converter coil - 23.8 Mc (iron slug S5)
2. First picture I.F. coil - 25.6 Mc (iron slug S6)
3. Second picture I.F. coil - 22.2 Mc (iron slug S7)
4. Third picture I.F. coil - 22.0 Mc (iron slug S8)
5. Fourth picture I.F. coil - 25.4 Mc (iron slug S9)

To align the I.F. system, the coils are peaked to the specified frequency with an unmodulated signal generator. The over-all I.F. response is then observed by use of the sweep generator and oscilloscope.

TRAP CIRCUIT

In order to avoid sound carrier interference in the picture, 2 sound traps are incorporated. They are tuned by iron slug S10 to a frequency of 21.25 Mc and by iron slug S21 to a frequency of 27.25 Mc to absorb excessive sound energy.

PICTURE SOUND DETECTOR

The detector is a germanium crystal rectifier (1N60) and is obtained in Video Detector Can Assembly 279-63.

SOUND SYSTEM

The sound channel operates on the intercarrier principle. The output of the second detector contains a 4.5 Mc component which is frequency modul-
ated with the sound, and is amplified by the 6CB6 Video amplifier and the
6AU6 Ratio detector driver. A 6AL5 Ratio detector demodulates the 4.5 Mc
F.M. sound signal and feeds the two stage audio amplifier. A 4.5 Mc trap
(79-85) is placed in the plate circuit of the video amplifier to prevent
FM interference in the picture, and to raise the gain of the Video ampli-
for 4.5 Mc. Provision is made for the connection of a record player
for phonograph reproduction.

VIDEO AMPLIFIER, CONTRAST CONTROL AND A.G.C.
The single stage video amplifier uses a 6CB6 tube which provides a video
amplification of approximately 25 times and has a flat frequency response
up to 4 mc.

The contrast control is part of the A.G.C. system. It provides either a
positive or a negative voltage which is placed in series with the developed
potential becomes more positive and tends to increase the signal output of the second
detector. This action is particularly beneficial for weak signals because
it counteracts the contact potential of the I.F. tubes.

DC RESTORER
Since the video amplifier is an AC amplifier, the DC component of the video
signal that represents the average illumination of the original scene will
not be passed. Unless this DC component is restored, difficulty will be
experienced in maintaining proper scene illumination. For any given scene,
this average illumination could be set properly by the brightness control.
However, a change of scene would probably necessitate resetting this con-
trol. The DC restorer accomplishes this setting automatically, thus ass-
uring proper picture illumination at all time.

SYNC. AMPLIFIER AND CLIPPER
The single stage sync. clipper amplifier separates the synchronizing in-
formation from the composite video signal signal and delivers well limited,
amplified sync. pulses. The composite signal from the video amplifier is
fed into a 6AU6 amplifier with the sync. pulses going in the positive di-
rection. The grid and cathode of the 6AU6 act as peak rectifier. Thus a
peak DC voltage equal to the composite video signal appears across the grid
resistor keeping this tube biased off between sync. pulses. As soon as a
new sync. pulse arrives, the grid will conduct and the sync pulse will ap-
pear amplified in the plate circuit. The video signal which follows the
sync. pulse does not appear in the plate circuit since the sync. pulse
has moved the grid potential to cut off again. Thus the video and blanking
pulses are removed and only the sync. pulses appear at the sync. clipper
plate.

VERTICAL SYNC. AMPLIFIER
The sync. pulses appearing at the sync. clipper plate are negative in
polarity. One half of a 12AU7 acting as an amplifier and in conjunction
with an integrating network effectively extracts the vertical synchroniz-
ing signal and feeds vertical sync. pulses of positive polarity to the
vertical oscillator.

VERTICAL OSCILLATOR AND AMPLIFIER
The function of these circuits is to provide a sawtooth of current of the
proper frequency and phase to perform the vertical scanning for the pic-
ture tube.

1. In models TV-104, TV-167A, and TV-191 a 6C4 tube with its associated
components form a blocking oscillator and discharge circuit. The voltage
pressure is used to lower the sawtooth, and a coupling capacitor is used to
store the energy of the pulses.

the use of the 6C6 tube is permitted.

PHASED FILTER
The high frequency pass filter is utilized to produce the a.c. component of
the composite signal.

The output of the sync. clipper amplifier and the output of the high pass one of the B1-3 tubes is tapped. The B1-3 tube is placed across the sawtooth generator before the output of the a.c. amplifier.

The high frequency pass filter is placed between the sawtooth generator and the sync. clipper amplifier. The B1-3 tube is a 4.75 mc. type, and has a capacitance of 0.005 microfarads. The B2-3 tube has a voltage capacity of 250 volts.

HORIZONTAL OSCILLATOR
The horizontal scanning oscillator characterizes the picture which is a sawtooth wave. The B1-3 tube is a horizontal oscillator. The output of the oscillator is coupled back to the grid of the oscillator, which acts as a collector for the horizontal oscillator. In other words, the horizontal oscillator is a self-contained oscillator.

To function properly, the sawtooth wave should be between 7.5 and 9.5 cycles per millimeter. The sawtooth wave should be shaped like a sine wave, but should have a sawtooth wave shape at the end.
present at the plate of this tube is of the shape required to produce a
sawtooth of current in the vertical deflection coil. This voltage is
coupled to a 6S4 tube which amplifies it and supplies a sufficient amount
of power to the vertical deflection coil.

2. In the Model TV-127 one-half of a 6SN7 tube with its associated com-
ponents form a blocking oscillator and discharge circuit. The other half
of the 6SN7 is used in the same manner as the 6S4 in the 16" and 19" mo-
dels.

PHASE INVERTER AND HORIZONTAL DETECTOR

The horizontal phase detector (6AL5) is a dual diode in a circuit which
produces a DC output voltage which is proportional to the phase displace-
ment between two input voltages.

The composite sync. signal is split in phase by the 12AU7 phase inverter
and the resultant signals (nearly equal and 180° out of phase) comprise
one of the input voltages to the phase detector. The other input voltage
is taken from a tap on the horizontal output transformer. This peaked
sawtooth voltage is shifted in phase and properly shaped by an RC network
before being applied as the other input voltage to the phase detector.

The DC output voltage which is proportional to the phase displacement be-
tween the two input voltages, namely, the sync. pulses and the output
sawtooth voltage, appears at the junction of the two 100K ohm resistors.
A 4.7 megohm resistor is connected from this point to ground to provide
a DC return for the horizontal sweep oscillator grid circuit. A conven-
tional AFC filter consisting of the 470K ohm resistor in parallel with an
0.005 mfd. condenser in series with an 0.05 mfd. condenser is used. The
voltage appearing across the 0.05 mfd. condenser is then the filtered con-
trol voltage which is applied to the horizontal sweep oscillator.

HORIZONTAL SWEEP OSCILLOSCOPE

The horizontal sweep oscillator has been developed to realize the char-
acteristics which are most desirable for this purpose. The circuit shown
is a stabilized cathode coupled multivibrator, which combines the sensi-
tivity of the multivibrator with the stability of the sine wave oscillator.
The circuit is essentially a sine wave oscillator with good stability, but
the resistor in series with the tuned circuit adds an impulse component
which provides the desired rapid return time, and in conjunction with the
other circuit constants, provides the proper control sensitivity both for
the DC applied to the first grid for AFC, and with change in resistance in
the second grid circuit for the manual control. Figure 4 shows the wave
shape appearing at the plate of the first section of the oscillator.

![Wave Shape at Plate of Horizontal Oscillator](image)

To place the circuit in operation, the 50K ohm horizontal hold control
should be set in the center of its range and the variable inductor (part
#72-66) adjusted until the picture is properly synchronized.
HORIZONTAL OUTPUT AND HIGH VOLTAGE SUPPLY

The horizontal output amplifier (6CD6G) and "flyback" type power supply uses standard components and is conventional except that no electrical centering means is provided. Centering of the raster is accomplished by manipulating the mechanical adjustments of the focus magnet and ion magnet. The correct centering procedure is outlined in the OPERATING INSTRUCTIONS booklet.

The function of the output tube (6CD6G) is to supply sufficient current of the proper waveform to the horizontal deflection coil in order to provide horizontal scanning for the cathode ray tube. The function of the damper tube (6W14GT) is to stop oscillation and thus help provide a linear trace. It also recovers some of the energy from the yoke kickback and uses it to help supply additional power to the horizontal and vertical sweep circuits.

The width of the picture is controlled by adjusting slug S22 which varies the amount of inductance shunted across a portion of the secondary of the horizontal output transformer. Clockwise rotation of the adjustment increases picture width.

Adjustment of the horizontal drive control located on the rear apron of the chassis determines optimum linearity and maximum high voltage and, therefore, crispness of picture. Before setting Horizontal Size, advance Drive Control until white vertical lines appear near the center of picture. Then turn back slightly to make lines disappear. The Horizontal Size of the picture should now be set by use of the Horizontal Size Control.

After changing tubes or re-locating the receiver in different location, the Horizontal Size may have to be redjusted due to change in tube characteristics or line voltage, it is always advisable to redjust the Drive Control as mentioned above to maintain maximum high voltage.

Rotation of the horizontal linearity control, S20, will affect the center portion of the picture and should be adjusted for best horizontal linearity as follows:

A.) Rotate slug in counter-clockwise direction until it is completely out of the coil.
B.) Slowly rotate slug in clockwise direction until good linearity is indicated by observation of the test pattern.

NOTE: If this operation is carried too far, a second point will be noticed where, apparently, good linearity is obtained. With this setting however, the center of the picture is distorted and therefore the adjustment should not be left in this position. The correct setting is the one where good linearity is obtained with the slug in the "out" position.

The high voltage power supply is a "kickback" type where the power is obtained from the energy stored in the deflection inductances during each horizontal scan. When the 6CD6G plate current is cut off by the incoming pulse, a pulse appears on the primary of the output transformer due to the collapsing field in the deflection coil. This pulse of voltage is stepped up, rectified by a voltage doubler, filtered, and applied to the second anode of the picture tube.

LOW VOLTAGE POWER SUPPLY

Although the low voltage power supply is a conventional circuit delivering about 360 volts at 200 ma. in Models TV-164, TV-167A, and TV-191 and 300 volts at 190 ma. on Model TV-127, the voltage distribution circuit through the receiver is unique. Those circuits which operate at lower voltages are supplied directly from this voltage source and no separate power supply is required. However, the voltage source is protected against overloads and overvoltage by means of a voltage limiter and a fuse. Front panel adjustments will
voltages are connected in series with each other and placed across the higher voltage required for other circuits. The RF-IF cathodes return to chassis and the plates and screens are at +140 volts. The cathode of the audio power amplifier is returned to +140 volts. This tube then operates on the difference between +140 and +360 volts or +220 volts on Models TV-164, TV-167A and TV-191. On Model TV-127, the tube operates on the difference between +140 and +300 volts or plus 160 volts. Resistance is added in series with the audio output tube plate circuit which, together with the 20 mfd. condenser returned to the cathode, acts as a filter to keep its current variations from modulating the B supply voltage.

The audio output tube also operates as a series regulator tube to maintain the +140 volts relatively constant. Because its grid is connected to a divider running from +360 volts (300 volts for Model TV-127) to ground, any change in the +140 volts, due to current variations in the RF-IF circuits, changes the effective grid - cathode voltage of the audio output tube thereby providing a substantial amount of automatic voltage regulation.

FM TUNER

The FM tuner section of this receiver consists of a 6BA6 RF amplifier, a 6BE6 first converter and a 12AT7 second converter. The RF and first converter stages are conventional and produce an intermediate frequency of 10.7 mc. at the output of the first converter. The second converter is a dual triode, one section operating as a mixer and the other section operating as an oscillator. The 10.7 mc. IF tube of the first converter is heterodyned with a fixed oscillator operating at 15.2 mc. in the mixer triode section. The 15.2 mc. signal is generated in the oscillator section of the 12AT7 tube. The difference frequency of 4.5 mc. appears in the mixer plate and is coupled into the video detector. From this point the signal is handled in the same manner as the sound component of the TV signal.

ALIGNMENT PROCEDURE

TEST EQUIPMENT

To properly service this receiver, it is necessary that the following test equipment be available:

1. RF Sweep Generator - Frequency ranges:
   a) 20 to 27 Mc.
   b) 50 to 90 Mc. (at least 10 Mc. sweep width)
   c) 170 to 225 Mc. (at least 10 Mc. sweep width)
   Output must be adjustable to a maximum of 1 volt.

2. Cathode Ray Oscilloscope
   Preferably one with a wide band vertical deflection, an input calibrating source and a low capacity probe.

3. Signal Generator to provide frequencies in the following ranges:
   a) 4.4 to 4.5 Mc.
   b) 10.7 Mc
   c) 20 to 27 Mc.
   d) 52 to 90 Mc.
   e) 88 to 108 Mc.
   f) 172 to 219 Mc.

4. Vacuum Tube Voltmeter and High Voltage Multiplier Probe for use with this meter to permit measurements up to 15,000 volts.

ADJUSTMENTS REQUIRED (Refer to Figure 1 for location of alignment adjustments)

Front end - Normally only the RF oscillator coils will require the attention of the service technician. All other circuits are very broad and will therefore only rarely require realignment. If a realignment should
be needed, only those thoroughly familiar with very high frequencies and sweep generators should attempt it. The oscillator coil adjustments are critical and may be affected by a tube change. Low band, as well as high band oscillator, are aligned by a trimmer and pudder like a normal AM receiver.

A.) Low Band

Switch band selector to the low band, engage variable condenser completely. Then, tune slug S1 until the frequency of the oscillator equals 80 Mc. Disengage variable condenser completely and adjust trimmer T2 for an oscillator frequency of 110 Mc. Repeat this procedure several times to check accuracy.

B.) High Band

Throw the band selector switch to high band. Engage the variable condenser fully and adjust slug S3 until the oscillator frequency equals 200 Mc. Disengage condenser completely and adjust trimmer T0 to an oscillator frequency of 239 Mc. Repeat procedure several times.

The detailed alignment procedure which follows is intended primarily as a discussion of the method used, precautions to be taken and the reasons for these precautions. Then, for more convenient reference during alignment, a tabulation of the method is given. All the information necessary for alignment is given in the table. However, alignment by the table should not be attempted before reading the detailed instructions.

ORDER OF ALIGNMENT

When a complete receiver alignment is necessary, it should be performed in the following order:

A.) Align ratio detector as indicated in alignment table at 4.5 Mc.
B.) Set 4.5 Mc. trap with slug S11.
C.) Align all I.F. transformers following procedure and table.
D.) Set sound traps to 21.25 Mc. with slug S10 and to 27.25 with slug S21.
E.) Retouch picture I.F. transformers for full band width as per alignment procedure in table.
F.) Align FM section as per alignment procedure in table.
G.) Connect receiver to an antenna and tune for a test pattern if possible.
H.) Pay special attention to the proper setting of the HORIZONTAL HOLD CONTROL. It is not enough to set the HORIZONTAL HOLD CONTROL at the time of installation to "hold" a picture. The setting should be checked for "pull-in". To make this check, the TUNING CONTROL should be tuned rapidly on and off a station. Find the point of adjustment for the HORIZONTAL HOLD CONTROL, where the picture will fall into frame, without hesitation.
I.) Adjust other size and hold controls as outlined in OPERATING INSTRUCTIONS booklet.
J.) Adjust FM trap slug S11 for minimum FM interference in picture.

PICTURE I.F. OSCILLATION

If the receiver is badly misaligned and two or more of the I.F. coils are tuned to the same frequency, or if the sound traps are not set properly, the receiver may fall into I.F. oscillation. I.F. oscillation shows up as a voltage in excess of a few tenths of a volt at the picture detector load resistor. If such a condition is encountered, it is sometimes possible to stop oscillation by adjusting the coils approximately by setting the adjustment screws to be nearly equal to those of another receiver known to be in proper alignment.

There is little likelihood of any oscillation occurring if the 21.25 Mc. trap (adjusted by slug S10) is at its proper frequency, and the third picture I.F. (slug S7) is set at 21.6 Mc. or lower. If oscillation persists, check for open by-pass condenser in I.F. strip.

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**RATIO DETECTOR ALIGNMENT**

Set the signal generator for approximately 1 volt output at 4.5 Mc. and connect it to the grid of the ratio detector driver. To align the primary of the Ratio Detector, connect the vacuum tube voltmeter to pin No. 2 of the 6AL5 and tune S13 for maximum negative voltage. To balance the secondary of the ratio detector, connect the vacuum tube voltmeter from the phono input jack to ground. Adjust S14. It will be found that it is possible to produce a positive or negative voltage depending on this adjustment. Obviously, to pass from a positive to a negative voltage, the voltage must go through zero. S14 should be adjusted for zero output. It is possible to use any television station for this alignment since the difference between the frequency of the picture and the sound carrier is 4.5 Mc.

**SOUND I.F. ALIGNMENT**

Connect the signal generator to terminal #4 of the video detector assembly and maintain it at 4.5 Mc. Connect the vacuum tube voltmeter to pin No. 2 of the 6AL5 Ratio Detector and adjust slug S12 for maximum DC reading. Reduce output of signal generator to a very low level and readjust S12.

**ALIGNMENT CHART**

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<th>NOTES</th>
<th>CONNECT R.F. SIGNAL GENERATOR TO:</th>
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<th>SET SIGNAL ADJUST GENERATOR TO: (Mc.)</th>
<th>OUTPUT INDICATIONS</th>
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<td>Coil Assembly</td>
<td>22.2 S7</td>
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<td>(Pin #7)</td>
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<td></td>
<td>22.0 S8</td>
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<td>25.4 S9</td>
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<td></td>
<td></td>
<td></td>
<td>21.25 S10</td>
<td>Minimum on V.T.V.M.</td>
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<td></td>
<td>27.25 S21</td>
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<tr>
<td>Switch to FM (Close Gang)</td>
<td>Terminal #4 of Video Detector</td>
<td>Pin #2 of 6AL5 Ratio Detector</td>
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<td>Maximum on V.T.V.M.</td>
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<td>Maximum on V.T.V.M.</td>
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<td>Accurately for Zero Balance</td>
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<td>Same</td>
<td>Phono Input Jack</td>
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<td>Pin #1 of 6BE6 FM 1st Converter</td>
<td>Same</td>
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<td>Maximum on V.T.V.M.</td>
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Repeal Slugs S13, S12, S18, S16 and S15
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<th>FUNCTION</th>
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<th>SET R.F. SIGNAL GENERATOR and DIAL POINTER TO:</th>
<th>ADJUSTMENTS</th>
<th>CONNECT SCOPE TO:</th>
<th>ADJUSTMENTS</th>
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<tr>
<td>3) FM RF Alignment</td>
<td>Switch to FM RF</td>
<td>Antenna Through 2 Resistors</td>
<td>Pin #2 of 6AL5 Ratio Detector</td>
<td>90 MC. Oscillator Disc (P1)</td>
<td>Connect R.F. SIGNAL GENERATOR and DIAL POINTER TO:</td>
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<td>Contrast Control to Maximum</td>
<td>Terminals (Dummy)</td>
<td></td>
<td>Set Tuner to 106MC. and locate 106 MC. by 1/2 the Error Found. Recheck Calibration at 90 MC. If Necessary, Repeat.</td>
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<td></td>
<td>Set Generator to 106MC. and locate Signal on FM Dial. Note amount of error.</td>
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<tr>
<td>4) VIDEO I.F. SWEEP ALIGNMENT</td>
<td>Loosely coupled to 12AT7 mixer tube by means of a metal sleeve 1&quot; wide. A miniature tube shield may be used.</td>
<td>Loosely coupled to Sweep Generator Output Cable.</td>
<td>Signal Generator is used as marker. Set from 20-28 Mc. as needed for markers.</td>
<td>Terminal #4 of Video Detector Coil Assembly 279-63 (Scope is synchronized to Sweep Generator.)</td>
<td>Adjust S5, S6, S7, S8, S9 (as needed) to get following response</td>
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<td>NOTE: Switch to Channels 2-6</td>
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</tbody>
</table>

**NOTE:** Keep input signal at low level to avoid overloading. Keep contrast control at center setting.
SERVICE SUGGESTIONS

I. NO RASTER ON C.R.T. - SOUND NORMAL

A.) IF ALSO NO HIGH VOLTAGE

1. Check 1/4 amp. Fuse. Before replacing blown fuse check the follow-
ing:

a.) Deflection yoke coils - check for grounded windings and shorts between
Vertical and Horizontal windings.

b.) Defective horizontal output transformer.

c.) Defective 6Q6G, 1B3GT's or 6W4GT.

d.) Shorted yoke series condenser.

e.) Shorted Boost filter electrolytic

2. Check 6SN7GT horizontal oscillator tube and associated circuit com-
ponents. No horizontal drive.

3. Check 900 mmfd. high voltage filter capacitors.

4. Open high voltage filter resistor.

B.) IF HIGH VOLTAGE IS NORMAL

1. Ion trap magnet set incorrectly or reversed.

2. Defective C.R.T.

3. Wrong operating voltages at C.R.T. socket.

4. Check setting of brightness control.

II. NO VERTICAL DEFLECTION

1.) Check 6C4 (6SN7 in TV-127) vertical oscillator and associated circuit
components.

2.) Check 6S4 (6SN7 in TV-127) vertical amplifier and associated circuit
components.

3.) Check vertical deflection coils.

4.) Check vertical output transformer.

5.) Check for B+ supply voltage.

III. POOR VERTICAL LINEARITY

1.) If adjustments do not correct, change 6C4 and/or 6S4 vertical sweep

2.) Low B+ supply voltage.

3.) Defective vertical output transformer.

IV. UNSTABLE VERTICAL HOLD (JITTER)

1.) If adjustments do not correct, change 6C4 and/or 6S4 vertical sweep

2.) Check as in sections II and III for intermittent operation.

3.) Check 4700 mmfd. vertical oscillator grid capacitor.

4.) Excessive external noise conditions combined with weak signals due to
poor reception or misalignment.

5.) Contrast control operated at excessive level.

6.) Excessive input signal causing overload. Attenuate antenna input.

7.) Check for loose connections or noisy tubes.

V. NO VERTICAL SYNC. (ROLLING)

1.) Check 1/2 12AU7 vertical sync. amplifier, and associated components.

2.) Check components associated with timer grid (pin 4) of 6SN7 vert.
oscillator.

MODELS TV-127, TV-164,
TV-167A, TV-191
VI. TRAPEZOIDAL OR NON-SYMMETRICAL RASTER

1.) Improper setting of focus magnet or ion trap magnet. This will also cause shading at the sides or corners of the raster.
2.) Defective yoke.
3.) Defective C.R.T.
4.) Defective focus magnet.

VII. POOR HORIZONTAL LINEARITY

1.) If adjustments do not correct, change 6SN7GT, 6CD6G or 6W4GT tubes in horizontal sweep circuit.
2.) Horizontal output transformer defective.
3.) Defective deflection yoke.
4.) Check horizontal linearity control associated components.
5.) Broken slug inside linearity coil.
6.) Check circuit components coupling 6SN7GT horizontal oscillator tube to 6CD6G.
7.) Check D.C. operating voltages at tube sockets.
8.) Raster may be off center due to:
   a.) Focus magnet set wrong.
   b.) Shorted or leaky .25 mfd. capacitor returning horizontal deflection coil to B+.

VIII. NO HORIZONTAL SYNC. (PICTURE TEARING)

1.) SI9 improperly adjusted - readjust for sync. with horizontal hold control at center of rotation.
2.) Check 1/2 12AU7 phase inverter and 6AL5 phase detector tubes and associated circuit components.
3.) Horizontal output transformer defective.
4.) Check horizontal oscillator coil, part #72-66.
5.) Check tubes and components in horizontal oscillator circuit.
6.) Dress C.R.T. cathode lead (yellow) away from deflection yoke cable. If too near, will cause horizontal jitter.

IX. NO HORIZONTAL OR VERTICAL SYNC. (SIGNAL NORMAL AT C.R.T.)

1.) Check 6AU6 sync, clipper and associated circuit components.
2.) Check 1/2 6AL5 D.C. restorer.
3.) Check 1N60 germanium crystal video detector.
4.) Defective deflection yoke.
5.) Defective 100 mfd., 25 V. cathode by-pass capacitor on 6S4. (6SN7 in TV-127)

X. RASTER AND SIGNAL ON C.R.T. BUT NO SOUND

1.) Check 6AU6 ratio detector driver, 6AL5 ratio detector and audio amplifier tubes and circuit components.
2.) Check shielded audio leads for grounds.
3.) Defective loudspeaker.
4.) Check phono input jack for bad contacts.

John F. Rider
XI. SOUND DISTORTED

1.) Check alignment and balance of ratio detector.
2.) Check operating bias on 6AQ5 tube (at 117 volt A.C. line and with no signal, should be between 6 and 10 volts).
3.) Defective audio tubes.
4.) Defective loudspeaker.

XII. HUM OR BUZZ IN SOUND-VOLUME CONTROL MINIMUM

1.) Dress .05 mfd. coupling condenser to 6AT6 grid away from high band oscillator coil.
2.) Check main power supply filter capacitors.
3.) Check 80 mfd., 150V., 6AQ5 cathode by-pass capacitors.

XIII. PICTURE STABLE - POOR RESOLUTION

1.) Check video detector coil assembly and 1N60 germanium crystal.
2.) Check 6CB6 Video Amplifier tube.
3.) Check peaking coils in video amplifier.
4.) Check alignment of 4.5 Mc. trap.
5.) Check setting of focus magnet.
6.) Defective C.R.T.
7.) R.F. - I.F. circuits improperly aligned.

XIV. PICTURE SMEARY, TRAILERS

1.) Video amplifier overloaded by excessive input. Reduce contrast control setting.
   NOTE: In strong signal areas, excessive input at the antenna terminals will produce smear, picture jitter, etc. An attenuator network at the antenna terminals will remedy this condition.
2.) Check for open 500 microhenry choke (75-26) in video detector can.
3.) Check video coupling capacitors and grid resistors.

XV. RASTER BUT NO SOUND, PICTURE OR SYNC.

1.) Defective antenna or transmission line.
2.) R.F. oscillator not operating or off frequency.
3.) R.F. unit completely inoperative. Check tubes and voltages.
4.) I.F. section inoperative. Check tubes and voltages.
5.) Check video detector coil assembly and crystal.
6.) Video amplifier inoperative. Check tubes and voltages.

XVI. PICTURE AND SOUND NOT TUNING TOGETHER

1.) Complete realignment.
2.) Extremely weak signal conditions due to location or poor antenna.
3.) Set being tuned improperly.

XVII. DIFFICULTY IN TUNING ACCOMPANYED BY BUZZ

1.) Check alignment of 21.25 mc. trap (S10)
2.) Check ratio detector alignment.
3.) Complete realignment.
4.) Weak or poor signal conditions due to location or antenna.
5.) Everything normal, but set is being tuned improperly.
6.) Contrast control turned up too far, overloading video amplifier.
VOLTAGE CHART TV-164, TV-167A, TV-191

Measurements made with receiver operating on 117 volt 60 cycle line, no signal input.
Volume control, brightness control, and contrast control set at minimum (counter clockwise position) except where noted.
Band Switch in Channel 2-6 position except where noted. Measurements made at low freq. end of bands (gang closed).
Voltages measured with vacuum tube voltmeter.
Grid voltages measured between grid and cathode. Other voltages measured to chassis.

<table>
<thead>
<tr>
<th>TUBE TYPE</th>
<th>FUNCTION</th>
<th>PLATE</th>
<th>SCREEN</th>
<th>CATHODE</th>
<th>GRID</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>PIN</td>
<td>VOLTS</td>
<td>PIN</td>
<td>VOLTS</td>
</tr>
<tr>
<td>12AT7</td>
<td>High Band R.F.</td>
<td>1</td>
<td>140</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>12AT7</td>
<td>High Band Mixer</td>
<td>1</td>
<td>140</td>
<td>-</td>
<td>-</td>
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<tr>
<td>12AT7</td>
<td>High Band Osc.</td>
<td>1</td>
<td>140</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>12AT7</td>
<td>Low Band R.F.</td>
<td>6</td>
<td>140</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>12AT7</td>
<td>Low Band Mixer</td>
<td>6</td>
<td>140</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>12AT7</td>
<td>Low Band Osc.</td>
<td>6</td>
<td>140</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>6AU6</td>
<td>1st I.F.</td>
<td>5</td>
<td>140</td>
<td>6</td>
<td>140</td>
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<tr>
<td>6AU6</td>
<td>2nd I.F.</td>
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<td>3rd I.F.</td>
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<td>6</td>
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<td>5UL5</td>
<td>Ratio Det.</td>
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<td>-</td>
<td>-</td>
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<tr>
<td>5UL5</td>
<td>1st Audio</td>
<td>7</td>
<td>650</td>
<td>-</td>
<td>-</td>
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<tr>
<td>6AQ5</td>
<td>Audio Output</td>
<td>5</td>
<td>340</td>
<td>6</td>
<td>140</td>
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<td>6CR6</td>
<td>Video Amp.</td>
<td>5</td>
<td>190</td>
<td>6</td>
<td>140</td>
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<tr>
<td>6UL5</td>
<td>D.C. Rest.</td>
<td>7</td>
<td>-25</td>
<td>-</td>
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<tr>
<td></td>
<td>A.G.C.</td>
<td>2</td>
<td>-1.5</td>
<td>-</td>
<td>-</td>
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<td></td>
<td></td>
<td>2</td>
<td>2.25</td>
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<td>6CL</td>
<td>Vert.Osc.</td>
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<td>-</td>
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<tr>
<td>6CL</td>
<td>Vert.Out-</td>
<td>9</td>
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<tr>
<td>6SN7</td>
<td>Hor.Osc.</td>
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<td>260</td>
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<td>-</td>
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<tr>
<td>6CD5G</td>
<td>Hor.Output</td>
<td>5</td>
<td>180</td>
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<td></td>
<td></td>
<td>8</td>
<td>140</td>
<td>-</td>
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TUBE TYPE | FUNCTION | NOTES ON MEASUREMENTS
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>12AT7</td>
<td></td>
<td>Band Switch Sent on TV Ch. 7 to 13 Gang Closed</td>
</tr>
<tr>
<td>12AT7</td>
<td></td>
<td>Band Switch Set on TV Ch. 2 to 6 Gang Closed</td>
</tr>
</tbody>
</table>

These voltages vary with signal and noise.

NOTE ON MEASUREMENTS:

- Band Switch set on TV Ch. 7 to 13 Gang Closed
- Band Switch set on TV Ch. 2 to 6 Gang Closed
- Contrast Grid to Grid - 130V varies with signal.
**VOLTAGE CHART TV-127**

MEASUREMENTS MADE WITH RECEIVER OPERATING ON 117 volt 60 cycle line, no signal input.
Volume control, brightness control, and contrast control set at minimum (counter clockwise position) except where noted. Band Switch in Channel 2-6 position except where noted. Measurements made at low freq. end of bands (gang closed). Voltages measured with vacuum tube voltmeter. Grid voltages measured between grid and cathode. Other voltages measured to chassis.

<table>
<thead>
<tr>
<th>TUBE</th>
<th>FUNCTION</th>
<th>PLATE PIN</th>
<th>SCREEN PIN</th>
<th>CATHODE PIN</th>
<th>GRID PIN</th>
<th>NOTES ON MEASUREMENTS</th>
</tr>
</thead>
<tbody>
<tr>
<td>16TP4</td>
<td>Picture Tube</td>
<td>Cap</td>
<td>12.8 KV</td>
<td>10</td>
<td>360</td>
<td>11</td>
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<tr>
<td>16KP4</td>
<td></td>
<td>Cap</td>
<td>14 KV</td>
<td>10</td>
<td>360</td>
<td>11</td>
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<tr>
<td>19AP4</td>
<td>FM - RF Amp.</td>
<td>5</td>
<td>135</td>
<td>6</td>
<td>95</td>
<td>7</td>
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<tr>
<td>6BE6</td>
<td>FM - 1st Conv.</td>
<td>5</td>
<td>140</td>
<td>6</td>
<td>90</td>
<td>2</td>
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<tr>
<td>12AT7</td>
<td>FM - 2nd Osc.</td>
<td>1</td>
<td>140</td>
<td>-</td>
<td>-</td>
<td>3</td>
</tr>
<tr>
<td>12AT7</td>
<td>FM - 2nd Mix.</td>
<td>6</td>
<td>140</td>
<td>-</td>
<td>-</td>
<td>8</td>
</tr>
<tr>
<td>5U4G</td>
<td>Rect.</td>
<td>4</td>
<td>370 AC</td>
<td>2</td>
<td>360</td>
<td>Band Switch in FM-Phono Pos.</td>
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<tr>
<td>5U4G</td>
<td>Rect.</td>
<td>6</td>
<td>370 AC</td>
<td>2</td>
<td>360</td>
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<tr>
<td>5U4G</td>
<td>Rect.</td>
<td>4</td>
<td>390 AC</td>
<td>2</td>
<td>360</td>
<td>Band Switch in TV Ch. 2-6 Pos.</td>
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</table>

**NOTES ON MEASUREMENTS**

+520 V. at + end of 20 mf 250 V. Booster Electrolytic, 5500V. Pulses at G6060G Plate. Do Not Measure at this Point.

**MODELS TV-127, TV-164, TV-167A, TV-191**
**Tube Table**

<table>
<thead>
<tr>
<th>TUBE TYPE</th>
<th>FUNCTION</th>
<th>PLATE PIN</th>
<th>VOLTS</th>
<th>SCREEN PIN</th>
<th>VOLTS</th>
<th>CATHODE PIN</th>
<th>VOLTS</th>
<th>GRID PIN</th>
<th>VOLTS</th>
</tr>
</thead>
<tbody>
<tr>
<td>6AL5</td>
<td>Ratio Detector</td>
<td>7</td>
<td>0</td>
<td>-</td>
<td>-</td>
<td>1</td>
<td>.1</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>6AT6</td>
<td>1st audio amplifier</td>
<td>7</td>
<td>75</td>
<td>-</td>
<td>-</td>
<td>2</td>
<td>0</td>
<td>1</td>
<td>- .7</td>
</tr>
<tr>
<td>6AS5</td>
<td>Audio power amp.</td>
<td>7</td>
<td>280</td>
<td>6</td>
<td>275</td>
<td>1</td>
<td>145</td>
<td>2.5</td>
<td>-13</td>
</tr>
<tr>
<td>6CB6</td>
<td>Video amplifier</td>
<td>5</td>
<td>190</td>
<td>6</td>
<td>145</td>
<td>2</td>
<td>0</td>
<td>1</td>
<td>- .7</td>
</tr>
<tr>
<td>1/2 6AL5</td>
<td>D.C. Restorer</td>
<td>7</td>
<td>-3</td>
<td>-</td>
<td>-</td>
<td>1</td>
<td>.4</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>1/2 12AU7</td>
<td>Vertical sync amp.</td>
<td>6</td>
<td>100</td>
<td>-</td>
<td>-</td>
<td>8</td>
<td>55</td>
<td>7</td>
<td>-1</td>
</tr>
<tr>
<td>1/2 12AU7</td>
<td>Phase inverter</td>
<td>1</td>
<td>110</td>
<td>-</td>
<td>-</td>
<td>3</td>
<td>55</td>
<td>2</td>
<td>1</td>
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<td>6AL5</td>
<td>Horizontal Phase det.</td>
<td>2</td>
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<td>5</td>
<td>.1</td>
<td>-</td>
<td>-</td>
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<tr>
<td>1/2 6SN7</td>
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<td>-</td>
<td>6</td>
<td>0</td>
<td>4</td>
<td>-50</td>
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<tr>
<td>1/2 6SN7</td>
<td>Vert. output</td>
<td>2</td>
<td>410</td>
<td>-</td>
<td>-</td>
<td>3</td>
<td>15</td>
<td>1</td>
<td>-15</td>
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<tr>
<td>1/2 6SN7</td>
<td>Hor. osc.</td>
<td>2</td>
<td>270</td>
<td>-</td>
<td>-</td>
<td>3</td>
<td>12</td>
<td>1</td>
<td>-10</td>
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<tr>
<td>6AU6</td>
<td>Sync. clipper amp.</td>
<td>5</td>
<td>55</td>
<td>6</td>
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<td>7</td>
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<td>1</td>
<td>-1</td>
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<tr>
<td>1/2 12AU7</td>
<td>Vertical sync amp.</td>
<td>6</td>
<td>100</td>
<td>-</td>
<td>-</td>
<td>8</td>
<td>55</td>
<td>7</td>
<td>-1</td>
</tr>
<tr>
<td>1/2 12AU7</td>
<td>Phase inverter</td>
<td>1</td>
<td>110</td>
<td>-</td>
<td>-</td>
<td>3</td>
<td>55</td>
<td>2</td>
<td>1</td>
</tr>
</tbody>
</table>

**Notes**
- These voltages will vary with different signal or noise conditions.
- These values are for contrast minimum and maximum.
- These values are for contrast minimum and maximum.
- These values are for contrast minimum and maximum.

**Measurement Notes**
- All vertical controls set at normal picture setting.
- All horizontal controls set at normal picture setting.

**Block Diagram**

*Note 1* --- +144-0 V. at + end of 20 mf 250 V. Booster Electrolytic, 4000 V. Pulses at 6AU5 Plate. Do not measure at this point.

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ALL CAPACITOR VALUES IN MAHF UNLESS OTHERWISE STATED
ALL RESISTANCE VALUES IN OHMS
ALL RESISTANCE RATED AT .5 WATTS/0.1W
K EQUALS 1000
M EQUALS MEGOHMS.

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