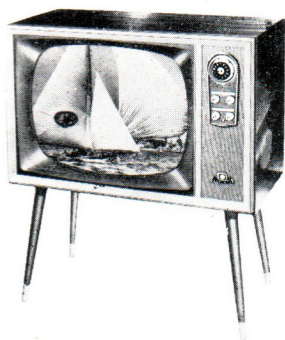


## TECHNICAL INFORMATION AND SERVICE DATA

MANUFACTURERS



SUPERVISED SERVICE



220-L



221-C

# A.W.A. RADIOLA TELEVISION RECEIVER Models 220-L, 221-C

220-L, 221-C: 21 inch, 20 valves, A.C. operated

Issued by Amalgamated Wireless (Australasia) Ltd.

## GENERAL DESCRIPTION

Models 220-L and 221-C are 21 inch, 20-valve A.C.-operated Television Receivers.

Features of design include: Cascode tuner; 3-stage video I.F. amplifier; Peak-level A.G.C.; Stabilised vertical hold; A.F.C. horizontal hold; 110° deflection; Electrostatic focus; Aluminised kinescope; Intercarrier F.M. system; Ratio detector; Twin loudspeakers; Tone control.

## ELECTRICAL AND MECHANICAL SPECIFICATIONS

**PICTURE SIZE:** Approximately 261 sq. ins. on a 21CEP4 Kinescope.

**TELEVISION CHANNELS:** All 10 V.H.F. channels.  
(Refer Alignment Procedure)

### INTERMEDIATE FREQUENCIES

Video I.F. Carrier Frequency ..... 36.0 Mc/s

Sound I.F. Carrier Frequency ..... 30.5 Mc/s

**POWER CONSUMPTION:** 200 watts max.

**UNDISTORTED AUDIO POWER OUTPUT:** 3 watts max.

### VALVE COMPLEMENT:

- 1 (V1) Radiotron 6BQ7-A ..... R.F. Amplifier
- 2 (V2) Radiotron 6CQ8 ..... R.F. Oscillator and Converter
- 3 (V101) Radiotron 6AU6 ..... Sound I.F.
- 4 (V102) Radiotron 6AL5 ..... Ratio Detector
- 5 (V103) Radiotron 6AV6 ..... Audio Amp.

### VALVE COMPLEMENT (continued)

- 6 (V104) Radiotron 6AQ5 ..... Audio Output
- 7 (V201) Radiotron 6BZ6 ..... 1st Video I.F.
- 8 (V202) Radiotron 6BZ6 ..... 2nd Video I.F.
- 9 (V203) Radiotron 6BZ6 ..... 3rd Video I.F.
- 10 (V204) Radiotron 6AW8-A ..... Video Amp. and Noise Cancellation
- 11 (V205) Radiotron 6AQ5 ..... Video Output
- 12 (V206) Radiotron 21CEP4 ..... Kinescope
- 13 (V301) Radiotron 6U8 .. A.G.C. and Sync. Separator
- 14 (V302) Radiotron 6CG7 ..... Sync. Amplifier and Vertical Oscillator
- 15 (V303) Radiotron 6CZ5 ..... Vertical Output
- 16 (V401) Radiotron 6CG7 .... Horizontal Control and Oscillator
- 17 (V402) Radiotron 6DQ6-A ..... Horizontal Output
- 18 (V403) Radiotron 6AU4-GTA ..... Damper
- 19 (V404) Radiotron 1B3-GT .. High Voltage Rectifier
- 20 (V405) Radiotron 5AS4 ..... Rectifier

**AERIAL INPUT IMPEDANCE** 300 ohms balanced  
**VIDEO RESPONSE** ..... To 4.25 Mc/s  
**FOCUS** ..... Electrostatic (Low Voltage)  
**DEFLECTION** ..... 110° Magnetic  
**SCANNING** ..... Interlaced, 625 lines  
**HORIZONTAL SCANNING FREQUENCY** ..... 15,625 c/s  
**VERTICAL SCANNING FREQUENCY** ..... 50 c/s  
**PICTURE REPETITION RATE** ..... 25 per second

**LOUDSPEAKERS—**

Model 220-L

7" x 5" Permanent Magnet No. 21540 and  
 4" Permanent Magnet No. 21541.

Model 221-C

12" Permanent Magnet No. 21542 and  
 4" Permanent Magnet No. 21543.

**OPERATING CONTROLS:**

Channel Selector	} Concentric.
Fine Tuning	
Power/Tone	} Single Controls on Front Panel.
Volume	
Contrast	
Brightness	

**NON-OPERATING CONTROLS** (not including R.F. and I.F. adjustments)

Vertical Hold ..... Control knob at rear of cabinet  
 Height ..... rear cabinet adjustment  
 Vertical Linearity ..... rear cabinet adjustment  
 Horizontal Hold ..... rear cabinet adjustment  
 Width ..... rear cabinet adjustment  
 A.G.C. Control ..... rear cabinet adjustment  
 Focus ..... rear cabinet adjustment  
 Horizontal Drive ..... chassis adjustment  
 Horizontal Sine Wave ..... chassis adjustment  
 Horizontal Linearity ..... chassis adjustment  
 Noise Cancel ..... chassis adjustment  
 I.F. A.G.C. .... chassis adjustment  
 Picture Centring ..... above chassis adjustment  
 Deflection Yoke ..... above chassis adjustment

## HIGH VOLTAGE WARNING

OPERATION OF THIS RECEIVER OUTSIDE THE CABINET INVOLVES A SHOCK HAZARD FROM THE RECEIVER POWER SUPPLIES. WORK ON THE RECEIVER SHOULD NOT BE ATTEMPTED BY ANYONE WHO IS NOT THOROUGHLY FAMILIAR WITH THE PRECAUTIONS NECESSARY WHEN WORKING ON HIGH VOLTAGE EQUIPMENT. DO NOT OPERATE THE RECEIVER WITH THE HIGH VOLTAGE COMPARTMENT SHIELD REMOVED. MAKE SURE THAT THE EARTH STRAP BETWEEN THE CHASSIS AND THE KINESCOPE ASSEMBLY IS SECURELY FASTENED BEFORE TURNING THE RECEIVER ON.

## KINESCOPE HANDLING PRECAUTIONS

DO NOT INSTALL, REMOVE OR HANDLE THE KINESCOPE IN ANY MANNER UNLESS SHATTER-PROOF GOGGLES ARE WORN. PEOPLE NOT SO EQUIPPED SHOULD BE KEPT AWAY WHILE HANDLING KINESCOPIES. KEEP THE KINESCOPE AWAY FROM THE BODY WHILE HANDLING.

When the receiver has been switched off after operating for a time, the kinescope will retain a certain charge. Therefore it is advisable to discharge it before handling.

The kinescope bulb encloses a high vacuum and, due to its large surface area, is subjected to considerable air pressure. Therefore, kinescopes must be handled with more care than ordinary receiving valves.

The large end of the kinescope bulb, particularly that part at the rim of the viewing surface, must not be struck, scratched or subjected to more than moderate pressure at any time. When installing, if the valve sticks or fails to slip smoothly into its socket or deflecting yoke, do not force it, but investigate and remove the cause of the trouble. All Radiotron replacement kinescopes are packed in special cartons and should be left in the cartons until required for installation.



## OPERATING INSTRUCTIONS

The following adjustments are necessary when turning the receiver on for the first time:

1. Pull the POWER/TONE control outwards to switch the receiver "ON" and set the control near the middle of its range. An interval of about one minute is necessary for the valves to heat before satisfactory operation is obtained.
2. Set the CHANNEL SELECTOR to the desired channel.
3. Turn the FINE TUNING control fully anti-clockwise.
4. Adjust the VOLUME control, until the desired volume is obtained.
5. Turn the BRIGHTNESS control to the extreme anti-clockwise position and then clockwise until a pattern appears on the screen.
6. Adjust the VERTICAL hold control until there is no vertical movement of the pattern.
7. Adjust the HORIZONTAL hold control until a picture is obtained.
8. Adjust the FINE TUNING, CONTRAST and BRIGHTNESS controls until the picture contrast and brightness is satisfactory.

9. After switching from one channel to another, it may be necessary to repeat adjustments 4 and 8.

10. When the set is switched on again after an idle period, it should not be necessary to repeat the adjustments unless the positions of the controls have been altered. If any adjustment is necessary, adjustment No. 8 is generally sufficient. However, if the controls have been altered it may be necessary to repeat adjustments 1 to 8.

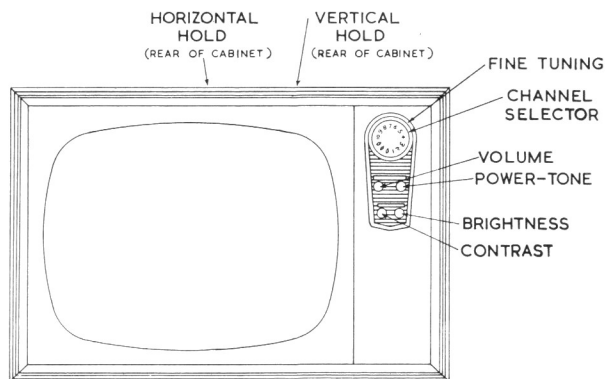


FIG. 1—RECEIVER OPERATING CONTROLS

## INSTALLATION INSTRUCTIONS

### RECEIVER LOCATION

The owner should be advised of the importance of placing the receiver in the proper location in the room.

The location should be chosen to agree with the following—

Away from windows so that bright light will not shine directly on the screen or in the viewer's eyes. However, some illumination in the room is desirable.

To give easy access for operation and comfortable viewing.

To permit convenient connection of the external aerial.

Convenient to a power point.

To allow adequate ventilation.

### UNPACKING

These receivers, complete with valves, are packed in cardboard cartons.

Take the receiver from the carton and remove the wooden packing block from the base of the cabinet.

Refer to the label inside the cabinet and make sure that the valves are in their correct sockets and pressed firmly down.

Check to see that the kinescope high voltage lead clip is in place.

Plug the power cable into a 200-240 volt A.C. Power Point after making sure that the mains adjustment is set at the correct voltage tap.

The receiver is supplied ready for operation on 240 volts. In districts where the average power supply voltage during viewing times is consistently below this value adjust the tap to the correct setting.

Connect the aerial to be used to the terminals at the rear of the cabinet.

### AERIAL INPUT

A 300 ohm aerial input is provided.

In locations where a very strong signal is likely to cause overloading of the receiver, an attenuator of the type shown in Fig. 5 should be used.

### INITIAL OPERATION CHECK

Pull the Power/Tone control outwards to switch the receiver "ON" and check all operations.

This instrument has been accurately aligned by the manufacturer with precision instruments and should require no further adjustments. However, a check should be made of all the various functions and if further adjustments are found necessary the following should be carried out.

### DEFLECTION YOKE ADJUSTMENT (Fig. 2)

If the lines of the raster are not horizontal or squared with the kinescope, rotate the deflection yoke until this condition is obtained. Tighten the yoke clamp.

## INSTALLATION INSTRUCTIONS

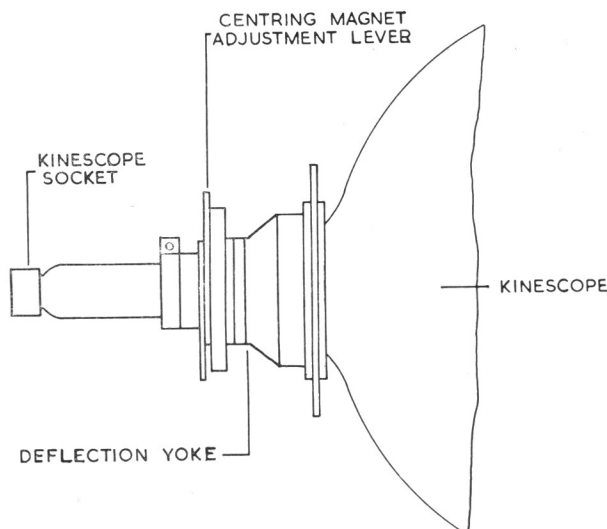


FIG. 2

**NOTE:** Rotational directions specified are viewed from the spindle end or, when no spindle is visible, from the rear cabinet end.

### FOCUS ADJUSTMENT

This adjustment has been made at the factory and it should only be necessary to re-adjust if the kinescope is replaced. In this case, adjust the focus control (R240) on the rear of the chassis until maximum definition of the line structure of the raster is obtained.

### CHECK OF HORIZONTAL OSCILLATOR ADJUSTMENT

Turn the horizontal hold control to the extreme clockwise position. The picture will be out of synchronisation with a minimum of 12 bars slanting downwards towards the left. Turn the control slowly anti-clockwise. The number of diagonal black bars will gradually reduce and when only  $1\frac{1}{2}$  to 3 bars remain, the picture will synchronise with further slight anti-clockwise rotation of the control. The picture should remain synchronised for approximately two full turns of additional anti-clockwise rotation of the control. Continue to turn the control anti-clockwise until the picture falls out of synchronisation. Turning the control beyond the fall-out position should produce between 2 and 3 bars before motorboating occurs. Motorboating should occur before the extreme anti-clockwise position is reached.

When the receiver passes the above checks and the picture is normal and stable, the horizontal oscillator is correctly aligned. Therefore, the "Horizontal Oscillator Adjustment" may be by-passed.

### HORIZONTAL OSCILLATOR ADJUSTMENT

If during the above check the receiver failed to hold synchronisation over two full anti-clockwise turns of the control from the pull-in point, the following adjustments are necessary.

Turning the horizontal hold control anti-clockwise will produce a number of bars before motorboating occurs. Adjust the horizontal sine wave coil (L401) until 3 or 4 bars are present before motorboating occurs, when the horizontal hold control is turned anti-clockwise from the fall-out point.

If it is impossible to synchronise the picture and the A.G.C. system is correctly adjusted, it will be necessary to align the Horizontal Oscillator by the method laid down in the Alignment Procedure.

### CENTRING ADJUSTMENT

Centring of the electron beam is important for good linearity, horizontally and vertically. When the linearity has been adjusted as per following instructions, if the horizontal linearity is poor this indicates that the centring magnets require adjustment for horizontal centring. Similarly, if the vertical linearity is poor after adjusting the height and vertical linearity controls, this indicates the need for vertical centring.

**Note:** The centre of test patterns as transmitted on various channels may vary and should not be relied upon for centring purposes.

The centring magnets are in the form of two discs mounted on the rear of the deflection yoke cap. When the magnets are rotated around the tube neck so that the levers are opposite, minimum centring effect with either lever is produced. To obtain correct centring of the picture the magnets are alternatively rotated with respect to each other.

### CAUTION

**Under no circumstances should the receiver be switched on with the deflection yoke removed from the picture tube. This may produce an undeflected spot which may damage the screen.**

### WIDTH, DRIVE AND HORIZONTAL LINEARITY ADJUSTMENTS

Adjustment of the horizontal drive control affects the high voltage applied to the kinescope as well as the width of the picture. In order to obtain the highest possible voltage and hence the brightest and best focussed picture the drive trimmer C408 is adjusted in the following manner:

Turn the drive control anti-clockwise until either one of the following effects take place:

- (a) there is no variation in picture width
- (b) a bright white line appears in approximately the centre of the raster.

If condition (b) exists turn the control clockwise until the line disappears.

Adjust the width control T404 to obtain approximately correct picture width. This is with the picture extending  $\frac{3}{4}$ " on either side of the kinescope mask with normal picture brightness.

Connect a voltmeter between 6DQ6-A cathode and chassis.

**NOTE:** For this purpose a test point is situated near the 6DQ6-A socket.

Adjust the linearity control until minimum voltage is obtained across the cathode resistor. This minimum voltage should be coincident with obtaining best linearity, maximum E.H.T. voltage and maximum width. However, in some cases this may not be correct and a slight readjustment of the linearity control to obtain maximum width may be required. If this is necessary then UNDER NO CIRCUMSTANCES MUST THE VOLTAGE ACROSS THE CATHODE BE ALLOWED TO BE EXCEEDED BY 1.0V ABOVE THE MINIMUM VALUE.



## INSTALLATION INSTRUCTIONS

### HEIGHT AND VERTICAL LINEARITY ADJUSTMENTS

The height control (R325) has more effect on the bottom of the picture than the top, tending to give bottom stretch or cramp, depending on the setting of the control. The opposite effect is noticeable with variation of the vertical linearity control (R333) in that it tends to give top stretch or cramp depending on its position. Therefore, to adjust for height and linearity, the two controls should be adjusted in conjunction, so that approximately  $\frac{1}{2}$ " of the picture extends beyond the top and bottom of the kinescope mask while maintaining the best linearity from top to bottom.

### A.G.C. CONTROL

Both A.G.C. controls have been set at the factory to cover a very wide range of signal levels and should not require attention in the field. Should the settings ever have been shifted, however, remember that clockwise rotation of the A.G.C. control increases the level at the detector and anti-clockwise rotation of the I.F. A.G.C. decreases the amount of snow.

### NOISE CANCEL ADJUSTMENT

Rotate the "Noise Cancel" control clockwise until a horizontal bend or shift in position is visible in the picture, then anti-clockwise about  $30^\circ$  past the point where the bend just disappears.

### CHASSIS REMOVAL

To remove the chassis from the cabinet for repairs proceed as follows:—

Remove all the control knobs by pulling them straight off their spindles.

Disconnect aerial lead-in wires.

Remove the cabinet back.

Remove the tuner earth braid from the main chassis.

Free the tuner and control panel from the front panel by removing two bolts, one at bottom of the control panel and one at the rear of tuner.

Attach the tuner to the main chassis, using the screw that held the tuner earth braid as an anchor point for the upper side lug on the control panel, the lower lug fitting under a raised portion of the chassis.

Disconnect the speaker, kinescope, yoke and Ultor leads.

The chassis is held in the cabinet by three (four)\* bolts, one at the top of cabinet, one on each side at the bottom support brackets. Removal of these bolts will allow the chassis to slide free after the bottom support brackets have been forced inwards to allow their tongues to clear their captive slots.

Installing the chassis is the reversal of the above procedure taking care that when tightening up the top mounting bolt that the dust sealing rubber is correctly located around the mask. Also check that the cables going to the Control Panel are dressed behind the lug on the kinescope cradle base.

### KINESCOPE HANDLING PRECAUTIONS

Do not install, remove or handle the kinescope in any manner unless shatter-proof goggles are worn. People not so equipped should be kept away while handling kinescopes.

Keep the kinescope away from the body while handling.

### REMOVAL AND INSTALLATION OF KINESCOPE

Attach the tuner to the main chassis as above.

Disconnect the speaker cable.

The chassis and cradle assembly are attached to the cabinet by five (six)\* bolts, the removal of which allows the complete assembly to be withdrawn.

Remove kinescope and yoke sockets and the Ultor lead.

Remove earthing sling.

Loosen kinescope clamp strap and ease the kinescope out of its cradle.

Loosen yoke cap clamp and slide the yoke assembly off the neck of the kinescope.

Replacing the kinescope is by reversing the above procedure, making sure that the dust seal is in its correct position.

When viewed from the rear of the cabinet the high-voltage contact on the kinescope should be on the left hand side.

### SAFETY GLASS REMOVAL

Remove chassis and kinescope assembly as in kinescope removal.

Remove the centre vertical trim.

The mask and safety glass are retained by a wooden bar at the base of the mask. Remove the Philips-head screws securing this bar. Holding the mask and glass assembly in one hand, remove the bar by sliding it to the left until the right hand end is free from its recess and the bar may then be lifted out.

Remove the mask.

Sliding the glass to the left then downwards and back, steadying it from the front at the same time, will allow the glass to be removed. Necessary care should be taken that the glass does not become scratched.

Replacing the glass is the reversal of the above procedure. When the glass is in position make sure that the inside surface is free from finger marks and the like.

\*Note. Some chassis had an extra support bracket on the power transformer.

### REPLACEMENT OF FUSES

Fuses are provided for power mains and high tension protection. Both are accessible on removing the cabinet back, the function of each being indicated on the label attached to the lid of the high voltage box.

## ALIGNMENT PROCEDURE

### AUSTRALIAN TELEVISION CHANNELS

Channel No.	Picture Carrier Freq. Mc/s	Sound Carrier Freq. Mc/s	Receiver R.F. Osc. Freq. Mc/s
1	50.25	55.75	86.25
2	64.25	69.75	100.25
3	86.25	91.75	122.25
4	133.25	138.75	169.25
5	140.25	145.75	176.25
6	175.25	180.75	211.25
7	182.25	187.75	218.25
8	189.25	194.75	225.25
9	196.25	201.75	232.25
10	210.25	215.75	246.25

#### TESTING INSTRUMENTS

To properly service the television receiver, it is recommended that the following testing instruments be available—

- (1) A.W.A. Television Sweep Generator, type A56036.
- (2) A.W.A. Cathode Ray Oscilloscope (C.R.O.), type A56031.
- (3) A.W.A. Television Calibrator, type A56057.
- (4) A.W.A. Volt Ohmyst, type A56010.
- (5) A.W.A. Universal Measuring Bridge, type A56048.

#### TESTING PADS AND CIRCUITS

(Referred to in Alignment Procedure.)

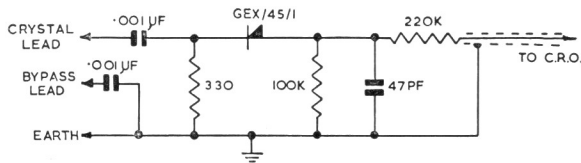


FIG. 3—CRYSTAL DETECTOR PROBE.

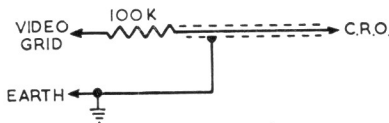


FIG. 4

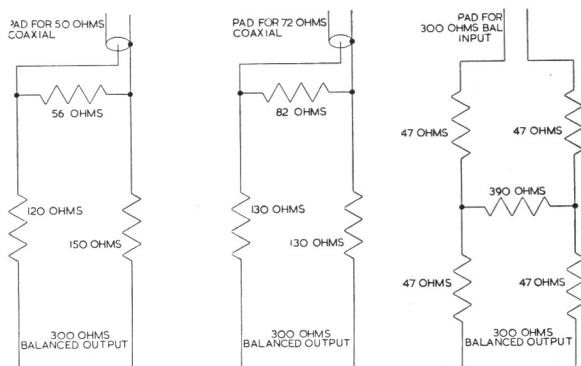


FIG. 5—SWEEP ATTENUATOR PADS

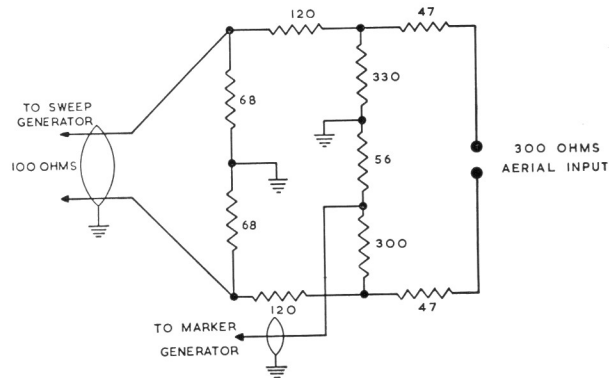


FIG. 6—INPUT PAD

#### RESPONSE CURVES

The response curves referred to throughout the alignment procedure were taken from a production set, but some variations can be expected.

#### CRITICAL LEAD DRESS

The cables from the receiver to the tuner must be positioned behind the lance on the kinescope cradle with the slackness of the cable between the lance and the tuner.

All leads in the I.F. section, particularly those on by-pass capacitors, must be kept as short as possible.

Wire wound resistors should be dressed away from neighbouring components.

## ALIGNMENT PROCEDURE

**NOTE:** When two positions of the core appear to give the correct adjustment, the following apply:—

\* coil tuned with core close to chassis.

† coil tuned with core close to can top, i.e., remote from chassis.

### SOUND I.F. ALIGNMENT

Connect the output of the television calibrator to pin 7 of V204 (video amplifier).

Set the calibrator frequency at 5.5 Mc/s.

Set the contrast control maximum clockwise.

Short circuit pin 2 of V203 (3rd video I.F.) to ground.

Connect the Volttohyst D.C. probe to pin 1 of V102 (ratio detector) and set the range switch to +5 volts D.C.

Adjust the following transformers for peak output, varying the input to maintain a reading of about +3 volts.

T101 (ratio detector transformer) secondary (bottom core)\*.

T101 primary (top core)†.

L101 (sound take off)\*.

L205 (sound trap)†.

Repeat this sequence once.

Transfer the Volttohyst probe to the junction of R104 and C108.

Re-adjust T101 secondary (bottom core)\* for zero reading on the Volttohyst.

Set the calibrator modulation switch to 600 c.p.s.

Connect the C.R.O. to the kinescope grid (test point "video out") through a crystal probe. (Volttohyst probe 2R56020 is suitable.)

Re-adjust L205 (sound trap)† for minimum 600 c.p.s. on the C.R.O.

### VIDEO I.F. ALIGNMENT

Turn R301 and R218 to their extreme clockwise position when viewed from the wiring side.

Connect a source of —3V bias to the video I.F. at the junction of R201 and C301 (test point "I.F. A.G.C.").

Connect the Volttohyst D.C. probe to pin 7 of V204 (video amplifier) and set the range switch at —5V D.C.

Set the channel selector on channel 6 and the fine tuning control at its mechanical centre. Check that the oscillator frequency is 211.25 Mc/s  $\pm 0.5$  Mc/s.

Connect the calibrator output to TP2 on the tuner through 1,000 pF capacitor using short leads.

Set the calibrator to the frequencies shown and adjust the following transformers for a peak output, reducing the input to maintain a reading of about —3 volts.

31.6 Mc/s ..... T201\*

34.0 Mc/s ..... T203\*

35.25 Mc/s ..... T202 (bottom core)\*

Set the calibrator to the frequencies shown and adjust the following traps for a minimum output increasing the input to maintain an output of —1V D.C.

37.5 Mc/s ..... L201\*

30.0 Mc/s ..... T202 (top core)†

Remove Volttohyst and calibrator.

Connect a source of —2.5 volts bias to the tuner A.G.C. terminal. The I.F. bias remains at —3 volts.

Connect the sweep generator to the aerial input terminals on the tuner. Set the sweep to channel 6. Connect the C.R.O. vertical input to TP1 on the tuner through a shielded lead.

Check that the R.F. response viewed on the C.R.O. conforms with that shown in Fig. 11.

Connect the crystal detector probe (Fig. 3) to pin 5 of V201 (1st video I.F.) and the bypass lead to pin 5 of V202 (2nd video I.F.).

Set the sweep generator output to give 0.3V p/p on the C.R.O.

Adjust T2 (tuner)† and L202\* to give 36 Mc/s at 80% with symmetrical peaks.

Adjust trimmer C204 and L202 to give 31.75 Mc/s at 80%.

T2 mainly affects 36 Mc/s position.

L202 mainly affects tilt.

C204 mainly affects bandwidth.

Required response is shown in Fig. 7.

Remove the crystal detector probe and connect the C.R.O. to pin 7 of V204 (video amplifier) using the network shown in Fig. 4.

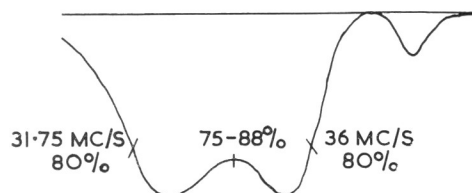


FIG. 7

View the overall response with 3V p/p output and adjust, if necessary, the following coils to give the required response of

36 Mc/s at 50% ..... T202\*

30.5 Mc/s at 5% ..... T201\*

No tilt ..... T203\*

The required response is shown in Fig 8.

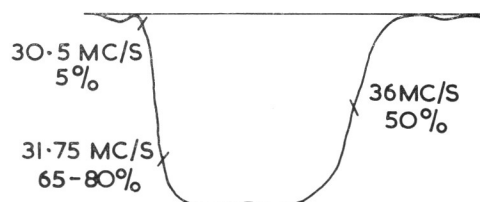


FIG. 8



## ALIGNMENT PROCEDURE

### TUNER ALIGNMENT

A tuner unit which is completely out of alignment, due to most unusual circumstances, should be re-aligned by carrying out the procedure listed below in correct order. In cases where only slight re-adjustment is necessary, due to component or valve failure, the tuned circuits associated with them need only be re-adjusted. In such cases, follow the appropriate procedure.

The tuner is normally aligned in three steps.

- (1) Aerial filter panel is separately adjusted as a sub-assembly.
- (2) Tuner with its cover removed is adjusted with respect to correct bandpass characteristics and approximately correct oscillator frequencies.
- (3) Tuner, with cover in place, is accurately aligned with respect to oscillator frequencies.

Step (1) should not normally be necessary in the field. Components which may cause trouble, i.e., broken windings on T1, may be replaced without re-adjustment. Capacitors C1, C2 and C3 may be replaced without danger of serious malalignment on all channels except channel 1.

For the sake of completeness the factory method of adjustment of the filter panel is included below:

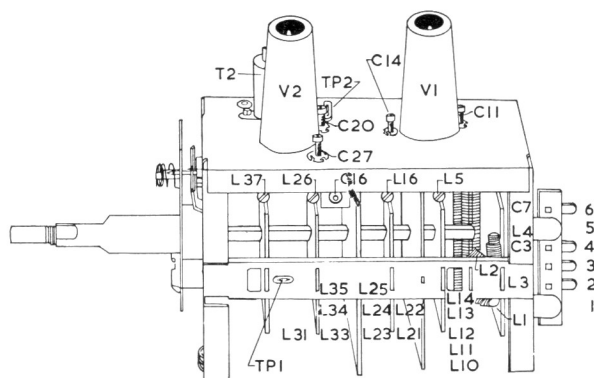


FIG. 9A. TUNER ADJUSTMENTS

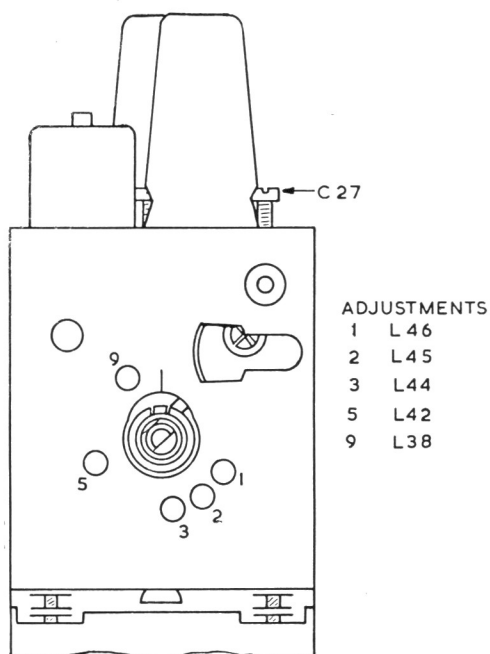


FIG. 9B. OSCILLATOR ADJUSTMENTS

### AERIAL FILTER ADJUSTMENT

Connect the A.W.A. Television Calibrator (36 Mc/s C.W. source) to the 300 ohm aerial terminals on the panel via a 72 ohm to 300 ohm balanced pad (Fig. 5). Disconnect C7 from the junction of L4 and C3; connect this junction via a screened cable to the input of a 36 Mc/s high gain amplifier.

Adjust L1 and L4 for maximum attenuation of the 36 Mc/s signal as observed at the output of the amplifier.

Connect the sweep generator to the 300 ohm aerial terminations. To prevent coupling reactance from the sweep generator into the filter unit, it is advisable to again use a resistance pad. Connect the A.W.A. Television Calibrator loosely to the matching unit terminals. For this purpose it will be found convenient to use the pad shown in Fig. 6.

Disconnect C7 again and connect a crystal detector probe to the junction of L4 and C3. A probe such as that shown in Fig. 3 constructed with very short leads will be most useful.

Adjust the sweep generator to sweep from 42 to 52 Mc/s. This may be achieved on the A.W.A. Sweep Generator Type A56036 by switching to channel 1 and screwing the core in several turns.

Adjust L2 and L3 to obtain the response shown in Fig. 10. Note that the adjustment of L3 affects the shoulder of the response curve, while L2 affects the position of the 46.5 Mc/s point.

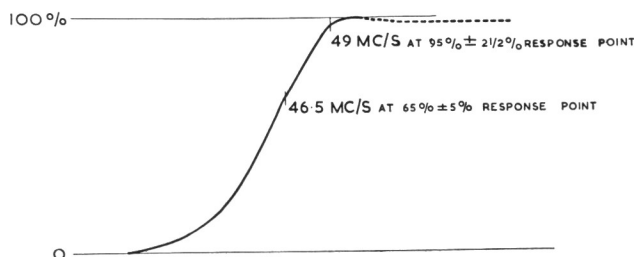


FIG. 10—AERIAL MATCHING UNIT RESPONSE

Remove the crystal probe connections and re-connect C7 to junction of C3 and L4.

### COMPLETE R.F. ALIGNMENT

For complete tuner alignment the tuner must be removed from the receiver. Disconnect the co-axial lead from the I.F. input and connect up extension leads for B+, Filament and Earth. Remove the tuner from the chassis and remove its cover.

Connect the sweep generator to the aerial input terminals of the matching unit. It is advisable to have on hand a special cable for connection from tuner to sweep generator with a resistive pad (Fig. 6) having balanced connections going directly to the aerial input terminals.

Connect a bias source to the A.G.C. terminal of the tuner and set the bias to  $-2.5$  volts while making all adjustments for correct responses. Connect the vertical input of the C.R.O. direct to TP1 on the tuner with a shielded lead. Earth the shield at the tuner.

Switch on the receiver or power supply to the tuner and carry out the following adjustments with the correct voltages: 265V H.T., 6.3V Filament and  $-2.5V$  Bias.

## ALIGNMENT PROCEDURE

Loop an insulated wire from the R.F. input terminal of the calibrator around the 6CQ8 valve with its cover removed.

Switch to channel 10 and adjust L37 to give oscillator frequency of 246.25 Mc/s.

Switch to channel 9 and adjust L38 to give oscillator frequency of 232.25 Mc/s.

Switch to channel 6 and re-adjust C27, if necessary, to 211.25 Mc/s.

Repeat the above procedure until no adjustment is necessary for correct oscillator frequencies on channels 10, 9 and 6 within  $\pm 0.3$  Mc/s. Channels 8 and 7 have no separate frequency adjustment, but the frequency will be found to be 225.25 Mc/s and 218.25 Mc/s  $\pm 0.3$  Mc/s respectively, if adjustments of 10, 9 and 6 frequency are carried out correctly.

Connect the calibrator to the input pad from the sweep generator as shown in Fig. 6.

Switch the tuner and sweep generator to channel 6 and adjust the output to give a response pattern on the C.R.O. Detune the core of T2 (converter I.F. transformer) when adjusting response curves until no variation of curve is observed on the C.R.O. Adjust C11, C14, C16 and C20 for correct response shape, with markers, from calibrator at video and sound carrier frequencies, correctly placed on the response curve. Be sure that the pattern shown on the C.R.O. is not disturbed by a 50 c/s pick-up. A direct earth strap between tuner, C.R.O. and power supply will eliminate this interference.

The correct adjustment of C11 is indicated by maximum amplitude at a frequency midway between video and sound markers. C16 is adjusted for the required bandwidth on top of the response curve. C20 affects the frequency of the response mainly and C14 the symmetry. C11 also affects symmetry and tilt but should always be adjusted for the maximum output in the centre.

Switch the tuner and sweep generator to channel 10 and adjust the calibrator to give video and sound markers. Adjust L5 for maximum output between video and sound markers and L26, L16 for correct curve. L16 affects mainly the frequency of the response and L26 the symmetry.

Return to channel 6 and observe the response curve. If re-adjustment is necessary, repeat the procedure contained in the previous three paragraphs, until correct response is obtained on channels 6 and 10 without recourse to adjustment. Observe the responses on channels 9, 8 and 7 which should be within the tolerances shown in Fig. 11.

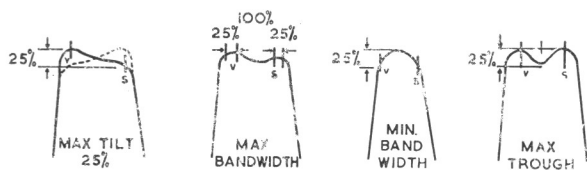


FIG. 11—RESPONSE CURVE TOLERANCES ALL CHANNELS

Re-check the oscillator frequency adjustment as in the first paragraph of this section. If re-adjustment is necessary, check the response curves of channels 10 and 6. Re-adjust if necessary.

Then proceed as follows:

Switch to channel 5 and adjust screw in L42 to give oscillator frequency of 176.25 Mc/s.

Switch to channel 3 and adjust screw in L44 to give oscillator frequency of 122.25 Mc/s.

Switch to channel 2 and adjust screw in L45 to give oscillator frequency of 100.25 Mc/s.

Switch to channel 1 and adjust screw in L46 to give oscillator frequency of 86.25 Mc/s.

Switch tuner and sweep generator to channel 5 and spread or close turns of L21 and L31 to give correct curve. Adjust L10, in the R.F. amplifier grid circuit, for maximum response in the centre of the channel. L21 affects the frequency of the response mainly and L31 the symmetry.

Switch to channel 4 and if necessary adjust L22 and L11 for correct response.

Switch to channel 3 and spread or close the turns of L23 and L33 to give approximately the correct response. Spread or close the turns of L12, in grid circuit, for maximum response at the centre frequency which corresponds to the minimum hollow in the top of the curve.

Switch to channels 2 and 1 in turn and adjust—

L24, L34, L13 on channel 2

L25, L35, L12 on channel 1

for correct response curve.

Re-check response curves of channels 10 and 6, and re-adjust C14, C20, L16, L26 if necessary. Then re-check response curves of channels 5, 4, 3, 2 and 1.

### FINAL OSCILLATOR ADJUSTMENT

This adjustment may be carried out with the tuner mounted in its normal manner on the chassis.

Replace the cover on the tuner unit and with the calibrator R.F. input lead looped around the 6CQ8 valve, re-adjust C27 on channel 6, L37 on channel 10, L38 on channel 9 for the correct frequency when the fine tuning control is in its central position. Then re-adjust screws through the front of the tuner for correct frequencies on channels 5, 3, 2 and 1.

Check that the correct frequency on all channels is obtained without adjustments when the fine tuning control is rotated  $\pm 45^\circ$  from its centre position. Check that the oscillator injection voltage, measured with the Voltohmyst D.C. probe at TP1, is between 2.0 and 5.0 volts.

Make sure that the screws retaining the covers are firmly in position and that the covers are well fitted to maintain a low oscillator radiation.

### SPECIAL NOTES

1. Always align with the correct bias of  $-2.5$  volts, which is an average figure of the A.G.C. potential.

2. The cover of the tuner must be in position when making final adjustment to frequency of local oscillator.

3. Detune the core of T2 (converter I.F. transformer) when adjusting response curves until no variation of the curve is observed on the C.R.O.

## ALIGNMENT PROCEDURE

### HORIZONTAL OSCILLATOR ALIGNMENT

Normally the adjustment of the horizontal oscillator is not considered to be a part of the alignment procedure, but since the oscillator waveform adjustment may require the use of an oscilloscope, it usually can not be done conveniently in the field. The waveform adjustment is made at the factory and normally should not require re-adjustment in the field. However, the waveform adjustment should be checked whenever the receiver is aligned or whenever the horizontal oscillator operation is incorrect.

When no C.R.O. is available the horizontal oscillator may be aligned and checked as follows:

Tune in a station, if available, or, using a generator to provide the appropriate synchronising signals, synchronise the picture by adjusting the horizontal and vertical hold controls respectively. If the picture cannot be synchronised, short circuit the sine wave stabilising coil (L401) and then adjust the horizontal hold control until synchronisation is obtained. Remove the short circuit and adjust the core in L401 until the picture is again synchronised. If synchronisation is still unobtainable, adjust the horizontal hold control slowly, in conjunction with the core in L401, until the picture is synchronised.

Check for over-drive and make any necessary re-adjustments to the horizontal hold control or to the core in the sine wave stabilising coil.

To check if the correct adjustment has been made, turn the horizontal hold control to the extreme clockwise position. The picture should be out of synchronisation, with a minimum of twelve bars slanting downwards to the left. Turn the control slowly anti-clockwise. The number of diagonal black bars will be gradually reduced and when only  $1\frac{1}{2}$  to 3 bars sloping downward to the left are obtained, the picture will synchronise upon slight additional anti-clockwise rotation of the control. The picture should remain in synchronisation for approximately two full turns of additional anti-clockwise rotation of the control. Continue turning the control anti-clockwise until the picture falls out of synchronisation. Rotation beyond the "fall-out" position should produce between 2 and 5 bars before motorboating occurs. Motorboating should be reached before the control reaches the extreme anti-clockwise position.

If an oscilloscope is available, the procedure is as follows:

Connect the low capacity probe of the C.R.O. to the terminal of L401 which is connected to C406 and R407. Dress the probe at least one inch away from the sine wave coil (L401). Turn the horizontal hold control so that the picture is in synchronisation. The pattern on the C.R.O. should be as shown in Fig. 12A. If not, adjust the sine wave coil until nominal wave form, as shown, is obtained. Remove the C.R.O. on completion of this adjustment.

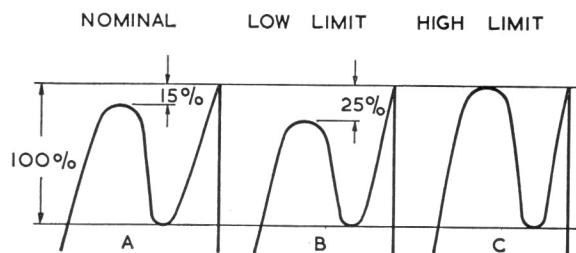


FIG. 12—HORIZONTAL OSCILLATOR WAVE FORMS

When the receiver passes the above checks and the picture is normal and stable, the horizontal oscillator is properly aligned.

### SENSITIVITY CHECK

A comparative sensitivity check can be made by operating the receiver on a weak signal from a television station and comparing the picture and sound obtained to that obtained on other receivers under the same conditions.

This weak signal can be obtained by connecting the service department aerial to the receiver through a ladder type attenuator pad. The number of stages in the pad depends upon the signal strength available at the aerial. A sufficient number of stages should be inserted so that a somewhat less than normal contrast picture is obtained when the contrast control is in the extreme clockwise position. Only carbon type resistors should be used to construct the pad.

### A.G.C. CONTROL ADJUSTMENT

Both A.G.C. controls have been set at the factory to cover a very wide range of signal levels and should not require attention in the field. Should the settings ever have been shifted, however, remember that clockwise rotation of the A.G.C. control increases the level at the detector and anti-clockwise rotation of the I.F. A.G.C. decreases the amount of snow.

The factory procedure for adjustment is as follows:

Set the "Noise Cancel" control fully anti-clockwise. Set the A.G.C. and I.F. A.G.C. control midway. Apply a 100mV fully modulated TV signal to the aerial terminals and set the A.G.C. control for 2.5 volts peak to peak at the detector. Reduce the signal to 1mV and adjust the I.F. A.G.C. for a reading of -1.7 volts at the Tuner A.G.C. tag. (Fine tuning control to be set at correct frequency.)

### NOISE CANCEL ADJUSTMENT

Rotate the "Noise Cancel" control clockwise until a horizontal bend or shift in position is visible in the picture, then anti-clockwise about 30° past the point where the bend just disappears.



# D.C. RESISTANCE OF WINDINGS

WINDING		D.C. RESISTANCE IN OHMS	WINDING		D.C. RESISTANCE IN OHMS
Tuner Windings		*	T202 2nd Video I.F.		
L101 Sound I.F.		1.3	Primary 1-4		*
L201 37.5 Mc/s Trap		*	Secondary 2-3		*
L202 Video I.F. Input		*	T203 3rd Video I.F.		
L203 Detector Filter Choke		4	Primary 1-4		*
L204 Detector Peaking Coil Rd		6	Secondary		*
L205 5.5 Mc/s Trap		1.5	T301 Vertical Oscillator Transformer		
L206 Video Amp. Shunt Peaking Wh		5	Primary Bu-Gr		450
L207 Video Output Shunt Peaking Bk		6.5	Secondary Ye-Bk		130
L208 Video Output Series Peaking Bu		4	T302 Vertical Output Transformer		
L401 Hor. Sine Wave Coil		55	Bu-Rd		400
L402 H.F. Choke		*	Rd-Ye		2.7
L403 Hor. Linearity Coil		7.7	T401 Horizontal Blocking Oscillator Transformer		
L405 Deflection Yoke		8.9	Ye-Anode		24
L406 Deflection Yoke		8.9	Ye-C405		64
L407 Deflection Yoke		18	T402 Horizontal Output Transformer		
L408 Deflection Yoke		18	2-3		3.5
L409 Filter Choke		40	3-4		11
T101 Ratio Detector			4-8		13
Primary 1-6		9.5	8-7		9
Secondary 3-4		1	7-6, 5		10
T102 Audio Output			6, 5-Anode		380
Primary		340-400	T403 Power Transformer		
Secondary		*	Primary Gr-Wh		7
T201 1st Video I.F.			Secondary Rd-Rd		62
Primary 1-2		*	T404 Width Coil		
Secondary 3-4		*	Primary		*
			Secondary		12.5

\* Less than 1 ohm.

The above readings were taken on a standard chassis, but substitution of materials during manufacture may cause variations, and it should not be assumed that a component is faulty if a slightly different reading is obtained.

## MECHANICAL REPLACEMENT PARTS

Description	Part No.	Code No.	Description	Part No.	Code No.
<b>MAIN CHASSIS:</b>			<b>TUNER UNIT:</b>		
Anode Cap, H.V. Rectifier		188011	Tuner		41441
Anode Cap and Lead, Horizontal Output	40044		Bracket Rear Support		41317
Bracket, Chassis Mtg. L.H.	41304		Cover Front		41384
Bracket, Chassis Mtg. R.H.	41305		Cover Main Body		40152
Bracket, Chassis Top Corner L.H.	41307		Pin Jack Assembly		40373
Bracket, Chassis Top Corner R.H.	41306		Screen, Valve		40164
Cable, Power	49743		Terminal Panel Assembly		40612
Cap Assembly, Yoke	41185		<b>FINE TUNING ASSEMBLY:</b>		
Clamp Assembly, Yoke Cap	41186		Detent Mech. Assembly		41414
Clamp Body, Power Cable	41397		Guide, Fine Tuning Spring		40140
Clamp Lock, Power Cable	41398		Lever Assembly		40165
Clamp, Yoke	41174		Retainer Spring, Fine Tuning		40502
Clamp, Ultor Lead	41330		Spring, Lever		40500
Dial Lamp Holder	4195		Spring, Wiper		40507
Earthing Lead Frame	49788		<b>MISCELLANEOUS:</b>		
E.H.T. Box Assy.	41412		Baffle, 7" x 5" Speaker Mtg.		40737
E.H.T. Box Lid	41310		Bracket, Chassis Mtg.		41318
E.H.T. Box Side	41309		Cabinet, Lowboy		37761
Fuse Holder	40845		Cabinet, Console		37762
Insulator, Preset Panel	41470		Clamp Baffle		40728
Lead, Ultor	49782		Dust Seal 21" Kinescope		40731
Panel Assembly, Mains		551500	Escutcheon		41371
Panel, Preset Controls	41381		Legs, Lowboy Cabinet		41466
Plug Assembly, Mains		581235	Kine Mount Rivet Assembly 21"		41331
Shield, Corona	41064		Kine Strap Assy. L.H. 21"		41327
Socket and Cable Assembly Kinescope	49780		Kine Strap Assembly R.H. 21"		41325
Socket, 8 Pin Mica Filled		794582	Knob Assembly Channel Selector		41337
Socket, 8 Pin Wafer		793033	Knob Assembly Fine Tuning		41369
Socket, 9 Pin Moulded Mica		794599	Knob Assembly Front Controls		41370
Socket, 7 Pin less Mount Flange		794579	Knob Assembly Power/Tone		41586
Socket, 7 Pin with Register, Mica Filled		794569	Plate Centre Trim Mtg.		41374
			Safety Glass		40701
			Sling Earthing		41324
			Spring, Kine Earth		40515
			Spring, Frame Earth		40242

## SOCKET VOLTAGES

Conditions of measurement unless otherwise specified:

(1) 30 mv Signal: Contrast, Brightness, A.G.C., I.F. A.G.C., Noise Cancel., Vert. Hold, Height and Linearity, Hor. Hold Width and Linearity and Focus all adjusted for correct normal picture. Tone and Volume maximum anti-clockwise.

(2) No Signal—Channel 1, Input S/C. Contrast, Brightness, A.G.C., I.F. A.G.C., Noise Cancel, Focus, Tone and Volume all maximum anti-clockwise, Vert. Hold, Height and Linearity, Hor. Hold, Width and Linearity, adjusted for correct normal picture. (Controls viewed from spindle end or from valved side of chassis for presets.) For all measurements Mains Input = 240V A.C. Signal Input as indicated. All D.C. voltages measured with a Voltohmyst.

NOTE: These voltages are the average of a number of chassis. Therefore variations should be expected on individual chassis.

CAUTION: Do not measure mains voltage with Voltohmyst unless earth lead from Voltohmyst is connected to chassis.

Valve No.	Type	Function	Operating Condition	Anode to Chassis		Screen to Chassis		Cathode to Chassis		Grid to Chassis		Remarks
				Pin No.	Volts	Pin No.	Volts	Pin No.	Volts	Pin No.	Volts	
V1	6BQ7A	R.F. Amp.	30 mV	6	250	—	—	8	148	7	140	Voltage difference from 30 mV to No Signal is less on Channels 10 to 4.
			No Signal	6	230	—	—	8	112	7	110	
V1	6BQ7A	R.F. Amp.	30 mV	1	148	—	—	3	0	2	—4.5	
			No Signal	1	112	—	—	3	0	2	—0.25	
V2	6CQ8	Converter	30 mV	6	90	3	100	7	0	2	3.0	Measure Oscillator and Converter voltages with 0.1 meg resistor in series with D.C. probe to avoid upsetting conditions.
			No Signal	6	100	3	110	7	0	2	3.1	
V2	6CQ8	R.F. Oscillator	30 mV	1	210	—	—	8	100	9	90	
			No Signal	1	220	—	—	8	110	9	96	
V101	6AU6	1st Sound I.F.	30 mV	5	70	6	70	7	0.75	1	0	
			No Signal	5	80	6	80	7	0.7	1	0	
V102	6AL5	Ratio Detector	30 mV	2	—5.1	—	—	5	1.5	—	—	*Varies with noise.
				7	1.45	—	—	1	5.1	—	—	
			No Signal	2	—7.5	—	—	5	*0 to —3	—	—	
				7	*0 to —3	—	—	1	7.3	—	—	
V103	6AV6	Audio Amp.	30 mV	7	100	—	—	2	0	1	—90	
			No Signal	7	100	—	—	2	0	1	—90	
V104	6AQ5	Audio Output	30 mV	5	250	6	260	2	15.1	1	0	
			No Signal	5	245	6	255	2	14.8	1	0	
V201	6BZ6	1st Video I.F.	30 mV	5	140	6	140	2	.17	1	—4.8	
			No Signal	5	120	6	120	2	.90	1	0	
V202	6BZ6	2nd Video I.F.	30 mV	5	260	6	260	2	143	1	139	
			No Signal	5	240	6	240	2	125	1	123	
V203	6BZ6	3rd Video I.F.	30 mV	5	235	6	135	2	1.77	1	0	
			No Signal	5	230	6	130	2	1.7	1	0	
V204A	6AW8A	Noise Cancel	30 mV	3	265	—	—	1	—85	2	—13	*Varies with noise.
			No Signal	3	255	—	—	1	*0 to —.8	2	—20	
V204B	6AW8A	Video Amp.	30 mV	9	140	8	155	6	2.1	7	—1.55	
			No Signal	9	110	8	150	6	*2 to 3	7	*—1 to —.5	
V205	6AQ5	Video Output	30 mV	5	225	6	265	2	22	1	0	
			No Signal	5	225	6	260	2	22	1	0	
V206	21CEP4	<input type="checkbox"/> Kinescope	30 mV	Side Contact	±16.1KV	3	400	7	[65 to 130	2	36	[Varies with Brightness control setting.
			No Signal		±16KV	3	390	7	[60 to 115	2	35.5	

☐ Pin 4: 0 to 620 volts with Focus control setting.



## SOCKET VOLTAGES (continued)

Conditions of measurement unless otherwise specified:

(1) 30 mv Signal: Contrast, Brightness, A.G.C., I.F. A.G.C., Noise Cancel., Vert. Hold, Height and Linearity, Hor. Hold Width and Linearity and Focus all adjusted for correct normal picture. Tone and Volume maximum anti-clockwise.

(2) No Signal—Channel 1, Input S/C. Contrast, Brightness, A.G.C., I.F. A.G.C., Noise Cancel, Focus, Tone and Volume all maximum anti-clockwise, Vert. Hold, Height and Linearity, Hor. Hold, Width and Linearity, adjusted for correct normal picture. (Controls viewed from spindle end or from valved side of chassis for preset.) For all measurements Mains Input = 240V A.C. Signal Input as indicated. All D.C. voltages measured with a Volt ohmyst.

NOTE: These voltages are the average of a number of chassis. Therefore variations should be expected on individual chassis.

CAUTION: Do not measure mains voltage with Volt ohmyst unless earth lead from Volt ohmyst is connected to chassis.

Valve No.	Type	Function	Operating Condition	Anode to Chassis		Screen to Chassis		Cathode to Chassis		Grid to Chassis		Remarks
				Pin No.	Volts	Pin No.	Volts	Pin No.	Volts	Pin No.	Volts	
V301A	6U8	A.G.C. Amp.	30 mV	6	—53	3	270	7	155	2	130	*Varies with noise.
			No Signal	6	*+.1 to —6	3	260	7	150	2	120	
V301B	6U8	Sync. Sep.	30 mV	1	40	—	—	8	0	9	—27	
			No Signal	1	*50 to 90	—	—	8	0	9	*—4 to —10	
V302A	6CG7	Sync. Amp.	30 mV	1	68	—	—	3	0	2	—3.2	
			No Signal	1	66.5	—	—	3	0	2	*—1.6	
V302B	6CG7	Vert. Osc.	30 mV	6	110	—	—	8	.02	7	—26	Depends on positions of Vert. Height and Linearity controls. Figures given for correct settings of Vert. Height and Lin. Control.
			No Signal	6	105	—	—	8	.02	7	—25	
V303	6CZ5	Vert. Output	30 mV	9	245	1	260	7	22.5	3	2	
			No Signal	9	235	1	250	7	22	3	5	
V401	6CG7	Hor. Control	30 mV	1	270	—	—	3	°0 to 20	2	—18.5	°Depends on Hor. Hold Setting.
			No Signal	1	265	—	—	3	°—4 to +6	2	—21	
		Hor. Osc.	30 mV	6	195	—	—	8	0	7	—84.5	
			No Signal	6	190	—	—	8	0	7	—90	
V402	6DQ6A	Hor. Output	No Signal	Top Cap	†5.2KV Peak	4	160	8	(11.5	5	—25	(For optimum Hor. Linearity but must not exceed 12.0V. †Do not measure.
V403	6AU4GTA	Hor. Damper	No Signal	5	260	—	—	3	†4.3KV Peak	—	—	‡Measured with Volt ohmyst fitted with high-voltage probe and at minimum Brightness.
V404	1B3GT	H.V. Rect.	No Signal	Top Cap	†16KV Peak	—	—	2.7	‡16KV	—	—	
V405	5AS4	Rectifier	30 mV	4,6	286A.C.	—	—	2,8	287	—	—	
			No Signal	4,6	286A.C.	—	—	2,8	284	—	—	

H.T. Voltages	Across	C116C	C317C	C423	At junction of C413 & C414
Operating Condition	30 mV	275	155	265	745
	No Signal	270	150	260	730

Filament Voltages: Between pins 2 and 8 V405: 4.85V A.C. (Do not use Volt ohmyst.)

Between pin 8 V403 and chassis: 6.15V A.C.

## CIRCUIT A.W.A. TELEVISION RECEIVER MODELS 220-L & 221-C

In some chassis C202 was mounted in L201.

In some chassis the voltage rating on C418 was 600. These should be changed to a 1,600-volt rated capacitor.

In some chassis R345 and R346 were omitted.

The height-control circuit has been changed in the following stages:—

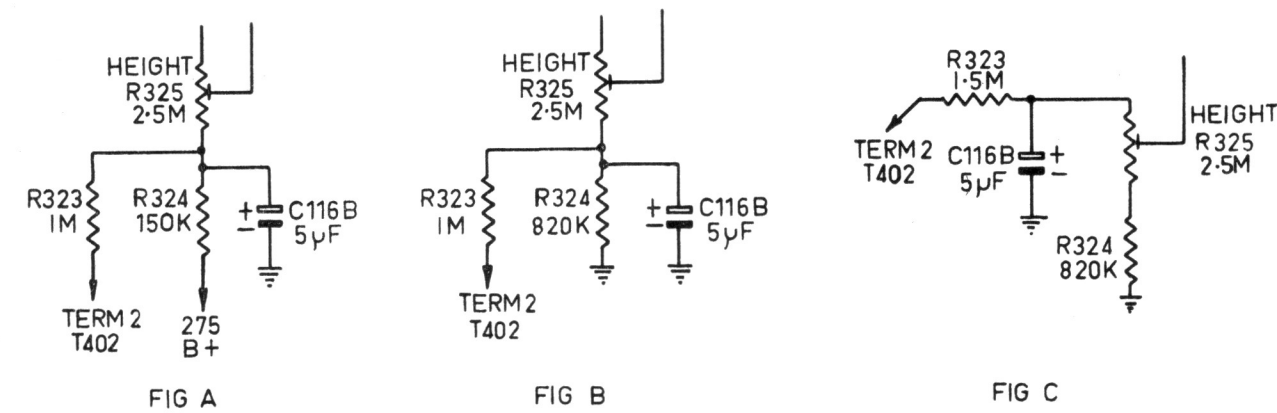
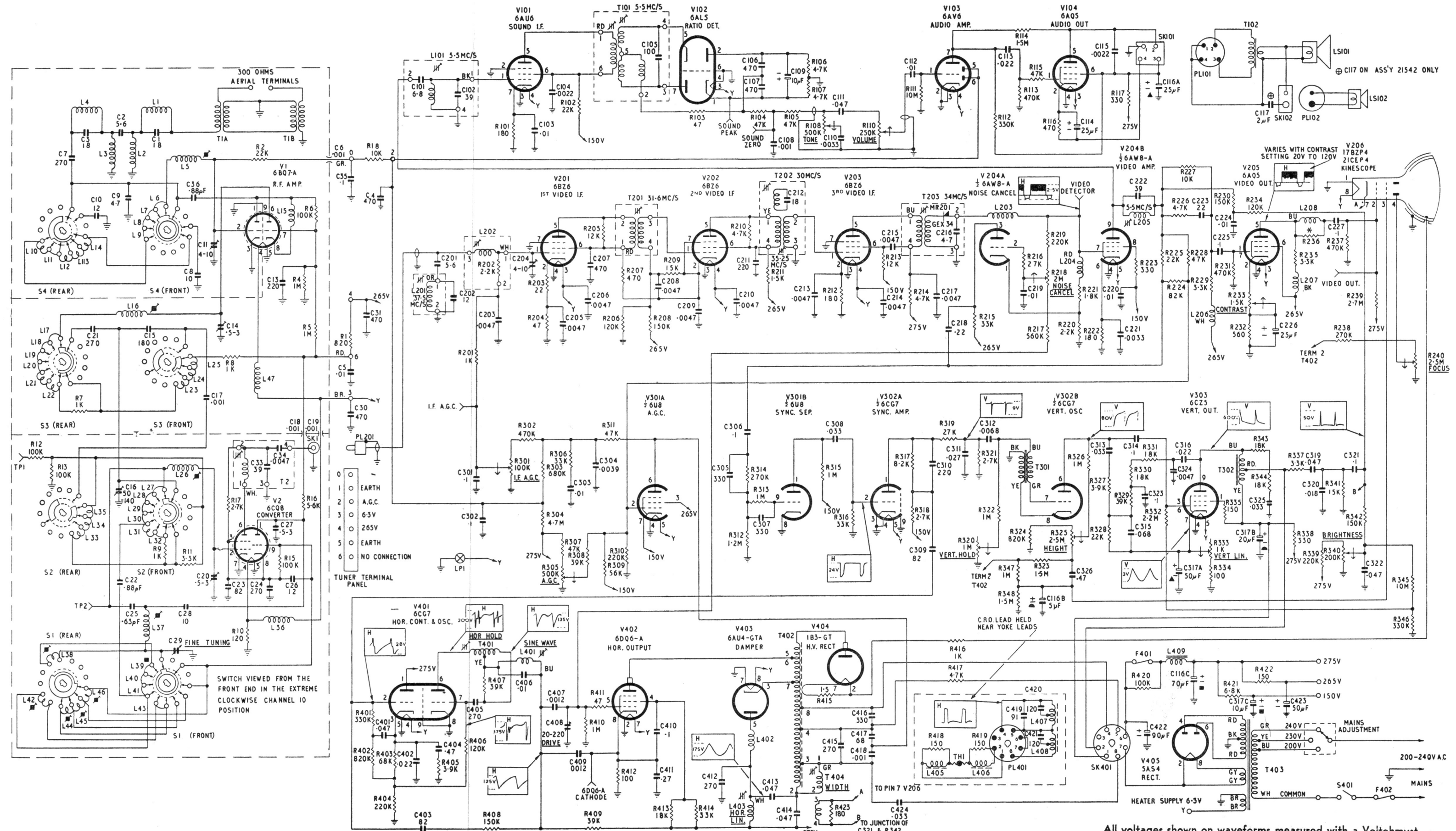
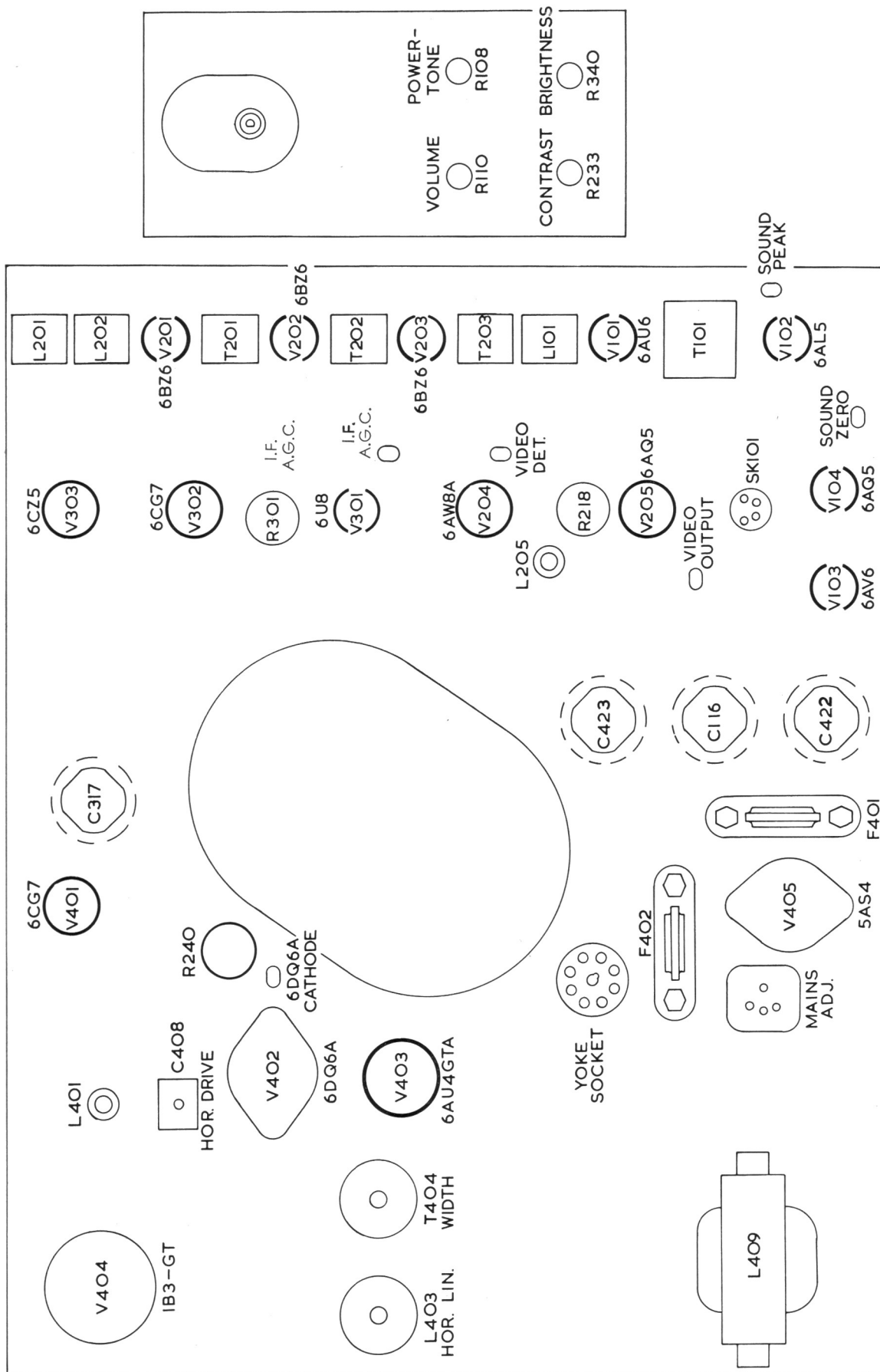


Fig. C variation allows a rather slow build-up of the picture when switching the receiver on. Should the customer require it, change to the present circuit.

R236\*: In some chassis this was a 6.8K ohm resistor on which L208 was wound and a 22K ohm resistor was wired externally in parallel.



All voltages shown on waveforms measured with a VoltOhmyst.



UNDER CHASSIS ALIGNMENT ADJUSTMENT.

FIG. 14





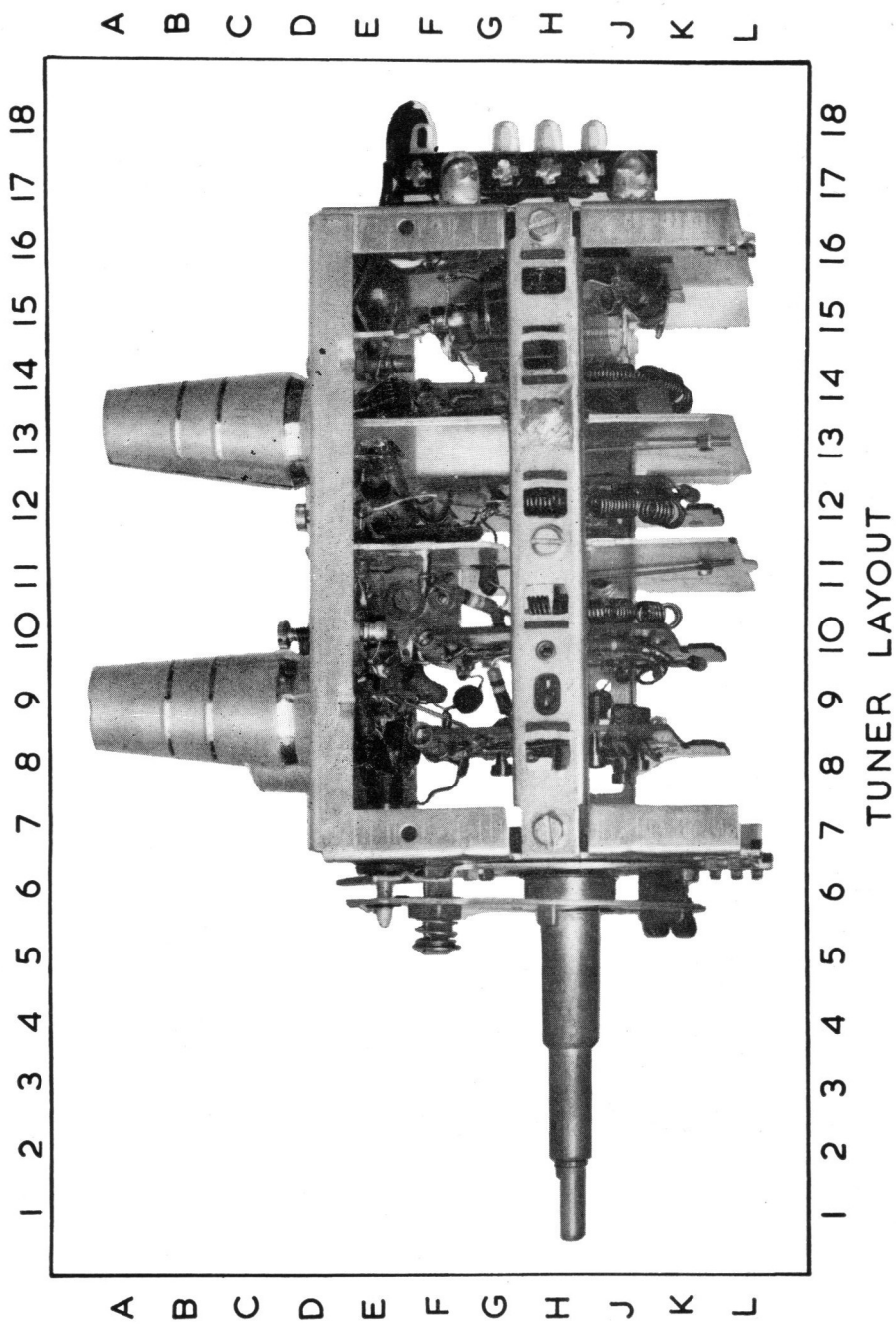
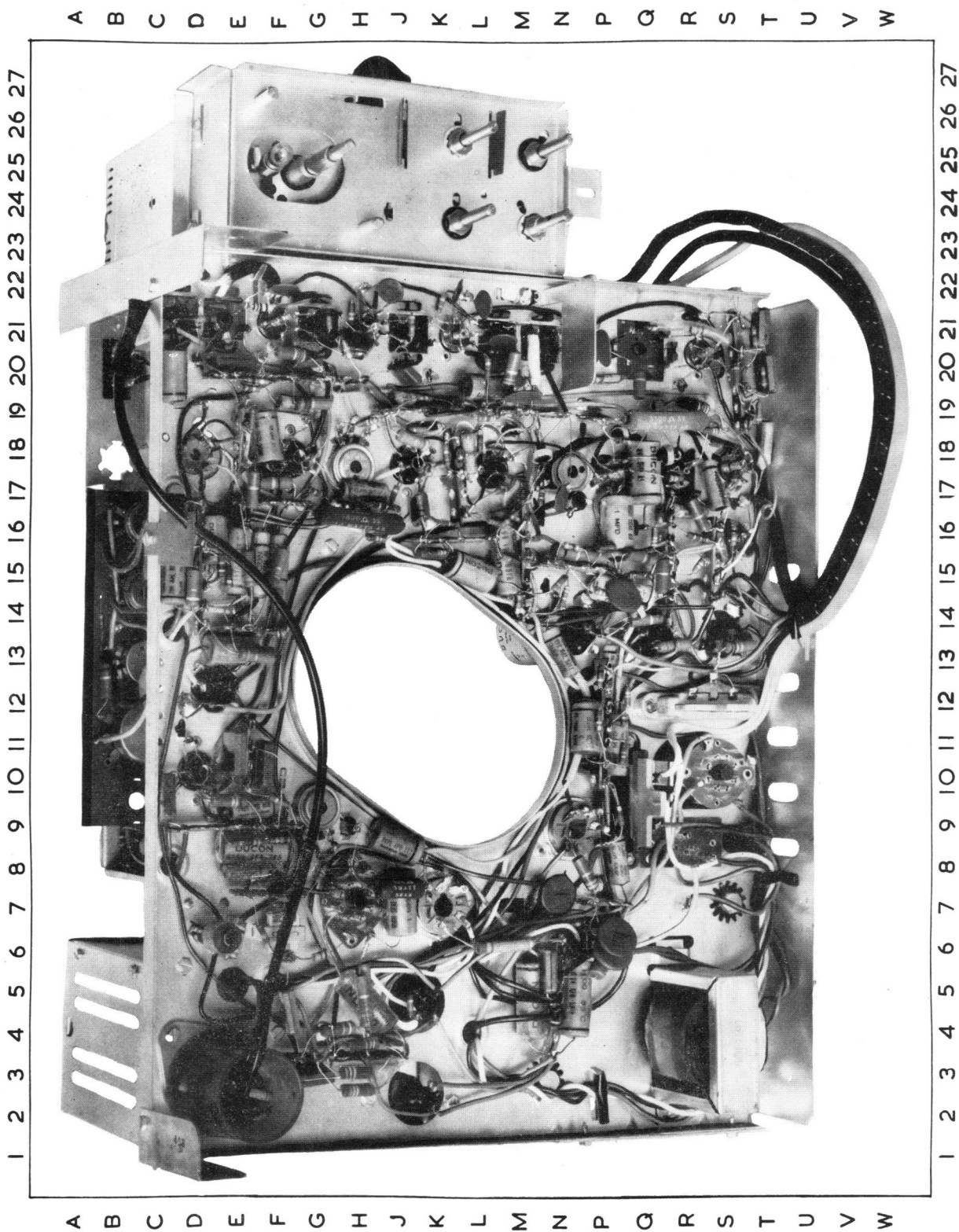
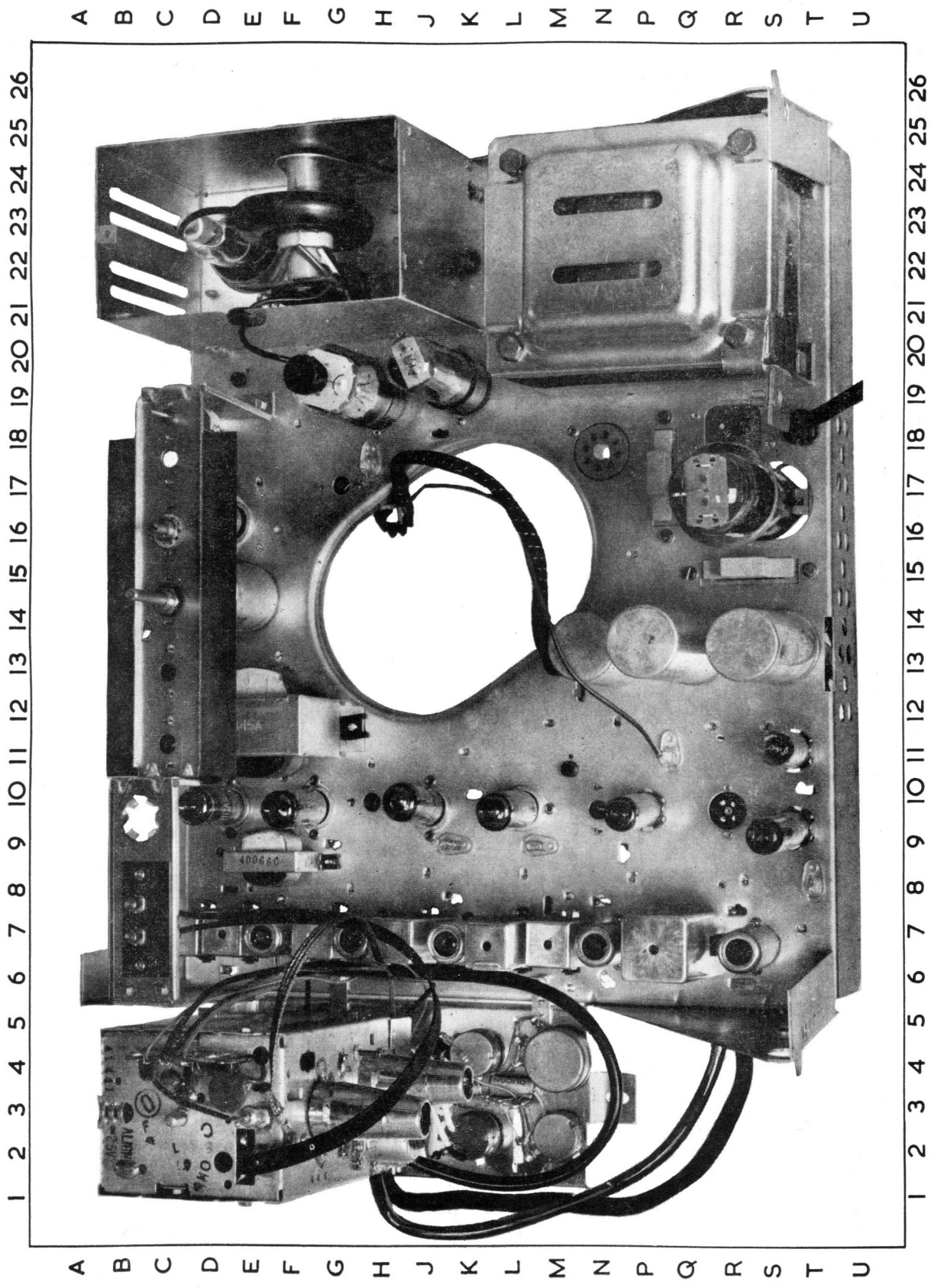


FIG. 16



BOTTOM LAYOUT

FIG. 17



TOP LAYOUT

FIG. 18

## CIRCUIT CODE

[illegible]



# CIRCUIT CODE

CODE No.	DESCRIPTION	PART No.	FIG. No.	LOCATION	CODE No.	DESCRIPTION	PART No.	FIG. No.	LOCATION
RESISTORS (continued)					RESISTORS (continued)				
R204	47 ohms	± 10%	17	F22	R316	33K ohms	± 10%	17	G18
R205	12K ohms	± 5%	17	G21	R317	8.2K ohms	± 10%	17	G19
R206	120K ohms	± 10%	17	H21	R318	2.7K ohms	± 5%	17	G20
R207	470 ohms	± 20%	17	H20	R319	27K ohms	± 10%	17	F20
R208	150K ohms	± 10%	17	H20	R320	1 Megohm Linear Carbon. Vertical Hold	37209	17	B13
R209	15K ohms	± 10%	17	H20	R321	2.7K ohms	± 10%	17	E20
R210	4.7K ohms	± 5%	17	J21	R322	1 Megohm	± 10%	17	E20
R211	1.5K ohms	± 20%	17	J20	R323	1.5 Megohm	± 10%	17	H3
R212	180 ohms	± 10%	17	K22	R324	820K ohms	± 10%	17	B14
R213	12K ohms	± 10%	17	L20	R325	2.5 Megohm Linear Carbon. Height Control	620781	17	B14
R214	4.7K ohms	± 10%	17	M20	R326	1 Megohm	± 10%	17	D16
R215	33K ohms	± 10%	17	L16	R327	3.9K ohms	± 10%	17	E15
R216	27K ohms	± 20%	17	M17	R328	22K ohms	± 10%	17	D15
R217	560K ohms	± 10%	17	F6	R329	39K ohms	± 5%	17	D15
R218	2 Megohms	± 10%	17	N18	R330	18K ohms	± 5%	17	E13
R219	220K ohms	± 10%	17	M18	R331	18K ohms	± 5%	17	E13
R220	2.2K ohms	± 5%	17	M15	R332	2.2 Megohms	± 20%	17	E19
R221	1.8K ohms	± 5%	17	M16	R333	1K ohms W.W. Linear Vertical Linearity	41468	17	B11
R222	180 ohms	± 10%	17	K18	R334	100 ohms	± 10%	17	B12
R223	330 ohms	± 10%	17	L19	R335	150 ohms	± 10%	17	E17
R224	82K ohms	± 10%	17	M14	R336	Not used			
R225	22K ohms	± 10%	17	N15	R337	3.3K ohms	± 10%	17	P9
R226	4.7K ohms	± 10%	17	N15	R338	330 ohms	± 10%	17	F17
R227	10K ohms	± 10%	17	N15	R339	220K ohms	± 10%	17	R15
R228	47K ohms	± 10%	17	N14	R340	200K ohms Linear Carbon. Brightness	37208	18	M2
R229	3.3K ohms	± 10%	17	Q15	R341	15K ohms	± 10%	17	Q12
R230	150K ohms	± 10%	17	P15	R342	150K ohms	± 10%	17	P12
R231	470K ohms	± 20%	17	R17	R343	18K ohms	± 10%	17	E15
R232	560 ohms	± 10%	17	Q15	R344	18K ohms	± 10%	17	F15
R233	1.5K ohms W.W. Contrast Control	41467	18	M4	R345	10 Megohms	± 10%	17	P12
R234	120K ohms	± 10%	17	P11	R346	330K ohms	± 10%	17	Q12
R235	3.3K ohms	± 10%	17	R19	R347	1 Megohm	± 10%	17	H3
R236*	4.7K ohms	± 10%	17	P18	R348	1.5 Megohms	± 10%	17	H3
R237	470K ohms	± 20%	17	Q16	R401	330K ohms	± 10%	17	F10
R238	270K ohms	± 10%	17	G8	R402	820K ohms	± 10%	17	F9
R239	2.7 Megohms	± 10%	17	R16	R403	68K ohms	± 10%	17	E9
R240	2.5 Megohms Linear Carbon. Focus	620781	17	G9	R404	220K ohms	± 10%	17	E9
R301	100K ohms Linear Carbon I.F. A.G.C.	620322	17	H18	R405	3.9K ohms	± 10%	17	F7
R302	680K ohms	± 10%	17	H19	R406	120K ohms	± 10%	17	E10
R303	470K ohms	± 20%	17	K19	R407	39K ohms	± 10%	17	B9
R304	4.7 Megohms	± 10%	17	L19	R408	150K ohms	± 10%	17	F10
R305	500K ohms Linear Carbon A.G.C. Control	620569	17	B16	R409	39K ohms	± 10%	17	G4
R306	33K ohms	± 10%	17	J18	R410	1 Megohm	± 10%	17	F6
R307	47K ohms	± 10%	17	G17	R411	47 ohms	± 10%	17	G6
R308	39K ohms	± 10%	17	J17	R412	100 ohms	± 10%	17	J8
R309	56K ohms	± 10%	17	J17	R413	18K ohms	± 10%	17	H5
R310	220K ohms	± 10%	17	J16	R414	33K ohms	± 10%	17	H5
R311	47K ohms	± 10%	17	K18	R415	1.5 ohms	± 10%	17	F3
R312	1.2 Megohms	± 10%	17	K16	R416	1K ohms	± 10%	17	F2
R313	1 Megohm	± 10%	17	K17	R417	4.7K ohms	± 10%	17	P8
R314	270K ohms	± 10%	17	K16	R418	150 ohms	± 10%		
R315	1 Megohm	± 10%	17	J17	R419	150 ohms	± 10%		

\*On some chassis this was a 6.8K ohm resistor paralleled by a 22K ohm ½ watt resistor.

# CIRCUIT CODE

CODE No.	DESCRIPTION	PART No.	FIG. No.	LOCATION	CODE No.	DESCRIPTION	PART No.	FIG. No.	LOCATION
CAPACITORS (continued)					CAPACITORS (continued)				
R420	100K ohms	± 10%	2 watts	S13	C111	0.047 $\mu$ F ± 10% 200V Working Paper		18	L4
R421	6.8K ohms	± 10%	10 watts W.W.	H16	C112	0.01 $\mu$ F ± 20% 200V Working Paper		17	S16
R422	150 ohms	± 10%	1 watt	Q14	C113	0.022 $\mu$ F ± 20% 400V Working Paper		17	S17
R423	180 ohms	± 10%	$\frac{1}{2}$ watt	J5	C114	25 $\mu$ F 25V Working Electrolytic		17	R19
					C115	0.0022 $\mu$ F ± 10% 600V Working Paper		17	R17
CAPACITORS					CAPACITORS				
C1	18 pF ± 5% NPO Tubular Ceramic			J16	C116A	25 $\mu$ F 400V Working			
C2	5.6 pF ± 5% NPO Tubular Ceramic			H15	C116B	5 $\mu$ F 450V Working	229720	17	Q14
C3	18 pF ± 5% NPO Tubular Ceramic			G16	C116C	70 $\mu$ F 400V Working			
C4	470 pF ± 100% — 0% K5000 Disc			J17	C117	2 $\mu$ F ± 10% 200V Working Paper (On LS101)			
C5	0.01 $\mu$ F ± 100% — 0% K5000 Disc			F18		N.B. C117 on 12" Speaker 21542 Only			
C6	0.001 $\mu$ F ± 100% — 0% K5000 Feed Thru			F16	C201	5.6 pF ± .25 pF NPO Tubular			
C7	270 pF ± 20% K1200 Tubular			G15	C202	12 pF ± 5% NPO Tubular			
C8	10 pF ± 5% NPO Tubular			G14	C203	0.0047 $\mu$ F ± 100% — 0% K5000 Disc			
C9	4.7 pF ± 5% NPO Tubular			F13	C204	4-10 pF Trimmer	231123		
C10	12 pF ± 5% NPO Tubular			G14	C205	0.0047 $\mu$ F ± 100% — 0% K5000 Disc			
C11	4-10 pF Trimmer	231123		E14	C206	0.0047 $\mu$ F ± 100% — 0% K5000 Disc			
C12	Not used				C207	470 pF ± 10% 500V Working Mica			
C13	220 pF ± 20% K1200 Disc			E12	C208	0.0047 $\mu$ F ± 100% — 0% K5000 Disc			E22
C14	0.5-3 pF Trimmer	231122		E12	C209	0.0047 $\mu$ F ± 100% — 0% K5000 Disc			D21
C15	180 pF ± 5% N750 Style "B" Tubular			F12	C210	0.0047 $\mu$ F ± 100% — 0% K5000 Disc			D21
C16	50-140 pF Mica Trimmer	40038		F10	C211	220 pF ± 10% 500V Working Mica			F20
C17	0.001 $\mu$ F ± 100% — 0% K5000 Tubular			G11	C212	18 pF ± 5% NPO Tubular (In T202)			G22
C18	0.001 $\mu$ F ± 100% — 0% K5000 Feed Thru			E11	C213	0.0047 $\mu$ F ± 100% — 0% K5000 Disc			G21
C19	0.001 $\mu$ F ± 100% — 0% K5000 Feed Thru			F11	C214	0.0047 $\mu$ F ± 100% — 0% K5000 Disc			H22
C20	0.5-3 pF Trimmer	231122		E10	C215	4.7 pF ± .5 pF N750 Bead (In T203)			J22
C21	270 pF ± 20% K1200 Tubular			F12	C216	0.0047 $\mu$ F ± 100% — 0% K5000 Disc			J20
C22	0.88 pF ± 20% NPO Bead			J9	C217	0.0047 $\mu$ F ± 100% — 0% K5000 Disc			J21
C23	82pF ± 10% N750 Style "C" Disc			E9	C218	0.22 $\mu$ F ± 20% 200V Working Paper			K22
C24	270 pF ± 20% K1200 Disc			E8	C219	0.01 $\mu$ F ± 100% — 0% K5000 Disc			L22
C25	0.63 pF ± 20% NPO Bead			G9	C220	0.01 $\mu$ F ± 100% — 0% K5000 Disc			M21
C26	12 pF ± 5% N750 Tubular			E9	C221	0.0033 $\mu$ F ± 10% 600V Working Paper			L21
C27	0.5-3 pF Trimmer	231122		E9	C222	39 pF ± 10% N220 Disc			L20
C28	10 pF ± 5% NPO Tubular			F9	C223	22 pF ± 10% N750 Tubular			M15
C29	Trimmer (Fine Tuning) AWA Special	40135		E7	C224	0.01 $\mu$ F ± 100% — 0% K5000 Disc			N18
C30	470 pF ± 100% — 0% K5000 Disc			H17	C225	0.1 $\mu$ F ± 10% 600V Working Paper			M19
C31	470 pF ± 100% — 0% K5000 Disc			G17	C226	25 $\mu$ F 25V Working Electrolytic			L18
C32	Not used				C227	0.1 $\mu$ F ± 20% 600V Working Paper			N17
C33	39 pF ± 10% N220 Disc (In T2)			C8	C301	0.1 $\mu$ F ± 20% 200V Working Paper			P15
C34	0.0047 $\mu$ F ± 100% — 0% K5000 Disc (In T2)			C8	C302	0.1 $\mu$ F ± 20% 200V Working Paper			P15
C35	0.1 $\mu$ F ± 10% 200V Working Paper			J17	C303	0.01 $\mu$ F ± 100% — 0% K5000 Disc			P16
C36	0.88 pF ± 20% NPO Bead			F15	C304	0.0039 $\mu$ F ± 10% 400V Working Paper			P15
C101	6.8 pF ± 5% NPO Tubular (In L101)			N21	C305	330 pF ± 10% 500V Working Mica			Q17
C102	39 pF ± 10% N220 Disc (In L101)			P20	C306	0.1 $\mu$ F ± 20% 400V Working Paper			C20
C103	0.01 $\mu$ F ± 100% — 0% K5000 Disc			P20	C307	330 pF ± 10% 500V Working Mica			L19
C104	0.0022 $\mu$ F ± 10% 400V Working Paper			P20	C308	0.033 $\mu$ F ± 20% 400V Working Paper			K19
C105	100 pF ± 5% 600V Working Styrofoam (In T101)			Q21	C309	82 pF ± 10% 1000V Working Silvered Mica			J19
C106	470 pF ± 5% 500V Working Silvered Mica			T20	C310	220 pF ± 10% 500V Working Mica			K16
C107	470 pF ± 5% 500V Working Silvered Mica			T21	C311	0.027 $\mu$ F ± 10% 400V Working Paper			L15
C108	0.001 $\mu$ F ± 10% 600V Working Paper			T18	C312	0.0068 $\mu$ F ± 5% 500V Working Silvered Mica			K17
C109	10 $\mu$ F 50V Working Electrolytic			T20	C313	0.033 $\mu$ F ± 10% 600V Working Paper			E11
C110	0.0033 $\mu$ F ± 10% 600V Working Paper			K3	C314	0.1 $\mu$ F ± 10% 400V Working Paper			G21
					C315	0.068 $\mu$ F ± 10% 400V Working Paper			F19
									E20
									D16
									F18
									D15

# CIRCUIT CODE

CODE No.	DESCRIPTION	PART No.	FIG. No.	LOCATION	CODE No.	DESCRIPTION	PART No.	FIG. No.	LOCATION
CAPACITORS (continued)					TRANSFORMERS (continued)				
C316	0.022 $\mu$ F $\pm$ 10% 1000V Working Paper		17	E15	T403	Power Transformer	41443	18	N22
C317A	50 $\mu$ F 50V Working				T404	Width Coil	41447	17	K5
C317B	20 $\mu$ F 400V Working	229680	17	E12					
C317C	10 $\mu$ F 400V Working								
C318	Not used					VALVES			
C319	0.047 $\mu$ F $\pm$ 20% 600V Working Paper		17	Q11	V1	Radiotron 6BQ7-A		18	H3
C320	0.018 $\mu$ F $\pm$ 10% 400V Working Paper		17	P13	V2	Radiotron 6CQ8		18	J4
C321	0.1 $\mu$ F $\pm$ 10% 400V Working Paper		17	P11	V101	Radiotron 6AU6		17	P20
C322	0.047 $\mu$ F $\pm$ 10% 200V Working Paper		17	P11	V102	Radiotron 6AL5		17	R20
C323	0.1 $\mu$ F $\pm$ 10% 400V Working Paper		17	E13	V103	Radiotron 6AV6		17	S16
C324	0.0047 $\mu$ F $\pm$ 10% 1600V Working Paper		17	F15	V104	Radiotron 6AQ5		17	S18
C325	0.033 $\mu$ F $\pm$ 10% 400V Working Paper		17	F15	V201	Radiotron 6BZ6		17	F21
C326	0.47 $\mu$ F $\pm$ 10% 400V Working Paper		17	F15	V202	Radiotron 6BZ6		17	H21
C401	0.047 $\mu$ F $\pm$ 20% 400V Working Paper		17	H5	V203	Radiotron 6BZ6		17	K21
C402	0.022 $\mu$ F $\pm$ 10% 200V Working Paper		17	E8	V204	Radiotron 6AW8-A		17	L18
C403	82 pF $\pm$ 10% 1000V Working Silvered Mica		17	E8	V205	Radiotron 6AQ5		17	P17
C404	0.47 $\mu$ F $\pm$ 20% 100V Working Paper		17	F10	V206	Radiotron 21CEP4			
C405	270 pF $\pm$ 5% 1000V Working Silvered Mica		17	E8	V301	Radiotron 6U8		17	J18
C406	0.01 $\mu$ F $\pm$ 5% 600V Working Styrofoam		17	E6	V302	Radiotron 6CG7		17	F18
C407	0.0012 $\mu$ F $\pm$ 10% 1000V Working Silvered Mica		17	F4	V303	Radiotron 6CZ5		17	D18
C408	20-220 pF Trimmer Horizontal Drive	231127	17	F6	V401	Radiotron 6CG7		17	D10
C409	0.0012 $\mu$ F $\pm$ 5% 500V Working Silvered Mica		17	G3	V402	Radiotron 6DQ6-A		17	H7
C410	0.1 $\mu$ F $\pm$ 20% 600V Working Paper		17	J7	V403	Radiotron 6AU4-GTA		17	K7
C411	0.27 $\mu$ F $\pm$ 20% 100V Working Paper		17	J9	V404	Radiotron 1B3-GT		17	E3
C412	270 pF $\pm$ 20% 1000V Working Silvered Mica		17	N5	V405	Radiotron 5AS4		17	S10
C413	0.047 $\mu$ F $\pm$ 10% 1000V Working Paper		17	N5		SWITCHES			
C414	0.047 $\mu$ F $\pm$ 10% 1000V Working Paper		17	M5	S1	Channel Selector		16	G8
C415	270 pF $\pm$ 10% N750 2500V Working Disc		17	P6	S2	Channel Selector		16	G10
C416	330 pF $\pm$ 10% N750 2500V Working Disc		17	P6	S3	Channel Selector		16	G12
C417	68 pF $\pm$ 10% N750 2500V Working Disc		17	P6	S4	Channel Selector		16	G14
C418	0.001 $\mu$ F $\pm$ 10% 1600V Working Paper		17	P6	S401	Power ON/OFF (On R108)		18	K2
C419	91 pF $\pm$ 10% N750 2500V Tubular	In Yoke				LOUDSPEAKERS			
C420	120 pF $\pm$ 10% N750 2500V Tubular				LS101	7" x 5" Permanent Magnet, Lowboy	21540		
C421	120 pF $\pm$ 10% N750 2500V Tubular				LS101	12" Permanent Magnet, Console	21542		
C422	90 $\mu$ F 525V Peak Electrolytic		17	S13	LS102	4" Permanent Magnet, Lowboy	21541		
C423	50 $\mu$ F 400V Peak Electrolytic		17	P8	LS102	4" Permanent Magnet, Console	21543		
C424	0.033 $\mu$ F $\pm$ 10% 400V Working Paper					FUSES			
					F401	0.375 Amp. Cartridge		17	S12
					F402	1.5 Amp. Cartridge		17	Q10
TRANSFORMERS						MISCELLANEOUS			
T1A	Aerial Matching Transformer	40156	16	H15	MR201	Germanium Diode GEX 34 (In T203)			
T1B	Aerial Matching Transformer	40156	16	H14	PL101	4 Pin Plug (On LS101)	581404		
T2	Converter I.F.	41401	16	D8	PL102	2 Pin Wafer Plug	581215		
T101	Ratio Detector	40077	17	Q20	PL201	Video Input Plug	581549		
T102	Audio Output Transformer (On LS101)				PL401	Mica Filled Octal Plug	581380		
T201	1st Video I.F.	40902	17	G21	SK1	Video Input Socket	793249		
T202	2nd Video I.F.	41407	17	J21	SK101	4 Pin Wafer Socket	793287	17	R18
T203	3rd Video I.F.	41409	17	L21	SK102	2 Pin Wafer (On LS101)	793038		
T301	Vertical Blocking Oscillator	40066C	18	E9	SK401	Octal Socket	794587		
T302	Vertical Output	41445	18	F12					
T401	Horizontal Blocking Oscillator	40953	17	C9					
T402	Horizontal Output (High Volt Box)	41449			LP1	12V 2.2 watt M.E.S. Pilot Lamp		17	F25

