Admiral TV

SCHEMATIC DIAGRAMS

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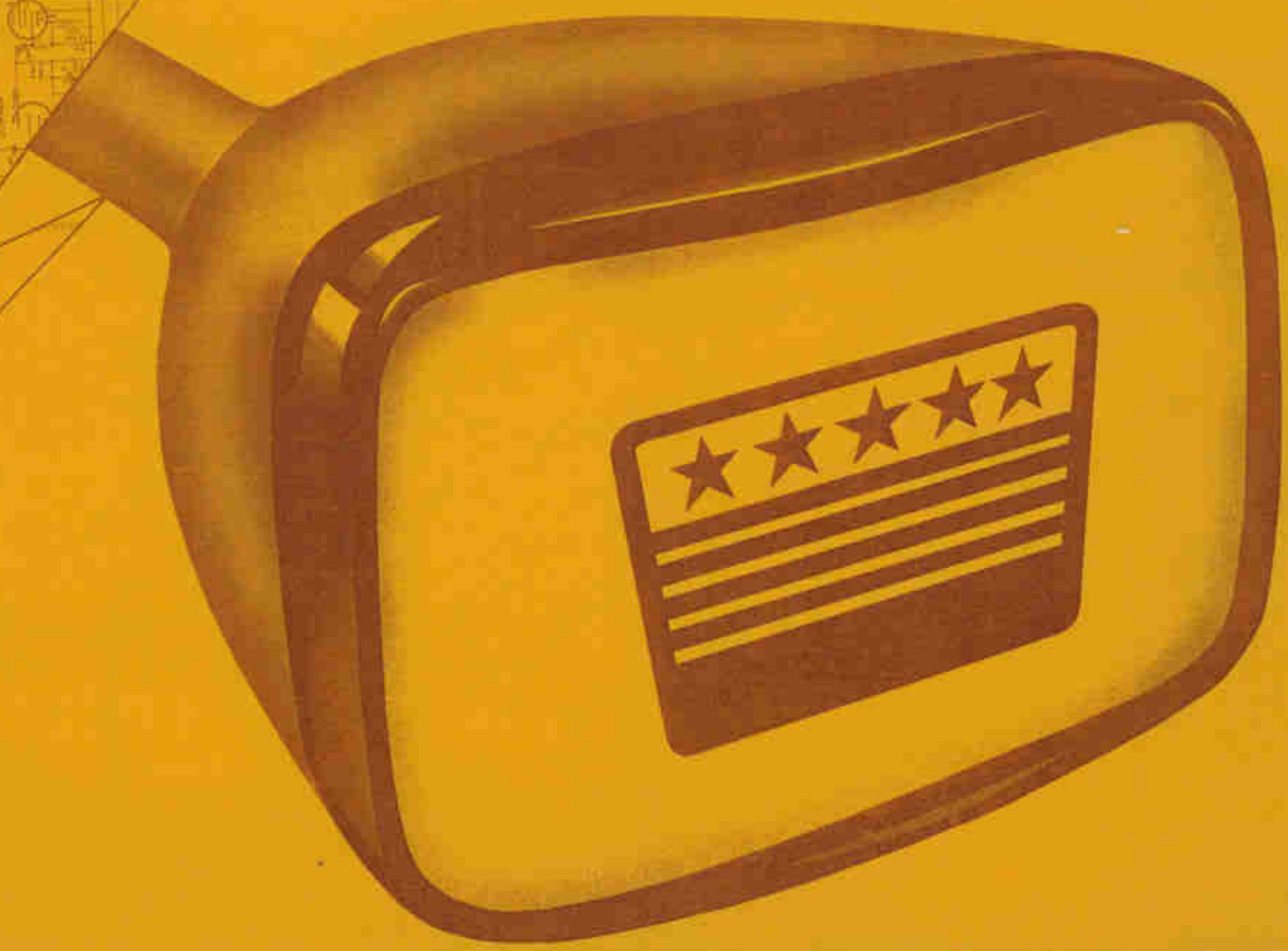

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TV MODEL AND CHASSIS CROSS-REFERENCE LIST

MODEL NUMBER	MODEL NUMBER SUFFIX LETTER	TV CHASSIS	PICTURE TUBE	RADIO CHASSIS
4H15, 16, 17	A or B	20A1	10″ Round	4J1 (AM-FM)
	S	30B1	10″ Round	4H1 (AM-FM)
4H18, 19	C	20B1	12″ Round	4K1 (AM-FM)
	S	30C1	12″ Round	4H1 (AM-FM)
4H115, 116, 117	S	30B1	10″ Round	4H1 (AM-FM)
4H126	A or B	21A1	16″ Round	4J1 (AM-FM)
	C	21A1	16″ Round	4K1 (AM-FM)
	S	30D1	16″ Round	4H1 (AM-FM)
4H137	A or B	21A1	16″ Round	4J1 (AM-FM)
	S	30D1	16″ Round	4H1 (AM-FM)
4H145, 146, 147	A or B	20B1	12″ Round	4J1 (AM-FM)
	C	20B1	12″ Round	4K1 (AM-FM)
	S	30C1	12″ Round	4H1 (AM-FM)
4H155, 156, 157	A or B	20B1	12″ Round	4J1 (AM-FM)
	C	20B1	12″ Round	4K1 (AM-FM)
	S	30C1	12″ Round	4H1 (AM-FM)
4H165, 166, 167	A or B	20B1	12″ Round	4J1 (AM-FM)
	C	20B1	12″ Round	4K1 (AM-FM)
	S	30C1	12″ Round	4H1 (AM-FM)
8C11, 12, 13	UL, S, T	30A1	10″ Round	8C1 (AM-FM)
12X11, 12	..	20Z1	12″ Round	.....
14R12	..	20T1	14″ Rect.	.....
14R16	..	20T1	14″ Rect.	.....
15K21, 22	..	20T1	14″ Rect.	.....
16R11, 12	..	21B1	16″ Rect.	.....
17K11, 12	..	21F1, P1	17″ Rect.	.....
17K16	..	21F1, P1	17″ Rect.	.....
17K22	..	21F1, P1	17″ Rect.	.....
17M16, 17	..	21F1, P1	17″ Rect.	.....
17T11, 12	S	17T1	7″ Round	.....
19A11, 12	S	19A1	7″ Round	.....
19A15	S	19A1	7″ Round	.....
20X11, 12	..	20X1	10″ Round	.....
20X122	..	20X1	10″ Round	.....
20X136	..	20Y1	12″ Round	.....
20X145, 146, 147	..	20Y1	12″ Round	.....
22X12	..	20Z1	12″ Round	.....
22X25, 26, 27	..	20Z1	12″ Round	.....
24A12	..	20A1	10″ Round	.....
24A125	..	20A1	10″ Round	.....
	A	20X1	10″ Round	.....
24C15, 16, 17	..	20B1	12″ Round	.....
24R12	..	20T1	14″ Rect.	.....
24X15, 16, 17	§	20X1	10″ Round	4L1 (AM only)
25A15, 16, 17	..	21A1	16″ Round	.....
26R12	..	21B1	16″ Rect.	.....
26R25, 26	..	24H1	16″ Rect.	.....
	A	21B1	16″ Rect.	.....
26R35, 36, 37	..	24H1	16″ Rect.	.....
	A	21B1	16″ Rect.	.....
26X35, 36, 37	..	24D1	16″ Round	.....
26X45, 46	..	24H1	16″ Rect.	.....
26X55, 56, 57	..	24D1	16″ Round	.....
	A	21D1	16″ Round	.....
26X65, 66, 67	..	24D1	16″ Round	.....
	A	21D1	16″ Round	.....
26X75, 76	..	24D1	16″ Round	.....
	A	21D1	16″ Round	.....
27K12	..	21F1, P1	17″ Rect.	.....
27K15, 16, 17	§§	21F1, P1	17″ Rect.	.....
27K25, 26, 27	§§	21F1, P1	17″ Rect.	.....
27K35, 36	§§	21F1, P1	17″ Rect.	.....
27K46	§§	21F1, P1	17″ Rect.	.....
27K85, 86, 87	..	21F1, P1	17″ Rect.	.....
29X15, 16, 17	..	24F1	19″ Round	.....
29X25, 26, 27	..	24F1	19″ Round	.....
	A	21H1	19″ Round	.....
30A12, 13	UL, S, T	30A1	10″ Round	.....
30A14, 15, 16	UL, S, T	30A1	10″ Round	.....
	SA	30A1	10″ Round	.....
30B15, 16, 17	S	30B1	10″ Round	.....
30C15, 16, 17	S	30C1	12″ Round	.....
30F15, 16, 17	..	20B1	12″ Round	4J1 (AM-FM)
	A	20B1	12″ Round	4K1 (AM-FM)
32X15, 16	†	20Z1	12″ Round	4S1 (AM only)
32X26, 27	†	20Z1	12″ Round	5B2 (AM-FM)
32X35, 36	†	20Z1	12″ Round	5B2 (AM-FM)
34R15, 16	†	20V1	14″ Rect.	3C1 (AM only)
36R37	..	21C1	16″ Rect.	5D2 (AM-FM)
36R45, 46	..	21C1	16″ Rect.	5D2 (AM-FM)
36X35, 36, 37	..	24E1	16″ Round	5B2 (AM-FM)
	A	24E1	16″ Round	5D2 (AM-FM)
	S, AS	21E1	16″ Round	5D2 (AM-FM)
37F15, 16	§§	21G1, Q1	17″ Rect.	5D2 (AM-FM)
37F27	§§	21G1, Q1	17″ Rect.	5D2 (AM-FM)
37F28	§§	21G1, Q1	17″ Rect.	5D2 (AM-FM)
37F35, 36	§§	21G1, Q1	17″ Rect.	5D2 (AM-FM)
37F55, 56	..	21G1	17″ Rect.	5D2 (AM-FM)
37F67	..	21G1	17″ Rect.	5D2 (AM-FM)
37K15, 16	§§	21G1, Q1	17″ Rect.	3C1 (AM only)
37K27	§§	21G1, Q1	17″ Rect.	3C1 (AM only)
37K28	§§	21G1, Q1	17″ Rect.	3C1 (AM only)
37K35, 36	§§	21G1, Q1	17″ Rect.	3C1 (AM only)
37K55, 56	..	21G1, Q1	17″ Rect.	3C1 (AM only)
37K67	..	21G1, Q1	17″ Rect.	3C1 (AM only)
39X16, 17	†	24G1	19″ Round	5B2 (AM-FM)
	B	24G1	19″ Round	5D2 (AM-FM)
	C	21J1	19″ Round	5D2 (AM-FM)
39X25, 26	..	24G1	19″ Round	5D2 (AM-FM)
	A	21J1	19″ Round	5D2 (AM-FM)
39X35, 36	..	21J1	19″ Round	3C1 (AM only)
121K15, 16, 17	..	21M1	20″ Rect.	.....
221K16	†	21K1	20″ Rect.	.....
221K26	..	21K1	20″ Rect.	.....
221K28	..	21K1	20″ Rect.	.....
221K35, 36	..	21K1	20″ Rect.	.....
221K45, 46, 47	..	21M1	20″ Rect.	.....
320R17	..	21J1	20″ Rect.	5D2 (AM-FM)
320R25, 26	..	21J1	20″ Rect.	5D2 (AM-FM)
321F15, 16	..	21L1	20″ Rect.	5D2 (AM-FM)
321F18	..	21L1	20″ Rect.	5D2 (AM-FM)
321F27	..	21L1	20″ Rect.	5D2 (AM-FM)
321F35, 36	..	21L1	20″ Rect.	5D2 (AM-FM)
321F46, 47, 49	..	21L1	20″ Rect.	5D2 (AM-FM)
321F65, 66, 67	..	21N1	20″ Rect.	5D2 (AM-FM)
321K15, 16	..	21L1	20″ Rect.	3C1 (AM only)
321K18	..	21L1	20″ Rect.	3C1 (AM only)
321K27	..	21L1	20″ Rect.	3C1 (AM only)
321K35, 36	..	21L1	20″ Rect.	3C1 (AM only)
321K46, 47, 49	..	21L1	20″ Rect.	3C1 (AM only)
321K65, 66, 67	..	21N1	20″ Rect.	3C1 (AM only)

§§ These models may have suffix "A", "B" or no suffix at all.
† These models may have suffix "A" or no suffix at all.
§ These models may have suffix "S" or no suffix at all.

MODEL NUMBERS Model numbers may have suffix letter "N"	TV Chassis	Picture Tube	TV Tuner
17DX10, 17DX11, 17DX12	19B1	17BP4A	94D52-1 or 94D52-2
121DX10, 121DX12, 121DX16, 121DX17	19C1	20DP4A	94D46-2
121DX11	19F1A	21WP4 or 21WP4X	94D46-2 or 94D46-3
121DX12A, 121DX16A, 121DX17A	19C1	20DP4A	94D46-2
	19F1	21WP4 or 21WP4X	94D46-2 or 94D46-3
121DX16L, 121DX17L	19K1	21ZP4A	94D46-2 or 94D46-3
221DX15, 221DX16, 221DX17, 221DX26, 221DX38	19C1	20DP4A	94D46-2
221DX15A, 221DX16A, 221DX17A	19C1	20DP4A	94D46-2
	19F1	21WP4 or 21WP4X	94D46-2 or 94D46-3
221DX15L, 221DX16L, 221DX17L, 221DX26L	19K1	21ZP4A	94D46-2 or 94D46-3
221DX26A	19F1	21WP4	94D46-2 or 94D46-3
221DX38A	19C1	20DP4A	94D46-2
	19F1	21WP4 or 21WP4X	94D46-2 or 94D46-3
222DX15	19H1	21EP4A	94D46-2
222DX15S	22C2		
321DX15, 321DX16, 321DX17	19E1	20DP4A	94D46-2
321DX15A, 321DX16A, 321DX17A	19E1	20DP4A	94D46-2
	19G1	21WP4 or 21WP4X	94D46-2 or 94D46-3
321DX15L, 321DX16L, 321DX17L	19N1	21ZP4A	94D46-2 or 94D46-3
321DX25B, 321DX26B, 321DX27B	19E1	20DP4A	94D46-2
	19G1	21WP4 or 21WP4X	94D46-2 or 94D46-3
321DX26	19E1	20DP4A	94D46-2

MODEL NUMBERS Model numbers may have suffix letter "N"	TV Chassis	Picture Tube	TV Tuner
222DX15S, 222DX16, 222DX17	22C2	21EP4A	94D47-2
222DX15	19H1		
222DX26, 222DX27	22C2	21EP4A	94D47-2
222DX48, 222DX49	22C2	21EP4A	94D47-2
322DX16	22E2	21EP4A	94D47-2

MODEL NUMBERS Model numbers may have suffix letter "N"	TV Chassis	Picture Tube	TV Tuner
121M10, 121M11A, 121M12A	22M1	20CP4 or 20DP4	94D45-1
121M11, 121M12	21M1		
121K15A, 121K16A, 121K17A	22M1	20CP4 or 20DP4	94D45-1
121K15, 121K16, 121K17	21M1		
221K45A, 221K46A, 221K47A	22M1	20CP4 or 20DP4	94D45-1
221K45, 221K46, 221K47	21M1		
321M25A, 321M26A, 321M27A	22Y1	21EP4A	94D45-1
321M25, 321M26, 321M27	21Y1		
421M15A, 421M16A	22Y1	21EP4A	94D45-1
421M15, 421M16	21Y1		
421M35, 421M36, 421M37	22Y1	21EP4A	94D45-1
520M11, 520M12	22A2A	20CP4 or 20DP4	94D45-1
520M15, 520M16, 520M17	22A2	20CP4 or 20DP4	94D45-1
521M15A, 521M16A, 521M17A	22Y1	21EP4A	94D45-1
521M15, 521M16, 521M17	21Y1		

MODEL NUMBERS Model numbers may have suffix letter "N"	TV Chassis	Picture Tube	TV Tuner
228DX16, 228DX17	23A1	27EP4	94D47-2

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TV SCHEMATICS

RADIO SCHEMATICS

SERVICE NOTES - 17T1 & 19A1 CHASSIS

Always use this "Service Manual Supplement for 17T1 Chassis" FIRST, then refer to 19A1 service data.

SPECIFICATIONS

The 17T1 television chassis uses an intercarrier sound system and a 7 inch picture tube using electrostatic deflection. The circuits used in the 17T1 chassis are similar (in most cases identical) to the circuits used in the latest production 19A1 chassis. All circuit differences are outlined in the discussion under the heading "Circuit Differences" below.

WRITING TO FACTORY OR DISTRIBUTOR

When reporting about any Admiral product, be sure to include the following information:

1. Model number and anything stamped on model label.
2. Fill out and send the Inspection Tag, if a tag is attached to chassis.
3. If Inspection Tag is NOT sent in, give all letters and numbers stamped on back of chassis.
4. Detailed explanation to speed investigation.
5. If reporting parts failure, give symbol number, part number and any brand name on part.
6. For record changers, give model and anything stamped on model label on bottom of changer pan.

IMPORTANT DIFFERENCES BETWEEN 17T1 AND 19A1 SETS

CIRCUIT DIFFERENCES

When comparing the 17T1 schematic with the latest 19A1 chassis, you will note that there are differences in the following circuits.

a. Differences in B+ distribution to the sound IF (V1, 6AU6) and sound amplifier (V3, 6SQ7).

b. Differences in video detector and AGC circuit (V8, 6AL5).

c. Differences in video amplifier (V9, 6AU6) and contrast control (R33) circuits.

d. Differences in picture tube deflection circuit.

e. For protection from high voltage leaking to the chassis, a 270,000 ohm, ½ watt resistor (R93) is connected from one side of the power transformer primary (T6) to chassis ground. This resistor was used in late 19A1 chassis.

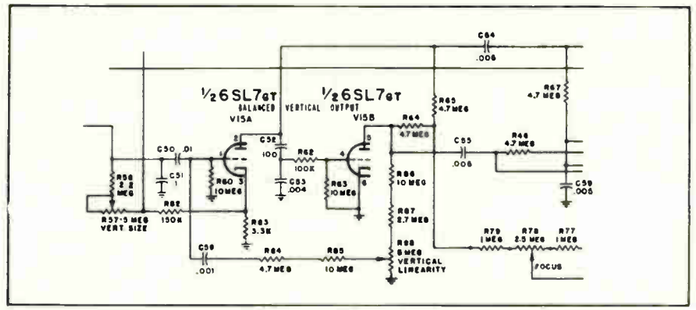
PRODUCTION CHANGES

VERTICAL LINEARITY CONTROL

In later production sets, a change has been made to the vertical output circuit (V15A and V15B) by addition of vertical linearity control (R88) and associated resistors and condenser. See schematic tor this section of the vertical deflection circuit on this page.

Sets naving vertical linearity control can be identified as having nine rear panel controls. The vertical linearity control is located competely to the left. This control is pre-set at the factory and will seldom require readjustment, unless it has been accidently disturbed or because of replacement or aging of tubes.

Checking of the vertical linearity control should be made prefereably using a television test pattern. Examine the central circles of the circular test pattern image and if the pattern appears "egg shaped" in a VERTICAL direction, the "VERT. LIN." control should be adjusted until the circles in the test pattern image become circular again.



Vertical Output Circuit with Linearity Control

CIRCUIT CHANGE IN AUDIO AMPLIFIER V3 (6SQ7)

To avoid possible interference pickup (grid rectification of strong radio signals from nearby transmitters) in later production, C57 condenser (50 mmfd.) has been added and C11 condenser changed from .001 mfd. to 250 mmfd. Condenser C57 (59 mmfd.) is connected from socket terminal 2 of V3 (6SQ7) to chassis.

AUDIO OUTPUT TUBE V4

Some 19A1 chassis used a 6Y6G instead of a 6AS5 in this stage.

CHANGE IN SYNC SEPARATOR V11A (6SN7GT)

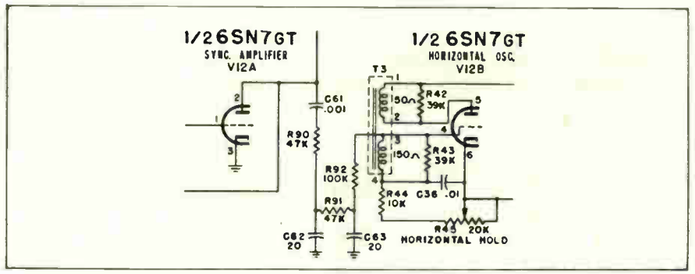
In later production, a parallel RC network consisting of R89 resistor (270,000 ohms) and C60 condenser (140 mmfd.) has been wired in series with junction of C33 consenser (.05 mfd.) and R37 resistor (10, 000 ohms).

HORIZONTAL SYNC FILTER ADDED

Vertical lines in the picture appear jagged or broken if high frequency noise signals reach the Horizontal Oscillator. This interference appears in areas having low signal strength and a high noise level. This condition can be corrected by insertion of a noise filter between the Sync Amplifier and Horizontal Oscillator. Production has been changed to include such a filter in later sets.

If this interference condition is encountered in a chassis, a horizontal sync filter can be installed after removing capacitor C35. All parts, with the exception of C61, must be mounted on a tie-strip- The tie-strip can best be mounted under the chassis between vertical oscillator transformer T7 and third IF amplifier V7. See Figure 56, Bottom View of Chassis, for physical placement. C61 should be connected between terminal 2 of V12 and the tie-strip. Dress the leads from C61 to avoid shorts.

NOTE: When the above circuit modification is incorporated, adjustment of the Horizontal Hold control is critical. This adjustment must be carefully made and checked on all channels currently in use. However, once set, readjustment is seldom necessary.



Horizontal Sync Filter Circuit in Later Sets

ELIMINATION OF AUDIO BUZZ

The "Inter-carrier Sound System" used in the 19A1 circuit may cause a buzzing sound (not HUM) under certain conditions. Buzzing sound is the result of amplitude modulation (picture modulation) being superimposed on the 4.5 MC beat FM IF carrier to such an extent that it is impossible for the ratio detector to remove this amplitude modulation completely.

Some of the conditions which may produce a buzzing sound are given below. Corrective measures which may be applied IN THE CUSTOMERS home are also listed below.

The most common causes of buzzing sound are improper setting of the Sharp Tuning control, and the Contrast control being too far advanced (clockwise). Merely turn down the contrast or tune the Sharp Tuning control for best picture definition. Under normal conditions, the sound will be free of audio buzz at this point.

Audio buzz can also be caused by slight misalignment of the oscillator coils for a particular channel. Oscillator adjustment (for individual channels) can easily be made WITHOUT REMOVING THE CHASSIS FROM THE CABINET. This adjustment must be made while receiving a transmitted television station test pattern or program, and should be performed as follows:

TOUCH-UP of OSCILLATOR SLUG ADJUSTMENTS for INDIVIDUAL CHANNELS.

a. Allow 30 minutes for set to warm up.

b. Remove Channel and Sharp Tuning knobs.

c. Remove channel-indicating escutcheon: For plastic cabinets, pry the channel-indicating escutcheon away evenly (with fingernails or screwdriver) being careful not to break off the plastic mounting pins from the escutcheon. For wood cabinets, slide the escutcheon to the left, and pry the right side away from the cabinet.

d. Replace knobs after removing escutcheon. Set channel switch on station with test pattern or program. Set Contrast control for normal picture. Turn Sharp Tuning control completely to the left.

e. Insert NON-METALLIC screwdriver (1/8" blade and 7" length) in the 3/8" hole in cabinet at right of Sharp Tuning control. Tune oscillator slug for best defined picture with minimum buzz. Do this carefully as only a slight rotation in either direction of slug will br required.

If station buzz will not tune out completely, with this adjustment remaining buzz may be due to minalignment of ratio detector secondary. This adjustment can easily be made WITHOUT REMOVING THE CHASSIS FROM THE CABINET. This adjustment must be made while receiving a transmitted television station test pattern or program, and should be performed as follows:

TOUCH-UP OF RATIO DETECTOR SECONDARY.

NOTE: THIS ADJUSTMENT NEEDED ON ONE CHANNEL ONLY.

a. Tune station for normal picture or test pattern. Advance Contrast control until buzz is audible (full on or almost full on).

b. Insert NON-METALLIC screwdriver in 3/8" hole in center of cabinet bottom.

c. Adjust ratio detector-secondary slug for maximum volume with minimum buzz. Do this carefully as only a slight rotation of the slug in either direction will be required. Correct point of adjustment is between the two maximum buzz peaks that can be noticed when turning the slug back and forth slightly in either direction.

d. If necessary, repeat oscillator adjustment and conclude with retouching the ratio detector sdcondary. NOTE: If oscillator adjustment is required for other channels, it will NOT be necessary to retune the ratio detector secondary after ONCE correctly adjusting it as indicated above.

Buzzing sound may also be caused by misalignment or the IF coils. It may be necessary to preform the "IF Amplifier Alignment".

If electrolytic condenser C5 opens or its capacity decreases substantially, audio buzz may be apparent.

Buzzing sound (usually momentary) can also be caused by a drop in transmission level of the video carrier at the transmitter. Naturally, this can not be compensated for by adjustment of the receiver.

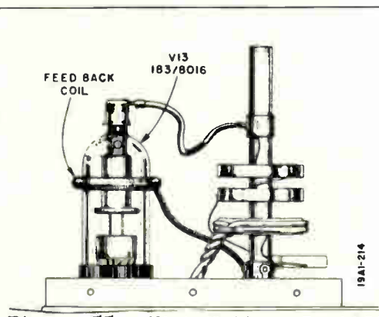


Figure 55. High Voltage Rectifier, Showing Feed Back Coil.

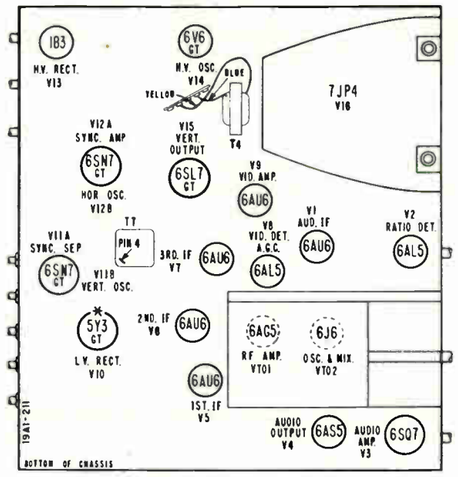


Figure 56. Bottom View of Chassis.

PRODUCTION CHANGES

VERTICAL OSCILLATOR CIRCUIT

Changes have been made in the vertical oscillator circuit in later production. The late production circuit is shown in the schematic. The parts list also show the late production components. The adjoining illustration, figure 54, shows the early production circuit.

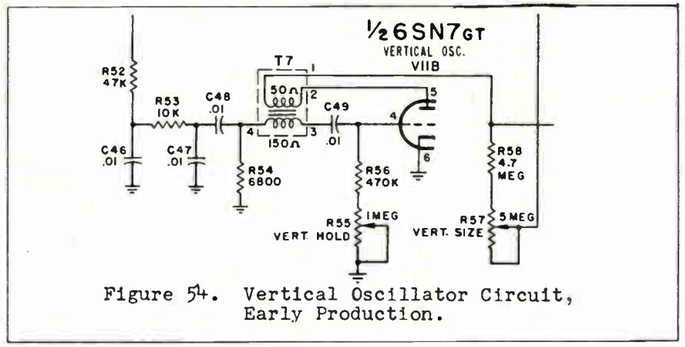


Figure 54. Vertical Oscillator Circuit, Early Production.

LOW VOLTAGE RECTIFIER

A small quantity of 5U4G rectifier tubes have been used instead of the 5Y3GT rectifier originally specified for the 19A1 chassis. These tubes were used because some of the power transformers (supplied by several sources) were slightly different electrically. However, these transformers are carried under the same part number 80B13.

The transformer used with the 5U4G rectifier has a red dot on the laminations. (A very small number of these transformers were first used with out the identifying red dot). The transformer used with the 5Y3GT rectifier has no red dot.

When servicing power transformer T6 or the low voltage rectifier tube, be sure to use the correct tube for the transformer used. If a 5Y3GT rectifier tube is substituted for the 5U4G normally used with the "red dot" power transformer, the DC output voltage on pin 8 of the rectifier will be approximately 220 volts. This is approximately 30 volts below the normal operating voltage. FOR THIS REASON, A 5Y3GT TUBE SHOULD NOT BE USED WITH A TRANSFORMER DESIGNED FOR USE WITH A 5U4G. ALSO, A 5U4G TUBE SHOULD NOT BE USED WITH A TRANSFORMER DESIGNED FOR USE WITH A 5Y3GT.

Since it may sometimes be impossible to recognize transformers from the original markings, the above voltage check will identify the transformer. A second check is a resistance check, across the high voltage winding, made between pin 4 and pin 6 of the rectifier tube. A resistance reading of approximately 175 ohms indicates a transformer designed for use with a 5Y36T rectifier tube. A resistance reading of approximately 150 ohms indicates a transformer designed for use with a 5U4G rectifier tube.

For REPLACEMENT PURPOSES, transformer T6 (part NO. 80B13) is supplied only for use with a 5Y3GT rectifier tube. If the set has used a type 5U4G tube with the original transformer, replace with a 5Y3GT tube being sure to change tube marking on chassis and model label to show 5Y3GT rectifier tube now used.

94C8-1 TUNER DETENT CHANGE

The mechanical dimensions of parts in the detent mechanism of the 94C8-1 Tuner have been changed slightly in later production. See figure 33 and "94C8-1 Tuner Parts List". In addition to the differences indicated in the parts list, the detent cut-out (left side of tuner chassis) is 1-1/16" longer than the cut-out in the early production tuner chassis.

NOISY TV TUNERS

Noise is generally caused by dirty contacts, loose or intermittent connections and microphonic tubes.

Dirty contacts can be cleaned with carbon tetrachloride or other commercial contact cleaner. A small atomizer filled with carbon tetrachlarlde can be used to spray the switch contacts.

With 94C8-2 tuner, remave several sets of coils from turret and rotate turret to position making contact points of contact plate accessible for cleaning. Using a small, stiff brush and carbon tetrachloride, clean contact surfaces and shafts of stationary contacts. Remove accumulated dust or grease from contact plate with a light canvas cloth dampened with carbon tetrachloride. Clean contact surfaces of rotating coils in same manner.

Loose and intermittent connections can be found by tapping the components ar rotating the channel selector and watching the pattern on the ascilloscope. A visual inspection or a continuity check will also be helpful. Microphonic tubes can be located by tapping the tube.

For 94C8-2 (Turret Type) Tuners: Noise with rotation of the Sharp Tuning Control is often caused by poor contact af the tuner shaft with the metal bearing plate (No. 15A247-1). This noise can be eliminated by securing better shaft contact through use of (new part) tuner shaft contact spring No. 19A55. This spring is similar to the front turret shaft spring used on the tuner and is assembled to metal bearing plate (No. 15A-247-1) in the same manner.

FREQUENCY DRIFT IN 94C8-2 TUNERS

High ambient temperatures encountered under certain operating conditions may result in excessive oscillator frequency drift in some 94C8-2 tuners. Under such conditions, frequent readjustment of the Sharp Tuning Control may be necessary. In some cases, oscillator drift may even go beyond the normal tuning range of the Sharp Tuning Control.

This condition is most probable in 30D1 (16") chassis due to higher operating temperatures in this model.

When excessive oscillatar frequency drift is encountered in a 94C8-2 tuner, the following part change will usually correct this condition:

Replace old part, C109 (10 mmfd., - 300 temp. coef. ceramic) with new part C109, 65B6-33 (10 mmfd., - 750 temp. coef. ceramic).

In some sets, condenser C109 is accessible by removing the cover plate located on the side of the chassis pan, next to the tuner. Condenser C109 is connected between terminal 2 on the turret contact block and ground.

Replacement of C109 will require realignment of Overall Oscillator Adjustment (A18) and then individual channel oscillator adjustments.

PULLING AT TOP OF PICTURE

In some televisian receivers, pulling shows up across the top of the picture or pattern and extends approximately one inch down from the top. Vertical lines in the picture or pattern will pull to the right or left. This trouble is caused by vertical synchronizing pulses "riding through" the horizontal sync discriminator circuit and momentarily upsetting the horizontal oscillator. Since vertical sync pulses occur at the frame frequency (during the vertical blanking period), the pulling exists immediately after the vertical blanking period and shows up only in the top portion of the picture.

The low frequency response of the horizontal sync discriminator can be reduced to overcome this problem. It is recommended that resistors R413 and R414 be changed from 470,000 ohms each to 180,000 ohms each (180,000 ohms, ½ watt, part number 60B8-184).
CAUTION: With R413 and R414 reduced in value, the circuit becomes critical to tolerance variations. TOLERANCE ON R413 and R414 MUST BE WITHIN 5 PER CENT OF EACH OTHER. This tolerance limit can be met by selecting a matched pair from stock resistors. After changing the resistor values of R413 and R414, the horizontal oscillator must be readjusted.

AUDIO BUZZ (Chassis 30B1, 30C1 or 30D1 only)

In some localities audio or station buzz may be apparent on some channels.
Early production 30B1, 30C1 or 30D1 chassis have the 6.3 volt heater lead from the TV tuner (94C8-2) connected to pin 4 of V401 (6BA6). Changing the TV tuner heater connection to pin 7 of V411 (6K6GT) will eliminate this trouble in most cases.

MICROPHONICS IN 30A1 CHASSIS

Microphonics have been a source of trouble in some early 30A1 television receivers using the 94C8-2 tuner (turret type). Listed below are suggestions for eliminating this microphonic condition. In general, this information will also be helpful in sets with other type television tuners.

(1) Check for microphonic oscillator mixer tube, V101 (6J6). It is recommended that several tubes be tried, in order to select a tube which will be least microphonic and at the same time, cause a minimum of oscillator frequency shift, as noted with rotation of Sharp Tuning Control. In some cases, replacement of the oscillatar mixer tube, may necessitate readjustment of the Overall Oscillator Adjustment (A18) and then individual channel oscillator adjustments.
(2) Spot-solder the tube socket saddles and ascillator mixer tube shield bracket to the tuner chassis.
(3) Loosen the chassis mounting screws, in order to float the chassis on the rubber mounts placed under the chassis mounting lugs. If the chassis does not have the rubber mounts, they can be made from one inch rubber tubing, cut to 1/4" lengths. Slip the rubber tubing underneath each chassis mounting lug. Rubber tubing shockmounts can be ordered from the Admiral distributor under part 12A6-7.
(4) Check control shafts and knobs (particularly on the Sharp Tuning Control) making sure that they clear the escutcheon or front panel of the cabinet.
(5) Microphonics can sometimes be eliminated by shock-mounting the speaker with rubber grommets, (part number 12A2-6) and grommet spacer (port number 29A2-5-71). Ream the speaker mounting holes sufficiently to allow insertion of a rubber grommet and spacer, and remount the speaker with the grommets in place.
(6) In early production 94C8-2 tuners, microphonics can be caused by vibration of the rotating dielectric disc of the oscillator Sharp Tuning Control. In order to avoid vibration with resulting microphonics, the rotating dielectric disc should be made to contact the grounded stator plate of the oscillator Sharp Tuning Control.
IMPORTANT: Use extreme caution when making adjustment of the stator plates of the oscillator Sharp Tuning Control. If tightening of the stator plate mounting screw is required, extreme care should be exercised in order to avoid stripping of the screw thread. A major repair job may result from breakage of the rotor disc or plastic contact strip. If the threads in the plastic insulating block become stripped, tap the hole for a larger screw.
(7) Microphonics can result from oscillation or vibration of components in the audio IF system. This can often be cured, by pressing condensers close to the chassis, re-dressing wires and shortening leads wherever possible. Moving of wiring in critical circuits may necessitate audio IF and ratio detector realignment.
(8) Check trimmer adjustments on the top side of the tuner for loose locknuts.

LOSS OF HORIZONTAL SYNC (IN EARLY PRODUCTION 30A1 ONLY)

Loss of horizontal sync in early 30A1 receivers has in many cases been due to dielectric leakage or breakdown of coupling condensers V407 or V408 (100 mmfd.), used in V403A plate and cathode circuits.

Early sets used a 100 mmfd. ceramic condenser, which was replaced in later production by a 100 mmfd., 10%, mica condenser, part 65B5-17, to correct this trouble.

PRODUCTION CHANGES IN 30A1 ONLY

Many production changes usually take place during a long production run. These changes are necessary to facilitate purchasing of component parts to improve manufacturing techniques, and to incorporate current circuit refinements. Several such changes were made during the 30A1 production run. The following paragraphs describe these changes.

1. FUSE PROTECTION AND HORIZONTAL CENTERING

In early production models, 6BG6G horizontal output tube (407) failure sometimes results in damage to circuit components (such as horizontal output transformer T402). This original circuit is shown in figure 1-6. The new circuit (see Figure 1-20) results in improved horizontal centering as well as fuse protection.

This new circuit refinement should always be wired into an early production model television receiver when major repairs make it necessary to remove the chassis from the cabinet. Parts required for adding this modification are listed below. Parts may be ordered individually or in a complete kit from the Admiral distributor.

Fuse Protection Conversion Kit 98A50-8 contains the following parts and material:

C426 .5 mfd., 200 volts, paper.....64B 6-27
M402 Fuse, 0.25A/250V.....84A 4-2
Fuse Holder.....84A 5-1
Screw, Self-tapping, 6x½".....1A 51-6-2
Spaghetti tubing, 1 ¼".....96A 2-5
Hook-up wire, 7".....95B10-20-20-92.

Line drawings showing the bottom of the television receiver chassis before and after modification are shown in Figures 1-3 and 1-4. The fuse holder mounting details are shown in Figures 1-5. The circuit modifications are made as follows:

a. Remove C426 (50 mfd., 25 volts, eletrolytic) and R436 (10 ohm, 1 watt) resistor; see figure 1-3.
b. Clip out jumper wire between terminals 1 and 2 on tie-strip "A".
c. Remove lead on R432 from terminal 3 of tie-strip "B" and reconnect to terminal 2 of tie-strip "A".
d. Disconnect red wire from terminal 1 of tie-strip "A" and reconnect to terminal 3 of tie-strip "B".
e. Disconnect deflection yoke lead (yellow) from terminal 5 and reconnect to terminal 1 on tie-strip "A". Do not disconnect yellow lead from focus coil (this lead must remain connected to terminal 5).
f. Insulate one lead of a 0.5 mfd. 200 volt condenser (new C426, part number 64B6-27) with a 1 ¼" length of spaghetti tubing (96A2-5). Solder condenser mounting strap to chassis next to terminal 3 af tie-strip "A". Connect condenser between terminals 1 and 2 of tie-strip "A", attaching the insulated lead to terminal 2.
g. Connect a 7" length of wire (95B10-20-20-92, white with red tracer) to terminal 1 of tie-strip "C". Insert free end through nearest hole at rear of chassis (for connection to fuse holder in 9 KV rectifier compartment).
h. Use a 36 drill bit to drill a hole 1 1/8" from rear of chassis and 2¼" from left side of chassis (see figure 1-5). Since there isn't too much room to work in the 9 KV rectifier compartment, it is convenient to dismount R435 and remove V409 from its socket while drilling the hole as described above. This hole permits mounting the fuse holder (84A5-1) with a 6 self-tapping screw (1A51-6-2).

i. Cut lead (white with yellow tracer) 2¾'' from terminal 5 on horizontal out-put transformer T402. Skin back the two ends ½'' and tin. Solder both wires to the fuse holder terminal nearest rear of chassis.
j. Connect white wire with red tracer (see step g) to other terminal of fuse holder.
k. Press 0.25 ampere fuse (84A4-2) into the fuse holder clips. Check lead dress to avoid possible shorts before placing receiver chassis in operation.

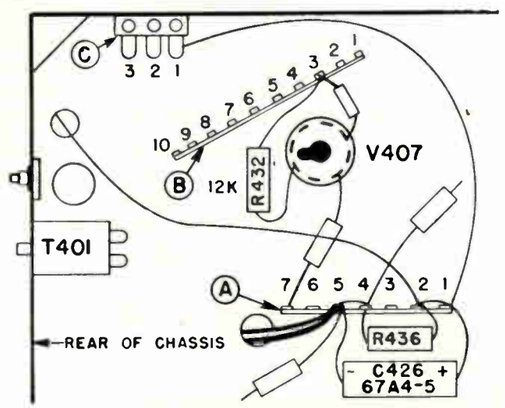


Figure 1-3. Original Circuit, Before Fusing.

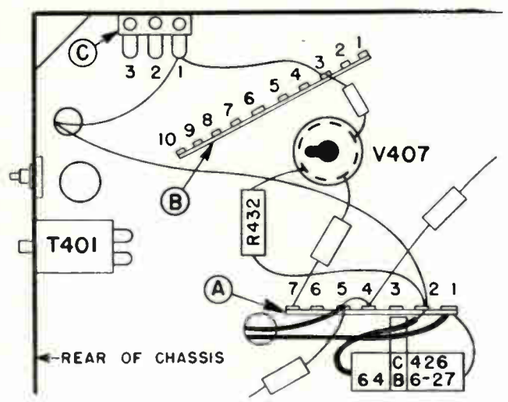


Fig. 1-4. Modified Circuit, After Fusing.

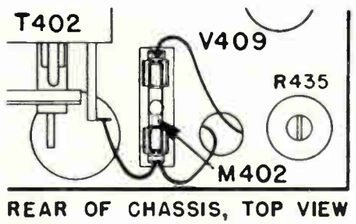


Fig. 1-5. Fuse Location

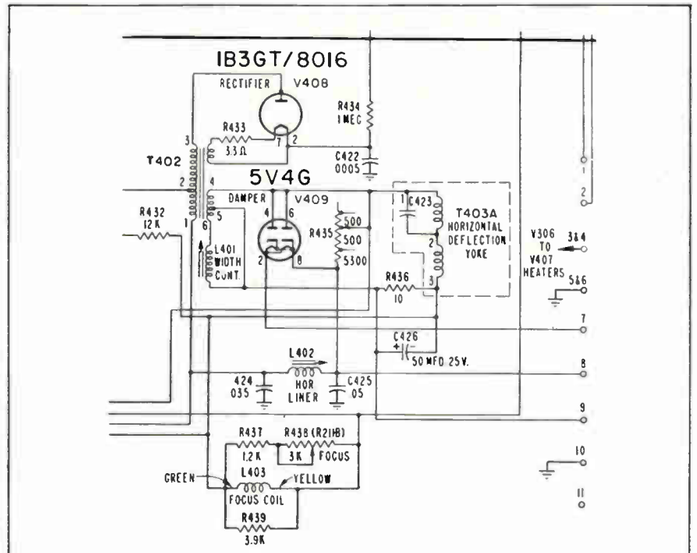


Fig. 1-6. Circuit Before Adding Fuse

2. FUSED CIRCUIT CHASSIS CONNECTION MODIFICATION

When the fuse change discussed in paragraph 1 was first incorporated in the horizontal output circuit, a small number of the 30A1 chassis were not wired according to the schematic, figure 1-20. This incorrect chassis wiring is shown in figure 1-7.
If a fuse burns out in a chassis wired as shown in figure 1-7, excessive voltage appears across condenser C426. Subsequent failure of C426 may result in damage to other circuit components. Therefore, chassis wired as shown in figure 1-7 must be modified when brought in to the shop. The modified chassis connections are shown in figure 1-8. The necessary modification is chassis wiring can best be accomplished as follows:

*a. Unsolder the lead of R330 from terminal 1 of tie-strip "D" and clip off the other lead on R330 as close to the ground lug as possible. See figure 1-7.
*b. Connect R330 between the two terminals of tie-strip "E". See figure 1-8.

*c. Unsolder the lead from terminol 1 of tie-strip "D" and clip the other end of this lead off terminal 3 of tie-strip "C". See figure 1-7.
*d. Transfer the connections from terminal 1 of tie-strip "A" to terminal 1 of tie-strip "D".
e. Transfer condenser lead of C426 and deflection yoke lead (white or yellow, depending on the production run) from terminal 2 to terminal 1 on tie-strip "A".
f. Clip off the other lead of condenser C426 from terminal 5 (figure 1-7) and reconnect the terminal 2 of tie-strip "A" (figure 1-8). It will be necessary to splice a length of tinned copper wire to this lead.
g. Connect an insulated lead between terminal 2 of tie-strip "A" and terminal 5 of tie-strip "B".
h. Check wiring per figure 1-8 and figure 1-20 before operating receiver.

*Due to the substitution of a four-terminal tie-strip at "F" in later production, some chassis will not appear exactly the same as shown in figure 1-7. The additional terminal on tie-strip "F" was used for the tuner plate decoupling filter in place of terminal 1 of tie-strip "A". Since such a chassis connection leaves terminal 1 of tie-strip "A" open, steps "a" through "d" of the above modification procedure do not apply. A chassis having the four-terminal tie-strip at "F" must be modified by following steps "e" through "h" only.

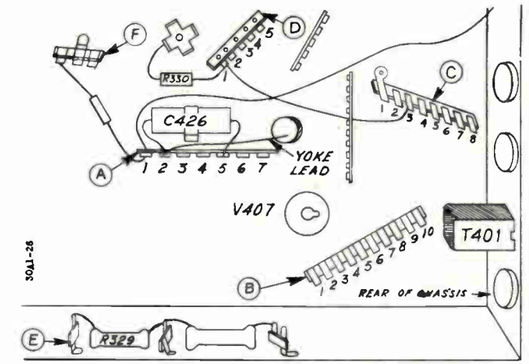


Figure 1-7. Original "Fused Chassis" Connections (Before Wiring Modification).

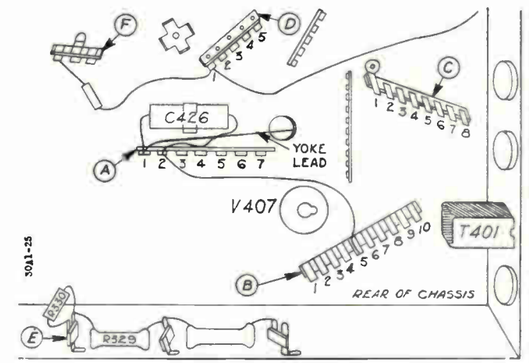


Figure 1-8. Modified "Fused Chassis" Connections. (After Wiring Modification).

3. POWER SUPPLIES

Early production 30A1 sets used two separate power supply chassis. After a small number of sets were run, the two separote power supply chassis were combined into one unit.

When the power supplies were on a separate chassis, upright transformers were used for T501 and T502. When both power supplies were put on the same chassis, these transformers were changed to half-shell mounting. See parts list.
When both power supplies were combined on one chassis, a 39 ohm isolating resistor was deleted.
Some of the double-cable power supplies had a 270,000 ohm, ½ watt (bleeder) resistor connected across C503C in the high voltage power supply, and a 270,000 ohm, 1 watt (bleeder) resistor connected across C501B

in the high voltage power supply. These resistors were deleted when a single cable was substituted for the double-cable arrangement. Later production chassis are connected to the power supply through a single cable, instead of two connecting cables as used in earlier production sets. Order replacement cables, sockets or plugs from the description given in the parts list, under heading "Sockets and Plugs". Refer to symbols M203 for cables or connectors attached to the chassis and symbol M513 for cables or connectors attached to the power supply.

4. CONTRAST CONTROL BIAS

Several changes have been made in the contrast control bias circuit. Condenser C301 was originally a 4 mfd. electrolytic condenser. This condenser is now a 50 mfd., 25 volt electrolytic (67A4-7). Part number 67A4-7 is recommended for replacement of C301 in all cases.

The value of R304 has been changed in later production to provide a greater contrast control range. This change should prove helpful in areas of unusually high video signal strength. The value has been changed from 27,000 ohms, ½ watt to 15,000 ohms, ½ watt (60B8-153). Replacement should be made with new part, 60B8-153.
In early production sets (first 500 units), an RC filter was used in the selenium bias rectifier circuit M405. This filter is a PI circuit consisting of a 180 ohm resistor, and two 50 mfd., electrolytic condensers. In later sets, the 180 ohm resistor and one 50 mfd., electrolytic condenser have been removed from the circuit. The remaining 50 mfd., electrolytic condenser is used in the circuit and corresponds to C440 in the present schematic. In the event that service is required for sets using the early PI filter circuit, the 180 ohm resistor and one 50 mfd. electrolytic condenser should be removed; the remaining electrolytic condenser should be connected as shown in the schematic. IMPORTANT: the 180 ohm resistor and 50 mfd, electrolytic condenser (as used in the older circuit) should not be removed unless circuit connection of M405 (50 mfd., 25 volts condenser, 67A4-7) has been changed as well.
A contrast control bias decoupling filter consisting of a 12,000 ohm resistor and a 1500 mfd. ceramic condenser, was deleted in later production (after 500 units). This decoupling filter was first used in the grid circuit of the V302 (6AG5), but was found unnecessary.

5. ALTERNATE TRANSFORMER T201 (1st AUDIO IF)

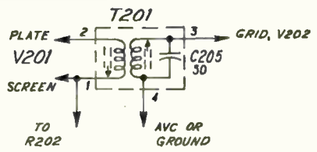


Figure 1-9. Wiring Above is for 72B58 IF Transformer. (Schematic, Fig. 1-20 shows 72B44 IF Transformer).

Production used 72B58 as an alternate for 72B44 (T201) for a short period of time, Alternate transformer 72B58 has a different terminal numbering arrangement than transformer 72B44. The terminal connections shown in the schematic are those of transformer 72B44. The terminal connections for transformer 72B58 are shown in figure 1-9.

Due to the tendency for transformer 72B58 to detune in shipment, the slugs were sealed with glyptal. In the event that alignment adjustment is necessary, a few drops of solvent must be applied to the glyptal around each slug. The solvent will free the slug in a short time. Alignment adjustment can then be made in the usual manner.

Lacquer thinner or amyl acetate (banana oil) are commonly used thinners which can be used on glyptal.
Replacement for T201 should always be ordered by part number 72B44 even though part number 72B58 was originally used in the chassis.

6. DELETED HEATER DECOUPLING FILTER

Heater decoupling filter choke and 1500 mmfd. ceramic condenser were deleted after 500 units.

7. DELETED V 201 BYPASS CONDENSER

V201 plate circuit and screen bypass (.05 mfd) was deleted in later production. C203, 1500 mmfd., proved adequate in itself.

8. C407 and C408 CHANGED TO MICA

Ceramic condensers were used for C407 and C408 in the horizontal sync discriminator circuit (V404). These condensers were replaced in later production by two 100 mfd., 10%, mica condensers (65B5-17). The new part number 65B5-17 should be used for service replacements for C407 and C408. This change was made to avoid horizontal sync difficulties caused by dielectric leakage or breakdown of the ceramic type condensers.

9. WATTAGE RATING INCREASE, R415

R415 was a 150,000 ohm, ½ watt resistor. In later production, R415 was changed to a 150,000 ohm, 1 watt resistor (60B28-14). Part number 60B28-14 should be used for service replacements.

10. WATTAGE RATING INCREASE, R416

R416 was a 82,000 ohm, ½ watt resistor. In later production, R416 was changed to a 82,000 ohm, 1 watt resistor (60B28-15). New part number 60B28-15 should be used for service replacements.

11. FM INTERFERENCE TRAP, TUNER A1582

An FM interference trap (98A44-28) consisting of part L984, L985, C921 and C922 was added to tuner A1582 in later production. In the event that FM interference is encountered on an early production receiver using tuner A1582 (see figure 1-8), an FM interference trap assembly can be obtained under service part number 98A44-28.

12. AVC CIRCUIT IN SOME SETS

Some early production sets were wired with AVC action, controling the 2nd audio IF stage, V202.

AVC voltage is developed across a 180,000 ohm resistor and a 470,000 ohm resistor in series, connected between point "Y" (in early ratio detector V203 circuit) and chassis. The 470,000 ohm resistor connects to chassis.
Terminal 1 (AVC lead) of T201 audio IF transformer is connected to junction of the 180,000 ohm resistor, 470,000 ohm resistor, and a .005 mfd. min. ceramic bypass condenser (other end of .005 mfd. condenser is connected to chassis).

13. R205 LOCATED INSIDE RATIO DETECTOR TRANSFORMER T202

Resistance value of R205 in early sets was 47 ohms, and in later sets was changed to 150 ohms. In early sets, R205 was located inside the ratio detector can T202 (72B45). In the event that T202 (72B45) must be replaced in a chassis that included R218 inside transformer T202, resistor R205, 150 ohms ½ watt (60B8-151) will be required in addition to replacement transformer 72B45. Connect R205 under the chassis after replacing transformer T202 (72B45).

14. C109 CHANGE IN TV TUNER 94C8-2
(Chassis 30A1, 30B1, 30C1 and 30D1)

In later production 94C8-2 TV tuners, ceramic condenser C109 has been changed from 10 mmfd., negative 300 temperature coefficient to 10 mmfd. 5%, negative 750 temperature coefficient (part 65B6-33). This change was made to improve frequency stability of the oscillator and mixer stage V102 (6J6) with conditions encountered under high ambient temperatures.

For replacement details, see paragraph "Frequency Drift in 94C8-2 Tuners".

15. DIFFERENT TUBES USED FOR 2nd and 3rd VIDEO IF, V302 and V303 (Chassis 30A1, 30B1, 30C1 only)

Type 6AG5 and 6AU6 tubes have been used for V302, and also for V303. Due to differences in tubes characteristics, corresponding video IF transformers T301, T302 must be used with the different tubes.
When type 6AG5 and 6AU6 tubes are used, T301 and T302 are part numbers 72B40-1 and 72B41-1, respectively. When type 6AU6 tubes are used, T301 and T302 are part numbers 72B81 and 72B82, respectively.

16. DIFFERENT 2nd and 3rd VIDEO IF TRANSFORMERS, T301 and T302 (Chassis 30A1, 30B1, 30C1 only)

See discussion in paragraph 15 directly above.

17. ALTERNATE DEFLECTION YOKE
(Chassis 30A1, 30B1, 30C1, 30D1)

Two alternate deflection yoke are currently being used, part number 94B2-1 and 94B2-2. Condenser C423, which is part of the yoke assembly, has to be a different value when used with the alternate yokes. Condenser C423 should be 56 mmfd., 5%, mica (65B1-54) when used with 94B2-1. Condenser C423 should be 39 mmfd., 5%, mica (65B1-55) when included in 94B2-2. The two yokes are interchangeable when complete with the proper resistors, condenser and wire leads. Yoke 94B2-2 (correct parts and leads included) is supplied for service replacement.

18. CHANGE IN TV TUNER FILAMENT CONNECTION
(Chassis 30B1, 30C1 and 30D1 Only)

In later production 30B1, 30C1 and 30D1 chassis, the 6.3 volt filament connection to the TV tuner has been changed from pin 4 of V401 (6BA6) to pin 7 of V411 (6K6GT). This change was made to avoid possible audio or station buzz noticeable on certain channels.

19. DIFFERENT 12" PICTURE TUBES USED (Chassis 30C1 Only)

Different 12" picture tubes (types 12PB4, 12LP4, 12TP4, 12KP4 or 12QP4) have been used in the 30C1 models. The various tube types require different chassis wiring and ion traps.

A1897 AND A1945 POWER SUPPLIES

Double cable. 5 tube power supply chassis. Cables for A1897 Power Supply are not detachable. A1945 Power Supply has one non-detachable and one detachable cable.

RESISTORS

Sym.	Description	Part No.
R511	2,500 ohms, 5 Watts, Candohm	61A 3-8
R512	4.7 Megohms, ½ Watt	60B 8-475
R513	4.7 Megohms, ½ Watt	60B 8-475
R514	470,000 ohms, ½ Watt	60B 8-474
R515	470,000 ohms, ½ Watt	60B 8-474
R516	47,000 ohms, ½ Watt	60B 8-473
R517	470,000 ohms, ½ Watt	60B 8-474
R518	470,000 ohms, ½ Watt	60B 8-474
†R519	18 ohms, 1 Watt	60B 14-180
R520	270 ohms, 2 Watt	60B 20-271
R521	470,000 ohms, ½ Watt	60B 8-474

CONDENSERS

Sym.	Description	Part No.
C511	.01 mfd., 400 Volts, Paper	64B 5-25
C512	.1 mfd., 400 Volts, Paper	64B 5-20
C513	.01 mfd., 400 Volts, Paper	64B 5-25
C514	.01 mfd., 400 Volts, Paper	64B 5-25
C515	.01 mfd., 400 Volts, Paper	64B 5-25
C516	.002 mfd., 600 Volts, Paper	64B 5-14
C517a	60 mfd., 350 Volts }	
C517b	40 mfd., 350 Volts } Electrolytic	67C 15-5
C517c	20 mfd., 350 Volts }	
†C518a	40 mfd., 450 Volts } Electrolytic	67C 15-1
†C518b	40 mfd., 450 Volts }	

COILS, TRANSFORMERS, ETC.

Sym.	Description	Part No.
L511	Choke, Filter (2.8 henrys)	74A 13
†L512	Choke, Filter (2 henrys)	74A 12
T511	Transformer, Output	79A 16
T512	Transformer Low Voltage Power	80B 16
†T513	Transformer, High Voltage Power	80B 15
M516	Speaker	
	for 4H15, 4H16, 4H17, 4H145, 4H146, 4H147, (10" PM)	78B 41
	for 4H115, 4H116, 4H117, 4H155, 4H156, 4H157 (12" PM)	78B 44-1
	for 4H18, 4H19, 4H126, 4H137, 4H165, 4H166, 4H167, (12" PM)	78B 44-2
	Spring, Tube Holder	87A 22-2

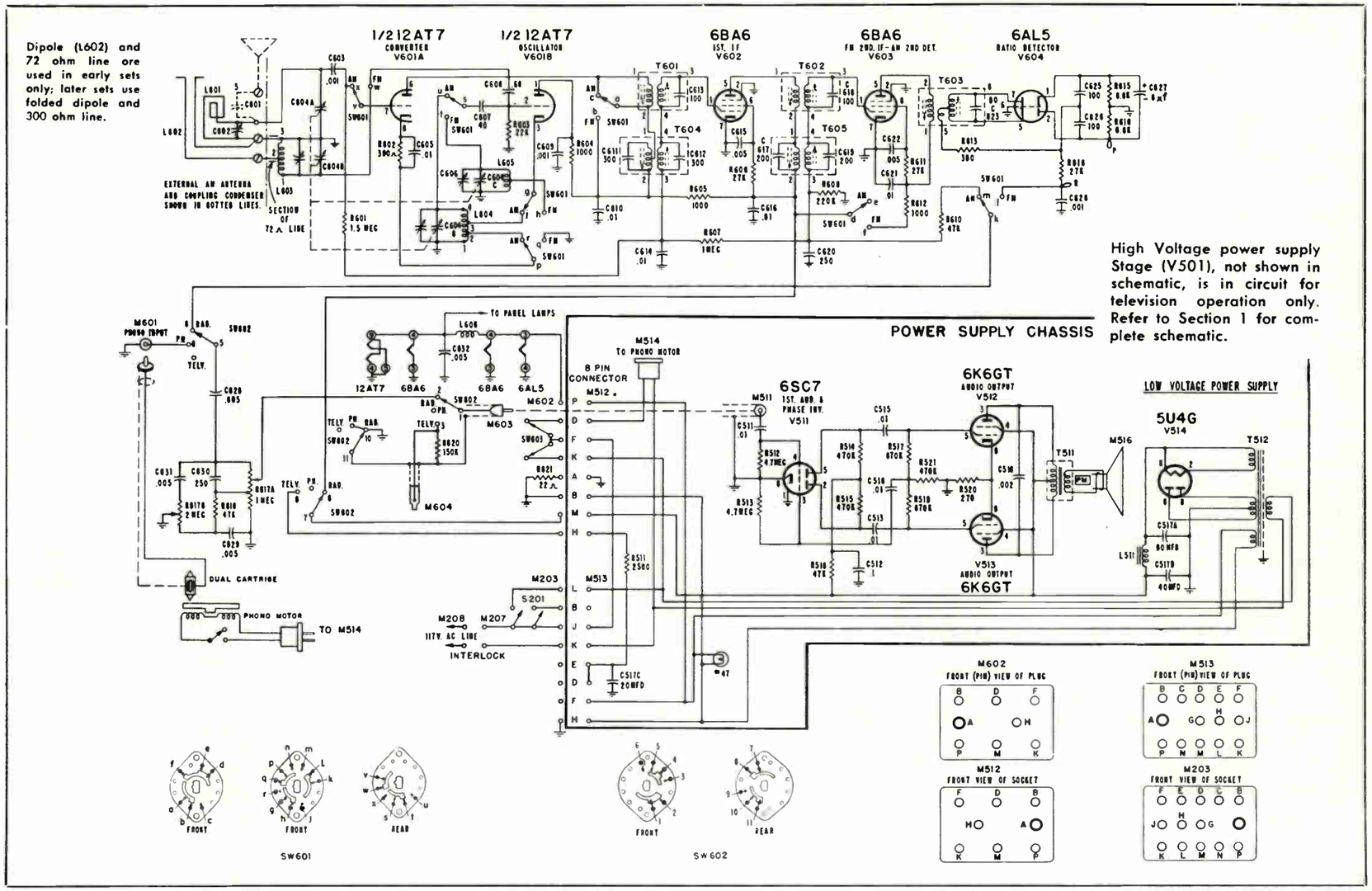
20. CHANGE IN INTERLOCK CONNECTORS AND WIRING TO DEFLECTION YOKE AND FOCUS COIL (Chassis 30D1 Only)

An interlock circuit is wired into the plugs connecting the deflection yoke and focusing coil to the 30D1 chassis.
In some early production sets, the interlocking circuit in the chassis had been incorrectly wired, whereby the 110 volt AC circuit was not opened when plug M407 connection th the deflection yoke, or plug M408 connection to the focus coil, are removed from the chassis.

21. INSUFFICIENT WIDTH, Early 30D1 Chassis

This trouble can in most cases be corrected by adjustment of width control L404 or by replacement of tubes V403 (6SN7GT) or V407 (6BG6G). If this will not correct the condition, shunt a 68,000 ohm, 1 watt resistor across R465 (15,000 ohm, 2 watt, V407 screen dropping resistor), or replace R465 with a 12,000 ohm, 2 watt resistor, part number 60B20-123. Readjust L404 after changing value of R465 resistor. NOTE: In later production sets, R465 was changed to 12,000 ohms, 2 watt.

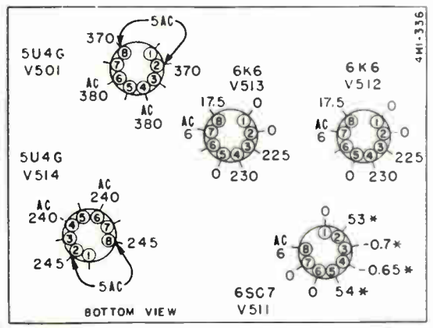
Dipole (L602) and 72 ohm line ore used in early sets only; later sets use folded dipole and 300 ohm line.



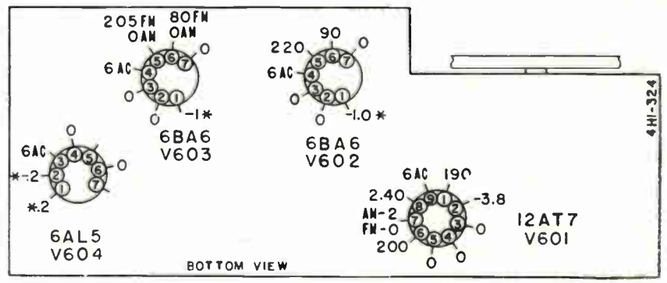
High Voltage power supply Stage (V501), not shown in schematic, is in circuit for television operation only. Refer to Section 1 for complete schematic.

VOLTAGE DATA

- Line voltage 117 Volts AC.
- Voltages measured with a vacuum tube voltmeter, between tube socket terminals and chassis, unless otherwise indicated.
- "Tel-Phono-Rad" switch in "Rad" position.
- Voltages measured with band switch in FM position unless otherwise indicated.
- Volume control set at minimum.
- Dial turned to low frequency end.
- Antenna disconnected.
- Television chassis must be turned off, but remain connected to power supply, unless an AC line cord is wired to plug M513, see illustration page 4-1, or use adapter socket (98A30-5) available from Admiral Distributor.



* If taken with a 1000 ohm-per-volt meter, readings will be lower or zero.



* If taken with a 1000 ohm-per-volt meter, readings will be lower or zero.

VOLTAGE DATA

- Line voltage 117 volts AC.
- Voltages measured with a vacuum tube voltmeter between tube socket terminals and chassis, unless otherwise indicated. Note that the grid and cathode of V4 (6AS5) are about 130 volts positive with respect to chassis.
- Antenna disconnected from set.
- Speaker should be connected when taking voltages.
- Contrast set fully clockwise. Channel selector on channel 2 or other unassigned low channel.
- All rear chassis controls set at approximately half rotation (usual setting for normal picture).
- Some tube socket terminals are used as tie-points and a voltage reading may be present.

CAUTION

High voltages are present on the cap and filament of 1B3/8016. NO ATTEMPT SHOULD BE MADE TO TAKE MEASUREMENTS FROM THESE POINTS UNLESS SUITABLE TEST EQUIPMENT IS AVAILABLE.

Picture tube deflection voltages can be measured at the point of connection to chassis wiring and should be taken only with a high voltage instrument such as a kilovoltmeter. Proper filament voltage check of 1B3/8016 tube may be made by observing filament brilliancy as compared with that obtained with a 1.5 volt dry cell battery.

Sym.	Tube	Function	Pin 1	Pin 2	Pin 3	Pin 4	Pin 5	Pin 6	Pin 7	Pin 8
V101	6AG5	RF Amplifier	−.3	NC	6.3 AC	0	125	125	0	
V102	6J6	Osc. & Mixer	125	125	6.3 AC	0	0	0	0	
Voltages at V101 and V102 measured from top of chassis with tubes removed. Point "W" is −3 volts measured with tubes in sockets.										
V1	6AU6	Audio IF Amplifier	0	0	6.3 AC	0	120	120	1	
V2	6AL5	Ratio Detector	.6	−.6	6.3 AC	0	0	0	0	
V3	6SQ7	Audio Amplifier	0	−.8	0	0	0	70	6.3 AC	0
V4	6AS5	Audio Output	130	125	6.3 AC	0	125	243	230	
V5	6AU6	1st IF Amplifier	−.6	0	0	6.3 AC	115	115	.6	
V6	6AU6	2nd IF Amplifier	−.6	0	0	6.3 AC	115	115	.6	
V7	6AU6	3rd IF Amplifier	0	0	6.3 AC	0	115	115	−1.3	
V8	6AL5	Video Detector & AGC	0	−.7	0	6.3 AC	0	0	0	
V9	6AU6	Video Amplifier	−.9	0	6.3 AC	0	110	125	0	
V10	5Y3GT	Low Voltage Rectifier	NC	275*	NC	280 AC	NC	280 AC	NC	275*
V11	6SN7GT	Sync Sep. & Vert. Osc.	−1.7	30	0	−13	60	0	6.3 AC	0
V12	6SN7GT	Sync Amp. & Hor. Osc.	−.9	110	0	−70	230	2.8	0	6.3 AC
V13	1B3/ 8016	High Voltage Rectifier	NC	6500	NC	NC	NC	NC	6500	NC
		Voltage on tube cap: See "CAUTION" note above.								
V14	6V6GT	High Voltage Osc.	0	6.3 AC	255	230	−120	NC	0	3
V15	6SL7GT	Vertical Output	−5.5	300	5.5	−4	245	0	0	6.3 AC
V16	7JP4	Picture Tube	6.3 AC	105	NC	NC	2000	NC	6000	6000
Pin 9: 6000 Pin 10: 6000 Pin 11: 6000 Pin 12: NC Pin 13: NC Pin 14: 0 Voltages taken at point of connection to chassis wiring.										

* 5.2 volts AC measured between pins 2 and 8 of 5Y3GT.

NC Indicates no connection to tube element.

VOLTAGE DATA

- All measurements made with vacuum tube voltmeter.
- Contrast control full on. All rear controls set at approximately half rotation (usual setting for normal picture).
- Transmission line disconnected from set receiver.
- Channel switch on channel 2.
- Line voltage 117 volts, 60 cycles.
- Proper filament voltage check of V13 (1B3/8016) tube can be made by observing filament brilliancy as compared with that obtained with a 1.5 volt dry cell battery.

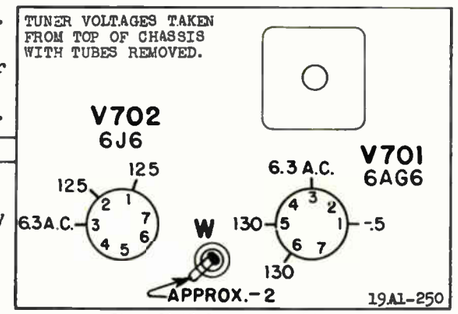
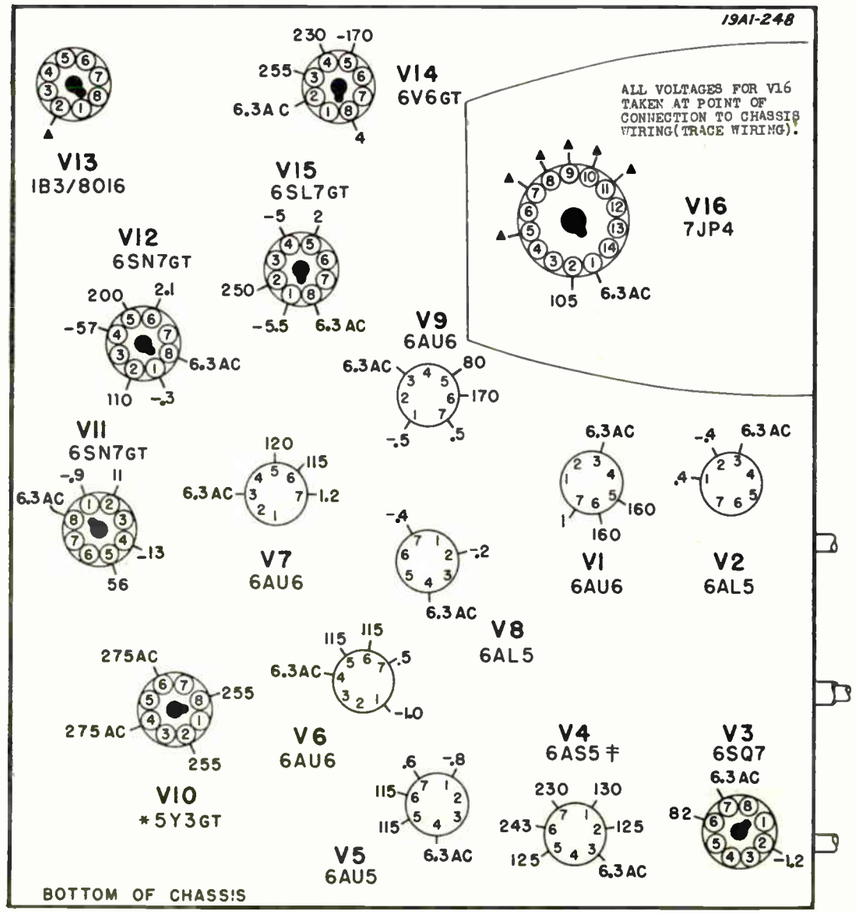


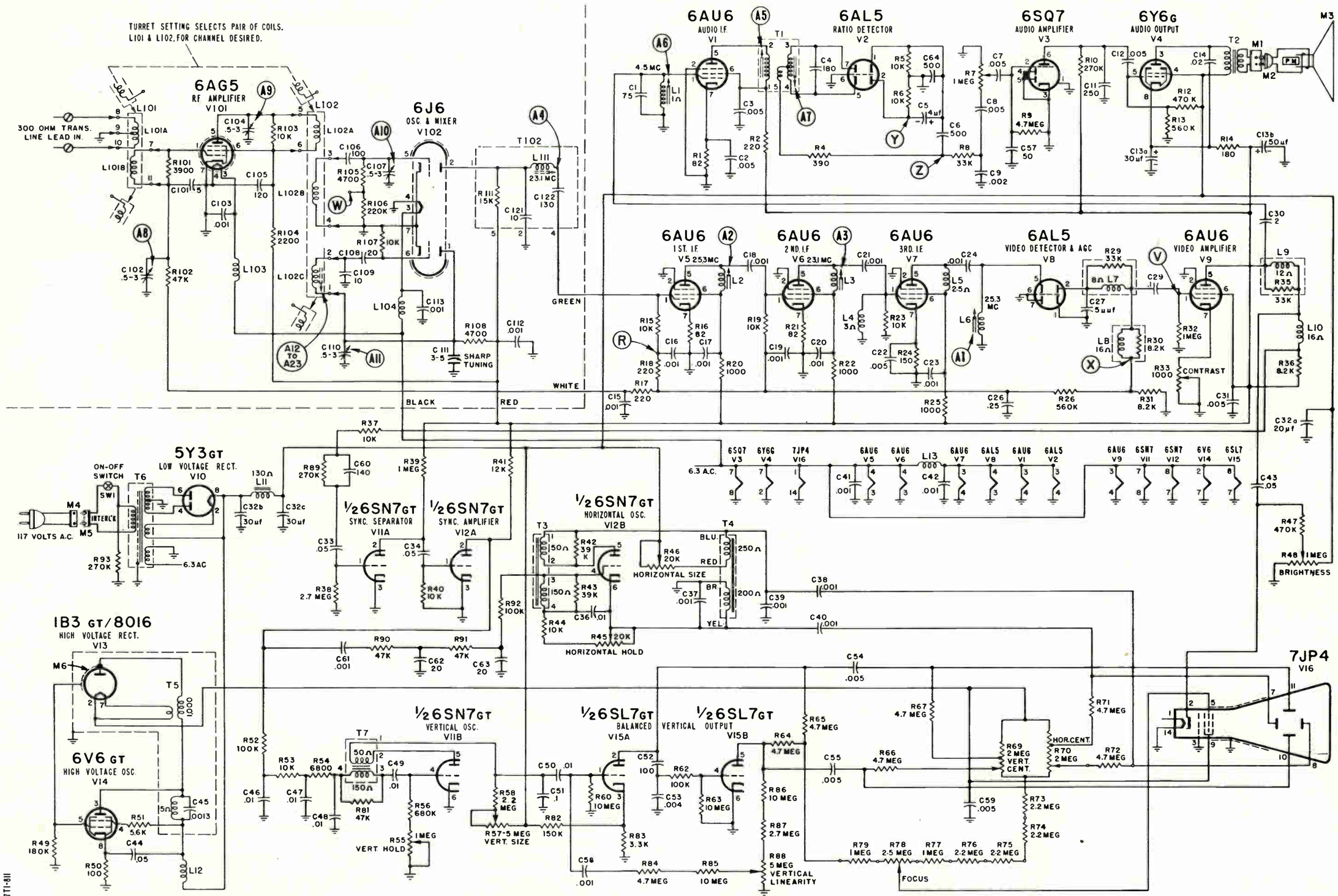
Figure 57. 9408-1 Tuner Voltage Diagram.



* 5U4G ALSO USED: SEE PRODUCTION CHANGES,

‡ SOME 19A1 CHASSIS USE A 6Y6G TUBE, INSTEAD OF A 6AS5 TUBE FOR V4.

▲ HIGH VOLTAGES: DO NOT USE ORDINARY TEST EQUIPMENT. 6500 VOLTS AT PIN 2 OF V13. 2000 VOLTS AT PIN 5 OF V16. 6000 VOLTS AT PINS 7, 8, 9, 10 AND 11 OF V16.



SCHEMATIC DIAGRAM FOR 17T1 CHASSIS

VOLTAGE DATA

- Line voltage 117 volts AC.
- Voltages measured with a vacuum tube voltmeter between tube socket terminals and chassis, unless otherwise indicated. Note that the grid and cathode of V4 (6AS5) are about 130 volts positive with respect to chassis.
- Antenna disconnected from set.
- Speaker should be connected when taking voltages.
- Contrast set fully clockwise. Channel selector on channel 2 or other unassigned low channel.
- All rear chassis controls set at approximately half rotation (usual setting for normal picture).
- Some tube socket terminals are used as tie-points and a voltage reading may be present.

CAUTION

High voltages are present on the cap and filament of 1B3/8016. NO ATTEMPT SHOULD BE MADE TO TAKE MEASUREMENTS FROM THESE POINTS UNLESS SUITABLE TEST EQUIPMENT IS AVAILABLE.

Picture tube deflection voltages can be measured at the point of connection to chassis wiring and should be taken only with a high voltage instrument such as a kilovoltmeter. Proper filament voltage check of 1B3/8016 tube may be made by observing filament brilliancy as compared with that obtained with a 1.5 volt dry cell battery.

Sym.	Tube	Function	Pin 1	Pin 2	Pin 3	Pin 4	Pin 5	Pin 6	Pin 7	Pin 8
V101	6AG5	RF Amplifier	−.3	NC	6.3 AC	0	125	125	0	
V102	6J6	Osc. & Mixer	125	125	6.3 AC	0	0	0	0	
Voltages at V101 and V102 measured from top of chassis with tubes removed. Point "W" is −3 volts measured with tubes in sockets.										
V1	6AU6	Audio IF Amplifier	0	0	6.3 AC	0	120	120	1	
V2	6AL5	Ratio Detector	.6	−.6	6.3 AC	0	0	0	0	
V3	6SQ7	Audio Amplifier	0	−.8	0	0	0	70	6.3 AC	0
V4	6AS5	Audio Output	130	125	6.3 AC	0	125	243	230	
V5	6AU6	1st IF Amplifier	−.6	0	0	6.3 AC	115	115	.6	
V6	6AU6	2nd IF Amplifier	−.6	0	0	6.3 AC	115	115	.6	
V7	6AU6	3rd IF Amplifier	0	0	6.3 AC	0	115	115	−1.3	
V8	6AL5	Video Detector & AGC	0	−.7	0	6.3 AC	0	0	0	
V9	6AU6	Video Amplifier	−.9	0	6.3 AC	0	110	125	0	
V10	5Y3GT	Low Voltage Rectifier	NC	275*	NC	280 AC	NC	280 AC	NC	275*
V11	6SN7GT	Sync Sep. & Vert. Osc.	−1.7	30	0	−13	60	0	6.3 AC	0
V12	6SN7GT	Sync Amp. & Hor. Osc.	−.9	110	0	−70	230	2.8	0	6.3 AC
V13	1B3/8016	High Voltage Rectifier	NC	6500	NC	NC	NC	NC	6500	NC
		Voltage on tube cap: See "CAUTION" note above.								
V14	6V6GT	High Voltage Osc.	0	6.3 AC	255	230	−120	NC	0	3
V15	6SL7GT	Vertical Output	−5.5	300	5.5	−4	245	0	0	6.3 AC
V16	7JP4	Picture Tube	6.3 AC	105	NC	NC	2000	NC	6000	6000
Pin 9: 6000 Pin 10: 6000 Pin 11: 6000 Pin 12: NC Pin 13: NC Pin 14: 0 Voltages taken at point of connection to chassis wiring.										

* 5.2 volts AC measured between pins 2 and 8 of 5Y3GT.

NC Indicates no connection to tube element.

VOLTAGE DATA

- All measurements made with vacuum tube voltmeter.
- Contrast control full on. All rear controls set at approximately half rotation (usual setting for normal picture).
- Transmission line disconnected from set receiver.
- Channel switch on channel 2.
- Line voltage 117 volts, 60 cycles.
- Proper filament voltage check of V13 (1B3/8016) tube can be made by observing filament brilliancy as compared with that obtained with a 1.5 volt dry cell battery.

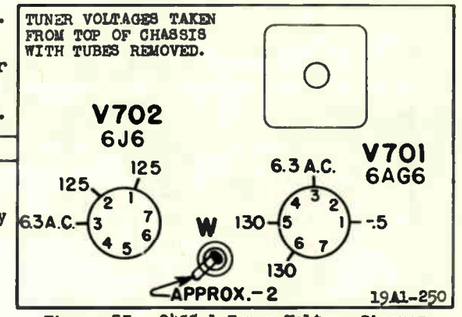
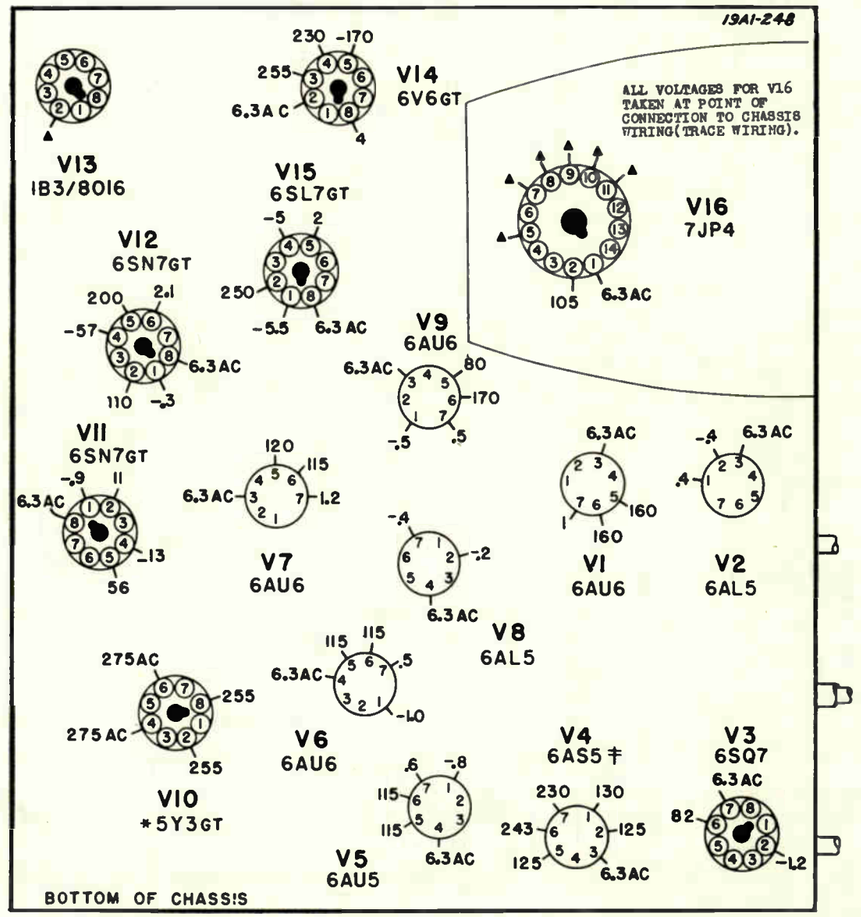


Figure 57. 9408-1 Tuner Voltage Diagram.

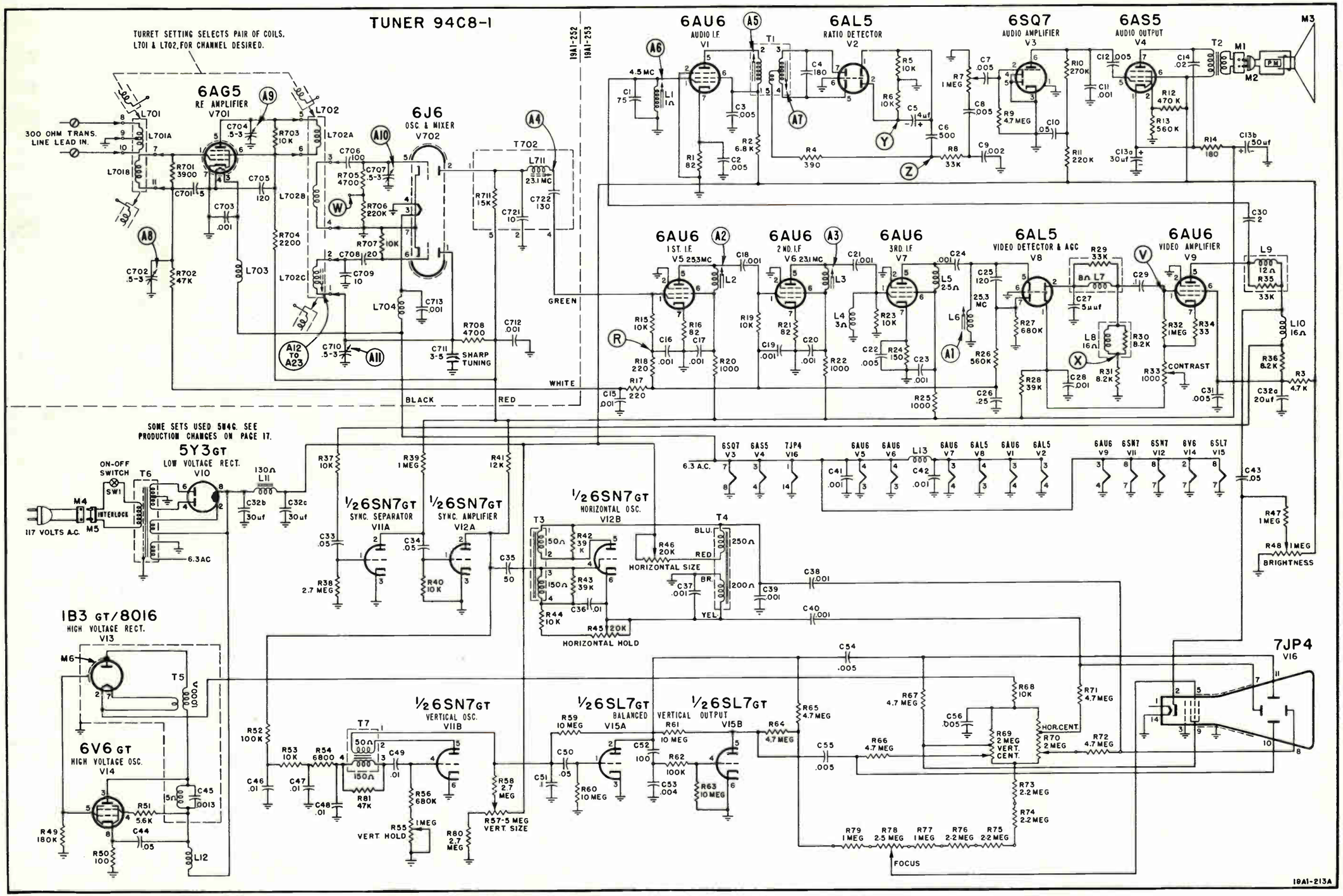


* 5U4G ALSO USED: SEE PRODUCTION CHANGES, PAGE 17.

† SOME 19A1 CHASSIS USE A 6Y6G TUBE, INSTEAD OF A 6AS5 TUBE FOR V4.

▲ HIGH VOLTAGES: DO NOT USE ORDINARY TEST EQUIPMENT. 6500 VOLTS AT PIN 2 OF V13. 2000 VOLTS AT PIN 5 OF V16. 6000 VOLTS AT PINS 7, 8, 9, 10 AND 11 OF V16.

Figure 58. Chassis Voltage Diagram.



* Some sets use a 6Y6G tube instead of a 6AS5 tube for V4.

ALTERNATE TV TUNERS USED IN 30A1 CHASSIS

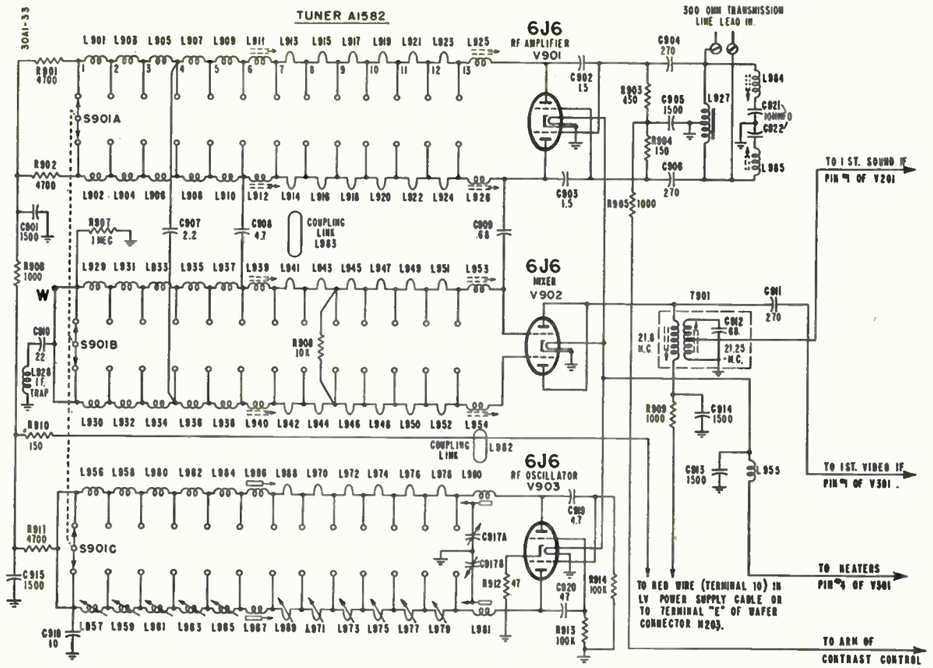
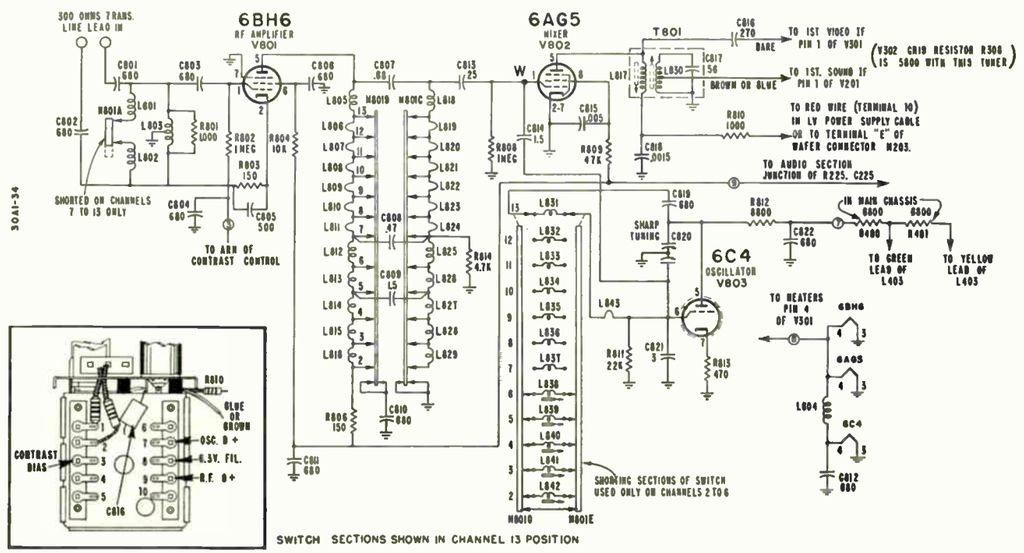


Figure 1-18. Schematic, TV Tuner A1582.

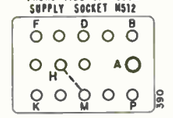


Schematic, TV Tuner 94C9-2.

VOLTAGE DATA

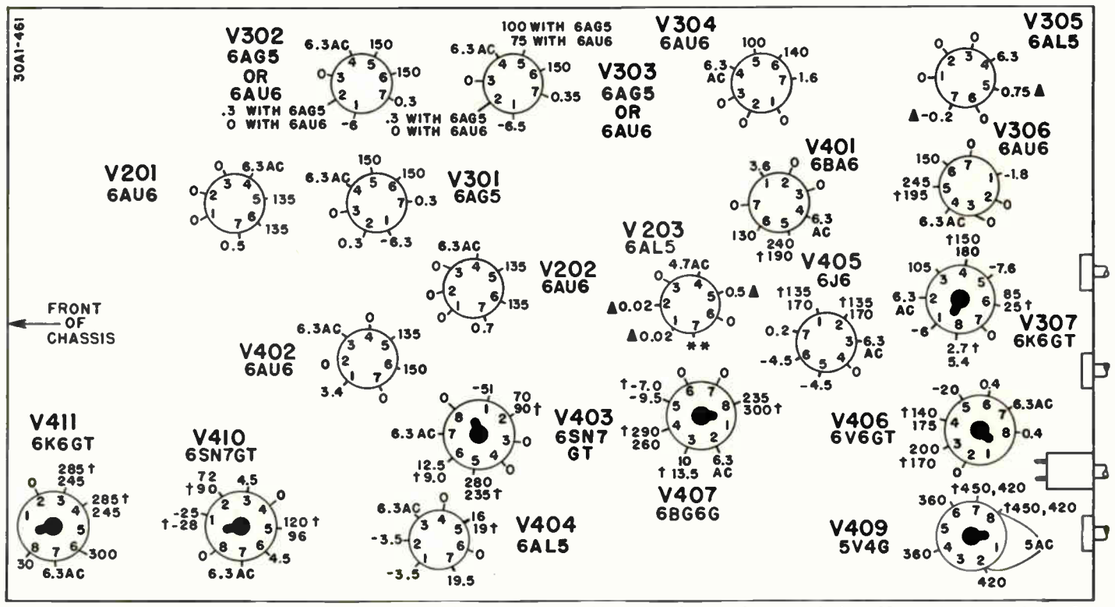
- For combination models, 4H1 Radio Tuner must be connected to power supply unless a jumper or adapter plug (part number 98A-30-4) is inserted in the radio tuner power supply socket M512 to complete the B+ circuit. See adjoining illustration.
- Line voltage, 117 Volts, AC.
- Voltages measured with a vacuum tube voltmeter, between tube socket terminals and chassis, unless otherwise indicated.
- Antenna disconnected from television receiver.
- All front controls except Contrast set at approximately half rotation; Contrast set at minimum (all the way to the left).
- All rear panel controls, except HOR. LOCK, HOR. LIN., and WIDTH, set at approximately half rotation. (Do not disturb HOR. LOCK, HOR. LIN., and WIDTH settings.)
- Channel selector on channel 2. (Channel 1 for sets with A1582 Tuner, Figure 1-13).

FRONT VIEW OF POWER SUPPLY SOCKET M512



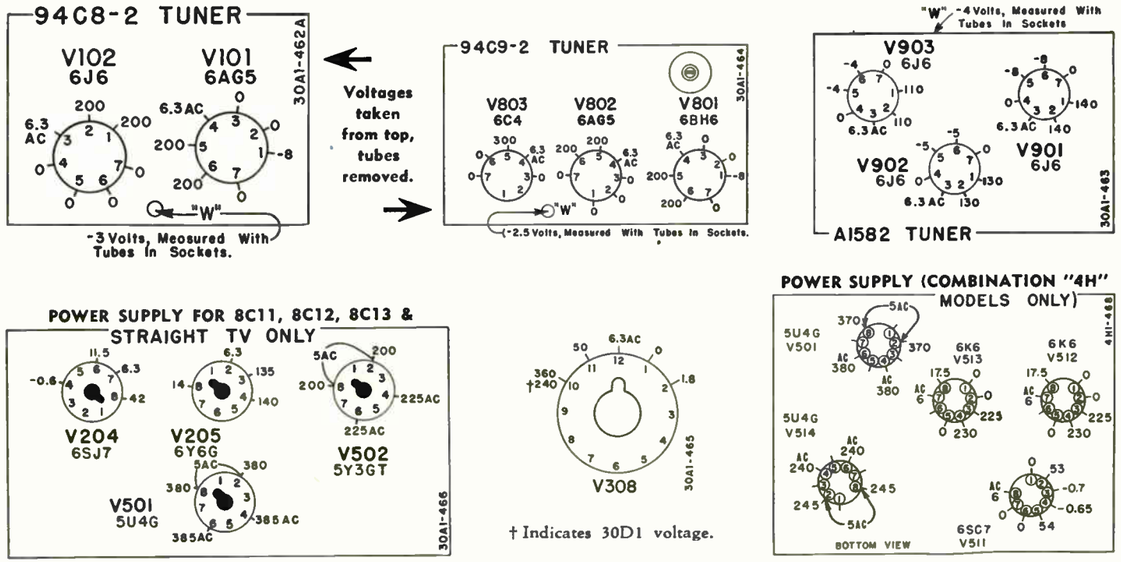
CAUTION: Pulsed high voltages are present on the cap of V407 (6BG6G) tube, and on the filament terminals and cap of V408 (or V412 in 30D1) 1B3/8016 tube. NO ATTEMPT SHOULD BE MADE TO TAKE MEASUREMENTS FROM THESE POINTS.

Picture tube 2nd anode voltage can be measured at the high voltage cap of picture tube (V308) and should be taken only with a high voltage instrument such as a kilovoltmeter. Voltage for 2nd anode of 10" or 12" tube is approximately 9KV, for 16" tubes, 12KV. Proper filament voltage check of V408 (and V412) 1B3/8016 tube may be made by observing filament brilliancy as compared with that obtained with a 1.5 volt dry cell battery.



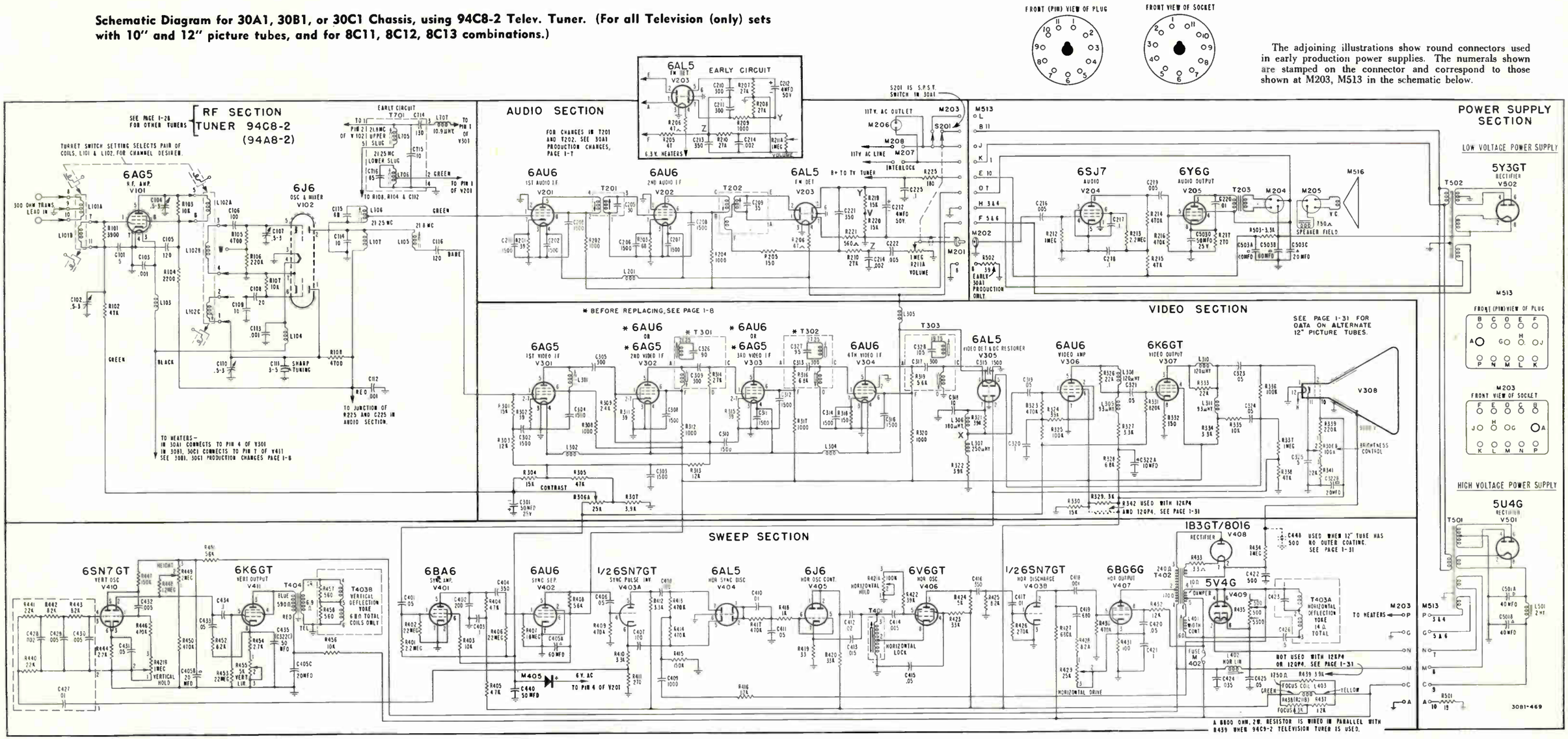
▲ Indicates contact potential which may vary widely.
† Indicates 30D1 voltages.

** Zero volts in chassis with late V203 circuit. —0.5 volts (contact potential) in chassis, with early ratio detector V203.



Voltage Charts.

Schematic Diagram for 30A1, 30B1, or 30C1 Chassis, using 94C8-2 Telev. Tuner. (For all Television (only) sets with 10" and 12" picture tubes, and for 8C11, 8C12, 8C13 combinations.)



FRONT (PIN) VIEW OF PLUG

FRONT VIEW OF SOCKET

The adjoining illustrations show round connectors used in early production power supplies. The numerals shown are stamped on the connector and correspond to those shown at M203, M513 in the schematic below.

If parts not shown here or different circuit arrangements are found in a chassis, see "Production Changes".

CIRCUIT DIFFERENCES BETWEEN 30D1 CHASSIS and 30B1, 30C1 CHASSIS

(Use illustrations below with Figure 1-21.)

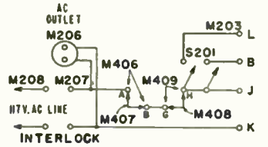


Figure 1-22. 117V, AC Interlock Circuit (30D1).

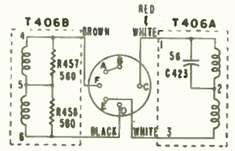


Figure 1-23. Deflection Yoke Connector (early type). Pin View M407, Bottom View M406.

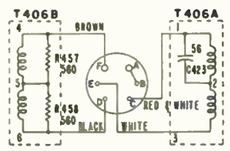


Figure 1-24. Deflection Yoke Connector (late type). Pin View M407, Bottom View M406.

Figure 1-25. Focus Coil Connector. Pin View M408, Bottom View M409.

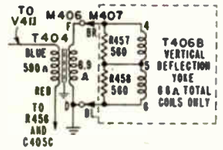
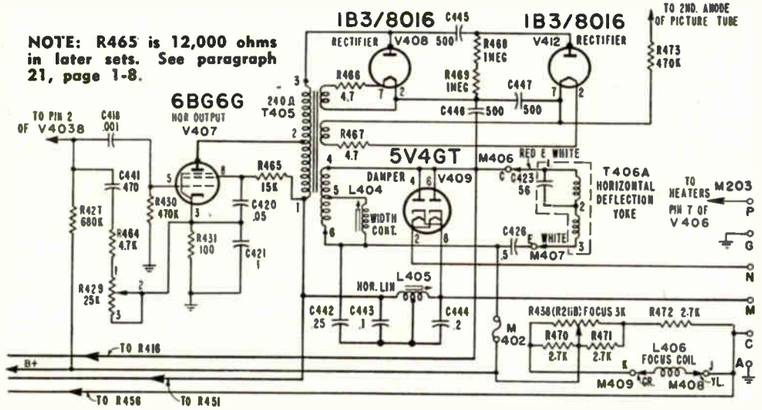
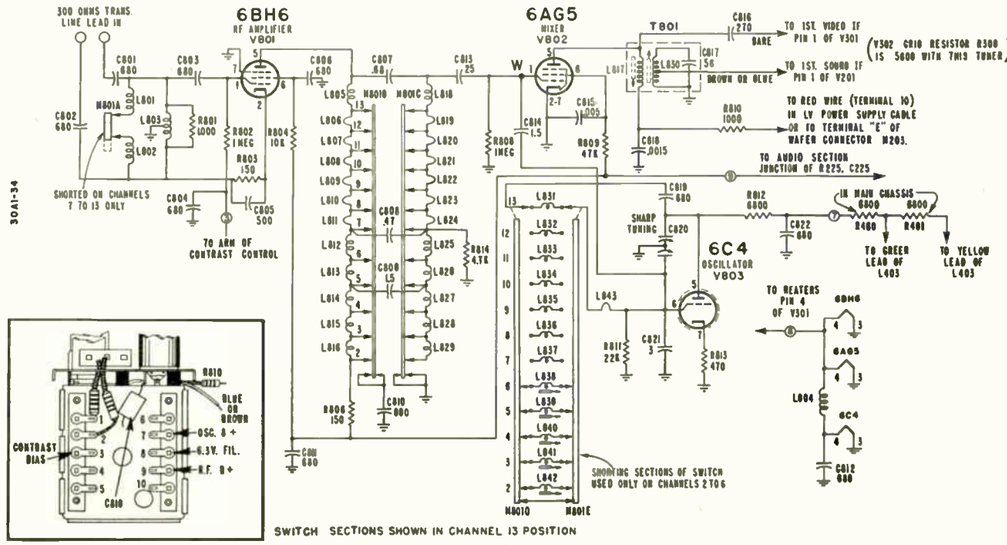


Figure 1-26. Vertical Deflection Yoke Circuit (30D1).



2nd Anode Supply Circuit for 30D1;

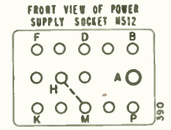
TUNER 94C9-2



Schematic, TV Tuner 94C9-2.

VOLTAGE DATA

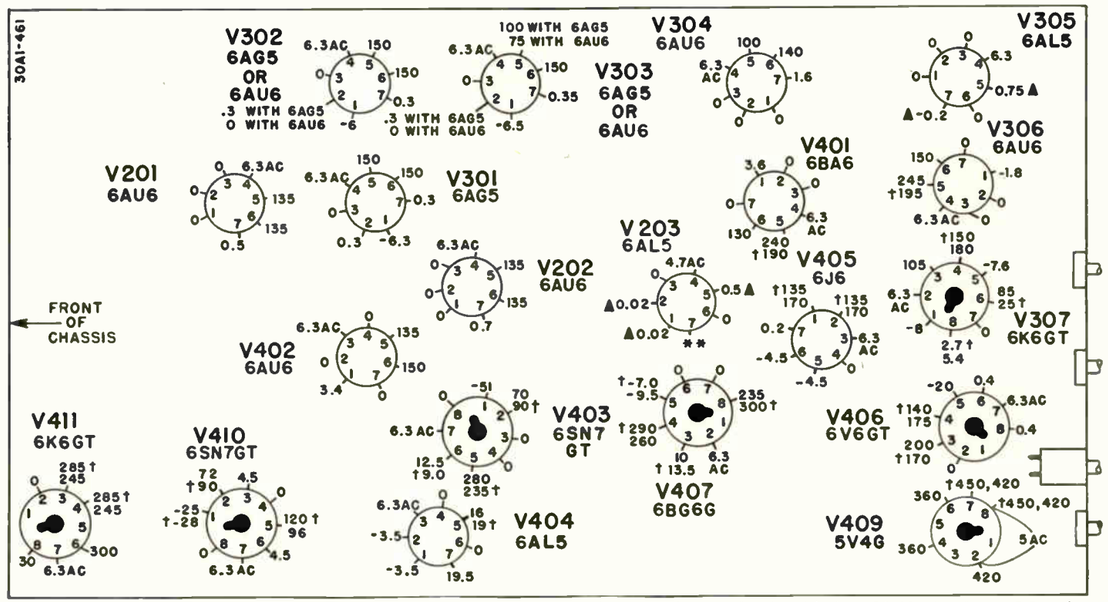
- For combination models, 4H1 Radio Tuner must be connected to power supply unless a jumper or adapter plug (part number 98A-30-4) is inserted in the radio tuner power supply socket M512 to complete the B+ circuit. See adjoining illustration.
- Line voltage, 117 Volts, AC.
- Voltages measured with a vacuum tube voltmeter, between tube socket terminals and chassis, unless otherwise indicated.
- Antenna disconnected from television receiver.
- All front controls except Contrast set at approximately half rotation; Contrast set at minimum (all the way to the left).
- All rear panel controls, except HOR. LOCK, HOR. LIN., and WIDTH, set at approximately half rotation. (Do not disturb HOR. LOCK, HOR. LIN., and WIDTH settings.)



- Channel selector on channel 2. (Channel 1 for sets with A1582 Tuner, Figure 1-13).

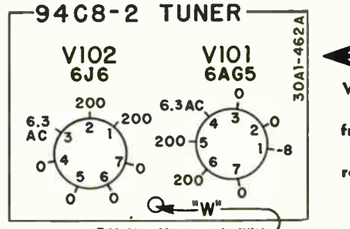
CAUTION: Pulsed high voltages are present on the cap of V407 (6BG6G) tube, and on the filament terminals and cap of V408 (or V412 in 30D1) 1B3/8016 tube. NO ATTEMPT SHOULD BE MADE TO TAKE MEASUREMENTS FROM THESE POINTS.

Picture-tube 2nd anode voltage can be measured at the high voltage cap of picture tube (V308) and should be taken only with a high voltage instrument such as a kilovoltmeter. Voltage for 2nd anode of 10" or 12" tube is approximately 9KV, for 16" tubes, 12KV. Proper filament voltage check of V408 (and V412) 1B3/8016 tube may be made by observing filament brilliancy as compared with that obtained with a 1.5 volt dry cell battery.

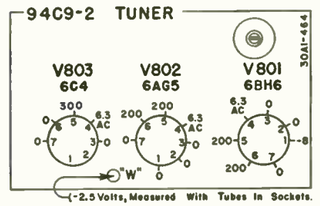


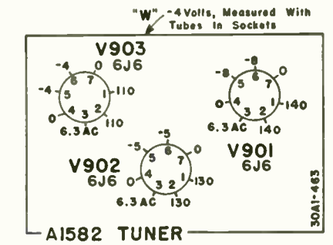
▲ Indicates contact potential which may vary widely.
† Indicates 30D1 voltages.

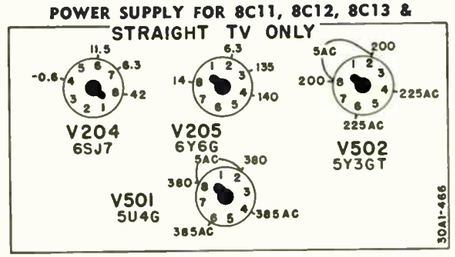
** Zero volts in chassis with late V203 circuit. —0.5 volts (contact potential) in chassis, with early ratio detector V203.



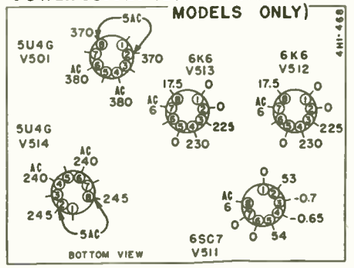
Voltages taken from top, tubes removed.







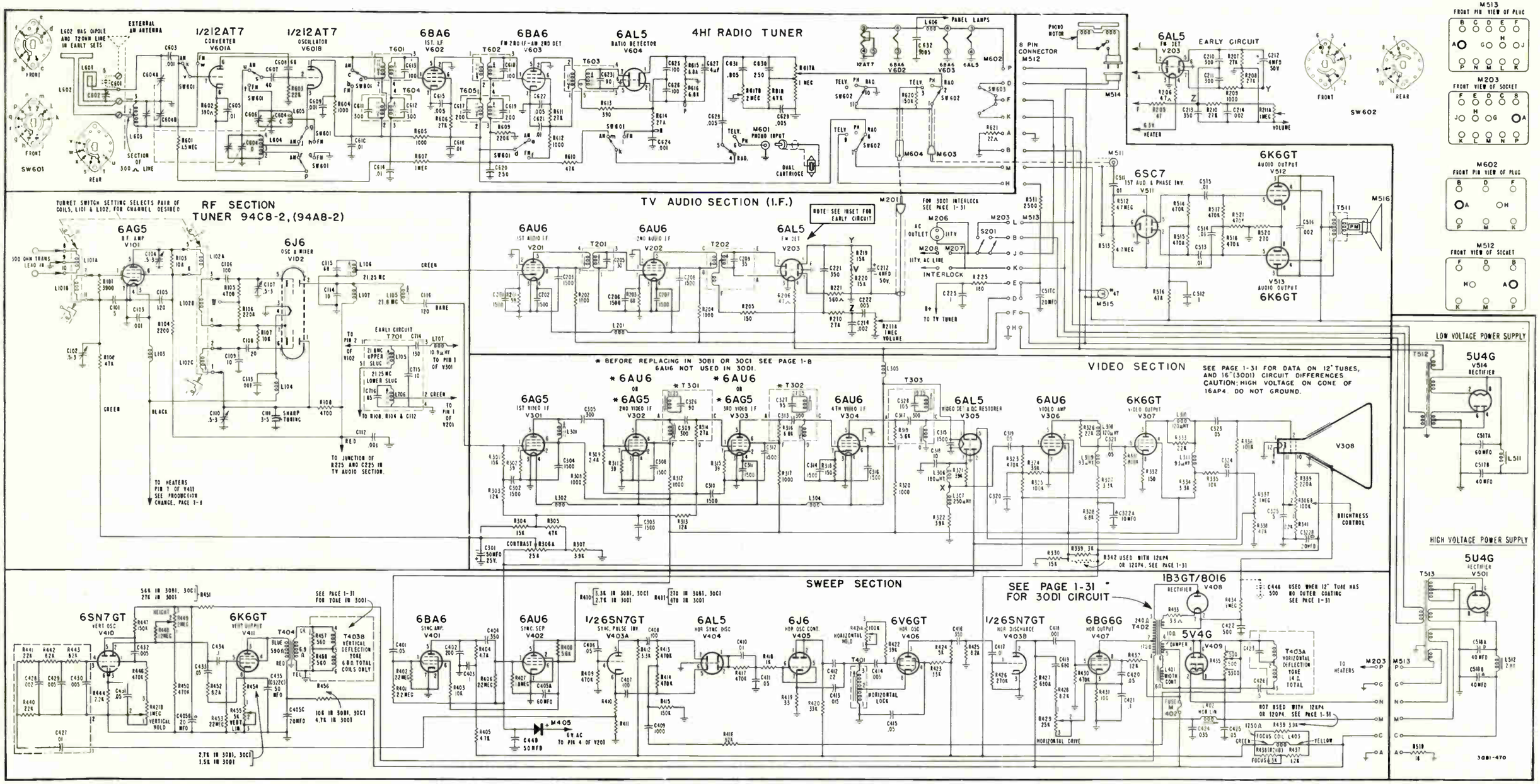
† Indicates 30D1 voltage.



Voltage Charts.

Figure 1-21. Schematic Diagram for 4H1 Radio Tuner Chassis, and 30B1, 30C1, or 30D1 Television Chassis. (For all "4H" Radio-Phono-Television combinations with 10", 12" and 16" picture tubes.)

Circuit differences for 30D1 chassis (16" picture tube) are shown
Circuit changes necessary for different 12" picture tubes



PRODUCTION CHANGES

A. VIDEO IF SUB-CHASSIS

Very early production IF sub-chassis may have a 6AG5 in the 2nd Video IF stage. In later production, a 6AU6 tube is used and may be substituted if pin No. 2 (suppressor) is grounded to the chassis.

Early production video IF sub-chassis employ two stages of amplification before the sound signal is applied to the grid of the 1st sound IF (V201). Early production sub-chassis can be identified by a RED color dot near the 2nd Video IF (V302) on the top of the chassis. In this early sub-chassis, T301 is part number 72A83-1 and is aligned at 25.3 MC. T302 is part number 72A84 and is aligned at 22MC. R305 is 10,000 ohms; R310 is 12,000 ohms.

Late production IF sub-chassis have only one stage (V301) of amplification before the sound signal is applied to the grid of V201. This change was made to prevent weak audio output, resulting from increased AGC voltage, on STRONG signals. In this late sub-chassis, T301 is part number 72A84 and is aligned at 22 MC. T302 is part number 72A83-2 and is aligned at 25.3 MC. R310 is 10,000 ohms. R305 was 12,000 ohms; then changed to 8200 ohms. Changing R305 to 8200 ohms in later production sets, has improved the overall RF-Video IF response curve.

B. 6AU6 SYNC SEPARATOR SCREEN RESISTOR

In early production, the sync separator screen (V403) was maintained at a constant voltage by a voltage dividing network made up of a 47,000 ohm resistor (part No. 60B8-473) from pin No. 6 to ground and an 82,000 ohm resistor (R421) from pin No. 6 to B . In later production, the 47,000 ohm resistor was deleted and R421 was connected from pin No. 6 to the contrast control arm to simultaneously regulate the screen voltage on the sync separator (V403) and video amplifier (V306). This eliminates the possibility of overdriving the sync separator when the contrast is increased.

C. ALTERNATE DEFLECTION YOKE T404

Two alternate deflection yokes, part number 94B2-1 and 94B2-2 are currently being used. Condenser C428, which is part of the yoke assembly, is 56 mmfd., 5%, mica (65B1-54) when used with 94B2-1; it is 39 mmfd., 5%, mica (65B1-55) when used with 94B2-2). The two yokes are interchangeable when complete with the proper resistors, condenser and wire leads. Yoke 94B2-2 (correct parts and leads included is supplied for service replacement.

D. R333 ADDED TO REDUCE PICTURE "FLUTTER"

Chassis with this change stamped run "9" or higher. To reduce picture "flutter" caused by impulse noises or by weak of fading sync signals, resistor R333 (2.2 megohms, ½ watt, part number 60B8-225) is connected from the screen grid (pin 6) to the control grid (pin 1) of V305 (6AU6), AGC tube. This results in a higher amplitude sync. signal with less suppression of sync pulse by the 6AC7 video amplifier tube.

E. CHANGE TO ELIMINATE INTERFERENCE FROM HARMONICS OF THE SOUND IF STRIP IN EARLY 20A1, 20B1, 21A1 CHASSIS

Chassis with this change stamped run "11" or higher. In early production sets, the tenth harmonic of the sound IF channel can cause interference in the form of a herringbone pattern on channel 13. (Other harmonics may cause interference on channels 3, 6 and 9.)

A check, for early production sets, to determine whether the interference is actually due to harmonics of the sound IF, is made by removing the second sound IF tube V202 (6AU6) and noting if the interference pattern disappears. If the interference pattern remains, the trouble is due to some other cause.

Circuit changes (made in later production sets) to eliminate this interference are given below. Changes in early production sets to eliminate this interference can be made in the following sequence:

a. Replace the wire lead between pin 6 of V202 (6AU6) tube and R213 (6000 ohms) resistor with a 1000 ohm, ½ watt resistor (R215). The resistor lead to pin 6 of V202 tube must be as short as possible.

b. Connect a 1500 mmfd., min. ceramic condenser (C213) from the junction of R213 resistor and terminal of R212B focus control to the ground lug next to the socket of V202 (6AU6) tube.

c. Mount a terminal board under the mounting nut of T202 (sound IF transformer) near the video IF shield. Locate the lead between pin 7 of V306 (6AC7) tube and pin 3 of V202 (6AU6) tube. Remove this lead from pin 3 V202 (6AU6) tube and connect it to the insulated lug on the terminal board. Connect a filament RF choke (L202) from the insulated lug on the terminal board to pin 3 of V202 (6AU6) tube.

d. Locate the ground lead wired from the socket of V202 (6AL5) tube to a terminal board. Clip this lead at the terminal board and solder it to the chassis near to the socket of V203 (6AL5) tube. This connection must be as short as possible.

Material Required For The Above Change

1	1000 ohm, ½ watt resistor (R215)	60B8-102
1	1500 mmfd. min. cer. condenser (C213)	65A10-4
1	Terminal board with 1 insulated lug	10B1-43
1	Filament RF choke (L202)	73A2-1

F. CHANGES TO INCREASE THE SOUND LEVEL IN EARLY 20A1, 20B1 AND 21A1 CHASSIS

Chassis with this change stamped run "15" or higher. The changes listed below were made in later production sets to increase the TV sound (audio) level. Chassis having these changes can be identified by a blue dot on top of the RF tuner, adjacent to L106 (1st IF coil) and on top of T201 (2nd sound IF transformer).

IMPORTANT: Before adding these changes to an early chassis, check to determine if the cause of low sound level is due to misalignment or other possible causes.

1. Sound level can be increased by adjusting slug A9 (L106) 1st IF transformer. Turn slug A9 in while watching the picture to make sure that there is no decrease in picture quality with increase in sound level. NOTE: If this adjustment is not sufficient to bring the sound to a satisfactory level, the following additional changes should be made.

2. Replace T201, 2nd sound IF transformer, part number 72B86-1 with new part number 72B86-2.

3. Remove damping resistor R203, (27,000 ohms).

4. Replace AGC voltage divider resistor R303, (47,000 ohms) with a 27,000 ohm, ½ watt resistor (part number 60B8-275). R203 may be used as a replacement for R303.

5. Realign all 21.25 MC sound IF and ratio detector trimmer adjustments.

6. Relpace original choke coil L105, part number 98A45-68, located in TV tuner 94C18-1, with new choke coil part number 98A45-72.

Replacement of L105 may be difficult since it is located inside the RF tuner. Generally, coil L105 will not require changing, since making the changes in steps 2 thru 5 should usually increase audio sensitivity to the desired level. However, should it be desired to replace L105, part number 98A45-72 can be obtained. If L105 coil is replaced, it will be necessary to realign slug A9 of the 1st IF transformer L106 in the RF tuner to 22.3 MC.

G. CHANGE IN 10" (20A1) SETS FOR INCREASED SWEEP WIDTH

The changes listed below were made in later production 20A1 (10") sets for increased sweep width without loss of horizontal linearity. Note that BOTH changes "a" and "b" must be made.

a. Horizontal damping resistor R444, has been changed from 6,300 ohms, 50 watt to 7,500 ohms, 25 watt (part number 61A12-2).

b. Cathode by-pass C424 has been changed from .1 mfd., 200 volts to 2 mfd., 200 volts (part 64B5-29).

H. CENTERING OPERATING RANGE OF FOCUS CONTROL (R212B) IN 21A1 (16") SETS

Chassis with this change stamped run "13A" or higher. In later 21A1 (16") sets, R334 resistor, 10,000 ohms, 2 watt (part No. 60B20-103) has been wired across the terminals of focus coil L306. When R334 is used, the terminal of C427 (500 mmfd) which goes to the plate of V408 (6W4) damper tube, should be connected to ground instead. See schematic.

This change was made in order to shift the operating point of focus control R212B reasonably close to the center point of rotation.

J. CENTERING OPERATING POINT OF VERTICAL HOLD CONTROL (R405A)

Grid resistor R404 of V401A (6SN7GT) vertical oscillator is generally 1.2 meg., ½ watt, (part No. 60B8-125). However, when vertical hold control (R405A) will not operate reasonably close to the center of its range resistance value of R404 mat be 1 mag., ½ watt (part No. 60B8-125) or 1.5 meg., ½ watt (part No. 60B8-155).

K. R332 WATTAGE RATING INCREASE IN 16" (21A1) SETS

In early 21A1 (16") sets, R332 focus coil shunt resistor was 3000 ohms, 5 watts, In later 21A1 (16") sets R332 was changed to 3000 ohms, 7.5 watts (61A1-16). This change was made to allow for greater heat dissipation under certain operating conditions.

L. SHIPPING BOLTS USED IN LATER PRODUCTION TELEVISION CHASSIS

Later production television chassis have been provided with shipping bolts to reduce the possibility of damage during shipment. Two of these shipping bolts are used, located between the four chassis mounting bolts one on each side of the chassis.

To avoid the possibility of microphonics due to the chassis being bound down tightly to the mounting board by these bolts, it is necessary to remove these bolts upon installation of the set. This allows the TV chassis to "float" on its rubber shock mounts.

M. POWER TRANSFORMER FUSE IN 20A1, 20B1, 21A1 TV CHASSIS

Chassis with this change stamped run "16" or higher. To protect the power transformer from damage due to the failure of either the 6X5GT or 5U4G rectifiers, a 3 ampere, 250 volt fuse M313 (part No. 84A1-14) has been wired in the primary circuit of the power transformer. This fuse, like the ¼ ampere horizontal output fuse M405 already in use, is located in the second anode supply housing. The fuse holder previously used to hold the ¼ ampere fuse M405, has been replaced with a double fuse holder (part No.84A5-3) which holds both the ¼ ampere fuse and the 3 ampere fuse. A bracket (part No. 15A539) is used to mount the fuse holder.

If desired, the primary fuse can be added to early sets by clipping off the line cord plug and replacing with a fused plug.

N.MISCELLANEOUS CHANGES IN 16" TUBE MOUNTING

An insulating sheet (part No. 32D122) is stapled to the inside of the cabinet next to the tube mask in current production. A piece of aluminum foil, 8" in length (part No. 52A1-17) was also inserted under the two sections of the tube mounting bracket to insure a ground connection between the two. A metal screen (part No. 16C13) has also been inserted under the 16" tube mounting board and tacked to the cabinet for customer protection.

P. BRAIDED WIRE ADDED TO MINIMIZE HUM

In later production sets, the power supply chassis is grounded to the television chassis to minimize hum. In 10" and 12" sets, a 25" length of 3/8" copper broided wire (95A12-7), with lugs at both ends, is connected from the small hole in front of the TV tuner to a mounting bolt on the power supply. On 16" sets, the chassis connection is made at an unused hole at the right front (facing rear of chassis).

Q. SYNC CIRCUIT MODIFICATION

Chassis with this change stamped run "16" or higher. To improve sync stability in weak signal areas having high level impulse type noise interference, the sync circuits of later production 20A1, 20B1, and 21A1 chassis have been modified.

The original sync separator tube V403 (6AU6) has been replaced by a 12AU7 dual-triode. One section of this tube functions as a sync separator and separates the sync pulses from the composite video signal. The second half of this tube functions mainly as a clipper. The sync pulse is amplified and noise peaks are clipped off.

In addition to using the 12AU7, the second section of the video detector V304 (6AL5) which formerly was not used, has been wired into the circuit and functions as a limiter on the grid of the sync inverter V401B (½ 6SN7). This limits the level of the sync signal, thereby eliminating transient or impulse noise peaks.

Also note that the wiring of horizontal sync discriminator V404 (6AL5) was changed.

R. BUILT IN TV ANTENNA ADDED

Late sets are equipped with a built-in (internal) antenna (part number AD 205), which is mounted to the inside top of the cabinet. Use this antenna in strong signal areas only. Adjust the antenna by moving the control on the back of the set from left to right to determine the best picture. Disconnect it before attaching another antenna.

S. BREAKDOWN OF C437

To prevent breakdown, the working voltage rating of coupling condenser C437 (.05 mfd.) was changed from 400 volts (DC) to 600 volts (DC). The new part number is 64B5-7. Chassis with this change are stamped run 17A or higher.

If C437 shorts in sets using a 12AU7 Sync Separator and Clipper, the Sync Separator section of the 12AU7 will draw grid current. This will bias the AGC tube (V305) to cut-off. Since no AGC voltage is developed, the 1st and 2nd video IF's are not controlled by AGC, and their gain will be maximum. With a strong signal, enough negitive voltage will be developed across video detector load resistor R319 to drive the video amplifier V306 to cut-off.

This trouble can be identified by either a weak picture with loss of horizontal and vertical sync, or no picture at all. In most cases, the picture may be observed faintly by turning up the brightness and contrast controls. In any case, vertical and horizontal synchronization will be impossible.

If this condition appears, remove the 12AU7 (V403) tube. If the picture appears with brightness and contrast restored, but will still not sync either vertically or horizontally, replace C437 with a .05 mfd. 600 volt condenser, part number 64B5-7.

T. R436 DECREASED IN VALUE TO IMPROVE HORIZONTAL OSCILLATOR STABILITY

Chassis with this range stamped run "18" or higher. Load resistor R436 was changed from a 270,000 ohm, ½ watt resistor to a 240,000 ohm, ½ watt, 5% resistor (part number 60B7-244).

R436 was changed to compensate for any increase in its resistance value that may occur during use of the receiver. If R436 does increase in value, horizontal sync will be affected, and a split-framed picture may result.

A check can easily be made with an ohmeter. When replacing R436, use part number 60B7-244.

U. AM PEAKING COIL L606 CHANGED TO PREVENT EXCESSIVE REGENERATION IN 4K1, 4J1 RADIO TUNER

Peaking coil L606 was changed in value from 475 microhenrys to 120 microhenrys. The new part number is 73A5-10. The early peaking coil is coded with a blue dot and the new peaking coil is coded with a black dot.

L606 is used to obtain positive feedback and eliminate the grid loading which is inherent in a triode mixer. This results in an increase in conversion gain. This change was made to prevent excessive feedback which resulted from an increase in value of loading resistor R605 beyond its specified tolerance. This difficulty can be identified by "motor boating" or "whistling" at the center of the band, when the AM-FM switch is on AM, and the loop antenna is connected. If the converter is oscillating at the center of the band, place your hand across the loop antenna If the oscillations stop, replace L606 and damping resistor with the new part.

If oscillations are present when the new type peaking coil is used, it is possible that the trouble is caused by the first AM IF transformer T604. In some instances the silver mica condensers in T604 have become open, causing the converter to oscillate. The replacement of transformer T604 (part number 72B92) will remedy the trouble.

V. CHANGE IN LENGTH OF 300 OHM LINE FROM ANTENNA TO TUNER WHEN BIULT-IN "ROTO-SCOPE" ANTENNA IS USED

FOR 20A1, 20B1 CHASSIS: In these chassis, the length of antenna twin lead (300 ohm) connected from the antenna terminals to the TV Tuner (94C18-1), has been shortened from 18 inches (in early sets) to 13 inches (in later sets).

FOR 21A1 CHASSIS: In these chassis, the length of the antenna lead has been shortened as much as possible (between 4 and 5 inches).

This change was made to increase the signal pickup on the high channels IN SETS USING THE BUILT-IN ROTO-SCOPE ANTENNA. When necessary to make this change in a set having the built-in Roto-Scope antenna, unsolder the antenna lead from the antenna terminals and shorten as described above. Then resolder the lead to the antenna terminals.

W. BREAKDOWN OF C311

Condenser C311 was changed from .05 mfd., 400 volts condenser to a .05 mfd., 600 volts condenser (part number 64B5-7).

A voltage divider network consisting of R323 and R324, supplies the proper bias voltage for the picture tube (V307). If C311 shorts, the total voltage is applied to the picture tube cathode, and the picture tube will be cut off. The symptom of this trouble would be: no raster, sound OK.

X. UNGROUNDED STATOR PLATE FOR SHARP TUNING CONDENSER C111 CHANGED TO MINIMIZE FREQUENCY DRIFT

A ceramic ungrounded stator plate was added to late production 94C18-1 Tuners. This new type stator plate is also used in the 94C18-2 Tuner as M118. Use of this stator minimizes frequency drift.

Y. COUPLING CONDENSER (C214) ADDED TO ELIMINATE NOISE IN VOLUME CONTROL

A coupling condenser (C214, .05 mfd., 400 volts, part No. 64B5-22) was connected in series between junction of de-emphasis network (R207 and C204) and terminal of volume control R212A. Addition of this condenser blocks direct current into the volume control, thereby avoiding noise with rotation of volume control.

Z. VERTICAL OUTPUT TRANSFORMER T402 LEAD LENGTH CHANGED

Lead length of vertical output transformer T402 has been increased to make this new part (part number 79B24-1) a universal replacement for the 20A1, 20B1 and 20X1 television chassis.

CHANGE IN AMPERAGE OF LINE FUSE M313

A 3-amperage fuse F313 was added in late production sets (see production change "M"). The amperage of this fuse M313 has since been increased from 3 amperes, 250 volts (part number 84A1-14) to 4 amperes, 250 volts (part number 84A1-18) to avoid burning out of fuse due to possible momentary increase in current drain.

HORIZONTAL OUTPUT CIRCUIT FOR 16" SETS (21A1 CHASSIS) WITH ROUNDED-END PICTURE WINDOW

Chassis with this change stamped run "19" or higher. Greater sweep width is required for 16" sets using a rounded-end picture tube window. The schematic insert in figure 85 indicates the horizontal output and 2nd anode supply circuits used in these sets. Cabinet parts also differ as indicated in the parts list for models 25A15, 25A16 and 25A17.

VOLTAGE CHARTS

To operate the television chassis with the Radio Tuner disconnected, a jumper must be inserted into the power supply socket (M514) to complete the heater circuit. See adjoining illustration. A special adapter plug is available from the Admiral Distributor under part number 89A31.

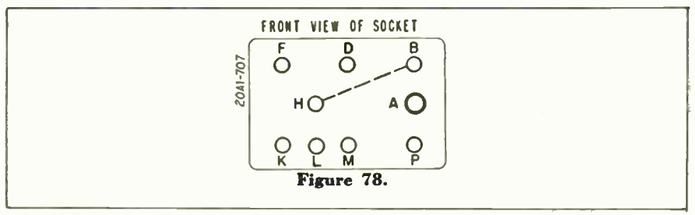


Figure 78.

Line voltage, 117 volts AC.

Antenna disconnected from receiver.

Contrast and focus control set fully counter-clockwise, all other front chassis controls set at approximately half rotation.

All rear chassis controls except HOR. LOCK. HOR. LIN. and WIDTH controls, set at approximately half rotation: Do not disturb HOR. LOCK. HOR. LIN. or WIDTH controls settings.

Channel selector set on an unused low channel (preferable channel 2).

Some tube socket terminals are used as tie-points and a voltage reading may be present.

Voltage measured with a vacuum tube voltmeter, between tube socket terminals and chassis, unless otherwise indicated. Measure heater voltages between tube socket terminals.

CAUTION

Pulsed high voltages are present on the cap of 6BG6G tube, and on the filament terminals and cap of 1B3/8016 tube. *No attempt should be made to take measurements from these points unless suitable test equipment is available.*

Picture tube 2nd anode voltage can be measured at the high voltage cap of picture tube and should be taken only with a high voltage instrument such as a kilovoltmeter. Voltage for 2nd anode of 10" or 12" tube is approximately 9KV., for 16" tubes, 12KV. Proper filament voltage check of 1B3/8016 tube may be made by observing filament brilliancy as compared with that obtained with a 1.5 volt dry cell battery.

OPERATING TELEVISION CHASSIS OR RADIO TUNER CHASSIS WITH EITHER UNIT DISCONNECTED FROM POWER SUPPLY

In combination models, the Radio Tuner and Television chassis cannot be operated with either unit disconnected from power supply, unless interconnecting circuits are completed.

To operate the television chassis with the Radio Tuner disconnected, a jumper is inserted into the power supply socket (M514) to complete the heater circuit. See figure "A". A special adapter plug is available from the Admiral Distributor under part number 89A31.

To operate the Radio Tuner chassis with the television chassis disconnected, an AC line cord must be wired to plug M515 to supply line voltage. See figure "B". A special adapter socket and line cord is available from the Admiral Distributor under part number 89A30.

In order to use the special adapter illustrated to operate the radio tuner without the television set, be sure that the band switch is in the "Radio" position. This adapter will not suffice to check the phonograph, since plate voltage is not supplied to the audio amplifier and output tubes when the band switch is in the "Phono" position.

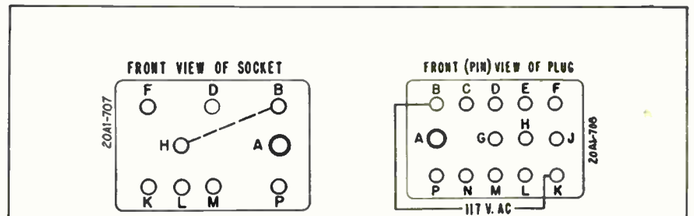


Figure A. Figure B.

VOLTAGE CHART FOR 4 TUBE POWER SUPPLY (TELEVISION ONLY SETS)
See previous page for conditions for taking measurements

Sym.	Tube	Function	Pin 1	Pin 2	Pin 3	Pin 4	Pin 5	Pin 6	Pin 7	Pin 8	Remarks
V501	6SQ7	Audio Amp.	0	-.7	0	NC	NC	78	6.3 AC	0	
V502	6V6GT	Audio Output	NC	6.3 AC	255 (c)205	265 (c)221	.2	NC	0	12 (c)2.5	
V503	6X5GT	L.V. Rectifier	NC	6.3 AC	160 AC	NC	160 AC	NC	0	160	
V504	5U4G	H.V. Rectifier	NC	380	NC	375 AC	NC	375 AC	NC	380	Pin 2 to pin 8: 5v. AC.

(c) Indicates voltage for 21A1 chassis.
NC Indicates no connection to tube element.

VOLTAGE CHART FOR 6 TUBE POWER SUPPLY (COMBINATION MODELS)

Sym.	Tube	Function	Pin 1	Pin 2	Pin 3	Pin 4	Pin 5	Pin 6	Pin 7	Pin 8	Remarks
V511	6SJ7	1st Audio Amp.	0	0	0	-.7	0	16	6.3 AC	24	
V512	6SQ7	Phase Inverter	0	-.7	0	NC	NC	62	6.3 AC	0	
V513	6K6GT	Audio Output	0	6.3 AC	185	190	0	0	0	12	
V514	6K6GT	Audio Output	0	6.3 AC	185	190	0	0	0	12	
V515	5U4G	H.V. Rectifier	NC	370	NC	365 AC	NC	365 AC	NC	370	Pin 2 to pin 8: 5v. AC.
V516	6X5GT	L.V. Rectifier	NC	6.3 AC	160 AC	NC	160 AC	NC	0	160	See "NOTE" below.

NOTE: Heater of 6X5GT (V516) disconnected unless "Tel-Phono-Radio" switch on Radio Tuner is in the "Tel" position.
NC Indicates no connection to tube element.

VOLTAGE CHART FOR 4J1 AND 4K1 AM-FM RADIO TUNER

- Line voltage 117 volts AC.
- Voltages measured with a vacuum tube voltmeter, between tube terminals and chassis. Heater voltages on the 4K1 Radio Tuner must be made **ACROSS** the heater.
- Voltages measured with band switch on FM position, unless otherwise indicated; an AM reading is given where difference is significant.
- "Tel-Phono-Rad" switch in "Rad" position.
- Volume control set at minimum.
- Dial turned to low frequency end.
- Antennas disconnected.
- Voltages measured with television chassis disconnected from power supply. (Voltages indicated will be slightly higher if the television chassis is connected to power supply.)

To operate the Radio Tuner chassis with the television chassis disconnected, an AC line cord must be wired to plug M515 to supply line voltage. See adjoining illustration. A special adapter socket and line cord is available from the Admiral Distributor under part number 89A30.

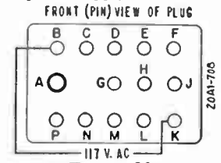


Figure 80.

Sym.	Tube	Function	Pin 1	Pin 2	Pin 3	Pin 4	Pin 5	Pin 6	Pin 7	Pin 8	Pin 9	Remarks
V601	12AT7	Converter and Oscillator	198	-6 FM -20 AM	0	0	0	209 FM 245 AM	0 FM 3.2 AM	3	6.3 AC	
V602	6BA6	1st IF Amp.	-1	0	0	6.3 AC	240	90	0			
V603	6BA6	FM 2nd IF or AM 2nd Det.	-1	0	0	6.3 AC	215 FM 0 AM	92 FM 0 AM	0			
V604	6AL5	Ratio Det.	.2	-.2	6.3 AC	0	0	0	0			

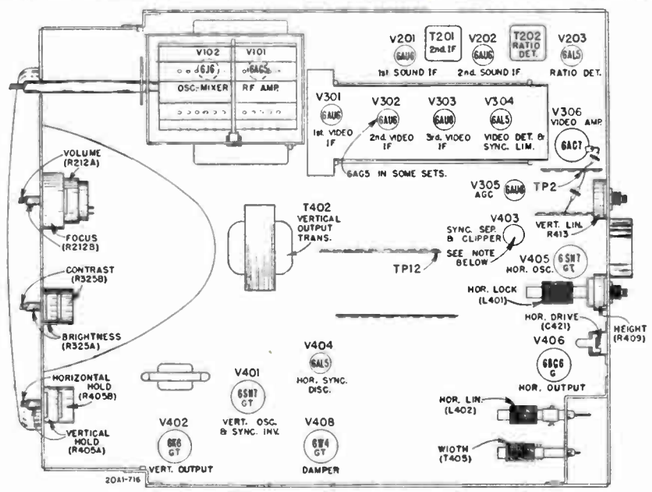
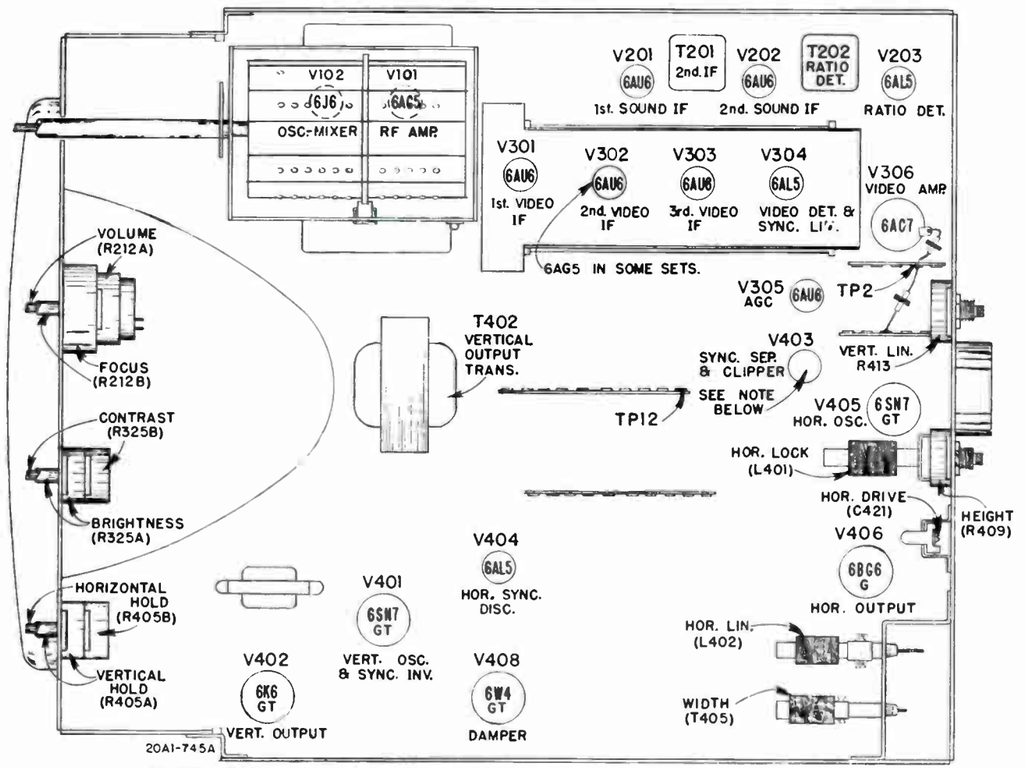
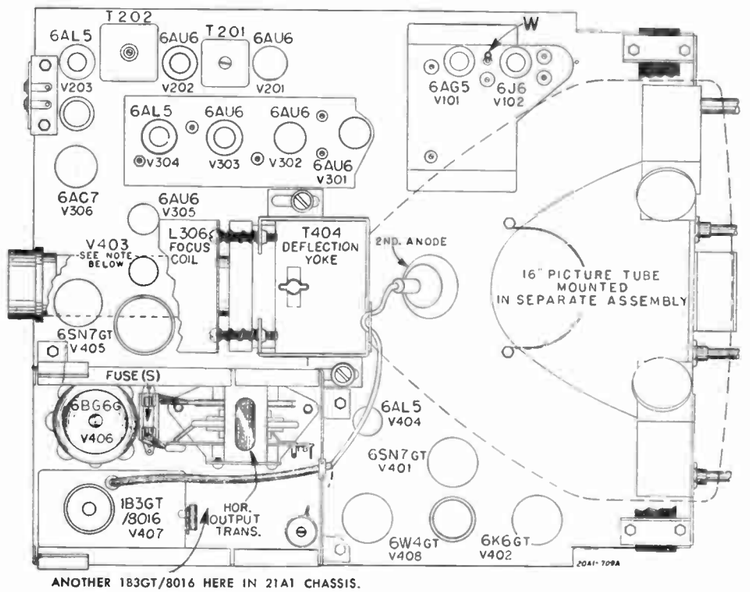


Figure 79. Bottom View of Chassis.
Note: V403 is 6AU6 in early sets, 12AU7 in later sets. See figures 85 and 87.



NOTE: V403 is 6AU6 in early sets, 12AU7 in later sets. See figures 85 and 87.
Figure 81. Television Chassis, Bottom View Showing Tube Locations.



NOTE: V403 is 6AU6 in early sets, 12AU7 in later sets. See figures 85 and 87.
Figure 82. Television Chassis, Top View Showing Tube Locations.

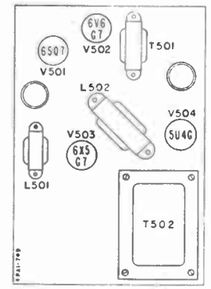


Figure 83. 4 Tube Power Supply.

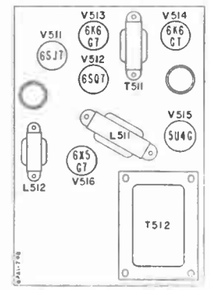


Figure 84. 6 Tube Power Supply.

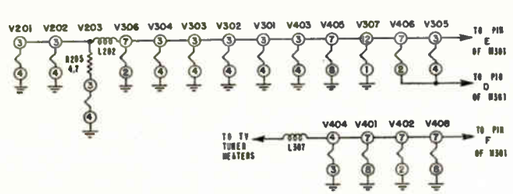
20A1, 20B1, AND 21A1 TELEVISION CHASSIS VOLTAGE CHART

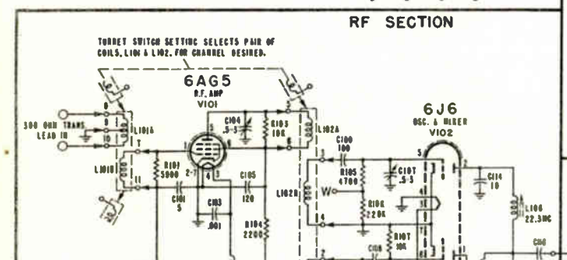
Sym.	Tube	Function	Pin 1	Pin 2	Pin 3	Pin 4	Pin 5	Pin 6	Pin 7	Pin 8	Remarks
V101	6AG5	RF Amp.	-.3	0	6.3 AC	0	150	150	0		Point "W" (Fig. 27) is -4 volts measured with tubes in sockets.
V102	6J6	Osc. and Mixer	160	160	6.3 AC	0	0	0	0		
		Voltages at V101 and V102 measured from top of chassis with tubes removed.									
V201	6AU6	1st Sound IF	0	0	6.3 AC	0	80	80	.9		
V202	6AU6	2nd Sound IF	0	0	6.3 AC	0	145	145	2.4		
V203	6AL5	Ratio Det.	0	0	5 AC	0	.3	0	0		
V301	6AU6	1st Video IF	-1.5	0	6.3 AC	0	140	140	.6		
V302	6AU6	2nd Video IF	-1.5	0	6.3 AC	0	140	140	.6		
V303	6AU6	3rd Video IF	0	0	6.3 AC	0	142	142	1.3		
V304	6AL5	Video Det.	0	0	6.3 AC	0	0	0	-.4		
		Vid. Det. & Lim.	0	-8	6.3 AC	0	0	0	-.4		
V305	6AU6	AGC	(a)135 (b)155	(a)145 (b)160	6.3 AC	0	200V P.toP.	(a)275 (b)270	(a)145 (b)160		
V306	6AC7	Video Amp.	0	0	0	-1	(a).4 (b) 0	(a)60 (b)45	6.3 AC	(a)120 (b)150	

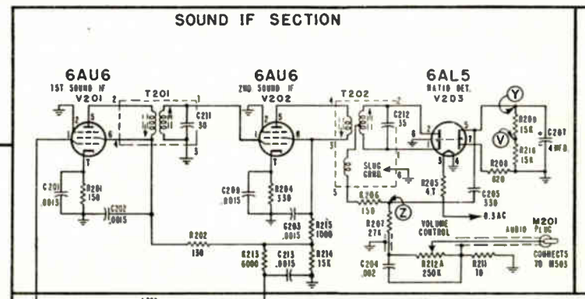
20A1, 20B1, AND 21A1 TELEVISION CHASSIS VOLTAGE CHART

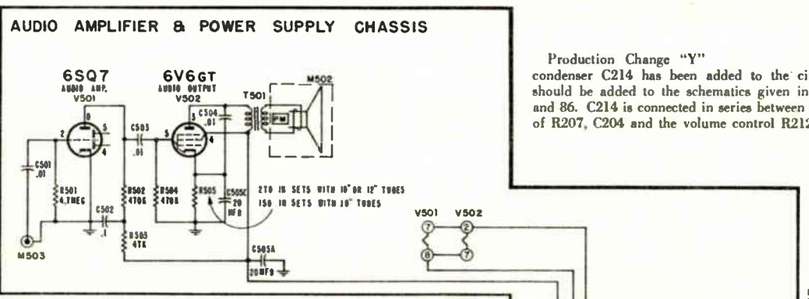
Sym.	Tube	Function	Pin 1	Pin 2	Pin 3	Pin 4	Pin 5	Pin 6	Pin 7	Pin 8	Remarks
V401	6SN7GT	Vert. Osc. and Sync. Inv.	-55	200	0	(a).2 (b)-8	(a)135 (b)315	(a)5 (b)8	6.3 AC	0	
V402	6K6GT	Vert. Output	NC	0	325	325	-.5	38 (c)20	6.3 AC	50 (c)40	
V403	6AU6	Sync Sep.	-1	0	6.3 AC	0	150	60	0		
	12AU7	Sync Sep. and Clipper	270	152	165	6.3 AC	6.3 AC	65 (c)75	-.6	0	Pin 9: Zero volts.
V404	6AL5	Hor. Sync Disc.	(a).2 (b) 8	(a).2 (b)-4	0	6.3 AC	(a) 5 (b).8	0	(a)-3 (b).8		
V405	6SN7GT	Hor. Osc.	.9	255	9.5	-4.5	100	9.5	6.3 AC	0	
V406	6BG6G	Hor. Output	NC	0	9	NC	-16 (c)-6	NC	6.3 AC	245 (c)270	Cap: See "Caution" note above.
V407 and V409	1B3GT	Rectifier	See "CAUTION" note above on 1B3GT/8016 voltages.								
V408	6W4GT	Damper	NC	NC	420	NC	360	NC	6.3 AC	NC	
V307		Picture Tube	0	70	NC	NC	NC	NC	NC	NC	Pin 9 Pin 10 Pin 11 Pin 12 NC 365 60 6.3 AC
		Voltages taken at picture tube socket (removed from tube. For 2nd anode, see "CAUTION" above.									

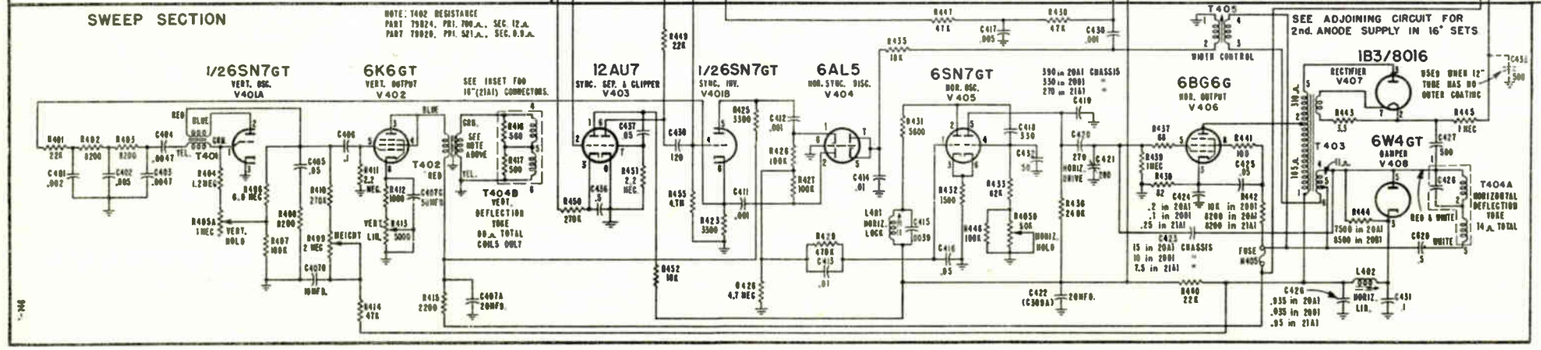
(a) Indicates voltage for sets with 6AU6 sync separator circuit.
(b) Indicates voltage for sets with 12AU7 sync separator and clipper circuit.
(c) Indicates voltages for 21A1 chassis.
NC Indicates no connection to tube element.



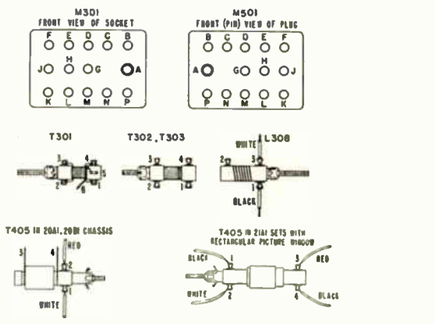




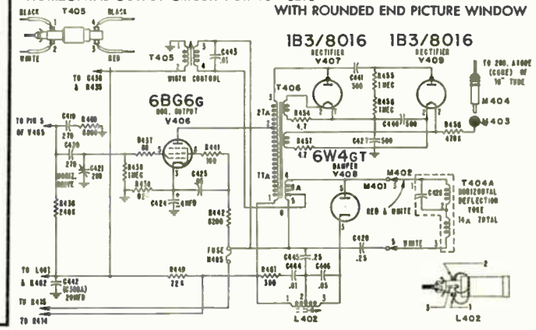




Production Change "Y" states that condenser C214 has been added to the circuit. C214 should be added to the schematics given in Figures 85 and 86. C214 is connected in series between the junction of R207, C204 and the volume control R212A.



HORIZONTAL OUTPUT CIRCUIT FOR 16" SETS WITH ROUNDED END PICTURE WINDOW



2nd. ANODE SUPPLY, DEFLECTION YOKE and AC INTERLOCK CIRCUIT USED IN 16" (21A1) SETS WITH RECTANGULAR PICTURE WINDOW

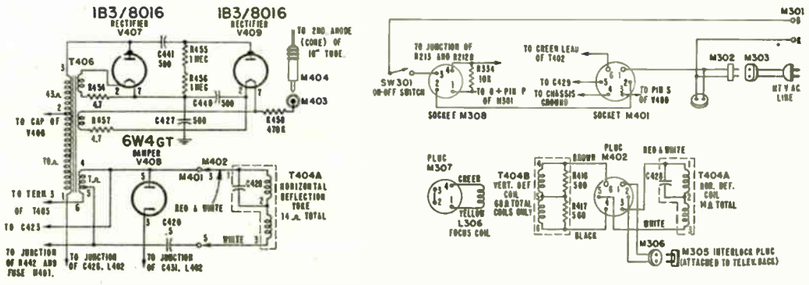


Figure 85. Schematic for 20A1, 20B1, 21A1 Television Chassis with 12AU7 Sync Separator and Clipper. (For sets with 6AU6 Sync Separator, refer to Figure 87 or 88.)
Chassis having 12AU7 Sync Separator and Clipper are rubber-stamped with run number "16" or higher at rear of television chassis.

20A1, 20B1, AND 21A1 TELEVISION CHASSIS VOLTAGE CHART

Sym.	Tube	Function	Pin 1	Pin 2	Pin 3	Pin 4	Pin 5	Pin 6	Pin 7	Pin 8	Remarks
V101	6AG5	RF Amp.	-.3	0	6.3 AC	0	150	150	0		Point "W" (Fig. 27) is -4 volts measured with tubes in sockets.
V102	6J6	Osc. and Mixer	160	160	6.3 AC	0	0	0	0		
		Voltages at V101 and V102 measured from top of chassis with tubes removed.									
V201	6AU6	1st Sound IF	0	0	6.3 AC	0	80	80	.9		
V202	6AU6	2nd Sound IF	0	0	6.3 AC	0	145	145	2.4		
V203	6AL5	Ratio Det.	0	0	5 AC	0	.3	0	0		
V301	6AU6	1st Video IF	-1.5	0	6.3 AC	0	140	140	.6		
V302	6AU6	2nd Video IF	-1.5	0	6.3 AC	0	140	140	.6		
V303	6AU6	3rd Video IF	0	0	6.3 AC	0	142	142	1.3		
V304	6AL5	Video Det.	0	0	6.3 AC	0	0	0	-.4		
		Vid. Det. & Lim.	0	-8	6.3 AC	0	0	0	-.4		
V305	6AU6	AGC	(a)135 (b)155	(a)145 (b)160	6.3 AC	0	200V P.toP.	(a)275 (b)270	(a)145 (b)160		
V306	6AC7	Video Amp.	0	0	0	-1	(a).4 (b) 0	(a)60 (b)45	6.3 AC	(a)120 (b)150	

20A1, 20B1, AND 21A1 TELEVISION CHASSIS VOLTAGE CHART

Sym.	Tube	Function	Pin 1	Pin 2	Pin 3	Pin 4	Pin 5	Pin 6	Pin 7	Pin 8	Remarks
V401	6SN7GT	Vert. Osc. and Sync. Inv.	-55	200	0	(a).2 (b)-8	(a)135 (b)315	(a)5 (b)8	6.3 AC	0	
V402	6K6GT	Vert. Output	NC	0	325	325	-.5	38 (c)20	6.3 AC	50 (c)40	
V403	6AU6	Sync Sep.	-1	0	6.3 AC	0	150	60	0		
	12AU7	Sync Sep. and Clipper	270	152	155	6.3 AC	3.3 AC	65 (c)75	-.6	0	Pin 9: Zero volts.
V404	6AL5	Hor. Sync Disc.	(a).2 (b) 8	(a).2 (b)-4	0	6.3 AC	(a) 5 (b).8	0	(a)-3 (b).8		
V405	6SN7GT	Hor. Osc.	.9	255	9.5	-4.5	100	9.5	6.3 AC	0	
V406	6BG6G	Hor. Output	NC	0	9	NC	-16 (c)-6	NC	6.3 AC	245 (c)270	Cap: See "Caution" note above.
V407 and V409	1B3GT	Rectifier	See "CAUTION" note above on 1B3GT/8016 voltages.								
V408	6W4GT	Damper	NC	NC	420	NC	360	NC	6.3 AC	NC	
V307		Picture Tube	0	70	NC	NC	NC	NC	NC	NC	Pin 9 Pin 10 Pin 11 Pin 12 NC 365 60 6.3 AC
		Voltages taken at picture tube socket (removed from tube. For 2nd anode, see "CAUTION" above.									

(a) Indicates voltage for sets with 6AU6 sync separator circuit.
(b) Indicates voltage for sets with 12AU7 sync separator and clipper circuit.
(c) Indicates voltages for 21A1 chassis.
NC Indicates no connection to tube element.

In the schematics for combination models, on pages 60 and 62, the band switch section (SW601) connected between the oscillator (V601B) and the 1st IF Transformer (T601) is shown in the FM position. This should have been shown in the AM position since all other sections of this switch are shown in the AM position.

Production Change "Y" states that condenser C214 has been added to the circuit. C214 should be added to the schematics given in Figures 85 and 86. C214 is connected in series between the jnnction of R207, C204 and the volume control R212A.

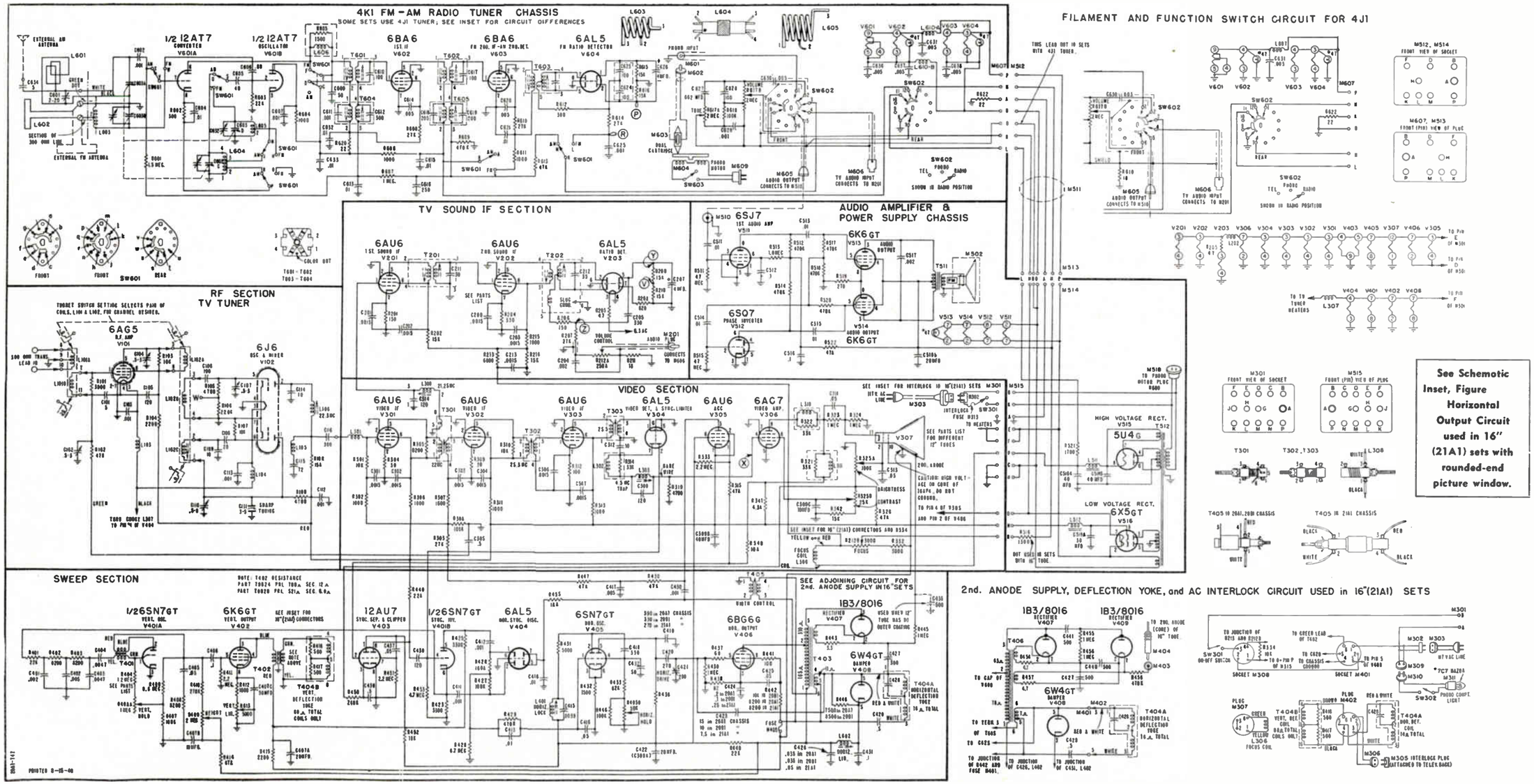


Figure 86. Schematic for 4K1 and 4J1 Radio Tuner, and 20A1, 20B1, 21A1 Television Chassis with 12AU7 Sync Separator and Clipper.
Chassis having 12AU7 Sync Separator and Clipper are rubber-stamped with run number "16" or higher. For sets with 6AU6 Sync Separator, refer to Figure 87.

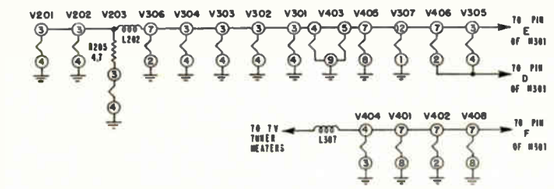
20A1, 20B1, AND 21A1 TELEVISION CHASSIS VOLTAGE CHART

Sym.	Tube	Function	Pin 1	Pin 2	Pin 3	Pin 4	Pin 5	Pin 6	Pin 7	Pin 8	Remarks
V101	6AG5	RF Amp.	-.3	0	6.3 AC	0	150	150	0		Point "W" (Fig. 27) is -4 volts measured with tubes in sockets.
V102	6J6	Osc. and Mixer	160	160	6.3 AC	0	0	0	0		
Voltages at V101 and V102 measured from top of chassis with tubes removed.											
V201	6AU6	1st Sound IF	0	0	6.3 AC	0	80	80	.9		
V202	6AU6	2nd Sound IF	0	0	6.3 AC	0	145	145	2.4		
V203	6AL5	Ratio Det.	0	0	5 AC	0	.3	0	0		
V301	6AU6	1st Video IF	-1.5	0	6.3 AC	0	140	140	.6		
V302	6AU6	2nd Video IF	-1.5	0	6.3 AC	0	140	140	.6		
V303	6AU6	3rd Video IF	0	0	6.3 AC	0	142	142	1.3		
V304	6AL5	Video Det.	0	0	6.3 AC	0	0	0	-.4		
		Vid. Det. & Lim.	0	-8	6.3 AC	0	0	0	-.4		
V305	6AU6	AGC	(a)135 (b)155	(a)145 (b)160	6.3 AC	0	200V P.toP.	(a)275 (b)270	(a)145 (b)160		
V306	6AC7	Video Amp.	0	0	0	-1	(a).4 (b) 0	(a)60 (b)45	6.3 AC	(a)120 (b)150	

20A1, 20B1, AND 21A1 TELEVISION CHASSIS VOLTAGE CHART

Sym.	Tube	Function	Pin 1	Pin 2	Pin 3	Pin 4	Pin 5	Pin 6	Pin 7	Pin 8	Remarks
V401	6SN7GT	Vert. Osc. and Sync. Inv.	-55	200	0	(a).2 (b)-8	(a)135 (b)315	(a)5 (b)8	6.3 AC	0	
V402	6K6GT	Vert. Output	NC	0	325	325	-.5	38 (c)20	6.3 AC	50 (c)40	
V403	6AU6	Sync Sep.	-1	0	6.3 AC	0	150	60	0		
	12AU7	Sync Sep. and Clipper	270	152	165	6.3 AC	6.3 AC	65 (c)75	-.6	0	Pin 9: Zero volts.
V404	6AL5	Hor. Sync Disc.	(a).2 (b) 8	(a).2 (b)-4	0	6.3 AC	(a) 5 (b).8	0	(a)-3 (b).8		
V405	6SN7GT	Hor. Osc.	.9	255	9.5	-4.5	100	9.5	6.3 AC	0	
V406	6BG6G	Hor. Output	NC	0	9	NC	-16 (c)-6	NC	6.3 AC	245 (c)270	Cap: See "Caution" note above.
V407 and V409	1B3GT	Rectifier	See "CAUTION" note above on 1B3GT/8016 voltages.								
V408	6W4GT	Damper	NC	NC	420	NC	360	NC	6.3 AC	NC	
V307		Picture Tube	0	70	NC	NC	NC	NC	NC	NC	Pin 9 Pin 10 Pin 11 Pin 12 NC 365 60 6.3 AC
Voltages taken at picture tube socket (removed from tube. For 2nd anode, see "CAUTION" above.											

(a) Indicates voltage for sets with 6AU6 sync separator circuit.
(b) Indicates voltage for sets with 12AU7 sync separator and clipper circuit.
(c) Indicates voltages for 21A1 chassis.
NC Indicates no connection to tube element.



See Schematic Inset, Figure 85 for Horizontal Output Circuit used in 16" (21A1) sets with rounded-end picture window.

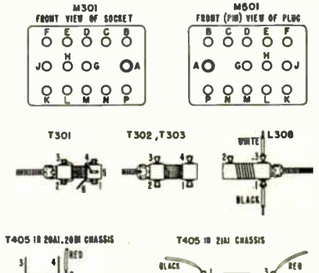
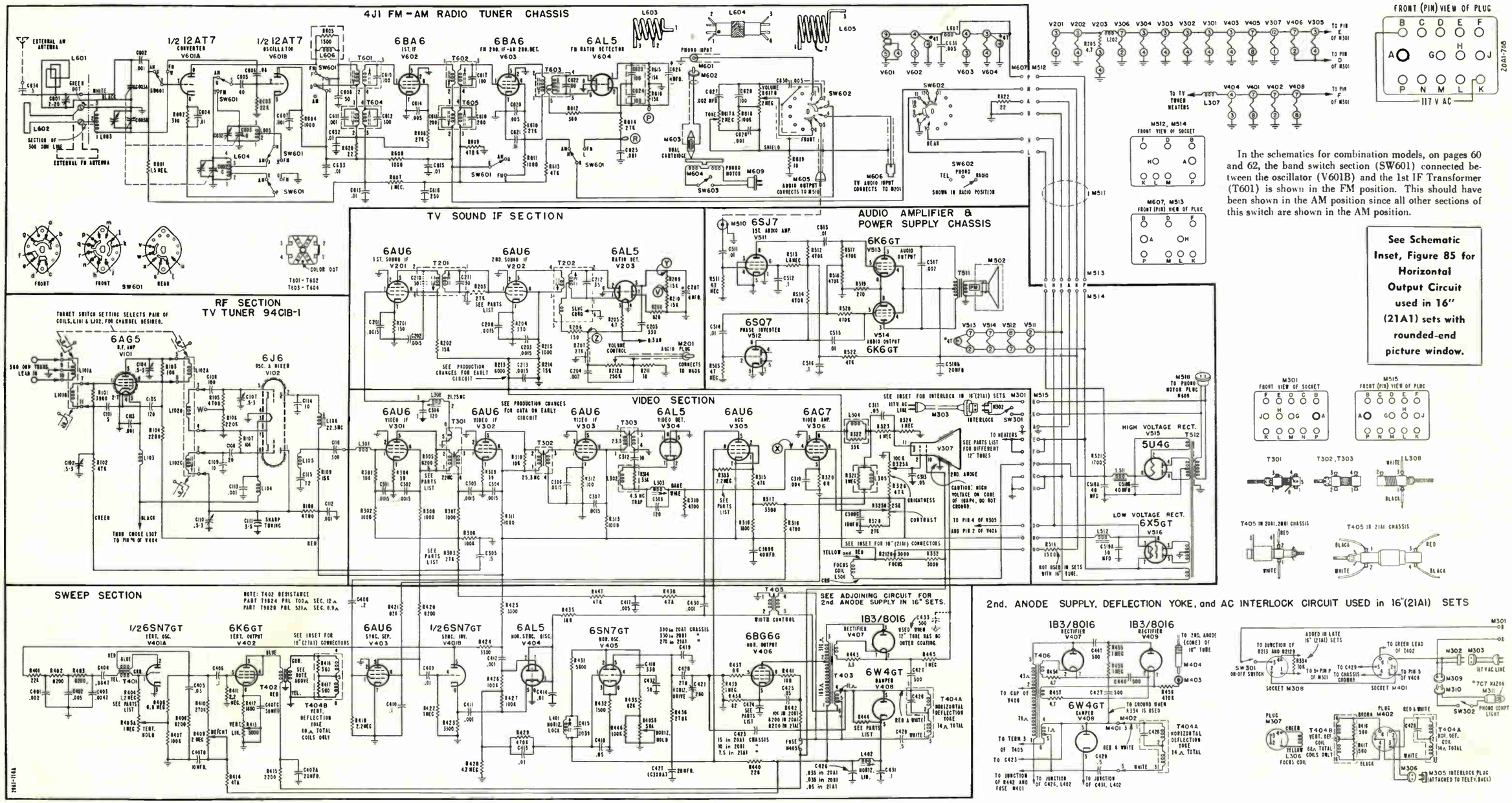


Figure 87. Schematic for 20A1, 20B1, 21A1 Television Chassis with 6AU6 Sync Separator. (For sets with 12AU7 Sync Separator, refer to Figure 85.)
Chassis having 6AU6 Sync Separator are rubber-stamped with run number "15" or lower at rear of television chassis.



In the schematics for combination models, on pages 60 and 62, the band switch section (SW601) connected between the oscillator (V601B) and the 1st IF Transformer (T601) is shown in the FM position. This should have been shown in the AM position since all other sections of this switch are shown in the AM position.

See Schematic Inset, Figure 85 for Horizontal Output Circuit used in 16" (21A1) sets with rounded-end picture window.

Figure 88. Schematic for 4J1 Radio Tuner Chassis and 20A1, 20B1, 21A1 Television Chassis with 6AU6 Sync Separator.
Chassis having 6AU6 Sync Seporator and Clipper are rubber-stamped with run number "15" or lower at reor of television chassis.
(For sets with 12AU7 Sync Separator, or 4K1 Rodio Tuner, refer to figure 85 or 86.)

PRODUCTION CHANGES

At the start of production, chassis were not stamped with a run number. The first run number used was "2". Final production 20Y1 chassis were stamped "Run 12". Final production 20X1 chassis were stamped "Run 13".

Production changes are coded Run 2, Run 3, etc., as given in the headings below. All chassis stamped with any particular run number or any higher run number, have the change discussed under that particular run number heading as well as all preceding changes.

Note that numerical symbols (2), (3), (4) etc., on schematic are run numbers.

RUN 2

TOLERANCE OF R211 CHANGED TO INSURE PROPER BIAS ON 6AS5 SOUND OUTPUT TUBE. Resistor R211 was changed from 820,000 ohms, 10%, ½ watt to 820,000 ohms 5%, ½ watt (part number 60B20-821). When replacing, use the late production part.

RUN 3

MODIFICATION OF VIDEO AMPLIFIER TO DECREASE AUDIO "BUZZ". In early sets, the control grid of video amplifier V305 was connected to the junction of series peaking coil L301 and shunt peaking coil L302. Also, the cathode of V305 was returned to ground through a 15,000 ohm resistor.

In later sets, this resistor was removed, and coupling condenser C321 (.1 mfd, 200 volt, part number 64B5-30) was added to the circuit. Resistor R328 (1.2 megohms, ½ watt, part number 60B8-125) was added to provide grid leak bias to the tube.

RUN 4

R425 INCREASED IN VALUE TO IMPROVE HORIZONTAL STABILIZATION. Resistor R425, which is common to both the horizontal oscillator V403B and horizontal oscillator control tube V403A, was 150,000 ohms. It was changed to a 220,000 ohm resistor, ½ watt (part No. 60B8-224). When replacing this resistor, use the late production part.

RUN 5

V204 FILTER NETWORK CHANGED TO DECREASE "HUM". In some sets, the de-coupling filter network connected to the sound output tube (V204) plate supply was connected as shown in Figure 42 below. This network consisted of two sections (C209A and C209B) of a four section electrolytic and a single electrolytic (C211).

Other early sets, used different combinations of filter condensers but they were wired as shown in the schematic.

In late sets, the four section electrolytic (C209) was replaced by a three section electrolytic (C209A, C209C, C209D) part number 67C15-11, and one section of a dual electrolytic (C213B), part number 67C15-52. The other half of the dual electrolytic was used to replace the single electrolytic (C211). See schematic.

EARLY FILTER CIRCUIT

C209A	60 mfd,	150 V	
C209B	20 mfd,	450 V	4 section
C209C	20 mfd,	450 V	Electrolytic
	.....67C 15-9		
C209D	100 mfd,	25 V	
C211	40 mfd,	250 V,	Electrolytic
	.....67A 19-1		

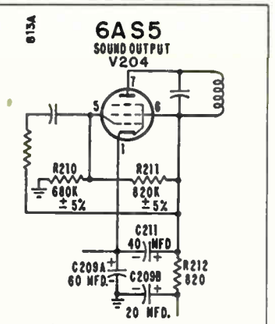


Figure 42. Early Filter Circuit.

RUN 6

MODIFICATION OF VERTICAL OSCILLATOR CIRCUIT V204A. In early sets, a 6.8 megohm resistor was connected from the plate (pin 1) of the vertical oscillator (V204A) to the control arm of the vertical hold control R432B. Also, a 100,000 ohm resistor was connected in series with R412 and R432B to ground. Both the 6.8 megohm resistor and the 100,000 ohm resistor were removed from the circuit.

RUN 7

VERTICAL OSCILLATOR PLATE VOLTAGE CHANGED TO IMPROVE HEIGHT AND LINEARITY. 'Boot Strap" voltage supplies the vertical oscillator with plate voltage in early production 20X1 chassis and all 20Y1 chassis. In late production 20X1 chassis, the vertical oscillator plate voltage is supplied directly through the focus coil L404 (approximately 340 volts). In some 20X1 chassis, load resistor R416 is 2.7 megohms. If vertical lineary or height is poor in these 20X1 chassis, try replacing R416 with the 2.2 megohm resistor (part number 60B8-225).

VOLTAGE RATING OF C423 INCREASED. Decoupling condenser C423 was changed from a .05 mfd, 400 volts, condenser to a .05 mfd, 600 volts condenser (part number 64B5-7. When replacing C423, be sure to use late production part.

RUN 8

COUPLING CONDENSER ADDED TO IMPROVE AUDIO. A coupling condenser (C214, .05 mfd, 400 volts, part number 64B5-22) was added between the de-emphasis network (R206 and C206) and volume control R207A. This results in removing direct current from the volume control R207A.

FOCUS CIRCUIT MODIFIED. If replacing components in focus circuit, see "Run 10 in 20Y1–Run 11 in 20X1."

RUN 9 IN 20Y1 – RUN 10 IN 20X1

LOCATION OF FUSE (M401) CHANGED. In early sets, the second anode supply pig-tail fuse M401 (¼ amp., 250 volts, part number 84A7-1) is located at the under-side of the chassis. In late sets, the fuse is mounted on a terminal board inside the second anode supply housing near the rear.

FOCUS CIRCUIT MODIFIED. If replacing components in focus circuits, see "Run 10 in 20Y1 – Run 11 in 20X1".

RUN 10 IN 20Y1 – RUN 11 IN 20X1

FOCUS CIRCUIT MODIFIED. See schematic. In early sets, the focus control (R207B) was 1,500 ohms. In these sets, R448 and R449, shown in dotted lines on the schematic, were NOT used.

In later sets, resistors R448 (150 ohms, 1 watt, part number 60B14-151) and R449 (750 ohms, 7.5 watt, part number 61A1-17) were added as shown by dotted lines on the schematic. Note: In some of these sets, R449 (750 ohms) and R446 (750 ohms) were replaced by a 1,500 ohm resistor.

In latest sets, the focus control was changed from 1,500 ohms, 2 watt to 1,350 ohms, 4 watt, part number 75B12-5. When this focus control is used R448 and R449 are NOT used.

If it is necessary to replace a focus control in any set, it is advisable to use the latest type focus control (part number 75B12-5) and the latest circuit (does not include R449 and R448).

RUN 11 IN 20Y1 – RUN 12 IN 20X1

PICTURE POSITIONING LEVER ADDED TO SIMPLIFY FOCUS COIL ADJUSTMENT. In early sets, the focus coil is adjustable by means of its four mounting screws. Focus coil adjustment required removal of cabinet back.

In late sets, a new type of deflection yoke and focus coil mounting arrangement is used. This allows the focus coil adjustment to be made, without removing the cabinet back, by means of the "picture positioning lever" which extends from the rear of the set through the cabinet back.

For part numbers of early type focus coil and mounting parts, see "Picture Tube Mounting Parts for Sets WITHOUT Picture Positioning Lever" in parts list. For part numbers of the late type focus coil and mounting parts, see "Picture Tube Mounting Parts for Sets WITH Picture Positioning Lever" in parts list.

RUN 12 IN 20Y1 – RUN 13 IN 20X1

TUBE SHIELD ADDED TO ELIMINATE RF INTERFERENCE ON CHANNEL 4. A tube shield (part number 87A7-7), and tube shield base (part number 87A7-6) were added to the Ratio Detector V202 (6AL5) stage. This was done to eliminate harmonic interference of the 4.5 MC IF sound signal when the channel selector is on channel 4. If a herringbone pattern or other type of harmonic interference is apparent on channel 4, check for cause of this condition by removing the ratio detector tube V202 (6AL5). If the interference stops, try re-routing the antenna leads. If this does not help, it will be necessary to install a tube shield.

CONDENSER C314 CHANGED TO MINIMIZE BREAKDOWN. Decoupling condenser C314 was changed from a .005 mfd disc ceramic condenser to a .01 mfd, 600 volt paper condenser (part number 64B5-10).

CONDENSER C316 CHANGED TO IMPROVE SYNC STABILITY. Condenser C316 was changed from a 120 mmfd condenser to a 250 mmfd, ceramic condenser (part number 65B6-5). This resulted in increased sync stability.

CONDENSER C432 ADDED TO 20Y1 CHASSIS TO INCREASE SWEEP WIDTH. Condenser C432 (.035 mfd, 600 volts, part number 64A2-5) was added across width control L403 to increase sweep width in 20Y1 chassis only.

AC OUTLET ADDED TO POWER SUPPLY FOR 4L1 RADIO

An AC outlet was added to one end of the 1PA1 power supply used with the 4L1 AM radio in combination models. Plug the television line cord into the AC outlet on the power supply and plug the power supply line into the wall socket.

ALTERNATE C501 FILTER CONDENSERS

In some sets, filter condenser C501 (a three section electrolytic 40 mfd, 40 mfd, 80 mfd, part number 67C15-10) is replaced with two dual 40 mfd, condensers. In place of the 80 mfd. section (C501A), the sections of one of the dual 40 mfd. condensers are connected in parallel, and mounted underneath the chassis. If a section of these alternate condensers becomes defective, replace C501 as shown on schematic with the three section electrolytic.

ALTERNATE DEFLECTION YOKE T403

Some early sets used deflection yokes 94B2-1 and 94B2-2 alternately. The only difference between these yokes is in the size of C429; it is 56 mmfd., in 94B2-1 and 39 mmfd., in 94B2-2.

Two new alternate deflection yokes are currently used; part number 94B24-1 and 94B24-2. C429 is 56 mmfd. in part number 94B24-1, and 39 mmfd. in part number 94B24-2. Yoke 94B24-2 (supplied under part No. A3044) can be used for all replacements; only this yoke is listed in the parts list.

HORIZONTAL OUTPUT TRANSFORMER T405 CHANGED

Horizontal output transformer T405 was stamped 79C23-3 in early production sets, and 79C28-1 in late production sets. Late production transformers include the transformer mounting bracket, while early production did not. However, they are otherwise interchangeable. When replacing, order late production transformer, part number 79C28-1.

CORONA RING

Late production sets have a corona ring (part number 19A62) located below tube contacts of V405 (1X2) 2nd anode rectifier.

TV PRODUCTION CHANGES 20Z1, 5B2, 4S1

RUN NUMBERS

A system of run numbers is used for the television chassis. The run number is rubber stamped on the rear of the chassis. Whenever a production change is made in the television chassis, the run number changes to the next higher number. Final production 20Z1 chassis were stamped Run 7.

RUN 2

Pilot light socket added to TV chassis. A two contact wafer socket (part number 88A5-6) was added to all TV chassis. This socket is used in combination models only. The pilot light connector plugs into this socket.

RUN 3

Resistor R454 (270,000 ohms) added to meet UL requirement. Resistor R454 (270,000 ohms, 1 watt, part number 60B14-274) is connected from power transformer connection on volume control switch (SW501) to chassis ground. Addition of this resistor eliminates possible shock hazard should the 2nd anode connector lead come in contact with earth. Resistor R444 changed from 470,000 ohms to 1 megohm to meet UL requirement. Resistor R444 was changed from 470,000 ohms, to 1 megohm, 1 watt (part number 60B23 - 33). Resistor R444 (connected across terminals 7 and 9 of 1X2 tube socket) was changed in order to avoid possible corona discharge. Important: Order exact replacement from Admiral Distributor, or use replacement resistor bearing "Speer" brand name.

RUN 4

C425 changed to improve horizontal linearity. C425 was changed from .05 mfd. to .1 mfd. (part number 64B5-5) to improve horizontal linearity.

RUN 5

R319 wattage rating increased. In early sets, R319 (video amplifier plate load resistor) was 5600 ohms, 1 watt. In later sets R319 was changed to 5600 ohm, 2 watt resistor (number 60B20-562) or two 12,000 ohm 1 watt resistors (number 60B14-123) in parallel.

RUN 6

Modification of sound IF amplifier V201 (6AU6) to reduce sync buzz. In early sets a 120 mmfd. condenser (C202) was connected between L201 and pin 1 of V201 and 1 megohm resistor (R201) was connected between pin 1 of V201 and ground. See schematic inset for this early circuit.

In later sets the 120 mmfd, condenser (C202) was replaced with a short length of wire, and the 1 megohm resistor (R201) was omitted. A 82 ohm, ½ watt resistor R214 (part number 60B28-31) is added; it is connected between pin 7 of V201 and ground.

When making this modification to an early receiver, it is important that the sound IF stages be realigned.

RUN 7 in 20Z1 CHASSIS

Adjacent Lower Channel Sound Trap (L308, C322) Added. Later production sets have an Adjacent Lower Channel Sound Trap added between the connector lug (terminal of C115) on the TV tuner and pin 1 of 1st video IF amplifier V301 (6AU6). The trap (part No. 72A102) consists of L308 and C322. The trap is pretuned to 27.25 MC.

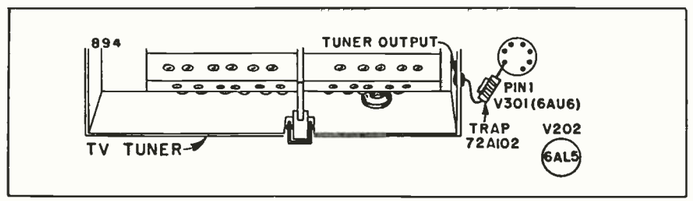


Figure 82. Bottom of Chassis Showing Trap Location.

This trap will eliminate herringbone interference pattern produced by the sound carrier of the adjacent lower channel. Close examination of this type of interference will reveal that the fine lines of the herringbone pattern will vary in accordance with the speech or music on the adjacent lower channel.

Since FM interference from other sources will also produce a herringbone pattern, the presence of a station on the adjacent lower channel should be definitely determined before installing the trap. After installing the trap realign slug A4 (mixer plate coil L105)

TV CHASSIS NOTES

The 20Z1 television chassis is similar to the 20X1, 20Y1 television chassis. The circuit for the first production 20Z1 chassis is almost identical to the circuit of latest production 20X1, 20Y1 chassis. The main difference between the 20Y1 and 20Z1 chassis are the front panel operating controls. In the 20Z1 chassis, the "Brightness," "Vertical," "Horizontal," "Focus" controls are single potentiometers which are concealed behind the small door in front of the receiver. The "Picture" (called "Contrast" in 20Y1) and "Off-Volume" are a dual control.

In the 20Z1 chassis, the individual channel oscillator slugs can be reached through the ¼" hole in the control escutcheon by merely removing the "Tuning" and "Channel" knobs.

Television only models use an electrodynamic speaker (part number 78B50-1, 78B51-1 or 78B54-1), with a field coil (100 ohms) and output transformer.

SERVICING TV SEPARATELY

Combination models with the 5B2 (FM-AM) radio, use a PM speaker (part number 78B44-3) and separate filter choke and two output transformers (located on the 2PA1 radio power supply). In order to operate the television chassis with the 5B2 (FM-AM) radio and power supply disconnected, it will be necessary to use either a dynamic speaker with an output transformer similar to that used in television only models, or to substitute an equivalent filter choke and speaker output transformer.

Combination models with 4S1 (AM) radio use a PM speaker (part number 78C53-1) and two output transformers. In these sets the filter choke and one output transformer (used on TV operation) are part of the PM speaker. The other output transformer (for radio operation) is located on the radio chassis. The television chassis in combination models with the 4S1 (AM) radio can be operated independently of the radio.
The 5B2 and 4S1 radio used in these models can be operated independently of the TV chassis.

HIGH VOLTAGE WARNING

Operation of the set outside of the cabinet or with the cabinet back removed involves shock hazard. Exercise normal high voltage precautions.

High voltages are present throughout the horizontal output and second anode supply circuit. No attempt should be made to make measurements from these points with ordinary test equipment.

Very carefully follow instructions given in this manual regarding location of test points for alignment, for taking voltage measurements, or in making oscilloscope wave-form analysis. Do not connect test equipment across other points in the receiver unless you are thoroughly familiar with the circuit wiring and points at which high voltages are present.

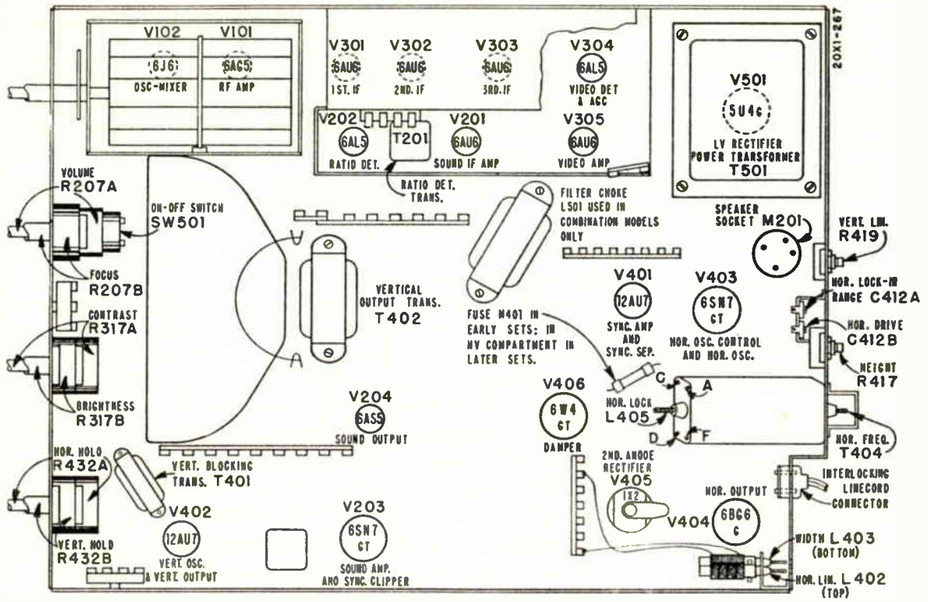


Figure 75. Bottom View of Television Chassis Showing Tube Locations.

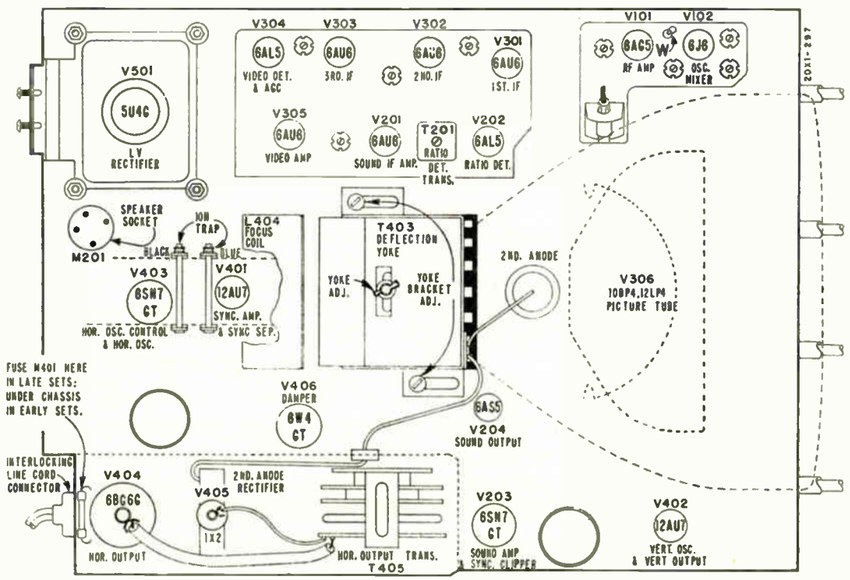


Figure 76. Top View of Television Chassis Showing Tube Locations.

VOLTAGE DATA

For B+ voltage distribution differences between late 20X1 chassis, and early 20X1 and all 20Y1 chassis, see figure 43

- Line voltage 117 volts AC.
- Voltages measured with a vacuum tube voltmeter between tube socket terminals and chassis, unless otherwise indicated. Note that the cathodes of V204 (6AS5) and V305 (6AU6) are operated approximately 130 volts above chassis ground.
- Antenna disconnected from set with terminals shorted.
- Speaker must be connected while taking voltages.
- Contrast turned fully clockwise. Channel Selector set on an unused low channel. Other front controls set at approximately half rotation.
- Rear chassis controls should not be disturbed unless otherwise indicated.
- Some tube socket terminals (not connected to tube elements) are used as tie-points and a voltage reading may be present.

CAUTION

Pulsed high voltages are present on the cap of 6BG6G tube, and on the filament terminals and cap of the 1X2 tube. NO ATTEMPT SHOULD BE MADE TO TAKE MEASUREMENTS FROM THESE POINTS UNLESS SUITABLE TEST EQUIPMENT IS AVAILABLE.

Picture tube 2nd anode voltage can be measured at the high voltage cap of picture tube and should be taken only with a high voltage instrument such as a kilovoltmeter. Voltage for 2nd anode is approximately 9 KV. Proper filament voltage check of 1X2 tube may be made by observing filament brilliancy as compared with that obtained with a 1.5 volt dry cell battery.

Sym.	Tube	Function		Pin 1	Pin 2	Pin 3	Pin 4	Pin 5	Pin 6	Pin 7	Pin 8	Pin 9
V101	6AG5	RF Amplifier		-.1	NC	6.3 AC	0	130	130	0		
V102	6J6	Osc. & Mixer		130	130	6.3 AC	0	0	0	0		
Voltages at V101 and V102 measured from top of chassis with tubes removed. Point "W" (Fig. 30) is -3 volts measured with tubes in sockets.												
V201	6AU6	Sound IF Amp.		-.6	0	0	6.3 AC	120	120	0		
V202	6AL5	Ratio Detector		.4	-.4	0	6.3 AC	-.2	0	0		
V203	6SN7GT	Sound Amp. & Sync Clip.		-1.2	40	0	-1	22	0	6.3 AC	0	
V204	6AS5	Sound Output		135	120	0	6.3 AC	120	270	260		
V301	6AU6	1st IF Amp.		-.5	0	0	6.3 AC	120	120	.9		
V302	6AU6	2nd IF Amp.		-.5	0	0	6.3 AC	120	120	.6		
V303	6AU6	3rd IF Amp.		0	0	0	6.3 AC	130	130	1.5		
V304	6AL5	Video Detector & AGC		135	0	6.3 AC	0	1.5	0	130		
V305	6AU6	Video Amplifier		115	130	6.3 AC	0	230	300	130		
V401	12AU7	Sync Amp. & Separator		60	-4	0	0	0	6	0	6	6.3 AC
V402	12AU7	Vert. Osc. & Output	20Y1	115	-36	0	0	0	390	-14	6	6.3 AC
			20X1	100	-34	0	0	0	390	-9	9	6.3 AC
Voltages measured at V402 (12AU7) taken with vertical linearity and height control turned fully clockwise.												
V403	6SN7GT	Hor. Osc. Cont. & Hor. Osc.		-22	165	-15‡	-85	200	0	6.3 AC	0	
V404	6BG6G	Horizontal Output		NC	0	8	NC	-9	NC	6.3 AC	270	
		Voltage on tube cap: See "CAUTION" note above.										
V405	1X2	2nd Anode Rectifier		See "CAUTION" note above.								
V406	6W4GT	Damper		NC	0	450	NC	375	NC	6.3 AC	0	
V501	5U4G	Low Voltage Rectifier		NC	**400	NC	*400AC	NC	*400AC	NC	**400	
V306	10BP4 12LP4	Picture Tube		0	80	NC	NC	NC	NC	NC	NC	NC
		Pin 10: 410V. Pin 11: 110V. Pin 12: 6.3AC 2nd Anode: See "CAUTION" above.										
Voltages taken at picture tube socket (socket removed from tube).												

* Measured from top of tube socket with 5U4 removed.
** Voltage taken from pin #1 of speaker connector socket M201. Filament 5.2 volts AC measured between pins 2 and 8 of 5U4G.
‡ Voltage will vary both positive and negative with setting of slug adjustment for Hor. Freq. T404.
NC—Indicates no connection to tube element.

99D73
12-22-49

TURRET SETTING SELECTS PAIR OF COILS. L101 & L102 FOR CHANNEL DESIRED.

See Page 40 for Modified Sound IF Amplifier Circuit.

M205 BUILT-IN ANTENNA

6AG5 RF AMPLIFIER V101

6J6 OSC. & MIXER V102

6AU6 SOUND IF AMP. V201

6AL5 RATIO DET V202

½6SN7GT SOUND AMP. V203A

6AS5 SOUND OUTPUT V204

M203 SPEAKER

M203 IS ELECTRODYNAMIC SPEAKER IN "TV ONLY" MODELS; PM SPEAKER AND CHOKE L501 IN COMBINATIONS.

TO PIN 2 OF V501 & C501A

B+ TO JUNCTION OF C501B, R450 AND L404 IN "TV ONLY" MODELS; NOT USED IN COMBINATIONS.

6AU6 1ST. IF V301

6AU6 2ND. IF V302

6AU6 3RD. IF V303

6AL5 VIDEO DET. & AGC. V304

6AU6 VIDEO AMP. V305

½12AU7 SYNC. AMP V401A

½12AU7 SYNC. SEPARATOR V401B

½6SN7GT SYNC. CLIPPER V203B

½12AU7 VERTICAL OSC. V402A

½12AU7 VERTICAL OUTPUT V402B

T403A VERTICAL DEFLECTION YOKE 68Ω TOTAL

T403B HORIZONTAL DEFLECTION YOKE 14Ω TOTAL

½6SN7GT HOR. OSC. CONTROL V403A

½6SN7GT HOR. OSC. V403B

6BG6G HOR. OUTPUT V404

1X2 2ND. ANODE RECTIFIER V405

6W4GT DAMPER V406

V501 LOW VOLTAGE RECT. 5U4G

V306 PICTURE 10BP4 12LP4

9000 V.

320 V.

365 V

PINS 1,4,6 CONNECTED TO TOP OF C426

TO 2ND. ANODE

1X2 FILAMENT VOLTAGE

BOTTOM VIEW OF 1X2 SOCKET CONNECTIONS

FUSE M401 ¼A. 250V.

NOTE: L501 IS SPEAKER FIELD IN "TV ONLY" SETS. CHOKE IN COMBINATIONS. SEE M201.

NOTES

NUMERICAL SYMBOLS (2), (3), ETC. INDICATE A PRODUCTION CHANGE. THESE RUN NUMBERS ARE RUBBER STAMPED AT REAR OF CHASSIS AND DISCUSSED ON PAGES 31, 32, 33.

ALPHABETICAL SYMBOLS (A1), (A2)....(Y) (Z) ETC. INDICATE ALIGNMENT POINTS AND CONNECTIONS.

Figure 77. Schematic For 20X1, 20Y1 Television Chassis.

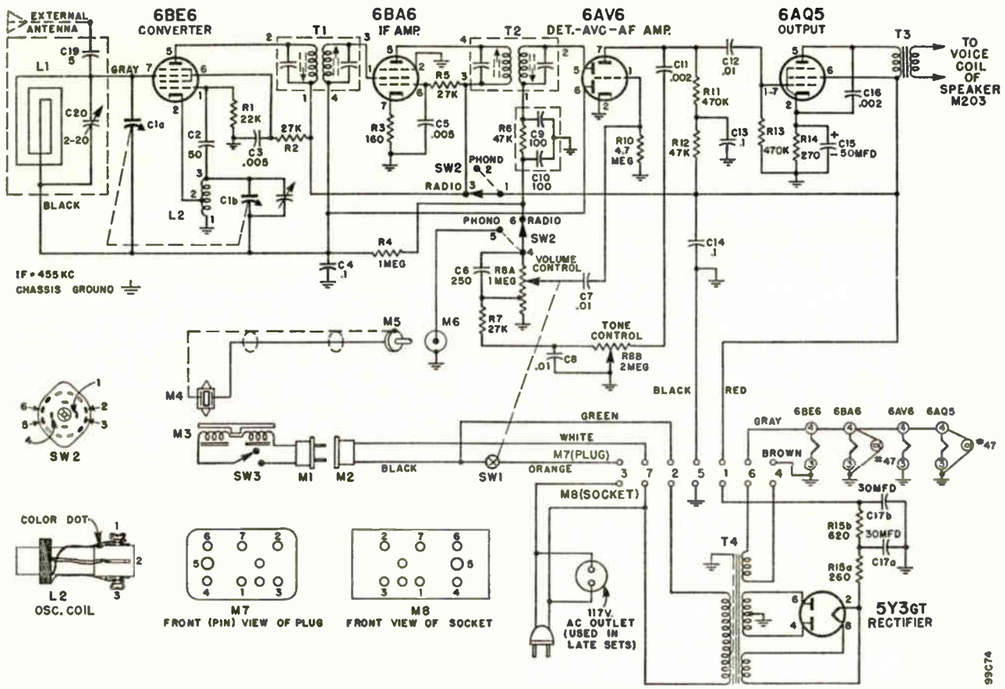


Figure 37. Schematic of 4L1 Radio.

4L1 VOLTAGE DATA

- Readings taken from tube socket terminals to chassis.
- Switch in Radio position. Voltages marked with ▲ taken on Phono position.
- Measured on 117 volt AC line.
- Volume control minimum; gang closed.
- Voltages measured with vacuum tube voltmeter.

Figure 38. Pointer Setting.

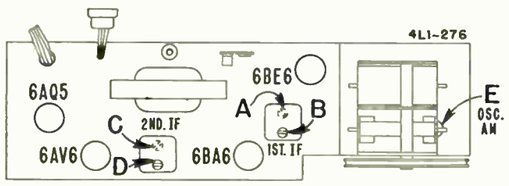


Figure 39. Radio Trimmer Locations.

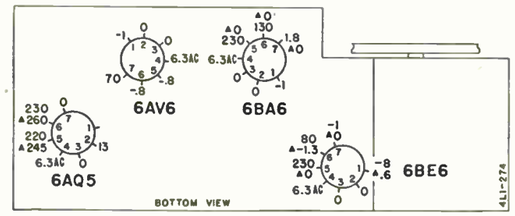


Figure 40. Voltage Chart for 4L1 Radio.

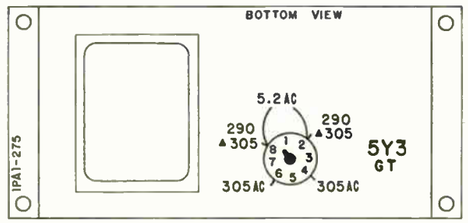


Figure 41. Voltage Chart for Radio Power Supply.

REMOVING RADIO OR CHANGER FOR SERVICE

REMOVING COMPLETE RADIO AND RECORD CHANGER ASSEMBLY

The complete Radio-Phono unit does not need to be removed unless the "Tilt-Out mechanism requires repair. The radio tuner can be removed separately as explained under "Removing Radio Chassis Only for Servicing". The record changer can be removed separately by unscrewing the three screws on the top of the changer, unplugging the cable connectors, and then lifting the changer out.

If it is necessary to remove the complete Radio and Record Changer assembly, disconnect the power cable and unsolder the radio speaker leads. Disconnect one side of the tie-bar spring and one side of the tie-rod from a titlt-out bracket. Hold the radio-phono unit with one hand while springing each of the four tilt-out hinge arms away from the sides. As this is done, the four pivot studs will come out of their sockets and free the unit from the cabinet.

To reinstall, place the radio-phono unit back in the cabinet; spring the tilt-out arms out so that the unit will drop down between them; guide the studs back into their sockets; then reassemble the tie-bar spring and tie-rod to the tilt-out brackets. Reconnect the power cable and re-solder the speaker leads.

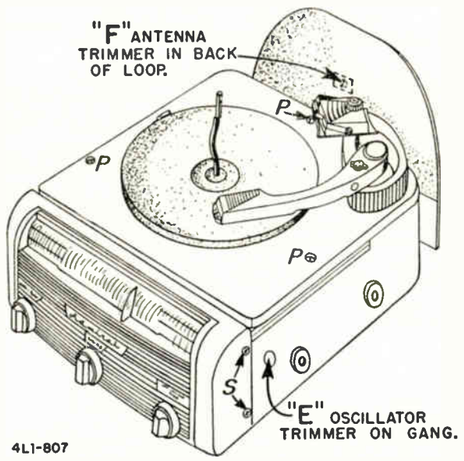


Figure 35. Radio-Phono Unit.

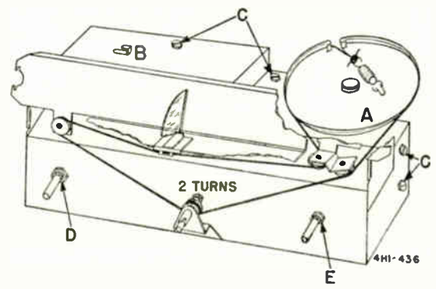


Figure 36. Radio Tuner Showing Chassis Cover and Dial Assembly.

REMOVING RADIO CHASSIS ONLY FOR SERVICING

Oscillator trimmer "E" and antenna trimmer "F" are accessible from the outside of the radio-phono housing, see figure 35.

The radio tubes can be serviced from top of the chassis by merely unscrewing the three screws "P" (figure 35) and lifting away the record changer assembly.

To remove the radio chassis for complete alignment or for servicing the underside of the chassis, follow steps "a" through "g" below.

a. Loosen the power supply cable clamp on the underside of the radio-phono housing and on the cabinet or power supply. Disconnect the power supply cable plug from the power supply.
b. Remove one of the loop antenna mounting screws, move that side of the loop up so the black and white leads to the loop antenna can be unsoldered. Also unsolder the black and white leads connecting to the speaker voice coil terminals.
c. Remove the radio front housing mounting screws "S" (Figure 35) at the sides and at the seams on the underside of the housing.
d. Carefully pull the radio chassis down and forward until you can reach in and unplug the phono pickup and phono motor connector plugs. Then, pull the radio tuner completely forward.
e. Remove the tuning knobs. Position the dial drum as shown in figure 36; unhook spring at "A"; and keeping tension on dial cord, hook it to tab "B".
f. Remove the six hex-head screws "C" which hold chassis cover and dial scale to chassis.
g. After removing the pilot light brackets and hex nut "D" and "E", the chassis front can be pulled away from the chassis. All trimmers and parts are now accessible for adjustment or service.
h. Reassemble in the same manner.

EXTERNAL RADIO ANTENNA

The radio is provided with a built-in Aero-scope antenna. This antenna eliminates the need for external antenna or ground wires in most locations.

The built-in radio (loop) antenna is directional in that better reception of weak or distant stations may be had by slightly rotating the set. In extra noisy locations, the set may be rotated to the position that gives a minimum of noise or other interference.

If an external antenna is desired, connect the external antenna lead-in wire (preferably by soldering) to the terminal lug on the back of the internal loop antenna. The internal loop antenna is mounted on a fibre board which is attached to the back of the radio-phono chassis.

The lead-in should be stapled or tacked to the cabinet rail, being sure to allow enough slack so the lead is not pulled tight when the "Tilt-Out" cabinet door is opened.

After connecting the external antenna to the set, reception of weak or distant stations may further be improved by readjusting the antenna trimmer located on the loop antenna. Adjust the antenna trimmer for maximum signal while tuned to a weak station, preferably at 1400 or 1500 KC.

NOTE: Models 8C11, 8C12 and 8C13 include the 30A1 television chassis. See the Television Service Manual for service information and parts list.

RESISTORS

Symbol	Description	Part No.
R1	390 Ohms, ½ Watt	60B 2-391
R2	470,000 Ohms, ½ Watt	60B 2-474
R3	22,000 Ohms, 1 Watt	60B 14-223
R4	1 Megohm, ½ Watt	60B 3-105
R5	47,000 Ohms, ½ Watt	60B 2-473
R6	47,000 Ohms, ½ Watt	60B 2-473
R7	15,000 Ohms, 2 Watt	60B 20-153
R8	470 Ohms, ½ Watt	60B 2-471
R9	470,000 Ohms, ½ Watt	60B 2-474
R10	27,000 Ohms, 1 Watt	60B 14-273
R11	470 Ohm, ½ Watt	60B 2-471
*R12	47,000 Ohms, ½ Watt	
R13	220,000 Ohms, ½ Watt	60B 2-224
R14	220,000 Ohms, ½ Watt	60B 2-224
R15	15,000 Ohms, 2 Watt	60B 20-153
R16	27,000 Ohms, ½ Watt	60B 2-273
R17	390 Ohms, ½ Watt	60B 2-391
R18	27,000 Ohms, 1 Watt	60B 14-273
R19	6,800 Ohms, ½ Watt, 5%	60B 1-682
R20	6,800 Ohms, ½ Watt, 5%	60B 1-682
R21	120,000 Ohms, ½ Watt	60B 2-124
R22	100,000 Ohms, ½ Watt	60B 2-104
R23	47,000 Ohms, ½ Watt	60B 2-473
R24	2 Megohms Tone Control (Includes ON-OFF Switch SW2)	75B 1-24
R25	1 Megohm Volume Control (Tapped at 500,000 Ohms)	75B 2-10
R26	10 Megohms, ½ Watt	60B 3-106
R27	22,000 Ohms, ½ Watt	60B 2-223
R28	470,000 Ohms, ½ Watt	60B 2-474
R29	470,000 Ohms, ½ Watt	60B 2-474
R30	390 Ohms, 1 Watt	60B 14-391

*Part of encased Diode Filter Unit 63A3-1. This unit consists of R12, C17, C18 (see schematic). If a section of the unit becomes defective, replace with component of proper value.

CONDENSERS

Symbol	Description	Part No.
C1	105 mmfd., 5%, —.00075 Temp. Coeff. Ceramic	65B 6-9
C2	.01 mfd., 400 Volts, Paper	64B 1-25
C3	.0015 mfd., "Hi-K" Ceramic	65A 14-1
C4	140 mmfd., 3%, Silver Mica	65B 1-26
C5a	486 mmfd. (max.) AM RF	Gang Cond.
C5b	15 mmfd. (max.), FM RF	
C5c	15 mmfd. (max.), FM Osc.	68B 16
C5d	143 mmfd. (max.), AM Osc.	
C6	22 mmfd., 5%, Ceramic	65B 6-47
C7	7 mmfd, ±1 mmfd., —.00047 Temp. Coeff., Ceramic	65B 6-45
C8	.01 mfd., 400 Volts, Paper	64B 1-25
C9	35 mmfd., 5%, Ceramic	65B 6-46
C10	105 mmfd., 5%, —.00075 Temp. Coeff. Ceramic	65B 6-9
C11	7 mmfd., ±1 mmfd., —.00047 Temp. Coeff., Ceramic	65B 6-45
C12	.0015 mfd., "Hi-K" Ceramic	65A 14-1
C13	.01 mfd., 400 Volts, Paper	64B 1-25
C14	.01 mfd., 400 Volts, Paper	64B 1-25
C15	.005 mfd. min., Ceramic (Disc)	65A 10-1
C16	.01 mfd., 400 Volts, Paper	64B 1-25
*C17	100 mmfd., Mica	
*C18	100 mmfd., Mica	
C19	.01 mfd., 400 Volts, Paper	64B 1-25
C20	.005 mfd. min., Ceramic (Disc)	65A 10-1
C21	105 mmfd., 5%, —.00075 Temp. Coeff., Ceramic	65B 6-9
C22	4 mfd., 150 Volts, Electrolytic	67A 4-2
C23	105 mmfd., 5%, —.00075 Temp. Coeff., Ceramic	65B 6-9
C24	.002 mfd., 600 Volts, Paper	64B 1-14

Symbol	Description	Part No.
C25a C25b C25c	30 mfd., 350 Volts 30 mfd., 350 Volts 20 mfd., 25 Volts } Elect.	67C 6-25
C26	.01 mfd., 400 Volts, Paper	64B 1-25
C27	.2 mfd., 200 Volts, Paper	64B 1-29
C28	.001 mfd., 600 Volts, Paper	64B 1-15
C29	.005 mfd., 600 Volts, Paper	64B 1-12
C30	500 mmfd., 10%, Mica	65B 5-27
C31	.005 mfd., 600 Volts, Paper	64B 1-12
C32	.01 mfd., 400 Volts, Paper	64B 1-25
C33	.1 mfd., 400 Volts, Paper	64B 1-20
C34	.01 mfd., 400 Volts, Paper	64B 1-25
C35	200 mmfd., 20%, Ceramic	65B 7-21
C36	.01 mfd., 400 Volts, Paper	64B 1-25
C37	.005 mfd., 600 Volts, Paper	64B 1-12
C38	2½ to 6 mmfd., Trimmer, Silver Ceramic	66A 24-2

*Part of encased Diode Filter Unit 63A3-1. This unit consists of R12, C17, C18 (see schematic). If a section of the unit becomes defective, replace with component of proper value.

COILS, TRANSFORMERS, ETC.

Symbol	Description	Part No.
L1	Antenna, FM (90" of #22 wire)	
L2	Antenna, Loop (AM)	95A 24-2
L3	Choke, RF	AB103-33
L4	Coil, Loop Loading (AM)	69A 56
L5	Coil, RF (FM)	69A 55
L6	Coil, Oscillator (FM)	69A 54
L7	Coil, Oscillator (AM)	69A 20-1
L8	Choke, Filter	74A 10
L9	Choke, Filament Approx. 10 turns (18") of solid #22 hook-up wire wound on C26. Solder one end to inside foil lead of C26	
T1	Transformer, 1st IF (FM)	72B 37
T2	Transformer, 2nd IF (FM)	72B 38
T3	Transformer, Ratio Detector	72B 39
T4	Transformer, 1st IF (AM)	72B 54
T5	Transformer, 2nd IF (AM)	72B 49
T6	Transformer, Power	80B 5
T7	Transformer, Output	79A 9
M7	Speaker 10" P.M. Dynamic	78B 28
SW1	Switch, Band (FM, AM, Phono)	77B 18
SW2	Switch, Power	Part of R24
SW3	Switch, Phono Motor (see Record Changer Manual)	
	Diode Filter (consists of R12, C17 and C18)	63A 3-1

DIAL PARTS

Description	Part No.
Dial Bulb, #47	81A 1-8
Dial Bulb Socket (with leads)	82A 8-3
Dial Cord (18")	50A 1-3
Dial Escutcheon and window (Radio)	23D 29-2
Dial Escutcheon, Television (8C11, 8C12, 8C13 only)	23D30-1
Dial Pointer, Plastic	A1685
Dial Scale Assembly	A1676
Drum and Hub Assembly	A-1318
Rubber Channel (Inner edge of Dial Scale — 29½")	12A 20-3
Set Screw, Dial Drum, 8-32x⅛"	1A 5-59-0
Spring, Dial Cord	19B 1-3
Sleeve, Dial Tuning (brass)	27A 45

PHONOGRAPH PARTS

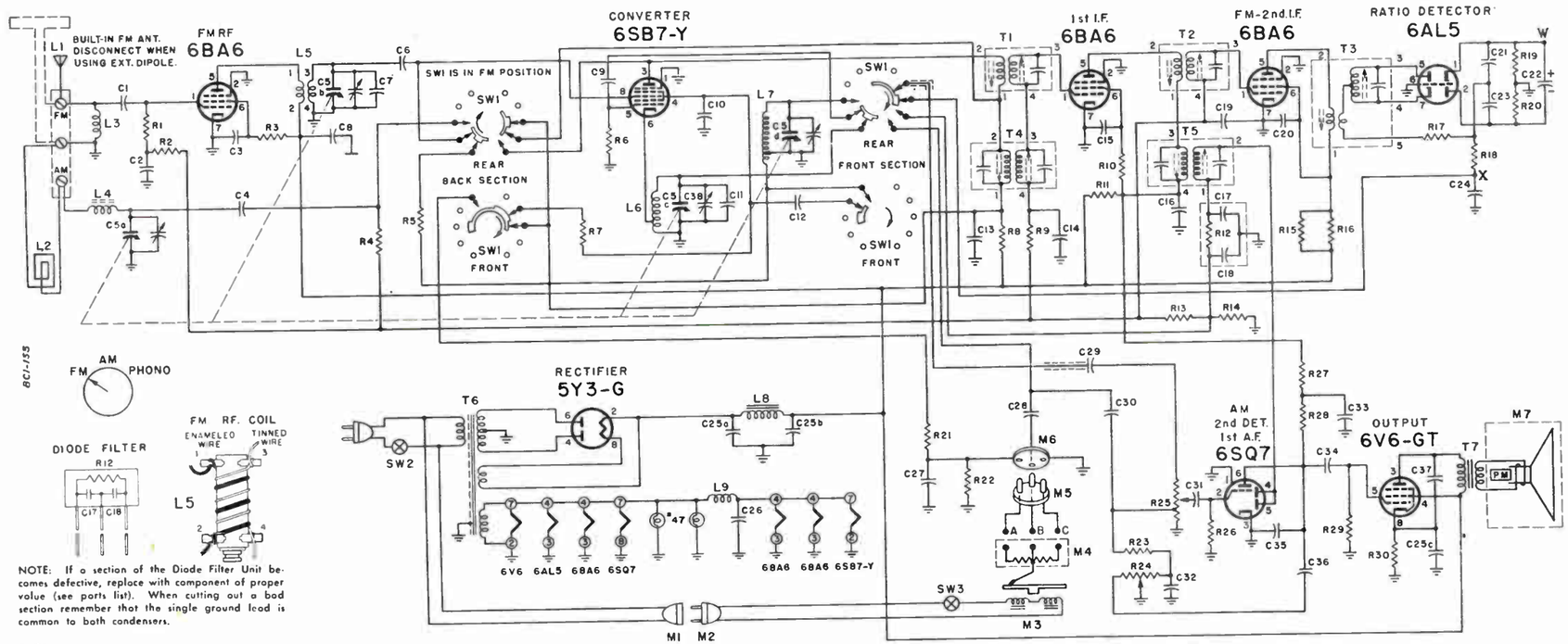
Note: See RC181 Record Changer Manual for complete parts list.

Symbol	Description	Part No.
M1	Cable and Socket, Phono Motor	89A 6-6
	Phono Motor Extension Cable (used on 8C11, 8C12, 8C13)	89A 6-32

Description	Part No.
M2 Plug, AC Phono Motor (Male)	88A 8-1
M3 Motor	407B 3-2
M4 Cartridge & Needle, Pickup	A1372
M5 Pickup Cable & Plug Assembly	A1624
M6 Socket, Phono Pickup	88A 5-8
Centerpost	G400B 137-1
Drive Disc Assembly (under Turntable)	G400A 252
Idler Wheel (407B3 Motor)	G400A 23
Idler Wheel (407B1 Motor)	G400A 57
Nut, Wing (for fastening Record Changer during shipment)	2A 5-9-2
Shoulder Eye Bolt (for Tilt-Out Spring)	1A 87-1
Strip, Sponge Rubber (1/16x⅛x1")	12A 5-5
Tilt-Out Hinge Assembly (Closest to Pickup Arm)	AC118-2
Tilt-Out Hinge Assembly (Farthest from Pickup Arm)	AC118-1
Tilt-Out Spring (2⅛" long)	19A 15-1
Tilt-Out Tie Bar	15B 126
Tilt-Out Tie Rod	28A 22

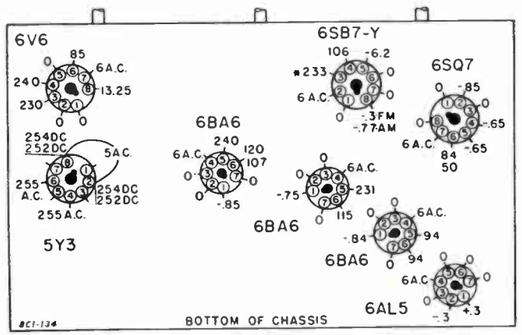
CHASSIS GROUND

NOTE: If a section of the Diode Filter Unit becomes defective, replace with component of proper value (see parts list). When cutting out a bad section remember that the single ground lead is common to both condensers.



VOLTAGE CHART

- Line Voltage 117.
- Voltages measured with a vacuum tube voltmeter. Second voltage readings and A.C. voltages measured with a 1000 ohm-per-volt meter.
- Voltages read between socket terminals and ground, unless otherwise indicated.
- Band switch in FM position.
- Dial turned to low frequency end.
- Volume Control—minimum.



*If measured with band switch in phono position, reading will be zero.

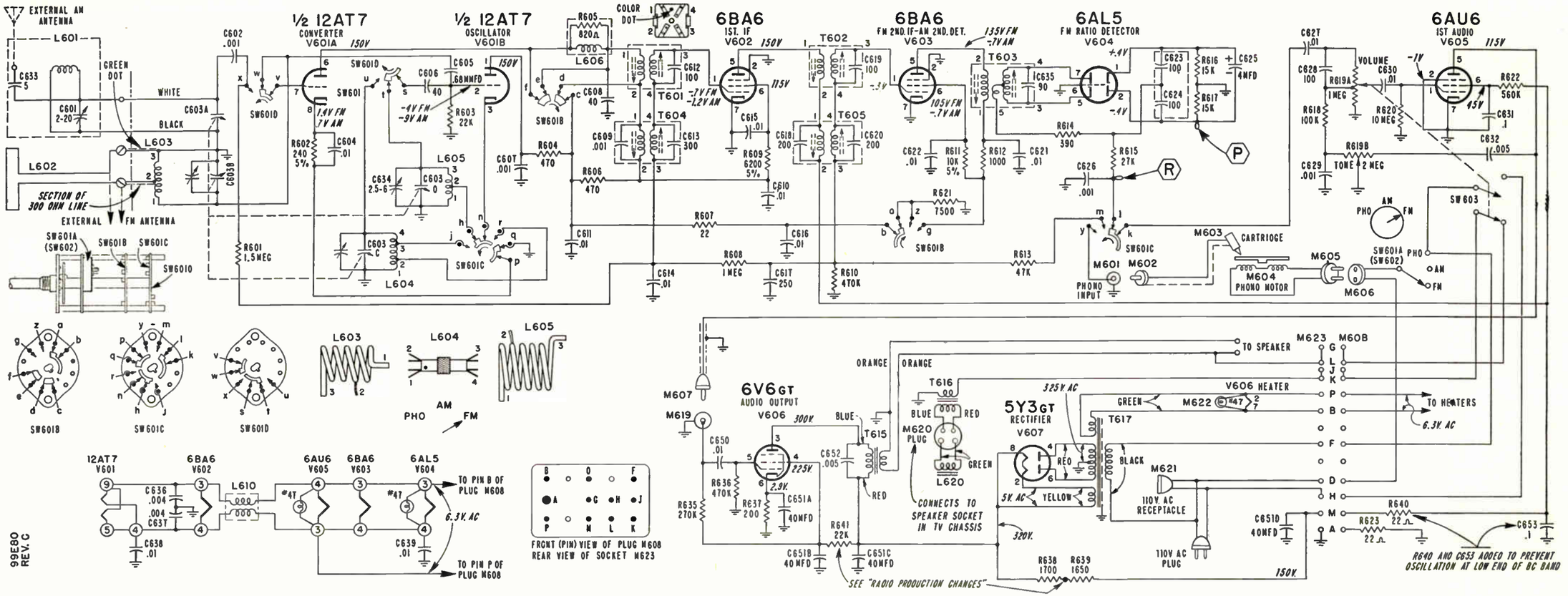


Figure 84. Schematic For 5B2 Radio and 2PA1 Power Supply Chassis.

AM-FM RADIO ALIGNMENT

FM ALIGNMENT EQUIPMENT

FM circuits should be aligned only with an AM signal generator and a vacuum tube voltmeter. Any standard vacuum tube voltmeter with a DC scale of not over 5 volts is suitable. A 3-volt zero center scale is desirable. A signal generator with a fundamental frequency range up to 110 MC is desirable. It is possible however, to align the receiver with a signal generator going up to 20 or 30 megacycles, by using the harmonics of these lower frequencies. To do this merely set the signal generator dial as indicated in the next paragraph and align exactly as explained in the alignment instructions.

Where alignment chart specifies 109 MC, 106 MC, 92 MC or 87 MC, set generator to the highest available frequency shown in the column under that frequency:

109. MC	106. MC	92. MC	87. MC
54.50MC	53. MC	46. MC	43.5 MC
36.33MC	35.33MC	30.66MC	29. MC
27.55MC	26.5 MC	23. MC	21.75MC
21.80MC	21.2 MC	18.4 MC	17.4 MC
18.17MC	17.66MC	15.33MC	14.5 MC

IMPORTANT PRELIMINARY ALIGNMENT STEPS

Under normal operating conditions or use, misalignment of RF or IF circuits with age will be slight. Lack of sensitivity and poor tone quality may be due to causes other than alignment. Do not attempt to realign the receiver until all other possible causes have first been thoroughly investigated.

In FM alignment, it is essential that every step be followed. Especially important is picking the center of the IF curve (step 4 in the FM-IF alignment instructions). During this portion of the alignment it is necessary to tune the signal generator very carefully; it may necessitate having to estimate the dial readings to a tenth of a division.

When completely aligning the FM circuit, it is essential to follow the sequence of steps in the chart. If only a portion of the FM circuit is being aligned, be sure to follow all the remaining steps. AM and FM alignment may be made independently of each other.

For alignment of IF slug adjustments, it will be necessary to disassemble the radio chassis from the escutcheon and housing and also remove the chassis cover and dial scale assembly. See figure 85. NOTE: AM and FM oscillator and antenna trimmers are accessible from top of chassis; disassembly of chassis cover and dial scale will generally not be required.

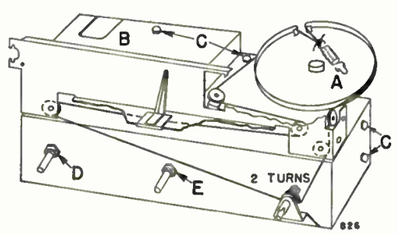


Figure 85. Radio Chassis With Front Housing Removed.

Disconnect FM antenna from twin lead cable. Stretch twin lead cable to full length during FM RF alignment.

To avoid splitting the slotted head of iron core tuning slugs in the IF transformers, use a non-metallic alignment tool with a ⅛" wide blade. Do not exert undue pressure as threads of slugs may strip.

Be sure both the set and the signal generator are thoroughly warmed up before starting alignment.

AM ALIGNMENT PROCEDURE

- Connect output meter across speaker voice coil.
- Turn receiver Volume control fully on; Tone control fully clockwise.
- Band switch in AM position.
- AM antenna must be connected and placed in the same relative position to the chassis as when in the cabinet.
- Use lowest output setting of signal generator that gives a satisfactory reading on meter.
- Use a non-metallic alignment tool for IF adjustments.
- Repeat adjustments to insure good results.

Step	Connect Signal Generator	Dummy Antenna Between Radio and Signal Generator	Signal Generator Frequency	Receiver Dial Setting	Adj. Trimmers in Following Order to Max.
1	Gang condenser antenna stator	.1 MFD	455 KC	Tuning gang wide open	*A-B (2nd IF) *C-D (1st IF)
2	"	"	1620 KC	"	E (oscillator)
3	Place generator lead close to loop of set to obtain adequate signal. No actual connection (signal by radiation).		1400 KC	Tune in signal	$F (antenna)

* Adjustments A and C made from underside of chassis.

$ AM antenna trimmer adjustment "F" in step 3 should be repeated after set and antenna have been installed in cabinet Important: AM antenna trimmer may not peak if antenna leads are not properly routed or separated.

5B2 PRODUCTION CHANGES

R640 and C653 added to 5B2 radio to prevent oscillation. In later production 5B2 radio chassis, R640 (22 ohms, ½ watt, part number 60B8-220) was added in series with the B+ lead going to pin "M" on plug M608. C653 (.1 mfd, 400 volts, part number 64B1-20) was connected between R640 and the B+ lead to chassis ground. This change was made to prevent oscillation on the low end of the AM band.

Change to reduce level of residual hum. The B+ filter circuit of later 2PA1 power supplies has been modified to reduce the level of residual hum (hum heard with the volume control turned fully to left, counter-clockwise). Before making this change, check to see that sections of the electrolytic condenser C651 are not defective (leaky or under capacity).

Figure 92 shows section of the old circuit used in the early power supply. Figure 84 shows the later power supply (with this change added).

To add these changes to an early power supply, proceed as follows:

Disconnect wires connecting to junction (tap) of candohm resistor R638, R639. Leave tap unconnected.

Solder together and tape ends of wire which have been removed from tap of R638, R639.

Connect a 22,000 ohms, 1 watt resistor (part number 60B14-223) across terminals of electrolytic condenser C651B and C651C.

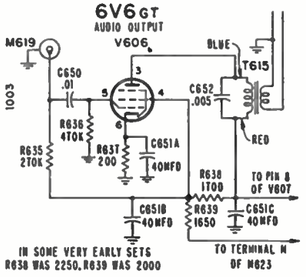


Figure 92. Circuit Used in Early 2PA1 Power Supply.

4S1 RADIO (AM ONLY)

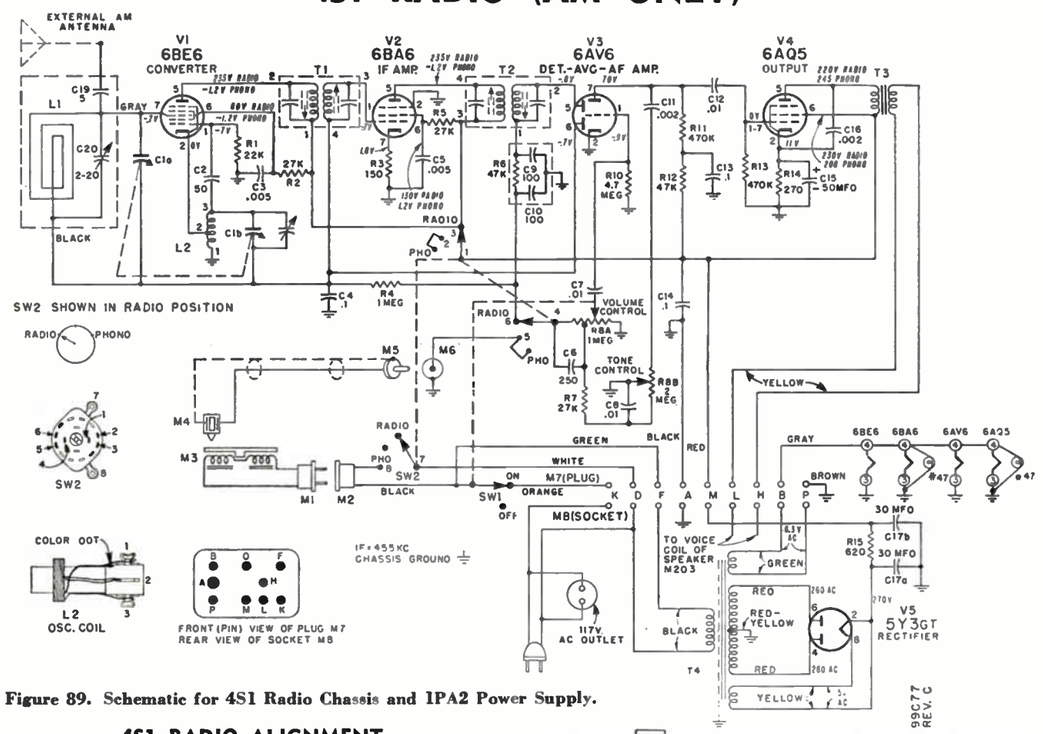


Figure 89. Schematic for 4S1 Radio Chassis and 1PA2 Power Supply.

4S1 RADIO ALIGNMENT

Follow the "AM Alignment Procedure" on page 65.

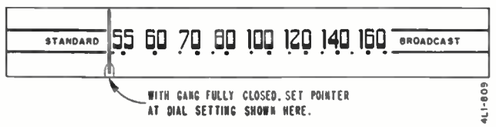


Figure 90. 4S1 Pointer Setting

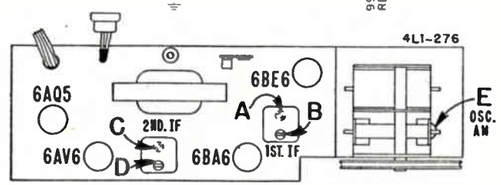


Figure 91. 4S1 Radio Trimmer Locations.

FM IF AND RATIO DETECTOR ALIGNMENT

- Keep VTVM leads well separated from signal generator leads and chassis wiring.
- Band switch in FM position.
- While peaking IF's, keep reducing signal generator output so VTVM reading is approximately —1.5 volts DC with exception of Step #5.
- o FM antenna disconnected during alignment.
- Trimmer adjustments "G", "H" and "J" made from underside of chassis.

Step	Connect Signal Generator	Generator Frequency	Receiver Dial Setting	Output Connections	Adjust (very carefully)
Before proceeding, be sure to follow the instructions given under "Important Preliminary Alignment Steps."					
1	Thru .001 cond. to pin #1 of 6BA6 2nd IF (Ground to chassis, close to tube).	‡10.7 MC	Tuning gang wide open	Connect VTVM (DC probe) from point "P" to chassis.	"G" (ratio detector primary) for maximum reading on VTVM.
2	**Thru .001 cond. to pin #1 of 6BA6 1st IF. (Ground to chassis, close to tube).	"	"	"	"H" and "I" (2nd IF trans.) for maximum reading on VTVM.
3	Across ends of FM antenna twin lead.	"	"	"	"J" and "K" (1st IF trans.) for maximum on VTVM. Readjust G, H, I, J, K, for maximum. (Keep reducing generator output o keep VTVM at 1.5 volts.)
4	"	a. Reduce output of signal generator until VTVM reads EXACTLY —1.5 volts DC. b. Tune generator frequency above 10.7 MC until VTVM reads EXACTLY —1.0 volt. Note EXACT generator frequency. Extreme care in reading this is essential. c. Tune generator frequency below 10.7 MC until VTVM reads EXACTLY —1.0 volt. Note EXACT generator frequency. Extreme care in reading this is essential. d. Add generator frequency in step c to generator frequency in step b and divide by 2. The result is the center frequency of the IF curve to be used in step 5. See example under heading "Setting Signal Generator to Center of IF Selectivity Curve." e. Tune generator frequency above and below 10.7 MC and note voltage reading on VTVM at different frequency points until you have a good impression of the shape of the selectivity curve. If you have two peaks as in Figures D or E, note readings (voltage) of both peaks. If one peak is over 20% higher than the other one, it will be necessary to realign IF's. A selectivity curve that would require realignment is illustrated by Figure F.			
5	"	Center of IF selectivity curve per step 4d above.	Tuning gang wide open	Connect VTVM (DC probe) from point "R" to chassis. Use zero center scale if available.	"L" (ratio detector secondary) for zero voltage reading on VTVM. (The correct zero point is located between a positive and a negative maximum.)

If any of the above adjustments were very far off it is desirable to repeat steps 3, 4 and 5.

** Do not feed IF signal into converter grid as this will cause mis-alignment.
‡ Signal may be unmodulated or 400 cycle AM modulated.

SETTING SIGNAL GENERATOR TO CENTER OF IF SELECTIVITY CURVE

CAUTION: Due to the difficulty of setting a signal generator to the accuracy required by this operation, extreme care must be exercised in making each setting. Otherwise, improper alignment of the ratio detector and consequent audio distortion will result.

EXAMPLE: (See Figures A and B)
Voltage reading in step 4a is —1.5 volt.

Generator frequency on low side of 10.7 MC for a reading of —1 volt DC =10.640 MC.

Generator frequency on high side of 10.7 MC for a reading of —1 volt DC =10.800 MC.

Center frequency is obtained by adding 10.640 and 10.800, then dividing by 2. For these readings it will be 10.72 MC.

Set generator frequency to 10.72 MC as this is center of selectivity curve as shown in Figure B.

Note: Numerical vernier dial readings may be used instead of MC.

TYPICAL SELECTIVITY CURVES

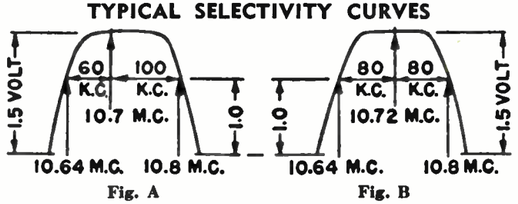


Fig. A Fig. B

Fig. C Fig. D Fig. E Fig. F

Early Circuit; See RUN 6 Under "Production Changes".

99E79
REV. F

TURRET SETTING SELECTS PAIR OF COILS.
L101 & L102 FOR CHANNEL DESIRED.

6AG5, 6BC5 OR 6CB6
RF AMPLIFIER
V101

6J6
OSC. & MIXER
V102

6AU6
SOUND IF AMP.
V201

M205
BUILT-IN ANTENNA

TV VOLTAGE DATA

- Picture control turned fully clockwise. Channel Selector set on an unused low channel. Other front controls set at approximately half rotation.
- Rear chassis controls should not be disturbed unless otherwise indicated.
- Line voltage 117 volts AC.
- Voltages measured with a vacuum tube voltmeter between tube socket terminals and chassis, unless otherwise indicated. Note that the cathodes of V204 (6AS5) and V305 (6AU6) are operated approximately 135 volts above chassis ground.
- Antenna disconnected from set with terminals shorted.
- Speaker must be connected while taking voltages.

CAUTION

Pulsed high voltages are present on the cap of 6BG6G tube, and on the filament terminals and cap of the 1X2 tube. NO ATTEMPT SHOULD BE MADE TO TAKE MEASUREMENTS FROM THESE POINTS UNLESS SUITABLE TEST EQUIPMENT IS VAILABLE.

Picture tube 2nd anode voltage can be measured at the high voltage cap of picture tube and should be taken only with a high voltage instrument such as a kilovoltmeter. Voltage for 2nd anode is approximately 9KV. Proper 1X2 tube filament voltage check may be made by observing filament brilliancy as compared with that obtained with a 1.5 volt dry cell battery.

6AL5
RATIO DET.
V202

½6SN7GT
SOUND AMP.
V203A

6AS5
SOUND OUTPUT
V204

M203
SPEAKER

PIN VIEW OF PLUG M202 — T202 — VOICE COIL
BLUE
RED
FIELD OR CHOKE

M203 IS ELECTRODYNAMIC SPEAKER IN "TV ONLY" MODELS. PM SPEAKER AND CHOKE IN COMBINATIONS.
IN COMBINATIONS WITH AM-FM RADIO, OUTPUT TRANSFORMER AND CHOKE ARE IN RADIO POWER SUPPLY.
IN COMBINATIONS WITH AM ONLY, OUTPUT TRANSFORMER AND CHOKE ARE ON PM SPEAKER.

BOTTOM VIEW OF SOCKET M201

8+ TO C501B, R453 AND L404

6AU6
1ST. IF
V301

6AU6
2ND. IF
V302

6AU6
3RD. IF
V303

6AL5
VIDEO DET. & ACC.
V304

6AU6
VIDEO AMP.
V305

6BG6G
HOR. OUTPUT
V404

6W4GT
V406

1X2
2ND. ANODE RECTIFIER
V405

½12AU7
SYNC. AMP.
V401A

½12AU7
SYNC. SEPARATOR
V401B

½26SN7GT
SYNC. CLIPPER
V203B

½12AU7
VERTICAL OSC.
V402A

½12AU7
VERTICAL OUTPUT
V402B

½26SN7GT
HOR. OSC. CONTROL
V403A

½26SN7GT
HOR. OSC.
V403B

5U4G
LOW VOLTAGE RECT.
V501

12LP4
V306

T403A VERTICAL DEFLECTION YOKE 68Ω TOTAL

T403B HORIZONTAL DEFLECTION YOKE 14Ω TOTAL

9000V.

PINS 1,4,6 CONNECTED TO TOP OF C426

TO 2ND. ANODE

1X2 FILAMENT VOLTAGE

BOTTOM VIEW OF 1X2 SOCKET CONNECTIONS

SEE PARTS LIST

VOLTAGE WILL VARY WITH SETTING OF SLUG T404

SPEAKER FIELD IN "TV ONLY" SETS. CHOKE IN COMBINATIONS. SEE NOTE ABOVE AT SPEAKER.

HORIZONTAL DRIVE

HOR. LINEARITY

FOCUS

BRIGHTNESS

PICTURE

VOLUME

HEIGHT

VERTICAL HOLD

VERTICAL LIN

HORIZONTAL HOLD

HOR. LOCK-IN RANGE

HOR. FREQ. LOCK

WIDTH

ON-OFF SWITCH SW501

PILOT LIGHT #47

M501 M502 M503 M504

L101A L101B L102A L102B L102C L104 L103 L105 L306 L308 L301 L302 L303 L304 L305 L401 L402 L403 L404

T501 T301 T302 T303 T401 T402 T404 T405

L201 L202 L203 L204 L205 L206 L207 L208 L209 L210 L211 L212 L213 L214 L215

R101 R102 R103 R104 R105 R106 R107 R108 R109 R110 R111 R112 R113 R114 R115 R116 R117 R118 R119 R120 R121 R122 R123 R124 R125 R126 R127 R128 R129 R130 R131 R132 R133 R134 R135 R136 R137 R138 R139 R140 R141 R142 R143 R144 R145 R146 R147 R148 R149 R150 R151 R152 R153 R154 R155 R156 R157 R158 R159 R160 R161 R162 R163 R164 R165 R166 R167 R168 R169 R170 R171 R172 R173 R174 R175 R176 R177 R178 R179 R180 R181 R182 R183 R184 R185 R186 R187 R188 R189 R190 R191 R192 R193 R194 R195 R196 R197 R198 R199 R200 R201 R202 R203 R204 R205 R206 R207 R208 R209 R210 R211 R212 R213 R214 R215 R216 R217 R218 R219 R220 R221 R222 R223 R224 R225 R226 R227 R228 R229 R230 R231 R232 R233 R234 R235 R236 R237 R238 R239 R240 R241 R242 R243 R244 R245 R246 R247 R248 R249 R250 R251 R252 R253 R254 R255 R256 R257 R258 R259 R260 R261 R262 R263 R264 R265 R266 R267 R268 R269 R270 R271 R272 R273 R274 R275 R276 R277 R278 R279 R280 R281 R282 R283 R284 R285 R286 R287 R288 R289 R290 R291 R292 R293 R294 R295 R296 R297 R298 R299 R300 R301 R302 R303 R304 R305 R306 R307 R308 R309 R310 R311 R312 R313 R314 R315 R316 R317 R318 R319 R320 R321 R322 R323 R324 R325 R326 R327 R328 R329 R330 R331 R332 R333 R334 R335 R336 R337 R338 R339 R340 R341 R342 R343 R344 R345 R346 R347 R348 R349 R350 R351 R352 R353 R354 R355 R356 R357 R358 R359 R360 R361 R362 R363 R364 R365 R366 R367 R368 R369 R370 R371 R372 R373 R374 R375 R376 R377 R378 R379 R380 R381 R382 R383 R384 R385 R386 R387 R388 R389 R390 R391 R392 R393 R394 R395 R396 R397 R398 R399 R400 R401 R402 R403 R404 R405 R406 R407 R408 R409 R410 R411 R412 R413 R414 R415 R416 R417 R418 R419 R420 R421 R422 R423 R424 R425 R426 R427 R428 R429 R430 R431 R432 R433 R434 R435 R436 R437 R438 R439 R440 R441 R442 R443 R444 R445 R446 R447 R448 R449 R450 R451 R452 R453 R454 R455 R456 R457 R458 R459 R460 R461 R462 R463 R464 R465 R466 R467 R468 R469 R470 R471 R472 R473 R474 R475 R476 R477 R478 R479 R480 R481 R482 R483 R484 R485 R486 R487 R488 R489 R490 R491 R492 R493 R494 R495 R496 R497 R498 R499 R500 R501 R502 R503 R504 R505 R506 R507 R508 R509 R510 R511 R512 R513 R514 R515 R516 R517 R518 R519 R520 R521 R522 R523 R524 R525 R526 R527 R528 R529 R530 R531 R532 R533 R534 R535 R536 R537 R538 R539 R540 R541 R542 R543 R544 R545 R546 R547 R548 R549 R550 R551 R552 R553 R554 R555 R556 R557 R558 R559 R560 R561 R562 R563 R564 R565 R566 R567 R568 R569 R570 R571 R572 R573 R574 R575 R576 R577 R578 R579 R580 R581 R582 R583 R584 R585 R586 R587 R588 R589 R590 R591 R592 R593 R594 R595 R596 R597 R598 R599 R600 R601 R602 R603 R604 R605 R606 R607 R608 R609 R610 R611 R612 R613 R614 R615 R616 R617 R618 R619 R620 R621 R622 R623 R624 R625 R626 R627 R628 R629 R630 R631 R632 R633 R634 R635 R636 R637 R638 R639 R640 R641 R642 R643 R644 R645 R646 R647 R648 R649 R650 R651 R652 R653 R654 R655 R656 R657 R658 R659 R660 R661 R662 R663 R664 R665 R666 R667 R668 R669 R670 R671 R672 R673 R674 R675 R676 R677 R678 R679 R680 R681 R682 R683 R684 R685 R686 R687 R688 R689 R690 R691 R692 R693 R694 R695 R696 R697 R698 R699 R700 R701 R702 R703 R704 R705 R706 R707 R708 R709 R710 R711 R712 R713 R714 R715 R716 R717 R718 R719 R720 R721 R722 R723 R724 R725 R726 R727 R728 R729 R730 R731 R732 R733 R734 R735 R736 R737 R738 R739 R740 R741 R742 R743 R744 R745 R746 R747 R748 R749 R750 R751 R752 R753 R754 R755 R756 R757 R758 R759 R760 R761 R762 R763 R764 R765 R766 R767 R768 R769 R770 R771 R772 R773 R774 R775 R776 R777 R778 R779 R780 R781 R782 R783 R784 R785 R786 R787 R788 R789 R790 R791 R792 R793 R794 R795 R796 R797 R798 R799 R800 R801 R802 R803 R804 R805 R806 R807 R808 R809 R810 R811 R812 R813 R814 R815 R816 R817 R818 R819 R820 R821 R822 R823 R824 R825 R826 R827 R828 R829 R830 R831 R832 R833 R834 R835 R836 R837 R838 R839 R840 R841 R842 R843 R844 R845 R846 R847 R848 R849 R850 R851 R852 R853 R854 R855 R856 R857 R858 R859 R860 R861 R862 R863 R864 R865 R866 R867 R868 R869 R870 R871 R872 R873 R874 R875 R876 R877 R878 R879 R880 R881 R882 R883 R884 R885 R886 R887 R888 R889 R890 R891 R892 R893 R894 R895 R896 R897 R898 R899 R900 R901 R902 R903 R904 R905 R906 R907 R908 R909 R910 R911 R912 R913 R914 R915 R916 R917 R918 R919 R920 R921 R922 R923 R924 R925 R926 R927 R928 R929 R930 R931 R932 R933 R934 R935 R936 R937 R938 R939 R940 R941 R942 R943 R944 R945 R946 R947 R948 R949 R950 R951 R952 R953 R954 R955 R956 R957 R958 R959 R960 R961 R962 R963 R964 R965 R966 R967 R968 R969 R970 R971 R972 R973 R974 R975 R976 R977 R978 R979 R980 R981 R982 R983 R984 R985 R986 R987 R988 R989 R990 R991 R992 R993 R994 R995 R996 R997 R998 R999 R1000

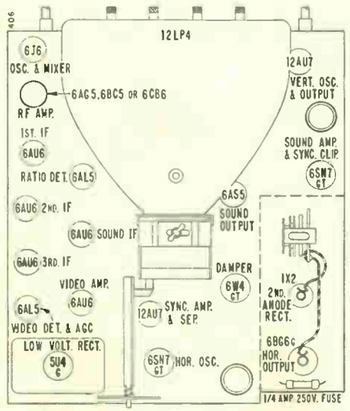
C101 C102 C103 C104 C105 C106 C107 C108 C109 C110 C111 C112 C113 C114 C115 C116 C117 C118 C119 C120 C121 C122 C123 C124 C125 C126 C127 C128 C129 C130 C131 C132 C133 C134 C135 C136 C137 C138 C139 C140 C141 C142 C143 C144 C145 C146 C147 C148 C149 C150 C151 C152 C153 C154 C155 C156 C157 C158 C159 C160 C161 C162 C163 C164 C165 C166 C167 C168 C169 C170 C171 C172 C173 C174 C175 C176 C177 C178 C179 C180 C181 C182 C183 C184 C185 C186 C187 C188 C189 C190 C191 C192 C193 C194 C195 C196 C197 C198 C199 C200 C201 C202 C203 C204 C205 C206 C207 C208 C209 C210 C211 C212 C213 C214 C215 C216 C217 C218 C219 C220 C221 C222 C223 C224 C225 C226 C227 C228 C229 C230 C231 C232 C233 C234 C235 C236 C237 C238 C239 C240 C241 C242 C243 C244 C245 C246 C247 C248 C249 C250 C251 C252 C253 C254 C255 C256 C257 C258 C259 C260 C261 C262 C263 C264 C265 C266 C267 C268 C269 C270 C271 C272 C273 C274 C275 C276 C277 C278 C279 C280 C281 C282 C283 C284 C285 C286 C287 C288 C289 C290 C291 C292 C293 C294 C295 C296 C297 C298 C299 C300 C301 C302 C303 C304 C305 C306 C307 C308 C309 C310 C311 C312 C313 C314 C315 C316 C317 C318 C319 C320 C321 C322 C323 C324 C325 C326 C327 C328 C329 C330 C331 C332 C333 C334 C335 C336 C337 C338 C339 C340 C341 C342 C343 C344 C345 C346 C347 C348 C349 C350 C351 C352 C353 C354 C355 C356 C357 C358 C359 C360 C361 C362 C363 C364 C365 C366 C367 C368 C369 C370 C371 C372 C373 C374 C375 C376 C377 C378 C379 C380 C381 C382 C383 C384 C385 C386 C387 C388 C389 C390 C391 C392 C393 C394 C395 C396 C397 C398 C399 C400 C401 C402 C403 C404 C405 C406 C407 C408 C409 C410 C411 C412 C413 C414 C415 C416 C417 C418 C419 C420 C421 C422 C423 C424 C425 C426 C427 C428 C429 C430 C431 C432 C433 C434 C435 C436 C437 C438 C439 C440 C441 C442 C443 C444 C445 C446 C447 C448 C449 C450 C451 C452 C453 C454 C455 C456 C457 C458 C459 C460 C461 C462 C463 C464 C465 C466 C467 C468 C469 C470 C471 C472 C473 C474 C475 C476 C477 C478 C479 C480 C481 C482 C483 C484 C485 C486 C487 C488 C489 C490 C491 C492 C493 C494 C495 C496 C497 C498 C499 C500 C501 C502 C503 C504 C505 C506 C507 C508 C509 C510 C511 C512 C513 C514 C515 C516 C517 C518 C519 C520 C521 C522 C523 C524 C525 C526 C527 C528 C529 C530 C531 C532 C533 C534 C535 C536 C537 C538 C539 C540 C541 C542 C543 C544 C545 C546 C547 C548 C549 C550 C551 C552 C553 C554 C555 C556 C557 C558 C559 C560 C561 C562 C563 C564 C565 C566 C567 C568 C569 C570 C571 C572 C573 C574 C575 C576 C577 C578 C579 C580 C581 C582 C583 C584 C585 C586 C587 C588 C589 C590 C591 C592 C593 C594 C595 C596 C597 C598 C599 C600 C601 C602 C603 C604 C605 C606 C607 C608 C609 C610 C611 C612 C613 C614 C615 C616 C617 C618 C619 C620 C621 C622 C623 C624 C625 C626 C627 C628 C629 C630 C631 C632 C633 C634 C635 C636 C637 C638 C639 C640 C641 C642 C643 C644 C645 C646 C647 C648 C649 C650 C651 C652 C653 C654 C655 C656 C657 C658 C659 C660 C661 C662 C663 C664 C665 C666 C667 C668 C669 C670 C671 C672 C673 C674 C675 C676 C677 C678 C679 C680 C681 C682 C683 C684 C685 C686 C687 C688 C689 C690 C691 C692 C693 C694 C695 C696 C697 C698 C699 C700 C701 C702 C703 C704 C705 C706 C707 C708 C709 C710 C711 C712 C713 C714 C715 C716 C717 C718 C719 C720 C721 C722 C723 C724 C725 C726 C727 C728 C729 C730 C731 C732 C733 C734 C735 C736 C737 C738 C739 C740 C741 C742 C743 C744 C745 C746 C747 C748 C749 C750 C751 C752 C753 C754 C755 C756 C757 C758 C759 C760 C761 C762 C763 C764 C765 C766 C767 C768 C769 C770 C771 C772 C773 C774 C775 C776 C777 C778 C779 C780 C781 C782 C783 C784 C785 C786 C787 C788 C789 C790 C791 C792 C793 C794 C795 C796 C797 C798 C799 C800 C801 C802 C803 C804 C805 C806 C807 C808 C809 C810 C811 C812 C813 C814 C815 C816 C817 C818 C819 C820 C821 C822 C823 C824 C825 C826 C827 C828 C829 C830 C831 C832 C833 C834 C835 C836 C837 C838 C839 C840 C841 C842 C843 C844 C845 C846 C847 C848 C849 C850 C851 C852 C853 C854 C855 C856 C857 C858 C859 C860 C861 C862 C863 C864 C865 C866 C867 C868 C869 C870 C871 C872 C873 C874 C875 C876 C877 C878 C879 C880 C881 C882 C883 C884 C885 C886 C887 C888 C889 C890 C891 C892 C893 C894 C895 C896 C897 C898 C899 C900 C901 C902 C903 C904 C905 C906 C907 C908 C909 C910 C911 C912 C913 C914 C915 C916 C917 C918 C919 C920 C921 C922 C923 C924 C925 C926 C927 C928 C929 C930 C931 C932 C933 C934 C935 C936 C937 C938 C939 C940 C941 C942 C943 C944 C945 C946 C947 C948 C949 C950 C951 C952 C953 C954 C955 C956 C957 C958 C959 C960 C961 C962 C963 C964 C965 C966 C967 C968 C969 C970 C971 C972 C973 C974 C975 C976 C977 C978 C979 C980 C981 C982 C983 C984 C985 C986 C987 C988 C989 C990 C991 C992 C993 C994 C995 C996 C997 C998 C999 C1000

M401 FUSE 1/4 A. 250V.

NOTES

NUMERICAL SYMBOLS (2), (3), ETC. INDICATE A PRODUCTION CHANGE. THESE RUN NUMBERS ARE RUBBER STAMPED AT REAR OF CHASSIS

ALPHABETICAL SYMBOLS (A1), (A2)....(Y), (Z) ETC. INDICATE ALIGNMENT POINTS AND CONNECTIONS.



Top View of Chassis Showing Tube Location.

Figure 83. Schematic For 20Z1 Television Chassis

PRODUCTION CHANGES

At the start of production, chassis were not stamped with a run number. Production changes are coded RUN 1, RUN 2, etc., as given in the headings below. Run number stamped on chassis indicates that this chassis has the change(s) incorporated which are explained under that particulat run number heading below, as well as all changes (lower run numbers) made prior to that time.

Note that numerical symbols ①,②,③, etc., on the schematic indicate run numbers (production chanaes) for chassis with round picture tubes. Numerical symbols 1, 2, 3, *etc., indicate run numbers (production changes) for chassis with rectangular picture tubes.*

RUN 1 in 24H1
and
RUN 2 in 24D1, 24E1, 24F1, 24G1

Alignment point "S" changed. Test jack connector for injection of the 4.5 MC signal as explained in step 10 in the "IF Amplifier and Trap Alignment" was changed from junction of L303, to plate (pin 7) of the video detector V304. This resulted in a more definite dip at 4.5 MC when aligning the 4.5 MC trap (L303 and C307).

RUN 1 in 24D1, 24E1, 24F1, 24G1

Voltage rating of C214 increased. Condenser C214 was changed from .0022 mfd, 600 volts to a .0022 mfd, 1000 volts (part number 64A2-11) to prevent breakdown.

RUN 2 in 24H1

R322 decreased in value to increase brightness control range. Picture tube brightness range was increased by changing resistor R322 from 100,000 ohms, ½ watt to 33,000 ohms, ½ watt (part number 60B8-333). With this change, the Brightness control will completely cut off the picture tube beam current when the Picture control is advanced all the way.

RUN 3 in 24D1, 24E1, 24F1, 24G1

Current limiting resistor (R328) deleted to improve focus. Due to variations in tube characteristics of short-neck picture tubes, it was necessary to add R328 (22,000 ohms, 2 watt) to some receivers produced before RUN 3. Other receivers did not have this resistor. In a few sets, a compromise resistor of 15,000 ohms was used.

If difficulty in focus is encountered in any chassis (either earlier or later than Run 3), determine if resistor R328 is necessary by checking as follows:

a. Picture will focus only with focus control all the way to the right (clock-wise). Add R328 (22,000 ohms, 5 watt, part number 60B20-223).

b. Picture will focus with focus control all the way to the left (counter-clockwise). Remove R328. If adding or removing R328 does not help, try changing the 6V6GT audio output tube (V205).

RUN 3 in 24H1

Interlock bracket changed. The 2nd anode housing was changed so that the line cord will pull away from the plug interlock and break the primary circuit of the power transformer when the 2nd anode housing cover is opened, thus preventing possibility of shock.

RUN 4 in 24D1, 24E1, 24F1, 24G1

Audio amplifier circuit changed. The 6SQ7 audio amplifier previously used (as shown under "Audio Amplifier Circuit in Early Sets" at right of schematic) in the 24D1, 24E1, 24F1, 24G1 chassis was deleted and replaced by a 6AU6 tube and circuit as shown on schematic.

R322 decreased in value to increase brightness control range. Picture tube brightness range was increased by changing resistor R322 from 100,000 ohms, ½ watt to 33,000 ohms, ½ watt (part number 60B8-333). With this change, the Brightness control can be made to completely cut off the picture tube beam current when the Picture control is advanced all the way.

RUN 4 in 24H1
and
RUN 5 in 24D1, 24E1, 24F1, 24G1

Resistor R448 added to 6CD6 screen grid to reduce parasitics. A 100 ohm, ½ watt resistor R448 (part number 60B8-101) was added to the 6CD6 screen grid as shown in schematic to reduce parasitic oscillations in this circuit. These oscillations will generally cause a double image with a "wavy" effect.

Do not confuse this condition with the "continual ripple" explained under "Copper Band Added To Power Transformer To Eliminate Picture Ripple".

RUN 5 in 24H1

R503 added to prevent static charge on chassis. A 270,000 ohm, ½ watt resistor R503 (part number 60B8-274) was added from one side of the 117 volt AC line to ground to provide a DC return for any static charge that might built up on the chassis.

RUN 6 in 24D1, 24E1, 24F1, 24G1

Interlock bracket changed. The 2nd anode housing was changed so that the line cord will pull away from the plug interlock and break the primary circuit of the power transformer when the 2nd anode housing cover is opened thus preventing possibility of shock.

RUN 7 in 24D1, 24E1

Picture tube and focus coil mounting bracket changed to improve picture centering. The picture tube and focus coil mounting brackets (top and bottom) were changed to improve picture centering. Early mounting brackets had a tendency to tilt backward slightly, making it difficult to bring the raster down enough to fill the picture window. See parts list for early and late top and bottom picture tube and focus coil mounting brackets.

RUN 7 in 24F1, 24G1

High voltage compartment changed. The high voltage compartment was changed so that the cover could be removed easily without removing the chassis. This change was only necessary on these chassis due to their mounting arrangement in the cabinet.

RUN 8 in 24E1, 24G1

Jumper wire added to socket M504 to accommodate 5D2 radio. A jumper wire was added between pins "M" and "N" of socket M504 to supply plate voltage to the extra lead on the 5D2 radio. The 5B2 radio connecting cable has 8 leads, and the 5D2 radio has 9.

24D1, 24E1, 24F1, 24G1, 24H1, 5B2, 5D2
RUN 8 in 24D1, 24F1

R503 added to prevent static charge on chassis. A 270,000 ohm, ½ watt resistor R503 (part number 60B8-274) was added from one side of the 117 volt AC line to ground to provide a DC return for any static charge that might build up on the chassis.

RUN 9 in 24E1, 24G1

R503 added to prevent static charge on chassis. A 270,000 ohm, ½ watt resistor R503 (part number 60B8-274) was added from one side of the 117 volt AC line to ground to provide a DC return for any static charge that might build up on the chassis.

R504 added to limit jewel light current. A 3.3 ohm, ½ watt resistor (part number 60B28-10) was added in series with jewel light M508 to limit current.

RUN 9 in 24F1
and
RUN 10 in 24G1

Picture tube and focus coil mounting bracket changed to improve picture centering. The picture tube and focus coil mounting brackets (top and bottom) were changed to improve picture centering. Early mounting brackets have a tendency to tilt backward slightly, making it difficult to bring the raster down enough to fill the picture window. See parts list for early and late top and bottom picture tube and focus coil mounting brackets.

RUN 6 in 24H1
and
RUN 9 in 24D1
RUN 10 in 24E1, 24F1
RUN 11 in 24G1

Traps added to eliminate possibility of adjacent channel interference. Two adjacent channel traps L309 (27.25 MC) and L310 (19.75 MC) were added between the output of the TV tuner and the input of the 1st Video IF amplifier V301 (6AU6). This was done to eliminate the possibility of interference from the video carrier of the adjacent channel above and the sound carrier of the adjacent channel below.

This interference might be evident if two stations are operating on adjacent channels in the same locality, especially when the wanted station is weaker than the interfering station.

Adjacent channel interference may take either of these two forms:

Adjacent Channel Video Interference. The picture has an interference pattern produced by the video carrier of the adjacent HIGHER channel. Sometimes the interference will appear as a superimposed picture (stationary or moving slowly); at other times it may appear as a number of diagonal lines or as a vertical moving bar.

Adjacent Channel Sound Interference. The picture has a herringbone interference pattern produced by the sound carrier of the adjacent LOWER channel. Close examination will often reveal that the fine lines of the herringbone pattern vary in accordance with the speech or music on the adjacent lower channel. This can be checked by quickly turning the channel selector to this station.

Since these types of interference effects can be produced by other sources of interference, and also by misalignment of the video IF's and traps

trouble from these saurces should be checked before deciding traps are required.

The 19.75 MC trap will remove adjacent channel video interference, and the 27.25 MC trap will remove adjacent channel saund interference.

A complete Adjacent Channel Trap Assembly (includes L309, L310, C313, C314 and mounting bracket) is supplied under part number A3320.

To install the adjacent channel trap assembly, proceed as follows:

Fit the legs af the bracket over candenser C426 so that the left mounting foot lines up with the unused hole in the chassis (to the left of C426). See illustration. Secure the left mounting foot to the chassis with a No. 8-¼" self tapping screw. Spot solder the other mounting foot to the chas. sis to save drilling a new hole.

Unsolder L301 from the TV tuner output and solder it to the empty lug on the assembly. It may be neccessary to extend the lead on L301 with a small piece of wire. Connect the base lead from the other lug to the tuner output lug.

The traps will cause the 25.75 MC marker to move slightly. This will not make any noticeable difference in the picture, but slight adjustment (not more than one turn in either direction) of slug A7 (25.3 MC coil) will bring it to its proper location.

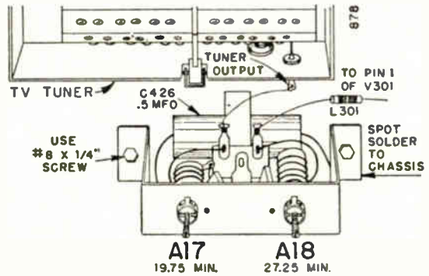


Figure 28. Bottom of Chassis, Showing Adjacent Channel Traps.

COPPER BAND (PAINTED BLACK) ADDED TO POWER TRANSFORMER TO ELIMINATE PICTURE RIPPLE

To reduce 60 cycle pickup, which produced a continual very slowly moving "wiggle" or ripple in the picture, a 2-inch copper band (painted black) was added to each side of the power transformer T501. This condition is only possible in areas where the power saurce for the statian is different than for the receiver. If this difficulty is encountered, try a similar shield on these early tra nsformers, or if necessary, replace with new transformer. All service replacement transformers will have the 2-inch copper band on each side.

Note that the power transformer is mounted on tap of the chassis in early production sets, and is maunted underneath on later production sets.

PICTURE WINDOW GROUNDED TO ELIMINATE STATIC CHARGE

A ground wire and spring clip are used in all but early production sets. with raund picture tubes, ta eliminate any static charge that might be present on the picture window, cabinet, ar cantrol escutcheon, which might also result in carona effects.

These early picture windows (part number 23D61 for 16-inch sets and part number 23E62 for 19-inch sets) can be grounded by connecting ordinary braided shield fram the maunting screw on the lower right hand corner of the picture window ta chassis.

HORIZONTAL OSCILLATOR CATHODE RESISTOR R430 CHANGED

Resistor R430, which is used for feedback from one section of the horizontal oscillator to the other, was changed in some sets from 1500 ohms to 1600 ohms. It is preferable to have a resistance of 1600 ohms in this circuit, however, in most chassis a resistance of near 1600 ohms was obtained by using 1500 ahms resistors with a positive tolerance. If this resistance is lower than specified, the horizontal linearity will change to a large degree with different Horizontal Hald settings.

ARCING FROM 6S4 TUBE SOCKET TO CHASSIS

In early sets, arcing might occur between pin 9 of the 6S4 vertical output tube socket and ground. This will cause damage to the socket and to the 2,200 ohm, 2 watt dropping resistor R417. If this happens, replace the socket with later productian socket, part number 87A25-3. Also replace resistor R417, part number 60B14-222, even though it might check OK with an ohmmeter.

SHIELD ADDED BETWEEN VERTICAL OSCILLATOR TUBE (V402) AND AUDIO OUTPUT TUBE (V205)

A shield was added between the vertical oscillator tube and audio output tube to prevent possibility of 60-cycle (vertical repetition rate) pick-up in the audio amplifier and audio output section. This shield (part number 15B625) is in all 24H1 chassis, and holes are available on early 24D1, 24E1, 24F1, 24G1 chassis. Use two No. 8-32 self-tapping screws for mounting the shield.

CHASSIS MOUNTING BOLT SHORT CIRCUITING WIDTH CONTROL T405 in 24D1, 24F1 CHASSIS

In early production "television only" models, the chassis is maunted on a mounting board with 1¼" mounting bolts. The mounting bolt near the "Horiz. Width" control might short circuit the width control, resulting in insufficient width, horizontal non-linearity, and loss of picture brightness, or no raster at all.

To correct, pull the mounting board four or five inches out of the cabinet to remove the mounting bolt, then place four ar five washers under the bolt head. Late production sets use a shorter bolt.

When installing chassis, do not use a sharp pointed tool for locating this mounting hole, as width control winding might be damaged.

MOUNTING OF C435 CHANGED

In early sets, the 2nd anode filter condenser C435 (500 mmfd., 20,000 volts, ceramic) used a tapped screw hole maunting at one end and a threaded stud an the other end. In later sets, C435 uses threaded studs on both ends of the candenser.

FM IF AND RATIO DETECTOR ALIGNMENT

- Keep VTVM leads well separated from signal generator leads and chassis wiring.
- Band switch in FM position.
- While peaking IF's, keep reducing signal generator output so VTVM reading is approximately —1.5 volts DC with exception of Step #5.
- FM antenna disconnected during alignment.
- Trimmer adjustments "G", "H" and "J" made from underside of chassis.

Step	Connect Signal Generator	Generator Frequency	Receiver Dial Setting	Output Connections	Adjust (very carefully)
Before proceeding, be sure to follow the instructions given under "Important Preliminary Alignment Steps."					
1	Thru .001 cond. to pin #1 of 6BA6 2nd IF (Ground to chassis, close to tube).	‡10.7 MC	Tuning gang wide open	Connect VTVM (DC probe) from point "P" to chassis.	"G" (ratio detector primary) for maximum reading on VTVM.
2	**Thru .001 cond. to pin #1 of 6BA6 1st IF. (Ground to chassis, close to tube).	"	"	"	"H" and "I" (2nd IF trans.) for maximum reading on VTVM.
3	Across ends of FM antenna twin lead.	"	"	"	"J" and "K" (1st IF trans.) for maximum on VTVM. Readjust G, H, I, J, K, for maximum. (Keep reducing generator output to keep VTVM at 1.5 volts.)
4	"	a. Reduce output of signal generator until VTVM reads EXACTLY —1.5 volts DC. b. Tune generator frequency above 10.7 MC until VTVM reads EXACTLY —1.0 volt. Note EXACT generator frequency. Extreme care in reading this is essential. c. Tune generator frequency below 10.7 MC until VTVM reads EXACTLY —1.0 volt. Note EXACT generator frequency. Extreme care in reading this is essential. d. Add generator frequency in step c to generator frequency in step b and divide by 2. The result is the center frequency of the IF curve to be used in step 5. See example under heading "Setting Signal Generator to Center of IF Selectivity Curve." e. Tune generator frequency above and below 10.7 MC and note voltage reading on VTVM at different frequency points until you have a good impression of the shape of the selectivity curve. If you have two peaks as in Figures D or E, note readings (voltage) of both peaks. If one peak is over 20% higher than the other one, it will be necessary to realign IF's. A selectivity curve that would require realignment is illustrated by Figure F.			
5	"	Center of IF selectivity curve per step 4d above.	Tuning gang wide open	Connect VTVM (DC probe) from point "R" to chassis. Use zero center scale if available.	"L" (ratio detector secondary) for zero voltage reading on VTVM. (The correct zero point is located between a positive and a negative maximum.)
If any of the above adjustments were very far off it is desirable to repeat steps 3, 4 and 5.					

** Do not feed IF signal into converter grid as this will cause mis-alignment.
‡ Signal may be unmodulated or 400 cycle AM modulated.

SETTING SIGNAL GENERATOR TO CENTER OF IF SELECTIVITY CURVE

CAUTION: Due to the difficulty of setting a signal generator to the accuracy required by this operation, extreme care must be exercised in making each setting. Otherwise, improper alignment of the ratio detector and consequent audio distortion will result.

EXAMPLE: (See Figures A and B)
Voltage reading in step 4a is —1.5 volt.

Generator frequency on low side of 10.7 MC for a reading of —1 volt DC =10.640 MC.

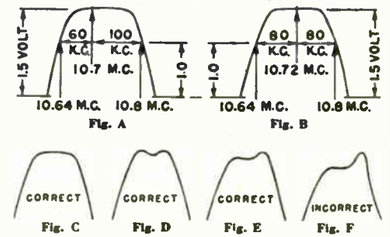
Generator frequency on high side of 10.7 MC for a reading of —1 volt DC =10.800 MC.

Center frequency is obtained by adding 10.640 and 10.800, then dividing by 2. For these readings it will be 10.72 MC.

Set generator frequency to 10.72 MC as this is center of selectivity curve as shown in Figure B.

Note: Numerical vernier dial readings may be used instead of MC.

TYPICAL SELECTIVITY CURVES



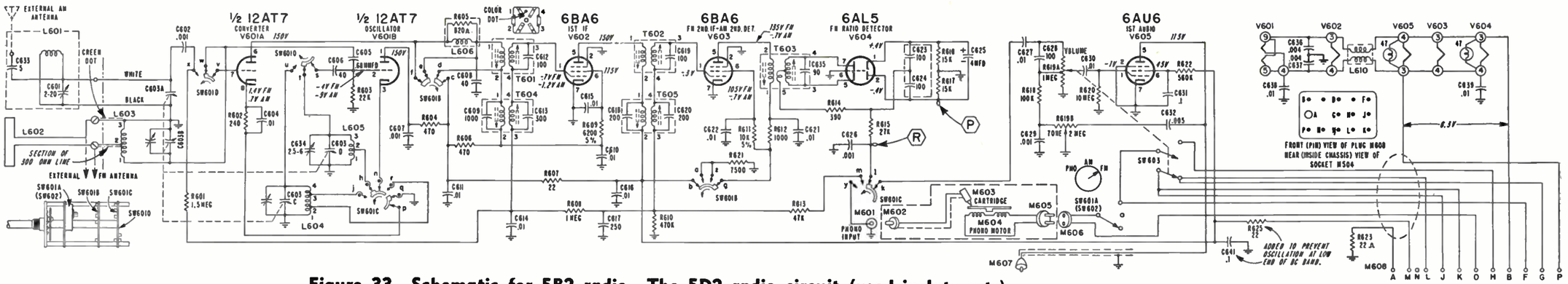


Figure 33. Schematic for 5B2 radio. The 5D2 radio circuit (used in late sets)

Note: Resistance value of volume control R619A should be 2 megohms instead of 1 megohm as shown in the above schematic.

5B2, 5D2 RADIO (AM-FM)

5B2 and 5D2 differences discussed in "Radio Chassis Notes" on page 3.

SWITCHING IN COMBINATION MODELS

If the television and radio are turned on at the same time, neither unit will operate. For details, see "Switching In Combination Models" on page 13.

SERVICING RADIO SEPARATELY

See discussion near schematic on preceding page.

R640 and C653 ADDED TO 5B2 RADIO TO PREVENT OSCILLATION

In the 5B2 radio chassis, R640 (22 ohms, ½ watt, part 60B8-220) was added in series with the B+ lead going to pin "M" on plug M608. C653 (.1 mfd, 400 volts, part 64B1-20) was connected between R640 and the B+ lead to chassis ground. This change was made to prevent oscillation on the low end of the AM band.

SENSITIVITY IMPROVED IN 5D2 RADIO

To improve the sensitivity of the 5D2 radio, the 1st IF transformers in the AM and FM stages were changed.

The 1st AM-IF transformer (T604) used in early sets, part 72B97 has been replaced with part 72B97-1.

The 1st FM-IF transformer (T601) used in early sets, part 72B98 has been replaced with part 72B98-1.

To accommodate this change of the IF transformers, C608 condenser has been changed from 40 mmfd (part 65B1-65) to 30 mmfd (part 65B1-69); R602 has been changed from 240 ohms 5%, ½ watt (part 60B7-241) to 1,500 ohms, ½ watt (part 60B8-152).

Important: All changes mentioned above must be made when replacing early IF transformers with late IF transformers.

REMOVING RECORD CHANGER

Remove by merely lifting it off its float springs.

REMOVING RADIO CHASSIS FOR SERVICING

The complete Radio-Phono unit does not need to be removed unless the Tilt-Out, or Slide-Out mechanisms need repair. The Tilt-Out mechanism is released by springing each of the four tilt-out hinge arms away from the unit's sides. The Slide-Out mechanism is removed in a conventional manner.

The radio tubes can be serviced from the top of the chassis by merely lifting the record changer up from the front. Be sure that the two shipping screws, one on each side of the changer pan, have been removed at time of installation. These screws should be retained in case of future moving or shipping.

To remove the radio chassis for complete alignment or for servicing the underside of the chassis, proceed as follows:

a. Remove the radio mounting screws at the sides and at the seams on the underside of the housing. Pull the radio chassis down and forward until you can reach in and unplug the phono connector plugs.
b. Remove the tuning knobs; remove the radio escutcheon and the front housing by removing the five screws at the bottom of the housing.
c. Position the dial drum as shown in Figure 34. Unhook spring at "A", and while keeping tension on the dial cord, hook it to tab "B".
d. Remove the six hex-head screws "C" which hold chassis cover and dial scale to chassis.
e. After removing the pilot light brackets and hex nut "D" and "E", the chassis front can be pulled away from the chassis. All trimmers and parts are now accessible.

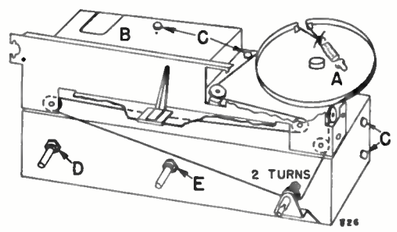


Figure 34. Radio Chassis With Front Housing Removed.

AM-FM RADIO ALIGNMENT

FM ALIGNMENT EQUIPMENT

FM circuits should be aligned only with an AM signal generator and a vacuum tube voltmeter. Any standard vacuum tube voltmeter with a DC scale of not over 5 volts is suitable. A 3-volt zero center scale is desirable. A signal generator with a fundamental frequency range up to 110 MC is desirable. It is possible however, to align the receiver with a signal generator going up to 20 or 30 megacycles, by using the harmonics of these lower frequencies. To do this merely set the signal generator dial as indicated in the next paragraph and align exactly as explained in the alignment instructions.

Where alignment chart specifies 109 MC, 106 MC, 92 MC or 87 MC, set generator to the highest available frequency shown in the column under that frequency:

109. MC	106, MC	92. MC	87. MC
54.50MC	53. MC	46. MC	43.5 MC
36.33MC	35.33MC	30.66MC	29. MC
27.55MC	26.5 MC	23. MC	21.75MC
21.80MC	21.2 MC	18.4 MC	17.4 MC
18.17MC	17.66MC	15.33MC	14.5 MC

IMPORTANT PRELIMINARY ALIGNMENT STEPS

Under normal operating conditions or use, misalignment of RF or IF circuits with age will be slight. Lack of sensitivity and poor tone quality may be due to causes other than alignment. Do not attempt to realign the receiver until all other possible causes have first been thoroughly investigated.

In FM alignment, it is essential that every step be followed. Especially important is picking the center of the IF curve (step 4 in the FM-IF alignment instructions). During this portion of the alignment it is necessary to tune the signal generator very carefully; it may necessitate having to estimate the dial readings to a tenth of a division.

When completely aligning the FM circuit, it is essential to follow the sequence of steps in the chart. If only a portion of the FM circuit is being aligned, be sure to follow all the remaining steps. AM and FM alignment may be made independently of each other.

For alignment of IF slug adjustments, it will be necessary to disassemble the radio chassis from the escutcheon and housing and also remove the chassis cover and dial scale assembly. See figure 34. NOTE: AM and FM oscillator and antenna trimmers are accessible from top of chassis; disassembly of chassis cover and dial scale will generally not be required.

Disconnect FM antenna from twin lead cable. Stretch twin lead cable to full length during FM RF alignment.

To avoid splitting the slotted head of iron core tuning slugs in the IF transformers, use a non-metallic alignment tool with a ⅛" wide blade. Do not exert undue pressure as threads of slugs may strip.

Be sure both the set and the signal generator are thoroughly warmed up before starting alignment.

AM ALIGNMENT PROCEDURE

- Connect output meter across speaker voice coil.
- Turn receiver Volume control fully on; Tone control fully clockwise.
- Band switch in AM position.
- AM antenna must be connected and placed in the same relative position to the chassis as when in the cabinet.
- Use lowest output setting of signal generator that gives a satisfactory reading on meter.
- Use a non-metallic alignment tool for IF adjustments.
- Repeat adjustments to insure good results.

Step	Connect Signal Generator	Dummy Antenna Between Radio and Signal Generator	Signal Generator Frequency	Receiver Dial Setting	Adj. Trimmers in Following Order to Max.
Before proceeding, be sure to follow instructions under heading "Important Preliminary Alignment Steps".					
1	Gang condenser antenna stator	.1 MFD	455 KC	Tuning gang wide open	*A-B (2nd IF) *C-D (1st IF)
2	"	"	1620 KC	"	E (oscillator)
3	Place generator lead close to loop of set to obtain adequate signal. No actual connection (signal by radiation).		1400 KC	Tune in signal	§F (antenna)

* Adjustments A and C made from underside of chassis.

§ AM antenna trimmer adjustment "F" in step 3 should be repeated after set and antenna have been installed in cabinet Important: AM antenna trimmer may not peak if antenna leads are not properly routed or separated.

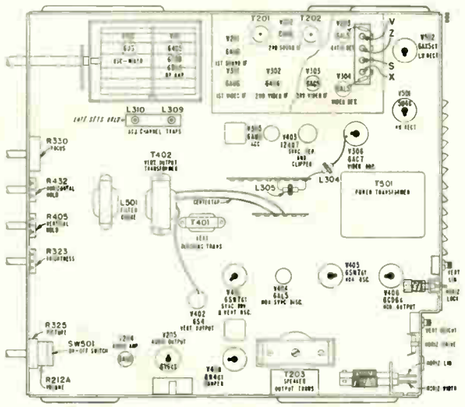


Figure 30. Bottom View of TV Chassis Showing Tube Locations.

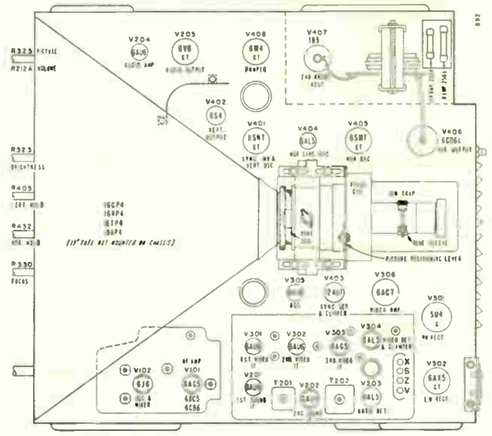


Figure 31. Top View of TV Chassis Showing Tube Locations.

SCHEMATIC NOTE

Run numbers are rubber stamped at rear of chassis and are discussed on page 38.

①, ②, ③, etc. indicate run numbers in 24D1, 24E1, 24F1, 24G1 chassis (round picture tube).

1 2 3 etc. indicate run numbers in 24H1 chassis (rectangular picture tube).

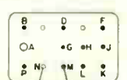
Ⓐ1, Ⓐ2,.....Ⓨ, Ⓩ, etc. indicate alignment points and alignment connections.

SERVICING TV SEPARATELY

In combination models, to service the television chassis with the radio disconnected, it will be necessary to complete the heater circuit by connecting a jumper wire between pins "L" and "K" of socket M504. See schematic.

SERVICING RADIO SEPARATELY

The radio can be operated without the television chassis if a 2PA1 power supply (used in TV-radio-phono models employing the 20Z1 (12") television chassis) is available. The 2PA1 can be used directly with the 5B2 radio. To operate the 5D2 radio, connect a 3,000 ohm, 5 watt resistor (part 61A1-15) from pin "M" to "N" on power supply socket.



3000 OHMS, 5 WATT

Socket, Rear View (Inside Chassis).

TV VOLTAGE DATA
(Voltages given on schematic)

- Picture control turned fully clockwise. CHANNEL control set on an unused channel. Other front controls and Vert. Lin. and Height set at approximately half rotation.
- Voltages marked with an asterisk * will vary widely with control setting. In combination models, B+ voltages in TV chassis will be slightly higher when set is switched to radio position.
- Line voltage 117 volts AC.
- Voltages measured with a vacuum tube voltmeter between tube socket terminals and chassis, unless otherwise indicated.
- Voltages at V101, V102, V306 measured from top of socket with tube removed.
- Antenna disconnected; terminals shorted.
- Under operating conditions, AGC (Automatic Gain Control) voltage developed at pin 1 of V301 (6AU6) should measure approximately —4 volts. This voltage depends on signal strength and Picture control setting.

CAUTION

Pulsed high voltages are present on the cap of the 6CD6 tube, and on the filament terminals and cap of the 1B3/8016 tube. NO ATTEMPT SHOULD BE MADE TO TAKE MEASUREMENTS FROM THESE POINTS UNLESS SUITABLE EQUIPMENT IS AVAILABLE.

Picture tube 2nd anode voltage can be measured from the 2nd anode connector and should be taken only with a high voltage instrument such as a kilovoltmeter. 2nd anode voltage is approximately 13 KV. Proper filament voltage check of the 1B3/8016 tube may be made by observing filament brilliancy as compared with that obtained with a 1.5 volt dry cell battery.

RADIO VOLTAGE DATA
(Voltages given on schematic)

- Line voltage 117 volts AC.
- Voltages measured with a vacuum tube voltmeter, between tube terminals and chassis.
- Voltages measured with band switch on FM position, unless otherwise indicated; an AM reading is given where difference is significant.
- Volume control set at minimum.
- Dial turned to low frequency end.
- Antennas disconnected.

5D2 radio circuit; see 5B2 circuit.

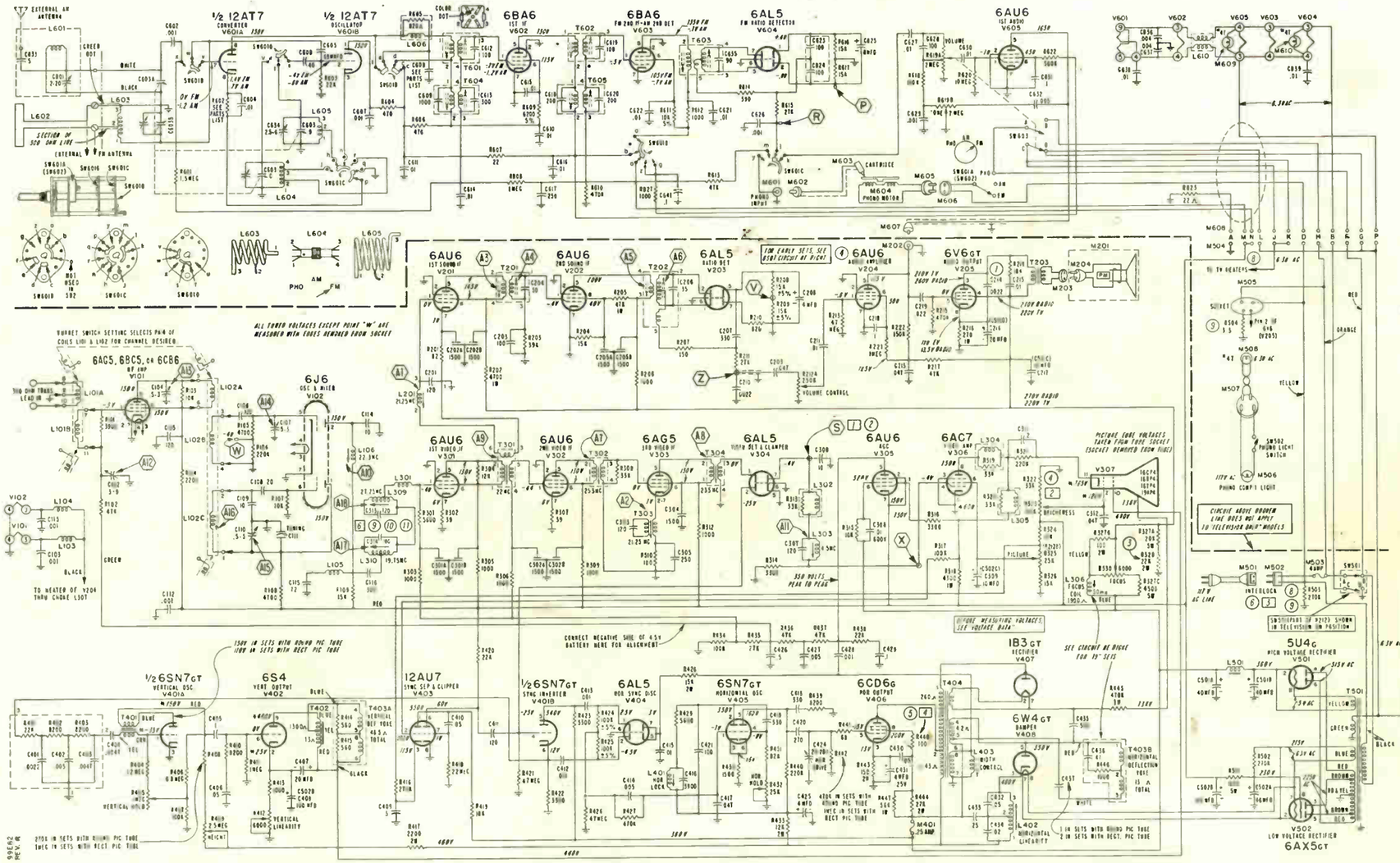


Figure 32. Schematic for 24D1, 24E1, 24F1, 24G1, 24H1 Television Chassis; 5D2 radio circuit and connections also shown. The 5B2 radio circuit (used in early sets)

PRODUCTION CHANGES

Production changes are coded RUN 1, RUN 2, etc,. as given in the headings below. Run number stamped on chassis indicates that this chassis has the change(s) incorporated which are explained under that particular run number heading below, as well as all changes (lower run numbers) made prior to that time. At the start of production, chassis were not stamped with a run number.

Note that numerical symbols [1], [2], [3], etc., on schematic correspond to run numbers stamped at rear of 20V1 chassis. Numerical symbols ①, ②, ③, etc., on schematic correspond to run numbers stamped at rear of 20T1 chassis.

C431 ADDED to INCREASE SWEEP WIDTH

Run 1 in 20V1 Chassis

Condenser C431, .02 mfd, 400 volts (part number 64B5-24) was added across width control L402 to increase sweep width in some sets.

R213 CHANGED to REDUCE SYNC BUZZ and PLATE DISSIPATION

Run 2 in 20V1 Chassis

Resistor R213 was changed from 270 ohms, 1 watt, to 330 ohms, 1 watt (part number 60B14-331). This change was made to reduce sync buzz and to reduce plate dissipation.

RANGE of BRIGHTNESS CONTROL INCREASED

Run 3 in 20V1 Chassis

With some picture tubes, the picture may be too bright even with the brightness control turned fully off Resistor R329, 470,000 ohms, ½ watt (part number 60B8-474) was added across coupling condenser C308 to increase the range of the brightness control. At the same time, the DC reinsertion is also improved.

DIFFERENT SOUND AMPLIFIER TUBE (V203)

Run 4 in 20V1 Chassis, Run 1 in 20T1 Chassis

Early sets used a 6AV6 miniature type tube in the sound amplifier stage V203. Some later production sets use the 6SQ7 tube. Although no circuit changes are necessary, note that the 6SQ7 pin numbering differs from the 6AV6.

DIFFERENT HORIZONTAL OUTPUT (T405) USED

Run 5 in 20V1 Chassis, Run 3 in 20T1 Chassis

In some sets, Horizontal Output Transformer T405, is part number 79C32-1, which requires a 1.8 ohm resistor (R440) in series with pin 2 (filament) of the 1B3GT. Use part number 79C36-1 as replacement and remove R440.

DIFFERENT TUBE USED for SYNC SEP. and CLIPPER (403)

Run 6 in 20V1 Chassis, Run 2 in 20T1 Chassis

Some sets may use a 6SN7GT tube instead of a 12AU7 miniature type tube at V403. Although no circuit changes are necessary, note that the 6SN7GT pin numbering differs from that of the 12AU7.

DIFFERENT IF TUBES (V302, V303)

Run 4 in 20T1 Chassis, Run 7 in 20V1 Chassis

In some sets, a 6AG5 tube is used instead of a 6AU6 tube in the 2nd and 3rd IF stages. The 6AU6 and 6AG5 tubes are not directly interchangeable. When the 6AG5 tube is used, tube socket terminal 2 is unused (not grounded) as pins 2 and 7 of this tube are connected internally. A tube shield is used with the 6AG5 tube in the 3rd IF stage.

Note that when V303 is a 6AG5, an 18,000 ohm resistor is connected from grid (pin 1) to ground in that stage, and resistor R302, 680,000 ohms is omitted.

DIFFERENT SOUND AMPLIFIER TUBE (V203)

Run 5 in 20T1 Chassis, Run 8 in 20V1 Chassis

A 6AV6 minature tube is used in place of a 6SQ7 tube. The 6AV6 was also used in very early production.

No circuit changes are necessary when substituting one tube for another but the socket will have to be changed.

SOCKET and PLUG ADDED for ATTACHMENT of a COLOR CONVERTER

Run 6 in 20T1 Chassis, Run 9 in 20V1 Chassis

A 9-contact socket M505 was added at the rear of the TV chassis to provide B plus voltages, and 110 volt AC power for attachment of a color converter. Plug M506 fits into the socket to complete the B plus circuits when a color canverter is not used. The plug has jumpers wired between pins 1 and 2, between pins 3 and 4, and between pins 5 and 6. A few of these sets with socket M505 had electrolytic condenser C407D (40 mfd.) connected to pin 8 of V501 (5U4G) tube.

Note: Sets which have the B plus circuits wired to socket M505 will not operate unless the plug (with jumpers connected) or a color converter is plugged into the socket to complete the B plus circuits.

In very late production sets, plug M506 and the wiring to socket M505 were omitted.

CHANGE in FOCUS CIRCUIT

Run 7 in 20T1 Chassis, Run 10 in 20V1 Chassis

In some sets, a permanent magnet (PM) focusing assembly (part number 94C33) is used. This assembly is mounted to the yoke support bracket: it consists of a mounting bracket, a picture positioning lever, and a permanent magnet focusing control.

The parts eliminated from the B plus (filter) circuit when the PM focus control is used are focus coil L404, focus control R445, and resistor R444. Electrically these parts are replaced with resistor R505, 200 ohms, 10 watt, part number 61A7-20. Screen resistor R438 (6,800 ohms, 2 watt), formerly connected to junction of fuse M401 and condenser C430 (.1 mfd.), is connected to the opposite side of C430 (junction of white lead from deflection yoke T403B and C430) when the PM focus assembly is used.

Two alternate types of PM focus assemblies are used. These assemblies are electrically and physically interchangeable. However, they differ slightly in location of adjustments and in method of adjusting. Differences in location of the focus adjustment screw and the picture positioning lever in the alternate types of PM focus assemblies are shown in figure 24.

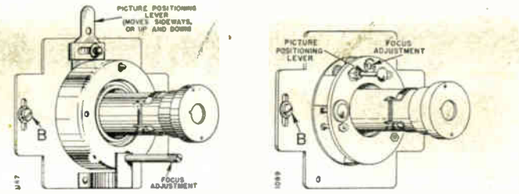


Figure 24. Alternate PM Focus Assemblies.

Run 11, Run 12, Run 13, Run 14 in 20V1 Chassis

Changes covered by these run numbers have no service significance.

FILTER ADDED to MINIMIZE VERTICAL BARS in PICTURE

Run 8 in 20T1 Chassis, Run 15 in 20V1 Chassis

A filter has been added to eliminate or reduce to a minimum the brightness of shadow-type vertical bars which may appear at the left side of the picture.

This filter consists of resistor R446 (680 ohms, 2 watts, part number 60B20-68), condenser C432 (.0022 mfd, 600 volts, paper, part number 64B9-17), and RF choke L405 (part number 73B8-3). These components are all connected in parallel and are wired in the set between terminal 8 of the horizontal output transformer (T405) and pin 5 of the damper tube V407 (6W4GT).

Adding a Filter to Early Sets

Before deciding that a filter is required in early sets giving this trouble be certain that the horizontal drive and width controls have been adjusted. Also check to see that the picture tube cathode lead (from pin 11) is not too close to the horizontal output tube V405 (6BQ6GT). This lead should be dressed as far away as possible from the horizontal output tube.

If vertical bars are still present after picture tube socket lead dress has been checked, install the filter. NOTE: A pre-assembled filter complete with instructions is available from the Admiral distributor under part number A3459S.

IMPORTANT: The filter must be placed inside the high voltage housing and NOT under the chassis.

Two alternate types of horizontal output transformers (T405) ave been used in these receivers. If transformer 79C32-1 is used, one filter will be required. If transformer 79C36-1 is used, two filters may be required. Transformer 79C32-1 has two E shaped cores. Transformer 79C36-1 has two U shaped cores.

CHANGE IN POWER TRANSFORMER T501

The power transformer (T501) used in later production sets will show a slightly higher voltage for the high voltage secondary than earlier transformers. These later transformers are marked with a green dot near the part number. Since the early and later power transformers are interchangeable, the part number remains unchanged. However, when taking voltage readings it is important to remember that B plus voltages at some points may be as much as 20 volts higher in sets which have the later power transformer (with the green marking).

ALTERNATE BLOCKING OSCILLATOR TRANSFORMER (T401) USED

Alternate blocking oscillator transformers (T401), part numbers 79A18-3 and 79A18-4, are used. These transformers are electrically identical and differ only in lead length. Transformer 79A18-4 (with longer leads) will be supplied for replacement.

ALTERNATE RESISTORS and CONDENSERS USED

Due to the scarcity of certain resistors and condensers, some substitutions have been made from those values and descriptions shown in the parts list. These substitutions were made only in non-critical circuits not requiring 5% resistors or temperature compensated condensers. It may be found that in some cases resistors are connected in series or in parallel to obtain the required resistance values. In some cases mica type condensers have been substituted for ceramic condensers.

SOME NON-STANDARD RESISTORS USED

Due to scarcity of some carbon resistors, various non-standard types have been used. These resistors may be uninsulated carbon or tubular ceramic types having non-standard values and color coding. SOME TUBULAR RESISTORS RESEMBLE CERAMIC CONDENSERS. Resistance values of some resistors are stamped on the body, others use the old dot color code method. These resistors are all within tolerance and are of correct current handling capacity to insure lasting service. All service replacement resistors will be of the insulated carbon, RMA color coded type.

FOCUS ADJUSTMENT in SETS HAVING a PM FOCUS ASSEMBLY

To adjust the focus, set the PICTURE control for normal picture and the BRIGHTNESS control at slightly above average brightness.

Slight rotation in either direction of the "Focus Adjustment" (see figure 24) should generally bring the picture into focus. An ordinary screwdriver can be used in sets having a brass adjustment slug; a non-magnetic screwdriver is preferable for sets having a steel adjustment slug. If the picture was greatly off focus, readjust the ion trap.

R302 CHANGED to REDUCE OVERLOADING

In late sets, resistor R302 has been changed to 1.2 megohms to prevent overloading in strong signal areas.

PICTURE CENTERING IN SETS HAVING A PM FOCUS ASSEMBLY

If the picture is off center, it can be centered by using the picture positioning lever, and when necessary, repositioning the PM focus assembly around the picture tube neck. Follow the instructions given below.

Centering the Picture

a. Adjust ion trap.
b. Center the picture by adjusting the picture positioning lever. Note that the picture positioning lever can be moved sideways, and up and down. It may be necessary to reduce picture height and width to determine correct centering unless a test pattern is used.
c. Readjust the ion trap and check focus adjustment.

Difficulty in Centering the Picture

a. Adjust ion trap.
b. Slightly loosen the two screws which mount the PM focus assembly to the yoke bracket. Facing the back of the chassis, move the PM focus assembly fully to the left while rotating it counterclockwise (to the left) as far as possible; then tighten the two mounting screws.
c. Center the picture with the picture positioning lever. If the picture cannot be centered with the lever, it may be necessary to repeat step "b", this time setting the focus assembly in another position and then centering the picture with the picture positioning lever.
d. Readjust the ion trap and check focus adjustment.

REPLACEMENT OF V402 (6S4) VERTICAL OUTPUT TUBE

Some brands of 6S4 tubes do not have pins 3 and 6 connected together internally. When replacing the 6S4 tube in some early sets, it may be necessary to connect a wire jumper from terminal 3 to terminal 6 of the tube socket. To accommodate all brands of 5S4 tubes, later production sets have the junction of C406 and R410 wired to pin 6.

DIFFERENT VERTICAL OUTPUT TUBE (V402)

Some sets may use a 6SN7GT tube instead of a 6S4 tube at V402. Note that 6SN7GT pin numbering differs from that the 6S4.

DIFFERENT TUBE (V703) USED IN 3C1 RADIO

Early sets used a 6AV6 tube for V703 (Det-AVC-AF). Later production sets use the 6SQ7 tube, which is the metal tube equivalent. Note that 6SQ7 pin numbering differs from that of 6AV6.

REMOVING VERTICAL BARS FROM PICTURE

VERTICAL FOLDOVER

Vertical foldover appears as a bright horizontal bar, at the bottom of the picture, after the height and linearity controls are adjusted for correct picture size and linearity. Low line voltage (below 105 volts) can often be the cause of foldover in a set which is otherwise normal. Always check the line voltage first if this trouble appears. However, if foldover occurs at normal line voltage, it may be corrected by making one or more of the following changes IN THE ORDER SHOWN BELOW:

1. Tubes. A weak vertical output tube (V402) can be the cause of foldover and a number of new tubes should be tried. This has been a source of trouble in sets using a 6S4 tube for a vertical output tube. Some brands of 6S4 give a greater output thus making it possible to obtain sufficient height without causing foldover. Low B plus voltage caused by a weak 5U4G rectifier tube (V501) will also cause foldover; try other rectifier tubes.

2. Resistor Change. Change grid resistor R410 from 1 megohm to 3.3 megohms, and decoupling resistor R439 from 1000 ohms to 560 ohms, 1 watt.

3. Additional Condenser Across Width Control. An additional condenser (.01 to .05 mfd.) connected across width control L402 will increase the sweep width and also provide increased vertical sweep without causing foldover. The second anode supply voltage will be decreased by several hundred volts after making this change. The decrease in brightness is not noticeable.

4. Deflection Yoke. The cores of the deflection yokes used in these sets consists of two pieces of powdered iron, each semi-circular in shape. For maximum efficiency, these two core pieces should fit closely together with the air gaps as small as possible. Inspect the iron cores in the yoke to see if the air gap is at a minimum. If the air gap is greater than 1/32", tighten the collar. If this does not reduce the gap, remove the collar and the iron cores, and smooth over the insulation between the cores so that the gap will be at a minimum.

Some yokes are made so that the fibre sleeve must be clipped away with a pair of diagonal cutters before the collar and iron cores can be removed.

BOOTSTRAP VOLTAGE VARIATION

In some sets, the output (bootstrap) voltage measured at pin 3 of the damper tube V407 (6W4GT), may read from 350 to 400 volts instead of the voltage (400 volts) shown on the schematic. This variation in voltage is due to tolerance of components in the horizontal sweep circuit. This voltage variation also affects the 1st anode voltage measured at pin 10 of picture tube V306.

EXCESSIVE PICTURE HEIGHT

Excessive picture height (which cannot be reduced by adjustment of the height control) can be due to tolerances of part such as the deflection yoke and power transformer.

This condition may be corrected by removing condenser C431, or replacing resistor R408 (1 megohm) with a 2.2 megohm resistor, part number 60B8-225.

HORIZONTAL "TEARING" or "BENDING"

Horizontal "tearing" may be caused by an excessively strong TV signal or by improper AGC action.

A strong signal can cause overloading of the video amplifier with resulting loss of sync pulses due to clipping. This overloading condition can be eliminated by increasing the AGC voltage. To do this, remove R302 (at test point "T") from the circuit.

High resistance leakage, between the control grid and other tube elements, in the RF and IF amplifier circuits may also cause clipping of the sync pulses. The tubes should be checked by replacement.

"VEILING" or HORIZONTAL FOLDOVER

This trouble will usually be apparent when the station sync pulses are not positioned correctly on the blanking pulses. A phase change in the sync pulses (or reference voltage) applied to the horizontal control circuit could also cause veiling or foldover.

Disconnecting R443 will remove the horizontal output reference voltage with very little change in the operation of the circuit. Short circuiting R323 will minimize any phase change of the sync pulses.

INTERMITTENT SOUND, PICTURE or SYNC

(In sets with color converter socket and plug)

Poor contact between the color converter plug M510 and socket M509 can cause one or more of the following troubles: (1) No sound, (2) No sync, (3) No picture, sound or raster.

If poor socket contact is suspected as being the cause of trouble, remove the plug and tighten the socket contacts with a pair of long nose pliers.

REMOVING RETRACE LINES

In some areas, where the signal strength is low, it is often desirable to to operate a receiver with the contrast reduced and the brightness turned up.

Under these conditions several bright retrace lines may be visible in the picture. If the following changes are made, the brightness control may be turned fully on without the retrace lines being visible in the picture. To add this change to the circuit proceed as follows:

1. Connect a 270,000 ohm, ½ watt resistor (part number 60B8-274) in series with pin 2 (grid) of the picture tube and the lead connected from the junction of C310 and R327.

2. Connect a .05 mfd. condenser (part number 64B5-22) from the junction of C405 and R407 to pin 2 (grid) of the picture tube.

LONG WARM-UP TIME

A poor connection between the plate cap lead and the plate cap connecting to the horizontal output tube V405 (6BQ6GT) may cause an excessively long "warmup" period before the raster appears. This is sometimes caused by a poor solder connection. Touching a hot soldering iron to the solder joint inside the plate cap will often correct the trouble.

DISTORTED SOUND

Distorted sound can be caused by missalignment of the ratio detector transformer T201. This missalignment is sometimes due to frequency drift of the ratio detector transformer. Realignment of the ratio detector transformer may correct this trouble for a period of time, after which realignment may again be required. A permanent remedy for this trouble is to connect a 20 mmfd, – 750 temperature coefficient, ceramic condenser (part number 65B6-26) in parallel with condenser C204 (180 mmfd, ceramic connected across the secondary of the ratio detector transformer T201). Realign ratio detector transformer after adding the 20 mmfd condenser.

SERVICE HINTS FOR HORIZONTAL SYNC

The horizontal oscillator control circuit controls the horizontal oscillator by a method called "Pulse Width Modulation". This method is so called because the width of the pulse applied to the grid of the horizontal oscillator control section determines the length of time that current flows through this section. The duration of current flows through the control section determines the DC control voltage applied to the grid of horizontal oscillator, thereby controlling the frequency.

The waveshape applied to the grid of the horizontal oscillator control section is formed by combining a partially intergrated pulse from the horizontal oscillator output, a partially intergrated pulse from the deflection yoke, and the horizontal sync pulse, if these three pulses combine properly, the waveshape shown in Figure 19 will be developed and the horizontal oscillator will be in sync.

With no sync input, the waveform at the horizontal oscillator control grid should appear as shown in Figure 20. Since the horizontal oscillator control voltage is dependent upon a waveshape formed at the horizontal output stages (V405, V406 and V407), a defective component in one of these stages may cause sync trouble. If the waveform shown in Figure 20 can be obtained, this will indicate proper operation of the horizontal sweep and reference voltage networks.

When the horizontal oscillator is out of sync, it may be difficult to observe this waveform (Figure 20) on an oscilloscope due to the presence of out-of-phase sync pulses. In this case, remove the sync amp. and separator tube (V403). If the waveshape shown in Figure 20 is obtained, place the sync and separator tube back into its socket. Then remove the horizontal oscillator and control tube V404 (6SN7GT). Conventional, well-shaped sync pulses should appear at control grid (pin 1) of V404.

If there are no sync pulses, or the pulses are of low or varying amplitude accompanied with noise, the sync circuits should be checked. However, if the sync pulses are well-shaped and of constant amplitude, the horizontal oscillator may be misaligned. Place V404 back into its socket and make the "Complete Alignment of Horizontal Oscillator".

If it is impossible to sync the picture, or obtain the correct waveform at terminal "C", check for a defective component in the following sequence:

a. Check tube V404 (6SN7GT) by substitution.

b. Check C418 by substituting identical condenser (180 mmfd, 5% – .0003 temperature coefficient) part number 65B6-59.

c. Check C415 for either open or short.

d. Check condenser C417 for short.

e. Check resistance of R427. It should be 100,000 ohms.

f. Lead dress is critical in the horizontal oscillator circuit. Check to see that lead dress has not been disturbed while servicing.

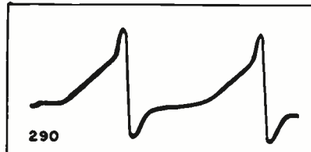


Figure 20. Waveform on Grid Pin 1 of V404 With Sync Pulse.

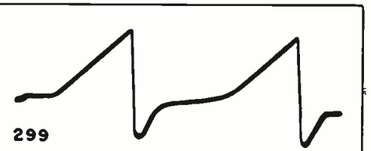


Figure 20. Waveform on Grid Pin 1 of V404 Without Sync Pulse.

PICTURE JITTER (SIDEWAYS)

Picture jitter may be caused by improper resistance value of R420, plate load resistor of V401B. Check R420 to see that it is 22,000 ohms.

FRINGE AREA SERVICE SUGGESTIONS

Best performance from a television receiver can be realized only after considerable care and thought had been given to the selection and installation of the proper type of antenna dependent on the TV signals in the area. This is especially important in fringe or weak signal areas. Before proceeding with these suggestions, it is recommended that the installation be checked. The Admiral Distributor nearest the area can be of help in advising on the selection and installation of the proper antenna system.

The following service hints will be of help in improving reception in fringe or weak signal areas. It is possible to apply more than one of these service hints to a chassis to obtain better reception. Generally tubes should be checked and realignment should always be tried before making any major circuit changes to increase sensitivity.

Check Line Voltage. Check for low power line voltage. If the voltage is known to vary greatly, it is recommended that the set be operated from a constant voltage transformer with a power rating of at least 300 watts.

Check IF Tubes. Check the IF stages to see that the correct tube types are used according to chassis wiring. Use of an incorrect tube type may cause decreased sensitivity.

Some sets use a 6AU6 tube in the 1st IF stage, and a pair of 6AG5 tubes instead of 6AU6 tubes in the 2nd and 3rd IF stages (V302, V303). Note that these tubes are not directly interchangeable, since they differ in pin numbering, in use of tube shields, and in use of R330 and R302.

Check Rectifier Tube. Check the rectifier tube (5U4G) by substitution as the voltage output of some tubes may be slightly higher. An increase in B plus voltage will increase sensitivity.

Check Video Amplifier Tube. Check the video amplifier tube (V305) by substitution. Increased contrast is sometimes obtained with tube replacement.

Improved Reception Obtained by Correct Alignment. Correct receiver alignment is an important factor when a receiver is to be operated in a low signal strength area. It is possible for a receiver to have a good over-all (RF-IF) response curve even though the RF and IF stages are not properly aligned. This type of curve is obtained when the RF alignment is off in one direction and the IF alignment is off in the other direction. This incorrect alignment may cause excessive snow in the picture when weak signals are received.

The RF tuner should always be aligned to produce a response curve of maximum amplitude, consistent with flat top appearance and correct marker location. Carefully align the RF and IF stages. If the RF and IF curves are similar to those shown in the manual, the receiver signal-to-noise ratio will be good and there will be a minimum amount of snow in the picture.

If it should be difficult to obtain a satisfactory response curve during IF alignment, check whether the set uses 6AG5 tubes in the IF amplifier

stages. If it does, alignment can be made easier if you use a 6AU6 tube in the first and possibly in the second IF stage. To do this, merely connect a short ground lead to pin 2 of the tube sockets and change to 6AU6 tubes.

Checking tubes (by substitution) in the RF amplifier, oscillator-mixer, IF stages, and video detector while aligning will often give considerable increase in gain. The increase in gain may be observed by an increase in the amplitude of the response curve. Realignment of the particular stage should always be made after each tube replacement, in order to realize the maximum gain possible.

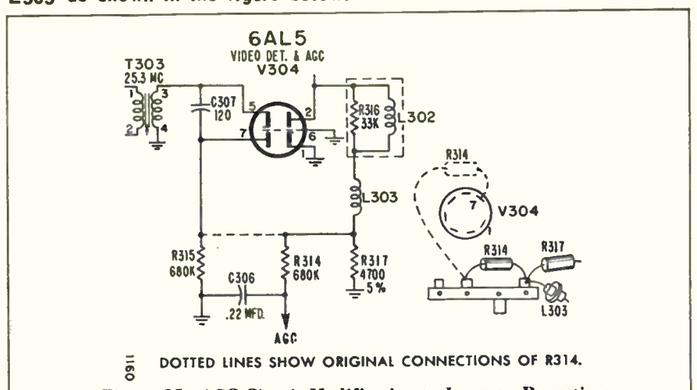
Increased Sensitivity Obtained By Removing AGC Bias From RF Tuner. Remove RF tuner AGC lead (white) from the AGC connecting lug and ground the lead to the chassis.

IMPORTANT: This change should not be made where strong signals may be received since over loading will result. A changeover switch (SPDT) can be installed to apply AGC bias to the RF tuner when strong signals are to be received.

AGC Change to Improve Reception in Weak Signal, High Noise Level Areas. If the hints above have been tried, and satisfactory results are not obtained, the following may be of further aid in improving reception under conditions of weak signal and high noise level.

In weak signal areas, where the noise level is high, the AGC diode, (½ V304, 6AL5), develops an AGC voltage which is proportional to the peak-to-peak noise voltage. When the high AGC voltage is applied to the controlled stages, the gain of the receiver is controlled by the noise level and not the sync pulse level. This may result in loss of sync, poor contrast or low sound level. When this trouble is encountered it may be corrected by using the voltage developed across the video detector load for the AGC voltage instead of the normal AGC voltage developed by the AGC diode V304. IMPORTANT: This change should not be made where strong signals may be received since overloading will result.

To make this change, disconnect the end of resistor R314 (680,000) form pin 7 of V304 and connect it to the terminal strip (junction of R317 and L303 as shown in the figure below.



DOTTED LINES SHOW ORIGINAL CONNECTIONS OF R314.

Figure 25. AGC Circuit Modification to Improve Reception in Weak Signal, High Noise Level Areas.

Increasing Sound Level. After making the changes outlined above, a further increase in sound level may be obtained by changing the sound take-off connections as follows:

1. Disconnect the sound take-off lead (connection to C201) from pin No. 2 of video detector and AGC tube V304 (6AL5) and reconnect lead to pin No. 5 of video amplifier tube V305 (6AU6).

2. Retune adjustment A6, on sound take-off coil L201. This adjustment should preferably be made using a station signal.

PRODUCTION CHANGES

21B1, 21C1, 21D1, 21E1, 21F1, 21G1, 21H1, 21J1, 21K1, 21L1, 21M1, 21N1, 21P1, 21Q1, 21W1, 21X1, 21X2, 21Y1, 21Z1, 21Z1A and 5D2, 3C1 CHASSIS

16. RESISTOR R303 CHANGED to INCREASE B PLUS VOLTAGE to RF TUNER

In later production resistor R303 was changed from 1000 ohms to 470 ohms, ½ watt, part number 60B8-471. Changing this resistor to a lower value increases the B plus voltage applied to the RF tuner, thereby providing an increase in sensitivity. This increased sensitivity will be apparent in fringe or weak signal areas. This resistor change should be made only in sets having less than 105 volts at the RF tuner B plus lead.

17. R430 WATTAGE CHANGED

*Run 1 in 21C1 Chassis

Resistor R430 was changed from 12,000 ohms, ½ watt to 12,000 ohms, 2 watt (part number 60B20-123) to prevent possible increase in resistance of R430.

18. CHANGE to IMPROVE AUDIO RESPONSE on RADIO OPERATION

*Run 2 in 21C1 Chassis

R210 was changed from 270,000 to 150,000 ohms, (part number 60B8-154) and R211 was changed from 100,000 ohms to 47,000 ohms, (part No. 60B8-473) to improve audio response on radio operation.

19. C433 ADDED to OBTAIN SUFFICIENT WIDTH

*Run 3 in 21C1 Chassis

To obtain sufficient sweep width, C433 (.002 mfd, 600V) was added across width coil L402. Do not make this change in sets with gated AGC.

20. HERRINGBONE PATTERN INTERFERENCE

*Run 4 in 21C1 Chassis, Run 1 in 21B1 Chassis

Later production sets have an Adjacent Lower Channel Sound Trap (L307 C314) added between the connector lug (terminal of C113) on the TV tuner and pin 1 of the 1st IF amplifier tube V301. This trap (part number 72A102) is pre-tuned to 27.25 MC.

This trap will eliminate herringbone interference pattern produced by the sound carrier of the adjacent lower channel in the same locality, especially when the wanted station is weaker than the interfering station. Close examination of this type of interference will reveal that the fine lines of the herringbone pattern will vary in accordance with the speech or music on the adjacent lower channel. This can be checked by quickly turning the channel selector to the lower channel.

Since FM interference from other sources will also produce a herringbone pattern, it should definitely be determined that the interference is caused

by the adjacent lower channel before installing the trap. After installing the trap, realign slug A4 (mixer plate coil L103).

21. CHANGE to IMPROVE SYNC STABILITY

*Run 5 in 21C1 Chassis, Run 2 in 21B1 Chassis

An RC filter consisting of a parallel combination of a 270,000 ohm, ½ watt resistor (part number 60B8-274) and a 150 mmfd, mica condenser (part number 60B21-151) is connected between resistor R323 and condenser C308. Resistor R323 was changed from 8,200 ohms to 18,000 ohms, ½ watt (part number 60B8-183). These changes will improve sync stability (immunity to noise) in areas having low signal strength and a high noise level.

22. DIFFERENT TUBES USED in 2nd and 3rd IF STAGES

Runs 3 & 4 in 21B1 Chassis produced at Cortland**
Run 5 in 21B1 Chassis produced at Bloomington **
Run 1 in 21D1 Chassis, Run 1 in 21J1 Chassis

Some sets use a 6AU6 tube in the 1st stage, and a pair of 6AG5, 6BC5, or 6CB6 tubes, instead of 6AU6 tubes in the 2nd and 3rd IF stages (V302 V303). For complete information on the use of these tubes, see schematic Note that these tubes are not directly interchangeable, since they differ in pin numbering, in use of tube shields, and in use of R330.

IMPORTANT: Alignment is generally required after replacing IF tubes. Check the IF alignment, and preferably, also the over-all RF and IF response curve after tube replacement.

23. C433 CHANGED to OBTAIN SUFFICIENT WIDTH

Run 2 in 21D1 Chassis, Run 2 in 21J1 Chassis.

C433 is .002 mfd, or .0047 mfd, 600 volts, as required to obtain sufficient width. Increasing the size of condenser C433 provides greater sweep width with slight reduction in picture brightness. When adding or replacing C433 use the smallest capacity possible which will produce sufficient sweep width.

24. VERTICAL OUTPUT TUBE (V402) CHANGED

Run 4 in 21B1 Chassis produced at Bloomington**

The vertical output tube 6S4 (V402) was changed to a 6SN7GT. Note that resistance values of R404, R406, and R411 are changed when a 6SN7GT is used.

25. DIFFERENT TUBE USED for SYNC SEPARATOR and CLIPPER (V403)

Run 5 in 21B1 Chassis produced at Bloomington **

A 6SN7GT tube is used instead of a 12AU7 at V403.

** This change was incorporated at beginning of production of all other chassis.*

*** The 21B1 chassis has been run at two plants. Sets produced at the Cortland plant have "Cortland Plant" printed on the model label. Sets produced at Bloomington have "Bloomington Plant" printed on the model number label.*

26. DIFFERENT SOUND AMPLIFIER TUBE (V203)
Run 3 in 21D1 Chassis, Run 5 in 21D1 Chassis

Runs 1, 2, 5 use a 6AV6 miniature tube in the sound amplifier stage V203, while Runs 3 and 4 use a 6SQ7 metal or a 6SQ7GT glass tube. To prevent pick-up of hum, a tube shield (part number 87A8) is used with the 6SQ7GT glass tube.

27. DIFFERENT TUBE USED for SYNC DISCRIMINATOR (V404)
Run 4 in 21D1 Chassis (see No. 32)

28. PILOT LOGHT SOCKET ADDED
Run 3 in 21J1 Chassis

A light pilot socket, part number 87A6-3 was added, to accommodate the 110 volt phono compartment pilot light.

29. CHANGES to REDUCE AUDIO HUM on TV OPERATION
Run 5 in 21B1 Chassis, Run 8 in 21C1 Chassis,
Run 6 in 21D1 Chassis

In some chassis (especially early 21D1 chassis) a sharp audible hum can be heard in the speaker with and without a TV station tuned in. Check for trouble as follows:

1. If the brightness control also varies hum level, it will generally be found that the sound amplifier (V203) is a glass 6SQ7 tube which may be used without a tube shield. To minimize hum level either use a tube shield or change to a metal 6SQ7 tube.

2. If the vertical hold control also varies the hum frequency, the hum is introduced from the vertical output stage. Change Condenser C211 from a .047 to at least a .47 mfd., 400 volt condenser. In many cases it may be necessary to use an electrolytic condenser as large as 10 mfd. to completely eliminate the hum.

3. If hum (buzz) is only evident when station is tuned in, check IF alignment. In 21D1 chassis, three 6AG5 tubes were used in the IF stages. In order to obtain a good IF curve (with the sound carrier low enough) it is necessary to change the first IF tube to a 6AU6, ground pin 2, and realign the IF stages. Be sure that the 4.5 MC sound IF adjustments are aligned with a station signal. Buzz can generally be reduced farther after alignment on station signal by turning sound take off coil L 201 slug out about ¼ turn.

31. SOCKET and PLUG ADDED for ATTACHMENT of a COLOR CONVERTER
Run 6 in 21B1 Chassis; Run 9 in 21C1 Chassis;
Run 7 in 21D1 Chassis; Run 5 in 21J1 Chassis;
Run 2 in 21H1 Chassis

A 9 contact socket M509 was added at the rear of the TV chassis to provide B plus voltages and 110 volt AC power for attachment of a color converter. See schematic.

Plug M510 fits into socket M509 to complete the B plus circuits when a color converter is not used. The plug has jumpers wired between pins 1 and 2, between pins 3 and 4, and between pins 5 and 6.

A few of the early sets with socket M509 had electrolytic condenser C432 (60 mfd) connected to pin 8 of V501 (5U4G) tube.

Note; In some later 21B1 chassis, plug M510 and wiring connections to socket M509 were omitted.

32. DIFFERENT TUBES USED for SYNC DISCRIMINATOR (V404)
Run 6 in 21J1 Chassis; Run 4 in 21D1 Chassis;
Run 7 in 21B1 Chassis; Run 10 in 21C1 Chassis

A 12H6 tube may be used instead of a 6AL5 tube for V404 sync discriminator. A 6H6 tube was also used in some sets. The pin numbering for the 12H6 and 6H6 is identical; the 6AL5 pin numbering is different.

When the 12H6 tube is used for V404, an auto-transformer T502 (part number 80B32) is used to step up the 6.3 volts to 12.6 volts required for the heater of the 12H6 tube. The low end (black lead) of T502 connects to chassis ground, the center tap (green lead) connects to pin 7 of V408, the high end (yellow lead) connects to pin 7 of 12H6 (V404).

The circuit for the 6H6 is the same as for the 12H6 tube except that T502 auto-transformer is not used. Heater voltage (6.3 volts AC) connects to pin 7 of 6H6 tube (V404).

Replacing 12H6 Tube with a 6H6 Tube. If a 12H6 is not available for replacement, a type 6H6 tube may be used in place of the 12H6 if the following changes to the heater circuit are made:

1. Remove the transformer lead from pin 7 of the V404 (12H6) socket. Tape the lead to prevent it shorting to chassis.

2. Connect a lead from pin 7 of V404 socket to pin 7 of V401 socket.

33. CHANGE in FOCUS CIRCUIT
Run 10 in 21B1 Chassis

In late 21B1 chassis, a permanent magnet focusing assembly (part number 94C35-1) is used. The parts eliminated from the B plus (filter) circuit when the PM focus assembly is used are focus coil L404 and focus control R446. These parts have been replaced with choke coil L405 (part number 74B18-4) and resistor R449 (100 ohms, 7.5 watt, part number 61A1-20) connected in series. The choke with the resistor in series are in the filter circuit between filter condensers C407 and C432.

34. VIDEO DETECTOR and AGC CIRCUIT CHANGED
Run 12 in 21B1 Chassis, Run 3 in 21F1 Chassis

Late production 21B1 sets and 21F1 sets employ a IN64 germanium diode (M301) as a video detector and a 6AU6 tube (V304) as a gated AGC stage. These sets use a 6AU6 tube in the 1st and 2nd IF stages and a 6AG5 tube in the 3rd IF stage. A cover shield is not used on the bottom of the IF amplifier sub-chassis. For sets with these circuit changes, see schematic figure 31 and partial schematics figures 18A and 18B.

35. CHANGE to PREVENT PICTURE CUT-OFF and to STABILIZE PICTURE BRIGHTNESS
Run 13 in 21B1 Chassis, Run 4 in 21F1 Chassis

The following changes were made to the B plus circuit to prevent possible picture cut-off due to blocking of the video amplifier. (This blocking may occur if the TV set is tuned to a very strong TV signal which could drive the video amplifier to cut-off. With the video amplifier at cut-off, B plus voltage applied to the cathode of the picture tube will increase thereby making the grid voltage more negative with respect to cathode, driving the picture tube to cut-off. Also since the gated AGC tube is dependent upon voltage from the video amplifier for its operation, blocking of the video amplifier will cause no AGC voltage to be developed and the system will remain blocked.)

Diagrams of voltage distribution and partial schematics before and after the change was made are shown in figures 18A and 18B. Note the changes made in the B plus circuit to the 3rd IF amplifier, AGC tube video amplifier and picture tube. Resistor R336 (4,000 ohms, 5 watt) was omitted from the circuit. Resistor R338 (7,500 ohms, 5 watt) was wired in parallel with R319.

To prevent a decrease in brightness when strong signals are received, resistor R324 (in the cathode circuit of the picture tube) was changed from 180,000 ohms to 560,000 ohms. Resistor R324 was changed to 470,000 ohms in later production sets.

Adding Changes to Prevent Picture Cut-off

If picture cut-off resulting from blocking of the video amplifier is experienced with a 21B1 chassis stamped Run 12 or 21F1 chassis stamped Run 3, the changes below should be made. See figure 19 and proceed as follows:

1. Remove resistor R336 (4,000 ohms).

2. Connect a 7,500 ohm, 5 watt resistor R338 (part number 61A1-18) across R319.

3. Connect together the positive terminals of filter condensers C307A and C307B.

4. Change resistor R324 from 180,000 ohms to 560,000 ohms, ½ watt (part number 60B8-564).

5. Erase the old run number from the chassis and mark in the next higher run number.

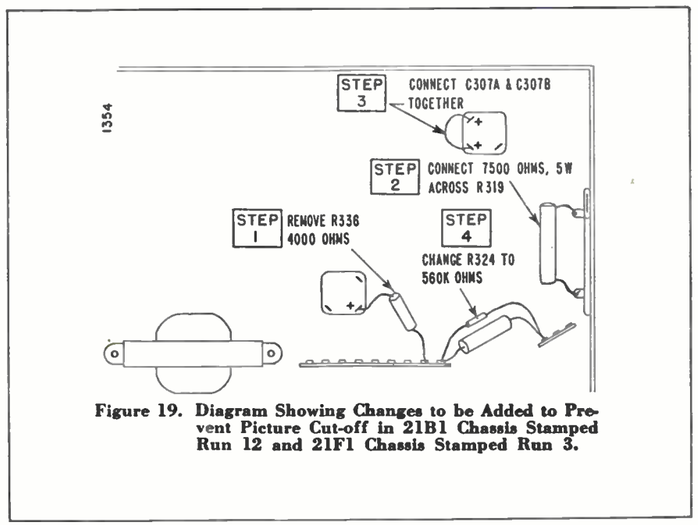


Figure 19. Diagram Showing Changes to be Added to Prevent Picture Cut-off in 21B1 Chassis Stamped Run 12 and 21F1 Chassis Stamped Run 3.

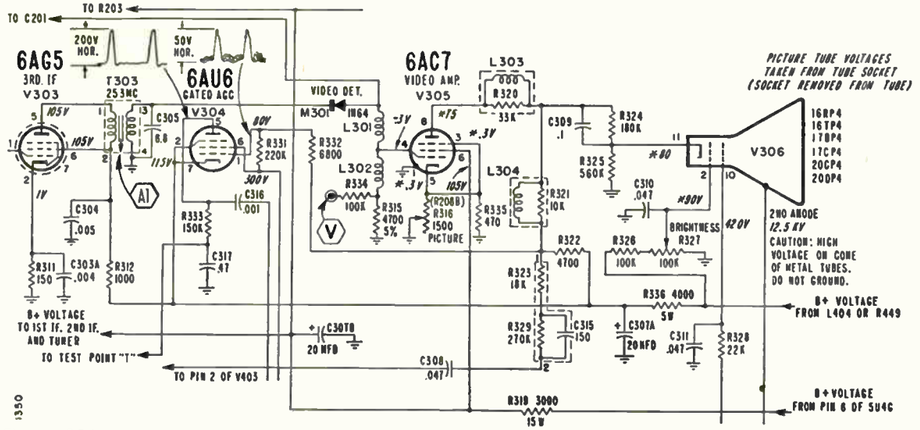


Figure 18A. Partial Schematic Showing B+ and Picture Tube Circuit in 21B1 Chassis Stamped Run 12 and 21F1 Chassis Stamped Run 3. See complete schematic figure 31 for other circuits.

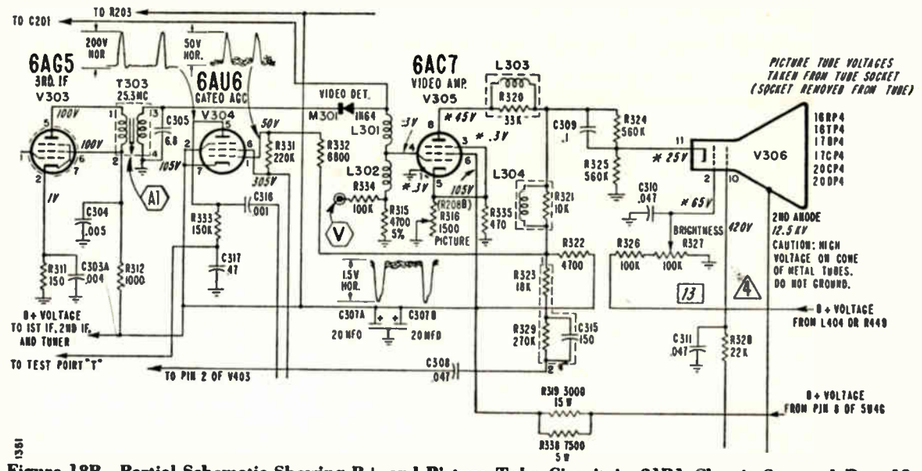


Figure 18B. Partial Schematic Showing B+ and Picture Tube Circuit in 21B1 Chassis Stamped Run 13 or Run 14 and 21F1 Chassis Stamped Run 4 or Run 5. For complete schematic, see figure 31.

36. SOCKET M509 and PLUG M510 ADDED and AGC TEST POINT WIRED to a TEST JACK

Run 14 in 21B1 Chassis, Run 5 in 21F1 Chassis

Color Connectors. A 9-contact socket M509 was added at the rear of the TV chassis to provide B plus voltages, and 110 volt AC power for attachment of a color converter. Plug M510 fits into the socket to complete the B plus circuits when a color converter is not used. The plug has jumpers wired between pins 1 and 2, between pins 3 and 4, and between pins 5 and 6. In some eariler production sets, plug M510 and the wiring to socket M509 were omitted. NOTE: Sets which have the B plus circuits wired to socket M509 will not operate unless the plug (with jumpers connected) or a color converter is plugged into the socket to complete the B plus circuits.

AGC Test Point. To make test point "T" (AGC buss) available from the top of the chassis, this test point has been wired to the test jack adjacent to test jack "Z".

37. CHANGE TO IMPROVE FOCUS

Run 8 in 21B1 Chassis

Some long neck 16TP4 picture tubes (Raytheon and Dumont brands) were used in some 21B1 chassis stamped Run 8. In order to obtain satisfactory focus when these picture tubes were used, a 10 watt bleeder resistor from 12,000 to 15,000 ohms was added from junction of resistors R326 and R211 to chassis ground. Important: It may be necessary to remove this resistor to obtain satisfactory focus when replacing an original long neck 16TP4 tube with a short neck tube.

CHANGE in 3C1 RADIO to IMPROVE TONE QUALITY

Resistor R709 was changed from 27,000 ohms to 82,000 ohms (part number 60B8-823).

Condenser C712 was changed from 250 mmfd. to 100 mmfd. (part number 65C6-3). C713 was changed from .01 mfd. to .002 mfd. (part number 64B5-25). C714 was changed from .002 to .005 mfd. (part number 64B5-12). The schematic figure 30 shows the 3C1 radio with these changes added.

DIFFERENT TUBE (V703) in 3C1 RADIO

Early sets used a 6AV6 tube for V703 (Det-AVC-AF). Later production sets use the 6SQ7 tube, which is the metal tube equivalent.

SENSITIVITY IMPROVED in 5D2 RADIO

To improve the sensitivity of the 5D2 radio. the 1st IF transformers in the AM and FM stages were changed.

The 1st AM-IF transformer (T604) used in early sets, part 72B97 has been replaced with part 72B97-1.

The 1st FM-IF transformer (T601) used in early sets, part 72B98 has been replaced with part 72B98-1.

To accommodate this change of the IF transformers, C608 condenser has been changed from 40 mmfd, (part 65B1-65) to 30 mmfd (part 65B1-69); R602 has been changed from 240 ohms 5%, (part 60B7-241) to 1,500 ohms, (part 60B8-152).

Important: All changes mentioned above must be made when replacing early with late IF transformers.

FRINGE AREA SERVICE SUGGESTIONS

*Check B Plus Voltage. Check B plus voltages at pin 5 of the 2nd IF stage with no signal input. If the B plus voltage is below 90 volts, check R317 and R318, and if necessary, replace with resistors having the correct value.

Improved Reception Obtained by Correct Alignment. Correct receiver alignment is an important factor when a receiver is to be operated in a low signal strength area. It is possible for a receiver to have a good over-all (RF-IF) response curve even though the RF and IF stages are not properly aligned. This type of curve is obtained when the RF alignment is off in one direction and the IF alignment is off in the other direction. This incorrect alignment may cause excessive snow in the picture when weak signals are received.

The RF tuner should always be aligned to produce a response curve of maximum amplitude, consistent with flat top appearance and correct marker location. Carefully align the RF and IF stages following the instructions given in this service manual. If the RF and IF curves are similar to those shown in the manual, the receiver signal-to-noise ratio will be good and there will be a minimum amount of snow in the picture.

Checking tubes (by substitution) in the RF amplifier, oscillator-mixer, IF stages, and video detector while aligning will often give considerable increase in gain. The increase in gain may be observed by an increase in the amplitude of the response curve. Realignment of the particular stage should always be made after each tube replacement, in order to realize the maximum gain possible.

INCREASING SENSITIVITY for EXTENDED FRINGE AREA RECEPTION

This change should not be applied to later production sets (starting with Run 12 in 21B1 chassis, Run 3 in 21F1 chassis) having a 1N64 germanium diode (M301) used as a video detector and a 6AU6 tube (V304) used in a "gated" AGC stage.

In weak signal areas where noise level is high, the AGC voltage developed is proportional to the noise peaks instead of the sync pulse level. This increased AGC voltage will reduce the gain of the controlled stages and thereby lower the sensitivity of the receiver. This condition may also cause momentary loss of sync poor contrast and weak sound. The circuit modifications shown in figures 20, 21 and 22 will greatly improve the operation of a receiver which is to be operated in an extended fringe area. A receiver with these modifications will also operate satisfactory in areas where strong TV signals can be received, since a Local-Distant

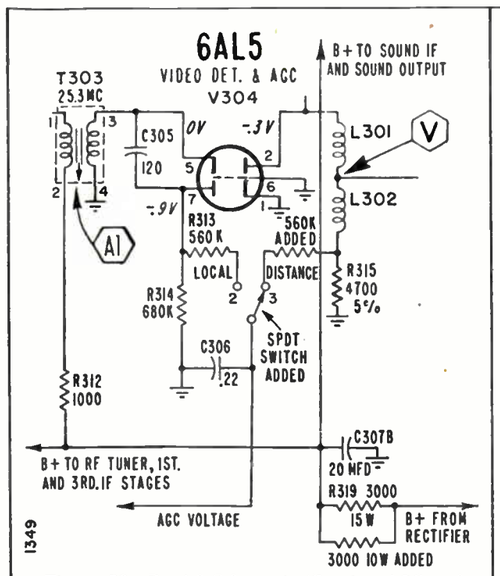


Figure 20. Partial Schematic Showing AGC and B+ Circuit Changes.

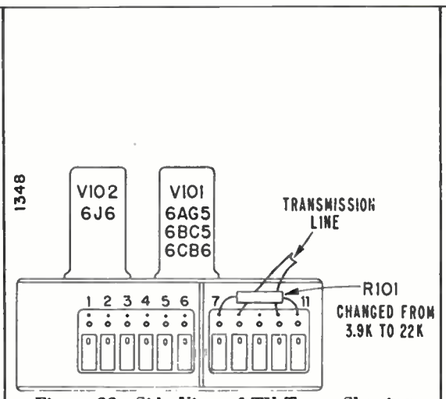


Figure 22. Side View of TV Tuner Showing R101 Resistor Change.

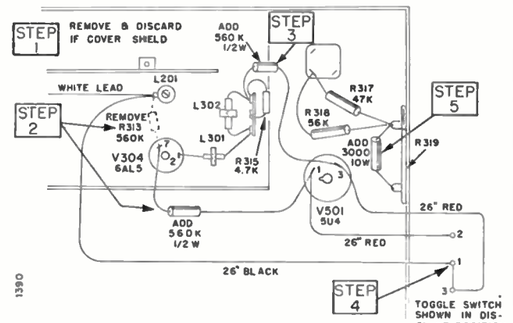


Figure 21. Diagram Showing AGC and B+ Wiring Changes.

switch is used to prevent circuit overload (picture bending) caused by a strong signal.

Before making the modification given below, it should be determined that the receiver has normal sensitivity by comparison with a receiver of the same type which is known to have normal sensitivity. Poor operation in fringe areas may be due to low sensitivity caused by one or more of the common troubles discussed in the previous paragraphs and a major circuit modification may not be necessary.

The parts will be required for making this modification:

2 — 560,000 ohms, ½ watt resistors (part number 60B8-564)
1 — 3,000 ohms, 10 watt resistor (can use part number 61A1-9)
1 — 22,000 ohms, ½ watt resistor (part number 60B8-223)
1 — Toggle switch (SPDT)
3 — 26" lengths of No. 28 or No. 30 insulated (stranded) wire (use 1 black and 2 red wires).

Adding Changes

To add the circuit modifications to a receiver, see figures 21 and 22; and proceed as follows:

Step 1. Remove and discard the IF cover shield from below the IF subchassis.

Step 2. Remove resistor R313 (560,000 ohms) and connect a new 560,000 ohm, ½ watt resistor from pin 7 of V304 (6AL6) socket, to pin 1 of V501 (5U4G) socket.

Step 3. Connect a 560,000 ohm, ½ watt resistor from junction of L302 and R315, to pin 3 of V501 (5U4G) socket.

Step 4. Connect each of the three (26" long) wires to a terminal of the SPDT toggle switch. Connect the other end of each wire to connection points shown in figure 21; note color of wires.

Step 5. Connect a 3,000 ohm, 10 watt resistor across R319.

Step 6. Remove tuner inspection plate from the side of the chassis and remove resistor R101 (3,900 ohms) from across contact terminals 7 and 11 of the RF tuner. Replace R101 with 22,000 ohm, ½ watt resistor. See figure 22.

Step 7. Realign the IF stages and check the IF response curve. Make all alignment adjustments and checks with the Local-Distant switch in the "Distant" position.

Step 8. Make the "RF and Mixer Alignment" with the exception that alignment is made on the weakest high channel in operation for the area concerned. Be sure to adjust RF trimmers for maximum amplitude on the response curve.

Step 9. After the above changes have been made, set the Local-Distant switch on the most sensitive position and check the receiver for relative sensitivity by comparison with the receiver used previously to determine whether the receiver to be modified was of normal sensitivity. IF another receiver is not available for a sensitivity check, then air check reception on the weakest TV signals available. If the modification and alignment were made properly, there should be a very noticeable improvement in sensitivity with the Local-Distant switch on distant position. Sensitivity can sometimes be further improved by making the checks given under the service hint on "Improving Sensitivity".

Step 10. Mount switch on the cabinet back near the top so it can be easily reached over the top of the cabinet. IMPORTANT: Be sure to instruct the customer on proper use of the switch. One position of the switch makes the set extra-sensitive for best reception when receiving weak or distant TV stations. The other position of the switch will prevent possible picture "bending" when receiving strong stations.

V101 is 6AG5, 6BC5, 6CB6, 6BK7 or 6BQ7.

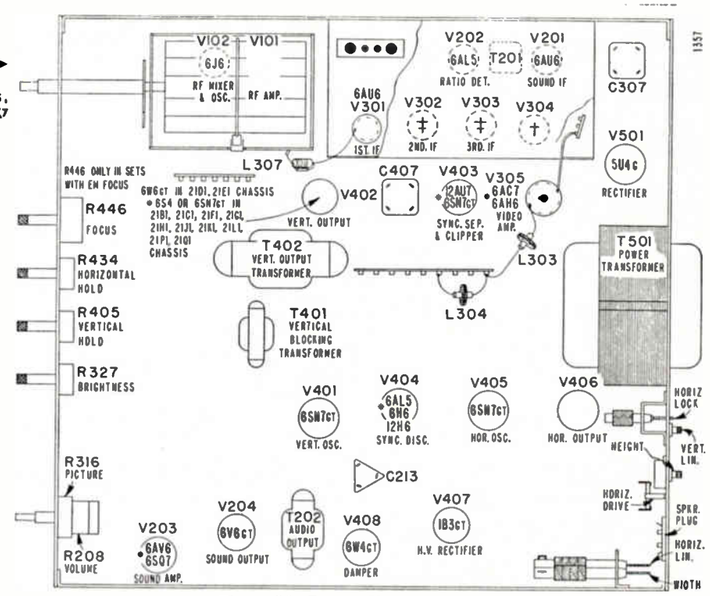


Figure 24. Bottom View of Chassis.

V406 is 6CD6G in 21D1 and 21E1 chassis and in later production 21K1, 21L1, 21M1 and 21N1 chassis; 6BQ6GT in 21B1, 21C1, 21F1, 21G1, 21H1, 21J1, 21P1, 21Q1, 21X1, 21X2 chassis and in early production 21K1, 21L1, 21M1 and 21N1 chassis.

V101 is 6AG5, 6BC5, 6CB6, 6BK7 or 6BQ7.

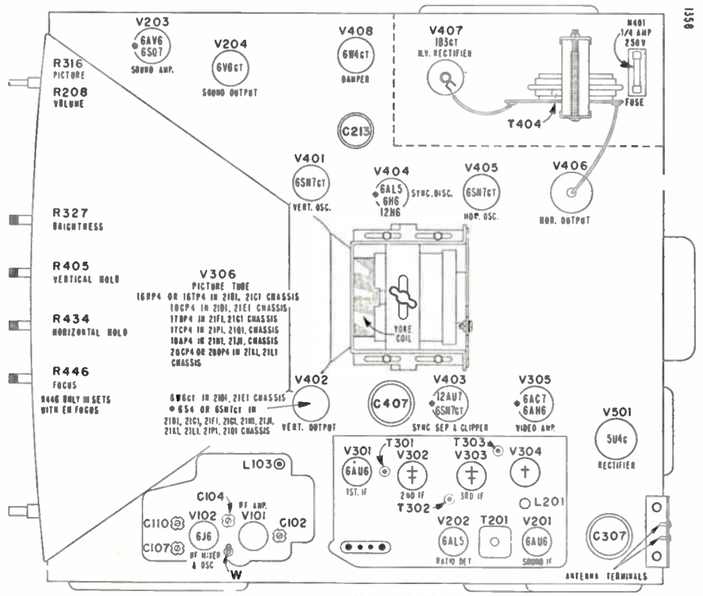


Figure 25. Top View of Chassis.

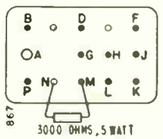
* Tubes not directly interchangeable. See schematic.
‡ 6AU6, 6AG5, 6BC5 or 6CB6 used. Tubes not interchangeable; see notes on schematic.
†6AL5 in sets without gated AGC, is 6AU6 in sets with gated AGC.

Figure 26. Schematic for all 20T1, 20V1 television chassis; 3C1 (AM only) radio circuit also shown.

SERVICING RADIO SEPARATELY

The radio can be operated without the television chassis if a 2PA1 power supply (used in TV-radio-phono models employing the 20Z1 (12") television chassis) is available. To operate the radio, connect a 3,000 ohm, 5 watt resistor (part 61A1-15) from pin "M" to "N" on the power supply socket.

This resistor drops the B plus voltage for proper operation.



Power Supply Socket, (Inside Chassis View).

SERVICING TV SEPARATELY

In combination models, to service the television chassis with the radio disconnected, it will be necessary to complete the heater circuit by connecting a jumper wire between pins "L" and "K" of socket M503. See schematic.

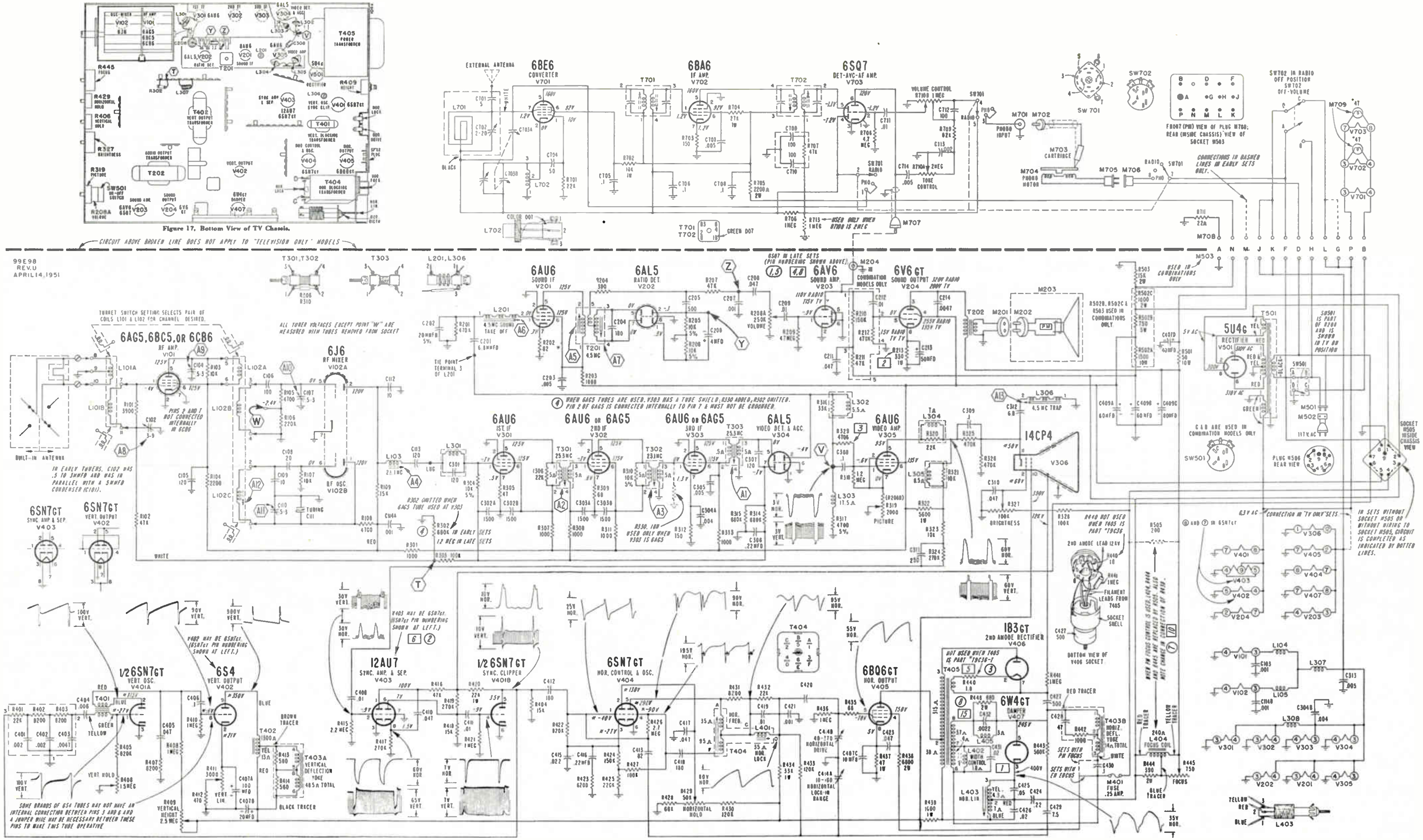


Figure 17. Bottom View of TV Chassis.

Figure 18. Schematic for 20T1, 20V1 Television Chassis; 3C1 radio circuit and connections also shown.

TV VOLTAGE DATA
(Voltages given on schematic diagram)

- PICTURE control turned fully clockwise. CHANNEL control set on an unused channel. Other front controls set at approximately half rotation. Vert. Lin. and Height set at approximately half rotation.
- Voltages marked with an asterisk * will vary widely with control setting.
  In combination models, B+ voltages in TV chassis will be slightly higher when set is switched to radio position. Alternate voltage readings for radio and TV are shown for sound output tube V204 (6V6GT). Also see "Boot Strap Voltage Variation" on page 28 and "Change in Power Transformer" on page 32.
- Line voltage 117 volts AC.
- Voltages measured with a vacuum tube voltmeter between tube socket terminals and chassis, unless otherwise indicated.
  Voltages at V101, V102, V306 measured from top of socket with tube removed.
- Antenna disconnected from set with terminals shorted.
- Under operating conditions, AGC (Automatic Gain Control) voltage developed at test point "T" (see schematic) should measure approximately —2.5 volts. This voltage depends on signal strength.

SCHEMATIC NOTES

Run numbers are rubber stamped at rear of chassis and are discussed on page 30. (1), (3), (5), etc. indicate run numbers in the 20T1 chassis, used in "television only" models. [1], [6], [3], etc. indicate run numbers in the 20V1 chassis, used in combination sets.

(A1), (A2),......(T), (Z), etc. indicate alignment points and alignment connections.

WAVEFORM DATA
(Waveforms given on schematic; see also "Waveform Analysis" on Page 36)

Waveforms taken with picture control set fully to the right, all other controls set for normal picture (in sync).

Waveforms at video and sync stages obtained with transmitted picture signal input to receiver.

The oscilloscope sweep is adjusted for 30 cycles (which is one-half of the vertical frequency), o. for 7875 cycles (which is one-half of the horizontal frequency) so that two pulses appear on the screen.

The peak-to-peak voltage readings shown are subject to some variations due to response of the oscilloscope and parts tolerances.

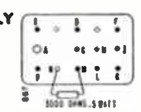
SERVICING TV CHASSIS SEPARATELY

In combination models, to service the television chassis with the radio disconnected, it will be necessary to complete the heater circuit by connecting a jumper wire between pins "L" and "K" of socket M503. See schematic.

SERVICING RADIO SEPARATELY

The radio can be operated without the television chassis if a 1PA2 power supply (used with the 4S1 radio) or 2PA1 power supply (used with 5B2 radio) is available. Connect a 3,000 ohm, 5 watt resistor (part number 61A1-15) from pin "M" to "N" on the power supply socket.

This resistor drops the B plus voltage for proper operation.



Socket, Rear View (Inside Chassis).

CAUTION

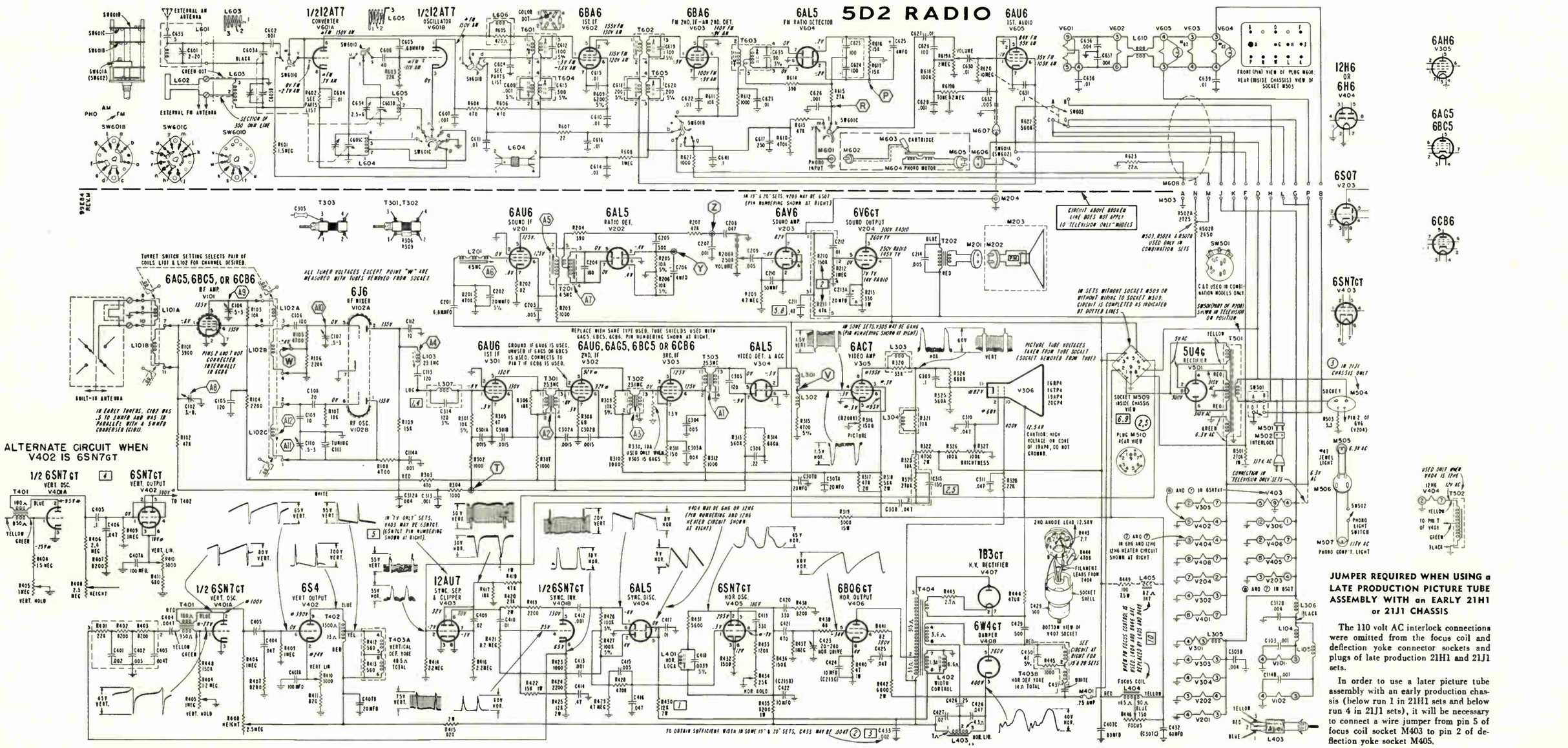
Pulsed high voltages are present on the cap of the 6BQ6GT tube, and on the filament terminals and cap of the 1B3GT tube. NO ATTEMPT SHOULD BE MADE TO TAKE MEASUREMENTS FROM THESE POINTS UNLESS SUITABLE TEST EQUIPMENT IS AVAILABLE.

Picture tube 2nd anode voltage can be measured from the 2nd anode connector and should be taken only with a high voltage instrument such as a kilovoltmeter. 2nd anode voltage is approximately 12 KV. Proper filament voltage check of the 1B3GT tube may be made by observing filament brilliancy as compared with that obtained with a 1.5 volt dry cell battery.

3C1 RADIO VOLTAGE DATA
(Voltages given on schematic diagram)

- Voltages measured with a vacuum tube voltmeter, between tube terminals and chassis.
- Line voltage 117 volts AC.
- Loop antenna connected.
- Volume control set at minimum.
- Dial turned to low frequency end.

Figure 26. Schematic for 21B1 Chassis (run 10 or earlier), 21C1, 21H1, 21J1 Chassis; 5D2 (AM-FM radio) circuit also shown. See figure 30 for 3C1 (AM radio chassis). For 21B1 chassis with gated AGC, see figure 31.



SCHEMATIC NOTES

Run numbers are rubber stamped at rear of chassis and are discussed on pages 48 thru 52.

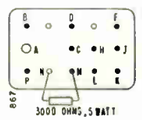
On figure 26 numerical symbols [1], [2], [3], etc. indicate run numbers for 21B1 and 21C1 chassis, and numerical symbols ①, ②, ③, etc. indicate run numbers for 21H1 and 21J1 chassis.

On figure 27, numerical symbols ①, ②, ③, etc. indicate run numbers for the 21D1 chassis.

(A1), (A2),.....(Y), (Z), etc. indicate alignment points and alignment connections.

SERVICING RADIO SEPARATELY

The radio can be operated without the television chassis if a 2PA1 power supply (used in TV-radio-phono models employing the 20Z1 (12") television chassis) is available. To operate the radio, connect a 3,000 ohm, 5 watt resistor (part 61A1-15) from pin "M" to "N" on the power supply socket as shown in the adjacent illustration of the rear (inside) view of the socket.



SERVICING TV SEPARATELY

In combination models, to service the television chassis with the radio disconnected, it will be necessary to complete the heater circuit by connecting a jumper wire between pins "L" and "K" of socket M503 on the TV chassis. See schematic.

RADIO VOLTAGE DATA

- Line voltage 117 volts AC.
- Voltages measured with a vacuum tube voltmeter, between tube terminals and chassis.
- Volume control set at minimum.
- Dial turned to low frequency end.
- FM antenna disconnected; AM antenna connected.
- In AM-FM sets, voltages measured with band switch on FM position, unless otherwise indicated; an AM reading is given where difference is significant.
- ▲ When R602 is 240 ohms, voltage on pin 1 of V601 is 152 volts, pin 2 is —.5 volts, pin 6 is 152 volts and pin 8 is 1.9 volts.
  When R602 is 1500 ohms, voltage on pin 1 of V601 is 160 volts, pin 2 is —3 volts, pin 6 is 160 volts and pin 8 is 3 volts.

TV VOLTAGE DATA

- PICTURE control turned fully clockwise. CHANNEL control set on an unused channel. Other front controls set at approximately half rotation. Vert. Lin. and Height set at approximately half rotation.
- Voltages marked with an asterisk * will vary widely with control setting.
  In combination models, B+ voltages in TV chassis will be slightly higher when set is switched to radio position. Alternate voltage readings for radio and TV are shown for sound output tube V204 (6V6GT).
- Line voltage 117 volts AC.
- Voltages measured with a vacuum tube voltmeter between tube socket terminals and chassis, unless otherwise indicated.
  Voltages at V101, V102, V306 measured from top of socket with tube removed.
- Antenna disconnected from set with terminals shorted.
- Under operating conditions, AGC (Automatic Gain Control) voltage developed at pin 1 of V301 should measure approximately —3 volts. This voltage depends on picture signal strength.

JUMPER REQUIRED WHEN USING a LATE PRODUCTION PICTURE TUBE ASSEMBLY WITH an EARLY 21H1 or 21J1 CHASSIS

The 110 volt AC interlock connections were omitted from the focus coil and deflection yoke connector sockets and plugs of late production 21H1 and 21J1 sets.

In order to use a later picture tube assembly with an early production chassis (below run 1 in 21H1 sets and below run 4 in 21J1 sets), it will be necessary to connect a wire jumper from pin 5 of focus coil socket M403 to pin 2 of deflection yoke socket M405.

FOCUS COIL and DEFLECTION YOKE CONNECTORS USED in 19" and 20" SETS

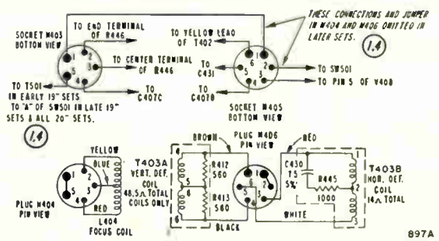
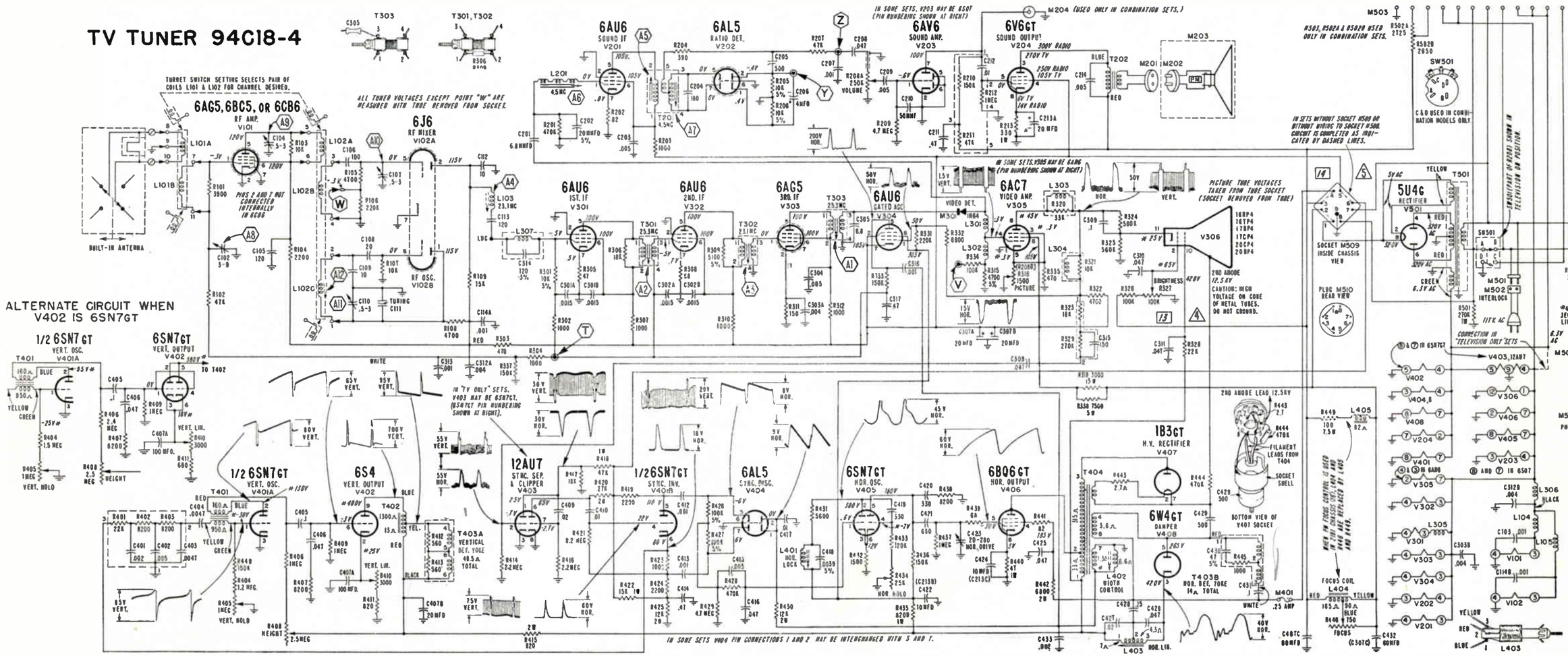


Figure 31. Schematic for 21B1 Chassis Stamped Run 13 or Run 14 and 21F1 Chassis Stamped Run 4 or Run 5. Use this schematic and partial schematic, figure 18A for 21B1 chassis stamped Run 12 and 21F1 chassis stamped Run 3.



TV VOLTAGE DATA
(Voltages given on schematic diagram)

- PICTURE control turned fully clockwise. CHANNEL control set on an unused channel. Other front controls set at approximately half rotation. Vert. Lin. and Height set at approximately half rotation.
- Antenna disconnected from set with terminals shorted.
- Line voltage 117 volts AC.
- Voltages measured with a vacuum tube voltmeter between tube socket terminals and chassis, unless otherwise indicated. Voltages at V101, V102, V306 measured from top of socket with tube removed.
- Voltages marked with an asterisk * will vary widely with control setting.
  In combination models, B+ voltages in TV chassis will be slightly higher when set is switched to radio position. Alternate voltage readings for radio and TV are shown for sound output tube V204 (6V6GT).
- Under operating conditions, AGC (Automatic Gain Control) voltage developed at test point "T" (see schematic) should measure from —.25 volts to —6 volts. This voltage depends on TV signal strength.

SCHEMATIC NOTES

Run numbers are rubber stamped at the rear of the chassis. For additional run number information see pages 44 and 48.

Numerical symbols [1], [2], [3], etc. indicate run numbers for 21B1 chassis and numerical symbols ⚠1, ⚠2, ⚠3, etc., indicate run numbers for 21F1 chassis.

⟨A1⟩, ⟨A2⟩,.....⟨Y⟩, ⟨Z⟩, etc. indicate alignment points and alignment connections.

Figure 30. Schematic for 21F1 Chassis (below run 3) and 21G1, 21K1, 21L1, 21P1, 21Q1 Chassis; 3C1 (AM only) radio circuit also shown. See figure 26 for 5D2 (AM-FM) radio circuit. For chassis with gated AGC circuit, see figure 31.

SERVICING RADIO SEPARATELY

The radio can be operated without the television chassis if a 2PA1 power supply (used in TV-radio-phono models employing the 20Z1 (12") television chassis) is available. To operate the radio, connect a 3,000 ohm, 5 watt resistor (part 61A1-15) from pin "M" to "N" on the power supply socket.

This resistor drops the B plus voltage for proper operation.

Power Supply Socket, (Inside Chassis View).

SERVICING TV SEPARATELY

In combination models, to service the television chassis with the radio disconnected, it will be necessary to complete the heater circuit by connecting a jumper wire between pins "L" and "K" of socket M503. See schematic.

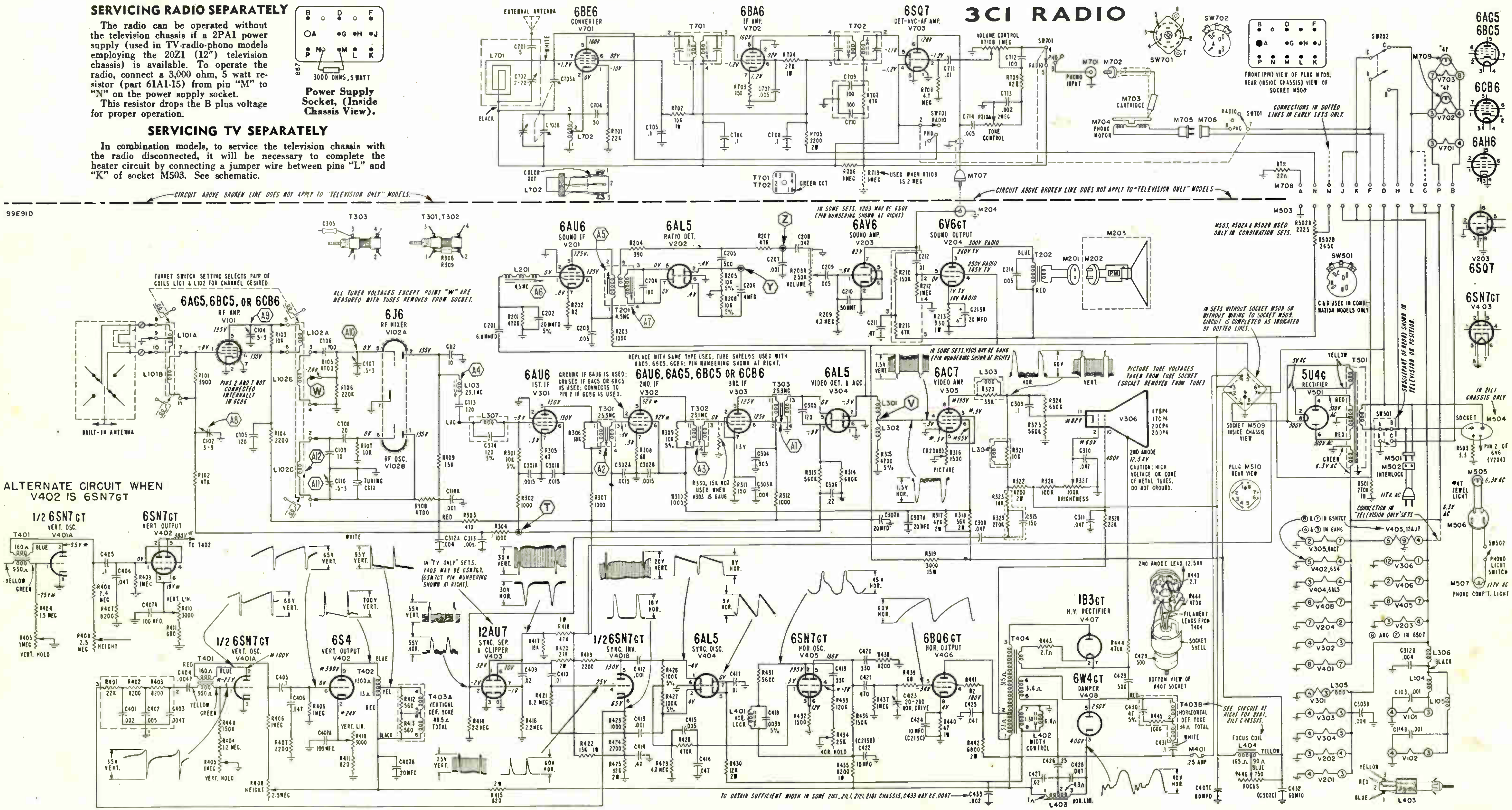
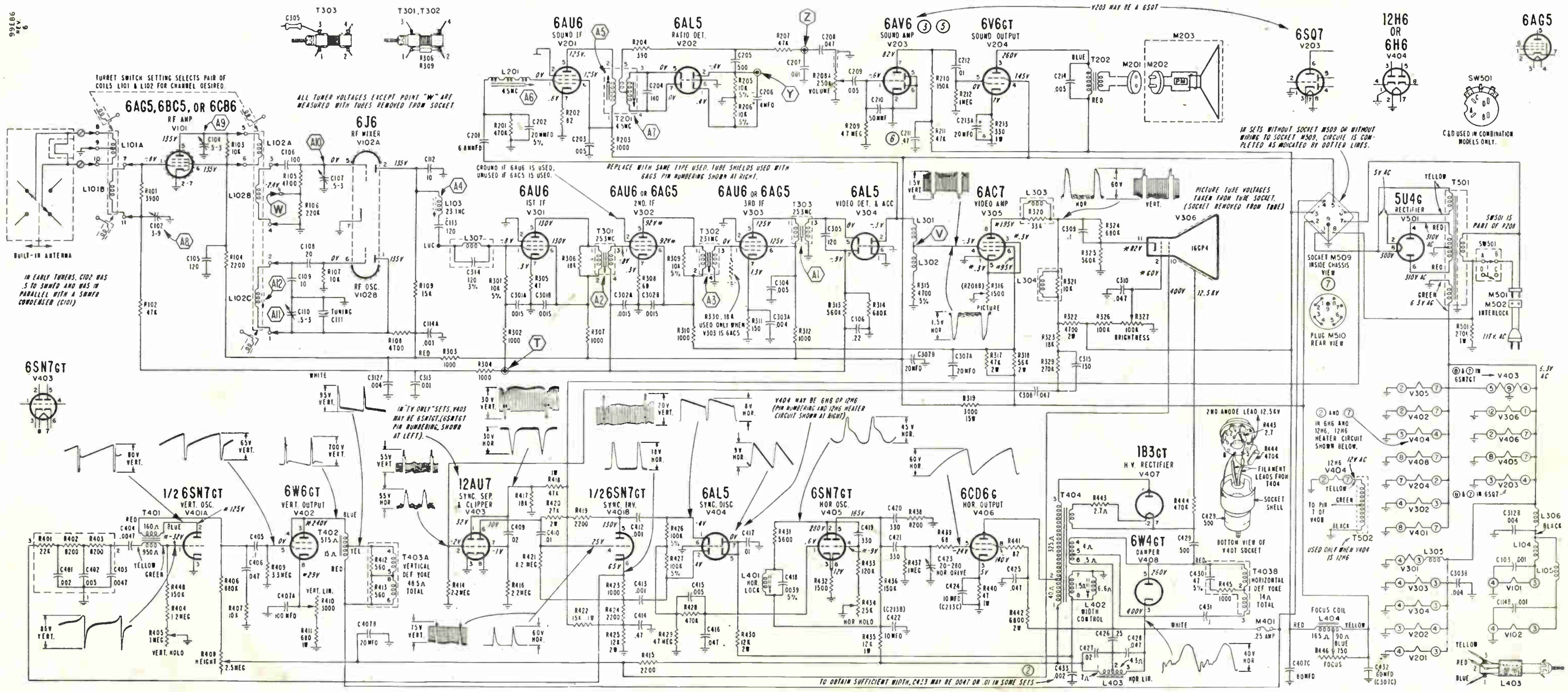


Figure 27. Schematic for 21D1, 21E1 Chassis (16" round tube). See figure 26 for 5D2 (AM-FM radio) chassis used with 21E1 chassis.



SCHEMATIC NOTES

Ⓐ1, Ⓐ2,......Ⓣ, Ⓩ, etc. indicate alignment points and alignment connections.

TV VOLTAGE DATA
(Voltages given on schematic diagram)

- PICTURE control turned fully clockwise. CHANNEL control set on an unused channel. Other front controls set at approximately half rotation. Vert. Lin. and Height set at approximately half rotation.
- Voltages marked with an asterisk * will vary widely with control setting. In combination models, B+ voltages in TV chassis will be slightly higher when set is switched to radio position. Alternate voltage readings for radio and TV are shown for sound output tube V204 (6V6GT).
- Line voltage 117 volts AC.
- Voltages measured with a vacuum tube voltmeter between tube socket terminals and chassis, unless otherwise indicated. Voltages at V101, V102, V306 measured from top of socket with tube removed.
- Antenna disconnected from set with terminals shorted.
- Under operating conditions, AGC (Automatic Gain Control) voltage developed at test point "T" (see schematic) should measure approximately —3 volts. This voltage depends on TV signal strength.

CAUTION

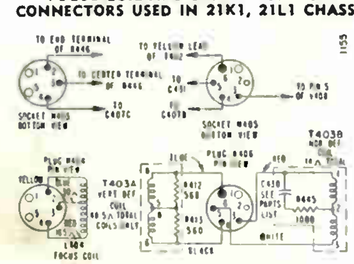
Pulsed high voltages are present on the cap of V406, and on the filament terminals and cap of the 1B3GT tube. NO ATTEMPT SHOULD BE MADE TO TAKE MEASUREMENTS FROM THESE POINTS UNLESS SUITABLE TEST EQUIPMENT IS AVAILABLE.

Picture tube 2nd anode voltage can be measured from the 2nd anode connector and should be taken only with a high voltage instrument such as a kilovoltmeter. 2nd anode voltage is approximately 12.5 KV. Proper filament voltage check of the 1B3GT tube may be made by observing filament brilliancy as compared with that obtained with a 1.5 volt dry cell battery.

RADIO VOLTAGE DATA

- Line voltage 117 volts AC.
- Voltages measured with a vacuum tube voltmeter, between tube terminals and chassis.
- Volume control set at minimum.
- Dial turned to low frequency end.
- AM antenna connected.

FOCUS COIL AND DEFLECTION YOKE CONNECTORS USED IN 21K1, 21L1 CHASSIS



PRODUCTION CHANGES

47. ALTERNATE MOUNTING PARTS FOR 17" METAL PICTURE TUBES

Run 7 in 21P1 Chassis

21P1 chassis stamped Run 7 or higher use three individual plastic mounting parts for insulating the 17 inch metal picture tube from the front of the chassis. Early production sets used a single plastic band.

Note: When replacing a one piece plastic band with a three piece plastic band, it will be necessary to order all parts listed in the illustration

48, CHANGE TO PREVENT VERTICAL ROLL AND PICTURE WASH OUT IN WEAK SIGNAL AREAS

Run 15 in all 21 Series Chassis

Vertical roll and picture wash-out in weak signal areas can be due to any of the following causes:

a. Noise pulses.

b. IF regeneration.

c. Defective tubes.

d. Defective germanium diode (M301).

e. Low line voltage.

Circuit changes were made in later production chassis (stamped Run 15 or higher) to prevent vertical roll and picture wash-out due to noise pulses and IF regeneration. The changes made were in the IF amplifier, video amplifier and sync circuits; the schematic in this supplement includes these changes. If vertical roll and picture wash-out is experienced in weak signal areas, the changes given below in paragraph 1 should be made.

For eliminating vertical roll (sync trouble) due to faulty tubes, see paragraph 2.

For vertical roll due to a faulty germanium diode (M301), see paragraph 3.

1. Adding Changes to Prevent Vertical Roll and Picture Wash-Out

This change should be made *only in sets with a gated* AGC circuit, which have run numbers lower than Run 15. (Sets with gated AGC use a 6AU6 for V304).

Using the proper schematic in Service Manual No. S362, make the changes as follows:

a. Remove resistor R442 (15,000 ohms).

b. Connect a wire jumper across C414 condenser (.47 mfd.) in order to remove C414 and R425 (12,000 ohms) from the circuit.

c. Disconnect the two leads connected to pin 6 of V305 (6AC7). Solder and tape leads together.

d. Connect a 15,000 ohm, 1 watt resistor (part number 60B14-153) from pin 2 of V305 (6AU6) to pin 6 of V306 (6AC7).

e. Connect a .005 mfd, condenser (part number 65C10-1) between pins 1 and 6 of V305 (6AC7).

f. Connect a 20 mfd, 450 volts, electrolytic condenser (part number 67A21-1) from pin 6 of V305 (6AC7) video amplifier to chassis ground.

g. Locate junction of resistors R418, R419 and R420. Disconnect R419 (2,200 ohms) at this junction and connect it to pin 6 of V305 (6AC7).

h. Replace resistor R418 (47,000 ohms) with a 33,000 ohm, 1 watt resistor (part number 60B14-333). If set is a TV-radio-phono combination model, use a 33,000 ohm, 2 watt resistor (part number No. 60B20-333).

i. Replace resistor R417, 18,000 ohms, ½ watt with an 18,000 ohm, 1 watt resistor (part No. 60B14-183).

j. Connect a .005 mfd. condenser (part No. 65C10-1) from pin 3 of V302 (6AU6) to chassis ground.

k. Solder a 3¼ inch length of ¼ inch shield braid (part number 95A12-6) from the top shield on the IF strip to the chassis; see figure 41. Before soldering shield braid, insulate it by slipping a 2 inch length of insulating tubing over it. Note: Some early sets may already have the wire braid shield added.

l. On the top side of the chassis, spot solder the IF sub-chassis to the main chassis at the center location shown in the adjoining illustration.

2. Vertical Roll Due to Faulty Tubes

Vertical roll (poor vertical sync stability) can be due to faulty tubes. The tubes listed below should be checked by replacement whenever difficulty in vertical roll is encountered.

a. Sync Separator and Clipper V403 tube (12AU7). A weak tube will provide insufficient sync input to lock-in picture.

b. In TV Tuner 94C18-4, RF Amplifier V101 tube (6CB6, 6BC5 or 6AG5). Leakage between tube elements will cause clipping of sync pulse due to incorrect AGC voltage.

c. Video Amplifier V305 tube (6AC7). When plate current is excessive, clipping of sync pulses will occur.

3. Vertical Roll Due to Faulty 1N64 Germanium Diode

A faulty 1N64 germanium diode (with low output) will cause vertical roll. A rough check of the 1N64 germanium diode can be made by disconnecting one side of the diode from the circuit and checking the front to back ratio with the ohmmeter range of a VTVM. (Diodes are easily ruined by heat and to eliminate the possibility of damage when applying a soldering iron, remove the diode from the circuit by disconnecting peaking coil L301 or L302 from the tie-point which is connected to pin 4 of V305 (6AC7). For additional important information on servicing germanium diodes, see "Servicing Video Detector (M301)" on page 47 of Service Manual No. S362. The front to back ratio should be on the order of 1,000 to 1,500 times. For example, if a diode measures 300 ohms in one direction, it should read 300,000 to 500,000 ohms in the other direction.

Lead dress is very important in the video detector and AGC circuits in order to prevent high peak voltages from the AGC circuit causing damage to the germanium diode. Be sure to:

a. Dress the germanium diode away from the white lead connected to pin 5 of AGC tube V304 (6AU6).

b. Dress the white lead close to the chassis.

c. Dress the orange lead connected to pin 1 of AGC tube V304 (6AU6) away from video amplifier tube V305 (6AC7).

49. WIRING TO COLOR CONVERTER SOCKET M509 OMITTED

Run 17 in all 21 Series Chassis

In later production sets, plug M510 and wiring connections to socket M509 were omitted.

Some later sets do not have socket M509.

50. B PLUS AND AUDIO COUPLATE CIRCUIT CHANGED

Run 18 in 21K1 Chassis, Run 19 in 21F1, 21G1 21M1, 21N1, 21P1 and 21Q1 Chassis

Changes were made in the B plus circuit to the sound amplifier V203 (6AV6) and to the first anode (pin 10) of picture tube V306. The schematic in figure 48 has these changes incorporated. *Fuse failure in sets having these changes will result in loss of both sound and picture.*

In some sets audio couplate, part number 63B6-3 was replaced with couplate 63B6-5. When couplate 63B6-3 is used, terminal 3 is unused and R215 (270,000 ohms, ½ watt) is connected in series with terminal 5. When couplate 63B6-5 is used, R210 is 470,000 ohms, and R211 is omitted. Couplate 63B6-5 is shown in the schematic Figure 48. A circuit of couplate 63B6-3 is shown at the right of schmatic.

51. CHANGE TO REDUCE CATHODE CURRENT

Run 21 in 21Y1 Chassis

To reduce the cathode current of horizontal output tube V406 (6CD6G), resistor R437 was changed from 470,000 ohms to 1 megohm, part number 60B8-105.

52. CHANGE TO IMPROVE PICTURE DEFINITION

Run 22 in all 21 Series Chassis

Changes were made to the video amplifier circuit of later production receivers to improve picture definition (eliminate picture smear). Picture smear may be apparent if the TUNING control is incorrectly tuned, when tuning to eliminate 4.5 MC beat interference.

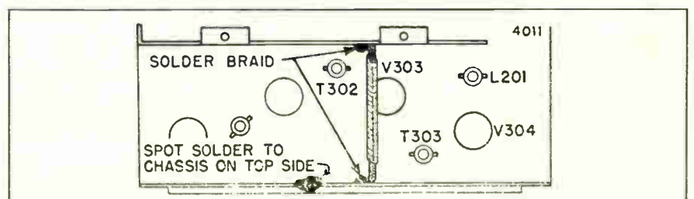


Figure 41. Underside of IF Strip.

The changes to the video amplifier circuit are asfollows:

Peaking coil L304, part number 73A5-9 (with a gray dot was replaced with peaking coil part number 73A11-1. Peaking coil, 73A11-1 has a three pi winding.

Peaking coil L303, part number 73A5-13 (with a white dot) was replaced with peaking coil, part number 73A5-14) (with a blue dot). Resistor R320 (part of L303) is 33,000 ohms when L303 has a white dot and 18,000 ohms when L303 has a blue dot.

A 4.5 MC trap coil (L308) with a 6.8 mmfd. condenser (C322) in series part number 72B99-3, is connected between pin 4 of video amplifier V305 (6AC7) and chassis ground. The 6.8 mmfd. condenser connects to pin 4 of V305 (6AC7).

Adding Change to Improve Picture Definition

To improve picture definition in an early production receiver (below Run 22), make the changes outlined in the previous paragraph; also note the following instructions:

If part number 73A11-1 is not available, use two 73A5-9 peaking coils connected in series, with shortlleads, so that the coils are not more than ¼ inch apart. Connect a 22,000 ohm, ½ watt resistor (part number 60B8-223) across this two coil assembly.

If part number 73A5-14 is not available, part number 73A5-13 should be left in the receiver and a 33,000 ohm, ½ watt resistor (part number 60B8-333) should be wired across it.

Mount the 4.5 MC trap coil in the chassis hole located between tubes V305 (6AC7) and V403 (12AU7), with the 6.8 mmfd. condenser C322 connected to pin 4 of V305.

The trap should be tuned by watching the picture and adjusting the slug for minimum 4.5 MC interference. If greater accuracy is required, the trap should be adjusted according to the instructions given on page 83 under "Alignment of 4.5 MC Interference Trap L308".

R342 ADDED TO PREVENT RINGING

In later production sets, resistor R342, 4,700 ohms, ½ watt (part number 60B8-472) was added across peaking coil L301 to prevent possible "ringing" in picture. In very late production sets, resistor R342 and peaking coil L301 are a single unit, part number 73A5-15. Peaking coil L301 is wound on the resistor R342.

53. DIFFERENT HORIZONTAL OUTPUT TUBE USED

Run 23 in 21K1, 21L1, 21M1 and 21N1 Chassis

In the above chassis the horizontal output tube V406 was changed from a 6BQ6GT tube to a 6CD6G tube. When a 6CD6G tube is used in the horizontal output stage, condenser C433 (across the width coil) is omitted. Resistor R437 (across horizontal drive trimmer) was changed from 470,000 ohms to 1 megohm; and screen dropping resistor R442, 6,800 ohms, 2 watt, is replaced by two 3,300 ohm, 2 watt resistors in series, symbols R442 and R451. Changing to a 6CD6G tube has increased the power in the output circuit.

54. FILTER ADDED TO MINIMIZE VERTICAL BARS IN PICTURE

Run 24 in 21M1 and 21Y1 Chassis

A filter has been added to eliminate or reduce to a minimum the brightness of shadow-type vertical bars which may appear at the left side of the picture.

This filter consists of resistor R450 (680 ohms, 2 watts, part number 60B20-681), condenser C434 (.0068 mfd, 600 volts, paper, part number 64A2-15), and RF choke L406 (part number 73B8-2). These components are all connected in parallel and are wired in the set between terminal 4 of the horizontal output transformer (T404) and pin 5 of the damper tube V407 (6W4GT).

55. CHANGE TO PREVENT PICTURE FLASHING AND IMPROVE SYNC STABILITY

Run 25 in All 21 Series Chassis

Changes were made in later production chassis to eliminate possible flashing (white horizontal bars in picture) and also improve sync stability in weak signal areas. Resistor R331 (connected between pins 1 and 6 of V304) was changed from 220,000 ohms to 270,000 ohms, ½ watt, part number 60B8-274. In the AGC lead to the TV tuner, resistor R304 (1,000 ohms) was omitted, and condenser C313 was changed from .001 mfd. to .47 mfd, 100 volts, part number 64A10-1. If slight flashing is still apparanet in a receiver having this change, see the paragraph below.

Adding Changes to Eliminate Flashing and Improve Sync Stability in Weak Signal Areas

The following change can be added to early production chassis below Run 25 to eliminate flashing (white horizontal bars in picture) and also prevent loss of sync from automobile ignition and other high amplitude noise pulses. This type of interference will only appear when the AGC voltage is at a certain level.

1. Connect a .47 mfd, 100 volt condenser (part number 64A10-1) across condenser C317.

2. Remove resistor R331 (220,000 ohms) and replace it with a 470,000 ohm, ½ watt resistor (part number 60B8-474). In areas where strong TV station is operating, it may be preferable to use a lower value resistor (270,000 to 220,000) to prevent possible picture "bending" when tuned to a TV station with a strong signal.

3. If vertical roll is encountered in chassis stamped Run 14 or lower, make the Run 15 changes as described in paragraph 48.

56. CHANGE TO PREVENT HORIZONTAL JITTER IN STRONG SIGNAL AREAS

Run 26 in 21F1, 21G1, 21M1 and 21Y1 Chassis

Changes were made in later production 21 series chassis stamped Run 26 to prevent possible horizontal jitterin strong signal areas. In some 21 series chassis with run numbers 25 and 26, pin 3 of sync separator V403, was connnected to one end of picture control R316. In later production sets, pin 3 of V403 is connected directly to chassis ground and one terminal of the picture control R316 is unused. Resistor R418 (in the plate circuit of V403) was changed from 39,000 ohms to 33,000 ohms, 3 watt, part number 60B20-333.

CHANGE IN 21Y1 CHASSIS TO PREVENT INSTABILITY ON RADIO OPERATION

In later production 21Y1 chassis, condenser C717, 100 mmfd, ceramic, part number 65C6-3 has been added from terminal 1 of T702 (2nd IF transformer) to chassis ground and one lead of the secondary winding of T202 (speaker output transformer) is connceted to chassis ground. These changes were made to prevent possible instability in the form of oscillation at the low end of the broadcast band.

DIFFERENCES IN SYNC SEPARATOR CIRCUIT

In some later production sets (stamped Run 24 and 25), pin 3 (cathode) of V403 sync separator was connected to a terminal of the picture control R316 instead of going directly to chassis ground. In later production sets pin 3 of V403 sync separator is connected directly to chassis ground and resistor R418 (in the plate circuit of V403) is 33,000 ohms, ½ watt, part number 60B8-333 in TV only sets, and 33,000 ohms, 2 watt, part number 60B20-333 in combination sets. Important: in some high signal strength areas, horizontal jitter may occur in sets (Run 24 and 25) having pin 3 of V403 sync separator connecting to the picture control. In these sets, horizontal jitter can be eliminated by making the changes outlined in paragraph 56.

ADDITIONAL CHANGES FOR SETS WITH "LOCAL-DISTANT" SWITCH

Some receivers have been modified in the field to improve reception in extended fringe areas. These modifications include the addition of a "Local-Distant" switch; the complete modification is described under the heading "Increasing Sensitivity for Extended Fringe Area Reception" on page 53 of Service Manual No. S362. The changes described below will further improve reception in these sets. Do not add these changes in sets which use a gated AGC circuit; these sets use a 6AU6 tube for V304.

Video Circuit Change: In some areas, particularly where a signal is subject to fading, the picture may bend when the "Local-Distant" switch is in the "Distant" position. This condition may be eliminated or reduced by removing the direct coupling between the video detector V304 (6AL5) and the video amplifier V305 (6AC7). The wire connected between pin 4 of V305 and the junction of L301 and L302 should be removed and replaced by a .1 mfd, 400 volt condenser (part number 64A2-10). Connect a 1.2 megohm ½ watt resistor (part number 60B8-125) between pins 4 and 5 of V305.

Improving Sound: To be sure that the sound will be satisfactory, realign the three sound section slugs (A5, A6, A7) when checking the tuner and IF stages. The ratio detector transformer T201 should be aligned very carefully. Where possible the bottom slug should be adjusted on a weak signal to a point where the sound is received with a minimum of noise.

R407 CHANGED TO IMPROVE LINEARITY

In sets using a 20 inch picture tube, resistor R407 was changed from 8,200 ohms to 10,000 ohms, ½ watt, part number 60B8-103. This change was made to improve linearity (prevent packing) at the top of the picture.

CHANGE (IN SETS WITH GATED AGC) TO PREVENT PICTURE CUT-OFF OR DELAY IN AGC ACTION

To prevent possible picture cut-off or momentary delay in AGC action (in sets having a gated AGC circuit), width control L402 has been changed from a two terminal coil (part number 94A29-1), to a three terminal tapped coil (part number 94A39-1).

Use of the three terminal width coil provides an increase (step-up) in the pulse amplitude (15.75 KC) applied to the plate (pin 5) of AGC tube V304 (6AU6).

The schematic diagram given in this supplement shows the circuit for both types of width coils. The three terminal width coil (part number 94A39-1) can be used as a replacement for the two terminal width coil if proper circuit connections are made.

DIFFERENT VERTICAL OUTPUT TRANSFORMERS (T402) USED

Several alternate vertical output transformers were used in later production sets having rectangular picture tubes. Transformer, 79B29-1 was used in early sets. Transformer, 79B39-1 was used in later production sets having a 16 or 17 inch rectangular picture tube. Transformer, 79B40-1 was used in later production sets having a 20 or 21 inch rectangular picture tube. Transformer, 79B29-1 has three leads and the transformers used in later production sets (79B39-1 and 79B40-1) have four leads as shown on the schematic diagrams in this supplement. The white and yellow leads on transformers 79B39-1 and 79B40-1 are connected together to correspond to the yellow lead on transformer 79B29-1. Transformers 79B29-1 and 79B39-1 are interchangeable. Only transformers 79B39-1 and 79B40-1 will be supplied as service replacements.

CHANGE TO REDUCE HISS IN SOUND

In high noise level areas, a hiss may be heard in the sound of the receiver. The following changes were made in the audio circuits of later production receivers to reduce the hiss level.

Condenser C207 was changed from .001 mfd. to .0022 mfd, 600 volts, part number 64B9-17. In TV only models, condenser C214 was changed from .005 mfd. to .01 mfd, 600 volts, part number 64B9-13.

WATTAGE OF SCREEN RESISTOR INCREASED

In later production sets which use a 6CD6G tube in the horizontal output stage V406, screen resistor R_{442} was changed from 6,800 ohms to 3,300 ohms, 2 watt, part number 60B20-332. Resistor R451, 3,300 ohms, 2 watt (part number 60B20-332) was added in series with R442 to bring the total value of screen dropping resistance to 6,600 ohms. This change was made to allow for the greater wattage dissipation required for 6CD6G tubes.

CHANGE TO IMPROVE SHAPE OF IF RESPONSE CURVE

To improve more uniform peaks at the opposite sides of the IF response curve, resistor R301 (in the grid circuit of V301, 1st IF amplifier) was changed from 10,000 ohms to 5,100 ohms, ½ watt, 5%, part number 60B7-512. Adding this change to the IF circuit reduces the peak at the low frequency side (23 MC) of the IF response curve.

CONNECTING AN EXTERNAL RECORD PLAYER TO MODELS USING A 21W1 OR 21Y1 CHASSIS

A record player can easily be connected to "TV-Radio only models" which use a 21W1 or 21Y1 chassis, since these chassis have a built-in "Television-Radio-Phono" switch, a phono input jack, and a 110 volt AC socket for supplying power to operate a phonograph turntable.

Plug the phono-input in the phono jack located on the chassis, adjacent to the 6AV6 tube (V203). To eliminate the need for opening the cabinet back each time the record player is to be removed, use a shielded extension cable with a socket and plug (part number 89A27-1).

The 110 volt AC socket (for operating a phonograph turntable) is located on the rear of the chassis, just below the speaker plug. This socket is designed to fit the special type 110 volt AC plug used with the record changer in combination models. If a record player having a standard AC plug is to receive its AC power from the set, the plug will have to be replaced with a special plug, part number 88A8-1. The record player can be plugged in a 110 volt AC wall receptacle, if it is not desired to replace the AC plug.

CHANGE TO REDUCE APPEARANCE OF RETRACE LINES

The following changes were made in later production sets to reduce the appearance of retrace lines in the picture, thereby making adjustment of the brightness control less critical.

Resistor R335 (shunting picture control R316) was changed from 470 ohms to 270 ohms, ½ watt, part number 60B8-271. Resistor R324 (in the cathode circuit of V306 picture tube) was changed from 560,000 ohms to 470,000 ohms, ½ watt, part number 60B8-474.

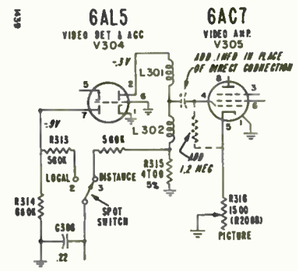


Figure 42. Partial Schematic Showing Video Circuit Change.

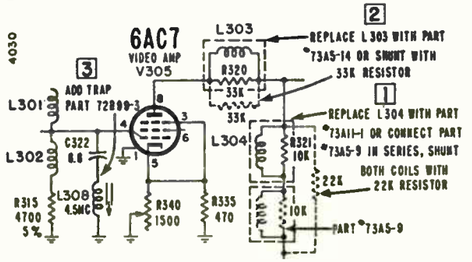
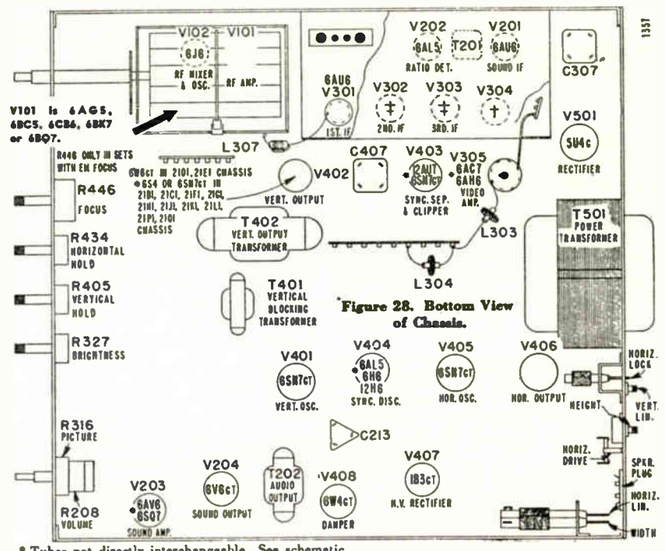


Figure 43. Video Amplifier Circuit Change to Reduce Picture Smear. Components drawn in dotted lines should be used only if peaking coils 73A11-1 and 73A5-14 are not available.



* Tubes not directly interchangeable. See schematic.
‡ 6AU6, 6AG5, 6BC5 or 6CB6 used. Tubes not interchangeable; see notes on schematic.
†6AL5 in sets without gated AGC, is 6AU6 in sets with gated AGC.

V406 is 6CD6G in 21D1 and 21E1 chassis and in later production 21K1, 21L1, 21M1 and 21N1 chassis; 6BQ6GT in 21B1, 21C1, 21F1, 21G1, 21H1, 21J1, 21P1, 21Q1, 21X1, 21X2 chassis and in early production 21K1, 21L1, 21M1 and 21N1 chassis.

Figure 28. Bottom View of Chassis.

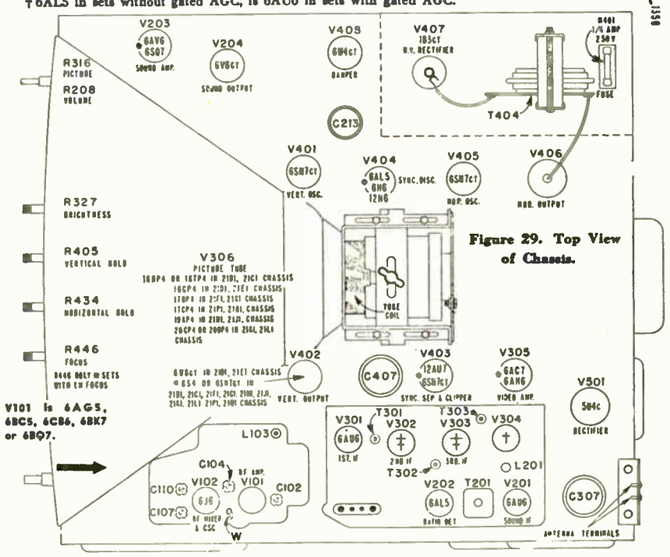


Figure 29. Top View of Chassis.

WAVEFORM DATA

(Waveforms given on schematic)

Waveforms taken with picture control set fully to the right, all other controls set for normal picture (in sync).

Waveforms at video and sync stages obtained with transmitted signal input to receiver.

The oscilloscope sweep is adjusted for 30 cycles (which is one-half of the vertical frequency), or for 7875 cycles (which is one-half of the horizontal frequency) so that two pulses appear on the screen.

The peak-to-peak voltage readings shown are subject to some variations due to response of the oscilloscope and parts tolerances.

TV VOLTAGE DATA

(Voltage given on schematic)

- PICTURE control turned fully clockwise. CHANNEL control set on an unused channel. Other front controls set at approximately half rotation. Vert. Lin. and Height set at approximately half rotation.
- Voltages marked with an asterisk * will vary widely with control setting.

In combination models, B+ voltages in TV chassis will be slightly higher when set is switched to radio position. Alternate voltage readings for radio and TV are shown for sound output tube V204 (6V6GT).

- Line voltage 117 volts AC.
- Voltages measured with a vacuum tube voltmeter between tube socket terminals and chassis, unless otherwise indicated.
  Voltages at V101, V102, V306 measured from top of socket with tube removed.
- Antenna disconnected from set with terminals shorted.

CAUTION

Pulsed high voltages are present on the cap of V406, and on the filament terminals and cap of the 1B3GT tube. NO ATTEMPT SHOULD BE MADE TO TAKE MEASUREMENTS FROM THESE POINTS WITHOUT SUITABLE TEST EQUIPMENT.

Picture tube 2nd anode voltage can be measured from the 2nd anode connector and should be taken only with a high voltage instrument such as a kilovoltmeter. 2nd anode voltage is approximately 12.5 KV in sets using a 6BQ6GT tube for V406 and approximately 14.5 KV in sets using a 6CD6G tube for V406. Proper filament voltage check of the 1B3GT tube may be made by observing filament brilliancy as compared with that obtained with a 1.5 volt dry cell battery.

SCHEMATIC NOTES

Run numbers are rubber stamped at the rear of the chassis.

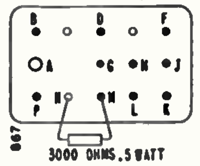
Numerical symbols [1], [2], [3], etc. indicate run numbers for 21B1 chassis, numerical symbols △1, △2, △3, etc. indicate run numbers for 21F1 chassis, numerical symbols (1), (2), (3), etc. indicate run numbers for 21K1 chassis, and numerical symbols ①, ②, ③, etc. indicate run numbers for all 21 series chassis.

(A1), (A2),......(Y), (Z), etc. indicate alignment points and alignment connections.

SERVICING RADIO SEPARATELY

The radio can be operated without the television chassis if a 2PA1 power supply (used in TV-radio-phono models employing the 20Z1 (12") television chassis) is available. To operate the radio, connect a 3,000 ohm, 5 watt resistor (part 61A1-15) from pin "M" to "N" on the power supply socket.

This resistor drops the B plus voltage for proper operation.



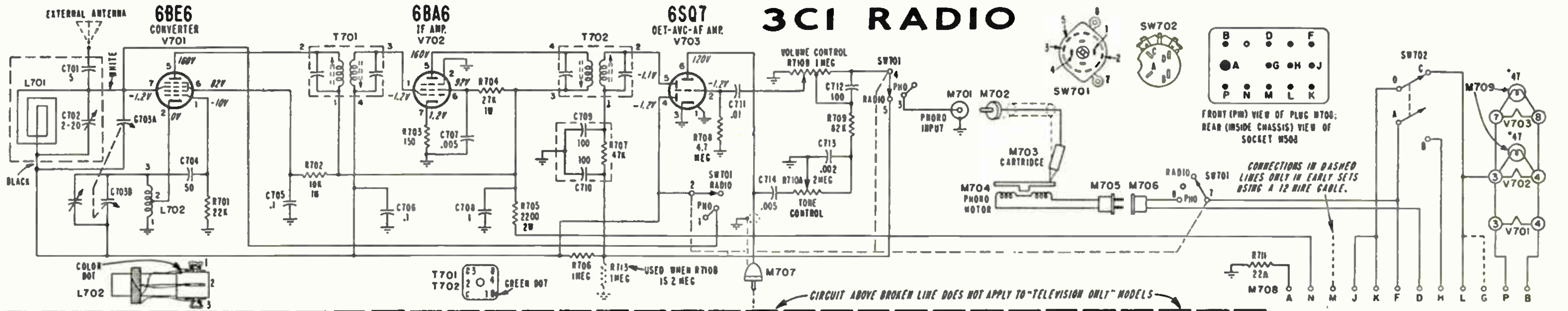
Power Supply Socket, (Inside Chassis View).

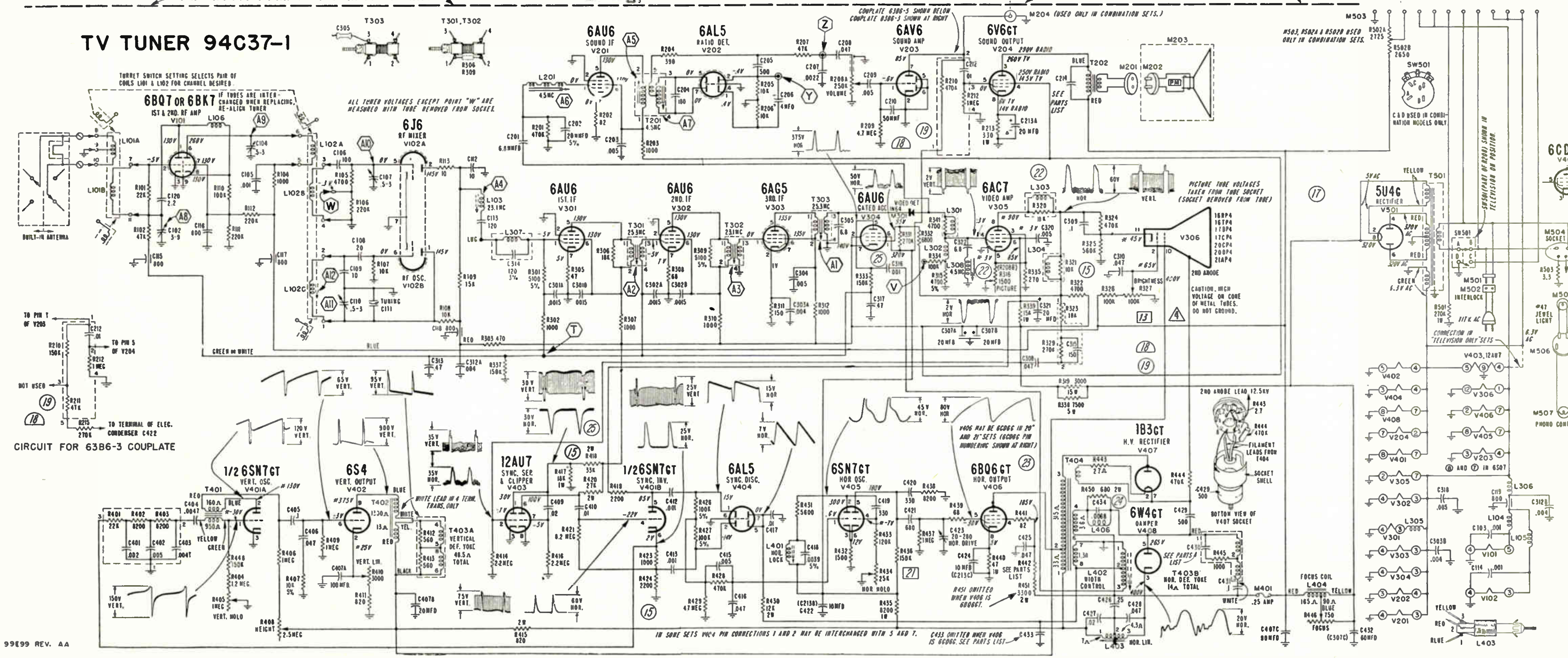
SERVICING TV SEPARATELY

In combination models, to service the television chassis with the radio disconnected, it will be necessary to complete the heater circuit by connecting a jumper wire between pins "L" and "K" of socket M503. See schematic.

Figure 48. Schematic for 21B1, 21F1, 21G1, 21K1, 21M1, 21N1, 21P1 and 21Q1 Television Chassis; 3C1 (AM only) radio circuit also shown.

Note: This schematic applies only to chassis stamped Run 18 to Run 26. See Production Change Index For chassis with lower run numbers, see schematics in Service Manual S362 and Service Manual Supplements No. S362A and No. S362B.





SCHEMATIC NOTES

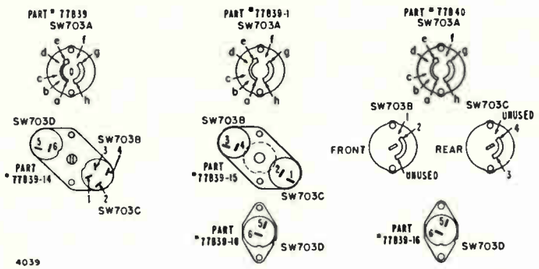
Run numbers are rubber stamped at the rear of the chassis.

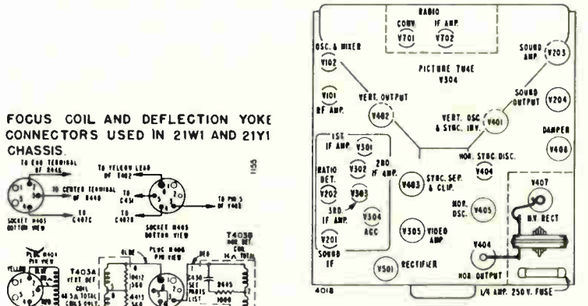
Numerical symbols [1], [2], [3], etc. indicate run numbers for 21Y1 chassis, and numerical symbols ①, ②, ③, etc. indicate run changes for all 21 series chassis.

(A1), (A2),.....(Y), (Z), etc. indicate alignment points and alignment connections.

Figure 47. Schematic for 21W1, 21Y1 Television and Radio Chassis.

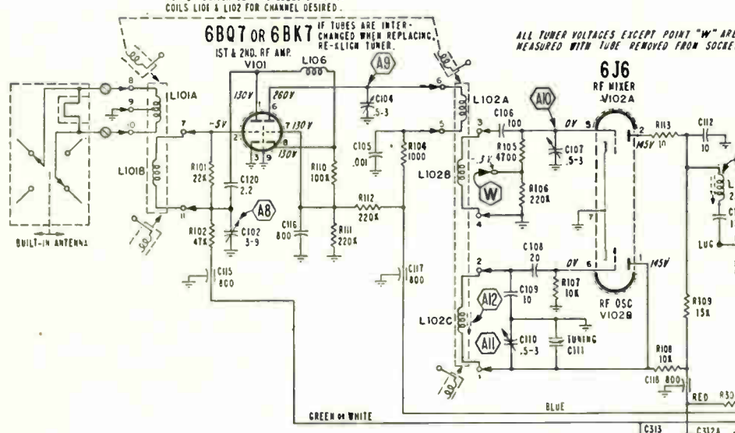
Note: This schematic applies only to chassis stamped Run 20 to Run 26.

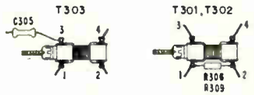




Top View of 21W1, 21Y1, 21Z1 and 21Z1A Chassis. (V701 and V702 are accessible from underside of chassis.)

TV TUNER 94C37-1





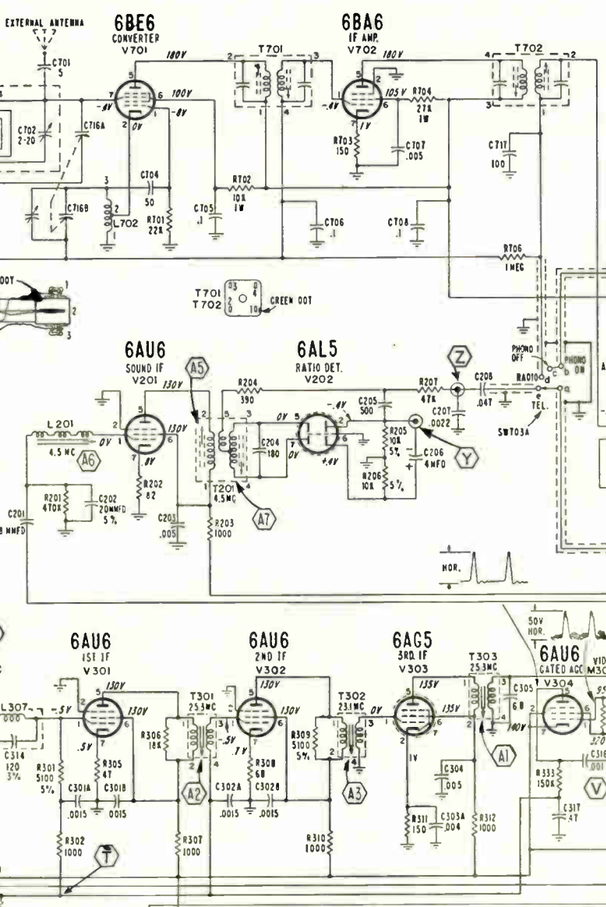


Figure 52. Schematic for 21W1, 21Y1, 21Z1 and 21Z1A Television and Radio Chassis.

Note: This schematic applies only to chassis stamped Run 20 to Run 26.

VOLTAGE DATA
(Voltages given on schematic)

- TV voltages taken with function switch on "TV" position. PICTURE control turned fully clockwise. CHANNEL control set on an unused channel. Other front controls set at approximately half rotation. Vert. Lin. and Height set at approximately half rotation. TV antenna disconnected from set with terminals shorted.
- Radio voltages V701 and V702 taken with function switch on "Rad" position; voltages measured from underside of tube sockets. When measured from top of tube sockets (with tube removed), B plus voltage at pins 5 and 6 of V701 and V702 will be approximately 275 volts.
- B plus voltages at V203 and V204, will be slightly higher when set is switched to "Rad" position. Voltages marked with an asterisk * will vary widely with control setting.
- Line voltage 117 volts AC.
- Voltages measured with a vacuum tube voltmeter between tube socket terminals and chassis, unless otherwise indicated.

  Voltages at V101, V102, V306 measured from top of socket with tube removed.

CAUTION

Pulsed high voltages are present on the cap of V406, and on the filament terminals and cap of the 1B3GT tube. NO ATTEMPT SHOULD BE MADE TO TAKE MEASUREMENTS FROM THESE POINTS WITHOUT SUITABLE TEST EQUIPMENT.

Picture tube 2nd anode voltage can be measured from the 2nd anode connector and should be taken only with a high voltage instrument such as a kilovoltmeter or other meter with a high voltage probe. 2nd anode voltage for 21W1, 21Z1 and 21Z1A chassis is approximately 14.5 KV. Proper filament voltage check of the 1B3GT tube may be made by observing filament brilliancy as compared with that obtained with a 1.5 volt dry cell battery.

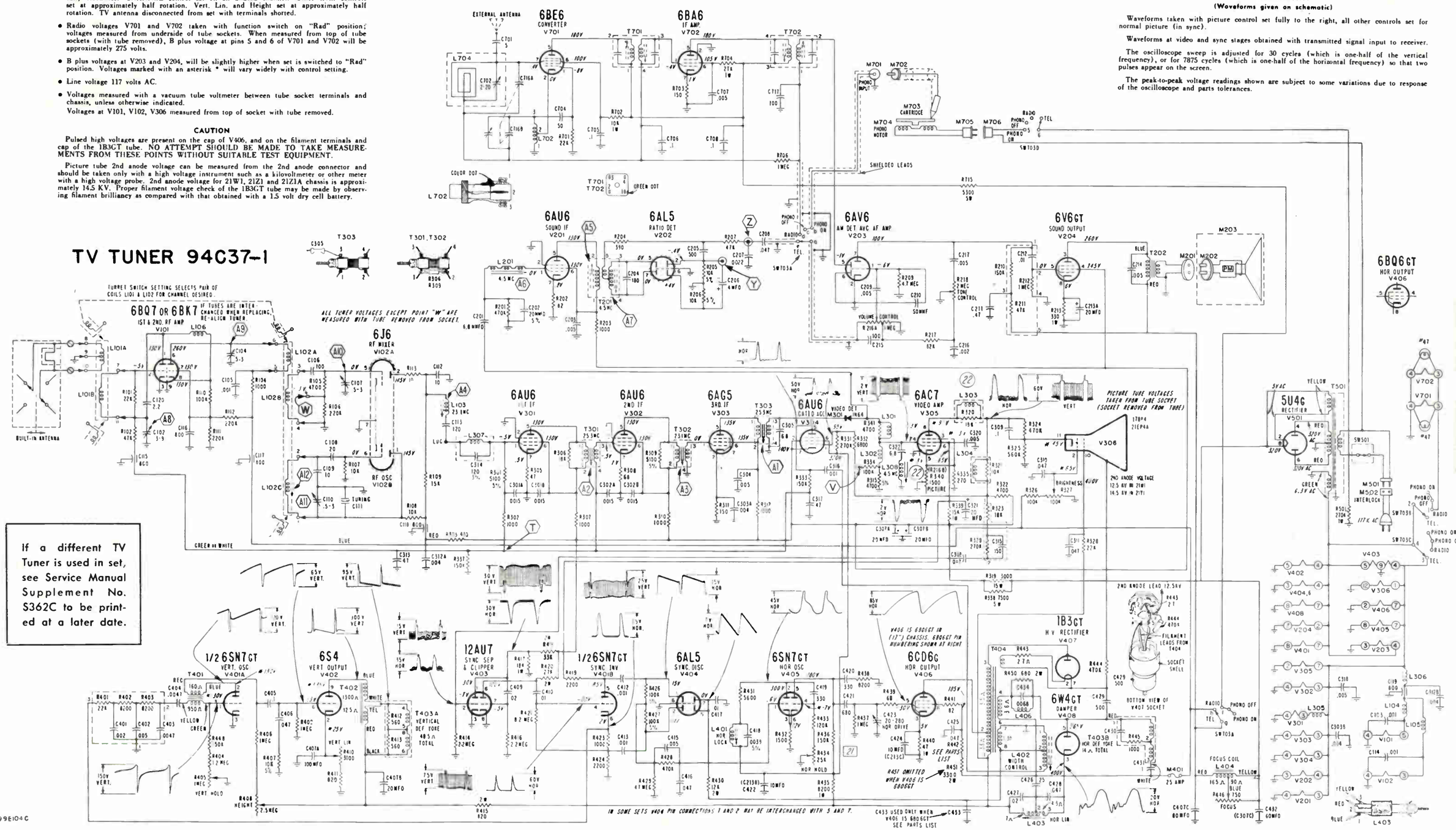
WAVEFORM DATA
(Waveforms given on schematic)

Waveforms taken with picture control set fully to the right, all other controls set for normal picture (in sync).

Waveforms at video and sync stages obtained with transmitted signal input to receiver.

The oscilloscope sweep is adjusted for 30 cycles (which is one-half of the vertical frequency), or for 7875 cycles (which is one-half of the horizontal frequency) so that two pulses appear on the screen.

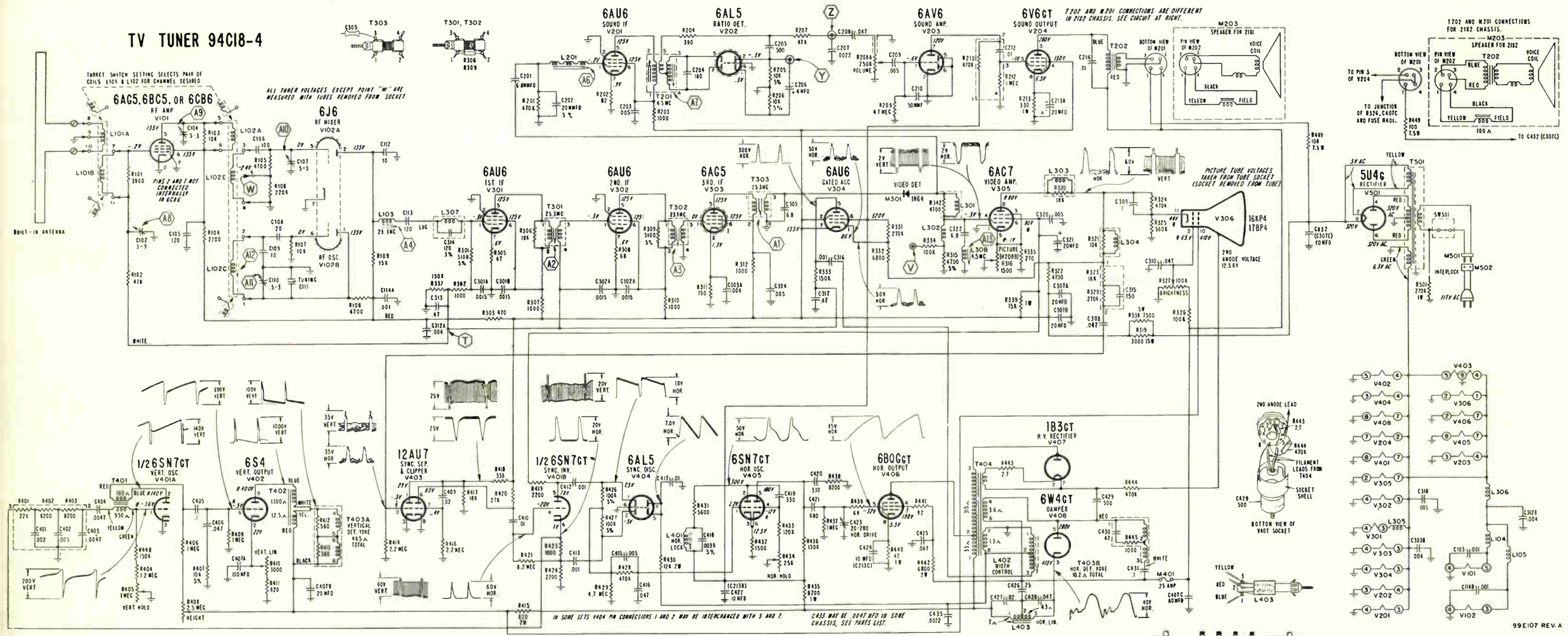
The peak-to-peak voltage readings shown are subject to some variations due to response of the oscilloscope and parts tolerances.

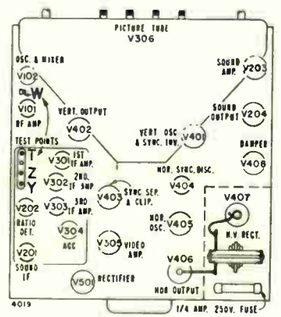


SCHEMATIC NOTES

(A1), (A2),.....(Y), (Z), etc. indicate alignment points and alignment connections.

Figure 53. Schematic for 21X1 and 21X2 Television Chassis.
Note: This schematic applies only to chassis stamped Run 26.





Top View of Chassis

TV VOLTAGE DATA
(Voltage given on schemotic)

- PICTURE control turned fully clockwise. CHANNEL control set on an unused channel. Other front controls set at approximately half rotation. Vert. Lin. and Height set at approximately half rotation.
- Voltages marked with an asterisk * will vary widely with control setting.
- Line voltage 117 volts AC.
- Voltages measured with a vacuum tube voltmeter between tube socket terminals and chassis, unless otherwise indicated. Voltages at V101, V102, V306 measured from top of socket with tube removed.
- Antenna disconnected from set with terminals shorted.

WAVEFORM DATA
(Waveforms given on schematic)

Waveforms taken with picture control set fully to the right, all other controls set for normal picture (in sync).

Waveforms at video and sync stages obtained with transmitted signal input to receiver.

The oscilloscope sweep is adjusted for 30 cycles (which is one-half of the vertical frequency), or for 7875 cycles (which is one-half of the horizontal frequency) so that two pulses appear on the screen.

The peak-to-peak voltage readings shown are subject to some variations due to response of the oscilloscope and parts tolerances.

CAUTION

Pulsed high voltages are present on the cap of V406, and on the filament terminals and cap of the 1B3GT tube. NO ATTEMPT SHOULD BE MADE TO TAKE MEASUREMENTS FROM THESE POINTS WITHOUT SUITABLE TEST EQUIPMENT.

Picture tube 2nd anode voltage can be measured from the 2nd anode connector and should be taken only with a high voltage instrument such as a kilovoltmeter or other meter with a high voltage probe. 2nd anode voltage is approximately 12.5 KV. Proper filament voltage check of the 1B3GT tube may be made by observing filament brilliancy as compared with that obtained with a 1.5 volt dry cell battery.

SCHEMATIC NOTES

Run numbers are rubber stamped at the rear of the chassis.

Numerical symbols ①, ②, ③, etc. indicate run numbers for all 22 series chassis.

⟨A1⟩, ⟨A2⟩,......⟨Y⟩, ⟨Z⟩, etc. indicate alignment points and alignment connections.

WAVEFORM DATA

(Waveforms given on schematic)

Waveforms taken with picture control set fully to the right, all other controls set for normal picture (in sync).

Waveforms at video and sync stages obtained with transmitted signal input to receiver.

The oscilloscope sweep is adjusted for 30 cycles (which is one-half of the vertical frequency), or for 7875 cycles (which is one-half of the horizontal frequency) so that two pulses appear on the screen.

The peak-to-peak voltage readings shown are subject to some variations due to response of the oscilloscope and parts tolerances.

VOLTAGE DATA

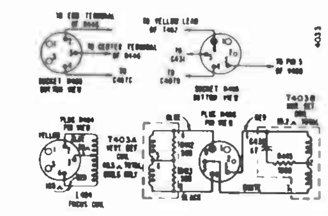
(Voltages given on schematic)

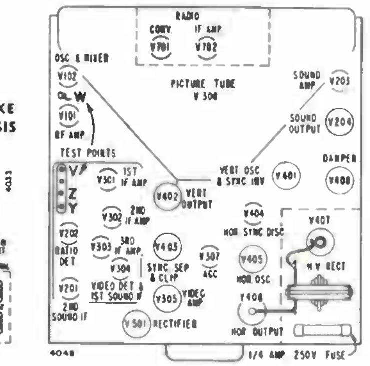
- TV voltages taken with function switch on "TV" position. PICTURE control turned fully clockwise. CHANNEL control set on an unused channel. Other front controls set at approximately half rotation. Vert. Lin. and Height set at approximately half rotation. TV antenna disconnected from set with terminals shorted.
- Radio voltages V701 and V702 taken with function switch on "Rad" position; voltages measured from underside of tube sockets. When measured from top of tube sockets (with tube removed), B plus voltage at pins 5 and 6 of V701 and V702 will be approximately 275 volts.
- B plus voltages at V203 and V204, will be slightly higher when set is switched to "Rad" position. Voltages marked with an asterisk * will vary widely with control setting.
- Line voltage 117 volts AC.
- Voltages measured with a vacuum tube voltmeter between tube socket terminals and chassis, unless otherwise indicated.
  Voltages at V101, V102, V306 measured from top of socket with tube removed.

Figure 14. Schematic for 22A2, 22A2A and 22Y1 Television and Radio Chassis.

Note: This schematic applies only to chassis stamped Run 1.

FOCUS COIL AND DEFLECTION YOKE CONNECTORS USED IN 22Y1 CHASSIS





Top View of 22A2, 22A2A and 22Y1 Chassis. (V701 and V702 are accessible from underside of chassis).

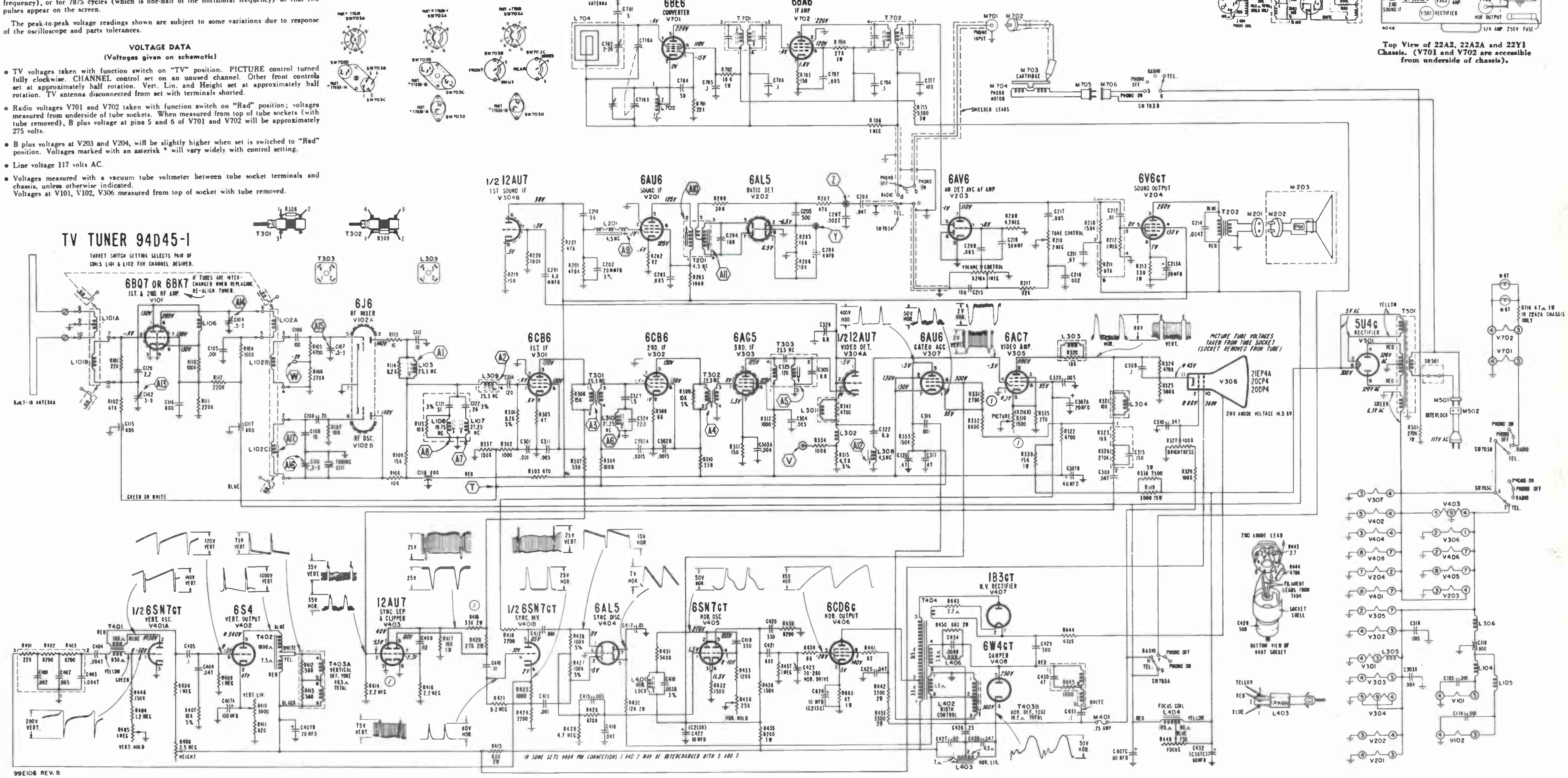
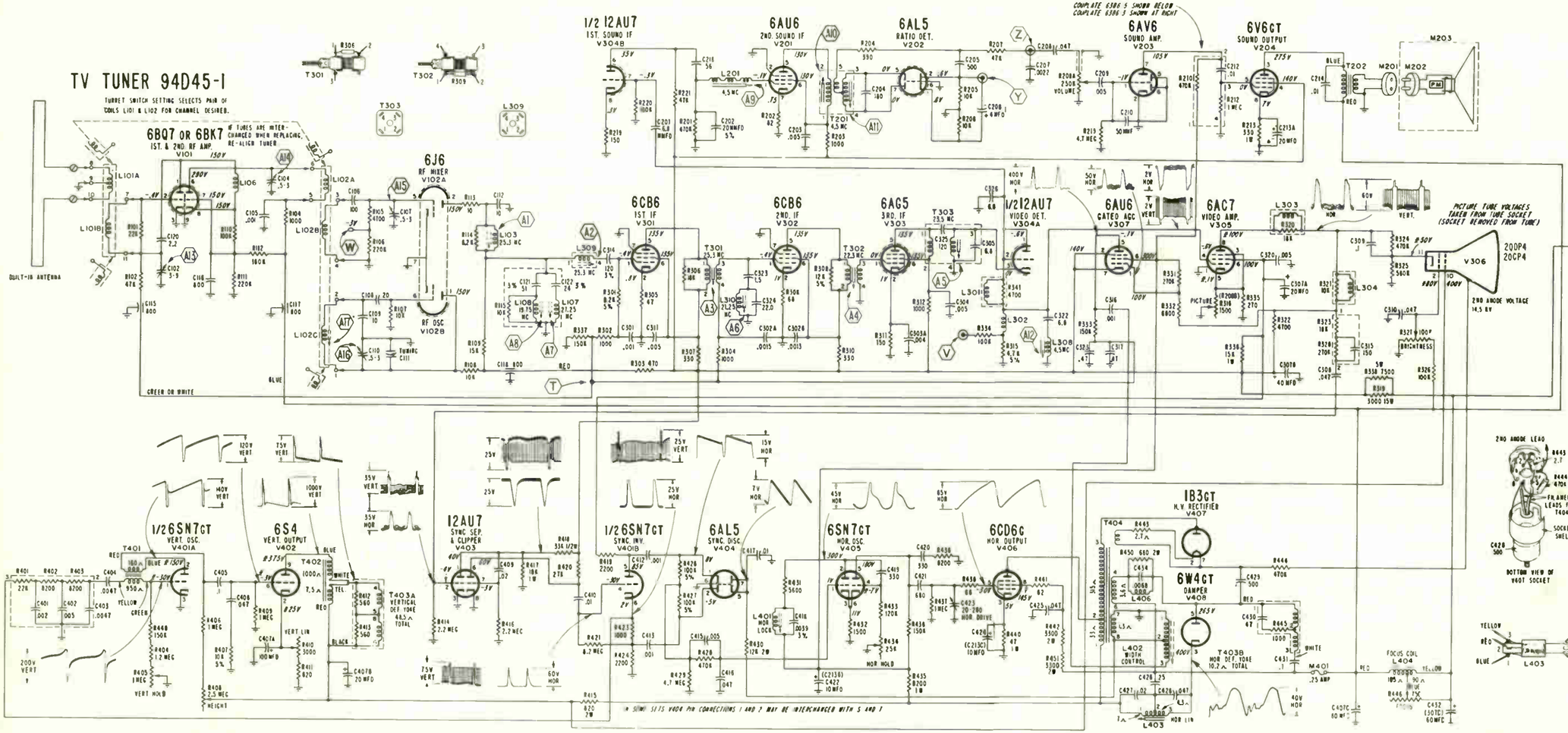


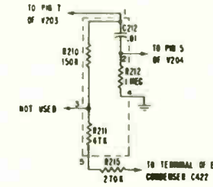
Figure 15. Schematic for 22M1 Television Chassis.

Note: This schematic applies only to chassis stamped Run 1. See Production Change

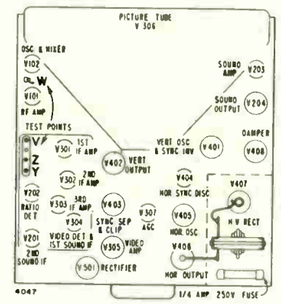
SCHEMATIC NOTES

(A1), (A2),.....(Y), (Z), etc. indicate alignment points and alignment connections.

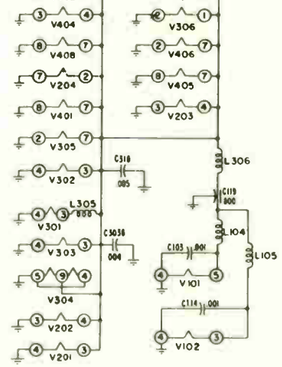




CIRCUIT FOR 63B6-3 COUPLATE



Top View of 22M1 Chassis.



99E112 REV. A

TV VOLTAGE DATA

(Voltage given on schematic)

- PICTURE control turned fully clockwise. CHANNEL control set on an unused channel. Other front controls set at approximately half rotation. Vert. Lin. and Height set at approximately half rotation.
- Voltages marked with an asterisk * will vary widely with control setting.
- Line voltage 117 volts AC.
- Voltages measured with a vacuum tube voltmeter between tube socket terminals and chassis, unless otherwise indicated. Voltages at V101, V102, V306 measured from top of socket with tube removed.
- Antenna disconnected from set with terminals shorted.

WAVEFORM DATA

(Waveforms given on schematic)

Waveforms taken with picture control set fully to the right, all other controls set for normal picture (in sync).

Waveforms at video and sync stages obtained with transmitted signal input to receiver.

The oscilloscope sweep is adjusted for 30 cycles (which is one-half of the vertical frequency), or for 7875 cycles (which is one-half of the horizontal frequency) so that two pulses appear on the screen.

The peak-to-peak voltage readings shown are subject to some variations due to response of the oscilloscope and parts tolerances.

CAUTION

Pulsed high voltages are present on the cap of V406, and on the filament terminals and cap of the 1B3GT tube. NO ATTEMPT SHOULD BE MADE TO TAKE MEASUREMENTS FROM THESE POINTS WITHOUT SUITABLE TEST EQUIPMENT.

Picture tube 2nd anode voltage can be measured from the 2nd anode connector and should be taken only with a high voltage instrument such as a kilovoltmeter. 2nd anode voltage is approximately 14.5 KV. Proper filament voltage check of the 1B3GT tube may be made by observing filament brilliancy as compared with that obtained with a 1.5 volt dry cell battery.

DX RANGE FINDER ADJUSTMENT

Incorrect adjustment of this control in a strong signal area may result in bending of the picture, excessive contrast and poor sync.

In normal signal strength areas, the DX Range Finder Control will generally be set at the "O" position. In intermediate areas, where the TV signal strength is lower and the noise level is higher, the DX Range Finder control will generally be set within the 10 to 150 position. In fringe areas or areas where long distance "DX" reception is possible, the DX Range Finder control will generally be set within the 150 to 300 position. In weak signal and high noise level areas, adjust the DX Range Finder for minimum noise (snow) in the picture.

Adjust the DX Range Finder as follows:

a. Rotate the DX Range Finder control fully to the left (to the "O" setting).

b. Tune in a picture, preferably on the strongest TV channel.

c. Set the Picture (contrast) control fully to the right (clockwise).

d. While observing a test pattern or picture, slowly rotate the DX Range Finder control to the right for best contrast with minimum snow in the picture.

Check for bending of vertical objects (overloading) in the picture. Also check to see that the picture locks in sync properly when switching off and on channel. If necessary, rotate the DX Range Finder control to the left or to the right until the operation is satisfactory.

In some fringe areas where long range reception is possible, TV signals may be subject to excessive fading. This may vary with season and time of day. If the signal in the area concerned is subject to excessive fading and the Range Finder is adjusted during the time the signal is weakest overloading (picture bending) will take place when the signal is stronger. For this reason be sure that the customer is instructed on the adjustment of this control for periodic variations in signal strength.

PRODUCTION CHANGE

CHANGE FOR INCREASED SOUND LEVEL

Run 1 in 22C2 and 22E2 chassis

Early production sets used a 12AU7 tube for video detector and first sound IF amplifier V304. Later production sets stamped Run 1 or higher used a 12AT7 tube for V304. The schematic figure 16 shows a partial circuit of the first IF amplifier in sets using the 12AU7 tube. Important: The 12AU7 and 12AT7 tubes are not directly interchangeable. Replace with same type tube used in receiver.

MECHANICAL CHANGE IN RADIO TUNER USED IN 22E2 CHASSIS

Mechanical changes were made to the later production radio tuner subchassis used in 22E2 combination models. The dimensions of the radio chassis were altered slightly and the mounting position of the gang condenser was changed.

Early production radio tuners used gang condenser (part number 68B53) which mounts in a vertical position. Later production radio tuners use gang condenser (part number 68B53-1) which mounts in a horizontal position.

CHANGE TO PREVENT HORIZONTAL JITTER IN STRONG SIGNAL AREAS

Run 1 and higher in all 22 Series Chassis

Changes were made in 22 series chassis (stamped Run 1 and higher) to prevent possible horizontal jitter in strong signal areas. In 22Y1 sets which have no run number stamp, pin 3 of sync separator V403, was connected to one end of picture control R316. In sets stamped Run 1 and higher, pin 3 of V403 is connected directly to chassis ground and one terminal of the picture control R316 is unused. Resistor R418 (in the plate circuit of V403) was changed from 39,000 ohms to 33,000 ohms, 2 watt, part number 60B20-333 and resistor R331 (connected between pins 1 and 6 of V307) was changed from 220,000 ohms to 270,000 ohms to ½ watt, part number 60B8-274.

SERVICE HINTS

TROUBLE SHOOTING

The 22C2 and 22E2 chassis described in this manual are similar to other chassis in the 22 series with respect to the sync, sweep and power supply circuit. The basic differences in the 22C2 and 22E2 chassis over other 22 series are outlined under "New Features in 22C2 and 22E2 Chassis".

In general, the trouble shooting of the 22C2 and 22E2 chassis will be similar to that of other chassis in the 22 series which use a cascode TV tuner.

It is important, however, to remember the following trouble shooting hints which apply to the 22C2 and 22E2 chassis.

No picture or sound: Raster OK. Incorrect adjustment of the DX Range Finder control in a weak signal area may result in complete loss of picture and sound. In strong signal areas, incorrec. adjustment may also result in picture bending, excessive contrast and poor sync.

No sound and no raster. In the 22C2 chassis, no sound and no raster or distroted sound and no raster can be due to a blown fuse M401. See paragraph on "Replacing Fuse M401".

Excessive curvature at the sides of the picture (pin cushion effect) or bending of corners. Excessive curvature at the sides of the picture (pin cushion effect) or bending of corners can be due to misadjustment of the curvature correcting magnets. See "Adjusting Curvature Correcting Magnets Used With 21EP4A (21") Picture Tube.

Picture bending, excessive contrast or poor sync. Incorrect adjustment of the DX Range Finder control in a strong signal area, may result in picture bending, excessive contrast and poor sync. Incorrect adjustment in a weak signal area may also result in complete loss of picture and sound.

MISCELLANEOUS TROUBLES DUE TO FAULTY TUBES

Faulty tubes cause the majority of receivers troubles. The list below contains most common troubles which are generally due to faulty tubes.

a. Poor fringe area reception due to low B plus voltage. Check the 5U4G tube.

b. Poor fringe area reception due to low sensitivity. Check the 6CB6, 6AG5, and 6BZ7 tubes.

c. Picture and sound separated due to IF oscillation. Check the 6CB6 and 6AG5 tubes.

d. Picture bending caused by leakage between tube elements. Check the 6CB6 tubes.

e. Poor stability, usually more noticeable in vertical circuit. Check 12AU7 tube.

f. Washed out picture due to negative grid current. Check 6AC7 tube.

EXCESSIVE SNOW IN PICTURE

Excessive snow in the picture can be caused by faulty tubes in the receiver. Check receiver as follows:

Short circuit the antenna terminals and turn the picture control (contrast) fully clockwise.

Connect a vacuum tube voltmeter from test point "V" to chassis. Set the channel selector on an unassigned channel. If the voltmeter reading exceeds .6 volt negative, excessive receiver (tube) noise is indicated This condition can usually be corrected by tube substitution. Substitute tubes in the following order: Video detector tube V304, RF oscillator tube V102, RF amplifier tube V101 and IF amplifier tube V301, V302 and V303.

Corona or arcing in the second anode supply can also cause a high noise reading at the video detector resulting in excessive snow in weak signal areas.

DISTORTED SOUND

Distorted sound can be caused by misalignment of the ratio detector transformer T201. This misalignment is sometimes due to frequency drift of the ratio detector transformer. If realignment of the ratio detector transformer does not correct this trouble permanently, a permanent remedy for this trouble is to connect a 20 mmfd, ___ 750 temperature coefficient, ceramic condenser (part number 65C6-26) in parallel with condenser C204 (180 mmfd, ceramic, connected across the secondary of the ratio detector transformer T201). Realign ratio detector after adding the 20 mmfd, condenser.

IMPORTANT NOTE ON 27.25 MC AND 19.75 MC TRAP ALIGNMENT

If difficulty is experienced in aligning the 27.25 MC and 19.75 MC traps (A7 and A8), using the method outlined in the alignment procedure make trap alignment as follows:

1. Connect an oscilloscope between pin 8 (plate) of video amplifier V305 (6AC7) and chassis.

2. Make all connections and receiver control settings as instructed in steps 5 and 6 of the alignment procedure.

3. Operate the signal generator with AM (audio) modulation turned on. Full generator output may be required.

Note: If a termination resistor is used in the generator output cable, increased generator output can be obtained by disconnecting the terminating resistor. Connect a condenser (.002 mfd. or larger) in series with the generator high side.

4. Adjust A7 (27.25 MC trap) and A8 (19.75 MC trap) for minimum amplitude of the waveform on the oscilloscope.

SPECIFICATIONS FOR 23A1 CHASSIS

Picture Tube

Type 27EP4 (27") rectangular picture tube with aluminum coated screen. Magnet deflection and focus.

Operating Voltage

110-120 volts, 60 cycles, AC.

Wattage

265 watts for all models.

Input Impedance and Transmission Line

300-ohm balanced (between antenna terminals).

Note that 72-ohm coaxial cable may be used by connecting the outer conductor to the chassis and the inner conductor to either antenna terminal. In weak signal areas, the use of coaxial cable should be avoided.

Antenna

All models equipped with a built-in TV antenna.

Intermediate Frequencies

Video 25.75 MC. Sound 21.25 MC.
Intercarrier Sound 4.5 MC.

Fuse Location

The horizontal output circuit is fused with a 3/8 amp., 250-volt fuse, part number 84A4-3. The fuse is located at the rear of the high voltage compartment.

TUBE COMPLEMENT FOR 23A1 CHASSIS

V101	6BZ7	RF Amplifier
V102	6J6	Oscillator and Mixer
V201	6AU6	2nd Sound IF
V202	6AL5	Ratio Detector
V203	6AV6	Sound Amplifier
V204	6V6GT	Sound Output
V301	6CB6	1st IF
V302	6CB6	2nd IF
V303	6AG5	3rd IF
V304A		Video Detector
V304B	12AT7	1st Sound IF
V305	6CL6	Video Amplifier
V306	27EP4	Picture Tube
V307	6AU6	Gated AGC
V401A		Vertical Oscillator
V401B	6SN7GT	Sync Inverter
V402	6AV5GT	Vertical Output
V403	12AU7	Sync Separator and Clipper
V404	6AL5	Sync Discriminator
V405	6SN7GT	Horizontal Oscillator
V406	6CD6G	Horizontal Output
V407	1B3GT	2nd Anode Rectifier
V408	6V3	Damper
V501	5U4G	Low Voltage Rectifier
V502	5U4G	High Voltage Rectifier

23A1 CHASSIS NOTES

The 23A1 chassis is a 23 tube television receiver using a 27 inch (27EP4) rectangular picture tube. The picture tube is mounted separately from the chassis. Circuitry of the 23A1 chassis is similar to that of the 22 series chassis with the exception of the video amplifier, vertical output, horizontal output, damper and power supply circuits. See paragraphs below on "New Features In 23A1 Chassis."

NEW FEATURES IN 23A1 CHASSIS

New Video Amplifier: A 6CL6 tube (9-pin miniature pentode) is used as a video amplifier. This tube is capable of higher output, thereby providing greater peak-to-peak output voltage with high efficiency and low amplitude distortion.

New 27" Picture Tube: A 27EP4 (27" rectangular) picture tube is used. This picture tube features a high quality neutral density face plate which produces increased picture contrast and detail under high ambient light conditions. A reflective metal back (aluminized screen backing) increases the light output and contrast.

Vertical Retrace Blanking Circuit: A vertical retrace blanking circuit is used to eliminate vertical retrace lines. Vertical retrace blanking is achieved by applying the pulse voltage appearing at the secondary of the output transformer to the grid of the picture tube.

New Vertical Output Tube: A 6AV5GT beam power amplifier is used as the vertical output tube. This tube is capable of greater output currents at low plate and screen voltages. Use of the 6AV5GT tube and other circuit improvements made to the vertical output stage has resulted in increased vertical output and improved interlace.

Improve Horizontal Output Circuit: A new high efficiency auto-transformer with a ferrite core is coupled directly to a high efficiency 90 degree deflection yoke. A potentiometer type Horizontal Drive control is used for the drive adjustment. A new Width control (having two windings) permits more effective and increased range of width adjustment.

Circuit improvements made to the horizontal output stage have resulted in increased output, capable of producing full 90 degrees deflection and increased 2nd anode voltage (approximately 19,000 volts).

New Damper Tube: A 6V3 tube (9-pin miniature) is used as the damper tube. This tube features a higher heater to cathode breakdown voltage rating, higher peak inverse plate voltage rating and greater ability to handle high peak currents. Use of this new damper tube minimizes possibility of tube failure in the damper circuit.

Improved Deflection Yoke: A newly designed deflection yoke, provides the 90 degree deflection angle required for the 27 inch picture tube.

SERVICE HINTS

Improper Focus (control focuses at extreme end of rotation, 23A1 chassis): This may be caused by a weak 5U4G rectifier tube V501. Try another rectifier tube.

It may also be impossible to obtain good focus with FOCUS control if the focus coil is spaced too far away from the deflection yoke coil. Spacing between the focus coil and the deflection yoke coil should be 3/8 of an inch minimum. The deflection yoke coil should be as far forward on the neck of the tube as possible.

Insufficient Picture Width (23A1 chassis). This may be caused by a weak rectifier tube V502, a weak horizontal output tube V406 or a weak damper tube V408.

Insufficient picture width may also be caused by incorrect adjustment of the Horizontal Drive control R447, or improper positioning of the focus coil on the deflection yoke housing. Moving the focus coil too close to the deflection yoke coil will result in reduction of picture width. The spacing between the focus coil and the deflection yoke coil should be 3/8 of an inch minimum.

White Flashes Across Picture (22C2, 22E2 and 23A1 chassis): In weak signal, high noise level areas, white flashes across the picture can sometimes be minimized by careful adjustment of the DX Range Finder control. Caution: Turning the DX Range Finder control too far to the right for a strong signal may cause the picture to disappear completely.

No Picture; Sound Normal (22C2, 22E2 and 23A1 chassis): If the DX Range Finder control is turned too far to the right for a strong signal, the picture may disappear completely. Advancing the DX Range Finder control too far to the right for a strong signal area will cause excessive delay in AGC bias thereby blocking the video amplifier.

TROUBLE SHOOTING B PLUS CIRCUITS

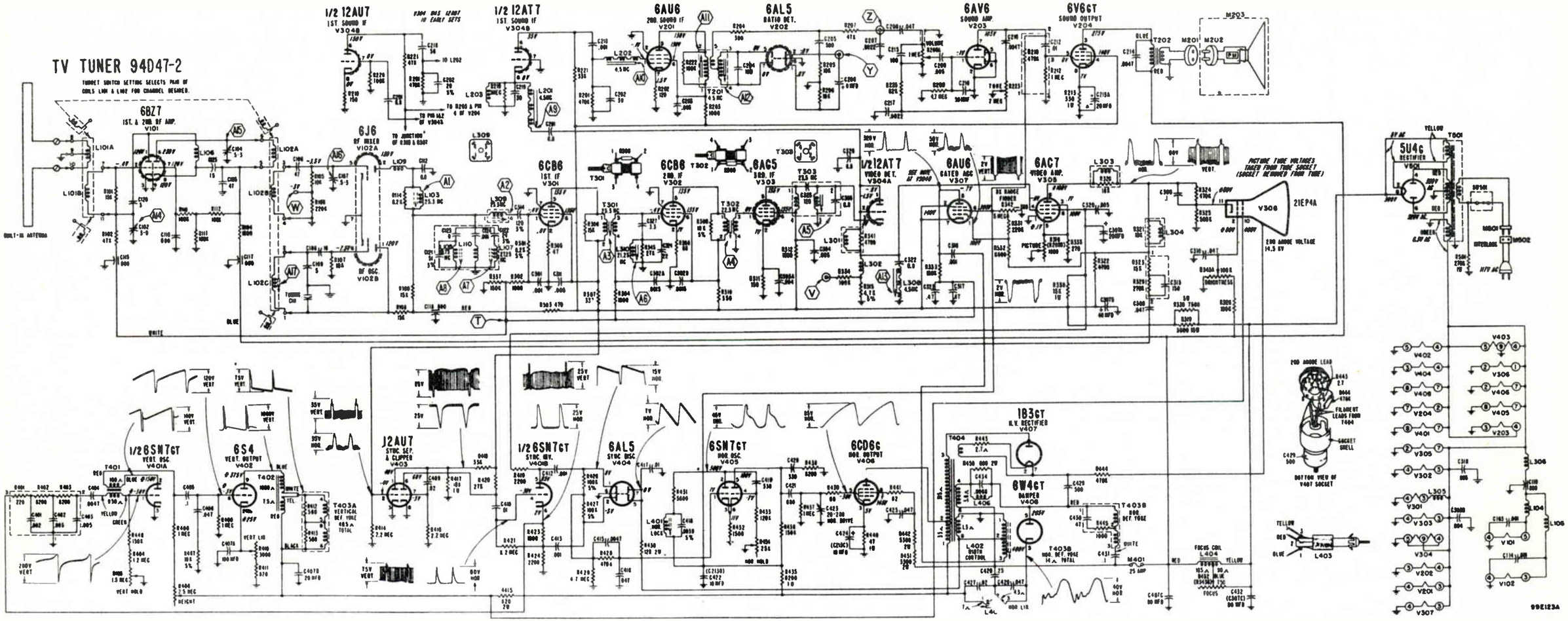
The power supply and B plus distribution circuits of the 23A1 chassis are different from previous model television receivers. A simplified diagram, showing the B plus distribution in the 23A1 chassis, is shown in figure 20.

REDUCING SNOW IN INTERMEDIATE FRINGE AREAS

(Applies to 22C2, 22E2 Chassis Below Run 2 and 23A1 Chassis without a Run Number)

To reduce snow (front end noise) in intermediate fringe areas, it is recommended that the tuner AGC voltage be reduced to 1½ or 2 volts. This reduction in AGC voltage can be accomplished by removing resistor R337 (150,000 ohms) and replacing it with a 100,000 ohm resistor and a 47,000 ohm resistor connected in series. Connect the 47,000 ohm resistor to chassis ground and the 100,000 ohm resistor to resistor R302, 1,000 ohms (test point "T"). Remove the tuner AGC lead (usually white) from test point "T" and connect it to the junction of the 100,000 ohm resistor and 47,000 ohm resistor. To reduce the possibility of unstable operation, it is recommended that the tuner AGC lead be by-passed to chassis by a .005 mfd, ceramic condenser.

Figure 16. Schematic for 22C2 Television Chassis.



WAVEFORM DATA

(Waveforms given on schematic)

Waveforms taken with PICTURE control set fully to the right, all other controls set for normal picture (in sync). Warning: Incorrect adjustment of the DX Range Finder control will cause waveform distortion.

Waveforms at video and sync stages obtained with transmitted signal input to receiver.

The oscilloscope sweep is adjusted for 30 cycles (which is one-half of the vertical frequency), or for 7875 cycles (which is one-half of the horizontal frequency) so that two pulses appear on the screen.

The peak-to-peak voltage readings shown are subject to some variations due to response of the oscilloscope and parts tolerances.

VOLTAGE DATA

(Voltages given on schematic)

- TV voltages taken with function switch on "TV" position. PICTURE control turned fully clockwise. CHANNEL control set on an unused channel. Other front controls set at approximately half rotation. Vert. Lin. and Height set at approximately half rotation. DX Range Finder control set fully to the left (at "O" position). TV antenna disconnected from set with terminals shorted.
- Radio voltages V701 and V702 taken with function switch on "Rad" position; voltages measured from underside of tube sockets. When measured from top of tube sockets (with tube removed), B plus voltage at pins 5 and 6 of V701 and V702 will be approximately 275 volts.
- B plus voltages at V203 and V204, will be slightly higher when set is switched to "Rad" position. Voltages marked with an asterisk * will vary widely with control setting.
- Line voltage 117 volts AC.
- Voltages measured with a vacuum tube voltmeter between tube socket terminals and chassis, unless otherwise indicated.
  Voltages at V306 measured from top of socket with tube removed.

CAUTION

Pulsed high voltages are present on the cap of V406, and on the filament terminals and cap of the 1B3GT tube. NO ATTEMPT SHOULD BE MADE TO TAKE MEASUREMENTS FROM THESE POINTS WITHOUT SUITABLE TEST EQUIPMENT.

Picture tube 2nd anode voltage can be measured from the 2nd anode connector and should be taken only with a high voltage instrument such as a kilovoltmeter. 2nd anode voltage is approximately 14.5 KV. Proper filament voltage check of the 1B3GT tube may be made by observing filament brilliancy as compared with that obtained with a 1.5 volt dry cell battery.

SCHEMATIC NOTES

Ⓐ1, Ⓐ2,.....Ⓨ, Ⓩ, etc. indicate alignment points and alignment connections.

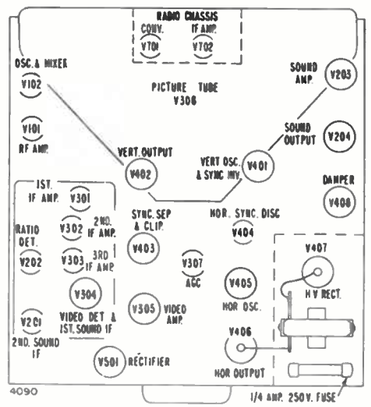


Figure 17. Schematic for 22E2 Television and Radio Chassis.

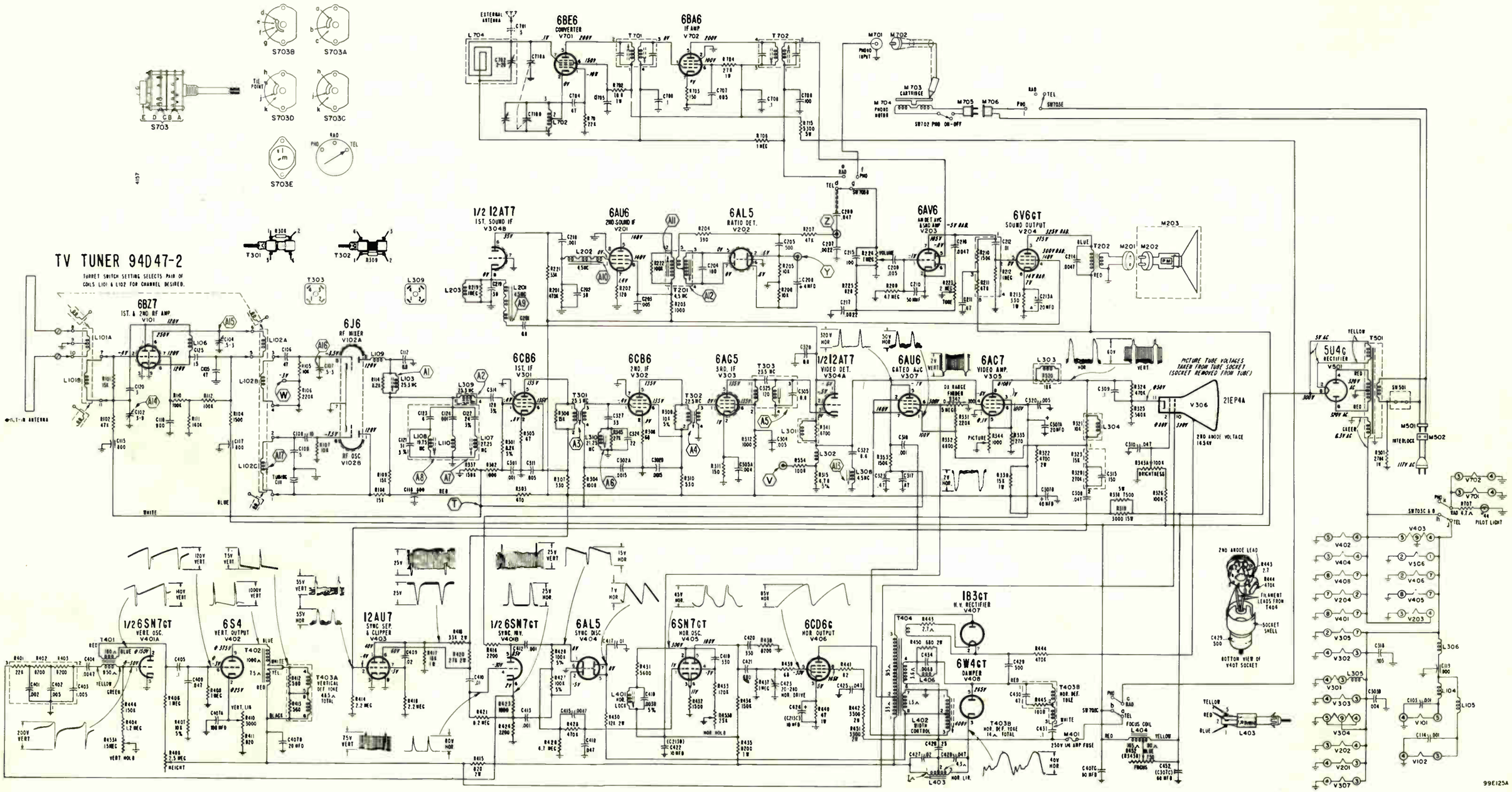
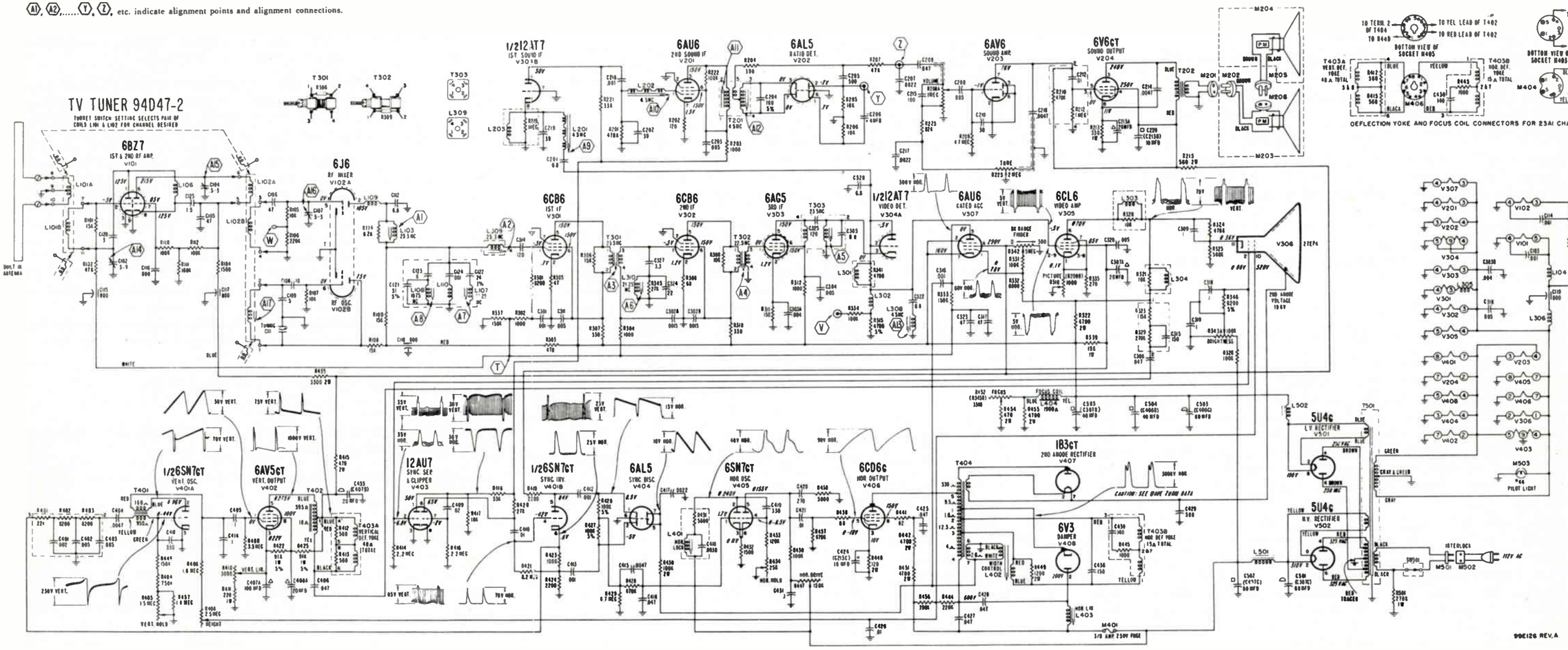


Figure 22. Schemotic for 23A1 Television Chassis.

NOTE: This schematic applies only to chassis which are not stamped with a run number.

SCHEMATIC NOTES

Ⓐ1, Ⓐ2,.....Ⓨ, Ⓩ, etc. indicate alignment points and alignment connections.



WAVEFORM DATA

(Waveforms given on schematic)

Waveforms taken with Picture control set fully to the right, all other controls set for normal picture (in sync). Important: Incorrect adjustment of the DX Range Finder control will cause waveform distortion. DX Range Finder should be at zero setting.

Waveforms at video and sync stages obtained with transmitted signal input to receiver.

The oscilloscope sweep is adjusted for 30 cycles (which is one-half of the vertical frequency), or for 7875 cycles (which is one-half of the horizontal frequency) so that two complete waveforms appear on the oscilloscope screen.

The peak-to-peak voltage readings shown are subject to some variations due to response of the oscilloscope and parts tolerances.

CAUTION

Pulsed high voltage is present on the caps of V406, V407 and V408. Do not make direct connection to these points with ordinary test equipment. Waveform and peak-to-peak voltage at cap of V408 taken, using an oscilloscope with a capacitive voltage divider probe. Waveform at the cap of V408 can be taken by clipping or twisting the lead from the oscilloscope high side over the insulation on the cap lead. When taking the waveform this way, the shape of waveform will be the same but the peak-to-peak voltage will be much lower, depending upon the degree of coupling.

TV VOLTAGE DATA

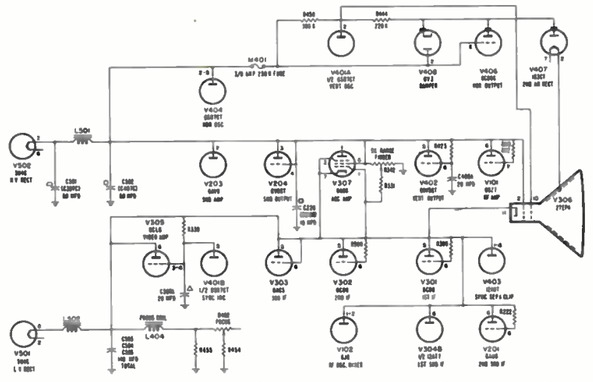
(Voltages given on schematic)

- Picture control turned fully clockwise. Channel control set on an unused channel. Other front controls set at approximately half rotation. Vert. Lin. and Height set at approximately half rotation. DX Range Finder control set fully to the left (at "0" position).
- Antenna disconnected from set with terminals shorted.
- Line voltage 117 volts AC.
- Voltages measured with a vacuum-tube voltmeter between tube socket terminals and chassis, unless otherwise indicated. Voltages at V306 measured from top of socket with tube removed.
- Voltages marked with an asterisk * will vary widely with control setting.

CAUTION

Pulsed high voltages are present on the caps of V406 and V408, and on the filament terminals and cap of the 1B3GT tube. NO ATTEMPT SHOULD BE MADE TO TAKE MEASUREMENTS FROM THESE POINTS WITHOUT SUITABLE TEST EQUIPMENT.

Picture tube 2nd anode voltage can be measured from the 2nd anode connector and should be taken only with a high voltage instrument such as a kilovoltmeter or a vacuum-tube voltmeter with a high voltage probe. 2nd anode voltage is approximately 19 KV. Proper filament voltage check of the 1B3GT tube may be made by observing filament brilliancy as compared with that obtained with a 1.5 volt dry cell battery.



NOTE: This diagram applies only to chassis which are not stamped with a run number. For a B+ distribution diagram covering chassis which are stamped with a run number,

Figure 20. Simplified Diagram Showing B+ Distribution in 23A1 Chassis.

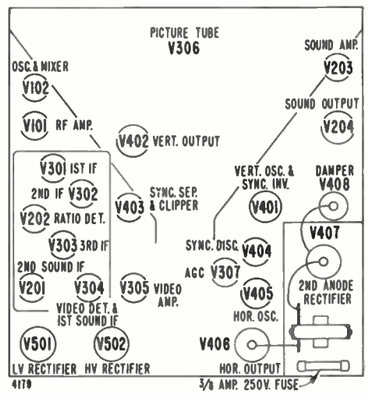


Figure 21. Top View of 23A1 Chassis.

TELEVISION CHASSIS NOTES

—All 19 series chassis employ the same basic television circuitry. The 19B1, 19C1, 19F1A and 19H1 chassis are television only models. The 19E1 chassis is used in combination models.

The 19B1 chassis uses a 17" rectangular picture tube (17BP4). The 19C1 and 19E1 chassis use a 20" rectangular picture tube (20DP4). The 19F1A chassis uses a 21" (spherical faced) rectangular picture tube (21WP4). The 19H1 chassis uses a 21" (cylindrical faced) rectangular picture tube (21EP4).

A tone control is used in the 19C1. 19E1 and 19H1 chassis. The 19E1 chassis uses a PM speaker. The 19B1, 19C1, 19F1A and 19H1 chassis use an EM speaker. All chassis use PM focus.

The 19B1 chassis uses the 94D52-1 TV tuner having a pentode tube (6BC5) used as an RF amplifier. All other chassis in the 19 series use the 94D46-2 (cascode) TV tuner using a twin triode tube (6BZ7) as an RF amplifier.

SERVICE HINTS

TROUBLE SHOOTING

The 19 series chassis covered in this section are newly designed sets incorporating the latest in television circuitry. These chassis are similar to other late Admiral chassis with respect to the sync, sweep and power supply circuits. New features incorporated in the 19 series chassis are outlined in paragraph on "New Features in 19 Series Chassis". Important: Since there are many differences in the 19 series chassis over earlier model Admiral receivers, it is important to remember the following when servicing or installing receivers having the 19 series chassis.

All 19 series chassis have a "DX Range Finder control" (AGC delay circuit). This control is a potentiometer located at the rear of the chassis to enable precision adjustment of receiver sensitivity to suit the signal conditions in any local of fringe area. Incorrect adjustment of this control in a strong signal area, may result in picture bending, excessive contrast and poor sync. Incorrect adjustment in a weak signal area may result in complete loss of picture and sound.

The sound output tube V204 (6Y6G or 6AS5) functions as a voltage dropping tube in addition to being a sound output tube. The cathode of the sound output tube operates at approximately 140 volts above chassis ground for TV operation. If the sound output stage becomes defective, B plus voltage to the TV tuner, sync separator and clipper, video amplifier and AGC delay circuit will be affected.

In chassis stamped Run 2 or lower, the first and second IF amplifiers V301 and V302 are in series. The cathode of V302 is operated at approximately 120 volts above chassis ground. If either V301 or V302 become defective, B plus voltage to the other stage will be affected.

In chassis stamped Run 3 or higher (except 19B1), B plus voltage to the first and second IF amplifiers V301 and V302 is in parallel. When making voltage measurements in chassis (except 19B1) stamped Run 3 and higher it is important to note that the plate and screen voltages at the first and second IF amplifier stages, V301 and V302, may vary over a wide range depending on the strength of the TV signal. The voltages shown on the schematics are taken with the antenna disconnected and antenna terminals shorted; see Voltage Data on schematic pages.

In sets using the 94D46-2 or 94D46-3 cascode tuner, the triode sections of the RF stages (V101) are in series. The cathode of the second triode section is operated at approximately 130 volts above chassis ground. If the tube should be come defective or be removed from the socket, there will be no B plus on the plate of the first triode section. See B plus distribution diagrams, figures 9 and 10.

The horizontal oscillator circuit utilizes pulse width modulation for control of the horizontal oscillator frequency. Information on servicing the horizontal oscillator and horizontal oscillator control circuit is given in paragraph "Service Hints for Horizontal Sync". Note: An oscilloscope is required for alignment of the horizontal oscillator waveform.

When servicing these chassis in the shop, it is important that the correct type of speaker or speaker substitute be used. The 19B1, 19C1, 19F1, 19F1A and 19H1 chassis use an EM speaker with output transformer, or a PM speaker with an output transformer and filter choke mounted to it. 19E1, 19G1 and 19N1 chassis stamped with the letter "T" at the rear of the chassis, use a permanent magnet (PM) speaker with the output transformer mounted on the television chassis. 19E1, 19G1 and 19N1 chassis without the letter "T" use a permanent magnet (PM) speaker with the output transformer mounted directly on the speaker. Use of an incorrect speaker will result in no B plus voltage or weak and distorted sound.

NEW FEATURES

New TV Tuners (part Nos. 94D52-1, 94D52-2, 94D46-2 and 94D46-3):

New improved TV tuners are used. The 94D52-1 and 94D52-2 (pentode type) TV tuners are used in models having a 17" picture tube. The 94D46-2 and 94D46-3 tuners (cascode type) are used in models having a 20" or 21" picture tube.

These new improved TV tuners feature high sensitivity and high signal to noise ratio. This is made possible by improved tuner circuitry. The circuits in the RF stage of the 94D52-1 and 94D52-2 tuners have been optimized for the 6BC5 tube and the circuits of the 94D46-2 and 94D46-3 tuners have been optimized for the 6BZ7 tube.

The 94D46-3 cascode TV tuner is used in all later production chassis (Run 6 and higher), with exception of the 19B1 chassis. The 94D52-2 pentode TV tuner is used in later production 19B1 chassis (Run 6 and higher).

TV tuners 94D46-2 and 94D46-3 are identical, with exception of shaft length. TV tuners 94D52-1 and 94D52-2 are identical with exception of shaft length.

DX Range Finder Control: A DX Range Finder control (AGC delay circuit) is used in all 19 series chassis. This control is a potentiometer located at the rear of the chassis to enable adjustment of receiver sensitivity to suit the signal conditions in any local or fringe area.

Improved Video Amplifier: Improved circuitry and use of the 6CB6 tube as a video amplifier have resulted in improved picture definition with greater range of contrast.

Tone Control: A tone control is used in all chassis with exception of the 19B1 and 19F1A.

Horizontal Oscillator Circuit: Pulse Width Modulation is used for control or horizontal oscillator frequency. Better control of oscillator frequency has increased the "hold-in" range of the oscillator and improved noise immunity and sync stability in weak signal high noise level areas over previous circuits of this type. The improved horizontal oscillator circuit also provides better drive to the horizontal output stage.

Horizontal Output Circuit: An improved horizontal output circuit, using a high efficiency auto-transformer provides second anode voltage (approximately 15,000 volts) for good picture definition. A new tube (6AX4GT) is used in the damper circuit.

Improved Width and Linearity Control: The width control and horizontal linearity controls are of the slider type. Use of slider type controls has made adjustment faster and more accurate.

PM Focus: A PM focus assembly is used in all 19 series chassis. Use of the PM focus assembly provides good line focus and minimizes the defocusing effect on the electron beam due to voltage variation.

Vertical Retrace Blanking Circuit: A vertical retrace blanking circuit is used in later production sets (stamped Run 5 and higher). Vertical retrace blanking is achieved by applying the pulse voltage appearing at the secondary of the putput transformer to the grid of the picture tube.

EXCESSIVE SNOW IN PICTURE DUE TO FAULTY TUBES

Excessive snow in the picture can be caused by faulty tubes in the receiver. Check receiver as follows:

Short circuit the antenna terminals and turn the Picture control (contrast) fully clockwise.

Connect a vacuum tube voltmeter from test point "V" to chassis. Set the channel selector on an unassigned channel. If the voltmeter reading exceeds .6 volt negative, excessive receiver (tube) noise is indicated. This condition can usually be corrected by tube substitution. Substitute tubes in the following order: Video detector tube V304, RF oscillator tube V102, RF amplifier tube V101 and IF amplifier tubes V301, V302 and V303.

Corona or arcing in the second anode supply can also cause a high noise reading at the video detector resulting in excessive snow in weak signal areas.

If the above does not eliminate excessive snow and the chassis is stamped Run 2 or lower, see the "Snow Changes" listed under Run 3 Production Change. Note: Since this portion of the Run 3 change is rather involved, we do not recommend that it be made in the field. However, if it is desired to make the changes complete instructions can be obtained by writing the Service Department of the Admiral Corportaion at 201 E. North Water Street, Chicago 2, Illinois.

VERTICAL JITTER AND POOR INTERLACE

Vertical jitter and poor interlace may occur in early production receivers, if the red lead (terminal 3) of the deflection yoke T403B is dressed too close to the grid circuit of the vertical output tube V402 (6S4). The red lead to the deflection yoke should be dressed against the chassis and as far away from the grid circuit of the vertical output tube as possible.

CIRCUIT CHANGES TO REDUCE BENDING AND IMPROVE HORIZONTAL SYNC

(Applies to chassis stamped Run 2 or lower.)

Making the following circuit changes to an early production chassis, will minimize bending of the picture at high contrast control settings in strong signal areas and improve horizontal sync in medium fringe areas.

IMPORTANT: Before making changes below, check whether bending or sync trouble is due to faulty tubes, defective components, misadjustment of the DX Range Finder control, or horizontal sync adjustment.

Add changes as follows:

1. Check connections to the DX Range Finder control R315. Be sure that the center terminal is grounded and that the white wire goes to the terminal of the DX Range Finder nearest the bottom edge of the chassis. Connect a wire lead from pin 1 of V304 (6AL5) to the remaining terminal of the Range Finder control. See figure 14.

2. In chassis using a 6AS5 sound output tube (V204), change resistor R212 from 3,600 ohms to 1,500 ohms, ½ watt, 5%. In chassis using a 6Y6G sound output tube (V204), change resistor R212 from 4,700 ohms to 2,000 ohms, ½ watt, 5%.

3. In chassis using a 6AS5 sound output tube (V204), change resistor R213 from 1,100 ohms to 910 ohms, ½ watt, 5%. In chassis using a 6Y6G sound output tube, change resistor R218 from 2,000 ohms to 1,500 ohms, ½ watt, 5%.

4. In some areas, it may be beneficial to increase the sync pulse level by changing the sync take-off on the video amplifier plate load. Disconnect R327 (2,700 ohms) from the junction of resistors R325 and R326 (2,700 ohms). Reconnect R327 to the junction of R325 (2,700 ohms) and peaking coil L306. See figure 14.

5. Make the Run 4 change, which consists of connecting a 8,200 ohm resistor (R443) in series with resistor R407 (between terminal 3 of the vertical integrator coupltae and pin 1 of V401B). See figure 14.

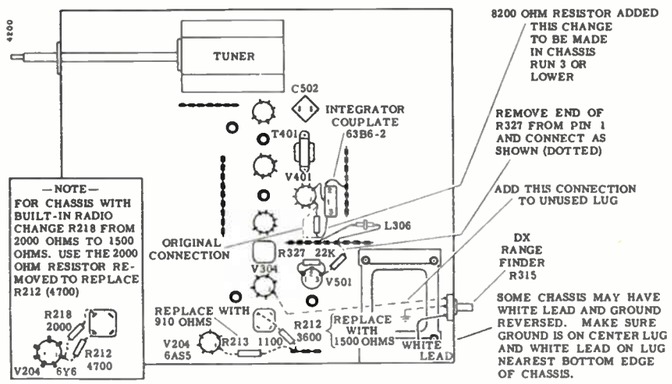


Figure 14. Bottom View of Chassis Showing Simplified Circuit Changes for Reducing Bending and Improving Horizontal Sync in Chassis Stamped Run 2 or Lower.

6. Since step 1 above is effective only with the DX Range Finder set at "0", use this setting unless higher setting gives better results.

ELIMINATING AUDIO HUM

Strong (60 cycle) audio hum in these receivers can be due to any one of the causes listed below, which can easily be corrected.

1. Hum may be due to coupling between components in the audio input circuit and the AC wiring. Check the 117 volt AC leads to the On-Off switch. These leads should dress away as far as possible from the grid circuit of the sound amplifier V203. In models using tone control and the plate (pin 7) of V203 away from the AC leads.

2. Check position of condenser C209 (.01 mfd.) in the sound amplifier circuit (V203) to make certain that it is not too close to the 117 volt AC wiring or On-Off switch. If C209 is a tubular paper condenser, the outside foil terminal should be connected to the junction of resistor R207 (47.000 ohms) and condenser C208 (.0022 mfd.).

3. Check the B plus (power supply) circuits for an open or under capacity electrolytic condenser. Especially check filter condenser C501, 60 mfd., 350 volts.

4. If the receiver is a TV only model using a 10" electro-magnetic (EM) speaker, it may be possible that the speaker is the cause of excessive hum. The speaker may be checked by substituting another speaker of the same type. The original 10" electro-magnetic (EM) speaker part number 78B75-1, can be checked by substituting a permanent magnet (PM) speaker with the filter choke attached such as part number 78B80-1.

SOUND BARS IN PICTURE

Sound bars noticeable at high volume levels, may be caused by heavy audio currents being induced in the B plus circuits. This can be due to the location or thr routing of leads to electrolytic condenser C215. Condenser C215 is the single section electrolytic condenser (80 mfd, 350 volts) which is mounted at the center of the chassis.

To minimize the possibility of sound bars in the picture, the mounting and routing of leads to electrolytic condenser C215 were changed. In later production sets, electrolytic condenser C215 is mounted in parallel and in front of the 9 lug terminal strip near the center of the chassis. When mounted this way, the terminals of condenser C215 face away from the TV tuner, thus permitting the negative lead C215 to connect directly to the cathode of the sound output tube V204.

TOUCH-UP OF RATIO DETECTOR SECONDARY USING TELEVISION SIGNAL (A8, BOTTOM SLUG OF T201)

*Adjustment A8 is accessible through the ¼" hole (just below T201) in bottom of the cabinet or the chassis mounting shelf, located toward the left side facing the rear of the set. Removal of the chassis is therefore not required. *Adjustment need be made on one channel only.* Proceed as follows:

a. Turn set on and allow about 15 minutes for warm up.

b. Tune set for normal picture and sound.

c. Carefully insert a non-metallic alignment tool through the opening in cabinet bottom below T201. An alignment tool with a screwdriver blade or hexagonal end is required depending on the transformer used, see * note below. When the alignment tool engages the bottom tuning slug A8, adjust the slug for best sound with minimum buzz level. Do this carefully as only slight rotation in either direction will generally be required. Correct adjustment point is located between the two maximum buzz peaks that will be noticed when turning the slug back and forth about ¼ to ½ turn.

ALIGNMENT OF 4.5 MC TRAP A9, USING A TELEVISION SIGNAL

Beat interference (4.5 MC) appears in picture as very fine vertical or diagonal lines, very close together having a "gauze-like" appearance, the pattern will vary with speech, forming a very fine herringbone pattern.

The trap can be tuned by watching the picture and adjusting slug A9 for minimum 4.5 MC interference. If greater accuracy is required, the trap should be adjusted as instructed in step 3 of the "4.5 MC Sound IF and Trap Alignment" procedure.

SERVICING RADIO TUBES AND DIAL LIGHT IN COMBINATION MODELS

The radio tubes can be serviced without removing the TV chassis from the cabinet. The radio tubes can be reached through the opening in the underside of the chassis shelf.

The dial light can be serviced by removing the tuning knobs and plastic control panel. A number 44 dial light (part number 81A1-5) is used in sets stamped Run 5 or lower; a number 47 dial light (part number 81A1-8) is used in sets stamped Run 6 or higher.

REMOVABLE PICTURE WINDOW

All models using the 19 series television chassis have picture windows which can be easily removed from the front of the cabinet for cleaning the inside of the window, picture tube and picture tube mask. Two types of picture window mountains are used. A removable molding in used in wood cabinet models. Removable corner brackets are used in plastic cabinet models.

* If ratio detector transformer (T201) has hollow hexagonal core slugs, bottom slug adjustment A8 can be made from top of chassis, if you use alignment tool (part number 98A30-7; available at Admiral Distributor). Bottom slug (A8) can be reached through the hole in the core of the upper slug (A10).

REMOVING PICTURE WINDOW FOR CLEANING

If the picture window has a removable molding (at the top), remove the window by first removing the Phillips head screws and molding at the top of the picture window. Pull the top of the window away from the cabinet slightly and lift it up out of the channel at the bottom.

After cleaning the window, picture tube and picture tube mask as instructed below, install the window by placing the bottom edge in the channel and replace the molding. Use care when tightening screws on molding to prevent stripping.

If the picture window has removable corner brackets, first remove the two brackets at the top of the window. Then, while holding the window loosen the screws on the bottom brackets. Allow the window to tilt out slightly at the top until it can be grasped and lifted free of the cabinet.

After cleaning, install the window by setting it in position and mounting the corner brackets. Use care when tightening bracket mounting screws to prevent stripping or cracking glass.

INSUFFICIENT HEIGHT

If adjustment of the Height and Vertical Linearity controls does not provide sufficient height, try replacing the vertical output tube V402 (6S4). Insufficient height can also be due to a weak vertical oscillator tube V303 (6U8).

B plus DISTRIBUTION IN TELEVISION CHASSIS

Figures 9 and 10 illustrate the basic B plus distribution used in these chassis. The B plus distribution in chassis stamped Run 2 or lower is shown in figure 9. The B plus distribution in chassis stamped Run 3 and higher is shown in figure 10. Note: There are variations in the B plus circuits of TV and combination models and TV models using a different RF amplifier tube (V101) in the TV tuner. Alternate connections for the RF amplifier tube (V101) is shown in figure 9.

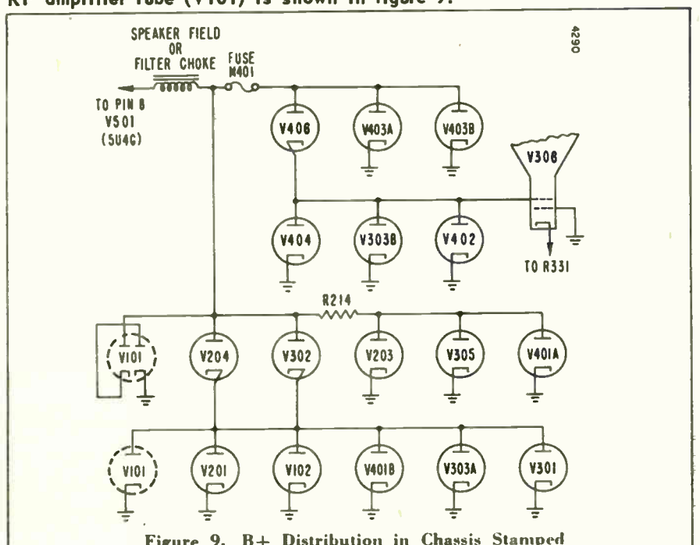


Figure 9. B+ Distribution in Chassis Stamped Run 2 or Lower.

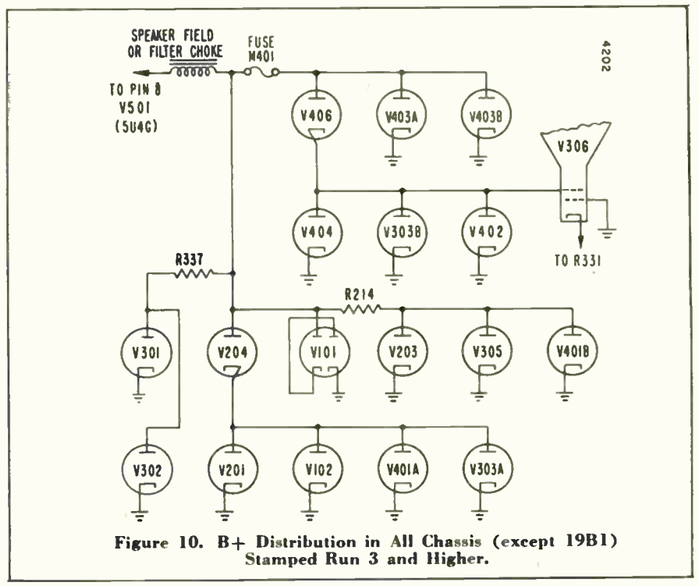


Figure 10. B+ Distribution in All Chassis (except 19B1) Stamped Run 3 and Higher.

SERVICE HINTS FOR HORIZONTAL SYNC

The horizontal oscillator control circuit controls the horizontal oscillator by a method called "Pulse Width Modulation". This method is so called, because the width of the pulse applied to the grid of the horizontal oscillator control section determines the length of time that current flows through this section. The duration of current flow through the control section determines the DC control voltage applied to the grid of horizontal oscillator, thereby, controlling the frequency.

The waveshape applied to the grid of the horizontal oscillator control section is formed by combining a partially integrated pulse from the horizontal oscillator output and the horizontal sync pulse. If these two pulses combine properly, the waveshape shown in figure 11 will be developed and the horizontal oscillator will be in sync.

Figure 11. Waveform on Grid Pin 1 of V403 With Sync Pulse.

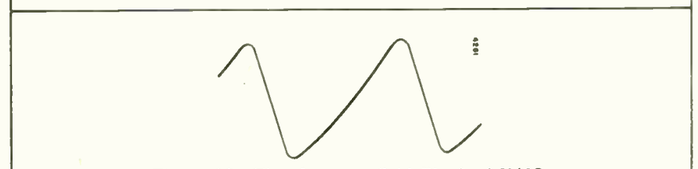


Figure 12. Waveform on Grid Pin 1 of V403 Without Sync Pulse.

With no sync input, the waveform at the horizontal oscillator control grid should appear as shown in figure 12. Since the horizontal oscillator control voltage is dependent upon a waveshape formed at the horizontal output stages (V404, V405 and V406), a defective component in one of these stages may cause sync trouble. If the waveform shown in figure 12 can be obtained, this will indicate proper operation of the horizontal sweep circuit.

When the horizontal oscillator is out of sync, it may be difficult to observe this waveform (figure 12) on an oscilloscope due to the presence of out-of-phase sync pulses. In this case, remove the sync separator and sync clipper tube V410. If the waveform shown in figure 12 is obtained, place the sync and separator tube back into its socket. Then, remove the horizontal oscillator and control tube V403 (6SN7GT). Conventional, well-shaped sync pulses should appear at control grid (pin 1) of V403.

If there are no sync pulses, or the pulses are of low or varying amplitude, accompanied with noise, the sync circuits should be checked. However, if the sync pulses are well-shaped and of constant amplitude, the horizontal oscillator may be misaligned. Place V403 back into its socket and make the "Horizontal Oscillator Alignment". See page 69.

If it is impossible to sync the picture, or obtain the correct waveform at terminal "C", check for a defective component in the following sequence:

a. Check tube V403 (6SN7GT) by substitution.

b. Check C417 by substituting identical condenser (270 mmfd) part number 65B21-271.

c. Check C413 for either open or short.

d. Check condenser C416 for short.

e. Check resistance of R428. It should be 150,000 ohms.

f. Lead dress is critical in the horizontal oscillator circuit. Check to see that lead dress has not been disturbed while servicing.

PRODUCTION CHANGES

CHANGE TO PREVENT FUSE FAILURE IN TV-RADIO CHASSIS
Run 8 in 19E1, 19G1 and 19N1 Chassis

The circuit location fuse M401 (3/8 amp. 250 V.) has been changed to prevent possible fuse failure when function switch S701 is rotated from Radio to TV position. Fuse failure may occur if all contacts of switch section S701 make simultaneous contact, thus applying a sudden surge of current through the fuse.

Schematic figure 33 shows the fuse location in early sets and schematic figure 35 shows the fuse location in later sets having this production change. This change can be made to an early set by simply interchanging the red and blue leads connecting to switch section S701C. With this change made, the red lead should connect to terminal "h" of S701C and the blue lead should connect to terminal "g" of S701C.

CHANGE TO INCREASE BRIGHTNESS
Run 2 and higher in all 19 series chassis

The following changes were made in the cathode circuit of picture tube V306 for increased brightness.

Resistor R330 was changed from 470,000 ohms to 180,000 ohms, ½ watt, part number 60B8-184. Condenser C316 was changed from .01 mfd. to .22 mfd. 400 volts, part number 64B8-24.

CHANGE TO ELIMINATE BENDING AND IMPROVE HORIZONTAL SYNC AND CHANGE TO REDUCE SNOW IN FRINGE AREAS

Run 3 in 19B1, 19C1, 19E1, 19F1, 19F1A, 19G1, 19H1, and 19K1 Chassis
Bending and Sync Changes

The following changes were made to eliminate possible bending at the top of the picture and to improve horizontal sync. If it is desired to make these changes to chassis stamped Run 2 or lower, see heading on "Circuit Changes to Reduce Bending and Improve Horizontal Sync".

In early production chassis (with exception of 19B1), the B plus voltage to the 1st and 2nd IF amplifiers V301 and V302 is effectively in series. In later production sets, B plus voltage to the 1st and 2nd IF amplifier stages is in parallel. This makes it possible to apply AGC voltage to 1st and 2nd IF amplifiers of later production sets, thus allowing the receiver to operate under a wider range of signal conditions without the possibility of overloading.

The circuit changes that were made to the IF amplifiers and AGC circuit of later production sets are as follows: The screen (pin 6) of 2nd IF tube V302 and terminal 2 of 2nd IF transformer T302 connect to common B plus through resistor R312 (1,000 ohms). Condenser C319 (.001 mfd.) is connected from terminal 2 of T302 to chassis.

The control grid (pin 1) of 2nd IF amplifier V302 is returned to AGC through T301 and decoupling resistor R309 (1,000 ohms). Condenser C318 (.001 mfd.) is connected from terminal 3 of T301 to chassis. The suppressor grid (pin 7) of V302 is connected directly to chassis. The cathode (pin 2) of V302 returns to chassis through R336 (68 ohms).

Overloading of the video amplifier and possible sync instability has been eliminated by the following circuit changes:

The B plus voltage at the screen (pin 6) of the video amplifier V305 (6CB6) was increased by lowering the value of resistors R212 and R213 in the grid and cathode circuits of sound output tube V204.

Resistor R212 was changed from 3,600 ohms to 1,500 ohms in sets using a 6AS5 tube for V204, and was changed from 4,700 ohms to 2,000 ohms in sets using a 6Y6 G tube for V204.

Resistor R213 was changed from 1,100 to 910 ohms in sets using a 6AS5 tube for V204 and from 2,000 ohms to 1,500 ohms in sets using a 6Y6G tube for V204.

Increased sync pulse input to the sync circuits is obtained by the following changes made to the video amplifier plate circuit. Resistor R326 was changed from 2,700 ohms to 5,600 ohms, 1 watt. Resistor R325 (2,700 ohms) was omitted.

RESISTORS R214 AND R215 REPLACED BY ONE RESISTOR IN SOME LATER PRODUCTION 19E1, 19G1 and 19N1 CHASSIS

In later production chassis, resistors R214 and R215, 2,200 ohms, 2 watt, were replaced by a single wire wound resistor, 1,200 ohms, 5 watt, part number 61A1-10.

CHANGE IN PILOT LIGHT AND VOLTAGE DROPPING RESISTOR R707

In later production combination sets a different pilot light and pilot light series dropping resistor is used.

Early production sets stamped Run 5 or lower use a number 44 pilot light (part number 81A1-5) and voltage dropping resistor R707 is 4.7 ohms, ½ watt, part number 60B28-11. In later production sets stamped Run 6 and higher, a number 47 pilot light (part number 81A1-8) is used and voltage dropping resistor R707 is 10 ohms, ½ watt, part number 60B28-100.

MECHANICAL CHANGE IN RADIO TUNER USED IN 19E1, 19G1 and 19N1 CHASSIS

Mechanical changes were made to the later production radio tuner subchassis used in combination models. The dimensions of the radio chassis were altered lightly and the mounting position of the gang condenser was changed.

Early production radio tuners used gang condenser (part number 68B53) which mounts in a vertical position. Later production radio tuners use gang condenser (part number 68B53-1) which mounts in a horizontal position.

CHANGE IN SIZE OF FUSE M401

To prevent possibility of fuse failure, due to momentary line voltage surges, fuse M401 was changed from a ¼ ampere, 250-volt fuse to a 3/8 ampere, 250-volt fuse, part number 84A4-3. Fuse replacement should be made only a 3/8 ampere, 250-volt fuse, part number 84A4-3.

VERTICAL RETRACE BLANKING CIRCUIT ADDED
Run 5 in all 19 Series Chassis

A vertical retrace blanking circuit was added to eliminate retrace lines. The vertical retrace blanking circuit consisting of components R444 (2,700 ohms), R445 (56,000 ohms), C427 (.01 mfd.) and C428 (.01 mfd.), is shown in schematic.

Vertical retrace blanking is achieved by applying the pulse voltage appearing at the low side (red lead) of the vertical output transformer T402 to the grid (pin 2) of the picture tube V306.

Snow Changes
(This portion of Run 3 production change does not apply to the 19B1 chassis.)

The circuit changes described below are rather involved. Generally we do not recommend that they be made in the field. However, if snow is still excessive after making the checks given under the heading of "Excessive Snow Due to Faulty Tubes", and it is desired to make the changes below, instructions may be obtained by writing the Service Department of the Admiral Corporation at 201 E. North Water Street, Chicago 2, Illinois.

To reduce the amount of snow (front end noise) in the picture the AGC voltage to the tuner has been reduced with respect to the AGC voltage to the 1st and 2nd IF stages by applying a small positive voltage from voltage divider network.

The voltage divider network consisting of R301 (3.3 megohms), R333 (15 megohms), R334 (2.2 megohms) and R338 (56,000 ohms) was added in the circuit between B plus, the AGC diode V304 and the DX Range Finder control R315.

One terminal of DX Range Finder R315 connects to the R338 (56,000 ohms). Resistor R317 connecting to pin 7 of diode V304 was changed from 820,000 ohms to 470,000 ohms. The delayed AGC bias developed at the AGC diode (½ of V304) is thus controlled by both the Contrast (picture) control and the DX Range Finder control. This provides a means of eliminating entirely the delay on the AGC diode in a very strong signal area and also a means of adjusting the AGC delay to a suitable value for best picture with minimum of snow in weak signal or intermediate fringe areas.

CHANGE IN TOLERANCE OF COMPONENTS IN THE HORIZONTAL OSCILLATOR CIRCUIT V403
In some Run 2 Chassis and all Chassis Run 3 and higher

Changes were made to horizontal oscillator circuit V403 of later production sets to mimimize possible variation of horizontal oscillator performance due to parts tolerances and variation in electrical characteristics of some brands of 6SN7 tubes. By reducing the permissible tolerance of components R422, R423, R428 and C418, the operation of the horizontal oscillator circuit becomes less critical.

In later production sets (stamped Run 3 and higher), tolerance of resistors R422 (330,000 ohms), R423 (82,000 ohms) and R428 (150, 000 ohms) were changed from 10% to 5% tolerance. Condenser C418 (.01 mfd.) was changed from 20% to 10% tolerance.

In cases where it is difficult to make satisfactory Horizontal Sync Adjustment, the components in the horizontal oscillator circuit should be checked for correct value as mentioned in the preceeding paragraph and under Horizontal Instability and Tearing In Picture.

DIFFERENT INTEGRATOR AND SYNC COUPLATE USED
Run 7 in All 19 Series Chassis

Integrator couplate, part number 63B6-11 has replaced integrator couplate, part number 63B6-2 used in earlier production sets. The circuit of both couplates is the same with the exception that resistor R407 (22,000 ohms), is not contained in couplate 63B6-11. Resistor R407 is connected externally from terminal 3 of couplate 63B6-11 to pin 1 of V401B. This change in integrator couplates has improved horizontal sync stability by increasing the amplitude and squaring up the sync pulse.

To replace couplate 63B6-2 with couplate 63B6-11, omit resistor R 433 (8,200 ohms) if used between pin 1 of V401B and terminal 3 of the couplate. Connect resistor R407 (22,000 ohms, ½ watt) between pin 1 of V401B and terminal 3 of couplate 63B6-11.

Sync couplate, part number 63B6-8 has replaced sync couplate part number 63B6-4 used in early production sets. Couplate 63B6-4 contains resistors R328, R329 and condenser C315. Couplate 63B6-8 contains resistor R329 and condensers C315 and C317. This change in sync couplates has simplified circuit wiring by reducing the number of components.

To replace couplate 63B6-4 with couplate 63B6-8, change resistor R327 from 22,000 ohms to 27,000 ohms. Remove condenser C317 (.01 mfd.). Connect couplate 63B6-8 between resistor R327 and pin 7 of V401A.

TV TUNER SHAFT LENGTH INCREASED
Run 6 in All 19 Series Chassis

The TV tuners used in chassis stamped Run 6 and higher, have a longer shaft length. This increase in shaft length was made to make the chassis adaptable for installation of a separate UHF tuner.

The 94D46-3 cascode TV tuner is used in all later production chassis (Run 6 and higher), with exception of the 19B1 chassis. The 94D52-2 pentode TV tuner is used in later production 19B1 chassis (Run 6 and higher).

TV tuners 94D46-2 and 94D46-3 are identical, with exception of shaft length. TV tuners 94D52-1 and 94D52-2 are idnetical, with exception of shaft length.

REISSTOR R443 ADDED TO IMPROVE HORIZONTAL SYNC STABILITY
Run 4 in all 19 Series Chassis

Later production sets using vertical integrated couplate, part number 63B6-2, have an 8,200 ohm, ½ watt resistor (R443) connected between terminal 3 of the couplate and pin 1 of sync separator tube V401 (12AU7). The integrator couplate contains components R407, R408, R409, C403, C404 and C405.

Adding resistor R443 to the circuit has increased the sync level by squaring up the sync pulses, thereby improving horizontal sync instability.

To install resistor R443 (8,200 ohms) remove the number three lead of integrator couplate 63B6-2 from pin 1 of V401 (12AU7). Connect resistor R443 between the number three lead of the couplate and pin 1 of V401 (12AU7).

ADDING VERTICAL RETRACE BLANKING CIRCUIT TO AN EARLY PRODUCTION CHASSIS

All 19 series chassis stamped Run 5 and higher, have a vertical retrace blanking circuit incorporated for eliminating retrace lines. A schematic of the retrace blanking circuit and detailed instructions for adding this change to an early production receiver, is given in the paragraphs below. The following parts are required:

Sym.	Description	Part No.
C427	.01 mfd, 600 volts, condenser	64B-9-13
C428	.01 mfd, 400 volts, condenser	64B 9-32
R445	56,000 ohms, ½ watt, resistor	60B 8-563
R444	2700 ohms, ½ watt, resistor	60B 8-272

1. Locate the red wire between pin 10 of the picture tube and the junction of the black lead of T403A (vertical deflection yoke) and the red lead of T402 (vertical output transformer).

2. Locate the bare wire between the junction of R431 (820,000 ohms) and R438 (1200 ohms) and the junction of the black lead of T403A and red lead of T402.

3. Disconnect the red wire and the bare wire from their common junction point. Reconnect both of these leads to the junction of the 7.5 ohm winding and the 100 ohm winding of T402 (common point of the white and yellow leads). See figure 13.

4. Locate the red (positive) lead from C410 (20 mfd) and the junction of the black lead of T403A and red lead of T402. Disconnect the red wire from this junction and reconnect to junction of 7.5 ohm and 100 ohm winding of T402.

5. Locate the green wire from pin 2 of the picture tube and disconnect from chassis ground. Connect green wire to a .01 mfd., 600 volt condenser. Connect the other end of this condenser to a 2700 ohm, ½ watt resistor. Connect the other end of the resistor to the junction of the red lead of T402 and the black lead of T403A.

6. At the junction of the .01 mfd., 600 volt condenser and the green wire from pin 2 of the picture tube (connected in step 5) connect a 56,000 ohm resistor to chassis ground. Connect a .01 mfd., 400 volt across the the 56,000 ohm resistor.

WARNING: Do not use any of the unused lugs of V402 (6S4) tube socket for the points. These lugs are connected to the internal tube structure of the 6S4 tube.

HORIZONTAL INSTABILITY AND TEARING IN PICTURE

Horizontal instability, tearing or bending may be due to misadjustment of the DX Range Finder or horizontal sync adjustments; or it may be due to a faulty tube or defective components. If causes of trouble have been checked as instructed in the following steps and the chassis is Run 2 or lower, make the circuit changes described under the heading below on "Circuit Changes to Reduce Bending and Improve Horizontal Sync".

Make checks as follows:

a. Check to see if trouble is due to misadjustment of the DX Range Finder control. Set control at "O", use this setting unless a higher setting gives better results.

b. Check horizontal sync adjustment as instructed under "Simplified Horizontal Sync Adjustment". If difficulty is experienced in making Horizontal Sync adjustment, continue with the following steps.

c. Replace the horizontal oscillator tube V403 (6SN7GT). Try tubes of different brands. Repeat Horizontal Sync adjustment.

d. Check resistors (R420, R421, R422, R423, R424 and R428). These resistors should be within 5% tolerance of the values shown in the parts list and on the schematic. Also, check condenser C418 (.01 mfd.) for correct capacity. If this condenser is suspected as being faulty, it should be replaced with a .01 mfd, 400 volt, 10% condenser, part number 64A2-16.

e. Check condenser C417 by substitution. Use a 270 mmfd, 10% mica condenser, part number 65B21-271.

f. Check condensers C413 and C416 for either open or short.

g. If tapping the horizontal oscillator trnasformer T404 causes erratic operation, a cracked adjustment slug in the transformer may be the cause. If transformer T404 is suspected as being the cause of the trouble it should be replaced.

h. If after following each of the above steps, horizontal difficulties are still present, and the set is Run 2 or lower, it is suggested that circuit changes be made as described in section below.

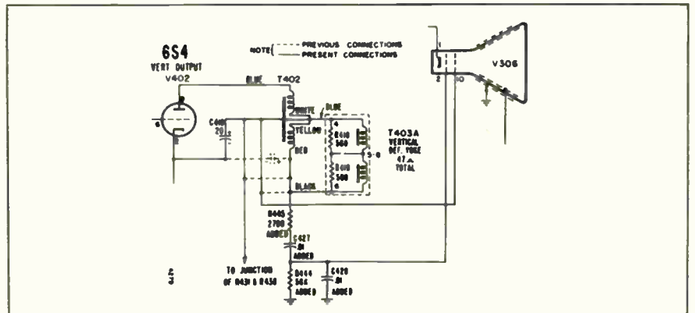


Figure 13. Vertical Output and Picture Tube Circuit With Vertical Blanking Added.

COMPLETE HORIZONTAL OSCILLATOR ALIGNMENT
(Requires Oscilloscope)

1. IMPORTANT: Set the DX RANGE FINDER at "O" position and set the PICTURE control (contrast on front panel) for normal picture.

2. In some chassis (stamped Run 1 or lower), the HORIZONTAL control (A) may be wired in reverse. If so, it will be impossible to make adjustment properly by following the instructions below.

To determine whether the control wiring is reversed, check the lug to which blue wire is connected. The blue wire should connect to the lug nearest bottom edge of the chassis and the 68,000 ohm resistor R425 should connect to the lug nearest the top of the chassis. If wiring is reversed, change the two connections in accordance with the information given here.

3. IMPORTANT: Connect oscilloscope high side through a 10 mmfd. condenser to terminal marked "C" or "2" on the horizontal blocking transformer T404. (See figure 6.) It is important to use short leads and a very low capacity condenser (at least 10 mmfd.) to avoid loading the circuit and thus distorting the waveform.

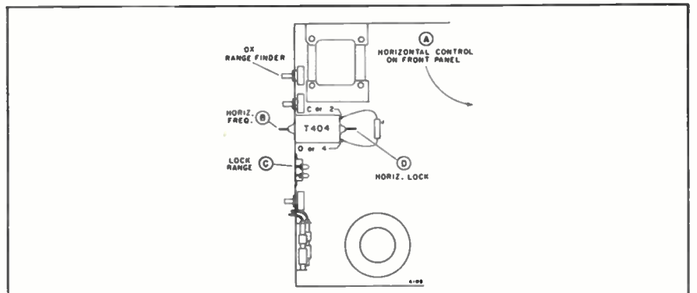


Figure 6. Bottom View of Chassis Showing Horizontal Sync Adjustments.

4. Set the oscilloscope sweep to 15.75 KC or a submultiple of it.

5. Adjust the HORIZONTAL LOCK slug (D) (see figure 6) until the oscilloscope waveform pattern appears as in figure 7. The rounded and pointed peaks of the waveform must have equal height. The picture must be kept in sync to obtain the proper oscilloscope waveform pattern. Keep the picture in sync by adjusting the HORIZONTAL FREQUENCY (B) and/or the LOCK RANGE trimmer (C). If the picture still will not sync, check for a defective tube, components, or wiring, before continuing further. See Service Hints on Horizontal Instability And Tearing.

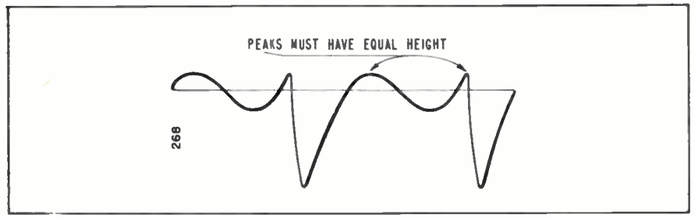


Figure 7. Horizontal Oscillator Waveform.

6. Disconnect the oscilloscope leads.

7. Set the HORIZONTAL control (A) fully counter-clockwise to break sync. If the picture does not go out of sync, momentarily interrupt the channel selector or adjust the HORIZONTAL FREQUENCY (B) until several bars appear sloping downward to the left. (See figure 8).

8. Slowly turn the HORIZONTAL control (A) clockwise and note the least number of bars present before the picture falls into sync. If two or three bars are present, the LOCK RANGE trimmer is set properly, so reset the HORIZONTAL control (A) to maximum counterclockwise and adjust the HORIZONTAL FREQUENCY (B) until the picture falls back into sync.

9. If more than three bars are present, adjust the LOCK RANGE trimmer (C) slightly clockwise. If less than 2 bars are present, adjust the LOCK RANGE trimmer (C) counterclockwise. Repeat steps 7 and 8.

10. Rotate HORIZONTAL control (A) on the front panel from one end to the other. The picture should hold sync as follows:

a. For strong or medium signals, the picture should remain in sync over the entire rotation of the HORIZONTAL control. If it falls out of sync, bends at the top (jitters), or doubles up on the side; sync adjustment is required; see step 11 below.

b. For weak or fringe area signals, the picture should remain in sync over ½ to ¾ of the rotation of the HORIZONTAL control. If it falls out of sync, bends at the top (jitters), or doubles up on the side; sync adjustment is required; see step 11 below.

11. If picture does not hold sync as described in paragraphs "a" or "b" above, set the HORIZONTAL control (A) at the point where the picture just loses sync or becomes unstable and adjust the HORIZONTAL FREQUENCY (B) until the picture just falls back into sync. If may require several turns of adjustment (B). Repeat this procedure until the picture holds as described in paragraphs "a" or "b" of step 10.

MISCELLANEOUS TROUBLE DUE TO FAULTY TUBES

Faulty tubes cause the majority of receiver troubles. The list below contains most common troubles which are generally due to faulty tubes.

a. Poor fringe area reception due to low B plus voltage. Check the 5U4G tube.

b. Poor fringe area reception due to low sensitivity. Check the 6BC5 and 6BZ7 tubes, if used in the receiver.

c. Picture and sound separated due to IF oscillation. Check the 6BC6 and 6U8 tubes.

d. Picture bending caused by leakage between tube elements. Check the 6BC5 and 6CB6 tubes.

e. Poor sync stability, usually more noticeable in vertical circuit. Check 12AU7 tube.

f. Washed out picture due to negative grid current. Check 6CB6 tube.

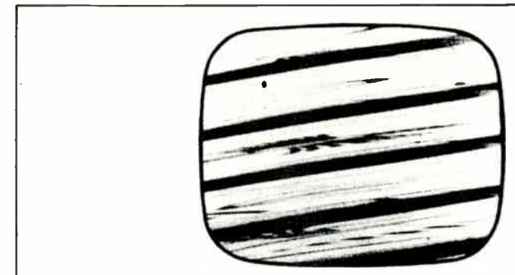


Figure 8. Picture Out of Horizontal Sync.

ADJUSTING CURVATURE CORRECTING MAGNETS FOR SETS USING A 21EP4A (21") PICTURE TUBE

If either side of the picture has excessive curvature (pin cushion effect) or if corners of the picture are bent inwardly, this can be minimized by adjustment of the correcting magnets located on the yoke bracket. Either side of the picture can be adjusted individually by using the magnet on using the magnet on that side of the picture tube. A picture or test pattern having straight vertical lines near the sides can be used for making adjustment; the pattern from a cross-hatch generator is preferable. IMPORTANT: A cross-hatch generator which is not capable of locking the picture in both horizontal and vertical sync is not suitable. Adjust as follows:

a. Set the receiver controls for normal picture. Be sure that the picture is centered properly and vertical linearity adjustment is made.

b. Check the radial position of the magnet brackets. The magnet brackets are generally set so that the mounting screw is centered in the curved slot. It should only be necessary to change from this setting if the curvature at the side of the picture is not centered with respect to the side of the picture tube.

c. Move the correcting magnet against the deflection yoke bracket. While observing the vertical lines on the same side of the picture that the magnet is located, slowly move the magnet forward until curvature of vertical lines near the side is minimized. If the magnets are moved too far forward, the corners of the picture will bend inwardly or become shaded.

SCHEMATIC NOTES

Run numbers are rubber stamped at the rear of the chassis.
Numerical symbols ①, ②, ③, etc. indicate run numbers for all 19 series chassis.

Ⓐ1, Ⓐ2,.....Ⓨ, Ⓩ, etc. indicate alignment points and alignment connections.

IMPORTANT: Before making waveform and voltage measurements, see instructions below.

WAVEFORM DATA
(Waveforms given on schematic)

Waveforms taken with PICTURE control set fully to the right, all other controls set for normal picture (in sync). DX Range Finder control set fully to the left (at "0" position). WARNING: Incorrect adjustment of the DX Range Finder control will cause waveform distortion.

Waveforms at video and sync stages obtained with transmitted signal input to receiver.

Waveform at pins 1 and 4 of V403 and terminal "C" (2) of T404 taken with a 10 mmfd. condenser connected in series with the oscilloscope high side.

The oscilloscope sweep is adjusted for 30 cycles (which is one-half of the vertical frequency), or for 7875 cycles (which is one-half of the horizontal frequency) so that two pulses appear on the screen.

The peak-to-peak voltage readings shown are subject to some variations due to response of the oscilloscope and parts tolerances.

CAUTION

Pulsed high voltage is present on the caps of V404 and V405 and at pin 3 of V406. Do not make direct connection to these points with ordinary test equipment. Waveform and peak-to-peak voltage at pin 3 of V406 taken, using an oscilloscope with a capacitive voltage divider probe. Waveform at V406 can also be taken by clipping or twisting the lead from the oscilloscope high side over the insulation on the lead connecting to pin 3. When taking the waveform this way, the shape of waveform will be the same but the peak-to-peak voltage will be much lower, depending upon the degree of coupling.

VOLTAGE DATA
(Voltages given on schematic)

- PICTURE control turned fully clockwise. CHANNEL control set on an unused channel. Other front controls set at approximately half rotation. Vert. Lin. and Height set at approximately half rotation. DX Range Finder control set fully to the left (at "O" position).
- Antenna disconnected from set with terminals shorted.
- Line voltage 117 volts AC.
- Voltages measured with a vacuum-tube voltmeter between tube socket terminals and chassis, unless otherwise indicated.
- Voltages at V101 and V102 (TV Tuner) are measured with tube in socket. Use an adapter or lift tube out of socket just high enough to allow a needle point probe to contact tube pins.

  In tuners using a 6BZ7 tube, voltages taken at pins 1 and 8 must be taken as described above or no voltage reading will be obtained.
- Voltages at V306 measured from top of socket with tube removed.
- Voltages marked with an asterisk * will vary widely with control setting. In combination models, B+ voltages in TV chassis will be slightly higher when set is switched to radio position. Alternate voltage readings for radio and TV are shown for sound output tube V204 (6Y6G).

CAUTION

Pulsed high voltages are present on the cap of V404, pin 3 of V406 and on the filament terminals and cap of the 1B3GT tube. NO ATTEMPT SHOULD BE MADE TO TAKE MEASUREMENTS FROM THESE POINTS WITHOUT SUITABLE TEST EQUIPMENT.

Picture tube 2nd anode voltage can be measured from the 2nd anode connector and should be taken only with a high voltage instrument such as a kilovoltmeter. 2nd anode voltage is approximately 15 KV. Proper filament voltage check of the 1B3GT tube may be made by observing filament brilliancy as compared with that obtained with a 1.5 volt dry cell battery.

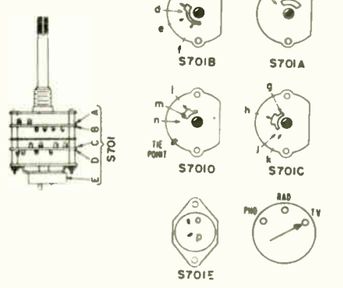
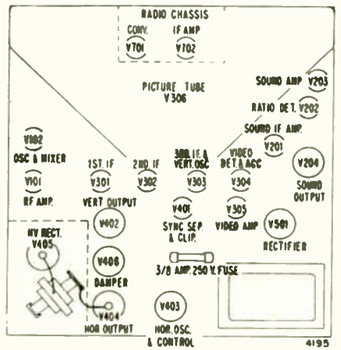
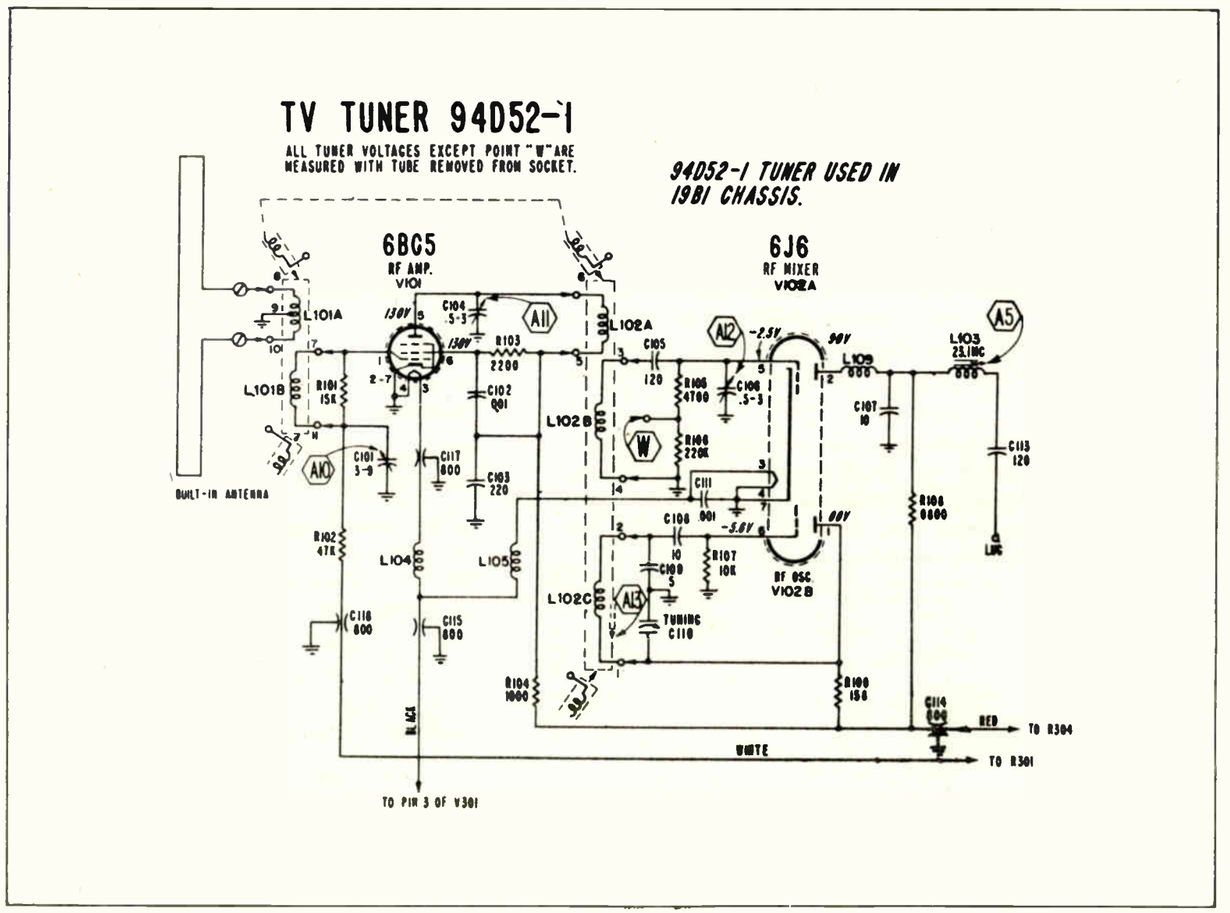
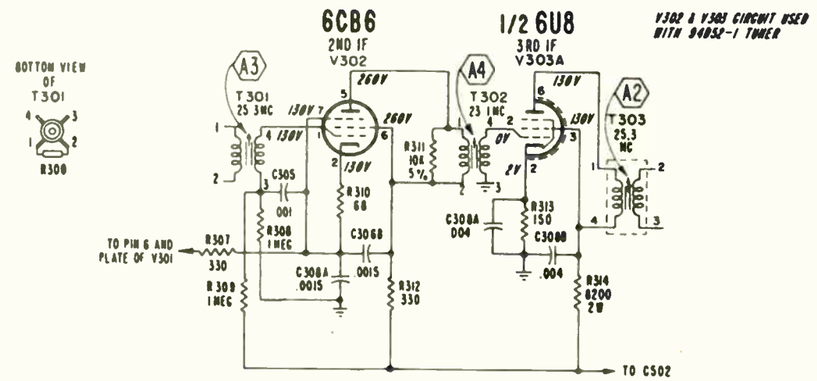


Illustration of TV-RAD-PHO switch S701



Top View of Chassis. (V701 and V702 are accessible from underside of chassis).





V302 & V303 CIRCUIT SHOWN BELOW USED ONLY WITH 94D52-1 TUNER.

Note: Tone control used only in the 19C1, 19E1 and 19H1 chassis.

Figure 18. Schematic for 19B1, 19C1, 19F1A and 19H1 Television Chassis.

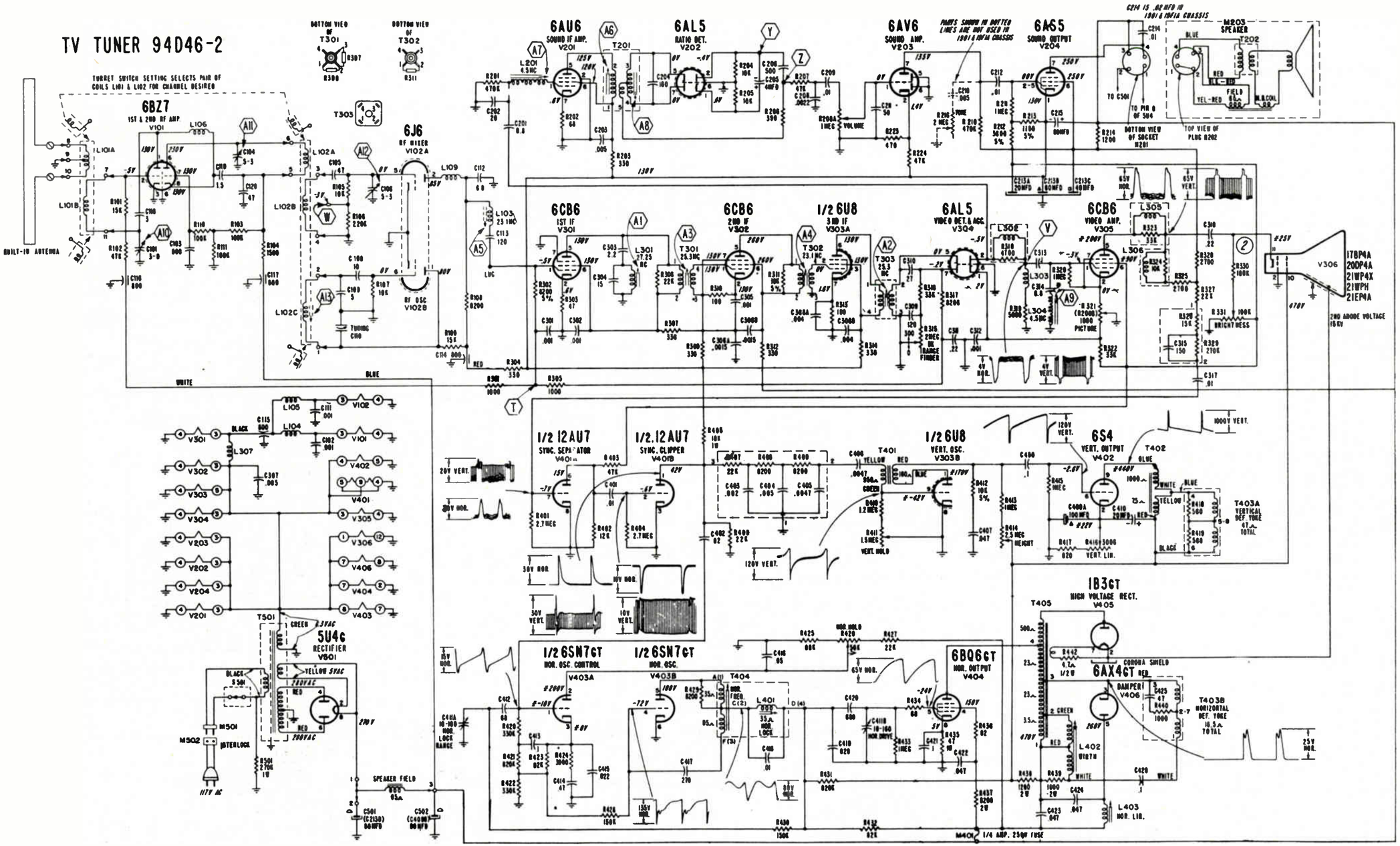


Figure 19. Schematic for 19E1 Television and Radio Chassis.

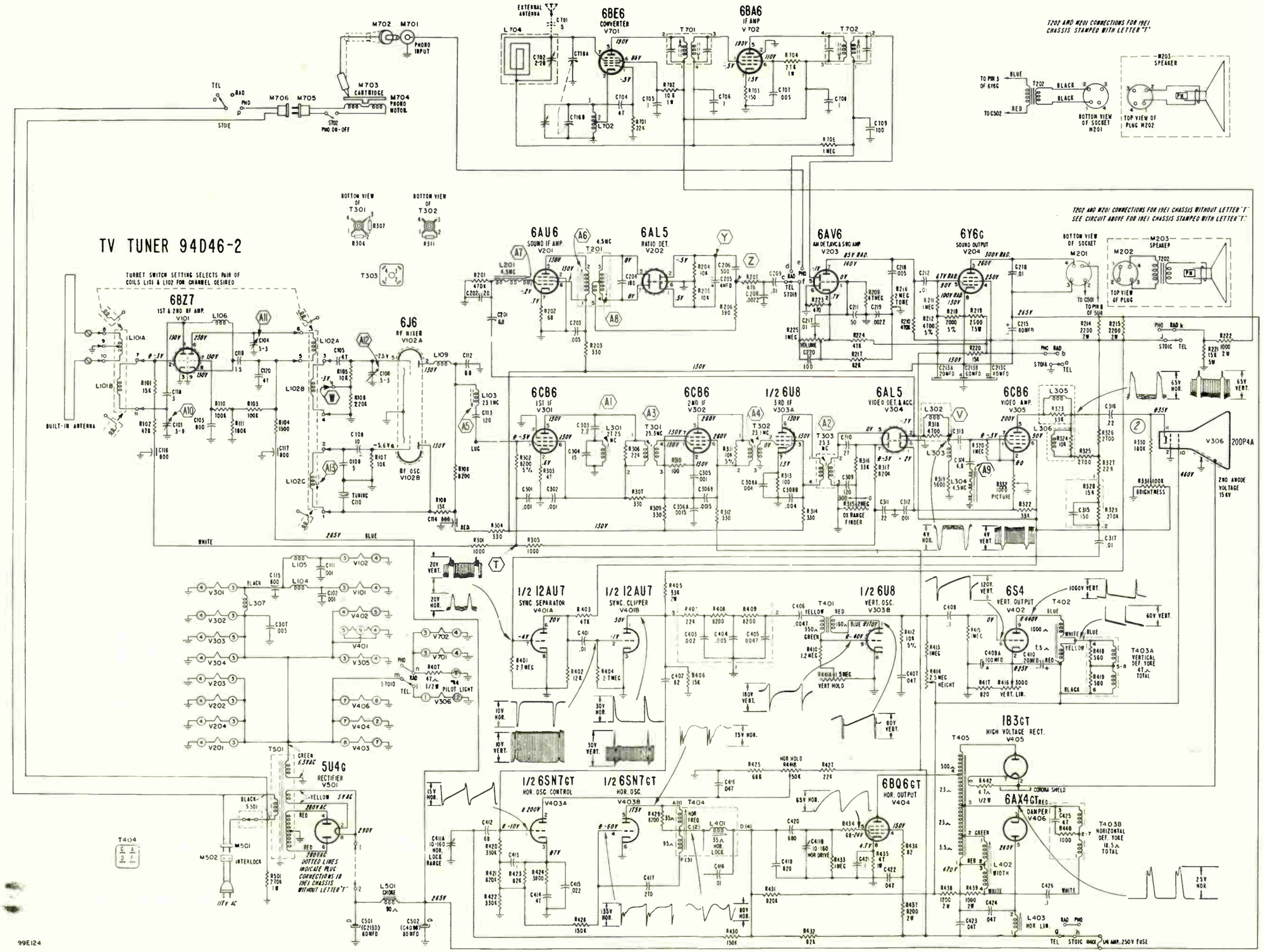
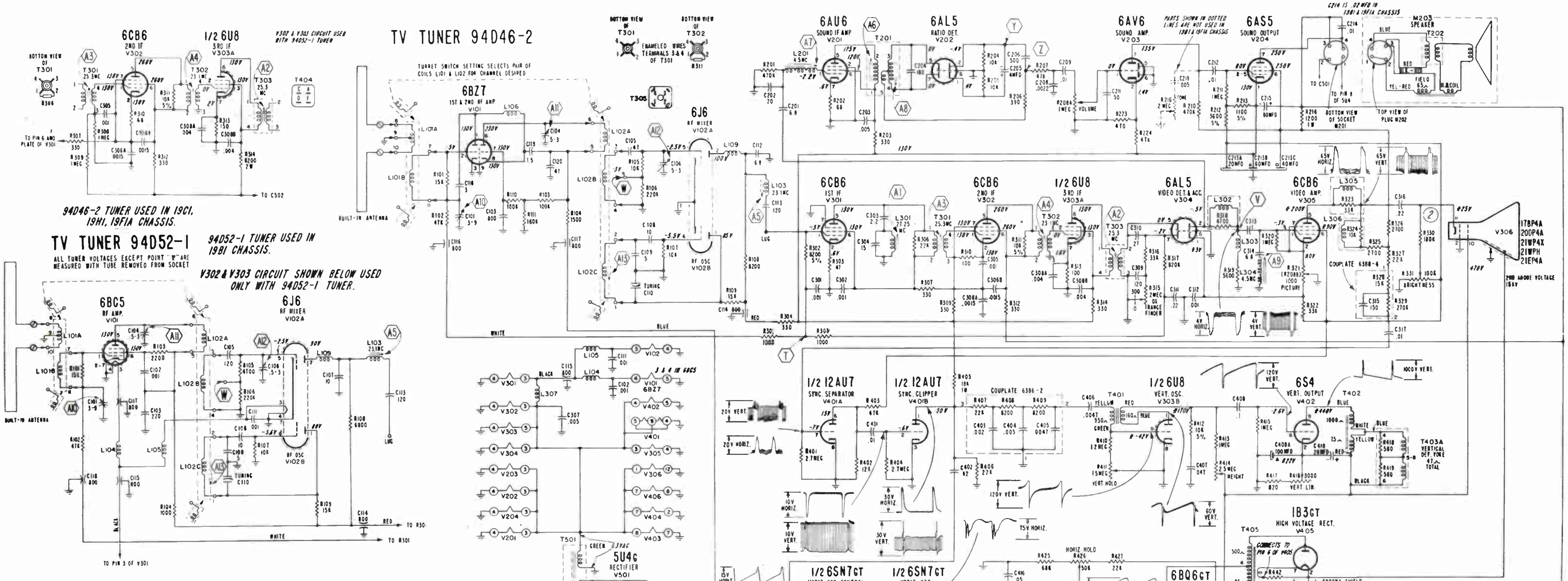
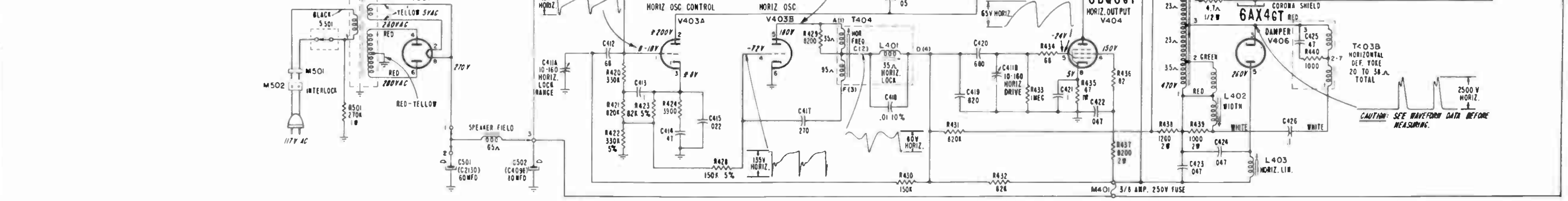
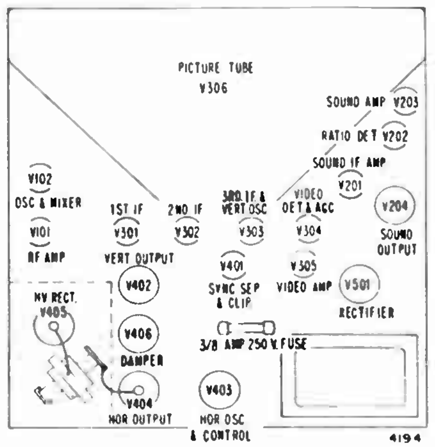


Figure 30. Schematic for 19B1, 19C1, 19F1, 19F1A, 19H1 and 19K1 Television Chassis.

Note: This schematic applies only to chassis stamped Run 2 or lower. See figure 32 for chassis stamped Run 3 and figure 34 for chassis stamped Run 4 and higher.







Top View of Chassis.

SCHEMATIC NOTES

Run numbers are rubber stamped at the rear of the chassis.

Numerical symbols ①, ②, ③, etc. indicate run numbers for all 19 series chassis.

(A1), (A2),...... (Y), (Z), etc. indicate alignment points and alignment connections.

IMPORTANT: Before making waveform and voltage measurements, see instructions below.

WAVEFORM DATA

(Waveforms given on schematic)

Waveforms taken with PICTURE control set fully to the right, all other controls set for normal picture (in sync). DG Range Finder control set fully to the left (at "0" position). WARNING: Incorrect adjustment of the DX Range Finder control will cause waveform distortion.

Waveforms at video and sync stages obtained with transmitted signal input to receiver.

Waveform at pins 1 and 4 of V403 and terminal "C" (2) of T404 taken with a 10 mmfd. condenser connected in series with the oscilloscope high side.

The oscilloscope sweep is adjusted for 30 cycles (which is one-half of the vertical frequency), or for 7875 cycles (which is one-half of the horizontal frequency) so that two pulses appear on the screen.

The peak-to-peak voltage readings shown are subject to some variations due to response of the oscilloscope and parts tolerances.

CAUTION

Pulsed high voltage is present on the caps of V404 and V405 and at pin 3 of V406. Do not make direct connection to these points with ordinary test equipment. Waveform and peak-to-peak voltage at pin 3 of V406 taken, using an oscilloscope with a capacitive voltage divider probe. Waveform at V406 can also be taken by clipping or twisting the lead from the oscilloscope high side over the insulation on the lead connecting to pin 3. When taking the waveform this way, the shape of waveform will be the same but the peak-to-peak voltage will be much lower, depending upon the degree of coupling.

TV VOLTAGE OATA

(Voltages given on schematic)

- PICTURE control turned fully clockwise. CHANNEL control set on an unused channel. Other front controls set at approximately half rotation. Vert. Lin. and Height set at approximately half rotation. DX Range Finder control set fully to the left (at "O" position).
- Antenna disconnected from set with terminals shorted.
- Voltages marked with an asterisk * will vary widely with control setting.
- Line voltage 117 volts AC.
- Voltages measured with a vacuum-tube voltmeter between tube socket terminals and chassis, unless otherwise indicated.
- Voltages at V101 and V102 (TV Tuner) are measured with tube in socket. Use an adapter or lift tube out of socket just high enough to allow a needle point probe to contact tube pins.

  In tuners using a 6BZ7 tube, voltages taken at pins 1 and 8 must be taken as described above or no voltage reading will be obtained.
- Voltages at V306 measured from top of socket with tube removed.

CAUTION

Pulsed high voltages are present on the cap of V404, pin 3 of V406 and on the filament terminals and cap of the 1B3GT tube. NO ATTEMPT SHOULD BE MADE TO TAKE MEASUREMENTS FROM THESE POINTS WITHOUT SUITABLE TEST EQUIPMENT.

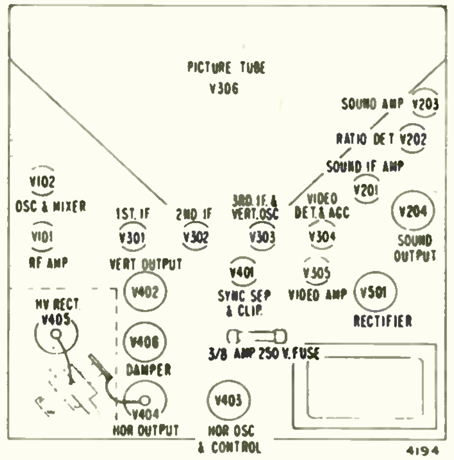
Picture tube 2nd anode voltage can be measured from the 2nd anode connector and should be taken only with a high voltage instrument such as a kilovoltmeter. 2nd anode voltage is approximately 15 KV. Proper filament voltage check of the 1B3GT tube may be made by observing filament brilliancy as compared with that obtained with a 1.5 volt dry cell battery.

Figure 32. Schematic for 19B1, 19C1, 19F1, 19F1A, 19H1 and 19K1 Television Chassis.

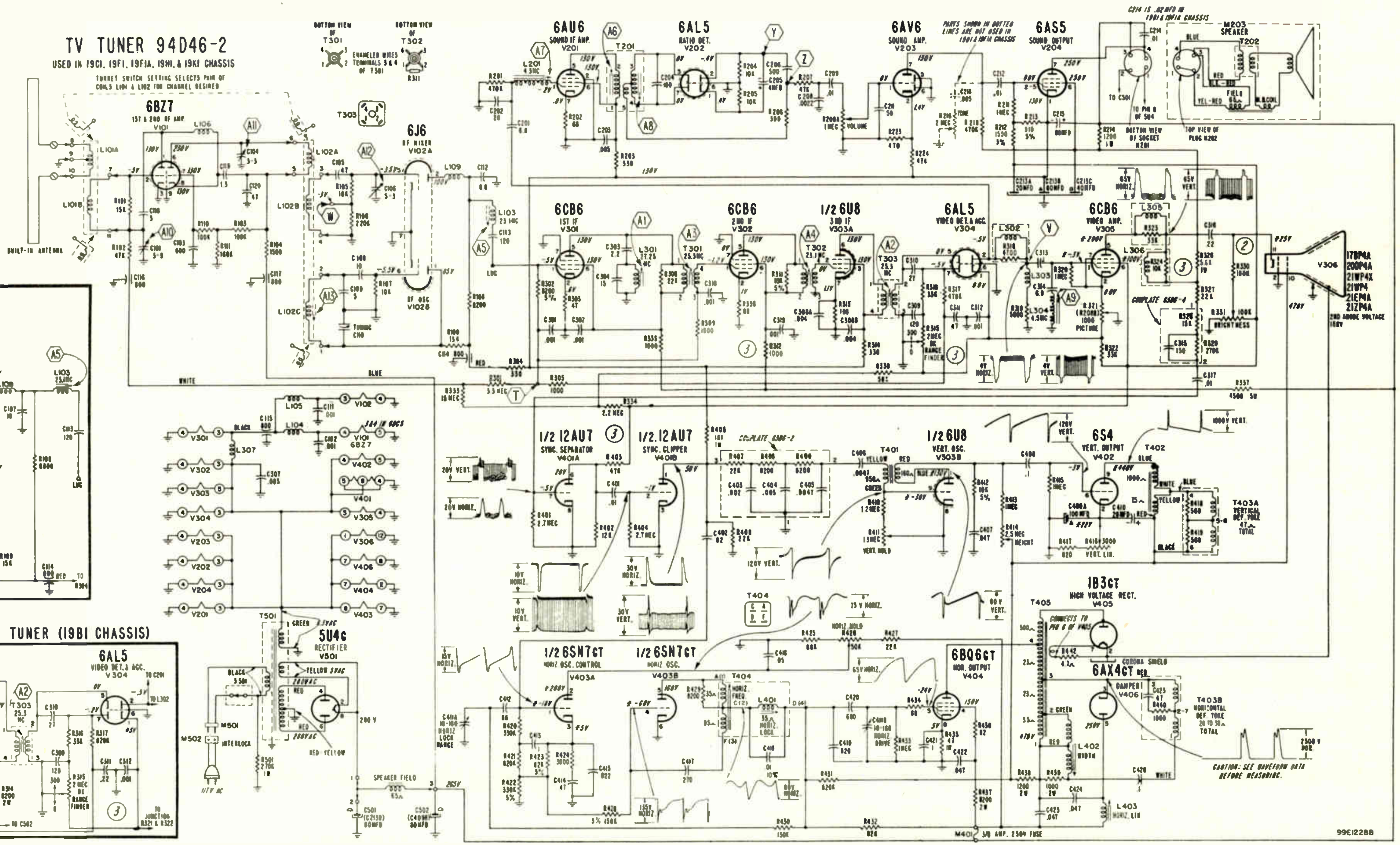
Note: This schematic applies only to chassis stamped Run 3. See figure 30 for chassis stamped Run 2 or lower and figure 34 for chassis stamped Run 4 and higher.

Note: Tone control not used in 19B1 and 19F1A chassis.

Waveform and Voltage data same as for Figure 30, Page 73.

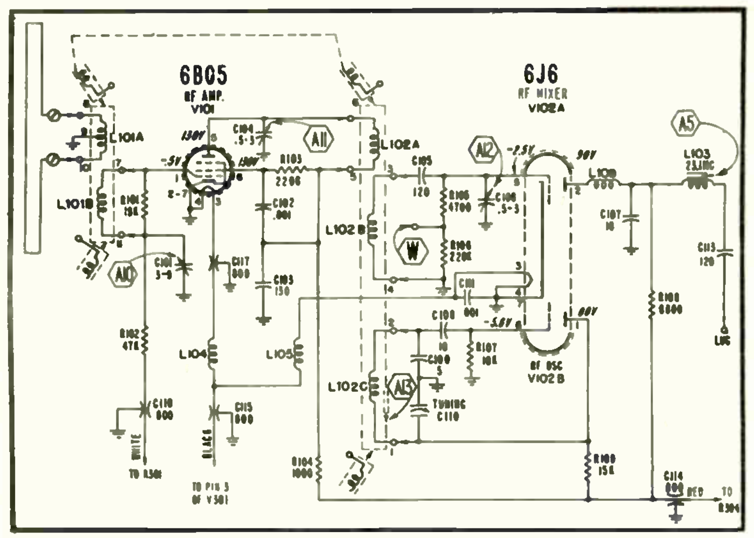


Top View of Chassis.



TV TUNER 94D52-1 USED IN 19B1 CHASSIS ONLY

THE CIRCUITS SHOWN BELOW ARE USED ONLY WITH 94D52-1 TUNER (19B1 CHASSIS)



THIS CIRCUIT USED WITH 94D52-1 TUNER (19B1 CHASSIS)

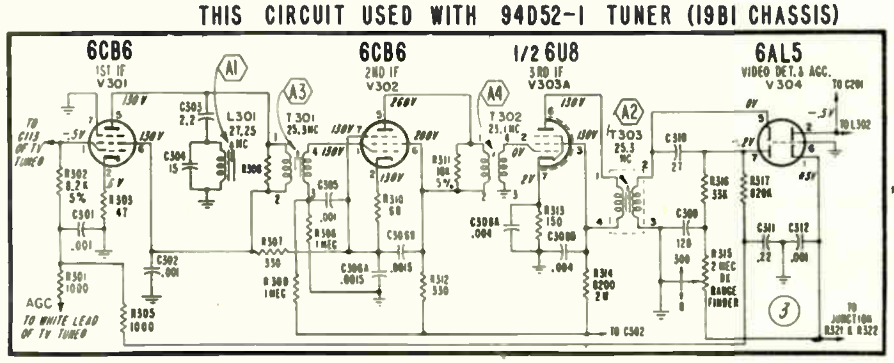
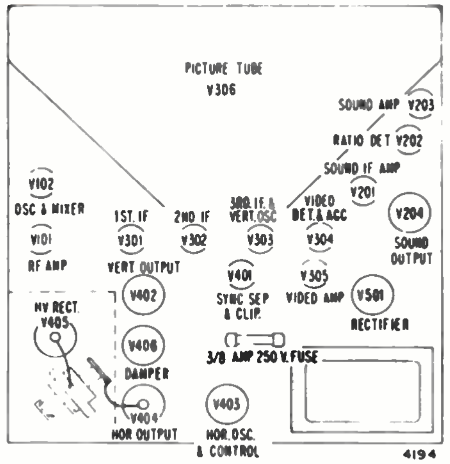


Figure 34. Schematic for 19B1, 19C1, 19F1, 19F1A, 19H1 and 19K1 Television Chassis.

Note: This schematic applies only to chassis stamped Run 4 and higher. See figure 32 for chassis stamped Run 3 and figure 30 for chassis stamped Run 2 or lower.

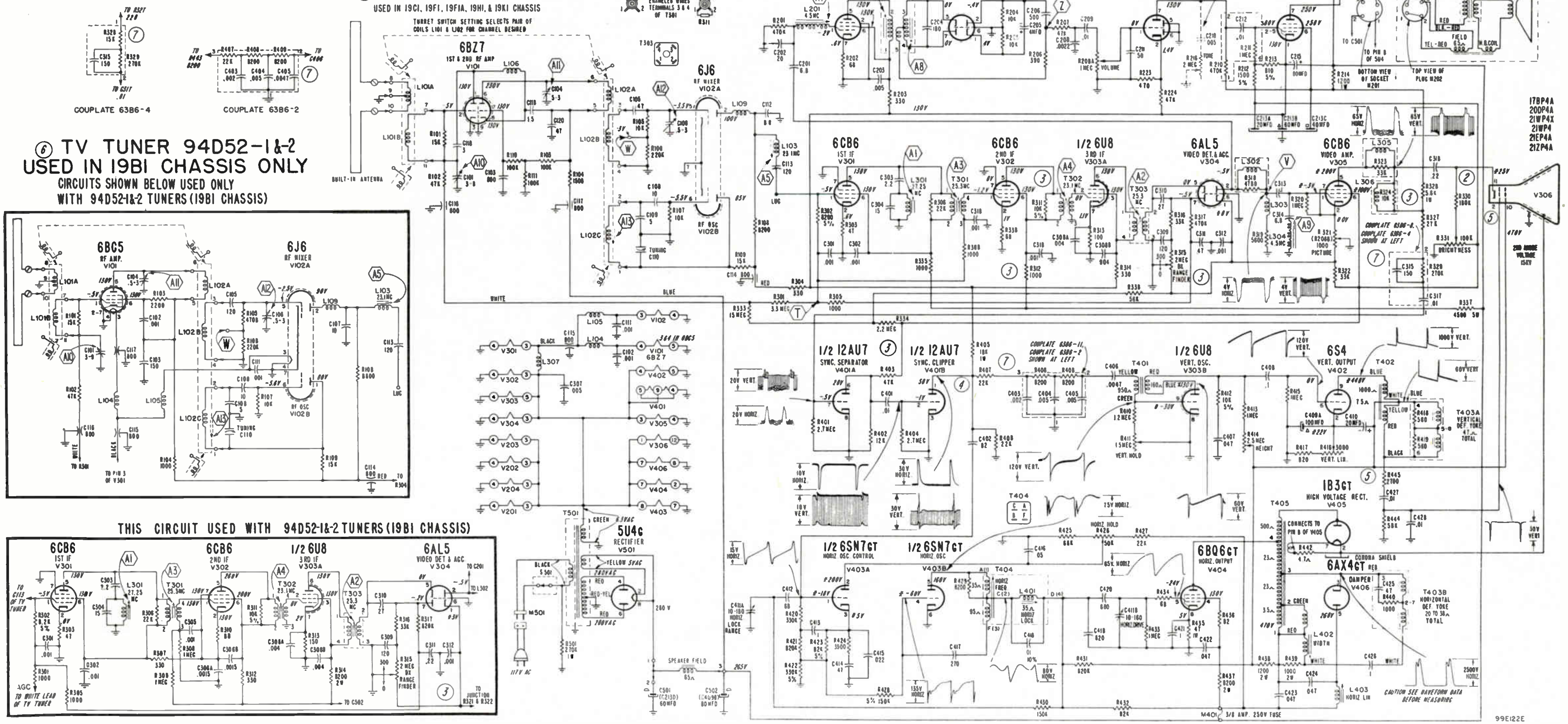
Wavefarm and Voltage data same as for Figure 30, Page 73.

Note: Tone control not used in 19B1 and 19F1A chassis.



Top View of Chassis.

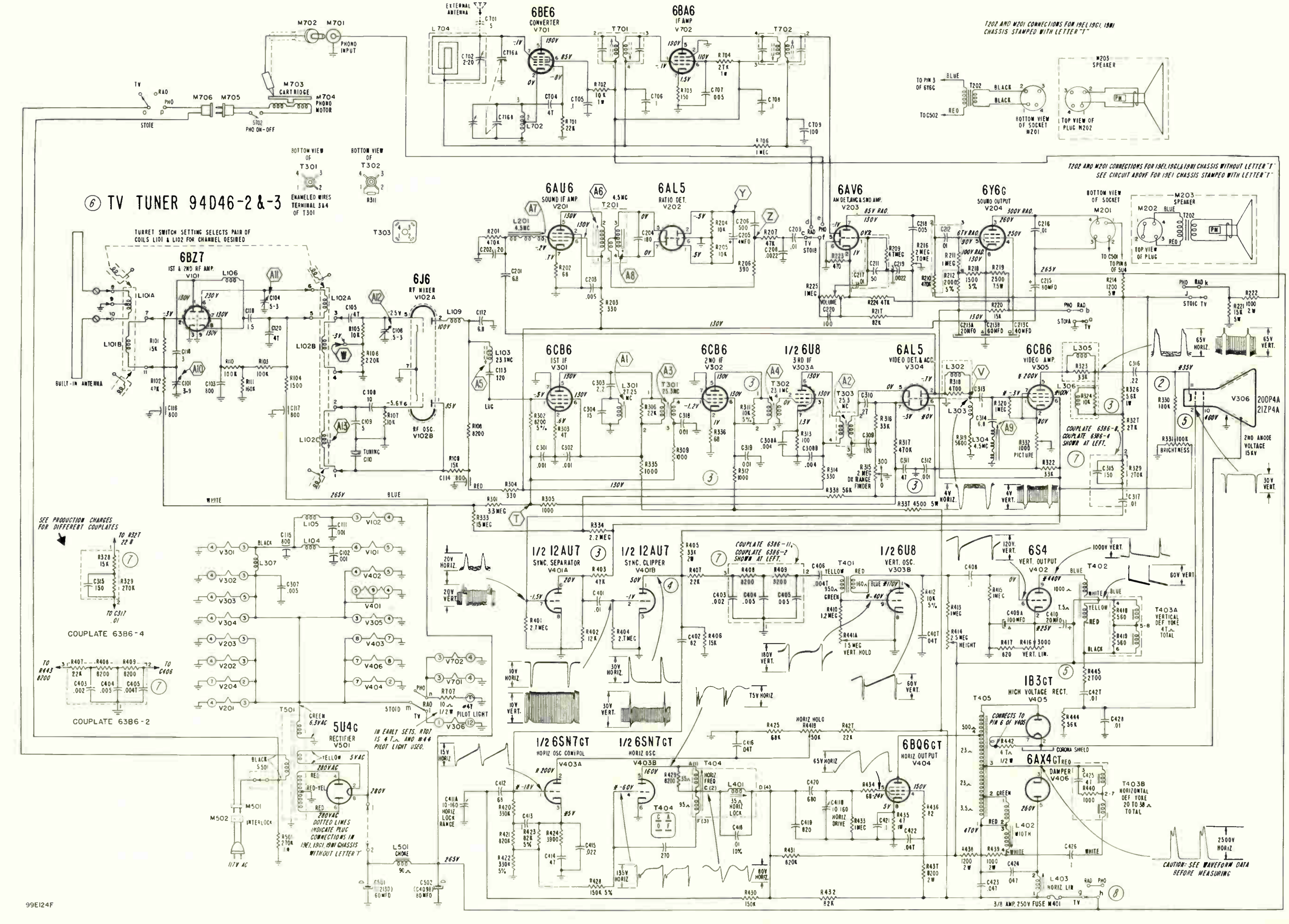
SEE PRODUCTION CHANGES FOR DIFFERENT COUPLATES USED



Waveform and Voltage data same as for Figure 18, Page 70.

Figure 35. Schematic for 19E1, 19G1 and 19N1 Television and Radio Chassis.

Note: This schematic applies only to chassis stamped Run 4 and higher. See figure 33 for chassis stamped Run 3 and figure 31 for chassis stamped Run 2 or lower.

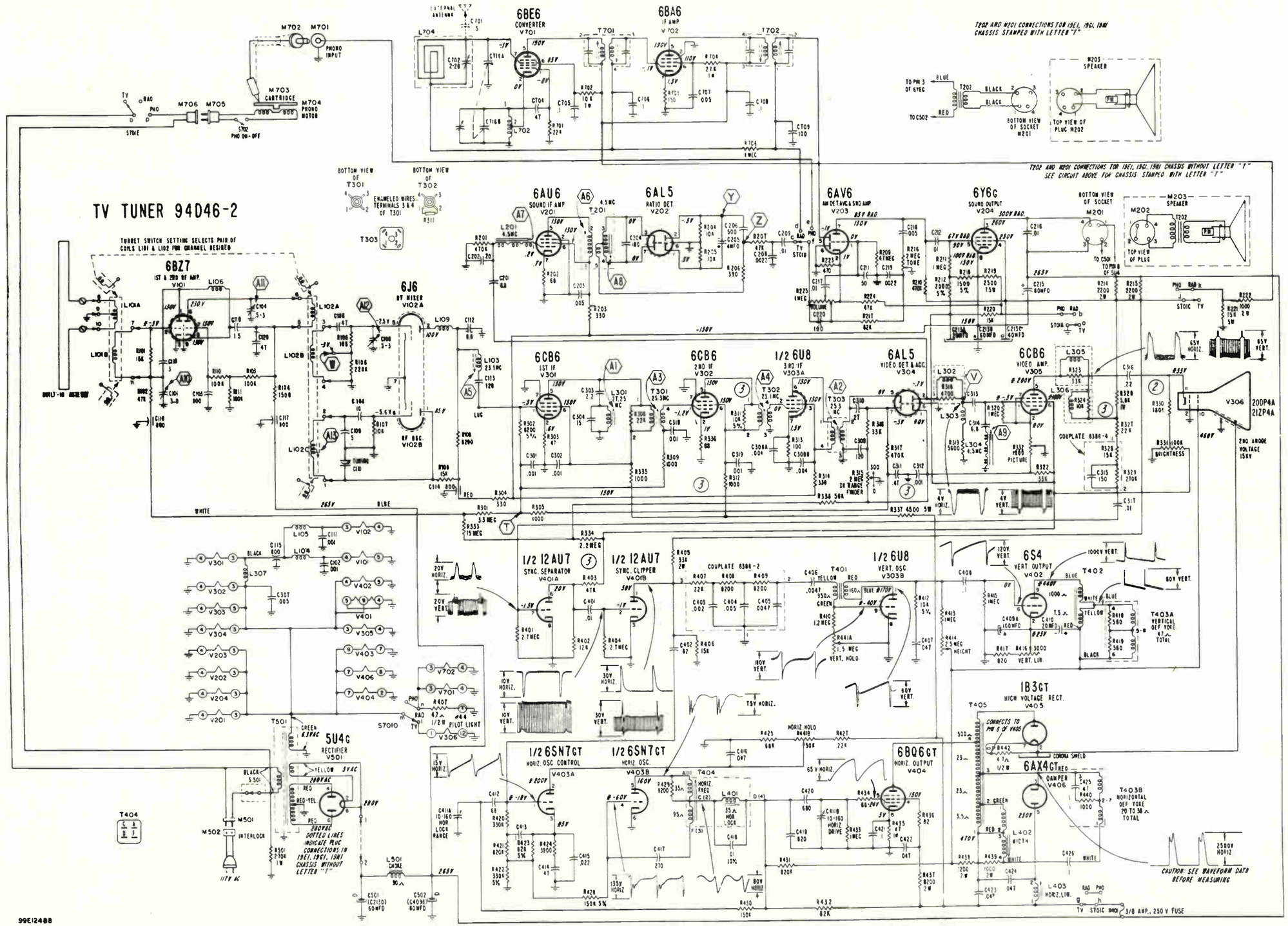


99E124F

Waveform and Voltage data same as for Figure 18, Page 70.

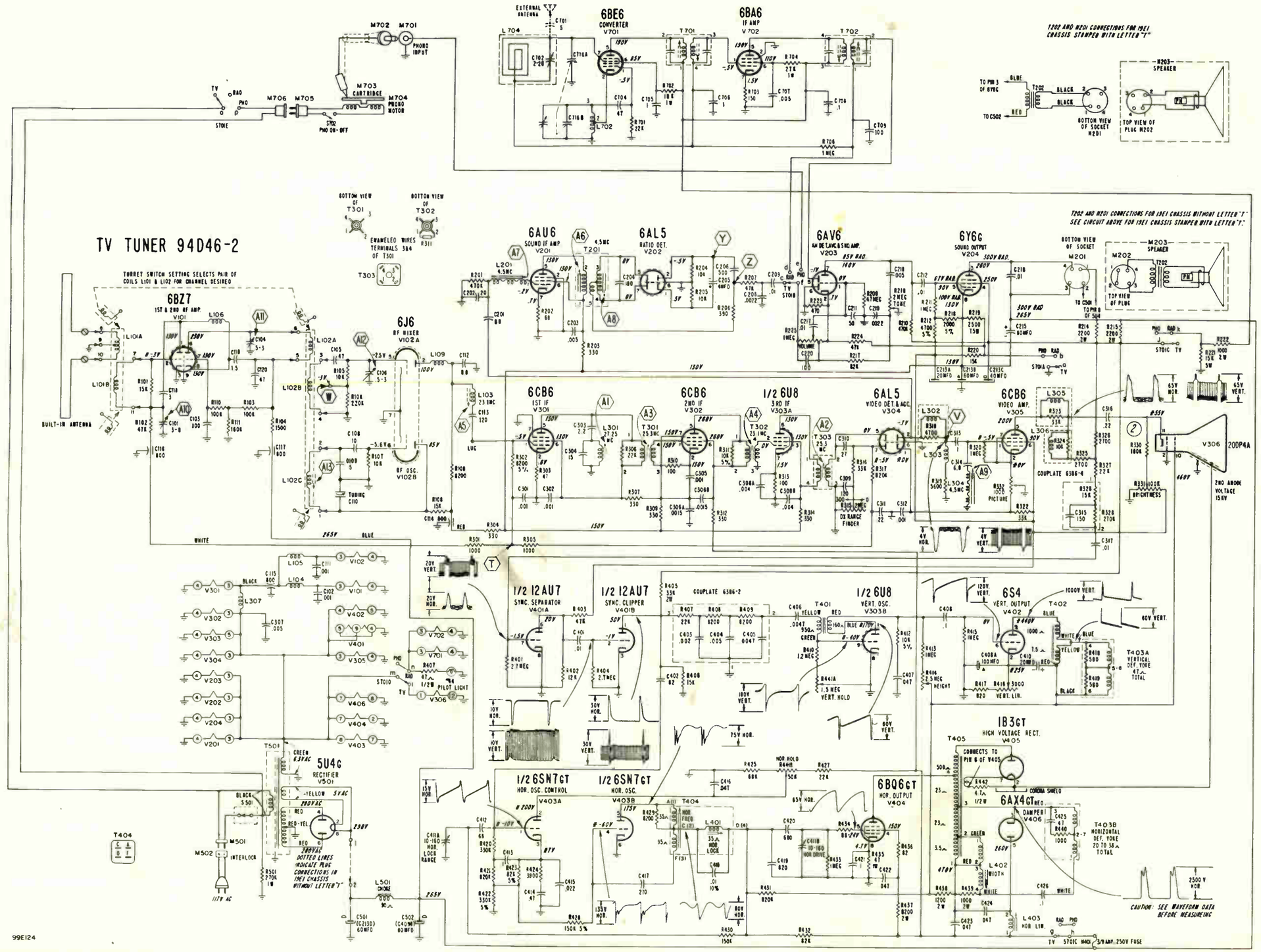
Figure 33. Schematic for 19E1, 19G1 and 19N1 Television and Radio Chassis.

Note: This schematic applies only to chassis stamped Run 3. See figure 30 for chassis stamped Run 2 or lower and figure 35 for chassis stamped Run 4 and higher.



Waveform and Voltage data same as for Figure 18, Page 70.

Figure 31. Schematic for 19E1, 19G1 and 19N1 Television and Radio Chassis.
Note: This schematic applies only to chassis stamped Run 2 or lower.
See figure 33 for chassis stamped Run 3 and figure 35 for chassis stamped Run 4 and higher.



17T1 19A1

Symbol	COILS, TRANSFORMERS, ETC.	Part No.
L1	Coil, Sound IF	72A 60-1
L2	Coil, Video IF	72A 59-1
L3	Coil, Video IF	72A 59-1
L4	Coil, IF Grid (Yellow dot)	AA139-4
L5	Coil, IF Plate (Yellow dot)	AA139-4
L6	Coil, Video IF	72A 59-1
L7	Coil, Peaking (145 millihenrys wound on R29) Blue dot	AA139-7
L8	Coil, Peaking (516 millihenrys wound on R30) Violet dot	AA139-8
L9	Coil, Peaking (520 millihenrys wound on R35) Gray dot	AA139-9
L10	Coil, Peaking (Green dot)	AA139-6
L11	Choke, Filter	74A 13
L12	Choke, RF	AB103-1
L13	Choke, Filament	73A 2-2
T1	Transformer, Ratio Detector	72B 68
T2	Transformer, Audio Output	79A 13
T3	Transformer, Blocking Oscillator	69B 70
T4	Transformer, Hor. Sweep Output	79B 15
T5	Transformer, H. V. Oscillator	69B 64
T6	Transformer, Power	80B 13
T7	Transformer, Blocking Oscillator	69B 70
SW1	On-Off Switch	Part of R7
M3	Speaker 5" less output	78B 40
		78B 44-2
30A1 to 30D1	6" Dynamic 750 or Field	76B31-1
6" PM		78B 46
12" PM		78B 44-1
10"		78B 41 or 78B-47
20X1	5" Electro Dynamic	78B 50-1
20Y1	6" Electro Dynamic	78B 51-1
20Z1	8" Electro Dynamic	78B 54-1

NOTE
IN REPLACING ANY PART CHECK PART REMOVED FOR PART NUMBER AND YOU ARE SURE TO GET THE RIGHT REPLACEMENT

19B1, 19C1, 19E1, 19F1, 19F1A 19G1, 19H1, 19K1, 19N1

C411A	10 to 160 mmfd. **Hor. Lock Range control**	66A 32-3
C411B	10 to 160 mmfd. **Hor. Drive control**	
L103	Mixer Plate Coil	94D 46-85
L104	Heater RF Choke	98A 45-13
L105	Heater RF Choke	98A 45-14
L109	Mixer Plate Choke	94D 46-86
L201	Sound Take-Off Coil	72B 99-7
L301	Trap Coil includes (C303, C304)	72C 96-23
L302	Video Peaking Coil (wound on R318)	73A 5-15
L303	Video Peaking Coil	73A 5-7
L304	Trap Coil	72B 99-6
L305	Video Peaking Coil (wound on R323)	73A 5-13
L306	Video Peaking Coil (wound on R324)	73A 5-9
L307	Heater RF Choke	73A 2-5
L401	**Hor. Lock control**	Part of T404
L402	**Width control**	94A 49-1
L403	**Hor. Linearity control**	94A 50-1
L501	Filter Choke	74B 18-2
L702	Oscillator Coil	69A 52-4
L704	AM Antenna, Iron Core	69C 155-2
T201	Ratio Detector Transformer	72B 68-1
T202	Audio Output Transformer	79A 8
T301	1st IF Transformer in sets using 94D46-2 and 94D46-3 tuners	72C 96-25
	1st IF Transformer in sets using 94D52-1 and 94D52-2 tuners	72C 96-21
T302	2nd IF Transformer	72C 96-22
T303	3rd IF Transformer	72B 107-1
T401	Vert. Blocking Oscillator Transformer	79A 18-4
T402	Vert. Output Transformer	79D 40-2
T403	Deflection Yoke	94C 51-1
T404	Hor. Blocking Oscillator Transformer (includes **Hor. Freq. control L401**)	69B 110
T405	Hor. Output Transformer	79D 41-1
T501	Power Transformer	80C 35-1
T701	1st IF Transformer	72B 28-7
T702	2nd IF Transformer	72B 28-7

20A1, 20B1, 21A1

Sym.	Description	Part No.	Function
L101	Antenna Coil	see pages 42 and 43	
L102	Mixer-Oscillator Coil		
L103	Choke, Filament RF	98A 45-13	
L104	Choke, Fil. Osc.	98A 45-14	
L105	Coil, Choke	98A 45-72	
	Early sets used part #98A 45-68 choke coil. Before replacing, see Production Change "F".		
L106	Coil, 1st IF	98A 45-69	
L202	Filament Choke	73A 2-1	Fil. choke
	R215, C213 and L202 were added in later production; see Production Change "E".		
L301	Coil, 4.2 microhy.	73A 6-1	RF choke
L302	Coil, 90 microhy. (wound on R314)	73A 5-4	Video peaking
L303	Coil, 7.3 microhy.	73A 4-1	4.5 MC trap
L304	Coil, 250 microhy. (wound on R322)	73A 5-1	Series peaking
L305	Coil, 150 microhy. (wound on R321)	73A 5-2	Shunt peaking
L306	Coil	69B 35-1	Focus coil
L307	RF Choke	73A 2-1	RF choke
L308	Coil, 1st Sound IF	72A 88-1	Sound trap
L310	Coil, 250 microhy. (wound on R322)	73A 5-5	
L311	Coil, 250 microhy. (wound on R321)	73A 5-5	
L401	Coil, 25 to 40 millihenrys (includes C415 and R431)	94A 17	Hor. lock cont.
L402	Coil, Horizontal Linearity for 16" sets with rounded-end picture window (2.5 to 9 millihenrys)	94A 26	Hor. lin. cont.
	for 16" sets with rectangular pic. window (5.5 to 20 millihenrys)	94A 3	Hor. lin. cont.
L501	Choke, 2.8 henry	74A 17	LV filter choke
L502	Choke, 2 henry	74A 12	HV filter choke
L511	Filter Choke, LV (2.8 henry)	74A 17	
L512	Filter Choke, HV (2 henry)	74A 12	
L601	Antenna, Loop (AM) (includes C601)	69C 100	
L602	Antenna, FM (54" twin lead folded dipole and lead-in)	AB195	
L603	Antenna Coil (FM)	69A 85	
L604	Coil, Osc. (AM)	69A 86	
L605	Coil, Osc. (FM)	69A 87	
L606	Coil, AM Peaking	73A 5-10	
	Early sets used part #73A5-3 coil. Before replacing, see production change "U"		
L607	Choke, Filament RF	73A 2-4	
L610	Choke, RF Dual	69A 102	
T201	2nd Sound IF Trans.	72B 86-2	
	Early sets used part #72B86-1, 2nd sound IF transformer. Before replacing, see Production Change "F"		
T202	Ratio Det. Trans.	72B 87-1	
*T301	1st Video Trans. & Sound Link (Before replacing, see Production Change "A".)	72A 84	
T302	2nd Video Trans. (Before replacing, see Production Change "A".)	72A 83-2	
T303	3rd Video Trans.	72A 83-1	
T401	Vert. Osc. Trans.	79A 18-1	
T402	Vert. Output Trans. in 20A1, 20B1	79B 24	
	in 21A1	79B 20	
	Part 79B20 used in early 20A1 and 20B1; 79B20 and 79B24 are interchangeable.		
T403	Horiz. Output Trans. in 20A1	79C 19-2	
	Horiz. Output Trans. in 20B1	79C 23	
T404A T404B	Horiz.-Vert. Deflection Yoke	94B 2-2	
	(Before replacing, see Production Change "C".)		

T405	Trans., Width Control for 20A1, 20B1	94A 16
	for 16" sets with rounded-end picture window	94A 19-1
T405	Trans., Width Control for 16" sets with rectangular picture window	94A 19
T406	Hor. Output Trans. for 16" sets with rounded-end picture window	79C 17-3
	for 16" sets with rectangular picture window	79C 17-2
T501	Trans., Output (for 4 tube power supply)	79A 9
T502	Trans., Power	80B 17
T511	Trans., Output (for 6 tube power supply)	79A 16
T512	Trans., Power	80B 17
T601	Trans, 1st IF (FM)	72B 93
T602	Trans, 2nd IF (FM)	72B 76
T603	Trans, Ratio Det.	72B 39
T604	Trans, 1st IF (AM)	72B 92
T605	Trans, 2nd IF (AM)	72B 94

20T1, 20V1

Sym.	Description	Part No.
L306	Trap Coil, 4.5 MC (includes C312)	72B 99-3
L307	Heater RF Choke	73A 2-5
L308	Heater RF Choke	73A 2-5
L401	Horizontal Lock Coil	Part of T404
L402	Width Control	94A 29-2
L403	Horizontal Linearity Control	94A 28
L404	Focus Coil	69C 117-3
L405	Choke, RF	73B 8-3
L701	AM Loop Antenna (includes C701, C702)	69C 100-1
L702	Oscillator Coil	69A 52-1
T201	Ratio Detector Transformer	72B 68
T202	Audio Output Transformer for 20V1 chassis	79B 31-1
	for 20T1 chassis	79B 31-2
T301	1st IF Transformer (includes R306, R307, C302A, C302B)	72C 96-11
T302	2nd IF Transformer (includes R310)	72C 96-10
T303	3rd IF Transformer (includes C305)	72C 96-9
T401	Blocking Oscillator Transformer	79A 18-4
T402	Vertical Output Transformer	79B 29-1
T403	Deflection Yoke (includes R413, R414, R442, C428)	A3222
T404	Horizontal Blocking Transformer (includes L401)	69B 110
T405	Horizontal Output Transformer (includes tube cap clips)	79C 36-1
	In some sets, T405 is part number 79C32-1, which requires a 1.8 ohm resistor (R440) in series with pin 2 (filament) of the 1B3GT (see schematic). Use part number 79C36-1 as replacement and remove R440.	
T501	Power Transformer	80C 26-2
T701	1st IF Transformer	72B 28-7
T702	2nd IF Transformer	72B 28-17
L103	Mixer Plate Coil	98A 45-77
L104	Heater RF Choke	98A 45-13
L105	Heater Oscillator Choke	98A 45-14
L201	Sound, Take-off Coil (includes R201, C201, C202)	72B 99-2
L301	Trap Coil, 27.25 MC (includes C301)	72A 102
L302	Video Peaking Coil (wound on R316)	73A 5-6
L303	Video Peaking Coil	73A 5-7
L304	Video Peaking Coil (wound on R320)	73A 5-8
L305	Video Peaking Coil (wound on R321)	73A 5-9

20X1, 20Y1

Sym.	Description	Part No.
L103	Choke, Filament RF	98A 45-13
L104	Choke, Filament Oscillator	98A 45-14
L105	Coil, Mixer Plate	98A 45-77
L201	Coil, Sound IF	72A 60-1
L301	Video Series Peaking Coil (Wound on R325)	73A 5-6
L302	Video Shunt Peaking Coil	73A 5-7
L303	Video Series Peaking Coil (Wound on R322)	73A 5-8
L304	Video Shunt Peaking Coil (Wound on R321)	73A 5-9
L305	Choke, Filament	73A 2-5
L306	Choke, Filament	73A 2-5
L402	Horizontal Linearity Control	94A 3
L403	Width Control	94A 4-1
L404	Coil, Focus for sets without picture positioning lever	69B 35-2
	for sets with picture positioning lever	69B 114-2
L405	Coil, Horizontal Lock	Part of T404
L501	In Television only models Speaker Field Coil	Part of M203
	In combination only models Choke, Filter	74A 12
T1	Transformer, 1st IF	72B 28-7
T2	Transformer, 2nd IF	72B 28-17
T3	Transformer, Speaker Output	79A 22
T4	Transformer, Power	80B 1
T201	Transformer, Ratio Detector	72B 68
T202	Transformer, Speaker Output	79A 27
T301	Coil, Video IF	72A 83-3
T302	Coil, Video IF	72A 83-3
T303	Coil, Video IF	72A 83-3
T401	Transformer, Vert. Blocking Osc.	79A 18-1
T402	Transformer, Vertical Output	79B 24-1
T403A T403B	Horiz.-Vertical Deflection Yoke	A3044
T404	Transformer, Horiz. Blocking Oscillator (includes L405)	69B 110
T405	Horizontal Output Transformer	79C 28-1
T501	Transformer, Power (includes rectifier tube socket)	80B 19

20Z1

Sym.	Description	Part No.
L402	Horizontal Linearity Control	94A 3
L403	Width Control	94A 4-1
L404	Coil, Focus	69B 114-2
L405	Coil, Horizontal Lock	Part of T404
L501	In "television only" models Speaker Field Coil	Part of Speaker
	In combination models, Filter Choke	74A 12
L601	Antenna, Loop (AM) (includes C601)	69C 116-1
L602	Antenna, FM (54" twin lead folded dipole and lead-in)	AB195
L603	Antenna Coil (FM)	69A 85
L604	Coil, Osc. (AM)	69A 86-1
L605	Coil, Osc. (FM)	69A 87
L606	Coil, AM Peaking (wound on R605)	73A 5-11
L610	Choke, RF Dual	69A 102
L620	Choke, Filter	74B 18-2
T1	Transformer, 1st IF	72B 28-7
T2	Transformer, 2nd IF	72B 28-17
T3	Transformer, Speaker Output	79A 22
T4	Transformer, Power	80B 1
T201	Transformer, Ratio Detector	72B 68
T202	Transformer, Speaker Output	79A 27
T301	Coil, IF	72A 83-3
T302	Coil, IF	72A 83-3
T303	Coil, IF	72A 83-3
T401	Transformer, Vert. Blocking Osc.	79A 18-1
T402	Transformer, Vertical Output	79B 24-1
T403A T403B	Horiz.-Vertical Deflection Yoke	A3044
	T403 includes R421, R422 and C429.	
T404	Transformer, Horiz. Blocking Oscillator (includes L405)	69B 110
T405	Transformer, Horizontal Output	79C 28-1
T501	Transformer, Power (includes rectifier tube socket)	80B 19
T601	Transformer, 1st IF (FM)	72B 98
T602	Transformer, 2nd IF (FM)	72B 76
T603	Transformer, Ratio Det.	72B 39
T604	Transformer, 1st IF (AM)	72B 97
T605	Transformer, 2nd IF (AM)	72B 94
T615	Transf., Output (core 2⅜"x1⅛"x¾")	79B 31-3
T616	Transf., Output (core 1⅛"x1⅜"x⅜")	79B 31-2
T617	Transformer, Power	80B 23-1
L103	Choke, Heater RF	98A 45-13
L104	Choke, Heater Oscillator	98A 45-14
L105	Coil, Mixer Plate	98A 45-77
L201	Coil, Sound IF (includes C201, C313)	72A 60-2
L301	Video Series Peaking Coil (wound on R325)	73A 5-6
L302	Video Shunt Peaking Coil	73A 5-7
L303	Video Series Peaking Coil (wound on R322)	73A 5-8
L304	Video Shunt Peaking Coil (wound on R321)	73A 5-9
L305	Choke, Heater	73A 2-5
L306	Choke, Heater	73A 2-5
L308	Adjacent Lower Channel Sound Trap (27.25 MC), includes C322 (See RUN 7 on TV schematic page.)	72A 101

21B1, 21C1, 21D1, 21E1, 21F1, 21G1, 21H1, 21J1 21K1, 21L1, 21M1, 21N1, 21P1, 21Q1, 21W1, 21Y1 5D2, 3C1

L103	Mixer Plate Coil	98A 45-77
L104	Heater RF Choke	98A 45-13
L105	Heater Oscillator Choke	98A 45-14
L106	Peaking Coil	94C 37-89
L201	Sound Take-off Coil	72B 99-4
L301	Video Peaking Coil (wound on R342) (R342 (4,700 ohms) was not used in early sets, see Production Change, "R432	73A 5-15
L302	Video Peaking Coil	73A 5-7
L303	Video Peaking Coil (wound on R320) with white dot used in early sets	73A 5-13
	with blue dot used in later sets (See "Change To Improve Picture	73A 5-14
L304	Video Peaking Coil (wound on R321) with gray dot used in early sets	73A 5-9
	with three pi winding used in later sets (See "Change To Improve Picture	73A 11-1
L305	Heater RF Choke	73A 2-5
L306	Heater RF Choke	73A 2-5
L307	Adjacent Lower Channel Sound Trap (includes C314)	72A 102
L308	Trap Coil, 4.5 MC (includes C322)	72B 99-3
L401	Horizontal Lock Coil (Includes C418 and R431)	94A 17
	Slug, Iron Core (for L401)	71C 1-40
L402	Width Control Coil 2 terminal coil (in early sets)	94A 29-1
	3 terminal coil (in later sets)	94A 39-1
L403	Horizontal Linearity Control	94A 28
T404	Horizontal Output Transformer Coil and Terminal Strip (less iron core and mtg. hardware) for all 21 series chassis with exception of 21D1 and 21E1	79C 30-14
	for 21D1, 21E1 chassis	79C 30-13
	(If T404 transformer core is not usable, order complete transformer. For all 21 series chassis with exception of 21D1 and 21E1, order part number 79C30-4. For 21D1 and 21E1 chassis, order part number 79C30-3.	
L404	Focus Coil for all sets, except those using 21W1 chassis	69C 117-3
	for sets using 21W1 chassis. (Part number 69C117-9 supplied with plug.)	69C 117-9

21B1, 21C1, 21D1, 21E1, 21F1, 21G1, 21H1, 21J1, 21K1, 21L1, 21M1, 21N1, 21P1, 21Q1, 21W1, 21Y1, 5D2, 3C1

(Continued from Page 79.)

L405 Choke, used with PM focus assembly.....74B 18-4
L406 Choke Coil 73B 8-2

L601 AM Antenna
Loop Antenna (includes C601, C602)...69C 116-1
Iron Core Ant. (includes C601, C602)..69C 121-1
(Iron core antenna used in slide out models)
L602 FM Antenna AB195
L603 FM Antenna Coil 69A 85
L604 AM Oscillator Coil.....69A 86-1
L605 FM Oscillator Coil.....69A 87
L606 FM Peaking Coil (wound on R605).....73A 5-11
L610 RF Dual Choke 69A 102

L701 AM Antenna
Loop Antenna (includes C701, C702)..69C 116-2
Iron Core Ant. (includes C701, C702)..69C 121-2
L702 Oscillator Coil 69A 52-1

T201 Ratio Detector Transformer.....72B 68
T202 Audio Output Transformer
for TV only sets.....79C 33-1
for combination sets 79C 33-2
T301 1st IF Transformer.....72C 96-14
T302 2nd IF Transformer.....72C 96-14
T303 3rd IF Transformer.....72C 96-14
T401 Blocking Oscillator Transformer.....79A 18-2
T402 Vertical Output Transformer
for sets using a 6BQ6GT for V406.....79B 39-1
for sets using a 6CD6G tube for V406, with exception of 21D1 and 21E1 chassis 79B 40-1
for 21D1, 21E1 chassis.....79B 34-1
(See "Different Vertical Output Transformers (T402)
T403 Deflection Yoke
(includes R412, R413, R445, C430)
for 16", 17" and 20" rectangular picture tubes which mount on chassis. A3222
for 16" round picture tube.....A3178
for 19" and 20" picture tubes which mount at side of cabinet.....A3197
for 17" and 21" picture tubes which mount at top of cabinet.....94C 30-3
(Part number A3197 and 94C30-3 include plug.)
T404 Horizontal Output Transformer
for all 21 series chassis with exception of 21D1 and 21E1.....79C 30-4
for 21D1, 21E1 chassis.....79C 30-3
T501 Power Transformer 80C 26-1
T502 Auto-Transformer 80B 32
(T502 used only when V404 is 12H6 tube).

T601 1st IF (FM) Transformer
for early 5D2 sets.....72B 98
for late 5D2 sets.....72B 98-1
Before replacing, see "Sensitivity Increased in 5D2 Radio"
T602 2nd IF (FM) Transformer.....72B 76
T603 Ratio Det. Transformer.....72B 39
T604 1st IF (AM) Transformer
for early 5D2 sets.....72B 97
for late 5D2 sets.....72B 97-1
Before replacing, see "Sensitivity Increased in 5D2 Radio"
T605 2nd IF (AM) Transformer.....72B 94

T701 1st IF Transformer.....72B 28-7
T702 2nd IF Transformer.....72B 28-7

T201 Ratio Detector Transformer.....72B 68

T202 Audio Output Transformer.....79C 33-2

T301 1st IF Transformer (includes R306).....72C 96-14

T302 2nd IF Transformer (includes R309)....72C 96-16

T303 3rd IF Transformer (includes C305 and C325).....72B 105-1

T401 Blocking Oscillator Transformer.....79A 18-4

T402 Vertical Output Transformer.....79B 40-1

T403 Deflection Yoke
(includes R412, R413, R445, C430 and connector plug).....94C 30-3

T404 Horizontal Output Transformer.....79C 30-4

T501 Power Transformer 80C 26-1

22C2, 22E2, 23A1

Sym.	Description	Part No.
L103	Mixer Plate Coil	98A 45-77
L104	Heater RF Choke	98A 45-13
L105	Heater RF Choke	98A 45-14
L106	Peaking Coil	94C 37-89
L107	Coil, 27.25 MC Trap }	Part of trap assem. 94D 47-56
L108	Coil, 19.75 MC Trap }	
L109	Mixer Plate Choke	94D 46-86
L110	Coil, Bandpass Coupling	Part of trap assem. 94D 47-56
L201	Sound Take-off Coil	72B 99-4
L202	Sound Coupling Coil	72B 99-4
L203	Peaking Coil (wound on R219)	73A 5-2
L301	Video Peaking Coil (wound on R341)	73A 5-15
L302	Video Peaking Coil	73A 5-7
L303	Video Peaking Coil (wound on R320)	73A 5-14
L304	Video Peaking Coil (wound on R321)	73A 11-1
L305	Heater RF Choke	73A 2-5
L306	Heater RF Choke	73A 2-5
L308	Trap Coil (includes C322)	72B 99-3
L309	Coil, 1st IF Input	72B 106
L310	Coil, 21.25 MC Trap (includes C327, C324 and R345)	72C 96-24
L401	Horizontal Lock Coil (includes C418, R431)	94A 17
L402	Width Control Coil	94A 39-1
L403	Horizontal Linearity Coil	94A 28
L404	Focus Coil	69C 117-3
L406	Choke Coil	73B 8-2
L702	Oscillator Coil	69A 52-4
L704	AM Antenna	69C 155-2
L401	Horizontal Lock Coil (includes C418, R431) for 22C2 and 22E2 chassis	94A 17
	for 23A1 chassis	94B 48-1
L402	Width Control Coil for 22C2 and 22E2 chassis	94A 39-1
	for 23A1 chassis	94A 56-1
L403	Horizontal Linearity Coil for 22C2 and 22E2 chassis	94A 28
	for 23A1 chassis	94A 55-1
L404	Focus Coil for 22C2 and 22E2 chassis	69D 117-3
	for 23A1 chassis (includes plug M404)	69D 117-10
L501	Filter Choke (2 Henry)	74B 18-6
L502	Filter Choke (6 Henry)	74B 18-5
T202	Audio Output Transformer for 22C2 chassis	79C 33-3
	for 22E2 chassis	79C 33-4
	for 23A1 chassis	79C 33-5
T402	Vertical Output Transformer for 22C2 and 22E2 chassis	79B 40-1
	for 23A1 chassis	79B 43-1
T403	Deflection Yoke for 22C2 and 22E2 chassis (includes R412, R413, R445 and C430)	94C 30-1
	for 23A1 chassis (includes R412, R413, R445, C430 and plug M406)	94D 54-1
T404	Horizontal Output Transformer for 22C2 and 22E2 chassis	79C 38-1
	for 23A1 chassis	79D 44-1
T501	Power Transformer for 22C2 and 22E2 chassis	80C 26-1
	for 23A1 chassis	80C 36-1
T201	Ratio Detector Transformer	72B 68-2
T202	Audio Output Transformer for 22C2	79C 33-3
	for 22E2	79C 33-4
T301	1st IF Transformer	72C 96-14
T302	2nd IF Transformer (includes R309)	72C 96-16
T303	3rd IF Transformer (includes C305 and C325)	72B 105-1

T401 Blocking Oscil. Transformer.....79A 18-4
T402 Vertical Output Transformer.....79B 40-1
T403 Deflection Yoke (includes R412, R413, R445, C430) 94C 30-1
T404 Horizontal Output Transformer.....79C 38-1

T501 Power Transformer 80C 26-1

T701 1st IF Transformer.....72B 28-7
T702 2nd IF Transformer 72B 28-7

24D1, 24E1, 24F1, 24G1, 24H1, 5B2, 5D2

Sym.	Description	Part No.
L103	Choke, Heater RF	98A 45-13
L104	Choke, Heater Oscillator	98A 45-14
L105	Coil, Choke	98A 45-72
L106	Coil, 1st IF	98A 45-69
L201	Coil, Sound Trap	72C 96-1
L301	RF Input Choke	73A 6-1
L302	Video Peaking Coil, 90 Microhy (wound on R313)	73A 5-4
L303	4.5 MC Trap, 7.3 Microhy	73A 4-1
L304	Series Peaking Coil, 250 Microhy (wound on R319)	73A 5-5
L305	Shunt Peaking Coil, 250 Microhy (wound on R320)	73A 5-5
L306	Focus Coil (less plug used in 19" sets)	69C 117-1
L307	RF Filament Choke	73A 2-1
L308	RF Filament Choke	73A 2-1
L309	Adjacent Channel Trap (27.25 MC) }	A3320
L310	Adjacent Channel Trap (19.75 MC) } (Assembly includes C313, C314 and mtg. bracket)	
L401	Horizontal Lock Coil (includes C416 and R429)	94A 17
L402	Horizontal Linearity Control Coil	94A 28
L403	Width Control Coil	94A 29-1
L501	Filter Choke for sets with 6SQ7 Audio Amp.	74B 18-1
	for sets with 6AU6 Audio A.mp.	74B 18-3
L601	Antenna, AM Loop Antenna (includes C601, C633)	69C 116-1
	Iron Core Ant. (includes C601, C633)	69C 121
L602	FM Antenna, for 16" sets }	AB195
	FM Antenna, for 19" sets }	AB211
L603	Antenna Coil (FM)	69A 85
L604	Coil, Osc. (AM)	69A 86-1
L605	Coil, Osc. (FM)	69A 87
L606	Coil, FM Peaking (wound on R605)	73A 5-11
L610	Choke, RF Dual	69A 102
L620	Choke Filter	74B 18-2
T201	Sound IF Transformer	72B 86-2
T202	Ratio Detector Transformer	72B 87-1
T203	Audio Output Transformer for sets with 6SQ7 Audio Amp.	79A 31-1
	for sets with 6AU6 Audio Amp.	79A 31-4
T301	1st Video IF Transformer	72C 96-5
T302	2nd Video IF Transformer	72C 96-3
T303	21.25 Sound Trap	72C 96-2
T304	3rd Video IF Transformer	72C 96-4
T401	Vertical Blocking Osc. Transformer	79A 18-2
T402	Vertical Output Transformer	79B 39-1
T403	Deflection Yoke for 16" round tubes	A3178
	for 16" rectangular tubes	A3222
	for 19" round tubes (includes plugs)	A3197
T404	Horizontal Output Transformer Coil and Terminal Strip (less iron core and mtg. hardware)	79C 30-11

(If T404 transformer core is not usable order complete transformer part number 79C30-1.)

T501 Power Transformer
for sets with 6SQ7 Audio Amp. 80B 24-1
for sets with 6AU6 Audio Amp. 80C 25-1
T601 Transformer, 1st IF (FM)
all 5B2 and early 5D2 sets.....72B 98
late 5D2 sets.....72B 98-1
Before replacing in 5D2 sets, see sensitivity change on page 46.
T602 Transformer, 2nd IF (FM).....72B 76
T603 Transformer, Ratio Det. 72B 39
T604 Transformer 1st IF (AM)
all 5B2 and early 5D2 sets.....72B 97
late 5D2 sets.....72B 97-1
Before replacing in 5D2 sets, see sensitivity change
T605 Transformer, 2nd IF (AM).....72B 94

30A1, 30B1, 30C1, 30D1

Sym.	Description	Part No.	Function
L103	Choke, Filament RF	98A 45-13	
L104	Choke, Filament Oscillator	98A 45-14	
L105	Coil, 1st IF	98A 45-48	
L106	Trap Coil with solder lug mtg.	98A 45-49	
	with spade lug mtg.	98A 45-53	
L107	Coupling Coil	Part of L106	
L201	RF Fil. Choke	73A 2	V201 heater decoupling
L301	1st Video IF Coil	69A 32	V301 plate load
L302	RF Fil. Choke	73A 2	Heater decoup. (V301)
L304	RF Fil. Choke	73A 2	Heater decoup. (V303)
L305	RF Fil. Choke	73A 2	Heater decoup. (V304)
L306	180 microhenrys (wound on R321)	AA139-1	Detector (V305) peaking coil
L307	250 microhenrys	AA139-2	Detector (V305) peaking coil
L308	120 microhenrys (wound on R326)	AA139-3	V306 peaking coil
L309	93 microhenrys	AA139-4	V306 peaking coil
L310	120 microhenrys (wound on R333)	AA139-3	V307 peaking coil
L311	93 microhenrys	AA139-4	V307 peaking coil
L401	Slug-Adj. Coil	94A 4	Width control
L402	Slug-Adj. Coil	94A 3	Horizontal lin. control
L403	Coil	69B 35-1	Focus coil
L404	Coil, Adjustable	94A 12	Width control
L405	Coil, Adjustable	94A 11	Horiz. lin. control
L406	Coil (with plug and leads)	69B 94-1	Focus coil
L501	Filter Choke 2hy.	74A 12	V501 filter choke
L511	Filter choke 2.8hy.	74A 13	V514 filter choke
L512	Filter choke 2hy.	74A 12	V501 filter choke
	Filter choke (speaker adapter for 8C11, 8C12, 8C13)	74A 14-1	
T404	Vert. Out. Trans.	79B 6	Transformer (V411)
T405	Hor. Out. Trans. for 30D1 only	79C 17-1	Transformer (V407)
T406A } T406B }	Deflection Yoke	94B 2-2	V308 Horiz.-Vert. Deflection
T501	HV Power Trans. Upright Mtg.	80B 7	Transformer (V501) (Used in double chassis power supply.
	Half-shell Mtg.	80B 11	Transformer (V501) (Used in single chassis power supply.
T502	LV Power Trans. Upright Mtg.	80B 8	Transformer (V502) (Used in double chassis power supply.
	Half-shell Mtg.	80 B12	Transformer (V502) (Used in single chassis power supply.

T511 Transformer, Output 79A 16
T512 Transformer, Low Voltage Power.....80B 16
T513 Transformer, High Voltage Power.....80B 15

T601 Transformer, 1st IF (FM).....72B 75
T602 Transformer, 2nd IF (FM).....72B 76
T603 Transformer, Ratio Detector 72B 39
T604 Transformer, 1st IF (AM).....72B 73
T605 Transformer, 2nd IF (AM).....72B 74

T701 Mixer Trans. (Early Production).....98A 45-1
Slug, Hollow Core (for T701).....98A 45-35
Slug, Solid Core (for T701).....98A 45-38

T801 Mixer Transformer 72B 61

T901 Mixer Transformer 98A 44-27